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VII.—*The Foraminifera of the Gault of Folkestone.*—VI.

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PLATE VIII.

*Sub-family NODOSARIINÆ—continued.*

VAGINULINA d'Orbigny [1826].

THE group of the *Vaginulinæ* from the Gault formation is an important one, since it bears characters distinct from those found in the Jurassic and other deposits. It is, moreover, an exceedingly difficult genus to deal with, as the specimens present few distinguishing points which will serve to separate them into specific or varietal forms. The *Vaginulinæ* of the French Gault formation have been very carefully worked out by M. Berthelin, who gives in his admirable and comprehensive monograph 'Sur les Foraminifères fossiles de l'étage Albien de Monteley' \* a system of classification which embraces some

EXPLANATION OF PLATE VIII.

- Fig. 1.—*Vaginulina recta* Reuss. *a*, side view; *b*, back edge view. × 45.  
" 2.—*V. recta* var. *tenuistriata* var. nov. × 45.  
" 3.—*V. strigillata* Reuss sp., typical form. *a*, side view; *b*, back edge view.  
× 35.  
" 4.—*V. strigillata* Reuss sp., slender variety. × 35.  
" 5.—*V. truncata* Reuss. *a*, side view; *b*, back edge view. × 45.  
" 6.—*V. truncata* Reuss. × 45.  
" 7.—*V. truncata* Reuss var. *robusta* Berthelin and Chapman. *a*, side view;  
*b*, back edge view. × 45.  
" 8.—*V. gaultina* Berthelin. *a*, side view; *b*, back edge view. × 45.  
" 9.—*V. arguta* Reuss. *a*, side view; *b*, back edge view. × 45.  
" 10.—*V. striolata* Reuss. × 45.  
" 11.—*V. comitina* Berthelin. × 45.  
" 12.—*V. sparsicostata* Reuss. *a*, side view; *b*, back edge view. × 60.  
" 13.—*V. discors* F. Koch. × 45.  
" 14.—*V. Biochei* Berthelin. *a*, side view; *b*, front edge view. × 45.  
" 15.—*V. Priceana* sp. nov. *a*, side view; *b*, front edge view. × 60.

\* Mém. Soc. géol. France, 1880, sér. 3, vol. i. No. 5.

of their more constant characteristics.\* The intimate relations existing between the groups of the *Froniculariæ* and the *Vaginulinæ* are also discussed by the same author.

In the series of Foraminifera from Folkestone a number of monstrous specimens of *Vaginulinæ* occur, which are very interesting from a morphological standpoint; and the notes upon these aberrant forms I propose to introduce at the end of this series of papers.

*Vaginulina recta* Reuss (plate VIII. fig. 1 *a, b*).

*Vaginulina recta* Reuss, 1862, Sitzungs. d. k. Ak. Wiss. Wien, vol. xlvi. p. 48, plate iii. figs. 14, 15. *V. recta* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 41, plate ii. figs. 5*a-6b*. *V. recta* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 559, plate X. figs. 10-13.

This species is distinguished by the elongate and narrow form of the shell, and its more or less parallel edges; moreover the diameter of the initial spherical chamber is nearly equal to the width of the lateral aspect of the shell at its commencement. The surface of the primordial chamber is sometimes decorated with one, or more rarely two crescent-shaped costulæ. The surfaces of the succeeding chambers are slightly convex.

*V. recta* was first described by von Reuss from beds equivalent to the Gault in North Germany, and it is also noted by that author from the Gault of Folkestone. It is also common in the Gault of Montcel (Berthelin), and mentioned as frequent from the Red Chalk of Speeton (Burrows, Sherborn and Bailey).

It is well distributed through the Gault formation at Folkestone, zone ii., spec. *a*, very rare; zone iii., frequent; zone iv., frequent; zone v., common; zone vi., very rare; zone vii., very rare; zone ix., rare; zone x., very common; zone xi., 55 ft. from the top, very common; 50 ft., very common; 45 ft., common; 40 ft., common; 35 ft., common; 30 ft., common; 25 ft., common; 20 ft., very rare; 12 ft., frequent; 6 ft., rare.

*Vaginulina recta* Reuss var. *tenuistriata* (plate VIII. fig. 2).

This variety resembles the specific form *V. recta* in having a rectilineal manner of growth, and a large and well-inflated initial chamber. The variety usually possesses a larger number of chambers, sometimes as many as fourteen. The surface of the shell is decorated with five vertical or oblique striæ which are interrupted and very rarely appear to bridge over the sutural costæ. The surface of the initial chamber is marked with striations, and is sometimes strongly costulate. It is distinguished from *V. paucistriata* Reuss,† by the absence of the four vertical ribs running down the back of the

\* Mem. Soc. géol. France, 1880. sér. 3, vol. i. No. 5.

† Sitzungs. d. k. Ak. Wiss. Wien, 1862, vol. xlvi. p. 48, pl. iii. figs. 16 *a-c*.

shell, and two on the front or inner side, the edge views of *V. recta* var. *tenuistriata* being unornamented and slightly convex. Von Reuss' variety, moreover, has two strong costulæ on the central area of each chamber. The length of the figured specimen measures 1/14 in.

It occurs at Folkestone in zone v., rare; zone vi., rare; zone vii., frequent; zone ix., rare; zone x., very common; zone xi., 50 ft. from the top, very rare; 35 ft., rare; 30 ft., very rare; 25 ft., very rare; 12 ft., frequent; 6 ft., rare.

*Vaginulina strigillata* Reuss sp. (plate VIII. figs. 3 a, b, and 4).

*Citharina strigillata* Reuss, Verstein. böhm. Kreidef., part ii., 1846, p. 106, plate xxiv. fig. 29.

The specimens from the Gault are easily recognized by the fine but sharp vertical striation of the shell-surface, the markings running uninterruptedly over the sutural lines of the chambers; the sutural costæ being depressed in this species nearly to the general level of the surface of the shell. The initial chamber is more or less well inflated and sometimes elongated in the direction of the length of the shell. The edges of the test are strongly costate. The coarser varieties of this form may, perhaps, be comparable with the fragmentary specimen figured by von Reuss under the name of *V. angustissima*.\*

*V. strigillata* was described from the Plänermergel of Bohemia (Reuss); recorded from the Gault of Kent, probably Folkestone (Rupert Jones in Morris' Catalogue and the "Weald" Memoir); and I have since found it in the Chalk Marl of Folkestone and the "Chalk detritus" of Charing, Kent.

This species is found in the Gault of Folkestone in zone viii., very rare; zone x., very common.

*Vaginulina truncata* Reuss (plate VIII. figs. 5 a, b, and 6).

*Vaginulina truncata* Reuss, 1862, Sitzungsber. d. k. Ak. Wiss. Wien, vol. xlvi. p. 47, plate iii. fig. 9. *V. truncata* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 39, plate i. figs. 25-28.

The figure given by von Reuss under the above name is taken by M. Berthelin for the type of a series of *Vaginulina* which occur abundantly in the Gault of France and elsewhere, and though presenting great variation in the general outline of the shell, are distinguished by the presence of a smaller initial chamber as compared with that of *V. recta*, by the more or less flat surface of the chambers between the sutural costæ, and by the absence of superficial ornamentation, with the exception of the initial chamber which is often decorated with lunar-shaped or branching costæ. This latter

\* Sitzungsber. d. k. Ak. Wiss. Wien, 1862, vol. xlvi. p. 45, pl. iii. fig. 3.

characteristic is illustrated by M. Berthelin (loc. cit.) on plate i. figs. A-F. M. Berthelin also recognizes two varieties of *V. truncata*, one of which he terms "var. *délicate*" and the other "var. *robuste*." Both of these varieties are well represented in the series from Folkestone, and since the robust variety is fairly distinct from the delicate form (the latter being more like the figure given by Reuss), I propose to retain the thinner and neater variety as the type species, and to call the coarsely grown specimens *V. truncata* var. *robusta*. This separation of the two forms may be useful in studying their zonal distribution in the Gault. *V. truncata* is recorded from the Upper Hils formation and the Speeton clay of North Germany (Reuss); and from the Gault of Montcley (Berthelin). It also occurs not unfrequently in the Chalk-marl of Folkestone and the "Chalk detritus" of Charing.

The species *V. eurynota*, which was described by von Reuss from Folkestone,\* and which has subsequently been obtained from the Red Chalk of Speeton (Burrows, Sherborn and Bailey)† appears to be closely related to *V. truncata*, to which name I have relegated the Gault specimens which show a curvature in the line of growth; these varieties are however impossible to separate in a large series of specimens.

*V. truncata* is found in the Folkestone Gault in zone ii., specimen *b*, very rare; zone iii., frequent; zone iv., rare; zone v., rare; zone vi., rare; zone vii., rare; zone viii., rare; zone ix., frequent; zone x., very common; zone xi., 45 ft. from the top, rare; 40 ft., frequent; 20 ft., very rare; 12 ft., rare; 6 ft., frequent.

*Vaginulina truncata* Reuss var. *robusta* Berthelin and Chapman,  
plate VIII. fig. 7 *a*, *b*.

*Vaginulina truncata* (pars) Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 40 ("var. *très-robuste*"), plate ii. fig. 4 *a* and *b*.

This variety differs from the type form of *V. truncata* in having a test of much thicker and coarser growth; the vertical costulate margins and the transverse sutural costæ being of thicker proportions than in the type form. The whole shell has a rough and ragged appearance, and the surfaces between the sutural ridges are in many cases deeply excavate. The edge view of the shell on the apertural side shows a surface sometimes curiously ornamented with short and twisted strigillations.

This variety was found in the Gault of France; at Folkestone it occurs in zone v., very rare; zone vii., common; zone viii., very rare; zone ix., rare; zone x., very common; zone xi., 55 ft. from the

\* Sitzungsab. d. k. Ak. Wiss. Wien, 1862, vol. xlvi. p. 90, pl. xii. fig. 9.

† Journ. Roy. Micr. Soc., 1890, p. 559, pl. x. fig. 9.

top, common; 50 ft., common; 45 ft., common; 40 ft., common; 35 ft., common; 30 ft., common; 25 ft., common; 20 ft., common; 12 ft., frequent; 6 ft., very rare.

*Vaginulina gaultina* Berthelin, plate VIII. fig. 8 *a, b*.

*Vaginulina gaultina* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 39, plate i. figs. 22 *a-24*.

This species has been described from the Gault of Montcley by M. Berthelin, and it is a characteristic fossil at Folkestone. I have also met with very good examples of *V. gaultina* from the "Chalk detritus" of Charing, Kent. In outline the shell is broader and more equi-triangular than *V. truncata*. It is easily distinguished by its strongly and obliquely striated sutural ridges. The initial chamber is inflated, and resembles that of *V. truncata* in point of size. The surfaces of the inter-sutural spaces are flat or slightly excavate.

*V. gaultina* is found in the Folkestone Gault, in zone iii., very rare; zone iv., very rare; zone v., rare; zone vii., frequent; zone viii., very rare; zone ix., rare; zone x., very common; zone xi., 55 ft. from the top, frequent; 35 ft., very rare; 30 ft., very rare; 25 ft., very rare.

*Vaginulina arguta* Reuss, plate VIII. fig. 9 *a, b*.

*Vaginulina arguta* Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 202, plate viii. fig. 4. *V. arguta* Reuss, 1862, op. cit., vol. xlvi. p. 47, plate iii. fig. 13. *V. arguta* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 42, plate ii. figs. 7 *a-8 b*. *V. arguta* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 559, plate x. figs. 14, 15.

The above name can be conveniently applied to those forms which do not possess a salient initial chamber, but which in other respects resemble *V. truncata*.

*V. arguta* is by no means a common form in the Gault series. It has previously been recorded from the Flammenmergel and the *Minimus*-thon of North Germany and the Gault of Folkestone (Reuss); from the Red Chalk of Specton (Burrows, Sherborn and Bailey) and from the Gault of France (Berthelin).

It is found in the Gault of Folkestone in zone x., rare; zone xi., 55 ft. from the top, rare; 50 ft., very rare; 45 ft., rare; 25 ft., rare; 20 ft., rare; 12 ft., frequent; 6 ft., rare.

*Vaginulina striolata* Reuss, plate VIII. fig. 10.

*Vaginulina striolata* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 46, plate iii. fig. 7.

This species resembles *V. arguta* in respect of the non-salient initial chamber, but differs from it in having the surface of the shell

striated obliquely, somewhat like that of *V. gaultina*. *V. striolata* was recorded from the Flammenmergel of North Germany by von Reuss.

One specimen only was found in zone x. of the Gault at Folkestone.

*Vaginulina comitina* Berthelin, plate VIII. fig. 11.

*Vaginulina comitina* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 38, plate i. fig. 21 *a-d*.

Some of the *Vaginulinæ* with striate costæ from the Gault, on careful observation are seen to possess an initial chamber which is not exactly in line with the rest of the shell, that is not terminal, but placed towards the inner side of the usually incurved commencement; the specimens showing this variation from the characters found in *V. gaultina* have been named *V. comitina* by M. Berthelin. The initial chamber is also smaller in this form, and, though more or less salient, is deeply set, and therefore scarcely seen when the edge view is taken. The costal ridges are not so conspicuously striate as in *V. gaultina*.

Besides occurring in the Gault, *V. comitina* is found in the "Chalk detritus" of Charing; and some of the specimens I have met with from the latter material are exceedingly beautiful and extreme varieties of the species.

It is found in the Gault at Folkestone in zone x., frequent; zone xi., 40 ft. from the top, very rare; 30 ft., very rare; 25 ft., very rare; 12 ft., rare; 6 ft., rare.

*Vaginulina sparsicostata* Reuss, plate VIII. fig. 12 *a, b*.

*Vaginulina sparsicostata* Reuss, 1862, Sitzungs. d. k. Ak. Wiss. Wien, vol. xlv. p. 50, pl. iv. fig. 4.

A fragmentary specimen was found in the Gault of Folkestone which is clearly referable to the above species. *V. sparsicostata* belongs to the series of triangular *Vaginulinæ*, with obscure segmentation and vertical or radial strigillate markings on the surface of the shell; the initial portion of the shell is distinctly pointed.

The above species is recorded by von Reuss from the Upper Hils-thon of N. Germany, and the same species is noted in the author's MS. as associated with the Foraminifera from the Neocomian (Lower Greensand) beds of Guildford, in Surrey.

The only specimen found at Folkestone was from zone v. of the Gault.

*Vaginulina discors* F. Koch, plate VIII. fig. 13.

*Vaginulina discors* F. Koch, 1848, Palæontographica, vol. i. p. 172, plate xxiv. figs. 1, 2. *V. discors* Reuss, 1862, Sitzungs. d. k. Ak. Wiss. Wien, vol. xlv. p. 50, plate iii. figs. 10-12.

This beautiful and variable form is rare in the Gault. It is strongly suggestive of an arrested or uni-laterally developed variety of *Frondicularia Karreri* or *F. strigillata*.

*V. discors* is recorded from beds of Neocomian age (Speeton Clay) in N. Germany. It occurs in the Gault at Folkestone in zone vii., very rare; zone xi., 6 ft. from the top, very rare.

*Vaginulina Biochei* Berthelin, plate VIII. fig. 14 *a, b*.

*Vaginulina Biochei* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 42, plate ii. fig. 9 *a, b*.

This elegant little species is apparently peculiar to the Gault formation; and, moreover, it is very rarely met with there, two specimens only occurring in an extremely large assemblage of *Vaginulinæ* obtained from the Folkestone Gault-clay. It is also rare in the Gault of France.

*V. Biochei* was found at Folkestone in zone i., specimen *b*, very rare; zone xi., 6 ft. from the top, very rare.

*Vaginulina Priceana*, plate VIII. fig. 15 *a, b*.

Shell sub-oval, produced at the oral extremity, and well rounded at the commencement. The sides are flat, and the margin rounded. Chambers numerous, eleven in the specimen found; the first chamber oval, as in *V. Biochei* (to which species this form bears some general resemblance), the rest narrow and recurved. The sutures of the chambers in the later growth of the shell are marked by a thickening or ridging of the shell, and this filleting extends beyond the general outline at the aboral end, appearing as blunt prickles. The first half of the shell is obliquely and sinuously striated, but the sutures of the 8th, 9th, and 10th chambers are regularly decorated with short oblique strigillæ; the margin of the last chamber is relieved by a sharp and interrupted ridge running more or less paralld with the edge of the shell. The aperture is situated just under the extremity of the last chamber, and consists of a simple but slightly elongated orifice. Length of shell,  $1/35$  in.; greatest breadth,  $1/66$  in.

I have much pleasure in naming this species after Mr. F. G. Hilton Price, F.G.S., to whom students of Cretaceous geology are indebted for his valuable work towards defining the various zones of the Cretaceous strata, and especially of the Gault.

*V. Priceana* was found at Folkestone in zone xi., 45 ft. from the top, very rare.

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