between the two stations, due to the effect of the less dense material filling the Gangetic trough, could not be less than 20" and might amount to over 30". From this it appears that without going beyond the known facts of the geological structure of the region—facts which are independent of any theory of the origin of mountains or the constitution of the interior of the earth—we can account for nearly, if not quite, the whole of the unexplained residual deflexions, which, instead of amounting to 23" and 7", would not come to more than 3" or 4", and the difference of 30" would disappear or, at the least, be reduced to one of a few seconds of arc.

In all that has gone before I have avoided the question of the origin of mountain ranges in general, or of the Himalayas in particular, as, although I entered on the investigation, which I hope to publish in detail, with the hope that the limit of fairly established deduction might be carried further into the domain of pure speculation, I have found that the geodetic results do not give any material assistance. They have confirmed some conjectural inferences regarding the form of the rocky bed of the Gangetic depression, but on the question of the origin of the Himalayas, and of the nature of their support, the evidence is too uncertain and equivocal to be of any material value. This much, however, seems certain, that there is no good evidence for the existence of a rift of 20 miles or so in depth, as, once the known facts of geological structure are taken into consideration, the existence of such a rift would explain too much and introduce fresh difficulties even greater than those for which it was introduced as an explanation. Moreover, we must add to this negative evidence the positive fact that every observer, in every part of the range which has been visited, has found evidence of compression in precisely that zone where Colonel Burrard's postulate demands extension.

III.—THE PLUTONIC ROCKS OF GARABAL HILL.

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(Concluded from the November Number, p. 508.)

AT various places, such as the north side of Garabal Hill, the two Garabal burns (loc. iv and v, Fig. 1), and elsewhere, remarkably coarse rocks are found. A good section showing an apparent passage from tonalite to a coarse hornblende is exposed at loc. v (Fig. 1). The rock in the bed of the burn is the normal tonalite, which appears to pass gradually to diorite. A closer examination of the unweathered rocks, however, shows that the passage is only apparent, and that the tonalite is clearly intrusive into the diorite with sharp junctions. The diorite near the junction is a rock of porphyritic aspect, containing large crystals of zoned diopside, abundant green hornblende and felspar, while the amount of quartz is small. A good deal of biotite is present, so that the rock might be described as a pyroxene-mica-diorite. Within a few feet the rock becomes coarser in texture, and the feldspathic content diminishes, while there is a corresponding

increase in the amount of amphibole. The latter is the green hornblende common to the diorites, and is occasionally replaced by mosaics of secondary actinolite. This substitution of feldspar by hornblende, accompanied by an increase in the coarseness of the texture, continues till a hornblendite containing about 85 per cent of amphibole is reached. This rock is exposed for a distance of 20 yards to the south, and then the ground is obscured by peat, so that the other margin of the diorites cannot be seen. The hornblendite consists essentially of large crystals, more or less uniform in size and up to 3 cm. in length, of green hornblende which has wholly or partly altered to brown, the alteration commencing invariably from the centre. Occasional pyroxene cores are found, and these are generally surrounded by a narrow band of green amphibole, with brown beyond and finally green margins. The interstices are filled up with aggregates of quartz, feldspar, and small green hornblendes, with occasional crystals of sphene. The finer-grained varieties of this sequence probably resembled very much the hornblendite which occurs along with scapolite in the Moine Gneiss regions.¹ Occasional schlieren, resembling those already described, occur among the coarser rocks. These are generally much more feldspathic than the surrounding rocks and contain long prismatic hornblendes up to 6 cm. in length.

The brown hornblende of this series differs considerably from that of the davainites. In the latter case the mineral has developed directly from pyroxene and is invariably brown, while in the former case it has formed from original green hornblende, different degrees of transformation being visible, varying from incipient alteration at the centres to completely brown crystals. The mineral shows pleochroism from deep brown to yellowish green and has strong absorption. It is generally traversed by series of parallel dark bands arranged in lattice fashion and with small outgrowths, the whole somewhat resembling arborescent microlites. Teall² has described similar structures in amphiboles from Cornwall and Anglesey, and Thomson³ also found them in hornblendites from Wicklow. In these cases the dark bands were assumed to be magnetite, formed by the magmatic resorption of pyroxene and consequent replacement by hornblende. In the Garabal Burn rock a careful examination, under a high power, of the ends of the bands and outgrowths showed that they are composed of aggregates of minute pale-green or colourless crystals, orientated in irregular fashion with respect to the main direction of the bands. It seems probable that the whole of the dark bands are made up of these minute crystals, the black colour being analogous to that observed in some opaque glasses, where the opacity is due to innumerable colourless longulites, which act as prisms and disperse and totally reflect the light, the degree of opacity varying with the amount of light totally reflected.⁴

¹ *Geology of Ben Wyvis, etc.* (Mem. Geol. Surv. Scotland), 1912, pp. 128-9.

² *British Petrography*, 1908, pp. 475-94.

³ *Quart. Journ. Geol. Soc.*, lxii, pp. 475-94, 1908.

⁴ Cf. Pirsson, "Artificial Lava Flow and its Spherulitic Crystallisation": *Amer. Journ. Sci.*, ser. IV, xxx, pp. 97-114, 1910.

GENERAL PETROLOGY.

Excluding for the moment the tonalite, and also the possible relations between the diorites and the ultrabasic rocks, we propose to consider shortly the variations exhibited by each of these two groups. Although chemical analyses have not been made of all the rocks concerned, it seems most probable that there is no great variation in chemical composition in the ultrabasic series, save where impregnation by the latter acid intrusives has occurred. The basic end-member is a pure olivine rock altered to serpentine, and with a composition approximating to that of olivine. The other end-member is the pyroxenite. The mineralogical variation could therefore be shown diagrammatically by two curves, one representing the increase of pyroxene—including hornblende—from zero to approximately 100 per cent, while the other would represent the decrease of olivine from 100 per cent to nearly zero. The chemical differences are so small, therefore, that it seems to us that local variations in the conditions are sufficient to account for them. That the intrusion did not take place all at one time is shown by the presence of the veins of porphyritic rock, the end-product of the consolidation of the magma. Hence, in a magma of such size, consolidating over a considerable period of time, the conditions could not remain uniform. Local variations in temperature and pressure would involve local partial consolidation, and therefore areas of lower potential, with the result that a potential gradient would be set up. This would be followed by intermagmatic chemical reactions, involving the formation of other molecules and resulting in local excesses of ortho- or metasilicate molecules, with an ultimate consolidation as olivine or pyroxene, as the case may be.

A similar explanation would account for the variations of the diorites. Here again we have a comparative uniformity in chemical composition, the chief variation being in the mineralogical composition, in the substitution of pyroxene by hornblende and of hornblende by feldspar and biotite. Supersaturation of the magma with respect to the ferromagnesian molecules would not occur everywhere at the same temperature, with the result that sometimes the high temperature modification, pyroxene, would form, sometimes the modification stable at lower temperatures, hornblende. The amount of water dissolved in the magma would also exert some effect, as the presence of water favours the formation of hornblende, in addition to reducing the viscosity. Local richness in potash would affect the production of biotite, while pressure would be an important factor owing to the probably high molecular volume of mica. A magma from which under certain conditions pyroxene would crystallize, would, under other conditions, give hornblende or biotite.¹ Hence it seems to us that there exists no necessity to postulate any differentiation beyond what would ensue from a locally heterogeneous magma.

We will now proceed to consider the Garabal Burn series in greater detail. The texture varies greatly, as in places chilled margins

¹ Cf. Doelter, *Neues Jahrb. für Min.*, pt. ii, p. 178 et seq., 1888; pt. i, p. 1 et seq., 1897.

which might almost be called aphanitic in structure, are found in contact with the schist, while elsewhere the crystals of hornblende average 3 cm. in width, such coarse rocks generally occurring some distance from the margins. Another significant feature is the dyke or boss-like form in which the hornblendites occur.¹ It seems to us, therefore, that they may be regarded as the roots or cores of giant apophyses of the diorite projecting into the schist roof and now laid bare by denudation. The fine-grained margins would crystallize quickly and form an impermeable envelope, which would inhibit the escape of water and other mineralizers and favour the formation of hornblende. Hence these may be compared to pegmatites on a large scale, resembling the 'peridotite-pegmatites' of Loch Garabal in the mode of formation, though the latter are on a much smaller scale. The abundance of hornblende also favours the pegmatite theory, as mineralizers such as water are essential for its formation.

FIG. 3. Variation diagram of rocks of loc. v. Note: Quartz and biotite curves are drawn with scale of ordinates doubled.

The mineralogical variation in the rocks of this series is most easily shown by means of a diagram. A number of specimens were taken at approximately uniform distances from the tonalite and their mineralogical composition calculated by the Rosiwal method.² The hornblende increases from 7 to 84 per cent, while the felspar shows a complementary decrease from 70 to 5 per cent. Quartz, which is never very abundant, decreases to a minimum before the coarsest rock

¹ Hornblendites with brown amphibole have been described by Wright and Bailey in Colonsay, forming the margin of a syenite intrusion: *Geology of Colonsay* (Mem. Geol. Surv. Scotland), 1911, p. 29.

² No. 1 is an acid diorite from Meall Breac, while the others are from the Garabal Burn.

is reached and then increases slightly, while the biotite curve, though more irregular, as is to be expected, is very similar. The hornblende and felspar curves tend to become horizontal at the 'coarse' end where a nearly uniform rock is reached. Since these rocks show no normative quartz, the latter has obviously been formed from silica which has undergone hydrolysis at high temperatures. The increase in the water content as the coarse rocks are reached favours this.

The chemical composition, on the whole, does not show any great variations. We have analysed a specimen of the diorite close to the tonalite (VI) and one of the coarse hornblendite (VII).

	VI.	VII.	VIIa.	VIII.	IX.
Si O ₂ . .	52.83	53.29	50.3	47.5	62.6
Ti O ₂ . .	1.82	1.41	1.6	—	—
Al ₂ O ₃ . .	11.74	8.81	8.5	15.6	17.7
Fe ₂ O ₃ . .	6.66	4.68	5.2	2.6	1.2
Fe O . .	6.13	6.66	7.7	7.1	3.3
Ca O . .	8.05	8.99	10.0	9.8	4.6
Mg O . .	6.41	9.07	10.2	11.7	3.7
K ₂ O . .	2.06	1.87	1.6	1.5	2.5
Na ₂ O . .	2.67	3.21	3.2	1.4	—
H ₂ O . .	1.20	1.51	1.7	—	—
H ₂ O — . .	.20	.17	—	2.4	.7
C O ₂ . .	nt. fd.	nt. fd.	—	—	—
P ₂ O ₅ . .	.08	tr.	—	—	—
	99.85	99.67	100.0	99.7	99.7

VI. Diorite near junction with tonalite, Garabal Burn.

VII. Hornblendite, Garabal Burn.

VIIa. Approximate composition of brown hornblende of hornblendite (VII).

VIII. Diorite (very rich in biotite), Ben Damhain, anal. J. H. Player.¹

IX. Granitite (tonalite), Ben Damhain, anal. J. H. Player.²

Though the silica is more or less constant, the hornblendite is somewhat more basic; that is, magnesia and lime increase at the expense of the alkalis, while the alumina decreases. These differences, however, are not sufficient to account for the mineralogical differences, as the 'norm' of the hornblendite shows a considerable amount of felspar. Hence we must conclude that the amphibole contains a considerable amount of alkali and lime, since the pyroxene which occasionally forms the core of the hornblende crystals is diopside. The amount of water has undoubtedly been an important factor in the production of the hornblende, though the relatively greater amount of magnesia must also have had an influence.

ORIGIN OF THE BROWN HORNBLENDE.

The case is more difficult when we come to consider the alteration of the hornblende. There is no doubt that the mineral was originally green, and that the change originated from the centres of the crystals, unless in the case of those with diopside cores where a band of green

¹ Teall & Dakyns, loc. cit., p. 115.

² Ibid., p. 115.

amphibole generally occurs round the diopside. It likewise seems most probable that the alteration took place after consolidation. The simplest explanation would seem to be that the change is due to the oxidation of the ferrous oxide and consequent passage of the iron from the basic radicles to the acid ones, to form ferrisilicates. The chemical analyses, however, are against this, as the hornblende actually has less ferric iron than the diorite, while there is no reason to suppose that the brown colour of amphiboles is due essentially to ferric oxide: indeed, analyses of brown hornblende are recorded, containing only a small percentage of ferric iron. That the green hornblende is a metastable form is shown by the separation of the minute crystals of the dark bands. Since these are too small to be identified directly all that we can deduce respecting them is that they are probably monoclinic hornblende or pyroxene, since the rhombic modifications require special conditions such as would inhibit their formation in the solid state.

Two explanations suggest themselves:—

1. The brown colour may be due to ultramicroscopic crystals of the same nature as those of the feathery bands. As has been stated above, the colour of pitchstones and other glasses is often due to minute crystallites, which are too small to be resolved under the microscope, and the only evidence of the presence of which is the brown colour of the glass. Many pitchstones, too, show two generations of crystallites, one microscopic, the other sub-microscopic. Hence it is plausible to suppose that the brown colour of the hornblende has originated in this way, by the formation of innumerable crystallites of an order of magnitude lower than that of the crystals of the dark bands. The only effects on the pleochroism of the separation of such crystallites would be a uniform increase in the absorption, the difference for light waves traversing the crystal in different directions remaining practically constant, and a change in colour due to the total reflection of the light at the violet end of the spectrum.

2. On the other hand, the explanation may be that the metastable green hornblende breaks up into two more stable minerals, the minute crystallites of the dark bands and a brown hornblende. Analysis No. VIIa was obtained by deducting from analysis No. VII the amount of the various oxides which go to make up the other minerals in the hornblende, quartz, orthoclase, andesine, and biotite, the amount of these present being calculated by the Rosiwal method. As these are only present in small amount, the error in assuming their composition as normal is negligible, and hence No. VIIa probably represents fairly closely the composition of the hornblende. Comparing this with analysis No. VI, it is seen that the amphibole of the coarser varieties contains a much greater proportion of sesquioxides than that of the finer types, as not only does more of the alumina in the latter rocks form felspar, but the iron partly crystallizes as biotite. In addition, the minute crystallites are colourless or nearly so, and hence may be assumed to be salts of lime or magnesia, with the result that their separation is accompanied by an enrichment of the residual material in 'total' iron. Thus we would have the

formation of an amphibole much richer in the oxides common to brown hornblende, accompanied by the separation of the bisilicates as the crystallites. There is very little difference between the optical properties of the two amphiboles. The extinctions are the same, as well as the positions of maximum and minimum absorption, the only difference being in the nature of the absorbed rays.

THE "NEWER IGNEOUS ROCKS".

The series of plutonic rocks which has been intruded into the Highland schists after the latter had been foliated are included under the general name of the "Newer Igneous Rocks". These intrusions, which are probably of Lower Old Red Sandstone age, show considerable lithological similarities. Granite usually composes the greater part, but diorites are of common occurrence, while ultrabasic rocks, on the other hand, are somewhat scarce. The only ultrabasic rocks which have been described are the peridotites of Garabal Hill, the kentallenites of Argyll,¹ the scyelites of the Moine Gneiss regions,² and the peridotites of the Coyles and Glen Doll,³ each of which is accompanied by picrites. It is only in the last-named localities that we have a suite of rocks at all resembling those we have described. This includes an olivine-enstatite rock (saxonite), an enstatite-picrite, a porphyritic diorite with green hornblende, and some acid diorites. This is apparently a series of intrusions of decreasing basicity, with some rocks formed by amalgamation due to the later intrusions. A peridotite which occurs along with scyelite in Ross-shire seems to resemble the Garabal Hill wehrnite, but the scyelite itself, as well as kentallenite, are totally unlike anything occurring elsewhere, and seem to be more or less abnormal.

Wherever ultrabasic rocks occur in the Highlands they are clearly the earliest intrusion, and are usually followed by diorite and finally tonalite and granite. That some time elapsed between the various intrusions is certain, as all the evidence goes to prove that the peridotites were consolidated long before the diorites came up, and the latter had obviously crystallized before the granite intruded. Another significant feature is the absence of intermediate types. Thus at Garabal Hill we have nothing between the felspathic davainite, representing the least basic of the peridotites and with 43 per cent silica, and the hornblendites, the most basic diorite, with 49–52 per cent silica. Again, in Glen Doll, there is no rock intermediate between a picrite, containing a good deal of olivine, and a fairly normal diorite. A similar gap exists between the tonalite and diorite, for the acid diorite of Garabal Hill has about 54 per cent of silica, while the tonalite has never less than 62 per cent. Hence we have clearly three separate series of rocks, each more or less complete in itself and each showing not only the normal rock with slight

¹ Flett in *Geology of Oban and Dalmally* (Mem. Geol. Surv. Scotland), 1908, pp. 82–109.

² Flett in *Geology of Ben Wyvis*, etc. (Mem. Geol. Surv. Scotland), 1912, pp. 126–9.

³ Barrow in *Geology of Braemar*, etc. (Mem. Geol. Surv. Scotland), 1912, pp. 73–83.

variations, but also the products of final consolidations in the form of schlieren; the porphyritic pyroxenite veins of Loch Garabal in the ultrabasic series, the hornblendites and the felspathic diorite-pegmatites of loc. v (Map, Fig. 1) in the diorites, and finally the aplites and acid pegmatites associated with the last intrusion.

For these reasons it seems to us exceedingly difficult to suppose that the whole of these rocks are "the result of the differentiation of an originally homogeneous magma".¹ Firstly, it is most improbable that a magma is ever in a state approaching homogeneity. Local variations of physical conditions as well as assimilation phenomena on the margins must be sufficient to keep the equilibrium heterogeneous. Secondly, while it is undoubtedly true that the basic elements would crystallize out first, the crystals thus formed would tend to sink, so that the upper parts of the magma would be relatively enriched in silica. Thirdly, the absence of intermediate types militates against the differentiation theory. This is also an argument against any theory of assimilation, as we should then expect a perfectly continuous sequence. Again, it is obvious that an original ultrabasic magma can never assimilate enough schistose material to form a tonalite, as the schist is more basic than the tonalite, while on the other hand an original acid magma could never form peridotite. In addition, it seems to us that difficulties arise when we come to consider the mechanism of differentiation. The application of Soret's principle² involves a large degree of diffusion and ignores, to some extent, the important rôle played by viscosity, so that its applicability is probably confined to marginal phenomena on a fairly small scale. Similar objections exist with regard to the principle of Gouy and Chaperon.³ The difference of concentration between the top and bottom of a magma due to a gravity concentration of the heavy molecules in the dissolved state would be so small as to be negligible, unless the magma were of enormous depth.⁴ It is most probable that gravity only operates on the heavy molecules where the latter form an immiscible liquid or have crystallized out. Hence it seems to us that a separate origin of the ultrabasic and the acid magmas must be postulated. While it is possible that the diorite has formed from the tonalite by assimilation, no such possibility exists with respect to the peridotites. It may be that the igneous material of the earth's crust is stratified to some extent and that the pyroxenites, etc., originated in some ultrabasic intraplutonic zone similar to that postulated by Fermor.⁵ The almost invariable association of acid rocks with the earlier peridotites suggests that the former were forced up the margins of the earlier intrusions, which would constitute areas of crustal weakness and hence be the most ready outlet for the acid material. Any attempts to verify these ideas, however, are so much hampered by our

¹ Teall & Dakyns, loc. cit., p. 117.

² *Ann. de Chim. et de Phys.*, ser. v, xxii, pp. 293 et seq., 1881.

³ *Ibid.*, ser. vi, xii, pp. 384 et seq., 1887.

⁴ Cf. Lehmann, *Molekularphysik*, i. p. 483, etc., 1884.

⁵ "Garnet as a Geological Barometer": *Rec. Geol. Surv. India*, xliii, pt. i, pp. 44-5, 1913.

incomplete knowledge of magmatic phenomena that they must remain as theories, and nothing more, for the present.

NOTE ON THE DIORITES OF GLEN LEDNOCK, COMRIE.

Numerous isolated patches of diorite occur to the north-west of Loch Lomond, but no intrusion of any size is met with, except in Glen Lednock near Comrie. This occurrence is of interest because of the fact that the plutonic mass gradually passes to a hypabyssal variety of very similar composition. The plutonic rock is a fairly coarse biotite-diorite of uniform character, and is made up of mica, hornblende, felspar, quartz, and sphene, while magnetite, apatite, and zircon occur as common accessories. The mica is a deep-brown biotite with strong absorption, and is intergrown with a green hornblende, which is generally very much altered to chlorite. The felspar is partly andesine, partly orthoclase, and has apparently undergone crushing to some extent. Sometimes it is enclosed by the ferromagnesian minerals. Quartz is subordinate, while fairly large crystals of sphene occur occasionally. On the whole, this rock resembles the typical biotite-hornblende-diorite of Garabal Hill, though it has suffered much greater alteration. The rock is very uniform, the chief variation being in the relative amounts of biotite and hornblende. Very occasionally, anorthoclase occurs in addition to the other felspars.

The hypabyssal rock may be described as a diorite-porphry, and has obviously formed as the result of quicker cooling of part of the magma. The phenocrysts include felspar, hornblende, and sphene, and show a tendency to occur in glomeroporphyritic aggregates. The felspars seem to be orthoclase, though they are generally so much altered that their determination is difficult. The hornblende has usually been replaced by fibrous aggregates of a secondary blue-green amphibole resembling actinolite; while occasionally the alteration has gone further and chlorite has developed. Sphene occurs as granular aggregates, intimately mixed up with the hornblende, though sometimes larger crystals are found. The groundmass is a micro-crystalline aggregate of quartz, felspar, biotite, hornblende, and granular sphene. The amount of quartz is small, but areas rich in sphene occur locally. The ferromagnesian minerals are found as small irregular crystals, and are accompanied by numerous cubes of magnetite. These rocks bear a close resemblance to the so-called porphyrites of Argyllshire,¹ not only in structure but also in the presence of two generations of hornblende.

Numerous veins of aplite occur in association with these rocks, differing, however, from those of Garabal Hill in some respects. The aplites of the latter area have granitic affinities, and are made up of quartz and alkali-felspar with subordinate muscovite. Those of Glen Lednock, on the other hand, are related to the syenite family, and contain orthoclase with abundant biotite, while quartz and plagioclase are subordinate.

¹ *Geology of Cowal* (Mem. Geol. Surv. Scotland), 1897, p. 103; Hill in *Geology of Mid-Argyll* (ibid.), 1905, pp. 103-15; Flett in *Geology of Oban and Dalmailly* (ibid.), 1908, pp. 96-102.

Obviously, we have here an intrusion of the same nature as the diorite intrusion of Garabal Hill, but differing from the latter by the fact that part has undergone more rapid cooling, and hence has formed the diorite-porphry. Analogous rocks, however, occur in the Strath Dubh Uisge valley, where a few dykes of very decomposed felspar-porphry outcrop. An occurrence of diorite apparently passing to porphyrite has been described from Loch Melfort,¹ but the Geological Survey are of the opinion that the porphyrite is an earlier intrusion which has been altered by the diorite. In the island of Colonsay intrusions of augite-diorites have been found, grading to lamprophyres on the margins.² The junctions of the different types in Glen Lednock are very obscure, and hence the relations between the rocks cannot be ascertained.

IV.—ON THE IMPORTANT PART PLAYED BY CALCAREOUS ALGÆ AT CERTAIN GEOLOGICAL HORIZONS, WITH SPECIAL REFERENCE TO THE PALÆOZOIC ROCKS.

By Professor E. J. GARWOOD, M.A., V.P.G.S.³

(Concluded from the November Number, p. 498.)

(WITH FOLDING TABLE II.)

Solenopora.—The discovery of this genus in the Lower Carboniferous rocks of Westmorland is of considerable interest, as its occurrence here gives us some insight into the history of its wanderings between the time when we last recorded it in the Gotlandian rocks of the Baltic area and its subsequent reappearance in the Lower Oolite of Gloucestershire. Whether it lived in the Baltic area during the Devonian and Carboniferous periods is, however, still unknown. The fact of its occurrence in the Caradoc, Carboniferous, and Jurassic rocks of the British Isles would appear to point to its existence not far off during the intervening periods.

In Westmorland and Lancashire *Solenopora* occurs in considerable abundance near the local base of the Lower Carboniferous rocks, and contributes largely to the formation of limestone deposits. It is present wherever the lowest beds of the succession are exposed, as at Shap, Ravenstonedale, and Meathop, and must formerly have flourished over a considerable area.

Though bearing a general resemblance, both in hand specimens and in microscopic structure, to the Ordovician and Jurassic forms, it has recently been shown by Dr. G. J. Hinde to be specifically distinct.⁴ It occurs as small, spheroidal nodules up to an inch in diameter, having a markedly lobulate outline embedded in compact and usually dolomitic limestones, and it is occasionally associated with oolitic structure. When fractured it exhibits the compact porcellaneous

¹ Flett in *Geology of Oban and Dalmally* (Mem. Geol. Surv. Scotland), 1908, p. 69.

² Wright & Bailey, loc. cit., pp. 33-4.

³ Edited and slightly abridged with the author's permission from the original Address as delivered at Birmingham, before Section C at the British Association meeting.

⁴ GEOL. MAG., Dec. V, Vol. X, p. 289, 1913.