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TERTIARY SIPHONEOUS ALGAE  
IN THE W. K. PARKER COLLECTION



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BRITISH MUSEUM  
(NATURAL HISTORY)

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TERTIARY SIPHONEOUS ALGAE

IN THE W. K. PARKER COLLECTION

WITH DESCRIPTIONS OF SOME EOCENE SIPHONEAE<sup>xref</sup>  
FROM ENGLAND

BY

LUCIEN AND JEAN MORELLET<sup>xref</sup>

WITH SIX PLATES AND SEVEN FIGURES  
IN THE TEXT

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## PREFACE

WITH the increasing recognition of the importance of calcareous algae in the fossil record, it is necessary to consider carefully the significance of those early researches in which forms since shown to be algae were described as animals. Among such forms, certain Tertiary specimens originally described as Foraminifera by W. K. Parker and T. R. Jones have long been a puzzle, owing to inadequate or misleading description (based on their supposed animal nature), to lack of figures, and to confusion with species already named by Lamarck. These specimens, mainly from the Paris Basin, were included in the collection of Foraminifera made by William Kitchen Parker (1823-1890), acquired by the Trustees in 1892. Overlooked for many years, their re-examination has now been carried out by MM. L. and J. Morellet, whose intimate acquaintance with early Tertiary algae has enabled them to elucidate the obscurities in Parker's and Jones's work, as well as to add materially to our knowledge of the fossils. Some recently discovered calcareous Siphoneae from the English Eocene are described in a separate section, and the inclusion of a classified list of all known Tertiary Siphoneae from the Paris Basin will also be useful to students in this country. In order that the work might appear in English, the authors kindly permitted me to translate their manuscript; they have themselves carefully checked the translation, but for any infelicities which may remain I alone am responsible.

W. N. EDWARDS

*Keeper of Geology*

*March 1939*



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## I. INTRODUCTION

CERTAIN Algae, belonging to different classes, have the property of fixing in their tissues either silica (Diatomeae) or carbonate of lime (Codiaceae, Dasycladaceae, Melobesieae, etc.), in consequence of which their fossil representatives in different geological periods have been better preserved than any other forms.

Those which we are about to study are calcareous algae from Tertiary beds belonging to the class Chlorophyceae (green algae). Long included in the animal kingdom and considered in turn as corals, bryozoa and foraminifera, these organisms only took their true place when Munier-Chalmas (1877, 1879)<sup>1</sup> admirably demonstrated for some the identity, and for a few others the great analogy of certain fossil genera (*Polytripa* Defr., *Vaginopora* Defr., *Ovulites* Lk., etc.) with living genera (*Cymopolia* Lmx., *Neomeris* Lmx., *Penicillus* Lk., etc.), whose vegetable nature had in some cases been equally unsuspected until revealed by Decaisne in 1842.

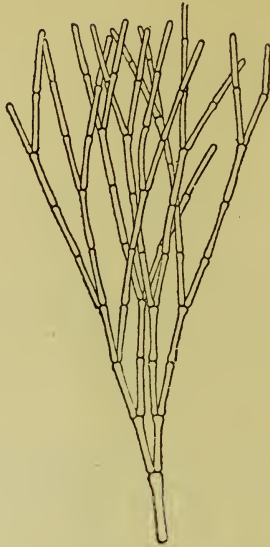
The specimens which are the subject of this work belong to two distinct families: the CODIACEAE, in which are now included the Siphoneae Dichotomae of Munier-Chalmas, and the DASYCLADACEAE, also known under the name of Siphoneae Verticillatae (Pia, 1927). Before embarking on our main subject, it is necessary to give a general account of these two families, and to define certain terms which we shall have occasion to use frequently in the sequel.

### I. CODIACEAE.

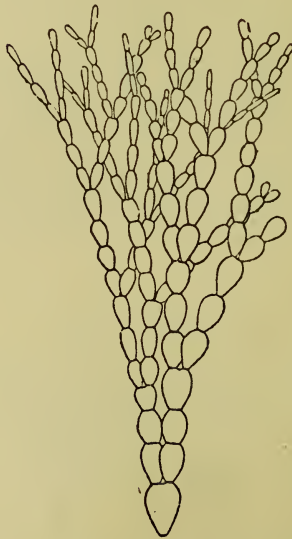
The only forms with which we shall be concerned are those known under the name *Ovulites* Lamarck (1816, p. 193).<sup>2</sup> They may be diagnosed as follows: Small hollow calcareous bodies, egg-shaped or tubular, 1.75 to 4 millimetres long, having at each end an irregularly circular opening, or more rarely two, but in the latter case at one end only; wall of variable thickness

<sup>1</sup> The dates in parentheses refer to the bibliography on pp. 50-52.

<sup>2</sup> First published in the form *Oveolites* (Lamarck, 1801, p. 402) and later in the vernacular "ovulite" (Lamarck, 1812, p. 26).



TEXT-FIG. 1. Restored branch of *Ovulites elongatus* Lk. (fossil),  $\times 4$ .  
After Munier-Chalmas, 1879.

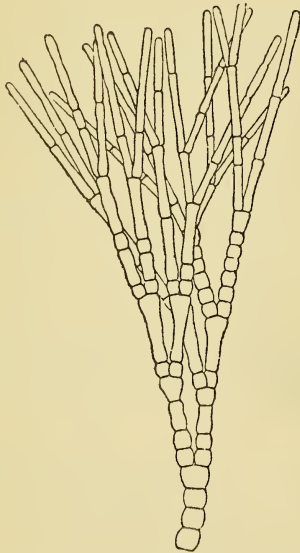


TEXT-FIG. 2. Restored branch of *Ovulites margaritula* Lk. (fossil),  $\times 2$ .  
After Munier-Chalmas, 1879.



(25 to 300 $\mu$ ), perforated by numerous very fine pores (8 to 28 $\mu$ ), arranged in no apparent order.

Contrary to what was long presumed, each of these bodies is not a complete organism ; it is actually a false segment dissociated from a branched alga, of which the calcified thallus is constricted at intervals, simulating a series of joints. The proof of this is provided by the specimen from the Lutetian of Grignon (Seine-et-Oise, France), photographed on Pl. III, fig. 1, in which, thanks to an encrusting Bryozoan, four individuals of *Ovulites* have



TEXT-FIG. 3. Branch of *Penicillus arbuscula* Mont. (recent),  $\times 3$ .  
After Munier-Chalmas, 1879.

remained in their position of growth, and form a fragment of a branch.

One can then accept the restorations given by Munier-Chalmas (1879) as correct ; they demonstrate at first glance the analogy between *Ovulites* (Text-figs. 1 and 2) and the branches of certain recent forms, notably *Penicillus arbuscula* Mont. (Text-fig. 3), taken by Kützing as the type of the genus *Coralliodendron* ; the analogy is emphasized by the similarity in the test, which is perforated in *Ovulites* and *Coralliodendron*, so that Munier, supported by an eminent botanist, J. B. E. Bornet, did not hesitate to suppress the fossil genus *Ovulites* and to transfer its members to the recent genus *Coralliodendron*. This course, however, is open to various criticisms ; in the first place, while

admitting that Munier's proposed combination was correct, the name *Coralliodendron* Kützing, 1841 (p. 11), should not be conserved, and ought to be replaced by *Penicillus* Lamarck, 1813 (p. 297),<sup>1</sup> since botanists do not admit the validity of the genus *Coralliodendron* (see the historical account by Gepp, 1911, p. 68; also Wille, 1890, p. 141, and Printz, 1927, p. 318); further, the segments of *Ovulites*, and particularly those of *O. margaritula*, show some important differences from those of *Penicillus*, notably in form, dimensions, thickness of the test and diameter of the pores traversing it; finally the habit of *Ovulites* is unknown, and one cannot say whether it resembled that of *Penicillus* (Pl. I, fig. 6) rather than that of *Tydemania* for example (Pl. I, figs. 7 and 8). In these circumstances it seems to us preferable to retain the name *Ovulites* for the fossil species, as indeed Pia (1927) has already done. None the less, as Munier divined, these species should no doubt eventually be distributed in different sections, if not in different genera.

However that may be, there does not seem to be any doubt that *Ovulites* should be classed in the Codiaceae and not in the Dasycladaceae as inferred by Solms-Laubach and by Seward (1931, p. 424), who wrongly compared it with *Cymopolia*.

The reproductive organs of *Ovulites* are unknown and must have been situated outside the calcareous investment.

The genus has so far only been found in Eocene beds; the Miocene specimens which have been referred to it by Parker and Jones (1860, p. 292) are neither *Ovulites* nor Algae, as we shall see shortly (p. 25).

From analogy with *Penicillus* and *Tydemania*, and above all from the fact that it is very widespread in Lutetian beds of the Paris basin, unquestionably deposited in a warm sea, one cannot but admit that *Ovulites* must have lived in waters of a temperature comparable with those of tropical or subtropical seas.

## 2. DASYCLADACEAE

(= SIPHONEAE VERTICILLATAE)

These algae, which play an important geological role since certain Triassic rocks, for example, are largely built up of their remains (*Diplopora* and *Gyroporella* limestones), are represented in Tertiary strata by numerous genera, some of which still flourish in the seas of to-day, belonging to several tribes. In this work we shall only be concerned with three of these tribes, which are, however, the three principal ones:

<sup>1</sup> The name *Penicillus* Lamarck, 1799 (p. 79), was applied to a mollusc.

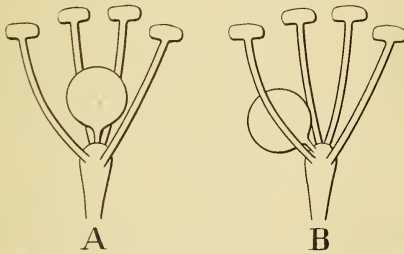
(I) The NEOMEREA<sup>1</sup>, comprising notably the genera *Neomeris* Lmx. (recent and fossil), *Cymopolia* Lmx. (recent and fossil), and *Larvaria* Defr. (fossil only).

(II) The BORNETELLEAE, in which the Tertiary representatives, such as *Dactylopora* Lk. and *Zittelina* Mun.-Ch., are exclusively fossil.

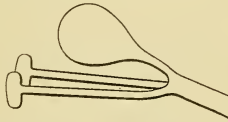
(III) The ACETABULARIAE, including *Acicularia* d'Arch. (recent and fossil), *Clypeina* Mich. (fossil only), and others.

### NEOMEREA

The Neomereae are tubular, either simple (*Neomeris*, Pl. III, fig. 11) or branched (*Cymopolia*, Pl. II, figs. 1, 2). All built on



TEXT-FIG. 4. *Cymopolia elongata* (Defr.). Diagram of a whorled branch.  
A. Normal specimen. B. Specimen in which the sporangium is laterally deflected.



TEXT-FIG. 5. *Larvaria* Defr. Diagram of a whorled branch.

the same general plan, they consist of a *principal stem* giving off very regular whorls of lateral branches; each of the latter consists of a basal portion (*primary branch*), giving rise to a number, varying according to the genus, of *secondary branches*

<sup>1</sup> Adopting at this point the classification proposed by Svedelius (1923) we now separate from the Dasycladeae (type *Dasycladus* Agardh, recent) and include in the Neomereae the genera *Neomeris* Lmx., *Cymopolia* Lmx., *Larvaria* Defr., *Meminella* Morellet, and *Lemoinella* Morellet, in which the whorled branches only branch once; on the other hand we cannot agree that *Bornetella* Mun.-Ch. and related fossil genera belong to this tribe, and we therefore maintain the tribe Bornetelleae. The fact that in *Neomeris* the apparently terminal sporangia (gametangia?) are originally parietal, and therefore comparable with the truly parietal sporangia of *Bornetella*, does not in our opinion justify the inclusion of these two genera in one tribe; they differ in a whole range of characters, obvious at first glance, as we shall endeavour to demonstrate in the descriptions which follow.

(3 to 9), of which one terminates in a spherical, oviform or pyriform *sporangium* (*gametangium* ?)<sup>1</sup> (Text-figs. 4 and 5). The alga is further enveloped in a fragile, faceted or alveolate sheath (*cuticle*, Pl. III, fig. 11), open in its upper part to give passage to the assimilatory hairs.

The calcareous incrustation differs in the various parts. The *principal stem*, the *primary branches* and the *cuticle* are usually scarcely calcified, and hence rarely preserved in the fossil state. The sporangial membranes are on the other hand always strongly encrusted, giving to the reproductive organs the appearance of a small calcareous capsule. These capsules rarely remain independent (*Neomeris dumetosa* Lmx., recent); more often those in one whorl are united to form either segments of rings (*Neomeris cokeri* Howe, recent), or entire rings (*Larvaria limbata* Defr., fossil: Pl. IV, fig. 21; certain *Neomeris*: Pl. III, figs. 7-10). Sometimes the rings are simply superposed (Pl. III, fig. 12), and kept in position by the cuticle (*Neomeris annulata* Dickie, recent; *Larvaria limbata* Defr., fossil), sometimes they are more or less intimately united into a tube which may be continuous (certain species of *Larvaria*: Pl. IV, figs. 9-12; *Neomeris* of the section *Vaginopora*) or jointed (*Cymopolia*). The lime then encrusts not only the *sporangia*, but also the *sterile secondary branches*, and sometimes even the terminal part of the *primary branches* (*Cymopolia*, Pl. V, fig. 7).

After the destruction of the organic matter, the Neomereae are represented, according to the degree of calcification, either by independent capsules or by partial or complete rings (some species of *Larvaria*; *Neomeris* of the section *Decaisnella*) or by tubes (other species of *Larvaria*; *Neomeris* of the section *Vaginopora*), some of which are dissociated from an articulated thallus (*Cymopolia*).

On the surfaces of the capsules and rings are furrows or even deep grooves marking the position of the *sterile secondary branches*, and in the wall are small and perfectly smooth cavities (*sporangial chambers*) which are exact moulds of the sporangia, and which, externally closed except when abraded, are pierced at the other

<sup>1</sup> It might seem that the term "sporangium" could now be definitely replaced by that of "gametangium", as most authors have indeed already done, by analogy with *Dasycladus*, in which reproduction by fusion of gametes appears to be undoubted; but it is necessary to remember that as far as *Neomeris* and *Cymopolia* are concerned, observations on this point are still imprecise or even contradictory, so that judgment should be reserved for the present.

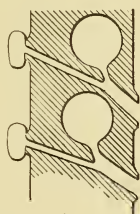
The sporangium is only apparently terminal, as Svedelius has shown in following its evolution in *Neomeris* (see note on p. 5). Its parietal origin can, moreover, be recognized in exceptional cases, even when it is fully developed. Thus in certain specimens of *Cymopolia elongata* (Defr.) the sporangia may be clearly lateral, and Gumbel founded his *Cymopolia* (*Dactyloporella*) *saccata* (1872, p. 264, pl. i, fig. 10) on an individual which had preserved this character in the adult state.

end by a small orifice through which passed the pedicel connecting them with the *primary branch*.

The wall of the tubular forms shows, from the interior to the exterior, in the most complex case (Text-fig. 6) :

(1) Superposed whorls of radial canals, opening on to the axial cavity, in which were contained the *primary branches*, and which we call *primary canals*.

(2) In continuation of these canals, (a) fine canals (2 to 8 to each primary canal, according to the genus) opening on the exterior of the tube, which were occupied by the *sterile secondary branches*, and which we designate *secondary canals*; (b) a fine canal leading from each primary canal to a cavity identical with that described above (the *sporangial chamber*).



TEXT-FIG. 6. *Meminella larvarioides* Morelet. Diagrammatic longitudinal section of the wall.

The recent Neomereae all live in tropical or subtropical seas at shallow depths.

## BORNETELLEAE

The Bornetelleae are flask-shaped, with an open base and closed apex (Pl. II, fig. 3). In the interior of the flask (Pl. II, fig. 4), occupying the axis, is a *main stem* which does not reach the upper wall, and from which arise whorls of lateral branches, either simple throughout their length (fossil genera) or branched terminally (*Bornetella* (Harv.) Mun.-Ch., recent), giving rise to parietal sporangia (gametangia?).

The calcification, very slight in *Bornetella*, is much stronger in the fossil genera, in which the main stem, the whorled branches, and above all the wall of the flask and the sporangia are always encrusted with lime.

The character of the wall is constant: its external surface is covered with a network, the centre of each mesh being occupied by a pore through which a lateral branch emerged. This network, fine and irregular in *Bornetella*,<sup>1</sup> consists in the fossil

<sup>1</sup> Only visible after the destruction of the organic matter, this network must not be confused with the imperforate facets formed by the dilated ends of the secondary branches.

genera of large, regularly hexagonal meshes. Thin in *Bornetella* (recent), *Zittelina* Mun.-Ch. and *Maupasia* Mun.-Ch. (fossil), the wall appears thick when the sporangia are included in it (*Dactylopora* Lk., Pl. V, figs. 8, 9, *Digitella* Morellet, fossil).

The sporangia, at least in the fossil genera and contrary to the state of affairs in the Neomereae, are filled with a calcareous *massula*, comparable with that of certain Acetabulariae (*Acicularia*), in which were embedded numerous spores, leaving small, smooth, spherical cavities. Of variable form (spherical, discoidal, irregular), the sporangia occupy, according to the genus, different positions in the interior of the flask. Sometimes, when very numerous, they almost fill the cavity (certain species of *Bornetella*, Pl. II, fig. 5; *Maupasia*, the fossil genus which is nearest to *Bornetella*), sometimes they form simply a coating of the internal surface of the wall (*Zittelina*), or again they may occur in the thickness of the wall itself (*Dactylopora*, *Digitella*). After the destruction of the alga, it is not rare to find them isolated, in which case it is often impossible to tell to which genus they belong; for this reason Munier-Chalmas gave them the provisional name of *Terquemella*.

By analogy with *Bornetella*, the fossil Bornetelleae may be considered as having lived in warm seas at a shallow depth.

#### ACETABULARIEAE

Owing to their diversity of habit, it is impossible to give a general description of the Acetabularieae comparable with that which we have sketched for the Neomereae and the Bornetelleae. Their only common characters are that, in contradistinction to what obtains in these two tribes, the principal stem gives rise to whorls of two kinds, one composed of sterile, the other of fertile branches, and that the sporangia (gametangia?), always lateral, are elongated or sometimes vesiculiform.

Sometimes the sterile whorls, which are moreover caducous, are localized in the lower part of the alga, and the fertile whorls in the upper part (*Acetabularia* Lmx. *sensu lato*, *Acicularia* d'Arch., recent and fossil; *Clypeina* Mich., fossil) and sometimes the fertile whorls are separated from one another by a number of sterile whorls (*Halicoryne* Harvey, recent).

In like manner the sporangia of one whorl sometimes remain isolated (*Halicoryne*; certain species of *Acetabularia*), and sometimes they are fused laterally to form an umbellate disc (most species of *Acetabularia*; *Acicularia*, Pl. VI, fig. 1), or a sort of basket (*Clypeina*) (Michelin, 1840-7; Morellet, 1918).

The main stem, the bases of the sterile branches and the walls of the sporangia are in general feebly calcified. The calcification of the sporangial contents varies much according to the genus. In *Acetabularia* and *Clypeina* the spores are completely

uncalcified; in *Chalmasia* Solms and *Halicoryne* they are encrusted with lime, remaining free in the sporangium in the former, and being united together in the latter; finally in *Acicularia* the sporangial cavity contains a calcareous *massula* of spicular form in which the spores are embedded (Pl. VI, figs. 2-4).

The only living genera known in the fossil state are *Acetabularia* and especially *Acicularia*, the calcified sporangia of which are frequently met with in Tertiary formations, either isolated or still united in groups (particularly in species of the section *Briardina* Mun.-Ch.). Small smooth spherical cavities indicate the position of the spores.

It is of interest to recall that the genus *Acicularia* was created by d'Archiac (1843) for a problematical fossil organism from the Auversian of the Paris basin, and that, before any living representative of the genus was known, Munier-Chalmas with keen insight recognized it as a relic of the Siphoneae Verticillatae, allied to *Acetabularia*.

Although a few species of *Acetabularia* (*sensu lato*) are exceptions, the Acetabularieae are algae of warm waters, and like all the Chlorophyceae, live at shallow depths. From the purely geological point of view, they appear to have flourished particularly in waters of low salinity, for they are especially abundant in brackish-lagoonal deposits.

## II. LIST OF TERTIARY CALCAREOUS SIPHONEAE FROM THE PARIS BASIN

Calcareous Siphoneae are abundantly distributed in the Tertiary formation of the Paris basin, and more particularly in the Lutetian. We think it would be of interest to publish here a list of the species so far recorded from each stage—a list which, however, is far from including the whole flora, for a considerable number of forms are still undescribed.

### CODIACEAE

Lutetian.

- Ovulites margaritula* Lk.
- Ovulites elongatus* Lk.
- Ovulites oehlerti* Mun.-Ch.

Auversian.<sup>1</sup>

- Ovulites margaritula* Lk.

### DASYCLADACEAE

Thanetian.

- Larvaria fragilis* Defr.
- Larvaria defrancei* Mun.-Ch. in Morellet (1922).
- Montiella macropora* Mun.-Ch. in Morellet (1922).
- Parkerella binodosa* Morellet.
- Jodotella veslensis* Morellet.
- Terquemella bellovacensis* Mun.-Ch. in Morellet (1922).
- Acicularia eocaenica* Mun.-Ch. in Morellet (1922).
- Belzungia borneti* Morellet.

Sparnacian.

*Nil.*

Cuisian.

- Cymopolia elongata* (Defr.).
- Cymopolia zitteli* Mun.-Ch. in Morellet (1913).
- Larvaria limbata* Defr.
- Neomeris (Vaginopora) scrobiculata* (Gümb.).

See footnote, p. 43.



*Neomeris (Vaginopora) herouvalensis* Mun.-Ch. in Morellet (1913).

*Terquemella macrocarbus* Mun.-Ch. in Morellet (1913).

*Uteria encrinella* Mich.

#### Lutetian.

*Cymopolia elongata* (Defr.).

*Cymopolia zitteli* Mun.-Ch. in Morellet (1913).

*Meminnella larvarioides* Morellet.

*Larvaria limbata* Defr.

*Larvaria reticulata* Defr.

*Larvaria filiformis* Morellet.

? *Neomeris (Decaisnella) annulata* Dickie.

*Neomeris (Decaisnella) pseudo-eruca* Mun.-Ch. in Morellet (1922).

*Neomeris (Vaginopora) fragilis* (Defr.).

*Neomeris (Vaginopora) arenularia* Mun.-Ch. in Morellet (1913).

*Neomeris (Vaginopora) herouvalensis* Mun.-Ch. in Morellet (1913).

*Neomeris (Vaginopora) radiata* Mun.-Ch. in Morellet (1922).

*Lemoineella geometrica* Morellet.

*Dactylopora cylindracea* Lk.

*Zittelina elegans* Mun.-Ch. in Morellet (1913).

*Maupasia parisiensis* Mun.-Ch. in Morellet (1922).

*Terquemella parisiensis* Mun.-Ch. in Morellet (1913).

*Carpenterella jonesi* Mun.-Ch. in Morellet (1922).

*Uteria encrinella* Mich.

*Acicularia pavantina* d'Arch.

*Acicularia cornigera* Morellet.

*Acicularia (Briardina) munieri* Morellet.

*Acicularia (Briardina) heberti* Mun.-Ch. in Morellet (1922).

*Clypeina infundibuliformis* Morellet nom. nov.<sup>1</sup>

*Clypeina stelliformis* Morellet.<sup>2</sup>

*Clypeina pezanti* Morellet.

*Thyrsoporella cancellata* Gumb.

#### Auverasian.<sup>3</sup>

*Cymopolia elongata* (Defr.).

*Cymopolia zitteli* Mun.-Ch. in Morellet (1913).

<sup>1</sup> We designate under this new name the Eocene form which we had previously included (1913) in *Clypeina marginoporella* Mich. from the Stampian. It is distinguished from that species by its funnel-shaped umbels and by the greater number of sporangial chambers which, though usually twenty, may reach twenty-six in some specimens. Since it is figured on pl. iii, figs. 20 to 25, of our 1913 memoir, it is unnecessary to refigure it here.

HORIZON.—Brackish Lutetian of the Paris basin (Chambors, Parnes, Gentilly, etc.) and Auversian of the same basin (Chavençon, Crépy-en-Valois, Lévignen, etc.).

<sup>2</sup> See p. 28.

<sup>3</sup> See footnote on p. 43.

*Meminella larvarioides* Morellet.

*Larvaria limbata* Defr.

*Larvaria auversiensis* Morellet.

*Larvaria filiformis* Morellet.

*Neomeris (Vaginopora) arenularia* Mun.-Ch. in Morellet (1913).

*Neomeris (Vaginopora) radiata* Mun.-Ch. in Morellet (1922).

*Dactylopora cylindracea* Lk.

*Zittelina elegans* Mun.-Ch. in Morellet (1913).

*Digitella dactyloporoides* Morellet.

*Maupasiasia simplex* Morellet.

*Terquemella parvula* Morellet.

*Terquemella dissimilis* Morellet.

*Uteria encrinella* Mich.

*Acicularia pavantina* d'Arch.

*Acicularia michelini* Mun.-Ch. in Morellet (1922).

*Clypeina infundibuliformis* Morellet.

*Clypeina pezanti* Morellet.

Bartonian (Sables de Cresnes).

*Cymopolia elongata* (Defr.).

*Cymopolia zitteli* Mun.-Ch. in Morellet (1913).

*Larvaria limbata* Defr.

*Larvaria auversiensis* Morellet.

*Neomeris (Vaginopora) arenularia* Mun.-Ch. in Morellet (1913).

*Dactylopora cylindracea* Lk.

*Acicularia pavantina* d'Arch.

*Clypeina pezanti* Morellet.

Ludian (Marls with *Pholadomya ludensis*).

*Cymopolia elongata* (Defr.).

*Acicularia parvula* Mun.-Ch. in Morellet (1922).

Sannoisian.

Nil.

Stampian.

*Cymopolia elongata* (Defr.).

*Neomeris (Vaginopora) courtyi* Morellet.

*Clypeina marginoporella* Mich.

### III. THE CALCAREOUS SIPHONEAE IN THE W. K. PARKER COLLECTION

IN their important work "On the Nomenclature of the Foraminifera", W. K. Parker and T. R. Jones (1860) studied *Ovulites* of Lamarck (pp. 291, 473) and described a number of forms under the name *Dactylopora* Lamarck (pp. 473-477), but, in the absence of figures, their text is difficult to interpret, more especially as, wrongly considering these organisms to be Foraminifera (as indeed was the rule at the time), they employed a totally inappropriate terminology. W. B. Carpenter, who figured some of Parker's and Jones's material, certainly did elucidate the question considerably in his memoir of 1862, "Introduction to the Study of the Foraminifera". None the less, a number of points remained doubtful or obscure, for Carpenter, like his predecessors, was ignorant of the true nature of *Ovulites*, *Dactylopora* and *Acicularia*, only revealed in 1877 and 1879 by Munier-Chalmas, whose results were not known to Parker and Jones when they published a brief note on *Ovulites* in 1877.

We therefore gladly accepted Mr. W. N. Edwards's offer to send us for examination the algae in the W. K. Parker Collection, which was acquired by the British Museum in 1892, and which, as is well known, consists mainly of Foraminifera. We wish here to express our gratitude to Mr. Edwards.

In addition to the specimens themselves, we have taken cognisance of three sheets of unpublished drawings by W. K. Parker, and of a manuscript list (on three pages) which were appended to the manuscript catalogue by T. R. Jones of the W. K. Parker Collection.

The list, prepared by T. R. Jones at some date later than Carpenter's memoir (1862), is far from having the same interest as the drawings. The latter (except one on sheet 3 of *Orbitolites* and two on the same sheet without any legend), deal with the diverse forms which W. K. Parker and T. R. Jones united, wrongly as we shall see, under the generic name of *Dactylopora* Lamarck. All of these are illustrated, some very fully; *Dactylopora cylindracea* P. & J. non Lk., for example, occupies most of sheet 3. These drawings, which are only rough sketches, show

that the authors had in the main grasped the basic structure of these somewhat complex organisms, and some of them (such as the longitudinal section of the wall of *D. reticulata* P. & J. non Defr. on sheet 1, or the section of *D. cylindracea* P. & J. non Lk. perpendicular to the axis, on sheet 3) need only slight modifications to make them quite exact. But we have found these valuable documents useful above all in identifying those forms described by Parker and Jones which are not represented in the collection; these we shall discuss shortly (see p. 25).

The species described by Parker and Jones (1860) are twelve in number, namely two of *Ovulites*,

*O. margaritula* Lk. (pp. 291-293),

*O. elongatus* Lk. (p. 473),

and ten of *Dactylopora*, or rather ten forms which these authors referred to this genus. Of these ten, six were considered to be new species, and four to be species previously described under various generic names. They are, in the order in which Parker and Jones intentionally arranged them, beginning with the simplest and ending with the most complex:

- a. *Dactylopora eruca* P. & J. (pp. 473-474).
- b. *Dactylopora digitata* P. & J. (p. 474).
- c. *Dactylopora annulus* P. & J. (p. 474).
- d. *Dactylopora marginoporella* (p. 474), which in Parker's and Jones's opinion would be identical with *Clypeina marginoporella* Mich.
- e. *Dactylopora reticulata* (p. 474), which these authors considered to be the same form as *Larvaria reticulata* Defr.
- f. *Dactylopora perforata* P. & J. (p. 474).
- g. *Dactylopora glandulosa* (p. 475), considered to correspond with *Prattia glandulosa* d'Arch.
- h. *Dactylopora polystoma* P. & J. (p. 475).
- i. *Dactylopora bambusa* P. & J. (p. 475).
- j. *Dactylopora cylindracea* P. & J. non Lk., of which *Polytripa elongata* Defr. would be only a variety (pp. 473 and 475).

The two species of *Ovulites* and seven of the species of *Dactylopora* are represented in the Parker Collection, the missing ones being *D. perforata*, *D. polystoma* and *D. bambusa*. Fortunately the gap is largely filled by W. K. Parker's drawings which we have just mentioned, and they enable us to give at least a generic name to *D. polystoma* and *D. bambusa*.

Except in the case of *D. perforata*, we have then been able to form a precise idea of what Parker's and Jones's species of *Dactylopora* were. We can thus show that if these authors deserve great credit for recognising the affinity of organisms

previously scattered in the literature under various designations, the generic name under which they grouped them was a most unfortunate choice. As we had previously suggested (1913), solely from a consideration of the descriptions, not one of the specimens nor of the drawings can be referred to *Dactylopora* Lk. Further, we have been able to ascertain that the identifications made by Parker and Jones with previously described species were inexact, and so also are some of the identifications which we ourselves had suggested (1913). The necessary corrections will be noted in the course of our detailed examination of the specimens (p. 15, *et seq.*) and summarized in a special chapter (p. 27).

In addition to *Ovulites* and *Dactylopora*, there are, in the W. K. Parker Collection, some specimens of *Acicularia* on which Parker had intended to write at a later date, and which were very briefly described by W. B. Carpenter (1862).

Most of the specimens come from the Lutetian of Grignon (Seine-et-Oise, France) and the Eocene<sup>1</sup> of Hauteville (Manche, France),<sup>2</sup> but there are some, and not the least interesting, from the Sannoisian of Rauville (Manche, France),<sup>3</sup> and a few from the Miocene of the Antilles (San Domingo, Jamaica).

## I. ANALYSIS OF THE MATERIAL

The material we have examined in the W. K. Parker Collection comprises a series of forty-nine slides, numbered V. 24879 to V. 24927, of which twenty-two (V. 24879 to V. 24900) belong to *Ovulites* (Siphoneae Dichotomae = Codiaceae) and twenty-seven (V. 24901 to V. 24927) to "*Dactylopora*" (in the erroneous sense which Parker and Jones used) and to *Acicularia* (Siphoneae Verticillatae = Dasycladaceae). We have also examined seven other slides, from the main collection of Foraminifera, which include isolated algal specimens.

### (i) OVULITES (Codiaceae)

A. A first group of five slides (V. 24879 to V. 24883) is labelled: *Ovulites elongatus* Lk.,<sup>4</sup> Eocene, Hauteville (Manche, France).

<sup>1</sup> We have purposely not stated the exact age of the Hauteville beds which, in the opinion of certain authors, for example Abrard (1925, p. 338), are Lutetian, while others such as Boussac (1907, pp. 292-4) refer them to the lower Bartonian (=Auversian).

<sup>2</sup> The full name is Hauteville-Bocage, often spelt with a double t.

<sup>3</sup> These are labelled "Miocene?" which is the age formerly attributed to the *Corbula* clay from which the material came (Vieillard and Dollfus, 1875). To-day this bed is considered to be Sannoisian (Haug, 1911, p. 1456).

<sup>4</sup> The name is spelt *O. elongata* on the label, here as elsewhere, following Lamarck. We have adopted the more correct form throughout.

This determination is incorrect; the great majority of the specimens are fragments of filiform tubes which at first sight bear some resemblance to *O. elongatus*, but which certainly do not belong to this species, nor even to the genus *Ovulites*. Having a considerably greater average diameter, and having no swelling at either end, they show, although in most cases much worn, obvious traces of an external ornament which is never found in *Ovulites*. They recall certain forms *incertae sedis*, such as *Dactylopora bacillaris* Reuss (1869) from the Stampian of Gaas (Landes, France), which is, however, not a *Dactylopora*, and probably not an alga at all. Segments of the true *Ovulites elongatus* are shown on Pl. I, figs. 3-5 (compare also Text-fig. 1).

Mixed with these problematic organisms, which are very common in the Eocene of Brittany (Bois-Gouët), we have recognised a fragment of *Acicularia*, some *Ovulites margaritula* Lk., entire or crushed, and not the least interesting, a few segments of *Ovulites oehlerti* Munier-Chalmas (cf. Pl. I, fig. 2), the type of which is from the Eocene of Orglandes (Manche), a locality near Hauteville, and which is also known from the Lutetian of Chaussy (Seine-et-Oise, France; in the collection of the Geological Laboratory of the Sorbonne, Paris.)

The following tables will facilitate reference to the different forms mounted on one slide; each specimen is represented by a number, and the series is read from left to right, beginning at the top when the label is to the left. The black numbers correspond to algae; all the rest are the tubes *incertae sedis* which have just been mentioned.

Slide **V. 24879.**

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21

No. 4 is a fragment of *Acicularia* specifically indeterminable, and No. 10 is a segment of *Ovulites margaritula* Lk.

Slide **V. 24880.**

				1				
	2	3	4	5	6	7	8	
9	10	11	12	13	14	15	16	17 18
	19	20	21	22	23	24	25	
				26				

No. 5 is probably a fragment of *Ovulites margaritula* Lk., and No. 16 is a good specimen of *Ovulites oehlerti* Mun.-Ch.

Slide **V. 24881.**

				1				
	2	3	4		6	7	8	
				5				
9	10	11	12		13	14	15	16
17	18	19	20	21	22	23	24	25
26	27	28	29		31	32	33	34
				30				
	35	36	37		38	39	40	
				41				

Nos. 18, 19, 21 to 23, 25, 28 and 29 are *Ovulites margaritula* Lk., and Nos. 1, 10 to 17, 24, 26, 31, 33, 34 and 41 are *Ovulites oehlerti* Mun.-Ch.; No. 13 is particularly clear. Nos. 9, 20, 27 and 32 are *Ovulites* belonging to one or other of the preceding species, but which we are unable to determine with certainty.

Slide **V. 24882.**

			1	2	3					
			6	7	8	9				
	5								10	
4										11
12	13	14	15	16	17	18	19			
20										27
	21								26	
			22	23	24	25				
			28	29	30					

No. 17 is very probably *Ovulites oehlerti* Mun.-Ch., and No. 28 is a fragment of *Ovulites margaritula* Lk.

Slide **V. 24883.**

			1	2	3	4	5	6	7												
	8	9	10	11	12	13	14	15	16	17	18										
19	20	21	22	23	24	25	26	27	28	29	30	31	32								
	33	34	35	36	37	38	39	40	41	42	43										
			44	45	46	47	48	49	50	51	52										
				53	54	55	56	57	58												

Nos. 1 and 4 are fragments of *Ovulites margaritula* Lk., Nos. 5, 7 and probably 3 are *Ovulites oehlerti* Mun.-Ch.

No. 43 is a problematical organism; Nos. 48 and 55, although doubtless belonging to the same species as the tubes *incertae sedis*, deserve special mention, the first because it is branched, and the second because an annular constriction divides it into two false segments.

**B.** The second group consists of six preparations (**V. 24884** to **V. 24889**) labelled: *Ovulites elongatus* Lk., Eocene, Grignon, France.

The identification is correct, and these slides demand no special commentary; we may mention, however, that slide **V. 24884** shows also a fragment of *Ovulites margaritula* Lk., and that a fine Miliolid foraminifer<sup>1</sup> is mounted among the algae on slide **V. 24887**.

**C.** In the third group we include six slides (**V. 24890** to **V. 24895**) labelled: *Ovulites margaritula* Lk., *O. elongatus* Lk., Eocene, Grignon, France.

Slide **V. 24890** actually includes only *O. margaritula*, although some of the specimens are long and slender, which doubtless misled W. K. Parker.

On Slide **V. 24891** the two species are both represented, as shown in the following plan arranged in the same way as the preceding ones, in which the numbers in black type indicate segments of *Ovulites elongatus* Lk.:

				1																	
				2	3	4															
				5	6	7															
8	9	10	11	12	13	14															
				15	16	17															
				18	19	20															
				21																	

<sup>1</sup> Identified by Dr. K. P. Oakley as *Articulina* cf. *nitida* d'Orb.

The same mixture of *Ovulites margaritula* Lk. and *O. elongatus* Lk. may be seen on slides V. 24892 to V. 24895, but the specimens are irregularly arranged, so that we are unable to give a key plan for them.

D. The fourth and last group includes five slides (V. 24896 to V. 24900) labelled: *Ovulites margaritula* Lk., Eocene, Grignon.

All the specimens are undoubtedly *Ovulites margaritula* Lk., many of them being fragmentary.

(ii) DACTYLOPORA and ACICULARIA (Dasycladaceae)

A general remark is necessary concerning the slides labelled *Dactylopora*; they prove, as we had previously suggested (Morellet, 1913, p. 10), that Parker and Jones had an entirely wrong idea of Lamarck's *Dactylopora*. There is not, indeed, among these slides one single specimen belonging to this genus; side by side with forms that are not algae there are only, in order of abundance, specimens of *Cymopolia* Lamouroux, *Larvaria* Defrance, *Neomeris* Lamouroux, and *Clypeina* Michelin.

E. The specimens on slide V. 24901 (Eocene, Grignon) named *Dactylopora pauperata* Carpenter MS. are not algae, although in general appearance they have some analogy with spicules of *Acicularia*.<sup>1</sup> This same form is represented on slides V. 24914 and V. 24917 from Hauteville, of which we figure two specimens for reference (Pl. I, figs. 9, 10).

F. A series of six slides follows, labelled *Dactylopora annulus* Parker and Jones, three from the Eocene of Grignon (V. 24902 to V. 24904), and three from the Eocene of Hauteville, Manche (V. 24905 to V. 24907).

The three first comprise mainly isolated rings, on the whole very poorly preserved, irregularly arranged and often immersed in the mounting medium, but most of which, in spite of the difficulty of examining them, can with certainty be referred to *Larvaria limbata* Defrance.

Of the three slides from Hauteville, number V. 24905 is of no interest; the sections of rings on it are indeed indeterminable, though some might belong to a *Neomeris* (section *Decaisnella*) and others to a *Larvaria* (section *Parnesina*). Slides V. 24906 and V. 24907, however, show that under the name of *Dactylopora annulus* Parker and Jones united forms which were absolutely distinct; here the dominant species is not, as in the case of the Grignon slides, *Larvaria limbata* Defr. but *L. encrinula* Defr.

<sup>1</sup> The author of the manuscript catalogue (T. R. Jones) considered *D. pauperata* as a "worn cylindrical *Acicularia*". We cannot agree with this opinion since, in addition to the much more crystalline nature of the lime in *D. pauperata* than in any of the Siphoneae, the worn spicules of *Acicularia* never take on such an appearance.



## Slide V. 24906.

		1	2	3		
	4	5	6	7	8	
9	10	11	12	13	14	15
	16	17	18	19	20	
		21	22	23		

No. 13 may be set aside; it is a slender tube probably belonging to the Dasycladaceae, but we are unable to give it a name.

Nos. 11 and 12 are tubes of *Larvaria*, too rolled for exact determination, but very probably belonging to the same species as No. 10, which is a fragment of *Larvaria encrinula* Deufr., consisting of two rings still united. All the other specimens are isolated rings of this species, some stuck down by their lower, and others by their upper surface. Among the best we may mention Nos. 3 and 9 showing the lower surface, and Nos. 5, 15, 16 and 19 showing the upper surface.

## Slide V. 24907.

			1	2		
	3	4	5	6	7	
	8	9	10	11	12	
13	14	15	16	17	18	19
	20	21	22	23	24	25
		26	27	28	29	
			30	31	32	33

With the exception of No. 11, which is a ring of *Larvaria limbata* Deufr. showing the lower surface, all the specimens are isolated rings of *Larvaria encrinula* Deufr.; the best are Nos. 14, 16 (lower surface) and 26 (upper surface).

G. This third group comprises nine slides (V. 24908 to V. 24916), labelled: *Dactylopora cylindracea* Lk., Eocene, Hauteville (Manche).

The great majority of the specimens on these slides are *Cymopolia elongata* (Deufr.), formerly known as *Polytripa elongata*, a form which Parker and Jones, followed by W. B. Carpenter, wrongly considered to be a simple variety of *Dactylopora cylindracea* Lk. (Pl. V, figs. 8, 9), although it is as a matter of fact very different and does not even belong to the same tribe.

Slide V. 24908 (36 specimens) and V. 24909 (22 specimens).

Both comprise solely fragments of *Cymopolia*, some showing the external surface (cuticle), others longitudinal or transverse sections of segments. All these fragments, with the exception of one which is dubious, belong to *Cymopolia elongata* (Deufr.).

## Slide V. 24910.

Comprises only five specimens, which may be numbered thus:

	1	2	3	4	5
--	---	---	---	---	---

No. 1 is a poor *Cymopolia elongata* (Deufr.); Nos. 2 and 5 are segments of the same species, internally abraded so that the primary canals have disappeared and sections of the secondary canals can be seen in groups of four to seven; No. 3 is an excellent and very interesting longitudinal section of a new species of *Cymopolia* (*C. edwardsi*), which will be described shortly; finally No. 4 is perhaps a worn *Cymopolia*, but we are not even certain that it is an alga.

Figs. 24 and 23 of W. B. Carpenter's plate x (1862) represent respectively Nos. 3 and 4 on this slide.

## Slide V. 24911.

	1	2	3	4
5	6		7	8
9	10		11	12
13	14	15		16

No. 5 is indeterminable, No. 6 is probably a fragment of a hydrozoan; all the others are fragments of *Cymopolia elongata* (Defr.); the interiors of Nos. 1 and 2 are worn as in Nos. 2 and 5 of the preceding slide.

## Slide V. 24912.

	1	2	3	4
	5	6		7
8	9	11	12	13
	10			
14	15	16		17

No. 6 is indeterminable; No. 14 is probably a rolled fragment of *Neomeris*, which seems to have been figured by W. B. Carpenter (1862, pl. x, fig. 21) as a variety of *Dactylopora reticulata* P. & J. non Defr. Nos. 1 to 4 belong to a distinct species of *Cymopolia* to which we shall return later. All the other specimens are either *Cymopolia elongata* (Defr.), or *C. dollfusi* Morellet (Nos. 15 and 16 for example).

## Slide V. 24913.

			4	
1	2	3	6	
			5	
7	8	9	10	
11	12	13	14	

No. 2 is indeterminable; all the other specimens belong to *Cymopolia elongata* (Defr.); No. 8 is noteworthy for the large number and the diameter, greater than the normal, of its sporangial cavities.

## Slide V. 24914.

	1	2	3	
	4	5	6	
7	8	9	10	11
	12	13	14	
	15	16	17	

No. 9 is a fragment of *Larvaria encrinula* Defr.; No. 12 is a fragment of no interest; Nos. 10 and 13 are "*Dactylopora*" *pauperata*, a form which, as we have seen, is not an alga; Nos. 7 and 17 are the cuticles of an alga which we cannot identify without an examination of the internal surface of the tube; all the other specimens, with the possible exception of No. 8, are *Cymopolia elongata* (Defr.).

## Slides V. 24915 and V. 24916.

These are thin sections of specimens of *Cymopolia elongata* (Defr.); slide V. 24916 is the more interesting, and tangential sections show especially that each primary branch gives rise distally to a group of four to seven secondary branches.

H. Two slides, V. 24917 and V. 24918, are labelled *Dactylopora pauperata* Carp. and *Acicularia pavantina* d'Arch., Eocene, Hauteville (Manche).

## Slide V. 24917.

	1	2	3	4	
		5	6	7	8
			9	10	11
12	13	14	15	16	
17	18	19	20	21	
	22	23		24	

Nos. 1, 3-11, 13, 15, 17, 18, 20 and 21 are "*Dactylopora*" *pauperata* Carpenter MS., and are not algae. Nos. 13 and 15 are figured on Pl. I, figs. 9 and 10 (see above: slide V. 24901). Nos. 12 and 23 are indeterminable, but the latter is probably an alga.

All the other specimens are Acicularians, but none belongs to *Acicularia pavantina* d'Arch., except perhaps No. 16, in which the distal extremity is strongly bilobed. Nos. 19 and 24 are *Acicularia (Briardina) muniéri* Morellet. If one looks at No. 19 (which is mounted on its edge) laterally one can see very clearly that the intersporangial septum is much dilated at its marginal end—a character peculiar to this species. No. 2 is a fragment of a spicule of a species of *Briardina*, and No. 14 (figured by W. B. Carpenter, 1862, pl. xi, fig. 29) another species of *Briardina*. We shall return to these two forms shortly. Finally No. 22 belongs most probably to the same species as No. 14.

## Slide V. 24918.

			1						
			2	3	4				
	5	6	7	8	9	10	11		
12		13	14	15	16	17	18	19	
	20		21	22	23	24			
			25	26	27	28			
				29					

In spite of the label this slide does not include any "*Dactylopora*" *pauperata*; it does include, on the other hand, as indicated on the back, a certain number of specimens of *Cymopolia* wrongly named as usual *Dactylopora cylindracea* Lk. These are Nos. 1-15 and 17-19; all are fragmentary, with the exception of No. 3, which is a complete segment.

No. 16 is a *Neomeris (Vaginopora)* identical with specimens 1-3, 7 and 8 on slide V. 24921 (*Dactylopora glandulosa* P. & J. non D'Arch.).

There is not one specimen of *Acicularia pavantina* d'Arch. No. 20 is a spicule of *Acicularia* cf. *clavata* Morellet, to which we shall refer later. Nos. 22 and 23 are *Acicularia (Briardina) muniéri* Morellet (see Pl. VI, fig. 16). Nos. 21 and 24-27 are fragments of *Briardina* sp., among which Nos. 24-27 appear to belong to the same species as No. 2 of the preceding slide; we shall discuss it shortly. Finally Nos. 28 and 29 are most probably not algae.

I. Slide V. 24919 is labelled *Dactylopora reticulata* Defr., Eocene, Hauteville (Manche).

		1	2	3		
4	5	6	7	8	9	
		10	11	12	13	14
15	16	17	18	19	20	

Nos. 2, 12, 14, 17 and 18 are probably *Neomeris*, but their poor state of preservation does not permit us to be absolutely certain of the identification.

All the other specimens are *Larvaria*, very much worn except No. 10, which is well preserved. This last, consisting of five rings still united, was moreover figured by W. B. Carpenter (1862, pl. x, fig. 18); it is not, contrary to the opinion of W. K. Parker and T. R. Jones, followed also by W. B. Carpenter, the *Larvaria reticulata* of DeFrance, as one can tell from the photographs we

have given (Morellet, 1913, pl. i, figs. 38-40) of the types in the Defrance Collection; nor is it our *Larvaria auversiensis*, as we had formerly conjectured (1913, p. 16), and is none other than *Larvaria encrinula* Defr., the type of which indeed came from Hauteville.

The worn specimens, one of which, No. 8, was figured by W. B. Carpenter (1862, pl. x, fig. 17), should probably also be referred to *Larvaria encrinula* Defr.

As we have seen, this species is well represented by isolated rings on slides V. 24906 and V. 24907. In the light of all this material, and of that in our own collection from Hauteville, we give below a full description of this species, which has been up to the present very imperfectly known. (See p. 30.)

**J. Slide V. 24920** is labelled *Dactylopora marginoporella* (Mich.) and *Dactylopora reticulata* (Defr.), Eocene, Hauteville (Manche).

The left-hand label, which repeats the inscription on the back of the slide, is less correct than that on the right, which, although still erroneous, indicates *Dactylopora digitata* and *Clypeina marginoporella*. In reality the three specimens all belong to one and the same species of *Clypeina* which is neither *Clypeina marginoporella* Mich. nor the form which we have referred to *Clypeina digitata* (Morellet, 1913, p. 35), but which agrees exactly with our *Clypeina pezanti* (Morellet, 1922, p. 27, pl. ii, figs. 37-44). This necessitates a revision of nomenclature with which we will deal later (p. 27).

We may add that specimen No. 2 (a complete disc) has been figured by W. B. Carpenter (1862, pl. x, fig. 15) under the name of *Dactylopora clypeina* (= *Dactylopora marginoporella*), and the fragment No. 3 under that of *Dactylopora digitata* (pl. x, fig. 16).

**K. Slide V. 24921** is labelled *Dactylopora glandulosa* P. & J., Eocene, Hauteville (Manche).

1	2	3	4	5
6	7	8	9	10

These fragments have nothing in common with *Prattia glandulosa* d'Archiac (1860), to which Parker and Jones referred them (1860, p. 475); as a matter of fact all are *Neomeris*. Two of them (Nos. 4 and 5) are too imperfect for us to express an opinion on them; nevertheless we have figured No. 4 (Pl. IV, fig. 2). The eight remaining fragments belong to two different species, one represented by Nos. 1-3, 7 and 8, the other by Nos. 6, 9 and 10. They will be discussed later.

W. B. Carpenter's fig. 25, pl. x (1862) was probably drawn from No. 7, and fig. 26, pl. x from Nos. 6, 9 or 10; fig. 27, pl. x shows No. 5 as it now appears on the slide, and fig. 28 the same specimen seen from the other side.

\* \* \*

The six preparations which conclude the series come from the *Corbula* Clay (= Sannoisian) of Rauville (Manche), which in W. K. Parker's time was considered to be Miocene (see footnote, p. 15).

**L. Slides V. 24922 and V. 24923** are labelled *Dactylopora cylindracea* Lk., Miocene?, Rauville (Manche).

These two slides contain only poor fragments of *Cymopolia elongata* (Defr.), a species which we have already recorded from the *Corbula* Clay of Rauville (Morellet, 1917).

## M. Slides V. 24924 and V. 24925.

V. 24924, labelled *Dactylopora eruca* P. & J. (fossil), Miocene ?, Rauville (Manche).

			I				
			2	3			
	4	5	6	7	8		
9	10	11		12	13	14	
15	16	17	18	19	20	21	22
	23	24		25	26	27	
	28	29		30	31		
			32				

Nos. 1-8 and 23-32 are foraminifers and Nos. 9-22 are fragments of rings of a *Neomeris*, section *Decaisnella*. This *Neomeris* will be specially dealt with shortly (p. 29) and must be given a new name.

## Slide V. 24925.

Labelled *Dactylopora annulus* P. & J. and *Dactylopora eruca* P. & J. (fossil), Miocene ?, Rauville (Manche).

			I		2		
	3	4	5	6	7		
	8	9	10	11	12		
13	14	15	16	17	18		
	19	20	21	22	23		
	24	25					
		26					

Nos. 1-7 and 24-26 are foraminifers; No. 14 was wrongly referred by W. B. Carpenter (1862, pl. x, fig. 10) to *Dactylopora annulus* P. & J.; actually it is a complete ring of a *Neomeris*, section *Decaisnella*, belonging to the same species as the fragments of rings Nos. 8-13 and 15-23 of this slide and Nos. 9-22 on the preceding one.

N. Slides V. 24926 and V. 24927 are labelled *Acicularia pavantina* d'Arch., Miocene ?, Rauville (Manche).

## Slide V. 24926.

				I			
			2	3	4	5	
	6	7	8	9	10	11	
12	13	14	15	16	17	18	
	19	20	21	22	23	24	
		25	26	27			
			28				

Of the twenty-eight specimens on this slide, two are indeterminable debris (Nos. 5 and 12), and two are doubtful (Nos. 16 and 24). All the others are Acetabularian spicules, most frequently in a fragmentary condition, but not one is *Acicularia pavantina* d'Arch.

Nos. 2, 6, 22, 23, 25 and 28 cannot be specifically named. Nos. 3, 4, 7-11, 13, 14, 17-21, 26 and 27 belong to a new species which, with its marginal pores, is close to, but distinct from *Acicularia miocaenica* Reuss (1861); the best specimens are 4, 14, and particularly 18. No. 15 is a fragment of a disc of a *Briardina*, cf. *Acicularia (Briardina) archiaci* Mun.-Ch., in Morellet (1922), from the Stampian of Gaas (Landes), France; it was figured by W. B. Carpenter (1862, pl. xi, fig. 30). No. 1 finally is a spicule which is very unusual in its cuneiform appearance and in the regular arrangement of the spiferous cavities. These different forms will be described below (pp. 34-36).

Slide V. 24927.

				1		2						
			3	4	5					6		
	7		8	9	10				11	12		
13	14	15	16	17	18	19	20	21				
		22	23	24	25	26	27					
			28	29	30	31						
				32	33							

Here again there is no specimen of *Acicularia pavantina*; Nos. 28 and 33 are indeterminable, and Nos. 24 and 26 are spicule fragments of *Acicularia* sp. With the exception of No. 8, which is identical with No. 1 of the preceding slide, and of Nos. 16 and 17, which, like V. 24926, No. 15, recalls *Acicularia (Briardina) archiaci* Mun.-Ch., all the other specimens belong to the species near *Acicularia miocaenica* Reuss, already noted on slide V. 24926. Nos. 14 and 20 were figured by Carpenter (1862, pl. xi, figs. 28, 31).

\* \* \*

In addition to this series of forty-nine slides, we have examined seven others, which comprise mainly Foraminifera, and hence were included in that part of the W. K. Parker Collection devoted to those organisms. Five of them have only a minor interest; these are:

Slides **LXXXI-6** (MS. list, p. 98) and **LXXXI-9** (MS. list, p. 99).

Eocene, La Fosse-à-Launay, near Néhou (Manche, France); *ex coll.* C. Lyell.

In spite of the label, there is no siphonous alga on these two slides. The specimens referred to *Ovulites elongatus* Lk. are, like those from Hauteville so designated on slides V. 24879 to V. 24883, organisms *incertae sedis* (see p. 16).

Slide **LXXXIV-37** (MS. list, p. 102).

Eocene, Grignon (Seine-et-Oise, France).

	1				
		2	3		
4	5	6			
		7			

Specimen No. 1 is *Ovulites margaritula* Lk.; Nos. 2 and 3 are foraminifera; No. 4 is an indeterminable fragment of *Acicularia (Briardina)*; No. 5 a fragment of *Acicularia (Briardina) munieri* Morellet; No. 6 a fragment of an *Acicularia (Briardina)* belonging to a new species, but too fragmentary for description; and No. 7 finally a poor scrap of an *Acicularia*.

Slide **LXXXIV-126** (MS. list, p. 126).

Eocene, Grignon (Seine-et-Oise, France).

This slide, composed mainly of *Lagena*, includes three specimens of *Ovulites margaritula* Lk., but the two elongated tubes, referred to *O. elongatus* Lk., do not belong to that species and are not even Siphonaeae.

Slide **CXXVI-1** (MS. list, p. 151).

Lower Pliocene, "delle Crete Senesi" (Tuscany, Italy); *ex coll.* C. Strozzi.

		1					
		2	3				
4	5	6	7	8			

This slide is composed solely of Foraminifera, with the exception of No. 3, referred to by Jones and Parker (1860, p. 299) as *Dactylopora*, which is a minute fragment of *Acicularia* doubtless belonging, considering its provenance, to the ill-defined species which has been given the name of *Acicularia italica* Clerici (1895).

Slide **CXII-2** (MS. list, p. 132).

Miocene, Jamaica. [Not from San Domingo, as stated in error by Parker and Jones, 1860.]

						7
1	2	3	4	5	6	
						8

Besides Foraminifera (*Bulimina*, *Dentalina*, *Nodosaria*, *Frondicularia*) this slide includes two specimens (Nos. 7 and 8) which Parker and Jones (1860, p. 292) mistakenly referred to *Ovulites*. These specimens, however, are not even algae, and seem to belong to the molluscan genus *Cadulus* Philippi.

The remaining slide is much more interesting.

Slide **CXI-22** (MS. list, p. 130).

Miocene, San Domingo.

	1	2	3		
4				5	
		8			
	6		7		
	9	10	11		

Associated with Foraminifera (*Textularia*, *Lingulina*, *Frondicularia*) and with problematical filiform tubes, this slide includes one specimen (No. 1) which is most probably that referred by Parker and Jones (1860, p. 474) to *Dactylopora reticulata*. Actually it is a fragment of a *Neomeris* tube of the section *Vaginopora*, very different from any we know, but unfortunately too worn on the outside to be described as a new species. This fragment (Pl. I, fig. 1), 1 mm. long, and showing six whorls of ruptured sporangial chambers, between which can be seen the pores for the passage of the sterile secondary branches, is remarkable for its minute size. The external diameter is only 0.75 mm.; the walls are scarcely 0.125 mm. in thickness, and the height of the rings is under 0.175 mm. In addition, the sporangial chambers are few in number—about twenty per whorl.

To close this chapter it remains to add a few words on the three species of W. K. Parker and T. R. Jones, which are known to us only through the unpublished drawings by W. K. Parker.

*Dactylopora polystoma* (1860, p. 474; Lutetian, Grignon) is unquestionably a *Neomeris*, very close to a species hitherto undescribed, in spite of its abundance, from the Lutetian of the Paris basin.

*Dactylopora bambusa* (1860, p. 475; Lutetian, Grignon), which Carpenter (1862, p. 135, footnote) rightly considered an unsatisfactory species, is merely a worn specimen of *Cymopolia*, very probably of *C. dollfusi* Morellet, the characters of which it seems to show, with all its whorled branches fertile, and sporangial chambers of large size occupying almost the whole thickness of the wall.

On the other hand, it is not possible to identify *Dactylopora perforata* (1860, p. 474; Lutetian, Grignon). It certainly

recalls *Meminella larvarioides* Morellet, in that it shows no external annulation (which distinguishes it from *D. reticulata* P. & J. non Defr., as Parker and Jones noted), and that the large and well-spaced pores of the internal and external surfaces of the tube are surrounded by a circular lip; but the other characters indicated in the description as well as on the drawings do not accord with that species nor with any known Tertiary member of the Dasycladaceae. It seems to us, however, that *D. perforata* does belong to that family, and we therefore think that Parker and Jones, misled by the poor state of preservation, wrongly interpreted the structure of the specimens on which they founded the species, which, all things considered, should not be maintained.

### (iii) RÉSUMÉ OF THE ANALYSIS OF THE MATERIAL

OVULITES.—Contrary to the indication on the labels, the five slides V. 24879 to V. 24883 (Eocene, Hauteville, Manche) do not include any *Ovulites elongatus* Lk., but are mainly of an organism *incertae sedis*, with which are associated several specimens of *Ovulites oehlerti* Mun.-Ch. and of *Ovulites margaritula* Lk.

*Ovulites elongatus* (Lk.) is, on the other hand, well represented on slides V. 24884 to V. 24889 (Eocene, Grignon), as well as on slides V. 24890 to V. 24895 (Eocene, Grignon), where they are mixed with *Ovulites margaritula* Lk. The last-named species alone is found on slides V. 24896 to V. 24900 (Eocene, Grignon).

DACTYLOPORA.—There is not in the W. K. Parker Collection, in spite of the labels, any specimen belonging to this genus.

1. *D. pauperata* Carp. MS. (slide V. 24901, Eocene, Grignon, and in part slide V. 24917, Eocene, Hauteville) is not a *Dactylopora*, nor even an alga.

2. *D. annulus* P. & J.—Under this name are united two different species of *Larvaria* and a *Neomeris*.

*Larvaria limbata* Defr. (slides V. 24902 to V. 24904, Eocene, Grignon; one specimen on slide V. 24907, Eocene, Hauteville).

*Larvaria encrinula* Defr. (slides V. 24906–7, Eocene, Hauteville).

*Neomeris (Decaisnella) alternans* n. sp. (see p. 29; complete ring on slide V. 24925, *Corbula* Clay, Rauville).

3. *D. cylindracea* P. & J. non Lk.—All the specimens so named belong to *Polytripa*, that is to say *Cymopolia*: the majority to *C. elongata* (Defr.), others to *C. dollfusi* Morellet and *C. edwardsi* n. sp. (slides V. 24908 to V. 24916, Eocene, Hauteville, and slides V. 24922 and V. 24923, *Corbula* Clay, Rauville).

4. *D. reticulata* P. & J. non Defr., isolated rings of which are called *D. annulus* (slides V. 24906 and V. 24907, Eocene,



Hauteville), is not *Larvaria reticulata* Defr., but *L. encrinula* of the same author; we were in error in having referred it formerly to *Larvaria auversiensis* Morellet (1913, p. 16).

5. *D. digitata* P. & J. is a *Clypeina* Mich., different from the form which we formerly described and figured under the name of *Clypeina digitata* (1913, p. 35), and on the other hand, identical with our *Clypeina pezanti*.

6. *D. eruca* P. & J. is a *Neomeris* (*Decaisnella*), described below under a new name, and identical with that wrongly included under *D. annulus* by Parker and Jones (see above).

7. *D. glandulosa* P. & J.—Under this name are united at least two species of *Neomeris* (*Vaginopora*).

ACICULARIA.—Contrary to what appears on the labels, we have not seen any undoubted specimen of *Acicularia pavantina* d'Arch., either in the slides from Hauteville (V. 24917 and V. 24918), or in those from Rauville (V. 24926 and V. 24927).

From Hauteville, by the side of undescribed species of *Acicularia sensu stricto* and of *Acicularia* section *Briardina*, there are several specimens of *Acicularia* (*Briardina*) *munieri* Morellet.

From Rauville the predominant form is a new *Acicularia*, near *A. miocaenica* Reuss, associated with which are an *Acicularia* (*Briardina*) cf. *archiaci* Mun.-Ch. and *Acicularia* sp.

#### (iv) RECTIFICATIONS OF NOMENCLATURE

The analysis which we have just completed enables us as a first result to settle certain points in nomenclature.

To begin with, the name *Dactylopora annulus* P. & J. must be definitely suppressed, for it was applied to three different species, of which two had been previously described (*Larvaria limbata* Defr. and *L. encrinula* Defr.), while the third is identical with Parker's and Jones's *Dactylopora eruca*.

Next it is possible to establish the following synonymies :

*Dactylopora cylindracea* P. & J. non Lk.

= *Cymopolia* (*Polytripa*) *elongata* (Defr.), and for certain specimens = either *Cymopolia dollfusi* Morellet or *Cymopolia edwardsi* n. sp.

*Dactylopora reticulata* P. & J. non Defr.

= *Larvaria encrinula* Defr.

A more delicate question is raised in connection with *Dactylopora digitata* P. & J., the three specimens of which, in the Parker Collection, are, as we have shown above (p. 22), a *Clypeina* belonging to one and the same species and identical with our *C. pezanti*. In order to be convinced of this identity it is only necessary to compare figs. 25 to 27 of Pl. VI, which represent these three specimens, with those in our memoir of 1922 (pl. ii, figs. 37-44), of which figs. 43 and 44 are of specimens from the Eocene of Cotentin, as are W. K. Parker's specimens.

Is it, then, necessary to substitute the name *digitata*, which is earlier, for that of *pezanti*? We think not, for although *digitata* was described, it was not figured by its authors, and according to the rules of nomenclature a species to be valid must be not only described but figured. Carpenter (1862, pl. x, fig. 16) did certainly give a figure of *D. digitata* clearly drawn from one of the three specimens in the Parker Collection, but it only represents a mere fragment showing no distinctive characters, while the best specimen of *D. digitata* was figured by the same author (pl. x, fig. 15) under the name of *Dactylopora clypeina*, his synonym for *Clypeina marginoporella* Mich., the specific name of which he considered inappropriate.

We therefore maintain the name *Clypeina pezanti* Morellet and suppress that of *Clypeina digitata* (P. & J.). It then becomes necessary to give a new name to the form from the Eocene of the Paris basin, which we wrongly attributed to Parker's and Jones's species, and which we have described and figured (Morellet, 1913, p. 35, pl. iii, figs. 26-31) under the name of *Clypeina digitata*. We propose to call it *Clypeina stelliformis* nob.

The second result of our critical examination is that we have been enabled to state more precisely the characters of certain ill-defined species, and to make known some hitherto undescribed forms. This will be the subject of the following chapter.

## 2. NEW OR INTERESTING SPECIES IN THE W. K. PARKER COLLECTION

In addition to those forms which, by their clearly defined characters, justify the institution of new species, we have thought well to describe briefly or even to figure a few which, although also new, are scarcely sufficiently well represented to be given a specific name.

### *Neomeris (Vaginopora)* sp. 1 (Pl. IV, fig. 1)

This species, represented by specimens Nos. 1 to 3, 7 and 8 on slide **V. 24921**, Eocene, Hauteville (Manche), is very close to *Neomeris (Vaginopora) fragilis* (Defr.), which, moreover, is found at Hauteville (our collection); it may be only a variety of *N. fragilis* in which the individuality of the sporangial calcifications has been retained, so that these are less intimately united to each other.

**Neomeris (Vaginopora) sp. 2**  
(Pl. IV, figs. 3, 4)

This species, represented by specimens Nos. 6, 9 and 10 of slide V. 24921, Eocene, Hauteville (Manche), cannot be referred to any known form. The insufficiency and the poor state of the material unfortunately do not permit us to give it a new name. We must content ourselves with indicating the chief characters which we have particularly noted; the abnormally large diameter of the calcified tube, the surface of which is not regularly cylindrical; the remarkable regularity with which the apertures of the sporangial chambers are quincuncially arranged on the axial cavity; and finally the not less regular form of the rounded pustules in the centre of which these apertures are situated.

**Neomeris (Decaisnella) alternans n. sp.**  
(Pl. III, figs. 13-19)

1860 *Dactylopora eruca* Parker & Jones (*pro parte*).

1862 *Dactylopora annulus* Parker & Jones: Carpenter, pl. x, fig. 10 only.

To avoid confusion we have been compelled to give a new name to the fossil specimens in the Parker Collection which, under the name of *Dactylopora eruca*, Parker and Jones united with certain living forms (from the Indies, etc.). Although belonging to the same group (*Neomeris* Lmx. section *Decaisnella* Mun.-Ch.), the former are, as a matter of fact, different from the latter; moreover, it is perfectly clear from the text of these authors (1860, pp. 473-474) that the actual type of *D. eruca* is the recent form, to which alone the specific name *eruca* should be applied. However, owing to insufficient description based on incomplete material, botanists have abandoned the name, and it now figures only in synonymies, either of *Neomeris kelleri* Cramer (1891, p. 9) or of *N. annulata* Dickie, or of *N. cokeri* Howe (1904, p. 98).

*N. alternans* is represented in the Parker Collection by some thirty specimens (slides V. 24924 and V. 24925) from the Sannoisian of Rauville (Manche). One only is a complete ring (fig. 10) under the name of *Dactylopora annulus* P. & J., a name (Pl. III, fig. 19), and was figured by W. B. Carpenter (1862, pl. x, which, as we have seen above (p. 27), cannot be retained; the rest are only segments (Pl. III, figs. 13-18), which may have been broken from rings originally entire, or may have been derived from sporangial whorls which were normally built up of such segments, as is often the case in the recent *Neomeris (Decaisnella) annulata* Dickie. For convenience of description we shall adopt the former hypothesis.

DIAGNOSTIC DESCRIPTION.—The rings of *N. alternans* are characterised by a central cavity, which is, on the whole, very large in proportion to the thinness of the wall, and by the presence

on both surfaces of strong radial costae which, more marked on one surface than the other, are fairly regularly spaced and alternate with grooves which are wider than these costae. The rings are composed of twenty-four to forty sporangial calcifications, narrow, almost rectangular at their distal ends, united to each other, yet distinguishable owing to the presence of a fine separating furrow. On one surface, which we will call surface *a*, since it is impossible to say whether it is inferior or superior, this furrow divides the costa into two parts, and on the other (surface *b*) is, on the contrary, situated in the middle of the grooves. The sporangial calcifications have thus two dissimilar surfaces; one (*b*) shows in the middle a thick radial swelling, making a well-marked costa, while the other (*a*) is hollowed into a groove, each edge of which, adjoining that of the next groove, forms a less salient costa than on (*b*). Each groove on one surface of the ring thus corresponds with a costa on the other surface and *vice versa*; thus, since the rings fitted together, this arrangement gave greater stability to the alga.

In the plane separating two neighbouring sporangial calcifications are two fine radial canals which were occupied by the sterile secondary branches. On fig. 18, Pl. III, one can see the orifices of these canals as well as the regular whorl of pores leading to the sporangial chambers, one of which is revealed by the breaking of the wall:

**AFFINITIES.**—This is one of the best characterized species of *Decaisnella*. It is distinguished particularly from *Neomeris* (*Decaisnella*) *annulata* Dickie (to which some authors attach the recent specimens of *Dactylopora eruca* P. & J.) by having whorls composed of fewer elements, and sporangial calcifications more strongly costate and grooved on the upper and lower surfaces, as may be clearly seen on comparing the figures on Pl. III where these two species are juxtaposed.

**DIMENSIONS :**

Total diameter of a ring : 0.75 to 1.25 mm.

Diameter of the central cavity : 0.4 to 0.8 mm.

**HORIZON AND LOCALITY.**—Sannoisian (*Corbula* Clay), Rauville (Manche), France.

**MATERIAL.**—Slides **V. 24924** and **V. 24925**. The designation of a holotype is scarcely satisfactory when only one surface of a specimen is visible. No. 14 on slide **V. 24925** (Pl. III, fig. 19) is one of the best specimens.

**Larvaria (Parnesina) encrinula** Defrance  
(Pl. IV, figs. 7-20)

1822 *Larvaria encrinula* Defrance, p. 288.

1830 *Larvaria encrinula* Defr. : Blainville, p. 406.

1917 *Larvaria encrinula* Defr. : Morellet, p. 365, pl. xiv, figs. 2, 3.

The original diagnosis, which was not accompanied by a figure, was extremely brief—"étranglements des anneaux marqués comme les articulations de certaines encrines; trou central très petit"; and it would have been difficult to identify *L. encrinula* had not Prof. Bigot kindly lent us, some time ago, DeFrance's type-specimens, preserved in the Faculty of Sciences at Caen. Although imperfect, these specimens, which are from the Eocene of Hauteville (Manche), enabled us to identify the species in the Eocene of Brittany (Bois-Gouët), and to publish the first figures of it, poor though they were.

The subsequent collection of a few specimens at Hauteville, and the presence in the W. K. Parker Collection of some very good specimens from Hauteville (tubes<sup>1</sup> and isolated rings<sup>2</sup>), prompt us to give a detailed description of *L. encrinula* and to figure it more adequately.

This alga occurs in the form of a cylindrical tube, straight or slightly curved, contracted at the lower end, composed of ribbed rings, superposed and united to each other. By analogy with *L. auversiensis* Morellet we may presume that the boundary between adjoining rings is at the upper edge of the costa, although in this case the boundary is partly arbitrary.

Externally, a little above its base, each ring shows a circular constriction, above which it widens regularly to the upper suture, giving to the whole tube a subimbricate appearance. The portion below the constriction, generally worn smooth, is normally ornamented with an elegant and finely crimped festoon. At the bottom of the constriction is a whorl consisting of an even number of pores (twenty-six to thirty), which are the orifices of the sterile secondary canals; each pore is situated at the origin and in the axis of a longitudinal rib which runs to the upper part of the ring, becoming progressively thicker, and thus accentuating the imbricate appearance just mentioned. The ribs, narrow and compressed in fresh specimens (Pl. IV, fig. 7), are blunted and widened in rolled individuals. To demonstrate the very different appearances which this alga can assume according to its state of preservation, we have figured a series of specimens illustrating the transition from an intact individual (always rare) to one showing the maximum of deterioration (Pl. IV, figs. 9-12).

Internally the axial cavity shows the annulate structure very clearly; one sees a series of circular swellings alternating with deep grooves. At the bottom of each of the latter is a whorl of twenty-six to thirty small pores (internal orifices of the secondary canals); a little above, on the swelling, one can see a second whorl of still smaller pores, in number exactly half of that of the preceding whorl; these are apertures leading to the

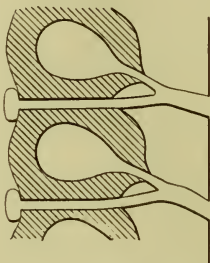
<sup>1</sup> Slide V. 24919, under the name of *Dactylopora reticulata*.

<sup>2</sup> Slides V. 24906-7, under the name of *Dactylopora annulus*.

subspherical sporangial chambers, embedded in the thickness of the wall. This structure is usual in *Larvaria* (and particularly in the section *Parnesina*), where each primary branch gives rise to a sporangium,<sup>1</sup> and to two sterile secondary branches situated in a plane below that of the sporangium, as shown in Text-fig. 7.

The calcification of the principal stem, which may frequently be seen in *Larvaria auversiensis* Morellet, was not preserved in any of the specimens examined.

Associated with the tubes we have just described there are at Hauteville isolated rings certainly belonging to *L. encrinula*. They appear to be derived from the dissociation of the upper part of the alga, where the rings were simply superposed and had not yet formed a continuous tube. They are minute flattened cylinders, centrally perforated and longitudinally channelled by the ribs.



TEXT-FIG. 7. *Larvaria* Deffr. Diagrammatic longitudinal section of the wall.

The lower surface (Pl. IV, figs. 13-15) may be recognized by the presence, bordering the axial cavity, of a whorl of pores (orifices of the sporangial chambers), and by the radial furrows; almost flat, with no swellings corresponding to the sporangial chambers, finely crenulate on the periphery, it has the appearance of a small dentate wheel, and by these characters is clearly distinguishable from the lower surface of *Larvaria limbata* Deffr. (Pl. IV, fig. 21).

The upper surface, with a similarly denticulate margin (Pl. IV, figs. 16-20), has a less developed central cavity owing to the presence of a plate (or floor), which at this level connects the ring with the axial calcification; it is flatter, almost smooth, and has slight radiating undulations at the periphery only, thus differing from *L. limbata*, in which the upper end of the rings is notched by strong radial fluting.

**AFFINITIES.**—The tubes of *L. encrinula* are closely analogous with those of *L. auversiensis*, and still more with those of *L.*

<sup>1</sup> We may draw attention to a curious anomaly which we have observed in a specimen from Hauteville, and which we have never seen in any other *Larvaria*. Several primary branches, belonging to different whorls, give rise not to one but to two sporangia, which are almost joined together.

*davisi* n. sp., which we shall describe shortly, and shall then indicate the distinctive characters of the three species.

As for the isolated *rings*, we have just dealt with the differences between them and those of *L. limbata*; we shall revert to the comparison with those of *L. davisi* when we consider that species (see p. 45).

DIMENSIONS :

Length of the longest tube we have seen : 6 mm.

External diameter of the tube in parts where it is not contracted : 0.5 to 0.9 mm.

Diameter of the axial cavity :

Lower surface of a ring : 0.25 mm.

Upper surface of a ring : 0.1 mm.

Length of a ring : 0.175 to 0.275 mm.

HORIZON AND LOCALITIES.—This species is only known from the Eocene of the Departments of Manche (Hauteville, type locality; ? Fresville, ? Port Bréhay) and of Loire-Inférieure (Bois-Gouët, La Close).

***Cymopolia edwardsi* n. sp.**

(Pl. V, fig. 1)

Although it is only a fragment, specimen No. 3 on slide V. 24910, labelled *Dactylopora cylindracea* Lk. and figured under that name by W. B. Carpenter (1862, pl. x, fig. 24), shows sufficient details for one to recognize it as a *Cymopolia*, differing from any species hitherto described.<sup>1</sup> This new species, which we name after Mr. W. N. Edwards, may be diagnosed as follows :

Segments tubular with finely alveolate cuticle; whorls composed of a relatively small number of branches (18 to 22); branches *all fertile*, noticeably perpendicular to the axis of the segment; primary canal very short, projecting into the axial cavity and dilating abruptly at its entry into the wall into a bulbous portion from which arise four to six secondary canals, and, surrounded by them, a sub-spherical, *non-marginal*, sporangial chamber; dilatations of the primary canals forming a wide circular furrow visible on transverse sections as in *Cymopolia* (*Karrerria*) *zittei* Mun.-Ch.

AFINITIES.—Were it only by the dilation of the primary canals this species could not be confounded either with *C. elongata* (DeFr.) (see Pl. V, fig. 7), or with *C. dollfusi* Morellet, which are found with it in the same bed. In this character, on the other hand, it approaches *C. tibetica* Morellet (1916) from the Maestrichtian (?) of Tibet, but in the latter the number of branches

<sup>1</sup> Since we regard this specimen as belonging to a new species, it is necessary to omit Carpenter's pl. x, fig. 24, from the synonymy which we formerly gave (Morellet, 1913, p. 10) of *Cymopolia elongata* (DeFr.).

in each whorl is only eight to twelve, the primary canal is longer, and finally the sporangial chambers are much smaller.

DIMENSIONS :

Length of fragment : 2 mm.

External diameter of segment : 1.25 mm.

Diameter of axial cavity : 0.7 mm.

Thickness of wall : 0.275 mm.

Diameter of sporangial chamber : 0.15 mm.

Distance between two consecutive whorls : 0.2 mm.

HOLOTYPE.—Specimen 3 on slide V. 24910.

HORIZON AND LOCALITY.—Eocene, Hauteville (Manche, France). Also occurs at Fresville (Manche), see p. 41.

*Cymopolia* sp.

(Pl. V, fig. 5)

Under this heading we group four segments from the Eocene of Hauteville (V. 24912, Nos. 1 to 4), which, although differing in form, have in common their small size and, above all, a much coarser cuticular network than in any *Cymopolia* we know, with the exception of a specimen from the Auversian of England (see p. 47).

We have figured No. 2, which is remarkable for its fusiform appearance.

DIMENSIONS :

Length of a segment : 0.9 to 1.3 mm.

Diameter of a segment : 0.3 to 0.6 mm.

*Acicularia marginata* n. sp.

(Pl. VI, figs. 5-9)

DIAGNOSTIC DESCRIPTION.—This species, to which we refer figs. 28 and 31 of Carpenter's plate xi (1862), belongs to the same group as *Acicularia miocaenica* Reuss (1861; see also Morellet, 1926) from the Neogene and *A. schenkii* (Möb.) of recent seas, and is very close to them. As in these two species, the sporeiferous cavities are surrounded by a small circular lip (see Pl. VI, figs. 2, 3, 7), but here the spicules are flatter, and their distal ends instead of being rounded or rectilinear, are most often clearly emarginate (Pl. VI, figs. 5, 6).

We consider that the arrangement of the spicules in the fertile disc was the same as in the two species mentioned above, and that they were arranged like the leaves of a book, the flat surfaces against each other and the edges turned towards the upper and lower walls of the umbel (Pl. VI, fig. 4).

We may note that the fossil species which are nearest to the living one are found in the relatively more recent formations—Oligocene and Miocene.



As far as can be judged from mere fragments, the maximum length of the spicules was about 5 mm. and their number in each umbel about fifty-five.

MATERIAL.—Slide **V. 24926**, Nos. 3, 4, 7-11, 13, 14, 17-21, 26, 27, and slide **V. 24927**, Nos. 1-7, 9-15, 18-23, 25, 27, 29-32. The choice of a holotype is almost impossible, since no one specimen shows all the characters of the species. For the general form the best specimen is No. 14 on slide V. 24927, but in this the pores are poorly preserved, and are best seen in some of the small fragments, such as V. 24927, No. 15.

HORIZON AND LOCALITY.—Sannoisian (*Corbula* Clay) ; Rauville (Manche, France).

**Acicularia** sp. 1  
(Pl. VI, fig. 10)

This species is represented by a single specimen from the Eocene of Hauteville (**V. 24918**, No. 20), characterized by its flask-shaped form, elongated and elliptical in section, by its rounded margin, and by its regularly and longitudinally aligned sporiferous cavities. It appears to belong to the same group as *Acicularia clavata* Morellet from the Montian of Mons (Belgium), which is distinguished by its club-shaped form, circular in section, and its much larger size.

DIMENSIONS.—Length of spicule : 1.6 mm.

? **Acicularia** sp. 2  
(Pl. VI, fig. 11)

If the figured specimen is actually an *Acicularia*, of which we are not certain, it belongs to a species very different from all those so far described. The particularly small umbel consists of only a dozen sporangia, of which the flattened, *cuneiform* calcareous massula is most unusual from the large number and small size of the sporiferous cavities, arranged in regular lines.

DIMENSIONS :

Length of massula : 0.5 to 0.6 mm.

Width of massula at its distal end : 0.4 mm.

MATERIAL.—**V. 24926**, No. 1, and **V. 24927**, No. 8.

HORIZON AND LOCALITY.—Sannoisian (*Corbula* Clay), Rauville (Manche, France).

**Acicularia (Briardina)** sp. 1  
(Pl. VI, fig. 17)

In this specimen, composed of two sporangia still joined together, the marginal end is unfortunately not intact. But for the lack of this important character we might have created a new species for it. It may be distinguished from the species of *Briardina* of the same group (*B. munieri* Morellet, *B. heberti*

Mun.-Ch.) by the extreme thinness of the intersporangial septum, by the slight swelling of the upper and lower surfaces of the sporangia, and finally by the large number of sporiferous cavities, somewhat irregularly arranged.

This specimen appears to have been figured in Carpenter (1862, pl. xi, fig. 29). We have met with some comparable specimens, but similarly damaged, in the Lutetian of the Paris Basin.

DIMENSIONS :

Length of a spicule : 7 mm.

Width of a spicule at its distal end : 0.5 mm.

MATERIAL.—V. 24917, No. 14.

HORIZON AND LOCALITY.—Eocene, Hauteville (Manche, France).

*Acicularia (Briardina)* sp. 2

(Pl. VI, figs. 22-24)

The spicules of this *Briardina*, represented by several fragments, are characterized by the slight swelling of their lower and upper surfaces, by the rounded form of their distal ends, and above all by the fluting which can be seen on their edges and which runs right round the sporangium. This fluting very probably represents the position of the intersporangial septum which projected into the massula, but of which no trace remains in the specimens.

DIMENSIONS :

Length of a spicule : about 1 mm.

Width of a spicule at its distal end : 0.35 mm.

MATERIAL.—V. 24917, No. 2, and V. 24918, Nos. 24-27.

HORIZON AND LOCALITY.—Eocene, Hauteville (Manche, France).

*Acicularia (Briardina)* cf. *archiaci* Munier-Chalmas

(Pl. VI, figs. 19-21)

1922 *Acicularia archiaci* Mun.-Ch. : Morellet, p. 26, fig. 6 ; pl. ii, figs. 35, 36.

From the thinness of their intersporangial septa and from their general appearance these specimens belong to the group of *Acicularia archiaci* Mun.-Ch. They are, however, distinguished from this species in having the upper and lower surfaces of the sporangia slightly protuberant instead of flat or even hollowed. The number of sporangial cavities is also less ; these, irregularly arranged near the axial part of the sporangium (Pl. VI, fig. 21), subsequently form, as in *A. archiaci*, well-arranged lines, which however in this case only seem to number two on each surface (Pl. VI, fig. 19). The marginal end of the spicules seems to be rectangular.

## DIMENSIONS :

Length of a spicule : 2 to 3 mm.

Width of a spicule at its distal end : 0.15 to 0.2 mm.

Number of sporangia per umbel : 120 to 140.

MATERIAL.—Slide V. 24926, No. 15, and V. 24927, Nos. 16, 17. Slide V. 24926, No. 15, was figured by Carpenter (1862, pl. xi, fig. 30).

HORIZON AND LOCALITY.—Sannoisian (*Corbula* Clay), Rauville (Manche, France).

\* \* \*

As a result of this study we are in a position to add the following forms to the Dasycladaceae which we have already recorded from the Eocene of Hauteville and the Sannoisian (*Corbula* Clay) of Rauville (Morellet, 1917):

## EOCENE OF HAUTEVILLE

*Neomeris* (*Vaginopora*) sp. (at least two species).

*Cymopolia edwardsi* n. sp.

*Cymopolia* sp.

*Acicularia* sp.

*Acicularia* (*Briardina*) *munieri* Morellet.

*Acicularia* (*Briardina*) sp. (two species).

## SANNOISIAN OF RAUVILLE

*Neomeris* (*Decaisnella*) *alternans* n. sp.

*Acicularia marginata* n. sp.

? *Acicularia* sp.

*Acicularia* (*Briardina*) cf. *archiaci* Mun.-Ch.

The forms from Hauteville scarcely serve to decide the disputed age (Lutetian or Auversian?) of the beds which yielded them, though on the whole their affinities are rather with the Lutetian.

As for the forms from Rauville, they present clear analogies, as might be expected, with Stampian and Miocene species.

### 3. CRITICAL EXAMINATION OF THE FIGURES IN W. B. CARPENTER'S MEMOIR, "INTRODUCTION TO THE STUDY OF THE FORAMINIFERA"

As we noted at the beginning of this work, Carpenter (1862) figured part of W. K. Parker's material; we believe therefore that it would be of interest to correct his determinations, and to indicate as far as possible which of Carpenter's figures agree with specimens in the W. K. Parker Collection.

## PLATE X

Figs. 1 to 8 ("*Dactylopora eruca*") actually represent fragments of rings of *Neomeris*, section *Decaisnella*. According to the legend, two of them (figs. 4 and 8) were fossil. It may be doubted whether this is true for fig. 4, which does not agree with any of the fossil specimens in the W. K. Parker Collection; on the other hand, fig. 8 represents specimen No. 16 of slide V. 24925 from the Sannoisian of Rauville. It is surface *a* of *Neomeris* (*Decaisnella*) *alternans* nob., here photographed on Pl. III, fig. 15.

Figs. 9 to 14 ("*Dactylopora annulus*") belong to several species. Fig. 9 (two united rings) appears to be a *Larvaria*, but is too imperfect to admit even of a generic determination. Fig. 10 is a complete ring, seen on surface *a*, of *Neomeris* (*Decaisnella*) *alternans* nob., and represents specimen 14 on slide V. 24925 (Sannoisian, Rauville), which we have figured on Pl. III, fig. 19. Figs. 11, 13 and 14 are rings of *Larvaria limbata* Defr. (figs. 11 and 14—lower surface; fig. 13—upper surface, diagrammatic), probably from the Lutetian of Grignon. Finally, fig. 12 perhaps also belongs to the same species, but is not determinable with certainty.

Fig. 15 ("*Dactylopora clypeina*") represents specimen 2 and fig. 16 ("*Dactylopora digitata*"), specimen 3 of slide V. 24920 (Eocene, Hauteville); both belong to one and the same species, *Clypeina pezanti* Morellet, and are here figured on Pl. VI, figs. 25, 26.

Figs. 17, 18 and 19 ("*Dactylopora reticulata*") are *Larvaria encrinula* Defr., from the Eocene of Hauteville. Figs. 17A and 17B, which represent worn specimens, seem to have been drawn from No. 8 of slide V. 24919, and fig. 18 from No. 10 of the same slide, but one of the five rings has been suppressed (see our figs. 8 and 7, Pl. IV), and the drawing is, moreover, very imperfect. Fig. 19 is of the end of the same specimen, and gives a good idea of the upper surface of a ring (see our figs. 16 to 20, Pl. IV).

Fig. 20 ("*Dactylopora cylindracea*") is a segment of *Cymopolia elongata* (Defr.); fig. 20A represents, much enlarged, part of the cuticle of the same specimen, and fig. 20B a poor transverse section of a wall.

Fig. 21 ("variety of *Dactylopora reticulata*") is no doubt specimen 14 on slide V. 24912 (Eocene, Hauteville), which has nothing in common with *D. reticulata* and is probably a rolled *Neomeris*.

Fig. 22 ("*Dactylopora cylindracea*" etched with acid) actually represents *Cymopolia elongata* (Defr.), and doubtless comes from the Eocene of Hauteville.

Fig. 23 ("the most complex type of *Dactylopora cylindracea*")

agrees with specimen 4 of slide V. 24910 (Eocene, Hauteville) ; it is perhaps a worn *Cymopolia*.

Fig. 24 ("*Dactylopora cylindracea*") is a partial representation of specimen No. 3 of the same slide, and is of a *Cymopolia* belonging to a new species : *C. edwardsi* nob. (see our fig. 1, Pl. V).

Figs. 25 to 28 ("*Dactylopora glandulosa*") are drawn from the specimens on slide V. 24921 (Eocene, Hauteville), and are referable to *Neomeris* (*Vaginopora*), belonging to at least two species. Fig. 25 was no doubt inspired by specimen No. 7 ; fig. 26 represents either No. 6, 9 or 10, and figs. 27 and 28 the two surfaces of specimen No. 5.

Fig. 29 ("*Dactylopora cylindracea*") is a diagram of the normal structure of *Cymopolia elongata* (Defr.).

Fig. 30 ("*Dactylopora cylindracea*", of which the internal surface has been treated with acid) is a fragment of *Cymopolia elongata* (Defr.).

#### PLATE XI

Fig. 27 is an *Acicularia* of the group of *A. pavantina* d'Arch.

Fig. 28 is a spicule of *Acicularia marginata* nob., represented on our Pl. VI, fig. 5, and agrees with specimen 14 on slide V. 24927 (Sannoisian, Rauville).

Fig. 29 is an *Acicularia* (*Briardina*) sp., which probably represents specimen 14 on slide V. 24917 (Eocene, Hauteville), figured by us on Pl. VI, fig. 17.

Fig. 30 (specimen No. 15 on slide V. 24926, Sannoisian, Rauville) is a fragment of the disc of *Acicularia* (*Briardina*) cf. *archiaci* Mun.-Ch., of which a photograph will be found on Pl. VI, fig. 21.

Fig. 31 is the axial extremity of a spicule of *Acicularia marginata* nob. (specimen No. 20 on slide V. 24927, Sannoisian, Rauville), here reproduced on Pl. VI, fig. 8.

Fig. 32 does not in the least suggest an *Acicularia* ; nevertheless it may be an exceedingly poor drawing of specimen 15 on slide V. 24927 (Sannoisian, Rauville) which is a fragment of a spicule of *Acicularia marginata* nob. (see our Pl. VI, fig. 9).<sup>1</sup>

#### PLATE XII

Fig. 9 is *Ovulites margaritula* Lk., and not *O. margaritifera* as the legend wrongly has it.

Fig. 10 ("*Ovulites elongata*") is actually *Ovulites oehlerti* Mun.-Ch.

<sup>1</sup> Solms-Laubach (1887, 1895) gave to Carpenter's figs. 27 to 32, on pl. xi, an interpretation which is partly incorrect. Thus he thought he recognized in figs. 28 and 30 representatives of the genus *Orioporella* Mun.-Ch., while in point of fact the former represents an *Acicularia* and the latter a *Briardina*, as we have been able to ascertain from the specimens themselves.

#### IV. SOME EOCENE SIPHONEAE IN THE BRITISH MUSEUM

For the sake of completeness we include here a brief list of a few additional slides, derived from various sources, of French Eocene Siphoneae in the Geological Department of the British Museum.

- V. 21322.** *Ovulites margaritula* Lk.  
Three specimens. Calcaire grossier (Lutetian); Mouchy (Oise). The middle specimen is remarkable for its large size (length 4 mm., breadth 3.5 mm.), above the average but within the dimensions given by Munier-Chalmas. *M. Cossmann Coll.*, 1888.
- V. 21323.** *Ovulites margaritula* Lk.  
Three specimens. Eocene (Lutetian); Mouchy (Oise). *M. Cossmann Coll.*, 1888.
- V. 21324** (3 specimens), **V. 21325** (5 specimens) and **V. 21326** (5 specimens).  
*Ovulites margaritula* Lk.  
Eocene (Lutetian); Damery (Marne). These three slides were referred to by Jones (1882, p. 38) under the old registered number P. 920 as "*Ovulites margaritacca*". *T. R. Jones Coll.*, 1881.
- V. 21328.** *Ovulites margaritula* Lk.  
Thirty-two specimens. Eocene (Lutetian); Parnes (Oise). Two of the specimens show two openings at one end. ("*O. margaritacca*" in Jones, 1882, p. 36, under P. 938.) *T. R. Jones Coll.*, 1881.
- V. 25991.** Two specimens. Eocene (Lutetian); Chaussy (Seine-et-Oise). (*Ovulites* in Jones, 1882, p. 38, under P. 1156.) *T. R. Jones Coll.*, 1881.
- V. 25992.** *Ovulites elongatus* Lk.  
One specimen. Eocene (Lutetian); Chaussy (Seine-et-Oise). (*Ovulites* in Jones, 1882, p. 38, under P. 1156.) *T. R. Jones Coll.*, 1881.
- V. 25993.** Eocene (Lutetian); Grignon (Seine-et-Oise).  
Six specimens, all of which are *Ovulites margaritula* Lk., except No. 4, which is probably a Foraminifer (? *Lagena*). *S. V. Wood Coll.*, 1884.
- V. 2552a.** *Ovulites margaritula* Lk.  
Twelve specimens. Eocene (Lutetian), Grignon (Seine-et-Oise). A few of the specimens are elongated and others very small, demonstrating the variability of form of the segments according to their position in the branch. *H. B. Holl Coll.*, 1887.
- V. 2552b.** Eocene (Lutetian), Grignon (Seine-et-Oise).  
The slide has three rows of specimens. The first (six specimens) is of little rounded bodies which are not *O. margaritula*, and of which we do not know the true nature, though we have been acquainted with them for a long time. They are perhaps *Ovulites globulosa* Defr. The other two rows (14 and 4 specimens) are *Ovulites margaritula*, mostly small and elongated. *H. B. Holl Coll.*, 1887.

- V. 25309. *Cymopolia elongata* (Defr.).  
One specimen. Calcaire grossier (Lutetian), Fercourt-Cauvigny (Oise). T. R. Jones Coll., 1881.
- V. 25310. *Larvaria* sp.  
Two specimens. Calcaire grossier (Lutetian), Paris Basin (? Damery, Marne). *Larvaria*, somewhat worn, of the group of *L. filiformis* Morellet. T. R. Jones Coll., 1881.
- V. 25994. Eocene, Fresville (Manche).  
Fifteen specimens.
- |   |   |   |    |    |    |    |    |  |  |  |  |  |
|---|---|---|----|----|----|----|----|--|--|--|--|--|
|   |   |   | I  | 2  | 3  |    |    |  |  |  |  |  |
| 4 | 5 | 6 | 7  | 8  | 9  | 10 | 11 |  |  |  |  |  |
|   |   |   | 12 | 13 | 14 | 15 |    |  |  |  |  |  |
- Nos. 1 to 3 are *Clypeina pezanti* Morellet, identical with specimens on slide V. 24920; Nos. 4, 5, 8, 9, 13 and 14 belong to *Cymopolia elongata* (Defr.); Nos. 6 and 7 to *Cymopolia dollfusi* Morellet, and No. 10 to *Cymopolia edwardsi*, a new species just described on p. 33; Nos. 12 and 15 are indeterminable fragments of *Cymopolia*, and No. 11 is most probably not an Alga. T. R. Jones Coll., 1881.
- V. 25995. Eocene (Lutetian), Chaussy (Seine-et-Oise).  
Eleven specimens, all belonging to the genus *Larvaria*.  
Nos. 5 and 8 and very probably No. 3 are *L. limbata* Defr.; No. 7 a fragment of tube of *L. filiformis* Morellet. Nos. 1 and 11 seem to be a distinct species, to which we shall revert when we study slide V. 25996. As for the other five specimens, they are so badly preserved that we dare not give them a specific name; nevertheless we should be inclined to refer No. 9 to *L. limbata*, and Nos. 2, 4, 6 and 10 to *L. filiformis*. T. R. Jones Coll., 1881.
- V. 25996. Eocene (Lutetian), Chaussy (Seine-et-Oise).  
Two specimens.  
The one on the left (No. 1) is a fragment of a tube of *Larvaria filiformis* Morellet; the other (No. 2) seems to be a ring of the same species as Nos. 1 and 11 of slide V. 25995 and Nos. 1 and 6 of slide V. 25998. All these rings are characterised by the small number (10-13) of their sporangial calcifications, and by the presence, in the middle of these, of a radial and obsoletely angular rib, which on some specimens (e. g. V. 25996, No. 2) gives to the outline a many-horned appearance, while on others (V. 25995, No. 11) this line is merely roundly festooned. T. R. Jones Coll., 1881.
- V. 25997. *Larvaria filiformis* Morellet.  
One fragment of tube, Eocene (Lutetian), Chaussy (Seine-et-Oise). T. R. Jones Coll., 1881.
- V. 25998. Eocene (Lutetian), Chaussy (Seine-et-Oise).  
Seven specimens, of which Nos. 1 and 6 are the same species of *Larvaria* as Nos. 1 and 11 of slide V. 25995 and No. 2 of slide V. 25996; No. 2 and possibly No. 3 are *Larvaria limbata* Defr.; Nos. 4 and 5 are probably *Larvaria filiformis* Morellet, and No. 7 is doubtful. T. R. Jones Coll., 1881.
- V. 25999. *Cymopolia elongata* (Defr.).  
One segment, Eocene (Lutetian), Grignon (Seine-et-Oise). S. F. Wood Coll., 1884.
- V. 26000. *Larvaria limbata* Defr.  
One ring seen on its upper surface, Eocene (Lutetian), Grignon (Seine-et-Oise). S. F. Wood Coll., 1884.

The following specimens (V. 25752-61) were all presented by L. and J. Morellet, 1937-8:

- V. 25752. *Maupasia parisiensis* Mun.-Ch.  
One specimen. Eocene (Lutetian); Ferme de l'Orme (Seine-et-Oise).
- V. 25753. *Zittelina elegans* Mun.-Ch.  
One specimen. Eocene (Lutetian); Ferme de l'Orme (Seine-et-Oise).
- V. 25754. *Cymopolia elongata* (Defr.).  
Six specimens. Eocene (Lutetian); Chambors (Oise).
- V. 25755. *Cymopolia elongata* (Defr.).  
Six specimens. Eocene (Lutetian or Auversian); Hauteville (Manche).
- V. 25756. *Larvaria fragilis* Defr.  
Eighteen specimens. Eocene (Thanetian); Boncourt, near Noailles (Oise).
- V. 25757. *Larvaria auversiensis* Morellet.  
Ten specimens. Eocene (Auversian); Mériel (Seine-et-Oise).
- V. 25758. *Neomeris (Vaginopora) scrobiculata* (Gümb.).  
Twenty specimens. Eocene (Cuisian); Cuise (Oise).
- V. 25759. *Neomeris (Vaginopora) herouvalensis* Mun.-Ch.  
Ten specimens. Eocene (Cuisian); Hérouval (Oise).
- V. 25760. *Dactylopora cylindracea* Lk.  
Six specimens. Eocene (Auversian); Le Fayel (Oise).
- V. 25761. *Uteria encrinella* Mich.  
One hundred specimens. Eocene (Cuisian); Hérouval (Oise).



## V. CALCAREOUS SIPHONEAE FROM THE EOCENE OF ENGLAND

So far as we know, no calcareous Siphoneae have yet been recorded from the Eocene of England, with the exception of *Ovulites*, to which we shall return in a moment. The British Museum, however, possesses several specimens collected by Mr. A. G. Davis; it is these which we propose to study here, together with some which we have ourselves obtained from material kindly placed at our disposal by Mr. A. G. Davis. All are from the Upper Bracklesham Beds (Auversian<sup>1</sup>), and, more exactly, from Bed Fisher XVII, where these algae, very rare at White Cliff Bay (Isle of Wight), are, on the other hand, not uncommon in the bed at Medmerry Farm, Selsey, Sussex. Other horizons have proved unproductive: Lutetian of White Cliff Bay (Isle of Wight) and of Southampton Docks; Auversian of Bramshaw and Lee-on-Solent; Bartonian of Barton (Hants); Long Mead End sands; Middle Headon beds, and so on. This is somewhat surprising, especially for the Lutetian, of which the molluscan and bryozoan fauna, so well studied by Mr. A. Wrigley (1934) and by Mr. A. G. Davis (1934), indicates a biological facies very similar to that of the Paris Basin, where calcareous Siphoneous algae are abundant.

### *Ovulites margaritula* Lk.

The presence of *Ovulites margaritula* Lk. has been recorded by Mr. A. Wrigley (1931) in the Blackheath Beds (Landenian) of Abbey Wood (Kent), from specimens collected by Mr. F. J. Epps and preserved in the British Museum (V. 21327). This determination is, however, incorrect. Although the ovoid,

<sup>1</sup> There is a divergence of opinion between English and French geologists on the subject of the stratigraphical nomenclature to be used for the sediments above the Lutetian (Lower Bracklesham Beds). While the former call the Upper Bracklesham Beds (with *Nummulites variolarius*) "Auversian", and the Barton Beds "Bartonian", the latter usually apply "Bartonian" to the whole series of beds with *N. variolarius* which, in the Paris Basin, overlie the Lutetian (R. Abrard, Morellet and others). In order to facilitate the comparison of the age of the English and French beds, we shall here apply the term "Auversian", as moreover Boussac does, to the lower part of the sands with *N. variolarius* of the Paris Basin, up to and including the horizon of *Avicula defrancei* (horizon of Mortefontaine).

hollow bodies from Abbey Wood are somewhat analogous to *Ovulites*, they are really very different in that they have an opening at one end only and their test is imperforate. We do not even consider that they are algae; nevertheless, we have figured them on Pl. III, figs. 3-6, in order to draw attention to them, and in the hope that some reader may be able to recognize their true nature.

*O. margaritula* does, however, exist in the English Eocene. Munier-Chalmas (1879, p. 669) recorded it, but without stating either the exact age or the locality,<sup>1</sup> and we ourselves have found one segment in the Auversian of Medmerry Farm (Bed Fisher XVII) which, being entirely typical, does not merit any special description. In the Paris Basin, moreover, this species occurs at the same stratigraphical horizon (Auversian of Auvers, Beauchamp, Caumont, Bézu-le-Guéry, and so on), but there it is always rare, while in the Lutetian, on the contrary, it is very abundant.

#### ***Neomeris (Vaginopora)* sp.**

(Pl. IV, figs. 5, 6)

From the Auversian of Medmerry Farm (Bed Fisher XVII) we know of three fragments of tube and an internal cast of a *Neomeris*, section *Vaginopora*. One of the fragments and the internal cast are preserved in the British Museum (V. 24874 and V. 24878); the two other fragments are from our own sorting.

These four specimens, of unquestionable generic determination, belong to the same species, which appears to be new, but they are too incomplete and too poorly preserved to be given a specific name. They approach *Neomeris (Vaginopora) fragilis* (Defr.) in having the cuticle closely united with the test, but the latter is here more strongly calcified, and each mesh of its network is occupied by a deep and regularly rounded cup (Pl. IV, fig. 6)—a character which is not seen in any other species. On the internal surface of the tube (Pl. IV, fig. 5) the arrangement of the pores is of the usual type in *Vaginopora*, but since all relief has been worn down, one of the chief specific characters has disappeared: the form of the projections which the sporangial calcifications normally make in the interior of the axial cavity.

#### ***Neomeris (Decaisnella) oligospora* n. sp.**

(Pl. III, fig. 20)

We have no hesitation in creating this species for a minute and unique ring which we have found in the Auversian of Medmerry Farm, and which is differentiated by clearly marked

<sup>1</sup> In an endeavour to decide this point we have searched in vain among the English specimens in the Munier-Chalmas Collection (Geological Laboratory of the Sorbonne).

characters from all species of *Decaisnella*, described or undescribed, with which we are acquainted.

The diameter of the central cavity is small, and scarcely exceeds a third of the total diameter; the two surfaces are much alike and slightly convex; each shows fifteen strong radiating ribs, bifurcating at the marginal end, separated by large grooves which widen from the interior outwards and may be twice the width of the ribs. Grooves on one surface correspond with ribs on the other. The sporangial calcifications, fifteen in number, are intimately fused together; each ends in a small gullet, which juts into the axial cavity and is perforated terminally by a very fine pore (the orifice of the sporangial chamber). Finally there is, on each face of the ring, bordering the central cavity and between two neighbouring ribs, a pore through which passed a sterile secondary branch, which does not seem here to have been enclosed in a continuous canal.

AFFINITIES.—*N. oligospora*, which from the strength and regularity of its ribs approaches *N. alternans* n. sp., is distinguished from the latter and also from *N. annulata* Dickie and *N. pseudo-eruca* Mun.-Ch. by its much smaller size, by the slight diameter of its central cavity and by the small number of its sporangial calcifications.

DIMENSIONS :

Total diameter of ring : 0.65 mm.

Thickness of wall : 0.2 mm.

Diameter of central cavity : 0.25 mm.

HORIZON AND LOCALITY.—Auversian of Medmerry Farm, Selsey (Bed Fisher XVII); a single ring (Morellet Coll.).

**Larvaria (Parnesina) davisii** n. sp.

(Pl. V, figs. 10-22)

DIAGNOSTIC DESCRIPTION.—This species, which we have much pleasure in dedicating to Mr. A. G. Davis, to whom we are indebted for its discovery, is intermediate between *L. encrinula* Deufr. and *L. auversiensis* Morellet. It has their general appearance (Pl. V, figs. 10-13) and the same internal structure (Pl. V, figs. 14, 15), which makes it unnecessary for us to give a detailed description similar to that which we have just given of *L. encrinula* (see p. 30). We shall therefore merely indicate the characters by which it can be distinguished from these two species. Firstly, it is much slenderer; the tube is not regularly cylindrical as in *L. auversiensis*, but has a sub-imbricate appearance, though less so than in *L. encrinula*; the ribs are narrower and more prominent than in the former and yet less compressed than in the latter; the external pores of the sterile secondary branches are, as in the form from Auvers, surrounded by a sort of aureole which is lacking in the Hauteville species; finally, in *L. davisii*, as in *L. auversiensis*, there is neither the interval which can be seen

in *L. encrinula* between the upper extremity of the ribs and the whorl of pores in the superposed ring, nor the circular constriction at the base of the ring.

We have ascertained the existence of plates which would connect the rings with the axial calcification, but the latter was not preserved in any of the specimens.

Associated with these tubes one finds isolated rings which for the most part are certainly derived from the break-up of tubes of *L. davisii*. Their lower surface (Pl. V, figs. 17, 18) is very similar to that of the rings of *L. encrinula* (Pl. IV, figs. 13-15), but their upper surface (Pl. V, figs. 19-22), instead of being almost smooth as in that species (Pl. IV, figs. 16-20), is strongly channelled radially, as in *Larvaria filiformis* Morellet. We have some doubt only concerning a few specimens in which the lower surface is protuberant and the individual sporangial calcifications are vaguely discernible (Pl. V, fig. 23) two characters which are found in *L. limbata*. Generally speaking, moreover, isolated rings in *Neomeris* as well as in *Larvaria* are difficult of interpretation and determination.

#### DIMENSIONS :

Length of the largest known tube : 3.5 mm.

External diameter of tube in the non-contracted part :  
0.3-0.6 mm.

Mean diameter of axial cavity : 0.2 mm.

Height of ring : 0.175-0.2 mm.

HOLOTYPE.—V. 24873, No. 1 (Pl. V, fig. 13).

HORIZON AND LOCALITY.—*L. davisii* is abundant in the Auversian of Medmerry Farm (Bed Fisher XVII); the British Museum has several specimens collected by Mr. A. G. Davis (V. 24856, Nos. 2-5, and V. 24873, Nos. 1-5), from among which we have chosen the type (Pl. V, fig. 13), and we ourselves have isolated more than a hundred. It occurs at the same horizon at White Cliff Bay (Isle of Wight); there is a single individual, which is, however, rolled, in the British Museum (V. 24857; Pl. V, fig. 16).

#### *Cymopolia elongata* (Defr.)

(Pl. V, figs. 2-4)

The British Museum has, from the Auversian of Medmerry Farm (Bed Fisher XVII), an internal cast of a segment of *Cymopolia* (V. 24877), and we should have contented ourselves with merely recording the presence of the genus in the English Auversian had we not, in sorting material from the same bed, had the good fortune to find several fragments of test, poor on the whole, but nevertheless sufficient to indicate *Cymopolia elongata* with certainty.

This species, the type of which is from the Lutetian (Grignon

Seine-et-Oise, France), is also known from the Auversian of the Paris Basin (Auvers, Le Fayel, Mortefontaine, etc.).

**Cymopolia** sp.  
(Pl. V, fig. 6)

Also from the Auversian of Medmerry Farm (Bed Fisher XVII) we have a minute segment (length 0.7 mm., width 0.3 mm.) which might belong to a new species. It is noteworthy from its unusually small dimensions, its ovoid rather than cylindrical form, and its relatively coarse cuticular network, and recalls segments from the Eocene of Hauteville which we have separated from *Cymopolia elongata* under the heading of *Cymopolia* sp. (see above, p. 34). As in the case of the Hauteville specimens, we are ignorant of the internal structure of the unique specimen from Medmerry Farm.

**Acicularia** sp.  
(Pl. VI, figs. 12-14)

We are able to record the presence in the Auversian of Medmerry Farm (Bed Fisher XVII) of somewhat numerous fragments of an *Acicularia* (*sensu stricto*), belonging to the group of *A. pavantina* d'Arch. Its spicules are tapered and small (length 1.25 mm.), but the marginal extremity is not preserved in one of them, which renders specific determination quite impossible. Two of the fragments show two sporangia still united (Pl. VI, figs. 12 and 13; Morellet Coll.).

**Acicularia (Briardina) gracilis** n. sp.  
(Pl. VI, fig. 15)

Although it is only a fragment of an umbel, comprising only two sporangia, specimen **V. 24876** in the British Museum (Auversian; Bed Fisher XVII; Medmerry Farm) is sufficiently well characterised to justify the creation of a new species.

DIAGNOSIS.—The sporangia are slender, regularly rounded at their marginal end, and show on each face of the disc two rows of rounded sporiferous cavities, between which, towards the periphery, a third is intercalated. Projecting and clearly bipartite, the intersporangial septum widens in its distal part and juts slightly over the free edge of the two sporangia, which it separates.

AFFINITIES.—*A. gracilis* belongs to the same group as *A. heberti* Mun.-Ch. and *A. munieri* Morellet (Pl. VI, fig. 16) from the Lutetian of the Paris Basin; it is particularly distinguished from these two species by its smaller size, by the form of its sporangia (the ends of which are almost rectangular in *A. heberti* and plainly ogival in *A. munieri*), and by the marginal dilatations of the intersporangial septa (which are stronger than

in *A. heberti*, but are much less striking and dilate less sharply than in *A. munieri*).

**DIMENSIONS.**—The fragment is only 1 mm. long ; the restored umbel would be about 4.5 mm. in diameter, and would be composed of 50 to 60 sporangia.

*Acicularia gracilis* is not the only species of *Briardina* which we know from the Auversian of Medmerry Farm ; there is at least one other, of which unfortunately we have found only very imperfect debris, such as that figured as a record on Pl. VI, fig. 18.

### **Clypeina cf. pezanti L. & J. Morellet.**

We have found in the Auversian of Medmerry Farm (Bed Fisher XVII) two complete fertile whorls and a fragment of a *Clypeina* very close to *C. pezanti* (see p. 27), but their defective condition makes us hesitate to refer them unreservedly to this species. Our specimens being unfortunately difficult to photograph, we can only describe their characteristics.

*Specimen No. 1.*—Somewhat more spread out and less basket-shaped than the typical form ; sixteen sporangia per whorl ; diameter of the axial cavity at the base of the umbel, 0.6 mm. ; diameter of the restored umbel, about 1 mm.

*Specimen No. 2.*—Practically identical with the typical form ; seventeen sporangia per whorl, diameter of the axial cavity at the base of the umbel, 0.6 mm. ; diameter of the restored umbel, about 1 mm.

*Clypeina pezanti*, the type of which is Lutetian (Parnes, France), occurs in the Auversian of the Paris Basin (Le Fayel, Caumont, Lévignen, etc.).

\* \* \*

The list of calcareous Siphoneous Algae from the English Eocene comprises at present only the species which we have just described, namely :

- \**Ovulites margaritula* Lk.
- Neomeris (Vaginopora)* sp.
- Neomeris (Decaisnella) oligospora* n. sp.
- Larvaria (Parnesina) davisi* n. sp.
- \**Cymopolia elongata* (Defr.).
- Cymopolia* sp.
- Acicularia* sp.
- Acicularia (Briardina) gracilis* n. sp.
- Acicularia (Briardina)* sp.
- \**Clypeina* cf. *pezanti* Morellet.

All these forms, not one of which, *O. margaritula* excepted, had previously been recorded from England, come from one and the same bed of the Auversian (Bed Fisher XVII). Three of

them, or at least three very near species (those marked with an asterisk), are known in the Lutetian and Auversian of the Paris Basin, as well as in the Eocene of the Cotentin. The remainder are either new or specifically indeterminable. Contrary to what we had hoped, the study of the English algae throws no light on the age of the Cotentin deposits, which, as we have already mentioned in dealing with the W. K. Parker Collection, are referred by different authors to the Lutetian (Abrard, 1925) or to the Auversian (Boussac, 1907).

\* \* \*

In conclusion, it remains for us to address our very sincere thanks to the Trustees of the British Museum, who have sanctioned the publication of this work ; to the Keeper of the Geological Department, Mr. W. N. Edwards, for the loan of material, for facilitating our studies, and for translating the manuscript ; and finally to Mr. Arthur G. Davis for very kindly placing at our disposal important material from the Eocene of England.

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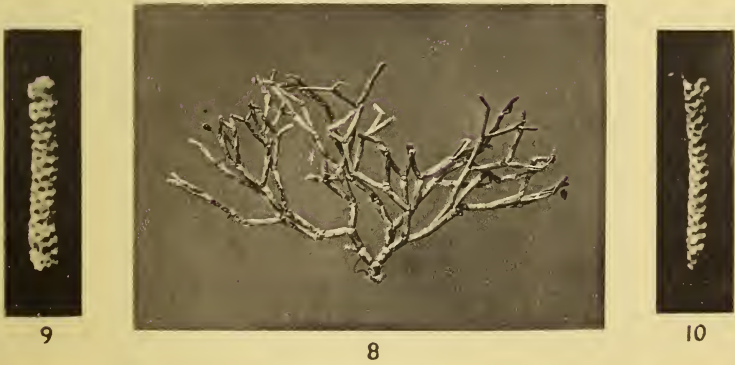
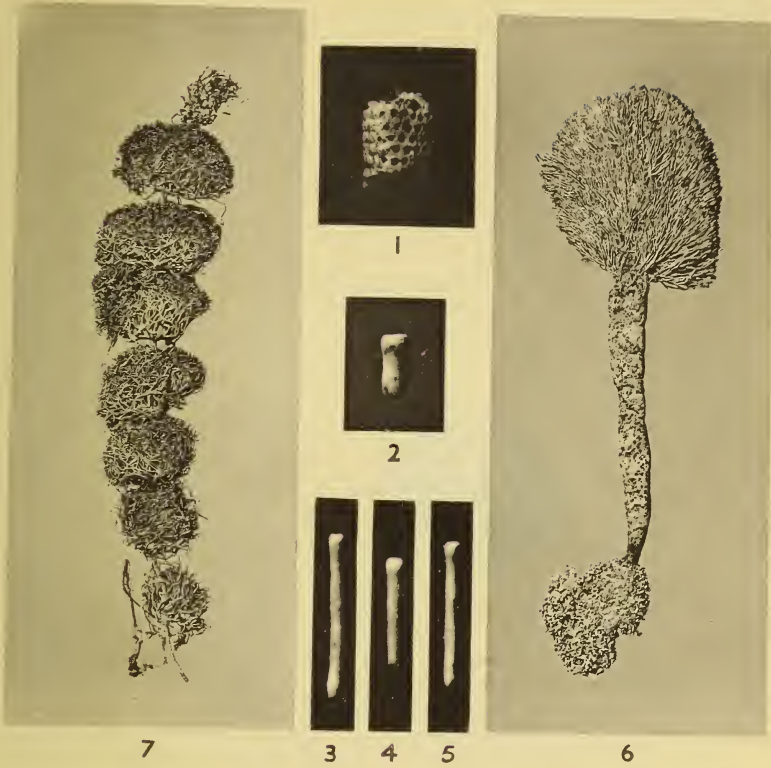
## EXPLANATION OF PLATES

[Unless otherwise stated all the specimens are in the British Museum (Nat. Hist.), Department of Geology.]

PLATE I

- Fig. 1. *Neomeris (Vaginopora)* sp.,  $\times 15$ . Miocene: San Domingo. CXI-22, specimen No. 1.
- Fig. 2. *Ovulites oehlerti* Mun.-Ch.,  $\times 15$ . Eocene: Hauteville (Morellet Coll.).
- Figs. 3-5. *Ovulites elongatus* Lk.,  $\times 15$ . Lutetian: Grignon (Morellet Coll.).
- Fig. 6. *Penicillus capitatus* Lk. General appearance, natural size. Recent: Guanica, West Indies, on the beach. (Morellet Coll.)
- Figs. 7, 8. *Tydemania expeditionis* Weber v. B. Recent: Fau Island, East Indies, in the lagoon.
7. General appearance, natural size.
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- Figs. 9, 10. "*Dactylopora*" *pauperata* Carpenter MS.,  $\times 14$ . Eocene: Hauteville. V. 24917, specimens Nos. 13 and 15.





PENICILLUS, TYDEMANIA (Recent)  
NEOMERIS, OVULITES (Fossil)



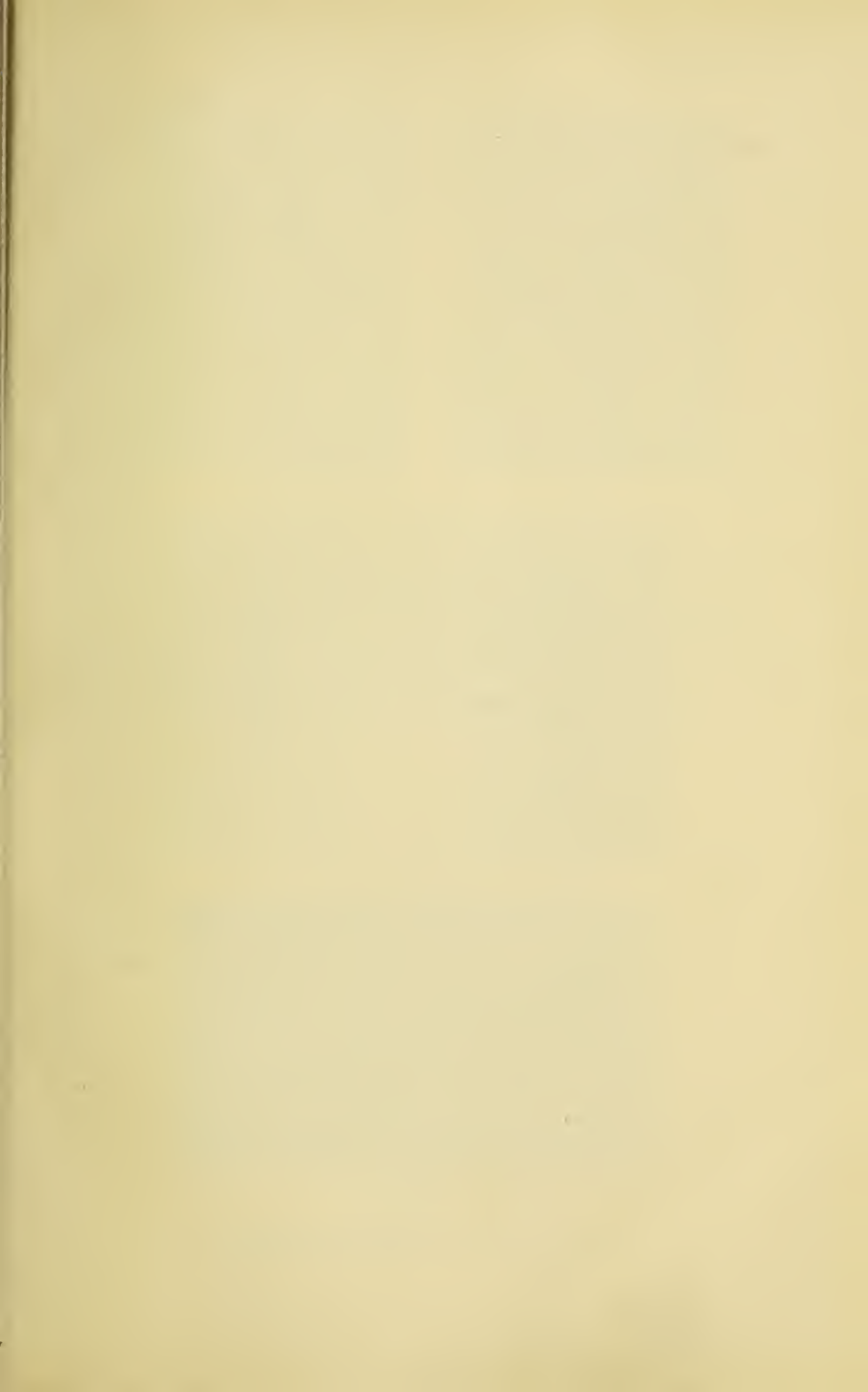


PLATE II

- Figs. 1, 2. *Cymopolia barbata* (L.) Lmx. Recent : Havana.
1. Fragment of branch, natural size.
  2. Portion of the same,  $\times 3$ . (Morellet Coll.)
- Figs. 3-5. *Bornetella nitida* (Harvey) Mun.-Ch. Recent : Celebes.
3. General appearance, natural size.
  4. Longitudinal section, showing the axial tube and the whorled branches,  $\times 2$ .
  5. Part of a longitudinal section showing the sporangia,  $\times 10$ . (Morellet Coll.)



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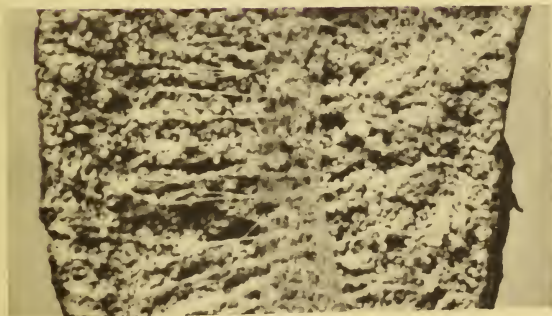
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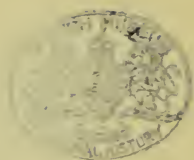


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CYMOPOLIA, BORNETELLA (Recent)



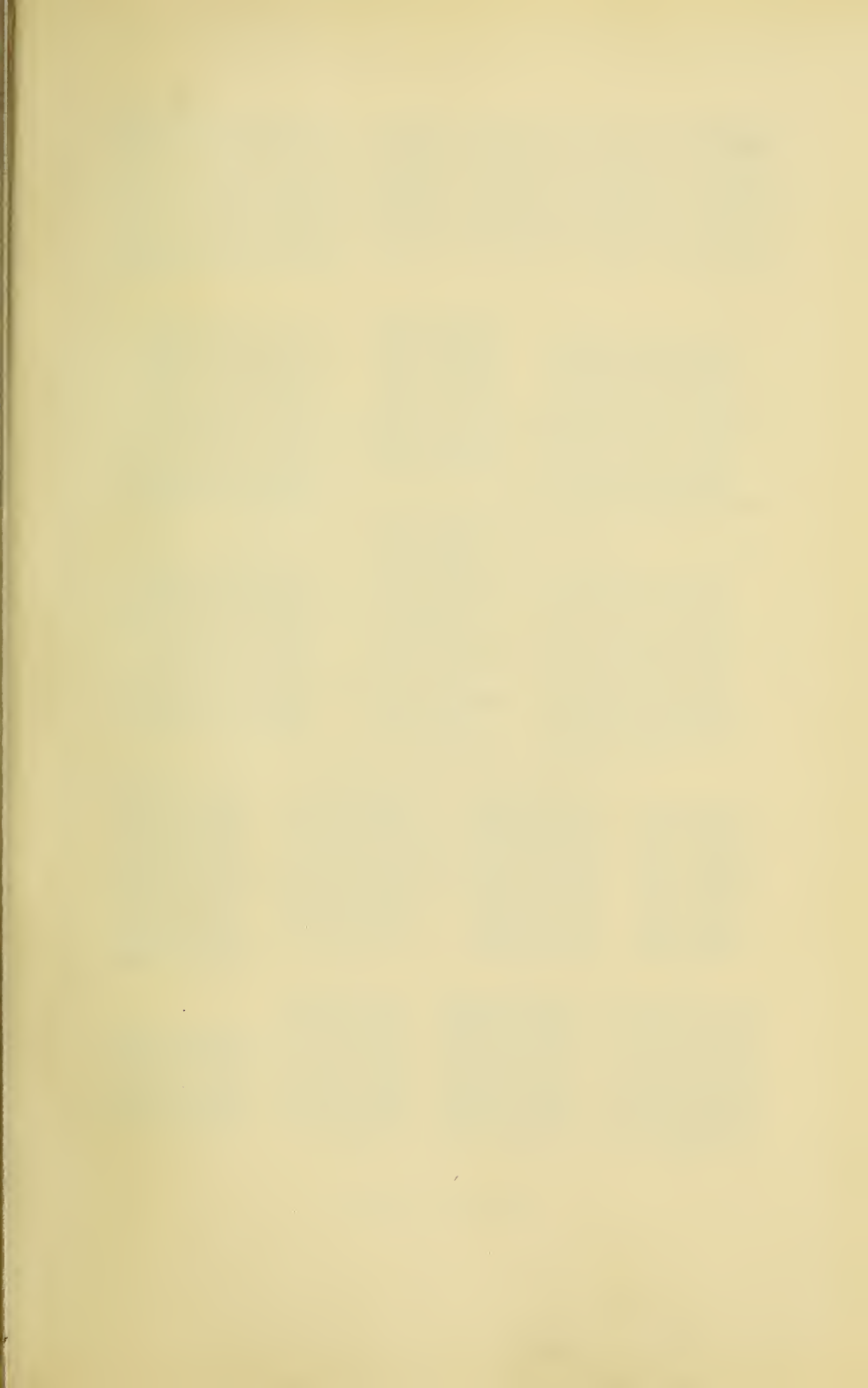
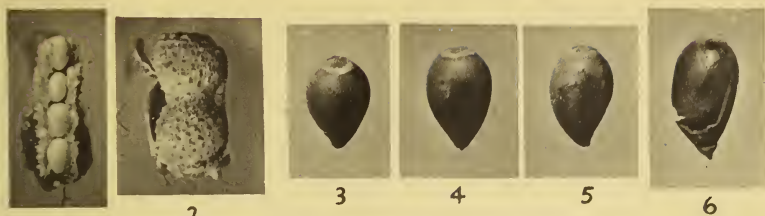


PLATE III

- Figs. 1, 2. *Ovulites margaritula* Lk.  
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- Figs. 3-6. Problematical organisms wrongly referred to *Ovulites*,  $\times 5$ . Lande-  
nian (Blackheath Beds) : Abbey Wood, Kent. V. 21327.
- Figs. 7-12. *Neomeris (Decaisnella) annulata* Dickie. Recent : Bermuda.  
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7, 8. Isolated sporangiferous rings with their primary canals  
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9, 10. Isolated sporangiferous rings in which the primary  
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11. Portion of the alga showing the cuticle,  $\times 6$ .  
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- Figs. 13-19. *Neomeris (Decaisnella) alternans* n. sp.,  $\times 20$ . Sannoisian :  
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13-17. Fragments of sporangiferous rings (13, 14 and 16,  
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18. Fragment of ring showing the orifices of the sporangial  
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19. Complete ring (surface *a*).
- Fig. 20. *Neomeris (Decaisnella) oligospora* n. sp. Complete sporangiferous  
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(Morellet Coll.).





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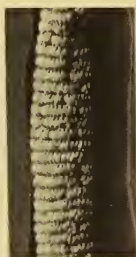
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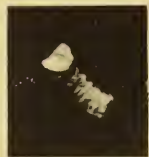
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OVULITES, NEOMERIS.



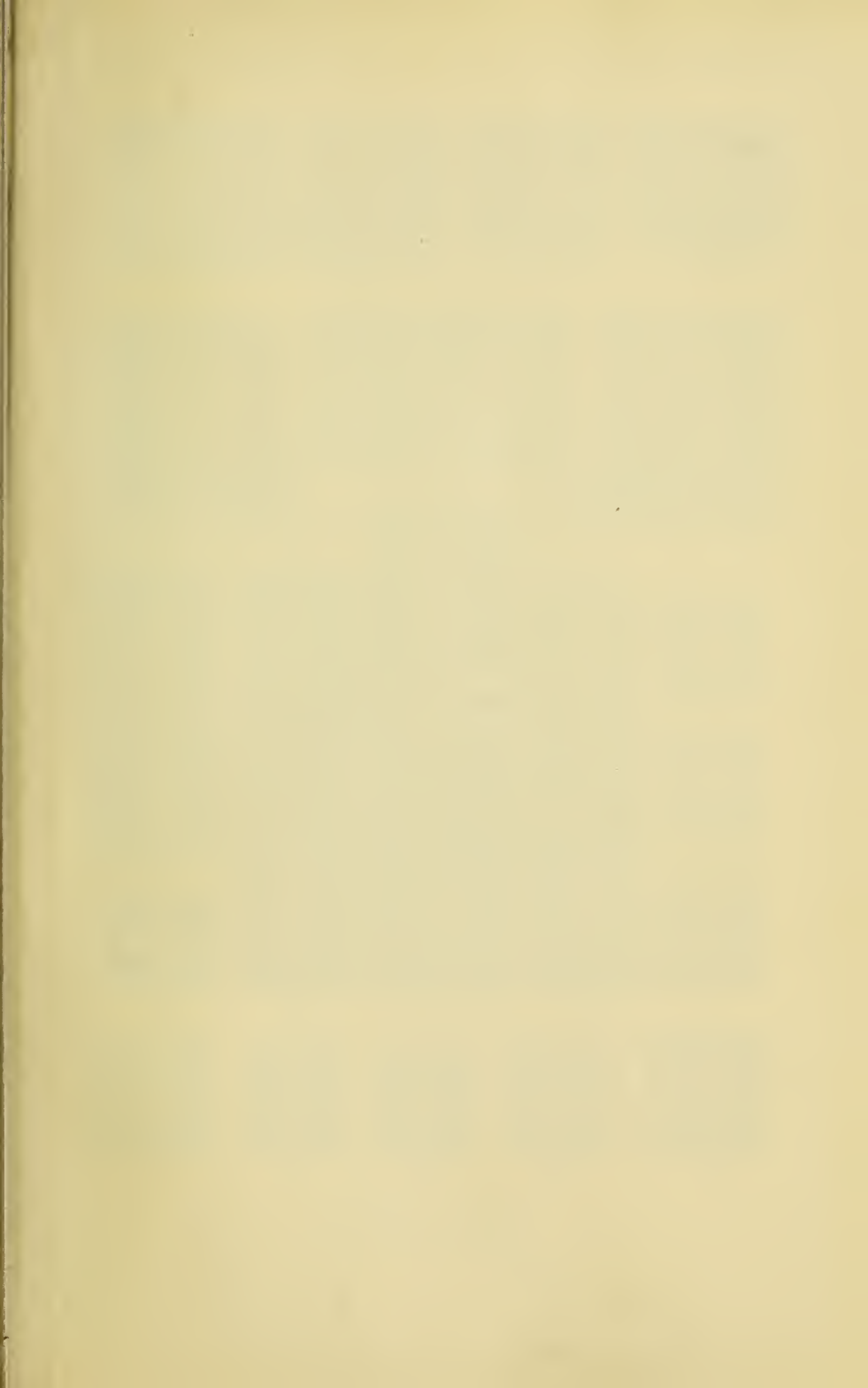
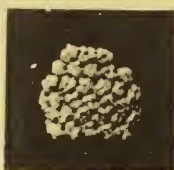


PLATE IV

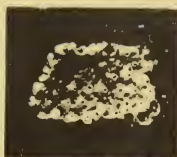
- Fig. 1. *Neomeris (Vaginopora)* sp. 1. Internal surface,  $\times 15$ . Eocene : Hauteville. V. 24921, No. 3.
- Fig. 2. *Neomeris (Vaginopora)* sp. External surface, lacking the cuticle,  $\times 15$ . Eocene : Hauteville. V. 24921, No. 4.
- Figs. 3, 4. *Neomeris (Vaginopora)* sp. 2,  $\times 20$ . Eocene : Hauteville. V. 24921, Nos. 9 and 10.
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4. Internal surface, unabraded.
- Figs. 5, 6. *Neomeris (Vaginopora)* sp.,  $\times 15$ . Auversian : Medmerry Farm, Selsey, Sussex.
5. Internal surface (Morellet Coll.).
6. External surface. V. 24874.
- Figs. 7-20. *Larvaria (Parnesina) encrinula* Defr. Eocene : Hauteville.
7. Fragment of tube, perfectly preserved,  $\times 15$ . V. 24919, No. 10.
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- 9-12. General appearance,  $\times 12$ . The abrasion increases from fig. 9 to fig. 12. (Morellet Coll.)
- 13-20. Isolated rings (13-15, lower surface ; 16-20, upper surface),  $\times 15$ . V. 24906 and V. 24907.
- Fig. 21. *Larvaria limbata* Defr. Ring viewed from below,  $\times 20$ . Eocene : Hauteville. V. 24907, No. 11.



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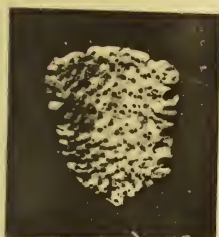
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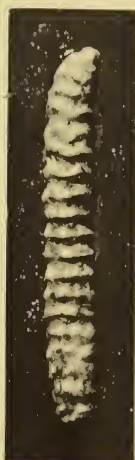
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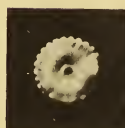
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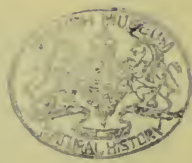


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NEOMERIS, LARVARIA.



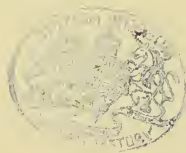
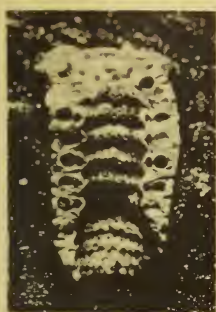


PLATE V

- Fig. 1. *Cymopolia edwardsi* n. sp. Longitudinal section,  $\times 15$ . Eocene : Hauteville. V. 24910, No. 3.
- Figs. 2-4. *Cymopolia elongata* (Deufr.). Auversian : Medmerry Farm, Selsey, Sussex. (Morellet Coll.)
2. Internal cast,  $\times 5$ .
- 3, 4. Longitudinal sections,  $\times 10$ .
- Fig. 5. *Cymopolia* sp.,  $\times 12$ . Eocene : Hauteville. V. 24912, No. 2.
- Fig. 6. *Cymopolia* sp.,  $\times 15$ . Auversian : Medmerry Farm, Selsey, Sussex. (Morellet Coll.)
- Fig. 7. *Cymopolia elongata* (Deufr.). Longitudinal section,  $\times 10$ . Lutetian : Villiers-Neauphle. (Morellet Coll.)
- Figs. 8, 9. *Dactylopora cylindracea* Lk.,  $\times 3$ . Auversian : Le Fayel.
8. Longitudinal section.
9. Transverse sections. (Bornet Coll., Mus. Nat. d'Hist. nat., Paris.)
- Figs. 10-15. *Larvaria (Parnesina) davisi* n. sp.,  $\times 12$ . Auversian : Medmerry Farm, Selsey, Sussex.
10. Tube, contracted at its lower end. (Morellet Coll.)
- 11-13. General appearance; 13 represents the type. V. 24873, No. 1.
- 14, 15. Longitudinal sections. (Morellet Coll.)
- Fig. 16. *Larvaria (Parnesina) davisi* n. sp. Worn specimen,  $\times 12$ . Auversian : White Cliff Bay, I. of Wight. V. 24857.
- Figs. 17-22. *Larvaria (Parnesina) davisi* n. sp. Isolated rings,  $\times 15$ . Auversian : Medmerry Farm, Selsey, Sussex. (Morellet Coll.)
- 17, 18. Lower surface.
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- Fig. 23. *Larvaria* sp.,  $\times 15$ . Auversian : Medmerry Farm, Selsey, Sussex. (Morellet Coll.)

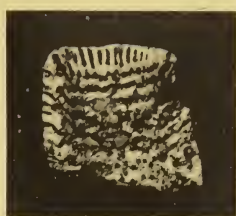




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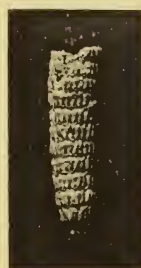
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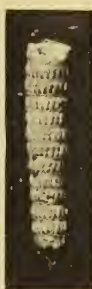
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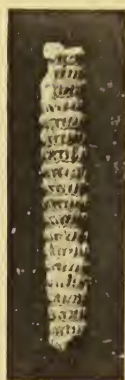
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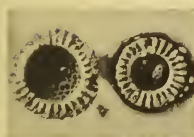
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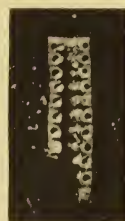
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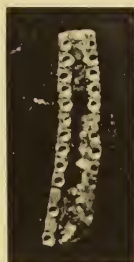
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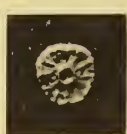
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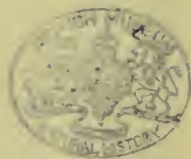


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CYMOPOLIA, DACTYLOPORA, LARVARIA.



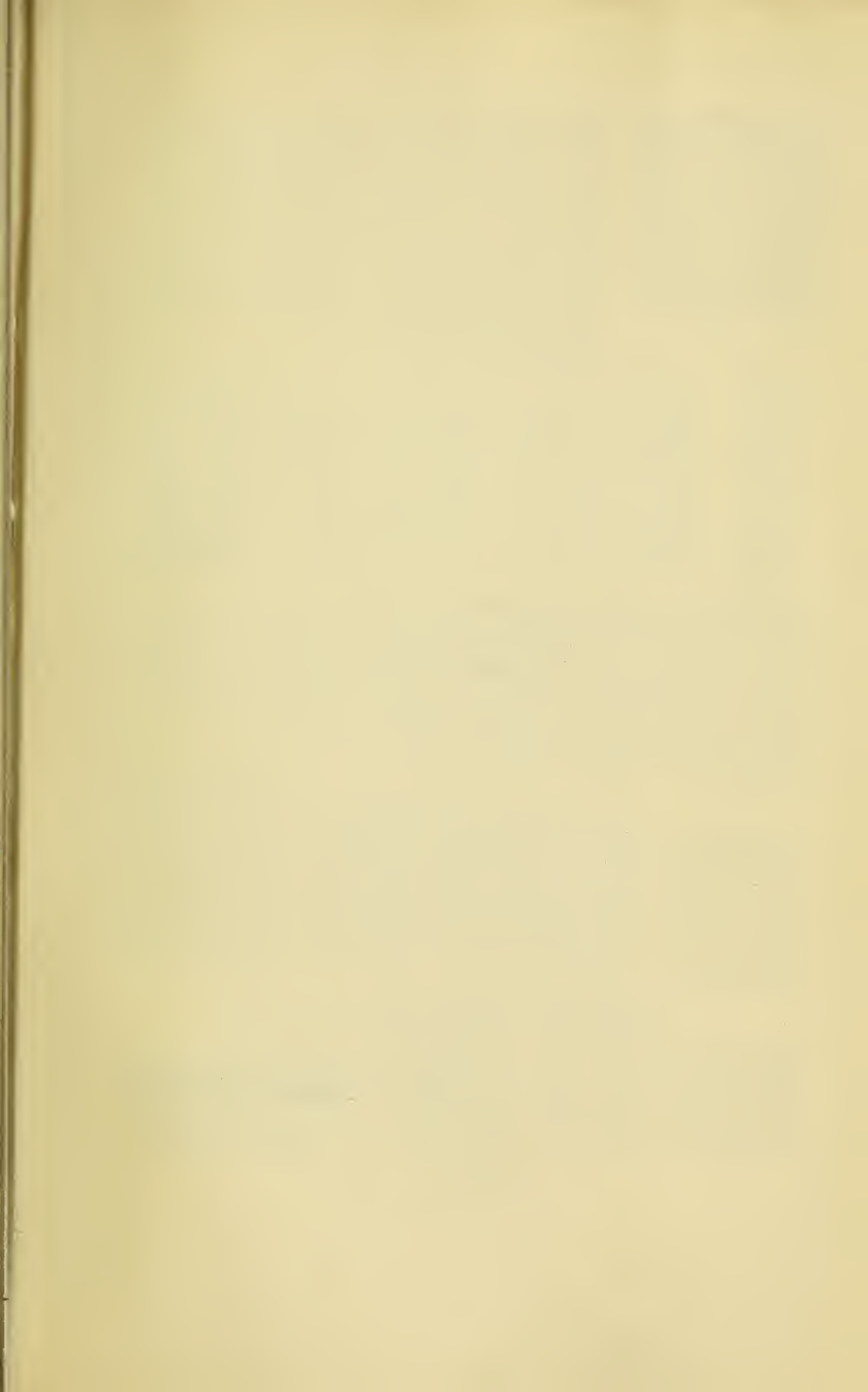
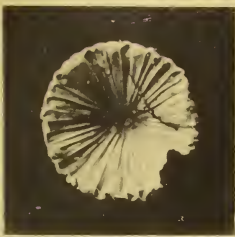


PLATE VI

- Figs. 1-4. *Acicularia schenckii* (Möb.) Solms. Recent: Bermuda. (Morellet Coll.)  
 1. Fertile disc (upper surface),  $\times 5$ .  
 2, 3. Sporangial spicules (lateral surface),  $\times 15$ .  
 4. Fragment of disc showing the spicules in place,  $\times 10$ .
- Figs. 5-9. *Acicularia marginata* n. sp. Sannoisian: Rauville.  
 5, 6. Spicules viewed laterally,  $\times 14$ . V. 24927, Nos. 12 and 14.  
 7. Fragment of spicule,  $\times 20$ . V. 24926, No. 13.  
 8, 9. Fragments of spicules viewed from below and above respectively,  $\times 14$ . V. 24927, Nos. 15 and 20.
- Fig. 10. *Acicularia* sp. 1,  $\times 14$ . Eocene: Hauteville. V. 24918, No. 20.  
 Fig. 11. ? *Acicularia* sp. 2,  $\times 14$ . Sannoisian: Rauville. V. 24927, No. 8.  
 Figs. 12-14. *Acicularia* sp.,  $\times 14$ . Auversian: Medmerry Farm, Selsey, Sussex (Morellet Coll.)  
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 Fig. 16. *Acicularia (Briardina) munieri* Morellet,  $\times 14$ . Eocene: Hauteville. V. 24918, No. 22.  
 Fig. 17. *Acicularia (Briardina)* sp. 1,  $\times 14$ . Eocene: Hauteville. V. 24917, No. 14.  
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 Figs. 19-21. *Acicularia (Briardina)* cf. *archiaci* Mun.-Ch. Sannoisian: Rauville.  
 19, 20. Fragments of disc,  $\times 14$ . V. 24927, Nos. 16 and 17.  
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 26. Fragment of disc showing the apertures of the sporangia into the axial cavity. V. 24920, No. 3.  
 27. Fragment of disc. V. 24920, No. 1.



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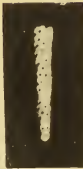
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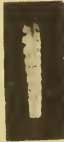
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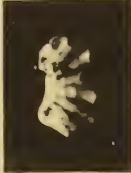
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ACICULARIA, CLYPEINA.











