GEOLOGY of the OUTER HEBRIDES — NORTH HARRIS

and

UIG, MORSGAIL and ALINE in LEWIS.

by

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CONTENTS.

I. INTRODUCTION.

The area of the Outer Hebrides described in this paper includes North Harris and the Uig, Morsgail and Aline districts in Lewis. In addition, a narrow strip of country is included, north of Loch Erisort and extending eastwards from Balallan as far as the river Laxay on the estate of Soval.

North Harris and its adjacent islands such as Scarp and Fladday on the west, and Soay in West Loch Tarbert on the south, forms part of Inverness-shire; Uig, Morsgail and Aline are included in Ross-shire.

North Harris, joined to South Harris by the narrow isthmus at Tarbert, is bounded on the south by East and West Loch Tarbert, on the east by Loch Seaforth and on the west by the Atlantic Ocean. Its northern limit is formed partly by Loch Resort and partly by a land boundary much disputed in the past, passing from the head of Loch Resort between Stulaval and Rapaire to Mullach Ruisk and thence to the Amhuin a Mhuil near Aline Lodge on Loch Seaforth. Seaforth Island in Loch Seaforth lies partly in Inverness-shire and partly in Ross-shire.

The/

The extensive estate of Uig includes the western part of Lewis west of Little Loch Roag from Loch Resort in the south to the Gallan Head in the north.

Morsgail lies between Little Loch Roag and Loch Langavat while Aline includes most of the ground between the last-named loch and Loch Seaforth.

The area is interesting because of the varied types of scenery which it presents. Thus, North Harris is almost entirely mountainous including six peaks over two thousand feet in height, by far the highest in the Long Island. The hills of the western part of North Harris are continued north into the Uig district forming there one of the main areas of high ground in Lewis. North of Harris and east of Uig the hills die away gradually into an undulating moorland with occasional ridges and low isolated hills. This, in turn, passes into the great moor of central Lewis most of which however, lies beyond the area dealt with in this paper.

The coast-line is equally varied presenting steep cliffs overlooking dark and narrow sea lochs like Loch Seaforth and Loch Resort; frowning cliffs front-ing the open sea as at the Gallan Head, Aird More, Mangersta/

Mangersta, or Northwest Scarp; or open stretches of sandy beach fringed with blown sand as at Husinish and Scarp in Harris or the beautiful bay of Uig in Lewis. The physical features, however, will be more fully des-cribed before dealing with the glaciation (p. 76).

North Harris, Uig, and Morsgail are occupied mainly as deer forests but partly also for grazing. Aline and the moorland near Balallan are devoted to the grazing of sheep and cattle. Cultivated ground which forms a very small proportion of the whole is confined mainly to the open coasts or to the shores of the sea lochs. The population is sparse and confined in every case to the coast. With the exception of a few inhabitants at the head of Loch Resort and at Loch Tamanavay the central parts are quite uninhabited and the stranger may walk over the hills for weeks without meeting a human being. The lack of accommodation and the general inaccessability of the region accounts amply for the lack of attention which has been devoted in the past to its geology.

II. PREVIOUS LITERATURE.

There are few references in geological litera-
-ture to this part of the Outer Hebrides. The most important are as follows:-

Macculloch (1) described Harris as "a country of gneiss" but his observations on the geology are con-
-fined mainly to South Harris. With regard to North Harris, he noted its mountainous character, the absence of any considerable tract of level ground, the bare rock of the hills, the relative scarcity of trap dykes and of freshwater lochs. He makes the observation with regard to North Harris that a country "where un-
-surmountable rocks and impassable bogs alternately claim the mastery cannot be traversed with much ease." Though unprovided with a map he tried, with indifferent success, to ascertain the names of the hills. He climbed "Langa" (probably Mullach an Langa), "one of the highest hills which bounds the north side of West Loch Tarbert" and by barometer ascertained its height to lie 2407 feet (true height 2012 feet) from which he estimated the height of Clisseval (Clisham) to be 300 feet higher (true height 2622 feet) and obviously the highest hill in the Long Island. He visited the island/

(1). "A Description of the Western Isles of Scotland" 1819, Vol. 1, pp. 163-167.

island of Scarp where he discovered "nothing worthy of particular regard".

Sir R. Murchison and A. Geikie (1) visited the Outer Hebrides in connection with a general investiga--tion of the rocks of the Scottish Highlands, and de--voted special attention to the older or Laurentian Gneiss of Lewis and Harris. Within the limits of the area described in this paper they visited Soval and Morsgail in Lewis and extended their researches into North Harris. They visited Vickadell (Vigadale), Scalladale, the Clisham and Scorse Scalladell (Sgurr Scalladale). They noted in North Harris the well marked strike of the gneissic foliation -- N.W. - S.E. with dips to S.W. or N.E., and the highly crystalline gneiss of the above named localities as grey and quartz--ose, also, that "in numerous places the strata are strikingly interfered with by intrusions of granite as well as by hornblende rock and greenstone". In a footnote to their paper (p. 173) they remark that "these glens of Harris, radiating from lofty and steep mountains, afford splendid evidences of glacial action, their mouths and flanks being studded with stupendous erratic/

(1). "On the Altered Rocks of the Western Islands of Scotland and the Northwestern and Central Highlands", Q. J. G. S., Vol. XVII., p. 171, 1881.

erratic blocks. The hills of the Lews are too low to have been the seats of glaciers; and on that northern portion of the island erratics are scarcely to be dis--covered". This footnote is of great interest as being the first recorded observation of evidence of a local glaciation.

James Geikie (1) showed that there had been in Lewis and Harris an epoch of intense glaciation when the mer de glace flowing out from the mainland of North--west Scotland attained so great a thickness as 1500 -1600 feet, overwhelming the Outer Hebrides. The general direction of movement was S.E. - N.W. in the upper strata of the ice, but the lower strata were de--flected by the high land of the Outer Hebrides, part flowing along the bottom of the Minch towards the N.E. and part towards the S.W.

He noted, also, evidence of a local and later period of glaciation in Harris and Lewis when valley glaciers radiated in all directions from the mountain valleys towards the low ground.

Further reference will be made to James Geikie's work when dealing with the glaciation (p.89)

J. W. Gregory (2) ascribed the fiords,

fiards/

(1). "The Great Ice Age" 3rd Edn., 1894.

(2). "The Fiords of the Hebrides", Geographical Jour--nal, Vol. LXIX., 1927, pp. 193-212.

fiards and gutter valleys of Lewis and Harris to earth movements and fracturing brought about as follows: In Upper Miocene times subsidence took place in the North-east Atlantic along N.W. - S.E. lines accompanied by volcanic eruptions on the borders of the sinking area from the Hebrides to Iceland and Greenland. The vol--canic period in the Hebrides closed with the dyke swarms on N.W. - S.E. lines.

Lower Pliocene time was marked by extended Atlan--tic subsidence breaking up the volcanic belt of Ice--land, Faroes and the Hebrides on N.E. - S.W. lines, producing torsion and diagonal fractures in the Scot--tish area, which was subsequently reduced to a plain sloping to the S.E.

In Middle Pliocene times there was uplift of the British Islands with the formation of the fiords and Scottish loch basins by diagonal and meridional frac--tures accompanied by fresh faulting and the formation of E. - W. valleys and geographical lines.

The Pleistocene glaciation accomplished no more than the moulding and modification of surface features already in existence.

Heddle (1) marked the presence of <u>allanite</u> "on the north side of East Loch Tarbert about 300 yards east/

(1). "The Mineralogy of Scotland", Vol. II. 1901,p.68.

east of the pier in graphic granite with black mica".

J. Wilson Dougal (1) made the following observa-tions within the area of the Outer Hebrides dealt with in this paper. He noted:-

(1) A red microcline granite on Mealisval (Uig) and extensions of it upon Suainaval on the east, Tamanavay in the south and Islivick shore on the west. In Glen Valtos he marked the course of the granite-gneiss as a solid belt one mile wide exposed on precipitous cliffs 200 feet high.

(2) A mass of basic rock at Maaruig on Loch Seaforth and at Tamanavay in west Lewis.

(3) The presence of a belt of crushed rock at Laxay and minor belts of crushing west of Balallan, at Aline, Grimshader, and Nisa Mhor (Uig).

Dr. William Mackie (2) records the presence of allanite in a granite from the island of Lewis from near Loch Roag.

Wolfgang Panzer gives a general description of the physiography, glaciation and weathering of the Outer Hebrides based chiefly on observations in North Harris and adjacent parts of Lewis.

(1) "Observations on the Geology of Lewis", Trans. Edin. Geol. Soc. Vol. XII., Part 1, 1928, p.12.
(2) "The Heavier Accessory Minerals in the Granites of Scotland", Trans. Edin. Geol. Soc. Vol. XII. Part 1, 1928, p. 30.
(3) "Zur Oberflächengestalt der Aussern Hebreden", Zeitschrift für Geomorphologie, Vol. iii, 1928, pp. 169-203.

III. SUMMARY of the ROCK FORMATIONS.

Before proceeding to a detailed account of the rocks which have been noticed during the present investigation it might be well to give a brief summary of the chief rock groups and of their relationships to each other.

North Harris, Uig, Morsgail and Aline are made up almost entirely of various types of gneisses belonging to the Archaean Complex. The only other constituents of the region are dykes probably of Tertiary age and glacial and post-glacial deposits.

The rocks of the Archaean Complex contain the following constituent elements distributed as follows: The eastern half of North Harris is made up almost en--tirely of a well foliated biotite-gneiss. North of the Harris-Lewis boundary, in Aline, Morsgail and the northeastern part of Uig, the biotite-gneiss is wholly or partly replaced by hornblende-biotite-gneiss.

The biotite-gneiss and the hornblende-biotite-gneiss enclose rounded and lens-shaped masses of all sizes of hornblendite, hornblende gneiss, hornblende-pyroxene gneiss and pyroxene-granulite in such a way as to suggest that the biotite-gneiss and the horn--blende-biotite gneiss are later and have invaded an area of basic rocks of various types. These masses of/

of basic rocks enclosed in the biotite-gneiss and hornblende-biotite-gneiss occur throughout the area but they are noticeably more numerous and larger in the east near Loch Seaforth than elsewhere. Collectively however, they form a small part of the complex.

Probably intrusive into and therefore later than the biotite and hornblende-biotite-gneisses is a coarse acid hornblende-gneiss with associated pegmatites. This, so far as observed is confined mainly to the southeast part of North Harris though probable exten--sions occur in the north of Uig and at Tamanavay.

In addition to the last named there are, mainly in North Harris, dyke-like and irregular masses of hypersthene-hornblende rock and of hornblende-mica rock which appear to be intrusive into those already enume--rated and therefore younger, but older than the granite-gneiss to be described next.

The greater part of the western half of North Harris and the western part of the Uig district is oc--cupied by a granite-gneiss and its pegmatites which is intrusive into and clearly later than all the other members of the complex. Within the area occupied mainly by the granite-gneiss remains of the older com--plex can be seen and in the eastern part of the area sporadic/

sporadic outcrops of the granite-gneiss occur. With the granite-gneiss pegmatites of similar character are associated and these appear not only in the immed--iate neighbourhood of the granite-gneiss itself but throughout the whole area.

Of uncertain age are a number of exposures of ultra-basic rock which have been found in the older complex but not in the granite-gneiss. They are ir--regular, dyke-like, or sill-like in form and sporadic in their distribution. In composition most of them are peridotites but one of them is very rich in olivine and approaches a dunite in composition.

The rocks of the Archaean Complex show marked signs of crushing by earth movement, exhibited by the occurrence of belts running in definite directions within which the rocks are crushed and sheared. One set of these disturbances trends W.N.W., N.W., or N.N.W., the other nearly N. - S. While the northwes--terly trending belts are usually narrow and well de--fined the N. - S. zones may be very wide. Where narrow, they exhibit on a small scale the production of mylonites, flinty crush-rock and pseudo-tachylyte.

The strike of the gneissic foliation of the Archaean Complex varies throughout the area. Thus, over/

over the greater part of North Harris the main strike is S.E. - N.W. or S.S.E. - N.N.W., with the dip ver--tical or sometimes to N.E., but more usually to S.W. In the eastern part of Harris this direction of strike and dip is remarkably constant over wide areas. In Lewis, however, between Loch Langavat and Loch Seaforth the main strike changes from N.W. with a S.W. dip near Loch Langavat to nearly N. - S., with an easterly dip near Roineval to a N.N.E. or N.E. strike with S.E. dip near the Laxay River. The changes here are pro--bably connected with approach to a great line of crushing. From Loch Langavat towards Loch Tamanavay and the southern part of the Uig hills the dip is usually N.W. with S.W. dip but on Aird Mhor and Aird Bheag the dip and strike are highly irregular. On the S.E. part of the island of Scarp the strike is mainly S.W. - N.E. As the rocks are followed north through the Uig district however, the direction of strike changes until in the neighbourhood of Islivick, Mangersta and the Gallan Head it is N.E. with vertical dip and remarkably regular over large areas.

Later than all elements of the Archaean Complex are dykes mostly trending S.E. - N.W. but trending in other directions as well. These are mainly olivine-dolerites/

dolerites, mostly of Crinan type. They are more num-
-erous along the South coast of Harris than elsewhere and are probably of Tertiary age.

The area described shows abundant evidence of glaciation. Traces of a general glaciation from S.E. - N.W. remain and in addition clear evidence both in Harris and Lewis of a local glaciation. (Pl. VII).

The latest deposits consist of peat and blown sand. Evidence of recent subsidence is afforded by the presence of peat at or below tide mark in certain localities and recent changes of climate are shown by the remains in the peat of a forest where trees now no longer grow.

IV. DESCRIPTION of the ROCK FORMATIONS.

(1). The Archaean Complex.

(a). Biotite-Gneiss.

Nearly the whole of North Harris east of a N.-S. line from Amhuinnsuidhe to Loch Resort is made up of a strongly foliated, often crumpled biotite-gneiss. West of the line indicated the biotite-gneiss becomes interbanded with or wholly replaced by granite-gneiss. The strike of the gneissic foliation which is remark-
-ably regular over wide areas is S.E. - N.W. or S.S.E.-N.N.W. with/

with the dip vertical or steep to S.W. The biotite-gneiss contains lenses and irregular masses of more basic gneisses and is cut by an acid hornblende-gneiss, by basic rocks and by pegmatites and quartz veins but all of these whether older or younger form a small part of the whole complex. It seems likely that the high hills of east and central Harris with their uniform character are due to the agents of denudation acting upon rocks which as compared to those around them are relatively homogeneous and resistant to weathering. Towards the north as in the neighbourhood of Ardvourlie and Balallan and from thence towards the N.W. the biotite-gneiss becomes more and more replaced by horn--blende-biotite-gneiss and other rocks to be described (p. 19).

A few examples of the biotite-gneiss from different parts of the area and indicating its general characters will now be described.

The gneiss of Torasclett west of the Laxadale Lochs near Tarbert is grey, medium-grained, splintery under the hammer, and shows in hand specimens indica--tions of crushing. Under the microscope it is seen to consist of abundant quartz, strain shadowed, drawn out and partly granulitised; orthoclase and an acid plagioclase/

plagioclase (oligoclase in most cases); rather sparing brown biotite, and occasional grains of apatite, epidote and iron ores. (Plate I., Fig. 1).

Another example taken from a point on the Straia--val ridge half a mile south of Loch Maaruig is a grey acid gneiss with well marked foliation sometimes crum--pled. In the field it encloses occasional knots of hornblendite and larger lenses and bands of garneti--ferous hornblende gneiss. In section it is seen to consist of abundant quartz, orthoclase and oligoclase, sparing biotite, occasionally a few very minute flakes of muscovite and accessory apatite and zircon.

The typical rock from the southwest shore of Loch Trollmarig is a grey, medium-grained, strongly folia--ted acid gneiss which shows little sign of crushing in hand specimen but does so under the microscope. In the field it shows occasional small deep red garnets. In thin sections it shows marked signs of crushing and consists of quartz, orthoclase, oligoclase, biotite, apatite and iron ores. The quartz is strain shadowed, drawn out and granulitised, the biotite is in the form of torn ragged flakes but the felspar is relatively undisturbed and though individual grains are broken and the twin lamellae are bent the original character of the felspar is obvious. (Plate III., Fig. 1).

Similar/

Similar examples though varying in detail can be seen throughout the district to the north as on the heights south of Ardvourlie, on Seaforth Island, on the hills between Loch Seaforth and Loch Langavat, on Roineval and on the ridges north of Balallan. A num--ber of specimens collected along a S. - N. line but further west illustrates the composition of the hills of central Harris.

Thus a specimen from the West end of the ridge of Gillival Glas is in hand specimen a massive grey quar--tzo-felspathic rock with remarkably regular foliation. It is made up of abundant quartz which shows the usual strain shadowing and granulitization. Felspar which is subordinate to the quartz consists of orthoclase and oligoclase. The biotite is drawn out, frayed, and sometimes edged with small flakes at right angles to the larger ones. There are a few very minute flakes of muscovite, occasional grains of apatite and small zircons. The Gillival Glas ridge is almost en--tirely made up of similar rock.

The summit of Clisham, the highest hill in the Outer Hebrides, is made up of a well foliated grey acid gneiss showing the usual abundant quartz with orthoclase and oligoclase, biotite, apatite, zircon and/

sparing iron ores. Similar rock with the usual strongly marked N.W. foliation makes up Mullach fo Dheas, Mullach an Langa, the Tomnaval ridge and the hills N. to Stulaval near Loch Langavat.

Far beyond the main area of the biotite-gneiss and in localities where the granite-gneiss is the main constituent the biotite-gneiss retains its characters. Thus, on Husinish Point at the extreme west of North Harris the biotite-gneiss with its enclosed dark horn--blende-gneisses is cut by great bands of granite-gneiss. The biotite-gneiss varies in texture from medium to coarse grained but preserves the mineral char--acters made familiar by the previous descriptions.

The biotite-gneiss is typically grey in colour and gives its characteristic tone to the hills of east and central Harris but especially towards the west and northwest it may in places take on a pinkish colour. In the case of the rock of Sgaoth Iosal the colouring appears to be due to the orthoclase and oligoclase and in section the rock does not differ materially from the examples already described. Elsewhere the colour--ing appears to be due to the addition of pinkish fels--pathic knots and streaks to the normal rock. On the steep south face of Clisham where pegmatites of all sizes/

sizes are very abundant and where the pink streaking is well shown the rock is of the typical medium-grain--ed variety with the usual strain shadowed and granul--itised quartz. The felspar which is more abundant than usual includes orthoclase, microcline and oligo--clase. Perthite occurs and rather abundant myrme--kitic intergrowths of felspar and quartz. Biotite occurs in the usual ragged flakes and muscovite be--comes equal in amount to the biotite. The accessory constituents are apatite, zircon, and sphene. Somewhat similar phenomena are to be seen on the north face of Gillival Glas, on Tomnaval, on the east face of Stula--val near Loch Langavat, but are more obvious to the west as on Uisgnaval and the west slopes of Ullaval, in southeast Scarp, and northeast of Tamanavay. It appears that we are dealing here with a part of the normal biotite-gneiss which has received additions from another source - possibly from the granite-gneiss. Bands of similar appearance and composition can be found at Forsnaval, Nisa Mhor and Mangersta in the north of the Uig district.

The preceding descriptions of the biotite-gneiss though involving considerable repetition serve to em--phasise what is so obvious in the field, namely, the remarkably uniformity of this member of the complex,

not/

not only in Harris where it is the main constituent but also in the adjacent parts of Lewis where it is subordinate to other types.

(b). The Hornblende-Biotite-Gneiss.

In North Harris the prevalent biotite-gneiss is occasionally interbanded with a closely similar rock which contains hornblende in addition to biotite. Along the south coast where the rocks are exposed con--tinuously for long distances these bands can often be seen. An example from the west side of Husinish Point is in hand specimen a medium-grained dark grey rock consisting of quartz subordinate in amount to the fels--par which consists of orthoclase and oligoclase. Hornblende deep green or bluish green in colour is equal in amount to the biotite. Apatite, granular groups of sphene and iron ores complete the constituents.

Rocks of similar type are exposed at intervals along the shore of Loch Seaforth from Maaruig north--wards to Ardvourlie. On the shore just north of the large peridotite mass at Maaruig the rock is dark grey, medium-grained with well marked N.W. foliation. In section it is seen to be composed of quartz quite sub--ordinate to the felspar which is andesine often show--ing cross twinning and enclosing blebs of quartz. Hornblende/

Hornblende and biotite are in equal amount. Apatite and sparing iron ores occur as accessories. North of Ardvourlie Bay, however, the hornblende-biotite-gneiss becomes more prominent and probably exceeds the biotite-gneiss in amount. In the Amhuinn a Mhuil near Aline, which forms for a short distance the boundary between Harris and Lewis the prevalent rock is dark grey in colour, medium-grained, and contains less quartz than felspar. The typical felspar is oligoclase. Horn--blende and biotite are equal in amount. Apatite is common and iron ores occur sparingly. To the north-west of Aline this type is common on the ridges all the way to Loch Langavat and beyond, on Seaforth Island, interbanded with biotite gneiss, along the shore of Loch Seaforth between Aline and Kintaravey, and in the neighbourhood of Balallan as far east at least as the Laxay River. It can be seen also on Sleitashal Mor and on Roineval. On both sides of Loch Langavat and on the ground to the northwest, where, however, great areas are obscured by drift and peat.

Further to the west and northwest, the hornblende-biotite-gneiss becomes common. Thus near the head of Loch Tamanavay several well marked hillocks of this rock occur surrounded by or veined by the granite gneiss. A specimen from the most prominent mound just south of

the/

the head of the loch is a medium-grained well foliated pink and white striped gneiss with glistening black spots an eighth of an inch or longer of orthite. In thin section it shows quartz, abundant orthoclase in--cluding some microcline with subordinate oligoclase. Hornblende and biotite are both present and there is also abundant yellow epidote which often has a core of dark brown orthite. Apatite, magnetite and sphene occur sparingly.

Another example from the Gallan Head may be taken as typical of the N.E. striking vertically foliated rock which forms the greater part of the district north of Uig and of the west coast south to Brenish. It is a gneiss of medium to coarse grain marked by pink and white felspars and dark streaks of hornblende and biotite. In section the rock shows quartz, orthoclase and oligoclase. Hornblende and biotite are in equal amount. In addition it contains rather abundant yellow epidote and granular sphene.

It has not been found possible to separate the hornblende-biotite-gneiss from the biotite gneiss. So far as occurrence in the field is concerned they appear to be of the same age.

(c). Basic Rocks associated with (a) and (b).

Associated with the biotite-gneiss and the horn--blende-biotite-gneiss are numerous exposures of dark coloured basic rock. These take the form of small knots or eyes or of larger pillow-shaped or lens-shaped masses many yards across or, again, of bands of varying width generally parallel to the strike of the foliation. The knots and larger lens-shaped masses are always sharply defined and even on bare rock surfaces the bands cannot be followed far, usually tapering out within a distance of 100 yards or less. All varieties can be observed at different places to be traversed by vein-like branches which are visibly in continuity with the biotite-gneiss or the hornblende-biotite-gneiss, in such a way as to suggest that these basic rocks represent the remnants of an older formation into which the acid gneiss has been intruded.

Another feature of interest well illustrated in this area is that while there are many varieties of these basic rocks they tend to occur in groups the isolated members of which are all of one variety. This is well seen on the north shore of Loch Troll--marig on the cliffs of Loch Seaforth south of Ardvour--lie, on Sleitashal Mor, on Roineval, or further to the/

the northwest as on the ground north of the Uig Hills, on Aird Mhor Mangersta, and on the cliffs south of the Gallan Head.

Their distribution is irregular. Thus they appear to be relatively more abundant on the east coast, e.g. along the shore of Loch Seaforth and north to Roineval than elsewhere. Among the high hills of Harris as on Clisham and its neighbouring peaks they are scarce but even though irregularly distributed they occur throughout the whole district from the southeast extremity of North Harris, to Gallan Head. They have not been observed however, bearing the relationships to the granite-gneiss such as they have with the biotite-gneiss and the hornblende-biotite-gneiss, and they have not been found within the granite-gneiss area except as forming part of the older complex which the granite-gneiss has invaded.

They show considerable variety of texture. Some are coarse-grained with marked gneissic foliation; others are fine-grained and schistose. Others again both coarse and fine have a marked granular structure and may be described as granulites.

In mineral composition they vary considerably. For convenience of description they may be sub-divided as follows:-

(1) Rock composed entirely of hornblende - amphibolites.

(2) Rocks with a varying amount of quartz and fels--par in which hornblende is the only ferro-magnesian mineral.

(3) Rocks in other respects similar to (2) above which in addition to hornblende contain a variable amount of monoclinic pyroxene.

(4) Rocks with hornblende, monoclinic pyroxene, and an orthorhombic pyroxene - generally a red hypersthene.

(5) Rocks with hornblende-pyroxene, garnet and felspar, with or without quartz.

(6) Rocks with hornblende, pyroxene and mica.

(1). The rocks of this group occur as phacoids or eyes never more than a few feet in length and gene--rally much smaller. Green hornblende makes up the bulk of the rock the only other constituents being brown biotite and iron ores. Rocks of this kind have often been described from the southern part of the Long Island and from the Lewisian gneiss of Northwest Scotland.

(2). Rocks composed of hornblende with quartz and felspar are by far the commonest types. They occur usually as narrow tapering bands parallel to the prevailing strike of the foliation of the enclosing acid gneiss by which they are traversed in veins. Occasionally on their edges wisps of the hornblendic rock/

rock have been separated off from the parent mass and dispersed for short distances through the acid gneiss but on the whole their margins are entire and sharp. Typical examples are as follows:-

The rock occurring as narrow bands in the biotite gneiss of the Torasclett ridge near Tarbert is a typic--al dark medium-grained, well foliated hornblende-gneiss, its foliation being parallel to that of the enclosing gneiss. In section it is seen to consist of abundant dark green hornblende, andesine felspar, quartz and ilmenite the amounts of these minerals being present in the order named. Apatite occurs as an accessory. Rocks of this type are frequently veined with yellow epidote (Pl.III.Fig. 2).

Another example from the southeast slopes of Gillival Glas is a fine-grained gneiss containing horn--blende, andesine, quartz and iron ores.

Numerous examples of similar rock can be found all along the east side of North Harris. In Lewis they are very common on Roineval and in its neighbourhood.

In rocks of this type sphene, probably derived from ilmenite, occasionally becomes important. Thus the edge of a large mass of dark rock on the north side of Rudha Leacach west of Amhuinnsuidhe is a dark, coarse-grained gneiss containing a little quartz,

andesine/

andesine-felspar, hornblende, abundant sphene in crys-
-tals and groups of granules sometimes associated with leucoxenic ilmenite. Small isolated grains of sphene occur, also, scattered throughout the rock.

This type is common in the Uig district. A specimen from the cliff on the east side of Mangersta sands shows under the microscope a very small amount of quartz, abundant andesine, abundant bluish green hornblende and groups of crystals of sphene sometimes a quarter of an inch in diameter. A similar rock from Nisa Mhor (Uig) is illustrated in Pl. III., Fig. 3.

(3). Rocks with hornblende and monoclinic pyro-
-xene. - Rocks which contain monoclinic pyroxene in addition to hornblende come next in frequency of occur-
-rence. The amount of pyroxene varies much in differ-
-ent specimens. Thus ~~in~~ a specimen from the Tarbert-
-Stornoway road ~~opposite~~ west of Sgaoth Iosal from a band about 30 yards wide striking for a short distance E. - W. is a fine-grained blotchy black and white rock showing foliation but also having a granular structure. It consists of rather sparing quartz, a plagioclase (andesine-labradorite) some untwinned, abundant dark green hornblende, subordinate grains of pale green monoclinic pyroxene, ilmenite sometimes altered to leu-
-coxene. The hornblende tends to be aggregated into groups/

groups giving the rock its blotchy appearance. The pyroxene on the other hand is scattered throughout the rock sometimes in contact with the hornblende, some-times among the felspar. There is no evidence in the slide of the passage of pyroxene into hornblende.

Specimens from the road bridge across the stream between the Laxadale Lochs east of Tarbert and of the scarce pillows of dark gneiss on the summit of Clisham and a typical band from a point on the north side of Ardvourlie Bay and a whale-backed mass in the cliff of Creag Mo, west of Ardvourlie — are similar in composi-tion though varying in coarseness of grain.

Another example which contains nearly equal pro-portions of hornblende and pyroxene is taken from a point on the shore of Loch Seaforth on the south side of Ardvourlie Bay. It is a fine-grained rock with numerous small deep red garnets scattered unevenly through the rock. Under the microscope the rock has an uneven granular texture. It contains little or no quartz, abundant felspar near labradorite and some-times untwinned in rounded grains, hornblende, pale green monoclinic pyroxene, garnet, ilmenite and apatite.

Another example from the same locality but from a/

a point on the shore of Loch Seaforth 50 yards further south is in hand specimen a blotchy black and white rock of uneven grain. The slide contains no quartz, half of the rock consisting of labradorite in rounded grains sometimes untwinned. What appear to be large crystals in hand specimen appear under the microscope to be aggregates of rounded or irregular grains of green hornblende and pale green monoclinic pyroxene.

(4). Rocks with hornblende, monoclinic and rhombic pyroxene. - Occurring less frequently than the foregoing but in similar form are rocks with horn--blende and two pyroxenes. An example from the low hills southeast of Scalladale and south of Ardvourlie is in hand specimen a heavy black rock showing no folia--tion. Under the microscope it is seen to be uneven--ly granular in structure, the dark minerals tending to segregate in groups. It contains a very small proportion of quartz, abundant rounded grains of labra--dorite, dark green hornblende in groups of rounded grains and short crystals, a reddish hypersthene, pale green monoclinic pyroxene sometimes enclosing flakes and blebs of hornblende, iron ores, apatite and scattered garnets.

Another example occurring in broad bands in coarse/

coarse acid hornblende-gneiss on the new road south of Ardvourlie is black heavy medium-grained and well fol--iated. In section it shows marked granular structure. Quartz is sparing or absent altogether; plagioclase, labradorite make up a third of the rock, in rounded grains. Green hornblende is the most abundant ferro--magnesian constituent along with monoclinic pyroxene and red hypersthene; garnet, rather abundant, ilmenite and apatite. (Pl. III., Fig. 4).

A third example typical of pillows and bands at Clett na Stuire on the Stornoway Road north of Aline is in hand specimen a blotchy black and white rock — somewhat crushed which in section has an evenly granu--litic texture. It contains very little quartz, pla--gioclase (andesine or acid labradorite), green horn--blende, green monoclinic pyroxene and red hypersthene. The dark minerals tend to be segregated in groups and are accompanied by ilmenite.

(5). Hornblende-pyroxene garnet rocks. May be illustrated by an example from the Straiaval ridge half a mile south of the head of Loch Maaruig. It consists of a large lenticle or band 50 yards wide en--closed in biotite gneiss. It has sharp boundaries running with the strike; fine-grained on the edge, coarser/

coarser in the centre. It is not noticeably granular and consists of quartz, plagioclase, garnet, hornblende, monoclinic pyroxene, haematite, apatite.

(6). Hornblende-pyrocene-mica rocks. A curious type which occurs rarely may be illustrated by an ex--ample from the left bank of the Skegadale River, 150 yards upstream from Ardhasig Bridge. In hand specimen it is a blotchy black and white rock with good foliation weathering with a rough surface on which black horn--blendes stand out. It contains a very small propor--tion of quartz which occurs in the usual irregular grains among the felspar and also in rounded blebs in the hornblende. The felspar which is abundant is andesine. The abundant dark green hornblende often contains cores of light green pyroxene which are usual--ly sharply separated from the hornblende. Occasion--ally however, the pyroxene is laminated with hornblende indicating a passage into it. Biotite occurs quite commonly forming an edging to the hornblende, in paral--lel position with it, in isolated flakes and also in long narrow flakes which cut across the foliation and across the hornblende and felspar crystals.

(d). Acid Hornblende Gneiss intrusive into (a) and (b).

Another element of the Archaean Complex which is clearly intrusive into the biotite-gneiss is a rather coarse acid gneiss with prominent crystals of horn--blende. The exposures of this rock are of limited extent and confined mainly, as far as observed, to the southeast and east of North Harris. They consist of narrow bands or tongues parallel with the foliation of the biotite-gneiss or cutting sharply across it. Wherever they occur there is marked local disturbance of the adjacent rocks. The best exposures are seen on the south coast of North Harris, between the ex--treme southeast extremity of North Harris and the Laxadale Lochs and again between these and Tarbert but the hornblende-gneiss does not appear to extend far inland for it has not been noted on the hills north of Tarbert or further to the Northwest. It can be seen again on the east coast from south of Loch Trollmarig; it occurs on the western face of Toddun and on the shore of Loch Seaforth between Loch Trollmarig and Loch Maaruig; and again on the roadside at Clett Ard south of Ardvourlie.

An example of this rock from Clettachan east of the Laxadale Lochs near Tarbert is in hand specimens

a/

a light grey or faintly greenish rock with prominent crystals of black hornblende half an inch or more in length. Under the microscope signs of crushing are marked, as indeed they are in all the rocks in this neighbourhood. Quartz is abundant, strain-shadowed, drawn out and granulitised. The felspar, which as usual retains its form better than the quartz, is much sericitised but appears to have been orthoclase. Large crystals of green hornblende fresh but broken are the most prominent feature. Epidote in strings and groups of granules and scattered crystals of fresh pyrite are the remaining constituents.

A narrow band from the steep western face of Tod--dun is a corase-grained black and white gneiss. It consists of quartz, orthoclase and oligoclase, the former much altered, large relatively well preserved crystals of hornblende, a few small flakes of biotite, granular epidote, and apatite.

Rocks of this type are frequently accompanied by thin pegmatitic modifications of the same kind in which the hornblende crystals may reach a length of two inches or more.

This hornblende-gneiss with its accompanying pegmatites in North Harris is probably a northerly extension/

extension of a similar rock observed on the east side of South Harris at Plocrapol and Loch Stockinish*.

(e). Basic Rocks intrusive into (a) and (b).

A number of exposures of basic rocks will now be described. These are considered to be intrusive into and therefore later than the biotite-gneiss and the hornblende-biotite-gneiss but older than the granite-gneiss to be described later (p.53). They can be divided into two well marked groups, the first made up mainly of hypersthene and hornblende with sub-ordinate felspar; the second characterised by the presence of abundant hornblende and biotite with sub-ordinate felspar and quartz.

The hypersthene-hornblende rocks have been noted at the following localities:-

(1) Skegadale near Ardhasig Bridge west of Tarbert.

(2) Near the shore of Loch Seaforth north of Loch Trollmarig.

(3) On the ridge of Straiaval northeast of the Laxadale Lochs near Tarbert.

(4) On the north side of Loch Maaruig.

(5) On the shore of Loch Seaforth between Loch Maaruig and Ardvourlie Bay.

(6) At the southwest extremity of Seaforth Island.

*T. J. Jehu and R. M. Craig: "The Geology of the Outer Hebrides - Part IV., South Harris", Trans. Roy. Soc. Edin. Vol. LV., Part 2, p. 481, 1927.

(7) In Glen Scalladale, south of Ardvourlie.

(8) On the new road west of Reef, Southwest of Valtos, Uig (Lewis).

In the field these rocks are noticeable wherever they occur, appearing to be unfoliated and weathering dark brown with a rough pitted surface. On a freshly broken surface they have a blotched brown and white appearance like a gabbro, showing especially on their margins specks of brassy sulphides. They will be described in the order given above.

(1). In Skegadale near Ardhasig Bridge:- This example consists of a lenticle probably not less than 300 yards long trending in a nearly E. - W. direction parallel with the floor of the valley. The breadth cannot be ascertained because the exposure is partly drift covered, a small terminal moraine of a local glacier which occupied the Skegadale Valley crowded with large boulders of the same rock overlying the greater part of it. It weathers with a rough pitted surface. A specimen from the southern edge near the road bridge is seen in section to be made up of minerals which have been roughly segregated into groups. Large crystals of hypersthene schillerised with brown plate-like and dust-like inclusions form centres around which are grouped granules of the same mineral and

groups/

groups of larger granules and short crystals of light green hornblende, along with which appears occasionally groups of flakes of a bright reddish brown mica. Occurring interstitially and also forming separate areas are granules of acid labradorite, much of it un--twinned. Iron ores occur sparingly.

Specimens taken from different parts of the mass show variations in the proportions of pyroxene, and hornblende present. Thus, a specimen taken from a point on the right bank of the Skegadale River about 200 yards upstream from the road-bridge is finer grained than the example last described and tends to have granular structure. The proportion of hornblende to pyroxene is higher and there is relatively more felspar, but otherwise the mineral constituents are the same. Another specimen from the same locality is interesting as showing the presence of scapolite asso--ciated with the felspar. In all the slices examined specks of pyrite and pyrrhotite appear.

(2). Near the shore of Loch Seaforth north of Loch Trollmarig:- Another example of the same kind of rock, but poorly exposed, occurs near the shore of Loch Seaforth at Rudha na Uamha north of Loch Troll--marig. The surrounding rocks are the usual biotite-gneiss/

gneiss with lenticles of dark hornblende-gneiss and quartz veins the whole complex with foliation flat-lying, undulating or quite irregular. This complex is crossed by a crush foliation dipping E. or N.E. parallel to the shore of the loch and cut by powerful joints parallel to the same direction. Among these but on the low ridge near the shore the rock to be described appears and shows where exposed little trace of foliation. Its contact with the surrounding rocks is not seen. It weathers with the usual brown pitted surface. In thin section this rock (Pl.III.Fig. 5). shows large crystals of hypersthene schillerised by numerous thin brown plates and crossed by cloudy bands due to lines of crushing reducing these thin plates to the condition of fine dust. These large crystals are surrounded either by a rim of hornblende crystals or by a groundmass of granular hornblende. Other large crystals represent an intimate intergrowth of ortho--rhombic pyroxene and granular hornblende, the separa--ted parts of the pyroxene being in optical continuity. With the hornblende goes a small proportion of bright brown biotite. The plagioclase which tends to be grouped in granules is labradorite. There are also present numerous blebs of pyrrhotite.

(3)/

(3). On the Straiaval ridge Northeast of the Laxadale Lochs:- This exposure consists of a band about 50 yards wide traceable for some distance along the ridge in a northwest direction. The rock is massive, unfoliated and weathers like a gabbro, which it resembles on a freshly broken surface. In thin sections it is seen to resemble in structure the rock from Ardhasig in that the minerals are grouped. As before, large crystals of hypersthene are surrounded by small crystals of hornblende with which is associated groups of red brown biotite. The felspar (labradorite) forms groups of short crystals and rounded granules. Iron ores occur sparingly.

(4). On the North side of Loch Maaruig:- Another example can be seen on the north shore of Loch Maaruig near the postman's house forming a dyke-like band ap--parently striking N.W., but not well exposed. In hand specimen and in thin section this rock resembles closely the examples already described.

(5). On the shore of Loch Seaforth between Maar--uig and Ardvourlie Bay:- This example is one of the largest and most important observed. It appears on the shore of Loch Seaforth between Creagan Glasa on the north and the mouth of the Alt Loch an Eang in the south./

south. The total breadth on the coast is about a quarter of a mile. The southern margin seen at Treal--leachan Mor about 100 yards north of the mouth of the Alt Loch an Eang follows a course inland at first S.S.W. but gradually swinging round to S.W. and finally W. The northern margin appears to follow the same course but is mainly concealed. The mass can be followed in--land for about three quarters of a mile to a conspicu--ous knoll south of Loch an Eang. The ground here, however, is extensively peat covered. It thus appears to have a curving course roughly at right angles to the prevalent strike of the gneiss. On the coast at Trelleachan Mor its southern margin is seen in contact with the prevalent biotite-gneiss of the region. Here it appears to have a chilled margin but this appearance is deceptive due to the fact that both the gneiss and the basic rock have been subjected to shearing parallel to the shore of Loch Seaforth, the shearing planes dipping E.N.E. The crushed margin is bronze coloured, flecked with sulphides, dense and fine-grained. A short distance to S.W. where it crosses the stream it is seen opposite different members of the complex but beyond the stream contacts are not seen. The northern margin at the small headland under Creagan Glasa is seen/

seen against hornblende-gneisses and biotite-gneiss but inland no further contacts were observed. The northern margin dips vertically and the southern where it crosses the stream is also vertical, but at Treal--leachan Mor the edge dips N.W. at about 45°. A point of interest is that at its seaward end it is seen to be cut by thin pegmatites of the usual type (p. 62).

In the field the rock has the blotchy appearance of a gabbro and weathers with a rough surface, the dark minerals standing out on a background of lighter col--oured felspar. It shows no foliation except at the southern margin where, as noted, it has been subjected locally to shearing.

A specimen of the typical rock from near the centre of the mass is a rock of igneous texture and rather coarse grain the most obvious constituents of which are crystals of hypersthene their central areas cloudy from inclusions. These crystals are fringed with small crystals of hornblende and small hornblendes are inclu--ded also within the hypersthene or along cracks in it but with sharp boundaries. Where the hypersthene comes in contact with felspar there is often in the felspar a rim of minute peg-like inclusions at right angles to the line of contact. These peg-like bodies on a larger scale reveal themselves as fringes of dark

brown/

brown garnet. These however, are not often seen. Bright reddish brown mica occurs sparingly with the hornblende. Felspar which makes up about one third of the rock is labradorite generally showing good lamellar twinning but sometimes in untwinned grains. Black crystals of magnetite and blebs of pyrrhotite are the remaining constituents.

A specimen from the southern edge of the mass within a foot of the contact is beautifully fresh, apparently fine-grained and having a bronzy lustre. Under the microscope however, the fine-grained appear--ance is found to be deceptive. The hypersthene cry--stals with their clouds of inclusions are seen to have been as large or larger than in the previous sample described from the centre of the mass, but they are bent, broken, and often reduced to a granular aggregate. The hypersthene crystals enclose parallel areas of a monoclinic pyroxene. The intermediate areas of horn--blende biotite and felspar form a finely granular ag--gregate in which broken granules of garnet can occa--sionally be detected. Magnetite and specks of brassy sulphides are common.

A specimen from near the northern edge within a few feet of well foliated biotite-gneiss and blotchy hornblende-gneiss is somewhat different from the two last/

last examples described. It is of finer grain, un--evenly granulitic in structure and contains less fels--par than the average rock. It consists of an irregu--lar mosaic of equidimensional grains of hypersthene set in a matrix of somewhat larger and more numerous crystals of hornblende. There is a small proportion of biotite. The felspar, which occurs in groups of granules, is labradorite.

(6). At the Southwest extremity of Seaforth Island: A small exposure of rock similar in all essential res--pects to those already described occurs in the small bay at the southwest end of Seaforth Island. It may represent an extension to the northeast of the rock described under (5) above.

(7). In Glen Scalladale south of Ardvourlie:- This is by far the largest example of this type of rock seen. It is exposed on both sides of the new road south of Ardvourlie where its breadth is seen to be not less than 150 yards. It appears again between Creag Mo and the Scalladale River. Still further west it forms a prominent feature on the long ridge of Mo Vigadale. It is seen again in the small stream course at the north end of Mullach an Langa, beyond which it has not been traced. It has therefore been traced about/

about four miles. Further to the west it has not been seen and no rock of this type has been seen in association with the granite-gneiss of the western part of the area described except when accompanied by biotite-gneiss. (Pl. III. Fig. 6, & Pl. IV. Fig. 1).

In the field and in hand specimens the rock repeats the characters already illustrated from previous ex--amples. On the roadside 100 yards east of Caisteal Ard it contains locally narrow veins of hypersthene crystals an inch or more in length, rather decomposed, which appear to be pegmatitic modifications.

(8). On the new road West of Reef, Southwest of Valtos (Lewis):- The last example noted occurs in dyke-like form, striking N.N.W. on the new road west of Reef, southwest of Valtos in the Uig district. It is exposed for a short distance only chiefly through quarrying operations for roadstone. In the field, in hand specimens, and under the microscope, it resembles in most respects the examples already described.

With the exception of the ultra-basic rocks to be described (p. 46) and certain parts of the granite-gneiss (p. 53) these interesting rocks have characters more truly igneous than any other component of the Archaean Complex so far observed. In the whole length of the Long Island from Barra Head northwards they have/

have not been seen and their sudden appearance in North Harris is a point of interest. How far they extend northwards cannot be fixed until the ground to the north has been examined. They may be related to the anorthosite and associated rocks seen further to the south in the neighbourhood of Rodel, South Harris.(1). It is hoped to deal with these rocks in greater detail in a later paper.

Examples of the second group, namely, the horn-blende-biotite rocks are few in number and have been noted chiefly in the western part of North Harris, but always in association with the biotite-gneiss.

A good example occurs on the island of Scarp forming a broad dyke-like mass trending N.E. - S.W., and occupying the well marked hollow which separates the southeastern part of the island from the higher northwestern part. In the southeast of Scarp the strike of the foliation of the remnants of the biotite-gneiss is irregular but in the main is N.E. - S.W. and while the basic rock has the same general direction it sometimes cuts across the irregularities of the biotite-gneiss. Both, however, are cut across at right angles by broad bands of the granite-gneiss trending N.W. - S.E. This can be seen clearly on the south coast at the/

(1) Jehu and Craig. Trans. Edin. Roy. Soc. Vol. LV. Part ii, p. 471. 1927.

the small bay where the basic rock passes out to sea.

In the field the rock weathers with a rough knobby surface which when freshly broken appears mottled black and white from the segregation of the light and dark minerals into patches. In thin slices it is seen to consist of quartz in small quantity; plagioclase which is typically andesine and also a more acid fels--par cloudy from alteration and full of inclusions which include hornblende and biotite and also minute clear rod-like bodies cross-jointed and of higher re--fractive index than the felspar. The greater part of the rock however, consists of a felted mass of large hornblende crystals and groups of small crystals and similar groups of brown biotite with abundant pleochroic haloes around inclusions. Usually associated with them are sparing iron ores, generally ilmenite, and associated with the hornblende occasional blebs of iron sulphide.

In the small bay on the coast at Rudha Leacach southwest of Amhuinnsuidhe occurs a roughly star-shaped exposure about 400 yards in diameter. The mass is partly surrounded by biotite-gneiss and is cut in various directions by numerous veins of granite-gneiss, pegmatites and quartz veins. The granite-gneiss is obviously/

obviously the later though both it and the basic rock have now a common foliation. The typical rock is dark and coarse-grained to its edges, weathering with a rough surface. On the north side of the bay it appears to pass into a hornblende-schist. Under the micro--scope the typical rock is seen to consist of a little quartz, plagioclase (andesine) and orthoclase, the latter much sericitised; light green hornblende with some pale actinolite; brown biotite with numerous pleo--chroic haloes, subordinate to the hornblende; gran--ules of pyrite edged with magnetite.

In Skegadale 100 yards upstream from the road bridge another example occurs on the right bank of the stream beneath a prominent pegmatite. This rock is made up mainly of pale green hornblende and biotite the latter occurring in long narrow plates traversing the hornblende in all directions, sometimes cutting across several crystals. The felspar is oligoclase-andesine and orthoclase the latter cloudy from decom--position. Quartz occurs sparingly as also ilmenite passing into leucoxene.

Similar but smaller examples can be seen on the coast of North Harris east of the Whaling Station, and between it and Amhuinnsuidhe.

(f). Ultra-Basic Rocks.

A number of small outcrops of ultra-basic rock have been noted at widely scattered localities. They vary in form occurring usually as lenticles, but occa--sionally as dykes. They have been observed at the following places:

(1). In the island of Scarp north of Manish.

(2). On the ridge south of the summit of Oreval.

(3). Near the coast at Brandersaig, Ard Meavaig.

(4). East of the head of Loch Laxadale, northeast of Tarbert.

(5). At Maaruig on Loch Seaforth.

(6). About 600 yards northeast of the Keeper's house at Loch Tamanavay, Lewis.

In addition to the occurrences enumerated above which are definitely in place a few examples have been noted as on the road west of Sgaoth Iosal; near the head of Glen Scalladale, and near the shore of Loch Seaforth about two miles northeast of Aline Lodge. These are imperfectly exposed and may not be "in situ".

(1). In the island of Scarp about 700 yards north of Manish a lenticular outcrop of rock 35 yards long by 15 yards broad forms an isolated and prominent fea--ture in the hollow south of Strone Romul. The long axis of the outcrop trends N.W. in conformity with the prevailing/

prevailing strike of the surrounding gneiss which consists of well foliated biotite-gneiss with subordinate hornblende-gneiss, these two being cut by ribs of granite-gneiss, pegmatites and small quartz veins. The rock consists of a felted mass of star-shaped clusters of fibrous amphibole imbedded in which are blades of green actinolite. These clusters may be two inches in diameter and give the rock a striking appearance in the field. The whole mass resembles closely the sheared parts of peridotite masses seen at places in the islands further south, as for instance, in the Loch Langavat valley in South Harris (1) or in Berneray and Pabbay (North Uist) (2). In this case its condition is probably due to the presence of a narrow line of crushing which will be referred to later (p. 66). In respect of its sheared and fibrous condition it differs markedly from the other examples to be described below. (Pl. II., Fig. 1).

(2). On the ridge south of the summit of Oreval. This rock forms a prominent dyke-like feature on the ridge south of the summit of Oreval about 2¼ miles N.N.W. of the head of Loch Meavaig. The outcrop traceable/

(1). T. J. Jehu and R. M. Craig - "Geology of the Outer Hebrides - Part IV. South Harris", Trans. Roy. Soc. Edin. Vol. LV., p. 479, 1927.

(2). T. J. Jehu and R. M. Craig - "Geology of the Outer Hebrides - Part III. North Uist and Benbecula" Trans. Roy. Soc. Edin. Vol. LIV. p. 488, 1926.

traceable on the ridge only is dark chocolate brown in colour, weathering with a rough pitted surface. On a freshly broken surface the rock is greenish black with occasional shimmering plates of a micaceous miner-al. Under the microscope the rock is seen to be a peridotite containing abundant olivine partly serpen-tinised, augite, hypersthene, a pale faintly pleo-chroic phlogopite, occasional blades of actinolite and black and dark brown grains and crystals of chromi-ferous iron ore.

(3). Near the coast at Brandersaig, Ard Meavaig. An interesting example occurs near the mouth of the stream at Brandersaig just west of Ard Meavaig. It is traceable in a northeast direction for some distance on the ridge towards Loch Meavaig. It has the form of a dyke and is clearly intrusive into the surrounding gneisses. It weathers with a reddish brown crust which makes its outcrop conspicuous but on a fresh sur-face it appears compact, fine-grained and yellowish green in colour. In thin section it is seen to be composed mainly of very fresh olivine with quite sub-ordinate enstatite and a colourless monoclinic pyro-xene. A few small flakes of nearly colourless phlo-gopite occur as well as numerous grains and euhedral crystals/

crystals of chromiferous iron ore. In respect of its very high content of olivine it approaches a dunite in composition and is by far the most olivine-rich rock so far observed in the Outer Hebrides. (Pl. IV. Fig.3).

(4). East of the head of Loch Laxadale, northeast of Tarbert. On the hillside east of Loch Laxadale near the Laxadale Burn another mass of ultra-basic rock occurs. Isolated exposures indicate that its area is about 80 yards square. The rock is rather coarse-grained and weathers brown with a rough pitted surface. The typical rock on a fresh surface is dark green with occasional bronze coloured plates of ortho-rhombic pyroxene. In section it shows fresh olivine which, however, is subordinate in amount to plates of much schillerised hypersthene. A pale actinolite occurs sparingly and there are in addition numerous grains of iron ore. (Pl. IV. Fig. 2).

Thirty yards northwards of the last exposure and on the bank of a small tributary of the Laxadale Burn there is a small outcrop of a peculiar rock which may be connected with the peridotite. It is made up of yellowish brown crystals an inch or more in length of a weathered ortho-rhombic pyroxene set in a felt of small green crystals of pyroxene.

(5). At Maaruig on Loch Seaforth. By far the largest exposure of ultra-basic rock seen within this area occurs on the north side of Loch Maaruig forming the promontory upon which the village stands and also the adjacent small island in Loch Seaforth. It is bounded on the east, south and west by the sea. The Northwest boundary is concealed under drift and peat but can be fixed approximately by the red soil and luxuriant grass to which its weathering gives rise. The whole extent of the mass on land appears to be about 600 yards long from E. to W., and 500 yards broad from N. to S. It does not appear upon the south shore of Loch Maaruig. On the southwest side it partly en--closes a lenticle 10 feet across of fine-grained granulitic hornblende-pyroxene-gneiss such as occurs among the prevailing biotite-gneiss of the neighbour--hood. A tongue of the acid gneiss and hornblende-gneiss runs into the mass on the north side of the creek west of the island. On the south side facing Loch Maaruig are a few rather ill defined lenticles which are the same as the parent mass but of finer grain. On the northeast side on the shore it is seen in contact with the prevalent gneisses of the area. It was first noticed by Dougal (1) who described it as an/

(1). Trans. Edin. Geol. Soc. Vol. XII. Part 1, p. 13. 1928.

an olivine gabbro. A specimen from the roadside near the centre of the mass is on a freshly broken surface a dark greenish grey rock with conspicuous bronze col-oured plates of hypersthene. In section it shows abundant olivine mainly fresh but showing serpentini-sation in cracks; relatively large and widely spaced crystals of schillerised hypersthene; pale green horn-blende in groups of small crystals; light brown phlogopite, and numerous rounded and cubic grains of chrome iron ore. The large plates of hypersthene en-close olivine poickilitically. The above description applies to the bulk of the rock.

A slide from one of the fine-grained lenticles from the south side shows the same minerals as the last described but appears to be richer in olivine.

(6). About 600 yards Northeast of the Keeper's house at Loch Tamanavay, Lewis. About 600 yards north-east of the Keeper's house at Tamanavay is a small out-crop 30 yards long by 10 yards broad trending E. - W. In the field and in hand specimens this rock shows the same characters as the others described.

The occurrence of these isolated outcrops of ultra-basic rock is curious and the question of their age presents difficulties. Where contacts can be seen it appears that they are intrusive into the older complex. Some/

Some of them such as the example cited from Scarpa and from Laxadale near Tarbert show signs of shearing, but the dyke-like body at Brandersaig is no more disturbed than is usual with the later doleritic dykes. Again, the Maaruig mass lies athwart the course of a marked line of shearing seen on the south side of the loch but is itself quite undisturbed. As many of these minor shear lines die out within a comparatively short dis--tance it is not clear whether the undisturbed condi--tion of the peridotite is due to the failure of the line of shearing before reaching it or to the fact that the peridotite is later in age than the crushing.

It is possible that these ultra-basic rocks are not all of the same period; in particular, the olivine rich dyke at Brandersaig may be of Tertiary age.

(g). ?Paragneisses.

Obscure remains which may have been derived from sedimentary rocks were observed at one locality only. On the left bank of the Skegadale River about 100 yds. upstream from the road-bridge two narrow bands of fine-grained quartzose rock can be seen. Under the micro--scope these rocks appear to be made up to the extent of two thirds of their bulk of quartz in rounded grains. The only other important constituent is oligoclase felspar/

felspar also in rounded grains and very fresh. Flakes of brown biotite, some elongated and passing through several of the felspar or quartz grains occur sparingly. Between the quartz grains occur minute threads of black material which may be graphite. (Pl. IV. Fig. 4).

These rocks, in the field, in hand specimens and under the microscope resemble closely the quartzose bands among the paragneisses seen on the western shore of South Harris near Borve Lodge(1). Their relation-ships to the surrounding rocks are quite obscure.

(h). The Granite Gneiss.

The western part of the area in North Harris and also in Lewis as far north as the Bay of Uig is occu-pied mainly by a granite-gneiss which is clearly in-trusive into the older complex. This rock in mass has a faint reddish colour and weathers with smoother outlines than the biotite gneiss. Hence, the hills of the west coast with their warmer colours and roun-der forms stand in contrast to the sharp peaks and ridges with their predominantly grey colour which mark east and central Harris. (Pl. I., Fig. 2).

Though so important a feature of the west coast its/

(1). T. J. Jehu and R.M. Craig - Trans. Edin. Roy. Soc. Vol. LV. Part 2, p. 478, 1927.

its boundaries are difficult to map because of its mode of occurrence. Thus, on a traverse of the south coast of North Harris it first becomes prominent west of Loch Meavaig forming ribs of all sizes penetrating the rocks of the older complex generally parallel to the strike but at places cutting sharply across it. Of this type of occurrence an excellent example can be seen at Cnoc Mor on Husinish Point. There, much crum-pled contorted and well foliated biotite-gneiss with hornblende-biotite-gneiss and phacoids of hornblende-gneiss has been cut by broad bands of granite-gneiss and pegmatites. The island of Scarp shows similar features well. The southeast part of the island is of particular interest for here the foliation of the older gneiss is irregular or strikes N.E. - S.W. The ribs of granite-gneiss and pegmatites however, cut across the biotite-gneiss in a N.W. - S.E. direction. This is well seen on the shore near Eilean na Maol Mor where a prominent black hornblende-biotite rock is cut at right angles by the granite-gneiss. In the north-west of Scarp however, the granite-gneiss becomes much more abundant and the rocks of the older complex appear as lenticles or large "floaters". A point of further interest here is that while these floaters of the older biotite-gneiss show their usual strong foliation even/

even when rotated out of their original alignment the granite-gneiss surrounding them frequently appears as a normal unfoliated granite. At other times, however, the granite-gneiss has a foliation parallel to the biotite-gneiss but seldom so strongly marked. Another area where the granite-gneiss appears merely as ribs penetrating the older complex is on the area of compa--rative low ground between Loch Resort and Loch Tamana--vay. But the most striking examples are seen on the sea cliffs from Aird Brenish to the Gallan Head. On the numerous cliff faces the granite-gneiss and its pegmatites though collectively forming probably less than a tenth of the whole complex appears as a light coloured irregular mesh surrounding the dark grey or black rocks of the older complex. (Pl. I. Figs. 3 and 4).

A further stage in the process of intrusion is seen on the slopes of Leosaval northwest of Amhuinn--suidhe where the rocks of the older complex are repre--sented by small detached "floaters" the granite-gneiss composing the bulk of the rock.

The granite-gneiss may also form whole mountain masses as Tirga More and Tirga Beg, north of Amhuinn--suidhe, and the greater part of the area to the north--west including Mas Garbh and Taran Mor. But the largest single exposure, undoubtedly, composes the

Uig/

Uig Hills between Loch Tamanavay and the Bay of Uig. These hills with their rounded bare tops and steep sided rocky valleys have a character all their own.

It may be noted that the main exposure of the granite-gneiss when traced from south to north strikes first N.W., and then N. and finally at its northern extremity turns towards N.E. The line shown on the map is drawn to enclose the area within which the gra--nite-gneiss is the most important constituent of the complex, and includes not only such areas as central Harris and the Uig hills where it occupies the ground to the exclusion of all other rocks, but also areas such as northwest Scarp, Mealsta Island, Husinish Point and Arda Mora where it forms at least half of the complex. Areas, such as southeast Scarp and that between Loch Resort and Loch Tamanavay where the granite gneiss though present is subordinate to other rocks of the complex are indicated by the wider spacing of the sym--bols used to indicate granite-gneiss.

The length of this main area in North Harris and the Uig district of Lewis is almost 16 miles, and if its southerly extension into South Harris be added the length would be increased to 24 miles. The breadth varies from about 4 miles in the central part of the Uig Hills to 8 miles in North Harris, including the island/

island of Scarp. Its form appears to be that of an elongated bathylyth only a small part of which is ex-posed. It is probable that it underlies much of the ground to the north and east of the actual exposure as outlined on the map for numerous small exposures are seen outside the main area as on Forsnaval, in Glen Valtos, on the hills east of the road at Geshader, and at numerous other points between the Uig Hills and Little Loch Roag. Even as far east as Gillival Glas north of Tarbert and again on Tomnaval northeast of Clisham exposures occur. Most of these however, are too small to be shown on the map.

It has been noted that in the northwest of Scarp the granite-gneiss is sometimes unfoliated but a survey of the whole area shows that though the foliation of the granite-gneiss is usually less developed than that of the biotite-gneiss and accompanying rocks, still the mass, as a whole, has the same direction of folia-tion as the surrounding gneisses. Possibly the in-trusion of the granite-gneiss was a late episode in the history of the Archaean Complex of this region and took place after the main foliation had been produced but before the movements which produced it had entirely ceased. The movements which produced the foliation, however, must have been long prior to the crushing

(p.65) which/

which affects all components of the complex including the granite-gneiss, and often in directions different to that of the foliation.

In hand specimen the granite-gneiss is usually of medium grain, though coarser varieties are found among the Uig hills, faint red due to the prevailing colour of the felspars, and unmistakably granitic in appear-ance. A large scale foliation seen in the field is not so obvious in hand specimens and hardly noticeable under the microscope.

A specimen from one of the numerous bands cutting the rocks on Husinish Point when examined under the microscope is seen to consist of quartz of the usual granitic type but less abundant than in the biotite-gneiss. The typical felspars are orthoclase and micro-cline, the latter predominating, with nearly equal quantities of albite-oligoclase (near albite). Myrme-kitic intergrowths of quartz and felspar are frequent. Biotite and muscovite are present, also relatively abun-dant epidote. Granules of sphene, apatite and magne-tite occur as accessories. (Pl.IV.,Figs. 5 and 6).

The typical granite-gneiss of Leosoval is a grani-tic rock of uneven grain which shows evidence of crush-ing. The quartz is drawn out into elongated groups of granules. The felspar, less disturbed than the quartz/

quartz, includes orthoclase, microcline and albite-oligoclase. Microperthitic intergrowths of microcline with plagioclase felspar are common. Biotite and muscovite are relatively abundant, also yellow epidote. Apatite is present but magnetite is scarce.

An example from the north side of Tirga More though in hand specimen like a typical granite shows in section abundant evidence of crushing, small lines of shearing, with intermediate uncrushed bands traver--sing the rock in a northwest direction. The quartz is drawn out, strain shadowed and often reduced to ag--gregates of granules. Orthoclase, microcline and albite oligoclase though less affected than the quartz are also bent and broken. Myrmekitic intergrowths of orthoclase and quartz are common, also micro-perthitic intergrowths of microcline with plagioclase. Biotite is the main ferromagnesian constituent but muscovite also occurs. Epidote is abundant usually in granules but occasionally as crystals having a core of deep brown orthite. Granular sphene, apatite and magnetite complete the mineral content of the rock.

To the north, in Lewis, the granite-gneiss retains its character though in the Uig hills especially at the northern end as on Mealisval, Tarain and Suainaval coarser varieties appear but these do not differ in

mineral/

mineral character from the normal rock. Thus a speci-
-men of the coarser rock from the ridge north of the summit of Mealisval shows quartz subordinate to the felspar. The felspar consists of orthoclase, micro-
-cline and albite-oligoclase. Biotite with numerous pleochroic haloes around inclusions is abundant, musco-
-vite occurs sparingly. There is rather abundant granular sphene and apatite, sometimes colourless, some-
-times coloured brown. Magnetite occurs sparingly. (Pl.V.,Fig. 1).

In the central part of the Uig hills especially where the Loch Raonasgail valley has cut deep into the mass a variety of the granite-gneiss redder in colour and somewhat coarser in grain is exposed. It appears to underlie the normal type. In mineral character, however, it does not differ in any essential respect from the rocks already described.

The granite-gneiss is easily distinguished in the field from the biotite-gneiss by its colour, granitic appearance, and less marked foliation. Under the mi-
-croscope it invariably contains less quartz and more potash felspar, especially microcline, which is not seen in the unmodified biotite-gneiss. The presence of muscovite in addition to biotite and the relatively greater abundance of epidote with cores of orthite are further points of difference.

It may be convenient to notice here certain bands of coarse red acid gneiss which occur chiefly on the south coast of North Harris, striking N.W. They are seen on both sides of the narrow isthmus at Tarbert and begin to be prominent on the southwest coast near Brandersaig southeast of Amhuinnsuidhe and are frequent from thence to the westwards as at Ard Hunish, and on Husinish Point itself. At Amhuinnsuidhe a well-marked band runs N.W. to the pass leading to Glen Cravadale. A curious feature of their occurrence is that they often lie along lines of crushing and the rock of which they are composed is so sheared that the determination of the constituent minerals is often difficult. A specimen from Ard Hunish southeast of Amhuinnsuidhe, where the rock is not so crushed as usual, consists of quartz much less in amount than the felspar which in-cludes orthoclase, microcline and oligoclase. Muscovite occurs very sparingly and there is also present some yellow epidote. The texture of the rock is coarser than the granite-gneiss but finer and more even than that of the pegmatites.

(i). Pegmatites.

Pegmatites are widely distributed throughout the region described. They occur most commonly in dyke-like form striking in the usual N.W. - S.E. direction and they maintain their course even when the direction of foliation varies, in which case they cut sharply across the older structures occasionally branching and veining in the surrounding rocks.

As a rule they are small, not more than a few feet in thickness and they do not form so conspicuous a feature of the landscape as in South Harris or the island of Taransay.

At certain localities however, they become numer--ous. Thus, on the steep south face of Clisham where as already noticed, the biotite-gneiss is shot with felspathic veins, the pegmatites are numerous and conspicuous.

On the slopes of Leosoval and Husival More north-west of Amhuinnsuidhe where granite-gneiss has almost entirely replaced the biotite-gneiss, the latter being represented only by occasional lenticles, pegmatites are very numerous though small.

On Tirga More and Tirga Beg N.W. trending pegma--tites are numerous and conspicuous in granite-gneiss.

Among/

Among the Uig hills, as for instance, on Teinnas--val they are well exposed while the coastal cliffs of the Uig district such as Aird Fenish, Ard More Mangers--ta and the Gallan Head show in numerous clear sections how thoroughly pegmatites have penetrated the rocks in every direction.

It is however, on the west coast of Harris and upon the island of Scarp that the pegmatites reach their greatest development. The southeast part of Scarp contains many but to the northwest they increase rapidly in number and in size; pegmatites of 6 feet or more in thickness being common. They can be close--ly studied on the coast from Manish Point to Tarta Geo and Bulla Charpa. Here too it can be seen that though the pegmatites are somewhat later than the granite-gneiss, in places they grade into it. The pegmatites and the granite-gneiss are obviously from the same magma.

The common type is quartzo-felspathic, the felspar predominating. The chief felspar is orthoclase or microcline often containing plagioclase in perthitic and micro-perthitic intergrowth. Graphic inter--growths of quartz and felspar are also common. Another constituent which occurs sparingly is a dark gren or black biotite. Many of them contain segregations of

magnetite/

magnetite up to six inches in length. These black segregations appear to be highly resistant to weather--ing and stand out conspicuously on weathered surfaces. They are common in the pegmatites in the west of Scarp, conspicuous in those of Tirga More and Tirga Beg in the Forest of Harris and particularly common in the southern part of the Uig hills as on Teinnasval and Tamanaisval. So far as examined, however, these peg--matites connected with the granite-gneiss appear to be singularly free from other and rarer minerals so often associated with such rocks.

A few small pegmatites confined to the southeast coast of North Harris where they appear to be connec--ted with the coarse acid hornblende-gneiss described in section (d), have been already referred to. These small pegmatites consist of quartz, orthoclase and oligoclase with prominent crystals of black hornblende. They can be seen at intervals along the coast east and west of Kyles Scalpay, east of Tarbert.

2. Zones of Crushing and Crushed Rocks.

Evidence of earth movement, later than all the elements of the Archaean Complex, is abundant both in North Harris and in the part of Lewis described. These movements have been accompanied by crushing and shearing resulting in the production of crushed rocks, mylonites, flinty crush rock, and, in certain cases pseudo-tachylyte. These zones of shearing follow de--finite directions and can be divided into two groups, the first trending N.W. - S.E., or N.N.W. - S.S.E., the other trending N. - S., or N.N.E. - S.S.W.

The shearing lines of the first group, though narrow, have a marked effect upon the topography be--cause, as a result of erosion, they have been cut out into well marked valleys. Probably the largest and best marked is that which crosses the isthmus at Tar--bert. The trend of this valley is N.W. - S.E. and the greater part is now covered by the sea though the crushed rocks out of which it has been cut can still be seen especially on the south side of the valley and west of Tarbert.

In the neighbourhood of Brandersaig and again at Amhuinnsuidhe this main line of shearing either bran--ches or is cut by a number of smaller and more northerly/

northerly directed lines. The crushing along these lines can be seen on the coast between Ard Meavaig and Ard Hunish.

One of these lines of crushing passes through the hollow marked by the chain of lochs west of Amhuinn--suidhe and from thence across the narrow neck of Husi--nish Point. On both sides of Husinish Bay the crush--ed red granite-gneiss involved is well seen. Further to the northwest traces of it are seen in Scarp but not so marked as on the mainland.

Another belt passes from near Ard Hunish along the hollow marked by the lochs northeast of Amhuinn--suidhe, from thence through Glen Leosaid and on to Glen Cravadale. In Glen Leosaid crushed red granite-gneiss and pegmatites can be seen along the stream course. Here too, as in the example previously des--cribed, several later dykes have followed the same path but the dykes may cross the crush lines obliquely and are probably independent of them.

On the east coast another small example is seen on the north side of Loch Trollmarig, at the head of the loch, and can be traced for some distance in the course of the stream which enters the loch there. Disturbed rocks in the upper part of the Laxadale Burn may mark its extension in a northwest direction but the

exposures/

exposures are poor. At its seaward end, on Loch Troll-marig, there is some evidence of faulting marked by a breccia of the local rocks with limonitic cementing material.

Another important line of shearing runs in line with the lower part of Loch Seaforth and forms on land a marked feature from Aline north-northwest to Loch Langavat and beyond it in the direction of Little Loch Roag. The depression marking its course is almost entirely filled with glacial drift which in turn is overlaid by peat and the underlying rocks are not seen except in the Amhuinn a Mhuil which for a short distance forms the boundary between Harris and Lewis. Along the course of this stream the rocks exposed consist of biotite-gneiss, hornblende-biotite-gneiss, and hornblende-gneiss with pegmatites. These are sheared in a N.N.W. direction the planes of shearing dipping E.N.E. In the neighbourhood of Loch Langavat, where this line should cross, the rocks are deeply covered by morainic material and on the peat covered hills between Loch Langavat and Morsgail it has not been observed. Further to the north-northwest however, in the well marked hollow through which the road runs towards Garyshader crushed rocks are seen which probably belong/

belong to this line. It is however, still further north-northwest between Uigean and Cliv-Sands that the best exposures are seen. On the top of Nisa Mhor the prevalent gneisses show shearing with production of new foliation planes striking N.N.W. - S.S.E. (the normal foliation here strikes N.E. - S.W.) and with dip to E.N.E. Occasional veins of green mylonite and darker flinty crush-rock can be seen but crushing becomes more and more marked as the observer descends the west side of the hill until just where the solid rock is concealed by scree the rocks have been reduced to green mylonite and typical flinty crush-rock. Just north--west of Nisa Mhor there is a hillock of the granite-gneiss which has been worked for road metal. The granite-gneiss has been reduced by crushing to a red flinty material. The valley from Uigean to Cliv-Sands appears to mark the course of the main part of this crush but another line is seen in the hollow east of Geshader. To the east of Uigean, at least two other lines having the same general trend are visible. Minor lines of shearing and disturbance are also seen to the west crossing Glen Valtos.

The crushed rocks involved along these lines of movement present no special features of interest. The rocks/

rocks are brecciated, drawn out, and less commonly re-(Pl.V., Figs. 2 and 3).
-duced to mylonites. On the south coast near Ard Hunish the crushed red granite-gneiss is highly epido--tised and the beach is strewn with brightly coloured pebbles. Finely mylonised red gneisses can be seen in Glen Leosaid and again at Husinish Point, but flinty crush-rock is rare or absent except at the northern end of the long N.N.W. line at Nisa Mhor in the Uig dis--trict. Veins of green and yellow flinty-crush rock are seen on the ridge north of Suainaval (Uig).

These lines of shearing resemble in all essential respects those described from South Harris (1), and the numerous examples mapped and described in the North-West Highlands by the Geological Survey (2). They are undoubtedly later than all the rocks of the Archæan Complex, though earlier than the later dykes.

The shear-lines of the second group, namely those which have a N. - S. or N.E. - S.W. trend are obviously connected with the movements from E. - W. which pro--duced the great belt of sheared rock which has been traced along the eastern side of the Long Island in Barra, South Uist, North Uist and South Harris by Jehu and Craig, and in Lewis by Dougal. They appear usually/

(1). Jehu and Craig, Trans. Roy. Soc. Edin. Vol. LV., Part IV., p. 483, 1927.
(2). "The Geological Structure of the North-West High--lands of Scotland", Mem. Geol. Surv. 1907, p. 3 and pp. 245 - 251.

usually as broad zones of partly crushed rock with occasional narrow belts where the crushing has been accentuated. These last, however, are not continuous. A general crushing from east to west affects practic-ally all the ground between the east coast and the Clisham ridge but is most marked along the east coast, on the headlands on Loch Seaforth, and upon the ground between Aline and the Laxay River.

One of these small inconstant shear lines is seen on the hillside east of the seaward end of the Laxadale valley. As followed north it turns more and more to the eastward and appears to die out near the path to Loch Trollmarig.

Further north another small one is seen on the steep slope on the east side of the Laxadale Valley and near the head of the valley.

One of the best marked in Harris is seen in the hollow east of Toddun, which leads from Loch Trollmarig to Loch Maaruig, the evidence being most marked at the north end. From Loch Mor in a N.N.W. direction to Loch Maaruig, in a narrow belt, typical mylonites, flinty-crush rock and pseudo-tachylyte have been de-veloped from the crushed biotite and hornblende-biotite-gneisses of the region. Here too, can be seen on a small scale, the passage of flinty-crush rock into pseudo-tachylyte/

pseudo-tachylyte which once formed, may behave intrus-
-ively, veining and threading the surrounding rocks in
all directions. (Pl.V.,Fig. 4).

Further north between Roineval and Balallan crush-
-ing from east to west affects practically every ex-
-posure seen and increases in the direction of the
Laxay River, where 500 yards north of the main road a
broad band of green and variegated mylonites and typi-
-cal flinty-crush rock crosses the river striking N.E.
To the southwest the crush runs by the southeast end
of Loch Diasport towards Loch Erisort. The extension
to the eastwards of this crushed belt lies outside the
area dealt with in this paper but a very careful exami-
-nation of the hills north of Balallan shows that the
mylonites and flinty-crush rock seen near the Laxay
River are by far the most extensively developed in this
area and probably mark the true base of the great zone
of shearing which marks the eastern side of the Long
Island. Traced northward from Barra it is well seen
in South Uist and North Uist, and again in South Harris
appearing last in the Island of Scalpay near the light-
-house where it strikes N.E. It is known to occur in
the Park District of Lewis and when seen north of the
Park District at the Laxay River must have swung round
more to the north. It is possible that the massive

biotite-gneiss/

biotite-gneiss of North Harris formed a resistant core causing a local deflection of the movements. Whether that be so or not it is clear that the lines of shear-ing in North Harris and in the part of Lewis described in this paper are quite minor features and represent no more than the small inconstant lines of crushing seen in advance of the main belt as in South Uist and North Uist.

3. Later Dykes.

Dykes of later age are not so common in North Harris and the parts of Lewis dealt with in this paper as in the islands further south. Most of these col-lected have been obtained from the south coast of North Harris between Tarbert and Husinish. Compara-tively few were observed along the shore of Loch Sea-forth and in the part of Lewis examined they appear to be still scarcer. Away from the coast they are not often seen and when seen, are not usually trace-able for long distances. As compared with the gneiss they appear to weather rapidly forming hollows filled with drift and peat.

Their general trend is S.E. - N.W., or S.S.E. - N.N.W. A few strike nearly E. - W., or even N.E. - S.W. Many of them, where clearly exposed on the coast/

coast, show marked variations in thickness laterally; a few are lenticular in form. As a rule the small dykes are much decomposed but the larger, 10 - 30 ft. wide, on the other hand, are often beautifully fresh.

There is not the same variety among these dykes as found in the islands of the Long Island chain fur-ther south. The quartz-dolerites, tholeiites, camptonites and lamprophyres of South Uist and Barra were not observed (1). Out of a collection of forty three dykes the chief varieties are as follows:-

(a). Olivine-Dolerites (Crinan Type). - Olivine-dolerites of Crinan Type (2) as defined by Sir John Flett are by far the most common. A very beautiful and fresh example among many forms a lenticle 70 yards long by 40 yards wide trending N.W. on the west side of the pass between Beinn a Teanga and Gillival Glas north of Tarbert. It is rather coarse in texture with marked ophitic structure. It consists of fresh olivine, purple or plum-coloured augite, fresh plagio-clase felspar mainly labradorite but with marginal modifications more acid in composition. There is present/

(1). Jehu and Craig - "The Geology of the Outer Hebri-des, Part 1. - The Barra Isles", Trans. Roy. Soc. Edin. Vol. LIII., p. 436 (1923), also Trans. Roy. Soc. Edin., Vol. LIII., p. 635, (1925).

(2). Mem. Geol. Surv. "The Geology of Colonsay" p. 42, 1911, and Mem. Geol. Surv. "The Geology of Knapdale, Jura and North Kintyre", p. 116, 1911.

present, also, rather abundant ilmenite with which is usually associated a few small flakes of brown biotite. In addition there are numerous slender needles of apa-tite and a limited amount of clear fresh analcime which occurs interstitially and appears to be unevenly distributed throughout the rock (Pl.V.,Fig. 5).

Another good fresh example trending E. - W. and up to 30 feet in width can be traced for some distance along the ridge of Gillival Glas and near the southern face of the ridge. It resembles closely the example last described.

A third example is seen as a lenticular exposure forming a prominent smooth ridge 100 yards long by 30 yards broad trending N.N.W. just south of the main road and west of the north end of Loch Stacsavat (Uig). Remarkably fresh and of rather coarse grain, this speci-men does not show the usual ophitic structure except in parts. The plum coloured augite tends to occur in groups of granules or in groups of parallel small lathes. The olivine is beautifully fresh and the clear analcime is relatively abundant.

(b). Olivine-Dolerites and Basalts. - Next in im-portance are dykes which may be described as olivine-dolerites and olivine-basalts. Some are medium-grained, a few are coarse-grained, others are of fine grain./

grain. Those classed as dolerites have the usual ophitic structure but others show the ophitic structure of a dolerite in one part and the basaltic structure at another. All of them contain the same purple augite as the crinanites and with the exception of the absence of analcime resemble them in mineralogical characters. It seems likely that they belong to the same magma.

As an example may be cited the second dyke seen on the shore east of Ard an Tolmachan on West Loch Tar-bert. It is at least 20 feet thick and in hand speci-mens appears to be fresh, coarse-grained like a gabbro, and highly felspathic. It consists of crystals or groups of crystals, sometimes half an inch in length, of plagioclase felspar (labradorite) which are usually spotted by minute inclusions of partly devitrified glass, the inclusions having a linear arrangement par-allel to successive zones of growth of the crystals. These felspars or groups of felspars are set in a ma-trix which has the texture of an ordinary dolerite made up of plagioclase and augite related ophitically. In addition in the matrix there is decomposed granular olivine, ilmenite and apatite. (Pl.V.,Fig. 6).

It appears likely that all these dykes belong to the same general period and that they are of Tertiary age./

age. They cut all members of the Archaean Complex and are entirely unaffected by the movements which have in places sheared and crushed the gneiss.

V. PHYSICAL FEATURES.

Hills.

The dominating feature of North Harris is a great ridge which runs E.S.E. - W.N.W. Along this ridge, and more especially towards the eastern end, where the biotite-gneiss is the prevalent rock, the highest hills occur. At the eastern end and in order towards the west are Beinn a Chaolais, Toddun, Gillival Glas, Sgaoth Iosal, and Sgaoth Ard. In a group by themselves stand Clisham (2622 feet), the highest point of the range, Mulla fo Dheas (2439 feet) and Mullach an Langa (2012 feet). Still further west are Uisgna--val More (2392 feet), Oreval (2165 feet), Ullaval (2153 feet) and Tirga More (2277 feet), making in all, seven peaks over 2000 ft. in height.

To the north and within the area dealt with an irregular ridge runs N.N.W. and N.W. from near Loch Langavat to Beinn Mheadhonach and from thence by Tein--nasval to the west coast, but this ridge though form--ing an important watershed is not so obvious on the ground./

ground. Of the hills of Lewis by far the most strik-ing are grouped in the western part of the Uig Dis-trict. Mealisval (1885 feet), Tahaval (1688 feet), Cracaval (1682 feet), North Liaval (1625 feet) and Suainaval (1404 feet) are the most important heights.

Valleys.

These ridges are trenched by well marked valleys which trend in different directions, the most important of which will be noted.

(1). Valleys trending N.W. - S.E. These are usually parallel to the prevailing strike of the gneis-sic foliation, to lines of crushing or to the trend of the later dykes. The largest example is that which separates North Harris from South Harris and now lies below sea-level except at Tarbert. Smaller examples diverging slightly in direction from the one last men-tioned pass from Amhuinnsuidhe to Husinish and from Amhuinnsuidhe to Glen Cravadale. A small example in the east runs landward from Loch Trollmarig. The main strike of the gneissic foliation and the trend of crush lines seems to be the controlling factor in the case of these valleys which are similar to those seen in South Harris. Where the strike changes as in the Uig dis-trict or near Balallan valleys of this kind do not appear.

(2)./

(2). Valleys trending N.N.W. On the east coast the lower part of Loch Seaforth and several smaller valleys trend N.N.W. A continuation of the Loch Sea--forth valley forms a prominent feature from Aline on Loch Seaforth to Little Loch Roag in Lewis. The two small valleys respectively east and west of Toddun trend in the same direction. It has been noted (p.67) that the marked feature between Aline and Loch Langavat lies along a minor line of crushing, but in the smaller valleys east and west of Toddun the valleys lie some--what oblique to the crushing which here pursue a more northerly course. Another factor, in addition to the crushing already described (p.67) appears to intervene. All along the western shore of Loch Seaforth from its mouth to near Ardvourlie the rocks are remarkably join--ted the main joints running respectively parallel with and at right angles to the trend of the lower part of the loch. Between Loch Maaruig and Loch Trollmarig, especially at the latter place, this jointing is so strongly marked that it has given a castellated appear--ance to the hill slopes and sea-cliffs unique within this district. Along the shores of Loch Seaforth immediately north of Loch Trollmarig the joints paral--lel to the loch become so numerous and closely spaced that it is difficult to avoid the conclusion that the excavation/

excavation of the Loch Seaforth valley has been due more to their presence than to the nature of the rock. A further point of interest is observed here. A num--ber of narrow very decomposed basaltic dykes striking N.W. are seen at intervals on the coast between Loch Trollmarig and Loch Maaruig. Several of these are observed to be jointed like the surrounding gneiss. No evidence of extensive faulting was observed but movement on a small scale has taken place along the joints. It seems possible that the formation of these joints was a late episode (probably Tertiary) in the history of the region and may have a bearing upon the direction of the lower part of Loch Seaforth and the adjacent sea lochs in the Park district. Nothing comparable with the jointing along the western shore of Loch Seaforth has been seen anywhere else in the district. In this connection the conclusions of Professor J. W. Gregory already cited (p.6) with re--gard to the formation of the Hebridean fiords are important.

(3). N.E. - S.W. Valleys. A number of well-marked valleys open either to the N.E. or to the S.W. Of those opening to the N.E. the best examples occur on the east coast such as the valley of the Maaruig, Glen/

Glen Scalladale and Glen Vigadale. Glen Scalladale is by far the largest and finest of these and appears to unite with Glen Vigadale to form a still larger val-ley further to the N.E. now occupied by Loch Seaforth. It will be shown, however, that this northeasterly directed part of Loch Seaforth has been greatly accen-tuated by glacial erosion.

Few valleys of importance open to the S.W. The best marked are the Loch a Mhorgain valley leading to Loch Bun Abhuin Eadar east of Tarbert, Loch Resort, the valley leading to Loch Tamanavay and the deep narrow valley at Mangersta (Uig).

(4). N. - S. Valleys. The most curious and char-acteristic valleys of this region, however, are those which trend true north and south. From east to west they are as follows:-

(1). The Laxadale Valley east of Tarbert.

(2). Glen Langadale and the southern part of the Loch Langavat valley in the north and the valley leading to West Loch Tarbert in the south.

(3). The Loch Voshimid Valley on the north and Glen Meavaig to the south.

(4). The Ulladale Valley on the north and that of the river Eavat on the south.

(5). The Loch Suainavat Valley (Uig).

(6). The Loch Raonasgail valley (Uig) opening to the north with a corresponding depression passing south into Loch Tamanavay.

In addition to those mentioned above remains appear of another and parallel valley still further west and now partly covered by the sea. A relic of this valley appears in the curious N. - S. depression between Aird Brenish and the Uig Hills. Its further extension southwards may be marked by the sound between Mealsta Island and the mainland, by the sound between Scarp and the mainland and by the low lying neck of Husinish Point.

The N. - S. valleys are best developed on high ground. They are deeply excavated and the watersheds between them are narrow and low. They appear to have been excavated faster than the adjacent valleys for the Meavaig River north of Loch Scourst has captured a N.W. flowing stream from Glen Uisletter.. Similarly the River Eavat at Amhuinnsuidhe has captured the River Leosaid. In North Harris these glens have been cut obliquely to the strike of the gneiss and they do not appear to follow lines of crushing, faults, or the course of dykes. In the Laxadale Valley a small zone of crushing is visible on the east side but when traced from the coast inland it turns away to the northeast within a short distance. On the other hand, in Laxadale and in the examples in central Harris undis--turbed gneiss with N.W. strike can sometimes be traced obliquely/

obliquely across them. Dykes are seen near the mouths of the Loch Suainavat and Loch Raonasgail valleys in Uig but though the exposures are short it appears that the dykes strike N.N.W., and that is, obliquely to the trend of the valleys.

It is difficult to explain the origin of these valleys but the suggestion is offered that occurring as they do only on the highest ground they may have been initiated upon a formation of simple structure overlying the gneiss and once formed have maintained their direction when by erosion they reached the underlying gneiss.

Streams.

There are no large rivers within the area. The chief are the stream draining the lochs at Amhuinnsuidhe, the River Housay draining into Loch Resort, the Maaruig River, the Scalladale River, the river draining Loch Stacsavat and Loch Suainavat and that which passes from Loch Raonasgail to the Bay of Uig. Those which drain the high bare hills come down rapidly in flood and as quickly subside, while those draining low lying moorland and lochs rise slowly and as slowly subside.

Freshwater Lochs.

The freshwater lochs within the

area/

area described though not so numerous as in Benbecula, North Uist or the central parts of Lewis are of great interest because they include nearly all the main types which form so prominent a feature of the Outer Hebrides. For purposes of description they may be divided into corry lochs, valley lochs and moorland lochs.

Corry lochs, consisting of rock basins produced by glacial erosion or partly rock basins and partly moraine-dammed, are beautifully illustrated both in Harris and Lewis. In Glen Scalladale the great corry at the head of the glen contains Loch Vistem and Loch nan Eang both of which are held up mainly by moraine material. Another fine example is Loch Maolaig on the southeast slopes of Tirga More which is mainly a rock basin, but has also a high barrier of morainic material on the southeast side. In Lewis, Loch Dibadale is a very beautiful rock basin excavated by ice out of the granite-gneiss in the corry east of Tamanaisval. Several good examples occur among the Uig hills of which may be mentioned the little rock basins north of Tarain.

The valley lochs generally long narrow and deep are well represented by the Laxadale Lochs east of Tarbert, by Loch Scourst, Loch Voshimid, and Loch a Ghlinne, all in Harris. In Lewis notable examples

are/

are Loch Langavat, Loch Suainavat and Loch Raonasgail.

Moorland lochs are well seen on the moor northwest of Balallan between the north end of Loch Langavat and Morsgail, east of Loch Tamanavay and again northwest of the Uig hills between Aird Brenish and Mangersta.

The lochs of North Harris were not examined by the Lake Survey during the Bathymetrical Survey of the Scottish Lochs, but several important examples within this area in Lewis were studied.(1) Chief of these is Loch Langavat, the most extensive loch in the Outer Hebrides, which lies partly in a well marked valley and partly on the open moorland and so in its southern part is a typical valley loch, but in its northern extension has all the characteristics of a moorland loch. Stand-ing 108 feet above sea-level it is 7.86 miles long and from one quarter to one third of a mile wide, with an area of 3.45 sq. miles. It consists of a number of de-tached basins the largest and deepest lying in the lower (southern) part of the loch. Another occurs north of the narrows and three lesser basins occur at the upper (northern) end. The maximum depth is 98 ft. The narrows are due to the presence of a terminal moraine and moraine material is abundant on both sides for/

(1). "Bathymetrical Survey of the Scottish Fresh-water Lochs", Vol. II., Part 2, p. 205, 1910.

for the greater part of its length. These features will be referred to more fully (p. 99).

Loch Suainaval, locally and probably more correct-ly called Loch Suainavat, is a beautiful loch occupy-ing the more easterly of the two main N.- S. valleys traversing the Uig hills. It stands 37.4 feet above sea-level and has a superficial area of about a square mile. In form it is a simple basin which reaches the astonishing depth of 219 feet, that is, more than three times the depth of any other loch in Lewis. Though having less than a third of the superficial area of Loch Langavat it actually contains more water. Geologically it is a rock basin.

Loch Raonasgail a small loch at the north end of the N. - S. valley between Mealisval and Tarain is two-thirds of a mile long and one fifth of a mile broad. Though small it attains a maximum depth of 95 feet.

Sea Lochs.

The sea lochs, though not so numerous within this area as in other parts of the Long Island, show considerable diversity of character. Perhaps the most interesting of them is Loch Seaforth which forms the eastern boundary of North Harris and further north separates Aline from the Park District. It is a long narrow/

narrow loch of variable depth made up of three distinct parts.

The southern seaward part, about six miles long, is narrow, deep and steep-sided, like a typical fiord, and trends N.N.W. Near the mouth there is a well-marked basin 54 fathoms deep separated from the Minch by a threshold 6 - 20 fathoms deep, from which several reefs and isolated rocks rise to the surface. The N.N.W. end is divided into two channels by Seaforth Island.

The middle stretch of the loch runs N.E. and forms a continuation in that direction of the Scalladale and Vigadale valleys. A small basin 9 - 12 fathoms deep opposite Aline is separated by shallow water from three smaller basins to the northeast.

The upper part lies E. - W. and has a maximum depth of 10 fathoms.

The composite nature of Loch Seaforth appears to be due to submergence beneath the sea of three land valleys of different trends and probably of different ages. The lower reach which runs N.N.W. has obviously been cut back by sub-aerial erosion across a valley trending N.E. and now represented by the Scalladale valley and the middle part of the loch. In this erosion the highly developed jointing referred to

earlier/

earlier (p. 79) must have played an important part.

The upper reach of the loch which lies E. - W. is obviously one of the "gutter valleys" which Professor J. W. Gregory ascribes to a period of uplift and fracturing of the British Islands in Upper and Middle Pliocene times (1).

East Loch Tarbert occupies a broad valley with a somewhat uneven floor deepening generally toward the sea. To the southwest of Scalpay there is a steep descent into the Minch from 20 to 70, 90, or even 100 fathoms. Within the loch, on the north side, between Scalpay and Tarbert there is a narrow basin parallel to the north shore reaching a depth of 34 fathoms. The submarine features of the lochs on the east coast are well brought out on the Admiralty Chart (2).

On the west coast the most important lochs are West Loch Tarbert, Loch Resort, Loch Tealasvay and Loch Tamanavay (3).

West Loch Tarbert on the opposite side of the isthmus to East Loch Tarbert opens to the N.W. It has/

(1). J. W. Gregory. "The Fiords of the Hebrides", Geographical Journal, Vol. LXIX., 1927, pp. 193 - 212.

(2). Admiralty Chart, No 2475, Ardnamurchan to Summer Isles.

(3). Admiralty Chart, No 2841, Sound of Harris to Aird Bhreidhnis.

has a more even floor than East Loch Tarbert, and deepens gradually to the open sea. No marked basins occur within it. This is the more remarkable as it lies on the course of the main ice movement as revealed by striae on its northern and southern shores. It may be, however, that lying as it does, exposed to the western ocean, any hollows formed by ice erosion have been filled with sand.

Loch Resort, a narrow loch about five and a half miles long and trending W.S.W. forms part of the boundary between North Harris and Lewis. It deepens gradually towards the mouth and there are within it no marked basins.

Loch Tealasvay has a similar form.

Loch Tamanavay, immediately to the north has a maximum depth of 21 fathoms and a well-marked threshold 5 - 14 fathoms deep from which several groups of rocks rise to near the surface.

VI. GLACIATION.

The glaciation of North Harris and of the adjacent parts of Lewis described in this paper is of special interest for here for the first time in a traverse of the Outer Hebrides from south to north is found clear evidence of two distinct phases of glaciation. The first and oldest was a general glaciation from S.E. - N.W., the second was a local glaciation guided and controlled by the hills and valleys of the district.

Macculloch noted the sands, gravels and clays but he did not interpret them as evidence of glacial action.

Sir R. Murchison and A. Geikie as already noted (p. 5) were the first to record the presence of mo--rainic material and erratics in the valleys of North Harris.

It was left to James Geikie to grasp the signifi--cance of the evidence and to him in the first instance, is due the discrimination between the general glacia--tion and the local glaciation.

General Glaciation.

The earlier general glaciation was in a general direction from S.E.- N.W. though as will be shown the form of the ground in places modified the direction of ice movement. This direction of movement is indicated by the form of the ground, by the attitude/

attitude of roches moutonnées, by striae and to a limited extent by erratics.

The hills east and north of Tarbert and in fact all along the south coast are beautifully moutonnéed and bare of soil on their southeast sides, while on their northwest slopes they are more often rough and drift-covered. The valley of the Urgha River east of Tarbert may be contrasted in this respect with the Langadale leading northwards from the high hills of Harris to Loch Langavat. The former presents bare rock surfaces with roches moutonnées fronting the south-east, the latter a drift-filled valley with moutonnéed surfaces on the western side but with steep rough faces on the east.

The hills of Uig, too, present fine moutonnéed surfaces to the southeast and south.

In valleys such as Skegadale west of Tarbert, or Glen Cravadale on the west coast ice erosion in connec-tion with the main dip and strike of the gneissic foliation has given rise to striking features. These valleys owing to the dip of the foliation are steep on their southeast or south sides but have gentle slopes to the northwest and west. While the north and north-west sides are smooth, moutonnéed and drift-free, the south and southeast sides are rough and encumbered with much/

much drift. The same applies to the N. - S. valleys, which are rougher and steeper on their eastern than on their western sides.

The high hills of Harris furnish more satisfactory evidence than is available elsewhere in the Long Island, of the thickness of the ice of the general glaciation at its maximum. James Geikie took 1600 feet as the maximum thickness and it is true that obvious signs of glaciation are present everywhere up to this height, but examination of all the high hills in Harris shows that signs of glaciation go higher. Thus, the hills north and east of Tarbert have certainly been glaciated to their summits. Gillival Glas, Sgaoth Iosal, Sgaoth Ard, the latter 1829 feet high, are beautifully smooth--ed on their summits though definite striae were not seen. On the southeast face of Gillival Glas striae occur at the head of the Urgha River in such a way as to show that the ice must have passed northwest against the slope. Toddun (1731 feet) which forms such a prominent ridge northwest of Loch Trollmarig has also been ice smoothed to the top. The hills of Uig in--cluding Mealisval (1885 feet) have clearly been covered.

It is however, on Clisham (2622 feet) that the best evidence is found. The summit of the hill forms a/

a sharp ridge consisting of rock covered deeply by great blocks which show no indication of the passage of ice but about 600 feet below the summit moutonnéed surfaces appear though now somewhat obscured by blocks fallen from the heights above. This is best seen on the northeast side of the ridge. From the evidence at Clisham it would appear that at its maximum the ice sheet reached a thickness of 2000 feet. The other hills of North Harris which lie to the west show the same features but in a lesser degree. These hills though steep are remarkably smooth near their summits and from the contrast between moutonnéed and unmouton-néed surfaces it would appear that only the tops of hills such as Uisgnaval More, Ullaval and Tirga More escaped glaciation. The ice at this stage must have been very clean in its upper layers but small erratics and perched blocks lie on the northeast side of Clisham and on Tomnaval at a height of 1800 feet.

Striae referable to the general glaciation are not so numerous or so well preserved as those of the local glaciation and in general are usually seen only in those localities where from the form of the ground they were preserved from the effect of local ice. In the northeast part of the area between Loch Seaforth and Loch Langavat, the ground is extensively peat covered

but/

but the striae seen on the roadside and on the ridge immediately northwest of Balallan trending W.N.W. pro-bably belong to the main glaciation.

At Maaruig striae on the east side of the ultra-basic mass and trending obliquely to the main valley may belong to the general glaciation.

On the north side of Loch Trollmarig numerous striae trend N.W.

On the south coast from Kyles Scalpay towards Tar-bert striae directed to the N.W. are occasionally seen on recently exposed rock surfaces.

West of Tarbert, as on Ard an Tolmachan, Ard Mea-vaig, on Husinish Point and on the south of Scarp striae trending E. - W. or W.N.W. or N.W. are common.

The central part around the head of Loch Resort is much obscured by drift and peat and striae referable to a general glaciation have not been seen but on the southern end of the Uig hills especially north of Loch Tamanavay striae pointing W.N.W. or N.W. are common. North of the mouth of Loch Tamanavay however the striae seen were parallel to the hill-slopes, that is E. - W. East and north of the northern part of the Uig hills striae point N.N.W. and this appears to be the general direction on Ben Meavaig, on Nisa Mhor and from thence east as far as Little Loch Roag. It is however, on

the/

the west coast from the Gallan Head southwards that striae are most numerous and best preserved. Inland the rocks are much drift-covered but along the edges of the sea cliffs where the drift has been stripped by the sea magnificently striated surfaces are exposed, the striae maintaining a constant direction N.N.W.

Further south on the west side of the Uig hills as on North Liaval and the neighbouring hills, where striae were not seen, the smoothed and moutonnéed sur-faces indicate a similar direction of movement.

With the general glaciation also is probably to be connected that part of the drift which most nearly resembles the boulder clay of the mainland of Scotland.

In North Harris it is always found on the low ground filling pockets and rock hollows which have no connection with the present valleys. This can be well seen along the south coast east and west of Tar-bert. The material is a hard stony rubble with little clay material. The boulders contained in it, so far as observed, are all of local rocks.

Away from the hills, as north of Ardvourlie and in the neighbourhood of Balallan true boulder clay makes its appearance. It is grey-blue in colour, tough, resistant to weathering and contains compara-tively few stones or boulders, these, as usual consis-ting of/

of local rocks. Material of this kind appears to overlie the rock and underlie the peat over the greater part of the area between Loch Seaforth and Loch Langavat. It is abundant on the ground at and north of the head of Loch Resort, between Little Loch Roag and the Uig hills, and again, to the north between the Gallan Head and Glen Valtos though here it has been largely removed by subsequent erosion. It appears again on the little island of Fladday near Scarp and on the northern part of Scarp itself.

On the high ground erratics are numerous but as these, so far as observed are all of local rocks the evidence they afford is scanty. An interesting example occurs on the island of Scarp where near Manish an isolated mass of ultra-basic rock now altered to an actinolite schist is capped by a boulder of granite-gneiss. The situation precludes the action of local ice. Another example which occurs on the south coast southeast of Amhuinnsuidhe is a small outcrop of hypersthene-hornblende rock. A trail of boulders of this rock is seen at intervals to the northwest as far as Rudha Leacach. Among the Uig hills especially at their southern end numerous erratics of the biotite- and hornblende-biotite-gneisses of the eastern area can be found.

Pl.II.Fig.1

Local Glaciation.

Clear evidence remains within this district to show that after the main glaciation and probably after a long interval the valleys of North Harris and the Uig district of Lewis were occupied by glaciers which moved outwards in all directions from the main areas of high ground. Evidence in support of this conclusion is afforded by striae, terminal and lateral moraines, erratics, freshwater lochs. A few examples will now be described.

As an example of local ice movement from north to south the valley of the Laxadale Lochs east of Tarbert may be cited. In this valley there are three lochs, the largest occupying the northern part of the valley. Between the middle loch and the sea there is a well-marked rock barrier so that in a general way the two upper lochs lie in a rock basin. Striae on both sides of the main valley but specially well seen on both sides of the middle loch and again on the east side of the loch nearest the sea indicate ice movement from N. - S. On the other hand south of the rock barrier and near Urgha striae, referable to the general glacia-tion and pointing N.W. are seen. It was here that James Geikie noted the crossing of an older poorly pre-served set of striations trending N.W. by a fresher set/

set trending N. - S.

Remains of terminal moraines occur near the head of the valley at the north end of the large loch and between it and the middle loch. The Laxadale glacier must have received tributaries from Coire Screen and from Dibidale. Probably also, at one stage ice spill-ed over into it from the shallow but higher Maaruig valley.

A good lateral moraine is seen on both sides of the large loch, the highest part of it standing about 25 feet above the present level of the loch. On the east side and near the head of the Laxadale Burn is an outcrop of ultra-basic rock which weathering reddish brown is easily identified. A trail of small boulders can be traced from the outcrop downhill to the top of the lateral moraine and from thence at intervals to the south. (Pl.VI.,Fig. 1).

Similar examples but with evidence less complete, so far as erratics are concerned, are furnished by the valleys draining to the south from the central axis of Harris. Thus Glen Meavaig is a typical U-shaped valley which presents steeper faces when looking up the valley than when looking down. Loch Scourst may be, in part at least, a rock basin, but terminal moraines appear at intervals all the way down to the sea, though

most marked at the loch and again at the foot of the valley. Striae are seen pointing S.S.W. on the steep rock face south of Tolmachan. In Brandersaig, about half a mile to the west where a smaller and steeper valley opens to the sea striae pointing S.S.W., that is, parallel with the trend of the valley, cut across others which point towards N.W.

The valley of the river Eavat north of Amhuinn--suidhe has been cut across a northwest valley so that the drainage of the northwest glen has been reversed, the north south glen having been over-deepened and now occupied by Loch Leosaid. This loch, apparently much more extensive at one time has been lowered by the cut--ting down of the rock barrier between it and the sea just east of the castle. Lateral moraine material is abundant on both sides of Loch Chleoster, and terminal moraines front Loch Ashavat. At the seaward end of the valley where there remains a broad rock barrier and about half a mile east of the castle numerous striated surfaces can be seen. These show striae trending E.-- W., or E.N.E. - W.S.W., which are clearly crossed and deepened by a later set which trend S.S.E.

In the N. - S. valleys at the south end of the Uig hills, which are now occupied by small pools or lochans, numerous small terminal moraines occur indica--ting ice/

ice movement on a small scale from the higher parts of the Uig hills towards the south.

South - North. Evidence of local ice movement from south to north is afforded by the main valleys on the north side of the main Harris ridge and again at the northern end of the Uig hills.

In North Harris perhaps the largest and most stri-king is that of Langadale, the valley which taking its rise near Mullach an Langa passes from Harris into Lewis leading into the great trough of Loch Langavat and from thence on to the great central moorland of Lewis. The higher part of the glen within North Harris is a very fine example of a U-shaped valley. From the Harris-Lewis boundary southwards one crescen-tic terminal moraine after another can be seen until under the falls at Cnoc a Caisteal the series is brought to an end by a great boulder moraine. North of the Harris boundary and between it and Loch Langa-vat several beautiful terminal moraines are seen while on both shores of the loch remains of still older ones can be seen. The largest of all, or what remains of it, forms the narrows which divide the valley part of the loch from the moorland part, but even north of this remains of older terminal moraines can be seen.

The/

The lateral moraine is seen on both sides of the loch but is most marked on the west side. (Pl. II. Fig. 2).

Further west in North Harris as in the Loch Voshi--mid Valley and in Ulladale similar evidence is avail--able. From Loch Voshimid and Loch Ulladale north to Loch Resort successive terminal moraines form a feature of the landscape and both the lochs named are held up by high moraines. Lateral moraines forming a hummocky terrace on both sides of the valley are also marked.

It is however at the north end of the Uig hills that evidence on the greatest scale presents itself. The two main S. - N. valleys in the Uig hills the one now holding Loch Suainavat and Loch Stacsavat, the other Loch Raonasgail and Loch Mor na Clibhe seem to have contained glaciers which at one period were con--fluent on the lower ground near Uig including the area of the bay of Uig. Evidence in support of this view is afforded by the great banks of drift now discontinu--ous from erosion which are found near Forsnaval, Aird Uige and fringing the cliffs from the Gallan Head south to the bay of Uig south of which they again recur around the coast from Aird More Mangersta to the south of Mangersta sands. These banks of drift were probab--ly at one period continuous filling up stream courses such as that now draining into the sea at Aird Uige and the/

the deep narrow valley draining Loch Scaslavat which enters the sea at Mangersta Sands. Forming an inner ring still only partially preserved are the deposits of drift forming low cliffs in the northern inlets of the bay of Uig and on the northwest side of Loch Scas--lavat. From this inner ring towards the hills the evidence is better preserved and it is possible to con--nect up at least three concentric lines of terminal moraines of the confluent glaciers. These are succeed--ed towards the hills especially in the Loch Raonasgail valley by numerous small terminal moraines marking suc--cessive pauses in the glaciers which had now shrunk into their own valleys. Loch Suainavat lies in a rock basin with a high rock barrier beautifully stria--ted at the northern end between it and Loch Stacsavat. The stream from the loch finds its way through a narrow groove in this barrier filled with boulder clay. Loch Stacsavat also has a rock barrier between it and the sea through which it has in post-glacial times cut a shallow rock gorge. Between it and the sea stands one of the most obvious of the terminal moraines which has been breached by the stream on the west side. (Pl.II. Fig.3).

The Raonasgail Valley is of great interest. Fine terminal moraines are seen at the head of the valley and holding up the waters of Loch Raonasgail and Loch Mor na Clibhe. The/

The rock valley is probably much deeper and wider than it appears to be, being nearly filled with morainic material. From the mouth of the glen at Loch Mor na Clibhe northwards for about three miles the stream has cut its way across a long succession of terminal mor--aines so that standing on the west side of the valley and looking northwards a succession of truncated spurs of gravel is seen, the hollows between them being utilised by tributaries entering the main stream. At the road bridge however, a marked change takes place the morainic material, here consisting of well washed sand, gravels and stones, becomes a continuous flat topped mass extending from the main road to the sea north of Carnish. The top is level and by Ordnance Survey 175 feet above present sea level. The eastern face next the bay of Uig and the northwest face next Loch Scaslavat have obviously been determined by ero--sion. The flat top and well washed character of the material points to its deposit in water and indicates a period when the site of the bay of Uig was occupied by melt water which it is suggested was held up by an outer barrier of drift now largely destroyed. If this explanation be the true one it would help mater--ially to explain a unique and puzzling feature seen further/

further east, namely, Glen Valtos. (Pl. II., Fig. 4). Commencing on the flat moorland 134.8 feet above sea level about three quarters of a mile east of Uig this curious valley cuts downwards to the eastwards against the general slope of the ground until where it enters Little Loch Roag it forms a bold steep sided glen 150 feet deep. Tributaries entering it on both sides invariably do so by waterfalls and the present stream which finds its way along it is out of all proportion to the valley in which it flows. The suggestion made here is that Glen Valtos represents an overflow channel from a lake of melt water held up on the site of the present Bay of Uig the depth of the water at one stage being indicated by the height of the sand and gravel platform at Carnish, namely 175 feet. The glacial phenomena of the northern part of the Uig district taken by themselves would form an interesting subject of study and can be dealt with here merely in outline.

S.W. - N.E. Local movement of ice from S.W. to N.E. is well illustrated by the Scalladale Valley in North Harris which starting in the corry between Mul--lach an Langa and Mulla fo dheas reaches Loch Seaforth at Ardvourlie. Vigadale a shorter and shallower glen with/

with the same trend lies about a mile to the north. In the corry in which Glen Scalladale takes its rise there are two corry lochs, the first Loch an Eang se--parated by a steep slope from a lower and larger one, namely Loch Vistem. Both of them are held up by ex--tensive terminal moraines, those of Loch Vistem being specially well marked. At intervals down the glen remains of terminal moraines appear, the last one clearly defined being seen at the road bridge. But evidence of various kinds remains to show that the Scalladale glacier extended much further to the North--east and included beyond Ardvourlie ice from Vigadale and still further to the northeast ice from the Park district of Lewis. Striae trending N.E. are seen near the mouth of Scalladale, at the gate of the Lodge and at intervals along the road and near the shore to the northeast of Aline. About two miles northeast of Aline, however, the few striae seen point N.N.E. or even S. - N. This may have been due to the deflection by ice from the high ground of the Park district.

Lateral moraine material is well seen on the slopes of Caisteal Ard, on the southeast face of Druim na Caorach and along the hill slopes northeast of Aline.

An interesting piece of evidence is afforded by Seaforth/

Seaforth Island. The northwest facet of the north end of the island is smoothed and striated parallel to the face, and when seen in profile from Scalladale appears as a section of a U-shaped valley. The north-east face on the other hand is steep, rough and unstriated.

But the most valuable evidence is afforded by er--ratics. It has already been noted that a great dyke-like mass of hypersthene-hornblende rock traverses ob--liquely first Scalladale itself and further west the ridge of Mo Vigadale. In Scalladale the rock has been deeply excavated and from Mo Vigadale a trail of boul--ders some of great size can be traced down the north-west side of the glen. On the roadside between the road bridge and the castle these boulders form the most noticeable feature of the district. They are seen again on the shore northeast of the Lodge and beyond Aline they have been followed in occasional boulders lying free or imbedded in the drift to within a mile and a half of Kintaravey. The evidence available seems to show that the Scalladale glacier reinforced by ice from Vigadale and probably also from the Park district pushed its way along what is now a part of Loch Seaforth at least three miles beyond the mouth of its parent glen. (Pl.VI. Fig. 2).

VII. RECENT CHANGES.

Subsidence.

No raised beaches were observed in any part of the area described. On the other hand the most recent movement appears to have been one of subsi--dence. Reference to subsidence has already been made when dealing with the sea lochs but further evidence may now be noted. In the upper part of Loch Seaforth between Aline and Kintaravey the sea at high water mark is now cutting into peat overlying drift. At the head of Loch Erisort beach gravel rests upon an eroded surface of peat. On the west coast at the boat harbour at Mealsta south of Brenish peat with re--mains of trees is exposed at low water mark of spring tides. At the head of the Bay of Uig the well marked flat is composed of peat of the usual type overlain by a dark sandy layer which supports a salt marsh flora, while to seawards the peat is overlapped by the ordi--nary shell sand of the bay. At high tide the whole flat is covered. It is probable that peat underlies a great part of Uig Sands.

Erosion.

In spite of the resistant nature of the rocks/

rocks of the district evidence of erosion of the coast can be observed especially in the west from the Gallan Head to the south. Lines of weakness especially joints have been attacked leading to the formation of arches, and caves, and the separation of skerries and islets such as Eilean Molach near Mangersta.

Erosion of drift gives rise to extensive boulder beaches as on the coast of North Harris opposite the island of Scarp.

Accumulation.

Occasionally where conditions are suitable considerable accumulations of shell sand are being formed partly on the beach and, by the action of the wind partly inland. Examples are seen at Husinish, on the mainland of Harris opposite Scarp, on Scarp itself, and further north on the southern side of Uig Sands. In Cravadale northeast of Scarp and at the bay of Uig the wind-blown sand has sometimes covered and modified morainic material.

Peat.

No account of the district would be complete without a reference to the peat which covers such extensive areas inland, especially on the low ground. Thus/

Thus, around Loch Langavat, and near the head of Loch Resort it forms an almost continuous sheet spreading upwards over the tops of the lower hills. In North Harris and among the Uig Hills it is confined to the low ground. As far as observed it appears to be undergoing erosion at the present time. An important point in connection with the peat may be noted here. Dr. Lewis (F. J. Lewis, "The Plant Remains of the Scottish Peat Mosses", Part III. Trans. Edin. Roy. Soc. Vol. XLVI., 1907, p. 45) during his interesting stu--dies of the Scottish peats examined sections of peat in Lewis in the Bragor and Gress basins (both outside the area dealt with in this paper). He noted the absence at these localities of the Upper Forest Bed (Pinus or Betula), its place being taken by Scirpus and Eriphorum, and concluded that the Upper Forest Bed was absent in the Outer Hebrides. It is interesting therefore to note that in North Harris in Scalladale and Vigadale and in Lewis north of Kintaravey and Balallan a well marked layer marked by the roots and stems of Pinus is exposed where the overlying peat has been removed for burning.

VIII. EXPLANATION of ILLUSTRATIONS.

Plate I.

Fig. 1. Typical biotite-gneiss enclosing and veining hornblende-gneiss. Torasclett, northeast of Tarbert.

Fig. 2. Typical granite-gneiss. Bula Charpach, Northwest Scarp.

Fig. 3. Junction of granite-gneiss (upper and left) with biotite-gneiss (lower and right) showing the well marked foliation of the biotite-gneiss and the imperfect folia--tion of the granite-gneiss. Northwest Scarp.

Fig. 4. Granite-gneiss with pegmatite above enclosing (lower right hand corner) remains of crumpled biotite-gneiss and hornblende-gneiss. Northwest Scarp.

Plate II.

Fig. 1. Ultra-basic rock now altered into actinolite-schist, showing form and weathering. The boulder resting on the top is an erratic of granite-gneiss. Manish, Scarp.

Fig. 2. View of southern half of Loch Langavat from the Langadale Valley; looking north. In the foreground is part of a terminal moraine. The truncated spurs can be seen on both sides of the loch. The small pro--montories projecting into the loch from both sides are mainly remains of terminal moraines. Lateral moraines are indicated by the terracing near the foot of the slopes. In the distance can be seen the narrows caused by the largest of the terminal moraines.

Fig. 3. View from Uig looking south towards the Loch Suainaval Valley. In the foreground is the sea encroaching upon peat. In the middle distance showing dark is one of the terminal/

Plate II. (contd).

Fig. 3. terminal moraines of the Loch Suainaval Valley. In the background can be seen the typical granite-gneiss hills of Suainaval (left) and Tarain (right).

Fig. 4. View of Glen Valtos looking towards the east. The photograph shows the trench-like glen, the small size of the present-day stream and the absence of drift. The N.E. directed ridges mark the outcrop of ribs of granite-gneiss. In the distance is seen Little Loch Roag.

Plate III.

Fig. 1. Typical biotite-gneiss. Head of Loch Troll-marig. The slide shows abundant quartz, oligoclase & orthoclase with sparing biotite. Crossed Nicols X 25 diameters.

Fig. 2. Typical hornblende-gneiss in bands and lenticles in biotite-gneiss. Torasclett northeast of Tarbert. The microphotograph shows quartz and plagioclase-felspar (light) abundant hornblende (indicated by the cleavage), and iron ores (dark). Crossing the field is a vein of epidote. Ordinary light X 25 diameters.

Fig. 3. Spheniferous hornblende-gneiss in pillows in biotite-gneiss. East side of Nisa Mhor, Uig. The rock is similar in most respects to that represented in Fig. 2 above but contains in addition abundant sphene which is seen as a vein-like mass of granules crossing the photograph above the centre. Crossed Nicols X 25 diameters.

Fig. 4. Garnetiferous hornblende-pyroxene-granulite. Roadside 4 miles south of Ardvourlie. Typical of numerous lenticles in the neighbourhood of Loch Seaforth. The slide shows a small amount of quartz, labradorite felspar part showing twinning, hornblende, pale green pyroxene and garnet. Crossed Nicols X 25 diameters.

Plate III. (contd).

Fig. 5. Hypersthene-hornblende rock from dyke-like mass on Loch Seaforth, north of Loch Troll-marig. The microphotograph shows large crystals of hypersthene cloudy along lines of crushing. Interstitially are groups of fine granules of hornblende with some hypersthene. Granules of pyrrhotite also occur.
Ordinary light X 25 diameters.

Fig. 6. Hypersthene-hornblende-felspar rock. Great dyke south of Ardvourlie. The dark part of the microphotograph is made up of a granular aggregate of hypersthene and hornblende. The light areas represent labradorite-felspar. Fringing the fels-par below the centre and near the right hand side are borders of granules of garnet.
Crossed Nicols X 25 diameters.

Plate IV.

Fig. 1. Hypersthene-hornblende-felspar rock. Great Dyke south of Ardvourlie. The microphoto-graph shows a large crystal of hypersthene fringed by granular hornblende. Felspar (labradorite) appears light, iron ores dark.
Ordinary light X 20 diameters.

Fig. 2. Peridotite. Head of Laxadale Burn northeast of Tarbert. A large plate of schillerised hypersthene occupies the left half of the field. The right half is made up mainly of olivine with several small flakes of mica.
Ordinary light X 20 diameters.

Fig. 3. Peridotite approaching dunite in composition. Brandersaig, Ard Meavaig.
The field is occupied almost entirely by olivine. A crystal of ortho-rhombic pyroxene is seen beneath the centre. The black areas are chrome iron ore.
Ordinary light X 25 diameters.

Plate IV. (contd).

Fig. 4. Quartz-biotite-granulite – supposed paragneiss. Skegadale northwest of Tarbert. The rock consists mainly of quartz (white), with some oligoclase (twinned) and long narrow flakes of biotite.
Crossed Nicols X 30 diameters.

Fig. 5. Granite-gneiss. Husinish Point, North Harris. The slide shows abundant quartz, ortho--clase, microcline and biotite.
Crossed Nicols X 25 diameters.

Fig. 6. Granite-gneiss. South coast of North Harris, west of Amhuinnsuidhe. A coarser variety of the rock shown in Fig. 5 (above). The slide shows abundant quartz and a large crystal of microcline.
Crossed Nicols X 30 diameters.

Plate V.

Fig. 1. Granite-gneiss. Summit of Mealisval (Uig). Typical of the rock forming the greater part of the Uig Hills. The microphoto--graph shows the granitic texture, the abundance of quartz along with orthoclase, microcline and biotite. Strain shadows due to crushing are seen in the quartz.
Crossed Nicols X 25 diameters.

Fig. 2. Crushed biotite-gneiss west of top of Straia--val, northeast of Tarbert. The slide shows the amount and nature of the crushing to which the rocks have been subjected over great areas along the east coast. In the photograph the biotite is represented by the black streaks; the quartz (grey) is granulated and drawn out; the felspar, of which a large crystal appears near the centre forms "eyes" around which the other minerals have flowed.
Crossed Nicols X 25 diameters.

Fig. 3. Crushed Red Granite-gneiss. Glen Leosaid near Amhuinnsuidhe. The microphotograph shows the amount of crushing which is common/

Plate V. (contd).

Fig. 3. common along narrow Northwest lines of movement. In the centre of the field the rock has been reduced to a mylonite.
Crossed Nicols X 30 diameters.

Fig. 4. Flinty crush-rock and pseudo-tachylyte in crushed hornblende-gneiss. Shore south of Maaruig, North Harris. The dark pseudo-tachylyte intermingled with remains of hornblende seen in the upper left hand quadrant has been invaded from above downward by a tongue of similar material showing flow-banding and carrying along with it undigested floaters of quartz.
Ordinary light X 30 diameters.

Fig. 5. Olivine-dolerite (Crinan type). Gillival Glas north of Tarbert. The slide shows olivine, augite, plagioclase, analcime and iron ores.
Ordinary light X 25 diameters.

Fig. 6. Dyke, probably of Tertiary age east of Ard an Tolmachan, North Harris. The slide shows very large zoned plates of plagioclase crowded with inclusions of glass. The ground-mass consists of plagioclase and augite related ophitically.
Ordinary light X 20 diameters.

Plate VI.

Fig. 1. Sketch Map of Laxadale Valley showing evidence of ice movement from N. - S.

Fig. 2. Sketch Map of neighbourhood of Ardvourlie showing ice movement S.W. - N.E.

Plate VII.

Geological Map of North Harris and of Uig, Morsgail and Aline (Lewis).

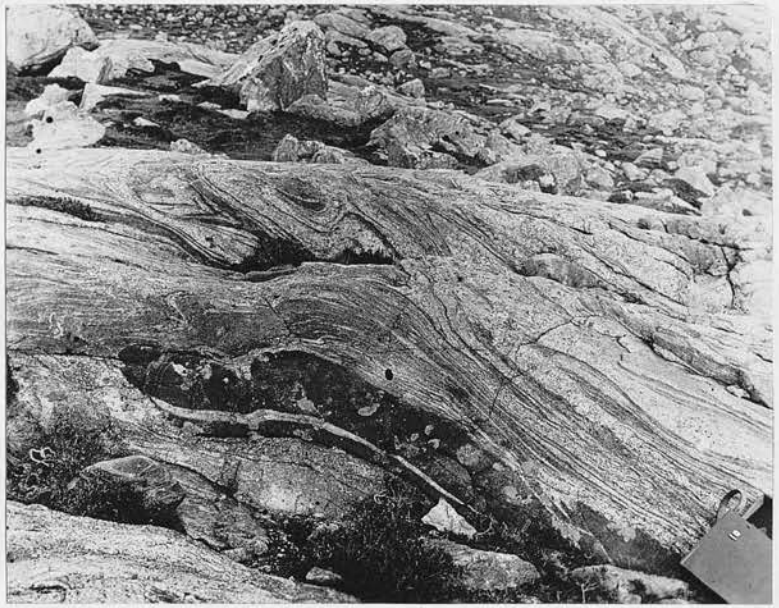


Fig. 1.

Fig. 2.

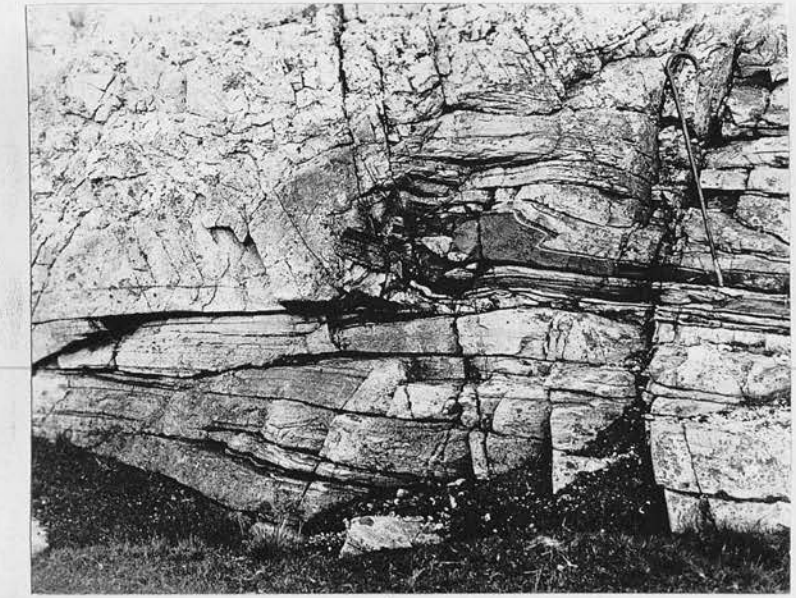


Fig. 3.

Fig. 4.

Plate I

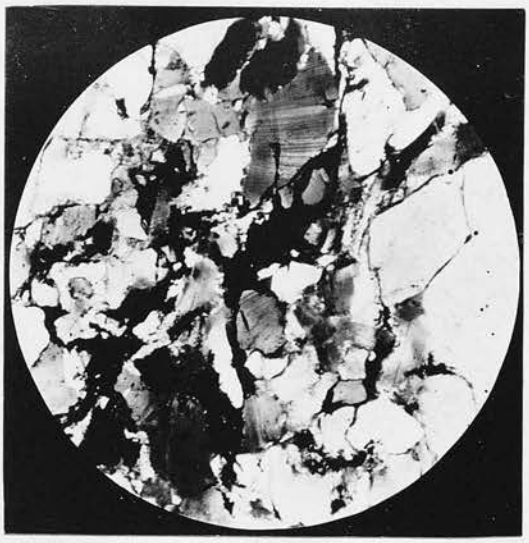


Fig. 1.

Fig. 2.

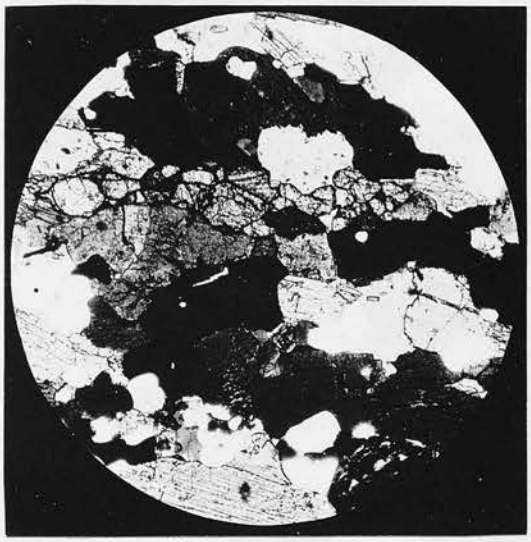


Fig. 3.

Fig. 4.

Fig. 5.

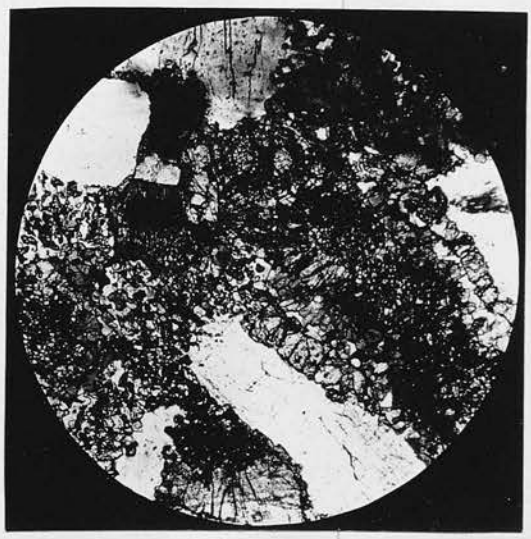


Fig. 6.

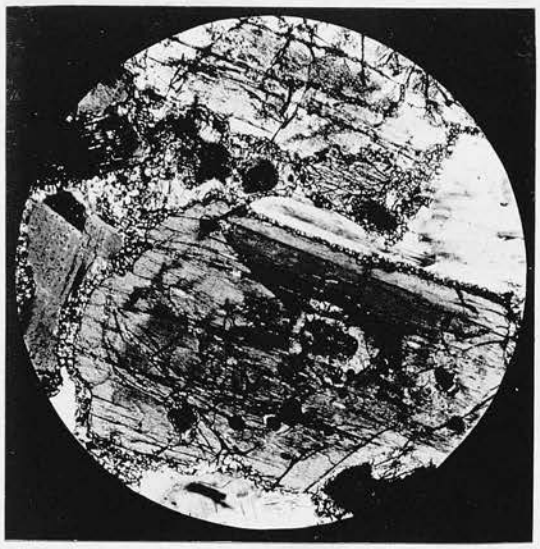
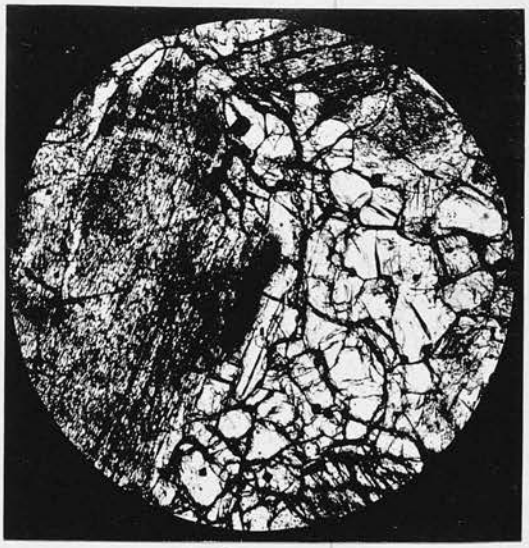


Fig. 1.



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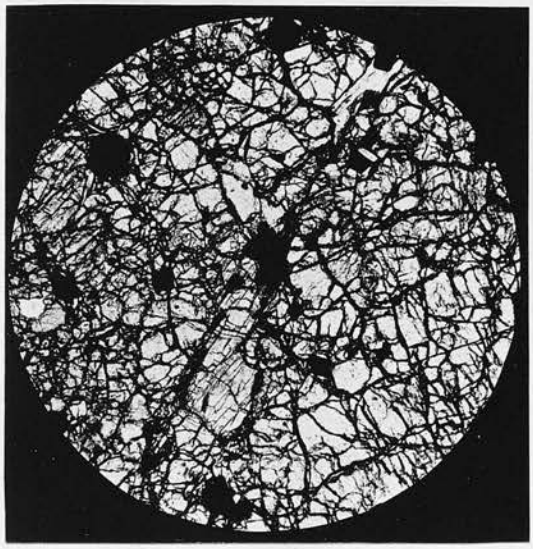
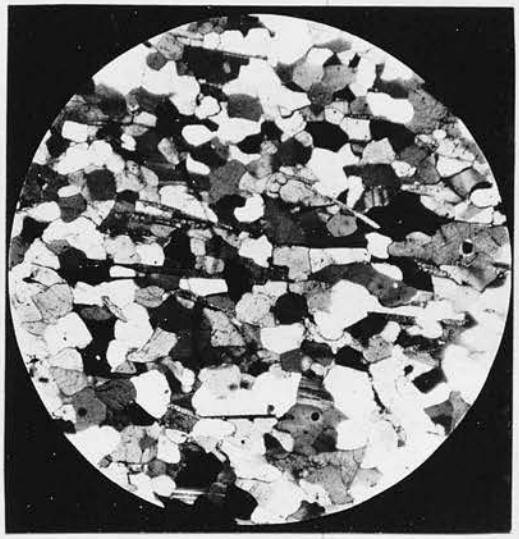


Fig. 3.



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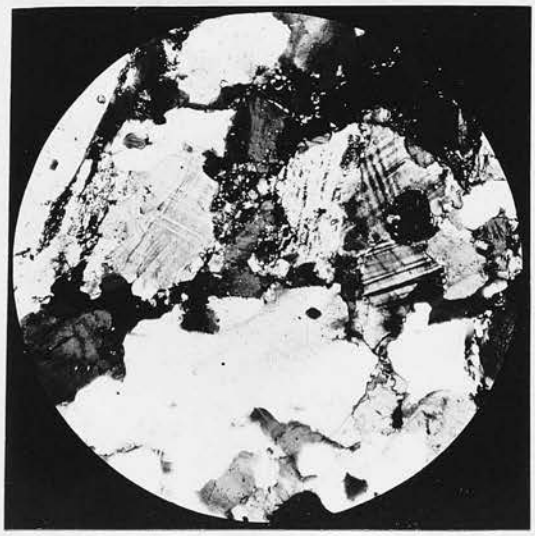

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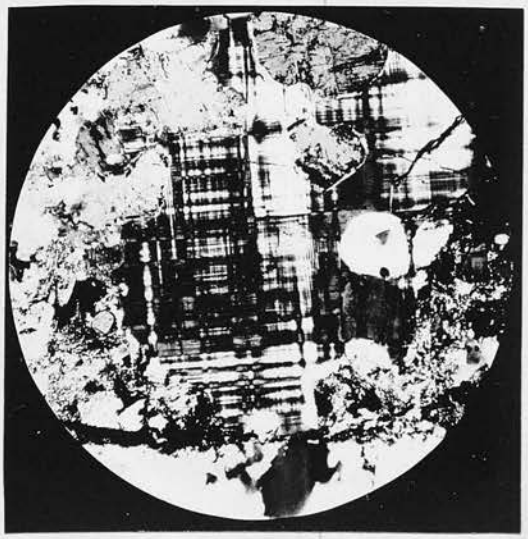

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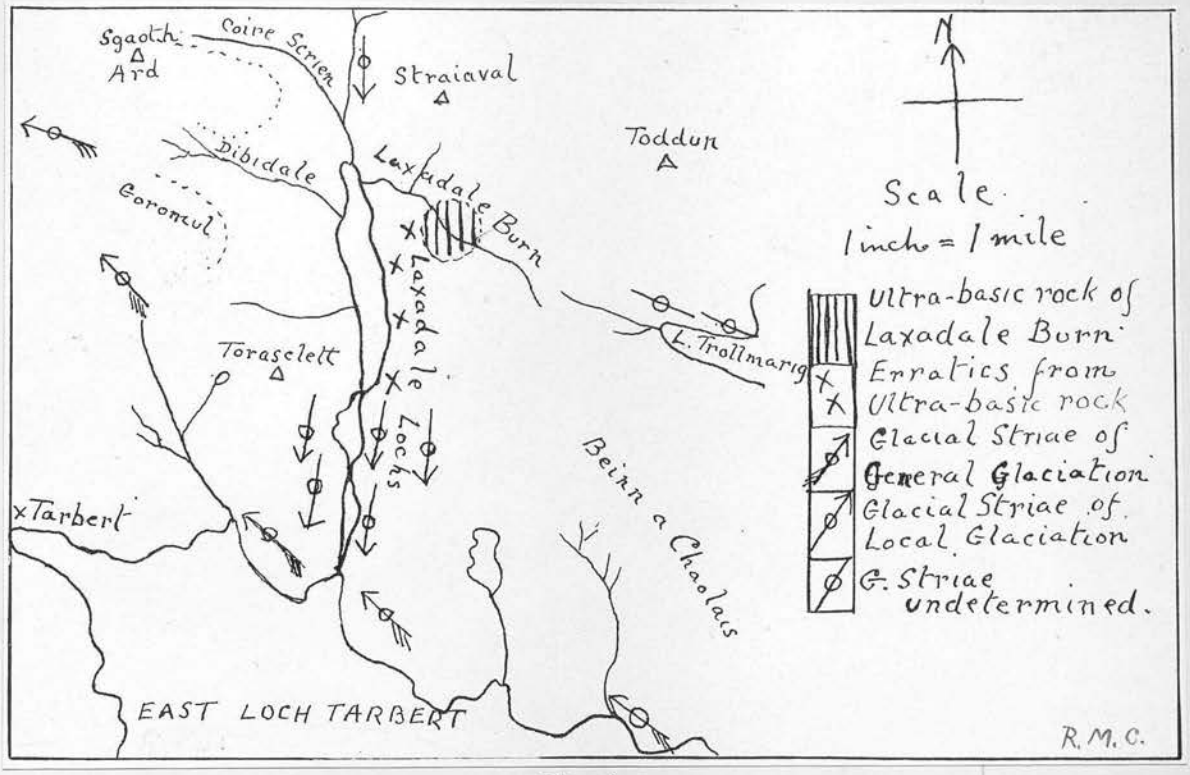
Sgaoth Ard
Coire Scrien
Straiaval
Toddun
Dibidale
Laxadale Burn
Coromul
Laxadale Lochs
L. Trollmarig
Torasclett
Tarbert
Beinn a Chaolais
EAST LOCH TARBERT
N
Scale
1 inch = 1 mile
Ultra-basic rock of Laxadale Burn
Erratics from Ultra-basic rock
Glacial Striae of General Glaciation
Glacial Striae of Local Glaciation
G. Striae undetermined.
R.M.C.

Fig. 1.

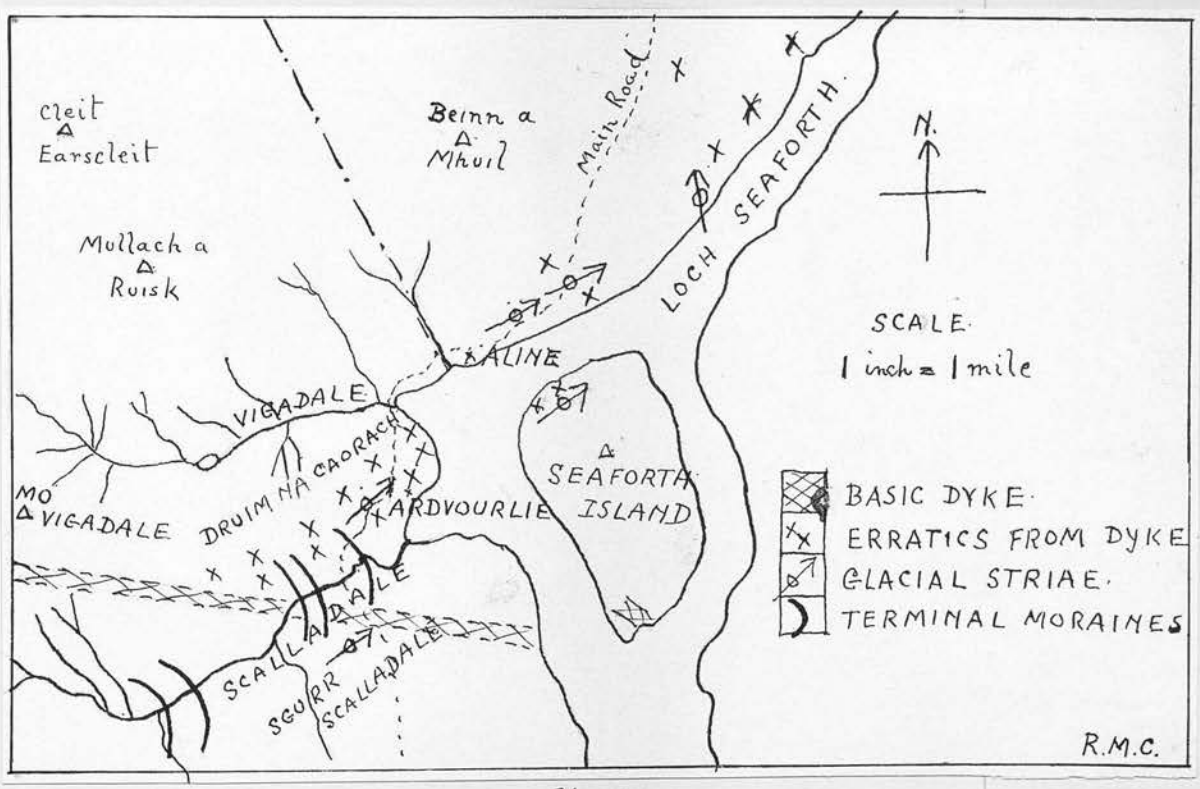
Cleit Earscleit
Beinn a Mhuil
Main Road
Mullach a Ruisk
LOCH SEAFORTH
N.
SCALE
1 inch = 1 mile
ALINE
VIGADALE
DRUIM NA CAORACH
ARDVOURLIE
SEAFORTH ISLAND
MO VIGADALE
SCALLADALE
SGURR SCALLADALE
BASIC DYKE
ERRATICS FROM DYKE
GLACIAL STRIAE.
TERMINAL MORAINES
R.M.C.

Fig. 2.

PLATE VII

GEOLOGY of NORTH HARRIS and of UIG MORSGAIL & ALINE (LEWIS)

Scale of Miles

0 1 2 3 4 5

GALLAN HEAD
Aird Uig
Valtos.
Forsnaval
Sa Mhor
Reef.
Glen Valtos
Meavaig
CAMUS UIG
Ard More Mangersta
Eilean Molach
Loch Sraslavat
UIG SANDS
Garyshal
L. Stacsaval
Aineval
Geshader
Ollashal
Aird Fenish
Svainaval
Loch Svainaval
Diabeg
Diabeg Beinn
L. Grunaval
LITTLE LOCH ROAG
L. Mor na Clibhe
Taravin
Aird Brenish
Islivick
Mealisval
L. Raonasgail
Taharal
Brenish
Teinnasval
Loch Dibadale
Beinn Mheadonach.
Codonn
Mealsta
Tamanaisval
Criomaval
U I G
A
MORSGAIL
Mealasta Isd.
L. Benisval
L. Bodavat
Sheilabric
L. TAMANAVAY
Aird Bheag
L. TEALASVAY
Aird Mhor
Ceann Resort
LOCH RESORT
Glen Ulladale
Bula Charpach
Strone Romul
SCARP
Tarta Geo
Beinn Ia Thuath
Manish
Fladday
Taran Bheag
Taran More
NORTH
HARRIS
Mas Garbh
Tirga Beag
Gearlaval
Strone Ulladale
Rapaire
L. Voshimid
Husival Beag
Glen Graivadale
TIRGA MORE
ULLAVAL
Husival Mor
HUSINISH
Leosaval
R. Envalt
OREVAL
L. Scourst
Strone Scourst
Cleisaval
Glen Meavaig
Uisgnaval More
Rudha Leacach
Amhuinnsuidhe Castle
Ard Hunish
Soay More
Ard Meavaig
Ard an Tolmachan
L. Bun Abhuinn-eadar
WEST LOCH TARBERT
Stolavaig R.
Langedale R.
Mallach Rudh
Liothaid
Beinn a Mhuil
Amhuinn a Mhuil
LOCH SEAFORTH
ALINE
Kearnaval
Vigadale R.
ARDVOURLIE
Seaforth Isd
Mo Vigadale
Mallach an Langa
Scalladale
Tomnaval.
CLISHAM
Maaruig
Sgaoth Iosal
Sgaoth Ard
Skegadale R.
Gillival Glas
Torasclett
Laxadale Lochs
Strailval
TODDUN
L. Trollmarig
Beinn a Chaolais
EAST LOCH TARBERT
TARBERT
SOUTH HARRIS
SCALPAY
L. Trealaval
R. Laxay
ROINEVAL
BALALLAN
LOCH ERISORT
Sleitashal More
Kintarsavaig
LOCH LANGAVAT
ALINE

Explanation of Geological Signs

- Later Dykes
- Ultra-basic rocks intrusive in A.
- Basic rocks intrusive in A.
- Granite Gneiss and associated rocks intrusive in A
- Biotite Gneiss and Hornblende-Biotite Gneiss and associated rocks.
- Glacial Striae
- Lines of Crushing with flinty crush-rock and pseudo-tachylyte.
- Foliation: Vertical
- Foliation: Irregular
- Foliation: Steeply Inclined
- Foliation: Inclined

R.M.C.