

VIII. *On the British Palæogene Bryozoa.* By J. W. GREGORY, B.Sc., F.Z.S.,  
*British Museum (Nat. Hist.).*

Received May 17th, 1892, read June 14th, 1892.

[PLATES XXIX.—XXXII.]

CONTENTS.

	Page		Page
I. Introduction .....	219	V. Miscellaneous Records .....	262
II. Terminology .....	220	VI. Stratigraphical Distribution ..	263
III. Classification .....	221	VII. Affinities of the Fauna .....	264
IV. Systematic Synopsis .....	225	VIII. Bibliography .....	266
IV. a. The Systematic Position of the <i>Adeonellidae</i> .....	241	IX. Explanation of the Plates .....	276

I. *Introduction.*

PROBABLY few groups of British Neozoic fossils have been so much neglected as the British Lower Cainozoic Bryozoa. While those of the Crag were carefully monographed by Busk in 1850 and those of the Cretaceous, Jurassic, and Palæozoic rocks have been described in numerous memoirs, but little has been done on the Palæogene fauna. In Morris's 'Catalogue of British Fossils' published in 1843 only one species is mentioned, and it was not till 1850 that some were described and figured by Lonsdale in Dixon's 'Geology of Sussex'; he described four species, of which only one was regarded as new. In 1866 the next contribution was made by Busk [No. 7] in a paper entitled "Description of three Species of Polyzoa from the London Clay of Highgate, in the collection of N. T. Wetherell, Esq., F.G.S." This paper, short though it be, is the best piece of work that has been done on the British Eocene Bryozoa. Since then Mr. G. R. Vine [A, p. 673] has published a list of the recorded species and has subsequently described two collections, both of which are now in the British Museum. With these additions the list numbered twenty-one, but of these only four are here retained, as the remainder are either based on identifications that I have been unable to verify or on indeterminable fragments.

The neglect of this group has no doubt been mainly due to the comparative rarity of specimens: collectors who have devoted a good deal of time to our Lower Tertiaries have only met with a few fragments and have not felt much interest in them. Even in the principal Museums the British Palæogene Bryozoa are very sparsely represented, with the single exception of the British Museum, which contains all the material from many large collections; the collection there now includes all existing types and figured specimens, with the exception of one specimen figured in this communication. The principal part of the Bryozoa collection in the British Museum consists of the

“F. E. Edwards Collection,” including Lonsdale’s types. Busk’s types and many other specimens were obtained with the “Wetherell Collection,” while additions from the London Clay of Fareham and Sheppey were made by the acquisition of the collections of Mr. G. R. Vine and Mr. A. Bell.

The present paper therefore consists mainly of a description of the British Museum Collection, and for permission to undertake this I have to thank Dr. H. Woodward, F.R.S. I have of course examined all other available material, including that in the Reed Collection at York, at the Woodwardian Museum, Cambridge, and in the Museum of Practical Geology. I must also thank Mr. E. H. M. Platnauer and Mr. E. T. Newton for valuable assistance when examining the collections under their care; and I am especially indebted to Mr. H. Woods for the kind loan of the Cambridge specimens.

Furthermore I must express my best thanks to my colleague Mr. R. Kirkpatrick, of the Zoological Department, for his ever-ready assistance; owing to his kindness, I have enjoyed every opportunity for the examination of the collections of recent Bryozoa, and especially the type specimens, to which constant reference has been necessary; he has also repeatedly discussed the difficulties that have been met with, and his knowledge of the recent Bryozoa and their literature has always been placed most generously at my service.

## II. Terminology.

Most of the terms employed have a well-established meaning, and consequently do not require to be here referred to; but the apertures and pores of the Cheilostomata are so important in diagnosis, and have been so differently employed therein, that it seems advisable to define them. At the same time a few alterations in terminology are suggested, as it is hoped thereby to secure greater precision in the description of the fauna.

*Orifice.* The opening of the mouth of the polypide: it corresponds in size and shape to the operculum. In fossil Membraniporidae, &c., it cannot be determined.

*Aperture.* The opening occupied by the membranous area which surrounds the orifice. The aperture may be *primary* and either correspond to the orifice as in *Lepralia* or may be a large space in the middle of which the orifice opened, as in *Membranipora*. Or it may be *secondary*, formed by the peristome rising up into a tube and concealing the original primary aperture; the form of the latter may, however, be always told from the operculum.

*Sinus.* A notch on the lower side of the aperture, as in *Schizoporella*.

*Trypa.* A pore which perforates the front wall of the zoecium; it occurs only in the Micro-porellidae: it is generally assumed to correspond to the sinus.

Other names have been previously given to this, but there seem to be valid objections to them all. Jullien has called it the “fenestrula;” but this term is already in use for the interspaces in the zoarium of the Fenestellidae. D’Orbigny included it among the “special pores,” and as such it is often referred to, though this also includes different structures.

The term “zoecial pore” is hardly definite enough; the terms “true pore,” “accessory opening” (*D’Orbigny*), “central pore” (*Busk*), are subject to the same objection.

*Peristomial Pore* ("Sublabial pore" of Busk). A pore below the aperture which simply leads into the peristomial chamber.

*Punctures*. A series of pores left between the anastomosing spines of the front wall of *Cribrilina*, &c.  
*Areolæ*. Pits or tubular depressions occurring in linear series around the margins of zoœcia, *e. g.* in *Notamia wetherelli*.

*Maculæ*. A term suggested for the small irregular cavities in the walls of the zoœcia: they correspond to the main part of the "pores d'origelles" of Jullien [No. 3, p. 607], but since Pergens [No. 7] has thrown such discredit on Jullien's views on these structures it seems hardly advisable to circulate this term. The name is derived from "maculæ," the meshes of a net, as, according to Pergens, they originate simply by non-calcification of part of the wall. When seen on the front wall of a zoœcium they resemble small pits or depressions.

*Opeziulæ*. A term applied by Jullien to the secondary small apertures, of which a pair usually occur on the front walls of the zoœcia of *Micropora*, &c.

### III. Classification.

Probably no one who has tried to determine to which of the twenty to thirty families of Cheilostomata some form new to him must be referred will complain of an attempt to arrange these families into groups. Among the Euechinoidea, for example, there are twenty-five families distributed amongst five orders, some of which are divided into sub-orders. But among the Cheilostomata we have as many or more families, without any definite larger groups, except the ill-fated ones proposed by Dr. Jullien [No. 4] and the antiquated ones of Mr. Busk<sup>1</sup>. The inconveniences of this are manifold; the diagnosis of each family has to be of inconvenient length, and the task of discovering the exact systematic position of any species is a matter of much difficulty.

Neither the Rev. T. H. Hincks nor Mr. Waters offer much encouragement to an attempt at any serious alteration, as the former points out emphatically that all classifications at present must be tentative and the latter discourages what he calls "an attack along the whole line." But then all classifications are probably more or less tentative and temporary, and, so far as I am able to judge, some grouping of the families is an essential preliminary to an attempt to revise the families in detail and dissipate the chaos in which at present the fossil Bryozoa are involved.

Though there is of course much uncertainty as to the exact taxonomic value of several characters, there does seem to be a pretty general agreement as to the most important structures. The development of the front wall seems about the leading feature, as so many of the other characters, *e. g.* the aperture, the position and development of avicularia, &c., are correlated with this. The use made by Jullien of the front wall has perhaps prejudiced some workers against this structure; but Jullien has based his classification on modifications that most workers regard as of very slight value, while his method of nomenclature is quite his own. As M. Dollfus has pointed out in an admirable criticism, Dr. Jullien simply does not accept the principle of priority.

<sup>1</sup> Busk of course based his divisions on zoarial characters, and these, though somewhat improved by Dr. Ortmann [No. 1, pp. 3, 4], are now quite inadequate.

Three groups of the Cheilostomata may be conveniently based on the character of the front wall. In one, including the Membraniporidan series, this structure is absent or only imperfectly developed: the name of "Athyriata" (from  $\alpha$  and  $\theta\upsilon\rho\epsilon\delta\alpha$ , an oblong shield) is therefore suggested for it. In a second group the wall is well developed, but there is an additional communication between the exterior and the polypide by means of a pore (trypa) on the front wall or by a sinus on the lower margin of the orifice. The exact homology of these two structures has never, so far as I am aware, been clearly demonstrated, but it has been generally accepted, for example, by Hincks, Waters, and Macgillivray. For this group the name of "Schizothyriata" is proposed. Finally, there is the group in which the calcification of the front wall is complete; it may therefore be called the "Holothyriata."

In addition to these there is a series of forms whose affinities seem very doubtful. With one or two exceptions they are rarely or never found fossil, and my opportunities of studying them have been but limited. They may be divided into two divisions, one of which may be a natural group. This includes the  $\mathcal{C}\epsilon$ tiidæ, Chlidoniidæ, and Eucratiidæ; the terminal or subterminal apertures and simple tubular or pyriform zoecia of these families suggest that they are among the most primitive of living Cheilostomata. They are here left grouped together, and Busk's name, the Stolonata, is accepted. For the other division Smitt's name of "Cellularina" is adopted; but this is certainly not a natural group. Thus some, such as the Cellulariidæ, Bicellulariidæ, and Epistomiidæ (Notamiidæ of Hincks), seem clearly allied by their large membranous areas and aperture to the Membraniporidan group; the Catenariidæ may include representatives of both the Holothyriata (e. g. *Catenicella utriculus*, Macgill.) and the Schizothyriata. Among the latter there may be divisions corresponding to both of the great families; thus *Catenicella amphora*, Busk, is analogous to the Microporellidæ, and *C. pulchella* (Maplestone) to the Schizoporellidæ. It is, however, not improbable that the Catenicellidæ branched off independently from the main Cheilostomatous stem at a very early period.

Without more detailed information upon the anatomical structure of the polypides of the families in this "carpet-bag" group it seems unadvisable to attempt to place them definitely. In the Catenariidæ we have both holostomatous and schizostomatous (e. g. *Claviporella*) genera, but until we know more of the anatomy of the polypides it seems very uncertain as to whether this character possesses the same significance as in those higher Cheilostomata where the skeleton is of a specialized and complex type. Amongst these the hard parts certainly seem to offer reliable classificatory characters.

Through each of the three suborders an evolutionary series can be traced. Thus among the Athyriata the Membranoporidae seem to be the most primitive, and this family passes up into the Cribrilinidæ and Hiantoporidae in the manner suggested by Mr. Hincks [No. 2, pp. 199-200, and No. 5 [pt. 3], pp. 471-472 and 479-480] and Mr. Kirkpatrick [No. 2, pp. 616-617].

There seems to be a similar evolutionary series in the Holothyriata, where the main branch develops from the simple *Cyclicoporinae* through the *Lepralinae* to the more specialized Smittiidae; also in the Schizothyriata from the simple *Schizoporella* or *Schismoporella* to such a form as *Aeonella pectinata*.

The division of both the Reteporidae and Celleporidae into the schizostomatous and holostomatous groups appears to be generally regarded as inevitable. The dismemberment of the Selenariidae is more likely to be criticized, but it is not a new idea. It was first done by Prof. Smitt in 1873 [No. 3], and Mr. Hincks [No. 7, p. 125] has given it the sanction of his high authority by the remark in describing *Cupularia umbellata*, Defr., that "this form clearly belongs to the Steganoporellidan series and must be transferred to it."

The survival of the family Selenariidae seems to me to well illustrate the necessity for a grouping of the families; so long as these have been allowed to remain in independence, such an *olla-podrida* of species of different families agreeing only in zoarial form has been able to hang together. The moment we introduce a more scientific system, define suborders, and try to indicate the affinities of the families, such a group as the Selenariidae falls to pieces.

These remarks are not intended as a formal defence of the classification. Its publication will be justified only if it is found to aid in bringing the Cheilostomata, and especially the fossil forms, into better order than they are in at present.

*Synopsis of the Classification followed.*

Order CHEILOSTOMATA.

I. Suborder STOLONATA.

Forms with simple tubular zoëcia and terminal or subterminal apertures.

- Family 1. AETIIDÆ. For diagnosis see Macgillivray, No. 3, p. 195.  
 2. EUCRATIIDÆ. " " " p. 196.  
 3. CHLIDONIIDÆ. " " " p. 196.

II. Suborder CELLULARINA.

A group of forms with simple zoëcia and tufted phytoid zoaria, and probably including representatives of the three following suborders.

- Family 4. CELLULARIIDÆ. For diagnosis see Macgillivray, No. 3, p. 199.  
 5. BICELLARIIDÆ. " " " p. 202.  
 6. EPISTOMIIDÆ (Notamiidæ). " Hincks, No. 2, p. 98.  
 7. CATENICELLIDÆ. " Macgillivray, No. 3, p. 197.  
 8. BIFAXARIIDÆ. " " " p. 199.

III. Suborder ATHYRIATA.

Cheilostomata with the front wall uncalcified or incompletely calcified.

- Family 9. FARCIMINARIIDÆ. For diagnosis see Macgillivray, No. 3, p. 204.  
 10. FLUSTRIDÆ. " " " p. 203.

- Family 11. MEMBRANIPORIDÆ. Athyriata with the front wall mainly membranous and occupied by an opesia aperture; this does not correspond to the operculum. The opesia is surrounded by a raised margin. External oœcia.
- Subfamily 1. *Membraniporinae*. Membraniporidæ with open opesia and without, or with but a small, extra-opesia front wall
- Subfamily 2. *Electrininae*. Membraniporidæ with the normal zoœcia tubular and with a terminal opesia.
- Subfamily 3. *Lunulitinae*. Membraniporidæ with patelliform zoaria, and with vibracularia systematically arranged.
- Family 12. CRIBRILINIDÆ. Athyriata with a front wall formed by the overarching and branching of one or more spines. External oœcia.
- Subfamily 1. *Cribrilininae*. Cribrilinidæ with the front wall formed by the overarching and fusion of numerous circumareal spines; the interspaces remain as grooves or pores.
- Subfamily 2. *Hiantoporinae*. Cribrilinidæ with the front wall formed of one large spine arising from the margin.
- Subfamily 3. *Steginoporinae*. Cribrilinidæ with the front wall formed by the overarching of spines arising from the peristome.
- Family 13. MICROPORIDÆ. Athyriata with a calcified front wall. Zoœcia surrounded by raised margins. No internal diaphragms. External oœcia.
- Subfamily 1. *Microporinae*. Zoœcia all normal or onychocellaria (large vicarious avicularia) irregularly distributed.
- Subfamily 2. *Selenarinae*. Microporidæ with patelliform zoaria and vibracularia systematically arranged.
- Family 14. STEGANOPORELLIDÆ. Athyriata without external oœcia and with the zoœcia divided into two chambers by a calcareous diaphragm.
- Family 15. CELLARIIDÆ. Athyriata with internal oœcia which open by a pore above the aperture. The zoœcia are surrounded by raised margins; the aperture is situated within the depressed front wall.

#### IV. Suborder SCHIZOTHYRIATA.

Cheilostomata which are schizostomatous or trypiate (*i. e.* provided with a trypa; see p. 220) or both.

Family 16. SCHIZOPORELLIDÆ. Schizothyriata not provided with a trypa.

- Subfamily 1. *Schizoporellinae*. Schizoporellidæ with simple primary aperture and external oœcia.
- Subfamily 2. *Schizoreteporinae*.<sup>1</sup> Schizoporellidæ with the zoœcia obliquely placed on a unilaminar, reticulate or ramose, erect zoarium.
- Subfamily 3. *Schismoporinae*.<sup>2</sup> Schizoporellidæ with urceolate zoœcia growing in dense masses; aperture terminal or subterminal.
- Subfamily 4. *Biporinae*. Schizoporellidæ with a patelliform unilaminar zoarium, with vibracularia systematically arranged.

<sup>1</sup> *Schizoretepora*, n. gen., for which at present the subfamily diagnosis also serves as the diagnosis, is the type genus; it includes the schizostomatous Reteporas, of which *S. (R.) tessellata* (Hincks) [No. 2, p. 358, pl. xix. figs. 9-12], is a convenient type.

<sup>2</sup> *Schismopora*, Macgillivray [No. 4, p. 29], is the type genus, and *S. costata* the type species: it does not

- Family 17. ADEONELLIDÆ. Schizothyriata with a schizostomatous primary aperture and a variable secondary aperture. Gonœcia and no external marsupia.
- Family 18. MICROPORELLIDÆ. Schizothyriata provided with a trypa.
- Subfamily 1. *Microporellinæ*. Holostomatous Microporellidæ with external marsupia.
- „ 2. *Schismoporellinæ*. Microporellidæ which are both schizostomatous and trypiate.
- „ 3. *Adeoninæ*. Microporellidæ which are holostomatous and have gonœcia, but no external marsupia.

## V. Suborder HOLOTHYRIATA.

Holostomatous Cheilostomata which have the front wall wholly calcified.

- Family 19. LEPRALIIDÆ. Holothyriata with a simple primary aperture.
- Subfamily 1. *Lepraliinæ*. Lepraliidæ with external œcia.
- Alliance 1. *Cycliopora*. Lepraliinæ with simple zoœcia having orbicular apertures which are often surrounded by raised rims.
- Alliance 2. *Lepralia*. Lepraliinæ with the aperture usually horseshoe-shaped and never truly orbicular.
- Subfamily 2. *Teichoporinæ*. Lepraliidæ with gonœcia and no external œcia.
- „ 3. *Reteporinæ*. Lepraliidæ with the zoœcia obliquely placed on a unilaminar, reticulate or ramose, erect zoarium.
- Family 20. CELLEPORIDÆ. Holothyriata with barrel-shaped or urceolate zoœcia, usually growing in heaped masses; aperture terminal or subterminal.
- Family 21. SMITTIIDÆ. Holothyriata with a raised secondary orifice; the primary orifice is often denticulate.

## Order CYCLOSTOMATA.

- Family 1. IDMONEIDÆ. | Family 2. HETEROPORIDÆ.

IV. *Systematic Synopsis.***Class ECTOPROCTA.**

## Subclass GYMNOLEMATATA.

## Order CHEILOSTOMATA.

## Suborder STOLONATA.

## Family EUCRATIIDÆ.

Genus NOTAMIA, Fleming, 1828 (non Busk, Hincks, &c.).

*Diagnosis.* Zoarium erect and phytoid; zoœcia biserial, joined back to back; the apertures of each series respectively open in the same direction. Aperture large, on the front of the cell. Neither vibracula, avicularia, nor œcia. [Fleming, No. 1, p. 541.]

---

appear to have been formally diagnosed; but the list of six species with the figures of their opercula published in the 'Prodromus' leaves no doubt as to its nature. [Macgillivray, No. 1, dec. xvii. pp. 168, figs. 1-6. See also Macgillivray, No. 2, pt. v. pl. ii.]

Species 1. *NOTAMIA WETHERELLI* (Busk), 1866.

Syn. *Dittosaria wetherelli*, G. Busk, 1866, Geol. Mag. iii. p. 301; G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. pp. 158-159, pl. v. fig. 1.

*Records.* W. Whitaker, No. 1, p. 594; G. R. Vine, No. 1, p. 673.

*Diagnosis.* Zoarium in small phytoid tufts; imperfectly known. Branching dichotomous.

Zoecia elongate, pyriform. Aperture median and symmetrical, oval, the longer axis in the direction of the length of the zoarium. The aperture opens on the upper border and occupies about a quarter of the front of the zoecium. The surface is ornamented with a double series of areolæ; the innermost series forms an ellipse passing close round the upperside of the aperture and crossing the front wall at about the middle; the outermost series runs close along the hinder margin. The number varies from 8 to 16 in the inner series, and from 20 to 26 in the outer.

*Distribution.* London Clay, Highgate (Brit. Mus.).

*Dimensions.* The zoecia of the specimen figured measure a trifle over .5 mm. in length.

*Figures.* Pl. XXIX. figs. 1 *a*, *b*. Part of a zoarium,  $\times 37$  diam. Brit. Mus.

*Affinities of the Species.* This species differs from *Notamia loricata* (Linn.) in that in the recent species the aperture occupies half the front of the zoecium and is obliquely placed; it also has no regular series of areolæ. The same characters serve to distinguish it from *Notamia americana* (Lamx.)<sup>1</sup>. A nearer ally is the *Notamia prima* (Reuss)<sup>2</sup>, which differs from it by the smallness of the mouth and the absence of areolæ.

*Remarks.* This species was founded by Busk on a specimen in the Wetherell Collection which cannot now be recognized, but other specimens labelled by Busk occur and enjoy almost as much authority as the actual figured specimens. Busk made it the type of a new genus, *Dittosaria*, which has been ignored or overlooked by nearly all subsequent writers. He recognized that it was a close ally of *Notamia* (*Gemellaria*), but distinguished it by its mode of branching; he restricted the old genus to those which at every fork retain a continuation of the main stem in addition to the two branches. But this is not even a specific character, as is shown by the following quotation from Mr. Hincks's [No. 2, p. 20] description of *Notamia* (*G.*) *loricata*:—"The branches are given off from each side of the uppermost pair in a stem close to the top, and at times the stem ascends between them and a triplet is formed in place of the more usual bifurcation." The only other point of difference is that the mouth in this species is not "slightly oblique" as it should be to conform to Mr. Hincks's diagnosis of the genus. But this is hardly of generic value, and Busk certainly regarded the other as the main character. The genus differs from *Pasythea*, Lamx., by the absence of the two notches at the lower corners of the aperture.

<sup>1</sup> *Loricaria americana*, Lamouroux, No. 2, p. 7, pl. lxxv. fig. 9.

<sup>2</sup> *Gemellaria prima*, Reuss, No. 7, p. 170. pl. vii. figs. 6, 7.

NOTE ON THE USE OF THE NAME *Gemellaria*.—The name *Gemellaria* was first invented for a genus of Bryozoa by J. C. Savigny somewhere about the year 1810; it was not, however, published till 1826 [Audouin, No. 1, p. 242], and then only in the French form of *Gémellaire*; so far as I am aware, it was first used in a Latinized form in 1830 by Blainville [No. 2, p. 425], who did not himself accept it. Before the publication of *Gemellaria* or *Gémellaire* the genus had been described in 1821 by Lamouroux [No. 2, p. 7], who named it *Loricaria*. Audouin, who completed Savigny's work when the latter was disabled by ill-health, of course treated "*Gémellaire*" as a manuscript name and accepted *Loricaria*. Most subsequent authorities, however, have accepted *Gemellaria* and date it from 1805, 1809, or 1811. Johnston [No. 2, p. 293, footnote] seems to have entertained doubts as to the accuracy of this proceeding, but accepted it on the idea that copies of some work of Savigny's had been placed in the principal libraries; he obviously could get no reliable information regarding it.

Mr. Hincks accepts the genus and quotes as its author "Savigny, 1811." The only reference he gives in his Bibliography [No. 2, p. 588] to Savigny is "Iconographie des Zoophytes de l'Égypte," from the 'Description de l'Égypte.' Miss Jelly [No. 1, p. 284] quotes the same work, and so does Macgillivray [No. 3, p. 223], who, however, adds "not seen by me." I regret to have been unable to find any such work; there is none such in the Natural History Museum copy of the 'Description de l'Égypte,' nor is any referred to in "A Bibliographical Account and Collation of 'La Description de l'Égypte'" (London Institution: private circulation, 1838, 8vo, 76 pp.). None of the ordinary bibliographical works of reference give any information regarding it. I therefore cannot help concluding that the authorities who have quoted this mysterious "Iconographie" really refer to Audouin's "Explication sommaire des planches de Zoophytes de l'Égypte . . . ." That the date of this is 1826 and not 1811 admits of no doubt: the work was only entrusted to Audouin for completion in 1825, and monographs issued in 1821 are quoted. *Loricaria* has therefore the prior claim to adoption, but unfortunately it had been previously used among fishes. Fleming [No. 1, p. 541], therefore, in 1828 renamed it *Notamia*. *N. loricata* he clearly regarded as the type, for the only other species he associated with it (*N. bursaria*) he made the type of a new genus, *Epistomia*. Lamouroux did not include this latter species in his *Loricaria*, but in the Sertularian *Dynamema* [No. 1, p. 79]. Fleming, it must be remembered, only proposed *Notamia* as a change of name owing to the preoccupation of *Loricaria*. The name *Notamia* cannot therefore be separated from its type species and applied to one which both Lamouroux and Fleming assigned to another genus. There is therefore no option but to follow Fleming and substitute *Notamia* for *Gemellaria* and regard the species *bursaria* as the type of *Epistomia*.

The only alternative is to accept Blainville's name *Gemicellaria* [No. 1, p. 425], proposed in 1830, but there does not seem any sufficient reason for a departure from the ordinary rule of nomenclature.

#### Suborder ATHYRIATA.

#### Family MEMBRANIPORIDÆ.

#### Subfamily MEMBRANIPORINÆ.

#### Genus MEMBRANIPORA, Blainville, 1834.

[Blainville, No. 2, p. 447.]

*Diagnosis*.<sup>1</sup> Membraniporidæ in which the opesial aperture is generally of a simple form and the lamina is absent or but slightly developed.

<sup>1</sup> It will be seen from this diagnosis that in deference to recognized opinion *Amphiblestrum* is accepted; it appears to be an artificial but very convenient group.

Species 1. MEMBRANIPORA EOCENA (Busk), 1866.

Syn. *Biflustra eocena*, G. Busk, 1866, Geol. Mag. iii. p. 300, pl. xii. fig. 2; W. Whitaker, 1872, Mem. Geol. Surv. iv. pt. 1, p. 594; G. R. Vine, 1886, Rep. Brit. Assoc. 1885, p. 673.

*Biflustra (Membranipora) eocena*, G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 160, pl. v. fig. 4.

*Flustra crassa*, Desm., J. Morris, 1843, Cat. Brit. Foss. p. 37; Huxley & Etheridge, 1865, Cat. Foss. M. P. G. p. 332; Huxley & Newton, 1878, Cat. Tert. & Post-Tert. Foss. M. P. G. p. 14.

*Diagnosis.* Zoarium large, expanded, foliaceous. Bilaminar, the internal face ribbed by long and prominent angular ridges.

*Zoecia* quadrangular, arranged in long, oblique lines. The opesia are elliptic and fairly regular, with a strong, slightly raised rim; this is surrounded by a flat area, on the part of which that covers the continuation of the zoecium are two distinct rounded avicularia. The width of the surrounding area and the prominence of the rim vary somewhat in different parts of the zoarium, but within a restricted area are quite uniform.

*Avicularia*: usually a pair on the front wall below the aperture.

*Figures.* Pl. XXIX. fig. 2. Part of zoarium, from a specimen from the London Clay, Highgate; Brit. Mus. No. 49729;  $\times 16$  diam. Fig. 3. Another specimen showing back view,  $\times 21$ .

*Distribution.* Thanet Sand, Pegwell Bay (M. P. G.). London Clay, Southampton. London Clay, Highgate. Edwards Coll. Brit. Mus. 49729.

? Bracklesham Beds, Bracklesham.

*Remarks.* This species was founded by Busk, who gave four figures of it; these well show the general form of the zoarium, the thickened longitudinally ribbed back, the form of the opesia, and the large front wall below the aperture. These are the main specific characters. Busk's type was in the Wetherell Collection, but it cannot now be found. Though the figures do not show the pair of avicularia, there can be no doubt of the species, for the Wetherell Collection contains many specimens from Highgate labelled by Busk and Wetherell. The specimen from which the accompanying figures have been drawn is from Southampton. A small specimen in the Edwards Collection from Bracklesham appears to belong to this species, but as it only shows the back view of the inner lamina it is impossible to be certain. The Thanet Sand specimens are so much worn that one cannot be sure of the identification.

The species belongs to the group of *Membranipora* of which *M. savarti* (Aud.) [No. 1, p. 240, pl. x. fig. 10; see also the figures by Smitt, No. 3, p. 20, pl. iv. figs. 92-5] is a convenient type; from this, however, it differs in the absence of the crenulate margin and the two tubercles sometimes present in that species; the area of the front wall is much larger than in Audouin's species, and the back is longitudinally ribbed instead of having the flat surface marked off into regular rectangles as shown by Smitt. The plain prominent rim and large front wall also separate this species from

*M. lacroixi* (Aud.) [No. 1, p. 240, pl. x. fig. 9]. *M. eocena* is more nearly allied to *Membranipora appendiculata* (Reuss), of which a good figure has been given by Mr. A. W. Waters [No. 12, pl. ii. fig. 3], but from this it differs in that Reuss's species has a single large avicularium on the lower side of the aperture and not quite in the median line; the opesia is also somewhat too large. *M. macrostoma* (Reuss) is another ally; but this has the rim that borders the opesia closer to the margin of the zoëcia, so that the flat depressed marginal space is absent.

Species 2. MEMBRANIPORA BUSKI, n. sp.

Syn. *Membranipora lacroixi*, G. Busk (non Aud.), 1866, Geol. Mag. vol. iii. pl. xii. figs. 1 a & d; (fide Vine), J. W. Judd, 1883, Geol. Mag. dec. 2, vol. x. p. 527; G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pt. 2, pp. 159-160, pl. v. fig. 2 (copied from Busk), fig. 3 (original); H. W. Bristow, 1889, Geol. I. Wight, ed. 2, p. 284.

*Membranipora reticulum*, Vine (non Linn.), *ibid.* vol. xii. pt. 1, pp. 59, 60.

*Diagnosis.* Zoarium encrusting or foliaceous. The back is flat and not ribbed.

*Zoëcia* arranged in long series. Opesia very large: no lamina or front wall, the raised rims of adjoining zoëcia being in contact. The general form is oblong, the length being not much greater than the width, except at the bifurcations of a row, where the two zoëcia are long and narrow. The raised rims are thick and plain.

*Avicularia* irregularly scattered, small, generally in the lower right-hand corner of the zoëcia.

*Oëcia* not always present, narrow, globose.

*Distribution.* Headon Beds, Colwell Bay, I. of Wight; London Clay, Highgate.

*Type.* Brit. Mus. No. B 4625.

*Figures.* Pl. XXIX. fig. 11. Part of a zoarium with an oëcium;  $\times 55$  diam. Brit. Mus. No. B 4625. Fig. 12. Part of a specimen (Mus. Pract. Geol.) with oëcia,  $\times 55$  diam.

*Affinities.* This species in its general characters very closely approaches *M. lacroixi*, Aud. [No. 1, p. 240, pl. x. fig. 9], and as such the London Clay specimen has been figured by Busk. With this identification I agreed until seeing the specimens in the Museum of Practical Geology: these were collected by Mr. Chapman and are clearly the same as those which he has kindly presented to the British Museum. They, however, show the oëcia, and thus clearly separate the species from *M. lacroixi*, from which, according to Mr. Hincks's diagnosis [No. 2, p. 130], these structures are absent.

Species 3. MEMBRANIPORA CRASSOMURALIS, n. sp.

*Diagnosis.* Zoarium irregular, encrusting.

*Zoëcia* oval, irregularly distributed. Each zoëcium surrounded by a thick prominent rim. The interspaces between these rims are very narrow. When encrusting ribbed bivalves the zoëcia are more regularly arranged, running along the ribs or pressed into the furrows. Opesia usually occupying the whole of the area, but in some a thin narrow lamina occurs.

*Oœcia* triangular: surrounded by a rim like that around the zoœcia.

*Avicularia* sparsely and irregularly scattered over the zoarium: occupying the small triangular areas between the zoœcial margins.

The raised rim is usually plain, but may bear a single minute tubercle, the base of a small spine.

*Distribution.* Barton Beds, Barton. Bracklesham Beds, Bracklesham.

*Type.* Brit. Mus. No. 49741.

*Figures.* Pl. XXIX. fig. 10 *a*. From Barton. Several zoœcia, showing the oœcia, avicularia, bases of spines, and lamina. Fig. 10 *b*. Another specimen, growing on a strongly ribbed *Pecten*.

*Remarks.* This species appears to be most closely related to that figured by Reuss [No. 14, p. 179, pl. ix. figs. 1, 2] as *Membranipora elliptica* (Hag.) from the Leithakalk (Helvetian) of Eisenstadt. But the London Clay species appears to be certainly distinct from that represented in von Hagenow's original figure [No. 1, p. 268, pl. iv. fig. 6], in which the rims surround the area instead of the zoœcia and thus are separated by a wide space, both in the centre and youngest part of the zoarium; there are neither laminæ nor oœcia. Hagenow remarks on the "vertieften Zwischenräumen" with ring-shaped pores. But as to the identity of *M. crassomuralis* with the Eisenstadt species I do not care to express a definite opinion without seeing Reuss's type. Pergens [No. 1, pp. 15, 16] seems to have entertained the same doubts as to the correctness of Reuss's identification, for though he quotes *M. elliptica* from the Austro-Hungarian Miocenes, he does not include Reuss's reference in his synonymy.

This species belongs to the *M. lacroixi* group, but it differs in the following characters: (1) it has triangular oœcia, whereas these structures are said by Hincks [No. 2, p. 130] to be absent in the recent species; (2) the rim is not crenulate; (3) the avicularia are fewer, and there is never more than one spine on the rim.

From *Membranipora eocena* (Busk) it differs in the absence of any space below the area and outside the rim, and also of the two small lateral avicularia; the zoœcia are also arranged more irregularly.

*Membranipora temporaria*, Waters [No. 6, p. 288, pl. vii. fig. 16], from the Murray River cliffs, is an allied species, but differs in the presence of two small lateral avicularia and a larger "infra-area."

Another species with which this new one must be compared is *Membranipora loxopora* (Reuss) [No. 2, p. 166, pl. viii. fig. 11: for later figures see No. 14, pp. 39-40, pl. ix. figs. 4, 5; the author's original figure in No. 1, p. 97, pl. xi. fig. 24, has been subsequently repudiated by him], but this has larger front walls, on which the avicularia are placed, instead of in the angles.

Reuss [No. 13, p. 101, pl. xxiv. figs. 4 & 5 *c*] has himself also figured the typical Cretaceous *M. elliptica* from the Unter Pläner of Saxony, and one of his figures shows

pores at the ends of some of the zoœcia in the positions occupied by the oœcia in *M. crassomuralis*; Reuss, however, regards them, no doubt correctly, as avicularia. In the same work Reuss [ib. pl. xxiv. fig. 3, pp. 100–101] has figured a variety of *M. subtilimargo* which resembles *M. crassomuralis* more than does the typical form; but the absence of oœcia and laminae clearly distinguishes it.

Species 4. MEMBRANIPORA TENUIMURALIS, n. sp.

Syn. *Membranipora lacroixi*, Busk, 1866, Geol. Mag. iii. pl. xii. figs. 1*b* & 1*c*; W. Whitaker, 1872, Mem. Geol. Surv. iv. pt. 1, p. 594.

*Diagnosis.* Zoarium encrusting (or ? sometimes free), spreading as a thin gauze-like layer.

*Zoœcia* irregularly distributed. Form irregular, oval, quadrangular, hexagonal or polygonal: closely crowded. The opesia are very large, almost as large as the zoœcia: coincident with the area. There are small triangular depressions between the margins of the opesia of the different zoœcia. Walls thin, sometimes crenulate. There is often a pair of tubercles on the margins of the zoœcia, and these may fuse to a single large tubercle on the infra-area.

*Avicularia*: usually a pair of small ones in the infra-area covering the continuation of the zoœcia.

*Oœcia*, none.

*Distribution.* London Clay, Highgate. Clarendon Hill, Fareham, Portsmouth.

*Type.* Wetherell Coll. Brit. Mus. No. 49736.

*Figures.* Pl. XXIX. fig. 5. London Clay, Highgate. Brit. Mus. No. 49736 (one of Busk's type specimens).—Figs. 6 & 7. Other specimens from same locality.

*Affinities.* This is also a species of the puzzling *lacroixi* group. Its nearest ally is probably *M. tuberculata* (Bosc), which it resembles in its tuberculation [No. 1, t. iii. p. 143. Bosc gives as a reference the *Flustra dentata* of O. F. Müller, Zool. Dan. iii. pp. 24, 25, pl. xcv. figs. 1, 2, but this is quite different]. But it differs from this in the greater thickness of the walls in *M. tuberculata* and in the presence in that species of a small front wall; in the new species, moreover, the zoœcia are more regularly hexagonal in form and are more elongated; there is also a small depressed area in the corners between the rims margining the opesia. From the recent *M. membranacea* (Linn.) it differs in the regularly alternate arrangement and rectangular shape of the zoœcia in that species; *M. tenuimuralis* also lacks the hollow marginal spines so characteristic of the recent species.

From *M. lacroixi* (Aud.) it differs in the presence of avicularia, and of the pair of tubercles or knobs; the form of the zoœcia is angular instead of oval, and the margins of the opesia are rarely crenulate. The comparison with *M. lacroixi* is especially necessary as Dr. Pergens makes *M. laxa*, Reuss [No. 11, p. 252, pl. xxxvi. fig. 14], a synonym of this species; and *M. laxa* appears to be the closest ally of the London

Clay Bryozoan. *M. laxa* is a somewhat doubtful species; it has not been referred to by Mr. Waters [No. 12] in his recent revision. Reuss's figure may only represent a specimen in which the whole of the front wall is broken away and only the lateral walls are left; but if that is the case it is certainly not *M. lacroivi*, and in view of Pergens's conclusion it would not be safe to act on this view. Reuss's figure shows more regularly hexagonal zoëcia; the margins appear to be separated entirely by a narrow groove, and there are no tubercles. Hence it seems safest to make a new species for this London Clay form rather than to assert the existence of so doubtful a species as the North Italian Bartonian *M. laxa* in the Lower Eocene of the London Basin.

Species 5. MEMBRANIPORA VIRGULIFORMIS, n. sp.

*Diagnosis.* Zoarium of elongate, cylindrical, solid shoots, somewhat resembling those of *Cellaria*.

*Zoëcia* in regular longitudinal series, elongate, rectangular. Opesia large, oval, surrounded by a thick raised and plain non-crenulate rim. A large depressed front wall below the area, often with a pair of triangular depressions.

*Oëcia*, none.

*Avicularia* single, prominent, lateral, on the upper left-hand margin of the zoëcia.

*Distribution.* London Clay, Highgate.

*Type.* Brit. Mus. No. 49658. Edwards Coll.

*Figure.* Pl. XXIX. fig. 8. Part of zoarium,  $\times 25$  diam.

*Affinities.* In its mode of growth this species resembles *M. sigillata* (Pourt.) [No. 1, p. 110; see also Smitt, No. 3, p. 8, pl. ii. figs. 64-68], but the zoëcia in that species are more irregular in form and distribution, while their general form is lozenge-shaped instead of rectangular. It also recalls to mind *M. monostachys*, Busk [No. 2, p. 31, pl. ii. fig. 2], but from this it differs by the somewhat pyriform shape of the zoëcia and the more curved instead of flattened front wall of that species.

Among the Lower Tertiary species, this most closely resembles *Membranipora macrostoma* (Reuss) [*Cellaria macrostoma*, Reuss, No. 1, p. 64, pl. viii. figs. 5, 6; *Biflustra macrostoma*, Reuss, No. 11, pp. 274, 275, pl. xxxiii. figs. 12, 13], but in that the subareal portion of the front wall is regularly rounded and has not the pair of triangular depressions seen in the new species.

Species 6. MEMBRANIPORA DISJUNCTA, n. sp.

*Diagnosis.* Zoarium forming a large encrusting surface; the zoëcia are arranged in disconnected rows, which are radially disposed; there are several centres of radiation in each zoarium.

*Zoëcia* elliptical; opesia large, surrounded by a prominent rim; the mouth opens at one end of the opesium; the rest is occupied by a thin calcareous lamina.

*Avicularia* and *oëcia* unknown.

*Distribution.* London Clay, Highgate.

*Type.* Brit. Mus. No. 69205. Wetherell Coll. Encrusting *Hippochrenes ampla*.

*Figures.* Pl. XXIX. figs. 9 *a*, *b*. Fig. 9 *a*, part of zoarium, magnified 4 diam., showing radial growths; fig. 9 *b*,  $\times 12$  diam.

*Affinities.* The mode of growth in loose disconnected rows resembles that often assumed by *M. catenularia* (Jameson) [No. 1, p. 561, name only] (*Pyripora* of Macgillivray) [No. 1, pt. xi. p. 24], but the much greater size of the opesia in this species is quite distinctive.

#### Genus LUNULITES, Lamarck, 1816.

[Lamarck, No. 1, ii. p. 194.]

*Diagnosis.* A genus of Membraniporidæ with a unilaminate, conical, or cup-shaped zoarium. The zoœcia are arranged in radial rows; radial rows of vibracularia either separate the zoœcia or occur alternately.

Type species. *L. radiata*, Lamk. [No. 1, p. 195].

Species 1. LUNULITES TRANSIENS<sup>1</sup>, n. sp.

Syn. *Lunulites urceolata*, Lonsdale, 1850, in Dixon's Geol. Suss. pp. 159, 160, pl. i. fig. 8; 1878, do. ed. 2, pp. 201, 202, pl. i. fig. 8.

*Lunulites ? radiata*, Lonsdale, 1850, in Dixon's Geol. Suss. ed. 1, pl. i. fig. 8; 1878, do. ed. 2.

*Diagnosis.* Zoarium of medium size, depressed, circular, thin, cup-shaped; convex margin curved.

*Zoœcia.* Opesia with the aperture large, orbicular, elongate; a small lamina at the lower end. The lateral margins are steep; the inner margin slopes more gently. A pair of small tubercles occur on some of the margins between the two zoœcia.

*Vibracularia* large, aperture clithridiate; the radial series are connected by a groove; they increase in size towards the periphery, and gradually pass into normal zoœcia (whence the specific name). On the concave side the ridges are irregularly distributed and are separated by deep grooves; there are numerous large pores; on the narrower parts of the ridges there may be only a single line of pores.

*Dimensions.* Diameter .5 mm.; height 1.25 mm. Taken from a small complete specimen. In some fragments the number of zoœcia is from 18-20; number of zoœcia in a radial series 10.

*Distribution.* Upper Eocene, Barton Beds, Barton. Middle Eocene, Bracklesham Beds, Bracklesham, Bramshaw, Brook, Whitecliff Bay.

*Type.* Brit. Mus. No. 49724. From Barton. Edwards Coll.

*Figures.* Pl. XXIX. fig. 13. Part of zoarium showing back,  $\times 24$  diam. Fig. 14. Several normal zoœcia,  $\times 24$  diam.—Pl. XXX. fig. 1. Another specimen, showing the

<sup>1</sup> Referring to the gradual passage from vibracularia to zoœcia.

ancestrula. Fig. 2. Part of zoarium from Bracklesham (B 4339), showing the front wall partly broken away. Fig. 3. Part of a worn specimen from Bracklesham, resembling *L. urceolata*.

*Affinities.* This species belongs to the *L. radiata*, Lamk., group, which the Marquis de Gregorio [No. 1, p. 248] has recently proposed to make into a new subgenus, *Demiclausia*; this, however, is against all rules, as *L. radiata* is clearly the type species of the genus. If, therefore, the separation is to be made, it is the other group that must be renamed and removed. *Demiclausia* is an absolute synonym of *Lunulites*.

This species was figured by Lonsdale as *Lunulites urceolata*, Lamk., but from the latter it widely differs in the fact that the vibracularia are connected by depressions into long radial lines; in *L. urceolata* they are disconnected.

From *Lunulites radiata*, Lamk., this differs by the gradual transition from the vibracularia to the normal zoecia, and by the presence of a lamina and tubercles on the rim of the opesia. The species agrees most closely with *L. subplana*, Reuss [No. 3, p. 264, pl. xi. fig. 108], but the apertures in that species are not clithridiate, nor does there seem to be a gradual transition from vibracularia to zoecia. It clearly differs from *Lunulites quadrata*, Reuss [*Cellepore quadrata*, Reuss, No. 1, p. 95, pl. xi. fig. 17; in the explanation of the better figure given in Reuss, No. 11, pl. xxviii. fig. 18, the species is called *Lepralia tetragona*], by the form of the aperture and the absence of the raised rim immediately around it. The original figure gives a suggestion of a similar passage from vibracularia to normal zoecia.

In the main character of this species it resembles *Lunulites goldfussi*, Hag. [No. 2, p. 102, pl. xii. fig. 5], but that differs by the irregular distribution of the vibracularia.

#### Genus *BISELENARIA*, nov. nom.

*Syn.* *Diplotaxis*, Reuss, 1867, non Kirby, 1837, Ueber Bry. deut. Unteroligocäns, Sitz. k. Ak. Wiss. Wien, Bd. lv. Abth. i. p. 231.

*Diagnosis.* A Membraniporid with a bilaminate zoarium, which is small and circular and discoid in form; typically the form is bun-shaped. The zoecia of the upper layer have regular Membraniporidan apertures, with numerous normal vibracularia irregularly scattered, or one to each zoecium. The zoecia of the lower surface are much modified; the aperture is contracted by the great thickening of the peristome; in the zoecia near the centre the aperture is sometimes completely closed or persists as a long narrow slit; the vibracularia are similarly modified; some of the peripheral zoecia more nearly resemble those of the upper layer.

Type species. *Biselenaria placentula* (Reuss), op. cit.

*Remarks on the Genus and its Affinities.*—Reuss practically founded his genus *Diplotaxis* simply on the one character of its bilaminate zoarium; the species included in it are forms of much interest, and there seems to be no reason to question the validity

of the genus, though it has been overlooked or merely mentioned by subsequent authors. Unfortunately, however, the name was preoccupied among Coleoptera by Kirby in 1837, and as it is still in use for that group the Bryozoan genus must be renamed. The nature of the zoœcia of the lower surface is somewhat puzzling; four explanations of their nature may be offered:—First: the zoarium may be fixed, probably in mud; in that case the peripheral zoœcia would be normal; but as they became more central by the growth of the colony they would gradually become aborted and their apertures closed; the distribution of the under zoœcia supports this view. Second: the zoarium may be free and the modified zoœcia of the lower surface may all be swimming vibracula instead of normal zoœcia; in that case the thickening of the peristome would be due to the necessity for greater muscular attachments. Third: the zoarium may be fixed by radical fibres or tubes given off from the modified zoœcia. And fourth: the zoarium may be free and the peculiar lower zoœcia may be gonœcia, as the thickened and contracted apertures resemble those of elements in other genera, such as *Teichopora*, which appear to be clearly gonœcia. So long as the genus remains known only by extinct species it may be impossible to decide between these views, but I am inclined to accept the first, though there are points that make for the second.

The genus differs from the rest of the group by its bilaminate nature and the structure of the inferior zoœcia. It is possible that it ought to be subdivided, one branch including the type species and all the rest of those in which there is a vibraculum to every zoœcium.

Species 1. *BISELENARIA OFFA*<sup>1</sup>, n. sp.

*Diagnosis. Zoarium:* a small circular disk, thickest in the middle and tapering towards the periphery.

*Zoœcia* irregular in form and distribution; a group of small ones occurs in the centre; the largest are in a circle at a little distance from the margin. The opesia are large and elliptical, surrounded by a thickened margin; some of the opesia are slightly trigonal. The vibracularia are very irregular in distribution; they resemble the normal zoœcia in general form, but the rim is thicker in proportion to their size.

The zoœcia of the lower side vary from being identical with those of the upper side to being quite closed; all intermediate forms occur, but a spatulate form with the aperture remaining as a slit or small pore is the commonest. Some of the vibracularia have the very typical auriculate appearance.

*Distribution.* Barton Beds, Barton.

*Type.* Brit. Mus. No. 49759. Edwards Coll.

*Figures.* Pl. XXX. fig. 4. Zoarium of type specimen: upper surface. Fig. 4*a*. Part of another specimen: under surface. Fig. 5. Upper surface of another zoarium.

<sup>1</sup> *Offa*, a bun.

*Affinities.* This species differs from the type species, *Biselenaria placentula* (Reuss), in several important respects; the most striking is that in the type there is a vibraculum to every zoecium, situated just at the apex. This is practically the main character used in the separation of *Cupularia* and *Selenaria*; as in this case it is therefore generic, it might be thought that the two species ought to be separated into two genera, one including *B. placentula*, corresponding to *Cupularia*, and one including *B. offa*, corresponding to *Selenaria*. The two species, however, agree so closely that it would appear to be unnecessary to make a new genus upon this character alone. In merely specific points, the concavo-convex form of *B. placentula*, its more irregular opesia, and the larger size and smaller number of its inferior zoecia all distinguish it from *B. offa*.

#### Family CRIBRILINIDÆ.

Genus CRIBRILINA, Gray, 1848.

*Diagnosis.* Hincks, No. 2, p. 184.

Species 1. CRIBRILINA VINEI, n. sp.

Syn. *Membraniporella nitida*, Johnst. var. *eocena*, G. R. Vine, Notes on Brit. Eoc. Polyzoa, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pt. ii. pp. 161-2, pl. v. fig. 6.

*Diagnosis.* Zoarium encrusting.

Zoecia large, quincuncially arranged; globose. Orifice large, orbicular; elongated transversely. Margin of the orifice raised, thin and plain.

The front walls of the zoecia are traversed by 9 or 10 pairs of furrows; the upper 5 or 6 pairs of these are horizontal; the lowest 3 or 4 pairs in a radial fan. There are two or three pores in each furrow. The furrows do not reach the middle line of the front wall, and upon this there is a varying number of fairly large pores.

*Avicularia* large: a pair on each side of the orifice.

*Oecia* large: very globose, often covering the lower part of the adjoining zoecium. Perforated by numerous, fairly large pores.

*Distribution.* London Clay, Sheppey.

*Type.* Brit. Mus. No. B 4514. Vine Coll.

*Figures.* Pl. XXX. fig. 8. Part of the zoarium,  $\times 55$  diam.

*Affinities.* This species was regarded by Mr. Vine as only a variety of the recent *Membraniporella nitida*; he remarked the presence of a series of small pores in the furrows, and that Mr. Hincks did not mention them in his diagnosis of that species. But the existence of these pores is the generic character that separates *Cribrilina* from *Membraniporella*, and into the former genus this species must necessarily go. From the species to which Mr. Vine referred it, it differs also in the presence of the pores on the oecia, in that the lower furrows are radial instead of them all being horizontal,

and in other features. From the common and widely distributed *C. radiata* [Moll, No. 1, p. 63, pl. iv. fig. 17] this species differs by its larger orifice and by the furrows being more numerous and differently arranged. Among recent species it most closely resembles *C. philomela*, Busk [No. 8, pp. 132-3, pl. xvii. fig. 6, pl. xxii. fig. 7], to which it is allied by the large size of the orifice and the big globose oœcia; it differs, however, in the oœcia being plain in the recent species, and also in having more pores on the furrows and none in the middle line.

Probably the nearest ally to this species is *Cribrilina manzonii* [*Lepralia manzonii*, Reuss, No. 14, p. 171, pl. i. fig. 6], from Mödling, near Vienna, which agrees with it in the large size of the orifice and the arrangement of the furrows: Reuss does not figure any oœcia, and consequently this important character cannot be used for comparison; but the absence of the pair of large lateral avicularia and the greater number both of pores and furrows in *C. manzonii* are sufficient to distinguish the two.

The species belongs to *Cribrilina*, even restricted as narrowly as is done by Dr. Jullien [No. 3, 604].

#### Family MICROPORIDÆ.

##### Genus MICROPORA.

*Diagnosis.* Hincks, No. 8, pt. i. p. 161.

Species 1. MICROPORA CRIBRIFORMIS, n. sp.

Syn. *Membranipora holostoma*, Busk, var. *perforata*, G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. vol. xii. p. 60.

*Diagnosis.* Zoarium encrusting.

*Zoœcia* oval, sometimes tapering below. The lower part of the front wall is very tumid and rises above the raised margin. The aperture is small; the upper margin is regularly curved, the lower margin sinuous. The front wall is crowded with maculæ, which are very irregular in form and numbers. There is usually a pair of narrow slit-like opesiulæ situated at the extreme margin of the oœcia, just below the corners of the aperture.

*Distribution.* Barton Beds, Barton.

*Type.* Brit. Mus. No. B 4583.

*Figures.* Pl. XXX. fig. 6. Part of zoarium. In one of the zoœcia the front wall has been broken away and shows the absence of internal partitions.

*Affinities.* This species is very clearly marked by the sinuous lower border of the aperture and the cribriform aspect of the whole front wall. Both characters, as well as the form of the zoœcia and other less important points, separate it from *M. holostoma* (Busk) [No. 6, p. 36, pl. iii. fig. 11], from the Crag.

Probably the most nearly allied species is *M. gracilis* (Münst.) [*Cellepora gracilis*,

Münster, in Goldfuss, No. 1, i. p. 102, pl. xxxvi. fig. 13], of which Reuss [No. 11, p. 291, pl. xxix. fig. 13] has given a good figure; from this it is distinguished by the form of the orifice, the absence of a ridge on the lower side of the aperture, and the much greater coarseness of the maculæ. Waters [No. 12, p. 13] includes the Crosara species as a synonym of *M. coriacea* (Esper). The same characters separate it from *M. münsteri* (Reuss) [No. 6, p. 30, pl. x. fig. 2], which is very nearly allied to *M. gracilis*.

As in the new species some of the zoëcia and the opesiulæ are replaced by large pores, while in others these are no larger than some of the maculæ, it is evident that Mr. Hincks is fully justified in refusing to regard the presence of these opesiulæ as an essential character of the genus.

#### Genus ONYCHOCELLA, Jullien, 1881.

*Diagnosis.* Microporidæ with large vicarious avicularia scattered over the zoëcia [Jullien, No. 1, p. 277].

Species 1. ONYCHOCELLA MAGNOAPERTA, n. sp.

*Diagnosis.* Zoarium encrusting, forming a large compact crust.

*Zoëcia* usually hexagonal, occasionally becoming rounded at the edges and oval where they are less crowded. Apertures slightly clithriate, very large, occupying nearly the whole front of the cell; the aperture is restricted by a small lamina at the lower side of the zoëcium. The margins of the zoëcia are raised, plain, and non-crenulate.

*Avicularia*: large vicarious cells, long and tapering; irregularly scattered over the zoarium.

*Distribution.* Brockenhurst Beds (Mid. Headon), Brockenhurst.

*Type.* Brit. Mus. No. 49738. Edwards Coll.

*Figures.* Pl. XXX. fig. 7. Part of zoarium,  $\times \frac{55}{3}$  diam., including one of the large tapering vicarious avicularia.

*Remarks.* The subdivision of the great genus *Membranipora* to which Jullien [No. 1, p. 277] gave the name *Onychocella* appears to be based on more reliable characters than most of the genera which that author has proposed, and it seems to be now generally accepted [see Waters, No. 12, pp. 8, 9]. The nature of the avicularian cells of this new species shows that it belongs to this group. Its nearest ally is *O. angulosa* (Reuss) [No. 1, p. 93, pl. xi. fig. 10], from which it differs in the much smaller size of the aperture in that species. If, as Waters suggests, *Rhagasostoma hexagonum*, Kosch. [No. 1, p. 30, pl. v. figs. 5-7], is only a synonym of *O. angulosa*, it will be unnecessary to compare them further; but if, as appears probable, it is a distinct species, the structure of the aperture will clearly distinguish it from the Brockenhurst form.

*O. magnoaperta* is closely allied to some Upper Cretaceous species; of these *O. cyclostoma* (Goldf.) [*Eschara cyclostoma*, Goldfuss, 'Petrefacta Germaniæ,' Th. i. 1826, p. 23, pl. viii. fig. 9] appears to be about the nearest; the evidence for referring it to *Onychocella* is given by von Hagenow's figures [No. 2, p. 75, pl. ix. figs. 7, 8, pl. xii. fig. 3]: from this, which is biflustrine in habit, it may be distinguished by its clithridiate aperture; the avicularian cells agree in general character. From *O. koninckiana* (Hag.) *Cellepora* (*Discopora*) *koninckiana*, Hag. *ib.* p. 95, pl. xi. figs. 10, 11] it differs in the ovate shape of the avicularian cells, which in the Maastricht species are lanceolate. *O. santonensis*, D'Orb. [*Eschara santonensis*, D'Orbigny, No. 2, p. 109, pl. 673. fig. 4], agrees with it in the large size of the aperture and the shape of the avicularia; but the oœcia in that species are pyriform, the lamina larger, and the lower side of the mouth straight. *O. drya*, D'Orb. [*Eschara drya*, *ib.* p. 168, pl. 677. figs. 7-9], has also a large aperture, but this is much wider and not clithridiate; the zoœcia are also different in shape. D'Orbigny has figured amongst his Escharas a large series of species which must be referred to *Onychocella*, though many of them may be reduced to synonyms. From most of them, such as *O. allica* (D'Orb.), *O. archosia* (D'Orb.), *O. charonia* (D'Orb.), *O. clito* (D'Orb.), and *O. cressida* (D'Orb.), the new species may be distinguished by its large aperture.

The occurrence of the genus *Onychocella* in Cretaceous rocks has been frequently pointed out; the British Museum Collection contains a specimen from the *Calcaire à polypiers* (Bathonian) of Ranville, that must be referred to this genus.

#### Suborder SCHIZOTHYRIATA.

#### Family SCHIZOPORELLIDÆ. (*Myriozoidæ* of Hincks.)

#### Genus SCHIZOPORELLA, Hincks.

*Diagnosis.* See Hincks, No. 2, p. 237.

Species 1. SCHIZOPORELLA MAGNOAPERTA, n. sp.

*Diagnosis.* Zoarium, a foliaceous expansion.

*Zoœcia* somewhat irregularly arranged, though with a tendency towards quincuncial. In shape they are pyriform, well rounded above, tapering below. The front wall is tumid, forming a raised triangular area. A raised lip around the orifice, which is oval; the sinus is median, small but distinct. The zoœcia are separated by a depressed flat margin, around which is a row of large deep areolæ.

*Avicularia* one on each zoœcium, beside and below the orifice; they have raised, elliptic borders.

*Oœcia* — ?

*Distribution.* Barton Beds, Barton.

*Type.* Brit. Mus. No. 49733. Edwards Coll.

*Figures.* Pl. XXX. fig. 9. Part of a zoarium from London Clay, Sheppey; Brit. Mus. No. B 4514,  $\times \frac{55}{2}$  diam.

*Affinities.* This species belongs to the group of which the common *Schizoporella unicornis*, Johnst., is a good representative; it agrees with the latter in its umbo, suborbicular mouth, and small sinus. From that species, however, it clearly differs in the much larger size of the aperture and the pyriform shape of the zoëcia in the new species, in which also the umbo is lower down, and there is one lateral avicularium instead of the pair usually present in *S. unicornis*; the areolæ are also limited to a single series. The large size of the aperture at once distinguishes this from most of the Continental Miocene and Lower Cainozoic species, such as *S. goniostoma* [*Cellepora goniostoma*, Reuss, No. 1, p. 87, pl. x. fig. 18; for better figures see Reuss, No. 14, p. 176, pl. ii. fig. 6, pl. iii. fig. 3] and *S. rugulosa* [Reuss, No. 14, p. 169, pl. iii. fig. 2]. *S. dunkeri* [Reuss, No. 1, p. 90, pl. x. fig. 27] agrees in some respects, *e. g.* the single lateral avicularium, the large mouth, and blunt umbo; it is probably the nearest ally of this species. Reuss's species may be distinguished by its higher umbo, marginal avicularia, and shorter and more rectangular zoëcia. Among recent species it agrees closely with *S. simplex* D'Orb. [*Eschara simplex*, D'Orbigny, No. 1, p. 13, pl. v. figs. 5-8], from which it differs in the pyriform shape of the zoëcia.

In the general form of the zoëcia this species agrees strikingly with *Microporella membranacea* (Reuss) [*Eschara membranacea*, Reuss, No. 6, p. 32, pl. v. fig. 6], from Oberburg; the possession of a sinus instead of a trypa, of course, distinguishes it from that species.

Species 2. SCHIZOPORELLA MAGNOINCISA, n. sp.

*Diagnosis.* Zoarium foliaceous.

*Zoëcia* narrow and elongated; peristome raised and almost subtubular. Aperture large and with a very large sinus; the angles of the peristome above the sinus vary considerably in prominence, but never meet. One line of areolæ. Front wall smooth and evenly convex.

*Avicularia*: one on each zoëcium, just below the aperture; lateral in position; mandible pointing upwards to the angle between the aperture and sinus.

*Oëcia* (none?).

*Distribution.* London Clay, Copenhagen Fields.

*Type.* Brit. Mus. No. B 4515. Fragment enclosed in a septarian nodule.

*Figure.* Pl. XXX. fig. 10,  $\times 30$  diam.

*Affinities.* The large size of the sinus of this species would necessitate its inclusion in *Gemellipora* if that genus of Smitt's [No. 3, p. 35] be accepted. Its nearest ally

appears to be *Schizoporella gonversi* (Reuss) [No. 14, p. 159, pl. vii. fig. 7], from Rauchstallbrunn, but in that species the zoœcia are shorter and broader, the areolæ, fewer, and there is a pair of avicularia above the aperture.

The large size of the sinus allies this species to *Schizoporella beyrichi*, Stol., but it differs in that the zoœcia are elongate and rectangular instead of hexagonal, they are not quincuncially arranged, and the zoarium is not Cellarian (*Cellaria beyrichi*, Stoliczka, No. 1, p. 83, pl. i. fig. 10).

*Schizoporella insignis*, Hincks [No. 4, pt. 5, p. 134, pl. v. fig. 10], differs in the quincuncial arrangement of the zoœcia, the central umbo, and the raised line at a little distance from the margins of the zoœcia. The shape of the zoœcia and the absence of the tubercles above the aperture distinguish this new species from *S. pauper* (Reuss) [*Lepralia pauper*, Reuss, No. 14, p. 164, pl. v. fig. 4], which has a large sinus. The last two species with which it is necessary to compare this are *S. variabilis* (Reuss) [*Hemeschara variabilis*, Reuss, No. 12, p. 508, pl. i. figs. 1-5] and *S. unicornis* (Johnst.) [*Lepralia unicornis*, Johnston, No. 2, p. 320], which both belong to the same group. From the former the London Clay species is mainly to be distinguished by the size of the sinus. The latter differs by its umbo, the absence of maculæ, and the smaller aperture; the zoœcia, however, agree in general form.

#### IV. a. *The Systematic Position of the Adeonellidæ.*

The genus *Adeona* was established by Lamouroux [No. 1, pp. 478-482, pl. xix. fig. 2] in 1816 for some Bryozoa with short jointed stems and reticulate zoaria; he took an Australian species, *A. grisea*, as his type: this species has also been made by Macgillivray the type of a genus *Dictyopora*, which is therefore necessarily a synonym. Enlarged figures of the zoœcia have been given by Kirchenpauer [No. 1, pl. i. fig. 8, pl. ii. fig. 10] and Macgillivray [No. 1, pl. 66], and these show that it possesses a trypa or zoœcial pore and a simple holostomatous orifice, and must therefore be referred to the Microporellidæ. But this genus and its allies have long given much trouble to systematists and the classification is still unsettled. Busk's 'Challenger' Report must certainly be held responsible for much of the confusion, as he there founded a genus *Adeonella* based wholly on zoarial characters; in consequence he included in it a miscellaneous series of species that must be divided among the several genera. Thus his *Adeonella distoma* has a trypa and is one of the Microporellidæ, while others, such as *A. polymorpha*, have no such pore and must belong to a different genus and family.

The subject has been attacked by Messrs. Hincks, Waters, and Macgillivray, and each of these has advocated very different conclusions. Mr. Hincks [No. 8, pt. i. pp. 150-158, especially 155 & 157] has discussed the matter at length with the following results: he maintains (1) that as *Adeonella* is based only on zoarial characters it is not distinct from *Adeona*; (2) the latter genus he places among the Microporellidæ, distinguished from *Microporella* by the substitution of gonœcia for external œcia; (3) as he

regards *Adeonellopsis* as based only on the possession of a peristomial pore he declines to accept it.

Mr. Waters's conclusions [No. 6, p. 294, and No. 10, pp. 3, 32, 33] are very different; he abandons *Adeona* as a synonym of *Microporella*, and speaks of the type species as *Microporella grisea*, form *Adeona*; in his last essay he accepts *Adeonella* for forms without a trypa but with a peristomial pore, the latter a character of very doubtful value.

Mr. Macgillivray's conclusions [No. 2, pt. ix. p. 134] seem to me more, though not entirely, satisfactory. He accepts *Adeonella* in much the same sense as Mr. Waters; but he fully grasps the significance of the absence of the trypa and removes the genus to the *Mucronellineæ* (or *Smittidæ*). He agrees with Mr. Hincks and differs from Mr. Waters in separating *Adeona* from *Microporella* owing to the absence of external oœcia in the former; finally, he founds the genus *Adeonellopsis* for forms resembling *Adeonella*, but without a peristomial pore.

Before proceeding to discuss these views I must again express my thanks to my colleague Mr. Kirkpatrick for allowing me constant access to the recent species, and especially to Busk's type specimens, and also for the opportunity of frequent discussion of all the points involved.

The first point to be decided is what are the true affinities of *Adeonella*. The first species described by Busk was *A. polymorpha*, and this he seems to have regarded as his type; Mr. Waters certainly includes it in the genus as restricted by him. Mr. Hincks [No. 4, pt. xiii. pp. 294-296] has quoted Busk's remark [No. 8, p. 183] that "as regards the general zoœcial characters there is no difference whatever between *Adeona* and *Adeonella*." This remark seems to me quite inexplicable. *Adeonella polymorpha* has no trypa, which seems to be generally regarded as implying a difference in family. *A. polymorpha* is therefore not one of the *Microporellidæ* at all, and cannot be synonymous with *Adeona*, which has a trypa\*. Macgillivray has clearly recognized this, and has removed *Adeonella* to his *Escharidæ*. But this seems to me to be going rather too far; in *Adeonella polymorpha* and all the species which seem to be congeneric with it, the primary orifice is always schizostomatous, and therefore the genus cannot enter the holostomatous group: its true affinities appear to me to belong to the *Schizothyriata* allied to the *Schizoporellidæ*; the secondary orifice appears to distinguish it from both the *Schizoporellidæ* and the *Microporellidæ*; the presence of gonœcia instead of external oœcia still further separates it from the *Schizoporellidæ*, but allies it to its old associates of the *Adeoninæ*. Its true position therefore appears to be as a distinct family intermediate between the *Schizoporellidæ* and the *Microporellidæ*, with one link attaching it to each.

\* Macgillivray's figures of *Adeona (Dictyopora) cellulosa* show an occasional absence of the trypa [Macgillivray, No. 1, dec. v. pl. 47. fig. 1 a, b]. A dissection of a specimen with the same feature shows that it is due simply to the trypa being overgrown and concealed by the avicularium.

In regard to *Adeonellopsis*, it seems to me absolutely necessary to accept that or Busk's [No. 8, p. 178] *Reptadeonella*, as it is going rather far to place such a species as "*Lepralia*" *violacea*, Johnst., in *Adeona* or *Microporella*. *Reptadeonella* is prior by two years, but it was based only on zoarial characters and was never properly diagnosed, and I therefore prefer to accept Macgillivray's better defined genus [No. 2, pt. ix. p. 134, and No. 3, p. 210].

Reuss has described another species which it is necessary to consider in connection with the Microporellidæ, as it possesses both a trypa and an oral sinus. The species which shows this feature is of such interest in connection with the evolution of this group that it is advisable here to diagnose the new genus necessary for its reception.

SCHISMOPORELLA<sup>1</sup>, n. g.

*Diagnosis.* Zoarium lepralian or escharine.

*Zoæcia* elongate, oblong (in known species). Aperture orbicular, with a large sinus. The front wall has a zoæcial pore.

*Oæcia* external, globose.

Type species. *Schismoporella schizogaster* (Reuss)<sup>2</sup>, 1847, Helvetian, Austria.

This genus may at first throw doubt upon the assumed homology of the sinus and trypa, the latter being regarded as the more specialized. The occurrence of *Schismoporella* may, however, be explained by a repeated formation of a sinus after the zoæcial pore has travelled well away from the peristome: or else the division of the trypa into two or more pores has very frequently taken place, and there seems no improbability in one of these parts persisting as a sinus. If neither of these explanations is correct, then *Schismoporella* is probably a primitive form uniting characters now divided between two families.

The following synopsis summarizes the classification of this group that is here proposed:—

Schizo- thyriata.	{	<i>Schizoporellidæ</i> : schizostomatous. External oæcia.																									
		<i>Adeonellidæ</i> : primary aperture schizostomatous. Gonæcia.																									
		<i>Microporellidæ</i> : trypa present.	<table style="border-collapse: collapse;"> <tr> <td style="font-size: 2em; vertical-align: middle;">{</td> <td style="padding-left: 5px;"><i>Adeoninæ</i> : with gonæcia.</td> <td style="padding-left: 10px;">{</td> <td style="padding-left: 5px;">Zoarium fenestrate, &amp;c. <i>Adeona</i>.</td> </tr> <tr> <td></td> <td></td> <td></td> <td style="padding-left: 5px;">,, foliaceous or encrusting. <i>Adeonellopsis</i>.</td> </tr> <tr> <td></td> <td style="padding-left: 5px;"><i>Microporellinæ</i> :</td> <td></td> <td style="padding-left: 5px;">= <i>Microporella</i>, <i>Tessarodoma</i>, &amp;c.</td> </tr> <tr> <td></td> <td style="padding-left: 5px;">external marsupia.</td> <td></td> <td></td> </tr> <tr> <td></td> <td style="padding-left: 5px;"><i>Schismoporellinæ</i> :</td> <td></td> <td style="padding-left: 5px;">= <i>Schismoporella</i>.</td> </tr> <tr> <td></td> <td style="padding-left: 5px;">with trypa and sinus.</td> <td></td> <td></td> </tr> </table>	{	<i>Adeoninæ</i> : with gonæcia.	{	Zoarium fenestrate, &c. <i>Adeona</i> .				,, foliaceous or encrusting. <i>Adeonellopsis</i> .		<i>Microporellinæ</i> :		= <i>Microporella</i> , <i>Tessarodoma</i> , &c.		external marsupia.				<i>Schismoporellinæ</i> :		= <i>Schismoporella</i> .		with trypa and sinus.		
		{	<i>Adeoninæ</i> : with gonæcia.	{	Zoarium fenestrate, &c. <i>Adeona</i> .																						
			,, foliaceous or encrusting. <i>Adeonellopsis</i> .																								
	<i>Microporellinæ</i> :		= <i>Microporella</i> , <i>Tessarodoma</i> , &c.																								
	external marsupia.																										
	<i>Schismoporellinæ</i> :		= <i>Schismoporella</i> .																								
	with trypa and sinus.																										

<sup>1</sup> From *σχίσμα*, a slit, and *πόρος*, a pore.

<sup>2</sup> *Cellepora schizogaster*, Reuss, 1847, No. 1, p. 84, pl. x. fig. 9; *Mollia schizogaster*, D'Orbigny, No. 2, p. 388; *Lepralia schizogaster*, Reuss, No. 14, p. 161, pl. iii. fig. 10.

It may be objected that the genera of the *Adeoninae* are based on zoarial characters; but these are of such a marked description, and lead to such modifications and dimorphism of some of the zoecia, that they seem certainly of generic value. In regard to *Adeona* and *Adeonellopsis* there is the further difference of the presence of a peristomial pore in the latter.

It seems also advisable to rediagnose *Adeonella* in accordance with this scheme, and consider what species should be included in it. But at present the diagnosis of the genus is the same as that of the family, as I am at present aware of only the one genus; the diagnosis is therefore: "Schizothyriata with a schizostomatous primary aperture and a secondary orifice variable in form. Gonœcia present, but no external marsupia." Before giving a list of the species I had better refer to the question of the value of the peristomial pore, as if Busk [No. 8, p. 167] and Ridley [No. 1, p. 47, pl. vi. fig. 6] are right in considering it of generic importance, then *Adeonella* must be subdivided. Since Mr. Kirkpatrick [No. 1, pp. 77, 78, pl. viii. fig. 5] has shown that this structure in "*Gigantopora*" *lyncoides*, Ridley [No. 1, p. 47, pl. vi. fig. 6], is only formed by the avicularia, little value has been attached to it. Messrs. Hincks [No. 6, pp. 268, 269] and Waters [No. 9, p. 192] also dismiss it as valueless, as the bridge is not always present in different zoecia of the same zoarium of *Schizoporella biturrita*, Hincks (or *S. tuberosa*, Reuss).

#### *List of Species of Adeonella.*

Type. *Adeonella polymorpha*, Busk, No. 8, p. 183, pl.

*Adeonella*, cfr. *polymorpha*, Gioli, No. 1, pp. 261, 262, pl. xiv. fig. 8.

— *platalea*, Busk, No. 8, p. 184.

— *intricaria*, Busk, No. 8, p. 185.

— *regularis*, Busk, No. 8, p. 186.

— *atlantica*, Busk, No. 8, p. 186.

— *pectinata*, Busk, No. 8, p. 189.

(This species has a large lyrula within the secondary orifice and hiding the primary aperture.

Busk has not figured the operculum, but its shape shows that the primary aperture is schizostomatous. It ought, perhaps, to be separated as a subgenus.)

— *polystomella* (Reuss), No. 1, p. 70, pl. viii. figs. 27, 28.

— *pallasi* (Heller), No. 1, p. 115, pl. iii. figs. 1, 2? = *A. polystomella*.

— *dispar* (Macgill.). For references see Jelly, No. 1, p. 259 (agrees with *Adeonella*, but has a sinus also in the secondary orifice).

— *sulcata* (M.-Edw.), *Eschara sulcata*, M.-Edwards, No. 1, pp. 47-49, pl. v. fig. 2, non *Flustra sulcata*, Lamouroux, No. 3, p. 609, pl. 92. figs. 3, 4.

— *fuegensis* (Busk), No. 3, p. 90.

*List of Species that have been referred to Adeonella.*

- Adeonella distoma* (Busk), No. 5, p. 127, pl. xviii. fig. 1 = *Adeonellopsis distoma*.  
 ———, var. *imperfurata* (Busk), No. 8, p. 188 = *Adeonellopsis*.  
 (This form has a trypa, but it is covered over by the avicularian cell; by the kindness of Mr. Kirkpatrick I have been enabled to dissect off an avicularium, and thus demonstrate the presence of a trypa. The form is probably entitled to specific distinction, and I therefore record it as *Adeonellopsis imperfurata*.)
- Eschara pulchra*, Stoliczka, No. 2, pp. 87, 88, pl. ii. fig. 10 = *Adeonellopsis*.  
 ——— *coscinophora*, Reuss, No. 1, p. 67. = „ „  
 ——— *mucronata* (Macgill.), No. 1, dec. v. p. 43. = „ „ (? *coscinophora*, Reuss).  
*Cellepora heckeli*, Reuss, No. 1, p. 85. = „ „ *heckeli* (Reuss).  
*Lepralia violacea*, Johnston, No. 2, p. 325. = „ „ (? *heckeli*, Reuss).  
*Eschara lichenoides*, Lamk., No. 1, p. 176. = „ „  
*Microporella fissa*, Hincks, No. 4, pt. ii. p. 381. = „ „
- Adeonella japonica*, Ortmann, No. 1, p. 54. = „ „  
 ——— *sparassis*, Ortmann, No. 1, p. 54. = „ „  
 ——— *tuberculata*, Ortmann, No. 1, pp. 53, 54. = „ „
- Porina subsulcata*, Smitt, No. 3, p. 29, pl. vi. figs. 136-140. = „ „  
*Eschara syringopora*, Reuss, No. 1, p. 68, pl. viii. fig. 23. ? = *Teichopora*.  
 ——— *ornatissima*, Stoliczka, No. 1, pl. ii. fig. 7. Probably a *Schismopora* with a peristomial pore.  
 ——— *ciliata*, Pallas, Elenchus, p. 38. = *Microporella*.  
*Flustra sulcata*, Lamx., No. 3, p. 609, pl. 92. figs. 3, 4. = ?  
*Cellepora imbricata*, Lousdale, No. 1, pp. 507, 508. = *Adeonellopsis*.

Ortmann does not figure the opercula, and the reference may be incorrect.

## Family MICROPORELLIDÆ.

## Subfamily ADEONINÆ.

## Genus ADEONELLOPSIS, Macgillivray.

## Species 1. ADEONELLOPSIS WETHERELLI, n. sp.

Syn. *Flustra*, sp., Wetherell, 1837, Trans. Geol. Soc. (2) iv. pl. ix. fig. 22.

*Microporella violacea*, var. *fissa*, var. *b*, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 162, pl. v. fig. 7 *b*.

*Microporella violacea*, var. *fissa*, var. *a*, Vine, 1891, *ibid.* xii. p. 61.

*Diagnosis.* Zoarium erect: branching dichotomous; bilaminar and either flat or cylindrical branches.

Zoecia tumid: usually pyriform; irregular in form; elongate and ovate or sub-hexagonal. Lower zoecia immersed. The orifice is at the summit of a large raised head, the peristome being somewhat tubular; the orifice is oval, lunate, or semi-

circular in shape. The front wall contains an elongate, depressed areola, the floor of which is cribriform, being perforated by from 4 to 8 pores. A line of punctures runs around the margin of the zoëcia.

*Avicularia* large, pointing obliquely upwards: situated close below the peristome.

*Gonæcia* sparsely scattered, low; aperture smaller than in the normal zoëcia.

*Distribution*.<sup>1</sup> London Clay: Fareham (abundant); Highgate; Haverstock Hill; Sydenham; White Conduit House.

*Figures*. Pl. XXX. fig. 12. Part of a zoarium from the London Clay, Haverstock Hill,  $\times 3$  diam. Fig. 12 *b*. Several zoëcia from the upper part of the same specimen. Fig. 12 *c*. Zoëcia from lower in the same specimen. Fig. 13. Zoëcia from base of another specimen.—Pl. XXXI. fig. 1. Another specimen.

*Type*. Brit. Mus. No. 49756, Edwards Coll.; Highgate. Wetherell's figured specimen is B. M. No. B 4443.

*Affinities*. Wetherell found a minute fragment of this species in a well at Hampstead, and gave a good but small figure of it; this, however, seems to have escaped subsequent notice. Mr. Vine first described the species, and he regarded it as a variety of the well-known recent species *Adeonellopsis* (*Reptadeonella*, *Microporella*, &c.) *violacea* (Johnst.); from this, however, it differs very markedly in the nature of the avicularia, the cribriform area, the subtubular peristome, &c. The species to which it is most closely allied is *Adeonellopsis distoma* (Busk); from this the main difference is in the avicularian orifice, which is much smaller in proportion to the size of the peristomial orifice, and it is placed below the latter and not included within the rim, which includes both the avicularium and orifice. In the London Clay species the avicularia are always directed very obliquely upwards.

Busk has suggested that Reuss's *Eschara coscinophora* is synonymous with *A. distoma*; but agreeing with Mr. Waters [No. 6, p. 283, and No. 13, p. 162], who records the latter from the Italian Upper Eocenes, I prefer to keep them distinct. The London Clay species agree more with *A. distoma* than *A. coscinophora*. The specimens of the latter which agree most with our species are those from the Middle Oligocene of Söllingen in Prussia, figured by Reuss [No. 7, p. 186, pl. xi. figs. 1-4]: his figure 1 allows of a careful comparison of equivalent zoëcia. The differences between the species are that in *A. wetherelli* the avicularia are oblique or transverse and much larger, the cribriform plate is larger and has more regular pores, and the secondary aperture is more raised.

<sup>1</sup> There seems some confusion as to the localities and horizons of Mr. Vine's types of this species and the next; the specimen figured as var. *b* (*i. e.* fig. 7 *b*) is recorded as from the Bracklesham Beds of the Isle of Wight; the slide is, however, correctly labelled from the London Clay.

Species 2. *ADEONELLOPSIS INCISA*, n. sp.

Syn. *Microporella violacea*, var. *fissa*, var. *a*, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 162, pl. v. figs. 7, 7 a.

*Diagnosis.* Zoarium erect, bilaminar, and forming thick, short, subcylindrical shoots. Zoecia elongate, lanceolate, quincuncially arranged. The orifice is oval or suborbicular; it opens on the sloping upper surface of the high tumid head, which also bears a large peristomial pore. A pair of large avicularia occur immediately below the orifice. The zoecia are sharply defined by lines of depression marked by rows of areolæ. The trypa is a median narrow slit.

*Gonæcia* —.

*Distribution.* London Clay: Haverstock Hill (? Bracklesham Beds, *vide* Vine).

*Type.* Brit. Mus. No. 49661.

*Figure.* Pl. XXX. fig. 11. Part of Mr. Vine's type.

*Affinities.* This species in its slit-like trypa closely resembles *Adeonellopsis perforata* (Reuss) [*Eschara perforata*, Reuss, No. 11, p. 231, pl. xxxiii. fig. 5], but the latter has no peristomial pore. It differs from *A. wetherelli*, Greg., by the pair of avicularia forming a peristomial pore, instead of having one median avicularium; the trypa is also different. The specimen figured by Reuss [No. 7, pl. xi. fig. 6] as *Eschara diplostoma*, Phil., also belongs to this genus, but differs in the form of the trypa and of the orifice. The two other forms (figs. 5 and 7) associated with it by Reuss seem different, and that represented in fig. 7 is probably a second species of *Schismoporella*.

#### Suborder HOLOTHYRIATA.

#### Family LEPRALIIDÆ.

#### Subfamily LEPRALIINÆ.

#### Genus LEPRALIA, Hincks, 1880 (non Johnst. &c.).

*Diagnosis.* Hincks, No. 2, p. 297.

Species 1. *LEPRALIA LONSDALEI*.

Syn. *Eschara bronniarti*, pars, Lonsdale (non M.-Edw.), 1850, Dixon, Geol. Suss. pp. 161, 162, pl. i. fig. 9\*.

*Diagnosis.* Zoarium thick, encrusting.

Zoecia small, ovate; very irregularly distributed. Form irregular, varying from somewhat elongate to short and round. Aperture lepralian, very large: lower margin straight or curved outwards; the lateral constriction is, however, very slight. Surface

granular. Zoëcia separated by deep depressions. A line of areolæ around the margin; these vary with the size of the zoëcia from 10 to 15 or 18.

*Avicularia*: usually one; lateral, placed close beside the orifice.

*Distribution*. Bracklesham Beds, Bracklesham Bay.

*Type*. Brit. Mus. No. 49734. Edwards Coll. (Encrusting.)

*Figure*. Pl. XXXI. fig. 2.  $\times 55$  diam.

*Affinities*. The shape of the orifice shows that this species is a true *Lepralia*, using that term, of course, in its modern restricted sense. It was figured by Lonsdale as *Eschara brongniarti*, a mistake due to his having failed to separate it from the Bryozoan on which it is encrusting. A comparison of his figure 9\* with his figure 9 shows that he has included two different forms under one name.

Among the species of *Lepralia* it most resembles *Lepralia anglostoma*, Reuss [No. 11, pp. 291, 292, pl. xxx. fig. 3], but it may be distinguished by the smallness of the orifice in the Austrian species.

#### Genus UMBONULA, Hincks.

*Diagnosis*. Hincks, No. 2, pp. 316 and cxxxviii.

Species 1. UMBONULA BARTONENSE, n. sp.

*Diagnosis*. Zoarium adnate, encrusting; forming a large and fairly thick crust over shells.

*Zoëcia* very crowded: quincuncially arranged; small, pyriform. Peristomial aperture semicircular or slightly clithridiate; lower margin straight; very large, sometimes occupying more than half the front of the zoëcium. The front wall is occupied by a large umbo, formed on an avicularian cell, the opening of which is just below the aperture and is hidden by the prominence of the umbo. Around the margin of the zoëcium runs a line of areolæ; those of the lower half are large, and from them furrows run some way up towards the umbo; the areolæ are small around the aperture.

*Avicularia* and external marsupia none.

*Distribution*. Barton Beds, Barton.

*Type*. Brit. Mus. No. 49741.

*Figure*. Pl. XXXI. fig. 4. Portion of zoarium,  $\times 55$ . diam.

Gottardi's *Eschara prominens* [No. 1, pp. 306, 307, pl. xiv. fig. 4] probably belongs to this genus, but the species is so diagrammatically figured that I cannot be quite sure. The genus is a convenient one, though, as Mr. Waters has pointed out, it is a very close ally of *Lepralia*, and perhaps ought not to be separated from it. The aperture in this species is typically lepralian.

Species 2. *UMBONULA CALCARIFORMIS*<sup>1</sup>, n. sp.

*Diagnosis.* *Zoarium*, a thick encrusting mass.

*Zoecia* roughly hexagonal in shape: short and thick. The front wall granular. The aperture is suborbicular, somewhat irregular on the lower margin from the ingrowth of the avicularia. The front wall is very tumid, and bears a large avicularian cell, this is attached to the front wall and continues over it as a pair of sharp pointed processes. The pore of the avicularium is raised and close beside the zoëcial aperture. The avicularium is always lateral and oblique.

*Oœcia* globose, low, and comparatively small.

*Distribution.* London Clay, Fareham.

*Type.* Brit. Mus. No. B 3831. (Growing on *Hornera*.)

*Figure.* Pl. XXXI. fig. 3. × 55 diam.

*Affinities.* The shape of the aperture, the tumid front wall, and the umbonate avicularium all agree with the genus *Umbonula*. Amongst the other species it probably is most nearly allied to *U. bartonense*, Greg., but from this it may be distinguished by its suborbicular aperture, the lateral position of the avicularia, and the pores of these being terminal instead of in the angle overhung by the umbo.

#### Subfamily TEICHOPORINÆ.

##### Genus TEICHOPORA<sup>2</sup>, n. g.

*Diagnosis.* *Zoarium* foliaceous or encrusting: in large flat surfaces.

*Zoecia* pyriform, much expanded above; elongate. Aperture large, holostomatous, orbicular; surrounded by a raised ring. Usually long sinuous lines of marginal areolæ continuous across successive zoëcia.

*Gonœcia* with the aperture contracted either marginally or by a bar or a central spot.

Species 1. *TEICHOPORA CLAVATA*.

*Diagnosis.* *Zoarium* in large foliaceous expansions.

*Zoecia* clavate, the lower part being much restricted in width. Orifice very large; the surrounding ring is continuous with the ridge on the front wall of the zoëcia. Punctures large and numerous.

*Avicularia*: usually one, just below the orifice; lateral.

<sup>1</sup> From the spur-shape of the avicularian cell.

<sup>2</sup> From *τείχος*, the wall of a fortress.

*Gonæcia* irregularly scattered. Orifice much restricted, either at the margin or by the central calcareous plate, the knob of which has a small central pit.

*Distribution.* Barton Beds, Barton.

*Type.* Brit. Mus. No. 49733. Edwards Coll.

*Figures.* Pl. XXXI. fig. 5. Part of zoarium of the type. Fig. 6. Basal zoæcia. Fig. 7. Part of a large specimen (B. M. No. 49757) showing gonæcia.

*Remarks on the Genus.* This is a Lepralidan with a simple orbicular aperture and thickened peristome, and gonæcia instead of external marsupia. The last character as well as the form of the aperture distinguish it from *Lepralia*; the absence of a secondary orifice separates it from the Smittidæ.

*Affinities of the Species.* The nearest ally of *T. clavata* is a specimen from the German Oligocene, described by Stoliczka [No. 1, p. 87, pl. ii. fig. 8] as *Eschara crenatula*, from which it differs by its plain margin. *Eschara semitubulosa* (Reuss) [No. 11, p. 272, pl. xxxiii. fig. 3] probably also belongs to *Teichopora*, though in the absence of knowledge as to the oœcial characters one cannot be quite sure: the greater length of the zoæcia and the more uniform width of the Austrian species clearly distinguish it. Mr. Waters has suggested that *E. semitubulosa* is a synonym of Reuss's earlier species, *E. syringopora* [No. 1, p. 68, pl. viii. fig. 23, and No. 11, p. 269, pl. xxxii. fig. 1]; but in the latter the orifice is smaller, the zoæcia expanded below, and the front wall has a long furrow instead of being tumid and solid. Mr. Waters's own figures [No. 12, p. 20, pl. iii. figs. 2-4] more resemble the English species, though the different nature of the closure, the general form of the zoæcia, and the proportions of the orifice show them to be distinct.

Amongst other species that will probably prove to belong to this species are *Eschara stipitata* (Reuss, MS. Manzoni) [No. 3, p. 60, pl. xii. fig. 3], and *Eschara sulcimargo*, Reuss [No. 1, p. 58, pl. v. fig. 18].

#### Genus MENISCOPORA<sup>1</sup>, n. g.

*Diagnosis.* A genus of Lepraliidæ with a simple primary orifice, usually biconvex in shape, with the lower margin a much flatter curve than the upper. Gonæcia and no external marsupia.

*Affinities.* This genus differs from *Teichopora* by the shape of the orifice and the form of the zoæcia. From most other Lepraliidæ it differs by the presence of gonæcia; when this cannot be determined, it may be distinguished from *Lepralia* (sensu stricto) by the form of the aperture, and from *Umbonula* by the absence of the umbo: these are the two genera which it most resembles in general aspect.

<sup>1</sup> From *μήνισκος*, a lune, referring to the shape of the orifice.

Species 1. *MENISOPORA BIGIBBERA*<sup>1</sup>.

Syn. *Eschara brongniarti*, Lonsdale, 1850 (non M.-Edw.), in Dixon, Geol. Suss. pp. 161, 162, pl. i. fig. 9.

*Diagnosis.* Zoarium erect, bilaminar; forming large flat foliaceous expansions.

*Zoecia* regularly quincuncial in arrangement. Surface plain. Shape pyriform. Aperture large, semicircular, but with the lower margin somewhat curved outward. The main part of the front wall is a raised triangular area; at the upper part are two prominent humps. The zoecia are separated by depressed furrows; a line of large round punctures occurs along the margin.

*Avicularia*: one large marginal pair beside the lower corners of the aperture; mandible pointing outwards.

*Distribution.* Bracklesham Beds, Huntingbridge.

*Type.* Brit. Mus. No. 49732. Edwards Coll.

*Figures.* Pl. XXXI. fig. 8. Part of the type from Huntingbridge. Fig. 9. Fragment with gonœcium.

*Affinities of the Species.* As this species was identified by Lonsdale with M.-Edwards's *Eschara brongniarti* it is necessary to compare the two: the fact that the English species has the aperture wider than long, has two humps and a raised triangular area of front wall, is quite sufficient to distinguish them. M.-Edwards's figure [No. 2, p. 335, pl. xi. fig. 9] leaves the generic position of his species quite uncertain; but even should it prove to be a *Meniscopora*, which is not probable, there need be no confusion between the species.

This species has a certain resemblance in general aspect to the *Eschara fenestrata*, Reuss [No. 11, p. 290, pl. xxxii. fig. 5], which Waters [No. 12, pp. 18, 19] regards as a synonym of *Lepralia bisulca* (Reuss) [No. 11, pp. 270, 271, pl. xxxii. fig. 10]; but the latter has external oecia.

## Family CELLEPORIDÆ.

## Genus CONESCHARELLINA, D'Orbigny, 1851.

[D'Orbigny, No 2, pp. 446, 447.]

Syn. *Batopora*, Reuss; *Fedora*, Jullien.

*Diagnosis.* A genus of Celleporidæ with a small, conical, hemispherical, or spherical free zoarium; uni- or multi-laminate. The zoecia are holostomatous; the aperture is usually on the highest part of the front wall, and is generally orbicular or clithriate. Oecia large and globose; comparatively rare.

*Distribution.* *Recent.* S. Atlantic, Australia.—*Fossil.* Eocene: England. Oligocene: Germany, Austria, Italy. Miocene: Austria.

<sup>1</sup> *I. e.* two-humped, referring to the prominences on the front wall.

Species I. *CONESCHARELLINA CLITHRIDIATA*, n. sp.

Syn. *Cellepora*, sp., Wetherell, 1837, Trans. Geol. Soc. ser. 2, vol. v. pl. ix. fig. 21; Busk, 1866, Geol. Mag. vol. iii. p. 301.

*Cellepora* sp. (*pumicosa*?), Vine, 1890, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 164.

*Diagnosis.* Zoarium a small, thick, globular mass; base contracted (? attached).

*Zoecia* few in number and irregularly distributed and not arranged around a central cell. The apertures of the zoecia are clithridiate in shape; they are large and terminal. The zoecia are tumid and generally hexagonal in outline; the front walls are granular and steep; the zoecia are separated by deep depressions.

*Oecia* very large in proportion to the size of the zoecia; globose, tumid, overhanging the aperture. Only rare zoaria show them, but then they are numerous.

*Distribution.* London Clay: Highgate, Sydenham, &c.

*Type.* Brit. Mus. No. B 1357 (Wetherell's specimen, No. 69554).

*Dimensions.* The largest zoarium is 1 mm. in diameter.

*Figures.* Pl. XXXI. fig. 10. A zoarium from the London Clay, Hampstead; Brit. Mus. No. 69554.—Fig. 11. A zoarium from Sydenham with oecia.

*Affinities.* A charming little figure of a specimen of this species has been given by Wetherell. The species, however, was not named and it has been missed by all subsequent workers. His specimen is in the British Museum collection, along with a great number from the London Clay at Sydenham. This species belongs to the group of which *Cellepora globularis*, Bronn [No. 2, p. 654], was the first described species; as Reuss [No. 9, pp. 113, 114] has, however, pointed out, several distinct forms have come in time to be included under this name. The specimen recently figured by Gioli [No. 1, pp. 263, 264, pl. xiv. fig. 9] appears to be quite distinct. Pergens's short synonymy [No. 4, p. xvi] shows much discrimination.

The nearest ally of this species, *C. scrobiculata* (Koschinsky) [No. 1, p. 63, pl. vi. figs. 2, 3], has a hemispherical or conical zoarium, the base being expanded instead of contracted as in all the English specimens; the aperture in the Bavarian species is also circular and surrounded by a rim. The new species differs from *C. multiradiata*, Reuss [No. 11, p. 265, pl. xxxi. figs. 1-4, and Waters, No. 12, pp. 32, 33], as in that the zoecia are barrel-shaped, the apertures flush with the surface of the zoarium, and it is composed of several layers; the oecia also are much larger. From the Miocene *Conescharellina rosula* (Reuss) [No. 1, p. 78, pl. ix. fig. 17, and Manzoni, No. 3, p. 54, pl. ii. fig. 6] the London species differs in its clithridiate aperture and the less elevated zoecia. The same characters also separate it from *C. stoliczkai* (Reuss) [No. 10, pp. 223-226, pl. ii. figs. 2-4].

In agreement with the zoologists I accept the name *Conescharellina* in preference to Reuss's *Batopora*, which has been adopted by most palæontologists. There seems little room for doubt as to the identity of the two. D'Orbigny's genus was diagnosed

exceptionally well for D'Orbigny, and its claims cannot be so quietly set aside as Reuss has done in the two lines in which he refers to it. *Batopora* is the better name, but that is of course a mere matter of detail.

GENUS ORBITULIPORA, Stoliczka, 1862.

[Stoliczka, No. 1, p. 90.]

Type species. *O. haidingeri*, Stol. op. cit. p. 91, pl. iii. fig. 5.

*Diagnosis.* A Celleporidan with a bilaminar zoarium composed of a flat round disk supported laterally by a short stem. The zoecia of the disk are usually arranged around a small central zoecium. The zoecia are holostomatous, with a large and typically orbicular aperture. The oecia are narrow, but globose and elevated. Small avicularia and vibracula may or may not occur.

Species 1. ORBITULIPORA PETIOLUS (Lonsdale), 1850.

Syn. *Cellepora? petiolus*, Lonsdale, 1850, Dixon, Geol. Suss. p. 151, pl. i. fig. 10; Morris, 1854, Cat. Brit. Foss. ed. 2, p. 120; Murlon, 1881, Geol. Belg. pp. 180, 191, 202; Vine, 1890, Proc. Yorks. Geol. & Polyt. Soc. xi. pp. 163, 164, pl. v. fig. 10; Reuss, 1867, Sitzb. k. Ak. Wiss. Wien, Bd. lv. Abth. 1, p. 217.

*Diagnosis. Zoarium:* disks rather large for this genus; thick at the margins and depressed in the centre. The stem is short and, so far as known, unjointed; when broken away it leaves a large round scar.

*Zoecia* numerous; usually in fairly regular radial rows; the apertures are orbicular in the centre, but become elliptical at the margin; those adjoining oecia have the margin nearest incurved owing to the overgrowth of the oecium. Separated by interspaces which are often marked by punctures.

*Oecia* very irregularly distributed; sometimes absent from the whole of one surface of a disk, at others there are a few irregularly scattered, at others nearly every zoecium has one. They are globose, but narrow.

*Distribution.* Bracklesham Beds: Bracklesham, Bramshaw, Brook, Whitecliff Bay (common).—*Foreign.* Belgium: Bruxellien, Laekenien, Wemmélien, and Tongrien.

*Type.* Brit. Mus.

*Figures.* Pl. XXXI. fig. 12. Zoarium,  $\times 4$  diam. Fig. 12 a. Part of the same,  $\times 18$  diam., to show the oecia. Fig. 13. Another specimen, to show the stem. Fig. 14. A young specimen in the Conescharellidan stage.

*Affinities of the Species.* This species differs from *O. haidingeri* mainly by the fact that the peripheral zoecia open upwards instead of outwards, a point well seen in a comparison of Stoliczka's and Lonsdale's figures. *O. haidingeri* is the nearest ally of the English species; if the two species should prove to be identical, Lonsdale's name will have the prior claim to adoption.

*Affinities of the Genus.* The British Museum contains a large number of specimens of this species, and these well show its range. One of the smallest specimens, having a zoarium barely 1 mm. in diameter, is of interest as showing that this genus passes through a *Conescharellina* (or *Batopora*) stage; the small central zoecium is surrounded by an irregular series of others having the tumid forms, granular walls, and terminal apertures of that genus. This therefore shows that *Conescharellina*, and especially such a species as *C. clithridiata*, is a more primitive form than *Orbitulipora* with its remarkably specialized zoarium.

The species is also clearly distinct from *O. lenticularis*, Reuss [No. 11, p. 289, pl. xxx. figs. 12-14], as to the generic position of which I do not feel able to express an opinion from Reuss's figures.

#### Family SMITTIDÆ.

##### Genus MUCRONELLA, Hincks, 1880.

*Diagnosis.* Hincks, No. 2, p. 360.

Species 1. MUCRONELLA ANGUSTOÆCIUM, n. sp.

Syn. *Porella concinna*, var. *eocena*, G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. vol. xii. p. 61.

*Diagnosis. Zoarium:* unilaminar flat surfaces (? erect or encrusting algæ).

*Zoecia* irregular, but with a tendency towards a disposition along radial branching lines. Shape approximately hexagonal. The zoecia are tumid, rising from a flat surface. Orifice suborbicular: the peristome is high and thickened, especially on the lower margin; it here bears a small simple mucro. The thick bases of a pair of marginal spines occur on the lower angles of the orifice. The thick lower lip has a distinct median transverse depression. Surface granular. Zoecia separated. About a dozen areolæ occur around the lower half of the zoecia.

*Oecia* numerous, granular, globose, but narrow. In one case there are two oecia to one zoecium.

*Avicularia:* none.

*Distribution.* Barton Beds, Barton; London Clay, Fareham.

*Type.* Brit. Mus. No. 49739. Edwards Coll. From Barton.

*Figures.* Pl. XXXI. fig. 15. Barton Beds. Brit. Mus. No. 49739. Fig. 16. Part of a zoarium from the London Clay, Fareham.

*Affinities.* This species reminds one at first sight of the common recent *Mucronella ventricosa* (Hass.), and it clearly belongs to the same group; it differs from that species, however, by the small simple mucro, the narrow instead of elongate oecia, the position of the marginal spines, and in less important points. Probably its nearest ally is *M. hörnesi* (Reuss)<sup>1</sup>, of the Middle Oligocene; the new species, however, may be distinguished by its low instead of elongate oecia. In this character it most resembles

<sup>1</sup> *Lepralia hörnesi*, Reuss, No. 8, pp. 633, 634, pl. xiii. fig. 5, and No. 7, pp. 173, 174, pl. vii. fig. 12.

*M. chilopora* (Reuss)<sup>1</sup>, but the general form of the zoëcia and the structure of the mucro are quite distinct in the two species.

Mr. A. Bell's collection of Fareham Bryozoa having recently passed into the possession of the British Museum, I am able to identify with this species the specimen referred to by Vine as *Porella concinna*.

Mr. Waters, in his 'Revision of the North Italian Bryozoa,' does not quote *Mucronella* from the Eocene deposits of that country. The genus occurs in the Austrian Leithakalk (Helvetian), as at least two species, *M. serrulata* (Reuss)<sup>2</sup> and *M. tenera* (Reuss)<sup>3</sup>, seem referable to it.

Mr. Waters [No. 11, pp. 14, 15] has shown that under the name "mucro" several distinct structures have been confused together, and he has proposed the dismemberment of *Mucronella* and the incorporation of most of its species in *Smittia*. The generic value of variations in the secondary orifice and its peristomial tube certainly appears very doubtful, but there does seem sufficient difference between this group of species of *Mucronella* and normal *Smittie* to justify the limitation and retention of Mr. Hincks's too comprehensive genus.

#### Genus SMITTIA, Hincks, 1880.

*Diagnosis.* Hincks, No. 1, p. 340.

Species 1. SMITTIA TUBULARIS<sup>4</sup>, n. sp.

*Diagnosis.* Zoarium erect; narrow cylindrical or shoot-like branches; branching dichotomous.

Zoëcia arranged alternately. Shape pyriform; ovate or elongate-ovate. Front wall tumid; surface granular. Secondary orifice orbicular or a distinct spout-like depression often shown on lower margin. Peristome thin. A row of large areolæ occurs around the margin.

Oëcia small, flattened, the lower side covered by the upper margin of the secondary orifice.

*Avicularia* large, lateral, on a prominent tubercle obliquely below the orifice.

*Distribution.* London Clay, White Conduit House.

*Type.* Brit. Mus. No. 49744. Edwards Coll.

*Figures.* Pl. XXXII. fig. 1 *a*. Zoarium, nat. size. Fig. 1 *b*. Several zoëcia, enlarged. Fig. 1 *c*. Basal zoëcia.

<sup>1</sup> *Cellepora chilopora*, Reuss, No. 1, p. 91, pl. xi. fig. 4, and No. 14, p. 168, pl. iv. fig. 1.

<sup>2</sup> *Cellepora serrulata*, Reuss, No. 1, p. 85, pl. x. fig. 12; and *Lepralia serrulata*, Reuss, No. 14, p. 167, pl. ii. figs. 2, 3 (? pl. iv. fig. 4).

<sup>3</sup> *Lepralia tenera*, Reuss, No. 14, p. 167, pl. ii. fig. 4, pl. iii. fig. 11.

<sup>4</sup> Referring to the subtubular orifice.

*Affinities.* This appears to be a very well-marked species, with its elevated peristome, its tumid front wall, and its large lateral avicularia and marginal punctures. The secondary orifice is so raised and subtubular that it first seemed that the species belonged to *Porella* (or *Tessarodoma*); but its secondary orifice and external avicularia show that the resemblance is superficial and that it is truly a *Smittia*. Its mode of growth, however, is exactly that of *Tubucellaria*; it lacks, however, the peristomial pore of that genus, and the peristome is not so raised. It is not improbable that some of the specimens figured as fossil forms of *T. opuntioides* (Pall.) may belong to this species. Such may be the specimen figured by Michelin [No. 1, pl. 46. fig. 21] as *Vincularia fragilis*, Defr., and some of Reuss's *Cellaria michelini*.

*Smittia* is well known in the Continental Upper Eocene and Oligocene<sup>1</sup>, but none of the species with which I am acquainted sufficiently resemble this one to necessitate a comparison.

#### Order CYCLOSTOMATA.

##### Family IDMONEIDÆ.

Genus IDMONEA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 80.]

*Diagnosis.* Pergens, No. 3, p. 342.

Type species. *Idmonea triquetra*, Lamx. No. 2, p. 80, pl. 79. figs. 13-15.

Species 1. IDMONEA GIEBELI, Stoliczka, 1862.

Syn. *Idmonea (Tubigera) giebeli*, F. Stoliczka, 1862, Olig. Bry. Latdf., Sitzb. k. Ak. Wiss. Wien, Bd. xlv. p. 81, pl. i. fig. 6; F. Schreiber, 1872, Bry. Mittelolig. Grünsand Magdeburg, Zeit. f. gesamt. Naturwiss. Bd. xxxix. p. 479.

*Idmonea giebeliana*, F. Stoliczka, 1865, Foss. Bry. Orakei Bay, Novara Reise, Geol. Theil, Bd. i. Abth. ii. Pl. p. 115, pl. xviii. figs. 4-6; F. W. Hutton, 1880, Man. New Zeal. Moll. Coll. Mus. Geol. Surv. N.Z. p. 196.

*Diagnosis.* Zoarium cylindrical, straight, erect branches; mode of branching unknown. The back of the zoarium is a full flat curve; the front is well raised.

Zoœcia in series of five; one forms a median row, on each side of which are two pairs placed on a line a little above the central zoœcium. The outermost zoœcia are the longest, but only slightly exceed the others. The walls are granular. Peristome entire, even.

Oœcia small, replacing one of the median zoœcia.

<sup>1</sup> See e. g. Waters, No. 12, pp. 21, 22.

*Distribution.* London Clay, Haverstock Hill.—*Foreign.* Oligocene: Latdorf, Magdeburg, &c., Germany. Palæogene: New Zealand.

*Type.* Brit. Mus. No. 49656.

*Figures.* Pl. XXXII. fig. 3 *a.* Part of zoarium, including an oœcium. Fig. 3 *b.* Transverse section.

*Affinities.* Busk has divided the genus *Idmonea* into two groups: in one the zoœcia all open in two lateral groups and the two innermost ones are the longest; in the second, corresponding to the genus *Tervia* of Jullien, the outermost are the longest and between the lateral series there are some zoœcia irregularly scattered. A third group may, however, be added, including species, such as the present, in which the outermost zoœcia are the longest, but in which there is only a single median row of zoœcia, and the lateral series are opposite.

I am aware of the existence of only six specimens of *Idmonea* from the London Clay; two of these are quite unrecognizable internal pyritous casts, one of which is identified by Mr. Vine as *Idmonea coronopus*, Defr., and the other as *I. gracillima*. A specimen which Mr. Vine tells me is that figured by him as the former is now in the British Museum Collection, but it is labelled, and correctly so, from the London Clay of Sheppey. Mr. Vine [B, p. 165, pl. v. fig. 12] has figured a third specimen also as *Idmonea gracillima*, Reuss, but it is an *Entalophora*. The remaining three small specimens belong one to each of these three groups of *Idmonea*. This helps one to realize that the British Eocene Bryozoan fauna was a singularly diversified one.

Lonsdale [No. 2, pl. ix. fig. 24] has also figured a specimen as *Idmonea coronopus*, but the figure is unrecognizable and I have not been able to find the specimen.

The only noticeable difference between the London Clay specimen and the type figure is in the greater length of the zoœcia in the former; but that may be only due to the fragments having come from a different position in the zoaria. The New Zealand specimen is more doubtful; Hutton quotes it, but Waters, in his paper on the New Zealand Cyclostomata [No. 8, pp. 337–350, pl. xviii.], does not refer to it. Miss Jelly [No. 1, pp. 118, 119] makes it a synonym of *I. milneana*, D'Orb., but I fail to see why it should be included with this rather than any other species of the genus.

Species 2. *IDMONEA BIALTERNATA*, n. sp.

*Diagnosis.* Zoarium sinuous, in thin elongated branches, evenly rounded in front, with a flattish curve at the back.

Zoœcia of medium length, thick, with large apertures; walls granular. They are arranged in two pairs; each pair open close together; the two pairs are placed alternately. Peristome thick, plain.

Oœcia: ? a small dilatation at base of the inner zoœcia.

*Distribution.* London Clay, Islington.

*Type.* Brit. Mus. No. 49662.

*Figures.* Pl. XXXII. figs. 2 *a*, 2 *b*. Zoarium and section.

*Affinities.* This species belongs to the first of the groups of *Idmonea*, including those with the zoëcia all in lateral series. It most closely resembles a specimen figured by Manzoni [No. 4, p. 5, pl. iii. fig. 10] as *I. carinata*?, Röm. A comparison with the figures both of Römer [No. 1, p. 21, pl. v. fig. 20] and Reuss [No. 1, pp. 44, 45, pl. vi. fig. 27] would seem to show that the query after the identification was very well founded; in the number of zoëcia, the shape and structure of cross-sections, and other points, Manzoni's figures markedly differ from those of the larger pluriserial triangular species figured by Römer from the North-German Chalk. From the typical *I. carinata* the London Clay species can be very readily distinguished.

*Idmonea reticulata*, Reuss [No. 11, pp. 281, 282, pl. xxxiv. fig. 13], belongs to the same series, but differs in the smaller size and more regular arrangement of the zoëcia and apertures, which are grouped in triplets instead of pairs. The same characters also separate the new species from the *I. laticosta*, Mars. [No. 1, p. 29, pl. ii. fig. 11], of Danian age, which belongs to the same group.

Species 3. *IDMONEA SERIATOPORA*, Reuss (?).

Syn. *Idmonea seriatopora*, Reuss, 1847, Foss. Polyp. Wiener Tertiärbeckens, p. 46, pl. vi. fig. 32;  
Manzoni, 1878, Brioz. foss. Mioc. Austr. Ungh., Denk. k. Ak. Wiss. Wien, Bd. xxxviii.  
Abth. 2, p. 6, pl. vi. fig. 12.

*Diagnosis.* Zoarium of thick irregular branches, composed of many zoëcia, well rounded at the back.

Zoëcia very irregularly arranged, the lateral ones the longest. There are no regular series arranged on either side of a medial line. Three zoëcia often open in an oblique line.

*Peristome* elliptic; border irregular.

*Distribution.* London Clay, Haverstock Hill.—*Foreign.* Leithakalk (Helvetian), Austria.

*Type.* Brit. Mus. No. B 4510.

*Figures.* Pl. XXXII. fig. 4 *a*. Part of a zoarium,  $\times 18$  diam. Fig. 4 *b*. Mouth,  $\times 32$  diam. Fig. 4 *c*. Transverse section,  $\times 18$  diam. Fig. 5. Back view of zoarium.

This species belongs to the subgenus *Tervia* of Jullien.

*Affinities.* The irregular distribution of the zoëcia of this species reminds one of *I. compressa*, Reuss [No. 1, p. 46, pl. vi. fig. 22], but the zoarium is not so laterally compressed. Its closest ally is *Idmonea seriatopora*, Reuss, as figured by Manzoni [No. 4, pp. 6, 7, pl. ii. fig. 8, pl. v. fig. 17]; to the original and no doubt diagrammatic figure of Reuss it has a less decided resemblance. But the London Clay specimen is not sufficiently large to allow of a more definite comparison; hence I do not feel able positively to affirm the occurrence of the Austrian Miocene species in the

English Eocenes. Among the species which M. Jullien [No. 2, p. 501, pl. xvii. figs. 72, 73] has referred to his genus *Tervia* it most resembles *Tervia solidula*.

Species 4. *IDMONEA CORONOPUS*, DeFrance, 1821.

Syn. *Idmonea coronopus*, DeFrance, 1821, Dict. Sci. Nat. t. xxii. p. 565 (non Atlas, pl. xlvi. fig. 2, as stated by Bronn); Blainville, 1830, *ibid.* t. ix. p. 385; *id.* 1834, Man. d'Actinol. p. 420; Milne-Edwards, 1836, in Lamarck, Anim. sans Vert. ed. 2, t. ii. pp. 281, 282; *id.* 1838, Mém. Crisiées, Ann. Sci. Nat. Zool. sér. 2, t. ix. pp. 215, 216, pl. xii. fig. 3; Michelin, 1844, Icon. Zooph. p. 172, pl. xlvi. fig. 16; Bronn, 1848, Index Palæont. Nomencl. p. 606; Lonsdale, 1850, in Dixon, Geol. Sussex, pp. 153–155, pl. ix. fig. 24; Hagenow, 1851, Bryoz. Maastr. Kreidebild. p. 25; Lonsdale, 1878, in Dixon, Geol. Sussex, ed. 2, pp. 204–206, pl. ix. [10] fig. 24; Harris and Burrows, 1891, Eoc. and Oligoc. Paris Basin, p. 61.

*Retepora trigona*, Morren, 1828, Desc. Corall. foss. Belgio, Ann. Gron. p. 37, pl. x. figs. 1–3 (identification *vide* Michelin); Galeotti, 1838, Mém. Géogn. Brabant, p. 187, pl. iv. fig. 13; Nyst, 1844, Coq. et Polyp. foss. Terr. Tert. Belg., Mém. Cour. R. Ac. Belg. t. xvii. pp. 619, 620.

*Chrysisina coronopus*, Moulton, 1881, Géol. Belgique, t. ii. p. 180.

*Hornera flabelliformis*, Vine (non Blainv.), Proc. Yorks. Geol. & Polyt. Soc. vol. xi. p. 166, pl. v. fig. 15; *id.* *ibid.* vol. xii. p. 53.

*Diagnosis.* Zoarium small, erect, rising from an encrusting, expanded base. The branches fork several times; they are triangular in section and well rounded behind; they end bluntly.

*Zoecia* in short transverse series, alternately arranged. The zoecia are single at the base, but rapidly increase to rows of four; this decreases to three above. The innermost zoecia are the longest.

*Peristome* even, usually oblong with rounded angles; younger and isolated zoecia have oval or even circular apertures.

*Wall* granular.

*Distribution.* *British:* Bracklesham Beds, Bracklesham (Brit. Mus., Dixon and Vine Collections).—*Foreign:* Calcaire grossier, Parnes, Grignon, Chaumont, &c.; Laekenien; Uccle (near Brussels), de Forêt, d'Assche.

*Figures.* Pl. XXXII. figs. 6 a, 6 b.

*Affinities and Differences.* As this species belongs to the typical group of *Idmonea* it clearly differs from *Idmonea (Tervia) seriatopora*, Reuss. As there is no median line of zoecia it differs from *Idmonea giebeli*, Stol. From the third British Eocene species it may readily be distinguished, as in that the zoecia are always in alternate pairs.

Genus *HORNERA*, Lamouroux, 1821.

[Lamouroux, No. 2, p. 41.]

*Diagnosis.* Pergens, 1889, No. 3, p. 353.

Type species. *Hornera frondiculata* (Lamarck), 1816, No. 1, pp. 182, 183.

Species 1. *HORNERA FAREHAMENSIS*, n. sp.

Syn. *Hornera ramosa*, D'Orb., G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. xii. pp. 54-56.

*Diagnosis.* Zoarium thick, dichotomously branching tufts; the branches do not anastomose.

*Zoecia* open somewhat regularly on the anterior side; the orbicular apertures form straight lines around the branches. In the middle line there is often an irregular and crowded series. The apertures are flush. The interzoecial pores are of medium size, but not very abundant, numbering from twice to thrice as many as the zoecia. The posterior side of the zoarium is deeply perforate, the punctures occurring in simple series, occasionally branching.

*Distribution.* London Clay, Fareham.

*Type.* Brit. Mus. No. B 3831.

*Figures.* Pl. XXXII. figs. 7-9.

*Affinities.* This species has been identified by Mr. Vine as *H. ramosa*, D'Orbigny [No. 2, pp. 937, 938, pl. 608. figs. 6-10, pl. 773. figs. 1-3]; from that species it appears to me to differ by the following characters: (1) the sections of the branches are round and not subtriangular; (2) the central series of zoecial apertures are very irregularly distributed; (3) the species figured by D'Orbigny has the exceptional character of a series of tubular prominences probably zoecial (see pl. 773. fig. 2); (4) the zoarium is irregularly branched and does not form the cupuliform structure shown by D'Orbigny (pl. 608. fig. 6).

The nearest ally of this species appears to me to be *Hornera concatenata*, Reuss (No. 11, pp. 71, 72, pl. xxxv. figs. 5, 6), but in that species the pores on the back are few and far between, the number of zoecia in a transverse series is less, the pores on the front wall are much less numerous, and there is no irregular middle series.

#### Genus ENTALOPHORA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 81.]

*Diagnosis.* Pergens, No. 3, p. 357.

Species 1. *ENTALOPHORA TERGEMINA*<sup>1</sup>, n. sp.

Syn. *Idmonea gracillima*?, Reuss, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pp. 165, 166, pl. v. fig. 13.

*Diagnosis.* Zoarium thick, apparently short. In section it appears quadrangular, with the angles well rounded. Surface minutely pitted.

*Zoecia* crowded, long, expanding above; series of three or four open together along a straight line; there are four such triplets at not quite the same level in a series around the zoarium. There are 12 or 13 in a complete series. The zoecia are somewhat infundibuliform, and have a somewhat quadrangular aperture.

<sup>1</sup> *Tergeminus*, triple, referring to the apertures being usually in triplets.

*Distribution.* London Clay, Sheppey.

*Type.* Brit. Mus. No. B 4509.

*Figures.* Pl. XXXII. figs. 10 *a*, 10 *b*.

*Affinities.* The specimen which serves as the type of this species is that which Mr. Vine figured as *Idmonea gracillima*, Reuss, but as it belongs to a different family there is no necessity to compare it with that species. It reminds one, in the form of the zoarium, of *Entalophora clavula*, Reuss<sup>1</sup>; from this it differs in the serial arrangement of the apertures. The same character separates it from *Entalophora palmata*, Busk<sup>2</sup>.

This species seems to me to be most allied to *Entalophora wanganuiensis*, Waters (No. 5, pp. 340, 341, pl. xviii. fig. 1): but the New Zealand species has only 10 zoecia in a series; these are verticillate, and the zoecia are not infundibuliform.

#### Family HETEROPORIDÆ.

Genus HETEROPORA, Blainville, 1830.

[Blainville, No. 1, p. 381.]

*Diagnosis.* Pergens, No. 3, p. 369.

Species 1. HETEROPORA GLANDIFORMIS<sup>3</sup>, n. sp.

*Diagnosis.* Zoarium very small, globular, free (the largest specimen is less than 3 millim. in diameter).

*Zoecia* irregularly bent tubes. The orifice varies from orbicular to subhexagonal in shape; they are surrounded by a strong raised rim. The zoecia are crowded, but interzoecial spaces occur on the surface of the zoarium; these are, however, entirely filled in the interior. Secondary pores numerous, somewhat less in number than the normal zoecia, irregularly scattered; they also have a thickened, slightly raised rim.

*Distribution.* Barton Beds, Barton (common). Bracklesham Beds, Bracklesham Bay. ? London Clay, Highgate. (One somewhat doubtful specimen: Brit. Mus. No. 49596.)

*Type.* Brit. Mus. No. B 4511. Edwards Coll.

*Figures.* Pl. XXXII. fig. 11. A zoarium from Barton; external view. Figs. 12 *a*, *b*. Fragments to show internal structure.

*Affinities.* In the form of the zoarium this species resembles most closely some specimens of *Heteropora conifera* (Lamx.) [No. 2, p. 87, pl. 83. figs. 6, 7; see Haime, No. 1, pp. 208, 209, pl. xi. figs. 1 *a-c*], figured by Haime, but the zoecial characters are quite distinct. *H. stellulata*, Reuss (No. 1, p. 35, pl. v. figs. 21, 22; Manzoni, No. 4,

<sup>1</sup> *Pustulopora clavula*, Reuss, No. 1, p. 41, pl. vi. fig. 11. For later figures see Reuss, No. 1, p. 194, pl. ix. figs. 3, 4.

<sup>2</sup> *Pustulopora palmata*, Busk, No. 6, p. 108, pl. xviii. fig. 2; and Manzoni, No. 4, p. 11, pl. ix. fig. 34.

<sup>3</sup> From *glauc*, a bullet.

p. 18, pl. xi. fig. 44), has certain affinities, but the raised triangular or oval zoecia and numerous pores of that species are quite distinctive. *H. stipitata*, Reuss (No. 1, p. 35, pl. v. fig. 19; Manzoni, No. 4, p. 19, pl. xi. fig. 45), has also more numerous cancellate pores and a greater thickness of wall. Most of the specimens are less than 2 millim. in diameter and are perfectly spherical; the largest is about 2.5 millim. in diameter, and is somewhat flattened and presents a slight resemblance to some specimens in the *Conescharellina* stage of *Orbitulipora*.

#### V. *Miscellaneous Records.*

As the Bryozoa are rare in the English Lower Tertiaries, the following records are inserted in the hope that they may lead to search in those horizons.

DIACHORIS INTERMEDIA, A. W. Waters, A, p. 224 (non Hincks); G. R. Vine, A, p. 673, B, p. 160, C, p. 54.

*Distribution.* Middle Eocene, Bournemouth.

The British Museum contains some specimens of Bryozoa from the same horizon, but they are quite indeterminable. Mr. Waters has also recorded *Lepralia*, sp., *Membranipora*, sp., and *Flustra*, from the same horizon.

DITAXIA VARIABILIS, D'Orb., G. R. Vine, C, p. 58.

The specimen on which this identification was founded is now in the British Museum (B 4589), but it seems to me to be generically indeterminable. It came from the London Clay at Fareham.

CRIBRILINA RADIATA (Moll), A. W. Waters, 1883, in H. M. Klassen, A, p. 244; W. Whitaker, B, vol. i. p. 237.

*Distribution.* Woolwich and Reading Beds (Blackheath Beds); Park Hill, Croydon.

FLUSTRA CRASSA, Desm., J. Morris, No. 1, p. 37; T. H. Huxley and R. Etheridge, A, p. 332; W. Whitaker, A, p. 594; G. R. Vine, A, p. 673; J. L. Lobley, A, p. 96.

*Distribution.* London Clay, Primrose Hill and London District.

FLUSTRA, sp., W. Whitaker, T. H. Huxley, and R. Etheridge, A, pp. 574, 577, 581; T. H. Huxley and E. T. Newton, B, p. 14; W. Whitaker, B, vol. i. p. 213.

*Distribution.* Thanet Beds, E. of Faversham. Woolwich and Reading Beds, Dulwich, Sundridge.

POLYZOA, indet., H. W. Bristow, A, p. 284.

*Distribution.* Bembridge Beds. (This is the only evidence known to me of the occurrence of Bryozoa in the British Upper Oligocene.)

HORNERA MINUTA, Vine, B, p. 166, C, p. 53. Bracklesham Beds.

The specimen appears to have been lost.

HORNERA ? FLABELLIFORMIS, Blainv., Vine, B, p. 166, pl. v. fig. 15, and C, p. 53.

The specimen upon which this record is founded is now in the British Museum; it is partly immersed, with the zoecial orifices downwards, the basal portion alone being visible: it is likely to belong to *Idmonea*, and to be the same species as that figured by Lonsdale, No. 2, pl. ix. fig. 24, as *I. coronopus*, Defr.

LICHENOPORA MEDITERRANEA ?, Blainv., Vine, C, p. 60.



VII. *Affinities of the Fauna.*

The preceding list shows that the Bryozoa included in the present paper belong to three fairly distinct faunas, but a comparison of the three shows that they possess certain features in common. In the first place, each of the three faunas is numerically small, both in species and individuals, in comparison with the wealth of forms that inhabited the contemporary seas of the Mediterranean basin.

The stunted and dwarfed aspect of the three faunas is apparently due mainly to climatic conditions. As has been pointed out in a recent revision of our Eocene Echinoids<sup>1</sup>, the British seas of that period were confined to the south by a land barrier which stretched across France and Northern Germany. Hence to the south of this area the Bryozoa flourished under favourable conditions in a tropical and subtropical ocean, while on the other side the seas were open to the chilling influences of the northern ocean. The land barrier was breached in Middle Eocene times, but the conditions were not seriously modified till later: then, with the gradual change to the brackish and freshwater deposits of the Oligocene, the marine Bryozoa cease to be represented in the British Palæogene.

The Echinoids of the period belong to the same genera as their contemporaries in the Mediterranean basin, but their generally dwarfed aspect and rareness indicate that they lived under unfavourable conditions. The Bryozoa present exactly the same parallel.

An effort has been made to explain the paucity of Bryozoa in English deposits of this period as due simply to unfavourable lithological conditions of life and preservation. The prevalence of clay and sharp sand is quoted as unfavourable to the growth of Bryozoa. But this is hardly sufficient. The shelly sands of the Bracklesham, on the contrary, would seem to indicate the conditions that would be most favourable to the existence and preservation of Bryozoa. That the clay shores of the London Clay and Barton are wholly responsible for the rarity of the Bryozoa is not likely to be accepted by any one who has dredged on the great mud-flats off the Essex coasts, where it is often difficult to procure a shell not encrusted by them. In other districts, such as the Paris basin, Belgium, and North Germany, which were also to the north of this land barrier, and where the lithological characters of the sea-floors were quite different from those of England, the Bryozoa are equally rare and stunted.

Hence, it is to geographical questions rather than to the lithological conditions of the sea-floor that we must attribute the marked characters of our Palæogene Bryozoan fauna.

The singular diversity of the fauna is another feature which supports the view that it is to be regarded as a remnant or an offshoot from one that was much greater and richer. Mr. Waters [Nos. 12 & 13], in his revision of the Oligocene Bryozoa of North Italy, admits 88 species, representing 35 genera. But the British fauna contains only

<sup>1</sup> Gregory, Proc. Geol. Assoc. xii. 1891, pp. 51, 52.

25 species, belonging to 17 genera. If we take the case of the species of a single genus, we find the same point very instructively shown. Thus the genus *Idmonea* is represented by only five specimens, of which two from Mr. Vine's collection appear to me to be indeterminable; *Idmonea* may be conveniently divided into three groups or subgenera, and one of the three recognizable specimens belongs to each of these three groups. This consideration ought to stimulate the search for more material, as the specimens already known appear to represent but a fragment of the fauna.

The high proportion of peculiar species in this fauna would not excite surprise in any of the higher groups, except the Bryozoa; but when we consider the vast range both in space and time claimed for some species, a few words of explanation are required. In the first place, rare though the Bryozoa are in the English beds, they appear to have been even scarcer in contemporary deposits of other parts of the same basin; the meagre lists given by Stremme (No. 1), Marsson (No. 2), Michelin (No. 1), Milne-Edwards (No. 2), and Mourlon (No. 1) show the paucity of Bryozoa at this time in Northern France, Germany, and Belgium.

The great range in time usually accorded to species of Bryozoa raises the general question as to the value of species in this group; their growth in colonies is the main reason for the "lumping" tendencies of zoophytologists. In the Cheilostomata species are usually founded, if only on one specimen, yet on hundreds of zoëcia: in a colony of this size great variation is inevitable; many of the polypites are crushed out by growth-pressure, and their zoëcia are malformed or aborted; the older zoëcia become immersed and lose their characters; the younger zoëcia at the tips of the branches are immature. Hence it is easy to pick out two zoëcia in a zoarium which differ far more markedly than do two zoëcia taken from different species; but that no more proves that the two species should be merged than that two species of frogs are identical because they resemble one another more closely than they do the tadpoles from which they have developed.

Dr. Waagen—'Pal. Indica' (xiii.), 'Salt Range Fossils,' iv. pt. 2, 'Geol. Results,' 1891, pp. 235, 236—has recently pointed out the disastrous effects that have been wrought by palæontologists "lumping" species and neglecting slight but definite differences; and one worker on Bryozoa has recently expressed his doubts as to the accuracy of the identification of recent and Cretaceous species. With this opinion I feel strongly disposed to concur, but will here only say that, so far, I have seen no Cretaceous species of Cheilostomata identical with a living one. If there are such constant differences, it seems certainly advisable to recognize them by name, whether we call them species, forms (Smitt), or mutations (Waagen). Unless this be done, if we accept species as ranging from the Jurassic to the present, then we must abandon all hope of deriving from the Bryozoa any assistance in the study of the geographical distribution of the past, though the group presents characters that should give its evidence great value.

VIII. *Bibliography.*

(Including only works referred to.)

A. *General.*

## AUDOUIN, VICTOR.

- No. 1.—1826. Explication sommaire des planches de Zoophytes de l'Égypte et de la Syrie . . . offrant un exposé des caractères naturels des genres avec la distinction des espèces. In 'Description de l'Égypte.' Histoire Naturelle, i. 1809, Polypes, pp. 225-244, pl. 14. Fol. *Paris*.

BLAINVILLE, H. M. D.<sup>r</sup>DE.

- No. 1.—1830. Zoophytes. Dict. Sci. Nat. lx. pp. 1-546, pls. 67, 68.  
No. 2.—1834. Manuel d'Actinologie ou de Zoophytologie. 8vo. *Paris*. 2 vols.

## Bosc, L. A. G.

- No. 1.—1830. Histoire naturelle des Vers. Ed. 2. 12mo. *Paris*.

## BRONGNIART, ALEX., and CUVIER, G.

- No. 1.—1822. Description géologique des Couches des environs de Paris parmi lesquelles se trouvent les gypes à ossemens. In Cuvier, Oss. foss. ed. 2. t. ii. pt. 2, 4to, pp. 239-648; 15 pls. & maps.

## BRONN, H. G.

- No. 1.—1825. System der urweltlichen Pflanzthiere. Fol. *Heidelberg*. iv+47 pp. 7 pls.  
No. 2.—1831. Uebersicht der fossilen Ueberreste in den tertiären subapenninischen Gebirgen. In Ergebnisse meiner naturhistorisch-ökonomischen Reise. Th. ii. Skizzen und Ausarbeitungen über Italien. *Heidelberg*. 8vo. Bd. ii. pp. 505-646. pl. iii.  
No. 3.—1848. Handbuch der Geschichte der Natur. Bd. iii. Index palæontologicus. A. Nomenclator palæontologicus. 8vo. *Stuttgart*, 1848. Pp. lxxxiv+1381.

## BUSK, G.

- No. 1.—1852. An account of the Polyzoa and Sertularian Zoophytes collected in the Voyage of the 'Rattlesnake' on the coasts of Australia and the Louisiade Archipelago. In J. Macgillivray, Narrative of the Voyage of H.M.S. 'Rattlesnake.' 8vo. *London*, 1852. Vol. i., App. No. iv. pp. 343-402, pl. 1.  
No. 2.—1852. British Museum Catalogues. Catalogue of Marine Polyzoa. Pt. I. Cheilostomata. Pp. viii+vi+54, pl. 68.  
No. 3.—1854. Ditto. Pt. II. Cheilostomata. Pp. viii+55-120, pls. 69-124.  
No. 4.—1875. Ditto. Pt. III. Cyclostomata. Pp. viii+41, pl. 34.  
No. 5.—1858. Zoophytology [9th part]. Quart. Journ. Micr. Sci. vi. pp. 124-130, pls. xviii. & xix.  
No. 6.—1859. A Monograph of the Fossil Polyzoa of the Crag. Palæont. Soc. Pp. xiii+136, pl. 22.  
No. 7.—1866. Description of three new Species of Polyzoa from the London Clay at Highgate, in the collection of N. T. Wetherell, Esq., F.G.S. Geol. Mag. iii. pp. 298-302, pl. xii.

- No. 8.—1884. Report on the Polyzoa collected by H.M.S. 'Challenger' during the years 1873-1876. Part I. The Cheilostomata. Chall. Exp., Zool. vol. x. (pt. xxx.), pp. xxiv+216, pls. 36.
- No. 9.—1886. Ditto. Part II. The Cyclostomata, Ctenostomata, and Pedicellinea. Ibid. vol. xvii. pp. viii+47, pls. 10.
- DESLONGCHAMPS, EUG.
- No. 1.—1824. In Encyclopédie Méthodique. Histoire Naturelle des Zoophytes ou Animaux rayonnés. 4to. *Paris*.
- DOLLFUS, G. F.
- No. 1.—1889. Bryozoaires. Ann. géol. univ. v. (1888) pp. 1159-1170.
- EDWARDS, H. MILNE.
- No. 1.—1836. Recherches anatomiques, physiologiques et zoologiques sur les Eschares. Ann. Sci. Nat., Zool. (2) vi. pp. 5-53, pls. i.-v.
- No. 2.—1836. Observations sur les polypiers fossiles du genre Eschare. Ibid. pp. 321-345, pls. ix.-xi.
- FLEMING, JOHN.
- No. 1.—1828. A History of British Animals. 8vo. *Edinburgh*. Pp. xxiii+565.
- GABB, W. M., and HORN, G. H.
- No. 1.—1862. Monograph of the Fossil Polyzoa of the Secondary and Tertiary Formations of North America. Journ. Acad. Nat. Sci. Phil. v. pp. 111-179.
- GIOLI, G.
- No. 1.—1889. Briozoi neogenici dell' isola di Pianosa nel Mar Tirreno. Atti Soc. Tosc. Sci. Nat. x. pp. 251-267, pl. xiv.
- GOLDFUSS, AUG.
- No. 1.—1827. Petrefacta Germaniæ. Fol. *Düsseldorf* (1827-1833). Vol. I. Bryozoa, pp. 23-41, pls. viii.-xii.
- GOTTARDI, G. B.
- No. 1.—1886. Briozoi fossili di Montecchio Maggiore. Atti Soc. Veneto-Trentina, ix. fs. ii. *Padova* (1885), pp. 297-308, pl. xiv.
- GREGORIO, Marquis ANTONIO DE.
- No. 1.—1890. Monographie de la Faune Eocénique de l'Alabama et surtout de celle de Claiborne de l'Etage Parisien. Ann. Géol. livr. vii., viii. 4to. *Palermo*. 316 pp. 46 pls.
- HAGENOW, FR. VON.
- No. 1.—1839. Monographie der Rügenschon Kreide Versteinerungen. Abt. I. Phytolithen und Polyparien. N. Jahrb. 1839, pp. 252-296, pls. iv., v.
- No. 2.—1851. Die Bryozoen der Maastrichter Kreidebildung. *Cassel*. Pp. xi+111, pls. 12.
- VOL. XIII.—PART VI. NO. 7.—*June*, 1893. 2 q

## HAIME, JULES.

- No. 1.—1854. Description des Bryozoaires fossiles de la formation Jurassique. Mém. Soc. Géol. France, (2) v. pp. 156-218, pls. vi.-xi.

## HELLER, CAM.

- No. 1.—1867. Die Bryozoën des adriatischen Meeres. Verh. k. k. zool.-bot. Ges. Wien, xvii. Abh. pp. 77-136, pls. i.-vi.

## HINCKS, T.

- No. 1.—1878. Notes on the Genus *Retepora*, with descriptions of new Species. Ann. Mag. Nat. Hist. (5) i. pp. 353-365, pls. xviii., xix.
- No. 2.—1880. A History of the British Marine Polyzoa. 2 vols. 8vo. London. Pp. clxi + 601, pls. 83.
- No. 3.—1880. On new Hydroida and Polyzoa from Barents Sea. Ann. Mag. Nat. Hist. (5) vi. pp. 277-286, pl. xv.
- No. 4.—1880-1891. Contributions towards a General History of the Marine Polyzoa:—
- |         |       |                              |                                      |
|---------|-------|------------------------------|--------------------------------------|
| Part I. | 1880. | Ann. Mag. Nat. Hist. (5) vi. | pp. 69-92, pls. ix.-xi.              |
| II.     | 1880. | „                            | vii. pp. 376-384, pls. xvi., xvii.   |
| III.    | 1881. | „                            | vii. pp. 147-161, pls. viii.-x.      |
| IV.     | 1881. | „                            | viii. pp. 1-14.                      |
| V.      | 1881. | „                            | viii. pp. 122-136, pls. i.-v.        |
| VI.     | 1882. | „                            | ix. pp. 116-127, pl. v.              |
| VII.    | 1882. | „                            | x. pp. 160-170, pls. vii., viii.     |
| VIII.   | 1883. | „                            | xi. pp. 193-202, pls. vi., vii.      |
| IX.     | 1884. | „                            | xiii. pp. 265-267.                   |
| X.      | 1884. | „                            | xiii. pp. 356-369, pls. xiii., xiv.  |
| XI.     | 1884. | „                            | xiv. pp. 276-285, pls. viii., ix.    |
| XII.    | 1885. | „                            | xv. pp. 244-257, pls. vii.-ix.       |
| XIII.   | 1891. | „                            | (6) vii. pp. 285-298, pls. vi., vii. |
- No. 5.—1891-1892. Ditto. Appendix:—
- |         |       |                                |                    |
|---------|-------|--------------------------------|--------------------|
| Part I. | 1891. | Ann. Mag. Nat. Hist. (6) viii. | pp. 86-93.         |
| II.     | 1891. | „                              | viii. pp. 169-176. |
| III.    | 1891. | „                              | viii. pp. 471-480. |
| IV.     | 1892. | „                              | ix. pp. 327-334.   |
- No. 6.—1886. The Polyzoa of the Adriatic: a supplement to Prof. Heller's 'Die Bryozoën des adriatischen Meeres,' 1867. Ann. Mag. Nat. Hist. (5) xvii. pp. 254-271, pls. ix., x.
- No. 7.—1887. On the Polyzoa and Hydroida of the Mergui Archipelago collected . . . by Dr. J. Anderson . . . Journ. Linn. Soc., Zool. xxi. pp. 121-135, pl. xii.
- No. 8.—1887. Critical Notes on the Polyzoa:—
- |         |       |                               |                    |
|---------|-------|-------------------------------|--------------------|
| Part I. | 1887. | Ann. Mag. Nat. Hist. (5) xix. | pp. 150-164.       |
| II.     | 1890. | „                             | (6) v. pp. 83-103. |

## HUTTON, F. W.

- No. 1.—1880. Manual of the New Zealand Mollusca. Misc. Public. Col. Mus. Geol. Surv. N. Zeal. No. xii. 8vo. Wellington. Pp. xvi + iv + 224. Bry. pp. 178-199.

## JAMESON, R.

- No. 1.—1811. Catalogue of Animals of the Class Vermes found in the Frith of Forth and other parts of Scotland. Mem. Wern. Soc. i. pp. 556-565.

## JELLY, E. C.

- No. 1.—1889. A Synonymic Catalogue of the Recent Marine Bryozoa, including Fossil Synonyms. 8vo. London. Pp. xv+322.

## JOHNSTON, GEORGE.

- No. 1.—1838. A History of British Zoophytes. 8vo. London. Pp. xii+333, pls. 44.  
No. 2.—1847. Ditto. Ed. 2. 2 vols. Pp. xvi+488, pls. 74.

## JULLIEN, JULES.

- No. 1.—1882. Note sur une nouvelle Division des Bryozoaires Cheilostomiens. Bull. Soc. Zool. France, vi. pp. 271-285.  
No. 2.—1883. Dragages du 'Travailleur.' Bryozoaires, espèces draguées dans l'Océan Atlantique en 1881. Ibid. vii. pp. 497-529, pls. xiii.-xvii.  
No. 3.—1886. Les Costulidées, nouvelle famille de Bryozoaires. Ib. xi. pp. 601-620, pls. xvii.-xx.  
No. 4.—1888. Bryozoaires. Mission Scientifique du Cap Horn, 1882-1883. Zool. vi. 4to. 92 pp., 15 pls.

## KIRCHENPAUER, G. H.

- No. 1.—1880. Ueber die Bryozoen-Gattung *Adeona*. Abh. Naturwiss. Ver. Hamburg, vii. pp. 1-24, pls. i.-iii.

## KIRKPATRICK, R.

- No. 1.—1888. Polyzoa of Mauritius. Ann. Mag. Nat. Hist. (6) i. pp. 72-85, pls. vii.-x.  
No. 2.—1890. Report on the Zoological Collections made in Torres Straits by Prof. A. C. Haddon, 1888-1889.—Hydroida and Polyzoa. Sci. Proc. Roy. Dublin Soc. new ser. vi. pp. 603-626, pls. xiv.-xvii.

## KLÖDEN, K. F.

- No. 1.—1834. Die Versteinerungen der Mark Brandenburg, insonderheit diejenigen welche sich in den Rollsteinen und Blöcken der südbaltische Ebene finden. 8vo. Berlin. Pp. x+378, pls. 10.

## KOSCHINSKY, C.

- No. 1.—1885. Ein Beitrag zur Kenntniss der Bryozoenfauna der älteren Tertiärschichten des südlichen Bayerns. I. Chilostomata. Palaeontogr. xxxii. 1885, pp. 1-73, pls. i.-vii.

## LAMARCK, J. B.

- No. 1.—1816. Histoire naturelle des Animaux sans Vertèbres, t. ii. 8vo. Paris.

## LAMOUROUX, J. V. F.

- No. 1.—1816. Histoire des Polypiers Coralligènes flexibles, vulgairement nommés Zoophytes. 8vo. Caen. Pp. lxxxiv+560, pls. 19.  
No. 2.—1821. Exposition méthodique des genres de l'ordre des Polypiers. 4to. Paris, 1821. Pp. viii+115, pls. 84.

- No. 3.—1824. In Quoy & Gaimard, Voyage autour du Monde . . . . exécuté sur les corvettes de S. M. 'l'Uranie' et 'la Physicienne' pendant les années 1817, 1818, 1819, et 1820. 4to. Paris. Pp. 604-641, pls. 89-95.
- LIENENKLAUS, E.  
 No. 1.—1891. Die Ober-Oligocän Fauna des Doberges. Jahresber. Naturwiss. Ver. Osna-brück, viii. pp. 43-178, pls. i., ii.
- LONSDALE, WM.  
 No. 1.—1845. Account of the species of Polyparia obtained from the Miocene Tertiary forma-tions of North America. Quart. Journ. Geol. Soc. i. pp. 495-509.  
 No. 2.—1850. In F. Dixon, The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex. 4to. Pp. xvi+xvi+433, 40 pls.  
 No. 3.—1878. Ditto. Ed. 2.
- MACGILLIVRAY, P. H.  
 No. 1.—1879-1890. In McCoy, Prodrômus of the Zoology of Victoria.  
 Dec. III. pls. 24-26. 1879. Dec. IX. pls. 89-90. 1884. Dec. XV. pls. 146-148. 1887.  
 IV. 35-38. „ X. 94-99. 1885. XVI. 156-158. 1888.  
 V. 45-49. 1880. XI. 105-108. „ XVII. 165-168. „  
 VI. 57-60. 1881. XII. 116-118. 1886. XVIII. 175-178. 1889.  
 VII. 66-68. 1882. XIII. 126-128. „ XIX. 185-187. „  
 VIII. 78. 1883. XIV. 136-138. 1887. XX. 195-196. 1890.
- No. 2.—1882-1891. Descriptions of new or little-known Polyzoa. Trans. Roy. Soc. Victoria.  
 Pt. I. 1882, xviii. pp. 115-121, 1 pl. Pt. VIII. 1885, xxi. pp. 106-119, 5 pls.  
 II. 1883, xix. pp. 130-138, 3 pls. IX. 1886, xxii. pp. 128-139.  
 III. „ „ pp. 191-195, 2 „ X. 1887, xxiii. pp. 34-38, 2 pls.  
 IV. „ „ pp. 287-293, 2 „ XI. „ „ pp. 64-72, 3 pls.  
 V. 1884, xx. pp. 103-113, 3 „ XII. „ „ pp. 179-186.  
 VI. „ pp. 126-128, 1 pl. XIII. 1890, (new ser.) ii. pp. 106-110, pls. iv., v.  
 VII. 1885, xxi. pp. 92-99, 3 pls. XIV. 1891, „ iii. pp. 78-83, pl. ix., x.
- No. 3.—1887. A Catalogue of the Marine Polyzoa of Victoria. Trans. and Proc. Roy. Soc. Vict. xxiii. pp. 187-224.
- No. 4.—1889. On some South Australian Polyzoa. Trans. and Proc. Roy. Soc. S. Austr. xii. pp. 24-30, pl. ii.
- No. 5.—1890. An additional List of South Australian Polyzoa. Trans. Roy. Soc. S. Austr. xiii. pt. 1, pp. 1-7, pl. 1.
- MANZONI, A.  
 No. 1.—1869. Briozoi pliocenici Italiani. Pt. I. Sitzb. k. Ak. Wiss. Wien, lix. Abt. i. pp. 17-28, 2 plates.  
 No. 2.—1869-1870. Briozoi fossili Italiani. Pt. II.-IV. Ibid. lix. Abt. i. pp. 512-523, 2 plates; lx. Abt. pp. 930-944, 4 plates; lxi. Abt. pp. 323-349, 6 plates.

- No. 3.—1877. I Briozoi fossili del Miocene d'Austria ed Ungheria. Parte II. Celleporidea, Escharidea, Vincularidea, Selenaridea. Denk. k. Akad. Wiss. Wien, xxxvii. Abt. ii. pp. 49–78, pls. i.–xvii.
- No. 4.—1878. Ditto. Parte III. Crisidea, Idmoneidea, Entalophoridae, Tubuliporidae, Diastoporidea, Cerioporidea. Ibid. xxxviii. Abt. ii. pp. 1–24, pls. i.–xviii.
- MARSSON, TH.
- No. 1.—1887. Die Bryozoen der weissen Schreiekreide der Insel Rügen. Pal. Abh. iv. Heft i. pp. 112, pls. 10.
- No. 2.—1888. In Fr. Noctling, Die Fauna des samlandischen Tertiärs. Th. ii. Lf. v. Bryozoa. Abh. geol. Specialk. Preuss. vi. Heft 4, pp. 555–560.
- MEUNIER, A., & PERGENS, ED.
- No. 1.—1886. Les Bryozoaires du Système Montien. 8vo. *Louvain*. Pp. 15, pls. 3.
- No. 2.—1886. Nouveaux Bryozoaires du crétacé supérieur. Ann. Soc. Malacol. Belg. xx. Mém. pp. 32–37, pl. ii.
- No. 3.—1887. La faune des Bryozoaires garumniens de Faxe. Ibid. xxi. (1886) Mém. pp. 187–242, pls. ix.–xiii.
- MICHELIN, HARDOUIN.
- No. 1.—1840–1847. Iconographie Zoophytologique: description par localités et terrains des Polypiers fossiles de France et pays environnants. Groupe Supracrétacé, pp. 149–178, pls. 43–46. 1844.
- MOLL, J. P. C.
- No. 1.—1803. Eschara ex Zoophytorum seu Phytozoorum ordine pulcherrimum ac . . . . . 4to. *Vindobonæ*. 70 pp., 4 pls.
- MORREN, C. F. A.
- No. 1.—1828. Descriptio coralliorum fossilium in Belgio reperorum. Ann. Ac. Groning. 4to. 76 pp., 7 pls.
- MORRIS, J.
- No. 1.—1843. Catalogue of British Fossils. 8vo. *London*. Pp. x + 222.
- No. 2.—1854. Ditto. Ed. 2. Ditto. Pp. viii + 372.
- MOURLON, MICHEL.
- No. 1.—1881. Géologie de la Belgique. 8vo. *Bruzelles*. T. ii. pp. xvi + 392.
- MÜLLER, O. F.
- No. 1.—1788–1806. Zoologia Danica, seu Animalium Daniæ et Norvegiæ rariorum ac minus notorum Descriptiones et Historia. Fol. *Havniæ*. Vols. i. 1788, 52 pp.; ii. 1788, 56 pp.; iii. 1789, 71 pp.; iv. 1806, 46 pp.
- MÜNSTER, VON.
- No. 1.—1835. Bemerkungen über einige tertiäre Meerwasser-Gebilde in nordwestlichen Deutschland zwischen Osnabrück und Cassel. N. Jahrb. 1835, pp. 420–451.
- NOVÁK, OTTOMAR.
- No. 1.—1877. Beitrag zur Kenntniss der Bryozoen der böhmischen Kreideformation. Denk. k. Ak. Wiss. Wien, xxxvii. Abt. ii. pp. 79–118, pls. i.–x.

## D'ORBIGNY, ALCIDE.

- No. 1.—1839 & 1846. Voyage dans l'Amérique méridionale. v. pt. 4. Zoophytes. 4to. *Paris*. 28 pp., 13 pls.  
 No. 2.—1850-1852. Bryozoaires. Pal. Franç. Terr. Crét. v. 8vo. *Paris*. 1192 pp., pls. 600-800.

## ORTMANN, A.

- No. 1.—1890. Die Japanische Bryozoenfauna. Arch. f. Nat. 1890, I. Heft i. pp. 1-74, pls. i.-iv.

## PERGENS, ED. (See also MEUNIER &amp; PERGENS.)

- No. 1.—1887. Pliocäne Bryozoën von Rhodos. Ann. k. k. Naturh. Hofmus. Wien, ii. pp. 1-34, pl. i.  
 No. 2.—1889. Zur fossilen Bryozoenfauna von Wola Lu'zanska. Ann. Soc. Géol. Belg. Mém., Hydr. iii. pp. 59-72.  
 No. 3.—1889. Revision des bryozoaires du Crétacé figurés par d'Orbigny. I. Cyclostomata. Ibid. iii. pp. 305-400, pls. xi.-xiii.  
 No. 4.—1889. Les Bryozoaires du Tasmajdan à Belgrade. Ann. Soc. Malac. Belg. xxii. (1887) Bull. pp. xii-xxviii.  
 No. 5.—1889. Note supplémentaire sur ditto. Ibid. pp. lix-lx.  
 No. 6.—1889. Note préliminaire sur les Bryozoaires fossiles des environs de Kolosvar. Ibid. pp. xxxiii-xxxvii.  
 No. 7.—1889. Untersuchungen an Seebryozoen. Zool. Anz. xii. pp. 504-510, 526-533.  
 No. 8.—1890. Notes succinctes sur les Bryozoaires. Ann. Soc. Mal. Belg. xxiv. Bull. pp. xx-xxiv.

## PHILIPPI, R. A.

- No. 1.—1844. Beiträge zur Kenntniss der Tertiärversteinerungen des nordwestlichen Deutschlands. 4to. *Kassel* (1843). 87 pp., 5 pls.

## POURTALÈS, L. F. DE.

- No. 1.—1868-1869. Contributions to the Fauna of the Gulf Stream at great depths (1867-8). Bull. Mus. Comp. Zool. i. pp. 103-120, 121-142.

## REUSS, A. E. VON.

- No. 1.—1847. Die fossilen Polyparien des Wiener Tertiärbeckens. Ein monographischer Versuch. Haidinger's Naturwiss. Abh. ii. S. i. *Wien*. 4to. 109 pp., 11 pls.  
 No. 2.—1851. Ein Beitrag zur Paläontologie der Tertiärschichten Oberschlesiens. Zeit. deut. geol. Ges. iii. pp. 149-184, pls. viii., ix.  
 No. 3.—1855. Beiträge zur Charakteristik der Tertiärschichten des nördlichen und mittleren Deutschlands. Sitzb. k. Ak. Wiss. Wien, xviii. Abt. i. pp. 197-273, 12 pls.  
 No. 4.—1864. Bemerkungen über die Bryozoengattung *Cumulipora*, v. M. Jahrb. k. k. geol. Reichs. xiv. Verh. pp. 21, 22.  
 No. 5.—1864. Ueber Anthozoen und Bryozoen des Mainzer Tertiärbeckens. Sitzb. k. Ak. Wiss. Wien, l. Abt. i. pp. 197-210, pls. i., ii.  
 No. 6.—1864. Die fossilen Foraminiferen, Anthozoen und Bryozoen von Oberburg in Steiermark. Denk. k. Ak. Wiss. Wien, xxiii. pp. 1-38, pls. i.-x.

- No. 7.—1865. Die Foraminiferen, Anthozoen und Bryozoen des deutschen Septarienthones. Ein Beitrag zur Fauna der mitteloligocänen Tertiärschichten. *Ibid.* xxv. pp. 117–214, pls. i.–xi.
- No. 8.—1865. Zur Fauna des deutschen Oberoligocäns. *Sitzb. k. Ak. Wiss. Wien*, I. Abt. i. pp. 614–691, pls. vi.–xv.
- No. 9.—1867. Die fossile Fauna der Steinsalzablagerungen von Wieliczka in Galizien. *Ibid.* lv. Abt. i. pp. 17–182, pls. i.–viii.
- No. 10.—1867. Ueber einige Bryozoen aus dem deutschen Unteroligocän. *Ibid.* pp. 216–234, pls. i.–iii.
- No. 11.—1869. Paläontologische Studien über die älteren Tertiärschichten der Alpen. Th. ii. Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosara. *Denk. k. Ak. Wiss. Wien*, xxix. pp. 215–298, pls. xvii.–xxxvi.
- No. 12.—1870. Ueber tertiäre Bryozoen von Kischenev in Bessarabia. *Sitzb. k. Ak. Wiss. Wien*, lx. Abt. i. pp. 505–513, pls. i., ii.
- No. 13.—1872. Die Bryozoen und Foraminiferen des unteren Pläners. In H. B. Geinitz, *Das Elbthalgebirge in Sachsen*. IV. *Palaeontogr.* xx. pp. 97–144, pls. xxiv.–xxxiii.
- No. 14.—1874. Die fossilen Bryozoen des österreichisch-ungarischen Miöcäns. Abt. i. *Salicornaridea, Cellularidea, Membraniporidae*. *Denk. k. Ak. Wiss. Wien*, xxxiii. pp. 141–190, pls. i.–xii.
- RIDLEY, S. O.
- No. 1.—1881. Account of the Polyzoa collected during the Survey of H.M.S. 'Alert' in the Straits of Magellan and on the Coast of Patagonia. *Proc. Zool. Soc.* 1881, pp. 44–61, pl. vi.
- RÖMER, F. A.
- No. 1.—1840. Die Versteinerungen des norddeutschen Kreidegebirges. 4to. *Hannover*. Bryozoen in Lf. i. pp. 11–25, pl. v.
- No. 2.—1863. Beschreibung der norddeutschen tertiären Polyparien. *Palaeontogr.* ix. pp. 199–246, pls. xxxv.–xxxix.
- SCHREIBER, A.
- No. 1.—1872. Die Bryozoen des mitteloligocänen Grünsandes bei Magdeburg. *Zeit. f. gesamt. Naturwiss.* xxxix. pp. 475–481, pls. iv., v.
- SMITT, F. A.
- No. 1.—1867. Bryozoa marina in regionibus arcticis et borealibus viventia recensuit. *Öfver. K. Vet.-Akad. Förh. Stockholm*, xxiv. pp. 443–487.
- No. 2.—1872. Floridan Bryozoa collected by Count L. F. de Pourtalès. Pt. I. *Handl. K. Svens. Vet.-Akad.* x. No. 11. 20 pp., 5 pls.
- No. 3.—1873. Ditto. Pt. II. *Ibid.* xi. No. 4. 83 pp., 13 pls.
- SPEYER, OSCAR.
- No. 1.—1864. Die Tertiärfauna von Söllingen bei Jerxheim im Herzogthum Braunschweig. *Palaeontogr.* ix. pp. 247–337, pls. xl.–xlii.

## STOLICZKA, FERD.

- No. 1.—1862. Oligocäne Bryozoen von Latdorf in Bemburg. Sitzb. k. Ak. Wiss. Wien, xlv. Abt. i. pp. 71-94, pls. i-iii.
- No. 2.—1862. Ueber heteromorphe Zellenbildungen bei Bryozoen, *Coelophyma*, Reuss. Verh. k. k. zool.-bot. Ges. Wien, xii. Abh. pp. 101-104.
- No. 3.—1864. Kritische Bemerkungen zu Herrn Fr. A. Römer's Beschreibung der norddeutschen tertiären Polyparien. N. Jahrb. 1864, pp. 340-347.
- No. 4.—1865. Fossile Bryozoen aus dem tertiären Grünsandsteine der Orakei-Bay bei Auckland. 'Novara' Reise, Geol. Th. i. Abt. ii. Pal. pp. 87-158, pls. xvii.-xx.

## STREMMER, E.

- No. 1.—1888. Beitrag zur Kenntniss der tertiären Ablagerungen zwischen Cassel und Detmold, nebst einer Besprechung der norddeutschen Pecten Arten. Zeit. deut. geol. Ges. xl. pp. 310-354, pls. xx.-xxi.

## WATERS, A. W.

- No. 1.—1881. On fossil Chilostomatous Bryozoa from South-west Victoria, Australia. Quart. Journ. Geol. Soc. xxxvii. pp. 309-347, pls. xiv.-xviii.
- No. 2.—1882. On fossil Chilostomatous Bryozoa from Mount Gambier, South Australia. Quart. Journ. Geol. Soc. xxxviii. pp. 257-276, pls. vii.-ix.
- No. 3.—1882. On Chilostomatous Bryozoa from Bairnsdale, Gippsland. Ibid. pp. 502-513, pl. xxii.
- No. 4.—1883. Fossil Chilostomatous Bryozoa from Muddy Creek, Victoria. Ibid. xxxix. pp. 423-443, pl. xii.
- No. 5.—1884. Fossil Cyclostomatous Bryozoa from Australia. Ibid. xl. pp. 674-697, pls. xxx., xxxi.
- No. 6.—1885. Chilostomatous Bryozoa from Aldinga and the River Murray Cliffs, South Australia. Ibid. xli. pp. 279-310, pl. vii.
- No. 7.—1887. On Tertiary Chilostomatous Bryozoa from New Zealand. Ibid. xliii. pp. 40-72, pls. vi.-viii.
- No. 8.—1887. On Tertiary Cyclostomatous Bryozoa from New Zealand. Ibid. xliii. pp. 337-350, pl. xviii.
- No. 9.—1887. Bryozoa from New South Wales, North Australia, &c. Pt. I. Ann. Mag. Nat. Hist. (5) xx. pp. 81-95, pl. iv. Pt. II. Ibid. pp. 181-203, pls. v., vi. Pt. III. pp. 253-265, pl. vii.
- No. 10.—1888. Supplementary Report on the Polyzoa collected by H.M.S. 'Challenger' during the years 1873-1876. Chall. Exp., Zool. xxxi. (pt. lxxix.). 4to. 41 pp., 3 pls.
- No. 11.—1889. Bryozoa from New South Wales. Ann. Mag. Nat. Hist. (6) iv. pp. 1-24, pls. i.-iii.
- No. 12.—1891. North Italian Bryozoa. Pt. I. Cheilostomata. Quart. Journ. Geol. Soc. xlvii. pp. 1-34, pls. i.-iv.
- No. 13.—1892. Ditto. Pt. II. Cyclostomata. Ibid. xlvi. pp. 153-162, pl. iii.

## WHITELEGGE, T.

- No. 1.—1887. Notes on some Australian Polyzoa. Proc. Linn. Soc. N. S. Wales (2) ii. pp. 337-347. [Reprinted 1888, Ann. Mag. Nat. Hist. (6) i. pp. 13-22.]

*B. Works bearing on the Distribution of the British Eocene Bryozoa.*

BRISTOW, H. W.

A.—1889. *Geology of the Isle of Wight.* Ed. 2.

HUXLEY, T. H., and ETHERIDGE, R.

A.—1865. *A Catalogue of the Collection of Fossils in the Museum of Practical Geology.* 8vo.  
Pp. lxxix + 381.

Ditto, and NEWTON, E. T.

B.—1878. *A Catalogue of the Tertiary and Post-Tertiary Fossils of the Museum of Practical Geology.* 8vo. 90 pp.

JUDD, J. W.

A.—1883. *The Oligocene Strata of the Hampshire Basin.* *Geol. Mag.* (2) x. pp. 525–527.

KLAASSEN, H. M.

A.—1883. *On a section of the Lower London Tertiaries at Park Hill, Croydon.* *Proc. Geol. Assoc.* viii. pp. 226–249.

LOBLEY, J. LOGAN.

A.—1887. *The Geology of the Parish of Hampstead.* *Trans. Middlesex Nat. Hist. Sci. Soc.*  
pp. 64–102.

VINE, G. R.

A.—1886. *Report on Recent Polyzoa.* *Rep. Brit. Assoc.* 1885, pp. 481–680.B.—1889. *Notes on British Eocene Polyzoa.* *Proc. Yorks. Geol. & Polyt. Soc.* xi. pt. i. pp. 154–  
169, pl. v.C.—1892. *Notes on some new or little-known Eocene Polyzoa from localities.* *Ibid.* xii. pt. i.  
pp. 52–61.

WATERS, A. W.

A.—1879. In Gardner, J. S., *Description and Correlation of the Bournemouth Beds.* Pt. I.  
*Upper Marine Series.* *Quart. Journ. Geol. Soc.* xxxv. pp. 224–225.

WETHERELL, N. T.

A.—1837. *Observations on a well dug on the south side of Hampstead Heath.* *Trans. Geol.*  
*Soc.* (2) v. pp. 131–135, pl. ix.

WHITAKER, W.

A.—1872. *The Geology of the London Basin.* Pt. I. *Mem. Geol. Surv.* iv. pt. i.B.—1889. *The Geology of London and of part of the Thames Valley.* *Mem. Geol. Surv.*  
2 vols.

## IX. EXPLANATION OF THE PLATES.

## PLATE XXIX.

- Fig. 1. *Notamia wetherelli* (Busk), p. 226. Fig. 1 *a*, front view; 1 *b*, lateral view. London Clay, Highgate. Brit. Mus. No. 49731.  $\times 37$  diam.
- Fig. 2. *Membranipora eocena* (Busk), p. 228. London Clay, Highgate. Brit. Mus. No. 49729.  $\times 16$  diam.
- Fig. 3. *Membranipora eocena* (Busk). View of the back of the zoarium. London Clay, Highgate. Brit. Mus. No. 6330.  $\times 12$  diam.
- Fig. 4. *Membranipora eocena* (Busk). Woolwich and Reading Beds, Croydon. Brit. Mus.  $\times \frac{55}{2}$  diam.
- Fig. 5. *Membranipora tenuimuralis*, n. sp., p. 231. London Clay, Highgate. Brit. Mus. No. 49736 (part of one of Busk's types of *M. lacroixi*).  $\times \frac{55}{2}$  diam.
- Fig. 6. *Membranipora tenuimuralis*, n. sp. London Clay, Highgate. Brit. Mus. No. 49736.  $\times \frac{55}{2}$  diam.
- Fig. 7. *Membranipora tenuimuralis*, n. sp. London Clay, Highgate. Brit. Mus. No. B 4331.  $\times 55$  diam.
- Fig. 8. *Membranipora virguliformis*, n. sp., p. 232. London Clay, Highgate. Brit. Mus. No. 49658.  $\times 25$  diam.
- Fig. 9. *Membranipora disjuncta*, n. sp., p. 232. London Clay, Highgate. Brit. Mus. No. 69205. Fig. 9 *a*.  $\times 4$  diam., to show general arrangement of the zoarium. Fig. 9 *b*.  $\times 12$  diam., to show structure of the zoëcia.
- Fig. 10 *a*. *Membranipora crassomuralis*, n. sp., p. 229. Barton Clay, Barton. Brit. Mus. No. 49741.  $\times 32$  diam.
- Fig. 10 *b*. *Membranipora crassomuralis*, n. sp. Barton Clay, Barton. Brit. Mus. No. 49740.  $\times 32$  diam. Another specimen growing on a strongly ribbed *Pecten*.
- Fig. 11. *Membranipora buski*, n. sp., p. 229. Headon Beds, Colwell Bay. Brit. Mus. No. B 4625.  $\times 55$  diam.
- Fig. 12. *Membranipora buski*, n. sp. Headon Beds, Colwell Bay. Mus. Pract. Geol. Specimen with numerous oëcia.  $\times 55$  diam.
- Fig. 13. *Lunulites transiens*, n. sp., p. 233. Barton Beds, Barton. Brit. Mus. No. 49724.  $\times 24$  diam. View of the external layer of the zoarium.
- Fig. 14. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 4339.  $\times 24$  diam.

## PLATE XXX.

- Fig. 1. *Lunulites transiens*, n. sp., p. 233. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 49724.  $\times \frac{55}{3}$  diam. The centre of a zoarium, with the "ancestrula."
- Fig. 2. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 4339.  $\times 18$  diam. In the lower part the front wall has been broken away.
- Fig. 3. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49723.  $\times \frac{55}{3}$  diam. Part of a worn zoarium resembling *L. urceolata*, Lamk.
- Fig. 4. *Biselenaria offa*, n. sp., p. 235. Barton Beds, Barton. Brit. Mus. No. 49766. Upper surface of the zoarium.  $\times 18$  diam. Fig. 4 *a*. A fragment of another zoarium showing the zoecia of the under surface. Brit. Mus. No. 49766.  $\times 18$  diam.
- Fig. 5. *Biselenaria offa*, n. sp. Barton Beds, Barton. Another specimen: upper surface. Brit. Mus. No. 49759.  $\times \frac{26}{2}$  diam.
- Fig. 6. *Micropora cribriformis*, n. sp., p. 236. Barton Beds, Barton. Brit. Mus. No. B 4583.  $\times 55$  diam.
- Fig. 7. *Onychocella magnoaperta*, n. sp., p. 237. Brockenhurst Beds (Mid. Headon), Brockenhurst. Brit. Mus. No. 49738.  $\times \frac{55}{3}$  diam.
- Fig. 8. *Cribrilina vinei*, n. sp., p. 238. London Clay, Sheppey. Brit. Mus. No. B 4514. (Vine's type of *Membraniporella nitida*.)
- Fig. 9. *Schizoporella magnoaperta*, n. sp., p. 239. Barton Beds, Barton. Brit. Mus. No. 49733.  $\times \frac{55}{3}$  diam.
- Fig. 10. *Schizoporella magnoincisa*, n. sp., p. 240. London Clay, Hampstead. Brit. Mus. No. B 4515.  $\times 30$  diam.
- Fig. 11. *Adeonellopsis incisa*, n. sp., p. 247. London Clay, Haverstock Hill. Brit. Mus. No. 49661.  $\times 55$  diam.
- Figs. 12 & 13. *Adeonellopsis wetherelli*, n. sp., p. 245. London Clay, Haverstock Hill. Brit. Mus. No. 49756. Fig. 12 *a*. A zoarium,  $\times 3$  diam. Fig. 12 *b*. Upper zoecia of the same,  $\times 55$  diam. Fig. 12 *c*. Lower zoecia of the same,  $\times 18$  diam. Fig. 13. Basal zoecia: No. B 3832;  $\times 18$  diam

## PLATE XXXI.

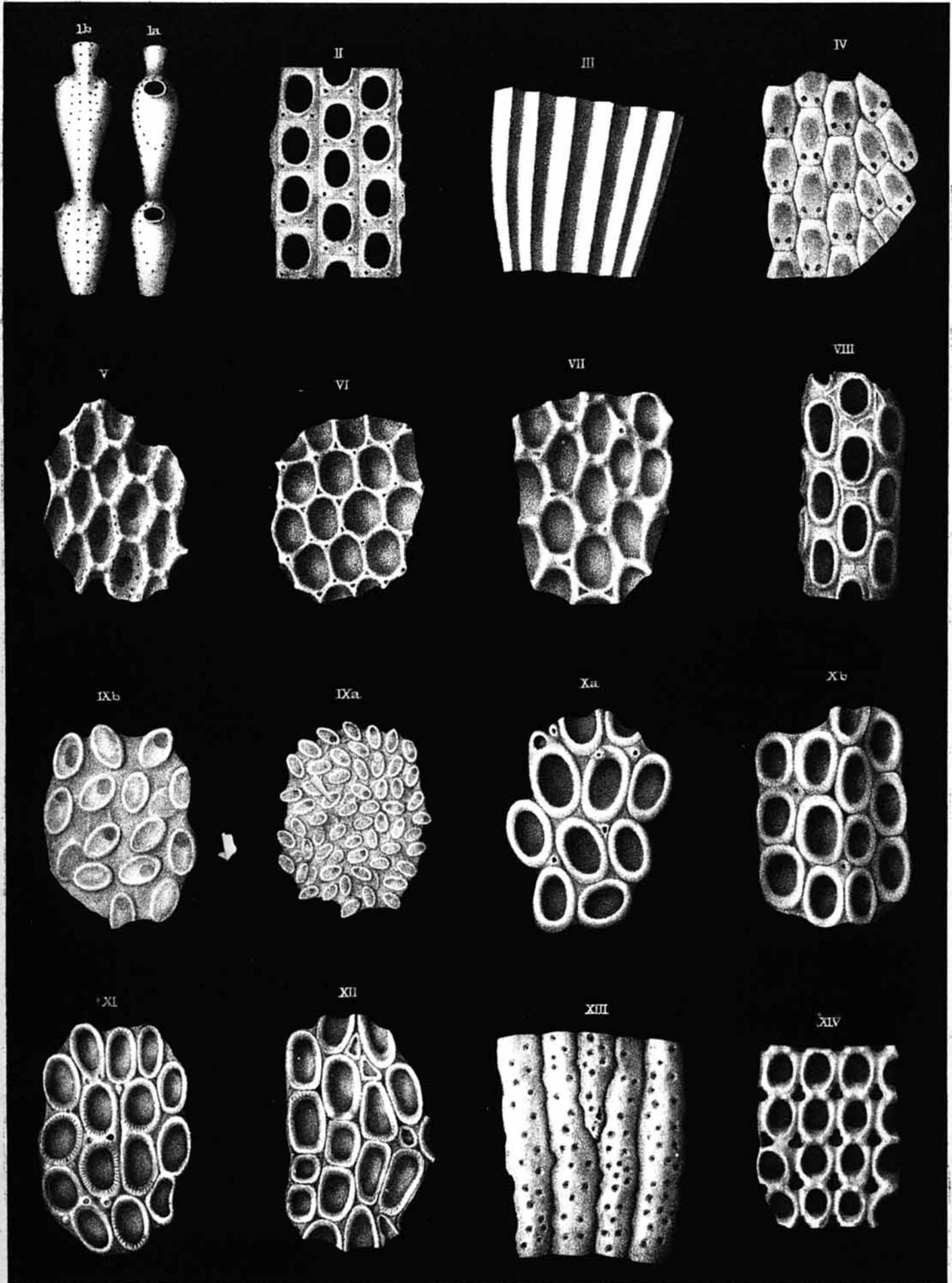
- Fig. 1. *Adeonellopsis wetherelli*, n. sp., p. 245. London Clay, Fareham. Basal zoëcia. Brit. Mus. No. B 4623.  $\times 55$  diam.
- Fig. 2. *Lepralia lonsdalei*, n. sp., p. 247. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49734.  $\times 55$  diam.
- Fig. 3. *Umbonula calcariformis*, n. sp., p. 249. London Clay, Fareham. Brit. Mus. No. B 3831.  $\times 55$  diam.
- Fig. 4. *Umbonula bartonense*, n. sp., p. 248. Barton Beds, Barton. Brit. Mus. No. 49741.  $\times 55$  diam.
- Figs. 5-7. *Teichopora clavata*, n. sp., p. 249. Barton Beds, Barton. Brit. Mus. No. 49733.  $\times 55$  diam. Fig. 5. Normal zoëcia. Fig. 6. Basal zoëcia: No. 49757. Fig. 7. Part with a gonœcium: No. 49659.  $\times 55$  diam.
- Fig. 8. *Meniscopora bigibbera*, n. sp., p. 251. Bracklesham Beds, Huntingbridge. Brit. Mus. No. 49732.  $\times 55$  diam.
- Fig. 9. *Meniscopora bigibbera*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49734.  $\times 55$  diam. Fragment with gonœcium.
- Fig. 10. *Conescharellina clithridiata*, n. sp., p. 252. London Clay, Hampstead. Brit. Mus. No. 69554.  $\times 18$  diam.
- Fig. 11. *Conescharellina clithridiata*, n. sp. London Clay, Sydenham. Brit. Mus. No. B 1357.  $\times 18$  diam. Another zoarium with oëcia.
- Fig. 12. *Orbitulipora petiolus* (Lonsd.), p. 253. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49760. Fig. 12. Zoarium,  $\times 4$  diam. Fig. 12 a. Zoëcia,  $\times 18$  diam.
- Fig. 13. *Orbitulipora petiolus* (Lonsd.). Bracklesham Beds, Bramshaw. Brit. Mus. No. B 4349.  $\times 12$ . Zoarium with stem.
- Fig. 14. *Orbitulipora petiolus* (Lonsd.). Whitecliff Bay. Specimen in *Conescharellina* stage. Brit. Mus. No. B 4347.
- Fig. 15. *Mucronella angustoœcium*, n. sp., p. 254. Barton Beds, Barton. Brit. Mus. No. 49739.
- Fig. 16. *Mucronella angustoœcium*, n. sp. Brit. Mus. No. B 4579.  $\times 55$  diam.

## PLATE XXXII.

- Fig. 1. *Smittia tubularis*, n. sp., p. 255. London Clay, White Conduit House. Brit. Mus. No. 49744.  $\times 55$  diam. Fig. 1 a. Nat. size. Fig. 1 b. Upper zoëcia,  $\times 55$  diam. Fig. 1 c. Basal zoëcia,  $\times 55$  diam.
- Fig. 2. *Idmonea bialternata*, n. sp., p. 257. London Clay, Islington. Brit. Mus. No. 49662. Fig. 2. Part of zoarium with oëcium. Fig. 2 b. Section.

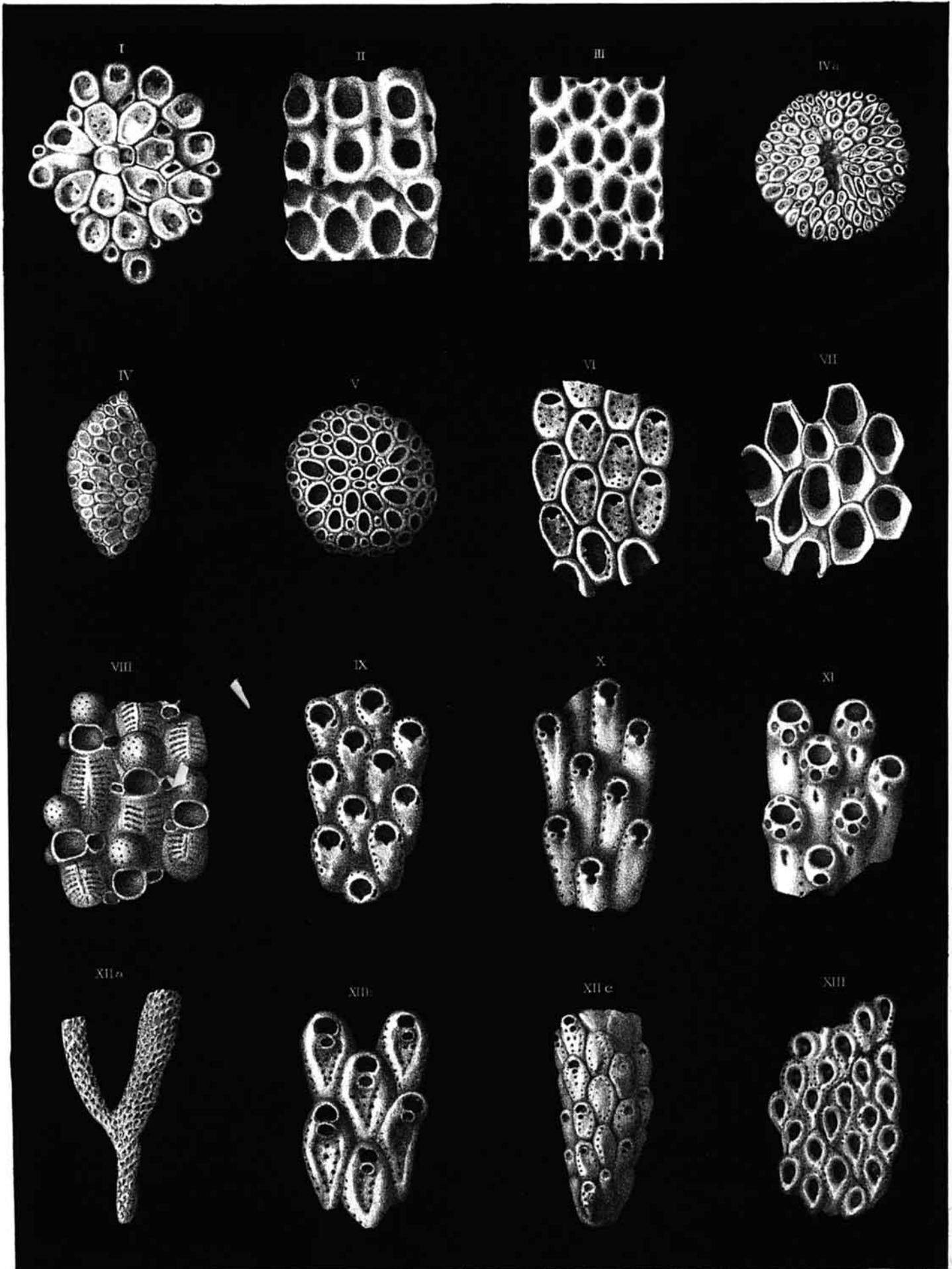
- Fig. 3. *Idmonea giebeli*, Stol., p. 256. London Clay, Haverstock Hill. Brit. Mus. No. 49656.  $\times 55$  diam. Fig. 3 *a*. Part of zoarium including an oöcium. Fig. 3 *b*. Transverse section.
- Fig. 4. *Idmonea* aff. *seriatopora*, Reuss, p. 258. London Clay, Haverstock Hill. Brit. Mus. No. B 4510. Fig. 4 *a*. Part of zoarium,  $\times 18$  diam. Fig. 4 *b*. Mouth,  $\times 32$  diam. Fig. 4 *c*. Transverse section,  $\times 18$  diam.
- Fig. 5. *Idmonea* aff. *seriatopora*. Back view of a zoarium,  $\times 55$  diam.
- Fig. 6. *Idmonea coronopus*, Defr., p. 259. Calcaire grossier, Parnes. Brit. Mus. Fig. 6 *a*. Nat. size. Fig. 6 *b*. An entire colony,  $\times 18$  diam.
- Figs. 7–9. *Hornera farehamensis*, n. sp., p. 260. London Clay, Fareham. Brit. Mus. No. B 3831. Fig. 7 *a*. A zoarium, nat. size. Fig. 7 *b*. View of back,  $\times 18$  diam. Fig. 8. Part of another zoarium,  $\times 18$  diam. Fig. 9. Basal zoöcia of another specimen,  $\times 18$  diam.
- Fig. 10. *Entalophora tergemina*, n. sp., p. 260. London Clay, Sheppey. Brit. Mus. No. B 4509. Figs. 10 *a* & 10 *b*. Two views of the same specimen,  $\times 55$  diam.
- Figs. 11 & 12. *Heteropora glandiformis*, n. sp., p. 261. Barton Beds, Barton. Brit. Mus. No. B 4511. Fig. 11. An entire zoarium,  $\times 18$  diam. Figs. 12 *a* & 12 *b*. Broken transverse sections showing internal structure. No. B 4512.  $\times 18$  diam.
- Fig. 13. *Lichenopora*, sp. Barton Beds, Barton. Brit. Mus. No. B 4583.  $\times 10$  diam.

The numerator of the magnifying-power ‘fractions’ represents the original magnification, and the denominator the reduction from the size of the field of the microscope.



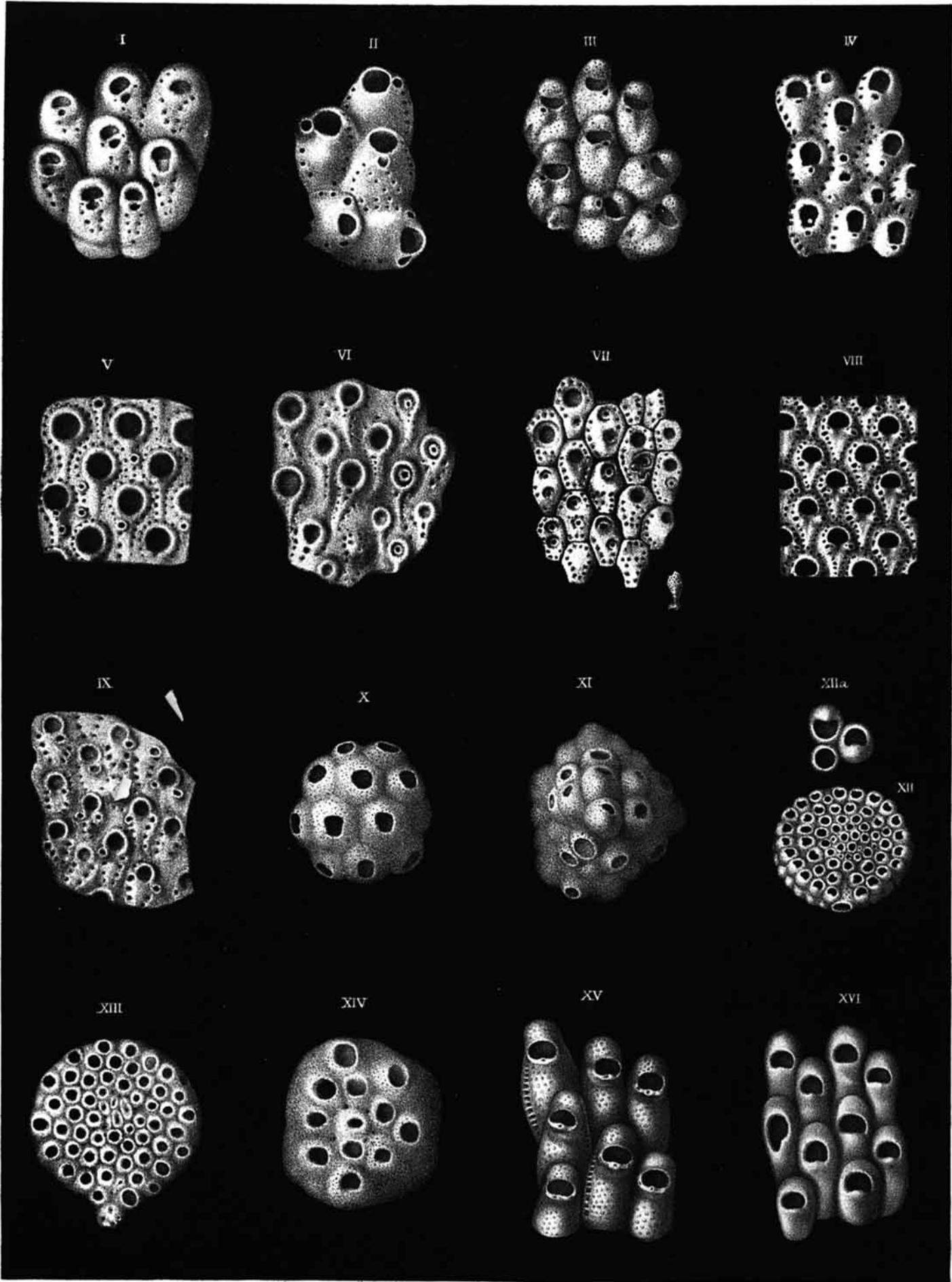
E.C. & G.M. Woodward del et lith.

West, Newman imp.



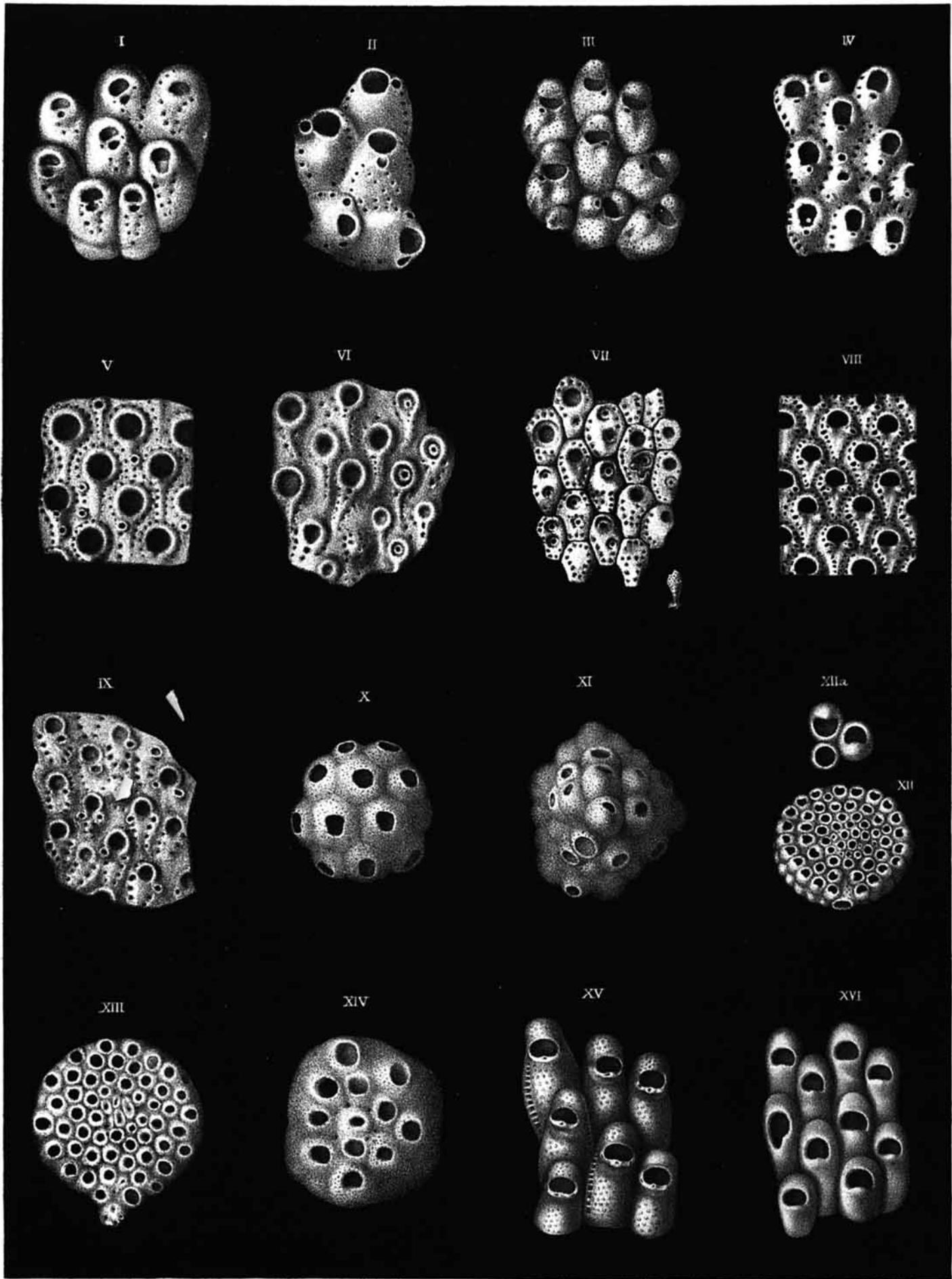
E. C. & G. M. Woodward del. et lith.

West, Newman imp.



E.C.&G.M.Woodward del. et lith.

West, Newman imp.



E.C.&G.M.Woodward del et lith.

West, Newman imp