EXPLANATION OF PLATE XVII.

The six microphotographs reproduced in this Plate are taken by *reflected* light, and illustrate the crystallization-phenomena of the plane surfaces or facets which bound the inclusions.

FIG. 1. Group of roundish mould-facets showing rhomboidal impressions. Oblique illumination, magnified 8 diameters.
,, 2. Knob-facet, with curved cracks and pseudo-striation. Oblique illumination, magnified 22 diameters.
,, 3. Mould-facet, with highly magnified, rhomboidal impression showing frayed edge. The perfecting of the outline of the impression in the enveloping crystalline material can be faintly seen, as shown by the white crosses.
,, 4. Knob-facet showing crystalline structure. A fragment of film is marked A.
,, 5. Structure of film, a portion of which is shown in Fig. 4 (marked A).
,, 6. Knob-facet showing crystal-shafts and resolution of pseudo-striation into aligned dots.

Figs. 3–6, vertical illumination, magnified 110 diameters.

II.—The Foraminifera of the Speeton Clay of Yorkshire.

By R. L. Sherlock, D.Sc., A.R.C.Sc., F.G.S.

(PLATES XVIII AND XIX.)[1]

(*Continued from the May Number, p. 222.*)

Family LAGENIDÆ.

Sub-family LAGENINÆ.

Lagena, Walker & Boys.

Lagena globosa (Montagu). (Pl. XVIII, Fig. 6.)

Vermiculum globosum, Montagu, 1803 : Test. Brit., p. 523.
Entosolenia globosa, Reuss, 1862 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 318, pl. i, figs. 1–3.
Lagena globosa, Burrows, Sherborn, & Bailey, 1890 : Journ. Roy. Micr. Soc., p. 555, pl. ix, figs. 1, 2, 4.

Remarks.—This species has been recorded in rocks as old as the Wenlock Limestone and shale (Brady), and is still living in almost every depth of water and in all latitudes.

Horizon.—Present in C_1, C_2, C_{10}. One specimen from each bed.

Lagena apiculata, Reuss. (Pl. XVIII, Fig. 12.)

Lagena apiculata, Reuss, 1862 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 319, pl. i, figs. 4–8, 10, 11.

Remarks.—*L. apiculata* is known from various formations from the Lias to the Recent. It is still abundant in both shallow and deep water. It is noteworthy that the specimens from C_1 and C_{10} are very large (see Pl. XVIII, Fig. 12).

Horizon.—Found in B base *c*, C_1, ? C_9 (broken specimen), C_{10}. One from each horizon.

[1] Plate XIX will appear in the July Number with the concluding part of the author's paper.

Lagena apiculata, var. *danfordi*, var. nov. (Pl. XVIII, Fig. 8.)

Test elongated, pointed at both ends, slightly oviform in cross-section. The narrower side is straight, the wider curving towards it at the ends. The base tapers rapidly to a point, the oral end is bluntly pointed. Length about ·475 mm. (·018 in.), greatest diameter ·095 mm. (·0037 in.). It resembles most nearly the figure of *L. apiculata* in Burrows, Sherborn, & Bailey's paper on the Red Chalk (pl. ix, fig. 6), but the three specimens found all agree in having both ends of the test in the same straight edge. The variety has been named after Mr. C. G. Danford, to whom, as already mentioned, I am indebted for the specimens of Speeton Clay which I have examined.

Horizon.—Found in Upper C_2. Three specimens.

Lagena lævis (Montagu). (Pl. XVIII, Fig. 14.)

Vermiculum læve, Montagu, 1803 : Test. Brit., p. 524.
Lagena lævis, Brady, 1884 : Chall. Rep., vol. ix, p. 455, pl. lvi, figs. 7–14, 30.
L. lævis, Burrows, Sherborn, & Bailey, 1890 : Journ. Roy. Micr. Soc., p. 555, pl. ix, fig. 3.

Remarks.—This is probably the commonest and most widely distributed of the *Lagenæ*, and has been recorded from the Woolhope Beds. At present it occurs at all depths down to at least 2,435 fathoms (Chall. Rep.).

Horizon.—Found in B base *c*. Several specimens.

Sub-family NODOSARIINÆ.

Nodosaria, Lamarck.

Sub-genera Glandulina and Dentalina, d'Orbigny.

Nodosaria (*G.*) *lævigata*, var. *strobilus*, Reuss. (Pl. XVIII, Fig. 11.)

Glandulina lævigata, var. *strobilus*, Reuss, 1870 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. lxii, p. 477 ; Schlicht, Foram. Pietzpuhl, 1870, pl. vi, figs. 15, 16.

Remarks.—The forms of *Nodosaria* are very variable, and the specimen found does not differ much from *N. mutabilis*, Reuss, figured in his paper on the Foraminifera of the Hils (pl. v, figs. 9–11). It is noteworthy that the earlier sutures are oblique, a condition regarded by Reuss as of generic importance when he founded the genus *Psecadium* (Sitzungsb. d. k. Ak. Wiss. Wien, vol. xliv, p. 368, 1861). The variety has been recorded from the Tertiary Septaria-clay of Pietzpuhl.

Horizon.—One specimen only from C_{10}.

Nodosaria hispida, d'Orbigny. (Pl. XVIII, Fig. 18.)

Nodosaria hispida, d'Orbigny, 1846 : For. Foss. Vien., p. 35, pl. i, figs. 24, 25.
N. conspurcata, Reuss, 1863 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlviii, p. 43, pl. ii, figs. 10–14.
N. hispida, Brady, 1884 : Chall. Rep., vol. ix, p. 507, pl. lxiii, figs. 12–16.

Remarks.—The species is known from the Middle and Upper Lias of the West of England (Brady, Walford), the Chalk of Ireland

(Wright), the London Clay (Jones & Parker), the Tertiary Septaria-clays of Hermsdorf and Pietzpuhl (Reuss), etc., and was found by the *Challenger* Expedition at depths of from 95 to 450 fathoms.

Horizon.—One broken specimen from B base *b*.

Nodosaria calomorpha, Reuss. (Pl. XVIII, Fig. 16.)

Nodosaria calomorpha, Reuss, 1865 : Denkschr. d. k. Ak. Wiss. Wien, vol. xxv, p. 129, pl. i, figs. 15–19.
N. (*Dentalina*) *consobrina*, Parker & Jones, 1865 : Phil. Trans., vol. clv, p. 342, pl. xvi, fig. 3.
N. calomorpha, Terrigi, 1880 : Atti dell'Accad. Pont., ann. xxxiii, p. 178, pl. i, fig. 7.
N. calomorpha, Brady, 1884 : Chall. Rep., vol. ix, p. 497, pl. lxi, figs. 23–7.

Remarks.—One specimen found has three chambers, the others but two, and they differ in the relative width of the chambers, resembling in this respect the figures of Parker & Jones and Terrigi. The species has been described from Tertiary beds by Reuss and Terrigi, and is present in the Atlantic and Pacific Oceans at depths varying from 6 to 2,200 fathoms (Brady).

Horizon.—Found in B base *c*. Several specimens.

Nodosaria (*Dentalina*) *siliqua* (?), Reuss. (Pl. XVIII, Fig. 19.)

Dentalina siliqua, Reuss, 1862 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 40, pl. ii, fig. 11.

Remarks.—A damaged specimen agrees rather closely with Reuss' figure, but the upper part is broken away. It has been recorded by Reuss from the highest bed of the German Hils and from the Pläner.

Horizon.—Found in B base *c*. One specimen.

Nodosaria (*Dentalina*) *fontannesi*, Berthelin. (Pl. XVIII, Fig. 7.)

Dentalina fontannesi, Berthelin, 1880 : Mém. Soc. géol. France, sér. III, vol. i, No. 5, p. 42, pl. ii, fig. 14.
N. (*D.*) *fontannesi*, Chapman, 1893 : Journ. Roy. Micr. Soc., p. 593, pl. ix, fig. 15.

Remarks.—The species is described from the Gault of France and Folkestone by Berthelin and Chapman respectively.

Horizon.—Found in Upper C_2. One specimen.

Nodosaria (*Dentalina*) *lorneiana*, d'Orbigny. (Pl. XVIII, Fig. 13.)

Dentalina lorneiana, d'Orbigny, 1840 : Mém. Soc. géol. France, vol. iv, p. 14, pl. i, figs. 8, 9.
Nodosaria lorneiana, Reuss, 1845 : Verstein. böhm. Kreideform., vol. i, p. 27, pl. viii, fig. 5.
N. (*D.*) *lorneiana*, Chapman, 1893 : Journ. Roy. Micr. Soc., p. 588, pl. viii, figs. 30, 31.

Remarks.—The species is recorded from the Folkestone Gault (Chapman), the Bohemian Cretaceous (Reuss), and the Lower Chalk of Dover (Jones). It seems probable that *N. nuda*, Reuss (Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 38, pl. ii, figs. 8, 9, 1862), is the same species, and if so the form occurs in the Gault of North Germany.

Horizon.—Found in Upper C_2. Two specimens.

Nodosaria (*Dentalina*) *legumen*, Reuss. (Pl. XVIII, Fig. 22.)

Nodosaria (*Dentalina*) *legumen*, Reuss, 1845 : Verstein. böhm. Kreideform., pt. i, p. 28, pl. xiii, figs. 23, 24.
D. legumen, Reuss, 1860 : Sitzungsb. d. k. Ak. Wiss. Wien, p. 187, pl. iii, fig. 5.

Remarks.—This form has been recorded from the Gault of Folkestone (Chapman), of France (Berthelin), and the Rhine (Reuss), and from the Cretaceous of Bohemia and Hanover (Reuss). Brady (Chall. Rep., vol. ix, p. 504) considers it to be the same as *N. communis*, d'Orb., which has at present a worldwide range.

Horizon.—Found in B base *c*. One specimen.

Nodosaria (*Dentalina*) *communis*, d'Orbigny. (Pl. XVIII, Fig. 24.)

Nodosaria (*Dentalina*) *communis*, d'Orbigny, 1826 : Ann. Sci. Nat., vol. vii, p. 254, No. 35.
N. (*D.*) *communis*, Brady, 1884 : Chall. Rep., vol. ix, p. 504, pl. lxii, figs. 19–22.
N. (*D.*) *communis*, Chapman, 1893 : Journ. Roy. Micr. Soc., p. 590, pl. ix, fig. 1.

Remarks.—The species is known from many deposits above and below the Cretaceous System (Chapman). Its present distribution is worldwide, and it is found at almost any depth.

Horizon.—Found in Upper C_2. One specimen.

Nodosaria (*Dentalina*) *roemeri*, Neugeboren. (Pl. XVIII, Fig. 9.)

Dentalina roemeri, Neugeboren, 1856 : Denkschr. d. k. Ak. Wiss. Wien, vol. xii, p. 82, pl. ii, figs. 13–17.
D. nana, Reuss, 1862 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 39, pl. ii, figs. 10, 18.
N. (*D.*) *roemeri*, Chapman, 1893 : Journ. Roy. Micr. Soc., p. 589, pl. viii, fig. 38.

Remarks.—Recorded from the Upper Hils and Gault of North Germany (Reuss), the Gault of Northern France (Berthelin) and Folkestone (Chapman); the species is still living at depths of not more than 400 fathoms (Brady).

Horizon.—Found in Upper C_2. One specimen.

FRONDICULARIA, Defrance.

Frondicularia gaultina (?), Reuss. (Pl. XIX, Fig. 11.)

Frondicularia gaultina, Reuss, 1860 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl, p. 194, pl. v, fig. 5.

Remarks.—A broken specimen probably belongs to this species. The base is missing, but the shell resembles Reuss' figure fairly closely. The species is recorded from the *Minimus*-clay of the Rhine (Reuss), the Red Chalk of Speeton (Burrows, Sherborn, & Bailey), and the Folkestone Gault (Chapman).

Horizon.—Found in Upper C_2. One specimen.

RHABDOGONIUM, Reuss.

Rhabdogonium insigne, Reuss. (Pl. XVIII, Fig. 21.)

Rhabdogonium insigne, Reuss, 1862 : Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 56, pl. v, fig. 2.

Remarks.—Reuss describes this species as very rare in the Upper

Hils to the north-west of Berklingen, and it does not seem to have been recorded since.

Horizon.—Found in D_6 mid. Several specimens.

Marginulina, d'Orbigny.

Marginulina linearis, Reuss. (Pl. XVIII, Fig. 10.)

Marginulina linearis, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 60, pl. v, fig. 15.
M. linearis, Chapman, 1894: Journ. Roy. Micr. Soc., p. 161, pl. iv, fig. 14.

Remarks.—Reuss' figure shows seven chambers and Chapman's six, whereas the specimen found has only four. The species is recorded from the *Minimus*-clay of North Germany (Reuss), the Gault of Northern France (Berthelin) and Folkestone (Chapman).

Horizon.—Present in Upper C_2. One specimen.

Marginulina glabra, d'Orbigny. (Pl. XVIII, Fig. 17.)

Marginulina glabra, d'Orbigny, 1826: Ann. Sci. Nat., vol. vii, p. 259, No. 6; Modèle No. 55.
M. inæqualis, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 59, pl. v, fig. 13.

Remarks.—The specimen is more curved than usual, but in other respects agrees with *M. glabra*. The species is recorded from the *Minimus*-clay of Germany (Reuss), the Red Chalk of Speeton (Burrows, Sherborn, & Bailey), the Folkestone Gault (Chapman), and is still living (Brady) in both shallow and deep water.

Horizon.—Found in B base *c*. One specimen.

Marginulina jonesi, Reuss. (Pl. XVIII, Fig. 15.)

Marginulina jonesi, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 61, pl. v, fig. 19.
M. jonesi, Chapman, 1894: Journ. Roy. Micr. Soc., p. 163, pl. iv, fig. 24.

Remarks.—This is much the commonest species of *Marginulina* in the Speeton Clay, and is fairly abundant. The individuals differ considerably, one specimen (in D_6) showing a passage to *M. striato-costata*, Reuss, which Brady regards as synonymous with *M. costata*, Batsch. In fact, *M. jonesi* is a mere variety of *M. costata*, characterized by fewer and more marked ribs. Other specimens pass into *M. robusta*, Reuss. *M. jonesi* has been recorded from the Upper Hils of Germany and by Chapman from the Folkestone Gault.

Horizon.—Found in B base *b*, Upper C_2, and D_6 mid. Fairly abundant.

Marginulina debilis, Berthelin. (Pl. XVIII, Fig. 23.)

Marginulina debilis, Berthelin, 1880: Mém. Soc. géol. France, sér. III, vol. i, No. 5, p. 35, pl. iii, fig. 28.
M. debilis, Chapman, 1894: Journ. Roy. Micr. Soc., p. 161, pl. iv, fig. 15.

Remarks.—The only specimen found agrees with Chapman's figure in possessing only five chambers. The species is known from the Gault of France (Berthelin) and of Folkestone (Chapman).

Horizon.—Found in Upper C_2. One specimen.

Vaginulina, d'Orbigny.

Vaginulina incompta (?), Reuss. (Pl. XIX, Fig. 10.)

Vaginulina incompta, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 45, pl. iii, fig. 5.

Remarks.—One specimen probably belongs to this species. The initial cell is rather small and the chambers are somewhat more obliquely set than in Reuss' figure. He describes it as very rare in the Upper Hils Clay at Glückauf.

Horizon.—Found in Upper C_2. One specimen.

Fragments of other species of *Vaginulina* have been found in B base *c*, Upper C_2, and D_6 mid, but too imperfect for specific determination.

Cristellaria, Lamarck.

Cristellaria gracillissima, Reuss. (Pl. XVIII, Fig. 26.)

Cristellaria gracillissima, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 64, pl. vi, figs. 9, 10.

Remarks.—The specimens vary greatly in length and the extent to which the spiral part is developed; some have scarcely any spiral commencement and are very close to *C. fœda*, Reuss (op. cit., p. 64, pl. vi, figs. 11–13). There can be little doubt that the two forms are really one species, and that *fœda* should be dropped as a specific name. It is possible that the form figured by G. R. Vine from the Cambridge Greensand as ? *Trochammina helvetico-jurassica*, Hausler (Proc. Yorks. Geol. Polytech. Soc., N.S., vol. ix, pt. i, p. 28, pl. ii, fig. 16, 1885 (1886)), is *C. gracillissima*. There is a resemblance in the outline of the shell and the mouth, and *C. gracillissima* in some cases appears to have an arenaceous test, owing to the rough prickly surface. The small side-chamber in Vine's figure is, however, very difficult to account for on this hypothesis.

Viewed as a transparent object, the rough surface of *C. gracillissima* is seen to be due to the outgrowths of calcite in optical continuity with the shell.

Horizon.—Common in B base *c*.

Cristellaria acutauricularis (Fichtel & Moll). (Pl. XIX, Fig. 2.)

Nautilus acutauricularis, Fichtel & Moll, 1803: Test. Micr., p. 102, pl. xviii, figs. *g–i*.
Cristellaria polita, Reuss, 1855: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xviii, p. 237, pl. iii, fig. 41.
C. acutauricularis, Brady, 1884: Chall. Rep., vol. ix, p. 543, pl. cxiv, figs. 17*a*, *b*.

Remarks.—The Cristellarians are (with the exception of *Pulvinulina caracolla*) the commonest of all the Foraminifera in the Speeton Clay, and offer great difficulties in specific determination, since no two specimens are quite alike and the number of described species is very great. Figures of the same species given by different authorities differ widely. A number of specimens seem certainly referable to *C. acutauricularis*, whose range in time extends at least as far back as the Lias. The species has been recorded from that formation by

Crick & Sherborn (Journ. Northants. Nat. Hist. Soc., 1891, p. 5, pl., fig. 25), and it is still living. The *Challenger* Expedition found it at depths of from 95 to 2,750 fathoms.

Horizon.—Present in B base *c*, C_1, and D_6 mid. Fairly abundant.

Cristellaria gibba, d'Orbigny. (Pl. XIX, Fig. 9A, B.)

Cristellaria gibba, d'Orbigny, 1839: Foram. Cuba, p. 63, pl. vii, figs. 20, 21.
C. nuda, Reuss, 1861: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xliv, p. 328, pl. vi, figs. 1–3.
C. pulchella, Reuss, 1862: ibid., vol. xlvi, p. 71, pl. viii, fig. 1.
C. gibba, Chapman, 1896: Journ. Roy. Micr. Soc., p. 4, pl. i, figs. 7*a*, *b*.

Remarks.—This species is closely allied to *C. acutauricularis* and has the same range in time. It is recorded from the Upper Hils Clay of Germany (Reuss), the Gault of Folkestone (Chapman), and the Bargate Beds (Lower Cretaceous) of Surrey (Chapman), and from the Red Chalk of Speeton (Burrows, Sherborn, & Bailey). The *Challenger* Expedition found it at depths of less than 500 fathoms.

Horizon.—Present in Upper C_2, Upper C_3, C_{10}. Common in Upper C_2, one specimen from each of the other horizons.

Cristellaria cephalotes, Reuss. (Pl. XVIII, Fig. 20.)

Cristellaria cephalotes, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 67, pl. vii, figs. 4–6.

Remarks.—A single, very thick specimen seems to belong to this species. It has been recorded by Reuss from the Upper Hils and the *Minimus*-clay of Germany.

Horizon.—Found in B base *b*. One specimen.

Cristellaria scitula, Berthelin. (Pl. XIX, Fig. 5.)

Cristellaria scitula, Berthelin, 1880: Mém. Soc. géol. France, sér. III, vol. i, No. 5, p. 53, pl. iii, figs. 3*a–c*.
C. scitula, Chapman, 1894: Journ. R. Micr. Soc., p. 652, pl. x, figs. 7*a*, *b*.

Remarks.—This species has been recorded by Berthelin and Chapman in the Gault of Northern France and Folkestone.

Horizon.—One specimen was found in B base *c*.

Cristellaria chapmani, sp. nov. (Pl. XIX, Fig. 7A, B.)

Description.—Test suboval, with nearly flat sides. It consists of about six chambers, arched, and divided by marked sutural ridges which end abruptly in front, and, near the back, end in a ridge parallel with the dorsal edge. The spiral commencement is obscure. There is no umbilicus. The dorsal edge is smoothly curved, and there is a keel about equally developed with the ridges following the dorsal edge. The aperture is terminal. Length about ·492 mm. (·0194 in.), greatest breadth ·304 mm. (·012 in.).

The form is nearest to *C. bradyana*, Chapman (Journ. Roy. Micr. Soc., 1894, p. 654, pl. x, figs. 13*a*, *b*). It has, however, fewer chambers, the sutural ridges and the dorsal edge are not sinuous, and the dorsal ridges are as well developed as the small keel.

I have named this species after Mr. Frederick Chapman in

recognition of the kindly assistance he has always given me in work on the Foraminifera.

Horizon.—Found in B base *c* and Upper C_2. Fairly abundant at both horizons.

Cristellaria crepidula (Fichtel & Moll). (Pl. XIX, Fig. 8.)

Nautilus crepidula, Fichtel & Moll, 1803: Test. Micr., p. 107, pl. xix, figs. *g–i*.
Cristellaria grata, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 70, pl. vii, fig. 14.
C. crepidula, Brady, 1884: Chall. Rep., vol. ix, p. 542, pl. lxvii, figs. 17, 19, 20; pl. lxviii, figs. 1, 2.
C. crepidula, Jos. Wright, 1886: Proc. Belfast Nat. Field Club, App., p. 331, pl. xxvii, fig. 4.

Remarks.—The species ranges from the Lias to Recent. It is recorded (as *C. grata*) by Reuss from the Upper Hils and the *Minimus*-clay of Germany, from the Folkestone Gault by Chapman, the Red Chalk of Speeton by Burrows, Sherborn, & Bailey, and from the Bargate Beds (Lower Cretaceous) of Surrey by Chapman. One specimen agrees most closely with Wright's figure quoted above.

Horizon.—Found in B base *c* (a few specimens) and one specimen from Upper C_2.

Cristellaria turgidula, Reuss. (Pl. XIX, Fig. 1.)

Cristellaria turgidula, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 73, pl. viii, figs. 4*a*, *b*.
C. ingenua, Berthelin, 1880: Mém. Soc. géol. France, sér. III, vol. i, No. 5, p. 54, pl. iii, figs. 20, 21.
C. turgidula, Chapman, 1896: Journ. Roy. Micr. Soc., p. 1, pl. i, fig. 1.

Remarks.—The form is recorded by Reuss from the *Milletianus*- and *Minimus*-clays of Germany, and from the Gault of Northern France and Folkestone by Berthelin and Chapman.

Horizon.—Present in C_1 and Upper C_2. One specimen from C_1, two from C_2.

Cristellaria cultrata (Montfort). (Pl. XIX, Fig. 4.)

Robulus cultratus, Montfort, 1808: Conchyl. Système, vol. i, p. 214, 54e genre.
Cristellaria cultrata, Brady, 1884: Chall. Rep., vol. ix, p. 550, pl. lxx, figs. 4–6.

Remarks.—A specimen from D_2 base is intermediate between *C. cultrata* and *C. rotulata*. The species is known from the Lias and successive formations to Recent times. Brady states that, as a rule, *C. cultrata* is rarely met with at a depth of less than 100 fathoms.

Horizon.—Found in D_6 mid and ? D_2 base. One specimen in each case.

Cristellaria gaultina, Berthelin. (Pl. XVIII, Fig. 27.)

Cristellaria gaultina, Berthelin, 1880: Mém. Soc. géol. France, sér. III, vol. i, No. 5, p. 49, pl. iii, figs. 15–19.
C. gaultina, Chapman, 1896: Journ. Roy. Micr. Soc., p. 7, pl. i, figs. 10*a*, *b*, 11.

Remarks.—The species has been recorded from the Gault of Northern France and Folkestone by Berthelin and Chapman. According to Chapman the *C. cultrata* of the Red Chalk of Speeton belongs to this species.

Horizon.—Present in B base *c* and D_6 mid. One specimen in each bed.

Cristellaria sternalis, Berthelin. (Pl. XIX, Fig. 3.)

Cristellaria sternalis, Berthelin, 1880: Mém. Soc. géol. France, sér. III, vol. i, No. 5, p. 54, pl. iii, figs. 2*a*, *b*.
C. sternalis, Chapman, 1896: Journ. Roy. Micr. Soc., p. 8, pl. ii, figs. 1*a*, *b*.

Remarks.—The only specimen found has a smaller keel than the one figured by Chapman. The species is known from the Gault of Northern France and Folkestone.

Horizon.—Present in B base *c*. One specimen.

Cristellaria orbiculata (Roemer). (Pl. XIX, Fig. 6.)

Planularia orbiculata, Roemer, 1842: Neues Jahrbuch, p. 278, pl. viiB, fig. 6.

Remarks.—Described by Roemer from the Hils Clay of Escherhausen, which Reuss (Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 8, 1862) thinks is probably the Speeton Clay of his classification; it does not seem to have been found since.

Horizon.—Found in B base *c*. One specimen.

Cristellaria rotulata (Lamarck). (Pl. XVIII, Fig. 25.)

Lenticulites rotulata, Lamarck, 1804: Annales de Muséum, vol. v, p. 188, No. 3; Tableau Encycl. et Méth., pl. cccclxvi, fig. 5.
Cristellaria münsteri, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 77, pl. ix, figs. 3*a*, *b*, 4*a*, *b*.
C. rotulata, Brady, 1881: Chall. Rep., vol. ix, p. 547, pl. lxix, figs. 13*a*, *b*.

Remarks.—This is by far the commonest species of *Cristellaria* in the Speeton Clay of Yorkshire, and, with the exception of *Pulvinulina caracolla*, is much the commonest of all the Foraminifera in that formation. A few specimens are doubtfully referred to *C. rotulata*, var. *macrodiscus*, Reuss (Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 78, pl. ix, figs. 5*a*, *b*, 1862).

C. rotulata is known from the Middle and Upper Hils and the Speeton Clay of North Germany (Reuss), from the Red Chalk of Speeton, the Gault of Folkestone and Northern France, and many other Cretaceous deposits, and probably ranges back as far as the Ordovician System (Ulrich, Journ. Cincin. Soc. Nat. Hist., vol. v, p. 119, pl. v, figs. 2, 2*a*, 1882(?)). It is still common in many parts of the world, and is found at all depths (Brady).

Horizon.—Present in B base *b*, B base *c*, C_1, C_2, C_3, C_9, D_3, D_6. Abundant.

Sub-family POLYMORPHINÆ.

Polymorphina, d'Orbigny.

Polymorphina fusiformis, Roemer. (Pl. XIX, Fig. 12.)

Polymorphina (*Globulina*) *fusiformis*, Roemer, 1838: Neues Jahrb. für Min., p. 386, pl. iii, fig. 37.
P. (*G.*) *angusta*, Egger, 1857: Neues Jahrb. für Min., p. 290, pl. xiii, figs. 13–15.
P. lanceolata, Reuss, 1851: Zeitschr. d. deutsch. geol. Gesell., vol. iii, p. 83, pl. vi, fig. 50.
Globulina prisca, Reuss, 1862: Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi, p. 79, pl. ix, fig. 8.
Polymorphina fusiformis, Brady, Parker, & Jones, 1870: Trans. Linn. Soc., vol. xxvii, p. 219, pl. xxxix, figs. 5*a*–*c*, and woodcut *e*, p. 220.

Remarks.—Brady has subdivided this species again into *P. angusta*, Egger, and *P. lanceolata*, Reuss (Chall. Rep., vol. ix, p. 563, 1884), but Chapman reunites them (Journ. Roy. Micr. Soc., 1896, p. 11, pl. ii, fig. 9). A number of specimens have been found, and they show transitional stages between the types recognized by Brady. The form is recorded by Reuss from the Upper Hils and the *Minimus*-clay of Germany, by Berthelin (Mém. Soc. géol. France, sér. III, vol. i, p. 57, pl. iv, figs. 20*a*, *b*, 1880) from the French Gault, and by Chapman from the Gault of Folkestone. Burrows, Sherborn, & Bailey record it as *P. lactea* in the Red Chalk (Journ. Roy. Micr. Soc., 1890, p. 561), and it is still living. Brady states that it ranges down to 2,400 fathoms.

Horizon.—Fairly abundant in Upper C_2; a single specimen in B base *c*.

Polymorphina problema, d'Orbigny. (Pl. XIX, Fig. 13.)

Polymorphina (*Guttulina*) *problema*, d'Orbigny, 1826 : Ann. Sci. Nat., vol. vii, p. 266, No. 14; Modèle No. 61.
P. (*G.*) *communis*, d'Orbigny, loc. cit., p. 266, pl. xii, figs. 1–4; Modèle No. 62.
P. problema, Brady, 1884 : Chall. Rep., vol. ix, p. 568, pl. lxxii, figs. 19, 20; pl. lxxiii, fig. 1.

Remarks.—The species is recorded by Chapman (*P. communis*) from the Gault of Folkestone (Journ. Roy. Micr. Soc., 1896, p. 13, pl. ii, fig. 15) and the Lower Cretaceous of Surrey (Q.J.G.S., vol. l, p. 716, 1894); by Berthelin from the Gault of France, as *P. cretacea* (Mém. Soc. géol. France, sér. III, vol. i, p. 58, 1880), and from the Red Chalk of Speeton, as *P. gibba*, by Burrows, Sherborn, and Bailey (Journ. Roy. Micr. Soc., 1890, p. 561), and it is still living. The greatest depth from which it was recorded by the *Challenger* Expedition was 155 fathoms.

Horizon.—Present in Upper C_2. One specimen.

EXPLANATION OF PLATE XVIII.

All figures are magnified 50 diameters except Fig. 25.

FIG. 1. *Reophax scorpiurus*, Montfort.
,, 2. *Bigenerina nodosaria*, d'Orb.
,, 3. *Haplophragmium latidorsatum* (Bornemann). 3*a*, lateral aspect; 3*b*, oral aspect.
,, 4. *Gaudryina filiformis*, Berthelin.
,, 5. *Ammodiscus gordialis* (Jones & Parker).
,, 6. *Lagena globosa* (Montagu).
,, 7. *Nodosaria* (*Dentalina*) *fontannesi*, Berthelin.
,, 8. *Lagena apiculata*, Reuss, var. *danfordi*, var. nov.
,, 9. *Nodosaria* (*Dentalina*) *roemeri*, Neugeboren.
,, 10. *Marginulina linearis*, Reuss.
,, 11. *Nodosaria* (*Glandulina*) *lævigata*, d'Orb., var. *strobilus*, Reuss.
,, 12. *Lagena apiculata*, Reuss.
,, 13. *Nodosaria* (*Dentalina*) *lorneiana*, d'Orb.
,, 14. *Lagena lævis* (Montagu).
,, 15. *Marginulina jonesi*, Reuss.
,, 16. *Nodosaria calomorpha*, Reuss.
,, 17. *Marginulina glabra*, d'Orb.
,, 18. *Nodosaria hispida*, d'Orb. Broken specimen.
,, 19. *N.* (*Dentalina*) *siliqua* (?), Reuss. Broken specimen.

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3A

3B

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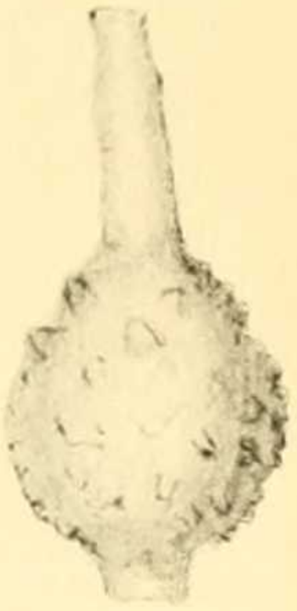

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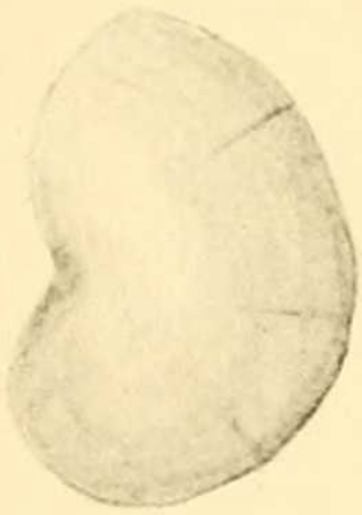

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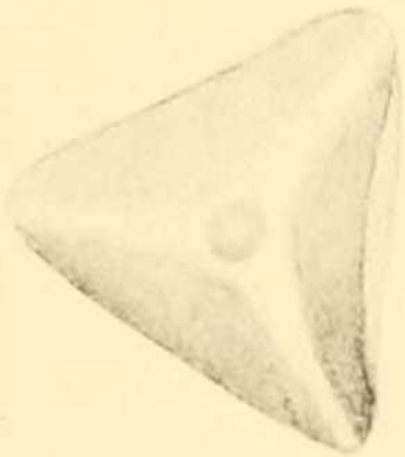
21A



21B

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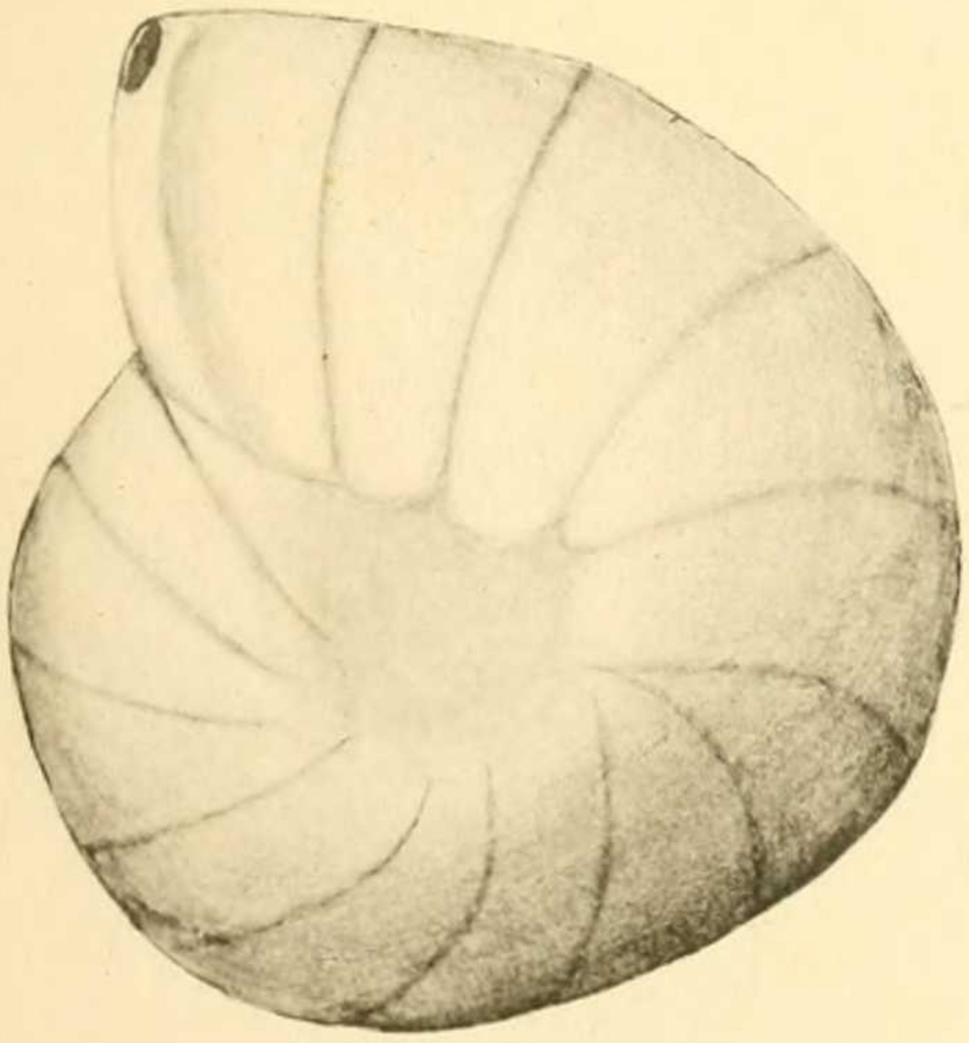

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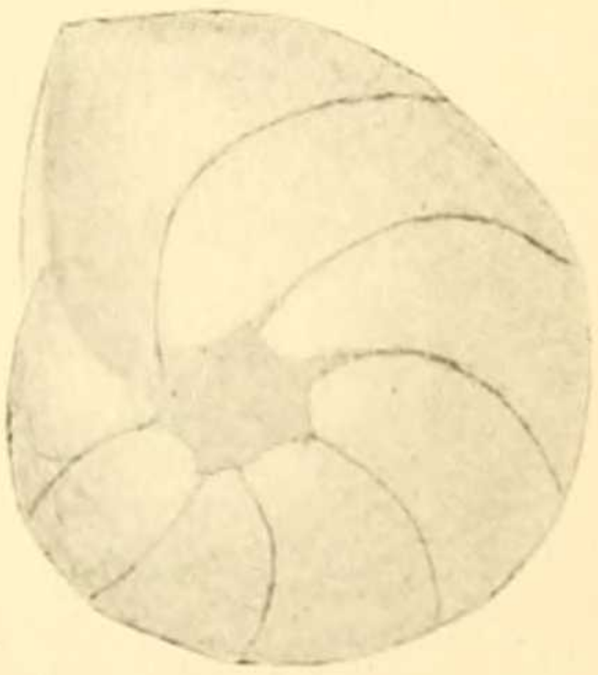

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Foraminifera, Speeton Clay, Yorkshire.

FIG. 20. *Cristellaria cephalotes*, Reuss.
,, 21. *Rhabdogonium insigne*, Reuss. 21*a*, lateral aspect; 21*b*, oral aspect.
,, 22. *Nodosaria* (*Dentalina*) *legumen*, Reuss.
,, 23. *Marginulina debilis*, Berthelin.
,, 24. *Nodosaria* (*Dentalina*) *communis*, d'Orb.
,, 25. *Cristellaria rotulata* (Lamarck). Magnified 33⅓ diameters.
,, 26. *C. gracillissima*, Reuss.
,, 27. *C. gaultina*, Berthelin.

(*To be concluded in the next Number.*)

III.—Some new Rock-building Organisms from the Lower Carboniferous Beds of Westmorland.

By Professor E. J. Garwood, M.A., F.R.S., F.G.S.

(PLATES XX AND XXI.)

IN my account of the Lower Carboniferous rocks of the North-West of England, published in 1912, I figured an organism, probably the thallus of a calcareous alga, which plays an important part as a rock-builder at the base of the *Seminula gregaria* sub-zone in Westmorland and Lancashire.[1] More recently, at the meeting of the British Association in Birmingham,[2] I pointed out the need of some distinctive name for this important form, and suggested for it the generic name of '**Ortonella**', from the village of Orton, near Tebay, in the neighbourhood of which this fossil is specially abundant. Two other structures were mentioned at the same time which occur constantly in microscopic sections of the Lower Carboniferous rocks of the North-West of England and elsewhere. The first of these was alluded to under the general descriptive term 'festoon structure', and the other was referred to Gürich's somewhat obscure genus *Spongiostroma*. In view of the zonal value of these organisms in the North-Western Province and the probability that they will be found to be widely distributed in the Lower Carboniferous rocks elsewhere, I propose here to give a somewhat fuller description of these forms than could be attempted in the limits of a presidential address.

Ortonella, gen. nov. (Pl. XX, Figs. 1–4.)

Mode of Occurrence.—The remains of this organism occur in the form of sub-spheroidal nodules varying in size from that of a marble to that of a tangerine orange, the largest example met with having a diameter of 5 cm. (Fig. 1). The fractured surfaces of the nodules show a porcellanous texture and a uniform rich brown tint, while a distinct concentric arrangement is usually noticeable. In transparent slices a fibrous structure radiating from the centre can also be observed with a strong hand lens. The smaller examples resemble, in general appearance, the nodules of *Solenopora* which occur in the underlying sub-zone in Westmorland and likewise the nodules of *Mitcheldeania* which are found so abundantly in the Lower Carboniferous deposits of Mitcheldean and North Cumberland.

Under the Microscope.—The thallus is seen to consist of a series of fine ramifying tubes which radiate from the centre of the nodule in

[1] Q.J.G.S., vol. lxviii, p. 449, pl. xlvii, fig. 2, November, 1912.
[2] Rep. Brit. Assoc. 1913, Section C; also GEOL. MAG., Dec. V, Vol. X, pp. 440, 490, 545, 1913.

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