Chapter 22 Later peridotites

In this chapter we have to describe certain ultrabasic rocks, and rocks bordering on the ultrabasic in composition, which are younger than the laccolitic bodies of plutonic peridotites described in Chapter 6. Some, at least, of them are very much younger, and are among the latest intrusions in Skye. The age of others cannot be determined with the same precision. We have indeed to recognise more than one group, and, since the differences are petrographical as well as geological, separate descriptions are necessary.

We take first the most numerous and striking group of later ultrabasic rocks, the *peridotite dykes of the Cuillins and of the Strathaird peninsula.* In the mountains these dykes are not uniformly distributed, but are found within the crescentic area indicated in (Figure 75), and are most abundant about the middle of that area. The most northerly example occurs about ¾ mile north of the summit of Sgùrr nan Gillean, upon the east side of the deep ravine which drains the corrie Am Basteir. Its bearing is a little E. of N. Another is seen not far to the west, in the burn which comes down from the east side of Meall Odhar. This has in places a curved course, but its general direction is towards N.N.W. Two others, bearing something W. of N.W., occur on Sgùrr Thuilm and in the upper part of Coir' a' Ghreadaidh, one of these crossing the main ridge close to the deep notch between Sgùrr a' Mhadaidh and Sgùrr a' Ghreadaidh. One on the slope below An Diallaid bears about W.N.W., and two or three on Sgùrr nan Gobhar W. by N. Some eight or nine dykes of this group are met with in a distance of about ¾ mile on. Sgùrr na Banachdich and Sgùrr Dearg, this being the part of the range in which they are most frequent. Here their direction is about W.–E. Farther south the dykes become rarer, and their direction swings round still further. Two on Sgùrr nan Eag strike almost due S., and two on the west slope of Gars-bheinn a little E. of S. After this the dykes of this group are apparently wanting for a considerable interval, though peridotite dykes belonging to the earlier epoch are found entangled in the gabbro, as already noticed. Then, nearly four miles away, at Ben Cleat in the peninsula of Strathaird, three other dykes of precisely similar characters are seen, two near the top of that hill and one in the dip between it and the neighbouring Ben Meabost. These run in a S.S.E. direction.

From the varying strike of all the dykes, as stated, it is evident they have a regular *radiate disposition* about a centre in the interior of the gabbro area. The group as developed does not, however, comprise a complete circle but a little more than a semicircle; and this is situated towards the south-west, the quarter in which the peridotite laccolites were intruded at a much earlier epoch.

The ultrabasic dykes of the Cuillins cut all other rocks which they encounter, including the inclined basic sheets, and are therefore the youngest rocks in the mountain district. There can be no reasonable doubt that the Ben Cleat dykes, in Strathaird, belong to the same well marked natural group, though direct evidence tells us only that they cut the basic sills of the great group, and are not themselves cut by any other dykes.

These dykes have very distinctive characters in the field, as well as petrographical peculiarities. Their direction, as we have seen, varies in different localities, in accordance with their radiate grouping about a centre. It is often noticeable, however, that they do not hold straight courses, being much more liable to irregularity in this respect than the basic dykes of the region. They often occur associated in twos and threes, and then may sometimes intersect one another (Sgùrr nan Gobhar) or run side by side in contact for a certain distance (An Diallaid). A dyke about 15 feet wide, conspicuous in the upper part of Coir' a' Ghreadaidh, is split along the middle by a parallel dyke, one foot in width, of similar type; and the latter has chilled selvages, indicating that, while the dykes of this group belong in a general sense to one epoch, they were not all strictly contemporaneous. These ultrabasic dykes range up to 30 or 40 feet in width, and most of them are wider than the generality of basic dykes; while they are further conspicuous from the fact that they always stand out in relief, as being more durable than the gabbro. Another feature whch catches the eye is the rusty weathered surface, which characterises these dykes in common with the older peridotites of the district.<ref> The name Sgùrr Dearg (Red Peak) is probably derived from the red-weathering dykes which are prominent objects on the slopes of the mountain; and Coireachan Ruadha, where the older peridotites give a similar effect, has presumably received its name from the same circumstance.</ref> Among other irregularities of behaviour, the dykes of this group pass in one or two instances into inclined sheets. This is seen on the summit ridges of Sgùrr na Banachdich and Sgùrr Dearg. In the latter case the sheet is seen to cut other peridotite dykes, which is sufficient to separate it sharply from the group of inclined basic sheets

already described, with which it agrees in dip.

To the dykes of the Cuillins we must add, as appertaining with tolerable certainty to the same group of intrusions, certain *peridotite sills* intercalated among the Torridonian strata in the Isle of Soay. Specimens have been examined from four such sills, mapped by Mr Clough. The only direct evidence of the age of these intrusions is that they cut such other rocks as they encounter; but the close petrographical resemblance which they present to the Skye dykes leaves little doubt of their belonging to the same epoch. We have already seen that Soay contains an outlying member of the older group of plutonic peridotites. The sills seem to be somewhat irregular in their behaviour, and may enclose portions of the Torridonian grit partially vitrified in the manner already described in the basic sills of the same island (S9985) [NG 433 132].

It is probable that peridotite dykes of late age are to be found at other centres of igneous activity in the Western Isles. In Rum Professor Judd, though not explicitly recognising two distinct epochs of ultrabasic intrusions, points out that the rocks of this family are not all of one age. He figures<ref>*Quart. Journ. Geol. Soc.,* vol. xli., p. 359; 1885.<ref> a vein of peridotite intersecting and shifting one of olivine-gabbro, which itself cuts an olivine-rock (dunite). He apparently regards the later peridotite as of the nature of a "segregation" or "contemporaneous" vein, but its petrographical nature (as a porphyritic dunite) suggests a different view. We shall see that porphyritic dunite is a type represented among the later peridotite dykes of Skye.<ref>Since this was written, the survey of Rum has shown that dykes of this group are only sparingly represented there. Two intersect the Torridon Sandstone of the south of the island, to the east of Papadil.</ref>

Petrographically our dykes and sills present several features of interest. They resemble in many respects the earlier peridotites of plutonic habit already described, but they differ from those just as the dolerite dykes differ from the gabbros, having distinctive characters which we may describe summarily as those of hypabys-sal rocks. The hypabyssal representatives of the peridotites in general have received hitherto but little notice from petrographers, and the literature of the subject furnishes only scanty information concerning them. Classificatory schemes, such as that of Rosenbusch, make no provision for these rocks, and they have received as yet no collective name, the few which have been recorded having been included with their abyssal equivalents under the name peridotite, here adopted under protest. Although the differences between abyssal and hypabyssal types among the ultrabasic rocks are less conspicuous than among those of acid, intermediate, and basic composition, they are nevertheless sufficiently noteworthy and significant.

The dykes and sills consist of dense crystalline rocks usually of dark colour, with the great hardness and toughness already remarked in the plutonic peridotites. The dykes almost constantly enclose xenoliths up to three or four inches in diameter, but these may be very unevenly distributed, across the width as well as along the length of a dyke; and in other respects also there may be very marked variations from place to place in a given dyke. The xenoliths, giving rise sometimes to projections, sometimes to depressions, on a weathered face, help to increase the characteristic roughness of the iron-stained surface.

The constituent minerals are the same as those of the rocks forming the earlier laccolites, but without the "schiller" structures and other peculiarities characteristic of deep-seated intrusions. The olivine only quite exceptionally contains the inclusions described on pp. 68, 69, and then only imperfectly developed, the dendritic growths of magnetite being too on a very- minute scale (S9233) [NG 480 180]. The augite is never diallagic, but shows only the ordinary prismatic cleavage, with a very pale brown colour in thin slices. The felspar seems to be always near anorthite in composition: it has albite twin-lamellation and, in the larger crystal-plates, occasional lamellae answering to the pericline law. The mineral which plays the part of an iron-ore, forming little octahedral crystals, is probably always chromiferous. In the thinnest parts of the slices it becomes translucent or transparent, with a deep coffee-brown colour, and it may be conveniently spoken of as picotite.

These dyke-rocks exhibit a range of petrographical variety corresponding generally with that presented by the earlier plutonic peridotites. The rare enstatite-anorthite type (norite), however, has not been met with here, and the olivine-anorthite-rock (troctolite) does not build separate dykes, though it is very common in the form of xenoliths. As seen in hand-specimens the dyke-rocks differ from those of the older laccolites in their generally finer texture and in the frequent coming in of the porphyritic structure. Where this latter is found, the phenocrysts are of olivine and sometimes augite.

One of the most beautiful rocks is that of a dyke crossing the ridge of Sgùrr na Banachdich not far north of the chief summit. It may be termed a porphyritic dunite, and exhibits abundant yellowish green crystals of olivine, ¼ to ½ inch long, in a darker ground of medium grain. The microscope shows that the ground-mass also consists essentially of olivine in a granular aggregate, enclosing little octahedra of picotite (S8838) [NG 440 224]. A tendency to parallel orientation of the crystals in this dyke gives rise to a rough platy fracture. A specific gravity determination gave 3.065, but the density of the specimen has been somewhat lowered by serpen-tinisation.

As in the older peridotite group, so in these later dykes and sills the pure olivine-rock is not the prevalent type. Several of the rocks are augite-peridotites, consisting of olivine (predominant) and augite, with the usual picotite and only a very small proportion of felspar. The prominent dyke on the N.E. slope of An Diallaid, in Coir' a' Ghreadaidh, is a good example (S9244) [NG 436 231]. In others, of the same general constitution, there is again a porphyritic development of olivine. Examples of this occur on Sgùrr Dearg and Ben Cleat (S8716) [NG 438 214], (S9245) [NG 524 153]. In some instances, while relatively large olivine crystals are seen in the hand-specimen and a thin slice shows that the finer grained portion of the rock consists largely of the same mineral, the separation into two distinct generations is somewhat obscured by the occurrence in addition of crystals or crystal-grains of intermediate size. This is the case in one of the sheets intruded in the Torridonian of Soay. It is a handsome rock of dark green colour with a specific gravity 3.16, and evidently consists mainly of olivine, partly in crystals up to ¼ inch in length. A thin slice (S9979) [NG 433 132] shows that olivine, in larger and smaller elements, is the dominant constituent, but there are also a fair amount of pale brown augite and some anorthite, in addition to the usual picotite crystals. This rock, which may be styled a porphyritic peridotite, has a certain parallel orientation of its crystals which gives rise to a decided fissility, as in the porphyritic dunite of Sgùrr na Banachdich.

By the coming in of some felspar (anorthite) as an essential constituent, with sonic diminution in the proportion of olivine, we have a transition from peridotites in the narrower sense to picrites. This is illustrated, *e.g.,* in the dyke of Allt an Uchd Bhuidhe, N.E. of Meall Odhar, on the northern border of the Cuillins (S9240) [NG 464 270]. Good examples of picrite dykes are found in Sgùrr Dearg and again between Ben Cleat and Ben Meabost in Strathaird (S7480) [NG 526 160]. This latter picrite has a specific gravity 3.02. All these peridotites and picrites are rocks of medium to rather fine grain. They have suffered more serpentinous alteration than the plutonic peridotites, but some of these are still in a remarkably fresh state.

One rock, differing somewhat from all the rest, requires more particular notice. It forms a small dyke already mentioned as running along the middle of a larger one in the upper part of Coir' a' Ghreadaidh. The large dyke is a peridotite approaching picrite in composition, and offers no peculiarity (S9241) [NG 438 231]. It is a prominent object, coming down from the northern end of Sgùrr a' Ghreadaidh, crossing the floor of the corrie, and running up to the ridge of Sem. Thuilm. The small dyke, resembling the larger in containing abundant xenoliths of troctolite, *etc.,* is of much finer texture, and microscopic examination shows at once that it is of less basic nature. Its central portion (S9242) [NG 438 231] has indeed the appearance of a basalt or fine olivine-dolerite rather than a picrite. Felspar is abundant, in narrow rectangular sections about 1/40 inch long, and it is apparently not true anorthite. The augite forms sub-ophitic grains, as in many doleritic rocks. Olivine, however, is very abundant, and the presence of picotite also affords a link with the ultrabasic rocks. Towards the margin of the dyke the rock becomes finer (S9243) [NG 438 231], the felspars sinking to about 1/100 inch in length, and the augite granules becoming very minute. At the same time olivine becomes comparatively scarce, though octahedra of picotite are still present, and there is also abundant magnetite in a finely granular form. Still nearer to the edge of the dyke the rock is very compact, with felspars only 1/500 inch long. Here olivine is plentiful again, though represented by serpentinous pseudomorphs. These have the form of perfect crystals, 1/1000 to 1/500, inch in diameter, often hollow. The actual selvage of the dyke is a narrow crust of brown glass. If other dykes of this type exist in the Cuillins, they have not been distinguished in the course of our survey from ordinary basalt dykes, and this rather peculiar rock seems therefore to be the only representative of the very latest magma intruded in the Cuillin district. It partakes of the characteristics both of basic and of ultrabasic rocks, and has noteworthy points in common with some intrusive sheets in the Sleat district to be described below (Ben Aslak type). It is probable, however, that rocks on the borderland between basic and ultrabasic have been intruded at more than one epoch, some preceding the later peridotites.

Another interesting type is presented by a sill mapped by Mr Clough in the Isle of Soay, about ■ mile S. by E. of Leac nan Faoileann. It is a dark, dense rock of specific gravity 3.14, showing very abundant fresh olivines in a fine-textured

ground. These porphyritic olivines are about ■ inch in length and have crystal outlines. In a thin slice (S9980) [NG 427 141] it is seen that the mineral occurs also in a second generation, forming more or less rounded grains about 1/200 inch in diameter. Octahedra of picotite are also present in two different sizes, and doubtless of two generations. The ground-mass consists mainly of innumerable slender rods of felspar with interstitial augite, the felspars having at any one spot a parallel or slightly divergent arrangement, as in many so-called variolites. This disposition of the felspars is not a flow-structure, for the direction of the rods often abuts upon the porphyritic olivines: the rods are indeed arranged in sub-parallel or sheaf-like fashion to form bundles, which lie in various directions and partly interlace with one another (Plate 26)., Fig. 1. The rock is mineralogically a picrite, its special features being the porphyritic development of olivine, which it shares with other members of this group, and the quasi-variolitic structure of the ground-mass, which we have not elsewhere observed in decidedly ultrabasic rocks, though something similar is found in the Ben Aslak type of intrusions, to be noticed below.

We have next to notice an isolated occurrence of ultrabasic rock of plutonic habit, the *picrite boss of An Sgùman*, forming the hill of that name on the south-western border of the Cuillins. It thus occupies about the middle of the crescentic area within which the dykes already described are developed, and with this group of dykes we connect it, notwithstanding its different mode of occurrence. The mass is 1000 yards long from N. to S., with a curiously irregular shape in ground-plan. Its relations along its boundary seem to be everywhere of the abruptly transgressive kind, the junction-surface being approximately vertical. The rocks through which it cuts are the metamorphosed basalt lavas and, at its northern end, the gabbro; and it is thus clear that this intrusion cannot belong to the earlier peridotite group. The boss runs out into rather pointed terminations both north and south, while it sends out from near its northern end straight dykes towards the east and west. These dykes closely resemble those of the radiate group already described, and they have the proper direction. A group of similar dykes is seen again to the west, on the coast close to the mouth of Allt Coire Labain, the intervening ground being covered by peat. The evidence, though not conclusive, is decidedly in favour of referring this boss-formed intrusion to the same epoch as the radiate dykes. A rock of plutonic habit belonging to so late an epoch in the sequence of intrusions is, however, anomalous, and the *direct* evidence of its age only proves that it is later than the marginal part of the gabbro of the Cuillins.

The picrite of the An Sgùman boss is a dark crystalline rock of specific gravity 3.10, of somewhat coarser texture than the dykes and resembling more closely the prevalent type in the earlier laccolites. The rusty weathered surface is usually pitted, owing to the xenolithic structure which affects most of the mass; but this is not always very pronounced, since xenoliths and matrix are of very similar nature. A noteworthy point of difference from the laccolites, and doubtless connected with the different mode of occurrence, is the absence of any banded structure. A thin slice shows the component minerals to be opaque iron-ore, olivine, augite, and felspar, crystallised in order as named (Plate 25)., Fig. 4, A. The iron-ore, in little octahedra, has not been tested for the presence of chromium. The abundant olivine, in crystal-grains 1/20 to 1/10 inch in diameter, contains flat cavities with dendritic inclusions of magnetite of the familiar kind, and these are of unusually large dimensions, being 0.002 to 0.005 inch in length (Plate 25)., Fig. 4, B. The augite, of a faint green tint in thin section, is perhaps a chrome-diopside. It has neither the diallagic structure nor the basal striation (salite-structure), but contains bands of dark inclusions. The felspar is anorthite, in shapeless plates with carlsbad, albite, and rarely pericline twinning. As minor accessories there are a few scraps of brown hornblende and red-brown mica associated with the augite.

In addition to the ordinary xenolithic structure, which it shares with most of our peridotites, the An Selman boss contains in places along its margin xenoliths of a different kind, belonging not to the "cognate" but to the "accidental" denomination. They are pieces of the immediately contiguous amygdaloidal basalts, but in so advanced a stage of dissolution that everything but the amygdules themselves has been totally destroyed, these remaining in a metamorphosed state but still capable of identification (S8724) [NG 436 182].

The phenomena are strictly comparable with those already described in the gabbro of the neighbouring part of the Cuillins, and must be taken as proving that this picrite, like the gabbro, has locally and to a very limited extent dissolved and incorporated portions of the contiguous basaltic lavas. (*Cf.* pp. 96, 97.)

Two other isolated intrusions, forming irregularly shaped masses, remain to be noticed. One of these is situated immediately below *Carn Dearg,* near Suishnish Point, between Lochs Slapin and Eishort. The epoch of its intrusion is

doubtful. It occurs among Liassic strata just below a triple composite sill already noticed in Chapters 12 and 13, and its behaviour certainly suggests that it is younger than the sill, which seems to have barred its upward passage. We may conclude that the intrusion belongs to some epoch during the phase of minor intrusions, but its relation to the later peridotite dykes of the Cuillins remains problematical.

References have been made to this locality, and diagrammatic sections drawn, by more than one author.<ref>Macculloch, *Description of the Western Islands of Scotland,* vol. i., p. 384, and vol. iii., pl. xiv., fig. 5; 181.9: Geikie, *Quart. Journ. Geol. Soc.,* vol. xiv., p. 17, and pl. i., fig. 4; 1857: Zirkel, *Zeits. deuts. geol. Ges.,* vol. xxiii., p. 83, and pl. iv., fig. 13; 1871: Geikie, *Trans. Roy. Soc. Min.,* vol. xxxv., pp. 59, 60, fig. 14; 1888. In the earlier papers cited the hill is called Carn Nathrach.</ref> The hill, with the immediately adjacent country inland, is formed by a thick sill of granophyre underlain by a thinner one of basalt, the whole constituting, as stated, one of the peculiar composite intrusions in the Lias already described at length. Immediately beneath the basalt on the southern or seaward face of Carn Dearg appears the picrite, a dark crystalline rock forming a broad rib in the face of the cliff. It runs down nearly vertically in a S.S.E. direction, and disappears under the waters of the sea-loch. Previous writers, differing on other points, have regarded this rib-like mass as passing into the basalt sill above, which was supposed to be a sheet-like expansion of it. The detailed mapping has led to a different conclusion (*see* (Figure 45)), and shown that the picrite mass is quite independent of the other intrusions. The basalt, very different in composition and texture from the picrite, has probably come from a dyke forming part of the northern boundary of the composite sill, just west of Loch Fada, a dyke which served also at a slightly later time for the uprise of the granophyre magma. The picrite mass viewed from the south might be considered as of the nature of a dyke, though of an irregular kind, the width of the outcrop increasing upward. But on closer examination it is found to pass at the top into an irregular sheet, which, at first touching the overlying basalt, soon breaks away from it, and quickly dies out. This is clearly seen on the western slope of the hill (*see* (Figure 45), p. 211).

The rock, which we have termed picrite, is in reality of rather variable nature, ranging from a typical picrite to a variety approaching olivine-gabbro. The specific gravity is 2.98 to 3.01 in different specimens. Mr Baker analysed a portion comparatively poor in olivine, which yielded 43.86 per cent. of silica and 16.64 of magnesia (I.). This is petrographically an ophitic olivine-gabbro (S8953) [NG 598 158]. The prevalent type is apparently a picrite very like those of the Cuillin laccolites, but without xenoliths. In thin slices of this olivine is seen to make up about one half of the bulk (S7076) [NG 596 160], (S7077) [NG 599 156]. The mineral has the dendritic magnetite inclusions already noticed in the plutonic rocks. Augite is abundant, showing in the slices a very faint yellowish tint and an incipient "schiller" structure. Felspar occurs interstitially in quite subordinate quantity, and the other constituents are a few grains of magnetite and ragged flakes of reddish brown mica. In the specimens sliced the rock shows considerable breccciation on a small scale.

	I	II
SiO_2	43.86	44.06
Al_2O_3	10.63	12.16
Fe_2O_3	0.74	4.85
FeO	10.15	5.48
MgO	16.64	18.21
CaO	6.68	9.80
Na_2O/KO2	*	0.98
Ignition	1.51	3.80
		99.34
Specific gravity	3.00	

I. Olivine-gabbro, verging on picrite (S8953) [NG 598 158], below Carn Dearg, near Suishnish Point: anal. T. Baker. (*The alkalies are omitted, as requiring redetermination.)

II. Olivine-dolerite, verging on picrite 18952], Aodann Clach, Heast Road, about 2 miles S. E. of Broadford: anal. T. Baker.

It is probable, however, that the transitions observed at Carn Dearg from picrite to olivine-gabbro and olivine-diabase do not express completely the range of variation in this intrusion. There is reason to believe that the mass extends northward beneath the composite sill which forms the hill, and is continuous with the rock which emerges near Loch. Pada and extends for some distance towards Allt Leth Slighe, as mapped by Mr Barrow and Mr Wedd. A sliced specimen from this supposed northward extension, between Glen Boreraig and Allt Leth Slighe, is a well characterised gabbro without olivine (S10078) [NG 590 179], and in the same neighbourhood this graduates into diabasic varieties. If the continuity through Carn Dearg can be assumed, there is thus a rather remarkable difference between the southern and northern parts of a single intrusive body.

The other isolated intrusion occurs a little west of the summit of *Glamaig,* near Sligachan. Like the Suishnish mass it is in one place like an irregular dyke and in another like an irregular sheet. It is not seen to cut any rock other than the basaltic lavas, and there is therefore no direct evidence as to its precise age. We may connect it conjecturally with the somewhat similar intrusion at Carn Dearg, near Suishnish. Like this it is rather variable in petrographical characters, but part of the mass consists of true peridotite. A slice of this (S9254) [NG 513 301] shows what is essentially an olivine-augite rock, with only an occasional small patch of felspar, and with octahedra and grains of picotite. This rock is in great part transformed to serpentine, colourless, yellow, or light brown in the slice, with the usual copious separation of magnetite dust in strings and patches.

Finally we shall notice certain irregular sills or *intrusive sheets rich in olivine* occurring in the south-eastern part of Skye. Mr Clough has observed such rocks near Drochaid Lusa, 3½ miles E.N.E. of Broadford, and near Kinloch, Allt Thuill, and Ben Aslak, all in the central part of the Sleat district. We may conveniently refer to these sheets as the *Ben Aslak type.* They are found in Torridonian strata far to the east of the true peridotites; but they have some of the features of ultrabasic rocks, and may perhaps be regarded as occupying an intermediate place between the basalts and the hypabyssal picrites. The data are insufficient to fix the epoch of intrusion of these sheets.

The rock of the Ben Aslak type of intrusion has rather peculiar characters. In hand-specimens it is seen to be crowded with crystal-grains of yellowish-green olivine, about ■ inch long, set in a dark groundmass of finely crystalline or microcrystalline texture. A fresh specimen from about a mile E. by N. of Kinloch gave the specific gravity 3.00. Thin slices show the rocks to consist of olivine to the extent of from one third to fully one half [S8852], [S8853], (S8854) [NG 754 189], the crystals sometimes showing good faces with the usual habit, but more frequently having a rounded shape. In a finer-textured variety of the rock there are in addition little granules of olivine about 1/300 to 1/100 inch in diameter, apparently of a later generation; but this point is not quite clear, and in one case at least a hand-specimen shows the conspicuous olivines becoming smaller towards the edge of the sheet. In decayed specimens from near Drochaid Lusa the olivine is replaced by pseudomorphs of carbonates (S5077) [NG 692 241], (S5078) [NG 692 241].

A prominent constituent in all the specimens is picotite, which is constantly the earliest product of crystallisation, and forms well shaped octahedra, occasionally as much as 1/30 inch in diameter, though usually smaller. As a rule it is quite transparent in the slices, with the usual deep brown colour, -but its appearance varies to a scarcely perceptible translucency in some cases. Apatite is not found. The felspar is in idiomorphic crystals, tabular parallel to the brachypinacoid, so as to give elongated rectangular sections. They range up to about 1/50 inch in length, but in the finer-textured variety of the rock are smaller and of more slender shape. They show at any given point an approximate parallelism, consequent upon their tendency to lie tangentially to the olivine-grains or to be squeezed in between two grains of that mineral. The sections show twin-striation and some degree of zonary banding, but the felspar is evidently in the main anorthite, the extinction-angles in symmetrically cut sections ranging up to about 55°. The augite, which has been the latest mineral to crystallise, is very pale in thin slices, but always brown rather than green. In the less fine-textured rocks it enwraps and encloses the felspars in typical ophitic fashion, but in other slides it shows a more peculiar habit. Here it is still ophitic, in the sense that it forms patches moulded upon and enveloping the felspars; but each such patch consists of a number of elongated rods or plates, in contact with one another, with a sub-parallel or slightly divergent arrangement.

A rock petrographically referable to this group has been analysed by Mr Baker, and we are permitted to give the results here (column II. above). In a thin slice it shows very numerous little octahedral crystals, some of which have the translucency and strong brown colour of picotite. Olivine is very abundant, and the other constituents are anorthite and

ophitic pale brown augite. We have no information as regards the mode of occurrence and geological relations of this rock, which was collected by Professor Lebour. It will be noticed that in chemical composition it compares rather closely with the specimen analysed from Carn Dearg.

It seems probable from Mr Clough's observations that sheets of the Ben Aslak type are not confined to the few localities from which specimens have been collected; and, further, that there are dykes of similar rock, very rich in olivine. One of these latter, with specific gravity 3.07, was noted near Isle Ornsay, about ■ mile W.S.W. of the pier. In this connection too may be mentioned a dyke of picrite, or of rock between picrite and olivine-dolerite, seen about a mile to the south-east of Drochaid Lusa. It is very near to one of the sills just described, but Mr Clough found no direct evidence of their connection. The rock consists of opaque octahedra (? magnetite), abundant grains of olivine up to ■ inch in length, pale yellowish brown augite in irregular grains, and felspar giving the extinction-angles of labradorite. The last is partly in roughly rectangular crystals with albite-lamellation, partly in more shapeless grains with less frequent twin-lamella but strong zonary banding — a feature common in many of the doleritic rocks (S5076) [NG 711 240].

The collections of the Geological Survey from the Inner Hebrides contain a few other rocks lying on the border-line between the basic and the ultrabasic. There may perhaps be a distinct group of sills in the Jurassic intermediate in character between olivine-dolerite and picrite and graduating into both; but our information is not sufficient to lay down the relations of such occurrences to the great group of basic sills and to other groups of intrusions; and, so far as our knowledge goes, such rocks seem to belong less to Skye than to some of the neighbouring islands. It is perhaps more likely that in the thicker members of the great group of sills itself there may sometimes have been differentiation of the magma after intrusion, which in extreme cases was carried so far as to produce rocks almost or quite of ultrabasic composition. Professor Judd<ref>*Quart. Journ. Geol. Soc.,* vol. xli., pp. 393, 294; 1885.</ref> found that the great sill, 500 feet thick, in the Shiant Isles, 12 miles N. of Skye, is in part of ordinary basic rock but in part of picrite and even peridotite; and Sir A. Geikie<ref>*Ancient Volcanoes of Great Britain,* vol. ii., pp. 307–310; 1897.</ref> has suggested that this is to be explained by differentiation under the action of gravity. A sill-rock from north of Meall Daimh in the Isle of Raasay, of specific gravity 2.92, is very rich in olivine, and in composition verges upon picrite. Like similar rocks from the Shiant Isles, it is characterised by a purplish brown augite with distinct pleochroism and an imperfect "hour-glass" structure (S6774) [NG 570 425]. An augite with these characters is well known in some nepheline-dolerites and teschenites, and some of the sills outside Skye seem to have affinities with these rocks. Nepheline has been recorded by Heddle<ref>*Mineralogy of Scotland,* vol. ii., p. 46; 1901.</ref> in the great sill of the Shiant Isles, and at least one sill of an analcime-diabase approaching teschenite occurs in the south of Arran.<ref>Corstorphine, *Tsch. Min. Petr. Mitth. (N.S.),* vol. xiv., p. 464; 1895.*Trachyte and Trachy-Andesite Dykes.*</ref>

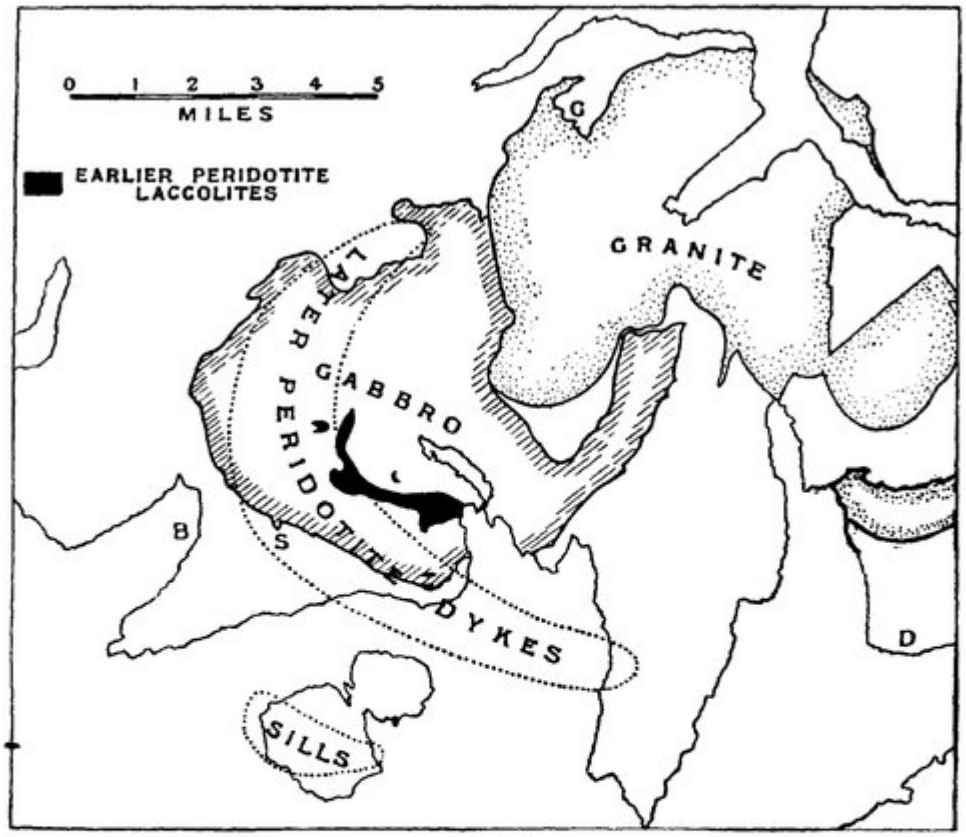
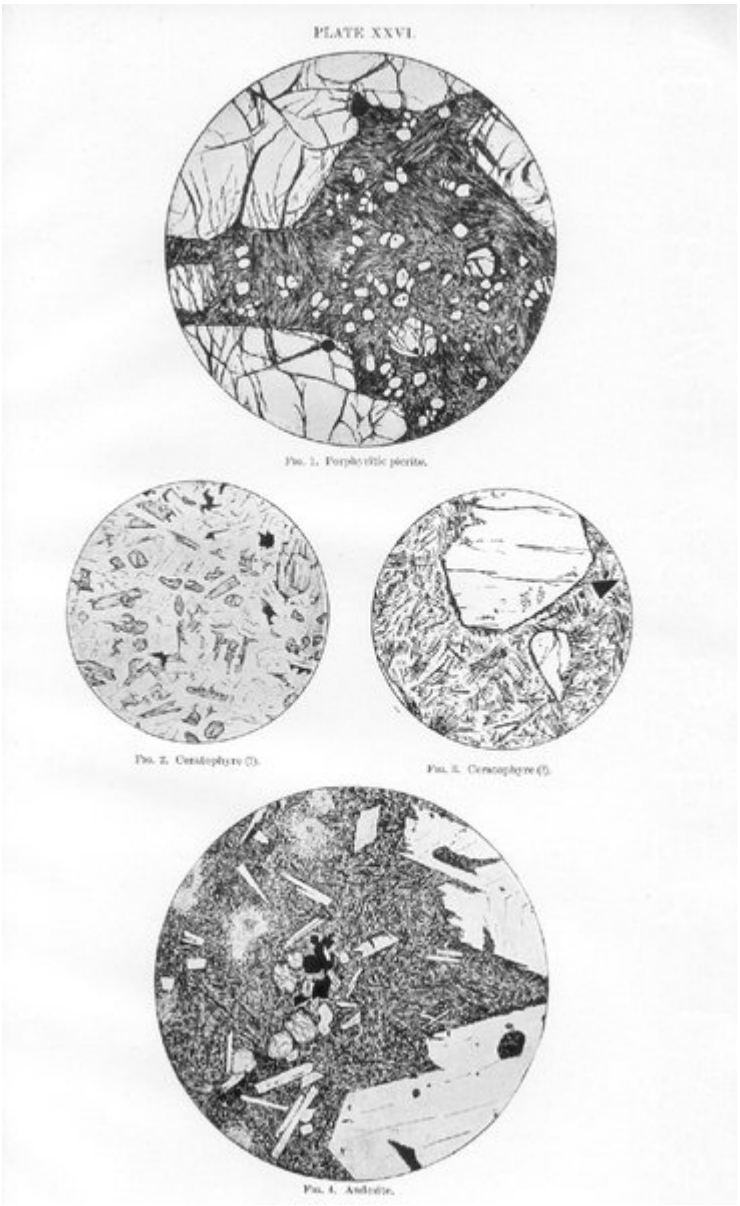


FIG. 75.—Sketch-Map to illustrate the distribution of the peridotites, older and younger. Scale, ¼ inch to a mile.

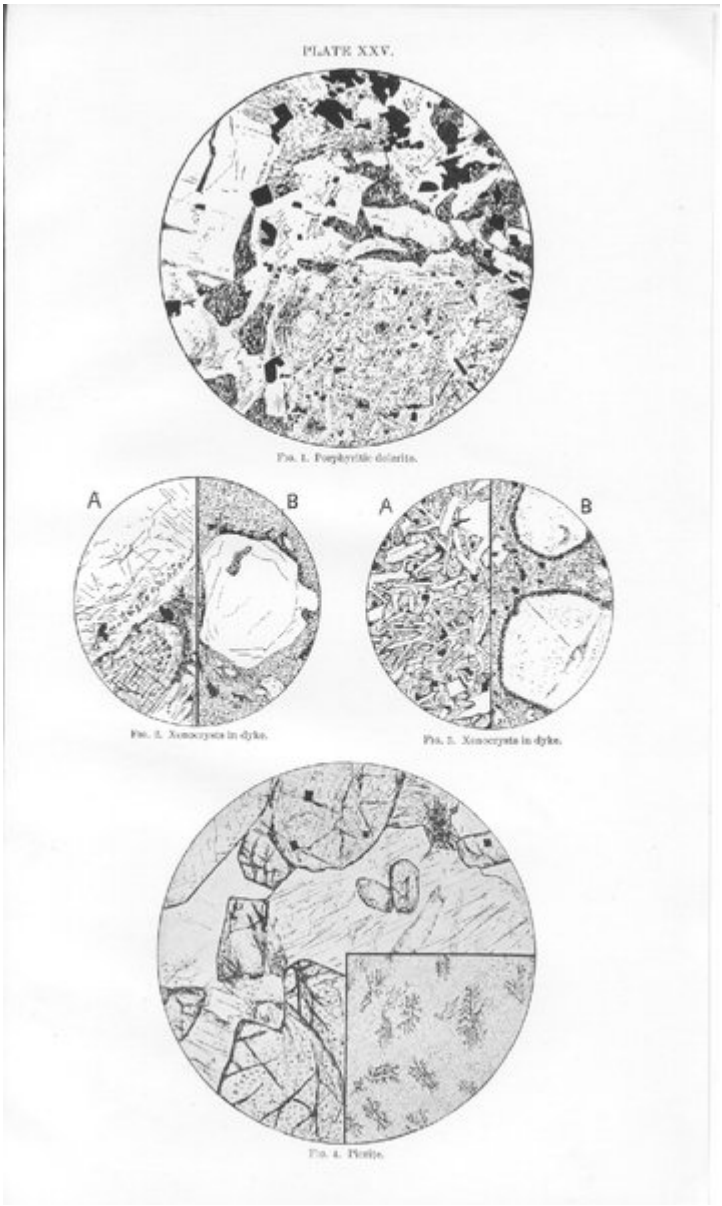
The older plutonic laccolites of the south-western Cuillins (with one in the Isle of Soay) are marked in black.

The large crescentic area enclosed by a dotted boundary embraces the younger peridotite dykes of the Cuillins and the Strathaird peninsula. The only peridotite dykes outside this area are a group on the coast of Loch Brittle at B, but peridotite sills occur in Soay as indicated. The boss of An Sgùman is situated at the point marked S, and the intrusions of Glamaig and Carn Dearg at G and D, on the prolongations of the two horns of the crescent.

(Figure 75) Sketch-Map to illustrate the distribution of the peridotites, older and younger. Scale, ¼ inch to a mile. The older plutonic laccolites of the south-western Cuillins (with one in the Isle of Soay) are marked in black. The large crescentic area enclosed by a dotted boundary embraces the younger peridotite dykes of the Cuillins and the Strathaird peninsula. The only peridotite dykes outside this area are a group on the coast of Loch Brittle at B, but peridotite sills occur in Soay as indicated. The boss of An Sgùman is situated at the point marked S, and the intrusions of Glamaig and Carn Dearg at G and D, on the prolongations of the two horns of the crescent.



(Plate 26) Fig. 1. (S9980) [NG 427 141] × 32. Porphyritic Picrite, sill S. of Leac nan Faoileann, I. of Soay. The porphyritic elements are olivine and picotite. These recur also in a second generation, but the bulk of the ground-mass is of slender rods of felspar with sub-parallel arrangement and interstitial augite, the structure recalling that of some variolitic basalts. See p. 380. Fig. 2. (S7370) [NG 585 105] × 20. Ceratophyre (?), large dyke W. of Loch Gauscavaig, near Tarskavaig, Sleat: showing an aggregate of crystals of alkali-felspar with small crystals of augite and grains of magnetite. See p. 397. Fig. 3, (S6851) [NG 610 045] × 20. Ceratophyre (?), dyke nearly ■ mile N. by W. of Cnoc an Sgùmain, Armadale: showing phenocrysts of crypto-perthite in a ground-mass composed of an aggregate of crystals of alkali-felspar penetrated by very numerous needles of augite. See p. 397. Fig. 4. (S3201) [NG 615 165] × 30. Glassy Augite-Andesite, dyke on shore of Loch Eishort, W. of Boreraig: showing phenocrysts of felspar, augite, and magnetite in a ground-mass composed of clear glass crowded with crystallitic growths, largely in the form of minute rectangular gratings. See p. 401.



(Plate 25) Fig. 1. (S9372) [NG 628 285] × 30. Porphyritic Dolerite, dyke 400 yards N.W. by N. of Scalpay House. The lower part of the figure shows part of one of the circular felspathic areas which represent vesicles filled by the oozing in of the residual magma. See p. 331. Fig. 2; × 20. Xenoliths in basic dykes. A. (S7483) [NG 526 194]. Edge of ga,bbro xenolith in dyke in Abhuinn nan Leac, Strathaird; showing the earliest stage of breaking up by the formation of numerous fissures; also the development of secondary inclusions in both felspar and augite. See pp. 355, 361. B. (S6716) [NG 633 208]. Detached quartz-grain from granite xenolith in dyke on ridge N. of Ben Suardal, near Broadford; showing the earliest stage of breaking up by the formation of fissures, which here tend to run parallel to the outline; also incipient corrosion. See p. 356. FIG, 3. × 20. Basic dyke carrying granite xenoliths, on shore N.E. of Corry Lodge, Broadford. See p. 357. A. (S6719) [NG 644 243]. The normal dolerite, where free from foreign material. B. (S6720) [NG 644 243]. Portion enclosing abundant debris of granite, of which two detached quartz grains are shown, eack with its corrosion-border of granular augite. The matrix, partly obscured by alteration, is of fine texture and of much less basic composition than the normal dolerite. Fig. 4. (S8723) [NG 436 182]. Picrite, An Sgùman. A. (occupying three quadrants); × 30. Showing olivine, augite, anorthite, etc. The dendritic inclusions of magnetite in the olivine are conspicuous in the large crystal in the lower left-hand quadrant: in the crystal at the top of the figure they are cut at right angles to their plane, and so appear like rods. See p. 381. B. (lower right-hand quadrant); × 110. Showing the dendritic inclusions more highly magnified. See pp. 68, 69, 381.

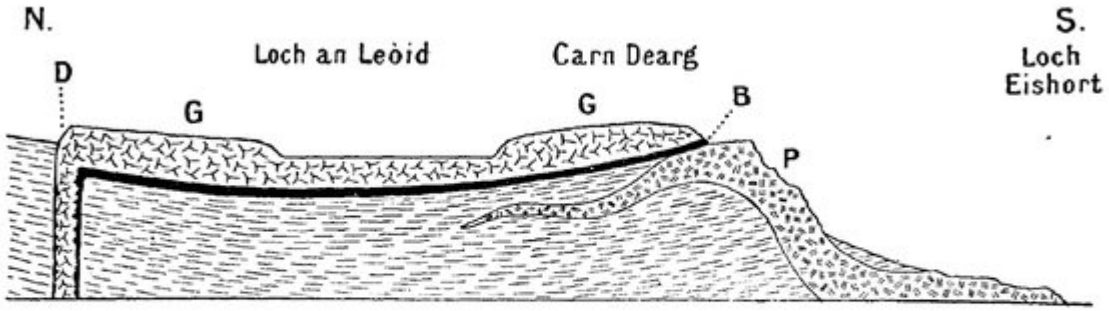


FIG. 45.--Section across the composite sill of Carn Dearg, near Suishnish. Scale, 6 inches to a mile. G, granophyre of sill; B, lower basalt member; D, supposed dyke-feeder of sill; P, later independent intrusion of rock varying from olivine-gabbro to picrite (see Chap. XXII.).

(Figure 45) Section across the composite sill of Carn Dearg, near Suishnish. Scale, 6 inches to a mile. G, granophyre of sill; B, lower basalt member; D, supposed dyke-feeder of sill; P, later independent intrusion of rock varying from olivine-gabbro to picrite (see Chapter 22).