V.—NOTE ON PSEUDO-SPHERULITES.

By Lieut.-General C. A. McMAHON, V.P.G.S.,
and W. MAYNARD HUTCHINGS, F.G.S.

THE January number of this MAGAZINE contains an interesting paper on a soda-bearing rock from Dinas Head, Cornwall, read by Mr. Howard Fox, F.G.S., at the Oxford meeting of the British Association. Mr. J. J. Harris Teall, F.R.S., supplied notes on the microscopic structure of some of the specimens; and four chemical analyses by Mr. J. Hort Player and Mr. Arthur F. Hosking are given in the paper, from which it appears that the specimens analysed are composed of from 64 to 66 per cent. of silica; from 19 to 20 per cent. of alumina; 9.8 of soda; and small amounts (generally under 1 per cent.) of potash, titanitic acid, ferric and ferrous oxides, magnesia and lime.

A sketch of a nodular spherulitic specimen is given at page 18, *GEOL. MAG.* 1895.

In a subsequent paper¹ read by Mr. Fox before the Royal Cornwall Geological Society in 1894, other specimens from the same locality, the microscopical examination of which was undertaken by one of the authors of this paper, are described.

Some of the soda rocks from Dinas Head, which form the subject of this paper, contain a number of nodules closely resembling spherulites to which it seems desirable to invite the attention of petrologists. They are mostly in rounded forms, but owing to their interference with each other's growth, thin sections of them, under the microscope, sometimes present irregular hexagonal outlines. Superficially examined they greatly resemble true spherulites, and have been accepted as such by some good observers.

The main question which arises in connection with these spherulites is, whether they are of igneous origin, and denote a vitreous igneous rock, or whether they represent contact action exercised on a sedimentary rock. After a prolonged study of the specimens sent to him, General McMahon came to the conclusion that they are sedimentary rocks indurated and altered into a variety of porcellanite, or adinole, by contact metamorphism.

The structure of the base in which the pseudo-spherulites are imbedded might be described as micro-granular or crypto-crystalline; and it is not, taken alone, of sufficiently distinctive character to enable a petrologist to answer the above question offhand. One sees this structure in some altered sedimentary beds, and also in some igneous rocks. In such cases one has, before arriving at a verdict, to search for felspar prisms, or microlites, scattered about in the base, and these are rarely absent in rocks of igneous origin. In the rocks under discussion, if we exclude the pseudo-spherulites from consideration, not a single lath-shaped prism of felspar, or microlith, is to be found in the base. On the contrary, one of the slides contains evidence which points decidedly to a sedimentary

¹ Notes on the Cherts and Associated Rocks of Roundhole Point, Cataclews Point, and Dinas Head. *Trans. R.C.G.S.* 1894.

origin. Here and there a very fine-grained lamination is to be observed in the base. The micro-granules are arranged in perfectly parallel straight lines, very close together, and possess a rigidly parallel structure, like the lamination of a very fine-grained sedimentary rock, and unlike the foliation of an igneous rock. It seems altogether unlikely that a fine-grained laminated structure, like that seen in the slide referred to, in rigidly parallel lines, could have been produced here and there in isolated patches in a vitreous rock of igneous origin. Their presence, however, in a partially melted fine-grained sedimentary rock is easy of comprehension.

The pseudo-spherulites in the Dinas Head specimens present, on careful examination, some features different from the normal spherulites of glassy igneous rocks. The pseudo-spherulites do not exhibit a dark cross when revolved between crossed nicols. Indeed, the base of these spherulites, namely, the micro-granular, or crypto-crystalline material seen in the centres, and between the blades of the felspar prisms, which radiate from the margins of the spherulites towards their centres, does not possess a fibro-radial structure at all; and does not in any way differ in structure from the crypto- or micro-granular base outside the boundaries of the pseudo-spherulites.

In normal spherulites the radial fibres, or fibrous prisms, have straight extinction; whereas in the Dinas Head pseudo-spherulites the prisms which radiate from the outer edge towards the centre (which they never reach) are those of a triclinic felspar and have, in every case, oblique extinction.

The conclusion reached by General McMahon regarding the pseudo-spherulites of the Dinas Head soda rocks is, that they are the product of contact action by a basic trap on a sedimentary rock which either contained, in whole or in part, the chemical constituents of albite; or into which those constituents were introduced, in whole or in part, at the time the contact action took place.

As the presence of spherulites in a vitreous rock has been regarded by many petrologists as evidence of the igneous origin of the rock in which they occur; and as a metamorphic origin has not hitherto, so far as we are aware, been suggested for spherulites, this determination seemed worth noting.

The independent researches of Mr. Hutchings, in another locality, carried out at the same time, has supplied the needed confirmation. This confirmation is all the more important as no doubt can be entertained regarding the sedimentary origin of the rocks studied by Mr. Hutchings and described in the March number of this *MAGAZINE*. They are shales forming part of beds of limestone, sandstone, and shales, in contact with the Whin Sill, and still retaining in their altered condition abundance of clastic quartz-grains and other witnesses to their original nature, even if this was not as positively assured as it is by the field evidence.

In these altered shales Mr. Hutchings describes at pages 124, 125 nodules which exhibit under the microscope much the same general character as those of the Cornish rocks, and which contain in some cases numerous well-developed spherulitic aggregates of fibres of