Chapter 3 Basic lavas: general petrography

We have now to consider more particularly the basic lavas, which are incomparably the most important products of the volcanic phase of activity, and in many respects constitute the most important group in the whole suite of Tertiary igneous rocks in our area. Their field-relations and their place in the succession have been sufficiently discussed. We have seen that in order of time they immediately follow the principal volcanic agglomerates and tuffs, and that probably with little or no interval, for in places fragmental accumulations are intercalated in the lower part of the lava group. These, however, at least outside the mountain tract, are of small extent and importance, and the most striking feature of the group is the great succession of basic lavas, broken, as a rule, only by innumerable intrusive sills of later date. The lavas rest then on the bedded volcanic agglomerates and tuffs where these occur; but in most places where the base, is seen it reposes directly upon the old pre-Tertiary land-surface. We proceed to describe the essential petrographical characters of the basic lavas, reserving for the following chapter an account of the subsequent changes which they have undergone under the operation of various agencies.

We have to remark at the outset that the published descriptions of these basaltic lavas in Skye, and presumably in other parts of the British Tertiary province, require to be read with some discrimination, owing to the fact that the great prevalence of sill-formed intrusions in the lava group has not hitherto been sufficiently recognised. It is highly probable that for this reason the dolerite sills, of later date, have sometimes been treated as constituent parts of the succession of lavas. These sills, as we shall show hereafter, not only make up a large part of the total thickness, but form all the salient features of the plateau country (*see* (Figure 79), below). Except where good sections are exposed in some of the streams, it is possible to walk many miles over the peat-clad moors without seeing anything of the lavas, and a collection of specimens made in such a traverse might include only sill-rocks. In a better selected locality a considerable proportion of the intrusive rocks would still be collected with the extrusive.

The lavas are constantly of fine texture, and in most places, though not everywhere, amygdaloidal. The sills, on the other hand, usually show a more evidently crystalline texture, and rarely exhibit any conspicuous amygdaloidal character. The ophitic structure is much more commonly met with in the latter rocks than in the former, though it does not afford a conclusive test. Professor Judd has stated<ref>*Quart. Journ. Geol. Soc.,* vol. xlii., p. 75: 1886.</ref> that "ophitic varieties… abound in, though theyare not confined to, intrusive rocks; while rocks of granulitic structure … are especially abundant among the lavas" In a later memoir<ref>Quart. *Journ, Geol. Soc.,* vol. xlv., 195: 1889. </ref> he speaks of the ophitic structure as one "characteristically exhibited by the basaltic lavas of Western Scotland" The former quotation expresses what is also the result of our own observations. The ophitic structure is certainly found in many of the lavas, but it is not characteristic of them as a group.

As seen in the field or in hand-specimens, only a small proportion of the lavas show conspicuous porphyritic crystals. The greater part of the rocks are amygdaloidal, the vesicular cavities, now occupied by zeolites, chlorites, calcite, quartz, etc., being usually from ■ to ½ inch long, though smaller ones are also found, and exceptionally some as much as two or three inches long. The smaller are often nearly spherical; the larger are ovoid. The contents of these amygdules will be considered below. The largest ones often have a vacant space in the interior, into which some of the secondary minerals project with good crystal-faces; but the vesicles of moderate and small size are rarely or never empty except from the destruction of their contents by weathering. The general mass of the rock is never of coarse texture. The freshest examples show a finely crystalline appearance and a nearly black colour; the more altered rocks are of dull aspect, with a dark-grey or greenish-grey tint, and more advanced decay may obscure the character Of the rock further by a development of chloritic and ferruginous matter. The more amygdaloidal varieties are usually the more decomposed. Olivine, even when present in some abundance, is rarely to be detected by eye: in this respect the rocks differ from many European basalts and also from many of the basaltic dykes of Skye.

Although, as we have intimated, the lava series includes rocks with a considerable range of composition, from thoroughly basic types, often rich in olivine, to andesites, sometimes of highly felspathic nature, we have found it impossible to distinguish the several types systematically in the field and so to subdivide the group on the map. It had been hoped that the difficulty might be mastered by making use of the specific gravity of the rocks, which, with Walker's balance, can be estimated without great labour. In practice this has not been found to afford a sufficient criterion, although it enables us to separate the most basic types on the one hand and some of the least basic on the other. The amygdaloidal varieties, which prevail almost everywhere, must in all cases be rejected. Even in compact non-amygdaloidal rocks the same secondary changes which are partly answerable for the monotonous uniformity of appearance have often altered the density very sensibly, and in a manner for which we cannot make allowance. It may be remarked, however, that of lavas without conspicuous amygdules and not greatly decomposed the majority have specific gravities between 2.80 and 3.00, with an average of about 2.90. Ten specimens out of seventy gave figures above 3.00, the highest being 3.11. Those which fell below 2.80 include no doubt most of what might fairly be named augite-andesites, which are apparently not very numerous; but they certainly include also some truly basic lavas of which the density has been reduced by partial decay.

There are no earlier published chemical analyses of the basic lavas of Skye, and this seems to be true also of the whole British Tertiary "province" Streng's<ref>*Pogg. Ann.,* vol. xc., p. 114: 1853.</ref> analysed rocks from Fingal's Cave in Staffa and the Giant's Causeway in Antrim may perhaps be lavas, but are more probably sills. An average example of the Skye basaltic lavas was selected for analysis, and Dr Pollard obtained the result given below. The rock was fresh, and contained only infrequent amygdules, and those of small size. The analysis shows it to be a thoroughly basic rock, rich in iron, magnesia, and lime. As compared with other basalts of like silica-percentage, however, there is perhaps a slight deficiency of magnesia. Probably analyses of some of the other basaltic lavas of our area would show a more marked deficiency in magnesia with a correspondingly high figure for the iron-oxides; for in some examples which must be of thoroughly basic composition olivine is wanting, and magnetite unusually abundant. A noticeable point in the analysis given is the rather high content of titanic acid.

SiO_2	46.61
TiO	1.81
Al_2O_3	15.22
Cr_2O_3	trace
Fe 2O3	3.49
FeO	7.71
NiO and CO_2	trace
MnO	0.13
MgO	8.66
CaO	10.08
Na_2O	2.43
K_2O	0.67
H_2O above 105°	2.07
H_2O at 105°	1.10
CO2	trace
P_2O_5	0.10
	100.08
Specific gravity	2.87

Olivine-Basalt lava (S8185) [NG 42 28], near bridge over Allt Fionnfhuachd, Drynoch: anal. W. Pollard, *Summary of Progress Geol. Sur.* for 1899, p. 174. The rock contains only a few small amygdules, which are included in the material analysed. It consists of olivine-grains with only incipient serpentinisa-tion, magnetite either in imperfect octahedra or enwrapping the felspar, labradorite in crystals of tabular habit parallel to the brachypinacoid, with albite-lamellation, and granules of augite, very pale in a slice, with occasionally a little chloritic alteration. (See (Plate 17))., Fig. 3, A.

Sir J. Norman Lockyer has made a spectroscopic examination of this and several others of the basic igneous rocks of Skye, taking photographs of the arc-spectra between silver poles; and he has very kindly placed these photographs at our disposal, after identifying a number of the lines shown. They reveal the presence of some elements not usually estimated in chemical analyses. In addition to the commoner constituents, the spectrum of this lava shows strong chromium lines and distinct lines of titanium and vanadium, while strontium is more faintly indicated.

The percentage mineral composition of the rock cannot be calculated without further knowledge of the composition of the several minerals, and in particular of the augite. If this were assumed to be a diopside, we should have about 54 per cent. of labradorite, 29 of augite, 9 of olivine, and 8 of iron-ores (largely titano-magnetite). Since the augite is probably an aluminous one, the proportion of that mineral must be greater than that thus found and the proportion of felspar less. Apatite amounts to about 0.2 per cent. of the rock.

The minerals just enumerated are the constituent minerals of this group of rocks in general, with the reservation, however, that olivine is often wanting. In a few cases we find a rhombic pyroxene in addition to the monoclinic. Further there are the secondary minerals, of which a long list might be made out. We proceed to notice briefly the several primary constituents.

The felspar of the true basalts appears to be in all cases some variety of *labradorite,* though with a certain range of composition in different rocks. It builds crystals of tabular habit parallel to the brachypinacoid, giving the usual elongated rectangular sections, commonly from 1/100 to 1/50 inch in length, but in some fine-textured rocks as small as 1/00[sic] inch. The narrowest crystals are often simple, but others are twinned on the albite law, once or with repetition according to the width of the crystals. Sometimes one individual of a twin projects slightly beyond its neighbour, imparting something of a stepped appearance to the termination of the crystal as seen in section. The only inclusions found are minute glass-cavities and occasionally a needle of apatite or granule of magnetite.

When porphyritic crystals of larger size occur, these, too, are of labradorite. They have usually the same tabular habit, but with a length of ¼ to ½ inch, and they are twinned on the carlsbad as well as the albite law. The principal inclusions are glassand stone cavities and small scraps of augite or granules of magnetite. Some basalts in the Talisker district contain porphyritic felspars with a very unusual crystallographic habit, giving a rhomb-shaped outline.

The *augite* occurs either in granules packed into the interspaces between the felspars or in little sub-ophitic patches partially enwrapping the felspar crystals; only exceptionally in the form of ophitic plates of any extent. It is a brown, as distinguished from a green augite, but becomes very pale or almost colourless in thin slices. Twinning has not been observed. Though we have no direct information concerning the composition of the mineral, it is doubtless, as usual in such rocks, an aluminous variety. This may be inferred from the fact that the common decomposition-product is a mineral of the chlorite group. It occurs as definite pseudomorphs after augite, as well as in the form of a lining to amygdaloidal cavities and as veinlets traversing the felspar, etc. It takes the form of an aggregate of little scales, usually without any definite arrangement in the case of pseudomorphs. It has a green colour, though varying in depth of tint in different cases, and is strongly pleochroic. Where, however, the scales are of very minute size, so that they overlap one another in the thickness of the slice, the characteristic optical properties are lost, and such an aggregate is quite dark between crossed nicols.

A few of the rocks [*e.g*. (S8697) [NG 421 196], from Allt Coire Labain, etc.] contain scattered porphyritic crystals of augite, usually of imperfect form and apparently corroded. These contain relatively large glass-inclusions, as was remarked by Zirkel.<ref>*Unters. über die mikrosk. Zusammensetzung und Structur der Basaltgesteine.* p. 13: 1870.</ref>

One type of basalt is characterised by *hypersthene,* in addition to the monoclinic pyroxene. This mineral has not been found in the fresh state, but is represented by the unmistakable pseudomorphs of green pleochroic bastite. These are idiomorphic, though not very perfectly shaped, and they show the usual delicate fibrous structure parallel to the vertical axis.

The *olivine* of the basaltic lavas may build well-shaped crystals, but more usually they are imperfect and often rounded or corroded to the form of shapeless grains. The grains have usually diameters of 1/50, to 1/20 inch, rarely as much as 1/10. This small size and the frequent secondary alteration of the mineral are the reasons why olivine is rarely to be identified clearly upon a hand-specimen. In some rocks it is fresh or only slightly serpentinised, but in many others it is more or less completely pseudomorphed. The replacing substances often observed in various slides are pale green serpentine, dark brown or red iron-oxide, and some mineral of the rhombohedral carbonate group (magnesite, dolomite, or calcite, not discriminated). Two or all of these substances usually occur together. The iron-oxide, which seems to be amorphous haematite in various stages of conversion to limonite, forms always the marginal zone of such a composite pseudomorph, the interior occupied by a serpentine or a carbonate, or both (*see* (Figure 7)). In some examples again the pseudomorphs are composed mainly of some undetermined mineral of which several varieties have been noticed, sometimes with the general appearance of a mica and recalling in some respects the iddingsite of Lawson.<ref>*Bull. Dept. Geol. Univ. Calif.,* vol. i., pp. 31, etc.,: 1893.</ref> Here again there is a copious separation of red iron-oxide, which forms a dense marginal crust, and occupies little veins running into the interior (Plate 17)., Fig. 1. The substance which forms the bulk of these pseudomorphs, though often with patches of serpentine enclosed, is usually of a very pale tint or almost colourless in a thin slice, and gives about the same interference-colours as augite. It has a strong cleavage, parallel to the brachypinacoid of the olivine, and extinguishes straight, or very nearly straight, with reference to this, the least axis of the ellipsoid of elasticity being that perpendicular to the cleavage. Another variety of pseudomorph of this class shows a more perfect and regular cleavage, like that of a mica, which it also resembles in its interference-colours (Plate 17)., Fig. 2. Here the extinction is decidedly oblique, sometimes to the extent of 10° or 12°. The greatest axis of the ellipsoid of elasticity is the one most nearly perpendicular to the cleavage, and vibrations in this direction give a pale reddish yellow colour, those perpendicular to it a pale green. The first stage in the alteration of the olivine in almost all our basalts is the separation of iron-oxide, and the mineral is presumably of a variety somewhat rich in iron. At a late stage both serpentinous pseudomorphs and those of the class which we have likened to iddingsite sometimes absorb part of the iron-oxide again, becoming of a deep green colour with strong pleochroism. We find also pseudomorphs with a deep red-brown colour, which probably belong to what Professor Heddle<ref>Min. Mag.*,* vol. v., p. 29: 1882</ref> has named ferrite.

Almost all the rocks contain, though in varying amount, an opaque black mineral of the *iron-ore* group. This is usually in distinct crystals, sharply bounded or with rounded edges and angles, and with a diameter of 0.001 to 0.002 inch. Sometimes, and especially in the less fine-textured basalts, the iron-ore occurs in shapeless patches, tending to enwrap the felspar crystals, and here the diameter may be as much as 0.01 inch. We have not made any direct chemical examination of these minute crystals and grains, and their true nature remains in some doubt. Wherever any crystallographic outline is shown, as is usually the case, the shape is always the familiar octahedral one of magnetite: no form suggestive of ilmenite has been observed. On the other hand, the rock analysed yielded 1.81 per cent. of titanic acid, and appears to be a typical example, though much of its iron-ore is in rather shapeless granules. If we admit the octahedral mineral titanomagnetite (Fe_2TiO_4), isomorphous with magnetite (Fe_2FeO_4), as the rhombohedral ilmenite ($FeTiO_3$) is isomorphous with haematite ($FeFeO_3$), we may conjecturally represent the iron-ore in this rock as an isomorphous mixture in nearly equal proportions of titano-magnetite and magnetite. The trace of chromic oxide found in the analysis must also be reckoned to the iron-ore: the manganese, nickel, and cobalt belong presumably to the ferro-magnesian silicates.

Minute slender needles of *apatite* were observed in some of the slides, and this mineral is probably generally distributed, though not always easily detected.

There remain only secondary minerals due to alteration of the primary constituents. Those most usual in the general mass of the rocks — as distinguished from the amygdules — are chlorite, serpentine, calcite, and red iron-oxide. This last is quite abundant in some of the more decomposed lavas, being derived from the destruction of olivine and perhaps of augite, as well as by oxidation of magnetite. It is commonly amorphous, but the minute flakes of hinatite which Zirkel<ref>*Unters. über die mikrosk. Zusammensetzung uwa Structur der Basaltgesteine*, p. 71: 1870.</ref> notes as abundant in certain basalts of this region are perhaps also of secondary origin.

The partial decomposition which has affected so large a proportion of these basic lavas somewhat obscures the question of the occurrence in them of some residual glassy base. It may safely be stated that the majority of the rocks have been holocrystalline, and that very few of the more typical basalts can have contained more than a small amount of vitreous matter. There are, however, among the finer-textured microlitic rocks, especially those whose affinities seem to be rather with the pyroxene-andesites than with the basalts proper, some showing an interstitial base which may have been glassy or partly glassy. It is to be presumed that the several lava-flows, as poured forth, formed each at its upper surface a scori-aceous crust, probably rich in glassy matter, but we have not found any case in which such crust is preserved in a recognisable condition. This we may probably attribute to the subaerial origin of the lavas, each flow, as soon as formed, becoming at once subject to atmospheric degradation, and the scoriaceous crust of a basalt being exceptionally easily destroyed.

The sequence of crystallisation of the several primary minerals, excepting only the iron-ores, is always the same; viz. apatite, olivine or hypersthene (these two not being found together), felspar, augite. The iron-ore is sometimes, and perhaps most commonly, idiomorphic towards the felspar, sometimes moulded upon it. This may perhaps be connected with the varying composition of the iron-ore (whether more or less titaniferous); but it is also possible that the iron-ore always began to separate out before the felspar, and in some cases continued to crystallise after it. We have found no evidence of two distinct generations of the iron-ore. It seems to be in general later than the olivine, and is always earlier than the augite.

The rocks show differences of *micro-structure* which are to be correlated partly with the preponderance of one or other of the two chief constituent minerals, felspar and augite, partly with the circumstances in which the consolidation took place. The most evident distinction is that between the '*granulitic*' and the *ophitic* varieties. Both types of structure are found in rocks of various degrees of fineness of texture, and also in connection with different relative proportions (within certain limits) of the constituent minerals. The difference must therefore be dependent upon the circumstances attending consolidation, and in particular, as Professor Judd<ref>*Quart. Journ. Geol. Soc.,* vol. xlii., p. 76: 1886. We follow Prof. Judd in using the term "granulitic", although it is open to objection, not being the structure met with in the rocks named granulites.</ref> has urged, upon the stage at which differential movement within the rock ceased. If the lava-flow had come to rest prior to the crystallisation of the augite, that mineral was able to build spreading plates, moulded upon the earlier-formed felspar crystals: if on the other hand movement continued to a late stage, such ophitic plates could not be formed, or were immediately broken up. and the augite consequently occurs in granules. So far as our observations go, the "granulitic" type of structure ((Plate 17)., Fig. 3, A) is the more common among these rocks, and especially in the amygdaloidal varieties; but the ophitic type ((Plate 17)., Fig. 3, B) is certainly more common than experience of other basaltic lavas would lead us to expect. We incline to attribute this to the subaerial eruption of the Skye lavas and the small size of the individual flows. Among those examples which we here group under the ophitic type, only a minority show the structure in its most typical development: many are better described as sub-ophitic, the augite tending to enwrap the felspar crystals but not wholly enclosing them. In the rare case where the augite freely encloses the little felspars (S2705) [NG 48 28], the rock resembles pretty closely a fine-textured micro-ophitic type met with in some of the sills [cf. (S9249) [NG 326 280]].

In varieties rich in augite the micro-structure sometimes becomes modified in other ways. One curious type has the augite partly in a rather finely granular form, but largely in irregular shafts or blades roughly radiating from certain centres, giving a kind of ocellar structure (Plate 17)., Fig. 3, C. Varieties rich in felspar and of fine texture assume a different character. In the fine-textured rocks the felspar generally takes the form of slender microlites (Plate 17), Fig. 3, D, and both the granulitic and the ophitic type of structure are met with among such rocks; but when there is a marked preponderance of felspar over augite, the micro-lites tend to pack together and assume a rude parallelism, and the rock thus acquires a more special character. This seems to be found rather among the rocks of andesitic affinities than among the typical basalts, and with it there may be a certain amount of interstitial base.

There remain the conspicuously *porphyritic* basalts, which, though not the prevalent type, are well represented in some parts of the area. The best examples which we have examined come from the inaccessible cliffs of Talisker. Numerous fallen blocks of the lavas (besides others of the sill-rocks) are strewn along the beach, and are well known to mineralogists for the beautiful crystals of various zeolitic minerals which are contained in their drusy cavities. Where these latter occur, the rock is always much decomposed, but in other parts — often on the same block — it is perfectly fresh. Here it is a dark basalt, with fine-textured ground, enclosing abundant phenocrysts of felspar and showing also little yellow grains of olivine. The felspars, up to about ¼-inch in length, have a peculiar crystal-habit. They are of flat tabular shape, and present the outline of a rhomb, resembling in this respect, though otherwise widely different, the well-known rhomb-porphyries of Norway. The angles, however, are in this case quite sharp. We have not been able to isolate the crystals or to make any satisfactory crystallographic determination of their forms. Slices (S9803) [NG 32 30] show that they are of medium labradorite, with a maximum extinction-angle of about 38° in sections perpendicular to the twin-lamellae. They have carlsbad- as well as albite-twinning, and a slight zonary banding between crossed nicols. The little elongated felspars of the ground-mass are also striated; the pale brown augite has the "granulitic" habit; round grains of fresh olivine and little octahedra of magnetite are present in moderate amount.

In another variety from the Talisker district the porphyritic felspars (medium labradorite) have the usual habit. The felspars of the ground are of more slender shape, and the augite, less abundant than before, is ophitic. This rock is very rich in olivine, and magnetite is present in fair amount (S9804) [NG 33 31].

In the tract surrounding the Cuillins porphyritic basalts are exceptional. They make some spread, however, along Allt Coire Labain, below the mouth of the corrie. Here the rock contains a large amount of epidote, principally replacing the porphyritic felspars; and this is possibly, though not necessarily, to be regarded as a metamorphic effect due to the neighbouring gabbro intrusion.

A conspicuously *amygdaloidal* character is, as has already been remarked, generally prevalent. It is found in most parts of the basalt tract, and in most of the separate flows, and usually affects the whole thickness of a flow. In some cases a more highly vesicular and scoriaceous structure marks the upper surface of a flow, but in most instances the scoriaceous crust which probably formed the surface of the freshly consolidated lava seems to have been destroyed before it was covered by the next outpouring. Where it has not been removed, it is always found to have suffered greatly from atmospheric decomposition, and is in great part converted into an obscure ferruginous material, too fragile and incoherent to admit of slicing. Good examples may be studied at many localities on the coast, *e.g.* near the Stack at the southerly point of Talisker Bay.

Although we have not found it practicable to map the basic lavas except as a whole, it is easy to see that they present considerable differences in mineralogical, and doubtless in chemical, composition, and in this respect fall under different heads. Such a classification is largely independent of micro-structure, which, as we have seen, is determined in great part by other considerations. There are firstly the *olivine-basalts,* which are probably the most prevalent type. These are of thoroughly basic composition. We do not, however, take the presence or absence of olivine as a criterion to discriminate between the basic and the sub-basic lavas. Many of our rocks devoid of that mineral are probably quite as basic in composition as some of those with olivine. These *basalts without olivine* consist of a medium or basic labradorite, abundant augite, and often a rather large amount of iron-ore. Further there are the *hypersthene-basalts* (Plate 17), Fig. 3. B), in which the rhombic pyroxene may be regarded as in some sense taking the place of olivine. These rocks rather closely resemble some which are widely distributed in the Lower Palaeozoic volcanic district of the English Lake Country. Finally, there are the less basic rocks, some at least of which may on petrographical grounds be styled *augite-andesites.* Here, not only is olivine absent, but magnetite is only a minor accessory, and felspar predominates decidedly over augite. In some cases at least this felspar is of a more acid variety than in the preceding types. Judged by its extinction-angles in the slices, it is in some cases andesine and even oligoclase. In rocks containing felspar of these relatively acid kinds augite is only sparingly present, and the mass consists chiefly of a plexus of small narrow felspar crystals giving a structure comparable with that of many trachytes. There is, however, a considerable amount of magnetite in minute grains, and often abundant little specks of secondary ferric oxide. Andesites of this type, both amygdal oidal and non-amygdaloidal, come from Allt Dearg Mòr, near Sligachan, and other places [(S2624) [NG 47 29], (S2625) [NG 47 29], etc.].

Not only have we found it impracticable to map out subdivisions of the lava-group based on the sequence of different petrographical types, but such information as we have gained on this point from the sliced specimens and from specific gravity determinations renders it very doubtful whether any simple sequence could be made out even from a much larger mass of data. It appears that more and less basic lavas are intimately associated, and alternate with one another. The lowest lavas were specially examined in this connection, as belonging to an easily defined horizon, though not necessarily the same in different localities. In most places where the base of the group is exposed the lowest lavas are decidedly basic, but sub-basic rocks are in some cases associated. Thus at Creagan Dubha, near Beinn Dearg Mhòr (of Strath), the lowest of all are andesites, then follow typical basalts, but above these andesitic lavas come on again. At other horizons in the series we find a similar alternation of different types, and the difficulty is much increased by the fact that the amygdaloidal lavas, which in most parts largely predominate, are often too much decomposed to permit their being referred confidently to recognised types (*see* (Figure 8)).

One negative characteristic of the basic lavas of Skye deserves notice. Professor Judd<ref>*Quart. Journ. Geol. Soc.,* vol. xlii., p. 70: 1886.</ref> has pointed out an interesting difference between these basaltic lavas of the Brito-Icelandic province and those, also of late geological age, in Bohemia, the Eifel, Auvergne, etc. The foreign basalts frequently enclose nodular crystalline patches of olivine, or of olivine and enstatite. Whether they be early crystalline segregations floated up from the deep-seated source of the lavas or actual fragments detached from concealed rock-masses — a distinction which in some circumstances may be more apparent than real — these nodules may be regarded as foreign bodies enclosed in the basalts: they are what Lacroix<ref>A. Lacroix, *Les enclaves des roches volcaniques,* Macon, 1893, p. 8.</ref> styles "enclaves homoegènes" Such inclusions are not met with in the British lavas. Further, the lavas in our area do not, so far as our observations go, carry inclusions of other rocks — troctolite, anorthosite, and especially gabbro and granite — such as are found abundantly in some of the neighbouring intrusive rocks. With this negative characteristic of our basaltic lavas we may perhaps correlate another, viz. the comparative rarity of conspicuous porphyritic crystals. This subject will be more fully discussed in the chapter devoted to xenolithic inclusions. Even enclosed fragments accidentally picked up (the "enclaves homoegènes" of Lacroix) are very rare in the basaltic lavas of Skye, and when they are found it is in association with special circumstances. We have already mentioned one locality, a little N.E. of Loch Cùil na Creig, near Strollamus, where little fragments of sandstone occur rather abundantly. This is not far from a place where the lavas are seen to have broken in an irregular fashion through the Torridon Sandstone. It is also worthy of note that the lavas here rest upon a conglomerate (a river-gravel of the volcanic epoch) composed wholly of material from the Torridon Sandstone; which suggests another possible source for the unusual occurrence of enclosed fragments in the basalt.

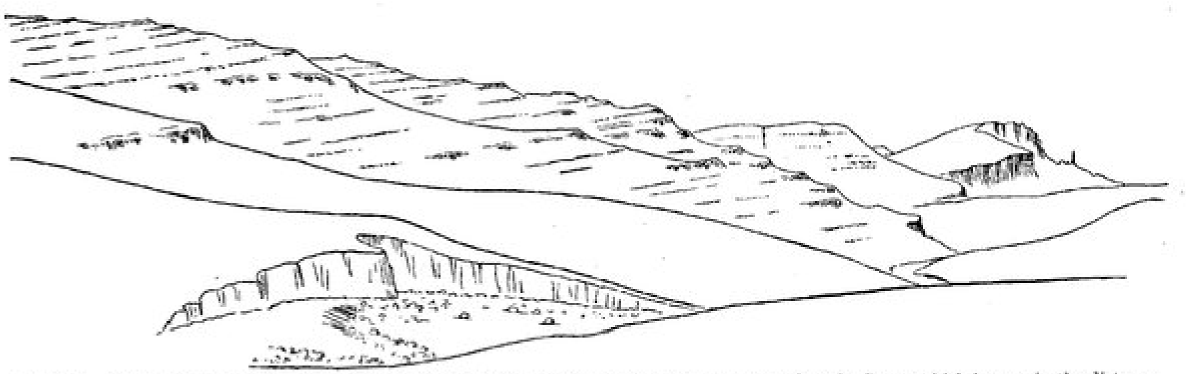
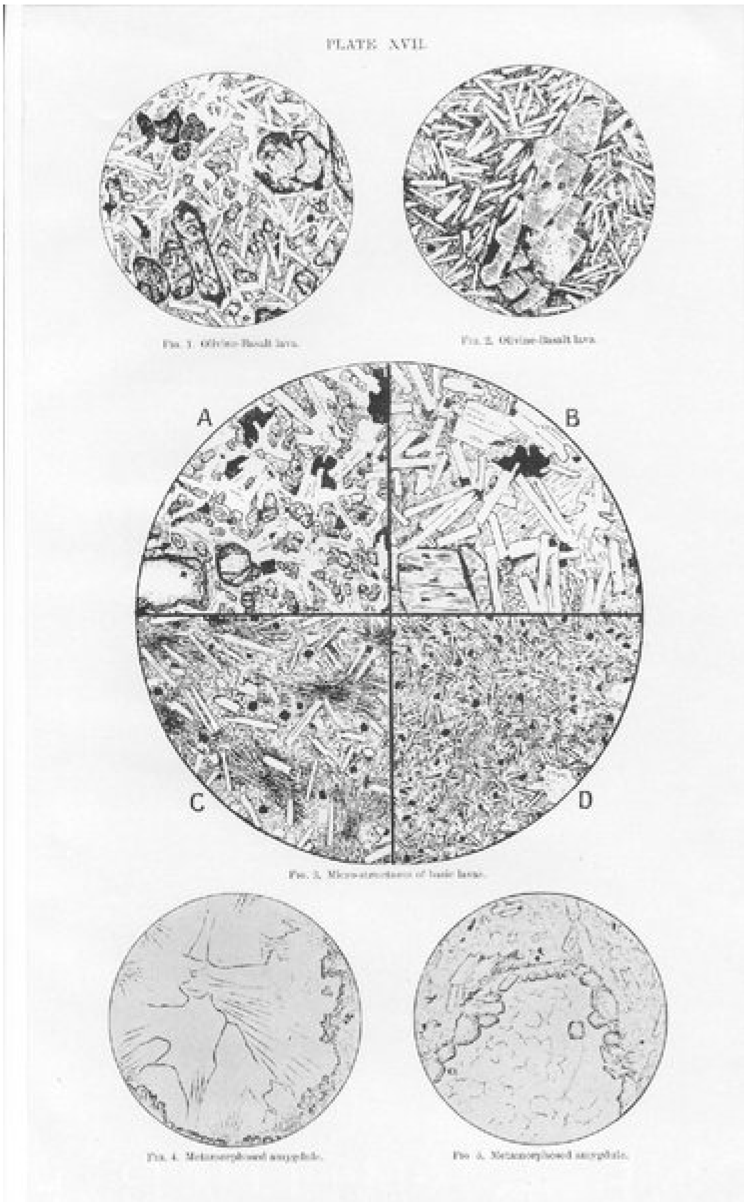


Fig. 79.—Terraced hills on the west side of Glen Varragill; outline view, looking northward to the Storr, which is seen in the distance (right). The terraces are caused by the very numerous intrusive sills intercalated in the basaltic lavas.

(Figure 79) Terraced hills on the west side of GIen Varragill; outline view, looking northward to the Storr which is seen in the distance (right). The terraces are caused by the very numerous intrusive sills intercalated in the dasaltic lavas.



(Plate 17) Fig. 1. × 20. Olivine-basalt lava, above schoolhouse, Braes, S. of Portree: showing olivine replaced by a mineral comparable with iddingsite. See p. 34. Fig 2. (S6772) [NG 520 363] × 20. Olivine-basalt lava, Rudha Buidhe, near Braes, S. of Portree: showing another type of pseudomorph after olivine. See p. 34. Fig 3. × 40. Microstructures of the basic lavas. A. (S8185) [NG 42 28] "Granulitic" structure in olivine-basalt, near bridge over Allt Fionnfhuachd, Drynoch; the rock analysed. See pp. 31, 36. B. (S9246) [NG 47 29] Ophitic structure in hypersthene-basalt, lower part of Allt Dearg Mòr, near Sligachan. A bastite pseudomorph after hypersthene appears in the lower left-hand corner. See pp. 36, 38. C. Ocellar structure in basalt at base of group, S. of Sgùrr nan Each: a type rich in augite and without olivine. See p. 37. D. (S9366) [NG 614 273] Microlitic structure in augite-andesite, S. coast of Scalpay: the augite is mostly chloritised. See p. 37. Fig. 4. (S7460) [NG 537 196] × 10. Metamorphosed amygdule in basalt, close to granite on E. side of Blath-bheinn; showing a crystalline aggregate of new plagioclase felspar, partly with radiate grouping, replacing zeolites. See p. 51. Fig. 5. (S2700) [NG 587 240] × 10. Metamorphosed amygdule in basalt, near granite, Creagan Dubha, N. of Beinn Dearg Mhòr (of Strath): showing a granular crystalline aggregate of new felspar, derived from zeolites, with a border of epidote grains. See pp. 51, 52.

Fig. 7.—[9359] × 20. Olivine-Basalt lava, in Allt Dearg Mòr, about 2 miles S.W. of Sligachan: showing pseudomorphs after olivine, composed of carbonates with a border of iron-oxide.

(Figure 7) [(S9359)]() [NG 457 280] × 20. Olivine-Basalt lava, in Allt Dearg Mòr, about 2 miles S.W. of Sligachan: showing pseudomorphs after olivine, composed. of carbonates with a border of iron-oxide.

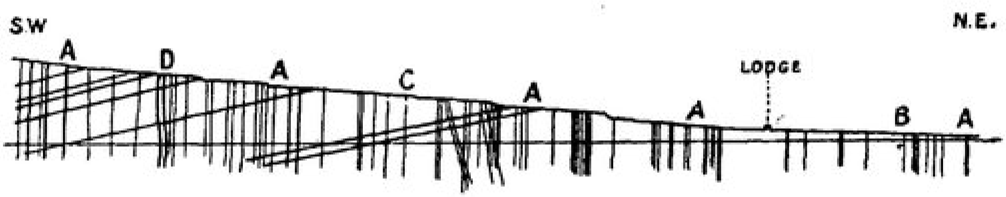


Fig. 8.—Section along Allt Dearg Mòr, near Sligachan: scale, 1½ inch to a mile. The general direction is N.E.-S.W., but the line is made to follow the principal bends of the stream. A number of dykes and a few thin sills are shown, the latter indicating the general dip of the lava-group.

A. Amygdaloidal lavas, usually much decayed.
B. Hypersthene-Basalt.
C. Amygdaloidal Andesite.
D. Basalt, very rich in olivine.

(Figure 8) Section along Allt Dearg Mòr, near Sligachan: scale, 1½ inch to a mile. The general direction is N.E.–S.W., but the line is made to follow the principal bends of the stream. A number of dykes and a few thin sills are shown, the latter indicating the general dip of the lava-group. A. Amygdaloidal lavas, usually much decayed. B. Hypersthene-Basalt. C. Amygdaloidal Andesite. D. Basalt, very rich in olivine.