Chapter 16 Minor acid intrusions

Under the head of the *minor acid intrusions* we include for the purpose of petrographical description in common various dykes, sills, and sheets, of small or quite moderate dimensions; of which some are offshoots, or presumed offshoots, of the granite of the Red Hills, while others belong to the second principal epoch of acid intrusions in Skye, when no large bodies of rock were formed. The former are in part visibly apophyses of abyssal rock-masses, while the latter are of typical hypabyssal habit; and the fact that the two are often indistinguishable in specimens has an evident bearing upon the question, what factors go to determine the micro-structure of igneous rocks. It is clear that no important difference of pressure can be postulated for the consolidation of the granite of Strath na Creitheach on the one hand and the spherulitic dykes of Druim an Eidhne, which are its apophyses, on the other hand.<ref>It may be remembered also that the marginal part of the large body has in places the same character as the dykes.</ref> Differences there would doubtless be in temperature and rate of cooling, and also more flowing movement within the narrow fissures than in the main body of magma. To discuss this general question, however, would be outside our present province.

Similarity of petrographical characters is a sufficient reason for describing the two groups of minor acid intrusions together; but there is a further reason in the practical difficulty in some cases of separating the later from the earlier group. The only important group of rocks which can be assigned with certainty to the interval between the two chief epochs of acid intrusions is the great group of basic sills; and it follows that where these are not present there is no absolute criterion for discriminating the minor acid intrusions of the later epoch from those of the earlier which are not visibly offshoots from the granite. The failure of the basic sills, with this consequent ambiguity, affects us principally in the mountain district. Beyond the mountains and a narrow sub-montane belt there is no difficulty, as a rule, in applying the simple criterion, and it is found that the minor acid intrusions there belong in general to the second group, which has a much wider distribution than the first. It is to be observed, however, that the break between the earlier and later groups is not an absolute one. A few acid rocks were intruded during the interval between the two principal epochs, and these entered into relations with basic intrusions to form the peculiar composite sills and dykes already described at length. The acid intrusions of the second group also sometimes form part of composite dykes, but without the peculiar relations referred to between the basic and acid members, so that they are to be included with the rest in this place. A few acid dykes again, mostly pitchstones and denitrified pitchstones, are to be referred to a time probably long posterior to the second principal epoch here recognised, and these will be described in a later chapter.

We have already considered the field-relations of those minor intrusions, chiefly dykes, which are in visible continuity with the granite and granophyre masses of the Red Hills. It is highly probable that we ought to include with these, as belonging to same epoch, many of the acid dykes within and just outside the Red Hills district which have no such direct connection with the plutonic masses, unless it be a subterranean connection. This may be true of some dykes which intersect the plutonic rocks themselves, for, as we have seen, the granite consists of a number of distinct intrusions. There are, for instance, spherulitic dykes cutting the granite in a few localities which are identical in characters with the Druim an Eidhne apophyses.

Probably some of the acid dykes in the same district, and certainly most of those outside it, are to be referred to the second chief epoch of acid intrusions which we have specified; and to these dykes we may add the sheets and irregular sills which are of less frequent occurrence. The area of distribution of these rocks is a fairly large one, but quite sharply defined; extending in every direction round the Red Hills, but to varying distances of one to eight miles from them. This extension is greatest towards N.W. and S.E., a circumstance observable in other groups of minor intrusions in Skye, and doubtless related in some way to the dominant direction of the dykes in the region, with which it agrees very closely. As is shown in the sketch-map (Figure 58), the area in question embraces all the acid igneous rocks of Tertiary age in Skye. The earlier groups of acid rocks (and also the pitchstones, etc., which came later) were limited to smaller areas lying within this large irregular oval. The intrusions pertaining to this group represent then the maximum extension of igneous activity in Skye as regards acid rocks. Next to the granites, they constitute by far the most important group of acid rocks in our region; and when we speak of the group of minor acid intrusions or the epoch of the minor acid intrusions, without qualification, it is this group or this epoch that will be intended.

The larger of the minor acid intrusions are usually of irregular shape, and have partly transgressive relations towards the stratified or other rocks among which they have been intruded. They partake more or less of the nature of sheets, but rarely, if ever, behave as perfect sills for any great distance. In this they contrast strongly with the minor basic intrusions. A good example is the mass of granophyre, intruded mainly in the Lias, to the east of the Broadford River. This has in great part the form of a sheet, but it passes obliquely from one horizon in the Lias to another, and in places is more sharply transgressive. Where it enters the Cambrian Limestones, it at once assumes a frankly transgressive attitude, with vertical junctions, and runs out in the form of narrow tongues or curving dykes, recalling the behaviour of the granite of Beinn an Dubhaich in the same country rock. This occurrence is probably to be referred to the epoch of the minor intrusions rather than to that of the granite, but there is no decisive evidence on this point.

Further north we have a group of granophyre intrusions in the Lias of the broad hill named Beinn Bhuidhe, N. W. of Broadford Bay. These, where best exhibited along the coast, have clearly the form of sills, although they show some irregularity of habit. They are referable to the principal epoch of minor acid intrusions, and in one place, near some ruined huts, they enter into rather peculiar relations with certain basic sills of earlier intrusion.

Mullach na Càrn, the highest hill on the isle of Scalpay, is nearly encircled by the outcrop of a rather large sheet of granophyre. This shows a higher degree of regularity than might be expected, considering that the country rock is coarse-textured Torridonian sandstone. It is probable, however, that this sheet belongs to the epoch of the granite, and has been connected with the large body of that rock which crosses over into Scalpay, and approaches within ¾ mile of the sheet. A like supposition cannot be applied to a smaller sheet or sill of granophyre in the northwestern part of the same island. It is exposed over a nearly circular area, 120 to 150 yards in diameter, forming the floor of a curious circus on the northern slope of the hill Rudha Chinn Mhòir. It is surrounded by a wall of Triassic conglomerate, and was evidently intruded along the junction of that formation with the underlying Torridonian, as shown in (Figure 59) and (Figure 60). The sill cannot extend far beyond the limits of the circus, and on the coast only 100 yards to the N.E. a basalt sill is seen occupying a like position at the horizon of the unconformity.

The granophyre sill seems to have been fed by a dyke ('G' in (Figure 60)), but the exposures are not sufficient to put this beyond question.

Several intrusions of granophyre, mostly of the nature of short stout dykes but with rather irregular habit, occur on the N.W. side of Loch Sligachan, besides a sheet exposed by the road-side on the opposite side of the loch. These are intruded in the basaltic lavas. The composite sill and dyke of Allt an t-Sithean in the same neighbourhood have already been described, as well as the similar composite intrusions in the Lias near and to the south of Broadford. The felsite intrusions on the slope of Sgùrr Thuilm have also been noticed (Chapter 5) as possibly connected with the rhyolitic lavas. A remarkable intrusion in the gabbro at the head of Coire Labain and in the "Alaisdair Stone-shoot" will be more particularly noticed in the petrographical part of this chapter.

The ordinary dykes referable to the principal period of minor acid intrusions need not be enumerated individually. Though always greatly inferior in number to the basic dykes, they occur with some frequency in the country to the north of the Cuillins, the most westerly being three on Braigh Coille na Droighniche, overlooking Loch Harport, and two in the Vikisgill valley. In numerous instances the acid dykes are in contact with, and then usually flanked by, basic dykes. Examples of this may be seen in Allt Airidh Meall Beathaig, a tributary of the Varragill River; in Allt Daraich, near Sligachan; and especially a group occurring in the belt of ground running from Coire na Creiche to near Drynoch. Several acid or sub-acid dykes occur in the Strathaird peninsula, and some of these also are members of composite dykes. Dykes, and occasionally sheets, of felsite and granophyre are found at numerous places on and near the borders of the granitic tract.

Concerning the tract of stratified rocks farther south-east, Mr Clough writes as follows: "No granophyre or felsite intrusions of Tertiary age have been seen N.E. of a line connecting Skulamus and Loch na Dal, nor S.W. of Sgiath-bheinn an Uird. They are most numerous near Ben Suardal, Skulamus, and Heast. Near these localities their mode of occurrence is varied. The larger intrusions may perhaps be regarded as laccolites, but none continue far on one stratigraphical horizon. The acid intrusions certainly keep to the bedding less usually than the basic sills. Only four or five intrusions belonging to this class have been seen on the S.E. side of Loch Eishort. These are all in the form of dykes which strike N.W. or N.N.W., about parallel to the basaltic dykes near them. The broadest of the granophyre dykes on this side of the loch is seen on the shore about a mile E N.E. of Rudha Dubh Ard, where it forms part of a composite dyke. It is ten or twelve yards wide, and has been traced about three quarters of a mile S.S.E. Another thinner dyke, again part of a composite dyke, occurs on the Rudha Dubh Ard itself. On the E. side of Monadh Morsaig there is a granophyre dyke varying in width between four and ten feet. On the W. side of Mullach an Achaidh Mhòir, near Drumfearn, there is a dyke about one foot thick. The dyke that occurs farthest S.E. is in Allt Duisdale, about three quarters of a mile W.N.W. of the bridge".

It is in accordance with the general behaviour of basic and acid magmas in our region, to which we have repeatedly alluded, that the acid dykes and sheets show less perfect regularity in their field-relations than the corresponding bodies of basic composition. The dykes show a certain degree of order in their direction, the prevalent bearing being about N.W. or N.N.W., as in the basic dykes of the region, but with more frequent departures from the general rule. It is noteworthy that, though belonging to a local group, connected with the special focus of central Skye, the dykes are governed as regards direction by the same rules as the dykes of regional distribution. In those of the basic dykes which are most intimately connected with the local focus of activity we shall find a different law prevailing (Chapter 21). The intrusive sheets of acid rocks, even where they preserve the sill habit with considerable persistence, sometimes show irregularities on a small scale at their surfaces of contact, and may send off little tongues along the bedding of the contiguous strata. A good example is seen in a low cliff a little west of Rudh' an Eireannaich, near Broadford.<ref>This was noticed by Sir A. Geikie, *Quart, Journ. Geol. Soc,,* vol. xiv., pl. I., fig. 8; 1858.</ref> In the basic sills any such irregularity is of rare occurrence; and equally so in an acid sill which has been guided by an earlier basic one, even where, as we have sometimes observed, it has totally destroyed its guide. Many of the ordinary minor acid intrusions give evidence of relatively rapid cooling at their edges, either by a finer texture or by spherulites of diminishing size, as in the sill near Broadford mentioned above.

We proceed to consider the *petrographical characters* of the rocks. With a few exceptions, to be noted below, they are of thoroughly acid composition. Although no chemical analyses have been made, the microscopic examination leads us to believe that these minor intrusions are as a whole somewhat more acid than the large masses of the Red Hills: they seem at least to be poorer in the ferro-magnesian minerals. The low specific gravity of most of the rocks points to the same conclusion: ten examples gave a mean of 2.54, as compared with 2.59 for the granites, etc. Those dykes which are visibly off-shoots from the granite intrusions show the same difference, at least when they are spherulitic or otherwise fine-textured. We shall confine our attention in the first place to the truly acid members of the group, reserving certain aberrant types for subsequent consideration.

The *constituent minerals* of the rocks may be dismissed briefly. They are quartz, orthoclase, and oligoclase, with in most cases some ferro-magnesian mineral and one of the iron-ore group, but these latter always in quite subordinate amount. The ferro-magnesian mineral is, in different cases, augite, hornblende, or biotite, the first-named being the most usual. In some instances the hornblende is secondary after augite, but primary hornblende is also found. The augite shows in thin slices the very pale green tint which is customary for this mineral in acid rocks, but it is often replaced by chloritic alteration-products of a deeper green colour. The hornblende is brown or, when of secondary origin, green. Many of the rocks show no ferro-magnesian mineral except little chloritic and limonitic patches, and even these may occur only sparingly. The iron-ore minerals met with in different examples are magnetite and pyrites. The former is the more common, but the latter is found in a considerable number of cases, with all the appearance of a primary mineral. It seems to be specially characteristic of the spherulitic types, and it is possibly connected, as Professor Judd has suggested, with some kind of solfataric action.<ref>In the Druim an Eidhne rocks, to be more particularly described below, iron sulphide occurs not only in visible crystals, but also in a finely disseminated form, as Dr Cullis has proved by blowpipe tests (*Quart. Journ. Geol. Soc.,* vol. xlix., p. 190; 1893).</ref> The pyrites forms little cubes, usually fresh but sometimes partially converted to hamatite.

The rocks present much more variation in *microstructure* than in mineralogical constitution. The more typical varieties met with range themselves for the most part in two parallel lines, the micro-granitic (quartz-porphyries, etc.) and the micrographic (granophyres of many kinds), though these are connected by numerous intermediate links. On the whole, the tendency to micrographic intergrowths, which we observed in the acid rocks of the large plutonic masses, is at least as strongly marked in these minor intrusions of like composition, and often attains in the latter a more typical development.

The rocks which fall under the former of the two divisions thus recognised do not require any lengthy description, and it will be sufficient to select a few illustrative examples. The evident porphyritic crystals are felspars, up to ■ or sometimes ¼ inch in length, and quartz, usually of rather smaller dimensions. The dominant felspar is orthoclase, and shows the customary crystal habit: the quartz is in bipyramidal crystals, and contains glass-inclusions. Ferro-magnesian minerals are never abundant, and there is at most a small amount of magnetite, or in some cases pyrite. The ground-mass, of various scales of texture but generally quite fine, usually resolves into a granular aggregate of felspar and quartz. In the finer-textured varieties the felspar, especially if it predominates very decidedly, may assume idiomorphic habit, forming narrow crystals. In some of the rocks there has doubtless been a glassy base, which is now devitrified or in great part decomposed.

A variety with relatively large and conspicuous dihexahedra of quartz is of somewhat exceptional occurrence. Examples occur in the form of small dykes near the northern base of Glamaig, above the village of Sconser. In most of the rocks the more evident phenocrysts are of felspar. The ferro-magnesian element, never very abundant, may be either a pale augite or a brown mica. The ground-mass has in general a microgranitic structure, and varies in size of grain, a fine texture being the most usual.

A well-characterised quartz-felsite forms two or three irregular sheet-formed intrusions on the northern face of Creag Strollamus, in the Broadford district. It contains very abundant pinkish crystals of orthoclase, about ■ inch across, and smaller crystals of quartz, in a compact light grey ground. Two specimens of identical appearance showed some differences in thin slices. In one from 500 yards N. by E. of the summit of the hill (S9572) [NG 606 267] the ground-mass, though fine-textured, is easily resolved. Besides the phenocrysts, it encloses little patches of micropegmatite, abruptly bounded and perhaps of the nature of xenoliths. In the second specimen (S8969) [NG 605 266], taken about 70 yards farther N.W., the ground-mass is similar to the other, though a little finer. Some one or more ferro-magnesian minerals have been fairly represented, but are now totally destroyed: the shapes suggest both augite and biotite. There are a few little cubes of pyrites. The specific gravity of this rock is 2.57. A rock with pink crystals of felspar, very like the preceding and of specific gravity 2.53, is seen on the eastern slope of Belig, about 500 yards N.W. by N. of Loch na Sguabaidh. Similar rocks are found elsewhere, not only in occurrences which we assign to the group of minor acid intrusions proper, but also, on Glamaig and in other places, where they are probably to be regarded as special modifications of the granitic intrusions of the Red Hills.

Rocks with characters which suggest the former presence of a large amount of glass in the ground-mass are found in the form of small intrusive sheets and dykes on Glamaig and in various parts of the Red Hills. They usually intersect the granite or granophyre, but this is the only datum for their age, and they are included in this place only for convenience. Here we may note an interesting rock, a specimen of which was kindly furnished by Professor Judd, who drew our attention to its occurrence in the screes on the western slope of Marsco. It has not been found in place. It has a dark ground-mass of dull aspect and bluish tint, in which are set abundant reddish-yellow crystals of orthoclase, about ■ inch long and sometimes aggregated in groups, with smaller pyramidal crystals of quartz. A thin slice (S9285) [NG 499 259] shows that the dark colour of the ground-mass is due to a crowd of minute rods, not more than 0.001 inch long, probably of augite. They show only a very faint colour under the microscope, and, being contained within the thickness of the slice, do not lend themselves to polariscopic examination. They show little parallel arrangement except where they lie tangentially to the porphyritic crystals. The base in which these rods are set is colourless and of low refractive index, and in natural light might be taken for a glass, but it is doubtful whether any truly vitreous matter remains. The bulk of it at least depolarises, having nearly the birefringence of an alkali-felspar. The specific gravity of the rock is 2.63, and it may not improbably be a devitrified pitchstone.

Comparable in some respects with the preceding is a dyke which intersects the gabbro just W. of the Sligachan River, near the out-fall of Allt Coire Riabhach. It is 2 feet wide, and has margins about 3 inches wide showing strong flow-structure. The central portion, of specific gravity 2.63, shows scattered crystals of white orthoclase up to 1/10 inch long in a dull compact ground-mass of dark bluish-grey colour. The slice (S8976) [NG 48 25] reveals also scattered crystals of some ferro-magnesian mineral, now destroyed. The ground-mass is crowded with little dark rods having at each spot a parallel arrangement, often with a second set grown at right angles to the first. The colourless matrix in which these minute rods are embedded has probably been vitreous, but is too obscure to permit of a definite pronouncement. The marginal modification of the dyke, specific gravity 2.60, with marked fluxion-structure, is paler, with narrow bands of lighter and darker tints, and encloses scattered felspars as before. Under the microscope (S8977) [NG 48 25] it has in natural light all the appearance of a glassy rock, clouded with minute limonite specks and having little patches and streaks of the same. Between crossed nicols, however, the ground breaks up into an irregular mosaic of little birefringent areas, the whole being very similar to what is seen in the devitrified pitchstones to be described in a later chapter.

Rocks showing a sinuous flow-structure, and presenting a "microfelsitic" texture which may probably be attributed to devitrification, are met with in numerous localities, either making up the whole width of a small dyke or forming the marginal part of a dyke or of a larger and less regular intrusive body. Examples may be seen on Ben Meabost, in the Strathaird district; near the coast ■ mile S. of Camasunary; at one or two places in Scalpay; and near An-t-Sithean, Broadford.

Some rocks containing only isolated and scattered spherulitic growths form a connecting link between the two main divisions which we have distinguished. They are found at numerous localities in the belt of country bordering the Red Hills, and occur not only in Skye but occasionally also in the smaller islands to the north-east. Here belongs a quartz-porphyry dyke to the north of Mullach na Càrn in Scalpay. It is a nearly white rock with orthoclase phenocrysts up to 1/10 inch and smaller crystals of quartz. There has been a little augite, now destroyed. The fine-textured ground-mass is in general of micro-granitic structure, but each quartz crystal (not felspar) is surrounded by a spherulitic border (S9376) [NG 611 297]. Here too we may probably place a felsitic dyke, part of a double dyke, intersecting the gabbro of Guillamon on the east coast of that islet. Quartz-crystals 1/20 inch in diameter, with glass-inclusions, are enclosed in a ground-mass which is much obscured by secondary changes; but numerous isolated spherulites are still recognisable as such, although their original structure is almost obliterated (S9378) [NG 6385 2725]. A few rocks of this kind show what we may term rhyolitic characters, and to this extent resemble the sph6rulitic dykes of Druim an Eidhne to be described below. We may cite especially a 2-ft dyke, parallel to a larger dyke, exposed about 400 yards N.N.W. of Scalpay House. It is a dull grey rock with a well marked laminated structure parallel to the bounding walls, and with altered spherulites showing as lighter spots about 1/50 inch in diameter. A thin slice shows it to consist largely of bundles of parallel felspar rods and interstitial granules of quartz, but the latter mineral seems to be in part secondary. The spherulites are nearly opaque, and no longer show any structure: each is surrounded by a rusty border.

We come now to that division of the acid rocks in which the whole, or almost the whole, of the ground-mass is affected by special structures, which are usually of the *spherulitic* kind. In using this term we desire to make no distinction between spherulites which exhibit a regular black cross between crossed nicols and those which Rosenbusch has distinguished as "pseudospherulites". The differences between these appear to be differences of degree rather than of kind, the essential characteristic of all being fine graphic intergrowths of alkali-felspar and quartz. From this statement we except certain complex spherulites to be separately noticed, and even these may probably be regarded as the final term of the series, connected with the others by unbroken gradations.

The transition from a visibly micrographic to a cryptographic intergrowth is well illustrated in some of the separate minor intrusions, but even better in the marginal modifications of coarser granophyres which occur in some places on the borders of the large intrusive bodies of the Red Hills. The chief features of such transition may be briefly summarised. The more regular micrographic structures in the granophyres in general always tend to arrange themselves about centres, either with or without a small phenocryst to serve as nucleus, and this tendency is more marked in proportion to the fineness of the intergrowth. With increasing fineness of texture, a radiate arrangement about the centre becomes more apparent, the distinct areas in a thin slice, within which the felspar and quartz severally show crystalline continuity, being disposed increasingly in the form of sectors of a circle. These sectors become narrower and more numerous, while the minute elements which compose them assume a more linear form and a more regular radiate grouping. A point is reached at which the several elements of the aggregate cease to be resolvable in a thin slice, and the structure may be styled cryptographic. Beyond this point, a spherulite, examined between crossed nicols, merely shows evidence of a radiate fibrous structure, the dark brushes approximating more or less to the ideal black cross with arms parallel to the principal planes of the nicols. Such a spherulite has the appearance of being built entirely of radiating fibres of felspar, and there can be little doubt that quartz really plays a less important part here than in the coarser micrographic intergrowths.

In spherulites of moderate diameter, say ¼ inch, there is often a marked difference between the central and peripheral portions; the former being finely cryptographic, with well marked radiate structure, while the latter is visibly micrographic, with an increasingly rude type of intergrowth, and may merge insensibly into a merely granular aggregate which forms the interspaces between the spherulites ((Plate 19), Fig. 1, B). The transition which we have described is thus illustrated in the different parts of a single spherulite. The peripheral portion of the spherulite appears also to be decidedly richer in quartz than the interior.

These facts perhaps throw some light on the mode of origin and growth of the structure. The spherulite began, as we may conceive, with a radiate growth of felspar fibres, preferably attached to some solid body as a nucleus. The surrounding magma at this stage had a composition equivalent to that of a mixture of alkali-felspar with a smaller proportion of quartz. As the felspar fibres grew by extending outward, the abstraction of this constituent tended to make the magma more acid, which was only partially counteracted by the liberation of free silica. This was set free at the places where the felspar was growing, and entered into an intimate intergrowth with that mineral. It seems to have been, not the spherulite, but the residual magma, that tended towards a determinate composition; and, if we suppose it to have solidified *en bloc* when this was reached, the said composition is represented by the interspaces between the spherulites, which have commonly a microgranitic structure. On this view, the substance of the inter-spaces would be comparable, under certain limitations, with a eutectic mixture (*see* (Plate 22)., Fig. 1).

There are, however, some spherulitic structures into which quartz does not enter at all, and in these the radiating felspar elements become distinct and take form individually. This is seen exceptionally and on a small scale in certain spherulitic groupings which have been embedded. in glass; and it is displayed in a remarkable manner in cases where large spherulites have been developed at places where vapour was disengaged from the magma, and a cavernous structure has resulted. To illustrate the former case we take an interesting micro-spherulitic rock which is found as a small dyke, 8 inches or a foot across, cutting the granite on the ascent of Druim an Eidhne from Strath na Creitheach, a little to the left of the tourist-track<ref> This dyke was not detected during the survey. For the information and for a specimen of the rock we are indebted to Mr A. K. Coomára Swamy.</ref>. It is a rather dark greenish grey rock, of specific gravity 2.56, with very evident flow-lines, sometimes curving, and full of minute darker spots. In a thin slice these are found to be spherulites, from 1/200 to 1/100 inch in diameter, and of two kinds. The majority are of a common type, ovoid in shape with well marked outline, and giving the characteristic black cross in polarised light. In certain bands there occur, instead of these, skeleton spherulites consisting men ly of a stellate arrangement of little felspar rods, not mere fibres. These rods occupy only a part of the space within the spherulite, the rest being filled by substance like that in the interspaces between the spherulites. This interstitial ground, quite small in amount in comparison with the crowded spherulites, has probably been glassy or partly glassy; but, if so, is now devitrified. It recalls in some respects the devitrified pitch-stones of Coire-chatachan, etc., to be described later.

The common type of spherulitic granophyre, in which the greater part of the mass is made up of regular cryptographic spherulites, is so frequently represented among our minor acid intrusions that there is no need to enumerate particular occurrences. As good and well preserved examples, easy of access, we may mention the rather irregular sills in the Lias which are exposed on the coast west of Broadford Bay. One is found in a little cliff west of the composite sill of Rudh' an Eireannaich, and another some 800 or 900 yards farther N.W. Here the spherulites are very evident in hand-specimens. In thin slices it is seen that they do not graduate into the granular interspaces, but are rather sharply bounaed, and preserve the fine radiate fibrous appearance to the actual boundary. Between crossed nicols they show well defined dark sectors or brushes, which correspond approximately, but not always exactly, with the principal planes of the nicols. In addition to small scattered felspar phenocrysts, there are others of quartz. These are either well formed crystals or grains with rounded outlines, and they seem to have the latter form especially when they serve as the nuclei of spherulites. An interesting feature is the occurrence of micropegmatite phenocrysts, having the outlines of felspar crystals but full of quartz in micrographic intergrowth. They are always surrounded by a spherulitic growth in the form of radiating bunches of fibres starting from numerous points on the boundary of the phenocryst. Scattered through the rock, in spherulites and interspaces alike, are slender rods, usually less than 1/20 inch in length, of some ferro-magnesian silicate, probably augite, now destroyed. These are not uncommon in other rocks of this group, and they sometimes share in the radiate arrangement of the spherulites, but in the specimens here noticed the rods have no definite orientation.

We have failed to establish any criterion of a petrographical kind to discriminate between those spherulitic dykes and sheets which are to be regarded as subterranean offshoots of the large masses of the Red Hills and those referable to the later epoch of independent minor intrusions. Again, there are some occurrences which perhaps belong to a different epoch (between the other two), viz. that to which we have relegated the composite intrusions of the Cnoc Càrnach group. It is at least possible that some portion of the acid magma of that epoch took lines of its own, and formed independent intrusive bodies which, in the absence of the guiding basalt, would be of somewhat irregular habit. Such may perhaps be the origin of the group of intrusions seen on the north-west side of Loch Sligachan, just east of the composite sill of Allt an 't-Sithean. A specimen from here shows turbid felspars about 1/10 inch in diameter, with rounded angles, and corroded quartz-grains in a spherulitic ground-mass. There is a close resemblance to the granophyres of Allt an 't-Sithean and of the neighbouring composite dyke, though the spherulites here have a more evidently micrographic structure (S3197) [NG 501 315].

We have next to notice a remarkable group of dykes which, in their petrographical characters, show decided *rhyolitic* affinities. This is the more interesting, since these dykes belong to the plutonic phase of intrusion, and are visibly apophyses of the granite. We may conveniently speak of them as the *Druim an Eidhne type,* the most characteristic examples being met with on the ridge of that name. Here, as already stated in Chapter 9, the dykes are seen to be offshoots from the granite mass of Strath na Creitheach, etc., which itself at some places along its margin assumes very similar petrographical characters; and they may be traced for some distance through the adjacent rocks, viz. the volcanic agglomerate and the banded gabbros. A few other dykes within the granitic area, in Strath na Creitheach and elsewhere, resemble the typical examples more or less closely. They intersect the granite; but, since the granite itself undoubtedly represents several distinct intrusions, this fact does not preclude our attaching these dykes provisionally to the Druim an Eidhne group.

The field-relations of the acid dykes of Druim an Eidhne have been sufficiently set forth in the former chapter. Our petrographical examination of the rocks does not add much to the account already given by Professor Judd,<ref> *Quart. Journ. Geol. Soc.,* vol. xlix., pp. 182–191, p1. II., III.; 1893.</ref> although our reading of the phenomena leads to very different conclusions as regards the origin of the rocks. It is to be remarked, however, that the dykes are not all of one type. In addition to the rocks to be described more particularly, there are others which are simple quartz-felsites, presenting no special features of interest and not calling for further notice. These have the same mode of occurrence as the others.

The rhyolitic dykes of Druim an Eidhne have in natural exposures a yellowish brown colour due to atmospheric action, and considerable excavation is sometimes needed to arrive at the unaltered rock. This shows a bluish grey ground of very compact texture, enclosing quartz-grains, small crystals of felspar, and pyrites. The characteristic features of the rock are, however, more apparent upon a weathered surface: they are especially an abundant development of large spherulites and a strongly-marked fluxion-banding — both characters, as Professor Judd remarks, belonging to rhyolitic rather than granitic rocks. The spherulites weather out in strong relief, and are easily detached (Plate 11). They range in diameter up to about 2½ inches (6 centimetres<ref>The 60 centimetres of Prof. Judd's paper is a clerical error, corrected in the author's separate copies. The only spherulites of this larger size (2 feet) recorded in Britain occur in some of the Lower I'almozoic intrusions of the Lleyn district of Gernarvonshire; but at Silver Cliff in Colorado Whitman Cross has remarked spherulites as much as 10 feet in diameter. The Welsh rocks mentioned present many analogies with the dykes of Druim an Eidhne: see Miss Raisin, *Quart. Journ. Geol. Soc.,* vol. xlv., pp. 247–269; 1889: and Harker, *The Bala, Volcanic Series of Caernarvonshire, Chapter* III.; 1889.</ref>), and, even to the naked eye, often give evidence of a complex structure. The flow-structure, which is most developed at the sides or the dykes, is also rendered very conspicuous by weathering, certain narrow bands, usually about ten or twelve in the width of an inch, standing out .prominently above the intervening bands (Plate 12). In some places the fluxion is indicated by an alignment of small spherulites, as in many rhyolitic lavas and in the "rodded" spherulitic dykes to be described in a later chapter.

The flow has been naturally parallel to the walls of the dykes; but, with increasing distance from the edge, it often becomes sinuous or even sharply reflexed at acute angles. This is partly due to the interference occasioned by large spherulites round which the flow-lines wind, or between which they thread their way. The phenomena certainly go to show that these spherulites were already in existence while flowing movement was still in progress, and cannot be attributed to devitrification at a later stage. A remarkable feature in some cases is the appearance of *discontinuity* in the flow. We may explain it by supposing that a small portion of the rock, having as nucleus a group of spherulites or phenocrysts but otherwise in a pasty condition, behaved in some degree as a solid inclusion, and was rolled over in the differential flowing movement of the enveloping mass. This peculiarity is seen on a small as well as on a larger scale (*see* (Figure 61)).

The microscopical characters of the rocks have been carefully described by Professor Judd in the paper already cited. Porphyritic elements, though generally distributed, are not very abundant. They consist mainly of small crystals of quartz, containing relatively large glass-inclusions and patches of the ground-mass, orthoclase

and oligoclase, and iron ores, both pyrites and magnetite. A ferro-magnesian mineral has also been sparingly present, and seems to have been a green augite; but it is replaced by pseudomorphs of some chloritic substance charged with ferric oxide. Occasionally there is a pseudomorph which may represent biotite. Very characteristic of this group of rocks is the occurrence of phenocrysts of micropegmatite or, to use Professor Iddings<ref>Iddings, *7th Ann. Rep. U.S. Geol. Sur.,* pp. 274–276, pl. XV.; 1888 (Obsidian Cliff, Yellowstone Park): *Monogr. XX. U.S. Geol. Sur.,* p. 375, p1. V., fig. 2; 1893 (Eureka district, Nevada): Reed, *Quart. ,Journ. Geol. Soc.,* vol. li., p. 162, p1. VI., figs. 3–5; 1895 (Fishguard, Pembrokeshire).</ref> term, "granophyre groups", a feature well known in rhyolitic lavas in various districts.* Professor Judd, following out his view, already discussed, that these rocks are not dykes but fused inclusions of granite in the gabbro, regards the micropegmatite phenocrysts as undestroyed relics; but we find nothing to indicate that they are of exceptional origin. That they may have been formed at a distinctly earlier stage than the ground-mass and under somewhat different conditions may be granted; and it is seen that, like the ordinary phenocrysts, they have served as nuclei for subsequent spherulitic growths ((Plate 20), Fig. 2; and (Figure 61) in text). On Professor Judd's view they should be either angular fragments or rounded by corrosion or fusion, whereas they often present the outlines proper to felspar crystals.

The spherulites, which are the most interesting feature of the rocks, range from microscopic dimensions to the large size already remarked, and they exhibit much variety of structure. The small ones are of a simple type, showing merely a radiate-fibrous arrangement of the felspar which is their principal element. They give an imperfect "black cross" effect between crossed nicols. They are often collected in groups, though without coalescing;and not infrequently they are enclosed in the larger spherulitic growths, which we may infer to be of somewhat later formation. The larger spherulites are of complex structure, the radiate arrangement of the delicate constituent felspar-fibres being modified in various ways. In some cases there seems to be repeated bifurcation of the fibres at acute angles, giving the fox's brush structure figured by Professor Judd (*l.c.* Plate III., Figs. 8 and 9). In other cases subsidiary centres of radiation have been established at certain points, which have become the apices of conical bundles of fibres disposed in accordance with the general radiation from the primary centre (Plate 22), Fig. 3). The fibres of the large spherulites may be interrupted by enclosed phenocrysts or small spherulites. The interstices between the felspar fibres are now occupied by quartz, but it is probable, as Professor Judd suggests, that they were once in great part vacant, and that these structures were then identical in all essentials with the much better preserved examples which have been described by Whitman Cross and Iddings from Colorado and the Yellowstone Park. He has even found in the large spherulites of Druim an Eidhne minute crystals which appear to be fayalite, as well as some indications suggesting the former presence of little aggregates of tridymite scales. The close resemblance to the American examples, extending to these interesting details, is further enhanced by the occurrence in some of our rocks of bodies which have apparently been lithophyses, and preserve something of the delicate concentric shell structure described by Iddings at Obsidian Cliff (Judd, *i.e.,* Plate II., Fig. 5).

If, while a portion of one of the large plumose spherulites is being viewed between crossed nicols, a mica-plate be interposed with its axes approximately at 45° to the fibres, it is observed that the polarisation-tints are raised in some parts and depressed in others in the same bundle of fibres. This presumably indicates that the axis of optical elasticity most nearly parallel to the length of the fibres is the mean axis, and that the crystallographic direction of elongation of these felspar-fibres is the vertical or c-axis. The same arrangement has been noticed by Iddings<ref> *Bull. Phil. Soc. Washington,* vol. xi., p. 457; 1891. See also Cross, *ibid.,* p. 427 (Silver Cliff, Colorado).</ref> in the Obsidian Cliff rocks. In our spherulitic acid rocks in general the spherulites are of the ordinary "negative" kind, the felspar fibres being elongated parallel to the a-axis, with which the greatest axis of optical elasticity makes only a small angle.

That the marginal portion of a large body of granite and the apophyses from it may in certain circumstances assume all the mineralogical and structural characters of rhyolites, including such special peculiarities as large composite spherulites and lithophyses, is, as we have remarked above, a fact of more than local interest. It certainly goes to show that the petrographical differences between plutonic and volcanic rocks as commonly developed are referable much more to differences of temperature and rate of cooling than to differences of pressure at the epoch of consolidation. It must be borne in mind that the rocks which build the Red Hills represent a number of distinct intrusions, which may have covered collectively a very considerable lapse of time, and we are led to refer the acid rocks of Druim an Eidhne to a rather late epoch of this time, when the neighbouring gabbro had long become cool. The relations between the two rocks here present the strongest contrast to what we have described on Marsco, where we believe the intrusions of gabbro and granite to have been separated by only a short interval.

So far, the rocks treated in this chapter have been of thoroughly acid types. We have now, in conclusion, to notice certain examples which are most properly included in this place, although they are of *sub-acid composition,* being highly felspathic and comparable rather with *quartzless porphyries and trachytes* than with quartz-felsites and granophyres. The rocks consist indeed essentially of alkali-felspars, with at most a small amount of interstitial quartz and in some cases a ferro-magnesian mineral. They differ petrographically from the trachytic dykes of the Broad-ford and Sleat districts, to be described in a later chapter. Further the scanty evidence available would lead us to refer them to a very early epoch of the phase of minor intrusions, while the Broadford and Sleat trachytes belong to one of the closing episodes. For these reasons, we regard the rocks in question, at least provisionally, as aberrant members of the group treated in the present chapter, representing a special line of development from the main stock of the minor acid intrusions. Their areal distribution is in accord with this view, for the several dyke-formed, and sometimes sill-formed, intrusions in which these rocks appear are situated in general on the fringe of the area which we have marked out (Figure 58) as that affected by the minor acid intrusions. It may also be remarked that, like these acid rocks and unlike the later trachytic dykes, the rocks now to be described often occur in close association with basic intrusions. The association is not usually of the regular and systematic kind; but this also is found in one instance in a rock which may possibly be attached to to this sub-group, viz. the felsitic or bostonitic rock already described as forming part of the triple composite sill of Rudh' an Eireannaich, near Broadford. If, however, following the argument set forth in a former chapter, we refer the peculiar symmetrical composite sills and dykes to a distinct group of somewhat earlier date, then the Rudh' an Eireannaich felsite bears the same relation to the acid members of that group as the rocks now in question bear to the principal group of minor acid intrusions.

The first occurrence to be noticed, in the heart of the Cuillins, is in some respects unique. The rock forms two or more irregular dyke-like bodies of considerable magnitude intersecting the gabbro of the main range about the head of Coire Labain. Between the highest summit of the Cuillins and its nearest neighbour less than 100 yards to the N.E., known to climbers as Sgùrr Alaisdair and Sgùrr Tearlach respectively, is a deep notch, from which the great talus called the *Alaisdair Stoneshoot* streams down some 1200 or 1300 feet to the floor of Coire Labain. The break in the ridge is caused by a strip, here about 50 feet wide, of a more perishable rock traversing the gabbro. At this place it is, in its freshest state, a dark grey, finely crystalline rock, in general appearance not unlike many of the dolerite dykes of the district, but containing amygdules of quartz sometimes ½ inch or even 1 inch in length. More usually it has a pale colour consequent upon weathering, and in this state contributes largely to the talus mentioned. The strip of pale rock can be followed south-eastward along the ridge joining SgùrrTearlach to Sgùrr Dubh-na-dabheinn for some 250 yards, dying out near the pass. It can be traced for about the same distance in the opposite direction, turning rather more westward and ramifying before it dies out. A similar strip is seen just above the screes farther north, and runs nearly northward along the western face of Sgùrr Mhic Choinnich for 400 yards to the Coire Labain pass, where it is considerably expanded. This too ramifies, and also sends small veins into the gabbro and encloses xenoliths of that rock. The situation of the intrusions is indicated in a generalised way at A on the sketch-map, (Figure 58). The amygdaloidal variety of the rock has been met with only near the head of the great stone-shoot. The common variety elsewhere, always with the pale tint due to weathering, is of somewhat less fine texture, and the little green crystals of altered augite are often visible.

A thin slice (S8717) [NG 447 211] of the prevalent type shows rectangular sections of felspar about 1/30 inch long as the principal constituent. This is largely orthoclase, but striated oligoclase is also present. Pale greenish pseudomorphs of hornblende after augite, about 1/50 inch in length, are fairly abundant, and as a prominent secondary constituent there is pale yellowish pleochroic epidote, partly replacing crystals of oligoclase. A certain amount of quartz is present, but this too is probably of secondary origin. A specimen of the fresher and finer-textured variety, with quartz-amygdules, from the head of the great stone-shoot, gives the specific gravity 2.68. Under the microscope it shows a different structure (S8718) [NG 450 211]. A microporphyritic character, which was scarcely evident in the former specimen, is here well developed. The phenocrysts include orthoclase, oligoclase, and fresh colourless augite in crystals from 0.01 to 0.05 inch in length. These occur closely clustered, with a few small octahedra of magnetite, in a finely granular ground-mass, which must be chiefly of orthoclase. The quartz which occurs here is certainly a secondary product.

In its geological relations as well as in its petrographical characters this rock stands alone. It is not seen to cut anything younger than the gabbro, and the only rocks which cut it belong to a late epoch. Its precise age is therefore not certainly fixed, but we attach it rather to the principal group of minor acid intrusions than to the granites.

Several dykes of the kind considered here — i.e. composed largely of alkali-felspars with little or no quartz — are seen in the neighbourhood of Allt a' Mhaìm, on the north-west side of the Cuillins, near the foot-path from Sligachan to Glen Brittle. They are of more than one type. One is a dull reddish rock, of fine texture but evidently crystalline, which may be termed a biotite-bearing orthophyre. The felspar phenocrysts, which are not closely set, are of orthoclase with less frequent oligoclase, and are about ■ inch long. There are scattered flakes of brown mica, sometimes enclosed in the felspars, some iron-ore, and a few grains of sphene. The ground-mass is composed of little felspars giving rather stout rectangular sections, and these are mostly if not wholly orthoclase.

A neighbouring dyke differs from the preceding in having hornblende instead of biotite, and also in having a trachytic instead of an orthophyric structure in its ground-mass. The rock is of light colour with white felspar phenocrysts, exceptionally as much as ¼ inch long, and lustrous black hornblendes ■ to ¼ inch. A thin slice (S9257) [NG 449 268] shows that the felspar is a plagioclase: the hornblende is brown, and the crystals, often twinned, have their outlines rounded by magmatic corrosion. Magnetite crystals and rather stout little prisms of apatite are present. The ground-mass consists of little interlacing felspars, only about 0.005 inch long, with minute granules of magnetite. This rock, with a specific gravity 2.63, is probably somewhat less acid than the preceding. Both dykes, as well as others in the vicinity, are associated in the field with basic dykes and run in contact with them, but not consistently.

A dyke seen on the lower slopes of Beinn Réidh-beag, near the north-west coast of Scalpay, resembles the former of the Allt a' Mhaìm dykes in its orthophyric structure, but the latter one in the nature of its ferro-magnesian element, and it may be named hornblendic orthophyre. It is stained to a brick-red colour very like that of the Torridonian sandstone which it intersects, and might easily be, passed over except for the occurrence in it of green crystals of hornblende up to ¼ inch in length. Its specific gravity is 2.66. In a thin slice (S9379) [NG 580 320] the hornblende shows as idiomorphic crystals, sometimes twinned, with a colour varying from brown to green, the latter owing to alteration. The rest of the rock consists of stout little felspar crystals, about 0.01 inch long, with a very little interstitial quartz. This dyke is only half a mile distant from the fringe of the large granite mass, but it is more probably to be referred to the minor intrusions than to the plutonic phase.

Some of the felsite dykes of the Strathaird peninsula belong to this place. We have already remarked that, like the Allt a' Mhaìm dykes which they resemble petrographically, they sometimes run for a certain distance in contact with basic dykes. A specimen from about 250 yards S.E. of Elgol is a pale grey, fine-textured rock enclosing rather abundant felspar phenocrysts, often clustered in "glomeroporphyritic" groups up to ½ inch in diameter. They are considerably altered, some being opaque and white, others nearly black. In a thin slice (S7485) [NG 522 139] these felspars show characters very suggestive of cryptoperthite. There are rare flakes of decayed biotite, and the ground-mass consists of little rectangular felspars, about 0.01 inch long, with sensibly straight extinction, and some interstitial quartz. Rocks of this kind approximate in some respects to the bostonite (or bostonite-porphyry) type. The resemblance to the original bostonites is closer, as regards micro-structure and the absence of ferro-magnesian minerals, in certain of our dykes which consist entirely of a plexus of little crystals of alkali-felspar. One rock of this kind (S2675) [NG 448 209], among the older collections of the Geological Survey, is labelled "Glen Brittle House", but we have not succeeded in discovering it in that locality. This specimen gives the low specific gravity 2.51. It is of fine texture, the little felspar crystals being only 0.005 to 0.01 inch in length.

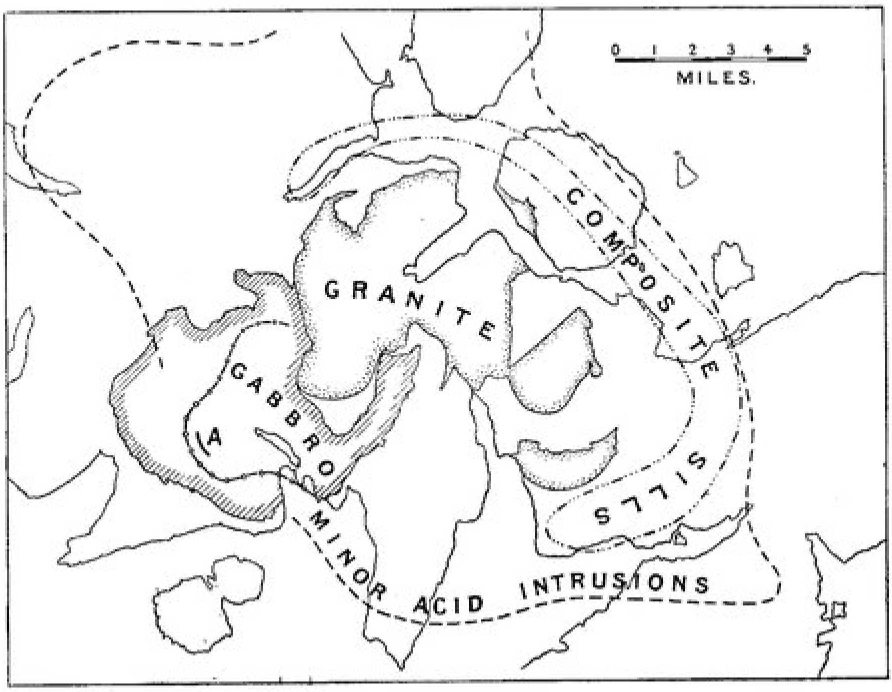


FIG. 58.—Sketch-map illustrating the distribution of certain groups of acid intrusions in relation to the granite of the Red Hills. Scale, ¼ inch to a mile.

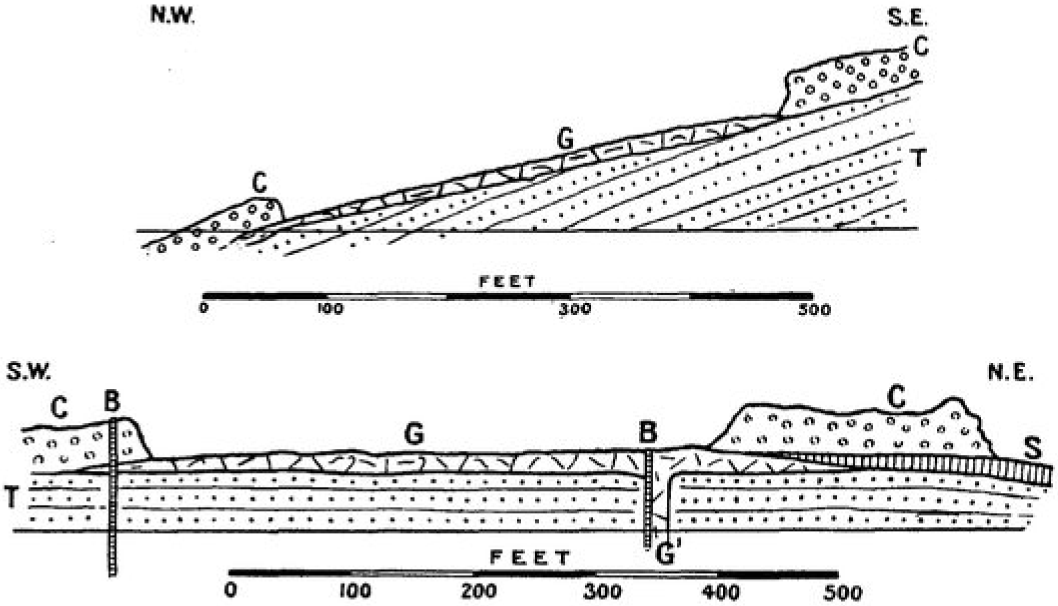
(*a.*) The line (of small circles connected by dashes) in the gabbro area indicates the western limit of granite and granophyre veins, in so far at least as they are locally abundant and noticeable, in the gabbro of the Cuillins. It may probably be taken as showing, with rough approximation, the concealed extension of the granite beneath the gabbro laccolite.

(*b.*) The roughly semicircular belt, enclosed by a line of dots and dashes, marks the distribution of the peculiar composite (basic and acid) intrusions of the symmetrical kind, which we have distinguished as the Cnoc Càrnach type.

(*c.*) The heavy broken line indicates the area of distribution of the minor acid intrusions in general. It is an irregular oval, about 24 miles long, centring in the granite of the Red Hills, and having its long axis in a direction nearly agreeing with that of the dykes.

(*d.*) The short heavy line at A marks the position of the peculiar felsite of the Alaisdair Stone-shoot.

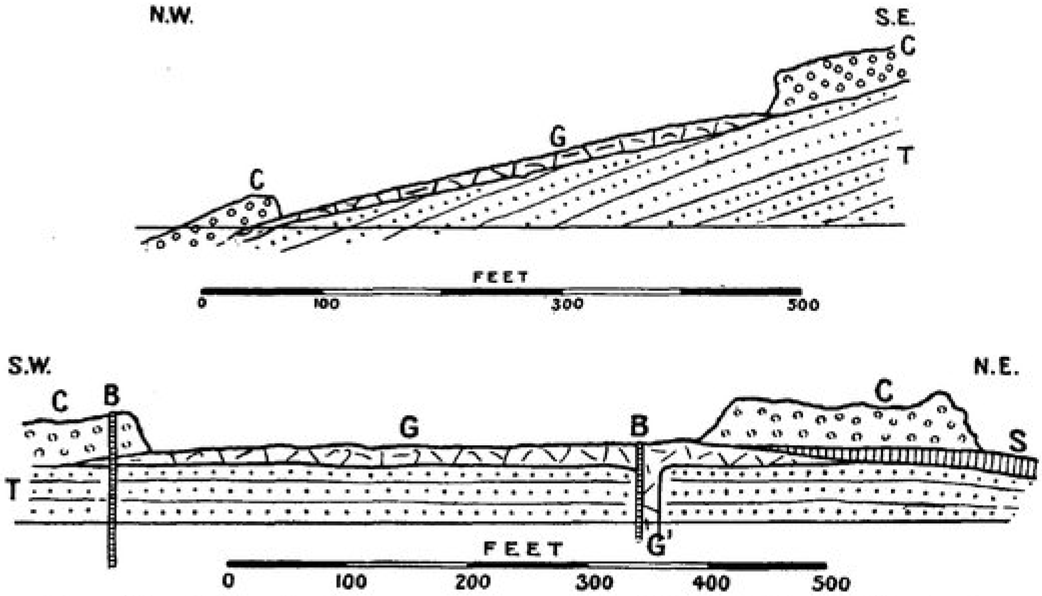
(Figure 58) Sketch-map illustrating the distribution of certain groups of acid intrusions in relation to the granite of the Red Hills. Scale, ¼ inch to a mile. (a.) The line (of small circles connected by dashes) in the gabbro area indicates the western limit of granite and granophyre veins, in so far at least as they are locally abundant and noticeable, in the gabbro of the Cuillins. It may probably be taken as showing, with rough approximation, the concealed extension of the granite beneath the gabbro laccolite. (b.) The roughly semicircular belt, enclosed by a line of dots and dashes, marks the distribution of the peculiar composite (basic and acid) intrusions of the symmetrical kind, which we have distinguished as the Cnoc Càrnach type. (c.) The heavy broken line indicates the area of distribution of the minor acid intrusions in general. It is an irregular oval, about 24 miles long, centring in the granite of the Red Hills, and having its long axis in a direction nearly agreeing with that of the dykes. (d.) The short heavy line at A marks the position of the peculiar felsite of the Alaisdair Stone-shoot.



Figs. 59 and 60.—Sections across circus north of Rudha Chinn Mhòir, in the N.W. of Scalpay.

T, Torridonian sandstone; C, Triassic conglomerate; G, granophyre sill; G′, granophyre dyke; S, basalt sill; B, B, basalt dykes.

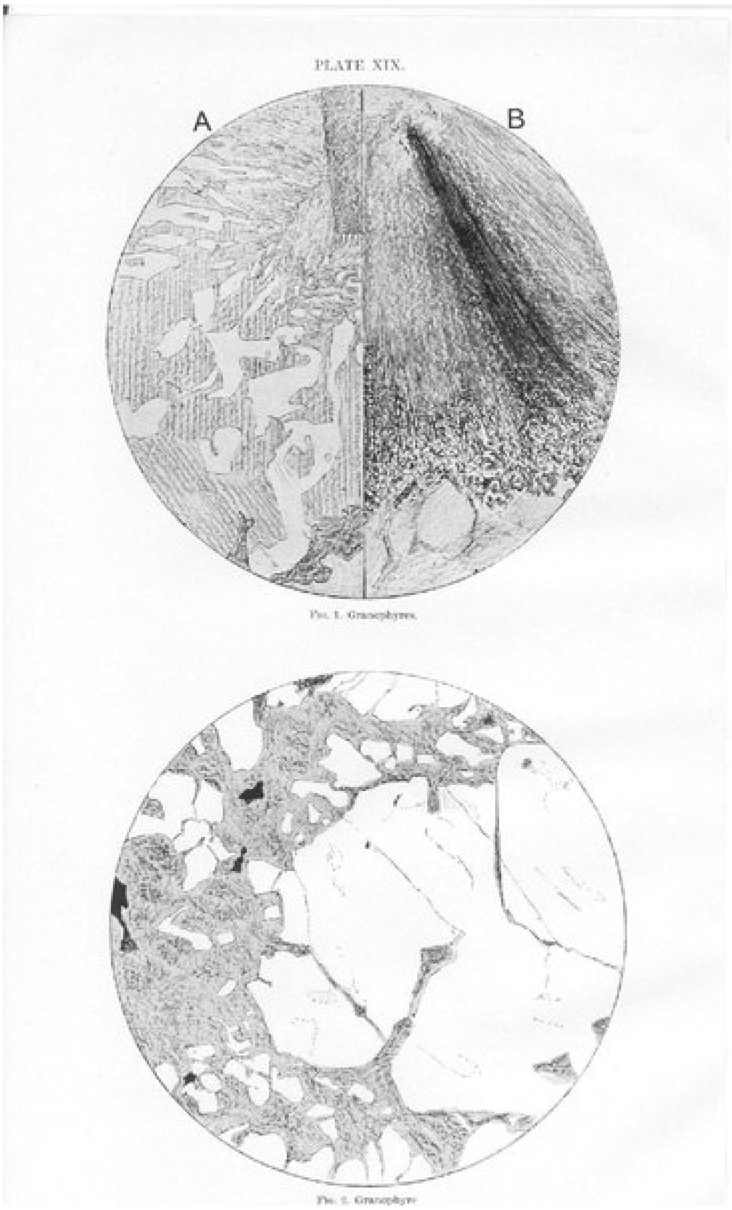
(Figure 59) Section across circus north of Rudha Chinn Mhòir, in the N.W. of Scalpay. T, Torridonian sandstone; C, Triassic conglomerate; G, granophyre sill; G′, granophyre dyke; S, basalt sill; B, B, basalt dykes.



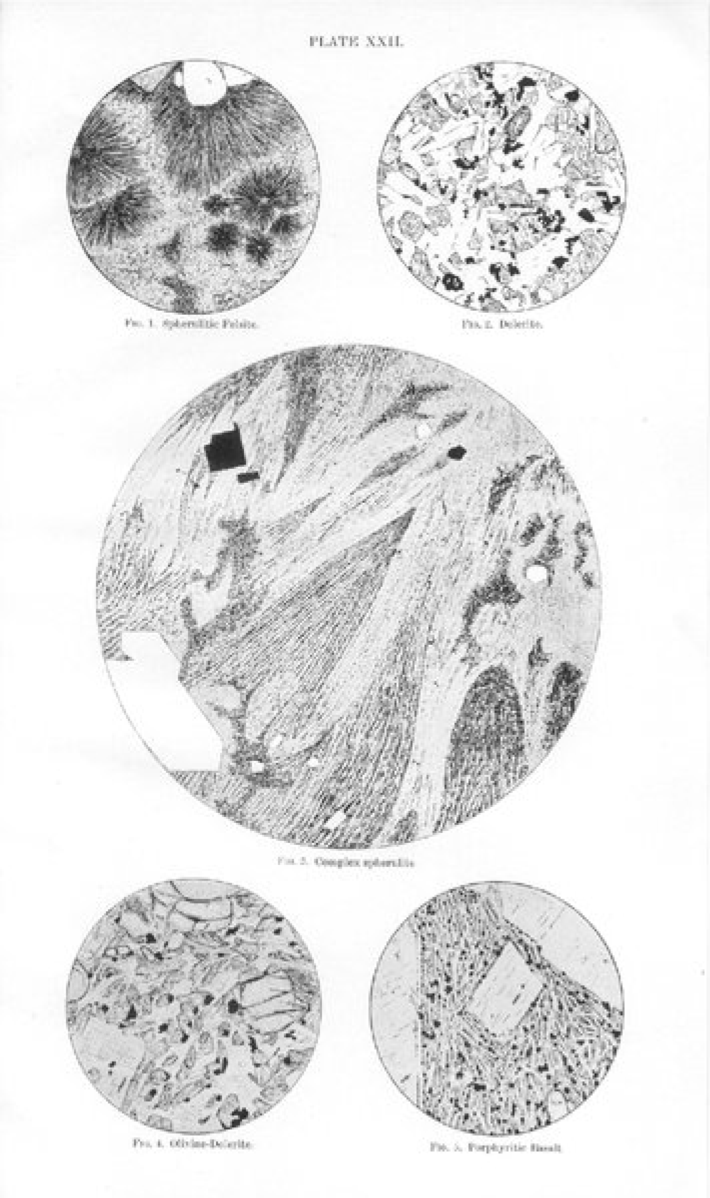
Figs. 59 and 60.—Sections across circus north of Rudha Chinn Mhòir, in the N.W. of Scalpay.

T, Torridonian sandstone; C, Triassic conglomerate; G, granophyre sill; G′, granophyre dyke; S, basalt sill; B, B, basalt dykes.

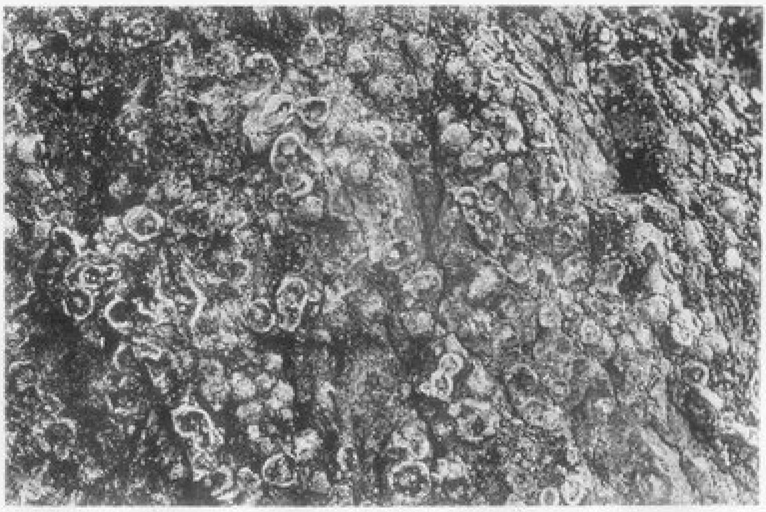
(Figure 60) Sections across circus north of Rudha Chinn Mhòir, in the N.W. of Scalpay. T, Torridonian sandstone; C, Triassic conglomerate; G, granophyre sill; G′, granophyre dyke; S, basalt sill; B, B, basalt dykes.



(Plate 19) Fig. 1. Graphic structures in granophyres; × 40, crossed nicols. A. Roadside E. of Strollamus Bridge: showing micrographic intergrowth of striated oligoclase and quartz, and in the upper part of orthoclase and quartz, in connection with an orthoclase phenocryst. See p. 161. B. Glas-Bheinn Bheag, near margin of intrusion: showing part of a single spherulite with the gradation from a cryptographic structure near the centre of growth to a visibly micrographic towards the periphery. See p. 281. Fig. 2. (S2667) [NG 50 24] × 40. Granophyric granite, Marsco: showing a rude micrographic growth round a grain of quartz. See p. 162.



(Plate 22) Fig. I. (S3200) [NG 621 170] × 20. Spherulitic felsite, above Boreraig: showing dense radiate spherulites, sometimes grown round quartz crystals, with interspaces having a granular structure. See p. 281. Fig. 2. (S8951) [NG 724 263] × 20. Dolerite, dyke at point E. of the mouth of Allt na Nighinn, 2 miles W. of Kyleakin. At the top of the figure is one of the shapeless later felspar crystals, enclosing numerous needles of apatite. See p. 322. Fig. 3, (S5389) [NG 48 22] × 40. Part of a large composite spherulite from an acid dyke cutting the gabbro of Druim an Eidhne. The centre of the spherulite is outside the figure, above and to the right. There are minor centres of radiation, which serves as the apices of conical growths directed outward, the axes of the cones conforming with the principal radiate arrangement. One such cone, cut along its axis, occupies the central part of the figure; while below, to the right, are others cut at some distance from their axes so as to present parabolic sections. The clear crystals are quartz, the opaque ones pyrites. See p. 286. Fig. 4. (S7862) [NG 515 261] × 20. Porphyritic Olivine-Dolerite, dyke cutting the granite of Ciche na Beinne Deirge, 3 miles S.E. of Sligachan. This represents the Beinn Dearg type of dykes, and is the rock analysed. See p. 326. Fig. 5. (S6711) [NG 623 205] × 20. Porphyritic Basalt, dyke cutting Cambrian limestone ¼ mile S. by E. of Suardal, about 2 miles S.S.W. of Broadford. This rock illustrates one variety of the Suardal group of dykes, containing phenocrysts of labradorite and grains of olivine in a ground-mass of smaller felspars, abundant magnetite, and finely granular augite. See p. 327.



Weathered surface of acid dyke, Druim an Eidhne, showing crowded spherulites.

(Plate 11) Weathered surface of acid dyke, Druim an Eidhne, showing crowded spherulites.

Weathered surface of acid dyke, Druim an Eidhne, showing tortuous flow-structure.

(Plate 12) Weathered surface of acid dyke, Druim an Eidhne, slowing tortuous flow-structure,

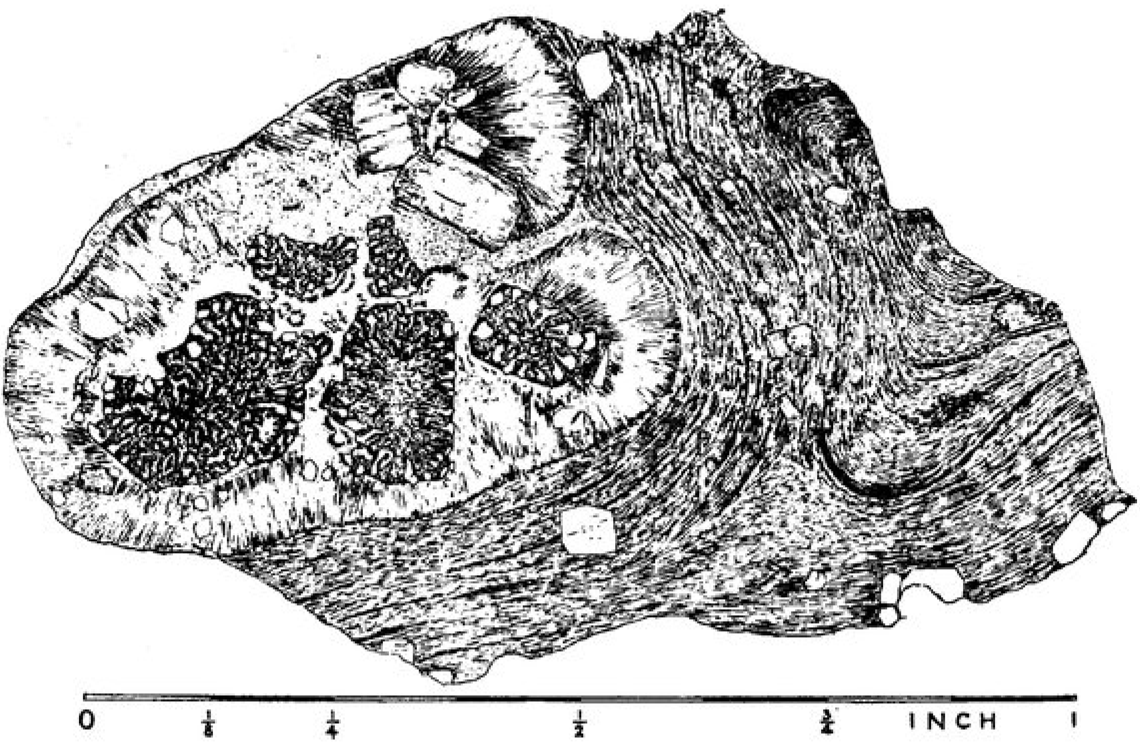
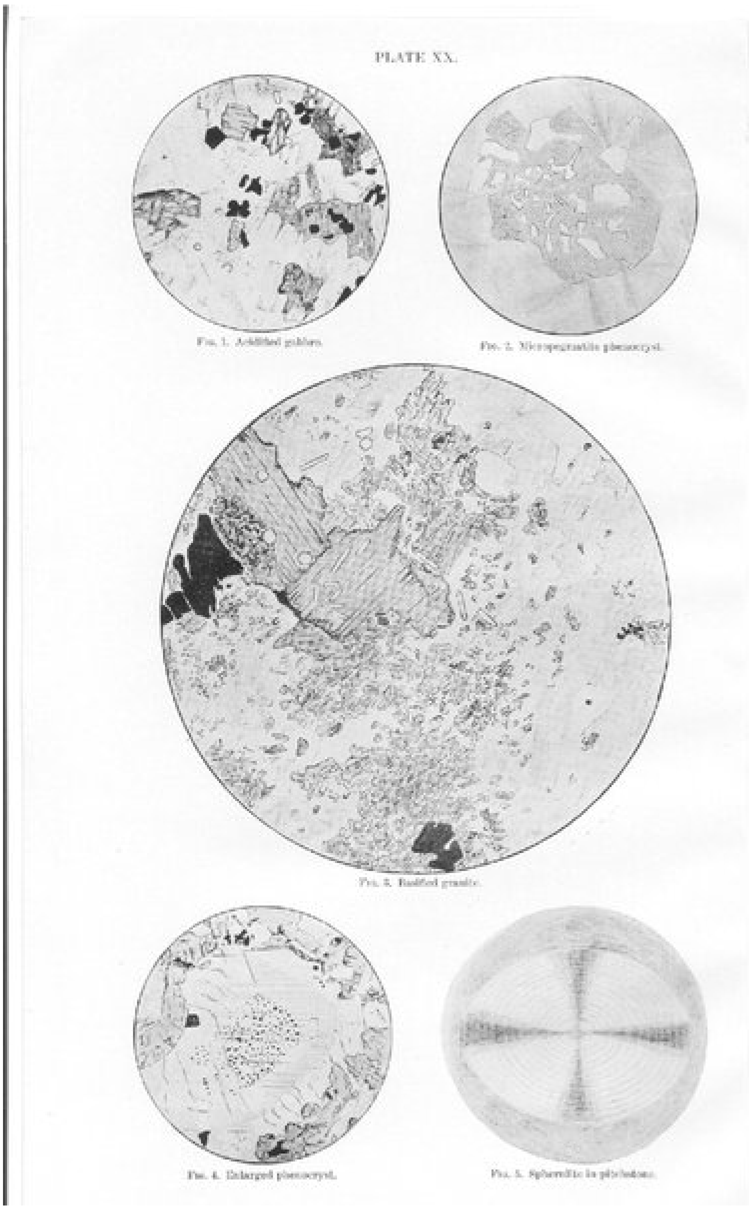


FIG. 61 [8971]. Thin slice from one of the rhyolitic dykes, apophyses from the granite, intersecting the gabbro of Druim an Eidhne; magnified four diameters.

To the left are seen a number of coalescing spherulites. These have grown in one place round a group of felspar crystals, in other places round micropegmatite phenocrysts, which have in part the outlines of felspar crystals but are crowded with inclusions of quartz in micrographic intergrowth.

The general mass of the rock has a strongly marked flow-structure, and in the right-hand half of the figure the fluxion-lines are seen to diverge in a fashion which indicates discontinuous flowing movement in the mass.

(Figure 61) [SS71]. Thin slice from one of the rhyolitic dykes, apophyses from the granite, intersecting the gabbro of Druim an Eidhne; magnified four diameters. To the left are seen a number of coalescing spherulites. These have grown in one place round a group of felspar crystals, in other places round micropegmatite phenocrysts, which have in part the outlines of felspar crystals but are crowded with inclusions of quartz in micrographic intergrowth. The general mass of the rock has a strongly marked flow-structure, and in the right-hand half of the figure the fluxion-lines are seen to diverge in a fashion which indicates discontinuous flowing movement in the mass.



(Plate 20) Fig. 1. (S8962) [NG 500 258] × 20. Gabbro partially fused and injected by the granite magma, gully on the N.W. face of Marsco. The minerals shown are felspar, partially destroyed augite, greenish brown hornblende, magnetite, apatite, and some interstitial quartz. Of the original constituents of the gabbro there remain relics of augite and some of the large crystals of labradorite. See p. 182. Fig. 2. (S5344) [NG 490 230] × 30. Phenocryst of micropegmatite in spherulitic dyke, Druim an Eidhne. It has served as the starting-place for subsequent spherulitic growths. See p. 284. Fig. 3. (S8694) [NG 513 249] × 40. Granite modified by absorption of gabbro material, S.E. ridge of Marsco. The figure shows aggregates composed of greenish brown hornblende with little scales of biotite, larger flakes of biotite enclosing apatite, and irregular grains of magnetite. The rest is of quartz, oligoclase, and orthoclase. See p. 184. Fig. 4. (S8188) [NG 418 351] × 20. Porphyritic Olivine-Dolerite, dyke on Roineval, two miles N of Drynoch: showing a felspar phenocryst enlarged by a later growth with crystalline continuity. See p. 329. Fig. 5. (S8733) [NG 50 30] × 50, crossed nicols. Spherulite in pitchstone, W. face of Glamaig: showing a concentric shell structure. See p. 404.