V.—ON THE OCCURRENCE OF PORPHYRITIC STRUCTURE IN SOME ROCKS OF THE LIZARD DISTRICT.¹

By HOWARD FOX, of Falmouth, and ALEX. SOMERVAIL, of Torquay.

BEING the fortunate possessors of Prof. Bonney's valuable papers² on the Lizard Serpentine and Schists in a pamphlet form, we examined the coast this spring somewhat minutely from Polurrian Cove on the west to the Blackhead on the east of the Lizard Point. We had tracings of the entire coast in our pockets, taken from the 25 inch Parish Maps, and owing to fine weather, and a favourable state of the coast, we were able to visit some of the less accessible rocks, and to trace some beds which at times are covered with seaweed and shingle or débris from the falling cliffs. Prof. Bonney's porphyritic diabase had been previously identified by one of us after a long search over the 18 acres of rocks and boulders exposed at Polpeor at low-water spring-tides. We made ourselves familiar with this rock, and were thereby enabled not only to trace it further, but to recognize a porphyritic structure in many dykes and intrusions along the coast, and also in the darker bands of Prof. Bonney's "Granulitic Group."

Commencing at Polurrian, the most westerly point, we will proceed eastward, noting the chief localities where the porphyritic structure may most readily be observed.

VELLAN HEAD.—About 250 yards N.W. of the granitic vein marked on the Ordnance Map, near the base of the cliff and opposite an island, some narrow porphyritic dykes occur in the midst of bands of disintegrated serpentine, steatite, etc., and quartzose rock.

GOOD GASTOL (?).—At the inner end of a little cove about 300 yards S.E. of Oliver's Refreshment Room at Kynance Cove there are some dykes with a few crystals of felspar scattered through their compact dark matrix.

HOLESTROW.—On the foreshore at the southern end of this land slip and a little N.W. of Pentreath Beach are several masses of banded crystalline rocks *in situ* resembling the "Granulitic Group." In these rocks may be discovered by careful search felspar crystals scattered through the matrix of the darker bands.

PENTREATH BEACH.—At the extreme north end of this beach a granitic vein runs up the cliff. Adjoining are some trap dykes also cutting the serpentine. About 100 yards south of this point a porphyritic dyke may be seen at low-water running in a N.W. and S.E. direction. This dyke is again found in a chine in the cliff in a line with its strike. At the south end of this beach occurs the junction of the serpentine with hornblende schist. About 100 yards south of this junction we find indications of porphyritic structure in the massive cliffs, here chiefly composed

¹ An Abstract of this paper was read before the British Association, Section C. (Geology), Manchester, September 1887.

² Quart. Journ. Geol. Soc. Nov. 1877, pp. 884-928, and Feb. 1883, pp. 1-24.

of micaceous schists. These indications continue for the next 300 yards, viz. to considerably south of Caerthillian, and on the foreshore are seen stones and boulders of typical porphyritic structure.

NORTH CAERTHILLIAN.—The most readily accessible place where a typical porphyritic rock may be seen *in situ* is immediately N.E. of the headland which bounds Caerthillian on the north. This spot can be reached with ordinary care from the top of the cliff, which is lower here than on either side. A quartzo-felspathic rock is exposed close under the soil, and a few yards below it are several bands alternating of porphyritic and granulitic rock much faulted. The darker bands are thickly studded with small well-defined crystals of felspar, which on the weathered surface project beyond the matrix. These bands can be traced for 20 yards in a N.W. and S.E. direction, much twisted. They extend in a S.W. direction to high-water mark and down the cleft to the south.

SOUTH CAERTHILLIAN.—Some rocks apparently *in situ* on the foreshore 70 to 100 yards south of Caerthillian Cove show crystals of felspar in their soft micaceous matrix. The adjoining cliffs show a porphyritic structure in a more compact rock.

PISTIL OGO.—Rounding the Lizard Head, we can descend the cliff at this place, where we find a greenish porphyritic rock running N.W. and S.E., and 200 yards further east we reach the most southern point.

POLPEOR.—When the shingle and seaweed have sufficiently left the coast, the porphyritic diabase discovered by Prof. Bonney can be traced running N.W. and S.E. for 150 to 200 yards. It is exposed in the micaceous and hornblende schists in an intricate manner, appearing again and again at and near the base of the cliff and on the foreshore both in Polpeor and the adjoining cove to the N.W. It can be traced in the mass of rock which at half-tide forms the eastern boundary of Polpeor beach, and through this on the foreshore still further east towards Polpeor Island. It appears again in Vellan Drang 200 yards S.W. of Polpeor Cove in the strike of the Pistil Ogo Beds.

PARN VOOSE (locally PENVOSE).—This cove directly north of the Balk Quarry is the place at which Prof. Bonney's "Granulitic Group" sets in, and continues with alternations of hornblende schist and serpentine to Kennack Beach. Here also the gabbros appear in mass, and here the porphyritic structure in the dark bands of this crystalline series may be seen to advantage. The foreshore is strewn with boulders recently fallen from the cliff, and the crystals of felspar in some of these are from one to two inches long and almost as broad. The same occurrence of crystals is seen in the cliffs, but not to such advantage as in the boulders.

POLBARROW.—Proceeding still eastward past Lean Water and Gothan Point or Whale Rock, we come to Polbarrow, and can trace porphyritic indications throughout this region.

KILDOWN.—East of Cadgwith we also find crystals and felspar in the dark bands of the granulitic group.

CAERLEON.—Here Prof. Bonney's porphyritic dyke¹ is seen about 100 yards south of the Poltesco Serpentine Factory.

Passing Caerleon Cove, we climb up the hill by the Coast-guard path, cross the rocky slope above "Little Cove," and scramble down into the next small cove north of a projecting serpentine headland called in the Parish Map Polbrearn Point. Here we find rocks with large crystals of felspar, both *in situ* and in boulders scattered over the rocky foreshore for the next 300 yards northward.

CAVOUGA.—The Parish Map gives the name of Cavonga to the serpentine rocks running out to sea 100 yards north of Polbrearn Point, and as the rocks containing large crystals of felspar occur on each side of these serpentine rocks, it may be an appropriate name by which to designate this region.

There are two exposures of these large-crystalled porphyries *in situ* at the foot of the cliffs; the first about 90 yards S.W. of Cavonga Rocks, the second about 200 yards north of them, or say 600 yards N.E. of Poltesco Serpentine Factory. The first of these appears to cut the serpentine, and can be traced up the cliff, the darker bands containing both large and small crystals of felspar at various angles, and the associated lighter bands resembling the quartzo-felspathic bands of the "Granulitic Group." The second exposure north of Cavonga Rocks resembles three dykes cutting through the serpentine; but, as Colonel MacMahon suggests, it may be one dyke which by pressure has been doubled up on itself. Between and on either side of these two exposures the darker bands of this crystalline series of rocks show from time to time distinct crystals of felspar in the massive rocks as well as in those which appear to cut the serpentine as dykes. On the foreshore are many boulders so studded with crystals as to resemble mosaic, the crystals occasionally reaching a length of nearly six inches and a breadth of from two to three inches. One boulder had some of the crystals beautifully tinted with red.

KENNAK.—In proceeding east to Kennack, we trace the crystals in the dark bands of the granulitic group, and on reaching the beach we find the porphyritic structure very marked in some isolated masses of the same group, one of which Prof. Sedgwick described as a "Greenstone porphyry."² North of these in a low cliff we trace a similar structure.

GREEN SADDLE.—About 500 yards E.S.E. of the thatched shed at the extreme east of Kennack Beach there is another exposure of rock with large crystals of felspar resembling a dyke cutting the serpentine. The foreshore is here also strewn with boulders of porphyritic rock.

Summary.

The crystals of felspar are found to be most numerous in those rocks which lie in the closest proximity to the gabbro and serpentine ;

¹ Quart. Journ. Geol. Soc. Nov. 1877, p. 900.

² Trans. Cambridge Phil. Soc. vol. i. p. 18.

they have their long axis at various angles, and are mostly small, except at Parn Voose, Cavonga, and Green Saddle. The felspathic and hornblendic lines often circle round the crystals.

Such is a brief statement of the bare facts of our observations in this particular direction. Without discussing any theory as to the true nature and origin of the whole of the schists, we think that the porphyritic structure, so prevalent in the dark bands of the "Granulitic Group," in many of the micaceous and other rocks, as also in the later intrusions cutting the serpentine, indicates an igneous origin for many rocks hitherto regarded as schists.

VI.—ON THE PRINCIPAL MODIFICATIONS OF THE SPIRALS IN THE FOSSIL BRACHIOPODA.

By the Rev. NORMAN GLASS.

DR. DAVIDSON, assisted by the writer, gave a provisional sketch of the classification of the spiral-bearing Brachiopoda in the volume of the Palæontographical Society for 1883.¹ As Dr. Davidson then said, our design was "to assist those palæontologists who might feel inclined to continue the subject." The following notes have been written by me for the same end, and I think that if they are carefully read and compared with the figures in Dr. Davidson's Carboniferous, Devonian, and Silurian Supplements, they will give a tolerably clear idea to the student of a very complex and difficult subject. I have perhaps some claim to write upon this subject from the years of close and continuous investigation which I have devoted to it, and from the fact that I have discovered a large proportion of what is now known concerning the spirals and their connections.

In the "Geologist," 1858 (vol. i. pp. 457–473, folding plate xii.), Dr. Davidson gave figures and descriptions of all that was known up to that date concerning the spirals and their connections. The comparison between these figures and those given in his Carboniferous, Devonian, and Silurian Supplements in 1880 and 1882 is very remarkable as showing how recent have been the great majority of the discoveries in this interesting group. I have thought, therefore, that it might add to the interest of my notes if I gave in each case the date of the discovery and the name of the discoverer, that is, so far as these are known. Of course it will be understood that there are many genera and species which have the same internal characters as to the position of the spirals, their attachments to the hinge-plate,

¹ Anticipating a delay of fifteen months, owing to the retarded appearance of his Monograph in the Palæontographical Volume, the veteran author on the Brachiopoda, Dr. Davidson, published the result of his labours, in association with the Rev. Norman Glass, concerning the calcareous spirals of the Palæozoic Brachiopoda, in the GEOLOGICAL MAGAZINE for 1881 (Decade II. Vol. VIII. pp. 1, 100, 145, and 289), illustrated by Plate V. and fourteen Woodcuts. It will be well for the reader to refer to these articles, as the figures therein given more fully elucidate the present paper, and the whole subject is treated in greater detail by Dr. Davidson; save and except the additional remarks made by Mr. Glass herein, which refer to discoveries of a later date than 1881.—ED. GEOL. MAG.