action of air and water, and of insects and other organisms gaining access to it through the interstices of the breccia, would soon disappear.

With the limited time and opportunities which I had, I was not able to form an exact idea of the extent of the formation. Its width is that of the slope to which I have referred—from two to three miles, perhaps more in places. The thickness must vary from point to point; it may sometimes—with interstratified beds of sand—amount to as much as five or six hundred feet. The length near Tumupasa will be equal to that of the Bala-Susi mountains, nearly a hundred miles, but breccias must be forming under exactly similar conditions in many other places at the foot of the outer ranges of the Eastern Andes.

It is sufficient for the present if I have shown that extensive breccia formations, in many respects similar to those found among the European strata, are now being accumulated in a thickly wooded, well-watered country, with a moderately warm and nearly uniform climate.

IX.—NOTE ON *VESTINAUTILUS CRASSIMARGINATUS*, A. H. Foord.

By G. C. CRICK, Assoc.R.S.M., F.G.S., of the British Museum (Natural History).

THE species *Vestinautilus crassimarginatus* was founded in 1900 by Dr. A. H. Foord¹ upon some (apparently three) specimens from the Carboniferous Limestone of Little Island, near Cork. It was described as follows:—

“Shell discoid, with slowly increasing whorls, all exposed in a deep umbilical cavity having a large central vacuity. The whorls are digonous in section, the peripheral area making a broad flattish arch; the sides, which form the steeply descending umbilicus, diverge at an obtuse angle from the margin of the latter; they are somewhat inflated in the lower half, and slightly concave in the upper, resembling those of *Vest. cariniferus*² in this respect. The contact or inclusion of the whorls is very slight, and, so far as can be made out from a section, there is no perceptible zone of impression. Owing to this slight amount of overlapping of the whorls, part of the peripheral area is exposed in the umbilicus, the inner whorls thus making a deep channel where they abut against those that embrace them. The umbilical border is marked by a strong, rounded rim, which becomes very prominent in the adult and senile stages.

“In the young shell the rim is about as prominent as it is in the adult of *Vest. cariniferus*, J. de C. Sow. [sp.], and other allied species. The conical apex of the young shell is ornamented with a series of close-set, fine, longitudinal ridges, and these are crossed

¹ Monograph on the Carboniferous Cephalopoda of Ireland (Pal. Soc.), pt. iii (1900), p. 79, pl. xxiii, figs. 5a–c.

² *Nautilus cariniferus*, J. de C. Sowerby, Min. Con., vol. v, p. 130 (1824), pl. cccclxxxii, fig. 3, excl. fig. 4. See also A. H. Foord, Mon. Carb. Ceph. Ireland (Pal. Soc.), pt. iii (1900), p. 82, pl. xxiii, figs. 1–3; pl. xxvii, figs. 2a, b.

by minute transverse striæ, which, cutting the former, impart a beautifully crenulated appearance to this part of the shell as seen under the lens. After the first whorl is passed the spiral lines begin to widen, and those of the lower half of the whorl entirely disappear, leaving five ridges, the two lower ones being very faint, till finally they all become obsolete, leaving only the transverse lines. These are regularly arranged and very numerous, their distance apart in the adult shell being almost exactly 1 mm. From the appearance presented by one of the specimens it would seem that they imbricate, but this is not very distinctly seen. They form upon the peripheral area a very distinct and deep, backwardly-directed sinus, indicating the presence of the hyponomic sinus of the aperture. On each side of the peripheral area there are three or four faint ridges in the young shell, but before the second whorl has been reached they have entirely disappeared. In a large individual in the senile stage of growth obscure folds and tubercles are developed upon the peripheral area and in one or two places upon its margin, but these are not sufficiently prominent to alter the general features of the shell.

"The septation is not known . . . . ."

"The siphuncle is about twice its own diameter from the peripheral margin.

"The body-chamber is imperfect in the specimen in which it is seen . . . . ."

"The test is rather thick, especially upon the umbilical border, where it forms the thickened rim . . . . ."

In his remarks on the species the author says: "The question of the generic affinities of this shell is a difficult one to settle in the absence of a sufficient number of specimens wherewith to study the stages of growth from the very young to the old shell, and their modifications. . . . It is unfortunate that the septation is not to be got at, as this would have aided very much in the determination of the affinities of the fossil."

The dimensions given of the largest specimen (which was elliptical) known to the author are:—greatest diameter, 127 mm.; smallest diameter, 102 mm.; height, from centre of area of inclusion to centre of ventral area, 24 mm.; width, from the summit of one umbilical rim to the summit of the other, 44 mm.

Though exhibiting some differences from the figured example, there is in the British Museum a specimen (No. C. 8861) which in my opinion is referable to this species; and which, if correctly identified, adds to our knowledge of the species by revealing to some extent the form of the septal sutures; unfortunately, the locality whence the specimen was obtained has not been recorded.

The latter half of the outer whorl of the fossil is very slightly crushed, but the specimen is not otherwise distorted. The fossil is 85 mm. in diameter; it is entirely septate; the body-chamber is wanting, and a portion of the inner whorls is either absent or obscured by the matrix which covers the central vacuity; the outer whorl and nearly a half of the penultimate whorl are clearly shown,

the rest of the latter being only faintly indicated in section in the matrix; then follows a length of about 10 mm. of the antepenultimate whorl, whilst the rest of the inner whorls are entirely covered by matrix. The lateral aspect of the shell agrees very well with that given by Dr. Foord (*op. cit.*, pl. xxii, fig. 5a), allowance being made for the elliptical form of the figured example. The fossil shows the crenulated ornamentation of the young shell; also the subsequent spiral ridges occurring on both the lateral and the peripheral sides of the prominent umbilical margin, and which, gradually disappearing, leave only fine, well-marked transverse striæ; on the greater part of the side of the whorl these striæ are a little reclined¹; rising with a backwardly-directed curve on to the umbilical margin, they cross the peripheral area with a very distinct and deep, backwardly-directed sinus, indicating the presence of the hyponomic sinus² of the aperture. On the outer whorl of the specimen this sinus is somewhat deeper and narrower than Dr. Foord's figure (fig. 5b) represents, but this seems to be due in part, but only in part, to the fact that the latter half of the outer whorl has been somewhat compressed laterally, sufficient, however, to force outwards the central portion of the peripheral area and eventually to fracture it. Consequently the median portion of the periphery of this part of the fossil is much more convex than is represented even in the lower part of Dr. Foord's figure (fig. 5b),³ in fact the two sides of the peripheral area are inclined to each other at an angle of rather more than 100°; the peripheral area of the earlier and uncompressed part of the whorl is, however, relatively less convex. Owing to the compression already mentioned, the transverse section of the anterior end of the outer whorl of the specimen is almost pentagonal in outline, and the proportion of its dorso-ventral diameter (or height) to its transverse (or width) is greater than shown in Dr. Foord's figure (fig. 5c), the height, from the centre of the area of inclusion to the centre of the peripheral area, being 35 mm., and the width, from the summit of one umbilical rim to the summit of the other, 41.5 mm., the corresponding dimensions given by Dr. Foord, in an example 127 mm. in diameter, being 24 mm. and 44 mm. respectively. This proportion is rendered greater than it would naturally be by the fact that the test is imperfect on the umbilical rim on one side and entirely wanting on the other. At the anterior end of the specimen the siphuncle is seen, but owing to the compression of the whorl it is not quite in the median line; it is nearly 5 mm. in diameter, its outer surface being 10 mm. below the centre of the periphery, this being the position assigned to it by Dr. Foord; the 'zone of

¹ In the coiled shell of a Cephalopod the ribs or striæ are said to be 'direct' when their direction coincides with the radius; 'inclined' when they are forwardly-disposed in relation to a radius; and 'reclined' when they are backwardly-directed in relation to the same line.

² The sinus of the aperture at the median part of the peripheral area or venter indicating the position of the funnel or hyponome.

³ It is to be noted also that the periphery in Dr. Foord's diagrammatic transverse section of the whorl (fig. 5c) is much less convex than it is represented at either the lower or the upper part of the front view of the fossil depicted in his fig. 5b.

impression,¹ though shallow, is here well marked and about 13·5 mm. wide, but this may have been much narrower or even have entirely disappeared on the body-chamber, so that the transverse section of the body-chamber may have been more nearly digonal. Fortunately in the present specimen a few of the septa are visible, or at least partially visible; near the anterior end of the specimen they are about 6·0 mm. apart; they are, however, best displayed at about the commencement of the last third of the outer whorl, i.e. where the specimen is 69 mm. in diameter; here they are seen on a portion of the peripheral area and on a part also of the side of the whorl; on the lateral area they form a very slight backwardly-directed curve, and, crossing the umbilical rim, traverse the peripheral area in almost a straight line, or with only a very feeble backwardly-directed curve; on the periphery they are about 7·0 mm. apart. So far as can be seen, the form of the septation closely resembles that of *Vestinautilus pinguis* as figured by Dr. Foord,² but the chambers are a little shallower than shown in that figure. Notwithstanding the characters which differentiate this specimen from Foord's figured example, viz., the greater convexity of the peripheral area, the narrower and deeper hyponomic sinus, and the relatively greater height of the whorl in proportion to its width, there can be no doubt that the two forms are very closely allied and most probably specifically identical. In referring his species to the genus *Vestinautilus*, Dr. Foord seems, therefore, to be correct, the form of the septal sutures supporting that conclusion.

NOTICES OF MEMOIRS, ETC.

I.—FLORAS OF THE PAST: THEIR COMPOSITION AND DISTRIBUTION.

By A. C. SEWARD, F.R.S., Fellow and Tutor of Emmanuel College, Lecturer on Botany in the University of Cambridge.

(Continued from the November Number, p. 512.)

THE geographical distribution of plants of approximately Rhætic age is shown in the following table on p. 557, which demonstrates an almost worldwide range of a vegetation of uniform character. The character of the plant-world is entirely different from that which we have described in speaking of the Palæozoic floras. Gymnosperms have ousted Vascular Cryptogams from their position of superiority; ferns, indeed, are still very abundant, but they have undergone many and striking changes, notably in the much smaller representation of the Marattiaceæ. The Palæozoic Lycopods and Calamites have gone, and in their place we have a Jurass of Cycadean and Coniferous types. As we ascend to the Jurassic plant-beds the change in the vegetation is comparatively slight, and the same persistence of a well-marked type of vegetation

¹ The 'zone of impression' or 'impressed zone' is the zone which is in contact with, and impressed by, the peripheral area of the preceding whorl.

² *Op. jam cit.*, pl. xxv, fig. 3a.