

STUDIES ON THE CYCLOSTOMATOUS BRYOZOA

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The present paper is our second contribution to the above subject, the first having been published in 1922¹ under the subtitle of "Fossil and Recent Parallelata and Rectangulata." As explained in this first paper, our efforts are especially directed, first, to the study of the internal structure of these organisms by means of thin sections in order to determine the method of gemmation and the occurrence and structure of the various kinds of tubes, and, second, to the function of reproduction as brought out by the ovicells. Cyclostomatous bryozoa are extremely abundant in certain Mesozoic rocks; indeed, they form almost the entire bryozoan fauna of most formations before the Upper Cretaceous.

2. LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

The Cretaceous Cyclostomata have received attention from many authors, but particularly through the work of D'Orbigny in volume 5 of the *Paléontologie française* and Gregory in his two volumes of the *Catalogue of the Cretaceous Bryozoa* in the British Museum. Both of these authors, in fact most previous students, have adopted an artificial classification which in the number of genera proposed and the slight reasons for their existence is amazing. Gregory's two volumes are valuable contributions to the bibliographic and historical sides of the subject and his studies of the internal structure mark a great advance in the science. Our studies carry Gregory's efforts still further; in fact, our main object has been an effort to determine the natural generic characters in this group.

We have undertaken the study of the Lower Cretaceous Cyclostomata at this time due to our possession of ample, well-preserved

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collections from the two classic localities, Faringdon², England, and Sainte-Croix, Switzerland. The Faringdon specimens coming from the Aptian division of the Lower Cretaceous were secured for us personally by W. E. Crane, of Washington, D. C., who with his usual generosity presented all of the material to the United States National Museum for study. Mr. Crane not only obtained an excellent representation of the large forms but also made extensive siftings of the Faringdon sands, thus securing many small ramose examples which are usually overlooked by collectors.

The Swiss Lower Cretaceous material from the locality in the Valangian division at Sainte-Croix was loaned us for study through the courtesy of Dr. Samuel Henshaw, director of the Museum of Comparative Zoology at Cambridge, Mass. All of the type specimens from Faringdon are the property of the United States National Museum while those from Sainte-Croix are shared with the Museum of Comparative Zoology.

Gregory's excellent bibliography of papers dealing with Cretaceous bryozoa published in volume 2 of his Catalogue of Fossil Bryozoa in the British Museum makes it unnecessary for us to quote the literature upon this subject. We have not been able to rediscover all the species described from the two localities studied, but we give in the following two lists all of the species considered in the present paper.

ALPHABETIC LIST OF BRYOZOA

LOWER CRETACEOUS (APTIAN) FARINGDON, ENGLAND

- Berenicea faringdonensis*, new species.
Berenicea filifera, new species.
Berenicea grandipora, new species.
Berenicea pulchella De Loriol, 1863.
Berenicea (Reptomultisparsa) tenella De Loriol, 1868.
Berenicea parvula, new species.
Cardioecia faringdonensis, new species.
Cardioecia pauper, new species.
Cea granulata, new species.
Cellulipora spissa Gregory, 1899.
Ceriopora dimorphocella, new species.
Clausa cranei, new species.
Clausa zonifera, new species.
Clinopora quadripartita, new species.
Diaperoecia orbifera, new species.
Diaperoecia simplex, new species.
Heteropora nummularia, new species.
Laterocavea dutempleana D'Orbigny, 1853.
Laterocavea intermedia, new species.
Lobosoecia semiclausa Michelin, 1845.
Meliceritites cunningtoni Gregory, 1899.

² The several spellings of this name are known to us but we understand that the present form of the word is the correct one.

- Meliceritites haimeana* D'Orbigny, 1851.
Meliceritites semiclausa Gregory, 1899.
Meliceritites transversa, new species.
Microecia (Proboscina) cornucopia D'Orbigny, 1851.
Multicrescis mammosa, new species.
Multigalea canui Gregory, 1909.
Multigalea marginata, new species.
Neuropora micropora, new species.
Neuropora tenuinervosa, new species.
Neuroporella hemispherica, new species.
Notoplagioecia faringdonensis, new species.
Plethopora aptensis, new species.
Proboscina coarctata, new species.
Proboscina depressa D'Orbigny, 1851.
Proboscina radiolitorum D'Orbigny, 1851.
Proboscina ricordeauana D'Orbigny, 1853.
Proboscina virgula D'Orbigny, 1851.
Proboscina zic-zac D'Orbigny, 1851.
Radiopora tuberculata D'Orbigny, 1850.
Reptoclausa denticulata, new species.
Reptoclausa hagenowi Sharpe, 1854.
Reptomulticava fungiformis Gregory, 1909.
Seminodicrescis nodosa D'Orbigny, 1854.
Siphodictyum gracile Lonsdale, 1849.
Siphodictyum irregulare, new species.
Sparsicavea irregularis D'Orbigny, 1851.
Stomatopora calypso D'Orbigny, 1850.
Tholopora virgulosa Gregory, 1909.
Tretocyloecia densa, new species.
Tretocyloecia multiporosa, new species.

LOWER CRETACEOUS (VALANGIAN) SAINTE-CROIX, SWITZERLAND

- Actinopora stellata* Koch and Dunker, 1837.
Berenicea confluens Reuss, 1846.
Berenicea flabelliformis Roemer, 1839.
Berenicea gracilis Milne-Edwards, 1838.
Berenicea pulchella De Loriol, 1863.
Cardioecia hyselyi De Loriol, 1869.
Cardioecia neocomiensis D'Orbigny, 1853.
Cardioecia verticellata, new species.
Cardioecia verticellata, var. *entalophoroides*, new variety.
Ceriocava grandipora, new species.
Ceriocava ingens, new species.
Ceriocava multilamellosa, new species.
Ceriocava junctata, new species.
Ceriocava tenuirama, new species.
Ceriopora aequipedis, new species.
Ceriopora angustipedis, new species.
Ceriopora fallax, new species.
Ceriopora lobifera, new species.
Ceriopora nummularia, new species.
Ceriopora ovoidea, new species.
Ceriopora parvipora, new species.

- Ceriodora solida*, new species.
Ceriodora spongioides, new species.
Ceriodora tenuis, new species.
Chartecylis compressa, new species.
Corymbopora neocomiensis D'Orbigny, 1854.
Cyrtopora campicheana D'Orbigny, 1853.
Defranciopora neocomiensis, new species.
Diplocava globulosa, new species.
Diplocava incondita, new species.
Diplocava inordinata, new species.
Diplocava orbiculifera, new species.
Fasciculipora flabellata D'Orbigny, 1853.
Leiosoezia aequiporosa, new species.
Leiosoezia constanti D'Orbigny, 1850.
Leiosoezia grandipora, new species.
Leiosoezia proxima, new species.
Mecynoecia icaunensis D'Orbigny, 1850.
Mecynoecia verticillata Goldfuss, 1827.
Mesenteripora marginata D'Orbigny, 1853.
Microecia cornucopia D'Orbigny, 1857.
Multicrescis (Acanthopora) formosa, new species.
Multicrescis galaefera, new species.
Multicrescis lamellosa, new species.
Multicrescis landrioti Michelin, 1841.
Multicrescis parvipora, new species.
Multicrescis pulchella, new species.
Multicrescis tuberosa Roemer, 1839.
Multifascigera campicheana D'Orbigny, 1853.
Multitubigera campicheana D'Orbigny, 1853.
Nematifera acuta D'Orbigny, 1853.
Nematifera incrustans, new species.
Nematifera reticuloides, new species.
Nematifera reticulata D'Orbigny, 1853.
Neuropora arbuscula, new species.
Neuropora ramosa, new species.
Proboscina crassa Roemer, 1839.
Proboscina toucasiana D'Orbigny, 1851.
Proboscina zic-zac D'Orbigny, 1851.
Radiofascigera ramosa D'Orbigny, 1853.
Reptoclausa meandrina De Loriol, 1868.
Reptoclausa neocomiensis D'Orbigny, 1853.
Reptomulticava bellula De Loriol, 1869.
Retenoa campicheana D'Orbigny, 1853.
Spinopora neocomiensis, new species.
Spiroclausa neocomiensis De Loriol, 1863.
Stomatopora filiformis De Loriol, 1863.
Stomatopora granulata, var. *neocomiensis*, new variety.
Trigonoecia haimeana De Loriol, 1863.
Trigonoecia (Mesenteripora) neocomiensis D'Orbigny, 1853.
Trigonoecia semota, new species.
Trigonoecia tubulosa D'Orbigny, 1850.
Zonopora arborea Koch and Dunker, 1837.
Zonopora compressa, new species.

Order CYCLOSTOMATA Busk

Division INOVICELLATA

Family DIASTOPORIDAE Gregory, 1899

Forma STOMATOPORA Bronn, 1825

STOMATOPORA CALYPSO D'Orbigny, 1850

Plate 26, fig. 11

1899. *Stomatopora calypso* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 19, pl. 1, figs. 8, 9. (Bibliography, geological distribution.)

Our specimen approaches, in its small oral dimensions, Figure 9 of Gregory, 1899, which represents a specimen from the Albian of Hunstanton. Here the aperture measures only 0.10 mm. in diameter.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Plesiotype.—Cat. No. 69829, U.S.N.M.

STOMATOPORA FILIFORMIS De Loriol, 1863

1863. *Stomatopora filiformis* DE LORIOI, Les invertébrés du Néocomien inférieur du Mont Salève, p. 132, pl. 16, figs. 6, 7.

Measurements.—Diameter of orifice, 0.08 by 0.10 mm. (0.07–0.10 mm.); diameter of peristome, 0.12 mm.; diameter of zoecium, 0.14 mm. (0.15–0.17 mm.); length of zoecium, 0.56–0.60 mm. (0.50–0.70 mm.). The Sainte Croix specimens are mediocre, and we have based our determination on a good specimen from the Canu collection, in which the orifice is elliptical. The measurements in parentheses are the extremes shown on specimens from the Geneva Museum determined by De Loriol.

Occurrence.—Lower Cretaceous: Mont Salève, near Geneva (Hautervian) and Sainte Croix (Valangian), Switzerland.

Cat. No. 69830, U.S.N.M.

STOMATOPORA GRANULATA, var. NEOCOMIENSIS, new variety

1838. *Alecto granulata* MILNE EDWARDS, Mémoire sur les Crisies, Annales Sciences naturelles, vol. 9, p. 205, pl. 16, fig. 3.

1853. *Stomatopora granulata* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 836, pl. 628, figs. 5–8.

1868. *Stomatopora granulata* DE LORIOI, Monographie des couches de étage Valangien d'Arzier (Vaud), Paléontologie Suisse, ser. 4, pl. 5, fig. 12.

Gregory, 1899 (p. 3), published a long synonymy of this species, in which the geological occurrence is also equally great. This does not seem to us perfectly exact and we prefer to form a special variety for the Lower Cretaceous specimens corresponding to the figures of Milne Edwards and of D'Orbigny.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of zoecium, 0.30 mm.; length of zoecium, 0.70 mm.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland. The authors have noted this species at Arzier (Vaud), at Vassy (Haute Marne), Les Saints-en-Puisaye and Les Croûtes (Yonne), and Morteau (Doubs), France.

Cat. No. 69831, U.S.N.M.

Genus *CELLULIPORA* D'Orbigny, 1849

1849. *Cellulipora* D'ORBIGNY, Description de quelques genres nouveaux de Mollusques bryozoaires, Revue et Magazin de Zoologie, ser. 2, vol. 1, p. 500.

CELLULIPORA SPISSA Gregory, 1899

Plate 26, figs. 8, 9

1899. *Berenicea spissa* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 108, pl. 7, fig. 4.

Gregory, 1899, wrote: "The name of the species refers to the thick form of the zoarium, but the most interesting feature of this bryozoan is its tendency to grow in a series of zoarial groups, as if it were a very primitive form of *Cellulipora*."

There is no reason to separate this species from the group *Cellulipora*, the exterior aspect being absolutely identical; the cellules are very short and cylindrical.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England, and Ervy, Switzerland.

Plesiotype.—Cat. No. 69832, U.S.N.M.

Forma *PROBOSCINA* Audouin, 1826

PROBOSCINA TOUCASIANA D'Orbigny, 1853

Plate 26, fig. 10

1853. *Proboscina toucasiana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 856, pl. 634, figs. 5, 6.

Gregory, in 1899, identified this species with *Proboscina fasciculata* Reuss, 1845. This is possible, and we refer the reader to page 29 of his catalogue for the synonymy and geological distribution. However, it differs from *Proboscina zic-zac* D'Orbigny, 1851. Our specimens correspond to the figure given by D'Orbigny and we therefore cite only this reference.

Occurrence.—Lower Cretaceous (Valangian): Sainte Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69833, U.S.N.M.

PROBOSCINA CRASSA Roemer, 1839

Plate 27, fig. 3

1853. *Proboscina crassa* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 848, pl. 631, figs. 9–11 (*divaricata*).

1899. *Proboscina crassa* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 34. (Bibliography and geologic distribution.)

From our study of the Sainte-Croix specimens we have observed:

(1) The variety *alectodes* Gregory, 1899 (p. 38), known hitherto only from the Upper Cretaceous, is now recognized in the Lower Cretaceous by specimens indicating it is only one of the zoarial forms.

(2) A specimen was noted expanded almost into the *Berenicea* growth form, as in the variety *elevata* Gregory, 1899, from the Lower Cretaceous.

(3) Another specimen corresponds rigorously to the figure published by D'Orbigny.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland, Censeau (Doubs), Villers-le-lac (Jura), and Berklingen (Germaine), France.

Plesiotype.—Cat. No. 69834, U.S.N.M.

PROBOSCINA RADIOLITORUM D'Orbigny, 1851

Plate 27, figs. 1, 2

1899. *Proboscina radiolitorum* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 48, pl. 3, fig. 5. (Bibliography, geological distribution.)

The figured specimen is incrusting a sponge. Although this species is easy to determine, it has not hitherto been observed in the Lower Cretaceous.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Plesiotype.—Cat. No. 69835, U.S.N.M.

PROBOSCINA ZIC-ZAC D'Orbigny, 1853

Plate 29, fig. 7

1853. *Proboscina zic-zac* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 847, pl. 631, figs. 6, 7.

Measurements.—Diameter of orifice, 0.08 mm.; diameter of peristome, 0.16 mm.; length of zoecium, 0.32–0.40 mm. It seems to us that Gregory is in error in identifying this species with *Proboscina fasciculata* Reuss. The micrometric dimensions are different.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Geological distribution.—Lower Cretaceous (Neocomian): Vassy (Haute Marne), France, and Sainte-Croix (Vaud), Switzerland (D'Orbigny).

Plesiotype.—Cat. No. 69840, U.S.N.M.

PROBOSCINA RICORDEAUANA D'Orbigny, 1853

Plate 27, figs. 7, 8

1853. *Proboscina ricordeauana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 850, pl. 750, fig. 6.

The specimen which we illustrate seems to agree very well with the one figured by D'Orbigny. It incrusts a sponge.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Geological distribution.—Lower Cretaceous (Aptian): Les Croutes, Gurgy, France (D'Orbigny).

Plesiotype.—Cat. No. 69836, U.S.N.M.

PROBOSCINA VIRGULA D'Orbigny, 1853

Plate 27, figs. 9, 10

1853. *Reptotubigera virgula* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 753, pl. 631, figs. 15-17.

Measurements.—Diameter of orifice, 0.06 mm.; diameter of peristome, 0.08 mm.; distance of orifices, 0.32-0.40 mm. The peristomes are not grouped in bundles, and we are ignorant of D'Orbigny's reason for classifying this species in his genus *Reptotubigera*.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Geological distribution.—Cenomanian: Le Mans (Sarthe), France.

Plesiotype.—Cat. No. 69837, U.S.N.M.

PROBOSCINA DEPRESSA D'Orbigny, 1853

Plate 27, figs. 5, 6

1853. *Proboscina depressa* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 849, pl. 631, figs. 12-14.

Measurements.—Diameter of orifice, 0.08 mm.; diameter of peristome, 0.10-0.12 mm.; diameter of zoecium, 0.14 mm.; distance of orifices, 0.48-0.60 mm. The fine specimen here figured incrusts a sponge. It corresponds very well to D'Orbigny's description and figure.

The type preserved in the Museum of Paris is worn, according to Pergens, 1889. With our new illustration we are able to maintain D'Orbigny's species.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Geological distribution.—Lower Cretaceous (Neocomian): Vassy and Nozeroy, France (D'Orbigny).

Plesiotype.—Cat. No. 69843, U.S.N.M.

PROBOSCINA COARCTATA, new species

Plate 28, fig. 1

Description.—The zoarium encrusts shells. It is formed of diverging, ramified fronds, each of which is claviform, much narrowed at the base and *contracted* in its inferior third; the surface is covered with large overlapping, concentric wrinkles. The tubes are invisible. The peristomes are very salient, thin, and much scattered.

Measurements.—Diameter of orifice, 0.035 mm.; diameter of peristome, 0.08 mm.; distance of peristomes, 0.40-0.80 mm.; separation of peristomes, 0.40 mm. The distance and separation of the peri-

stomes are quite variable. The submedian contraction of the fronds very well characterizes this species.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69000, U.S.N.M.

Forma BERENICEA Lamouroux, 1821

BERENICEA FLABELLIFORMIS Roemer, 1839

1839. *Aulopora flabelliformis* ROEMER, Die Versteinerungen des Norddeutschen Oolithen-Gebirges, App., p. 15, pl. 17, fig. 4.

1840. *Rosacilla flabelliformis* ROEMER, Die Versteinerungen der Norddeutschen Kreidegebirges, p. 19.

1863. *Berenicea flabelliformis* DE LORIOI, Les Invertébrés du Neocomian inférieur du Mont Salève près Genève, p. 134, pl. 17, fig. 2.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of tubes, 0.18–0.20 mm.; distance of peristomes, 0.60 mm.; separation of tubes, 0.60 mm.

Affinities.—De Loriol's determination was based upon specimens from Germany which still exist in the Museum of Geneva. The type of De Loriol's figure bears transverse wrinkles. In its metric dimensions this is an intermediate species between *Berenicea gracilis* Milne-Edwards, 1838, and *Berenicea grandipora*, new species.

Occurrence.—Lower Cretaceous (Neocomian): Mont-Salève, near Geneva and at Sainte-Croix (Vaud), Switzerland.

Geological distribution.—Neocomian at Shöppenstadt, Hanover, Germany (Roemer).

Cat. No. 69838, U.S.N.M.

BERENICEA GRACILIS Milne-Edwards, 1838

1899. *Berenicea gracilis* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, p. 73. (Bibliography and geological distribution.)

Measurements.—Diameter of orifice, 0.06–0.07 mm.; diameter of tubes, 0.18 mm.; distance of orifices, 0.50–0.60 mm.

Affinities.—From the bibliography given by Gregory it is necessary to eliminate *Aulopora flabelliformis* Roemer, 1839, which is a much larger species.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Cat. No. 69839, U.S.N.M.

BERENICEA CONFLUENS Reuss, 1846

Plate 27, fig. 4

1899. *Berenicea confluens* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 110, pl. 5, fig. 4. (Bibliography and geological distribution.)

Affinities.—Our illustrated specimen resembles the one figured by Gregory as a young zoarium which was obtained from the Albian at Cambridge, England. The dimensions of the orifice, 0.10 mm., is in

accord with that of Gregory, but the zoarium is only 2 mm. in diameter. In exterior aspect it corresponds still more to *Discosparsa cupula* D'Orbigny, 1852, from the French Turonian, but our zoarium is not free, as it incrusts a shell.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69841, U.S.N.M.

BERENICEA PARVULA, new species

Plate 28, figs. 8, 9

Description.—The zoarium encrusts sponges, in a small flabelliform lamella. The tubes are distinct, very convex, separated by a deep furrow, smooth, very small. The peristomes when broken are elliptical but intact are orbicular and oblique, always thin.

Measurements.—Diameter of orifice, 0.06 mm.; diameter of tubes, 0.12 mm.; distance of peristomes, 0.32 mm.; separation of peristomes, 0.40 mm.

Affinities.—This species is still smaller than *Berenicea gracilis* Milne-Edwards, 1838. It is distinguished again by the rectilinear form of the tubes and by its separation always superior to the distance.

The convexity of the tubes, the flabellate arrangement, the great saliency of the peristome, and the still smaller zoecial dimensions do not permit confusion with *Berenicea pulchella* De Loriol, 1863.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (very rare).

Holotype.—Cat. No. 69842, U.S.N.M.

BERENICEA PULCHELLA De Loriol, 1863

Plate 28, fig. 4

1863. *Berenicea pulchella* DE LORIO, Les invertébrés du Neocomien inférieur du Mont Salève pres Genève, p. 135, pl. 16, fig. 9.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of tubes, 0.16 mm.; distance of peristomes, 0.40–0.48 mm.; separation of peristomes, 0.48 mm.

Affinities.—The type at the Museum of Geneva is not very well preserved; our determination, based solely on the small micrometric measurements, is therefore a little doubtful. The studied specimens were incrusting *Meliceritites*.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (very rare). Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69845, U.S.N.M.

BERENICEA GRANDIPORA, new species

Plate 28, figs. 2, 3

Description.—The zoarium encrusts sponges. The tubes are arranged in fan-shape around the ancestrula and form an irregularly discoid colony; they are visible, convex, separated by a furrow, somewhat wrinkled transversely, and often swollen in their median part. The peristome is orbicular, thin, little salient.

Measurements.—Diameter of orifice, 0.12–0.15 mm.; diameter of peristome, 0.24 mm.; diameter of tubes, 0.32 mm.; distance of tubes, 0.66 mm.; separation of tubes, 1 mm.

Affinities.—Gregory, 1899, has figured from the Aptian of the Isle of Wight (pl. 5, fig. 1) under the erroneous name of *Berenicea gracilis* Milne-Edwards, 1838, a specimen in which the dimensions are very close to our species and which could indeed be the same species. This species has much larger micrometric dimensions than *Berenicea gracilis* Milne-Edwards, 1838, and *Berenicea flabelliformis* Roemer, 1839, which Gregory incorrectly identified with *B. gracilis*.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69846, U.S.N.M.

BERENICEA FARINGDONENSIS, new species

Plate 29, figs. 5, 6

Description.—The zoarium encrusts sponges in lamellae with irregular edges. The tubes are indistinct, smooth, somewhat convex. The peristome is thick, salient, perpendicular to the zooecial plane, orbicular.

Measurements.—Diameter of orifice, 0.15–0.16 mm.; diameter of peristome, 0.20 mm.; distance of peristomes, 0.70–0.80 mm.; separation of peristomes, 0.60–0.64 mm.

Affinities.—This large species differs from *Berenicea grandipora* new species in the irregular arrangements of its peristomes and in its indistinct tubes.

In exterior aspect it resembles *Diastopora neocomiensis* De Loriol, 1863, but differs in its incrusting zoarium and its much larger dimensions.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69847, U.S.N.M.

BERENICEA FILIFERA, new species

Plate 29, figs 3, 4

Description.—The zoarium encrusts sponges in thin and irregular lamellae. The tubes are arranged in quincunx, much scattered; they are distinct, separated by a salient thread, concave in the longitudinal direction; the frontal is ornamented with small salient interrupted, longitudinal *threads*. The peristome is orbicular, thick, salient, perpendicular to the zooecial plane.

Measurements.—Diameter of orifice, 0.12–0.13 mm.; diameter of peristome, 0.17 mm.; diameter of tubes, 0.24–0.30 mm.; distance of peristomes, 0.60–0.70 mm.; separation of peristomes, 0.80 mm.

Affinities.—This species is very well characterized not only by its concave tubes but also by its frontal ornamentation and especially by its small salient threads arranged in quincunx.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (very rare).

Holotype.—Cat. No. 69848, U.S.N.M.

BERENICEA (REPTOMULTIPARSA) TENELLA De Loriol, 1868

Plate 29, figs. 1, 2

1868. *Reptomultisparsa tenella* DE LORIOI, Monographie des Couches de l'etage Valangien d'Arzier (Vaud), Paléontologie Suisse, ser. 4, vol. 2, p. 61, pl. 5, figs. 15, 16.

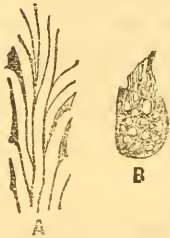


FIG. 1.—*Clinopora quadrupartita*, new species. A, B. Longitudinal and transverse sections, $\times 16$. Lower Cretaceous (Aptian): Faringdon, England

Measurements.—Diameter of orifice, 0.10 mm.; diameter of peristome, 0.12 mm.; distance of tubes, 0.34 mm.; separation of peristomes, 0.40 mm.

Affinities.—The figured specimen is not in the *Reptomultisparsa* form of growth but is an irregular *Berenicea*; it encrusts a sponge. The zone of growth is not visible. The exterior aspect of the tubes is that of the figure of De Loriol, but this author has never given the micrometric measurements. Our determination remains therefore doubtful.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Plesiotype.—Cat. No. 69849, U.S.N.M.

Genus CLINOPORA Marsson, 1877

1877. *Clinopora* MARSSON, Die Bryozoen der weissen Schreibkreide der Insel Rügen, Palaeontologische Abhandlungen, vol. 4, p. 24.

This genus is still little understood. The published sections are not in accord, and those which we give are still somewhat different. We have not been fortunate enough to discover the ovicell. The anastomosing lines which ornament the surface and form the chief generic characteristic seem to correspond only to parietal thickenings.

Genotype.—*Clinopora (Entalophora) lineata* Beissel, 1865, Cretaceous.

CLINOPORA QUADRIPARTITA, new species

Plate 29, figs. 8–11

Description.—The zoarium is free, cylindrical, bifurcated in the same plane. The tubes are visible, separated by salient threads divided into four parts by other anastomosing threads. The orifice is

orbicular or elliptical. The peristomes are somewhat salient, thin, scattered, arranged in quincunx.

Measurements.—Diameter of orifices, 0.14 mm.; diameter of peristomes, 0.20 mm.; diameter of branches, 0.75 mm.

Structure.—In transverse section the tubes are polygonal, equal, with adjacent and very thick walls. In longitudinal sections the tubes are cylindrical, with axial gemmation. The thickening of the walls seems to correspond to the salient threads of the exterior surface. The sectioned specimen was very small and did not permit of better observations.

This species differs from *Clinopora striatopora* Vine, 1885, from the Albian of Cambridge, England, by its much smaller micrometric measurements and very different arrangement of its salient threads.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Cotypes.—Cat. No. 69852, U.S.N.M.

Family HETEROPORIDAE Pergens and Meunier, 1886

Genus HETEROPORA Blainville, 1830

HETEROPORA NUMMULARIA, new species

Plate 20, figs. 6-8

Description.—The zoarium is free, *discoid*, little convex, unilamellar, ornamented with feeble tuberosities. The apertures are orbicular, arranged in quincunx, placed at the bottom of a small infundibuliform cavity. The mesopores are small, irregular, polygonal, widely spaced.

Measurements.—Diameter of aperture, 0.08 mm.; diameter of mesopores, 0.04 mm.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69853, U.S.N.M.

Genus MULTICRESCIS D'Orbigny, 1852

MULTICRESCIS TUBEROSA Roemer, 1839

1909. *Multicrescis tuberosa* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2, p. 205, figs. 52-54, pl. 9, fig. 4. (Bibliography and geological distribution.)

Our specimen corresponds exactly to Gregory's figure, so that a new figure is unnecessary. Canu, in 1902, has noted the occurrence of this species at Sainte-Croix.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

MULTICRESCIS GALAEFERA, new species

Plate 21, figs. 1-4

Description.—The zoarium is large, massive, subcylindrical, hollow at the base, solid at the summit, multilamellar. The orifices are polygonal or subcircular, oblique, ornamented by a very short and irregularly placed visor. The mesopores are polygonal, somewhat smaller than the apertures.

Measurements.—Diameter of aperture, 0.08 mm.; diameter of mesopores, 0.06 mm.; dimensions of zoarium, 2.5 by 1.5 mm.

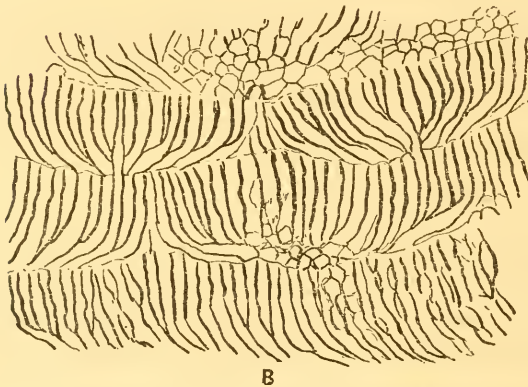
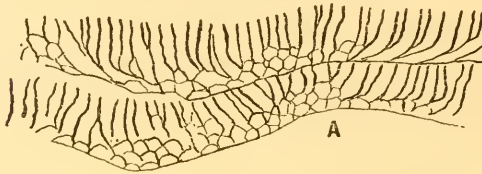


FIG. 2.—Genus *Multicrescis* D'Orbigny, 1881. A. *Multicrescis lamellosa*, new species. Portion of a transverse section, $\times 16$, with two lamellae. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland. B. *Multicrescis galaefera*, new species. Meridian section, $\times 16$. The subcolonies grow from a lateral tube of an inferior subcolony. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69854, U.S.N.M., and Museum Comparative Zoology.

MULTICRESCIS PARVIPORA, new species

Plate 20, figs. 9-11

Description.—The zoarium is globular, borne on a narrow base, formed of many completely enveloping lamellae. The orifices are *very small*, arranged in quincunx, ornamented with a very small irregular visor. The mesopores are very small, polygonal, arranged quite irregularly.

Structure.—Very probably *Multicrescis*, provided with visors, as in the present species, belong to the family Lichenoporidae, but in the absence of ovicells we prefer to preserve the zoarial classification.

The longitudinal section shows that the lamellae are formed by orbicular subcolonies united laterally. Each of them arises from the development of a lateral tube of an inferior subcolony. The tubes acylindrical, with dorsal gemmation and with thickened walls. The mesopores are numerous and of unequal length.

Measurements.—Diameter of apertures, 0.04 mm.; diameter of mesopores, 0.03 mm.; diameter of zoarium, 7 mm.

Structure.—The meridian section shows cylindrical tubes with solid thickened walls. The lamellae are formed by orbicular subcolonies invisible externally. The epithelial lines are thin and rare. The basal lamellae are thick. The mesopores are long and of little diameter; they are only visible in the portions where the subcolonies are cut in the same axis as their initial cell.

Affinities.—This species differs from *Multicrescis galaefera* in its still smaller micrometric measurements and its globular and smaller zoarium.

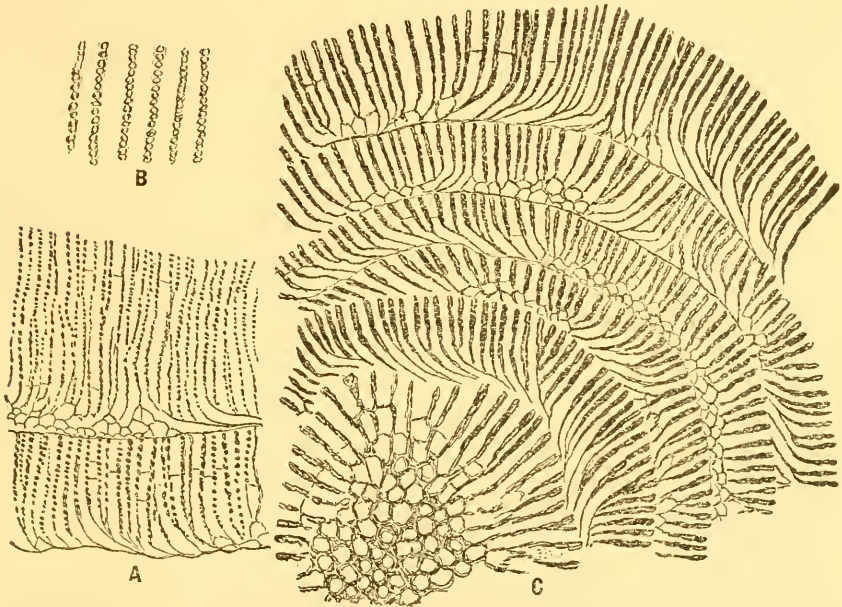


FIG. 3.—Genus *Multicrescis* D'Orbigny, 1852. A, B. *Multicrescis landrioti* Michelin, 1841. A. Portion of a meridian section, $\times 16$, showing two superposed lamellae. B. Sketch, $\times 30$, exhibiting annular structure of the tubes. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland. C. *Multicrescis parvipora*, new species. Meridian section, $\times 16$. The tubes of the enveloping lamellae are perpendicular to the tubes of the primitive zoarium. Each lamella is formed of a variable number of subcolonies. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

It differs from *Reptomulticava fungiformis*, Gregory, 1909, from Faringdon, England, in its much smaller zoarium and in the presence of small visors on the tubes.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69855, U.S.N.M., and Museum Comparative Zoology.

MULTICRESCIS (?) LANDRIOTI Michelin, 1841

Plate 20, figs. 12–15

1909. *Semimulticava landrioti* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2, p. 242. (Bibliography.)

Measurements.—Diameter of apertures, 0.08 mm.; diameter of mesopores, 0.06 mm.; diameter of zoarium, 2.5 by 1.5 cm.

Structure.—The zoarial base is an epitheca concentrically wrinkled flat, or concave. Some zoaria completely surround small shells.

Exteriorly there are no subcolonies visible, as in D'Orbigny's figure, so that our determination of the species, made according to zoarial analogies, is doubtful. We know, however, that this character disappears easily upon the least superficial alteration.

In meridian section the tubes are cylindrical and the mesopores of variable length. The tubes are annular and their walls vesicular. The small parietal vesicles correspond to the successive annuli of the tubes. The subcolonies are clearly outlined by their initial tubes.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Plesiotypes.—Cat. No. 69856, U.S.N.M.

MULTICRESCIS LAMELLOSA, new species

Plate 21, figs. 7-9

Description.—The zoarium is free, large, *lamellose*, orbicular, formed of many thin superposed lamellae. The inferior face is wrinkled concentrically. The apertures are polygonal, arranged in irregular quincunx. The mesopores are smaller, polygonal, irregularly placed.

Measurements.—Diameter of apertures, 0.12 mm.; diameter of mesopores, 0.08 mm.; zoarial diameter, 2.5 cm.

Structure.—The specimen figured is the largest fragment observed; it belonged certainly to a large orbicular colony.

In meridian section the tubes are cylindrical, short, recurved at their extremity. The mesopores are rather short. The walls are entire.

Affinities.—In zoarial aspect this species much resembles that which we have called *Multicrescis landrioti* Michelin, 1841, but differs in its greater micrometric dimensions and in sections by the nonannulated tubes.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69857, U.S.N.M., and Museum Comparative Zoology.

MULTICRESCIS MAMMILLOSA, new species

Plate 21, figs. 5, 6

Description.—The zoarium encrusts shells and is formed of many thin superposed lamellae. The orifices are polygonal or suborbicular, arranged in quincunx. The mesopores are few in number, polygonal, smaller than the orifices, irregularly placed. The zoarial surface is mammillose.

Measurements.—Diameter of apertures, 0.10 mm.; diameter of mesopores, 0.06 mm.

Affinities.—This is a *Multicrescis* in which the tubes have neither visors nor peristomes. We did not have enough specimens to prepare thin sections.

The species differs from *Semimulticavea variolata* Gregory, 1909, in its much smaller micrometric dimensions. It differs from *Heteropora subaequiporosa* Gregory, 1909, in its smaller micrometric measurements and in its zoarium, which is not free.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69860, U.S.N.M.

MULTICRESCIS PULCHELLA, new species

Plate 21, figs. 13-18

Description.—The zoarium is free, subcylindrical, branched, hollow in the interior. The orifices are circular, oblique, arranged in quin-

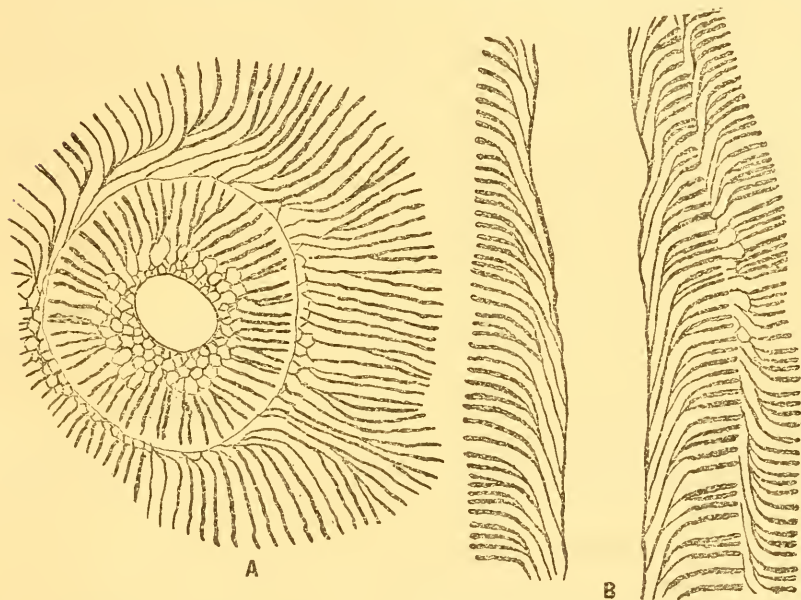


FIG. 4.—*Multicrescis pulchella*, new species. A. Transverse section, $\times 16$, of a hollow zoarium. The external lamella seems to have had only one tube of origin. B. Longitudinal section through the same zoarium, $\times 16$, showing the tube of origin which gave rise to the external lamella. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

cunx, ornamented with a tuberoso visor placed inferiorily. The mesopores are numerous, polygonal, smaller than the orifices.

Measurements.—Diameter of apertures, 0.06–0.08 mm.; diameter of mesopores, 0.04 mm.

Structure.—The zoarial branches are solid at their extremity. When the visors are worn the aspect of the surface is that of an ordinary *Heteropora*. The base is orbicular, little expanded, garnished with a concentrically wrinkled epitheca. The one we figure is not

hollow; many lamellae curve about a solid branch, as in *Leiosoecia proxima*.

In longitudinal section the tubes are cylindrical, with dorsal gemation on a basal lamella; they are much recurved at their extremity. The mesopores are long, numerous, variable in diameter and length. The exterior lamella has its origin in a tube of an internal lamella; the tubes and the mesopores are very much shorter, but they have the same characters as the tubes of the internal lamella.

In transverse section the tubes are polygonal, with thin and adjacent walls. They are much smaller in the vicinity of the basal lamella, which proves that these tubes are club-shaped in their inferior part and cylindrical as soon as they are recurved.

Affinities.—This species much resembles *Acanthopora pulchella* De Loriol, 1868. According to the figures of this author, the zoarial surface presents small very regular tuberosities surrounded by radiating mesopores. We have not had occasion to observe the genotype and we understand little of this particular arrangement. We believe that this is a figure somewhat fanciful of a *Multicrescis*, with tuberosities, like the present species. However, as we are not able to prove this supposition, we will maintain the generic term *Multicrescis*. If by chance it is identical with De Loriol's species the name of the genus would only be changed and all *Multicrescis* with visors would then be *Acanthopora*.

It is to be noted that the exterior lamella appears to have only a single origin. In the other known *Multicrescis* there are always several points of origin.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69859, U.S.N.M., and Museum Comparative Zoology.

MULTICRESCIS (ACANTHOPORA) FORMOSA, new species

Plate 21, figs. 10-12

Affinities.—Only the figured specimen has been found, and a description is not given, for we have not been able to make thin sections, and on the surface we can not see the difference between the orifice of the tubes and those of the mesopores.

This species has an aspect very close to *Acanthopora pulchella* De Loriol, 1868, but the zoarial tuberosities are here triangular visors diversely oriented, so that it is difficult to discover the pores to which they correspond.

The genus *Acanthopora* D'Orbigny, 1840, differs from *Neuropora* in that the thickened borders of the peristomes present small conical points in place of the elongated veinules (Haime, 1854). The figures given by Haime and by De Loriol, 1868, indicate clearly that the

small cones replace a consolidated tube. This is not the case here. More material is necessary in order to establish the nature of the genus *Acanthopora*.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Holotype.—Cat. No. 69859, U.S.N.M.

Genus SEMINODICRESCIS D'Orbigny, 1854

SEMINODICRESCIS NODOSA D'Orbigny, 1854

Plate 22, fig. 1

1854. *Seminodicrescis nodosa* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 1067, pl. 800, figs. 12-14.

Our zoarium is smaller than that figured by D'Orbigny, but the aspect is very much the same. It is hollow and thin at the two extremities. The nodosities do not present any particular character and correspond to the mammillosities of many other species belonging to the genus *Multicrescis* D'Orbigny, 1854. As we have not been able to make any section, we maintain D'Orbigny's name.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Geologic distribution.—Lower Cretaceous (Aptian), Saint-Dizier (Haute-Marne), and Les Croûtes (Aube), France (D'Orbigny).

Plesiotype.—Cat. No. 69861, U.S.N.M.

Genus CERIOPORA Goldfuss, 1827

and

Genus REPTOMULTICAVA D'Orbigny, 1854

In *Ceripora* the colonies are unilamellar, more or less massive or lobed, and formed of cylindrical tubes without peristomes and with peripheral gemination. In *Reptomulticava* the zoaria are multilamellar.

The structure of these genera is not as simple as their diagnoses would indicate. In thin sections they present important peculiarities for observation.

Zonal lines.—In longitudinal or meridian sections the zonal lines are curved concentric regular bands of very little width. They are closer together at the summit of the colony than at the base. They do not interrupt the tubes as the diaphragms. They are transformed frequently in a part of their length into basal lamellae supporting not subcolonies but series of tubes differently oriented (*Ceripora ovoidea*, *C. solida*, *C. lobifera*). This phenomenon is more frequent in the lateral portions of the colonies, where it is manifested externally by the lamellae appearing entirely surrounding the colony (*Ceripora*) or superposed (*Defranciopora*).

Rarely the zonal lines become transformed into epithelial lines in a portion of their length (*Ceriopora aequipedis*).

A zonal line is formed by divers elements, diaphragms, transverse bands of vesicles, and at the intersection of the zoecial walls by large vesicles with thicker walls. They correspond, therefore, along the entire extent of their length to the tubes contracted and with denser calcification. They may be only potential and manifested only by simultaneous deformations of the tubes (*Defranciopora*).

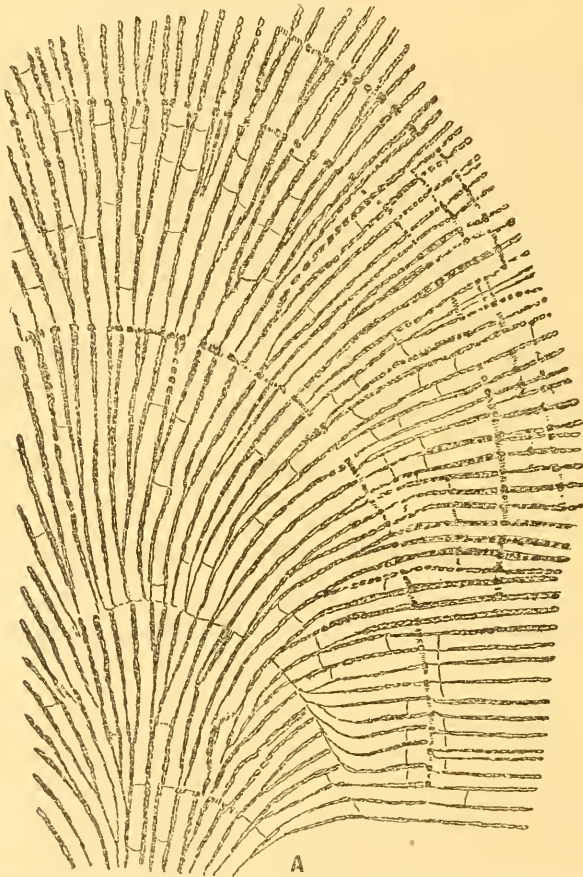


FIG. 5.—*Ceriopora ovoides*, new species. A. Meridian section, $\times 16$, through a zoarium with definite zonal lines. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

We are ignorant of the significance of the zonal lines. They perhaps correspond to the arrests of growth occasioned by the seasons. Their arrangement in the ensemble of colonial architecture seems to be more a question of mathematics than of biology.

Zoecial walls.—The walls of the tubes are very variable in thickness and in structure, characteristics which determine the species. Two different species have always a different vesicular constitution.

They are vesiculose either totally or partially (at the extremity). The vesicles are quite variable in form and in size. When large they give to the walls a moniliform aspect, which reveals sometimes annular tubes. When they are very small the tissue is dense and the preparations are little transparent. Finally, if their distal and proximal walls are thin, the zooecial walls seem then entirely hollow.

The vesicles are very difficult to draw and it is only by photography that they can be figured with fidelity.

In the course of this study we have not paid enough attention to the structure of the zooecial walls not only of the *Ceriopores* but also of many other species described, for in searching for the general laws we have neglected the details. We can affirm that very close study is always necessary because we are convinced that the microscopic structure of the zooecial walls is the best specific character. Good photographs with an enlargement of at least 50 diameters are also necessary.

Transverse sections.—The structure of the *Ceriopores* does not differ from that of other cyclostomata, and we have found in transverse sections the characters observed and described hitherto. We have observed (1) polygonal zooecia with thin adjacent walls occurring more often in the central part of the zoarium; (2) round, nonadjacent zooecia, corresponding to the tubes with vesicular walls and with their separation depending upon the thickness of their walls; (3) polygonal zooecia in which the interior is rounded, corresponding to the tubes with walls having many longitudinal rows of vesicles; and (4) tubular zooecia which correspond to the recurved parts of the tubes and are always vesicular.

CERIOPIORA TENUIS, new species

Plate 22, figs. 12-14

Description.—The zoarium is very *thin* and encrusts shells. The orifices are polygonal and regular, with walls little thickened.

Measurements.—Diameter of apertures, 0.10 mm. Only the figured specimen has been found.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Holotype—Cat. No. 69862, U.S.N.M.

CERIOPIORA OVOIDEA, new species

Plate 22, figs. 2-5

Description.—The zoarium is free *ovoid*, pedunculate, borne on a very small flat base, formed sometimes of lamellae entirely covering the base. The apertures are polygonal and irregular. The zonal lines become transformed in basal lamellae.

Measurements.—Diameter of apertures, 0.10 mm.; maximum zoarial width, 9 mm.; zoarial height, 14 mm.

Structure.—The zoarial form is rather constant, ovoid or fusiform. On the base, viewed from below, the tubes are arranged fan-shape in the manner of *Berenicea*.

Many of the zoaria appear to be formed of many lamellae inserted one on the other. In reality thin sections show that this is not so for there are no successive complete basal lamellae; sometimes the

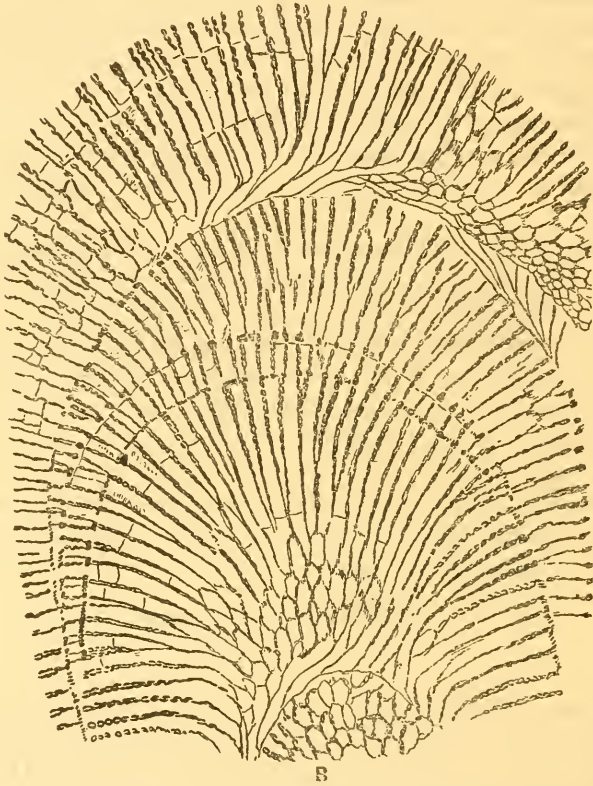


FIG. 6.—*Ceriopora ovoidea*, new species. B. Meridian section of another zoarium, $\times 16$, in which the zonal lines have been transformed into basal lamellae. The main zoarial tubes are oriented in a different direction from those of the primitive zoarium. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

zonal lines are transformed into basal lamellae but only along a part of their course. This is an arrangement intermediate between that of *Ceriopora* and of typical *Reptomulticava*, so that we do not know into which genus this species as well as most of the following should be placed.

The tubes are cylindrical, with concave diaphragms and with peripheral gemmation. The walls are rather thick, moniliform in a part of their course, and formed of two rows of vesicles in their

enlarged portion. The zonal lines are formed by vesicles which are larger and have very thick walls; they become transformed sometimes into true partial basal lamellae. The new tubes arise from a rootlike base and we can suppose that they cover tubes in which the polypide is aborted or diseased and is not able to continue its skeleton with enough of regularity.

Affinities.—This species differs from *Ceriopora angustipedis* in its more elongated zoarium, in the smaller diameter of its orifice, and in the presence of false lamellae covering the zoarium.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69863, U.S.N.M.

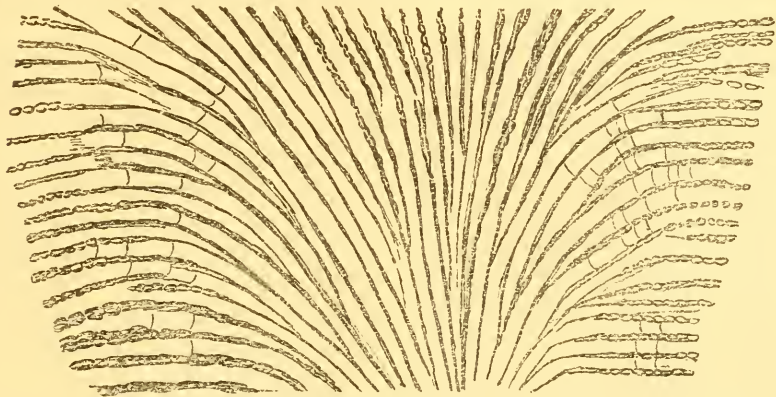


FIG 7.—*Ceriopora angustipedis*, new species. Meridian section, $\times 16$, entirely across a zoarium. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

CERIOPIORA ANGUSTIPEDIS, new species

Plate 22, figs. 15-17

Description.—The zoarium is free, globular, with a *narrow* base, somewhat broader than high, entire or apparently covered by lamellae wholly enveloping it. The tubes have thickened walls; the apertures are polygonal and arranged in quincunx. Zonal lines are rare.

Measurements.—Diameter of aperture, 0.12 mm.; maximum zoarial width, 9 mm.; maximum zoarial height, 8 mm.

Structure.—In meridian section the tubes are cylindrical, with very thick walls; these walls are very finely vesicular but never moniliform; the diaphragms are concave and very irregularly placed. Our sectioned specimen did not show zonal lines very clearly. It is probable that the specimen shown, which exhibits at the base three enveloping lamellae, would in sections show the zonal lines transformed into basal lamellae, as in *Ceriopora ovoidea*.

Affinities.—This new species differs from *Ceriopora ovoidea* in its larger aperture (0.12 mm. and not 0.10 mm.), in its zoarium broader than high, and, in section, in the zoecial walls, which are thicker and of different structure.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69864, U.S.N.M.

CERIOPORA AEQUIPEDIS, new species,

Plate 22, figs. 9–11

Description.—The zoarium is irregularly hemispherical, generally broader than high, with the base equal to the zoarial width. The orifices are polygonal and the tubes are very thick.

Measurements.—Diameter of aperture, 0.12 mm.; maximum zoarial diameter, 9 mm.; maximum zoarial height, 5 mm.

Structure.—In meridian section the tubes are long, cylindrical; the walls are moniliform, with large vesicles. The zonal lines are numerous, very close together, and are transformed partially into basal lamellae.

Affinities.—*Ceriopora aequipedis* differs from *C. angustipedis*, in which the diameter of the apertures is identical, in the hemispherical zoarial form, in the un-narrowed base, and, in sections, in the moniliform tubes.

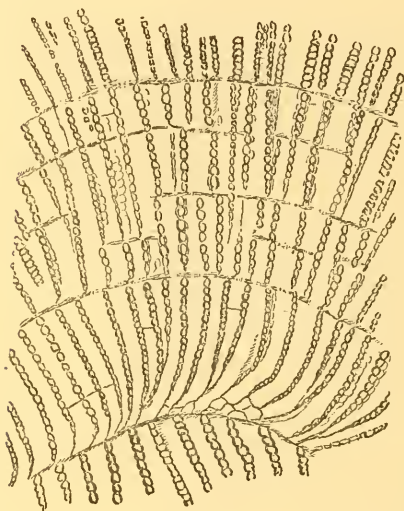


FIG. 8.—*Ceriopora aequipedis*, new species. Meridian section, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69865, U.S.N.M.

CERIOPORA SOLIDA, new species

Plate 22, figs. 6–8

Descriptions.—The zoarium is free, massive, convex, with a flat or concave base apparently covered by many enveloping lamellae. The tubes have little thickness; the apertures are large, polygonal.

Measurements.—Diameter of apertures, 0.16 mm.; zoarial width, 15 mm.; zoarial height, 9 mm.

Structure.—In meridian sections the tubes are long, sinuous; the diaphragms are concave and numerous; the zoecial walls are little

thickened and are moniliform. The zonal lines are irregular and may be transformed partially into basal lamellae.

Affinities.—In its zoarial form this species approaches *Ceriopora aequipedis* but differs in its large zoarium, its much larger aperture (0.16 mm. and not 0.12 mm.), and, in sections, in the irregularity of the zonal lines.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69866, U.S.N.M.

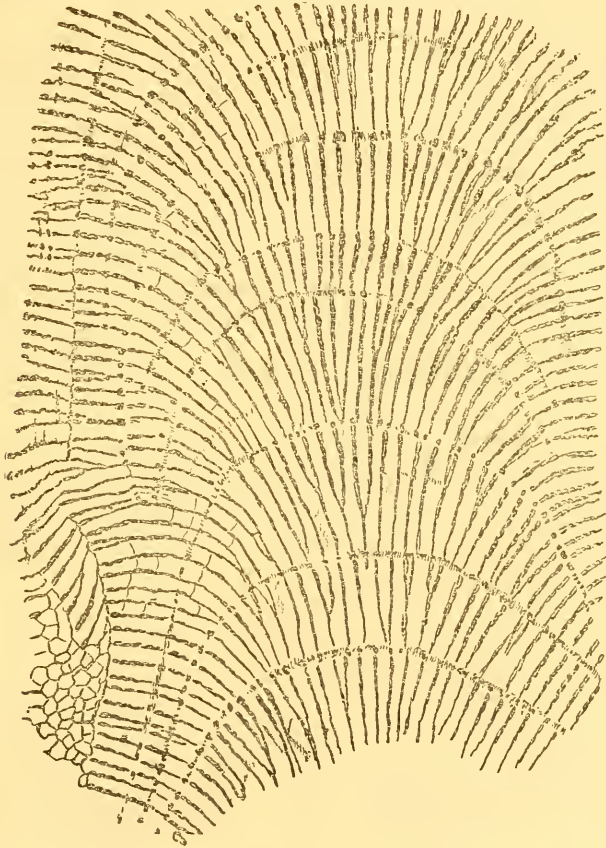


FIG. 9.—*Ceriopora solida*, new species. Meridian section, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

CERIOPORA PARVIPORA, new species

Plate 23, figs. 5-7

Description.—The zoarium is large, globular, with a concave, narrowed base. There are false enveloping lamellae. The tubes are thick; the apertures are polygonal and irregular.

Measurements.—Diameter of aperture, 0.08 mm.; diameter of zoarium, 7 mm.

Structure.—The zonal lines are numerous, very close together, formed in large part by diaphragms; they sometimes are transformed into basal lamellae. The walls of the tubes are quite thick and formed of a large number of small orbicular vesicles, arranged frequently in two rows. This structure is more visible in tangential sections, where all the small vesicles are quite visible between the polygonal tubes.

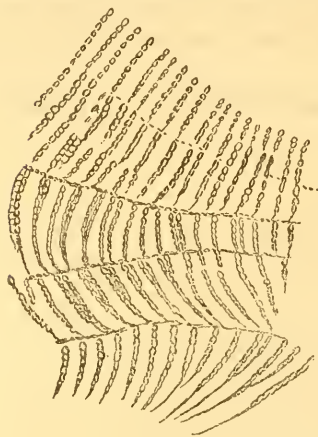


FIG. 10.—*Ceriopora parvipora*, new species. Meridian section, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Affinities.—In its zoarial form this species is rather close to *Ceriopora aequipedis*, but it differs in its much smaller aperture (0.08 mm. and not 0.12 mm.) and, in sections, in the nonmoniliform zoecial walls.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69867, U.S.N.M.

CERIOPORA NUMMULARIA, new species

Plate 23, figs. 1-4

Description.—The zoarium is free, orbicular or elliptical, *lenticular*, convex, apparently covered over by one or two enveloping lamellae; the base is somewhat concave. The tubes are little thickened; the apertures are polygonal, somewhat oblique, surrounded by very small and irregular tuberosities.



FIG. 11.—*Ceriopora nummularia*, new species. Longitudinal section, $\times 16$, exhibiting the moniliform tubes with large vesicles and the zonal lines. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Measurements.—Diameter of aperture, 0.14 mm.; diameter of zoarium, 7 mm.

Structure.—In meridian section the tubes are cylindrical, with peripheral gemmation; the walls are thin and moniliform. The zonal lines are little separated and formed by calcareous thickenings. Diaphragms are rare.

Our section does not indicate the enveloping false lamellae, but on certain specimens not sectioned these are quite visible.

The zoarial form characterizes this species very well exteriorly.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69868, U.S.N.M.

CERIOFORA LOBIFERA, new species

Plate 23, figs. 11-17

Description.—The zoarium is large, free, subcylindrical; it bears lateral lobes more or less developed. The zoarial surface sometimes exhibits small tuberosities. The tubes are thin; the apertures are polygonal and very irregular.

Measurements.—Diameter of aperture, 0.12 mm.; diameter of zoarium, 10 mm.; length of large fragments, 25 mm.

Structure.—The base is a somewhat expanded disk (fig. 13); the inferior part (fig. 14) shows the characteristic lozenge-shaped tubes recurved at their extremity, radiating around the ancestrula. In thin sections the tubes are cylindrical, recurved at their extremity. The walls are thin and formed of a single row of small vesicles. The zonal lines are widely separated and formed by the thickening of parietal vesicles. The diaphragms are almost always placed on the zonal lines. The latter are transformed into basal lamellae in the inferior part of the colonies.

The arborescent form of this species clearly distinguishes it from all other species from the same locality.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69869, U.S.N.M.

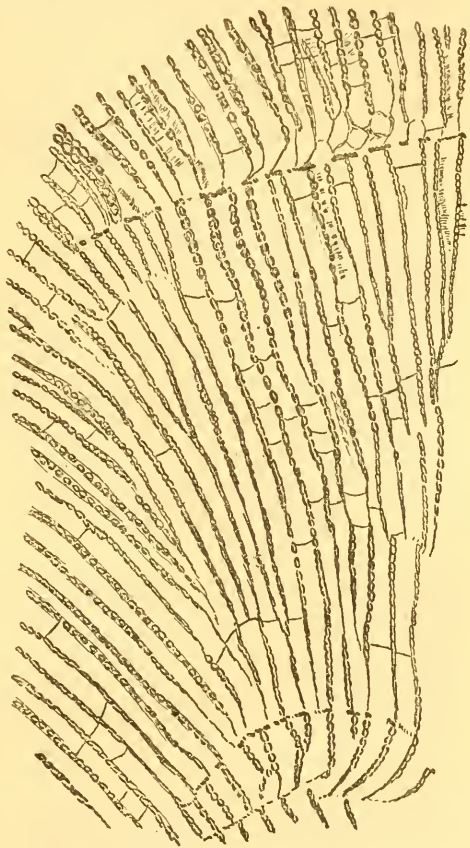


FIG. 12.—*Ceriopora lobifera*, new species. A meridian section, $\times 16$. The zonal lines are transformed sometimes into basal lamellae. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

CERIOFORA FALLAX, new species

Plate 23, figs. 8-10

Description.—The zoarium is free, subcylindrical, elongated, apparently formed of many enveloping lamellae. The tubes are thin; the apertures are polygonal, irregular, with heteroporoid aspect.

Measurements.—Diameter of large apertures, 0.16 mm.; diameter of small apertures, 0.08–0.12 mm.; diameter of zoarium, 5 mm.

Structure.—This species is very *deceiving*. Certain parts of the surface have large and small tubes, as in *Heteropora*; but sections do not show mesopores in the strict sense, for here some shorter tubes or others with a smaller diameter may be seen. The lamellae, visible exteriorly, are not complete and arise by the development of partial basal lamellae.

The zoecial walls are vesicular and moniform; the vesicles are little swollen and their lateral walls only are very thick. Diaphragms exist only at the center of the colony.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

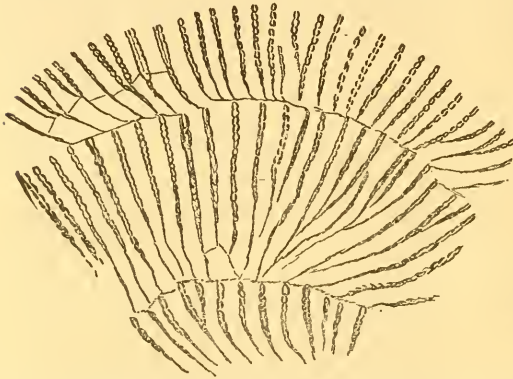


FIG. 13.—*Ceriopora fallax*, new species. A meridian section, $\times 16$. The zonal lines are transformed into basal lamellae. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Cotypes.—Cat. No. 69870, U.S.N.M.

CERIOFORA SPONGICIDES, new species

Plate 24, figs. 7-10

Description.—The zoarium is free, subglobular or massive, with a very narrow base. The tubes are thick; the apertures are very irregular and give to the surface the aspect of a calcareous *sponge*.

Measurements.—Diameter of orifices, 0.12 mm.; length of zoarium, 12 mm.; height of zoarium, 8 mm.

Affinities.—Our sections were not good and we have been unable to study the structure of this fossil. The species differs from *Ceriopora angustipedes* in the aspect of the surface and in its zoaria, which are higher than broad. It differs from *Ceriopora ovoidea* only in the general aspect of the surface, which is of a nature that may represent only alteration in fossilization. We figure traces of ovicells which are possibly those characteristic of *Leiosocia*.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotype.—Cat. No. 69871, U.S.N.M.

CERIOFORA DIMORPHOCELLA, new species

Plate 24, figs. 1-6; Plate 31, figs 7, 8

Description.—The zoarium is free, subcylindrical, with short, lobed branches. The tubes are thick; the apertures are polygonal, with two different sizes, and ornamented with very small tongues.

Measurements.—Diameter of large apertures, 0.08 mm.; diameter of small apertures, 0.04 mm.; zoarial diameter, 10 mm.; minimum height of fragments, 20 mm.

Structure.—The fragments found do not show the base; the colony should be, therefore, rather large and dendroid. An examination of the surface indicates a *Heteropora*; the large apertures are surrounded by smaller ones, which are rather regular in their dimensions. But in meridian sections there are no mesopores; the small orifices correspond to the ordinary tubes, in which the walls are thicker on the zoarial margin. This phenomenon is, moreover, rather irregular, as tangential sections indicate. There are neither diaphragms nor zonal lines.

Affinities.—This species differs from *Ceriopora fallax* in its much larger zoarium and in its smaller micrometric dimensions.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Cotypes.—Cat. No. 69872, U.S.N.M.

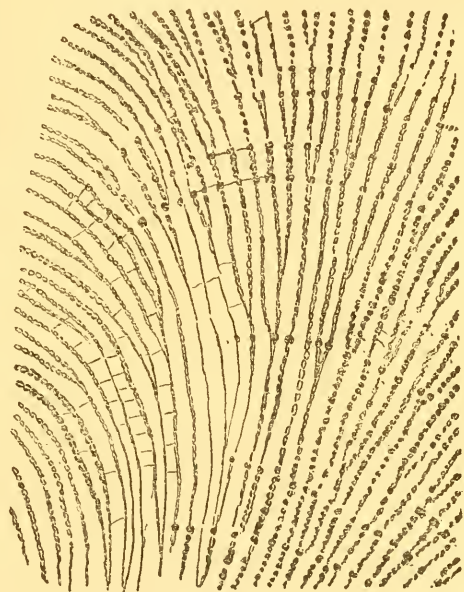


FIG. 14.—*Ceriopora dimorphocella*, new species. Portion of a meridian section, $\times 16$. Lower Cretaceous (Aptian): Faringdon, England

REPTOMULTICAVA FUNGIFORMIS Gregory, 1909

Plate 24, figs. 11-17

1909. *Reptomulticava fungiformis* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2, p. 135, figs. 38, 39, pl. 7, fig. 6. (Bibliography.)

Structure.—Our specimens are much smaller than those in the British Museum, although their appearance is identical. Moreover, the aperture is much smaller (0.10-0.12 mm. and not 0.20 mm.), although its form is similar to that figured by Gregory. Finally, our sections are quite similar to those of the English author. It appears

to us impossible to identify otherwise the numerous specimens collected in the same locality, Faringdon.

In meridian section the zoarium appears to be formed by complete, superposed lamellae, with their basal lamella entire. The latter is quite visible on account of a short zone of growth. The zoecial walls are very thick and formed of two or three rows of small vesicles, which, in tangential sections, are very irregular.

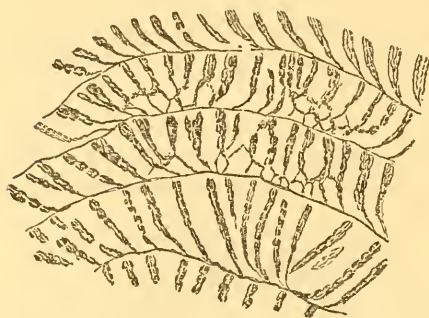


FIG. 15.—*Reptomulticava fungiformis* Gregory, 1909. Meridian section, $\times 16$, showing superposed cellular lamellae, and the thick walls with large vesicles. Lower Cretaceous (Aptian): Faringdon, England

Affinities.—In the micrometric dimensions, as well as in sections, our specimens are very close to *Reptomulticava micropora* Roemer, 1839, but they differ in the zoarial form and in the arrangement of the apertures in quincunx.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Plesiotypes.—Cat. No. 69873, U.S.N.M.

REPTOMULTICAVA BELLULA De Loriol, 1869

Plate 24, figs. 18–20

1869. *Reptomulticava bellula* DE LORIOLE and GILLIERON, Monographie paléontologique et stratigraphique de l'étage Urgonien inférieur de Landeron (Neuchâtel), Mémoires de la Société helvétique des Sciences naturelles, vol. 23, p. 41; pl. 3, figs. 9–11.

We refer to this species the unique specimen which we have figured, but the micrometric dimensions seem to us a great deal smaller, and there are 25 apertures to the square millimeter in place of 15, as indicated by Gregory.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (very rare).

Genus DEFRANCIOPORA Hamm, 1881

DEFRANCIOPORA NEOCOMIENSIS, new species

Plate 25, figs. 13–15

Description.—The zoarium is free, claviform, composed apparently of many discoidal superposed subcolonies. The base is narrower than the zoarium. The tubes are little thickened; the apertures are polygonal and close together.

Measurements.—Diameter of aperture, 0.14 mm.; maximum zoarial width, 7 mm.; maximum zoarial height, 10 mm.

Structure.—As in the other *Cerioporas* from Sainte-Croix, the exterior aspect of this species is deceiving, for in longitudinal sections the subcolonies are not complete and have a basal lamella only at the periphery of the colony. There are no zonal lines, as in *Ceriopora*, but instead imaginary concentric lines (potential) uniting at the basal lamella and marking the zooecial deformations in a manner that each subcolony seems to have a certain autonomy. This difference of structure from *Ceriopora* justifies the maintenance of the *Defranciopora* Hamm, 1880. Many of the diaphragms bear two tubes. The zooecial walls are moniliform and much expanded at their extremity; the vesicles are very small.

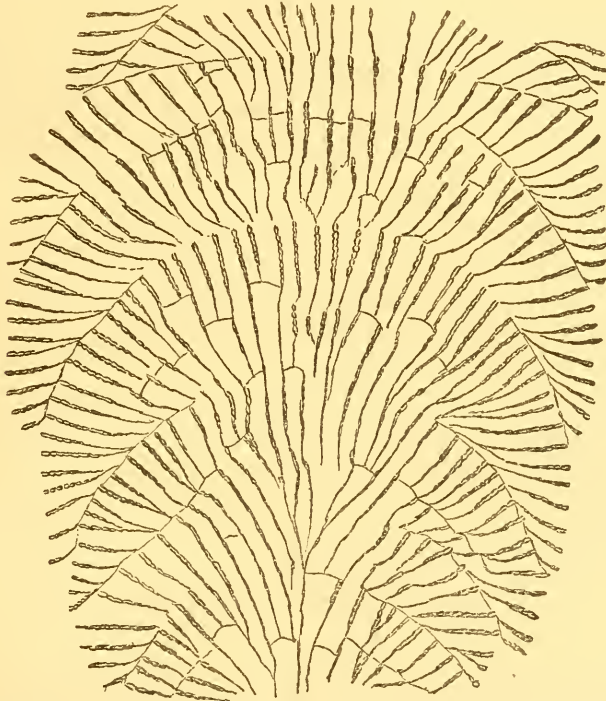


FIG. 16.—*Defranciopora neocomiensis*, new species. Meridian section through a characteristic specimen $\times 16$, with potential zonal lines. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69874, U.S.N.M.

Genus NEUROPORA Bronn, 1825

1825. *Neuropora* BRONN. Proposed to replace *Chrysaora* Lamouroux, preoccupied by Péron.

The zoarium is free, more or less claviform or arborescent. The surface is traversed by irregular veinules radiating from a special center. The orifices are ornamented with short visors. The tubes

are cylindrical, polygonal, crossed by numerous diaphragms; the walls are thick, vesicular, perforated, and united with the visors.

Genotype.—*Neuropora conuligera* Hennig, 1893, Cretaceous. The genus was at first referred to the bryozoa; then it was classed among the hydroids, but in 1893 Hennig's study of the genus definitely established its structure. The Lower Cretaceous species are simpler and less well characterized than those of the Upper Cretaceous.

The veinules are formed by solidified tubes. We are ignorant of their physiological function.

NEUROPORA RAMOSA, new species

Plate 25, figs. 9-12

Description.—The zoarium is free, ramose, borne on a very small base, with the branches often pyriform. The orifices are rather large, polygonal, arranged in quincunx, ornamented with tubercles at the angles. The veinules are irregular and converge toward the extremity of the lobes.

Measurements.—Diameter of the orifice, 0.12 mm.

Affinities.—The form of some zoaria approaches that of typical *Neuropora*, but such specimens are rare. The lobes become elongated generally into veritable branches, although pyriform also. In longitudinal sections the tubular walls are thick, formed by a compact tissue which corresponds to the exterior tubercles. The tubes, solidified and meeting at the point of convergence of the veinules, are somewhat wider than the others. The sections of this species are very opaque and difficult to interpret.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Cotype.—Cat. No. 69875, U.S.N.M.

NEUROPORA ARBUSCULA, new species

Plate 25, figs. 1-3

Description.—The zoarium is free, cylindrical, *arborescent*, with short branches. The orifices are polygonal, arranged in quincunx, ornamented with a lateral somewhat salient tuberosity. The veinules are irregular and longitudinal.

Measurements.—Diameter of orifice, 0.10 mm.; width of zoarium, 6 mm.

Affinities.—In the exterior aspect this species is very close to *Neuropora pyriformis*, but it differs in its cylindrical zoarium, its much broader base, and its somewhat smaller zooecial diameter.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Cotype.—Cat. No. 69876, U.S.N.M.

NEUROPORA MICROPORA, new species

Plate 25, figs. 4-8; Plate 30, fig. 20

Description.—The zoarium is free, hemispherical or pyriform; the base is always narrower. The orifices are very *small*, polygonal, irregular, surrounded by short points. The veinules are rare and irregular.

Measurements.—Diameter of orifice, 0.08 mm.; length of large zoaria, 20 mm.

Structure.—This species is very well characterized by the small diameter of its orifices.

The longitudinal section is quite identical with that of the genotype admirably figured by Hennig in 1893. It is quite complicated by the very large number of diaphragms. A certain number of the latter are simultaneous and form a kind of zonal line. The walls are thick and formed by a very finely vesicular tissue. Gemmation is peripheral.

In tangential sections the tubes are polygonal, not adjacent, separated by a vesicular tissue. A second orbicular tube is placed in their interior.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Cotypes.—Cat. No. 69877, U.S.N.M.

NEUROPORA TENUINERVOSA, new species

Plate 25, figs. 16-19

Description.—The zoarium is free, cylindrical, branched, borne on a base of less diameter. The orifices are small, polygonal, arranged in quincunx, separated by little salient tuberosities. The centers of convergence of the veinules are large smooth, salient tuberosities. The veinules are numerous, *very narrow*, often little visible, arranged in radiating lines around the zoarial tuberosities.

Measurements.—Diameter of orifices, 0.06-0.08 mm.; diameter of zoarium, 5 mm.

Affinities.—*Neuropora tenuinervosa* differs from *N. micropora* in its branched zoarium and in the presence of salient centers of convergence. It differs from *Neuropora arbuscula* in its smaller orifices, in its less salient visors, and in the presence of salient centers of convergence of the veinules.

The veinules are very narrow, quite transitory, as they disappear upon weathering, so that certain specimens lack them entirely, thus exhibiting the aspect of *Spinopora*.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Cotypes.—Cat. No. 69878, U.S.N.M.

Genus **NEUROPORELLA** Hennig, 1894

1894. *Neuroporella* HENNIG, Studies öfver Bryozoerna; Sveriges Kritsystem. II Cyclostomata Lunds Universitets Arsskrift, vol. 30, No. 8, p. 26.

The zoarium is formed of irregular incrusting, uni or multi lamellar masses. The centers of convergence of the veinules form smooth salient points. The internal structure is identical with that of *Neuropora*.

Genotype.—*Neuroporella ignabergensis* Hennig, 1894. Cretaceous. This genus is only a zoarial form of *Neuropora*, but we maintain it provisionally in order to facilitate determination and because our sections are not numerous enough for a more detailed study.

NEUROPORELLA HEMISPHERICA, new species

Plate 26, figs. 1-5; Plate 31, figs. 5, 6

Description.—The zoarium is massive, hemispherical, with a concave and somewhat narrower base; it is formed of many superposed lamellae. The orifices are polygonal, separated by small salient tubercles. The veinules are broad, salient, smooth, and bifurcated.

Measurements.—Diameter of orifice, 0.12-0.16 mm.; diameter of large zoarium, 17 mm.

Affinities.—This species differs from *Neuroporella ignabergensis* Hennig 1894, in the absence of centers of convergence of the very salient veinules and in its much larger orifices.

In longitudinal sections the tubes are cylindrical with peripheral gemmation, traversed by numerous diaphragms. A large number of the diaphragms are formed simultaneously and form the zonal lines.

In tangential sections the tubes are polygonal and their walls are very thick and opaque.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Cotypes.—Cat. No. 69879, U.S.N.M.

Genus **SPINOPORA** Blainville, 1830

The zoarial surface bears very salient, smooth tuberosities, but veinules are not present. The tubes have internal spines. The orifices and the internal structure are identical with *Neuropora*.

Genotype.—*Spinopora (Ceriopora) mitra* Goldfuss, 1827. Cretaceous. The large tuberosities correspond to the solidified tubes like the centers of convergence in *Neuropora*. This genus appears to us, therefore, as a *Neuroporella* without veinules. The genotype from the Campanian of Sweden and the Island of Rügen is the only species heretofore known.

SPINOPIORA NEOCOMIENSIS, new species

Plate 26, figs. 6, 7

Description.—The zoarium is free, subcylindrical, hollow, branched. The orifices are polygonal, small, arranged in quincunx, separated by very salient tuberosities. The zoarial tubercles are very salient, smooth, much scattered, arranged in quincunx.

Measurements.—Diameter of orifices, 0.16 mm.; diameter of zoarium, 4 mm.

Affinities.—The zoarial form in this species is very different from that of the genotype, but the external characters are absolutely identical. We have not been able to make sections.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Cotype.—Cat. No. 69880, U.S.N.M.

Division OVICELLATA

Subdivision PARALLELATA Waters, 1887

Family MECYNOECIIDAE Canu, 1918

Genus MECYNOECIA Canu, 1918

MECYNOECIA ICAUNENSIS D'Orbigny, 1850

Plate 1, figs. 1-4

1850. *Entalophora icaunensis* D'ORBIGNY, *Prodrome de Paléontologie*, vol. 2, p. 87.

1853. *Entalophora icaunensis* D'ORBIGNY, *Paléontologie française, Terrain Crétacé*, vol. 5, p. 781, pl. 616, figs. 12-14.

Measurements.—

	Small branches	Large branches	M. proboscidea
	Mm.	Mm.	Mm.
Diameter of aperture.....	0.16	0.12	0.16
Diameter of peristome.....	.24	.24-.30	.16-.20
Distance of peristomes.....	1.20 (1.76)	1.20	1.20-1.40
Separation of peristomes.....	.80	.80	.30-40

Affinities.—This species was identified by Pergens, in 1889 with *Entalophora proboscidea* Milne-Edwards, 1838, and by Gregory, 1899, with *Entalophora virgula* Hagenow, 1840. According to these authors, it begins in the Neocomian and still exists in the recent seas. The Neocomian species appears to us distinct and to differ from the recent species in its more crowded and smoother tubes. We figure a few variations. The structure is identical with that of the recent species and of some Tertiary specimens of which we have published sections

in 1920. The transverse section especially is puzzling and we can not explain its structure because the tubes in it are not rounded. This structure is peculiar to this group, and it is little probable that all the species which we have cited as belonging to this genus, because of the nature of the ovicell, have an identical structure.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland, and Censea (Doubs), France.

Plesiotype.—Cat. No. 69881, U.S.N.M.

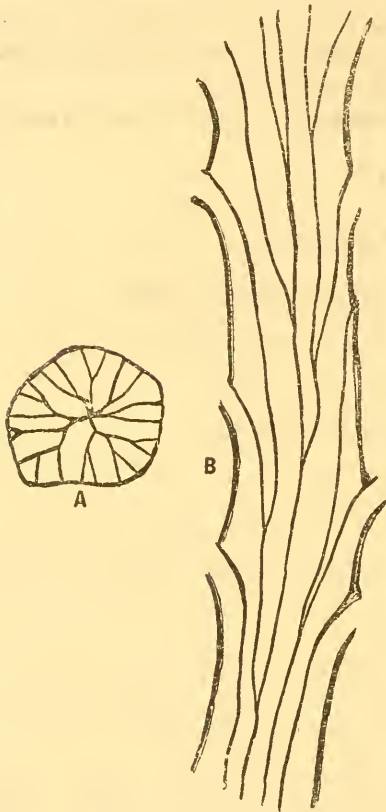


FIG. 17.—*Mecynocelia icaunensis* D'Orbigny, 1850.
A-B. Transverse and longitudinal sections,
× 16. Lower Cretaceous (Valangian): Sainte-
Croix, Switzerland

MECYNOECIA (SPIROPORA) VERTICILLATA
Goldfuss, 1827

1850. *Spiropora neocomiensis* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 708, pl. 742, figs. 1, 2.
1865. *Spiropora verticillata* BEISSEL, Ueber die Bryozoen der Aachener Kreidebildung, Naturkundige Verhandlungen Hollandsche Maatschappij der Wetenschappen te Haarlem, ser. 2, vol. 22, p. 70, pl. 8, figs. 91-93.
1869. *Spiropora neocomiensis* DE LORIOU, Monographie de l'étage Urgonien de Landeron, Memoires de la Société helvétique des Sciences naturelles, vol. 23, p. 37, pl. 2, fig. 18.
1909. *Spiropora verticillata* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 256, pl. 11, fig. 5. (Bibliography and geological distribution.)
1922. *Mecynocelia ? verticillata* CANU and BASSLER, Studies on the Cyclostomatous Bryozoa, Proc. U. S. National Museum, vol. 61, p. 13, pl. 1, figs. 16, 17.

Measurements.—Diameter of peristome, 0.20-0.24 mm.; distance of verticells, 0.60-0.90 mm. The

measurements are identical with specimens from the French Coniacian. In longitudinal section the tubes are cylindrical, with regular peripheral gemmation.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland, etc.

Genus *MICROECIA* Canu, 1918*MICROECIA CORNUCOPIA* D'Orbigny, 1851

Plate 28, figs. 5-7

1899. *Proboscina cornucopia* GREGORY, Catalogue of Cretaceous Bryozoa in the British Museum, vol. 1, p. 45, pl. 3, figs. 6, 9, 10; pl. 4, fig. 1. (Bibliography, geological distribution.)

Our specimens from Faringdon found incrusting shells correspond fairly well to Gregory's Figure 6*b*. They do not exhibit the large berenicoid expansions like the type specimen, but they have the same small dimensions.

A specimen from Sainte-Croix appearing to correspond to Figure 1, Plate 4, of Gregory, is ovicelled and belongs to the genus *Microecia*.

Occurrence.—Lower Cretaceous: Faringdon, England (Aptian), and Sainte-Croix (Vaud), Switzerland (Valangian).

Plesiotype.—Cat. No. 69882, U.S.N.M.

Genus *TRIGONOECIA* Canu and Bassler, 1922*TRIGONOECIA SEMOTA*, new species

Plate 1, fig. 5

Description.—The zoarium incrusts shells; it is suborbicular, berenicoid; the zone of growth is thin and irregular. The tubes are long, cylindrical, visible, convex, arched; the peristomes are thin, orbicular or elliptical, much *scattered* from each other. The ovicell is elongated or transverse, symmetrical, convex, wrinkled transversely; the oeciostome is small, salient, orbicular, opening on the same plane as the peristomes.

Measurements.—Diameter of orifice, 0.14 mm.; diameter of peristome, 0.16-0.18 mm.; distance of peristomes, 0.48-0.64 mm.; separation of peristomes, 0.64-0.72 mm.; diameter of oeciostome, 0.07 mm.; diameter of zoarium, 5 mm.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland (common).

Holotype.—Cat. No. 69883, U.S.N.M.

TRIGONOECIA TUBULOSA D'Orbigny, 1853

Plate 4, figs. 13-15

1853. *Diastopora tubulosa* D'ORBIGNY, Paléontologie française, Terrain Crétacé vol. 5, p. 827, pl. 635, figs. 1-3.

Measurements.—Diameter of orifices, 0.09 mm.; diameter of tubes, 0.10 mm.; distance of peristomes, 0.90 mm.; separation of peristomes, 0.50 mm.; diameter of peristome, 0.12-0.14 mm.

Structure.—The tubes become dilated in their free terminal portion, so that the diameter of the peristome is greater than that of

the tubes. The distance of the peristomes is quite variable. In certain portions the peristomes are very close together and in other places they are grouped in transverse rows.

The ovicell, in its complete form, is a large pyriform quite salient sack, very convex, perfectly symmetrical, and terminated by a very small oeciostome. But it often presents forms less symmetrical in

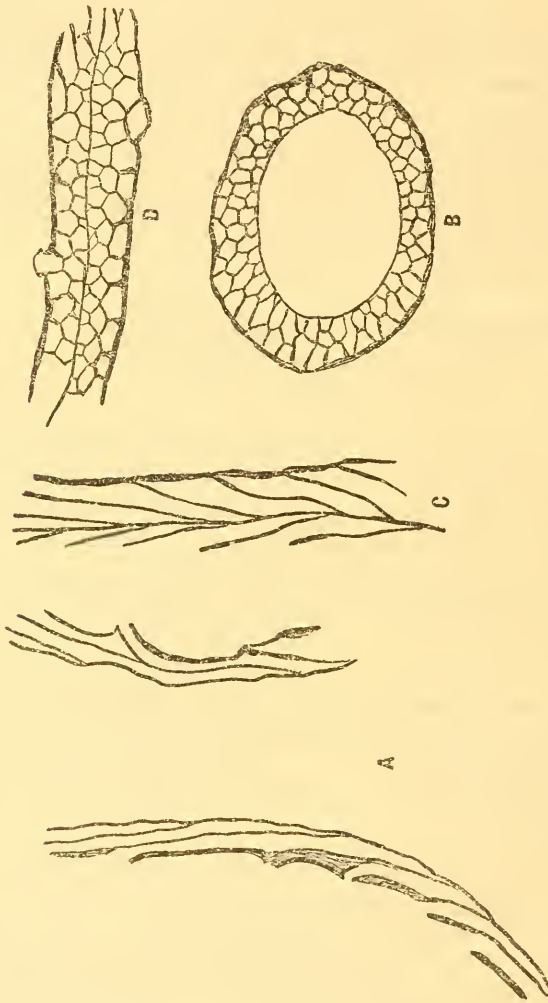


FIG. 18.—Genus *Trigonoeccia* Canu and Bassler, 1922. A, B. *Trigonoeccia tubulosa* D'Orbigny, 1851. A. Longitudinal section, $\times 16$, of the hollow zoarium, showing cylindrical tubes with dorsal gemmation. B. Transverse section of a branch, $\times 16$. Lower Cretaceous (Valangian); Sainte-Croix, Switzerland. C, D. *Trigonoeccia neocomitensis* D'Orbigny, 1853. Portion of a longitudinal section, $\times 16$, showing the triparietal gemmation and the club-shaped tubes. D. Transverse section, $\times 16$, exhibiting the polygonal form of the tubes. Lower Cretaceous (Valangian); Sainte-Croix, Switzerland.

shape. However, it is very rare that on the same specimen of cyclostomatous bryozoan all the ovicells are identical in shape. Irregularity is the rule.

In longitudinal section the tubes are cylindrical, long, with triparietal gemmation on the basal lamella and narrowed at their base

In transverse section the tubes are polygonal, with thin walls adjacent. The tubes adjacent to the lamella are small, because they correspond to the inferior part of the tubes.

Occurrence.—Lower Cretaceous: Sainte-Croix (Vaud), Switzerland; Hauterivian, Censeau (Doubs), France (Valangian), Fontenay and Auxerre (Yonne), France (Rhodonian).

Plesiotypes.—Cat. No. 69884, U.S.N.M.

TRIGONOECIA HAIMEANA De Loriol, 1863

Plate 1, figs. 6–12

1863. *Reptomultisparsa haimeana* DE LORIOI, Les Invertébrés du Neocomien inférieur du Mont Salève près Genève, vol. 2, p. 136, pl. 17, fig. 4.

1883. *Reptomultisparsa haimeana* KEEPING, Fossils of the Neocomian of Upware and Brickhill (Cambridgeshire and Bedfordshire), p. 137.

1899. *Reptomultisparsa haimei* GREGORY, Catalogue of Cretaceous Bryozoa in the British Museum, vol. 1, p. 117, fig. 5.

Measurements.—

	Ste.-Croix	Faringdon	Gregory	Type
	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>
Diameter of aperture.....	0.10	0.10	0.10	0.10
Diameter of peristome.....	.16	.16		
Diameter of tubes.....	.20	.20	.20-.25	.18-.22
Distance of peristomes.....	.72-.80	.64	.60-1.00	
Separation of peristomes.....	.72	.48-.60		

Affinities.—De Loriol's type is not very well preserved, but our specimens, which we have compared with it, are much better.

The zoarium incrusts sponges and shells over considerable surfaces (fig. 6). The large transverse overlapping wrinkles characteristic of the species have been observed in specimens from Sainte-Croix (fig. 7), as well as Faringdon (fig. 10). The ovicell is triangular, very convex, and quite similar to that in other species of the genus. Its dimensions are quite variable, varying from once to twice the size. The ovicell shown in Figure 12 is the largest one observed.

Occurrence.—Lower Cretaceous: Varappe, near Geneva, Switzerland (De Loriol) (Hauterivian), Sainte-Croix (Vaud), Switzerland (Valangian); Faringdon and Upware, England (Aptian).

Plesiotypes.—Cat. Nos. 69885, 69886, U.S.N.M.

TRIGONOECIA (MESENTERIPORA) NEOCOMIENSIS D'Orbigny, 1853

Plate 2, fig. 11

1853. *Mesenteripora neocomiensis* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 808, pl. 756, figs. 7–9.

Measurements.—Diameter of orifice, 0.14–0.16 mm.; diameter of peristome, 0.18–0.20 mm.; distance of peristomes, 1.00–1.20 mm.; separation of peristomes, 0.70 mm.

Structure.—Although very beautiful, D'Orbigny's figure is not complete. A considerable number of tubes bear at their base large transverse wrinkles. They are not constant, it is true; when the tubes are very long and are inserted between two peristomes (distance of 1.20 mm.), the wrinkles are quite visible in the inferior nonsalient portion; when the tubes are short (distance, 0.70 mm.), the wrinkles have disappeared.

We have not observed the ovicell, but we classify the species provisionally in the genus *Trigonoecia* because the sections are identical with those of other species of the genus. The fronds being undulated, there is never perfect symmetry in the sections. Pergens and Gregory have erroneously identified this species with *Diastopora compressa* Goldfuss, 1827, in which the micrometric measurements are much smaller.

Occurrence.—Lower Cretaceous: Sainte-Croix, Switzerland (Valangian); Morteau (Jura), France (Urgonian).

Plesiotype.—Cat. No. 69887, U.S.N.M.

Genus *CARDIOECIA* Canu and Bassler, 1922

The ovicell is triangular, transverse, *cordiform*, little convex, smooth, symmetrical; the oeciostome is small, salient, median. The tubes are club-shaped, with triparietal gemmation on a basal lamella.

Genotype.—*Cardioecia (Bidiastopora) neocomiensis* D'Orbigny, 1853. Lower Cretaceous (Neocomian, Aptian).

The ovicell is less salient and more expanded than in *Trigonoecia*. The tubes are longer and club-shaped. The latter character is clearly visible in transverse sections, which have a larger number of tubes and increase regularly from center to circumference. We have observed only the free forms of growth, but encrusting forms are quite possible. The oeciostome always measures 0.10 mm. and the oeciopore 0.06 mm. No exceptions to this have been found.

CARDIOECIA NECOMIENSIS D'Orbigny, 1853

Plate 2, figs. 1-7

1853. *Bidiastopora neocomiensis* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 800, pl. 784, figs. 9-11.

1902. *Bidiastopora campicheana* CANU, Bryozoaires fossiles, Collection Campich. Bull. Soc. Geol. France, ser. 4, vol. 2, p. 11.

Measurements.—Diameter of aperture, 0.10 mm.; diameter of peristome, 0.16 mm.; zooecial diameter, 0.20 mm.; distance of peristomes, 0.40-0.50 mm.; separation of peristomes, 0.50 mm.; width of large fronds, 3 mm.

Variations.—This species is very irregular and D'Orbigny's figure represents only one phase of it. In their perfect form the tubes are visible and salient (fig. 2). This character disappears easily even on

the same fragment of frond (figs. 2, 7); the tubes cease to be visible and the peristomes are very salient (fig. 2). The latter frequently are less developed (figs. 3, 4, 6) and the superficial aspect is totally different. In some very rare cases they become almost adjacent (fig. 5.)

The ovicell shown in Figure 3 is the typical and perfect form; it is heart-shaped, transverse, convex, smooth, symmetrical, and its

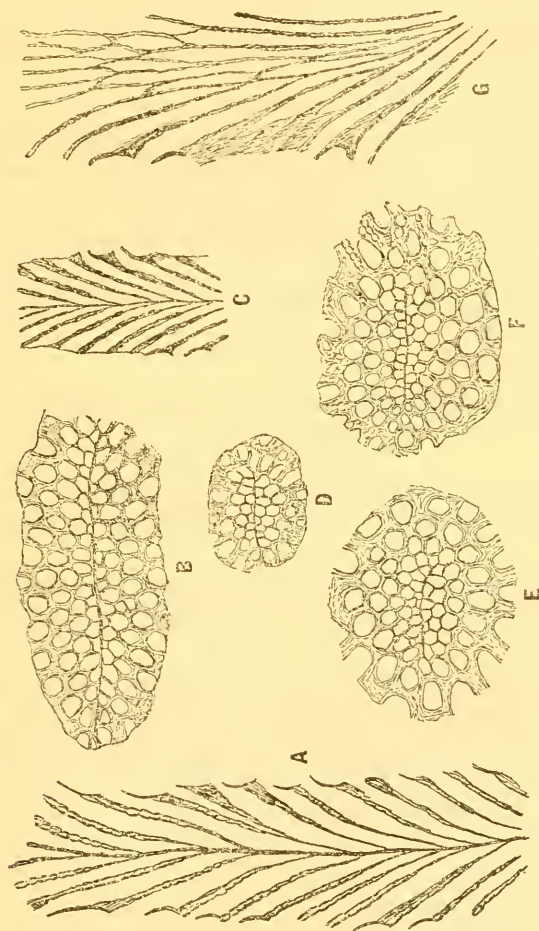


FIG. 19.—Genus *Carditoecia* Canu and Bassler, 1922. A, B. *Carditoecia neocomiensis* D'Orbigny, 1853. Longitudinal and transverse sections, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland. C, D. *Carditoecia verticillata*, new species. Longitudinal and transverse sections, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland. E, F, G. *Carditoecia faringdonensis*, new species. E, F. Two transverse sections, $\times 16$, with the median lamella short and curved in the second. G. Portion of a meridian section, $\times 16$, showing the form of the tubes. Lower Cretaceous (Aptian): Faringdon, England

small oeciostome is placed in the median axis; but regularity and symmetry disappear rather easily (fig. 6). The oeciostome measures 0.10 mm. and the oeciopore 0.06 mm.

The zone of growth is short but very thick (figs. 2, 5).

Structure.—In longitudinal section the tubes are long, club-shaped, much expanded at their extremity, where, in consequence of the closeness of the peristomes, they appear closed by pseudofacettes.

The gemmation is triparietal on a basal lamella (=median). The walls are thick and vesicular.

In transverse section the tubes are orbicular or elliptical, largest at the periphery, with very thick walls. The median (basal) lamella is almost rectilinear.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Plesiotypes.—Cat. No. 69888, U.S.N.M.

CARDIOECIA NEOCOMIENSIS PARVULA, new variety

Plate 2, fig. 8

The micrometric measurements are somewhat smaller and the ovicell less regular than in the typical form. The tubes are visible.

Measurements.—Diameter of orifice, 0.08 mm.; diameter of peristome, 0.14 mm.; distance of peristomes, 0.64 mm.; separation of peristomes, 0.50 mm.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Holotype.—Cat. No. 69890, U.S.N.M.

CARDIOECIA NEOCOMIENSIS ENTALOPHOROIDES, new variety

Plate 2, figs. 9, 10

The zoarium is cylindrical or somewhat compressed. The peristomes are arranged in verticells. The ovicell is more globular and less transverse.

Measurements.—Diameter of aperture, 0.12 mm.; diameter of peristome, 0.16 mm.; separation of peristomes, 0.56 mm.; distance of peristomes 0.34 mm.

The separation can be measured only in the portions of the surface where the peristomes are arranged in quincunx. The ovicell appears less cordiform and more globular because the zoarium is sub-cylindrical. This is not *Entalophora neocomiensis* D'Orbigny, 1853 in which the tubes are visible and more distant.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Cotype.—Cat. No. 69889, U.S.N.M.

CARDIOECIA VERTICELLATA, new species

Plate 3, figs. 1-4

Description.—The zoarium is cylindrical, arborescent. The tubes are very short, flat, indistinct or separated by a salient thread; the peristomes are thick, salient, orbicular, generally arranged in close *verticells*. The zone of growth is a broad cone. The ovicell is triangular, elongated, very convex, smooth; the oeciostome is small salient, orbicular.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of peristome, 0.14 mm.; distance of peristomes, 0.30 mm.; separation of peristomes, 0.40 mm.

Variations.—The tubes with prominent threads are visible only on the specimens with worn and little salient peristomes. The separation of the peristomes can be measured only on specimens where they are arranged in quinquex.

The ovicell is somewhat different from that in other species and resembles *Trigonoecia*. It differs, nevertheless, in the absence of transverse wrinkles. Moreover, we know that the typical expanded form visible on the lamellar zoarium disappears easily on these cylindrical specimens.

Structure.—The sections are, indeed, those of the genus *Cardioecia*. In longitudinal section the tubes are club-shaped, with moniliform walls, but very thick and strongly calcified; the gemmation is triparietal on the median lamella.

In transverse section the tubes are orbicular or elliptical, with diameter increasing toward the periphery. The walls here are very thick.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Cotypes.—Cat. No. 69891, U.S.N.M.

CARDIOECIA HYSSELYI De Loriol, 1869

Plate 3, figs. 5-8

1869. *Mesenteripora hyselyi* DE LORIOI and GILLIERON, Monographie paleontologique de l'Urgonien de Landeron, Memoires Société helvétique des Sciences naturelles, vol. 23, p. 40, pl. 3, fig. 1.

Measurements.—Diameter of aperture, 0.12 mm.; diameter of peristome, 0.26 mm.; diameter of tubes, 0.24 mm.; distance of peristomes, 0.40-0.70 mm.; separation of peristomes, 0.52-0.60 mm.

Affinities.—We have not examined De Loriol's figured type and we are not very certain of our determination. De Loriol's descriptions and figures were always incomplete and inexact.

The tubes are visible or invisible; the peristomes are little or very salient, sometimes arranged in verticells. The ovicell is cordiform, rather regular, little convex. The zone of growth is thick.

The sections are identical with those of *Cardioecia neocomiensis* D'Orbigny, 1853, but the present species, which has a similar exterior aspect, differs in its larger peristomes and in its foliated and much broader fronds.

Occurrence.—Lower Cretaceous: Sainte-Croix (Vaud), Switzerland; (Valangian), Landeron (Neuchatel), Switzerland (Urgonian).

Plesiotypes.—Cat. No. 69892, U.S.N.M.

CARDIOECIA FARINGDONENSIS, new species

Plate 3, figs. 9-15

Description.—The zoarium is free, cylindrical or compressed, with bifurcated fronds. The tubes are short, visible, convex, separated by a little developed furrow; the peristomes are obicular, salient, thick, arranged in quincunx or in close verticells. The zone of growth is broad or conical. The ovicell is cordiform, little salient, smooth; the oeciostome is salient, small, orbicular. The base is a little expanded.

Measurements.—Diameter of orifice, 0.14 mm.; diameter of peristomes, 0.28 mm.; distance of peristomes, 0.48-0.60 mm.; separation of peristomes, 0.80 mm.

Structure.—In longitudinal section the tubes are long, club-shaped, with moniliform walls, much expanded in their terminal portion; they appear closed by pseudofacettes on account of the closeness of the peristomes. The gemmation is triparietal on a median lamella.

In transverse section the tubes are round, increasing in size toward the periphery, separated by the vesicular tissue of the thickened walls. The median lamella is not always rectilinear.

In meridian sections the tubes are lozenge-shaped in the axis of the median lamella, which does not entirely traverse the zoarium; the lateral tubes have the normal form.

Affinities.—This beautiful species has the exterior aspect of *Cardioecia neocomiensis* D'Orbigny, 1853, but it differs in its larger micrometric dimensions in its fronds being much less expanded and more frequently cylindrical.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Cotypes.—Cat. No. 69893, U.S.N.M.

CARDIOECIA PAUPER, new species

Plate 5, figs. 1, 2

Description.—The zoarium is free, cylindrical. The tubes are indistinct, scarcely convex, smooth. The peristomes are arranged in transverse rows or in quincunx; they are orbicular, thin, little salient. The zone of growth is an elevated cone. The ovicell is small, elliptical, transverse, little convex, smooth.

Measurements.—Diameter of aperture, 0.14 mm.; diameter of peristome, 0.18 mm.; distance of peristomes, 0.48-0.56 mm.; separation of peristomes, 0.64 mm.; diameter of zoarium, 3 mm.

Affinities.—We figure the two sides of the same specimen in order to show that the peristomes are arranged in transverse rows on one

side and in quincunx on the other. This irregularity provokes an equivalent irregularity in the sections. Those that we have made show the same characters as in the preceding species, thus leaving no doubt as to the generic placing.

The species differs from *Cardioecia faringdonensis* in its smaller, more crowded and less salient peristomes.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Holotype.—Cat. No. 69898, U.S.N.M.

Genus NEMATIFERA Canu and Bassler, 1922

The ovicell is an elongated sack, subsymmetrical, irregular, scarcely convex; the oeciostome is terminal, very small, hardly salient. All of the tubes are bordered with salient threads exteriorly. The tubes are short, cylindrical, polygonal; the gemmation is triparietal on a basal lamella.

Genotype.—*Nematifera (Elea) reticulata* D'Orbigny, 1853. Lower Cretaceous (Neocomian, Urgonian). The ovicells so far discovered are little distinct but clearly different from those of *Trigonoecia*, although the structure in sections in these two genera is very similar. The tubes are bordered exteriorly by a salient thread, which never occurs in *Trigonoecia*. According to the exterior resemblances, this genus ought to have Jurassic representatives.

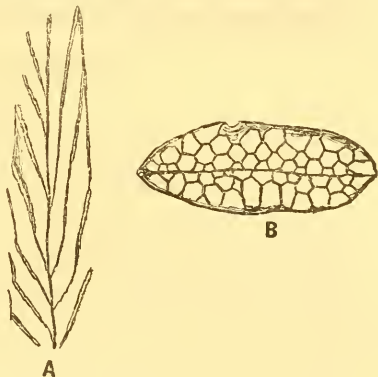


FIG. 20.—*Nematifera reticulata* D'Orbigny, 1853. Longitudinal and transverse sections, $\times 16$. Lower Cretaceous (Valangian): Sainte Croix, Switzerland

NEMATIFERA RETICULATA D'Orbigny, 1853

Plate 4, figs. 1-4

1853. *Elea reticulata* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 629, pl. 782, figs. 9-12.

Measurements.—Diameter of orifice, 0.14 mm.; diameter of peristomes, 0.24 mm.; distance of peristomes, 0.60 mm.; separation of peristomes, 0.64 mm.

Affinities.—This species is not at all a member of the Eleidae. The peristome is orbicular, but, through weathering, it becomes semielliptical. There are no facettes, but these are the walls of the tubes themselves that are very short because of the close approach of the peristomes. The tubes are almost always bordered with a

salient thread, a phenomenon produced in many other species with tubes much longer. Finally, there is never an operculum, and the ovicell is very different from that in the Eleidae. The separating threads outline the peristome entirely, a characteristic which deceived D'Orbigny.

Structure.—In longitudinal section the tubes are short, cylindrical, somewhat expanded nevertheless in the vicinity of the pseudofacettes; gemmation is triparietal on a basal lamella.

The transverse section does not show a large number of tubes; they are polygonal, with thin and adjacent walls; the smallest are in the vicinity of the median lamella.

Occurrence.—Lower Cretaceous: Sainte-Croix (Vaud), Switzerland (Valangian); Morteau (Doubs), France (D'Orbigny) (Neocomian).

Plesiotypes.—Cat. No. 69894, U.S.N.M.

NEMATIFERA ACUTA D'Orbigny, 1853

Plate 4, fig. 12

1853. *Bidiastopora acuta* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 799, pl. 784, figs. 3-5.

Measurements.—Diameter of orifice, 0.08-0.10 mm.; diameter of peristome, 0.12 mm.; diameter of zoecium, 0.20 mm.

This species is well characterized by its very thin and sharp zoarial margins. The separating threads turn around the peristome, which is thin; the pseudofacettes are flat.

We have not had the chance to discover the ovicell, and we have classified the species according to its exterior analogies and the transverse section which is always easily observed.

According to Pergens, 1889, *Bidiastopora campicheana* D'Orbigny, 1853, is a synonym, but we do not believe this is true; moreover D'Orbigny's figure indicates an altered specimen.

Marsson, 1887, believed he had found this species in the Campanian of Rügen. We have not rediscovered it ourselves.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69895, U.S.N.M.

NEMATIFERA INCRUSTANS, new species

Plate 4, figs. 5-7

Description.—The zoarium encrusts shells, with many irregularly arranged lamellae; it emits free, thick expansions irregular around a median lamella. The tubes are distinct, separated by a salient thread, flat, short (pseudofacettes). The peristomes are orbicular, salient,

arranged in quincunx. The zone of growth is rather broad and formed of three or four series of tubes. The ovicell is suborbicular, little convex, smooth.

Measurements.—Diameter of orifice, 0.12 mm.; diameter of tubes, 0.22 mm.; distance of peristomes, 0.64 mm.; separation of peristomes, 0.52–0.60 mm.

Affinities.—The superb figured specimen measures 5 centimeters in length. Some free broken expansions show the median lamella and consequently the identity with the other species of the genus.

This species differs from *Trigonoecia haimcana* De Loriol, 1868, which exhibits also large multilamellar specimens, in the presence of salient threads, in the absence of overlapping wrinkles, and in the very different form of its ovicell.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (very rare).

Holotype.—Canu collection.

NEMATIFERA RETICULOIDES, new species

Plate 4, figs. 8–11

Description.—The zoarium is free, cylindrical, bifurcated, or reticulate. The tubes are distinct, flat, separated by a salient thread, forming pseudofacettes when they are short. The peristomes are orbicular, salient, thick, arranged in *Peripora*, that is to say, in groups of closely arranged transverse rows. The zone of growth is a cone, little elevated.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of zoecium, 0.20–0.24 mm.; distance of peristomes, 0.40–0.64–0.80 mm.; separation of peristomes, 0.64 mm.

Affinities.—The peristomes are rarely arranged in quincunx and their distance is about 0.64 mm. They are somewhat salient and adjacent when they are arranged in transverse lines; with weathering they are no longer orbicular and their form is close to that of the peristomes in the Eleidae, but they never have opercula. The distance between the groups of transverse lines is from 0.80 to 1.00 mm.

This species differs from *Nematifera reticulata* D'Orbigny, 1853, in its smaller micrometric dimensions, in the arrangement of the peristomes in the *Peripora* form, and in the cylindrical zoarium. It differs from *Nematifera acuta* D'Orbigny, 1853, in the oral dimensions and in the cylindrical and not lamellar zoarium. The transverse section shows that the zoarium is sometimes a little compressed.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69896, U.S.N.M.

Genus *MESENTERIPORA* Blainville, 1834*MESENTERIPORA MARGINATA* D'Orbigny, 1853

Plate 6, fig. 3

1899. *Diastopora marginata* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 137. (Bibliography and occurrence.)

Measurements.—Diameter of aperture, 0.14–0.16 mm.; diameter of peristome, 0.22 mm.; diameter of tubes, 0.27 mm.; distance of peristomes, 2 mm.; separation of peristomes, 0.64–0.72 mm.

Structure.—We provisionally place this beautiful species next to *Nematifera* because of the presence of separating salient threads, but



FIG. 21.—*Mesenteripora marginata* D'Orbigny, 1853. Transverse section, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

We have not yet been able to discover the ovicell. Moreover, the transverse section is of a type entirely special. There is no basal lamella, and although the lamellar zoarium has two sides they

are not formed by two lamellae placed back to back. The tubes are polygonal, with thin walls arranged in quincunx and confused.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland, and Villers-le-lac (Jura), France.

Plesiotypes.—Cat. No. 69897, U.S.N.M.

Family *PLAGIOECIIDAE* Canu, 1918Genus *NOTOPLAGIOECIA* Canu and Bassler, 1922

The ovicell is an irregular convex capsule, replacing many peristomes. The tubes are short, club-shaped, with moniliform walls thickened at the extremities. The gemmation is dorsal. There is no basal lamella.

Provisional genotype.—*Notoplagioecia faringdonensis* Canu and Bassler, 1922.

Range.—Cretaceous (Aptian, Coniacian).

NOTOPLAGIOECIA FARINGDONENSIS Canu and Bassler, 1922

Plate 5, figs. 3–5

Description.—The zoarium is free, cylindrical or compressed. The tubes are indistinct, very little convex, smooth. The peristomes are orbicular, thin, arranged in quincunx or in transverse rows. The zone of growth is an elevated cone. The ovicell is an irregular sack covering many adjacent tubes.

Measurements.—Diameter of aperture, 0.16 mm.; diameter of peristome, 0.20 mm.; distance of peristomes, 0.48–0.56 mm.; separation of peristomes, 0.72 mm.; diameter of branches, 3 mm.

Structure.—In longitudinal sections the tubes are short, club-shaped, much expanded at their terminal parts, sometimes showing pseudofacettes. The gemmation is dorsal, although triparietal in appearance because of the little length of the tubes. The walls are moniliform, much widened at their extremity.

In transverse sections the tubes are rounded, much smaller at the center than at the circumference, with vesicular walls much thickened, especially at the periphery.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Cotypes.—Cat. No. 68718, U.S.N.M.

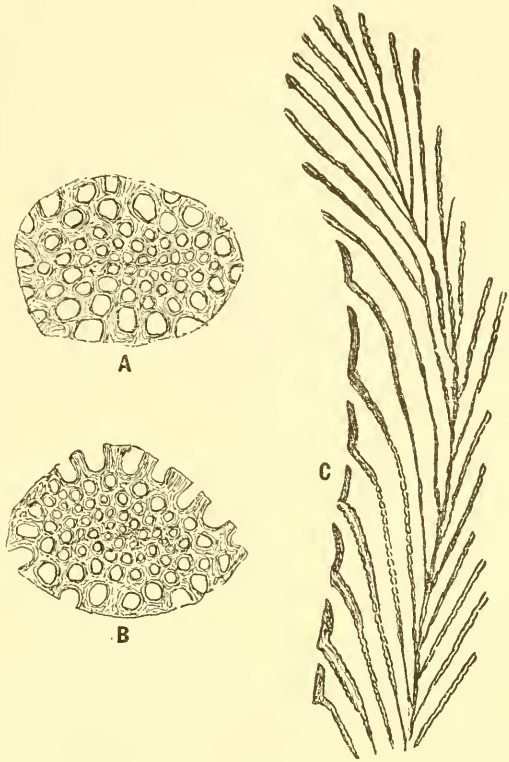


FIG. 22.—*Notoplagioecia faringdonensis* Canu and Bassler, 1922. A, B. Two transverse sections, $\times 16$. C. Longitudinal section, $\times 16$, showing the club-shaped tubes, the pseudofacettes, and the vesicular walls. Lower Cretaceous (Aptian): Faringdon, England

Genus *CEA* D'Orbigny, 1852

CEA GRANULATA, new species

Plate 5, figs. 6–14

Description.—The zoarium is free, formed of narrow, compressed bifurcated fronds. The tubes are rarely visible. The orifices without facette are large, polygonal, irregular, elongated or transverse. The facettes are indistinct, flat, *granular*. The peristomes are orbicular, thin, salient, arranged in quincunx. The zone of growth is large, becoming thinner on the median lamella.

Measurements.—Diameter of aperture, 0.10 mm.; diameter of peristomes, 0.14 mm.; distance of peristomes, 0.40 mm.; separation of

peristomes, 0.40 mm.; diameter of orifice without facettes, 0.20–0.24 mm.; diameter of zoarium, 3 mm.

Structure.—The most frequent aspect is that of Figure 9; the orifices are large and more or less transverse. The latter are sometimes elongated (fig. 11). The tubes are occasionally visible below the orifices, but they remain indistinct. As in all the Ceidae, the facettes are rarely preserved (fig. 13); they are perforated by an orbicular aperture.

In longitudinal section the tubes are club-shaped with walls thickened at their extremity; the gemmation is triparietal on a basal lamella.

In transverse section the tubes are polygonal, with thin walls in the vicinity of the basal lamella. They have a center, rounded toward the periphery by an internal secretion because the polygonal walls are always visible.

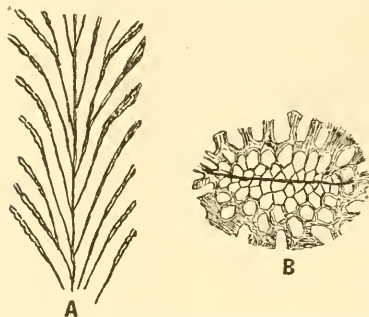


FIG. 23.—*Cca granulata*, new species. A, B. Longitudinal and transverse sections, $\times 16$. Lower Cretaceous (Aptian): Faringdon, England

The ovicell is not known.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Cotypes.—Cat. No. 69899, U.S.N.M.

Family DIAPEROECIIDAE Canu, 1918

Genus DIAPEROECIA Canu, 1918

DIAPEROECIA (?) SIMPLEX, new species

Plate 4, fig. 16

Description.—The zoarium is unilamellar; the noncellular face is transversely striated. The tubes are quite salient, arranged in quincunx; the orifices are orbicular; the peristomes are thick. The ovicell is a limited sack, very convex, perforated by a normal tube; the oeciostome is small, salient, placed at the middle of the ovicell.

Measurements.—Diameter of aperture, 0.12 mm.; diameter of peristome, 0.18 mm.; diameter of oeciostome, 0.10 mm.

Affinities.—This species is not a typical *Diaperoecia*, but we have classified it in this genus because of the median oeciostome. It appears intermediate between *Diaperoecia* and *Tubulipora*, but more specimens are necessary before the species can be classified without doubt.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69900, U.S.N.M.

DIAPEROECIA ORBIFERA, new species

Plate 8, fig. 17

Description.—The zoarium is subcircular; it incrusts shells. The tubes are very short, little distinct, finely granulated, and frequently longitudinally striated; the apertures are elliptical; the peristomes are thin, very close together. The ovicell is large, *orbicular*, very convex, traversed by the subjacent tubes.

Measurements.—Diameter of aperture, 0.06 mm.; diameter of peristome, 0.10 mm.; distance of peristomes, 0.40 mm.; separation of peristomes, 0.40–0.48 mm.

Affinities.—This species is very close to *Berenicea papillosa* Reuss in the closeness of its peristomes. It differs from it in its ovicells, which are orbicular and not elliptical and very elongated.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69901, U.S. N. M.

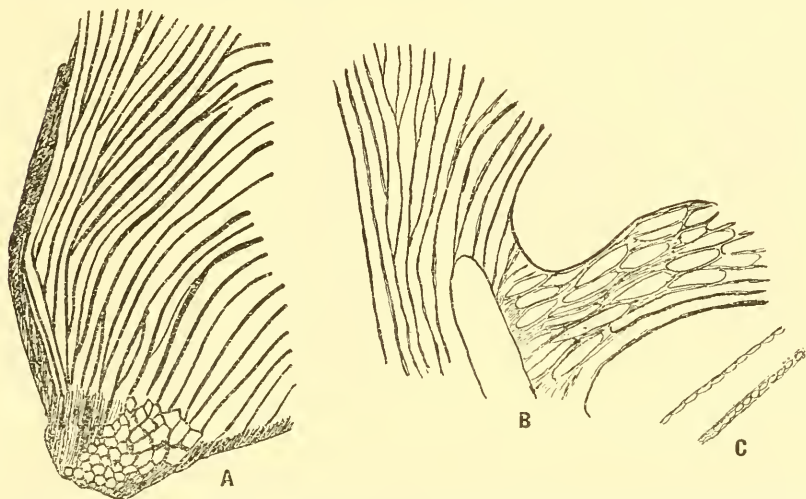


FIG. 24.—*Fasciculipora flabellata* D'Orbigny, 1853. A. Longitudinal thin section, $\times 16$. B. Meridian thin section, $\times 16$, in the vicinity of a bifurcation. C. Zooecial walls, $\times 35$, showing the arrangement of vesicles. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Family FRONDIPORIDAE Busk, 1875

Genus FASCICULIPORA D'Orbigny, 1846

FASCICULIPORA FLABELLATA D'Orbigny, 1853

Plate 7, figs. 1, 2

1853. *Fasciculipora flabellata* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 669, pl. 783, figs. 8–11.

D'Orbigny has figured only isolated fascicles, but in reality the zoarium is bushy. The fascicles are strongly and largely attached by their base; they are very irregular in form and size. The tubes open at the extremity of the fascicles and often laterally.

The base of the small zoarium is pointed, but in the large zoaria it is somewhat wider; they are flabelliform, and it is difficult to understand how they were able to maintain equilibrium on their support.

In longitudinal section the tubes are long, cylindrical, with intra-zoarial gemmation; the walls are vesicular but with very small elements. The zoarial walls are thickened.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69902, U.S.N.M.

Family CYTISIDAE D'Orbigny, 1854

Genus CYRTOPORA Hagenow, 1851

CYRTOPORA CAMPICHEANA D'Orbigny, 1853

1853. *Cyrtopora campicheana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 673, pl. 761, figs. 14, 15.

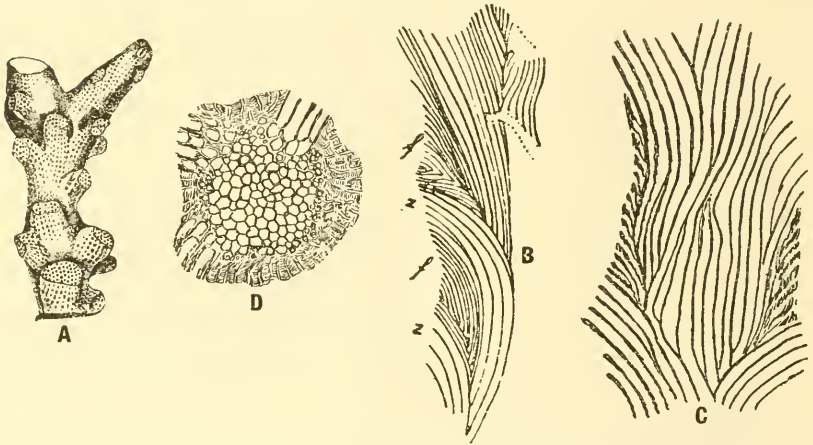


FIG. 25.—Genus *Plethopora* Hagenow, 1851. A, B. *Plethopora malmi* Hennig, 1894. A. Zoarium, $\times 2.6$. B. Longitudinal section magnified, showing zoecial tubes (z) and the nematopores (f) (A, B, after Hennig, 1894). Upper Cretaceous of Sweden. C, D. *Plethopora aptensis*, new species. C. Longitudinal section, $\times 16$, showing the nematopores with thickened walls and the large axial tubes. D. Transverse section, $\times 16$, exhibiting the base of the salient fascicles with open tubes and the thin zone of nematopores. Lower Cretaceous (Aptian): Faringdon, England

Our transverse section confirms that of Gregory, 1909. The tubes are very large, polygonal, with thin adjacent walls.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69950, U.S.N.M.

Genus PLETHOPORA Hagenow, 1851

1851. *Plethopora* HAGENOW, Die Bryozoen der Maastrichter Kreidebildung, p. 45.

The tubes are cylindrical; they are grouped in salient, orbicular bundles opening in all directions. The nematopores are arranged entirely around the zoarium.

Genotype.—*Plethopora verrucosa* Hagenow, 1851. Cretaceous (Aptian, Maastrichtian).

The place of the nematopores is variable in the Cytisidae, according to the nature of the genera. In *Plethopora* they are arranged entirely around the zoarium, while in other genera they are found only on the dorsal.

PLETHOPORA APTENSIS, new species

Plate 7, figs. 3, 4

Description.—The zoarium is free, cylindrical, bifurcated. The zooecia are grouped in fascicles, which are salient and orbicular. The nematopores are small, polygonal, arranged entirely around the zoarium.

Measurements.—Diameter of fascicles, 0.56 mm.; diameter of branches, 2 mm.

Structure.—In longitudinal section the tubes are cylindrical, long, with peripheral gemmation; they occupy the essential and principal part of the zoarium. The nematopores appear solely on the zoarial margin in small spaces between the fascicles, thus confirming the thin section of Hennig.

In transverse sections the larger tubes are in the middle. These, in branching, engender the axial tubes of the fascicles. On the borders the small pores are those of the peripheral nematopores.

Affinities.—The distinction between the species of this genus is rather difficult to make from the published figures. Comparisons of specimens, on the contrary, permit a differentiation, according to the relative size of the orifices, of the nematopores, and the form of the fascicles. The circular form of the latter and the large size of the zoarium well characterize this species.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Cotypes.—Cat. No. 69903, U.S.N.M.

Genus PLETHOPORELLA Canu and Bassler, 1922

The ovicell is elliptical, elongated, large, little convex, smooth. The tubes are cylindrical, without peristome, with orbicular orifice; their walls are moniliform; they are recurved at their extremity. The gemmation is peripheral around a bundle of axial tubes. No adventitious tubes.

Genotype.—*Plethoporella (Plethopora) ramulosa* D'Orbigny, 1847.

Range.—Cretaceous (Campanian, Maastrichtian).

History.—D'Orbigny was in error in comparing the genotype with *Plethopora verrucosa* Hagenow, 1851. The internal structure is very different, for not only are there no nematopores but the tuberosities which ornament the zoarial surface are not formed of bundles of tubes.

PLETHOPORELLA RAMULOSA D'Orbigny, 1847

1847. *Monticulipora ramulosa* D'ORBIGNY, *Prodrome de Paléontologie Stratigraphique*, p. 279, no. 1345.
 1854. *Plethopora ramulosa* D'ORBIGNY, *Paléontologie française, Terrain Crétacé*, p. 1045, pl. 799, figs. 1-3.

Structure.—D'Orbigny was deceived by the tuberosities which ornament the zoarial surface and classed this species in *Plethopora* incorrectly. The section which he illustrated, however, indicates not a single bunch of tubes. We have prepared several excellent longitudinal sections, one of which made from a normal zoarium showed on one side two subcolonies, while on the other side the tubes continued to grow regularly. The enveloping lamella partially surrounded the primitive colony and had its origin in a normal tube. All the species with peripheral gemmation pass easily from the free form to the incrusting form and conversely. Another longitudinal section shows that the tubes of the tuberosities are simply somewhat wider than the tubes of the intermediate spaces. The moniliform structure and the gemmation are identical in the two cases. The walls are formed of large vesicles.

In transverse sections the central tubes are equal in size and polygonal. The smaller ones, which appear sporadically, are indicative of the peripheral gemmation. The lozenge-shaped ones of the periphery represent the superior and recurved part of the tubes.

In tangential sections the tubes are subcircular and buried in a thick vesicular coenenchyma. They are smaller in the intertuberosity zones, in conformity with the longitudinal section. The small tubes which appear sporadically are young tubes; they reveal the peripheral gemmation.

This structure is exactly that of ramose *Cerriopora*, and it is in this genus that we would have classed this species had we not had the chance to discover the ovicell. The latter is analogous to that of other Cytisidae and is simply more elliptical.

Occurrence.—Cretaceous (Campanian): Montmoreau, Brossac, Draullard, St. Aulais, Echebrune and Daviat (Charente), France. Cretaceous (Maastrichtian): Royan (Charente inferieure), Manie Roux and St. Lheurine (Dordogne), France.

Plesiotypes.—Canu collection and Cat. No. 68980, U.S.N.M.

Genus CHARTECYTIS, new genus

Greek: Chartes, sheet, in allusion to the form of the branches.

The ovicell is elliptical, transverse, placed in the vicinity of the bifurcations. The tubes are cylindrical, with greatly thickened walls, with regular peripheral gemmation. The orifice is lozenge-shaped, much elongated, without peristome.

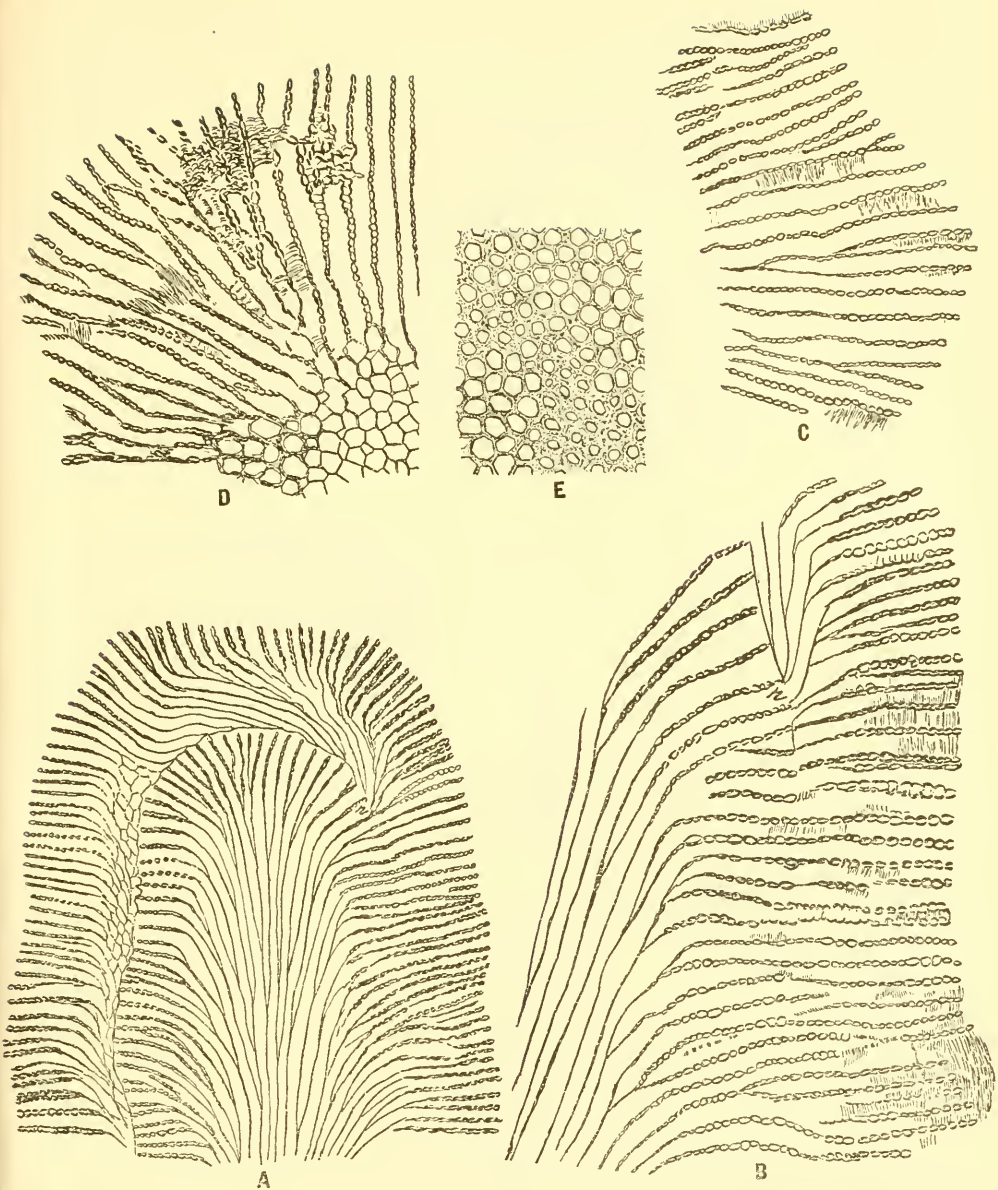


FIG. 26.—*Plethoporella ramuosa* D'Orbigny, 1853. A. Longitudinal section, $\times 8$, in a zoarium containing a partially enveloping subcolony, the initial tube of which is at r. B. Portion of fig. A, $\times 16$. C. Part of longitudinal section, $\times 16$, through a tuberosity where the tubes are broader. D. Portion of a transverse section $\times 16$. E. Tangential section, $\times 16$, showing the larger tubes of the tuberosities and the other smaller tubes. Upper Cretaceous (Maastrichtian): Royan, France

Genotype.—*Chartecytis compressa*, new species, Neocomian.

In the family Cytisidae zoarial forms with compressed fronds have not yet been noted. This form is the result of very regular peripheral gemmation; moreover, the extremity of the branches have the aspect of *Heteropora*.



FIG. 27.—*Chartecytis compressa*, new species. A. meridian section, $\times 16$, showing the special method of ramification of the branches. B. Longitudinal section, $\times 16$, illustrating the peripheral gemmation. C. Transversal thin section, $\times 16$, showing the minute central vesicles. D. Zooeical walls, $\times 45$, showing the minute central vesicles. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland.

CHARTECYTIS COMPRESSA, new species

Plate 7, figs. 8–12

Description.—The zoarium is free, branching, with compressed fronds. The orifices are elongated slitlike areas, lozenge-shaped, irregular, arranged in quincunx, without peristome. The ovicell is orbicular or elliptical, elongate or transverse, smooth, very salient, limited, and placed on the dorsal of the inferior tubes.

Measurements.—Diameter of orifice, 0.08 mm.; diameter of branches, 2.5 mm.; length of orifice, 0.16–0.20 mm.

Structure.—In transverse section the tubes are cylindrical, with greatly thickened walls; the central tube is perhaps a little larger. In longitudinal section the tubes are very long, with peripheral gemmation, very regular, with thickened walls.

This structure is quite simple. In general these forms of the tubes are oriented on one zoarial side; here the colony has two cellular sides, a rare occurrence.

Occurrence.—Lower Cretaceous. Valangian at Sainte-Croix, Switzerland; Hauterivian at Censeau (Doubs); Neocomian at St. Claude and Cinquetral (Doubs), France.

Cotypes.—Cat. No. 69904, U.S.N.M.

Genus *RETENOA* Gregory, 1909

1909. *Retenoa* GREGORY, Catalogue of Cretaceous Bryozoa in the British Museum, vol. 2, p. 28.

Cytisidae, with an erect frondose zoarium, composed of a network of dichotomous, anastomosing branches. The apertures all open on one face of the zoarium. The tubes are cylindrical, with lozenge-shaped orifices, with intrazoarial gemmation.

Genotype.—*Retenoa (Frondipora) campicheana* D'Orbigny, 1853.

This genus is little different from *Homoeosolen* Lonsdale, 1850. It differs exteriorly in the absence of pinnules, and especially in its reticulate zoarium, which is a character of little importance. However, the gemmation is intrazoarial and not dorsal, which is a genuine difference. Gregory erroneously in 1909 classified this genus in the family Theonoidae; it is one of the typical Cytisidae on account of the nature of its ovicell.

RETENOA CAMPICHEANA D'Orbigny, 1853

Plate 7, figs. 5–7

1853. *Frondipora campicheana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 678, pl. 783, figs. 12–16.

1909. *Retenoa campicheana* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2, p. 28. (Geologic distribution.)

Structure.—We have had the good fortune to discover numerous ovicelled specimens. The ovicell is an elliptical capsule, limited, convex, smooth, placed laterally on the dorsal, usually beneath the bifurcations.



FIG. 28.—*Retenoa campicheana* D'Orbigny, 1853. Longitudinal section, $\times 16$, showing the cylindrical tubes and the intrazoarial gemmation. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

In transverse section the tubes are equally rounded, with thick walls. In longitudinal sections they are cylindrical, with peripheral gemmation oriented around an imaginary axis. The dorsal tubes are closed (intrazoarial gemmation). The zoecial walls are vesicular, with very small elements. This is very much like the section in *Fron dipora*, but the ovicell is altogether different.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotypes.—Cat. No. 69905, U.S.N.M.

Family THEONOIDAE Busk

The family Theonoidae, as defined by Gregory in 1899 and 1909, embraced the following genera:

Actinopora D'Orbigny, 1853, *Conotubigera* D'Orbigny, 1853 (*Serietubigera* D'Orbigny, 1853), *Multitubigera* D'Orbigny, 1853, *Theonoo* Lamouroux, 1821, and *Retenoo* Gregory, 1909, with *Multifascigera* D'Orbigny, 1853 (= *Meandrocavea*), *Lopholepis* Hagenow, 1851, and *Radiofascigera* D'Orbigny, 1853, probably belonging to the Osculiporidae. In its ovicell *Retenoo* is a typical member of the *Cytisidae*. *Radiofascigera* in its ovicell, classed with doubt in the Osculiporidae, ought to be maintained in the vicinity of *Actinopora* (multiserial) and of *Multitubigera*.

The known ovicells are close to those of the *Cytisidae* without being perfectly identical. The family of Theonoidae could be maintained therefore with some restrictions. Unfortunately, the ovicell of the type genus *Theonoo* is still unknown. On the other hand, the uniserial *Actinopora* of the *complanata* group (= *organisans*) have a different ovicell of the type of *Plagioecia*.

If the family should be maintained it ought to contain the following genera:

Actinopora (multiserial) D'Orbigny, 1853, *Radiofascigera* D'Orbigny, 1853, *Multitubigera* D'Orbigny, 1853, and probably according to zoarial resemblances *Multifascigera* D'Orbigny, 1853, *Lopholepis* Hagenow, 1851, *Theonoo* Lamouroux, 1821, and *Serietubigera* D'Orbigny, 1853.

Although established on simple zoarial appearances, all of these genera, after a study of the known sections, appear to have an evident reality, the mode of gemmation and the arrangement of the tubes serving as generic characters.

Genus ACTINOPORA D'Orbigny, 1853

ACTINOPORA STELLATA Koch and Dunker, 1837

Plate 6, figs. 1, 2

1909. *Actinopora stellata* GREGORY, Catalogue of the Cretaceous Bryozoa, vol. 2, p. 21. (Bibliography.) (*Actinopora regularis* D'Orbigny, 1853.)

The young zoaria are berenicoid, like the one we have figured. Waters discovered the ovicell and has sent us a drawing, which we reproduce. The ovicell is an ovoid capsule with limited outlines, interrupting the fascicles. It belongs to the group of the Cytisidae, although somewhat smaller.

This species has been chosen as the type of the genus *Actinopora* D'Orbigny, 1853, by Gregory, 1909. The fascicles are multiserial. Canu, 1917, discovered the ovicell of *Actinopora complanata* Roemer, 1840 (= *organisans* D'Orbigny, 1851). It is of the type *Plagioecia*. The fascicles are uniserial.

Under these circumstances it is necessary, then, to maintain in the Cytisidae (or Theonoidae) the multiserial species (genus *Actinopora*) and in the Plagioeciidae the uniserial species (genus *Discotubigera*).

We still maintain the genus *Desmeplagoecia*, as it is not certain that all of the *Discotubigera* have the same ovicell.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix and Villers-le-Lac, Switzerland.

Plesiotype.—Cat. No. 69906, U.S.N.M.

Genus MULTITUBIGERA D'Orbigny, 1853

1853. *Multitubigera* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 767.

Theonoidae with a compound zoarium composed of many confluent *Actinopora*.

Genotype.—*Multitubigera gregaria* D'Orbigny, 1850. Cretaceous.

MULTITUBIGERA CAMPICHEANA D'Orbigny, 1853

Plate 6, figs. 4-8

1853. *Multitubigera campicheana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 768, pl. 763, figs. 10-13.

The ovicell is a small ovoid capsule with definite outlines, interrupting an intermediate fascicle between two other complete ones. It is analogous to that of *Actinopora stellata* Koch and Dunker, 1837; it belongs to the group of the Cytisidae, although a little smaller. The zoaria of this genus are formed of confluent *Actinopora*.

The general form is quite variable. Very often the zoarium is flabelliform and formed of two incomplete subcolonies united by their dorsal. Again the zoarium remains flabelliform and formed of three disks of *Actinopora*. Finally, the zoarium may form an irregular mass measuring as much as 3 centimeters in diameter and containing as many as eight confluent subcolonies. In all these cases the base is an edge more or less thin which does not permit one to

understand the mode of attachment and how the colony is able to retain its equilibrium. The tubes are cylindrical, with dorsal gemination. The fascicles are bi- or triserial. The ovicell is always placed on an exterior flabelliform subcolony in the neighborhood of the margin of growth. The zoarial pentagons figured by D'Orbigny are exaggerated; in reality the central subcolonies are irregularly orbicular.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotypes.—Cat. No. 69907, U.S.N.M.

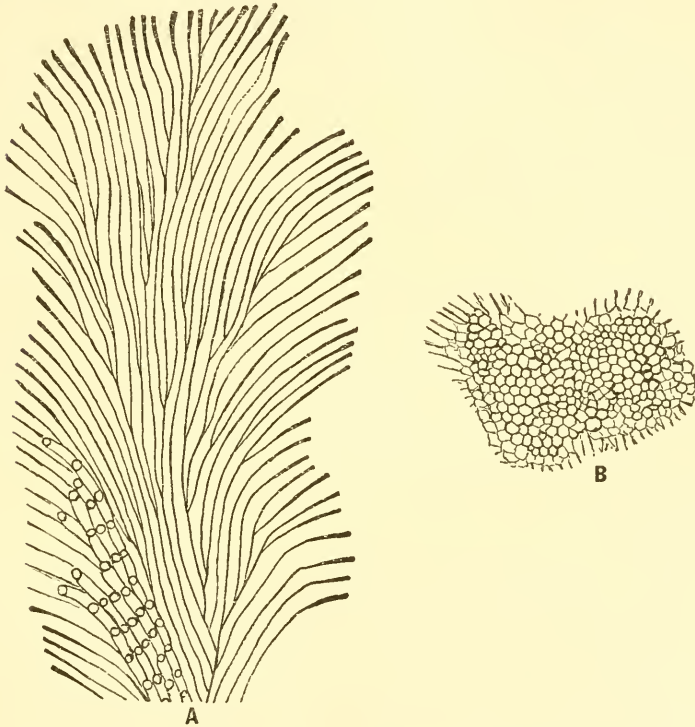


FIG. 29.—*Radiofascigera ramosa* D'Orbigny, 1853. A. Longitudinal section, $\times 16$. The tubes are thickened at their extremity. B. Transverse section, $\times 16$. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Genus RADIOFASCIGERA D'Orbigny, 1853

1853. *Radiofascigera* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol 5, p. 691.

Theonoidae of subcylindrical branches formed of numerous confluent colonies of *Actinopora*.

Genotype.—*Radiofascigera ramosa* D'Orbigny, 1853. Cretaceous.

RADIOFASCIGERA RAMOSA D'Orbigny, 1853

Plate 6, fig. 10

1853. *Radiofascigera ramosa* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 682, pl. 783, figs. 17-19.

The ovicell is a small capsule with limited outlines, absolutely analogous in form and position with that of *Actinopora* and *Multitubigera*. It belongs, therefore, in the group Cytisidae but the dimensions are smaller. The oeciostome, rarely visible, seems to be a very minute perforation more or less terminal.

According to D'Orbigny, the zoarium is formed of subcolonies of *Actinopora* grouped in cylindrical branches. In reality the colonies are more often claviform and never branched. The subcolonies are rarely orbicular, but are generally incomplete and flabelliform (*Pavotubigera*).

In transverse sections the tubes are polygonal, with adjacent walls. In longitudinal sections the tubes are cylindrical, with dorsal gemmation. It is difficult to decipher the subcolonies exteriorly visible.

D'Orbigny's figures are clearly diagrammatic. The zoaria are very irregular and become almost massive when they become greatly enlarged at their extremity. The multiserial fascicles are a great deal shorter than in *Actinopora stellata* Koch and Dunker, 1847, and *Multitubigera campicheana* D'Orbigny, 1853. For these various reasons we believe that the genus *Radiofascigera* D'Orbigny, 1853, can be maintained at least provisionally.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotypes.—Cat. No. 69908, U.S.N.M.

Genus MULTIFASCIGERA D'Orbigny, 1853

1853. *Multifascigera* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 687.

Theonoidae composed of superposed lamellae, each formed of subcolonies in the *Actinopora* and *Lopholepis* growth stages.

Genotype.—*Multifascigera campicheana* D'Orbigny, 1853. Cretaceous.

MULTIFASCIGERA CAMPICHEANA D'Orbigny, 1853

Plate 6, fig. 9

1853. *Multifascigera campicheana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 688, pl. 762, figs. 7, 9.

This species is very remarkable in its structure and the size that it attains—6 centimeters in diameter. The zoarium is formed of

superposed lamellae. Each lamella is supported on the fascicles of the inferior lamella, serving as pillars; it is formed of distinct subcolonies in the form of *Actinopora* or of *Lopholepis*, intimately joined together. Each of the subcolonies has a distinct origin and arises from a tube of a fascicle of the inferior lamella.

The section figured by D'Orbigny is incomplete, for it does not cut the basal portion of a subcolony and therefore does not show exactly the formation of the zoarium. A section properly made shows that the tubes are cylindrical, with dorsal gemmation, vertically elevated.

The fascicles are irregular, ovoid, rather short, irregularly multiserial. The specimen which we figure shows at the right a subcolony in the form of *Actinopora* and at the left a subcolony in the form of *Lopholepis*. The spaces between the fascicles are smooth. We have not been able to discover the ovicell.

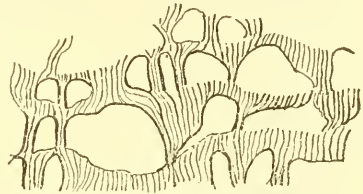


FIG. 30.—*Multifascigera campicheana* D'Orbigny, 1853. Transverse section, $\times 4$, showing the origin of a superior subcolony. Lower Cretaceous (Valangian); Sainte-Croix, Switzerland

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotypes.—Cat. No. 69909, U.S.N.M.

Subdivision RECTANGULATA Waters, 1887

Family LICHENOPORIDAE Smitt, 1866

MULTIGALEA, new genus

The ovicell is elongate, star-shaped, with many branches; the branches are separated by uni- or biserial groups of zoecia. The tubes have an exterior, triangular, very fragile visor (=galea). The tubes are cylindrical, with dorsal gemmation, elevated in their superior half. The zoarium is composed of orbicular subcolonies irregularly superposed. The cancelli are small and denticulated in the interior.

Genotype.—*Multigalea (Reptomulticava) canui* Gregory, 1909. This new genus differs from *Radiopora* D'Orbigny, 1849, in the presence of ovicells and in the occurrences of visors on the tubes.

MULTIGALEA CANUI Gregory, 1909

Plate 19, figs. 1-6

1854. *Reptomulticava tuberosa* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 1036, pl. 791, figs. 13, 14.

1909. *Reptomulticava canui* GREGORY, Catalogue of the Cretaceous, Bryozoa in the British Museum, vol 2, p. 128. (Bibliography.)

Structure.—The zoarial aspect is that shown in D'Orbigny's figure. The subcolonies are superposed and joined to each other by tubes of greater diameter. In each of them the tubes are arranged in quincunx. The visor is salient and triangular. The visors are very fragile; they disappear at the least weathering; then the tubes and cancelli are indistinguishable and appear as polygonal tubes with thickened walls of an aspect very similar to that of D'Orbigny's figure (14).

The ovicells are visible only in the protected parts of the zoarium. They have the usual aspect of the ovicells in the Lichenoporidae, but a remarkable phenomenon is that the tubes between which they are arranged are grouped in radial uni- or biserial lines and that on the zoarial surfaces the tubes are arranged in quincunx and never in lines or in fascicles with adjacent tubes.

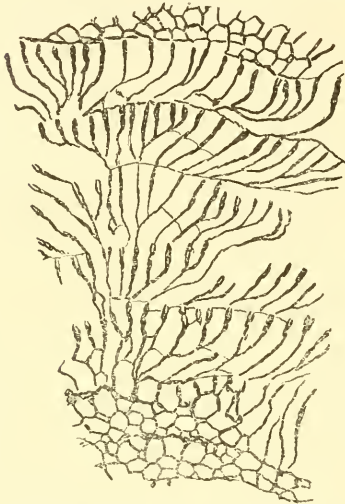


FIG. 31.—*Multigalea canui* Gregory, 1909. Longitudinal section, $\times 16$. Lower Cretaceous (Aptian): Faringdon, England

In longitudinal sections the tubes are cylindrical, with dorsal gemmation; the cancelli are ramifications of more or less length and of a diameter almost equal to that of the tubes. The interior spines of the cancelli, although visible exteriorly, are very fragile and disappear in sections.

The subcolonies are little distinct in small zoaria.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Plesiotypes.—Cat. No. 69910, U.S.N.M.

MULTIGALEA MARGINATA, new species

Plate 19, figs. 7-10

Description.—The zoarium is large, cylindrical, borne upon an expanded base. The subcolonies are orbicular, convex, bordered by a smooth lamella of more or less width. The tubes are polygonal, arranged in irregular quincunx, provided superiorly with a short and fragile visor. The cancelli are little distinct from the tubes.

Affinities.—This species differs from *Multigalea canui* Gregory, 1909, in its tubular walls little thickened and in the presence of smooth margins around the subcolonies.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69911, U.S.N.M.

Genus *THOLOPORA* Gregory, 1909*THOLOPORA VIRGULOSA* Gregory, 1909

Plate 20, fig. 1

1909. *Tholopora virgulosa* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2, p. 277. (Bibliography, geologic distribution.)

Our fine specimen corresponds very well to the figures of Goldfuss, 1829, and of Simonowitsch, 1871. It differs from the isolated colonies of *Tholopora colligata* Gregory, 1909, in the smaller diameter of its aperture (0.12 mm. and not 0.20 mm.).

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Plesiotype.—Cat. No. 69912, U.S.N.M.

Genus *RADIOPORA* D'Orbigny, 1849*RADIOPORA TUBERCULATA* D'Orbigny, 1850

Plate 20, figs. 2-5

1909. *Radiopora tuberculata* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2 p. 288, pl. 4, fig. 8. (Bibliography, geologic distribution.)

Diameter of the orifices, 0.16-0.20 mm.

This species is well characterized by the large size of its aperture. The zoarium is formed of many superposed lamellae of orbicular subcolonies. The study of the inferior face is interesting; it shows that the larva fixes itself on a grain of quartz and that the basal gemmation operates fan-shaped fashion as in *Berenicea*.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Plesiotype.—Cat. No. 69913, U.S.N.M.

Family *LOBOSOECIIDAE* Canu and Bassler, 1922Genus *LOBOSOEZIA* Canu and Bassler, 1922*LOBOSOEZIA SEMICLAUSA* Michelin, 1845

Plate 14, figs. 12-13

1922. *Lobosoezia semiclausa* CANU and BASSLER, Studies on the Cyclostomatous Bryozoa, Proceedings U. S. National Museum, vol. 61, p. 81, pl. 12, figs. 4-11. (Bibliography.)

Measurements.—

Aperture	{	ha = 0.08 mm.	}	Facettes	{	hf = 0.24 (max. 0.30) mm.
		la = 0.09 mm.				lf = 0.20 (max. 0.30) mm.

Diameter of branches, 1 mm. Our specimen from Faringdon shows facettes a little longer than 0.32 by 0.20 mm. If it belongs to this species it should possibly be considered as a variety.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (very rare).

Plesiotype.—Cat. No. 69914, U.S.N.M.

53648-26-5



FIG. 32.—*Lobosoezia semiclausa* Michelin, 1845. A. Transverse section, $\times 16$. B. Longitudinal section, $\times 16$, at the extremity of a branch. The tubes are widened and have dorsal gemmation. Cretaceous: Lemans, France

Family ELEIDAE D'Orbigny, 1852

Genus MELICERITITES Roemer, 1840

MELICERITITES HAIMEANA D'Orbigny, 1853

Plate 13, figs. 18-20

1853. *Entalophora haimeana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, pl. 617, figs. 11-14.

1853. *Meliceritites haimeana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 618.

1889. *Meliceritites haimeana* PERGENS, Revision des Bryozoaires du Crétacé figures par D'ORBIGNY, Memoires Société Belgé de Geologie, etc., vol. 3, p. 399.

Pergens, 1889, notes that the specimens in the Museum of Paris seem worn. This is in effect the habitual aspect of this species and such specimens are in reality normal. Those which we have found at Faringdon correspond very well with D'Orbigny's figure and description. The facettes are separated by furrows and not by salient threads. Certain specimens seem to be multilamellar.

Measurements.—

$$\text{Aperture} \left\{ \begin{array}{l} \text{ha} = 0.06 \text{ mm.} \\ \text{la} = 0.08 \text{ mm.} \end{array} \right\} \text{Facettes} \left\{ \begin{array}{l} \text{hf} = 0.30 \text{ mm.} \\ \text{lf} = 0.16 \text{ mm.} \end{array} \right.$$

Diameter of branches, 1.20 mm.

Occurrence.—Lower Cretaceous. Albian, Grandpré (Ardennes), France; Aptian, Faringdon, England (very common).

Plesiotypes.—Cat. No. 69915, U.S.N.M.

MELICERITITES TRANSVERSA, new species

Plate 12, figs. 1-12

Description.—The zoarium is free, cylindrical, ramified, borne on a little expanded base, formed of many superposed lamellae. On the central zoarium the peristomes are salient, adjacent laterally, and arranged in close transverse rows; the facettes are quite short and separated by very short threads. The aperture is triangular, somewhat transverse. The ovicell is very short, *transverse*, occupying all the zoarial width, quite convex, smooth; the oeciostome is a little salient tube. On the exterior lamellae the peristomes are arranged in quincunx; on the basal lamella they are little salient and almost orbicular.

Measurements.—

$$\text{Aperture} \left\{ \begin{array}{l} \text{ha} = 0.08 \text{ mm.} \\ \text{la} = 0.10 \text{ mm.} \end{array} \right\} \text{Facettes} \left\{ \begin{array}{l} \text{hf} = 0.20-0.26 \text{ mm.} \\ \text{lf} = 0.16 \text{ mm.} \end{array} \right.$$

Diameter of zoaria at the extremity, 1.5 mm.; diameter of zoaria at the base, 2.1 mm.; length of ovicell, 0.64 mm.

Variations.—When the peristomes are very salient the facettes are little visible (figs. 2, 3). On the same branch the peristomes may

be salient or not (fig. 4), in transverse regular rows (fig. 4), irregular (fig. 5), or oblique (fig. 6). On the exterior lamellae the peristomes are arranged in quincunx (figs. 7, 8). The facettes are visible only on the specimens with little salient peristomes (figs. 4, 7). On the basal lamellae the peristomes are little salient and almost orbicular (fig. 10). The incrusting exterior lamellae are enveloping subcolonies of reinforcement.

The longitudinal section shows a central bundle of very long cylindrical tubes emitting laterally by dorsal gemmation, short tubes narrowed at the base but much expanded in their recurved terminal part.

In transverse section the central bundle is formed by several large tubes around which are smaller tubes representing the base of the tubes with facettes.

The opercula are very rare. We have observed some cases of regeneration.

Affinities.—This species resembles greatly *Meliceritites foricula* D'Orbigny, 1853, of the French Turonian. It differs in the transverse aperture and in the transverse and not elongated ovicell.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (very common).

Cotypes.—Cat. No. 69916, U.S.N.M.

MELICERITITES CUNNINGTONI Gregory, 1899

Plate 13, figs. 1-8

1899. *Nodelea cunningtoni* GREGORY, Catalogue of Cretaceous Bryozoa in the British Museum, vol. 1, p. 308, figs. 35, 36.

Variations.—Gregory, 1899, gave an incomplete description of this species. The orifices are transverse; the peristomes are thin, adja-

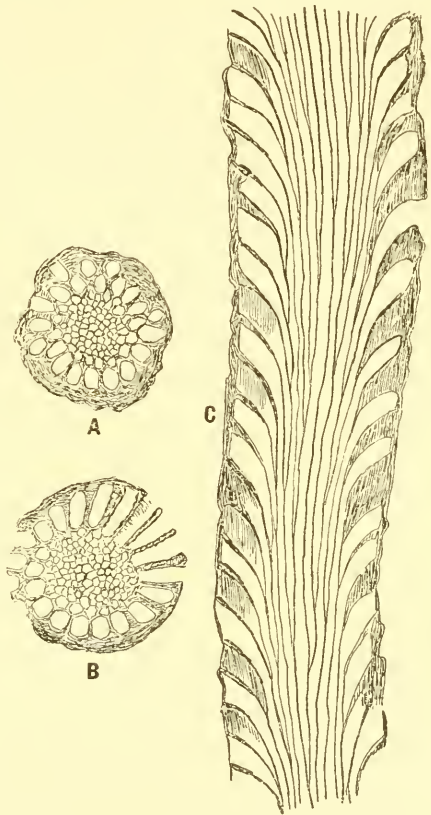


FIG. 33.—*Meliceritites transversa*, new species. A. Transverse section, $\times 16$, made between the orifices. The peristomes were in transverse somewhat oblique rows which causes the helicoidal arrangement of the peripheral tubes. B. Transverse section, $\times 16$, cutting some orifices. C. Longitudinal section, $\times 16$. The clear tubes are cut along the median axis while the shaded ones are cut tangentially to their walls, this arrangement resulting from the disposition of the peristomes in transverse rows. At the center is a long tube which may branch. Lower Cretaceous (Aptian): Faringdon, England

cent, arranged in transverse rows (fig. 2) and more rarely in quincunx (fig. 6). Opercula are frequent (fig. 2).

The eleocellaria are ordinary zooecia in which the aperture is elongated and presents two lateral denticles (fig. 4).

The chief characteristic of this species is the frequent presence of a transverse fossette placed below the aperture (fig. 5). The fusion of this fossette with the aperture engenders the eleocellarium (fig. 4). The longitudinal section of this species has been figured by Gregory, 1899. The ovicell is unknown. Figure 7 represents an arrest of development, resulting in a false base.

Measurements.—

Aperture $\left\{ \begin{array}{l} \text{ha} = 0.16-0.18 \text{ mm.} \\ \text{la} = 0.20 \text{ mm.} \end{array} \right\}$ Facettes $\left\{ \begin{array}{l} \text{hf} = 0.44 \text{ mm.} \\ \text{lf} = 0.44 \text{ mm.} \end{array} \right.$

Diameter of the branches, 3 mm.

Affinities.—This species is very well characterized by the nature of its eleocellaria and by the transverse fossettes which adorn a certain number of zooecia.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Plesiotype.—Cat. No. 69917, U.S.N.M.

MELICERITITES SEMICLAUSA Gregory, 1899

Plate 11, figs. 12, 13

1872. *Meliceritites gracilis* REUSS, Die Bryozoen und Foraminiferen des unteren Planers, Paleontographica, vol. 20, pt. 1, p. 120, pl. 29, figs. 12-16 (not synonymy).

1899. *Meliceritites semiclausa* (part) GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 328, pl. 14, fig. 2 (not figs. 1, 3).

Affinities.—Our examples correspond almost exactly in aspect and measurements with the specimen figured by Gregory (pl. 14, fig. 2), the single slight difference being in the more elongate form of the eleocellarium.

The ovicell belongs to the group of *Meliceritites transversa* in its great width. Unfortunately, the ovicell of our figured specimen was broken.

The species differs from *Lobosocia semiclausa* Michelin, 1845, in its much larger micrometric measurements, in the presence of an eleocellarium, and in its semicircular aperture.

Measurements.—

Aperture $\left\{ \begin{array}{l} \text{ha} = ? \\ \text{la} = 0.12-0.16 \text{ mm.} \end{array} \right\}$ Facettes $\left\{ \begin{array}{l} \text{hf} = 0.40-0.48 \text{ mm.} \\ \text{lf} = 0.27-0.30 \text{ mm.} \end{array} \right.$

Diameter of large branches, 2 mm.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Geological distribution.—Lower Cretaceous (Cenomanian): Le Mans (Sarthe), France, Warminster, England, and Plauen, Germany.
Plesiotype.—Cat. No. 69918, U.S.N.M.

MELICERITITES, species undetermined

Plate 12, figs. 13–15

We have found two very curious specimens of *Meliceritites*, one with all the facettes perforated and the other with some of them perforated. These perforations are enigmatical. We believe the specimen worthy of illustration, but we are unable to affirm that they belong to a special species until a larger number of examples has been collected.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.
 Cat. No. 69919, U.S.N.M.

Subdivision RECTANGULATA

Family CERIOCAVIDAE Canu and Bassler, 1922

Genus CERIOCAVA D'Orbigny, 1852

(See Canu and Bassler, 1922, for definition)

CERIOCAVA GRANDIPORA, new species

Plate 9, figs. 14–17

Description.—The zoarium is free, arborescent, formed of cylindrical or compressed branches; the base is quite small, orbicular, non-adherent to the substratum. The orifices are *large*, polygonal, arranged in quincunx or in transverse rows. The ovicell is capsule-shaped, deep, digitate, with an exterior concave and smooth surface.

Measurements.—Diameter of orifice, 0.32–0.40 mm.; diameter of large branches, 4 mm.

Affinities.—This species is well characterized by the large size of its orifices and by its digitate ovicell. In the Jurassic species the ovicells are entire and nondigitate.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (very rare).

Cotypes.—Cat. No. 69920, U.S.N.M.

CERIOCAVA JUNCTATA, new species

Plate 9, figs. 11–13

Description.—The zoarium is hollow, cylindrical, formed of fragments irregularly *joined* together or anastomosing; the branches are solid, with the normal section. The orifices are elliptical, placed at the bottom of a polygonal peristome; they are arranged in quincunx.

Measurements.—Diameter of interior orifice, 0.16 by 0.20 mm.; diameter of exterior orifice, 0.22 mm.; diameter of branches, 2.5 mm.

Structure.—The basal parts of the zoarium have the *Semicava* growth of D'Orbigny, but the branches which they emit are solid and their sections are identical with those of *Ceriocava*.

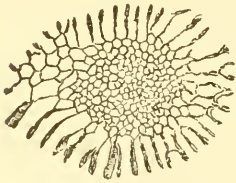


FIG. 34.—*Ceriocava junctata*, new species. Transverse section, $\times 16$, through a solid cylindrical branch. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

It is difficult to predict the direction of the tubes in an incrusting colony in order to section it correctly.

In tangential section it may be noted that the tubes are polygonal, adjacent, but their interior is calcified and thus forms a rounded interior tube.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (rare).

Cotypes.—Cat. No. 69921, U.S.N.M.

CERIOCAVA MULTILAMELLOSA, new species

Plate 9, figs. 1-10

Description.—The zoarium is free, cylindrical, dichotomous, formed of many enveloping lamellae; the outermost lamellae are incomplete and show at their extremity a short zone of growth. The facettes are hexagonal, arranged in transverse rows, perforated at the center by the aperture. The aperture is orbicular and surrounded by a thin and somewhat salient peristome. The orifices of the tubes without facettes are irregularly polygonal.

Measurements.—Diameter of apertures, 0.08 mm.; diameter of peristomes, 0.10 mm.; diameter of facettes, 0.16 mm.; diameter of larger branches, 2.5 mm.

Structure.—The extremity of the branches is conical, as in all colonies in which the tubes are expanded. This conical part is considered as the zone of growth and the orifices here do not bear facettes (fig. 3).

The exterior lamellae grow around the interior trunk and appear around it as a rather thick but short zone of growth (fig. 2); these lamellae bear facettes like the central trunk.

The facettes are often well distributed over all the colony (figs. 2, 3), but frequently they appear only in zones (fig. 5). We can not affirm that their existence is normal, for entire branches are deprived of them and seem even never to have had them (fig. 9). The appearance of facettes in the genus *Ceriocava* still remains a mystery. Perhaps they are very fragile, as in *Meliceritites*, and disappear easily by slight abrasion.

The longitudinal section of the extremity of a young branch shows the disappearance of the central bundles of tubes, the latter expanding in fan-shape around the zoarial axis. A longitudinal section made through a branch with facettes was not very successful, as silicification had invaded the tubes of the exterior lamella. The peristomes were arranged in quincunx and the tube appeared with thickened walls without any of them having been sectioned tangentially. In transverse section the central bundle is quite apparent.

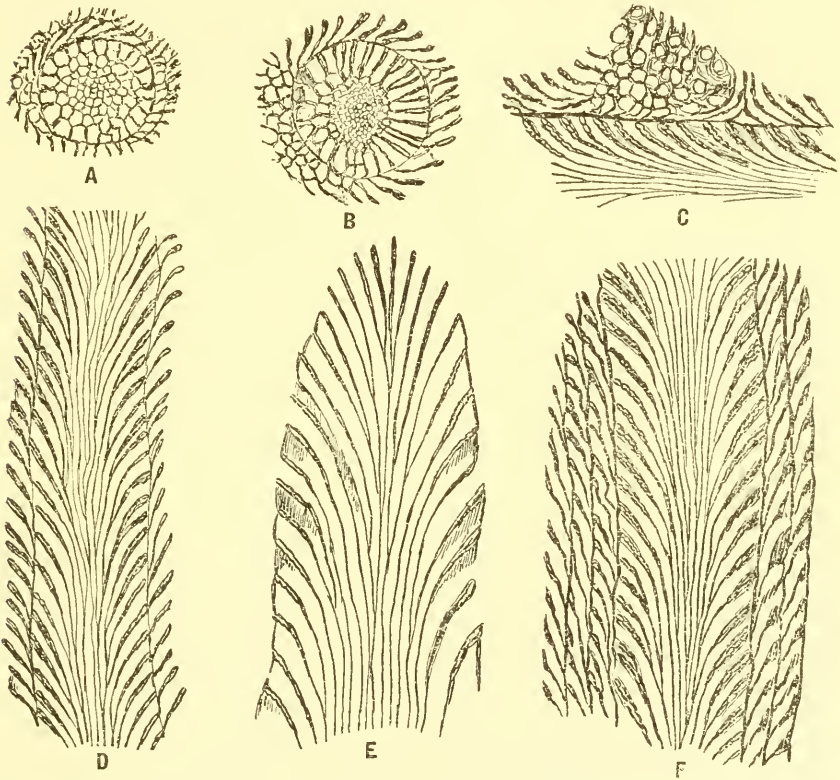


FIG. 35.—*Ceriacava multilamellosa*, new species. A. Transverse section of specimen D, $\times 16$. B. Transverse section, $\times 16$. C. Section through a branch, $\times 16$, in which the exterior lamella is engendering an adventitious branch. D. Longitudinal section (see also A), $\times 16$, in which the orifices are arranged in quincunx. E. Longitudinal section, $\times 16$, at the extremity of a branch. F. Longitudinal section, $\times 16$, through a multilamellar branch. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

We have had the fortune to find a branch containing these supposed lamellae with their zone of growth. The longitudinal section of this branch shows that the tubes are arranged in a different direction from that of the interior lamella; their extremity is alone visible and they appear there shorter than they are in reality. The study of the transverse section confirms this arrangement.

The exterior lamellae could become elevated to form false ramifications.

The longitudinal section shows a number of tubes cut tangentially and appearing in gray or in black. The facettes were in reality arranged regularly in transverse rows.

In *Ceriocava* the longitudinal section has different aspects according as the facettes are arranged in quincunx or transversely. This observation was known, but it is important that it has been confirmed on the same species.

The central tubes grow by axial gemmation around a single tube which branches only at the bifurcations of the branches. This tube appears in transversal sections with a larger diameter.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69922, U.S.N.M.

CERIOCAVA INGENS, new species

Plate 8, figs. 8–12

Description.—The zoarium is free, *large*, arborescent; the branches are compressed or cylindrical. The facettes are distinct, separated by a furrow of little depth, somewhat convex, smooth, arranged in quincunx, pierced at the middle by the aperture. The aperture is orbicular and surrounded by a thin, little salient peristome. The orifices of the tubes without facettes are large and irregularly polygonal.

Measurements.—Diameter of aperture, 0.14 mm.; diameter of peristome, 0.17 mm.; diameter of facettes, 0.30–0.40 mm.; diameter of orifices without facettes, 0.20 mm.; diameter of zoarium, 10 mm.

Affinities.—As in all species of the genus, the orifice of the tubes without facettes is expanded; it measures internally at the base of the visible peristomie 0.17 mm., but externally its diameter is about 0.40 mm., exactly equal to that of the tubes with facettes.

The species differs from *Diplocava inordinata* in its monomorphic zooecia, its large zoarium, and its much larger micrometric measurements. On the figured specimen the tubes with facettes are at the bottom of the zoarium; the branches are deprived of them.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (very rare).

Cotype.—Cat. No. 69923, U.S.N.M.

CERIOCAVA TENUIRAMA, new species

Plate 10, figs. 1–4

Description.—The zoarium is free, cylindrical, bifurcated, formed of *small branches*. The orifices of the tubes without facettes are lozenge-shaped, elongated, arranged in transverse rows. The orifices

of the tubes with facettes are terminal, orbicular, with a peristome thin and little salient; the facettes are elongated, hexagonal, little distinct.

Measurements.—Diameter of peristomes, 0.14–0.16 mm.; diameter of orbicular orifices, 0.10 mm.; diameter of lozenge-shaped orifices, 0.06–0.08 mm.; diameter of branches, 1 mm.

Affinities.—This new species differs from *Ceriocava multilamellosa* in its smaller branches, in the lozenge-shaped tubes without facettes, and in the terminal position of the orifices on the facettes.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69924, U.S.N.M.

DIPLOCAVA, new genus

Ceriocavidae with dimorphic zooecia.

Genotype.—*Diplocava incondita*, new species. Lower Cretaceous (Neocomian). In this genus tubes without facettes and much larger dimensions appear. They are most frequently in more or less orbicular and salient groups; rarely they are scattered. They are not constant, and it is not rare to discover zoarial fragments which lack them. The determination of species of this genus is therefore very difficult, especially on isolated specimens. The ovicell has not yet been discovered.

DIPLOCAVA INCONDITA, new species

Plate 10, figs. 5–12

Description.—The zoarium is free, dichotomous, in unilamellar fronds or in *irregularly* cylindrical, multilamellar fragments. The large zooecia are always open, grouped in salient orbicular areas which are separated from each other by zones of small zooecia with facettes. The facettes are hexagonal, distinct, separated by a furrow, convex, smooth, perforated in the middle. The apertura is large, orbicular, surrounded by a thin and salient peristome. The ovicell is star-shaped, with four branches, placed in the midst of the large tubes.

Measurements.—Diameter of aperture, 0.14 mm.; diameter of peristome, 0.20 mm.; diameter of facettes, 0.30 mm.; diameter of external orifice of large tubes, 0.30 mm.; diameter of external orifice of small tubes, 0.20 mm.; diameter of the large branches, 5 mm.

Variations.—This species is very irregular in its external aspect. We have observed some lamellar fragments simple or double with monomorphic zooecia, arborescent fragments formed of small tubes only, fragments formed of tubes with facettes only, irregular fragments formed of an inner trunk of zooecia with facettes, covered

over with irregular lamellae with open dimorphic zooecia. The normal aspect is that which shows salient groups of large zooecia surrounded by variable zones of small zooecia with facettes; these zones may become very large.

A longitudinal section taken at the extremity of a large branch shows the tubes expanded and recurved at their extremity, with axial gemmation around a large central ramified tube. The small tubes are grouped in special zones. The walls of the tubes are moniliform in their recurved parts.

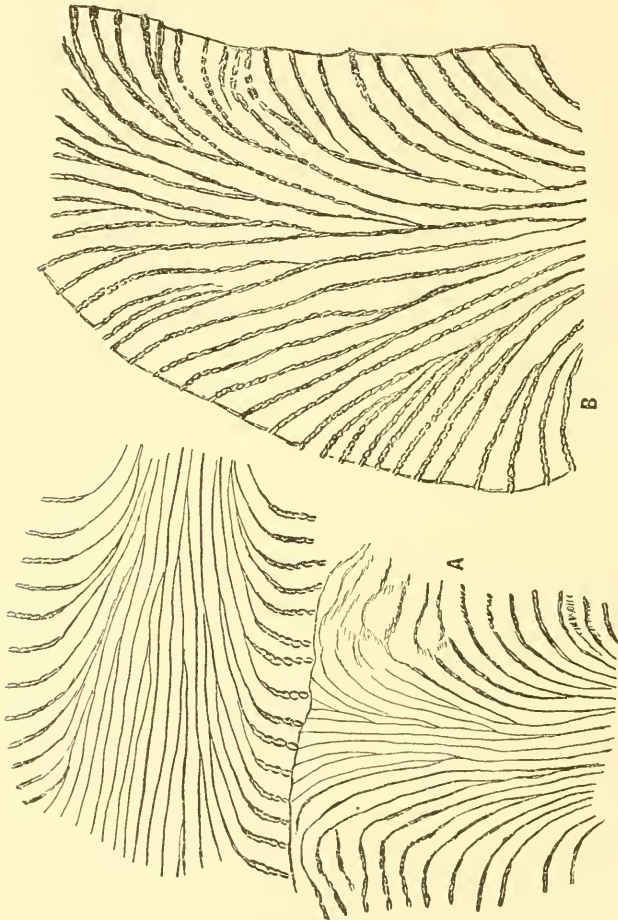


FIG. 36.—*Diplocava incondita*, new species. A. Longitudinal section, $\times 16$, through a specimen with two joined branches. B. Longitudinal section, $\times 16$, through the extremity of a branch in which the tubes have facettes. The walls are hollow and moniliform. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

A fragment which exteriorly appeared regularly branched showed in longitudinal section the union of two fragments of different origin.

Finally, a meridian section in a large irregular zoarium shows an extreme complication occasioned by the multiplicity of the enveloping lamellae.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland (common.)

Cotypes.—Cat. No. 69925, U.S.N.M.

DIPLOCAVA INORDINATA, new species

Plate 11, figs. 1-5

Description.—The zoarium is free, cylindrical, arborescent; the base is enlarged and placed on a substratum. The large tubes appear very irregularly among the others, sometimes isolated, sometimes grouped. The facettes are hexagonal, little visible, smooth, very little convex, perforated at the middle by the aperture. The aperture is orbicular, large or small, according to the nature of the tubes, surrounded by a peristome which is scarcely salient and very thin. The orifices of the tubes without facettes are polygonal.

Measurements.—Inner orifice of small tubes, 0.16 mm.; diameter exterior orifice of small tubes, 0.20 mm.; diameter inner orifice of large tubes, 0.20-0.24 mm.; diameter exterior orifice of large tubes, 0.30 mm.; diameter aperture, small tubes with facettes, 0.10 mm.; diameter aperture, large tubes with facettes, 0.14 mm.; diameter of the large branches, 3 mm.

Variations.—As our specimens are numerous, we have been able to study the variations. We have observed zoarial fragments formed uniquely of large (fig. 3) or small (fig. 2) zooecia, fragments with both kinds of zooecia (fig. 4), and finally a fragment with tubes bearing facettes (fig. 5).

In longitudinal sections the tubes have a diameter quite variable in their recurved expanded parts.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (common).

Cotypes.—Cat. No. 69926, U.S.N.M.

DIPLOCAVA ORBICULIFERA, new species

Plate 11, figs. 6-8

Description.—The zoarium is free, cylindrical, ramose. The large tubes are grouped in very regular *orbicular* areas irregularly arranged on the zoarium. The small tubes are much more numerous, hexagonal, arranged in quincunx.

Measurements.—Diameter orifice of small tubes, 0.10 mm.; diameter of large tubes, 0.20 mm.; diameter of zoarium, 10 mm.

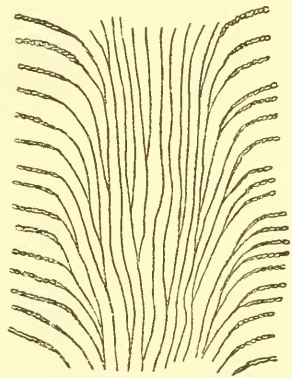


FIG. 37.—*Diplocava inordinata*, new species. Longitudinal section, $\times 16$, exhibiting the variations in diameter of the tubes at their extremity. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Affinities.—This species differs from *Diplocava incondita* in its larger zoarium, in the smaller measurements, and in the considerable separation of the groups of large tubes. It differs from *Diplocava globulosa* in its arborescent zoarium and in the separation of the groups of larger tubes.

The sections show the usual structure of *Diplocava*. They indicate that the central colony may be covered over by an exterior incrusting lamella.

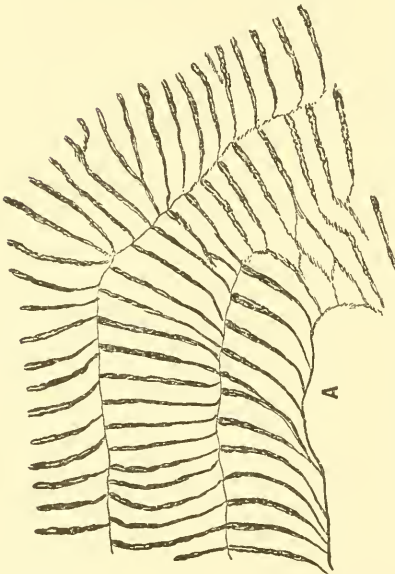
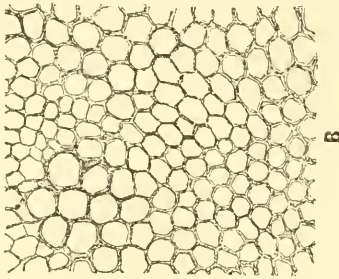


FIG. 38.—*Diplocava globulosa*, new species. A. Meridian section, $\times 16$, showing the many enveloping lamellae. B. Tangential thin section, $\times 16$. Dimorphism occurs. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (very rare).

Cotype.—Cat. No. 69927, U.S.N.M.

DIPLOCAVA GLOBULOSA, new species

Plate 11, figs. 9–11

Description.—The zoarium is a globular multilamellar mass; it is free or incrusts shells (*Semimulticava*). The large cells are grouped in orbicular spaces which are somewhat convex. The small zoecia form zones of more or less width around each group of large orifices.

Measurements.—Diameter interior of large tubes, 0.16 mm.; diameter interior of small tubes, 0.10 mm.; diameter of zoarium, 10 mm.

Structure.—In sectioning the elliptical zoarium along the large axis one would expect to cut the zoecia along their length, but this does

not happen, as the section cuts only the expanded extremity of the tubes. In this genus the direction of the tubes is absolutely independent of the zoarial form and the direction can only be surmised from the exterior. As may be readily observed, the large tubes occur only in the convex portions, while the small tubes are limited to the concave portions; the difference between them is of little importance.

In tangential section the tubes are rounded and included in the thick hexagonal walls. The difference in size between the large and

the small tubes is quite considerable. According to these two latter observations, it might be concluded that the dimorphism observed in *Diplocava* is more apparent than real and that it occurs only at the terminal part of the tubes.

Affinities.—This species differs from *Diplocava incondita* in its non-arborescent zoarium, its smaller micrometric dimensions, and in its less apparent dimorphism.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland (very rare).

Cotype.—Cat. No. 69928, U.S.N.M.

Genus SPIROCLAUSA D'Orbigny, 1852

SPIROCLAUSA NEOCOMIENSIS De Loriol, 1863

Plate 11, fig. 14

1863. *Spiroclausa neocomiensis* DE LORIOI, Les Invertébrés du Neocomien inférieur du Mont Salève pres Genève, p. 137, pl. 17, fig. 5.

Our figured specimen does not much resemble that of De Loriol, but not being able to make sections, we do not believe we ought to create a new species for it.

Its relationships seem to us to be with the *Diplocava*, for the superior tubes of the spires are much larger than the others. In each spire there is always one or more circles of inclosed zooecia.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix (Vaud), Switzerland.

Plesiotype.—Cat. No. 69929, U.S.N.M.

Family LEIOSOECIIDAE Canu and Bassler, 1920

Genus LEIOSOECIA Canu and Bassler, 1920

LEIOSOECIA AEQUIPOROSA, new species

Plate 16, figs. 15-18

Description.—The zoarium is free, cylindrical. The orifices are suborbicular and slightly polygonal; the peristomes are thick, non-salient, arranged in quincunx. The mesopores are little numerous, irregular, polygonal, equal to the apertures. The ovicell is large, orbicular or somewhat elliptical, thin, very convex.

Measurements.—Diameter of orifices, 0.10 mm.; diameter of mesopores, 0.08-0.10 mm.; diameter of zoarium, 2.5 mm.

Structure.—In longitudinal section the tubes are cylindrical. The mesopores are rare, rather long, with thickened, hollow or moniliform walls.

In transverse section the tubes are polygonal, with adjacent walls. The thickening of the walls of the mesopores forms a thick parietal zone.

In tangential section the mesopores are smaller than the tubes because their orifice is infundibuliform; they are separated by a thick, lamellose tissue.

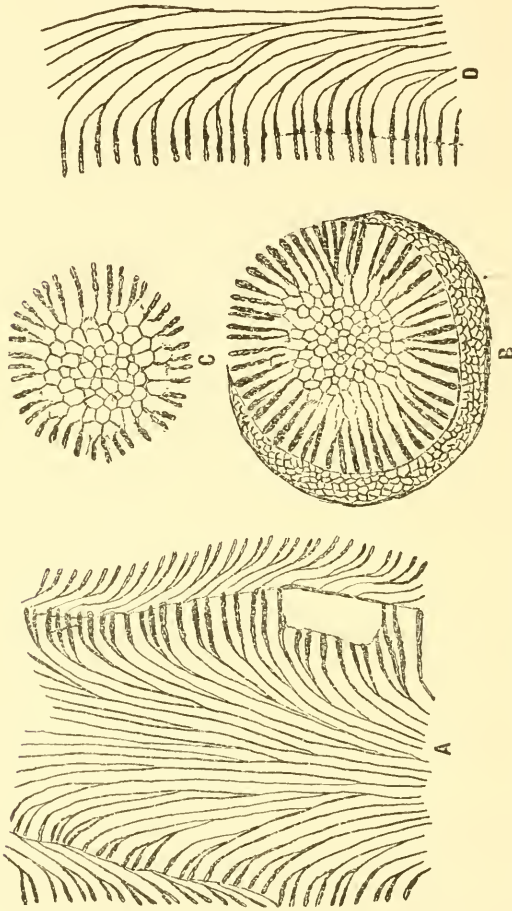


FIG. 39.—Genus *Leiosocia* Canu and Bassler, 1920. A-B. *Leiosocia proxima*, new species. A. Longitudinal section, $\times 16$, through a specimen with an extra lamellar layer. B. Transverse section, $\times 16$, of the same specimen. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland. C. *Leiosocia acquiporosa*, new species. Transverse thin section, $\times 16$. Lower Cretaceous. D. *Leiosocia grandipora*, new species. Longitudinal thin section, $\times 16$, showing the rarity of mesopores. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland.

Affinities.—This species differs from *Leiosocia grandipora*, in which the mesopores have the same dimension, in the smaller zoarium, in the smaller aperture (not 0.12 mm.), and in the less regular ovicell.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland (rare).

Cotype.—Cat. No. 69930, U.S.N.M.

LEIOSOECIA GRANDIPORA, new species

Plate 16, figs. 1-4

Description.—The zoarium is free, cylindrical, bifurcated. The orifices are polygonal; the peristomes are thin, nonsalient. The mesopores are large, polygonal, few in number, irregularly placed. The ovicell is large, orbicular, convex, smooth.

Measurements.—Diameter of aperture, 0.12 mm.; diameter of mesopores, 0.10 mm.; diameter of zoarium, 4 mm.

Structure.—In longitudinal section the tubes are cylindrical, with very thick walls, recurved at their extremity, with axial gemmation. The mesopores have a variable length; they appear at all heights and their distinction from the tubes is very difficult; they appear little numerous.

In transverse section the tubes are polygonal, with adjacent walls, as large at the center as at the periphery. The terminal thickening of the tubes and of the mesopores forms a thick parietal zone.

Affinities.—The species differs from *Leiosoecia aequiporosa* in its apertural diameter of 0.12 mm. and in its larger zoaria.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland (rare).

Cotypes.—Cat. No. 69932, U.S.N.M.

LEIOSOECIA CONSTANTI D'Orbigny, 1850

Plate 17, figs. 1-5

1850. *Ceripora constanti* D'ORBIGNY, Prodrôme de Paléontologie, vol. 2, p. 143.

1854. *Heteropora constanti* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 1071, pl. 799, figs. 6, 7.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of peristome, 0.14 mm.; diameter of mesopores, 0.06 mm.; diameter of terminal branches, 3 mm.; diameter of large branches, 7 mm.

Structure.—We have found very typical specimens corresponding to D'Orbigny's figures. They have, indeed, polygonal orifices surrounded by small mesopores. Moreover, the zoarial surface presents undulations and in places circular areas of mesopores.

Other specimens, less typical in appearance, have the same apertural diameter, the same orbicular area of mesopores, the same characters in longitudinal section, but the zoaria lack the undulations, and the mesopores (0.07, 0.08 mm.) are a little larger.

It is difficult to recognize two species in these specimens. The first lot seems to us to be the terminal branches, the second, moreover, larger, are the large adult branches. On the other hand, on the same specimen it is easy to observe the variations in the size of the mesopores.

In longitudinal sections the tubes are cylindrical, with rather regular peripheral gemmation. The mesopores are rather long and

little numerous. There are zonal lines, rather regular, very convex, scattered in the inferior part of the branches and approaching more closely at the summit. The zoarial margins are occupied by epithelial lines, very numerous, close together, represented in a drawing with difficulty. The diaphragms are widely spaced and their simultaneous occurrence forms the zonal lines. The extremity of the tubes is thickened and moniliform; the tubes are not then rigorously cylindrical but show constrictions more and more close to each other.

In transverse sections the tubes are polygonal, with thin and adjacent walls. On the edge the epithelial lines are so close together

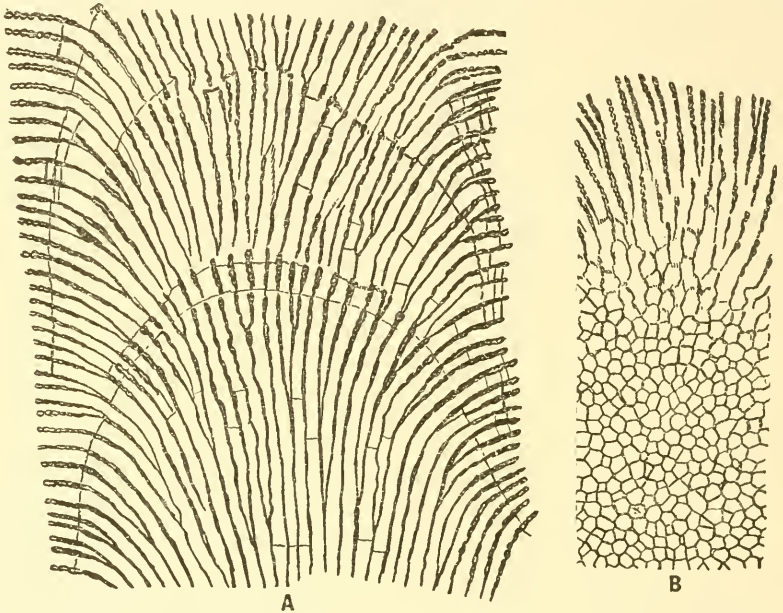


FIG. 40.—*Leiosoecia constanti* D'Orbigny, 1850. A. Longitudinal section, $\times 16$, showing the zonal lines and the undulated tubes with their diaphragms. B. Portion of a transverse section, $\times 16$, illustrating the polygonal form of the tubes. Lower Cretaceous (Valangian): Sainte-Croix, Switzerland

that they form an exterior epithelial zone so opaque that photography can show its complexity only imperfectly.

In tangential section the tubes are little polygonal and the mesopores are very small. The calcareous tissue which surrounds them is alveolar.

This species has the same internal structure as *Leiosoecia multiporosa* and *Leiosoecia grandipora*, but the zonal lines and the epithelial lines are more numerous.

Occurrence.—Lower Cretaceous: Sainte-Croix, Switzerland (Valangian); Grandpré (Ardennes), France (Aptian).

Plesiotypes.—Cat. No. 69933, U.S. N.M

LEIOSOECIA PROXIMA, new species

Plate 17, figs. 12-15

Description.—The zoarium is free, subcylindrical, bifurcated. The orifices are orbicular or subpolygonal, with salient peristomes. The mesopores are polygonal, smaller than the apertures, few in number. The ovicells are orbicular, very convex, smooth.

Measurements.—Diameter of aperture, 0.10-0.12 mm.; diameter of mesopores, 0.08 mm.; diameter of zoarium, 4 mm.

Affinities.—In its exterior aspect this species is *very close* to *Leiosoecia constanti* D'Orbigny, 1854. We believe, however, they are distinct. The zoarium is, in fact, multilamellar, as the longitudinal and transverse sections prove. There are no epithelial lines. Finally, in spite of irregularity of the specimens, the gemmation is peripheral but more axial and the central bundle of tubes is smaller.

Our longitudinal section is very interesting, as it shows the beginning of the exterior lamella. This is a tube which is prolonged on the surface of the primitive trunk which in turn is covered by the proliferation of its successive ramifications by dorsal gemmation. The phenomenon is then absolutely identical with that of lamellate *Reptomulticrescis* forms. It is thus proved that in such zoarial forms as *Heteropora*, *Reptomulticrescis*, and *Reptomulticava* there are two kinds of gemmation, dorsal and peripheral.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland (rare).

Cotypes.—Cat. No. 69931, U.S.N.M.

Family CLAUSIDAE D'Orbigny, 1854

Genus CLAUSA D'Orbigny, 1854

CLAUSA CRANEL, new species

Plate 17, figs. 6, 7

Description.—The zoarium is free, claviform. The peristomes are thin, nonsalient, arranged in interrupted transverse lines, and separated by small numerous, polygonal dactylethrae.

Measurements.—Diameter of orifice, 0.08 mm.; diameter of peristome, 0.10 mm.; diameter of zoarium, 1 mm.

Affinities.—Only the type specimen has been found, and we have figured it not only because of its perfect preservation but in order to show that the genus *Clausa* appears to be well represented in the Lower Cretaceous, where it has hitherto never been noted.

The species differs from *Clausa zonifera*, new species, in its peristomes not grouped in zones and in its smaller orifices. The specific name is in honor of W. E. Crane, who collected the fine bryozoan fauna here described from Faringdon.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (very rare).

Holotype.—Cat. No. 69934, U.S.N.M.

CLAUSA ZONIFERA, new species

Plate 17, figs. 8–11; Plate 31, fig. 9

Description.—The zoarium is free, cylindrical, borne upon a slightly expanded base, branching dichotomously in the same plane; the branches are cylindrical, rarely claviform. The peristomes are very thin, nonsalient, grouped in irregular zones, and separated by polygonal dactylethrae few in number. The tubes are cylindrical, with peripheral gemmation regularly developed around a central axis and at all heights. The ovicell is unknown.

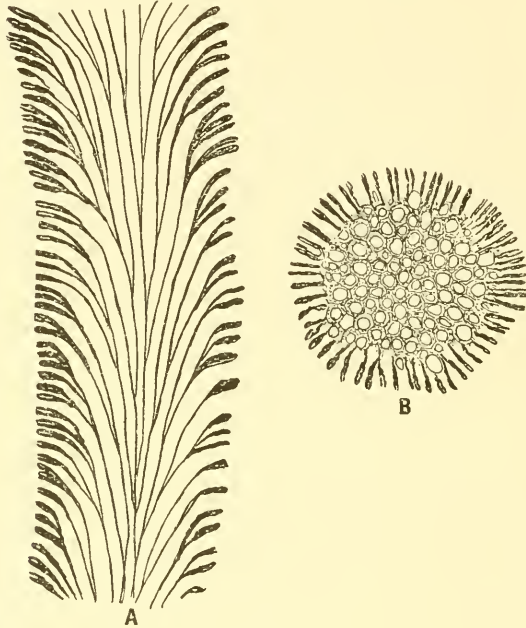


FIG. 41.—*Clausia zonifera*, new species. A. Longitudinal section, $\times 16$. The dactylethrae are produced by dichotomous branching of the walls (peripheral gemmation). B. Transverse section, $\times 16$. The dispersion of the small tubes among the large ones show that gemmation occurs at all distances from the central axis by regular peripheral dichotomous branching. Lower Cretaceous (Aptian): Faringdon, England

Measurements.—Diameter of orifice, 0.12 mm.; diameter of peristome, 0.15 mm.; diameter of large branches, 2.50 mm.

Structure.—Exteriorly this species has the appearance of a *Zonopora*. The grouping of the peristomes in circular zones is a deceptive generic character because it does not always correspond to the same internal structure. It is the same as in the clavulate zoarial form; indeed, in this species we have observed this form, although rarely, and we figure a superb unbranched specimen.

In longitudinal sections the tubes are cylindrical, recurved at their extremity, more or less long according to their distance from the central axis, and narrowed at their base. Their walls divide in two, engendering thus a new tube. This is the usual method of gemmation in the heteroporoids (peripheral). The peripheral tubes are thus

shorter and shorter; a certain number aborted (by the disappearance of the polypide), closed by a calcareous pellicule and become the dactylethrae. An examination of the extremity of a branch also reveals the same heteroporoid structure. This feature has been described by D'Orbigny, 1852, and by Gregory, 1899, who have established the family Clausidae upon it.

In transverse section the tubes are polygonal, with thickened walls, a little larger toward the periphery. Among the large tubes appear smaller tubes irregularly scattered; these are newly formed young tubes whose thin base is thus sectioned. The dactylethrae appear as smaller tubes visible only at the periphery.

In tangential sections the tubes are polygonal, with thick and adjacent walls but in which the interior is rounded. The dactylethrae are smaller and their interior remains polygonal.

Affinities.—This is the only species of the Clausidae in which the peristomes are grouped in circular zones separated by narrower zones of dactylethrae. This simple exterior character is sufficient to distinguish it from other species of the Cretaceous and notably from *Clausa heteropora* D'Orbigny, 1851, very commonly observed in the Cenomanian of Europe, as well as *Clausa cranei*, new species.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Cotypes.—Cat. No. 69935, U.S.N.M.

Genus REPTOCLAUSA D'Orbigny, 1853

1853. *Reptoclausa* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 887.

Based on historic considerations and the right of priority, Gregory in 1897 classified the species of this genus in *Idmonea* Lamouroux, 1821. The zoologists have not yet admitted this classification, which would necessitate a complete rearrangement of the bibliography relative to *Idmonea*. We have nothing to add to this discussion, and while awaiting a decision on the question as to whether *Idmonea* was clearly defined we will continue to follow the principle of least change. We will preserve, therefore, D'Orbigny's name for the curious forms herein described.

The tubes are grouped in idmoneiform fascicles, but the tubes do not have adjacent peristomes. The spaces between the fascicles are of real tubes or aborted. They are ramified on the tubes of the fascicles primitively formed and their coalescence engenders new fascicles. At the exterior they are visible or invisible, according to the thickness of the tissue.

REPTOCLAUSA DENTICULATA, new species

Plate 18, fig. 1

Description.—The zoarium creeps over shells in fronds branching at a right angle. The tubes are arranged on each side of the median crest in transverse rows. There are two tubes in each row; the peristomes are *denticulated* and nonadjacent. All the branches are surrounded by a more or less broad foliaceous expansion formed of aborted tubes.

Measurements.—Diameter of peristomes, 0.16 mm.; maximum diameter of branches, 1 mm.

Affinities.—In its zoarial simplicity this species much resembles *Idmonea alipes* Gregory, 1899, but differs in its denticulate peristomes.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Holotype.—Cat. No. 69936, U.S.N.M.

REPTOCLAUSA HAGENOWI Sharpe, 1854

Plate 18, figs. 2-5

1899. *Idmonea hagenowi* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 152, pl. 8, fig. 1. (Bibliography.)

Structure.—We have been able to make some sections of this species. In transverse section through a fascicle the tubes are rounded, and in the vicinity of the crest they are surrounded by a strong solid epitheca. In longitudinal section the tubes are short, oblique, club-shaped; the crest is a thickened continuous epitheca.

On the fascicles the tubes are arranged in quincunx; the peristomes are orbicular and somewhat salient and their diameter is larger in the vicinity of the crest of the fascicles.

Occurrence.—Lower Cretaceous: Faringdon, England (Aptian); Villers-le-Lac (Doubs), France (Valangian).

Plesiotype.—Cat. No. 69937, U.S.N.M.

REPTOCLAUSA MEANDRINA De Loriol, 1868

Plate 18, figs. 6-8

1868. *Reptoclausa meandrina* DE LORIO, Valanginién d'Arzier, Paléontologie Suisse, Liv. 4, p. 62, pl. 6, fig. 1.

The zoarium encrusts *Terebratulas* and oyster shells. The peristomes are wider than in *Reptoclausa hagenowi* and the fascicles are arranged much more irregularly. The interfascicular tubules are often visible exteriorly. We have found beautiful specimens in our collections.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix and D'Arzier, Switzerland.

Plesiotype.—Cat. No. 69938, U.S.N.M.

REPTOCLAUSA NEOCOMIENSIS D'Orbigny, 1853

1853. *Reptoclausa neocomiensis* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 888, pl. 765, figs. 1, 2.

1899. *Idmonca neocomiensis* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 155. (Bibliography.)

This species is well characterized by its short fascicles arranged in quincunx.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix and Mont Salevè, Switzerland, and Villers-le-Lac (Doubs), France.

Family TRETOCYCLOECIIDAE Canu, 1919

Genus TRETOCYCLOECIA Canu, 1919

TRETOCYCLOECIA (?) MULTIPOROSA, new species

Plate 16, figs. 5-8

Description.—The zoarium is small, cylindrical, bifurcated. The orifice is orbicular; the peristomes are thin, salient, arranged in quincunx, scattered or in annular rows. The mesopores are large, numerous, polygonal, irregularly placed around the orifices. The ovicell is orbicular.

Measurements.—Diameter of aperture, 0.08 mm.; diameter of peristome, 0.10 mm.; diameter of zoarium, 1.25 mm.; diameter of mesopores, 0.10 mm.

Affinities.—The mesopores seem to be parietal. Their exterior diameter is perceptibly equal to that of the peristomes. The ovicells found were broken and difficult to interpret. The tubes are cylindrical.

The species differs from *Tretocycloecia densa* by its very numerous mesopores as large as the peristomes.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (rare).

Cotypes.—Cat. No. 69939, U.S.N.M.

TRETOCYCLOECIA Densa, new species

Plate 16, figs. 9-14

Description.—The zoarium is free, small, cylindrical, bifurcated. The orifices are orbicular; the peristomes are thin, salient, close together, sometimes adjacent, arranged in quincunx. The mesopores are little numerous, small, irregularly distributed around the aper-

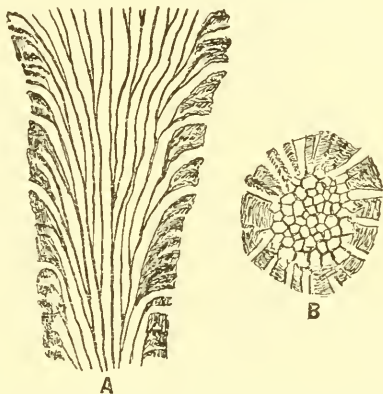


FIG. 42.—*Tretocycloecia densa*, new species. A, B. Longitudinal sections, $\times 16$. The mesopores are almost closed by thick tissue. Lower Cretaceous (Aptian): Faringdon, England

tures, short, parietal, sometimes closed by a lamella. The ovicell is orbicular, nonsalient, traversed by 15 tubes.

Measurements.—Diameter of orifice, 0.09 mm.; diameter of peristome, 0.11 mm.; diameter of mesopores, 0.04 mm.; diameter of zoarium, 1.25 mm.

Structure.—In transverse section the tubes are cylindrical or polygonal, with adjacent walls, with regular peripheral gemmation. In longitudinal section the tubes are long, cylindrical, narrowed at the base, with regular peripheral gemmation in the vicinity of the zoarial axis; they are recurved at their extremity. The mesopores are parietal, but, as their arrangement around the aperture is irregular, they are cut in sections irregularly and present the most varied forms;

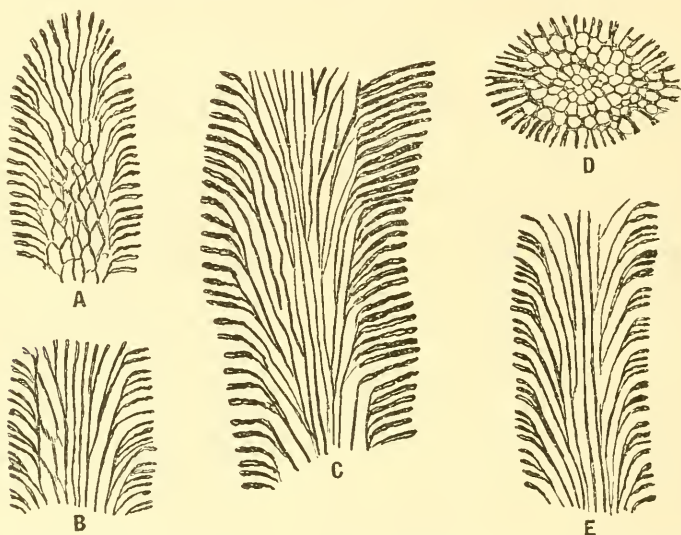


FIG. 43.—*Laterocavea dutempleana* D'Orbigny, 1853. A. Meridian section, $\times 16$, through a growing branch, showing the lozenge-shaped areas. B. Longitudinal section, $\times 16$, with an accessory exterior lamella at the left. C. Meridian section, $\times 16$, showing mesopores only in the lateral faces. D. Transverse section, $\times 16$, through a normal branch. E. Longitudinal section, $\times 16$, illustrating the cylindrical tubes with triparietal gemmation around a central tube. Lower Cretaceous (Aptian): Faringdon, England

their walls are very thick. In tangential sections the mesopores are very small and surrounded by very thick calcareous tissues.

Affinities.—This species differs from *Tretocycloecia multiporosa* in its much smaller mesopores. It differs from *Heteropora keepingi* Gregory, 1909, which has a similar exterior aspect, in its much smaller zoarium, and in its smaller zooecial diameter (0.09 and not 0.15 mm.).

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England (common).

Cotypes.—Cat. No. 69940, U.S.N.M.

Family ASCOSOECIIDAE Canu, 1919

Genus LATEROCAVEA D'Orbigny, 1853

1853. *Laterocavea* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 933.

Original diagnosis.—"Colonie fixe par sa base, d'ou partent des rameaux tres comprimés, divisés par des dichotomisations sur le même plan et représentant un ensemble flabelliforme dendroïde. Chaque branche comprimée est pourvue, sur ses deux faces larges de *lignées* transversales espacées, composées d'une seule rangée de *cellules* tubuleuses; entre ces lignées sont de nombreux *pores intermédiaires*. Sur le côté étroit des branches sont des surfaces tres grandes, couvertes seulement de *pores opposés* épars, ou par lignes longitudinales bifurquées dans des sillons."

Diagnosis.—The zoarium is dichotomous and formed of compressed fronds. The tubes are oriented toward two cellular faces; they are cylindrical, with peristome; their gemmation is axial around a central tube. They are separated by parietal mesopores. The two noncellular sides are formed only of parietal mesopores. The ovicell is placed on a side with mesopores.

Genotype.—*Laterocavea dutempleana* D'Orbigny, 1853. Cretaceous.

LATEROCAVEA DUTEMPLEANA D'Orbigny, 1853

Plate 15, figs. 1-6

1853. *Laterocavea dutempleana* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 933, pl. 772, figs. 7-10.

We have discovered some excellent specimens of this remarkable species, which have permitted us to study the detailed structure. In transverse section the tubes are round and grouped around a central tube. The parietal mesopores have very thick walls; they form an exterior zone, regular, enlarged laterally.

In longitudinal section the tubes are cylindrical, short, somewhat narrowed at their base. The gemmation is axial around a central tube, which ramifies at the dichotomisations. In their terminal recurved portion the tubes are separated by parietal mesopores, with thickened walls.

In meridian section the axial tubes have the lozenge-shape derived from their orientation toward the broad sides. The lateral tubes are aborted and emit only parietal mesopores much longer than the others.

In tangential section the orifices are elliptical, often adjacent laterally, and separated in the longitudinal direction by irregular groups of 4 or 5 mesopores.

We have sectioned a specimen containing on one side an exterior accessory intrazoarial lamella. It is a curious phenomenon which we have observed for the first time.

On the broad sides the peristomes are arranged irregularly on the median axis and in laterally transverse lines, an arrangement close to that observed in *Hornera*.

Occurrence.—Lower Cretaceous (Aptian): Grandpré (Ardennes), France; Faringdon, England (common).

Plesiotypes.—Cat. No. 69941, U.S.N.M.

LATEROCAVEA INTERMEDIA, new species

Plate 13, figs. 9-17

Description.—The zoarium is small, cylindrical, dichotomously branched. On the principal branches the orifices are arranged laterally, although the entire anterior surface is occupied by mesopores. On the terminal branches the orifices are disposed entirely around the colony. In the cellular parts the orifices are arranged in irregular transverse lines; the peristomes are almost always adjacent and separated longitudinally by groups of four mesopores. The ovicell is globular, elliptical, large, and always placed on a side with mesopores.

Measurements.—Diameter of orifice, 0.08 mm.; zooecial width, 0.14 mm.; distance of orifices, 0.25 mm.; diameter of branches, 1 mm.

Affinities.—The arrangement of the orifices is absolutely contrary to that in *Laterocavea dutempleana* D'Orbigny, 1853, because they are lateral and not on the plane of dichotomisation. Furthermore, the small branches, bearing orifices entirely around the colony, offer the aspect of *Petalopora* Lonsdale, 1850. Complete zoaria present, therefore, all the characters intermediate, between the two genera *Laterocavea* and *Petalopora*. This species differs again from *Laterocavea dutempleana* D'Orbigny, 1853, in its rounded instead of compressed and much smaller branches.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Cotypes.—Cat. No. 69942, U.S.N.M.

Genus SIPHODICTYUM Lonsdale, 1849

1849. *Siphodictyum* LONSDALE, Notes on Fossil Zoophytes, Quarterly Journal Geological Society London, vol. 5. p. 94.

The ovicell is an elliptical, very convex sack, perforated by a certain number of tubes (type of *Ascoseocia*). The tubes are short, with peristome, with triparietal gemmation around a central axis. The zoarial epitheca is very thick and perforated all around the colony by small numerous vacuoles, issuing from aborted tubes and arranged at the bottom of the sulci.

Genotype.—*Siphodictyum gracile* Lonsdale, 1849. Cretaceous (Albian, Albian and Campanian).

Affinities.—Gregory, 1899, classified this genus in the Horneridae. This is correct so far as the exterior aspect and the nature of the tubes is concerned, but the ovicell is quite different and is of the type characteristic of the Ascosoeciidae.

The genus differs for *Laterocavea* D'Orbigny, 1853, in the nature of the adventitious pores, which are vacuoles and not mesopores. In the occurrence of large noncellular areas the two genera are very close but the areas are arranged quite differently.

Siphodictyum differs from *Reteporidaea* D'Orbigny, 1853, in the nature of the adventitious pores, which are vacuoles placed at the bottom of the sulci, and in its nonreticulate zoarium.

The physiological function of the vacuoles in recent *Hornera* is not known, and we are unable, therefore, to understand the importance of the large noncellular spaces on species of *Laterocavea* and *Siphodictyum*.

Certain branches are petaloporoid, as they have orifices entirely around the zoarium.

SIPHODICTYUM GRACILE, Lonsdale, 1849

Plate 14, figs. 14-21

1899. *Siphodictyum gracile* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 1, p. 363, fig. 45, pl. 12, figs. 14, 15. (Bibliography.)

Measurements.—Diameter of orifices, 0.08 mm.; diameter of zooecia, 0.16 mm.; distance of orifices along margin, 0.40 mm.; diameter of large branches, .070 mm.

Structure.—The zoarium is cylindrical, dichotomously branched. The peristomes are salient, adjacent, and arranged in transverse rows interrupted in the middle, on the anterior face of the colony. They are separated in the longitudinal direction by 4 to 6 vacuoles. On the posterior face only vacuoles occur, at the base of broad sulci of little depth; the sulci are rarely longitudinal and are almost always more or less oblique. This arrangement prevents the discovery of the true nature of the pores as observed in thin sections. The dorsal is sometimes much reduced.

In longitudinal section the zoarium appears surrounded by a very thick lamellar epitheca; the tubes are short, cylindrical, with peristome, recurved at their extremity, with triparietal gemmation, and arranged around a central axis. The tubes oriented toward the frontal are complete and separated in the recurved portions by the epitheca perforated by vacuoles; the tubes oriented toward the

frontal dorsal are aborted and engender the vacuoles of the non-cellular face.

Our longitudinal sections do not correspond exactly with those of Gregory, 1899 (p. 364), which seem to show parietal mesopores (= maculae). The sections of Lonsdale are incomplete.

The meridian section confirms the longitudinal section, but the tubes are symmetrically arranged on each side of the central axis. Moreover, diaphragms appear sometimes.

In transverse sections the zoarial epitheca is thick, lamellar, perforated by irregularly scattered vacuoles; the tubes here are almost equal and polygonal.

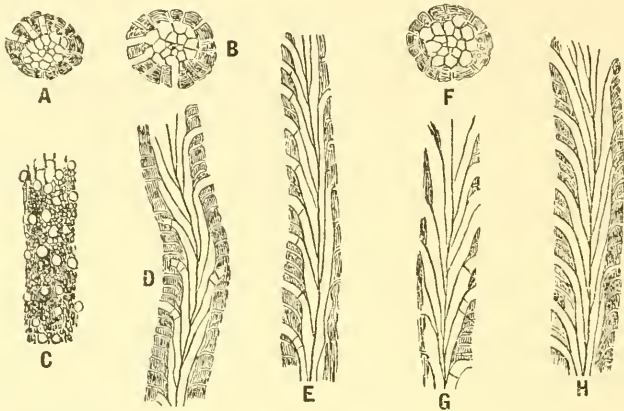


FIG. 44.—Genus *Siphodictyum* Lonsdale, 1849. A-E. *Siphodictyum irregulare*, new species. A. Transverse section, $\times 16$, showing the polygonal tubes. B. Another transverse section, $\times 16$, exhibiting the central axis. C. Tangential section, $\times 16$, illustrating the arrangement of the vacuoles around the orifices. D. Longitudinal section, $\times 16$. The vacuoles perforate the epitheca all around the zoarium. E. Longitudinal section, $\times 16$, showing the cylindrical tubes and the vacuoles perforating the epitheca. Lower Cretaceous (Aptian): Faringdon, England. F-H. *Siphodictyum gracile* Lonsdale, 1879. F. Transverse section, $\times 16$. G. Meridian section, $\times 16$. H. Longitudinal section, $\times 16$, with the vacuoles perforating the thick epitheca. Lower Cretaceous (Aptian): Faringdon, England

In these various sections the zoarial pores appear, therefore, as the extremities of small tubes perforating the zoarial epitheca; these are vacuoles, as in the genus *Hornera*. Moreover, the general aspect of the species is also that of *Hornera*, although the ovicell is decidedly different, being that of the Ascosocciidae.

Affinities.—This species differs from *Siphodictyum irregulare* in the salient peristomes arranged in transverse rows and more numerous on the cellular face; finally, branches formed entirely of vacuoles have never been observed.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, Folkestone, etc., England.

Plesiotypes.—Cat. No. 69943, U.S.N.M.

SIPHODICTYUM IRREGULARE, new species

Plate 14, figs. 1-11

Description.—The zoarium is cylindrical, slender, dichotomously branched. On the cellular face the orifices are arranged in irregular quincunx or in transverse lines interrupted in the middle; the peristomes are salient, thick, adjacent, or scattered; they are separated by groups of 2 to 4 vacuoles. On the dorsal face the vacuoles occur at the base of sulci of little depth, arranged longitudinally and obliquely. At the extremity of the branches the peristomes occur entirely around the colony. The cellular groups are separated by noncellular spaces showing only vacuoles. The ovicell is a large, very convex sack placed in the noncellular portion of the zoarium.

Measurements.—Diameter of orifice, 0.08 mm.; zooecial diameter, 0.12 mm.; distance of orifices, 0.28-0.32 mm.; diameter of largest branches, 0.65 mm.

Structure.—The longitudinal section of the cellular branches shows on the frontal a thick peripheral epitheca perforated by vacuoles, short cylindrical tubes with triparietal gemmation around a central axis, and dorsal tubes analogous but aborted and engendering the vacuoles.

The longitudinal section of the noncellular branches show identical characters, but all the tubes are aborted and engender numerous vacuoles.

The transverse section shows a very thick epitheca perforated by vacuoles, by complete tubes, or by incomplete tubes.

The tangential section of the cellular face shows the orbicular orifices and a variable number of small vacuoles very irregularly arranged and immersed in a thick epitheca. Irregular veinules indicate the presence of the sulci. The tangential section of the noncellular portions exhibit very small vacuoles arranged in quincunx and immersed in a thick epitheca in which the veinules are indicated by the darker portions.

This species has afforded sections closer to those of Gregory, 1899 (p. 364); but the walls of the adventitious tubes are much thicker and seem to indicate vacuoles rather than mesopores.

The orifices are arranged in transverse rows, interrupted or in quincunx. On the same zoarium there are large cellular spaces with peristomes on a single side, but they alternate with the large noncellular spaces. At the extremity of the branches the orifices are disposed entirely around the colony. The lateral dichotomisations are always very short.

Affinities.—This species differs from *Siphodictyum gracile* Lonsdale, 1849, in its more slender branches showing only 3 or 4 longitudinal series of tubes and in the presence of noncellular zoarial portions.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England.

Cotypes.—Cat. No. 69944, U.S.N.M.

Genus ZONOPORA D'Orbigny, 1854

ZONOPORA COMPRESSA, new species

Plate 15, figs. 15–17; Plate 31, fig. 1

Description.—The zoarium is free, dichotomous; the fronds are much compressed. The peristomes are small, thin, nonsalient, arranged in irregular quincunx, grouped in zones separated by wide areas of mesopores and surrounded by some mesopores.

Measurements.—Diameter of orifice, 0.10 mm.; diameter of mesopores, 0.04–0.06 mm.; distance of peristomes, 0.24–0.26 mm.; separation of peristomes, 0.36–0.40 mm.

Structure.—The sectioned specimens were accidentally hollow, giving the sections a strange aspect which might make them appear to belong to another genus. However, we have found the usual structure seen in sections of *Zonopora*.

The longitudinal section in *Zonopora* is very difficult to interpret because of the great multiplicity of tubes and of their vesicular walls. Those which we have made are not clear enough to be reproduced, but we have been able to observe the essential characters.

Affinities.—This is the only species of *Zonopora* in which the fronds are compressed.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland.

Cotype.—Cat. No. 69945, U.S.N.M.

ZONOPORA ARBOREA Koch and Dunker, 1837

Plate 15, figs. 7–10; Plate 31, figs. 2–4

1909. *Multizonopora arborea* GREGORY, Catalogue Cretaceous Bryozoa in the British Museum, vol. 2, p. 220, figs. 57–61. (Bibliography and geologic distribution.)

Measurements.—Diameter of the orifices, 0.08 mm.; diameter of the mesopores, 0.04 mm.

Structure.—The specimens from Sainte-Croix are large and rough, but they are not multilamellar. The cellular zones are very irregular and quite variable in their extent. The determination by the exterior features alone is always difficult if the observer is not acquainted with all the known variations in such fossils.

The illustrated sections of this species are those of Pergens, 1889, and of Gregory, 1909. Our specimens from Sainte-Croix were silici-

fied and could not be sectioned, but a well-preserved example from Berklingen has afforded some interesting results. In the transverse section here figured the tubes are polygonal, with a rounded center, cylindrical, of uniform diameter. The recurved parts of the tubes and the mesopores have very thick vesicular walls in confirmation of Gregory's figure 61. Gemmation takes place especially in the vicinity of the central axis.

The tangential section shows small scattered mesopores embedded in the zoarial epitheca.

Occurrence.—Lower Cretaceous: Sainte-Croix, Switzerland (Valangian); Berklingen, Germany.

Plesiotypes.—Cat. No. 69946, U.S.N.M.

Genus **SPARSICAVEA** D'Orbigny, 1853

SPARSICAVEA IRREGULARIS D'Orbigny, 1853

Plate 15, figs. 11–14.

1853. *Sparsicavea irregularis* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 949, pl. 617, figs. 5–7.

Measurements.—Diameter of aperture 0.07–0.08 mm.; diameter of peristome, 0.12 mm.; diameter of zoarium, 1–2 mm.

Structure.—Our determination is exact, as our specimens are rigorously analogous to those of D'Orbigny. His figure is not altogether exact, as admitted by himself, the unequal spacing of the peristomes not being visible. Our photographs show this feature very well. Mesopores are rather numerous; they are infundibuliform at their extremity and appear consequently smaller in tangential section. The peristome is salient and thick.

The longitudinal section shows the usual feature of *Sparsicavea*, namely club-shaped tubes, peripheral and axial gemmation, parietal mesopores (=maculae of Gregory), with very thick walls. In transverse section the thickening of the walls of the mesopores forms a regular epithelial zone.

All the known ovicelled species with *Sparsicavea* characters are referred to the genus *Parasosoezia*, but until the ovicell of the present one is known we believe it best to refer it to the older name.

Occurrence.—Lower Cretaceous (Aptian): Faringdon, England; Machoreménil (Ardennes), France.

Plesiotypes.—Cat. No. 69947, U.S.N.M.

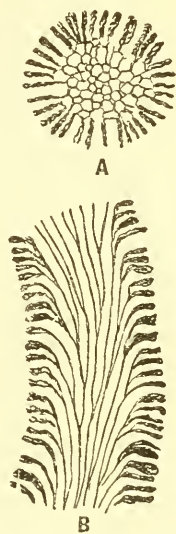


FIG. 45.—*Sparsicavea irregularis* D'Orbigny, 1851. A. Transverse section, $\times 16$. B. Longitudinal section, $\times 16$. Lower Cretaceous (Aptian): Faringdon, England

Family CORYMBOPORIDAE Smitt, 1866

Genus CORYMBOPORA Michelin, 1845

CORYMBOPORA NEOCOMIENSIS D'Orbigny, 1853

Plate 8, figs. 13-16

1853. *Corymbopora neocomiensis* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 670, pl. 783, figs. 20-23.

1909. *Fasciculipora neocomiensis* GREGORY, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 2, p. 37. (Bibliography.)

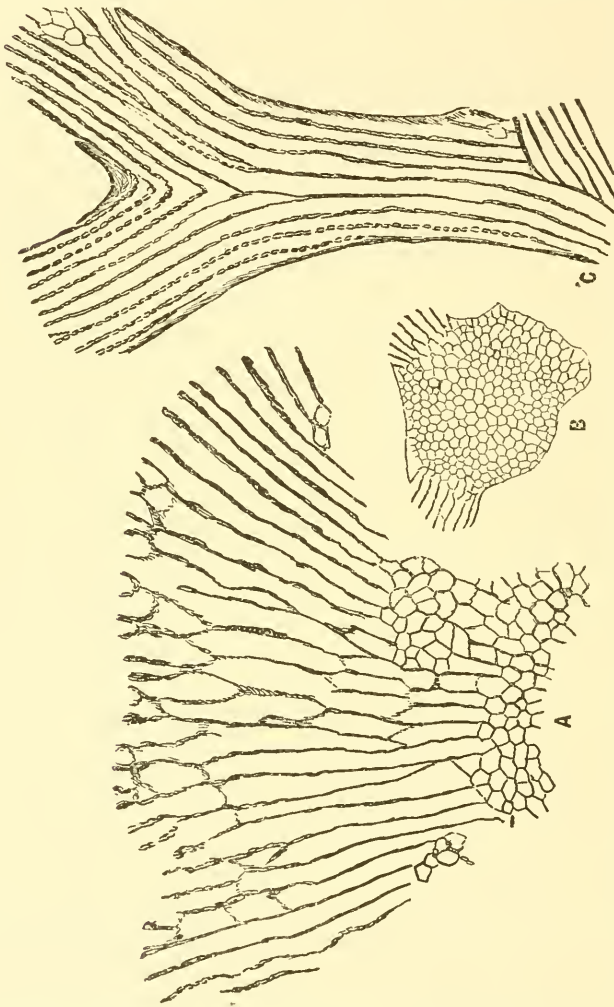


FIG. 46.—Genus *Corymbopora* Michelin, 1845. A. *Corymbopora f cupula* D'Orbigny, 1853. Meridian section, X 16. Cretaceous (Cenomanian) Le Mans, France. B, C. *Corymbopora neocomiensis* D'Orbigny, 1853. B. Transverse section, X 8. The tubes are polygonal with walls adjacent and larger at the zoarial center. C. Longitudinal section, X 16, in a branch with three pinnules. The walls of the tubes are moniliform. Cretaceous (Valaigian): Sainte-Croix, Switzerland

Structure.—The branches figured by D'Orbigny are of young specimens; as they are thin, they appear long. The older branches formed of a greater number of tubes have a broader, thicker aspect; the zoarium appears like a circular stem bearing short pinnules in all directions. The base is a circular disk, little expanded.

The longitudinal section is that characteristic of the Corymboporidae as Canu has figured in 1919. The walls of the tubes are moniliform. The gemination is incomprehensible and the nature of the pores remains still doubtful. Gregory's hypothesis is not clear. "The pores seem to be due to the nearly complete filling of the aperture of the dead zoaria by epizoarial material."

In transverse section the tubes are polygonal, with adjacent walls; they are larger at the zoarial center.

Occurrence.—Lower Cretaceous (Valangian): Sainte-Croix, Switzerland.

Plesiotypes.—Cat. No. 69948, U.S.N.M.

CORYMBOFORA (?) CUPULA D'Orbigny, 1853

Plate 8, figs. 1-7

1853. *Reptomulticava cupula* D'ORBIGNY, Paléontologie française, Terrain Crétacé, vol. 5, p. 1037, pl. 792, figs. 6-11.

Our determination is possibly incorrect, for D'Orbigny's figures do not indicate smaller tubes at the center of the zoarium nor colonies so thick. We maintain our determination, however, because specimens of D'Orbigny's species as figured by him have never been rediscovered at Le Mans.

Our specimens are capitate, simple or agglomerate. The ovicel is that of the Corymboporidae, absolutely analogous with that of the genotype figured by Canu. Exteriorly the zoarium appears to be formed of superposed lamellae in which the tubes are much smaller at the center and on the margin. This is an illusion resulting from the special mode of gemination in *Corymbopora*. Thin sections confirm this observation.

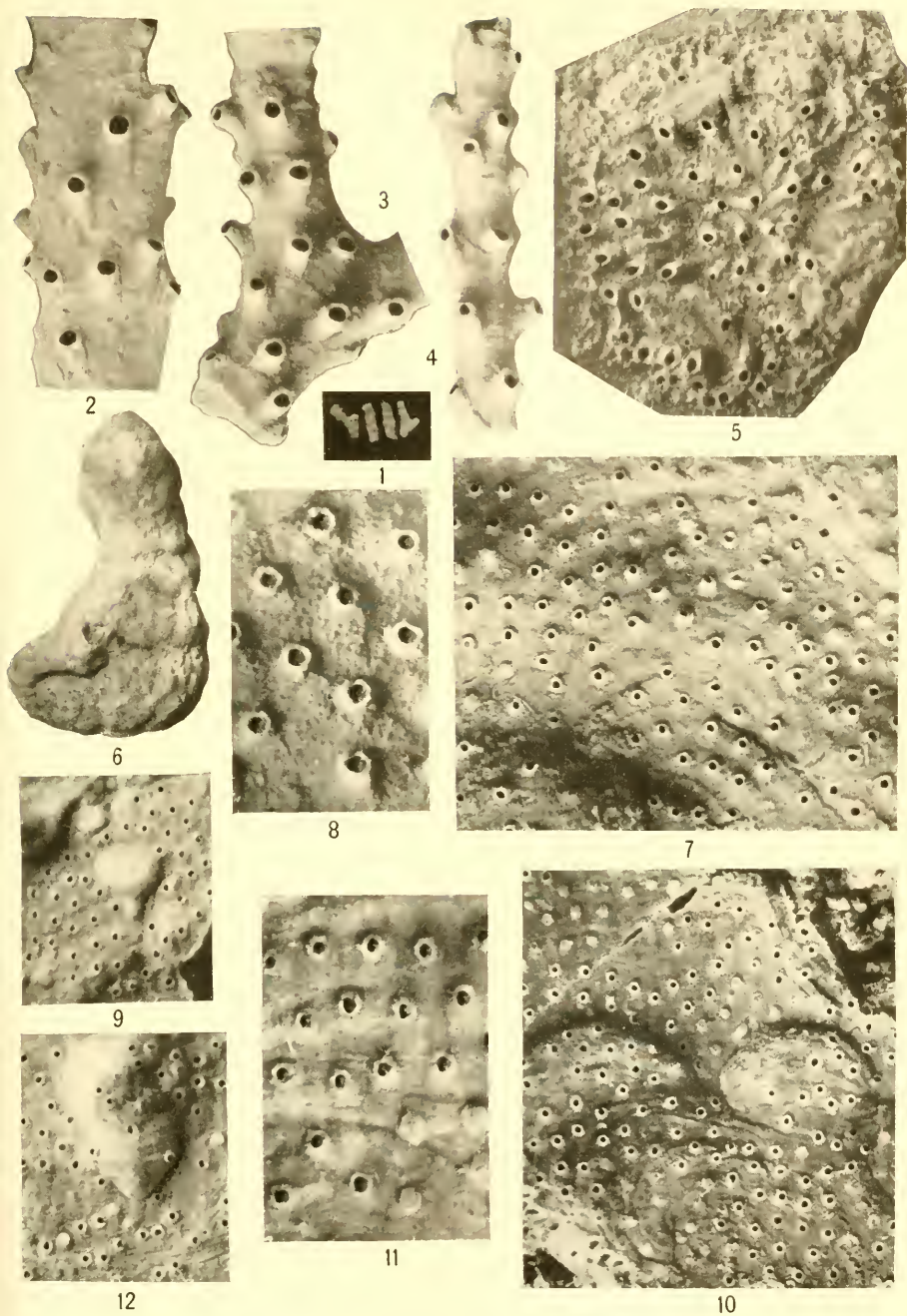
Occurrence.—Cretaceous (Cenomanian): Le Mans (Sarthe), France.

Plesiotypes.—Cat. No. 69949, U.S.N.M.

EXPLANATION OF PLATES

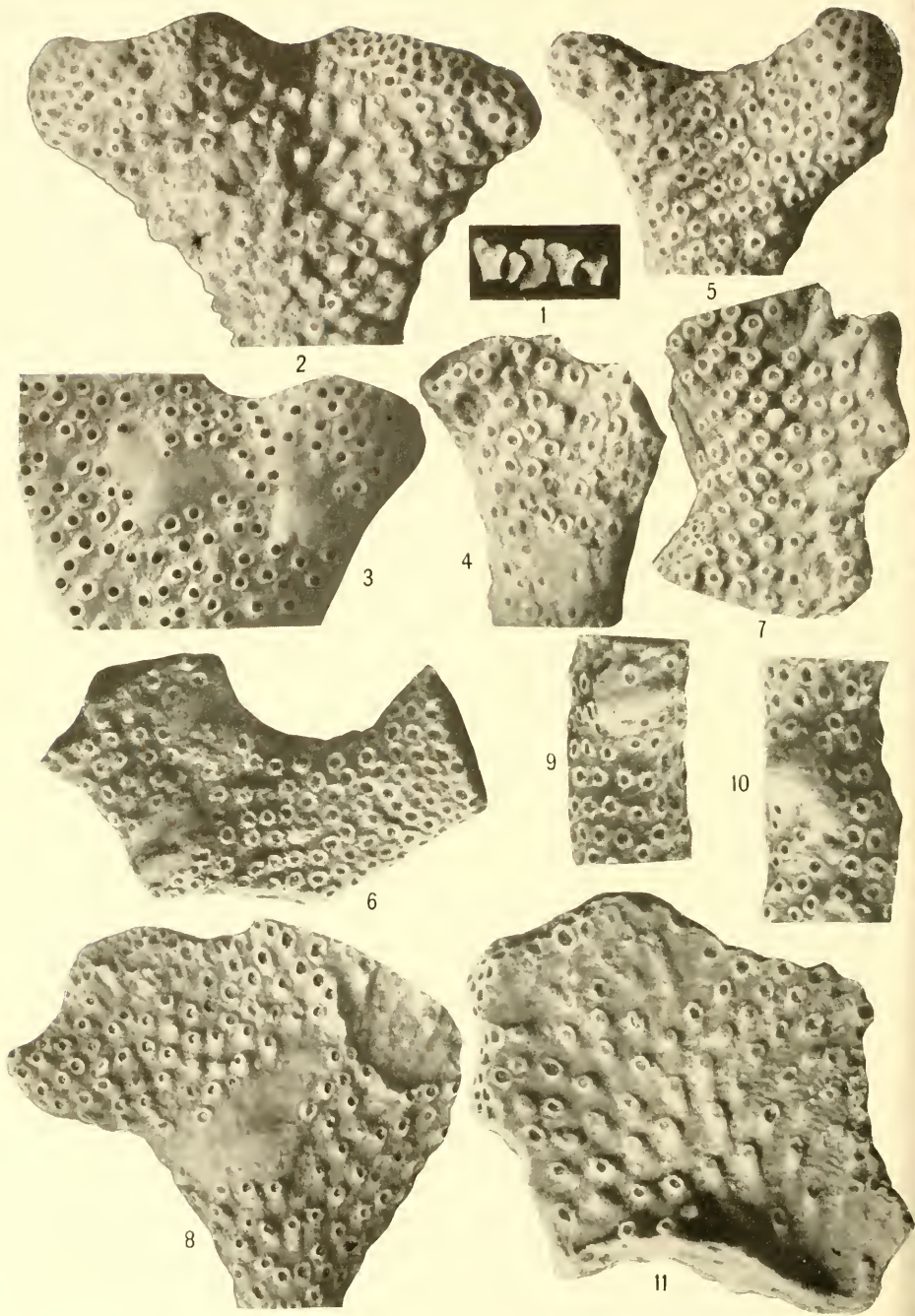
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Lower Cretaceous (Aptian): Faringdon, England.	



LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

FOR EXPLANATION OF PLATE SEE PAGE 94



LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

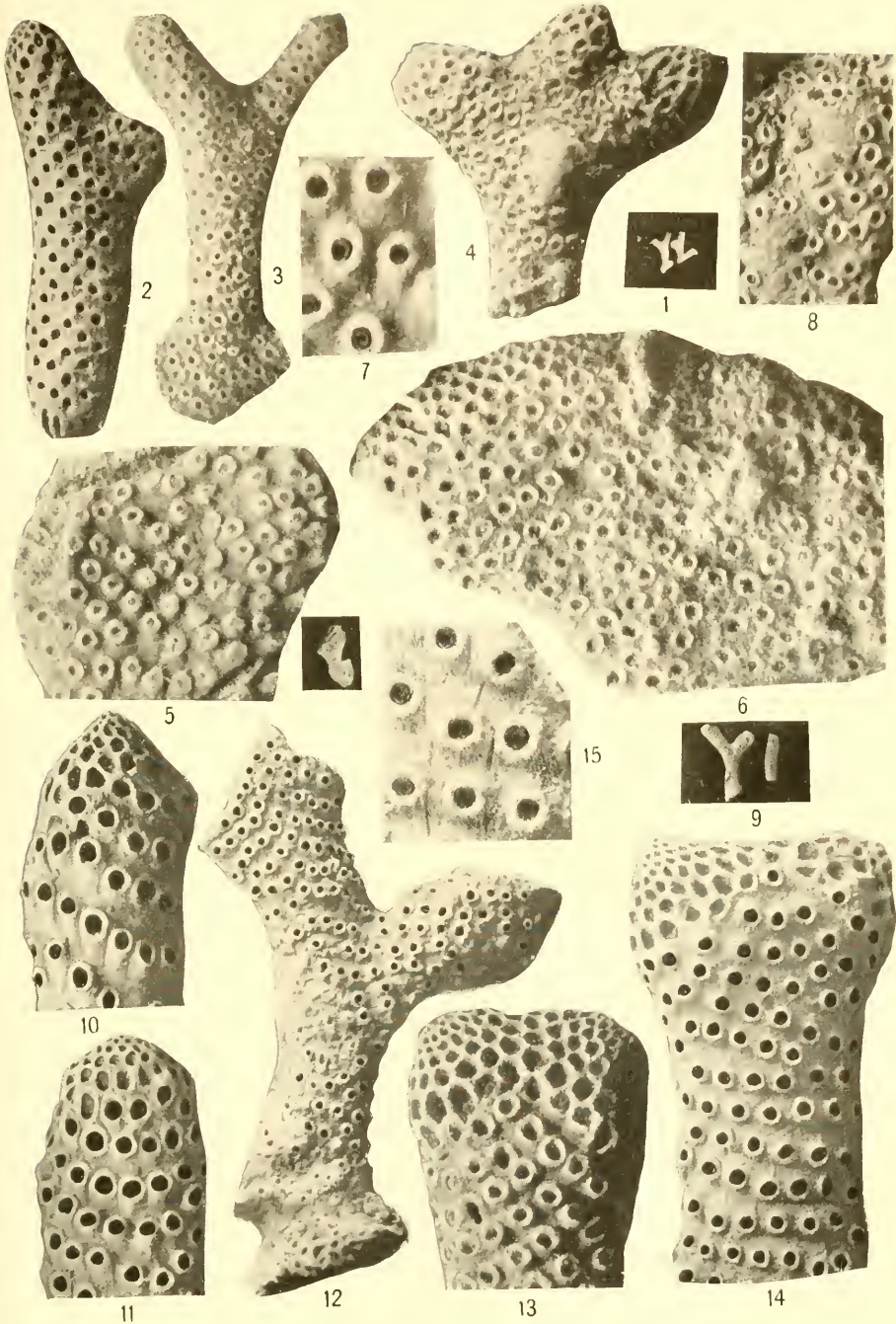
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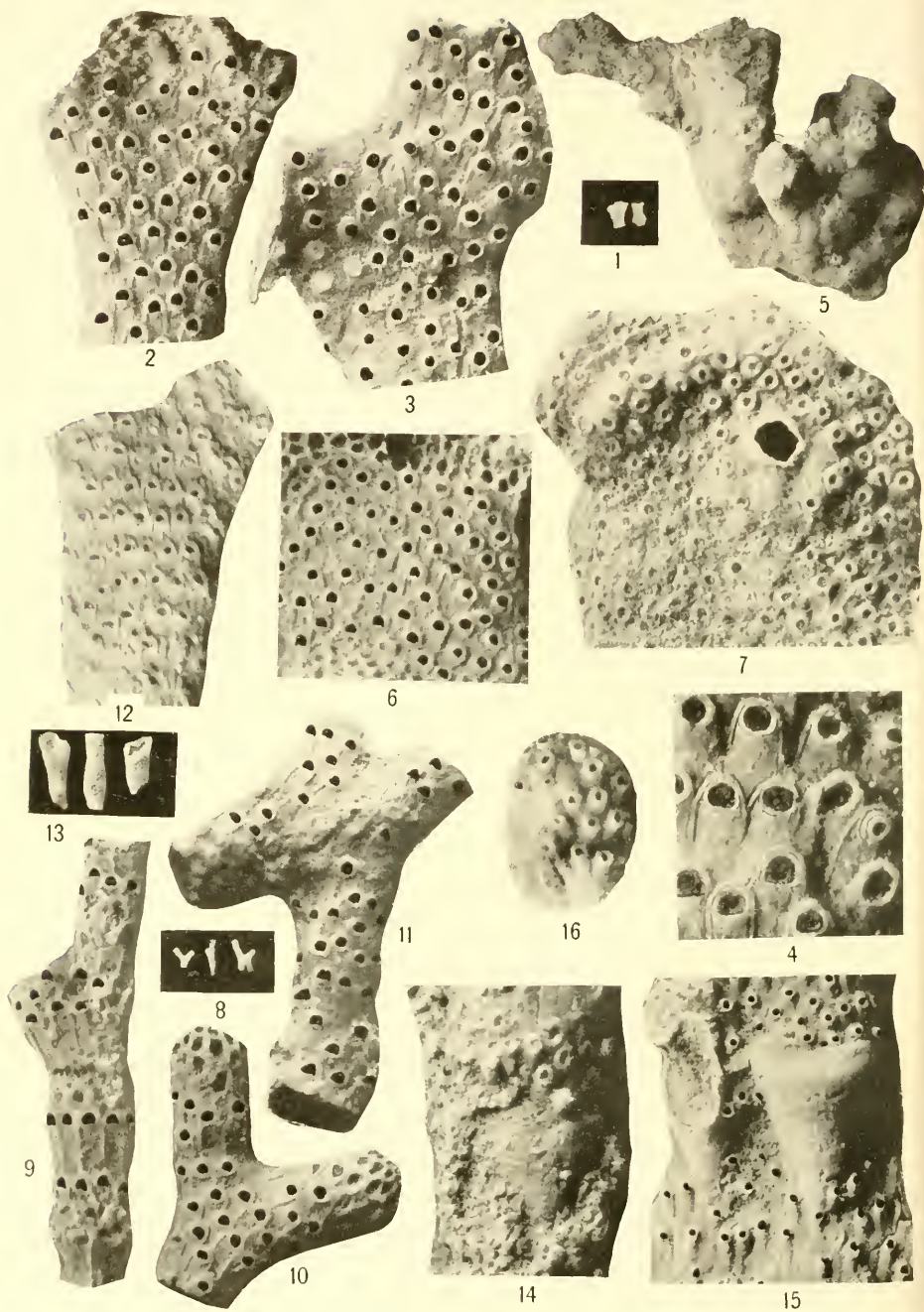
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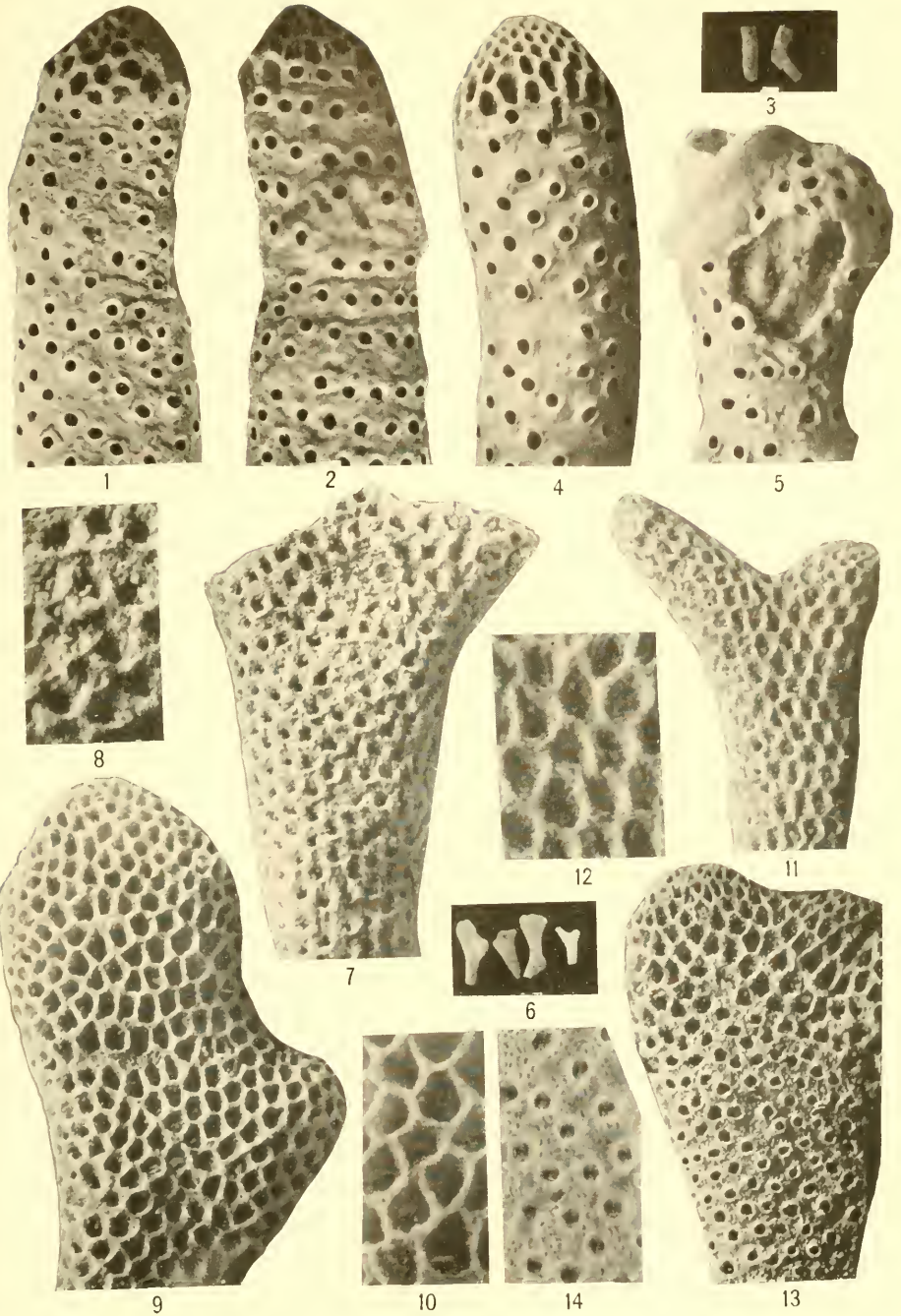
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Lower Cretaceous (Aptian): Faringdon, England.	



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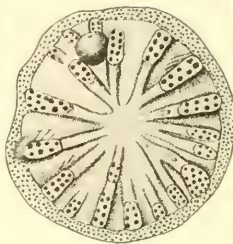
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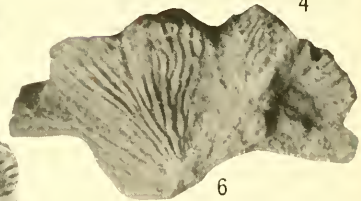
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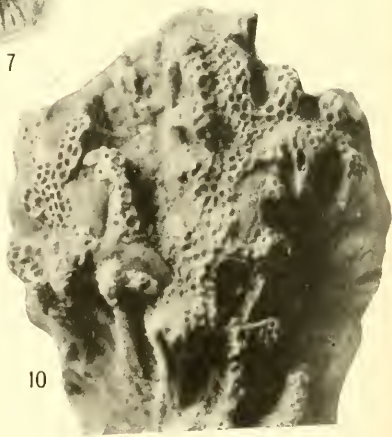
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LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

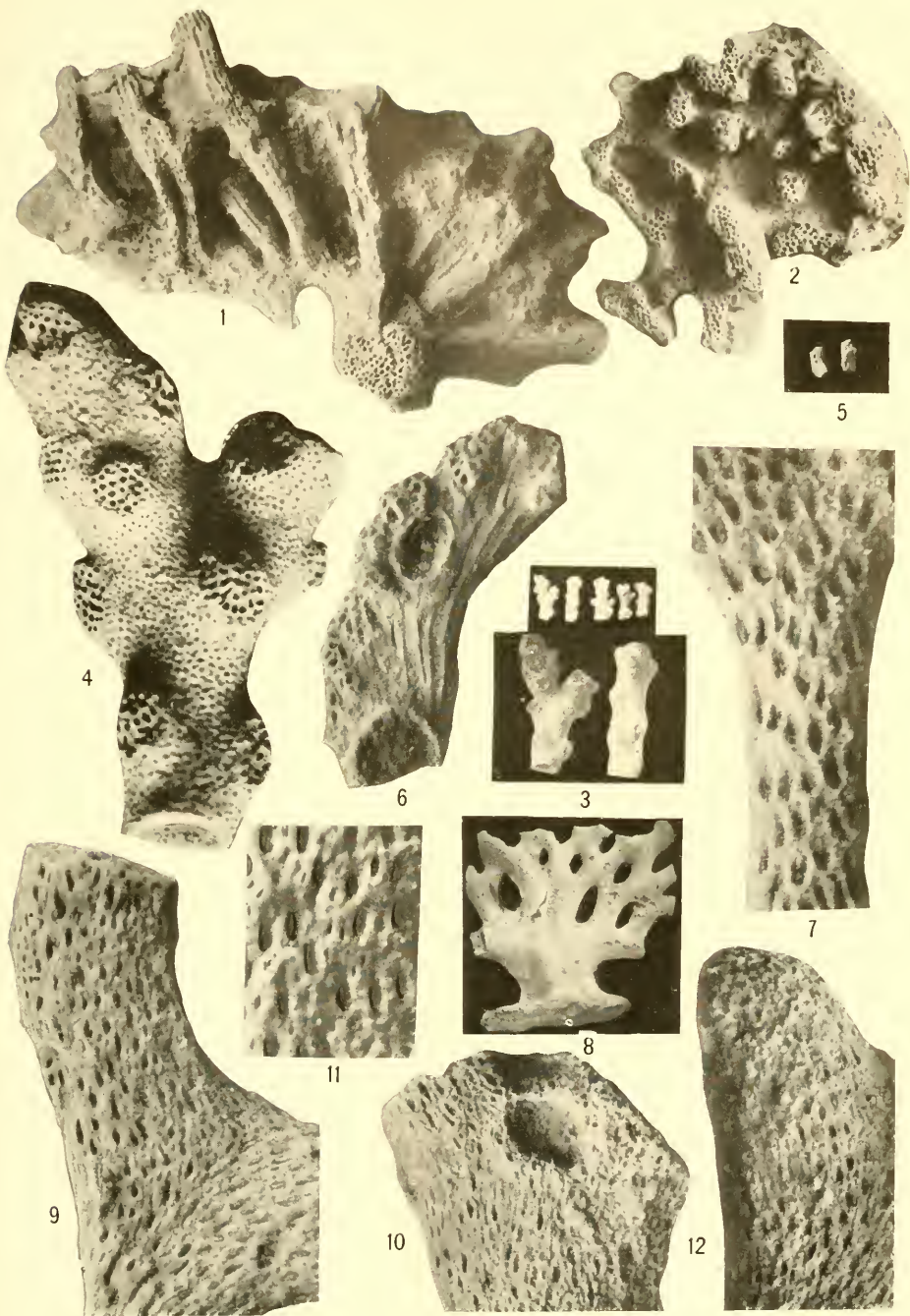
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Lower Cretaceous (Valangian): Sainte-Croix, Switzerland.	

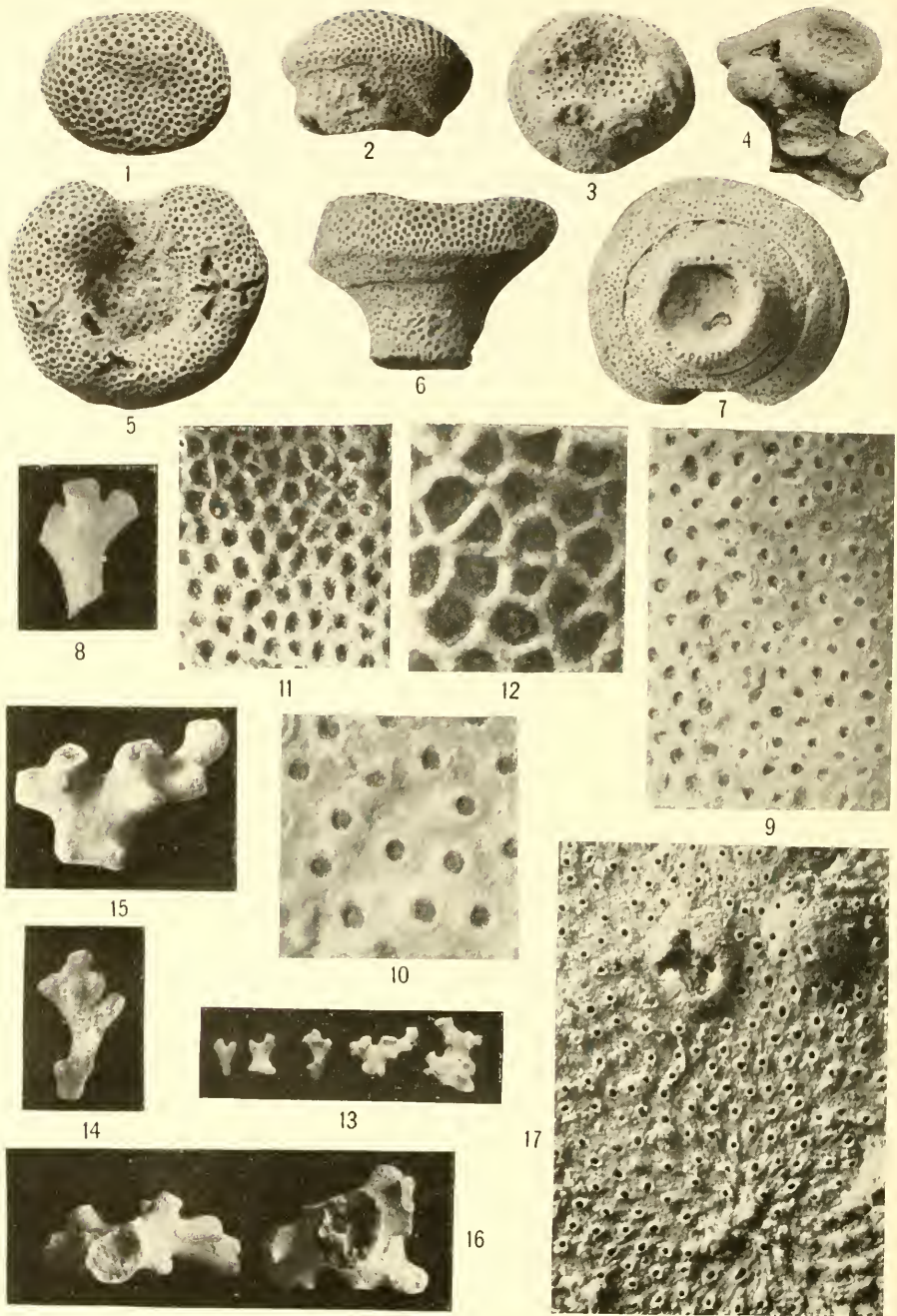
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Lower Cretaceous (Valangian): Sainte-Croix, Switzerland.	



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LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

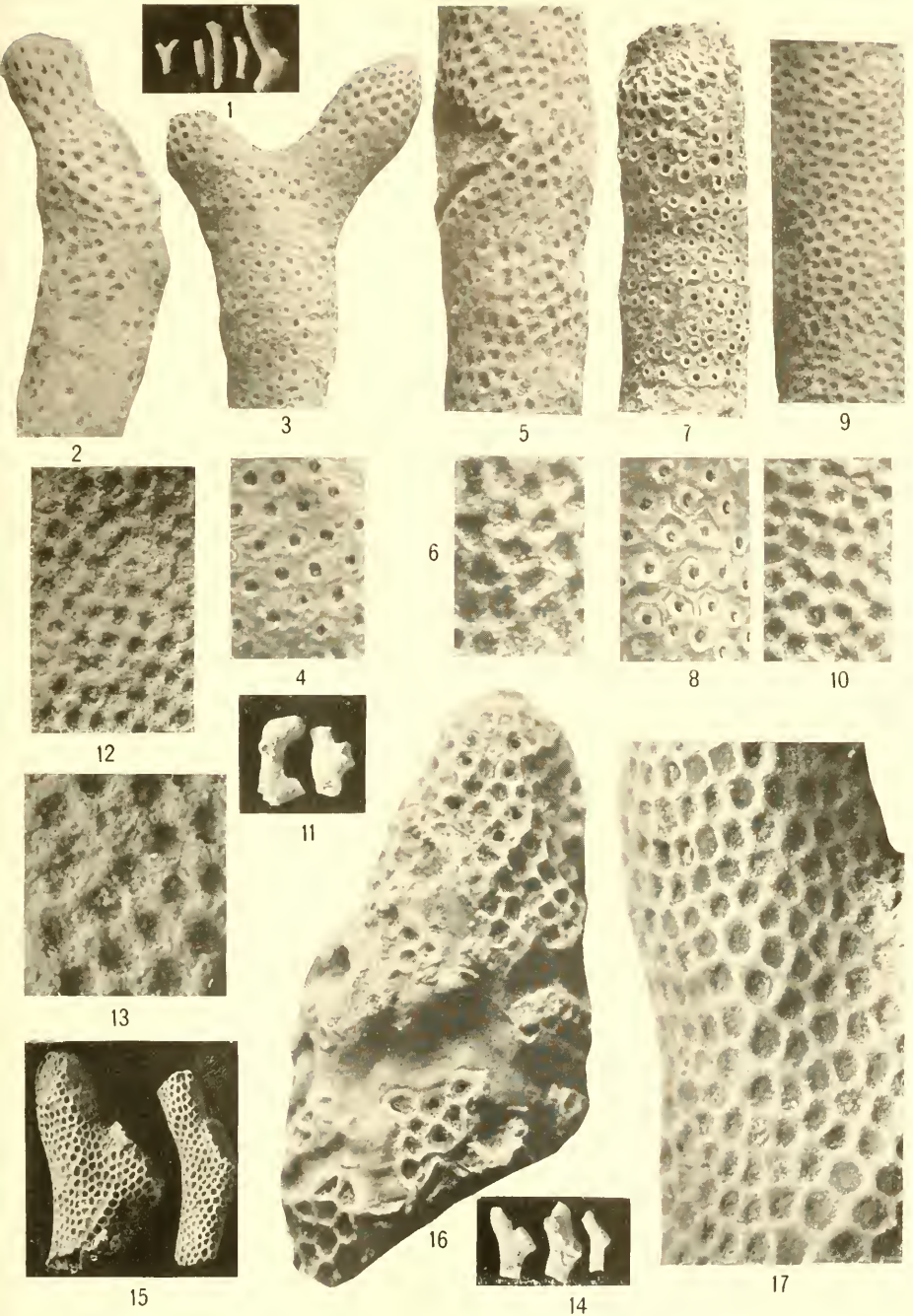
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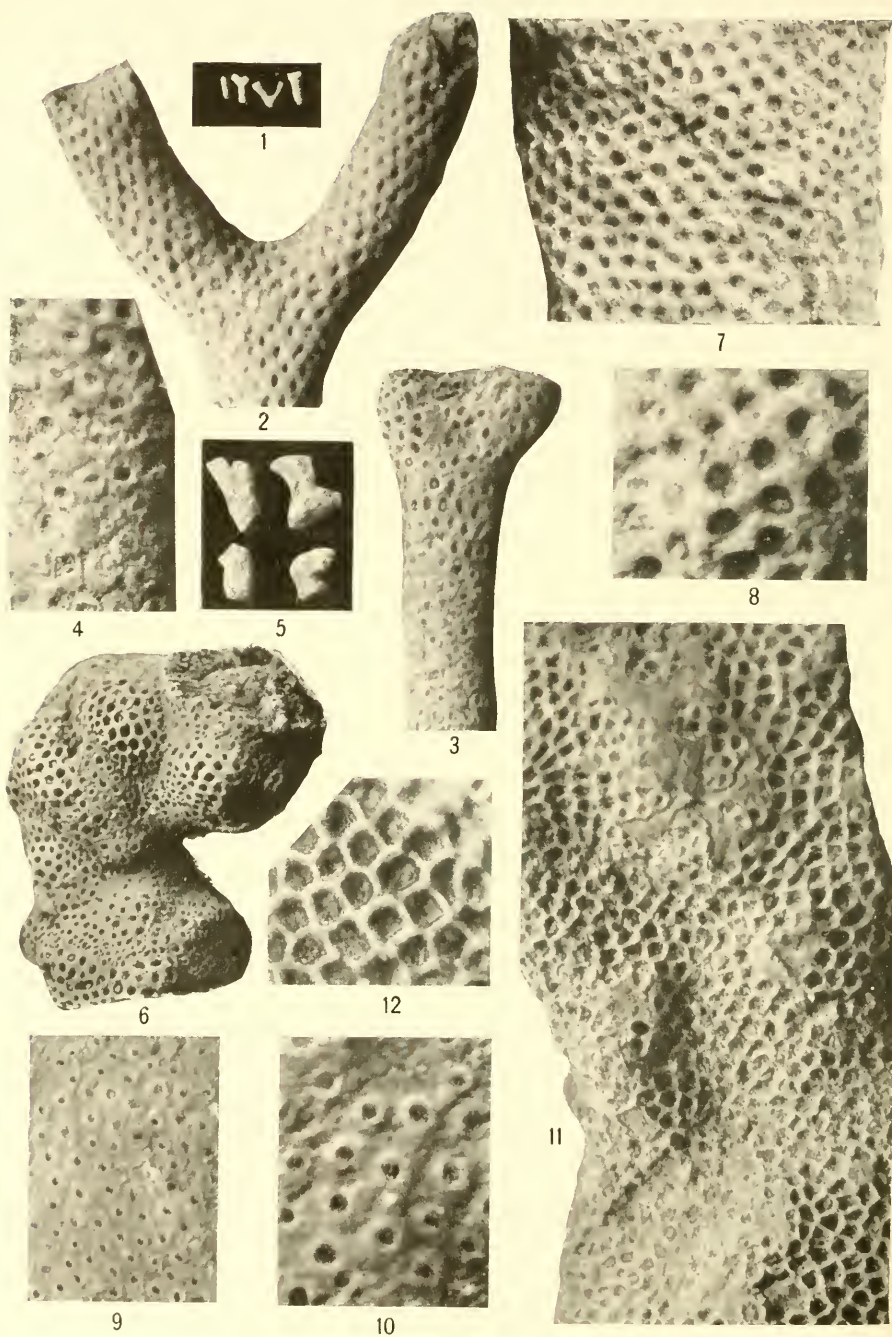
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LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

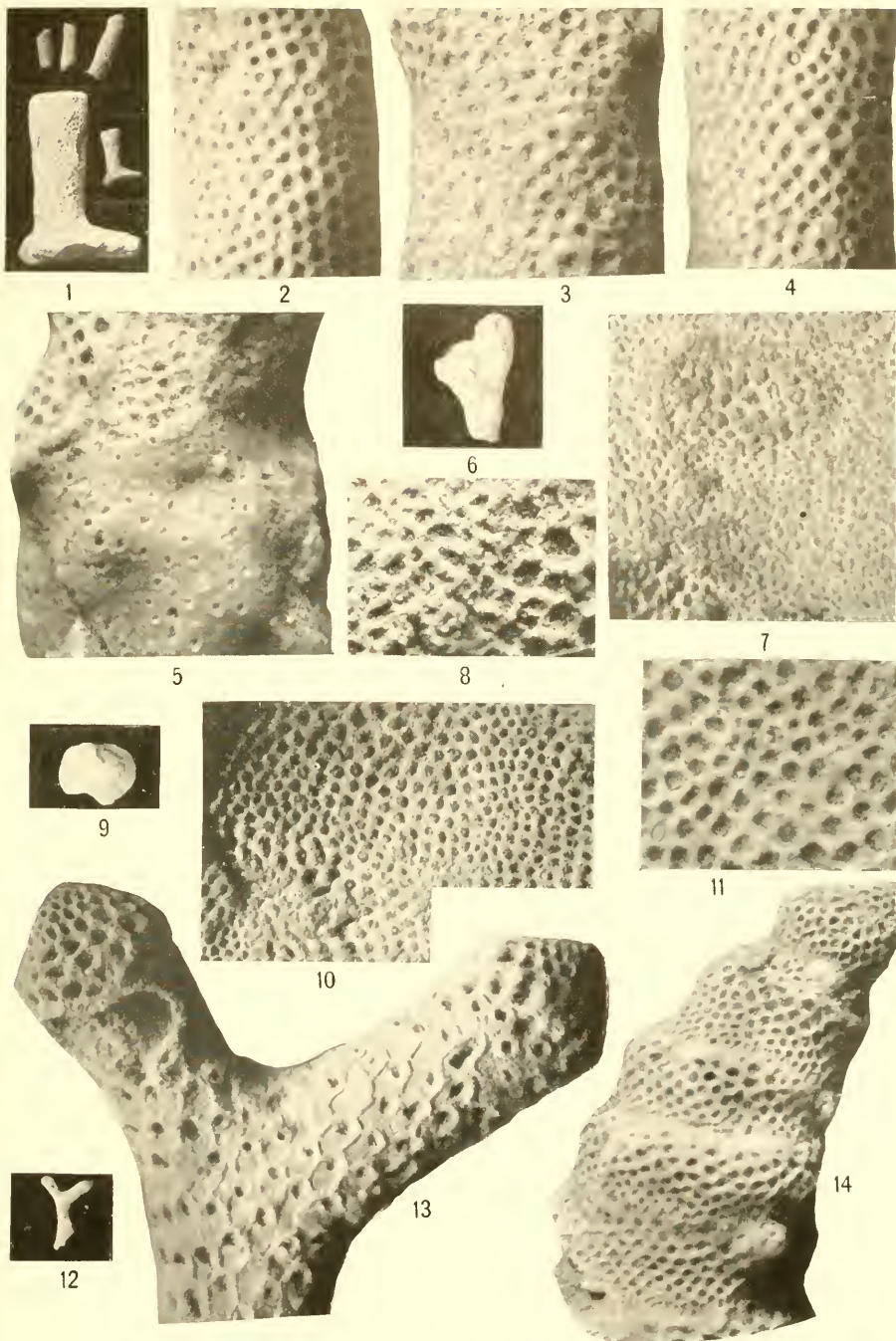
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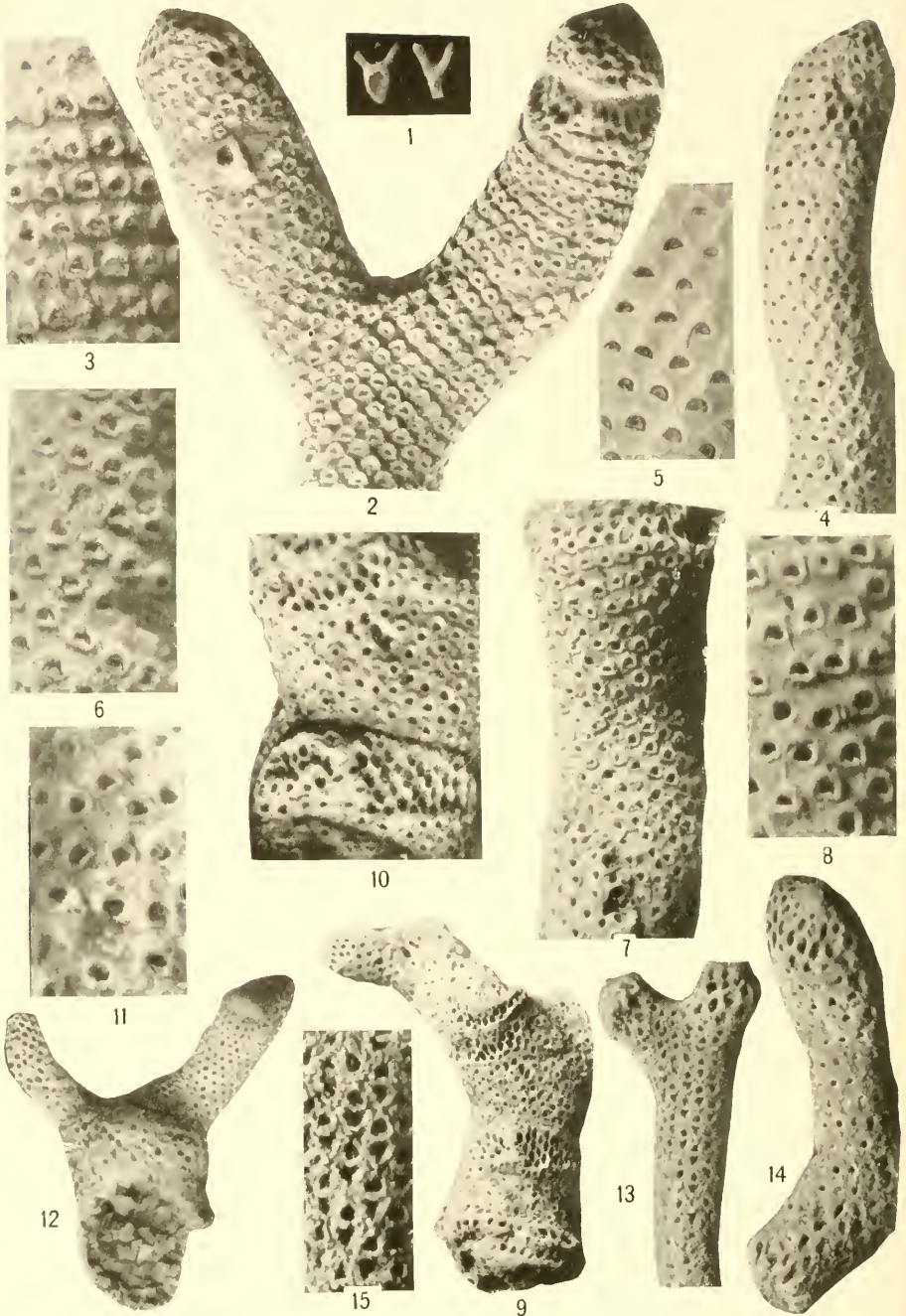
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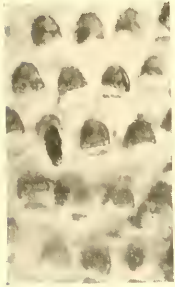
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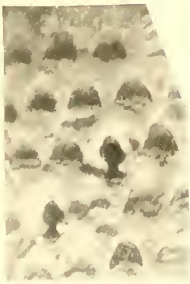
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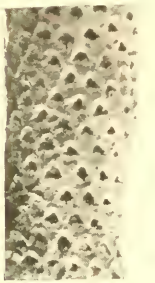
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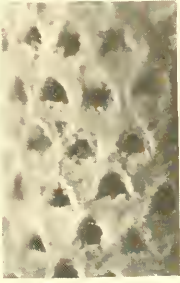
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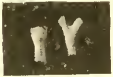
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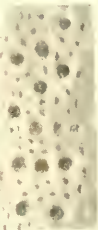
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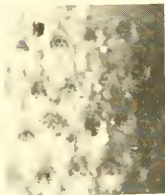
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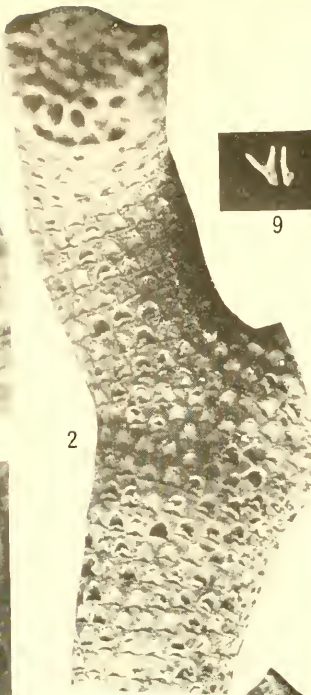
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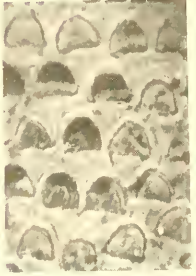
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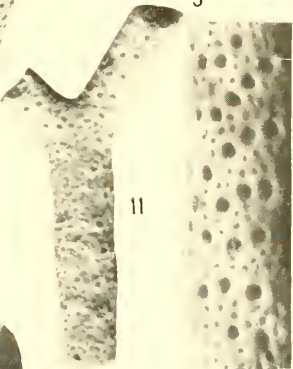
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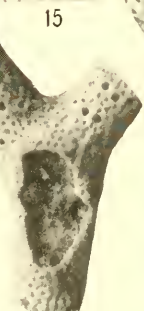
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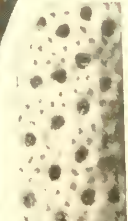
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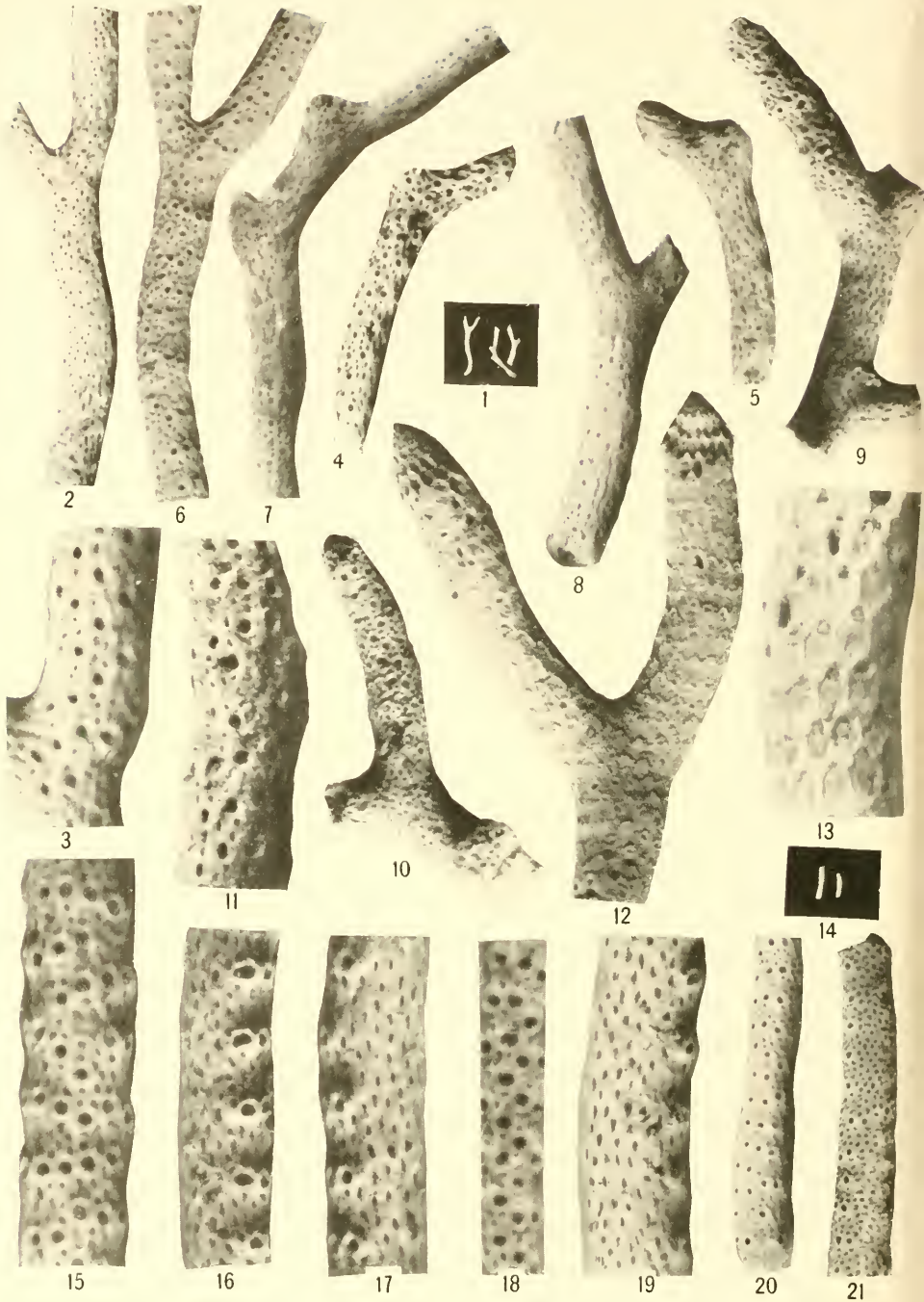
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LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

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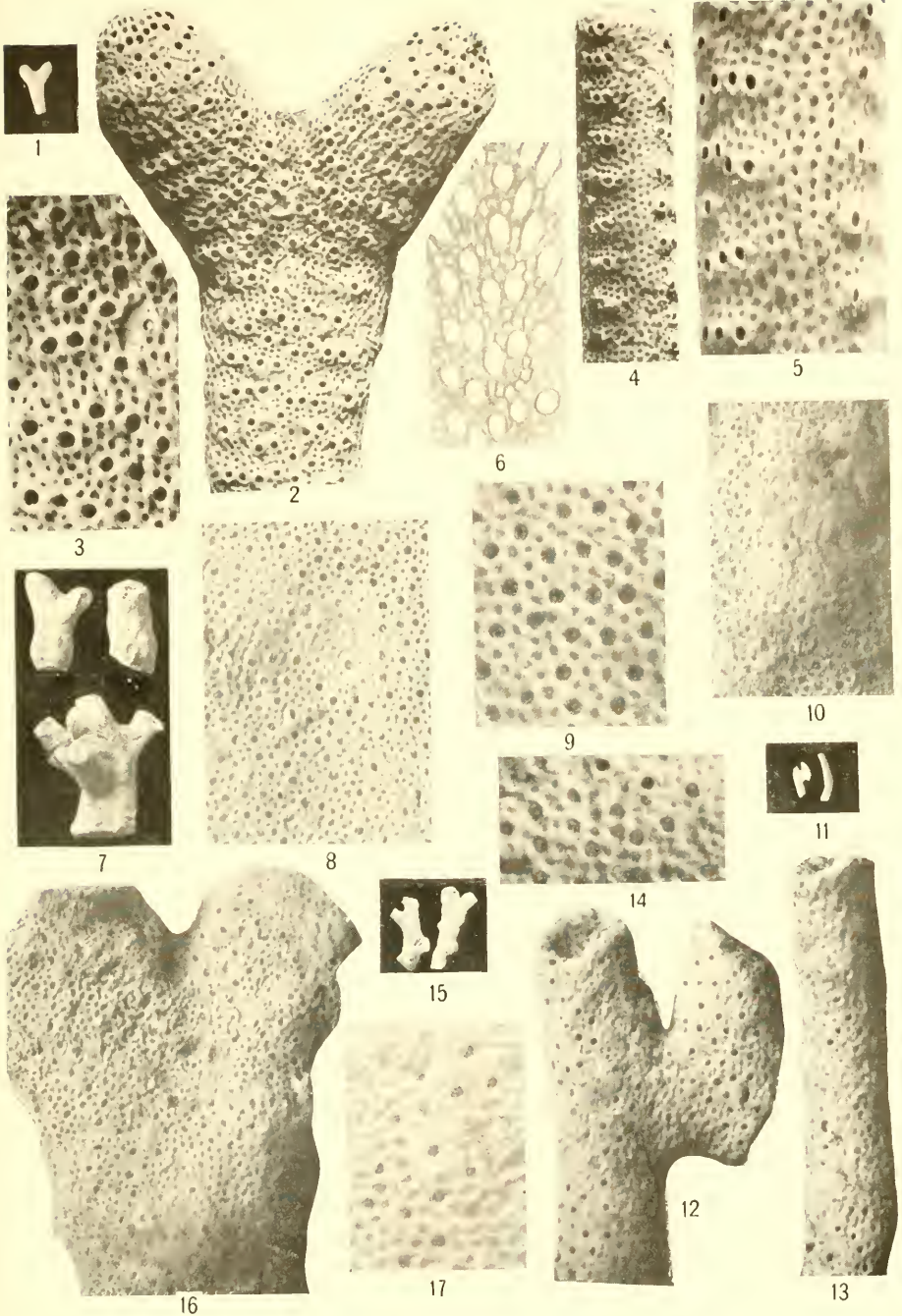
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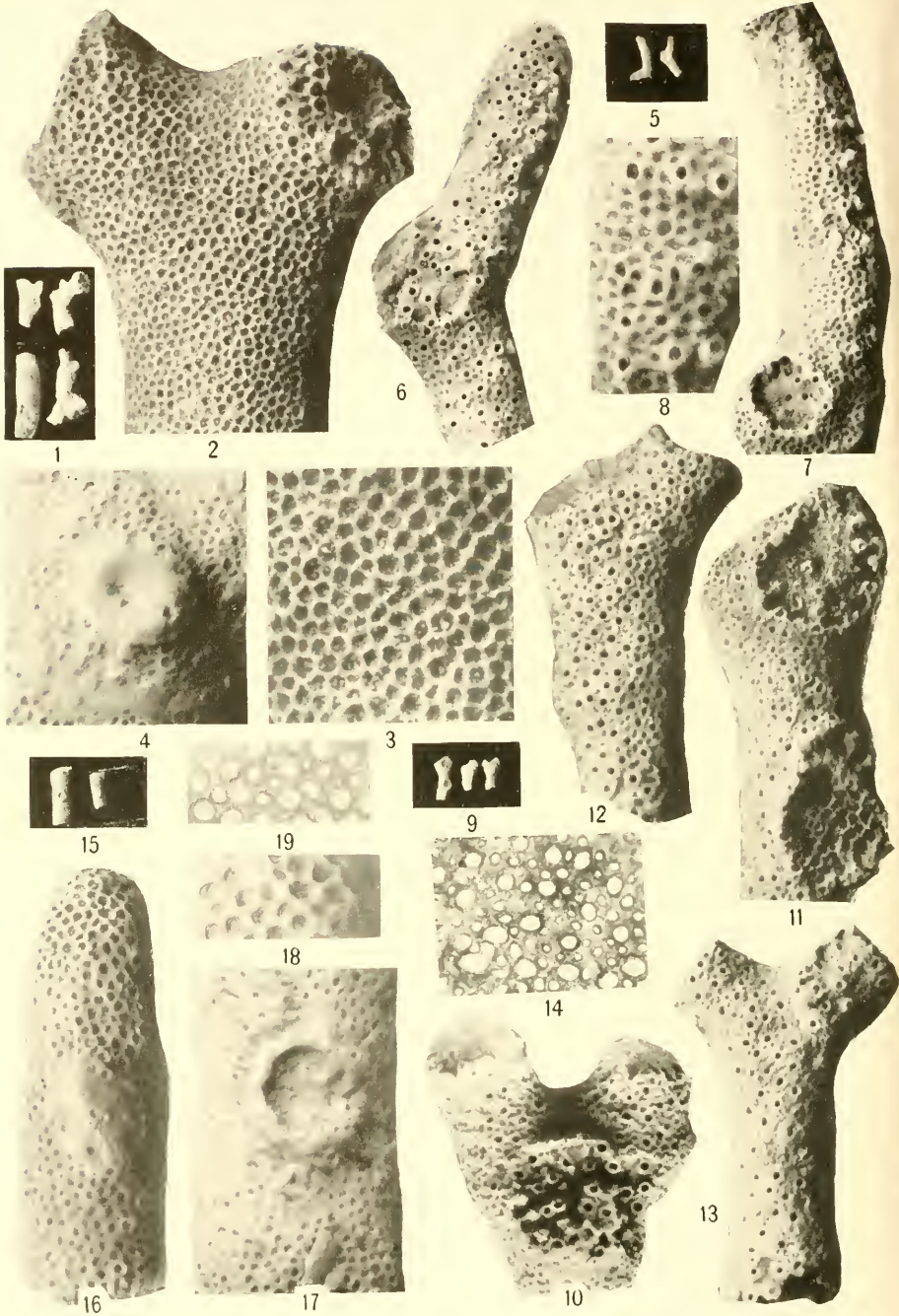
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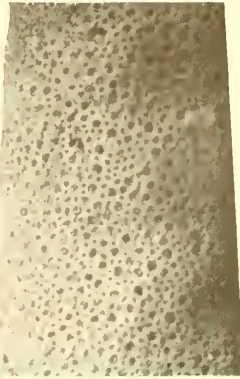
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15. Surface, $\times 25$.	
Lower Cretaceous (Valangian): Sainte-Croix, Swit- zerland.	



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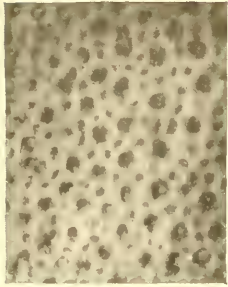
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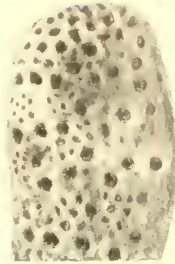
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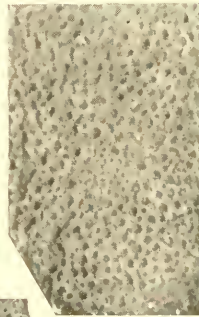
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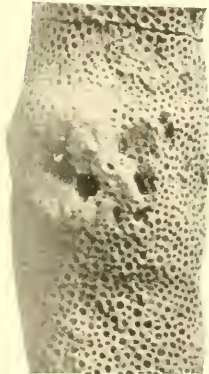
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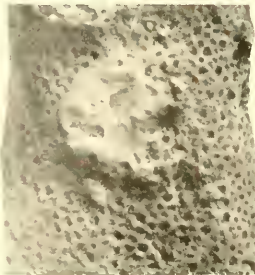
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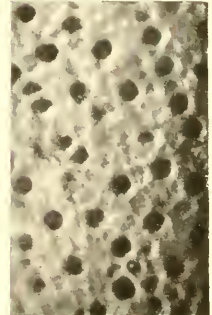
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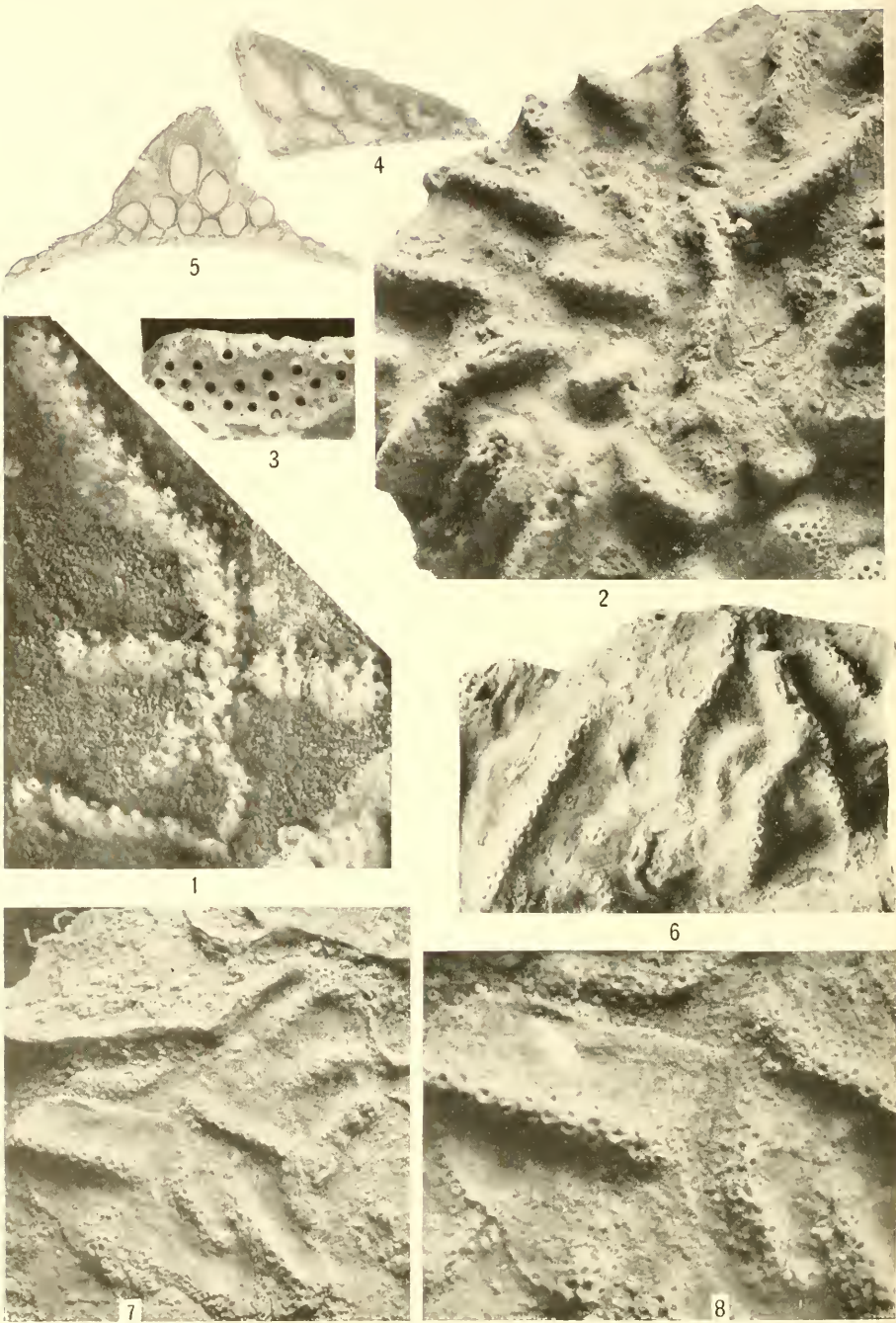
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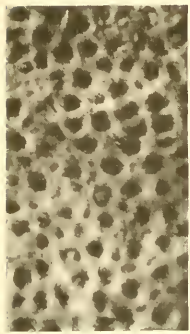
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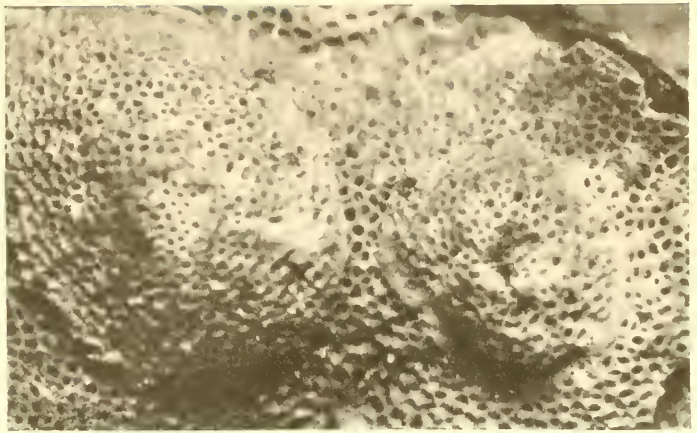
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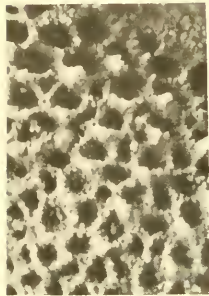
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| Lower Cretaceous (Aptian): Faringdon, England. | |



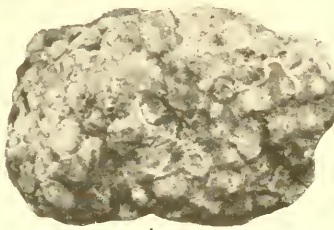
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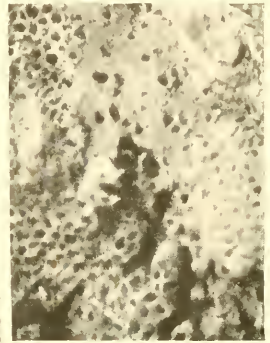
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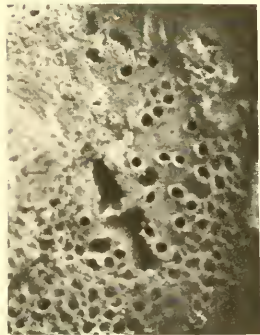
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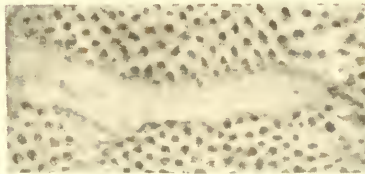
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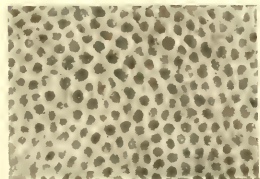
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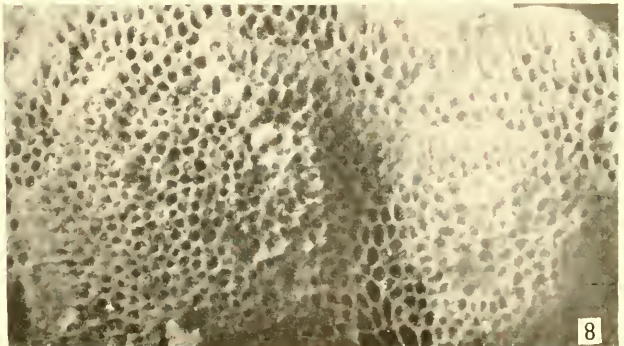
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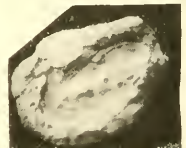
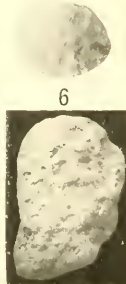
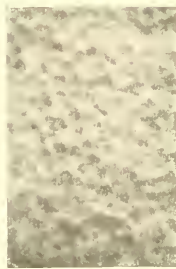
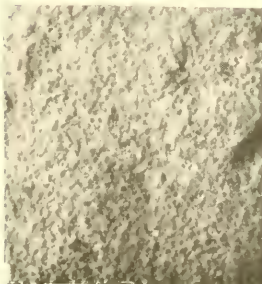
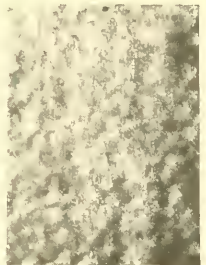
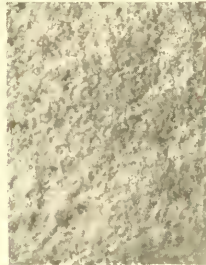
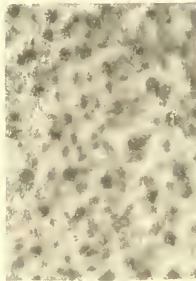
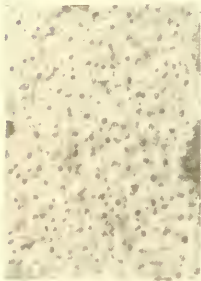
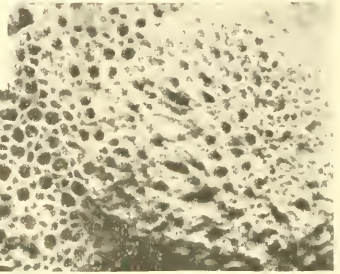
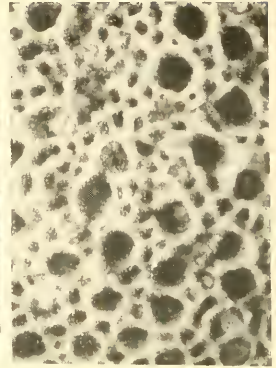
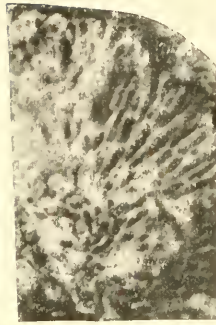
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LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

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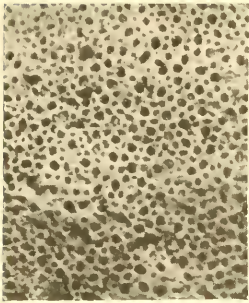
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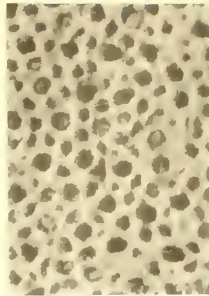
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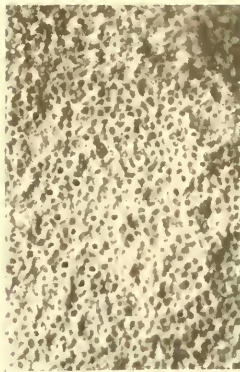
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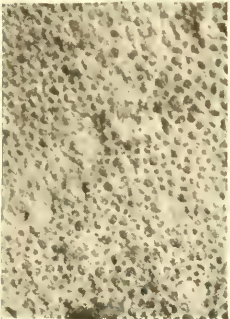
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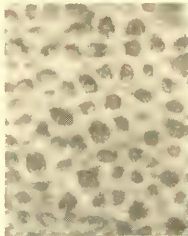
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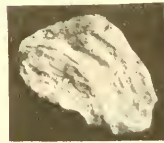
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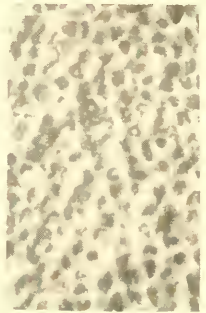
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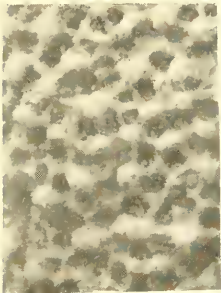
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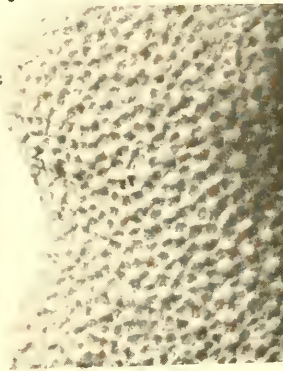
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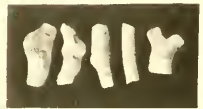
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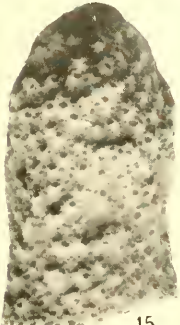
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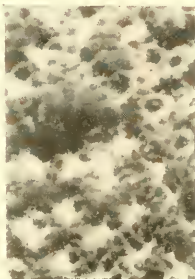
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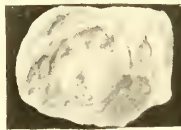
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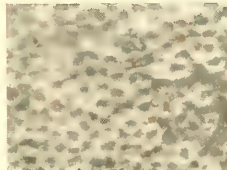
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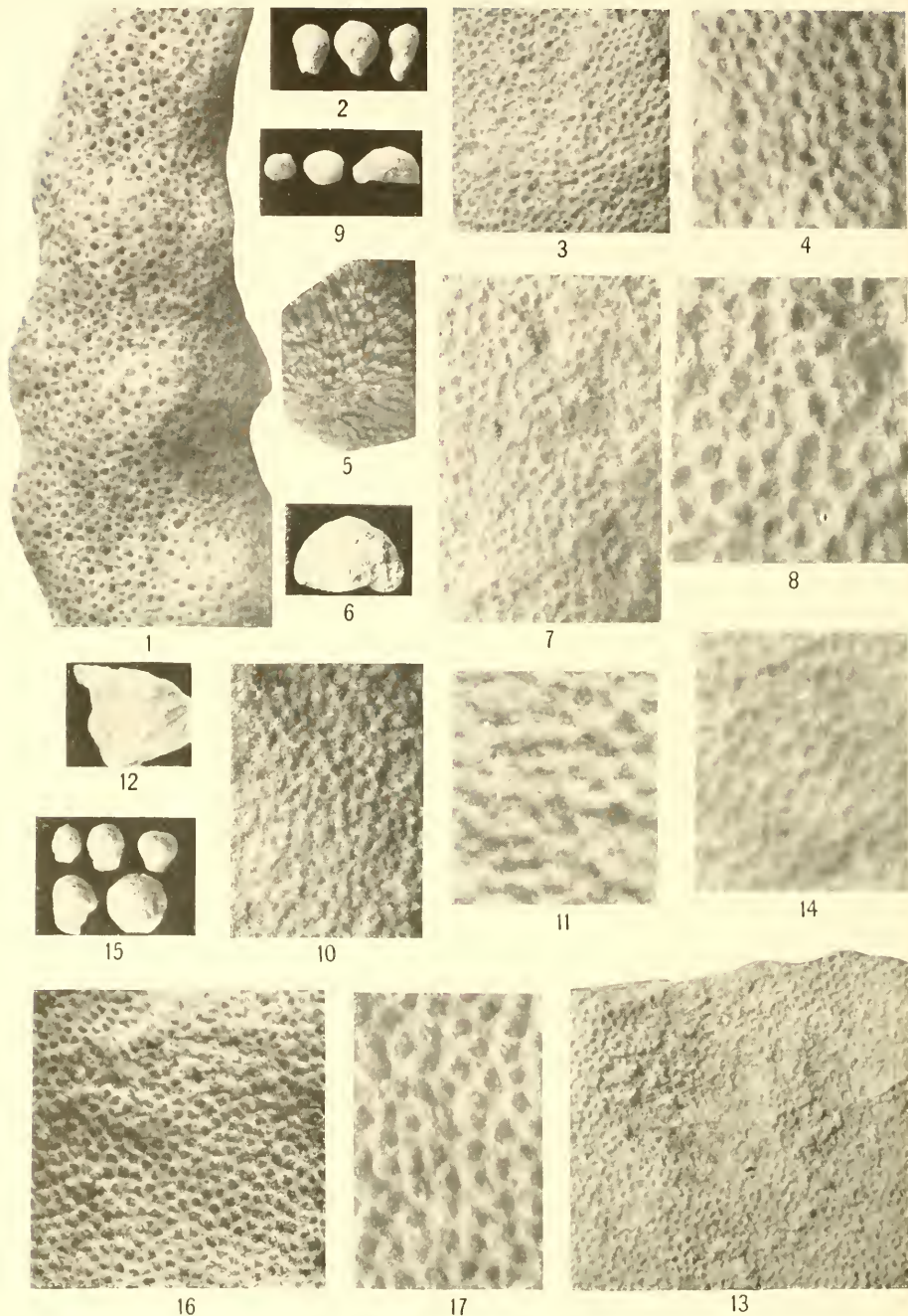
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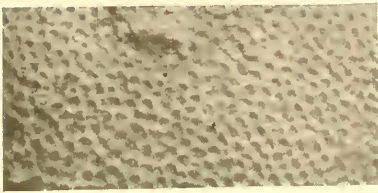
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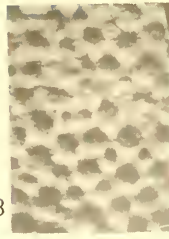
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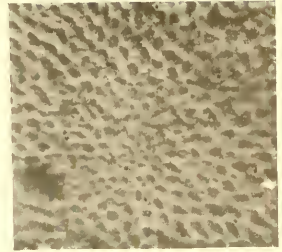
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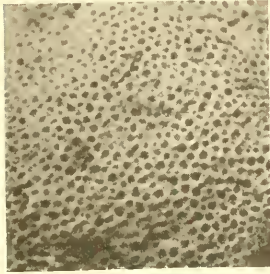
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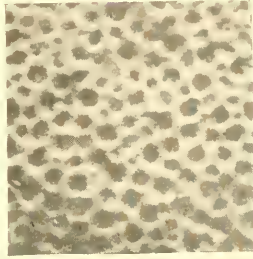
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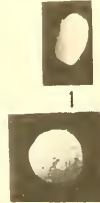
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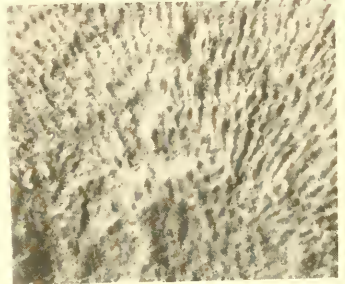
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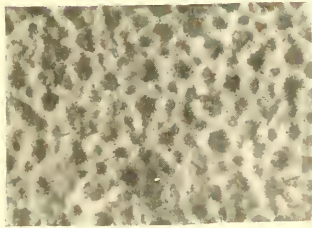
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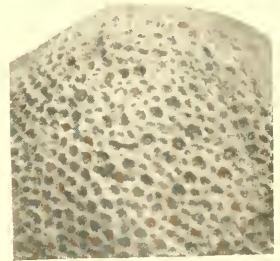
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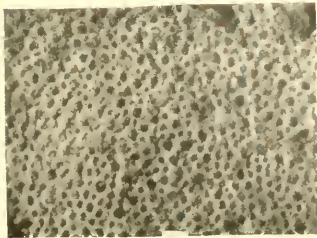
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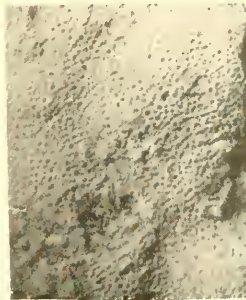
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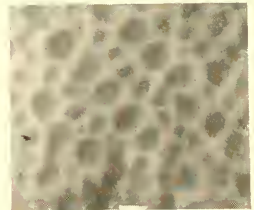
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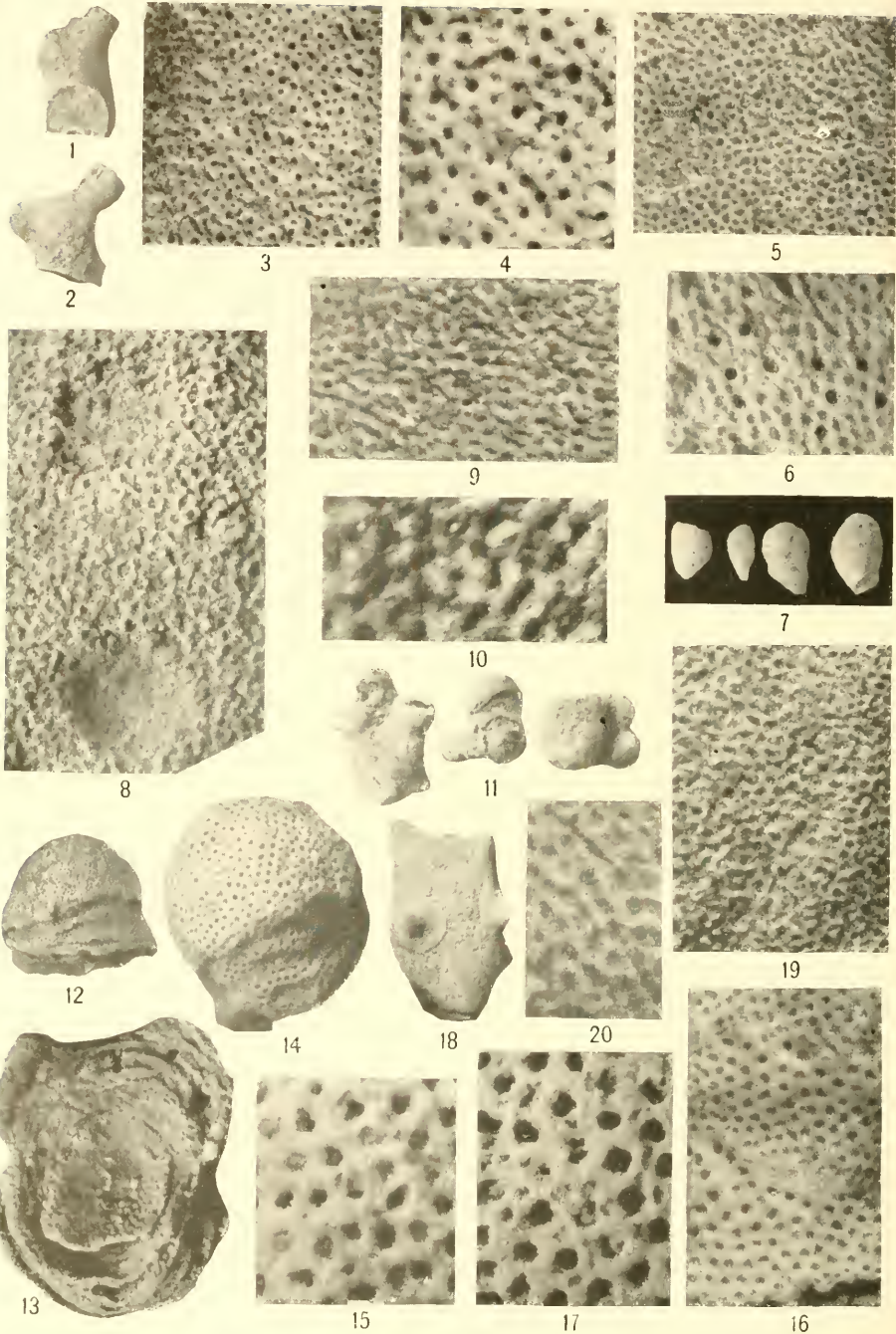
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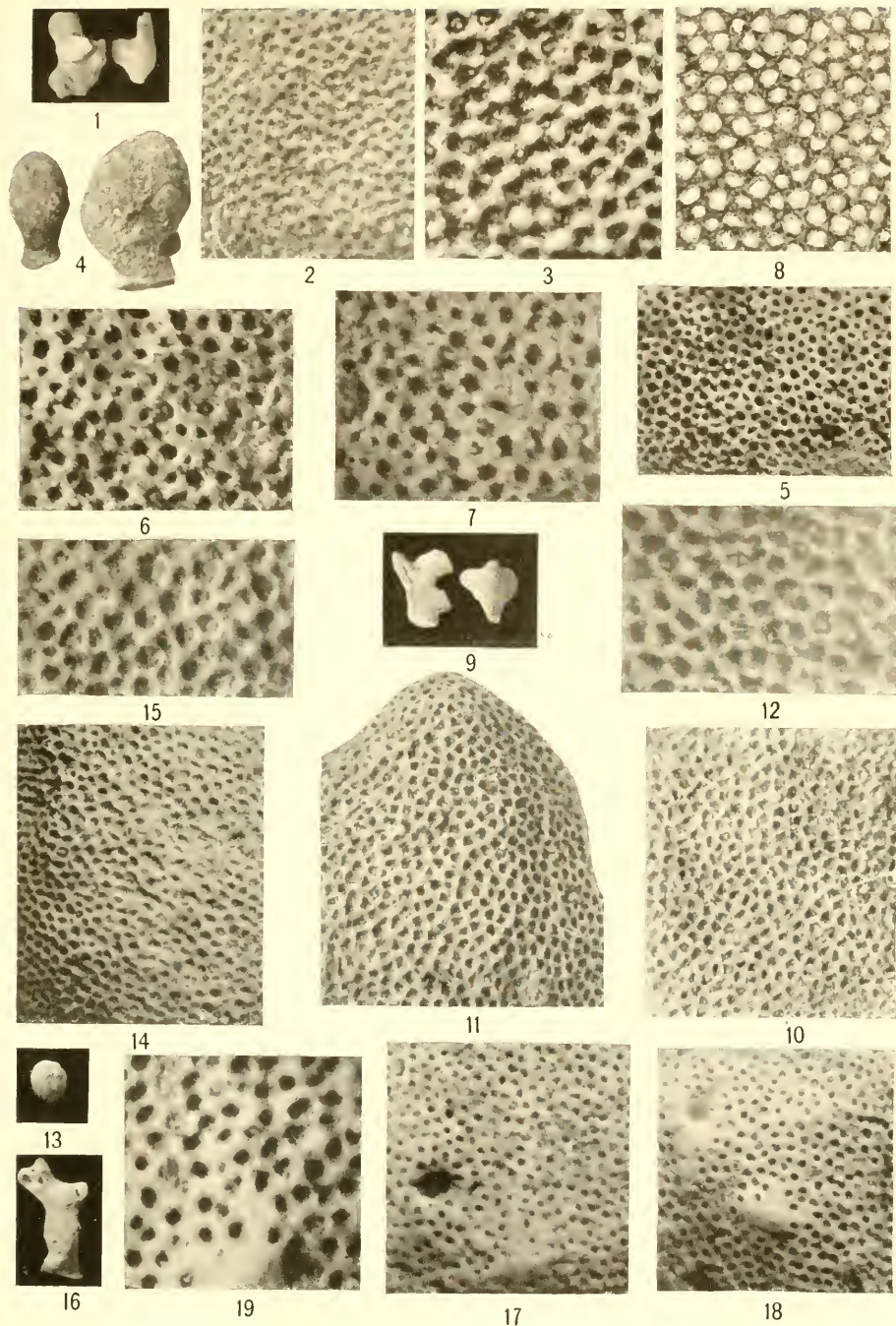
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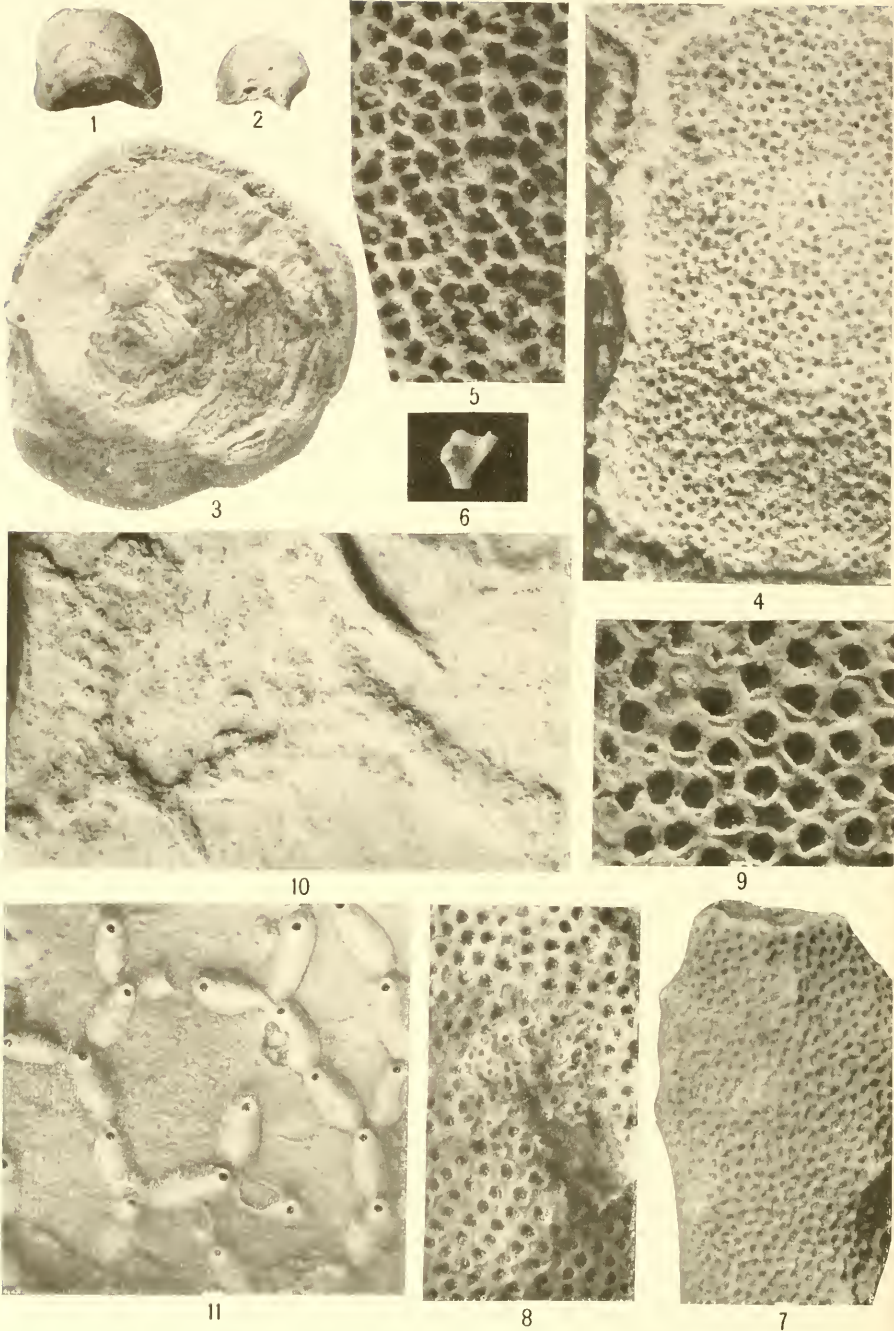
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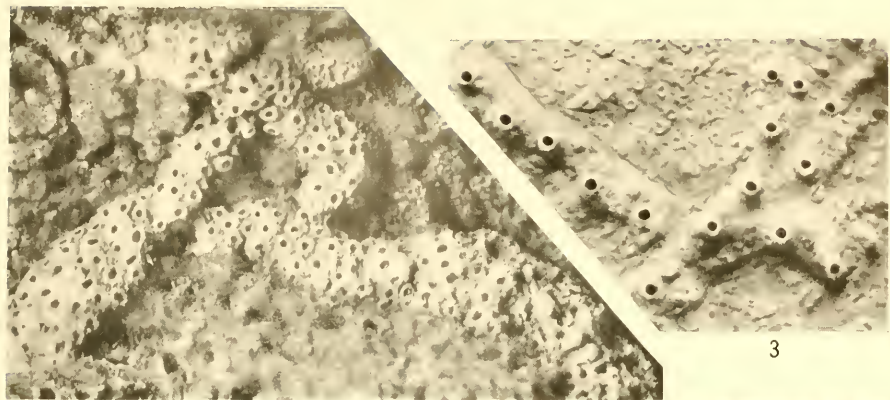
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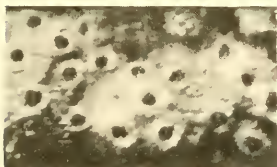
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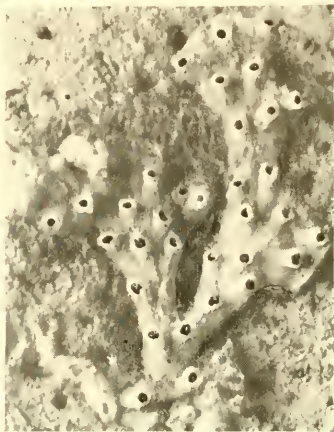
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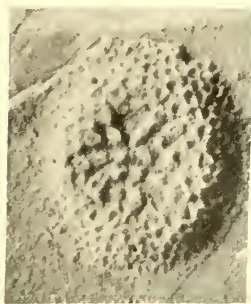
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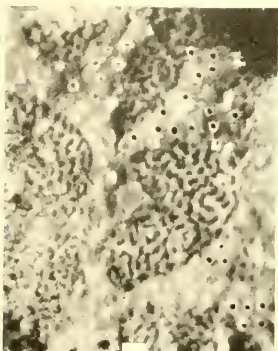
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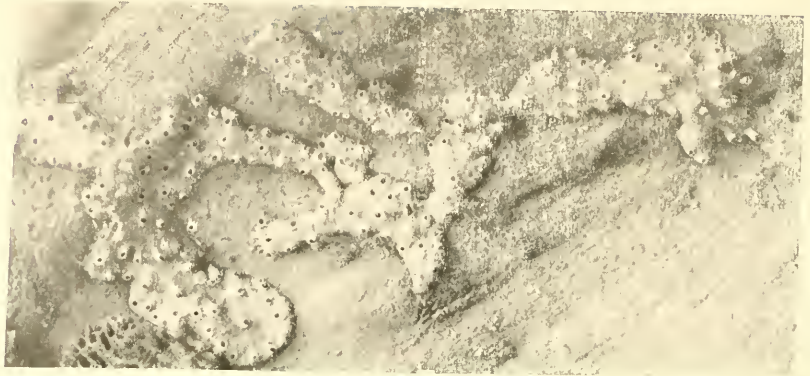
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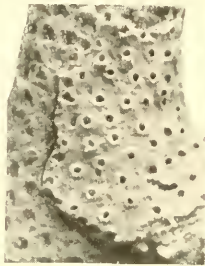
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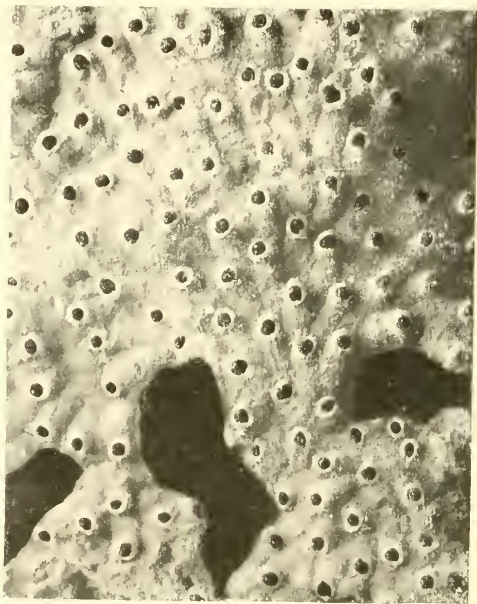
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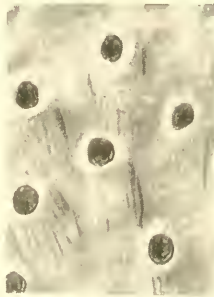
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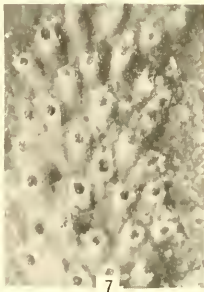
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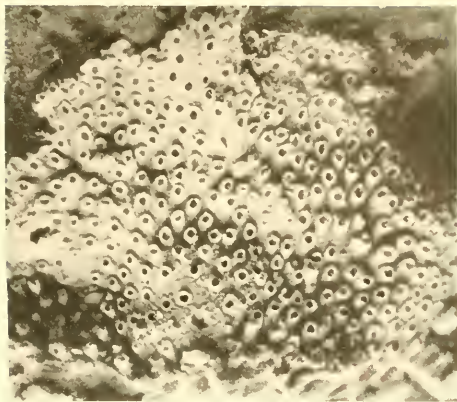
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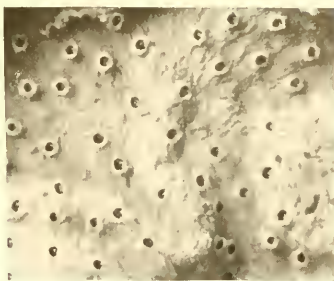
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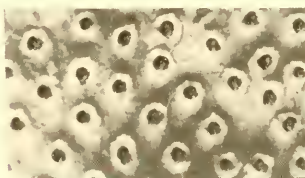
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Lower Cretaceous (Aptian): Faringdon, England.	



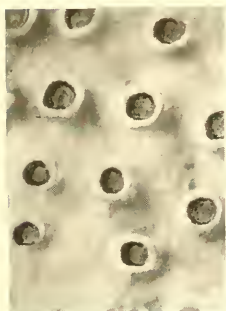
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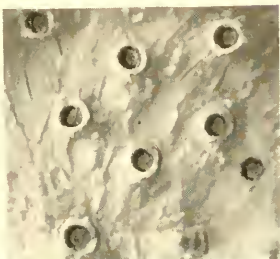
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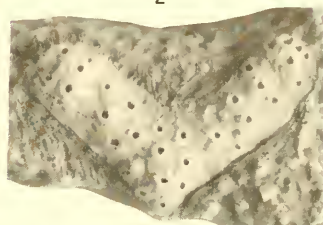
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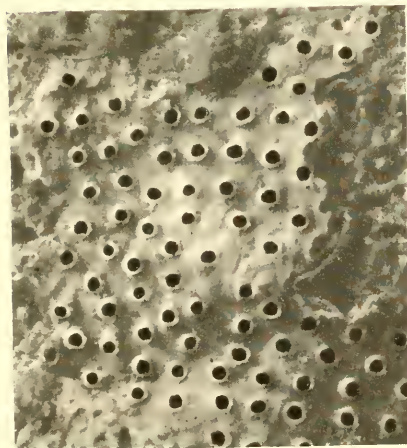
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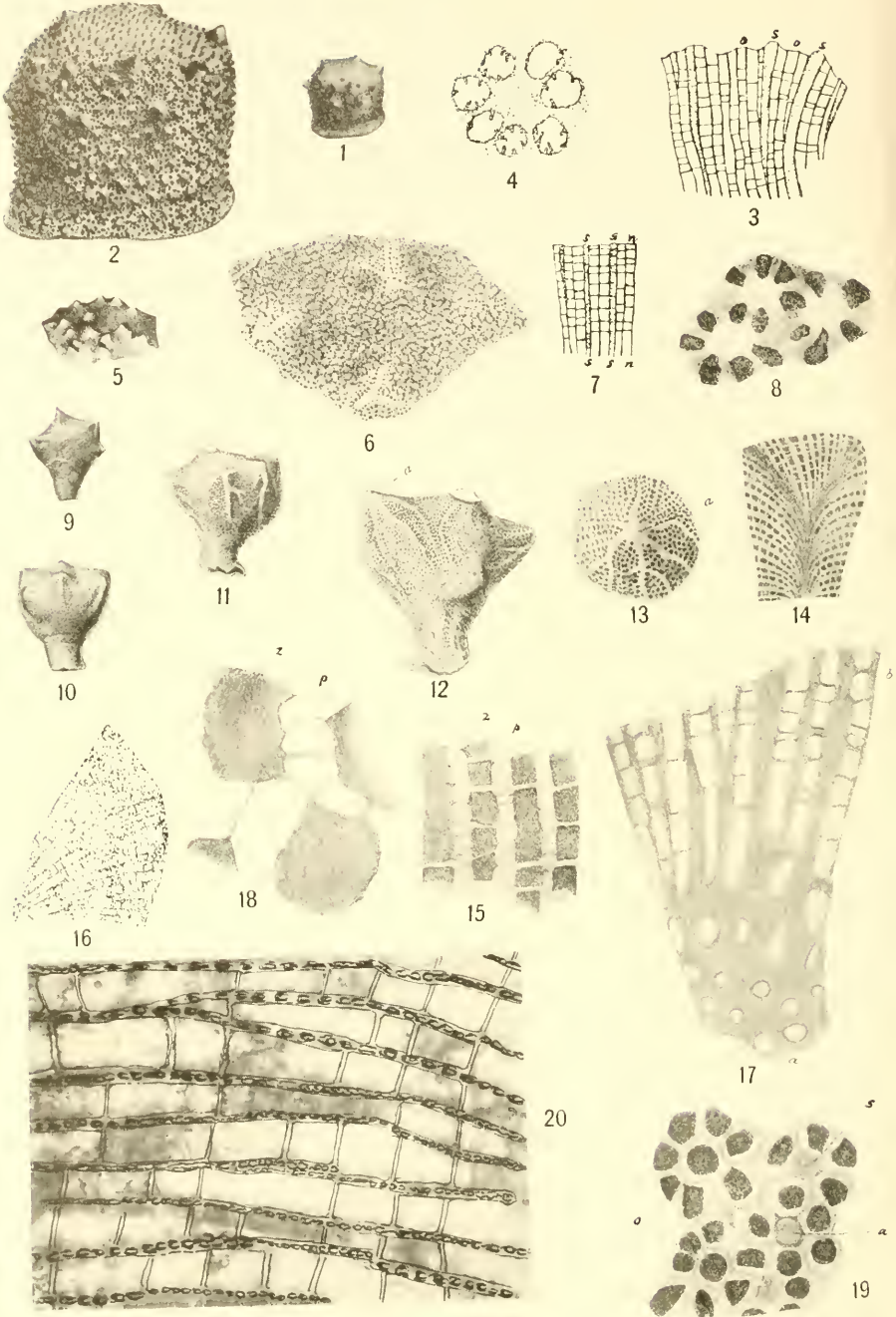
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9

LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

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LOWER CRETACEOUS CYCLOSTOMATOUS BRYOZOA

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