agreed with me, when I exhibited the fossil, that it was properly placed in the Lepidoptera (*Brassolinæ*, not "*Satyridæ*"), I may safely remain steadfast in my original opinion, reminding my friend Scudder that though I am not infallible, neither is he, but at the same time two heads are better than one.

III.—ON THE MICROSCOPIC STRUCTURE OF THE LAMBAY PORPHYRY (OR PORPHYRITE).¹

By Professor EDWARD HULL, M.A., F.R.S., President R. G. S. I.

THIS very handsome rock forms almost the whole surface of the Island of Lambay and of the adjoining coast, a few miles to the north of Dublin Bay. It is also laid open in the railway cutting at Donabate Station; and has received considerable notice owing to its intrinsic beauty as an ornamental stone, and its proximity to the Irish metropolis. I am informed by Rev. Dr. Haughton that he has identified specimens from the tessellated pavement of St. Kevin's Church, Glendalough, of the seventh century, which were submitted to his inspection by Sir W. Wilde. A polished table, together with a large block presenting two sides cut and polished, are placed in the gallery of the Royal College of Science in St. Stephen's Green; where, to those familiar with the marbles of Italy and Greece, the appearance of these specimens cannot fail to recall the green porphyry (*Marmor Lacedæmonium viride*) so largely used in ancient decorative works of art, and often reset in modern ones, the source of which is in the neighbourhood of Sparta and Marathon.² The two rocks, however, though resembling each other in appearance, are essentially distinct as regards mineral composition, M. Delesse having proved that the Grecian porphyry contains augite as an essential, and is apparently a porphyritic basalt, while the Irish porphyry is altogether destitute of this mineral. As regards geological age, the Lambay porphyry appears to have been intruded amongst the Lower Silurian rocks at a period antecedent to that of the Old Red Sandstone,³ as this latter formation overlies the porphyry without appearing to have undergone any alteration along the surface of contact.⁴

The appearance of the porphyry is locally variable; but in its normal condition it consists of a dark green base, inclosing numerous pale green crystals of felspar. These crystals are of various sizes up to an inch in length. Occasionally there are cavities inclosing segregations of chalcedony, epidote, chlorite, or calcite, which also fill in little veins and fissures in the rock itself. In some places it is highly vesicular, the cells containing flesh-coloured calcite. The late Professor Jukes and Mr. Du Noyer appear to have considered the rock to be hornblendic—attributing the dark colour of its base to the

¹ Read before the Royal Geological Society of Ireland, 13th April, 1874.

² E. Hull, "Building and Ornamental Stones of Great Britain and Foreign Countries," p. 73.

³ Maps of the Geological Survey, Sheet 102, with Explanation by Messrs. Jukes and Du Noyer.

⁴ It is represented in a similar manner in Griffith's Geological Map of Ireland. Edit. 1855.

presence of this mineral; and on the Maps of the Geological Survey it is named and coloured as "Greenstone Porphyry." But the thin translucent slices, one taken from Lambay Island, and the other from Portrairie, fail under the microscope to reveal this mineral; while, on the other hand, they show that the dark colouring of the base is due to its being highly charged with minute crystalline grains of magnetite, together with which is a little chlorite, imparting the greenish tinge to the rock.

While, therefore, from the character of the rock, it is by no means improbable that hornblende occurs as an accessory in some places, yet on the whole it ought to be regarded as a felstone porphyry; or, to adopt Naumann's term for the quartzless varieties of porphyritic felstones, "*a porphyrite*."¹ We shall now proceed to consider its microscopic structure in detail, beginning with the base.

The Base.—When a thin slice is examined with a moderate power (magnifying from 24 to 100 diameters), the base is seen to consist of a colourless felsitic material, amorphous, but sometimes containing long minute felspar crystals. Throughout this base small black crystalline grains of magnetite are distributed in immense numbers, often so small as not to come into sight till viewed with a high power. Along with the magnetite, a mineral which I take to be chlorite is abundantly diffused in the form of light green clouds, or else filling up along with calcite cavities and minute fissures. The dense and dark appearance of the base is therefore evidently due to its being charged so fully with magnetite, while the greenish tinge is due to the green structureless mineral which is more or less generally distributed throughout the felsitic base; and which, in all probability, is chlorite.

Orthoclase crystals.—These are abundant, and sometimes well formed. They frequently occur in pairs, sometimes in threes, less frequently in the form of a cross. They vary in size from half an inch downwards. In colour they are pale green, mottled white, and under the microscope are seen to be traversed by cleavage planes and fissures in various directions, altogether different from the fine parallel lines and bands which characterize the triclinic group of felspars. Occasionally, however, a banded structure parallel to the sides of the prism is observable in some of the crystals displayed on the polished block in the Gallery of the College of Science.

Magnetite.—Small black grains of magnetic iron-ore are so abundantly distributed throughout the base as almost to obscure it, unless the slice is exceedingly thin. Along with these are also occasionally larger perfect cubes, showing well-defined angles of 90° as estimated by the eye. It is remarkable, however, that it is only at rare intervals that a crystal of magnetite becomes enveloped in one of the felspar crystals, from which it may be inferred that these latter were consolidated while the iron remained dissolved throughout the materials from which the base was ultimately formed.

Very singular, however, is the manner in which these magnetite grains are arranged around the interior of some small cells, as shown

² B. von Cotta's "Lithology," English Version, pp. 168-9.

in Fig. 1. Here they assume a stellate, or plumose arrangement, branching out from certain centres placed at intervals around the sides of the original cell, now filled in with chlorite and calcite. This structure I regard as due to polarity, the magnetite grains having arranged themselves side by side somewhat in the manner in which steel dust will arrange itself between the opposite poles of a magnet. Dr. Reynolds, however, suggests that the structure is similar to the dendritic form assumed by manganese ore between the laminae of sandstone or shale, and which he has shown to be due to magnetic force. In this case he supposes the cleavage planes of the calcite to have afforded the necessary conditions.

FIG. 1.—Cell in the porphyry lined with chlorite and filled with calcite. Several stellate prominences formed of minute grains of magnetite project from the walls of the cell into the interior, and are imbedded in calcite. Mag. 25 diams.

Chlorite.—This mineral is abundantly disseminated throughout the base. It also occurs in small irregular grains, or (along with calcite) fills in cracks and cavities in the rock. It is of a pale leek-green colour, structureless, but often inclosing minute cells, probably gas or air bubbles, as shown in Fig. 3. It is to be presumed that this mineral is in every case of secondary origin, and is not directly the product of igneous fusion. It has therefore been introduced by the agency of water, which has permeated the whole mass of the rock through channels inconceivably narrow, and which can only be revealed by the aid of a high microscopic power. In the section of the cavity (Fig. 1) which has been filled in by this material and calcite, the chlorite forms a partial lining, interposed between the walls of the cavity and the calcite which fills the interior, so that it

is probable the chlorite was the first of these minerals infiltrated into the mass of the rock.

FIG. 2.

FIG. 3.

FIG. 2.—Group of orthoclase crystals imbedded in the felspathic matrix, darkened by grains of magnetite. Mag. 25 diams.

FIG. 3.—Cavity filled with chlorite showing cellular structure. Mag. 55 diam.
b. Cell in chlorite. Mag. 400 diams.

Calcite.—The calcite, which is very abundantly diffused throughout the porphyry, occurs chiefly in fissures, often extremely minute, and in the cells, which were probably filled originally with gas or steam. It is always in a crystalline state, and under the microscope the lines corresponding to the cleavage planes of the rhombohedron are clearly developed. With polarized light, the calcite exhibits as usual the faint and delicate pearly or opalescent play of colours, amongst which a pale smalt blue is the most easily recognized.

The calcite is unquestionably due to infiltration; and its abundance may with great probability be attributed to the Carboniferous Limestone of the district, which must once have overspread and covered up the rocks of Lambay and Portrairie, which have since been brought to light by the denudation of the limestone. It is easy to conceive that water percolating downwards through the limestone and the thin coating of Old Red Sandstone beneath would become strongly impregnated with carbonate of lime, which it would deposit amongst the fissures and cells of the older rocks beneath.

Along with the minerals here described are also to be found crystals of pyrites; and the order in which the different minerals seem to have been formed is as follows:—First, during consolidation, the crystals of orthoclase; next, the crystalline grains of magnetite;

and lastly the felsitic base itself. Then, after consolidation, chlorite, and calcite, and pyrites.

In fine, it may be said with truth, that but for the aid which the microscopic examination of thin slices of this rock affords, it would have been impossible to have arrived at a correct judgment regarding its mineral composition.

FIG. 4.

FIG. 4.—Portion of polished surface of the porphyry, showing the arrangement of the orthose crystals. Nat. size.

IV.—GEOLOGY OF WEST GALWAY AND S.W. MAYO, IRELAND.

By G. H. KINAHAN, M.R.I.A.

(Of the Irish Branch of the Geological Survey.)

HAVING received permission from the Director-General of the Geological Survey of the United Kingdom, I exhibited before the Geological Section of the British Association at Belfast in August last, the Maps and Sections of the rocks forming the hill-country of West Galway and S.W. Mayo, and gave a description of the district, of which the following is an epitome.

The extreme north part of the area represented in these Maps (Sheets 83, 84, 85, 93, 94, 95, 103, 104, 105, 113, and 114) was surveyed by my colleague, Mr. R. G. Symes, while the rest of it was examined by myself, assisted by the late Mr. Warren and Messrs. Wilkinson, Nolan, Leonard, and Cruise, while Mr. Baily and his assistants, Messrs. McHenry and Leeson, worked out the palæontology. To all the officers working under my directions I am indebted for the zeal they displayed, but especially to the late Mr. Warren, who was early and late in the field, thereby losing his life