Chapter 32 General description of the geological structure of the region affected by post-Cambrian movements in the North-West Highlands

By J. Horne.

The most remarkable feature in the geology of the North-West Highlands is the evidence of terrestrial movements, without a parallel in the British islands, which affected that region in post-Cambrian time. The tectonic structure resulting from these movements is extremely complicated, but the mass of details, obtained in the course of the survey, proves that, while the sections vary indefinitely along the belt of complication for 120 miles, from .the north coast of Sutherland to the southern promontory of the Isle of Skye, they nevertheless present certain persistent features, which may be thus summarised:

1. By lateral compression of the earth's crust the rocks have been thrown into a series of folds, usually inverted, accompanied by several faults or thrusts. The general strike of these folds and dislocations is from N.N.E. to S.S.W. The axial planes of the folds, the reversed faults, and the component beds dip, as a rule, in one direction towards the E.S.E. In the middle limb of the overfold the constituent particles are attenuated, and, along that limb, the overfold may or may not pass into a reversed fault.
2. Without incipient folding, the strata are repeated by a series of minor thrusts or reversed faults, which lie at an oblique angle to more important dislocations, termed by us major thrust-planes. They are likewise inclined to the E.S.E. — the direction from which the pressure proceeded. (Imbricate Structure, *Schuppen Struktur.*)
3. By means of major thrusts of varying magnitude, striking generally N.N.E. and S.S.W., the following structures have been produced: (a) Certain sub-divisions of the Cambrian system have been heaped up and driven westwards along planes produced in underlying undisturbed materials; (b) masses of Lewisian gneiss with its unconformable covering of Torridon Sandstone and Cambrian. strata override the piled-up strata beneath; (*c*) the Eastern schists have been thrust far to the west, till, in some instances, they rest directly on undisturbed Cambrian rocks.
4. Owing to the travelling of the rocks from east to west and also to the friction along the unyielding lower plane or "sole" of the thrust, there was a tendency in the materials to fold over and curve under, thus producing inversion.
5. While the planes of the major thrusts, along which the materials have been driven, usually dip at low angles to the E.S.E., yet they are frequently irregular both in direction and angle of inclination.
6. The outcrops of the major thrust-planes resemble boundary-lines between unconformable formations because (1) there is always a complete discordance between the strata lying above and below the planes of disruption and (2) each successive thrust may be overlapped in turn by a higher one.
7. Thrusts of smaller magnitude, when followed along the strike, may merge into folds.
8. By means of denudation, outliers of the materials lying above the planes of disruption have been formed, as, for instance, where patches of Lewisian gneiss, Torridon Sandstone, and Cambrian quartzites rest on the *Olenellus* zone or on Cambrian dolomite and limestone, the upper discordant members being separated from the lower by a fault with a circular outcrop.
9. The more powerful displacements were accompanied by differential movement of the materials which resulted in the development of new structures.

Classification of the structures

The several types of structure observable along the belt of complication have definite relations to each other in the field, and occur in consecutive order from west to east. From this point of view, the structures may be arranged in two divisions — (a) those which occur in advance of, or to the west of the great lines of disruption; (*b*) those immediately associated with each of the powerful thrusts which have produced extensive displacement of the strata.

i. Structures in advance of the Great Lines of Disruption

These are confined to the belt of complication that generally intervenes between the undisturbed area to the west and the outcrop of the great thrust-planes to the east. This stage in the history of the movements is represented by two well-marked types.

The first of these is characterised by the constant reduplication of sub-divisions of the Cambrian series, or of Cambrian and Torridonian strata combined, mainly by inverted folds, and to a limited extent by reversed faults or minor thrusts. This system is well illustrated in the mountainous region between Loch Maree and Strath Carron, where the same zones, consisting of the Cambrian quartzites with the underlying Torridon Sandstone, are repeated chiefly by isoclinal flexures dipping E.S.E. The repetition of these beds by this method extends over a belt several miles in width in parts of that region. (Figure 49), (Figure 50), (Figure 51), (Figure 52), (Figure 53). Again, in Skye, overfolding is more characteristic of the areas in advance of the great thrusts than reversed faults. (Figure 61)

The second type presents important points of difference from that just described. In this system the Cambrian zones are repeated by minor thrusts without incipient folding. Lower zones are made to rest on higher beds by means of reversed faults, the latter being inclined at a slightly higher angle than the dip of the strata. Save in exceptional instances, the beds between each reversed fault preserve their normal order of succession and have a persistent dip to the E.S.E., thus furnishing an example of imbricate structure (*Schuppen Struktur*). The slices of strata, thus repeated, have been driven westwards by major thrusts along planes, which truncate the overlying reversed faults, and nearly coincide with the lines of bedding of the sediments over considerable distances. This type has a remarkable development in Sutherlandshire from the eastern shore of Loch Eireboll to the southern limits of Assynt, though with somewhat varying features.

In certain areas, as, for instance, at Heilim in Loch Eireboll, and on the shores of Loch Glendhu and Loch Glencoul, north of Inchnadamff, the strata repeated by this system of reversed faults consist of fucoid-beds, *Salterella-* (serpulite-) grit, and basal dolomite, the whole thickness of sediments not exceeding 100 feet. In these sections, the observer may traverse con- tinuous exposures for long distances, showing the recurrence of these zones in successive slices, in which the beds preserve their normal sequence. (Figure 20), (Figure 28), (Figure 29), (Figure 31) This type of structure has been successfully reproduced experimentally. Further examples of it occur in the plateau east of Elphin in the southern part of Assynt, and also at Courthill east of Loch Kishorn, where the Cambrian dolomites and limestones, repeated by reversed faults, have been made to cover extensive areas. (Figure 39), (Figure 55).

Perhaps the most striking instance of the driving together of the Cambrian zones by this system of movements is to be found in the mountainous region between Loch More and the head of Loch Eireboll, where the basal quartzites and pipe-rock have been piled up by minor thrusts, all oblique to an underlying thrust-plane and inclined to the E.S.E. The section (Figure 25) from Creag Dionard across the Plat Reidh shows how, by this kind of displacement and repetition, a deceptive stratigraphical sequence is produced, together with an apparent thickness greatly in excess of the real depth of the strata. In all these examples of imbricate structure the resistance to the development of folds was obviously greater than the resistance to the formation of thrust-planes. It has sometimes happened that the structures characteristic of this phase of the movements have been buried underneath the materials overlying the great thrust-planes so as not to appear at the surface along the belt of complication; but wherever denudation has laid bare a portion of this belt, these structures are met with.

ii. Structures characteristic of the Great Thrusts

These structures may also be arranged in two groups in accordance with the nature of the materials that have been driven westwards. In the first or more westerly group, these materials consist of Lewisian Gneiss, Torridon Sandstone, and Cambrian strata, or of the first and last of these three great systems of rock, without any representative of the middle member. In the second group, which accompanies the Moine thrust, or most easterly of the great movement-planes, the displaced materials are composed of quartz-schists, mica-schists, garnetiferous muscovite-biotite-schists, and lenticular masses of acid and basic gneisses of Lewisian types.

The structures displayed in the first group, when exposed, always lie to the west of the Moine thrust-plane along the whole belt of complication from Loch Eireboll to Sleat in Skye. For convenience of description, the several major thrusts among them have received -local names, from the districts where they are typically developed (Arnaboll, Glencoul, Ben

More, Kinlochewe, Kishorn, Ben Suardal). In some areas only one of these powerful thrusts is represented, in others two or more occur, as Assynt, where the Glencoul and Polandroighinn displacements are overlapped by that of Ben More. Although these lines of disruption cannot be traced continuously along the belt of complication, yet it is probable that some which have received distinct names may really be identical — that, for example, the Ben More, Kinlochewe, and Kishorn displacements lie on the same horizon. The evidence further points to the conclusion that the Kishorn line of movement is prolonged into Sleat in Skye.

It is a remarkable fact, which has an important bearing on the theoretical question of the origin of the Moine-schists (Eastern schists), that the Torridon Sandstone never occurs in any of the displaced masses west of the Moine thrust between Loch Eireboll and the Ben More Assynt range — a distance of 34 miles. The materials brought forward by the great lines of disruption in advance of the Moine thrust in that portion of the belt consist solely of Lewisian gneiss and Cambrian strata. A striking feature of these displacements is observable in the vast thickness of the slice of the old Archaean floor that has been superimposed on the piled-up Cambrian rocks. Near Glencoul it must be, at least, 1500 feet thick, and in that region it has borne westward all the Cambrian zones in succession from the false-bedded quartzites to the dolomite and limestone. (Figure 28) When the Glencoul line of movement is traced southwards into Assynt, the thin veneer of quartzites on the crest of Glasven is found to fold over and to buckle under the western face of displaced gneiss which there rests in inverted order on that thrust-plane. (Figure 31).

A careful examination of the displaced masses in advance of the Ben More thrust in the northern part of Assynt shows that the Lewisian rocks form the core of a series of compound folds overlain by the Cambrian quartzites which have been driven west along the Glencoul plane of movement. (Figure 31), (Figure 32) The same system of folding on this horizon is doubtless prolonged northwards to Eireboll, though the quartzites overlying the displaced gneiss on the crests of the folds have been largely removed by denudation. (Figure 21), (Figure 22), (Figure 24).

In the southern portion of the belt between Ben More Assynt and Skye, the Torridon Sandstone is always represented in the displaced masses brought forward by the powerful lines of disruption in advance of the Moine thrust. It further appears that the slices of this formation increase in thickness southwards in the direction of Skye. Indeed, in Sleat, the belt of thrust Torridon Sandstone is several miles in breadth, and the thickness of the various groups represented, if there is no reduplication of the strata by folding, must be about 5000 feet. (Figure 59), (Figure 60), (Figure 61).

It is worthy of note that the system of plication which occurs above the Glencoul line of movement is repeated on a still grander scale above the Ben More thrust-plane in Assynt. A vast slice of Lewisian rocks, more than 1500 feet thick, overlain by Torridonian and Cambrian strata, forms there a great dome-shaped flexure with the unconformable sediments arranged in inverted order beneath the displaced gneiss. On the eastern ridge of Ben More the thin covering of quartzites on the crest of the fold has been largely removed, but on Sgonnan More, and particularly on its southern slope, the arch is seen in a less-advanced stage of decay. (Figure 32), (Figure 33), (Figure 34), (Figure 35), (Figure 36)

Again, from Kishorn southwards into Sleat, the most striking feature of the tectonics of the displaced materials on this horizon is the great inversion of Torridon Sandstone; this formation in the neighbourhood of Stromeferry being overlain by the overturned floor of Lewisian gneiss. The horizontal sections (Figure 55), (Figure 56), (Figure 57) show that this inversion forms part of a great fold which has been driven westward along the Kishorn thrust-plane. On the mainland south of Kishorn the Cambrian quartzite is never seen in visible connection with the thrust Torridon Sandstone, but the unconformable junction between the two appears in Sleat between the Ord and Tarskavaig, where a normal sequence can be followed upwards to the *Olenellus* zone.

The southern portion of the belt of complication between Assynt and Sleat affords conspicuous examples of the plication of the great movement-planes in advance of the Moine thrust, and of the subsequent denudation and isolation of masses of material that overlie these planes. (Figure 36), (Figure 48), (Figure 49) In Sleat a remarkable instance may be seen of the reversal of the west limb of the anticline of the Sgiath Bheinn an Uird thrust, with the folded and thrust Cambrian rocks in the core of the flexure. (Figure 62) It is highly probable that the production of these flexures was coincident with the advance of the Eastern schists, and may have been caused by the pressure of that advancing mass. At the same time, it must be remembered that in Skye evidence has been obtained of the post-Jurassic folding of one of these early Palaeozoic thrust-planes. The Ben Suardal thrust appears to have shared in the folding of the Mesozoic strata which curve round the north end of that hill.

Reference has already been made to the overlap of the Ben More thrust in Assynt, where it passes transgressively across powerful displacements to the west. Immediately to the north of Kinlochewe the transgression is still more apparent, for the slice of Lewisian gneiss, which has there been borne westward by the Kinlochewe thrust, oversteps all the underlying piled-up strata, so as to rest directly on the undisturbed fucoid-beds. (Figure 47), (Figure 48)

The second group of great lines of disruption, which is represented by the Moine thrust, differs, as already indicated, from all others to the west in the crystalline condition of the materials which it has transported westwards. These materials forming the crystalline schists of the Moine series, and comprising quartz-schists, quartz-biotite-granulites, garnetiferous micaschists, and limestones, evidently represent altered sediments the age of which is still uncertain. It will be shown in later chapters that recognisable zones of the Torridon Sandstone pass into rocks of intermediate type with structures akin to those of the granulitic schists of the Moine series, and that sills of igneous material resembling some of the igneous rocks intrusive in the Cambrian strata of Assynt are intercalated in the Moine schists and have shared in the movements that have affected them. At the same time, it should be mentioned that in some districts, as between Stromeferry and Loch Alsh and again in Sleat in Skye, the structures of the Moine schists have been broken down by the post-Cambrian movements, as if some, at least, of these rocks were already crystalline before being brought into their present positions.

The Moine thrust is perhaps the most important structural feature produced by the post-Cambrian movements in the North-West Highlands. Though, owing to the development of mylonites in association with this line of disruption, it is extremely difficult to determine everywhere its exact position, yet at various places between the north coast of Sutherland and Sleat the plane of movement has been laid bare, and its gentle angle of inclination to the E.S.E. can be definitely ascertained. A marked characteristic of the Eastern schists is seen in their double system of folding, evidently produced by the same series of earth-stresses; one set of flexures trending N.N.E. and S.S.W., in harmony with the general strike of the rock groups, and the other set W.N.W. and E.S.E. in the line or direction of the post-Cambrian movements. Another remarkable feature of these rocks is their extraordinary overlap across all underlying thrusts and displaced masses till they rest directly on the undisturbed Cambrian rocks to the west. The extreme narrowness of the belt of complication between Knockan in Sutherlandshire and Loch an Nid in the Dundonnell Forest in Ross-shire — a distance of 24 miles — is due to the transgression of the Moine schists along that thrust-plane. Along their present western limit the Eastern schists form a thin veneer covering either undisturbed Cambrian strata or thrust Lewisian, Torridonian, and Cambrian rocks. (Figure 40)

Extent of horizontal displacement of thrust masses

Fortunately direct evidence is obtained in certain areas of the minimum extent of the horizontal displacement of materials by the post-Cambrian movements. In the extreme north of Sutherland the various rock-groups included under the Eastern schists, and overlying the Moine thrust-plane, can be shown to have been driven westwards for a distance of ten miles from the hill-slopes on the east side of Loch Eireboll to the centre of the Durness basin and the promontory of Far-aird Head. (See geological map.) Again, near the county boundary between Sutherland and Ross, the great overlap of the Eastern schists can be traced continuously for a distance of six miles across the broad belt of folded and thrust materials in the Assynt mountains. Further evidence is furnished by the masses of Lewisian gneiss which have been driven westwards in advance of the Moine thrust. It seems to be a general rule that the types of gneiss in the displaced masses occur several miles to the south of corresponding types in the undisturbed areas to the west. The most remarkable example of this tectonic feature is to be found in the Glencoul district, where the thrust gneiss with broad veins of red pegmatite and basic dykes has been shifted southwards for a distance of six miles from Ben Stack to Glencoul. As the general trend of the basic dykes is north-west and as the direc lion of the post-Cambrian movements is W.N.W., it is obvious that the gneiss must have been thrust several miles from the E.S.E. Similar evidence is obtained in the Kinlochewe district of Ross-shire, where the displaced gneiss overlying the Kinlochewe thrust-plane presents original characters like those of Cadha Beag, near Gruinard, in the undisturbed area several miles to the north. It is further obvious that the driving together of the Cambrian zones resulting in imbricate structure (*Schuppen Struktur*) represents great lateral displacement of the zones, though it is difficult if not impossible to form any reliable estimate of its extent.

Metamorphism resulting from the post-Cambrian movements

The great terrestrial displacements were accompanied, within certain limits, by differential movement of the materials which resulted in the development of new structures. These phenomena become more pronounced as the rocks are traced eastward from the undisturbed area. They are highly developed along the belt of rocks in immediate association with the Moine thrust, where the outcrop of the plane of this great dislocation lies to the east of a broad belt of displaced materials. It is worthy of note that among the Cambrian strata heaped up by reversed faults (*Schuppen Struktur*) in advance of the great lines of disruption, no metamorphism of any importance is obserable, though there must have been considerable friction of the materials in the process of displacement.

The first appearance of the development of new structures east of the undisturbed area which flanks the belt of dislocation on its western side occurs in association with the chief planes of movement. The more westerly displaced masses of Lewisian gneiss have suffered little deformation save in immediate contact with the thrust-planes (Glencoul, Ben More, Kinlochewe), where the gneiss has usually been sheared. Again, along the line of unconformable junction between the thrust Lewisian rocks and Torridon Sandstone or Cambrian quartzite, the old structures of the gneiss have been effaced and differential movement of the constituents has taken place.

When, however, we pass eastwards to the belt of deformed rocks lying immediately in front of the Moine thrust or resting on its "sole" or plane of movement, the Lewisian gneiss merges into flaser-gneiss and schist and ultimately into a banded rock like platy schist. The pegmatites show fluxion-structure like that of rhyolites, with felspar "augen". These mylonised rocks present a variegated appearance, being red, green, or grey, according to the character of the original material from which they were derived. Good illustrations of these phenomena may be seen on the east side of Loch Eireboll and in the hilly region between Stromeferry and Loch Alsh. In all these examples of crushed material the planes of deformation lie more or less parallel with the great planes of movement.

The Torridonian conglomerates, grits, sandstones, and shales have also been affected by the post-Cambrian movements, particularly along the inverted limbs of the great overfolds. For example, in the Oykell valley, in the Ben More-Assynt region, where the basal conglomerate lies in inverted order beneath the Lewisian gneiss, its pebbles have been crushed, flattened, and elongated in the direction of movement, and a fine schistose or wavy structure has been developed in its matrix. Cleavage has been superinduced in the other sediments, the beds of coarse grit being less distinctly cleaved and the planes being more highly inclined than those in the finer sandstones and shaly bands. Occasionally lenticular veins of pegmatite occur, arranged in lines more or less parallel with the new ,schistose planes.

Again, along the great inversion at Fernaig, south of Stromeferry, foliation has been developed in the Torridon basal conglomerate and overlying Lewisian gneiss parallel with the axial plane of the overfold and with the plane of the Moine thrust. On this horizon, also, between Kishorn and Loch Alsh, and in the Coulin Forest, south of Kinlochewe, the development of new structures in the Torridonian sediments by the post-Cambrian movements is well marked. Dr. Teall has shown that the quartz-grains have been drawn out into thin folia that wind round "eyes" of felspar. A secondary crypto-crystalline material has been produced, sericitic mica appears in the divisional planes, and in some instances biotite has been developed.

The deformation of the Cambrian strata is no less conspicuous in the northern part of the belt of complication either in contact with the Moine thrust-plane or in the thrust-masses in advance of it. In the case of the basal false-bedded grits or quartzites, the pebbles of quartz and felspar have been elongated, the felspar having been often fractured and traversed with veins of secondary quartz. The vertical "pipes" or annelide-tubes in the pipe-rock have been bent over, flattened, and drawn out into ribands parallel with the direction of movement. Where the changes of form are observable muscovite has been abundantly developed and the strata have assumed the appearance of quartz-schists. Fine parallel lines, trending generally E.S.E. and W.N.W., appear on the new divisional planes, in accordance with the general direction of the post-Cambrian movements.

Further evidence of deformation is supplied by the series of intrusive sills in the successive thrust-masses in Assynt. The sheets of felsite in the basal quartzite above the Ben More thrust-plane have been converted into soft sericitic schists, the fine hornblende-porphyrites in the limestones pass into green¯chloritic schists, and the albite-porphyrites present the appearance of augen-schists. These changes become more pronounced as the rocks are followed eastwards to the Moine thrust.

Probable sequence of the movements

The various lines of evidence available lead to the conclusion that the pressure which gave rise to the overfolding and great displacements of the rock-masses came from the E.S.E. We may now consider the probable sequence of the earth-movements.

In the Reports which were published in 1884<ref>*Nature,* Nov. 13th, 1884.</ref> and 1888<ref>*Quart. Journ. Geol. Soc.,* vol. xliv. (1888), p. 378.</ref>·, it was implied that the structures first produced were those in advance of the great lines of disruption, and that the latter arose in sequence from west to east, the Moine thrust being the last of the series. But some of the data furnished by Mr. Cadell's experiments, which are referred to in the sequel, together with the field-evidence obtained in the Dundonnell Deer Forest, suggest the probability that the reverse order may have been the case, as was originally maintained by Professor Lapworth.<ref>The Close of the Highland Controversy. *Geol. Mag.,* New Series' Dee. iii., vol. ii., p. 105</ref>

From Mr Cadell's experiments it would appear that "the horizontal pressure is not propagated far forward into a mass of strata", and that the structures first produced override the subsequent ones. If this be the true order of appearance, it would seem that the Moine thrust was the first of the great lines of disruption to be produced, and that, on the continuation of the pressure, the force was successively communicated to masses further to the west. Thus the imbricate structure (*Schuppen Struktur*) found at intervals along the western edge of the belt of complication may indicate a late stage in the evolution of the structure of the region. But, though such may have been the case, it is obvious that the westerly movement of the Eastern schists that overlie the Moine thrust-plane must have been continued after the inception of the *Schuppen Struktur,* for, as we have seen, these sehists override all the displaced masses and rest directly on the undisturbed Cambrian rocks. Indeeil, the wedges of piled-up strata showing imbricate structure may be said to have acted like rollers for the transport of advancing masses on higher thrust-planes.

The evidence obtained in Dundonnell Forest, south of Loch Broom, which is described in Chapter 36., seems to have an important bearing on the question under consideration. In that area a denuded anticline runs for several miles in an E.N.E. direction, and affects alike all the displaced masses and thrust-planes, from the Eastern schists at the top to the heaped-up strata in advance of the Ben More thrust beneath. These materials rest on a plane or "sole" formed by the underlying undisturbed Cambrian rocks. (Figure 45) The inference seems reasonable that, after the inception of the Moine thrust and the Ben More thrust, and after the piling-up of the strata in advance of the latter, all the displaced materials moved westwards along the lowest thrust-plane or "sole". Eventually the friction in advance of the area represented in (Figure 45) accumulated to such an extent as to produce a sharp plication of all the structures overlying this "sole".

In discussing the sequence of events in the development of the structure of the North-West Highlands, we are confronted with the complications that must have arisen from the effects of increasing load due to the heaping-up of the advancing masses. Further, it ought to be borne in mind that denudation has exposed at the present surface structures which were produced at varying depths and under different conditions of load.

Age of the movements

It is obvious that the movements here under consideration must be later than the Cambrian dolomites and limestones and the igneous rocks intrusive in the sub-divisions of that system in Assynt. In the opinion of Dr. B. N. Peach, the fauna obtained at Durness is similar to, if not identical with, that which in Newfoundland, Mingan Islands, and Point Levis is found beneath strata that yield the Arenig *Phyllograptus* fauna, and is therefore of Cambrian age. On the other hand, the movements must be much older than the Old Red Sandstone, for its basal conglomerates rest unconformably on a denuded surface of the Eastern schists, and contain pebbles of basal quartzite, pipe-rock, dolomite, and limestone derived from the Cambrian rocks of the North-West Highlands.

Experimental researches By Mr. H. M. Cadell

The remarkable structures described in the previous paragraphs led Mr. H. M. Cadell, formerly a member of the Geological Survey, to institute a series of experiments<ref>*Trans. Roy. Soc. Edinb.*, vol. xxxv., Part VII.</ref> with the view of imitating in the laboratory processes which may have been in operation during the development of the post-Cambrian movements in the North-West Highlands. A study of the phenomena in the field had shown that, in some cases, the rocks of that region behaved like brittle rigid bodies under the influence of horizontal compression or earth-creep, and that, instead of undergoing plication, they had snapped across and been piled together in slices like so many cards swept into a heap on the table. To imitate such structures, Mr. Cadell made use of plaster of Paris interleaved with damp sand, which set into hard brittle laminae that snapped under strain, and in some instances allowed folding to take place. In some of the experiments black foundry-loam was employed, and in others clay, usually in association with less plastic layers.

The experiments were of three kinds. The first series (a) was designed to explain the behaviour of different types and arrangements of strata when pushed horizontally over an immovable surface; the second (b) to ascertain if possible how gently-inclined thrust-planes may have originated, and to trace their connection with fan-structure and other phenomena observed in mountain systems of elevation; and the third series (c) was conducted on principles suggested by the experiments of Favre, who placed layers of clay on a stretched indiarubber band, which, on contraction, produced miniature mountain ridges by the wrinkling of the surface of the clay.

In the course of his experimental researches, Mr. Cadell successfully reproduced two types of structure which are characteristi$_c$ of certain stages of the post-Cambrian movements in the North-West Highlands — (1) the imbricate structure (*Schuppen Struktur*), and (2) the inclined thrust-plane or "sole" along which the heaped-up slices were driven.

In the experiment that illustrated the first of these two types the depth of strata was only 11 inches, the breadth 8 inches, and the section was pressed in from an original length of 44 inches to a space of 15 inches. In the initial stage, horizontal force being applied at one end, a small overfold was produced, but afterwards the layers or strata underwent a process of piling-up in separate slices by slightly-inclined reversed faults. The accumulating mass slipped vertically up the face of the pressure board as each new wedge of material snapped and was driven under the piled-up layers. The accompanying (Figure 19)a is a diagrammatic representation of the structure thus produced.

In another experiment it was found that, after continued heaping up of the materials, the displaced layers rose and slid forward along a major thrust-plane or "sole" which truncates the overlying minor thrusts or reversed faults. (Figure 19)b. It is apparent that beds repeated in this manner in the field, without inversion or folding, might simulate a normal sequence of strata of great thickness.

These experiments furnish some suggestive indications of the order in which the various structures were developed. It is obvious that the wedges first piled-up are those nearest the compressing force, and that after the continuance of the heaping up for an indefinite period the major thrust-plane or " sole ' is produced.

In another illustrative experiment, instead of the pressure board being held in a vertical position, with its lower end against the fixed sole, a cushion of sand was substituted for it and force was applied behind. The result showed that the whole mass rose and slid forward over the lower and less-disturbed beds along a major thrust-plane, inclined at a very slight angle to the horizon. During the forward movement the friction tended to retard the front more than the back part of the advancing mass, thereby increasing the inclination of the thrust layers. Had the experiment been continued, the originally horizontal parts of the thrust mass would doubtless have become vertical, thereafter bending inwards towards the major thrust-plane below. (Figure 19)c

At the conclusion of his paper from which these notes and illustrations are taken, Mr. Cadell thus summarises the results of his researches:

1. Horizontal pressure applied at one point is not propagated far forward into a mass of strata.

2. The compressed mass tends to find relief along a series of gently-inclined thrust-planes, which dip towards the side from which pressure is exerted.
3. After a certain amount of heaping-up along a series of minor thrust-planes, the heaped-up mass tends to rise and ride forward bodily along major thrust-planes.
4. Thrust-planes and reversed faults are not necessarily developed from split overfolds, but often originate at once on application of horizontal pressure.
5. A thrust-plane below may pass into an anticline above, and never reach the surface.
6. A major thrust-plane above may, and probably always does, originate in a fold below.
7. A thrust-plane may branch into smaller thrust-planes, or pass into an overfold along the strike.
8. The front portion of a mass of rock being pushed along a thrust-plane tends to bow forward and roll under the back portion.
9. The more rigid the rock, the better will the phenomena of thrusting be exhibited.
10. Fan-structure may be produced by the continued compression of a single anticline.
11. Thrust-planes have a strong tendency to originate at the sides of the fan.
12. The same movement which produces the fan renders its core schistose.
13. The theory of a uniformly contracting substratum explains the cleavage often found in the deeper parts of a mountain system, the upper portion of which is simply plicated.
14. This theory may also explain the origin of fan-structure, thrusting, and its accompanying phenomena, including wedge structure.

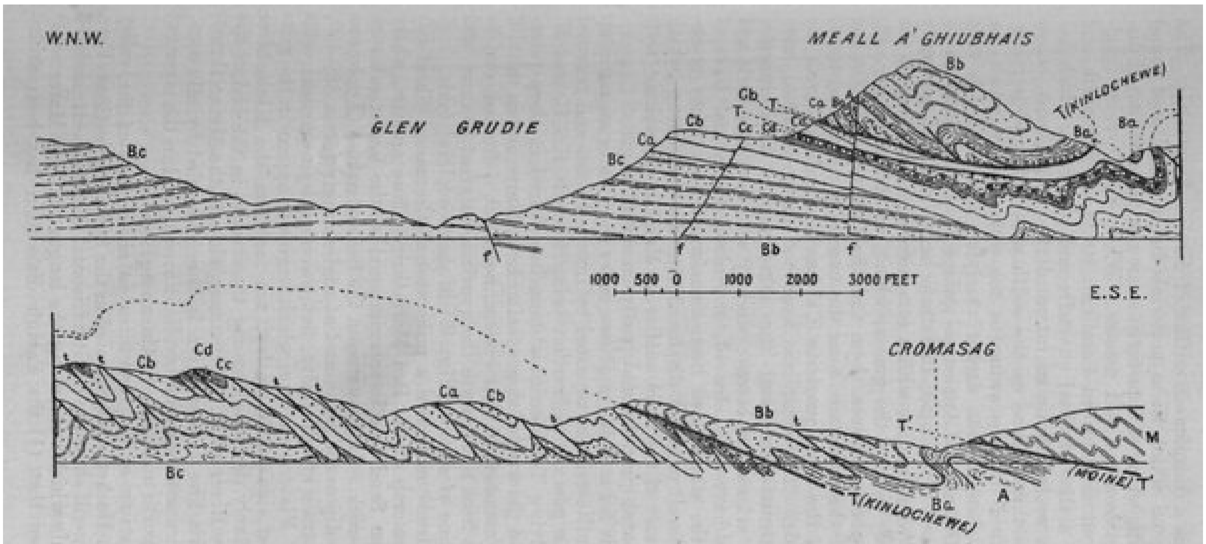
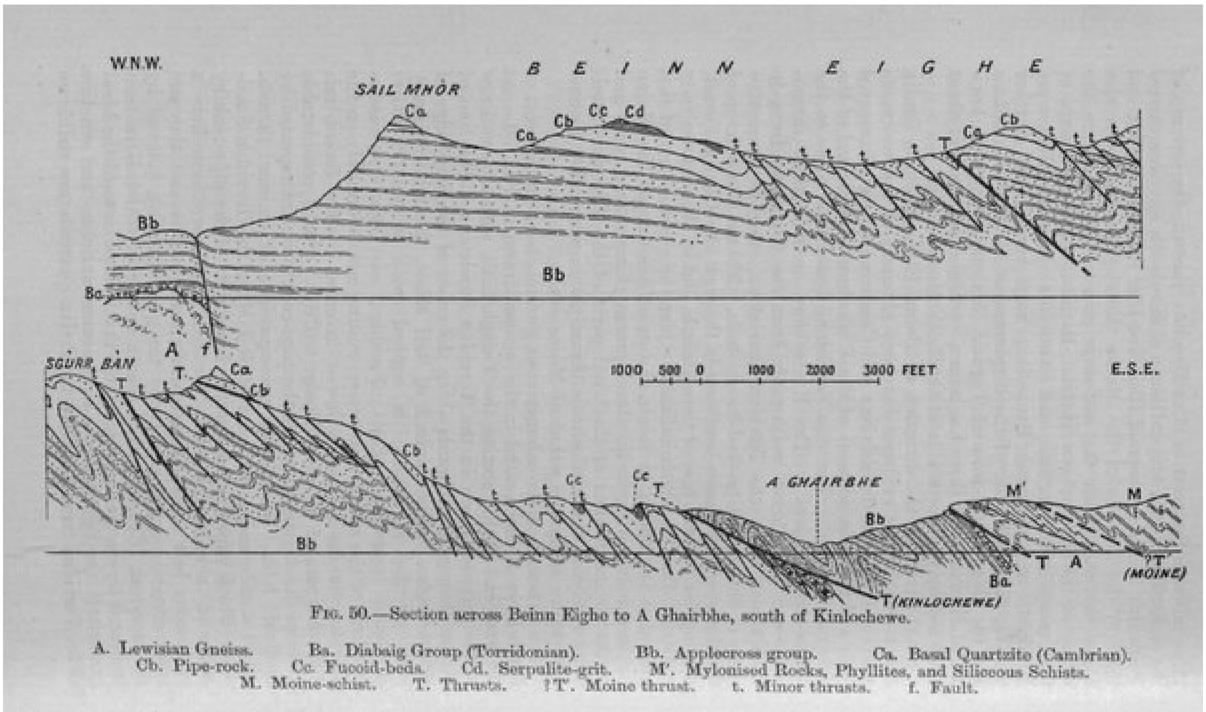


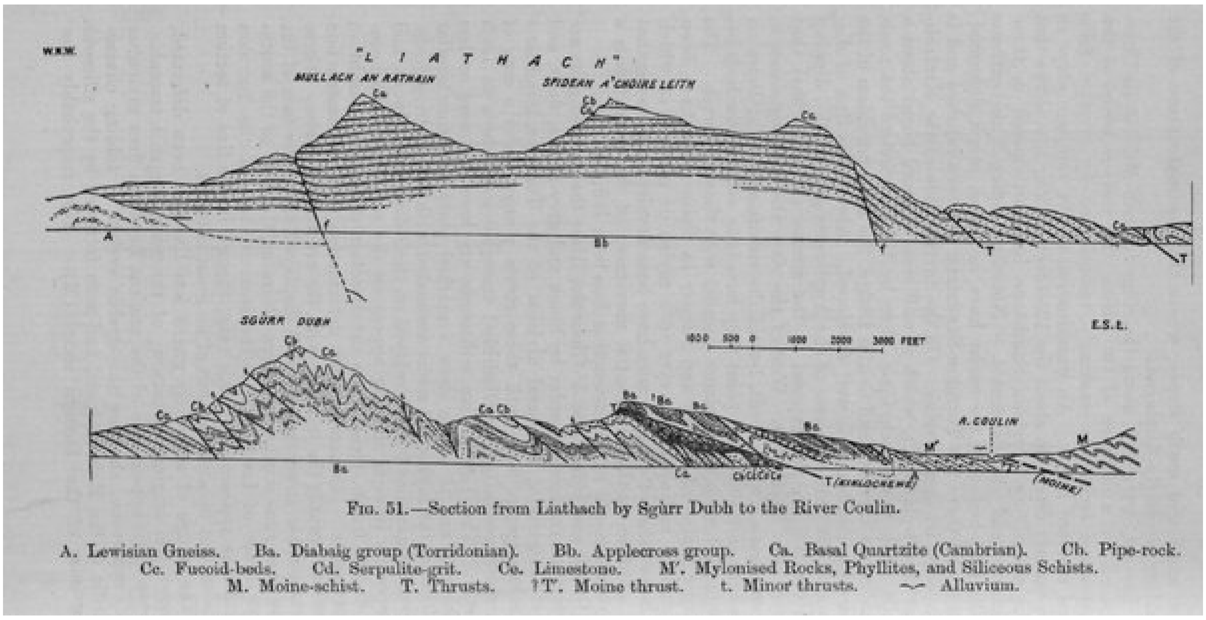
FIG. 49.—Section from Glen Grudie by Meall a' Ghiubhais to Cromasag, south of Kinlochewe.

A. Lewisian Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Bc. Aultbea group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. M. Eastern Schists. T. Thrusts. T'. Moine thrust. t. Minor thrusts. f. Normal faults.

(Figure 49) Section from Glen Grudie by Meall a' Ghiubhais to Cromasag, south of Kinlochewe. A. Lewisian.Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Be. Aultbea group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. M. Eastern Schists. T. Thrusts. T′. Moine thruit. t. Minor thrusts. f. Normal faults.



(Figure 50) Section across Beinn Eighe to A Ghairbhe, south of Kinlochewe. A. Lewisian Gneiss. BA.. Diabaig Group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. M′. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine-schist. T. Thrusts. ? T′. Moine thrust. t. Minor thrusts. f. Fault.



(Figure 51) Section from Liathach by Sgùrr Dubh to the River Coulin. A. Lewisian Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Ch. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M′. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine-schist. T. Thrusts. ? T′. Moine thrust. t. Minor thrusts. [symbol] Alluvium.

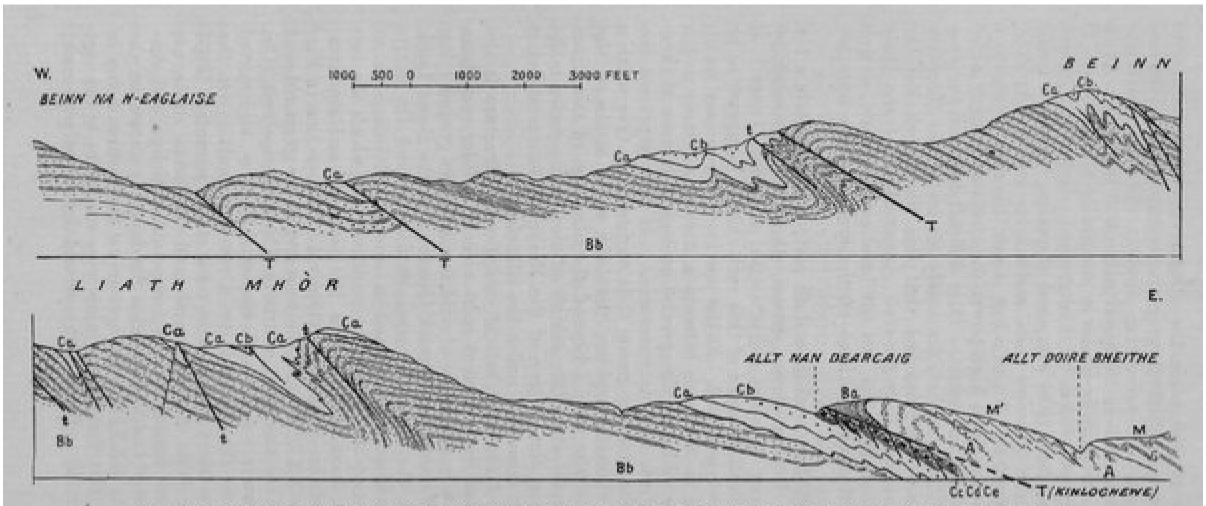


Fig. 52.—Section from Beinn na h-Eaglaise along Beinn Liath Mhòr to Allt Doire Bheithe, Auchnashellach Forest.

A. Lewisian Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross Group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M′. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine schist. T. Thrusts. t. Minor thrusts.

(Figure 52) Section from Beinn na h-Eaglaise along Beinn Liath Mhòr to Allt Doire Bheithe, Auchnashellach Forest. A. Lewisian Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross Group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M′. Mylonised Rocks, Phyllites, and Siliceous Schists. M. Moine schist. T. Thrusts. t Minor thrusts.

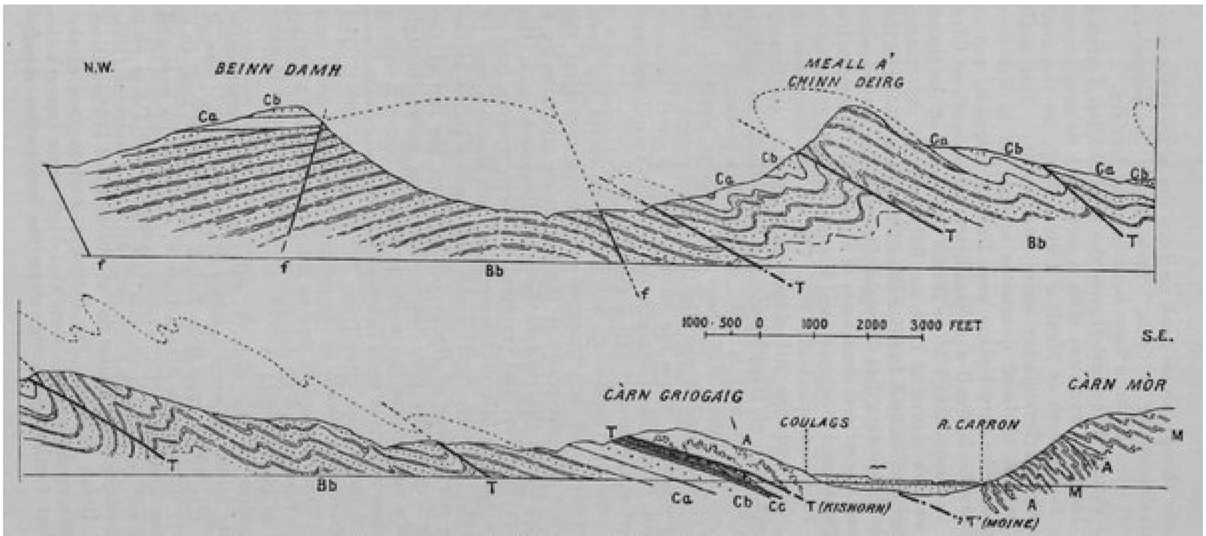


Fig. 53.—Section from Beinn Damh across Meall a' Chinn Deirg to Coulags in Strath Carron.

A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. M. Eastern Schists. T. Thrusts. ?T′. Moine thrust. f. Faults. ~ Alluvium.

(Figure 53) Section from Beinn Damh across Meall a' Chinn Deirg to Coulags in Strath Carron. A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. M. Eastern Schists. T. Thrusts. ? T′. Moine thrust. f. Faults. [symbol] Alluvium.

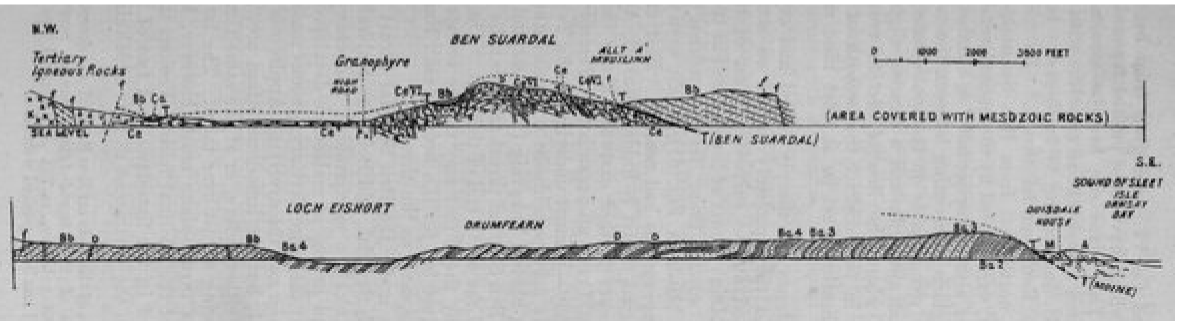


FIG. 61.—Section from the foot of Beinn na Caillich, Broadford, across Strath, Loch Eishort, and Sleat to Duisdale House, on the Sound of Sleat.

A. Lewisian Gneiss. Ba^2. Loch na Dal Shales (Torridonian). Ba^3. Beinn na Seamraig Grits. Ba^4. 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 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. Ba^2. Loch na Dal Shales (Torridonian). Ba^3. Beinn na Seamraig Grits. Ba^4. 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.

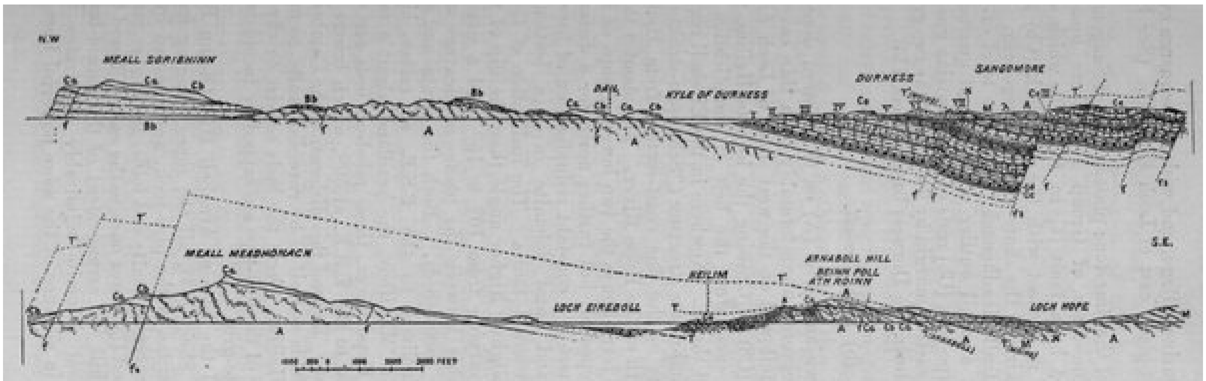


FIG. 20.—Section from Meall Sgribhinn by Durness, Sangomore, and Meall Meadhonach to Arnaboll Hill and Loch Hope.

A. Lewisian Gneiss. Bb. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite Grit. Ce. Limestone. Ce I. to Ce VII. Cambrian Dolomite and Limestone. M'. Mylonized Rocks, Green Schists, and Phyllites. M. Moine-schists. x. Quartz Schist. λ. Marble. T. Thrusts. T'. Moine-thrust. f. Faults.

(Figure 20) Section from Meall Sgribhinn by Durness, Sangomore, and Meall Meadhonach to Arnaboll Hill and Loch Hope. A. Lewisian Gneiss. Bb. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite Grit. Ce. Limestone. Ce I. to Ce VII. Cambrian Dolomite and Limestone. M′. Mylonized Rocks, Green Schists, and Phyllites. M. Moine-schists. x. Quartz Schist. λ. Marble. T. Thrusts. T′. Moine-thrust. f. Faults.

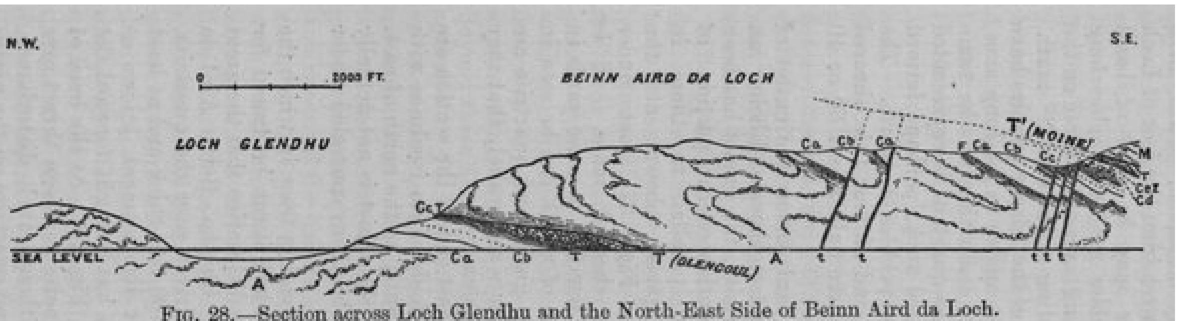


FIG. 28.—Section across Loch Glendhu and the North-East Side of Beinn Aird da Loch.

A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaidh group. M. Eastern Schists. F. Porphyrite Sill. T. Thrusts. T'. Moine-thrust. t. Minor thrusts.

(Figure 28) Section across Loch Glendhu and the North-East Side of Beinn Aird da Loch. A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaidh group. M. Eastern Schists. F. Porphyritc Sill. T. Thrusts. T′. Moine-thrust. t. Minor thrusts.

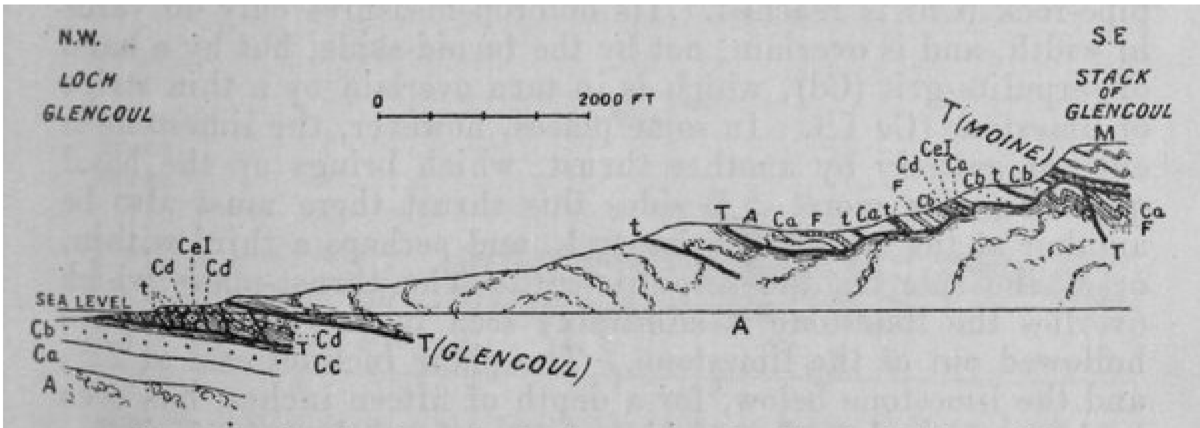


FIG. 29.—Section from Loch Glencoul to the Stack of Glencoul.*

A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaidh group. M. Eastern Schists. F. Intrusive Igneous Rocks. T. Thrusts. T′. Moine-thrust. t. Minor thrusts.

(Figure 29) Section from Loch Glencoul to the Stack of Glencoul.<ref>The Stack of Glencoul is not named on the one-inch map, but it lies nearly two miles south-east from Glencoul cottage.</ref> A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaidh group. M. Eastern Schists. F. Intrusive Igneous Rocks. T. Thrusts. T′. Moine-thrust. t. Minor thrusts.

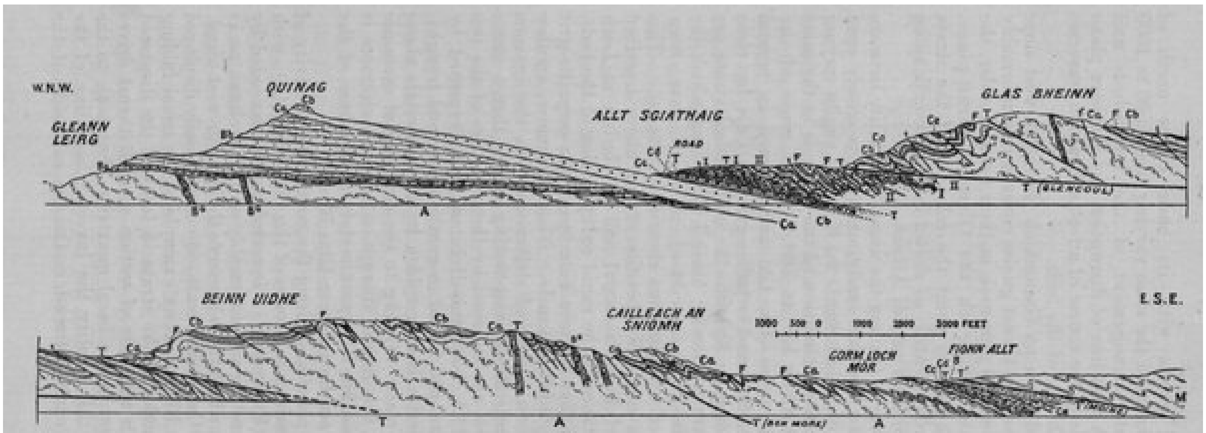


FIG. 31.—Section from Quinag by Glas Bheinn and Beinn Uidhe to Gorm Loch Mór and Fionn Allt.

A. Lewisian Gneiss. Bg. Dykes in Gneiss. B. Torridon Sandstone. Ba. Diabeg group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite grit. Ce. Limestone (Cambrian). Ce I. Limestone (Grudaidh group.) Ce II. Limestone (Eilean Dubh group). F. Intrusive Igneous Rocks. M. Eastern Schists. T. Thrusts. T′. Moine-thrust. t. Minor thrusts. f. Faults.

(Figure 31) Section from Quinag by Glas Bheinn and Beinn Uidhe to Gorin Loch Mar and Fionn Allt. A. Lewisian Gneiss. B^G. Dykes in Gneiss. B. Torridon Sandstone. Ba. Diabeg group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite grit. Ce. Limestone (Cambrian). Ce I. Limestone (Grudaidh group.) Ce II. Limestone (Eilean Dubh group). F. Intrusive Igneous Rocks. M. Eastern Schists. T. Thrusts. T′. Moine-thrust. t. Minor thrusts. f. Faults.

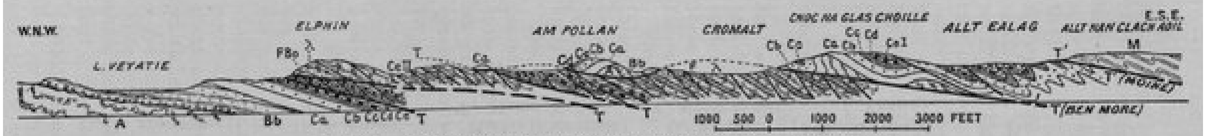


Fig. 39.—Section from Elphin by Cnoc na Glas Choille to Allt Ealag.

A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). λ. Marble (Cambrian). FBo. Borolanite. F. Porphyrite Sills. M. Eastern Schists. T. Thrusts. T′. Moine thrust.

(Figure 39) Section from Elphin by Cnoc na Glas Choille to Allt Ealag. A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). λ Marble (Cambrian). FBo. Borolanite. F. Porphyrite Sills. M. Eastern Schists. T. Thrusts. T′. Moine thrust.

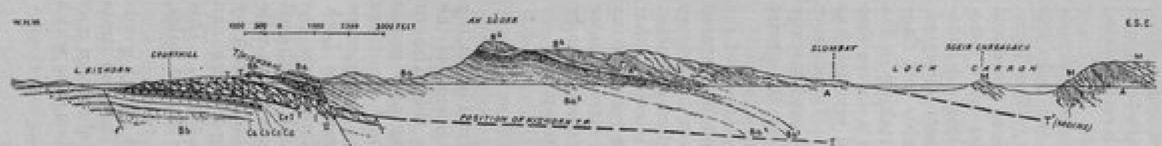


Fig. 55.—Section from Loch Kishorn by An Sgòrr to Slumbay, Loch Carron.

A. Lewisian Gneiss. Bα Epidiorite and Hornblende-schist in Gneiss. Ba, Ba¹ to Ba³. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T′. Moine thrust. f. Faults.

(Figure 55) Section from Loch Kishorn by An Sgòrr to Slumbay, Loch Carron. A. Lewisian Gneiss. Ba Epidiorite and Hornblende-schist in Gneiss. Ba, Ba^1 to Ba^3. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). Ce H. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T′. Moine thrust. f. Faults.

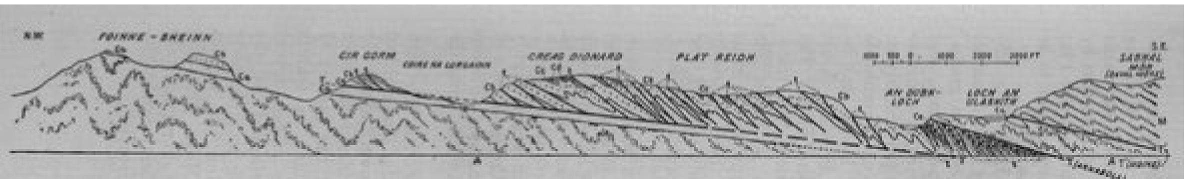


Fig. 25.—Section from Foinne-Bheinn by the Plat Reidh and An Dubh-Loch to Sabhal Mòr.

A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T′. Moine-thrust. t. Minor-thrusts.

(Figure 25) Section from Foinne-Bheinn by the Plat Reidh and An Dubh-Loch to Sabhal Mòr. A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T′. Moine-thrust. t. Minor-thrusts.

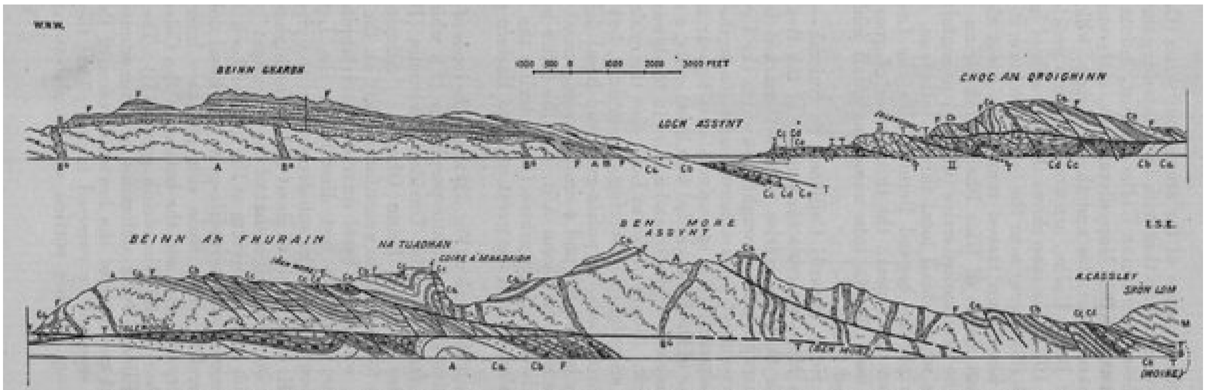


Fig. 32.—Section from Beinn Gharbh by Cnoc an Droighinn, Beinn an Fhurain, and Ben More, Assynt, to the River Cassley.

A. Lewisian Gneiss. Bg. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). F. Intrusive Igneous Rocks. M. Eastern Schists. T. Thrusts. T′. Moine-thrust. f. Faults.

(Figure 32) Section from Beinn Gharbh by Cnoc an Droighinn, Beinn an Fhurain, and Ben More, Assynt, to the River Cassley. A. Lewisian Gneiss. B^{G}. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone.Ce I. Limestone (Ghrudaidh group). Ce IL Limestone (Eilean Dubh group). F. Intrusive Igneous Rocks. M. Eastern Schists. T. Thrusts. T′. Moine-thrust. f. Faults.

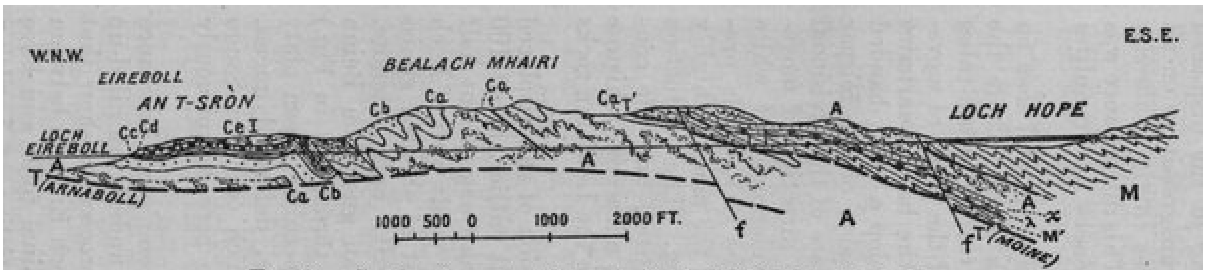


Fig. 21.—Section from An t-Sron by Bealach Mhairi to Loch Hope.

A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). M′. Mylonised Rocks, Green Schists and Phyllites. M. Moine-schists. x. Quartz-schist. λ. Marble. T. Arnaboll-thrust. T′. Moine-thrust. t. Minor-thrust. f. Faults.

(Figure 21) Section from An t-Sron by Bealach Mhairi to Loch Hope. A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). M′. Mylonised Rocks, Green Schists and Phyllites. M. Moine-schists. x. Quartz-schist. λ. Marble. T. Arnaboll-thrust. T′. Moine-thrust. t. Minor-thrust. f. Faults.

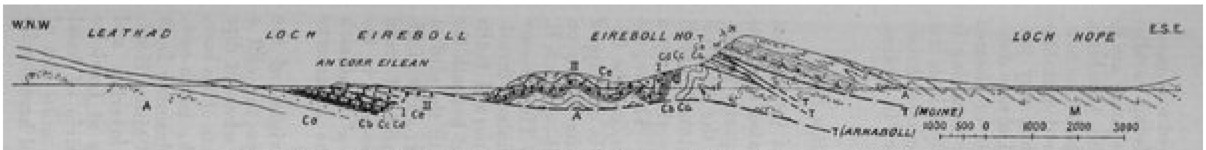


Fig. 22.—Section from Leathad by An Corr Eilean and Eireboll House to Loch Hope.

A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. Ce I. Dolomite (Ghrudaidh group). Ce II. Dolomite (Eilean Dubh group). M′. Mylonised Rocks, Green Schists, and Phyllites. M. Moine-schists. x. Quartz-schists. λ. Marble. T. Arnaboll-thrust. T′. Moine-thrust.

(Figure 22) Section from Leathad by An Corr Eilean and Eireboll House to Loch Hope. A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. Ce I. Dolomite (Ghrudaidh group). Ce II. Dolomite (Eilean Dubh group). M′. Mylonised Rocks, Green Schists, and Phyllites. M. Moine-schists. x. Quartz-schists. λ. Marble. T. Arnaboll-thrust. T′. Moine-thrust.

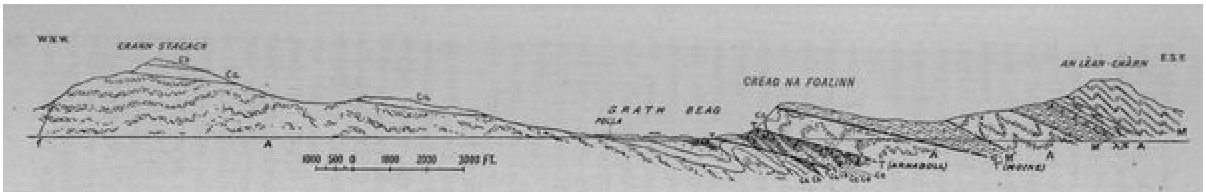


FIG. 24.—Section from Crann Stacach across Srath Beag and Creag na Faolinn to An Léan-chárn.

A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M′. Mylonised Rocks, Green Schists, and Phyllites. M. Moine-schists. x. Quartz-schist. λ. Marble. T. Thrusts. T′. Moine-thrust. f. Fault. ~ Alluvium.

(Figure 24) Section from Crann Stacach across Srath Beag and Creag na Faolinn to An Lean-charn. A. Lewisian Gneiss. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M′. Mylonised Rocks, Green Schists, and Phyllites. M. Moine-schists. x. Quartz-schist. λ. Marble. T. Thrusts. T′. Moine-thrust. f. Fault. [symbol] Alluvium.

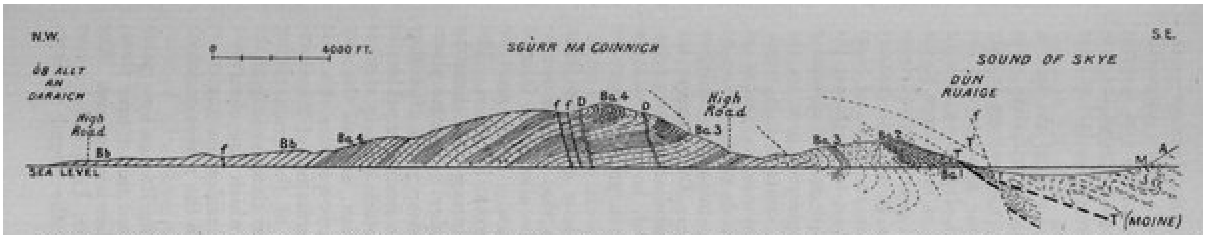


FIG. 59.—Section across the north end of Sleat, Skye, from the coast at Ob Allt an Daraich across Sgùrr na Coinnich to the Sound of Skye at Dùn Ruaige.

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 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 Dùm Ruaige. A. Lewisian Gneiss. Bal. Epidotic Grits (Torridonian). Ba'. Loch na Dal Beds. Be. Beinn na Seamraig Grits. Ba^4. Kinloch Beds. Bb. Applecross group. M. Moine Schists. D. Tertiary Dykes. T. Thrust. T. Moine thrust. f. Faults.

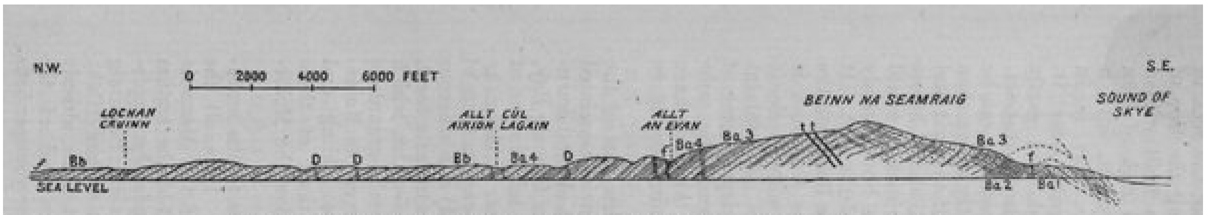


FIG. 60.—Section from near Skulamus across Beinn na Seamraig to the Sound of Skye.

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 60) Section from near Skulamus across Beinn na Seamraig to the Sound of Skye. Ba^1. Epidotic Grits (Torridonian). Ba^2. Loch na Dal Beds. Ba^3. Beinn na Seamraig Grits. Ba^4. Kinloch Beds. Bb. Applecross group. f. Trias. D. Tertiary Dykes. t. Minor thrusts. f. Faults.

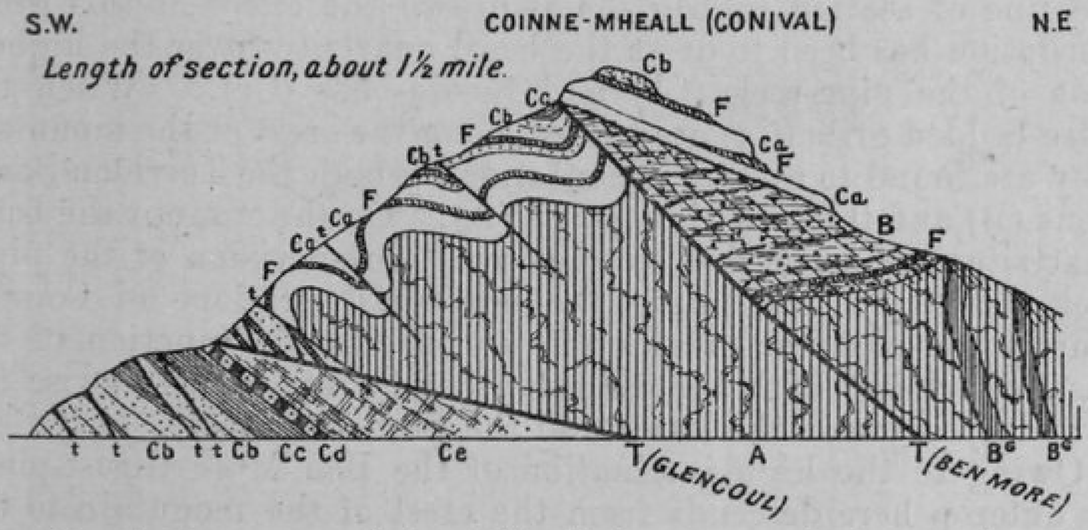


FIG. 33.—Section across Coinne-Mheall from one of the sources of the Traligill east to Corrie a' Mhadaidh.

A. Lewisian Gneiss. B^G. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. F. Intrusive Igneous Rocks. T. Thrusts. t. Minor thrusts.

(Figure 33) Section across Coinne-Mheall from one of the sources of the Traligill east to Corrie a' Mhadaidh. A. Lewisian Gneiss. B^G. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. F. Intrusive Igneous Rocks. T. Thrusts. t. Minor thrusts.

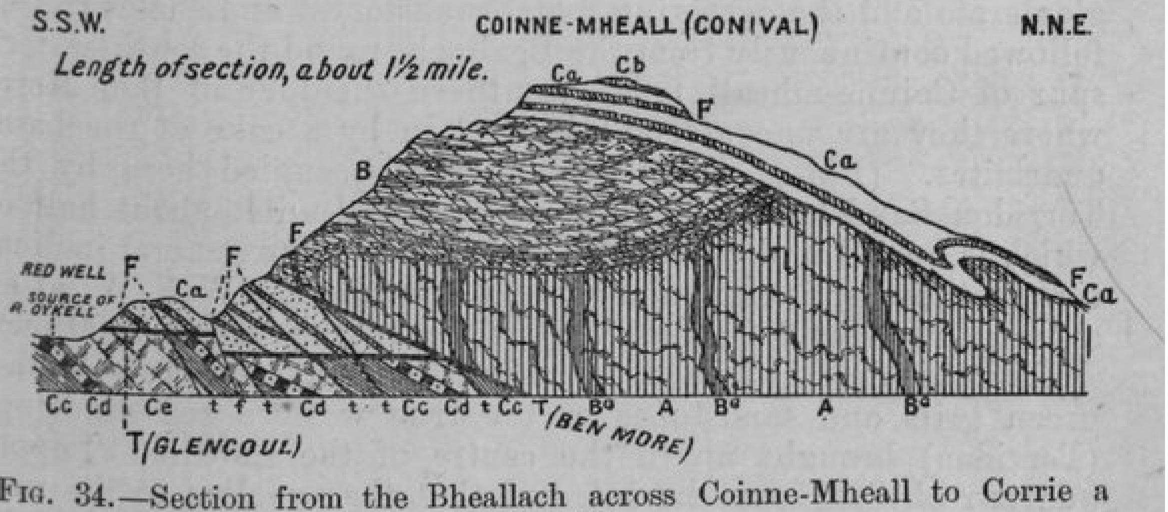
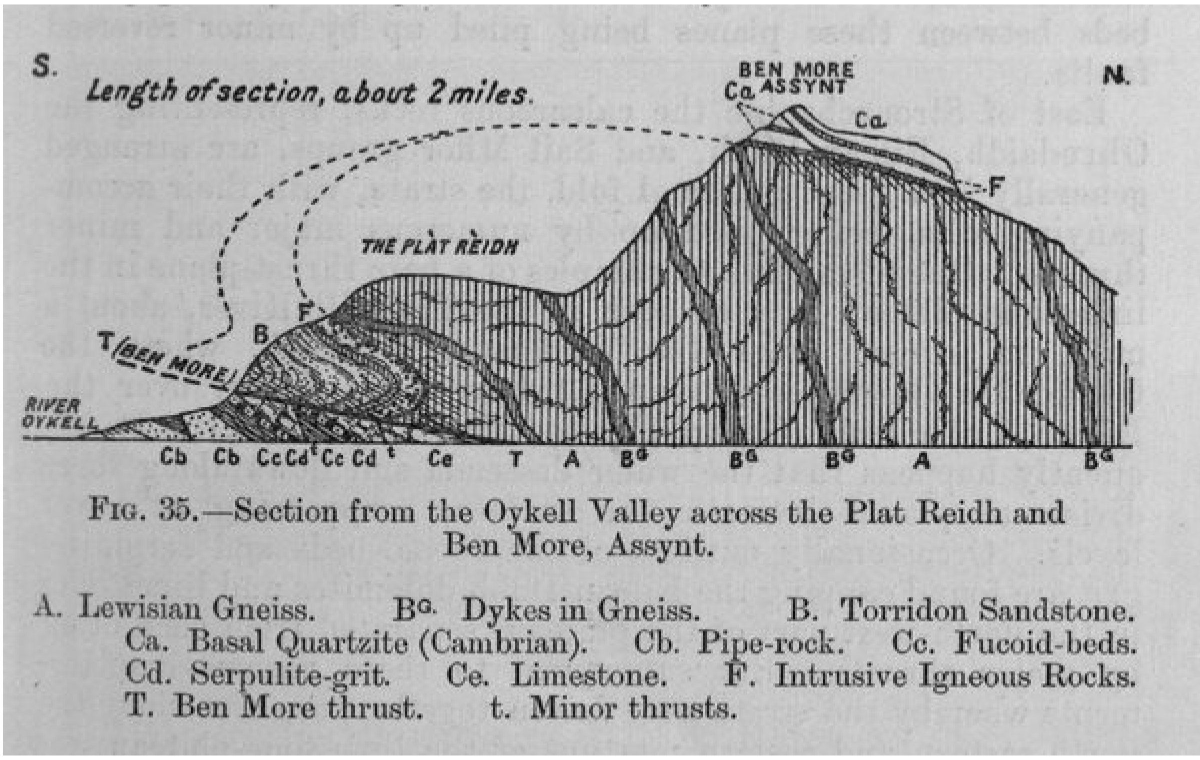


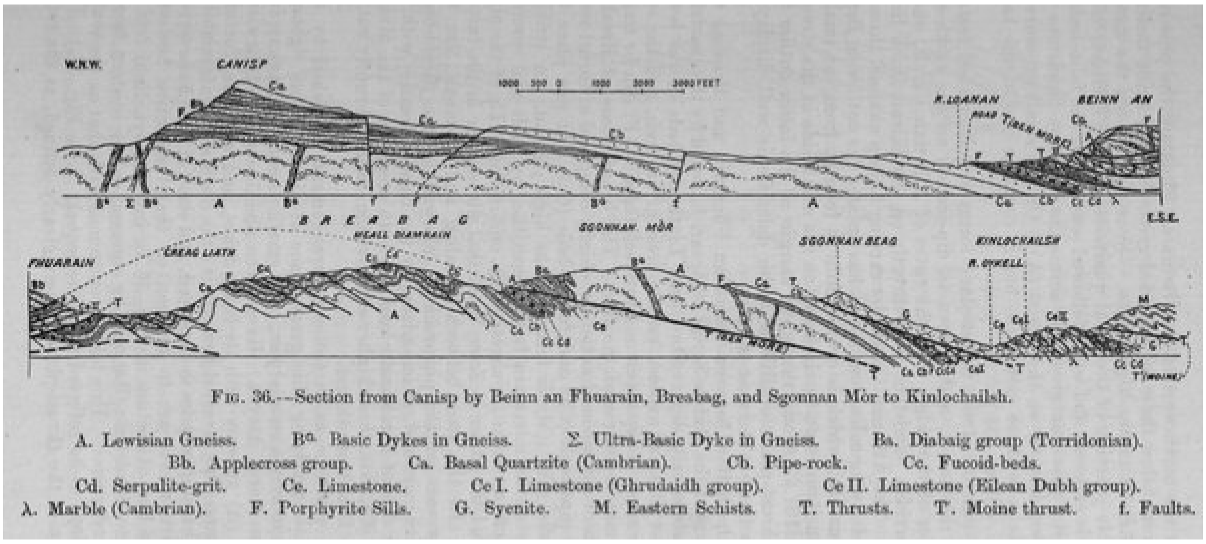
FIG. 34.—Section from the Bheallach across Coinne-Mheall to Corrie a Mhadaidh.

A. Lewisian Gneiss. B^G. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. F. Intrusive Igneous Rocks. T. Thrusts. t. Minor thrusts. f. Faults.

(Figure 34) Section from the Bheallach across Coinne-Mheall to Corrie a Mhadaidh. A. Lewisian Gneiss. B^G. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. F. Intrusive Igneous Rocks. T. Thrusts. t. Minor thrusts. f. Faults.



(Figure 35) Section from the Oykell Valley across the Plat Reidh and Ben More, Assynt. A. Lewisian Gneiss. B^G. Dykes in Gneiss. B. Torridon Sandstone. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. F. Intrusive Igneous Rocks. T. Ben More thrust. t. Minor thrusts.



(Figure 36) Section from Canisp by Beinn an Fhuarain, Breabag, and Sgonnan Mòr. to Kinlochailsh. A. Lewisian Gneiss. Σ. Basic Dykes in Gneiss. E. Ultra-Basic Dyke in Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). G. Syenite. M. Eastern SchisT's. T. Thrusts. T′. Moine thrust. f. Faults Cd. Serpulite-grit. Ce. Limestone. λ. Marble (Cambrian). F. Porphyrite Sills.

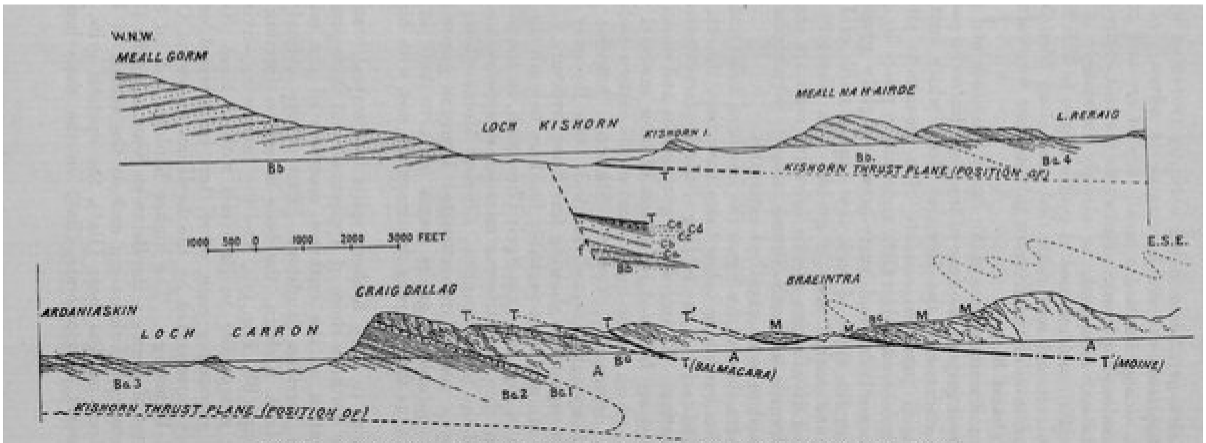


FIG. 56.—Section from Meall Gorm by Loch Reraig and Craig Dallag to Gleann Udalain.

A. Lewisian Gneiss. B^G Epidiorite and Hornblende-schist in Gneiss. Ba¹ to Ba⁴. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T'. Moine thrust. f. Fault.

(Figure 56) Section from Meall Gorm by Loch Reraig and Craig Dallag to Gleann Udalain. A. Lewisian Gneiss. B^G Epidiorite and Hornblende-schist in Gneiss. Ba^1 to Ba^4. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T′. Moine thrust. f. Fault.

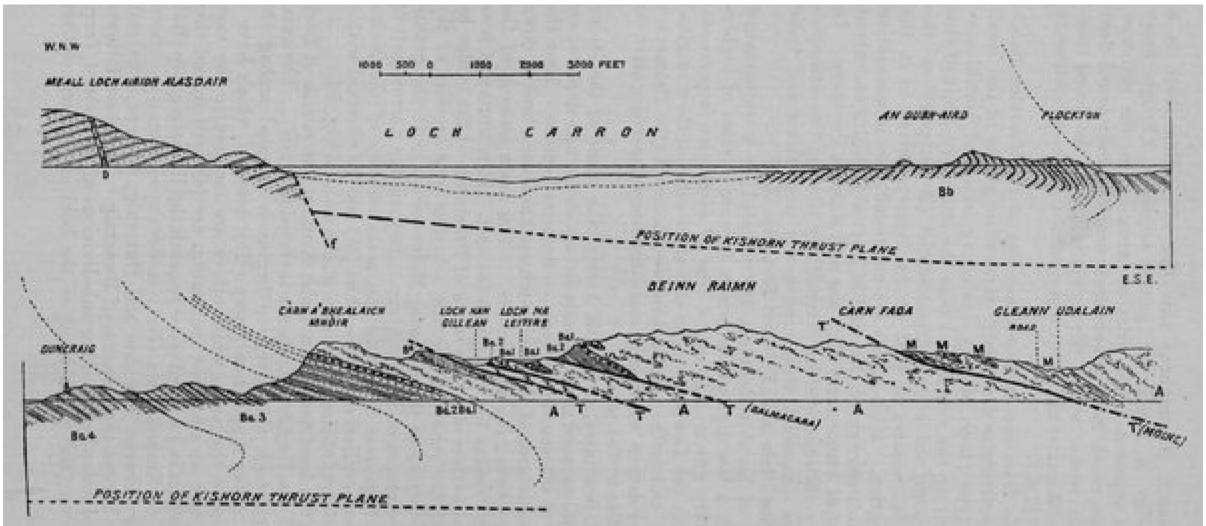


FIG. 57.—Section from Loch Carron by Plockton and Beinn Raimh to Gleann Udalain.

A. Lewisian Gneiss. B^G Epidiorite and Hornblende-schist in Gneiss. Ba¹ to Ba⁴. Diabaig group (Torridonian). Bb. Applecross group. M. Eastern Schists. D. Tertiary Dyke. T. Thrusts. T'. Moine thrust. f. Fault.

(Figure 57) Section from Loch Carron by Flockton and Beinn Raimh to Gleann Udalain. A. Lewisian Gneiss. ti° Epidiorite and Hornblende-schist in Gneiss. Ba^1 to Ba^4. Diabaig group (Torridonian). Bb. Applecross group. M. Eastern Schists. D. Tertiary Dyke. T. Thrusts. T′. Moine thrust. f. Fault.

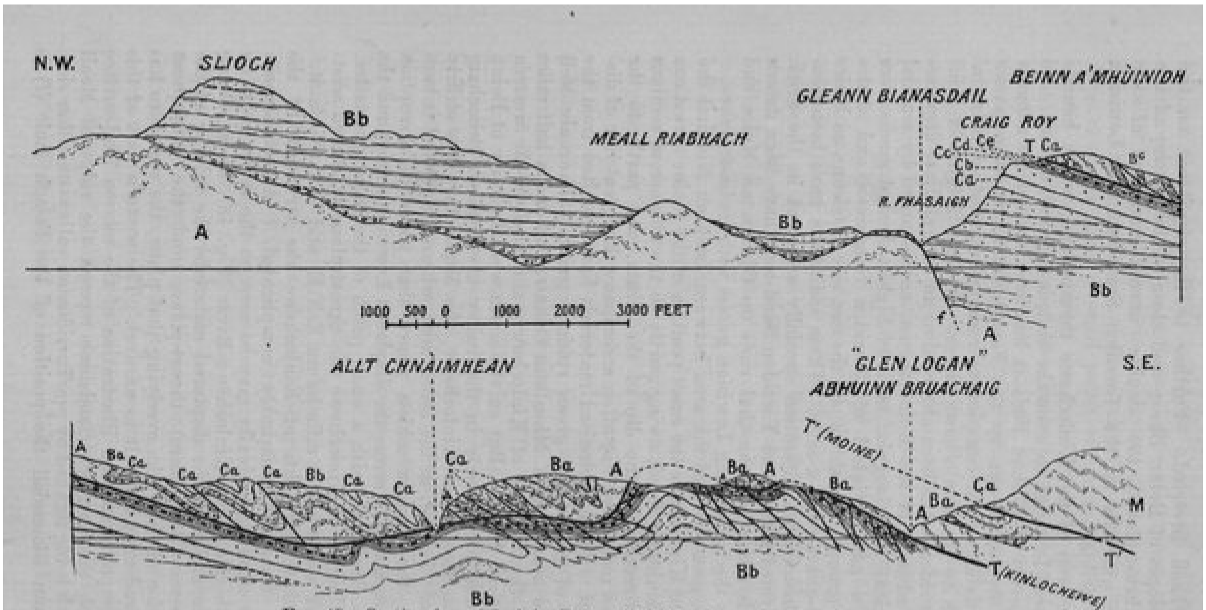


Fig. 48.—Section from Siloch by Beinn a' Mhùinidh to Abhuinn Bruachaig.

A. Lewisian Gneiss. BG. Dykes in Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T'. Moine thrust. f. Fault.

(Figure 48) Section from Siloch by Beinn a' Mhùinnidh to Abhuinn Bruachaig. A. Lewisian Gneiss. B^G. Dykes in Gneiss. Ba. Diabaig group (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T'. Moine thrust. f. Fault.

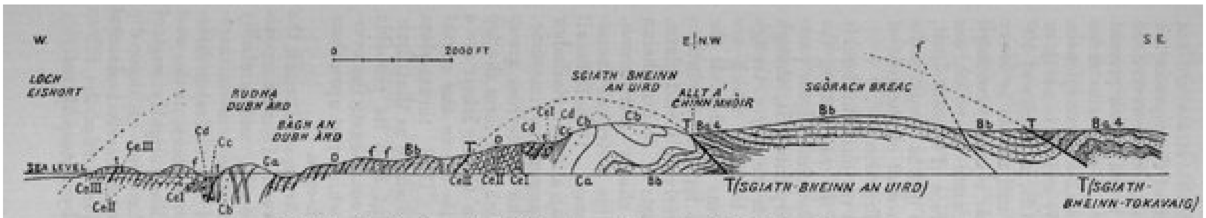


Fig. 62.—Section from Loch Eishort over the north side of Sgiath-bheinn an Uird.

Ba4. Kinloch Beds (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaidh group. Ce II. Eilean Dubh group. Ce III. Sailmohr group. D. Tertiary Dykes. T. Thrusts. t. Minor thrusts. f. Faults.

(Figure 62) Section from Loch Eishort over the north side of Sgiath-bheinn an Uird. Ba^4. Kinloch Beds (Torridonian). Bb. Applecross group. Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Ghrudaidh group. Ce II. Eilean Dubh group. Ce III. Sailmohr group. D. Tertiary Dykes. T. Thrusts. t. Minor thrusts. f. Faults.

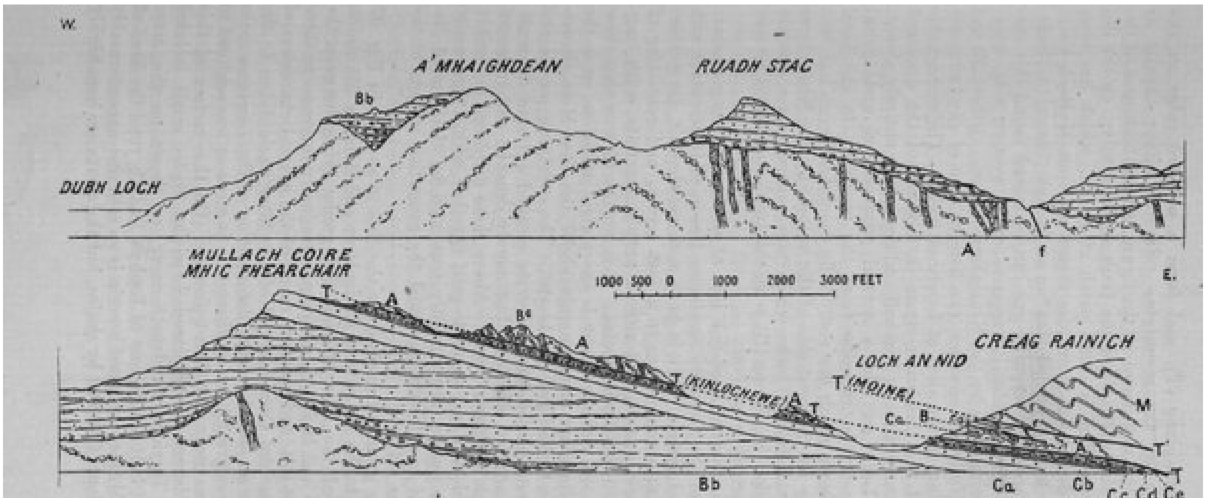


Fig. 47.—Section from A' Mhaighdean by Mullach Coire Mhic Fhearchair to Creag Rainich.

A. Lewisian Gneiss. BG Dykes in Gneiss. B. Torridon Sandstone. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Moine-schists. T. Kinlochewe thrust. T'. Moine thrust. f. Fault.

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

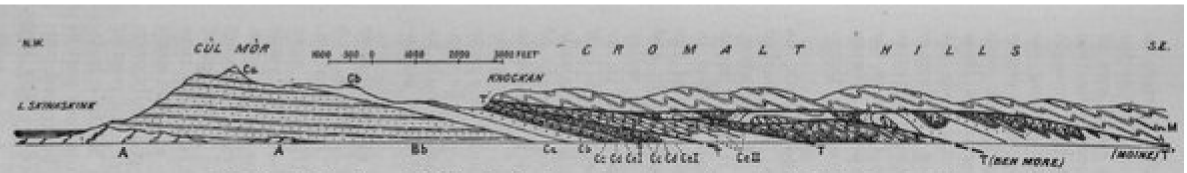


FIG. 40.—Section from Cùl Mòr, by Knockan, along the northern flank of the Cromalt Hills.

A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T′. Moine thrust.

(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. Fucoid-beds. Cd. Serpulite-grit. Ce I. Limestone (Ghrudaidh group). Ce II. Limestone (Eilean Dubh group). M. Eastern Schists. T. Thrusts. T′. Moine thrust.

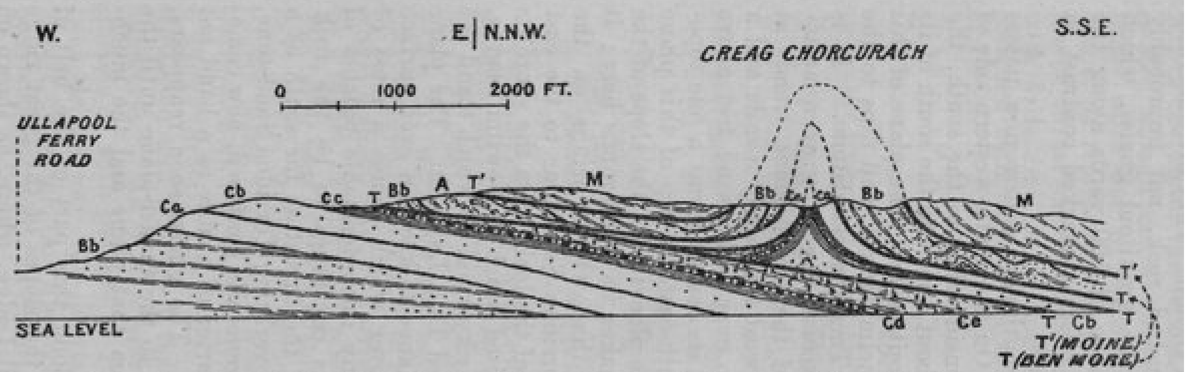


FIG. 45.—Section across Anticline near Creag Chorcurach, 1 mile east from Dundonnell Lodge, Little Loch Broom.

A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schists. T. Thrusts. T′. Moine thrust.

(Figure 45) Section across Anticline near Creag Chorcurach, 1 mile east from Dundonnell Lodge, Little Loch Broom. A. Lewisian Gneiss. Bb. Applecross group (Torridonian). Ca. Basal Quartzite (Cambrian). Cb. Pipe-rock. Cc. Fucoid-beds. Cd. Serpulite-grit. Ce. Limestone. M. Eastern Schist& T. Thrusts. T′. Moine thrust.

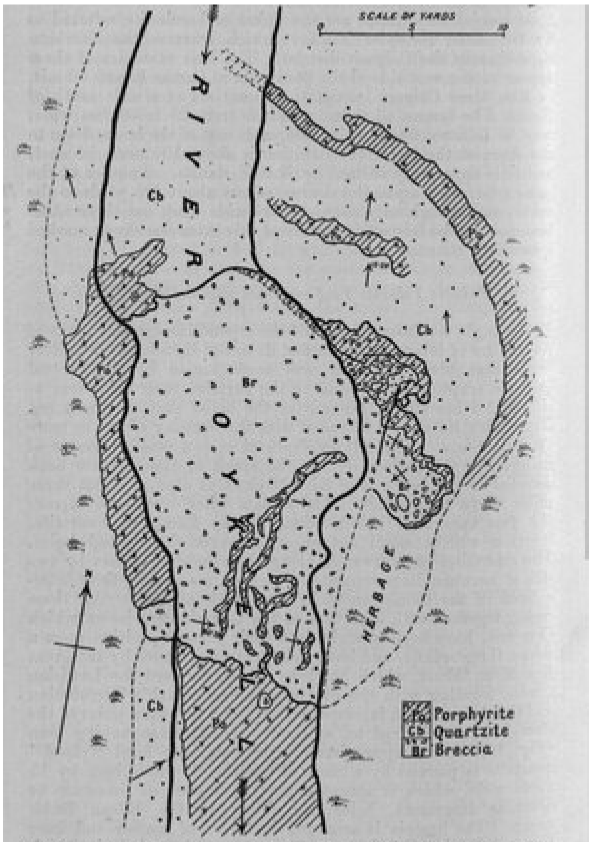


Fig. 19.—Ground Plan of possible Volcanic Vent, River Oykell, about three miles above Loch Ailsh.

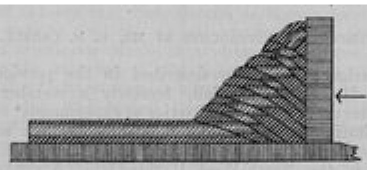


Fig. 19a.—Development of Imbricate Structure. (H. M. Cadell.)

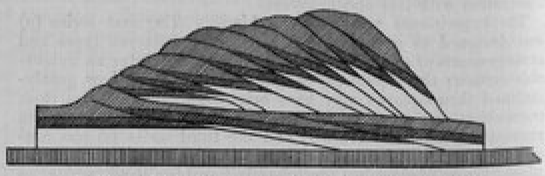


Fig. 19b.—Major thrust-plane or "sole." (H. M. Cadell.)

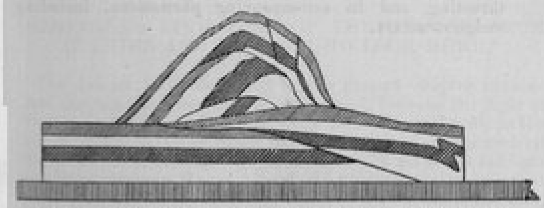


Fig. 19c.—Folding of Thrust Materials along a Major Thrust-plane. (H. M. Cadell.)

(Figure 19) Ground Plan of possible Volcanic Vent, River Oykell, about three miles above Loch Ailsh. Figure 19a. Development of imbricate structure (H. M. Cadell). Figure 19b Major thrust plane or sole (H. M. Cadell). Figure 19c. Folding of thrust materials along major thrust-plane. (H. M. Cadell).