Chapter 5 Architectural features of the fundamental complex

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The principal varieties of rock entering into the composition of the Fundamental Complex have now been described. It remains to give some account of the way in which they are associated so as to build up the complex; or, to use an expression introduced by Prof. Brögger, of the architectural features of the mass. As these features have been described in other portions of the Memoir, it will suffice, in this connection, to call attention to the more important points.

The fact that no one type of rock occurs over any large area has already been referred to. Variations in the relative proportions of the different constituents are almost everywhere noticeable, and there is great diversity in the mode of association of the different varieties of rock.

If we leave out of account the rocks of supposed sedimentary character, the most striking features of the complex are due to the mode of association of lighter and darker varieties; that is, of rocks rich in ferro-magnesian minerals and others rich in felspar and quartz. The primary cause of the architectural features is that which produced a heterogeneous mass wherein the ferromagnesian and quartzo-felspathic constituents were unevenly distributed. After a complex of this kind had been formed, either by differentiation, or by the intrusion of more acid into more basic material, or to both of these operations combined, the secondary and more striking features were undoubtedly determined by plastic deformation.

In wandering over the region of Lewisian gneiss in the northwest of Scotland, it is impossible to avoid being forcibly impressed with the resemblance between the architectural features of the rocks and the forms and dispositions of the foam-flecks on the pools of comparatively still water below falls and rapids. In the spaces where little or no movement is going on, irregular and rounded masses of foam are separated by dark areas of still water. On the margins of these spaces, where movement is in progress, they are drawn out first into lenticles and then into thin streaks which may remain parallel or be bent, by subsequent movements, into serpentine folds or complicated convolutions which defy analysis, and resemble the damascening of old sword-blades and gnu-barrels.

Every type of structure thus produced on the surface of the water can be matched in the rocks of the district: but it is the dark varieties that correspond to the white foam and the lighter coloured varieties to the dark water. It must, of course, be remembered that the disposition of the foam represents, in two dimensions of space, the results of complicated movements taking place in the mass of the water in three dimensions; and so also with the appearances seen on any plane surface of rock. If the water were heterogeneous instead of homogeneous, and if the freezing points of the different portions were different, then progressive cooling would undoubtedly result in the formation of a solid mass having the architectural features of many portions of the Lewisian gneiss. Similar features may be observed in the banded gabbros of Skye, Rum, and elsewhere.

Some of the principal types of architecture are represented in the photographs of rock-surfaces (Plate 6)to (Plate 14); but a very much larger number of photographs would be required to give an adequate idea of the almost endless variety which occurs in nature. In (Plate 6). the lighter felspathic and the darker hornblendic portions are imperfectly separated or imperfectly mixed, according to whichever view is taken as to the origin of the heterogeneous mass. In (Plate 7) the separation is more marked, and lumps of basic hornblende rock are seen to be separated by white quartzofelspathic material. Are the phenomena represented in these two photographs to be explained by differentiation in situ, or by the intrusion of acid into basic material ? They appear to favour the former hypothesis. The portion represented in (Plate 8). also shows a fairly sharp separation between the felspathic and hornblendic portions. In this case, veins of quartzo-felspathic material cut across the foliation of basic hornblende-gneiss, and the appearances favour the intrusive as opposed to the differentiation hypothesis. But in truth the two hypotheses are not necessarily opposed, for if the differentiation were accompanied by the concentration of the first formed ferro-magnesian constituents round local centres (Plate 7), and if the basic portions were the first to solidify, then the still fluid mother liquor would be free to act as an intrusive magma in relation to the first formed basic rock.

(Plate 9) introduces another set of phenomena. It illustrates the rapid but gradual passage from what may be termed a brecciated condition, devoid of parallel structure, to a banded condition in which that structure is strongly marked. The left-hand portion of the exposed face is very similar to that seen in Plate 7.; the right-hand portion is composed of the same materials in the form of a banded hornblende-gneiss.

In this particular case the phenomena are complicated by the occurrence of quartzo-felspathic material of two types, belonging to two distinct periods. The lighter patches and streaks, intimately associated with the darker masses, are rich in plagioclase, and were probably formed from the magma out of which the darker masses consolidated; but, on the extreme right, are two masses of foliated pegmatite containing large lenticular crystals of microcline, one of which is clearly recognisable in the photograph. Now, in other regions — as, for example, near Laxford Bridge — the microcline-pegmatites are obviously associated with gneissose granites which have been intruded into the rocks of the Fundamental Complex. They belong to a late phase in the history of the pre-Torridonian rocks, and are usually unfoliated. The occurrence of similar pegmatites in the region in which the photograph was taken (Loch Torridon) showing strong foliation probably indicates a deformation of a later date than that which converted the brecciated mass into a banded hornblende-gneiss.

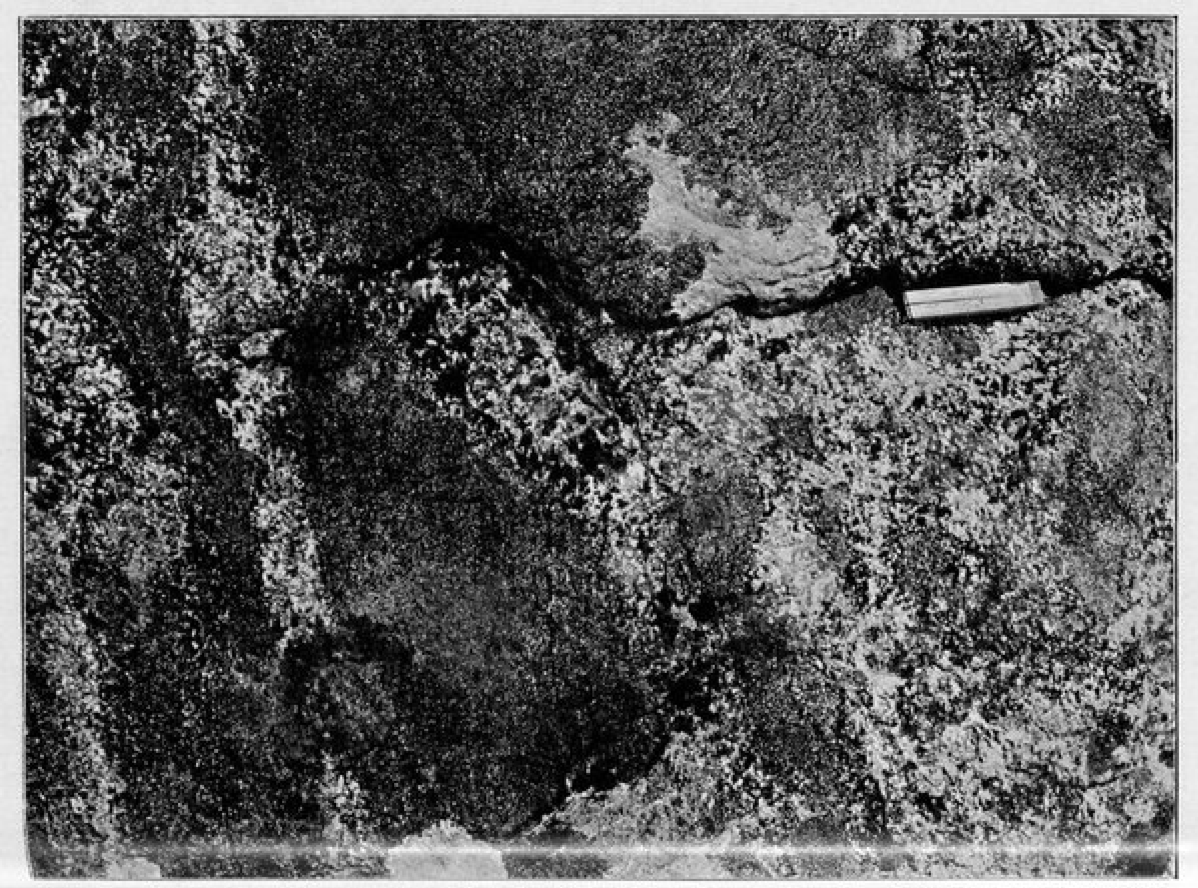
(Plate 10) and (Plate 11) represent an extremely interesting variety of brecciated structure discovered by Mr. Clough. Fragments of banded and contorted hornblende-biotite-gneiss are enclosed in a mass of similar material, much poorer in ferro-magnesian constituents. Flow-structure round the margin of one of these fragments is clearly seen in (Plate 11). The mass represented in these photographs may be regarded as the plutonic equivalent of a brecciated rhyolite, so far as structure is concerned.

One general law of considerable importance is brought out by an examination of these photographs, and becomes still more prominent when the rocks are examined in the field. Whenever evidence as to the relative ages of the more acid and the more basic portions of the Fundamental Complex is forthcoming, the latter are always seen to be the earlier.<ref>It must, however, be, remembered that the later basic intrusions which clearly cut the gneissose banding in the central area have in some regions, as for example, south of Poolewe, been so modified by later movements that they may easily be mistaken for a part of the fundamental complex.</ref> In the banded rocks it is usually impossible to make out any difference of age between the darker and lighter portions; but occasionally, as in the part represented in (Plate 14), this may be done, and the evidence is then seen to be in accordance with the general law. The darker bands have in places been torn to shreds, which now lie in a matrix of more acid material.

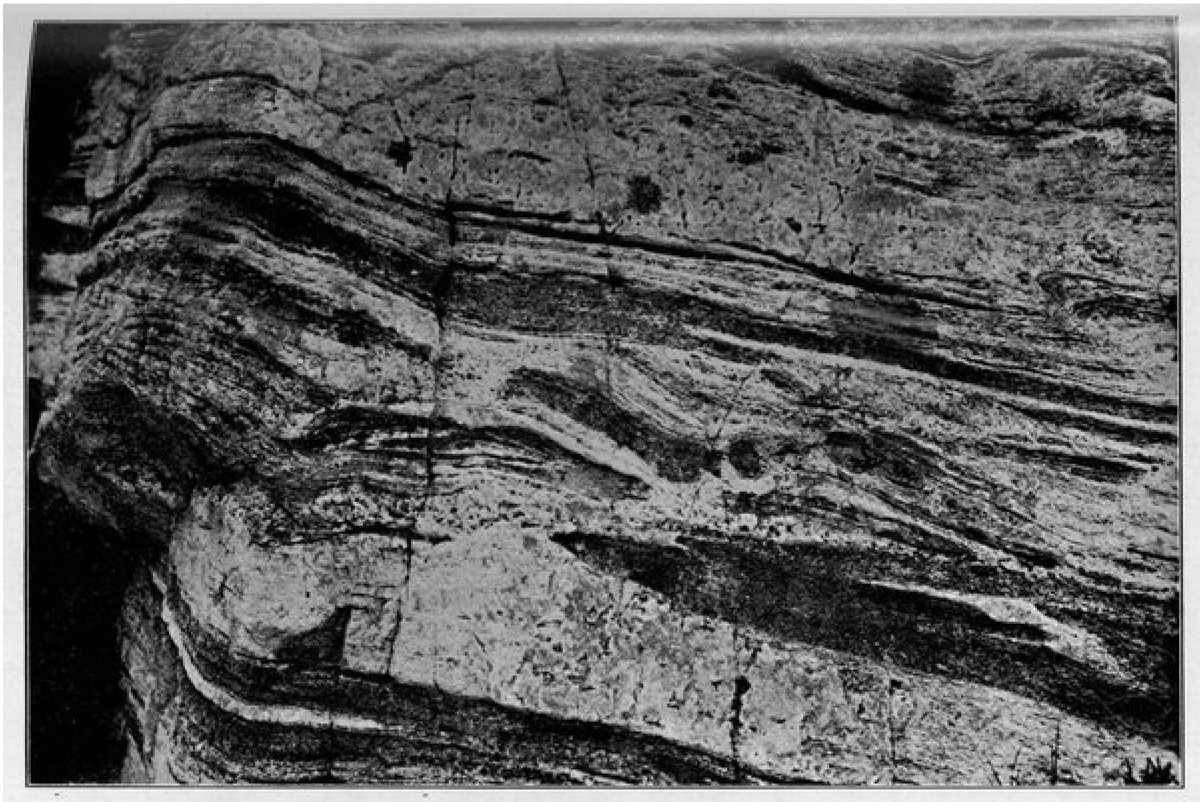
The architectural features above described occur in those portions of the complex in which the rocks have affinities with igneous products. It becomes interesting, therefore, to enquire whether normal plutonic masses present phenomena in any way comparable to those above described.

Hornblende-biotite-granites or quartz-diorites, such as those of Criffel, usually contain basic inclusions, and are traversed by acid veins. The relative ages of corresponding petrographic types are, therefore, the same in the Lewisian Oneiss and in those masses of plutonic rock which most nearly resemble it in composition. But the architectural features are in many respects very different. Under these circumstances it is extremely interesting to note that on the southern margin of the Criffel mass there is a narrow zone in which the characteristic features of the Lewisian gneiss are reproduced.<ref>See *Explanation to Sheet* 5, p. 24.</ref> Basic inclusions are here extremely common, and they have been drawn out into lenticles and bands by differential movement which has affected also the later acid veins.

Owing to the extreme petrographic diversity of the Lewisian Gneiss it is impossible to obtain a fair sample of the mass; but if this could be done it would probably be found that the average composition is that of an intermediate rock — not very different from the Criffel granite.



(Plate 6) Rock face showing imperfect separation of hornblendic and felspathic constituents, Cadha Beag, Little Gruinard, Ross-shire

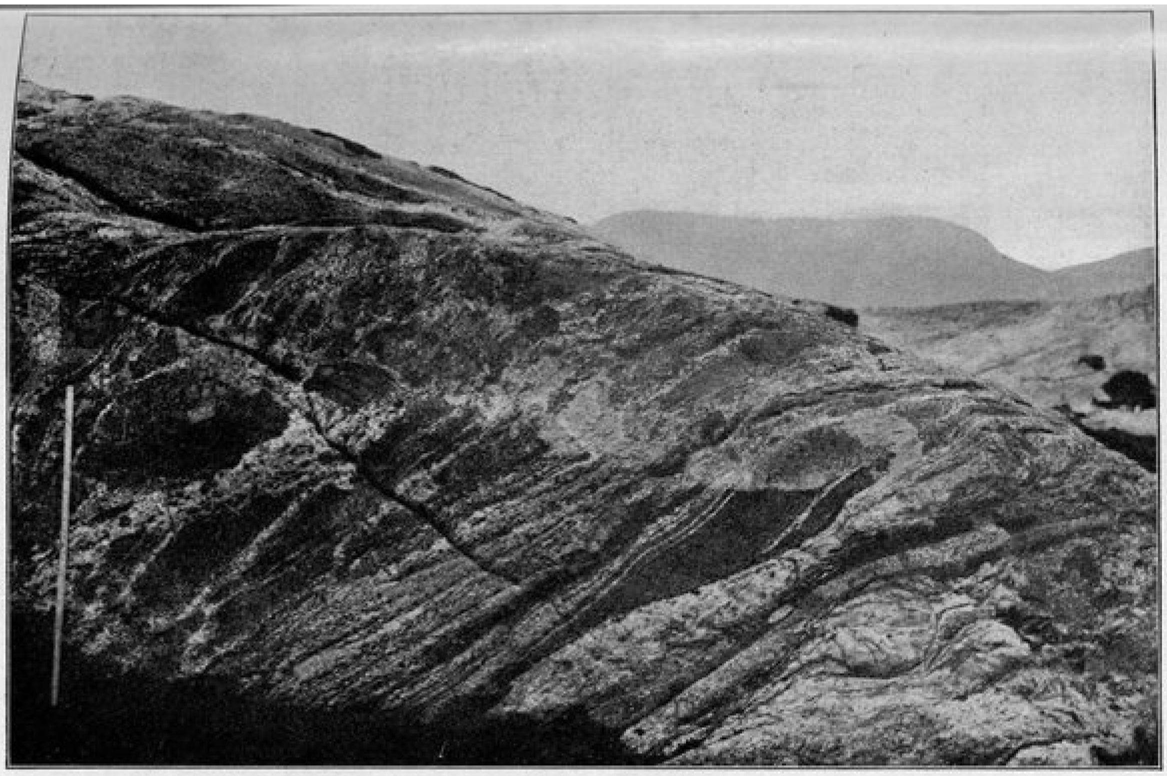


Bands and fragments of foliated basic material in more acid gneiss, near Loch a Bhaid Daraich, Scourie, Sutherlandshire.

(Plate 14) Bands and fragments of foliated basic material in more acid gneiss, near Loch a' Bhaid Daraich, Scourie, Sutherlandshire.

Lumps of basic rock mainly composed of hornblende, separated by quartzo-felspathic material.
Cadha Beag, Little Gruinard, Ross-shire.

(Plate 7) Lumps of basic rock, mainly composed of hornblende, separated by quartzo-felspathic material; Cadha Beag, Little Gruinard, Ross-shire.



Hornblende-Gneiss with veins of pegmatite, showing transition from brecciated condition on left to banded condition on right. Ard Shieldaig, Loch Torridon.

(Plate 9) Hornblende-gneiss with veins of pegmatite, showing transition from brecciated condition on left to banded condition on right; Ard Shieldaig, Loch Torridon. B116.

Fragments of banded Hornblende-biotite-gneiss in more acid material : a plutonic breccia.
Near Creag Mhor Thollie, Poolewe, Ross-shire.

(Plate 10) Fragments cf banded hornblende-biotite-gneiss in more acid material — a plutonic breccia; near Creag Mhor Thollie, Poolewe, Ross-shire. B100–B101.

Junction of one of the included fragments with the matrix shown in Plate X. 1200 yards S.E. of the top of Creag Mhor Thollie, two miles south of Poolewe, Ross-shire.

(Plate 11) Junction of one of the included fragments with the matrix shown in