

A CRITICAL REVIEW OF THE LITERATURE ON THE SIMPLE GENERA OF THE MADREPORARIA FUNGIDA, WITH A TENTATIVE CLASSIFICATION.<sup>a</sup>

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*Custodian, Madreporian Corals.*

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INTRODUCTION.

CAUSES THAT LED TO THIS COMPILATION AND THE ATTEMPTED CLASSIFICATION.

The following paper has grown out of the necessities of my work on the fossil corals of North America and the study of the recent Fungid corals in the United States National Museum. In my *Some Cretaceous and Eocene corals from Jamaica*<sup>b</sup> I had to describe simple Fungid corals belonging to three different genera; other species of Fungids had to be considered in my *Corals of the Buda Limestone (Texas)*<sup>c</sup>; and they are well represented in collections of Tertiary corals that I am at present studying for the United States Geological Survey.<sup>d</sup>

The last comprehensive attempt at the classification of these corals is that of Duncan, in his *Revision of the Families and Genera of the Madreporaria*.<sup>e</sup> This work is very faulty, and is often insufficient for the determination of the genera described in it. I was therefore unable to identify the genera to which some of the specimens referred to me belonged, even after I had collected the descriptions of those proposed since 1884. Furthermore, the original generic diagnoses were often inadequate and type-species had not been designated—in fact, it not only seemed, but actually is, hopeless, to find in the literature the differential characters of many of the proposed genera.

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<sup>a</sup>Published by permission of the Director of the U. S. Geological Survey.

<sup>b</sup>Bull. Mus. Comp. Zool., XXXIV, 1899, pp. 242-246.

<sup>c</sup>U. S. Geol. Surv. Bull., No. 205, 1903, pp. 39, 40.

<sup>d</sup>Tertiary corals of North America. Part II. Faunas of the Post-Eocene formations of the eastern and southeastern United States and the Tertiaries of the West Indies, U. S. Geol. Surv. Mon., vol. ———. (In preparation.)

<sup>e</sup>Journ. Linn. Soc. London, Zool., XVIII, 1884.



## OBJECT OF THIS WORK.

I therefore decided to make a compilation of the original diagnoses of the various genera, to fix the type-species wherever possible, to supplement the original diagnoses by subsequent observations based primarily upon the type-species, to make a tentative classification, and, where the information concerning a genus or a group of genera is not sufficient for purposes of classification, to point out what should be done in order to make the genera recognizable. After having given the original diagnosis of a genus, designated its type-species, and stated its distribution, under "remarks" a historic sketch of the increase in knowledge concerning it and critical notes on it are given. The method is cumbersome, but, as this paper is primarily a critical review of literature, it seems to me to be the correct one.

## THE NECESSITY FOR THE DESIGNATION OF TYPE-SPECIES.

Most modern systematic biologists will probably be surprised to see stated in a heading a principle that is all but universally recognized. Several of the older zoophytologists recognized the *necessity* of type-species for genera. Leuckart in 1841 did, Milne Edwards and Haime invariably designated a type-species, and Laube erected monotypic genera. Many of the later workers have not done this, making it extremely difficult to find out precisely how the genera should be defined. Investigations subsequent to the founding of a genus have frequently been based on some other species than the geno-type, and often not even the name of the species investigated is given. These studies have not infrequently been used in redefining a genus, giving rise to extreme confusion. The failure to base redefinitions of genera primarily upon type-species and the failure to give the names of the species upon which studies were based have invalidated some of the most painstaking work that has been done on corals.

The genus *Thamnasteria*<sup>a</sup> Le Sauvage furnishes an excellent illustration. This genus was established for *Thamnasteria lamourouxii* Le Sauvage = ? *Astrea dendroidea* Lamouroux.<sup>b</sup> The spelling of the name was subsequently changed to *Thamnastrea*, and is now usually spelled *Thamnastræa*. Pratz, in his Ueber die verwandschaftlichen Berziehungen einiger Korallengattungen,<sup>c</sup> gives an elaborate description of the finer structure of a coral referred by him to *Thamnastræa*, but he does not give the name of the species. Duncan, in his Revision of the Families and Genera, utilized Pratz's work. Ogilvie, in her Korallen der Stramberger Schichten, did the same. Koby

<sup>a</sup> Mém. Soc. d'Hist. nat., Paris, I, 1822, p. 243.

<sup>b</sup> Expos. méthod. Genres Polyp., 1821, p. 85, pl. LXXVIII, fig. 6.

<sup>c</sup> Palæontographica, XXIX, 1882, pp. 92-98.



says, in his *Monographie des Polypiers Jurassiques de la Suisse*: “Je prends pour type des véritables *Thamnastræes* la *Thamnastræa arachnoides*.” Felix, in his *Anthozoen der Gosauschichten in den Ostalpen*, follows Pratz’s characterization of *Thamnastræa*. Gregory was the first one to make a careful study of Le Sauvage’s type-species, and published a description and figure of the septa.<sup>a</sup> He says: “Three septa of this specimen are shown on Plate II A, figure 3. The septa are laminar and not trabicular. The figures which Pratz gives to represent the septal structure of *Thamnastræa* agree with those of *Dimorpharæa continua*. \* \* \* Hence the *Thamnastræa* of Pratz is an altogether different coral from the *Thamnastræa* of Le Sauvage. We must retain the name for the corals placed in it by Le Sauvage, and for those later described species, which have the same septal structure. Pratz’s *Thamnastræa* must be relegated to another family.” To another family! And every species referred by Felix in his beautiful work on the corals of the Gosau Cretaceous to the genus *Thamnastræa* is generically wrongly identified.

Blunders brought about by work like that of Pratz, in which type-species and specific names are ignored, are numerous. *Thamnasteria* is given as an example.

It can not be too strongly emphasized that *a correct understanding of genera is impossible unless the definitions are based primarily upon a single type-species*.

#### REVIEW OF WORK ON THE GENERAL CLASSIFICATION OF THE FUNGIDS.

Duncan published, in 1883,<sup>b</sup> two articles on the *Fungida*—(1) Observations on the Madreporarian family (the *Fungidæ*), with especial reference to the hard structures, and (2) On the structure of the hard parts of the *Lophoserinæ*. In the first-mentioned article a history of the development of the knowledge of the *Fungidæ* is given. At the time of writing these articles Duncan apparently did not know of Pratz’s *Ueber die verwandschaftlichen Beziehungen einiger Korallengattungen*, which was published during the previous year.

Pratz’s work is among the finest that has been done on the hard parts of corals, and can be regarded as of epoch-making importance. He unfortunately did not realize the importance of type-species and fixing the particular species that he investigated.

Pratz divided the *Fungidæ* into five subfamilies—*Pseudoastraeinæ*, *Pseudoagaricinæ*, *Agaricinæ*, *Funginæ*, and *Merulinæ*. The *Pseudoastraeinæ* were divided into the *Regulares* and *Irregulares*. The following is the classification that he proposed:

<sup>a</sup> Jurassic Fauna of Cutch, The Corals, 1900, pp. 134, 135, pl. II A, fig. 3.

<sup>b</sup> Journ. Linn. Soc. London, Zool., XVII, pp. 137–162, pls. v, vi; pp. 302–319, pl. XIII.



I. Subfamily *Pseudoastræinæ*: "Corallum simple or compound. Septal apparatus trabecular, porous. Calices in the compound forms confluent, not separated by walls or by true cœnenchyma, but united by radial septo-costæ. Pseudosynapticula, or true synapticula, present alongside dissepiments."

Ia. *Pseudoastræinæ Regulares* (= *Thamnastræinæ* Zittel + *Cyclolitinæ* Verrill): "Trabeculæ composed of regularly (symmetrically) grouped calcareous nodules, which are in contact at quite regular intervals, thus forming more or less uniformly distributed rows of pores that run perpendicular to the septal margins. Faces of neighboring septa united by pseudosynapticula and dissepiments."

The *Pseudoastræinæ Regulares* are divided into two groups:

1. Group: "With a pronounced tendency to form more or less compact septa through subsequent deposition of sclerenchyma. Septa not always and then only partially perforate."

GENERA: CYCLOLITES, LEPTOPHYLLIA, THAMNASTRÆA, ETC.

2. Group: "No tendency to fill the intertrabecular spaces through subsequent deposition of sclerenchyma. Septa fine, and regularly fenestrated."

GENERA: TROCHARÆA, MICROSOLENA, ETC.

Ib. *Pseudoastræinæ Irregulares*: "Trabeculæ composed of numerous irregularly grouped calcareous nodules, which are irregularly fused. Therefore, the intertrabecular spaces (pores) are of very dissimilar size and are irregular in arrangement. Septa united by both true synapticula and dissepiments. The basal part of the septa is often compact."

GENERA: HAPLARÆA, COSCINARÆA, ETC.

II. Subfamily *Pseudoagaricinæ*: "Corallum compound, massive or incrusting, never foliaceous or lobed. Septal apparatus compact. Septa of neighboring calices confluent. Wall absent or rudimentary. No cœnenchyma. Well-developed dissepiments and true synapticula present."

GENERA: ASTRAEOMORPHA, MESOMORPHA, ETC.

III. Subfamily *Agaricinæ* Verrill (*Lophoserinæ* Milne Edwards and Haime): "Corallum simple or compound, in the second instance; always more or less foliaceous or lobed, never massive. Septa solid, united by synapticula and sometimes by dissepiments. Common [basal] wall not spinose."

IV. Subfamily *Funginæ* Milne Edwards and Haime: "Corallum simple or compound. Septa solid, united by synapticula. Common [basal] wall spinose."



V. Subfamily *Merulininæ* Milne Edwards and Haime: "Corallum compound, foliaceous. Septa confluent, united by dissepiments. Wall rudimentary. Common [basal] wall perforate."

The principal value of the contribution of Pratz is that it showed that valuable information could be obtained from a more detailed study of the septal structure. The terms proposed by him are cumbersome, and they do not conform to modern nomenclatorial rules; it is, therefore, inadvisable to use them at the present time.

The specimens that Pratz considered *Thamnastraea* have been shown by Gregory not to be *Thamnastraea* at all (see p. 373). *Thamnastraea* Lesauvage (originally *Thamnasteria*) belongs in Pratz's "*Pseudoagaricinæ*." The distinction between the "*Pseudoagaricinæ*" and "*Agaricinæ*" is probably not valid, as shown by a species of *Agaricia*, *A. crassa*, recently described by Professor Verrill.<sup>a</sup> The septa of the *Funginæ* are often, the smaller one normally, perforate.

Pratz laid much stress on whether synaptacula are what he calls true or false ("true," where a calcification center joins opposed granulations; "false," where they fuse directly). Such a division of these structures is of no systematic importance.<sup>b</sup>

Duncan, in his Revision of the Families and Genera of the Madreporaria, divided the Madreporaria Fungida into five families, as follows:

#### "I. Family PLESIOFUNGIDÆ.

"This family unites more or less the Aporosa and Fungida.

"Fungida simple or colonial, with synaptacula in the interseptal loculi, besides endothecal dissepiments. Septa solid and imperforate, occasionally irregularly perforate and trabeculate."

#### "II. Family FUNGIDÆ.

"(Subfamily *Funginæ* (part), EDWARDS and HAIME, Hist. Nat. des Corall., III, 1860, p. 4.)

"Simple or colonial forms, usually depressed, with the septa solid or occasionally porous. Synaptacula crossing the interseptal loculi and uniting the septa without the presence of dissepimental endotheca. Wall more or less synaptaculate or special, perforated and echinulate. Calices with radiating septa in the simple forms; with or without radiating lamellæ, along a central axial line, or scattered in the colonial forms. Tentacles short, scattered, sometimes obsolete.

"This family stands very much by itself, and its genera are remarkable for their calicular structures and developments."

<sup>a</sup>Trans. Conn. Acad. Sci., XI, 1902, p. 145, pl. xxx, fig. 6; pl. xxxiv, fig. 2.

<sup>b</sup>Von Koch, Das Skelett der Steinkorallen, Gegenbauer Festschrift, 1896, p. 260; Vaughan, Eoc. and Lower Oligoc. Corals, Mon. U. S. Geol. Surv., XXXIX, 1900, pp. 47, 48.



### “III. Family LOPHOSERIDÆ.

“(Subfamily *Lophoserinæ* EDWARDS and HAIME.)

“Fungidæ in which the wall is neither perforated nor echinulate. Synapticula exist, but not endothecal dissepiments. Septal laminae usually solid, but occasionally with ill-defined perforations, remote from the bottom of the septa.

“Very considerable changes have taken place in the old subfamily of Milne-Edwards and Jules Haime, the *Lophoserinæ*, owing to the introduction of new genera and the elimination of old ones in consequence of the necessity of founding the family Plesioporitidæ.

“There are two subfamilies—the *Lophoseridæ simplices* and *Lophoseridæ aggregatæ*.”

### “IV. Family ANABACIADÆ.

“Madreporaria Fungida simple or colonial. Septa trabeculate and fenestrated. Synapticula small. Dissepiments absent. Wall indistinct.”

### “V. Family PLESIOPORITIDÆ.

“Fungida with trabeculate and regularly perforate septa. Synapticula between the septal laminae in the interseptal loculi. Schlerenchyma trabeculate. Dissepiments may or may not exist. Wall existing or not, and imperforate. Epitheca may exist and be well developed.”

M. Koby divided the Fungids described by him from the Jurassic of Switzerland into two families, *Thamnastréides* and *Microsolénides*.<sup>a</sup> He unfortunately used the wrong species, *Thamnastræa arachnoides*, as the geno-type of *Thamnastræa*.

Frech, in his *Korallen der juvavischen Triasprovinz*,<sup>b</sup> recognized among his material two families of Fungids, *Thamnastræidæ*, with two subfamilies, *Thamnastræinæ* and *Astræomorphinæ*, and a new family, *Spongiomorphidæ*. Frech was misled concerning the septal structure of the real *Thamnastræa*.

Ogilvie, in her Systematic study of the Madreporarian types of corals,<sup>c</sup> considered the Madreporaria Fungida of only family importance and recognized three subfamilies, namely, *Funginæ*, *Thamnastræinæ*, and *Lophoserinæ*. Her *Thamnastræinæ* is based on Pratz's misconception of *Thamnastræa*.

A decided advance in the classification of the Fungida was made by

<sup>a</sup>Schweitz. Pal. Gesellsch., Abhand., XVI, 1889, pp. 568, 569.

<sup>b</sup>Palæontographica, XXXVII, 1890, pp. 59-79.

<sup>c</sup>Phil. Trans. Roy. Soc. London, ser. B, CLXXXVII, 1897, pp. 342-343.



Gregory in his Jurassic corals of the Cutch.<sup>a</sup> One reason for this advance of Gregory was, he carefully determined the type-species of each genus and was thus able to give reliable generic diagnoses. He proposed the following classification to cover the genera represented by the Cutch Jurassic corals.

### “Order FUNGIDA.

“Madreporaria in which the walls and septa are perforate or imperforate. The septa consist of lamellæ or of palissades of trabiculæ. The septa are united by abundant synapticulæ. Dissepiments unimportant or absent.

#### “Family THAMNASTRAEIDÆ, Koby, em.

“Simple or compound Fungida, with lamellar septa, which are solid or perforated only along the upper or inner margins, owing to the fusion of trabicular projections from the septa. Synapticulæ and dissepiments both present.

#### “Subfamily 1: THAMNASTRAEINÆ.

“In compound coralla the septa of adjoining corallites are confluent. The corallites are not separated by collines or synapticular walls.

“Genera: *Thamnastraea*, LE SAUVAGE (not PRATZ).

“Genera: *Dimorphastraea*, D'ORBIGNY.

“Genera: *Centrastraea*, D'ORBIGNY.

“Genera: *Stibastraea*, ÉTALLON.

“Genera: *Latomacandra*, EDWARDS and HAIME.

#### “Subfamily 2: COMOSERINÆ.

“The corallites are surrounded by compact synapticular walls. The corallites may be free laterally at their distal ends or united into long series, externally bounded by collines.

“Genera: *Archaeoseris*, GREGORY.

“Genera: *Comoseris*, D'ORBIGNY.

#### “Family ETHMOTIDÆ, Gregory.

“Simple or colonial Fungida, in which the septa are lamellar; they are cribriform but not trabicular.

“Genera: *Protethmos*, GREGORY.

“Genera: *Metethmos*, GREGORY.

“Genera: *Frechia*, GREGORY.

“Genera: *Sematethmos*, GREGORY.

“Genera: *Kobyia*, GREGORY.

<sup>a</sup> Palæontologia Indica, Ser. IX, Jurassic Fauna of Cutch, II, 1900, Part 2—The Corals, pp. 29, 30.



“Family MICROSOLENIDÆ, Koby, em.

“Simple or colonial Fungida in which the septa are palissades of more or less vertical, disconnected, regular or irregular trabiculæ.

“Genera: *Anabacia*, EDWARDS and HAIME.

“Genera: *Genabacia*, EDWARDS and HAIME.

“Genera: *Trocharaea*, ÉTALLON.

“Genera: *Trochoplegma*, GREGORY.

“Genera: *Microsolena*, LAMOUROUX.

“Genera: *Tricycloseris*, THOMES.

“Genera: *Dimorpharaea*, DE FROMENTIL.

“Genera: *Thamnaraea*, ÉTALLON.”

BASIS OF THE CLASSIFICATION HERE PROPOSED.

Following the lines of the investigations of Pratz, Gregory, and others, the larger divisions are based upon septal structure; that is, whether the septa are solid or perforate; if perforate, whether they are more pronouncedly laminar or trabecular in composition, and I have also utilized in defining the families the character of the wall, whether normally perforate, even if only slightly, or whether normally solid. The genera are separated by columellar characters, the relative compactness of the septa, the presence or absence of paliform processes, costal characters (whether corresponding or alternating with the septa), and the epitheca. The value of the epitheca in separating genera has been severely attacked.<sup>a</sup> Gregory says, “There is no part of a coral skeleton over which more time has been wasted than over the epitheca.” From a study of large numbers of species belonging to the same genus, I am inclined to believe that the so-called complete epitheca is, in some instances at least, a generic character. There are genera in which epitheca is normally absent, and others in which it may exist in an imperfectly developed condition. Epitheca can not be considered to possess the importance once attached to it, but I believe that its supposed value as a classificatory character has not been entirely disproved.

TENTATIVE CHARACTER OF THIS CLASSIFICATION.

I have distributed the genera, considered in this paper, among four families, and have five headings for genera that are not referred to families. This classification, which embodies nothing new, except making a family, *Micrabaciidæ*, is only an attempt, and should be subjected to the most searching criticism to determine the validity of the characters used in differentiating the families. The *Leptophylliidæ*<sup>b</sup>

<sup>a</sup> Gregory, Jurassic Fauna of Cutch—the Corals, p. 11.

<sup>b</sup> The same as Gregory's *Ethmotidæ*, which is abandoned, as it was not derived from a genus name.



is very doubtfully separable from Gregory's *Thamnastracidæ*, though they probably should be kept separate. The *Micrabaciidæ* have solid septa and perforate walls. The *Anabraciidæ* are characterized by having a very pronounced and regular trabecular septal structure, but in some genera the basal pores between the trabeculæ are filled with stereoplasm, bringing this family and the *Leptophylliidæ* very close together.

Before the synonymy of the proposed genera can be determined, they must be accurately defined, and here I will repeat *that the generic definitions must be based primarily upon a type species*. After this has been done the study of variation can be undertaken, in order to determine the value of characters supposed to be of generic importance.

The present paper, it is hoped, will aid in the undertaking and carrying out of the studies that must be done before we can understand the Fungid corals.

#### CLASSIFICATION.

##### Family FUNGIIDÆ Dana (emend. Duncan).

1846. *Fungidæ* (part) DANA, Zooph. Wilkes Expl. Exped., p. 283.

1849. *Funginæ* MILNE EDWARDS and HAIME, Comptes rend. Acad. Sci., Paris, XXIX, p. 71.

1884. *Fungidæ* DUNCAN, Jour. Linn. Soc. London, Zool., XXVIII, p. 141.

*Diagnosis of the family*.—Corallum simple or colonial, depressed or mitroid in form, septa of higher cycles perforate, those of the lower cycles perforate or solid. Synapticula, but no dissepiments, present. Wall usually perforate in young, free individuals; subsequently more or less perforate or compact. No epitheca.

The above diagnosis of the family probably should be supplemented by the following: The embryo becomes attached and forms a trophozoid,<sup>a</sup> which gives rise to buds (anthoblasts); these become detached, forming free individuals (anthocyathi). The anthocyathi may remain simple (the genus *Fungia*), or by asexual reproduction become colonial.

The mode of formation of the "anthocyathi" of *Fungia* has been known for many years, Stutchbury first describing it in 1830.<sup>b</sup> Bourne has made the mode of reproduction of *Fungia* the subject of very detailed investigations. It has been proven for nearly every known species of the genus that the free disks are produced by buds becoming detached from a parent stock (originally a trophozoid).

J. Stanley Gardiner, in his "Fungid corals" collected in the South Pacific,<sup>c</sup> published the extremely interesting observation concerning *Halomitra* (*H. irregularis* Gardiner), that "the free corallum seems, from my specimens (2), to have been formed in a somewhat similar

<sup>a</sup> G. C. Bourne, On the Post-embryonic Development of *Fungia*, Sci. Trans. Roy. Dublin Soc., V (2d ser.), 1893, p. 206.

<sup>b</sup> Trans. Linn. Soc. London, XVI, 1830, pp. 493-498.

<sup>c</sup> Proc. Zool. Soc. London, 1898, pp. 527-528.



manner to that of the genus *Fungia*—by the breaking off of disks from an attached stock. At first there is one large central polyp with radiating septa; then, as growth proceeds, a number of calicular fossæ appear around this. On becoming free the central polyp may perhaps persist or, as in my specimens, may become indistinguishable from the daughter polyps, the septa gradually losing their regular radiating arrangement in the center of the colony.”

I have examined specimens of five of the compound genera of the *Fungidæ*, hoping to gain more information concerning young stages, and obtained the following results:

*Halomitra philippinensis* Studer, young. Shows a very distinct scar of detachment.

*Zoopilus echinatus* Dana. (Probably type specimen.) Shows a very distinct scar of detachment. This genus is scarcely more than a *Halomitra* with very few calices, and these are near the central corallite.

*Cryptabacia talpina* (Lamarck). There is some suggestion of a detachment scar, but the evidence is not positive.

*Herpetolitha limax* (Esper) and *H. stricta* Dana. Evidence for detachment scar very vague.<sup>a</sup>

*Lithactinia galeriformis* (Dana) (one of Dana's specimens). Found no evidence of a detachment scar.

Sufficient evidence, of course, is not presented to warrant a conclusion, but there is at least a suggestion that the free coralla of all of these corals may originate in a manner similar to that of *Fungia*.

#### Genus FUNGIA Lamarck.

1801. *Fungia* LAMARCK, Syst. Anim. sans Vert., p. 369.

*Original generic diagnosis.*—“Corallum stony, free, orbicular, or hemispherical, or oblong, convex, and lamellate above, with a furrow or depression in the center, concave and rough below.

“A single lamellate, subproliferous star. Lamellæ dentate or spinose laterally.”

*Type species.*—*Fungia agariciformis* Lamarck = *Madr. agaricites* Linnæus.<sup>b</sup> Lamarck originally referred six species to the genus, namely:

1. *Fungia agariciformis* LAMARCK = *Madrepora fungites* LINNÆUS.
2. *Fungia scutaria* LAMARCK, based on Seba, Mus., III, pl. CXII, figs. 28, 29, 30.
3. *Fungia limacina* LAMARCK = *Madrepora pileus* ELLIS and SOLANDER, pl. XLV.

<sup>a</sup>Since the above was written, I have unpacked a box of Fungid corals from the east coast of Africa, kindly sent to me for determination by Dr. Charles Gravier, of the Muséum d'Histoire Naturelle, Paris. There is a good suite of *Herpetolitha foliosa* Ehrenberg. The young specimens show as distinct a detachment scar as any species of *Fungia*. Therefore the young of *Herpetolitha* is a trophozooid, and the adults are formed by further growth of freed anthoblasts, or anthocyathi.

<sup>b</sup>See Döderlein, Senckenb. Naturforsch. Gesellsch. Abhandl., XXVII, 1902, pp. 136-156, pl. xx-xxv.



4. *Fungia talpina* LAMARCK, based on Seba, Mus., III, pl. CXI, fig. 6, and pl. CXII, fig. 31.
5. *Fungia patellaris* LAMARCK = *Madrepora patella* ELLIS and SOLANDER, pl. XXVIII, figs. 1-4.
6. *Fungia pileus* LAMARCK = *Mitra polonica* RUMPHIUS, Herb. Amb., VI, pl. LXXXVIII, fig. 3.

Lamarck confused in his *Fungia*, corals that are now considered to represent four different genera.

*Fungia limacina* Lamarck, now = *Herpetolitha limax* (Esper) Eschscholtz, 1825.

*Fungia pileus* Lamarck, now = *Halomitra pileus* (Pallas) Dana, 1846.

*Fungia talpina* Lamarck, now = *Cryptabacia talpina* (Lamarck) Milne Edwards and Haime, 1849.

This leaves in *Fungia* proper, *F. agariciformis* Lamarck (= *fungites* Linnæus), *F. scutaria* Lamarck and *F. patella* (Ellis and Solander).

Leuckart in 1841<sup>a</sup> cites *Fungia agariciformis* Lamarck as "Typus," fixing the type.

Milne Edwards and Haime in 1849<sup>b</sup> cite under *Fungia*, *F. agariciformis* and *patellaris* Lamarck. In 1850, in their Monograph of the British Fossil Corals,<sup>c</sup> *Fungia patellaris* Lamarck is definitely given as the type-species. *F. patellaris* Lamarck (*Madr. patella* Ellis and Solander) can not be the type-species, as *F. agariciformis* Lamarck had already been so designated. In the third volume of the Histoire naturelle des Coralliaires, pages 6, 7, Milne Edwards accepts the latter species as the type, using for it the Linnæan name *Madrepora fungites*.

*Remarks.*—Prof. Ludwig Döderlein has published an elaborate monograph, Die Korallengattung Fungia,<sup>d</sup> in which the various skeletal parts of the genus are described in much detail. A bibliography is also given. A discussion of the genus will not be attempted here, as the work of Professor Döderlein can be consulted.

*Fungia* has several synonyms, which are as follows:<sup>e</sup>

CYCLOSERIS Milne Edwards and Haime, Comptes rend. Acad., Paris, XXIX, 1849, p. 72.

The genus was placed by its author in their "*Lophoserinæ*," which was characterized by having "the plateau without epitheca or echinulations, and with imperforate tissues."

*Original generic diagnosis.*—"Corallum simple, free. Septa very numerous, uniting by their inner margins."

*Type species.*—*Fungia cyclolites* Lamarck, Hist. nat. Anim. sans

<sup>a</sup> Observ. Zoolog. de Zooph. Corall., spec. de Gen. Fungia, p. 42, pl. iv, figs. 1-4.

<sup>b</sup> Comptes rend. Acad. Paris, XXIX, 1849, p. 72.

<sup>c</sup> Introduction, p. xlvi.

<sup>d</sup> Senckenberg. naturfor. Gesellsch., Abhandl., XVII, Pt. I, 1902, pp. i-iii, 1-162, pls. L-XXV.

<sup>e</sup> All of these excepting *Actinoseris* d'Orbigny are discussed by Döderlein, in his Die Korallengattung Fungia. For further discussion consult that work.



Vertèbres, II, p. 236; Döderlein, Korallengat. Fungia, pp. 77-79, pl. iv, figs. 7-9, pl. v, figs 5, 5a.

*Distribution*.—Recent, China Seas and Philippines eastward to the mid-Pacific.

ACTINOSERIS d'Orbigny, Note sur des Polyp. foss., p. 12, 1849.

*Original generic diagnosis*.—"It is a circular *Cycloseris*, whose columella is central, round, and not in an elongated furrow."

*Type species*.—*A. cenomanensis* d'Orbigny, Note sur des Polyp. foss., nom. nud.; Prod. de paléontol., II, p. 180; Milne Edwards and Haime, Hist. nat. Corall., III, p. 53.

*Distribution*.—"Groupe de la craie tuffeau, Le Mans."

Milne Edwards<sup>a</sup> refers *Actinoseris cenomanensis* to the genus *Cycloseris*, making d'Orbigny's *Actinoseris* a synonym of their *Cycloseris*. The septal structure of d'Orbigny's genus should be investigated. It may be well to reinvestigate the Tertiary and Cretaceous species of *Cycloseris*, they may not be congeneric with *Fungia* (*Cycloseris*) *cyclolites* Lamarck. It is of especial importance to determine whether the free disks of these corals placed in *Cycloseris* originate as *anthocyathi*, as in *Fungia*.

DIASERIS Milne Edwards and Haime, Comptes rend. Acad., Paris, XXIX, 1849, p. 72.

This genus was placed by its authors in their "*Lophoserinae*," characterized by having "the plateau without epitheca and echinulations, and with imperforate tissues."

*Original generic diagnosis*.—"Differs from the preceding [*Cycloseris*] in that, when young, it is composed of separate parts that unite later."

*Type species*.—*Fungia distorta* Michelin, Mag. de Zool., 2d ser., V Année, Zooph., pl. v; Döderlein, Korallengat. Fungia, pp. 74-77, pls. III, v, figs. 3, 3a.

*Distribution*.—Philippines.

*Remarks*.—Duncan in his "Revision of the Genera and Families of the Madreporaria"<sup>b</sup> places *Ecmesus* Philippi<sup>c</sup> and *Hemicyathus* Seguenza<sup>d</sup> in the synonymy of *Diaseris*. *Ecmesus* is a doubtful coral, but probably is an imperfect specimen of a Trochocyathoid species. The *Hemicyathus* of Seguenza certainly belongs in that group.

PLEURACTIS Verrill, Bull. Mus. Comp. Zool., I, 1864, p. 52.

*Type species*.—*Fungia scutaria* Lamarck, Hist. nat. Anim. sans Vert., II, p. 236; Döderlein, Korallengat. Fungia, pp. 91-97, pl. VIII, figs. 1-6.

A type species was designated, but no description was published. The genus was intended to embrace more or less elongate, flat, *Fungia*, without tentacular lobes on the septa.

<sup>a</sup> Hist. nat. Corall., III, p. 53.

<sup>b</sup> Jour. Linn. Soc. London, Zool., XVIII, 1884, p. 150.

<sup>c</sup> Neues Jahrb. für Mineral., Jahrg. 1841, p. 665, pl. XI B, figs. 1 a-e.

<sup>d</sup> Corallarii fossili del. rocce terz. del dist. Messina, 1864, Pt. 2, p. 67.



LOBACTIS Verrill, Bull. Mus. Comp. Zool., I, 1864, p. 52.

*Type species.*—*Fungia dentigera* Leuckart, De Zooph. Corall. et spec. Gen. Fungia, pp. 48–49, pl. III, figs. 1, 2, cf. Döderlein, Korallengat. Fungia, pp. 91–97.

There was no original description; only a type species was cited. This group is composed of somewhat elongate, flat species, in which the tentacular lobes of the septa are greatly developed.

CTENACTIS, Bull. Mus. Comp. Zool., I, 1864, p. 51.

*Type species.*—*Madrepora echinata* Pallas, Elench. Zooph., p. 284; *Fungia echinata*, Döderlein, Korallengat. Fungia, pp. 101–105, pl. x, figs. 1–5.

No diagnosis of the genus was published. It was established for the very large, elongate, *Fungia*, the largest known, in which the septal margins are strongly dentate, the dentations resembling, as the name implies, the teeth of a comb.

HALIGLOSSA (part) Ehrenberg, Akad. Wissensch. Berlin, Abhandl., 1832, p. 274, 1834.

*Original generic diagnosis.*—[Fungids] compound (polystomatous), base expanded, stoloniferous, extended in two directly opposite directions (its oblong form recalling a tongue = *Manicina liberæ*).

To this genus he refers five species:

1. *Madrepora echinata* Pallas.
2. *Fungia limacina* Lamarck = *Madrepora pileus* Ellis and Solander.
3. *Halglossa interrupta* Ehrenberg = *Madrepora pileus* of Linnæus and Pallas = *Fungus pileus oblongus*, Seba, III, pl. CXI, fig. 5.
4. *Halglossa foliosa* Ehrenberg = *Madrepora pileus* Linnæus and Pallas, Seba, III, pl. CXI, fig. 3.
5. *Halglossa stellaris* Ehrenberg = *Madrepora pileus* var. Esper, pl. LXXIII.

No. 1 was considered by Leuckart to be wrongly identified, and was named *Fungia ehrenbergi* by him.<sup>a</sup> Professor Döderlein, in his Die Korallengattung Fungia,<sup>b</sup> places Leuckart *Fungia ehrenbergi* in the synonymy of *Fungia echinata* (Pallas). Milne Edwards and Haime refer the four others<sup>c</sup> to the synonymy of *Herpetolitha limax* (Esper) Eschscholtz, 1825.

Therefore the genus *Halglossa* contained two genera, one part of which belongs to *Fungia* Lamarck, 1801, the other to *Herpetolitha* Eschscholtz, 1825,<sup>d</sup> and consequently must lapse.

<sup>a</sup> De Zooph. corall. et gen. Fungia, 1841, p. 52, pl. II.

<sup>b</sup> Senckenberg. Naturfor. Gesellsch., Abhandl., XXVII, 1902, p. 101.

<sup>c</sup> Am. Sci. nat., 3d ser., Zool., XV, p. 94.

<sup>d</sup> Eschscholtz's *Herpetolitha* (Isis, XVI, 1825, p. 746), originally contained two species, *Fungia limacina* and *Fungia talpa*, of Lamarck. Milne Edwards and Haime, in 1849 (Comptes Rend., XXIX, p. 71), restricted *Herpetolitha* to the first mentioned species (citing *Madrepora pileus* Ellis and Solander, pl. XLV) and proposed the genus *Cryptabacia* for the second.



## Family AGARICIIDÆ Verrill.

1849. *Lophoserinæ* MILNE EDWARDS and HAIME, Comptes rend. Acad. Sci., Paris, XXIX, p. 72.

1865. *Lophoseridæ* VERRILL, Proc. Essex Inst., IV, p. 146.

1870. *Agaricidæ* VERRILL, Trans. Conn. Acad. Sci., I, p. 542.

1884. *Lophoseridæ* DUNCAN, Jour. Linn. Soc., Zool., London, XVIII, p. 146.

*Diagnosis of family*.—Simple or colonial Fungids, with solid septa<sup>a</sup> and solid walls. Synapticula present; dissepiments present or absent.

Three genera are placed in this family, *Trochoseris* M. Edwards and Haime, *Palæoseris* Duncan and *Bathyactis* Moseley. *Fungiacyathus*, though probably not a Fungid, is given here, because Moseley thought that it might be closely related to *Bathyactis*.

## TABLE OF DIFFERENTIAL CHARACTERS OF THE GENERA.

## I. Corallum trochoid or turbinate, pedicellate.

Columella papillary, no epitheca.

1. *Trochoseris* Milne Edwards and Haime.

Columella rudimentary, complete epitheca ..... 2. *Palæoseris* Duncan.

## II. Corallum discoid, free, not attached in the young stages.

Columella variable in development, no epitheca.

Septa in deltas, distant, wall thin. .... 3. *Bathyactis* Moseley.

[Columella none, no epitheca.

Septal ends not uniting ..... 4. *Fungiacyathus* Sars].<sup>b</sup>

## 1. Genus TROCHOSERIS Milne Edwards and Haime.

1849. *Trochoseris*, MILNE EDWARDS and HAIME, Comptes rend. Acad., Paris, XXIX, p. 72.

Genus placed by its authors in their "*Lophoserinæ*," which have the plateau without epitheca and echinulations, and have nonperforate tissues.

*Original generic diagnosis*.—Simple species, trochoid and fixed.

*Type species*.—*Anthophyllum distortum* Michelin, Iconog. Zoophytol., p. 149, pl. XLIII, figs. 8a, 8b.

*Remarks*.—The description published by Milne Edwards and Haime in their *Recherches sur les Polypiers*<sup>c</sup> is practically the same as the one in the *Histoire naturelle des Coralliaires*.<sup>d</sup> The salient characters are well covered in both. The following is the description given in the second work: "The corallum is simple, trochoid or cylindrical and attached. The wall is naked and shows throughout its height fine costal striæ. Columella papillary. Septa very numerous and laterally strongly granulate."

<sup>a</sup> I think that the young septa in some species of *Agaricia* may occasionally be perforated.

<sup>b</sup> The reason for inserting this genus here will appear under the description of *Bathyactis*. Moseley thought that they might be the same. I do not see how it is possible, and think that *Fungiacyathus* is one of the Turbinolid corals.

<sup>c</sup> Ann. Sci. nat., 3d ser., Zool., XV, 1851, p. 118.

<sup>d</sup> Vol. III, p. 57.



## 2. Genus PALÆOSERIS Duncan.

1870. *Palæoseris* DUNCAN, Quart. Jour. Geol. Soc., London, XXVI, p. 301.

Genus referred to the *Lophoserinæ*.

*Original generic diagnosis*.—"The corallum is simple, turbinate, and pedicellate. The septa are numerous. The epitheca is complete and dense, covering the costæ. The columella is rudimentary."

*Type species*.—*Trochoseris woodsi* Duncan, Ann. and Mag. Nat. Hist., 3d ser., XIV, p. 164, pl. VI, figs. 2a-2c, 1864. Also Quart. Jour. Geol. Soc., London, XXVI, p. 301, pl. xx, figs. 7a, 7b.

*Locality and geologic horizon*.—Tertiary, Muddy Creek, South Australia.

*Remarks*.—Duncan does not describe in detail the structure of the septa or the wall. The original figures of *Trochoseris woodsi* indicate that both the septa and the wall are imperforate. Therefore this genus apparently is an epithecate *Trochoseris* with a reduced columella.

Duncan, in his Revision of the Families and Genera of the Madreporaria,<sup>a</sup> makes *Palæoseris* a subgenus of *Turbinoseris* Duncan.

## 3. Genus BATHYACTIS Moseley.

1881. *Bathyactis* MOSELEY, Deep Sea Corals, Challenger Reports, p. 185.

Genus referred to the *Lophoserinæ*.

*Original generic diagnosis*.—"Corallum free, discoid, not attached or cup-shaped in the young condition, thin and fragile; primary septa free, the others united so as to form six deltoid combinations; upper margins of the septa usually coalescent over the apices of the deltas. Septa deeply toothed; synapticulæ sometimes abundant, sometimes few, arranged in a series of concentric circles. Columella well developed."

*Type species*.—*Fungia symmetrica* Pourtalès, Mus. Comp. Zool., Ill. Cat., No. IV, p. 46, pl. VII, figs. 5, 6; Moseley, Deep Sea Corals, Challenger Reports, p. 185.

*Distribution*.—Recent, almost universal in deep water.

Moseley remarks: "I am not sure whether *Fungiacyathus fragilis* of Prof. M. Sars<sup>b</sup> will not prove identical with *Bathyactis symmetrica*. If so, the name *Fungiacyathus* will take priority. *Fungiacyathus fragilis* agrees with *Bathyactis symmetrica* in all respects excepting that it has no synapticulæ. In some of the *Challenger* specimens there are very few synapticulæ indeed, but in none are these structures entirely absent. I therefore hesitate to place the two forms together at present. There can be little doubt that they are closely allied, and what little I have seen of the soft parts of *Bathyactis symmetrica* goes to confirm such an opinion."

<sup>a</sup> Jour. Linn. Soc. London, Zool., XVII, 1884, p. 148.

<sup>b</sup> On some remarkable forms of animal life from the great depths off the Norwegian Coast, I, p. 58, pl. v, figs. 24-32, Christiania, 1872.



## 4. Genus FUNGIACYATHUS M. Sars.

1872. *Fungiacyathus* M. Sars, Remarkable forms of animal life from great depths off the Norwegian coast, Pt. I, p. 60, pl. v, figs. 24-32.

*Original generic diagnosis.*—Corallum simple, free, without any sign of attachment, discoid, base horizontal, flat, beneath radially finely costate, no wall (theca) strictly speaking.<sup>a</sup> Calice subcircular, upper margin convex (septa tall), crispate. No columella, no pali. Septa numerous, 6 systems, forming 6-8 orders, primaries and secondaries much elevated, arched, transversely finely folded, upper margin faintly undulate, extending to the center, there irregularly lobed and flexed, throughout their length extremely thin, prominent above the outer margin of the calice. Calicular fossa rather large and uniformly depressed.

*Type species.*—*Fungiacyathus fragilis* M. Sars, Remarkable forms of animal life, etc., p. 58, pl. v, figs. 24-32.

*Distribution.*—Deep water, off the Norwegian coast.

*Remarks.*—Moseley (see p. 385) has raised a doubt regarding the systematic affinities of this coral, suggesting that it may be the same as his *Bathyactis*. Judging from the very careful description of G. O. Sars<sup>b</sup> I am inclined to believe it a Turbinolid, and not a Fungid.

## MICRABACIIDÆ, new family.

*Diagnosis of family.*—Simple fungids with solid septa and perforate wall.

Five genera are referred to this family: *Micrabacia* Milne Edwards and Haime, *Diafungia* Duncan, *Microsmilia* Koby, *Podoseris* Duncan, and *Antilloseris*, new genus.

## TABLE OF DIFFERENTIAL CHARACTERS OF THE GENERA.

## I. Costæ corresponding to intercostal spaces:

Corallum circular, lenticular, broader than high.

1. *Micrabacia* Milne Edwards and Haime.

Corallum with triangular piece extending to the center.

2. *Diafungia* Duncan.

## II. Costæ corresponding to the septa:

Columella strongly developed, corallum with narrow base, mural pores regular, epitheca thin ..... 3. *Microsmilia* Koby.

Columella small, base variable, mural pores irregular, epitheca present, variable, dissepiments present ..... 4. *Podoseris* Duncan.

Columella, s. s., absent, mural pores irregular, epitheca absent, dissepiments absent ..... 5. *Antilloseris* Vaughan.

<sup>a</sup> This must not be taken literally. There is a wall, but it is horizontal.—T. W. V.

<sup>b</sup> Remarkable forms of animal life, etc., pp. 58-60.



## 1. Genus MICRABACIA Milne Edwards and Haime.

1849. *Micrabacia*, MILNE EDWARDS and HAIME, Comptes rend. Acad., Paris, XXIX, p. 7.

Genus placed by Milne Edwards and Haime in their *Funginæ*, defined as having "the plateau without epitheca, usually strongly echinulate, tissues perforate."

*Original generic diagnosis*.—"Septa moderately numerous and straight. Wall scarcely echinulate, costæ alternating with the septa."

*Type species*.—*Fungia coronula* Goldfuss, Petref. German., I, p. 50, pl. XIV, fig. 10; *Micrabacia coronula*, Milne Edwards, Hist. Nat. Corall., III, p. 29.

*Distribution*.—Cretaceous, Craie tuffeau, Europe.

*Remarks*.—Milne Edwards and Haime, in their Recherches sur les Polypiers,<sup>a</sup> elaborated their characterization of this genus, and Milne Edwards gave additional detail in the third volume of the Histoire Naturelle des Corallaires (p. 29). Duncan, in his Revision of the Families and Genera of the Madreporaria,<sup>b</sup> gives a still fuller description, which I have verified by a study of the type species. It is as follows: "Corallum simple, free, lenticular, broader than high, convex above, slightly concave at the base, which has a circular outline. Calice with a small shallow axial depression, filled by a false columella, from which the principal septa radiate, being joined with those of the higher orders toward the circumference. Septa numerous, solid, imperforate, arched above, with a perpendicular outer edge. Costæ distinct on the base, bifurcating at the edge, a process from two costæ forming a septum. Intercostal spaces continuous with the line of direction of the septa, crossed by synapticula in concentric rows, and perforate between the synapticula. Interseptal loculi crossed by large and small synapticula, which radiate from the base in discontinuous lines, bounding canalicular spaces continuous below with the intercostal openings, and above with the interseptal loculi high up. Costæ granular. Septa crenulate or minutely denticulate."

## 2. Genus DIAFUNGIA Duncan.

1884. *Diafungia* DUNCAN, Jour. Linn. Soc. London, Zool., XVII, p. 417.

*Original generic diagnosis*.—"Corallum discoid, free, without trace of adhesion, not quite circular in outline, much broader than high. Base with a triangular piece extending beyond the center, slightly projecting downward, the rest of the coral grouping from its sides and apex, so that there is an appearance of former fracture and subsequent mending. Calice unsymmetrical from the prolongation of the larger septa of the primary piece beyond the center, and from the

<sup>a</sup> Ann. Sci. Nat., 3d ser., Zool., XV, 1851, p. 88.

<sup>b</sup> Jour. Linn. Soc. London, Zool., XVIII, 1884, p. 143.



radiation of septa from the sides and apex of the primary piece to the edge of the disc or the margin.

“Columella absent. Septa numerous, order confused; many join others near to and remote from the margin. Larger septa exsert, arched near the margin, from which they rise perpendicularly, and low near the septa of the primary piece. Septa dentate and strongly granular near their free edge, solid and stout.

“Costæ broad, unequal, often bifurcating, variously directed. At the margin each costa gives off a branch on either side to form a septum with the corresponding offshoot of the next costa. Hence the septa correspond with the intercostal spaces. Intercostal spaces regularly furnished with equidistant synaptacula, presenting a regularly perforated appearance. Synaptacula discontinuous, strongly developed between the septa, some reaching high up in the interseptal loculi. There is no true wall, the septa-costal structure being united by synaptacula alone.”

*Type species*.—*Diafungia granulata* Duncan, Jour. Linn. Soc. London, Zool., xvii, pp. 418, 419, pl. xx.

*Distribution*.—Corean Sea, shallow water, recent.

### 3. Genus MICROSMILIA Koby.

1888. *Microsmilia* Koby, Schweiz. palæontol. Gesellsch., Abhand., XV, p. 414.

*Original generic diagnosis*.—“Corallum small, simple, cylindrical, conical or discoid, attached by a narrow base. Calice circular or elliptical, superficial or more or less deep. Septa numerous, narrow, dentate on their inner margins, finely granulated on their faces. Columella strong, fasciculate. Wall well developed, membraniform, folded, pierced by equal and equidistant perforations. No dissepiments, but synaptacula are present.”

*Type species*.—*Anthophyllum erguelense* Thurmann, Abram. Gagnebin,<sup>a</sup> p. 137, pl. II, fig. 23; Koby, Schweiz. palæontol. Gesellsch., Abhand., XV, p. 415, pl. cxii, figs. 1–15. M. Koby places three species in his *Microsmilia*, *Anthophyllum erguelense* Thurmann, *Turbinolia delemontana* Thurmann, and *Microsmilia matheyi* Koby, but designates no type species. I have selected the first one, as it is quite elaborately described.

*Distribution*.—Jurassic, Oxfordian, Switzerland.

*Remarks*.—In describing *M. erguelense* (Thurmann), Koby gives several other interesting characters. He says that the septa are not perforate, that the wall is covered by a thin epitheca, and both describes and figures quite a number of specimens attached by the base to the inner side of a broken older corallum, reminding one very much of the budding of *Schizocyathus fissilis* Pourtalès.<sup>b</sup>

<sup>a</sup> I have not examined this work. The reference is copied from Koby.

<sup>b</sup> Mus. Comp. Zool. Cambridge, Ill. Cat., VIII, Mem. IV, 1874, p. 36, pls. vi, figs. 12, 13.



4. Genus *PODOSERIS* Duncan.

1869. *Podoseris* DUNCAN, Mon. Brit. foss. Cor., Sup., Pt. 2, No. 1, p. 25.

Genus placed in the *Lophoserinæ*.

*Original generic diagnosis*.—"The corallum has a large concave base, by which it is attached to foreign bodies. The epitheca begins at the basal margin, and is stout and reaches the calicular margin. The height of the corallum varies. The calice is generally smaller than the base and is convex. The septa are numerous and unequal, the largest reaching a rudimentary columella. The central fossula is circular and small. The costæ are seen when the epitheca is worn; they are distinct, connected by synapticalæ, and are straight.

"The genus has been created to admit *Micrabaciæ* with adherent bases and more or less of a peduncle."

*Type species*.—*Podoseris mammiliiformis* Duncan, Mon. Brit. foss. Cor., Sup., Pt. 2, No. 1, p. 25, pl. ix, figs. 2-15; also Ann. and Mag. Nat. Hist., 6th ser., IV, 1889, pp. 28-31, pl. v, fig. 9.

Duncan originally referred two species, *P. mammiliiformis* and *P. elongata*, to the genus without designating either one as the type. In his paper On the Cretaceous species of *Podoseris*,<sup>a</sup> however, he says, concerning the former: "This species was the type of the genus \* \* \* ." It therefore must be considered the type.

*Distribution*.—Red Chalk, Hunstanton, England.

*Remarks*.—Duncan gives in the paper just quoted much more information concerning the structural characters, and publishes the following more detailed diagnosis of the genus:

"The corallum has a narrow or wide base of permanent attachment, the height varies from very low, plano-convex to high; stem more or less cylindrical. Calice more or less circular, with a small axial fossa or projecting there; a columella formed by the septal ends, with or without other structure, small; septa numerous, uniting much, stout, or very slender, solid, largely granular at the free convex edge, minutely acicular at the sides; costæ as continuations of septa, in the direct line, usually the most numerous. Synapticalæ numerous, oblique, continuous with septal nodules, interseptal loculi also with recurved hook-like processes; a delicate arched dissepimental structure scanty. Epitheca exists on the sides and at the periphery.

"*Fossil*: Red Chalk, Oolite, England."<sup>b</sup>

Duncan does not make a positive statement concerning the structure of the wall except that in his original diagnosis he says the costæ "are distinct, connected by synapticalæ." Plate ix, fig. 3, of the original figures, shows that the wall is perforate.

<sup>a</sup> Ann. and Mag. Nat. Hist., 6th ser., IV, 1889, p. 28.

<sup>b</sup> Idem, p. 36.



Tomes<sup>a</sup> places Duncan's *Podoseris* in the genus *Rhizangia*, basing his identification on specimens labeled *Rhizangia sedgwicki* Reuss, from the Gosau, sent to him by W. Bölsche. As the type species of *Rhizangia* is the *Astrea brevissima* Deshayes,<sup>b</sup> the generic characters must be based primarily upon that species. The *Rhizangia sedgwicki* of Reuss may belong to *Podoseris* Duncan without affecting the validity of Duncan's genus. Tomes makes two observations that deserve consideration, namely, that there is asexual reproduction by gemmation from basal stolons in *Podoseris*, and that dissepiments are present. Tomes's figures (Plate XIV, figs. 7 and 8) do not look as if there was budding from stolons, and Duncan, in his reply to the criticism of Tomes,<sup>c</sup> says: "The form is not a social one, and never springs from stolons like *Rhizangia*." Tomes has more recently reiterated his identification of *Podoseris* and *Rhizangia*,<sup>d</sup> but has not adduced a particle of evidence to show that they are the same.

I should like to call attention to Felix's opinion on *Rhizangia sedgwicki*. He leaves it in the genus *Rhizangia* in his *Anthozoen der Gosauschichten in den Ostalpen*,<sup>e</sup> referring the genus to the *Astrangiaceæ* of M. Edwards and Haime. Most probably the specimens of Tomes are wrongly identified, or he has misinterpreted them.

### 5. Genus ANTILLOSERIS, new genus.<sup>f</sup>

1873. *Turbinoseris* DUNCAN, Quart. Jour. Geol. Soc. London, XXIX, p. 558.

[? *Turbinoseris* Duncan, 1870.]

1884. *Turbinoseris* (part) DUNCAN, Jour. Linn. Soc. London, Zool., XVIII, p. 148.

1899. *Turbinoseris* VAUGHAN, Bull. Mus. Comp. Zool., XXXIV, p. 243.

*Generic diagnosis*.—Corallum simple, cuneiform, or depressed, may be discoid, base narrow. No epitheca. Wall perforate, synaptulate. Costæ present as the distal terminations of the septa. Septa solid, septal margins dentate (dentations rounded in the type species), septal faces granulate. In cross section the granulations are usually directed inward and hooked. Synapticula out of the thecal ring rare; dissepiments appear to be entirely absent. Columella, strictly speaking, absent. When the more perfect calices are viewed from above, a narrow furrow is seen to occur in the axis; a thin section shows that lower down in the corallum the inner ends of opposed longer septa fuse directly across the axis; lateral fusion of the inner septal ends may, or may not, be complete in the axis.

<sup>a</sup> Geol. Mag., new ser. (Dec. III), II, 1885, p. 548.

<sup>b</sup> Comptes rend. Acad. Sci., Paris, XXVII, 1848, p. 496.

<sup>c</sup> Geog. Mag., new ser. (Dec. III), III, 1886, pp. 53, 54.

<sup>d</sup> Idem (Dec. IV), VI, 1899, p. 306.

<sup>e</sup> Palæontographica, XLIX, 1903, p. 268.

<sup>f</sup> Illustrations will be published in my forthcoming Tertiary Corals of North America, Part II, U. S. Geol. Surv. Mon., vol. —. (In preparation.)



*Type species.*—*Turbinoseris eocænica* Duncan, Quart. Jour. Geol. Soc. London, XXIX, p. 558, pl. XXI, fig. 12, 12a–12c.

*Distribution.*—Older Tertiaries of the Antilles.

*Remarks.*—Duncan referred the corals for which I am proposing *Antilloseris* to his *Turbinoseris*,<sup>a</sup> but it seems probable that *Turbinoseris* is a synonym of *Leptophyllia* Reuss. As will be pointed out later, *Turbinoseris* has never been properly defined (see p. 410). Rather than leave the West Indies species in the uncertain state in which they have been for many years, I have erected a new genus for them.

*Antilloseris* is very closely related to *Podoseris* Duncan. The former differ from the latter (1) by being devoid of epitheca, (2) by the absence of dissepiments, (3) by the absence of a columella. *Podoseris* appears to possess a small, but papillate columella.

### Family LEPTOPHYLLIIDÆ, new name.

1900. *Elhmotidæ* GREGORY, Jurassic Fauna of Cutch—The Corals, p. 30. (Synonymy given by Gregory on p. 161.)

*Diagnosis of the family.*—Simple or colonial Fungids, in which the septa are perforate lamellæ; perforations exist principally near the top or the inner ends of the septa, the pores below filled with stereoplasm.

I have placed nine of the described genera in this family, namely: *Gyroseris* Reuss, *Leptophyllia* Reuss, *Haplaræa* Milaschewitz, *Protethmos* Gregory, *Metethmos* Gregory, *Frechia* Gregory, *Placoseris* de Fromentel, *Lithoseris* Koby and *Procycololites* Frech. I have appended under the heading “Septa as in *Leptophylliidæ*; condition of wall unknown,” *Myriophyllia* Volz, *Omphalophyllia* Laube and *Craspedophyllia*, subgenus, Volz.

I think it very probable that the number of these genera will be considerably reduced.

#### TABLE OF DIFFERENTIAL CHARACTERS OF THE GENERA.

Wall solid:

I. No columella, thick epitheca ..... 1. *Gyroseris* Reuss.

Wall perforate:

II. Columella absent or rudimen- tary .....	Epitheca incom- plete or thin.	Septa perforate above, solid below, calice superficial .....	2. <i>Leptophyllia</i> Reuss.
		Septa perforate above, solid below, calice deep .....	3. <i>Procycololites</i> Frech.
		Septa with large irreg- ular pores, fusing with synaptacula to form an irregular mesh-work .....	4. <i>Haplaræa</i> Milasche- witz.

<sup>a</sup>For a discussion, see p. 410 of this paper.



III. Columella	spongy, parietal }	Epitheca absent or rudimen- tary .....	Septa perforate near axis and top .....	} 5. <i>Protethmos</i> Gregory. <sup>a</sup>
			Septa largely perfo- rate; no dissep- iments .....	
			Dissepiments highly developed .....	
IV. Columella	spongy, promi- nent ....	Epitheca com- plete .....	Septa little compact ("peu compactes")	} 8. <i>Lithoseris</i> Koby.
V. Columella	spongy, papillary.	Epitheca absent or rudimen- tary .....	Septa perforate near axis and near sur- face, solid below...	9. <i>Metethmos</i> Gregory.
VI. Columella	composed of com- pressed fused tra- becula...	Epitheca appar- ently absent..	Septa apparently per- forate along upper edge .....	10. <i>Placoseris</i> de Fro- mentel.

### 1. Genus GYROSERIS Reuss.

1854. *Gyroseris* REUSS, Denkschrift. Akad. Wiss. Wien, Mat. Naturhist. Cl., VII, p. 126.

Genus referred to the *Lophoserinae* of Milne Edwards and Haime.

*Original generic diagnosis*.—"Corallum free, simple, discoid or low-conical. Septa numerous, united by synaptacula. Papillary columella. Wall low, conical, with thick, concentrically wavy epitheca."

*Type species*.—*Gyroseris patellaris* Reuss, Denkschr. Akad. Wiss. Wien, Mat. Naturhist. Cl., VII, p. 126, pl. VII, figs. 12-15.

*Remarks*.—By neither Milne Edwards and Haime nor Duncan is anything additional given regarding this genus. Felix, however, in his *Anthozoen der Gosauschichten in den Ostalpen*,<sup>c</sup> says: "I should like to remark in addition to the description of Reuss that a columella either is absent or remains rudimentary. Isolated dissepiments, as well as synaptacula, occur between the septa. The septa originally are porous ('werden pöros angelegt'), but appear to become compact."

This genus appears very closely related to *Leptophyllia*. If the wall should be perforate the only means of differentiation is the thick, concentrically wavy epitheca, a character of doubtful diagnostic value.

<sup>a</sup> It is possible that the wall of this genus is solid. In that case it would belong near *Gyroseris*.

<sup>b</sup> This genus may have a papillary columella.

<sup>c</sup> *Palæontographica*, XLIX, 1903, p. 226.



## 2. Genus LEPTOPHYLLIA Reuss.

1854. *Leptophyllia* REUSS, Denkschr. Akad. Wiss. Wien, Mat. Naturhist. Cl., VII, p. 101.

*Original generic diagnosis.*—"Corallum simple, more or less conical or turbinate, attached by the base. No columella. Very numerous, crowded, thin septa that fuse directly in the center, upper free margins furnished with very distinct, regular, pointed, short teeth. The outer wall without epitheca, ribs distinct and covered with strong, pointed, grain-like teeth.

"Is separated from the very nearly related genus *Montlivaltia* by the absence of epitheca, from *Trochosmilia* by the dentation of the free margins of the septa."

*Type species.*—*Leptophyllia clavata* Reuss, Denkschr. Akad. Wiss. Wien, Mat. Naturhist. Cl., VII, p. 101, pl. VI, figs. 3-6.

*Distribution.*—Cretaceous, Senonian, Gosau, Austria.

Pratz, in his Ueber die verwandtschaftlichen Beziehungen einiger Korallengattungen mit hauptsächlichlicher Berücksichtigung ihrer Septalstruktur,<sup>a</sup> made a careful study of the septal structure of *Leptophyllia clavata*, and showed that the septa of that species are composed of trabeculae which stand more or less perpendicular to the septal margin. The trabeculae consist of rows of nodules (Knötchen), which are regularly grouped, quite often spirally, as in *Cyclolites*. The lateral granulations of neighboring trabeculae often fuse and form vertical rows of pores. In the bottom of the calice the pores are filled, the rows of pores are mostly seen on the upper part of the septum, while on the lower part they usually disappear. The wall is described as dissepimental.<sup>b</sup>

Ogilvie, in her Korallen der Stramberger Schichten,<sup>c</sup> redefined the genus and followed the data of Pratz in drawing up her definition. Felix, in his Anthozoen der Gosauschichten in den Ostalpen,<sup>d</sup> merely refers to Pratz's work for an account of the microstructure of the genus. He combines the *Leptophyllia irregularis* and *L. clavata* Reuss, thus making the genus monotypic. Several other forms not originally referred to *Leptophyllia* are also placed in the synonymy of *L. clavata*.

<sup>a</sup> Palaeontographica, XXIX, 1882, pp. 90-92.

<sup>b</sup> Gregory, in his Jurassic Corals of Cutch, p. 162, makes a statement that is difficult to understand. In discussing the affinities of his *Ethmotidae*, he says: "They form the chief part of the alliance *Leptophyllioida* of Duncan. But uncertainty as to the structure of true *Leptophyllia* of Reuss renders it inadvisable to take that genus as the type of the group." I do not see how the description of Pratz, based on one of Reuss's original species, could have been overlooked. There is scarcely any coral whose septal structure is more thoroughly known than that of *Leptophyllia*.

<sup>c</sup> Palaeontographica, Sup. II, VII Abtheil., 1897, p. 218.

<sup>d</sup> Idem, XLIX, 1903, pp. 200-202.



The following is Ogilvie's recharacterization of *Leptophyllia*:<sup>a</sup>

"Corallum simple, conical, or cylindro-conical, with superficial calice. Septa numerous, thin, margins regularly toothed, on the faces rows of granulations that run perpendicular to the septal margin and form pseudo-synapticula. Septa not always, and then only partially, perforate. Dissepiments thin, numerous, vesicular, thicker toward the periphery and with the septa forming a pseudotheca. Costal ends of the septa finely toothed. Thin epitheca present."

As full a discussion of the relations of *Leptophyllia* and *Turbinoseris* as is at present possible is given on pp. 410-412.

### 3. Genus PROCYCLOLITES Frech.

1890. *Procycolites* FRECH, Palæontographica, XXXVII, p. 64.

*Original generic diagnosis*.—"Simple, more rarely composed of two fused individuals. Calice deep. Inner structure partly similar to *Cyclolites*. However, the septa rather quickly become solid lamellæ, the number of pores that remain open is small and they are confined to the youngest parts of the septa (fig. 11 A). On the faces of the septa are horizontal, elongate dissepiments, but they almost never unite with those of the neighboring septa. True synapticula are rare. Dissepiments fine and numerous."

*Type species*.—*Procycolites triadicus* Frech, Palæontographica, XXXVII, p. 64, pl. xviii (all figs. except 17), text fig., p. 65.

*Distribution*.—Triassic, Fischerwiese, Gosau, etc., Austria.

*Remarks*.—Frech says that "The external differences (the deep calice) are scarcely sufficient to separate the genus from *Cyclolites*, especially as *Cyclolites undulata* possesses much external resemblance. However, the presence of synapticula alongside of dissepiments, also the relative rarity of septal pores, constitute sufficient differences. *Procycolites* probably represents, as its name indicates, a predecessor of *Cyclolites*. There is no nearer relationship to *Haplaræa* Milaschewitz (Upper Jurassic) (with which *Diplaræa* belongs), as the septa of the Jurassic corals are distinctly porous. The septal structure of *Leptophyllia*<sup>b</sup> shows only a remote resemblance. In it the septal spines originate separately, and are covered with numerous, regularly arranged nodules."

Frech published no observation on the wall, columella, or epitheca. However, information on these structures can be obtained from his figures. The distal ends of the septa are represented as free—they probably are united by synapticula. Fig. 7 represents a specimen, "wohlerhaltene Aussenseite mit Theka." Apparently there is an incomplete epitheca. Fig. 5, a section across the axis of a specimen, shows no vestige of a columella, nor does fig. 4 show any.

<sup>a</sup> Palæontographica, Sup. II, VII Abtheil., 1897, p. 218.

<sup>b</sup> Idem, XXIX, pl. xiv, fig. 9.



4. Genus *HAPLARÆA* Milaschewitz.

1876. *Haplaræa* MILASCHEWITZ, Palæontographica, XXI, p. 228.

*Original generic diagnosis*.—"Corallum simple, cylindrical, attached to the object of support by a broad surface, outside covered by a smooth, wavy epitheca. The septa are rather strongly developed, with large pores scattered without order. The younger septa unite with the older, and all the septa are united by numerous and well-developed synapticula. Columella absent."

*Type species*.—*Haplaræa elegans* Milaschewitz, Palæontographica, XXI, p. 229, pl. LI, figs. 2, 2a, 2b.

*Distribution*.—Jurassic, Nattheimer Schichten, Germany.

*Remarks*.—Pratz<sup>a</sup> describes a coral, that he refers to *Haplaræa*, from the Cretaceous of St. Gilgen, on Wolfgangsee. Unfortunately this coral can not be used in defining the genus *Haplaræa*.

Ogilvie in her Korallen der Stramberger Schichten, pages 250, 251, apparently bases her remarks on *Haplaræa* on the work of Pratz, a procedure that is unfortunate, but her redefinition of the genus (p. 261) does not differ specially from the original definition of Milaschewitz.

*Ogilvie's redefinition*.—"Corallum simple, cylindrical. Septa numerous, very perforate, irregularly curved, and abundantly fusing by their sides. Septa often resolved into short, thick trabeculæ, and forming with the synapticula an irregular, perforate mess work. Pseudosynapticula not numerous. Dissepiments numerous and vesicular. Columella not recognizable. No true wall present, only a pseudothecal thickening of the septal and interseptal skeletal parts near the outer wall. Epitheca thin, wrinkled, reaching to the calicular margin."

Milaschewitz referred *Haplaræa* to the *Poritidæ*; Zittel<sup>b</sup> placed it with *Calostylis* in the *Eupsammidæ*. Ogilvie followed Zittel. Gregory<sup>c</sup> places it in his *Ethmotidæ*.

5. Genus *PROTETHMOS* Gregory.<sup>d</sup>

1900. *Protethmos*, GREGORY, Jurassic Fauna of Cutch, The Corals, p. 162.

*Original generic diagnosis*.—"Ethmotidæ in which the corallum is simple and short; conical, turbinate, or pedunculate. Septa perforate near the axis and near the top; granulate laterally, and coarsely denticulate above; rather stout, numerous, and usually straight. Synapticulæ, scarce. Columella, parietal, spongy; well developed. Calice shallow or of medium depth."

*Type species*.—*Protethmos oldhami* Gregory, Jurassic Fauna of Cutch, The Corals, p. 164, pl. XVIII, figs. 10-13.

<sup>a</sup> Verwandtschaftliche Beziehungen einiger Korallengattungen, pp. 102, 103.

<sup>b</sup> Handb. Palaontologie, I, 1880, p. 242.

<sup>c</sup> Jurassic Corals of Cutch, p. 162.

<sup>d</sup> If the wall of this genus is imperforate it should be placed near *Gyroseris*.



*Distribution*.—Jurassic of India.

*Remarks*.—Gregory gives a lengthy discussion of the affinities of *Protethmos*.<sup>a</sup> It is separated from *Epistreptophyllum* Milaschewitz, *Lithoseris* Koby (probably a synonym of the former) and *Turbinoseris* Duncan by these genera probably having imperforate septa. I have pointed out in the present paper that none of them is adequately described. *Podoseris* Duncan is said positively to have imperforate septa.

Gregory does not describe the wall, nor does he state whether epitheca is present or absent. Figs. 10c and 12c (Plate XVIII) show a thick, imperforate wall—such is at least the condition below the upper edge of the calice. Epitheca appears from the figures to be absent or only vestigial.

#### 6. Genus FRECHIA Gregory.

1900. *Frechia* GREGORY, Jurassic Fauna of Cutch, The Corals, p. 167.

*Original generic diagnosis*.—" *Ethmotidæ*, with a small, simple corallum, which is free or pedunculate, trochoid, or cylindrical. Calice variable in depth; generally fairly deep. Septa largely perforate; synapticulæ scarce; no dissepiments. Columella parietal, but well-developed."

*Type species*.—*Frechia cornutiformis* Gregory, Jurassic Fauna of Cutch, p. 168, pl. xxi, figs. 1-3.

*Remarks*.—This genus is separated from *Protethmos* Gregory by its more abundantly perforated septa, and from *Leptophyllia* Reuss by its possessing a well-developed parietal columella.

Gregory in his generic diagnosis gives no information on the character of the wall, nor as to the presence or absence of dissepiments and epitheca. However, in the description of the type species, *F. cornutiformis*, he says, "near the margin of the coral the septa may be united by secondary thickening into an apparent wall." This would indicate an abundantly perforate wall. Judging from Plate XXI, fig. 3b, near the base the septa are distally much thickened, forming a thick pseudotheca. Plate XXI, fig. 2, apparently shows dissepiments alongside synapticulæ. If epitheca is present, it is only vestigial.

#### 7. PHYSOSERIS, new genus.<sup>b</sup>

1873. *Trochosmilia* DUNCAN, Quart. Jour. Geol. Soc., London, XXIX, p. 552, pl. XIX, figs. 2, 2a, 3, (not *Trochosmilia* Milne Edwards and Haime).

*Generic diagnosis*.—Corallum simple, subcylindrical or compressed. Epitheca entirely absent or rudimentary. Wall composed of pseudothecal thickenings of the septa, or of dissepiments; it is mostly dissepi-

<sup>a</sup> Jurassic Fauna of Cutch, The Corals, p. 163.

<sup>b</sup> Illustrations will be published in my forthcoming Tertiary corals of North America. Part II. U. S. Geol. Surv., Mon., vol. —. [In preparation.]



mental. In fact, the dissepiments are so arranged as to give the appearance of an imperforate wall in many, if not most, cases. Costæ present, representing the peripheral ends of the septa; rather prominent and distant, often with definite girdling exothecal rings, the dissepiments in these rings extending to the costal ends. Between the rings thinner dissepiments can often be seen. Septa irregularly perforate, the first and second cycles thicker and not so perforate as the higher cycles, however they show distinct perforations; in three polished sections I found about three thicker septa that seemed to be imperforate. The septa of the higher cycles are thinner and more perforate. There is no regularity in the perforations—they may exist near the columella, in the median portion of a septum, or near the peripheral (costal) end. A longitudinal section shows that the trabeculæ may be interrupted. The septal pores do not fill up near the base, probably due to the highly developed dissepiments cutting off the base of the corallum from the soft parts of the polyp. There is a tendency, but not a very striking one, to form septal groups. Synapticula scarce, present near the base, and probably also near the inner ends of the septa. Dissepiments well developed, curving outward, one set above another. In a cross section of a corallum they show as several definite rings—usually three or four rings occur between the columella and the peripheral or mural zone. Columella distinctly developed, shows in transverse section as a number of axial trabeculæ, which may be more or less fused among one another, and to the inner ends of the septa. Its upper surface is probably, though not positively, papillate.

*Type species*.—*Trochosmilia insignis* Duncan (= *T. insignis* Duncan + *T. arguta* Duncan (not Reuss)), Quart. Jour. Geol. Soc. London, XXIX, p. 552, pl. XIX, figs. 2, 2a; also fig. 3.

*Distribution*.—Old Tertiaries of St. Bartholomew, West Indies.

*Remarks*.—How Duncan ever referred his *Trochosmilia insignis* to *Trochosmilia* passes comprehension. As Prof. A. G. Högbom, of the University of Upsala, has kindly loaned me Duncan's type, I have been able to base a large portion of the above description on the type specimen. Two thin sections, two polished transverse sections, and one polished longitudinal section of other specimens were prepared. Duncan's type (which had been cut) shows nearly every character, given in the preceding diagnosis, that can be seen on a transverse section. His figure of the transverse section (Plate XIX, fig. 2a) clearly indicates perforate septa. The specimen identified by Duncan as *T. arguta* Reuss is precisely the same thing. It also has perfectly distinct septal perforations, and there are hints of columellar papillæ.

This genus, I think, is most closely related to *Frechia* Gregory, but can be immediately separated by its highly developed dissepiments. The genus seems to be unusually distinct from any of those previously described.



## 8. Genus LITHOSERIS Koby.

1886. *Lithoseris* Koby, Schweiz. Palæontol. Gesellsch., Abhand., XIII, p. 338.

*Original generic diagnosis.*—"Corallum simple, more or less elevated and turbinate. Septa numerous, crowded, little compact (*peu compactes*), free margin divided into irregular granulations, septal faces covered with irregular granulations. Columella spongy, prominent. Epitheca complete. Pseudo-synapticula numerous. Dissepiments rare."

*Type species.*—*Lithoseris gracilis* Koby, Schweiz. Palæontol. Gesellsch., Abhand., XIII, p. 338, pl. xciii, figs. 32, 32a. M. Koby in establishing this genus placed two species in it, *L. gracilis* and *L. compressa*, both named by himself. He did not designate a type species. I have therefore arbitrarily selected the first.

*Distribution.*—Jurassic, St. Ursanne, Switzerland.

*Remarks.*—M. Koby does not take up this genus in his *Remarques paléontologiques sur les Polypiers jurassiques de la Suisse*.<sup>a</sup> The structure of the wall and septa is not adequately discussed. However, from his placing it near *Leptophyllia*, one may be justified in thinking that it differs from that genus by possessing a complete epitheca and a well-developed, prominent columella.

Ogilvie, in her *Korallen der Strambergerschichten*,<sup>b</sup> places *Lithoseris* in the synonymy of *Epistreptophyllum* Milaschewitz.

The Nattheim specimens of *Epistreptophyllum* have not, I believe, been sufficiently studied for us to know positively the characters of that genus. *Lithoseris* also needs further study. However, I will say that an examination of the plates of Milaschewitz and Koby furnishes support to Ogilvie's view, but her conclusion can not be accepted as proven. Gregory<sup>c</sup> makes observations on the relations of *Lithoseris* and *Epistreptophyllum* of practically the same import as what is said above.

## 9. Genus METETHMOS Gregory.

1900. *Metethmos* GREGORY, Jurassic Fauna of Cutch, the Corals, p. 165.

*Original generic diagnosis.*—"Ethmotidæ in which the corallum is simple, short, conical, and pedunculate. Calice shallow. Septa perforate near the axis and near the surface, but near the base the pores are closed by stereoplasm. Septa fairly straight and crowded. Dentate. Synapticulæ scarce. Columella well developed, papillary."

*Type species.*—*Metethmos blanfordi* Gregory, Jurassic Fauna of Cutch, p. 165, pl. xviii, figs 4-6, 8, 11.

<sup>a</sup> Schweiz. Palæontol. Gesellsch., Abhand., XVI.

<sup>b</sup> Palæontogr., Sup., II, p. 255.

<sup>c</sup> Jurassic Fauna of Cutch, the Corals, p. 163.



*Remarks.*—Gregory says *Metethmos* is most closely allied to *Pro-tethmos*, differing from that genus by possessing a well-developed papillary, instead of a parietal columella. *Microsmilia* Koby differs in having a regularly perforate wall.

The structure of the wall is not given, nor is anything said concerning the epitheca. Fig. 6*b* (Plate XVIII) indicates that below the bottom of the calice the wall is compact; fig. 8*b* seems to show a few perforations. Epitheca, if not altogether absent, is only vestigial.

#### 10. Genus PLACOSERIS de Fromentel.

1860. *Placoseris* de FROMENTEL, Paléontol. franç., Crétacé, VIII, Pt. 24, p. 329.

*Original generic diagnosis.*—"Corallum attached by a wide base, wall cylindrical. Costæ granulated and well marked. Septa synapticate, numerous and unequal, columella elongate, composed of a series of trabeculæ fused together and laterally strongly spinose."

*Type species.*—*Placoseris patella* de Fromentel, Paléontol. franç., Crétacé, VIII, p. 330, pl. XLIX, fig. 4.

*Distribution.*—Cretaceous, Cenomanian, Saint Croix, France.

*Remarks.*—M. de Fromentel says nothing about the structure of the wall or septa, nor does he make any statement regarding the epitheca. According to his enlarged figure of the calice (Plate XLIX, fig. 4*b*), the wall appears perforate in places; the septa seem to be interrupted along the upper margins, strongly suggesting pores. Epitheca is not indicated in the upright view of the corallum, fig. 4. However, the type species needs to be carefully restudied.

SEPTA AS IN LEPTOPHYLLIIDÆ; CHARACTER OF WALL UNKNOWN.

Myriophyllia Volz.

Omphalophyllia Laube.

Subgenus Craspedophyllia Volz.

#### Genus MYRIOPHYLLIA Volz.

1896. *Muriophyllia* VÖLZ, Palæontographica, XLIII, p. 64.

*Original generic diagnosis.*—"Corallum simple, with numerous instances of transitions to compound or compact mode of growth. The septa are extremely fine and numerous. They are composed of distinctly differentiated trabeculæ (Balken), are mostly compact, but pores may be present. Especially characteristic are the long, jagged, macroscopically scarcely visible septal granulations, with which the septal faces are covered. Columella spongy. Synaptacula numerous. Endotheca, and usually also the pseudotheca, well developed. Central fossa round or elongate, sunken."



*Type species.*—*Myriophyllia badiotica* Volz, *Palæontographica*, XLIII, p. 75, pl. ix, fig. 9, text figs., pp. 74, 75.<sup>a</sup>

Volz places five species in *Myriophyllia*, namely: *Myriophyllia badiotica* Volz, new species, *Omphalophyllia gracilis* Laube (= *O. gracilis*+*O. cyclolitiformis* Laube), *Myriophyllia münsteri*, new species, *Montlivaltia dichotoma* Klipstein and *Myriophyllia mojsvari*, new species, without designating a type species.

*Distribution.*—Trias, Schichten von St. Cassian, South Tyrol.

*Remarks.*—According to Volz,<sup>b</sup> the *Omphalophyllia* of Laube contained two genera, both very closely related, but distinguishable through differences in their columellæ. Some of the species originally placed in *Omphalophyllia* by Laube possess a compact columella; these Volz retains in *Omphalophyllia*. Others possess a spongy and often very scant (*sehr spärlich entwickelt*) columella; for these he proposed the name *Myriophyllia*.

Volz does not describe the wall under the generic diagnosis, nor does he make any remarks on the epitheca. Under the description of the type species *M. badiotica*, however, he says: "The wall is very thin, not thickened by stereoplasmic deposit. Externally it appears solid. It is beset with coarse, often strongly projecting collarlike processes, between which are fine wrinkles. The septa are visible externally as longitudinal ribs." Therefore, apparently the wall is imperforate, and there is no epitheca.

#### Genus OMPHALOPHYLLIA Laube.

1865. *Omphalophyllia* LAUBE, Denkschr. Akad. Wissensch. Wien, Mat. Naturhist. Cl., XXIV, p. 251.

*Original generic diagnosis:* "Corallum simple, attached; epitheca strong; columella prominent, styliform; septa numerous, slightly unequal, dichotomous, curved, granulated, serrate; calice, subplane." (Translation of Latin diagnosis.)

"Corallum simple, attached, sometimes pedicellate; the columella distinctly developed, styliform, forming a buttonlike projection in the bottom of the calice. Septa numerous, slightly arched, serrate on the sides, granulate on the upper margin [*sic*, auf den Seiten gesägt, auf dem obern Rande gekörnt!],<sup>c</sup> straight or curved, anastomosing and radiating dichotomously or trichotomously from the calicular fossa. Epitheca strongly developed, always present, reaching to the

<sup>a</sup>This is the same as the *Montlivaltia*? new species Loretz, Zeitschr. deutsch. geolog. Gesellsch. 1875, p. 825, pl. xxii, fig. 9; the label of the original specimen bearing, according to Volz, the name *Montlivaltia badiotica* Loretz. Apparently Loretz never published the name, therefore the species must be credited to Volz.

<sup>b</sup>*Palæontographica*, XLIII, p. 63.

<sup>c</sup>I think Laube must have meant *auf dem obern Rande gesägt, auf den Seiten gekörnt*, i. e., by a printer's error the words "*Seiten*" and "*Rande*" have been transposed.



margin of the calice. Calice shallow, discoid." (Translation of German diagnosis.)

*Type species:* *Omphalophyllia boletiformis* (Münster) = *Montlivaltia boletiformis* Münster (Beitr. Geognos. und Petref. südöst. Tirols, Pl. II, fig. 9)<sup>a</sup> = *Omphalophyllia gracilis*, e. p. Laube. (Synonymy after Volz.)

Laube cites,<sup>b</sup> *Omphalophyllia gracilis* Münster as the type. Volz, in his *Korallen der Schichten von St. Cassian*,<sup>c</sup> says that Laube confused three different species under the name *Omphalophyllia gracilis*. Laube gives, on Plate III of his work cited, three figures, 5, 5a, and 5b. In the explanation of the figures, he says: "Fig. 5. *Omphalophyllia gracilis* Münster from the side, *a* from above, *b* very much enlarged cross section of a calice, diagrammatic." According to Volz:

"(1) Fig. 5 = *Omphalophyllia boletiformis* Münster not Laube.

"(2) Fig. 5a = *Craspedophyllia gracilis* Laube.

"(3) Fig. 5b = *Myriophyllia gracilis* Laube. (The septa are represented as black. There is no columella.)"

From a study of Laube's figures I believe that figs. 5 and 5a are two views of the same specimen and that the "black" in fig. 5b can not represent the septa. If such were the case there would be no wall, no columella, and the septa would be as perforate as in *Anabracia*. It is my opinion that Laube's figures all represent the same species. The type-species of the genus is represented by Plate III, figs. 5, 5a, 5b, or, if Volz's contention is true, by fig. 5.

*Distribution.*—Triassic, St. Cassian beds, southern Tyrol.

*Remarks.*—Volz, in his *Korallen der Schichten von St. Cassian* (p. 64), undertook to redefine *Omphalophyllia*. He, however, makes no reference to a type-species. His diagnosis is as follows: "*Thamnastreaeidae* of simple (fungioid, discoid, conical, or cylindrical form) or compound growth. The septa are composed of distinctly differentiated trabeculae; pores are rare. On the septal faces are more or less distinctly horizontal rows of granulations, sometimes also compact dissepiments. The columella firm and compact; more rarely are small holes recognized in its structure. Synapticula present." Although Volz does not say it, his description applies to his *O. boletiformis* (Münster), Plate VIII, figs. 1-8.

The wall is not satisfactorily described. Under *O. boletiformis* he says: "The wall is very thin; when preserved it appears externally to be solid. Covered with numerous weak transverse wrinkles." One is led to suspect that only the epitheca is described.

<sup>a</sup> This reference is taken from Volz. I have not been able to consult Münster's work.

<sup>b</sup> Denkschr. Akad. Wis. Wien., Math. Naturhist. Cl., XXIV, p. 251.

<sup>c</sup> Palaeontographica, XLIII, p. 66.



## Genus OMPHALOPHYLLIA Laube.

## Subgenus CRASPEDOPHYLLIA Volz.

1896. *Craspedophyllia* Volz, Palaeontographica, XLIII, p. 64.

*Generic diagnosis*.—"The new subgenus *Craspedophyllia* is separated from *Omphalophyllia* by possessing a primitive septum (*Urseptum*) and horizontal endothecal dissepiments."

*Type-species*.—*Craspedophyllia cristata* Volz, Palaeontographica, XLIII, p. 65, pl. VII, figs. 10-14, 22, text fig. 15, p. 15.

Volz referred three species to this subgenus, namely: *Axosmilia alpina* Loretz, *Craspedophyllia cristata*, new species, and *Omphalophyllia gracilis* Laube, designating no type-species. As Volz lays so much stress on the "*Urseptum*," I have selected as the genotype the species for which the "*Urseptum*" is figured (p. 15, fig. 15). However, the horizontal dissepiments appear to be more typically developed in *Craspedophyllia gracilis* (Laube) Volz.

*Distribution*.—Triassic, St. Cassian beds, south Tyrol.

## Family ANABRACIIDÆ Duncan (spelling emend.).

1884. *Anabraciæ* DUNCAN, Jour. Linn. Soc. London, Zool., XVIII, p. 165.

1900. *Microsolenidæ* GREGORY, Jurassic Fauna of Cutch, the Corals, p. 30 (synonymy, p. 173).

*Original diagnosis of family*.—"Madreporaria Fungida simple or colonial. Septa trabeculate and fenestrated. Synapticula small. Dissepiments absent. Wall indistinct."

The family must be extended to include genera in which dissepiments exist.

Gregory's *Microsolenidæ*<sup>a</sup> becomes an exact synonym. His definition is "Simple or colonial Fungida in which the septa are palissades of more or less vertical, disconnected, regular, or irregular trabeculæ."

Four genera, *Anabracia* d'Orbigny, *Trochophlegma* Gregory, *Cyclolites* Lamarek, and *Trocharæa* Étallon are placed in this family.

## TABLE OF DIFFERENTIAL CHARACTERS OF THE GENERA.

I. Columella—none	No epitheca...	Septa very thin, trabeculæ mostly separate, fusing very little.	1. <i>Anabracia</i> d'Orbigny.
		Septa externally subequal, trabeculæ somewhat fused below.	2. <i>Trochophlegma</i> Gregory.
	With epitheca.	Septa externally somewhat larger.	3. <i>Cyclolites</i> Lamarek.
II. Columella—parietal...	No epitheca	Septal trabeculæ united below into short series.	4. <i>Trocharæa</i> Étallon.

<sup>a</sup>Jurassic Fauna of Cutch, the Corals, 1900, p. 30.



## 1. Genus ANABRACIA d'Orbigny.

1849. *Anabracia* D'ORBIGNY, Notes sur des Polyp. foss., p. 11.

*Original generic diagnosis*.—"Form circular, depressed, convex, and covered above with small radiating, unequal septa; base horizontal, with radiating, granulated, dichotomous ribs."

*Type-species*.—*A. bajociana* d'Orbigny = *Fungia complanata* De-france, 1820, Dict. Sci. Nat., XVII, p. 217.

*Distribution*.—Inferior Oolite of Europe.

*Remarks*.—Milne Edwards in 1860<sup>a</sup> changed the spelling of the name from *Anabracia* to *Anabacia*, redefined the genus in much greater detail, and placed d'Orbigny's *A. bajociana* in the synonymy of the *Fungia complanata* of De-france.<sup>b</sup> This characterization holds good for to-day and is as follows: "The corallum is simple, free, and without trace of adhesion; it has the form of a small plano-convex lens. The upper surface shows in the center a small, shallow fossa, where no trace of a columella can be distinguished. The septa are subtrabecular (*subpoutrellaires*), very numerous and thin, finely and regularly crenulate; they terminate on the lower face of the corallum in crenulate costal edges similar to those of the upper surface, without there being a distinct basal wall. The septa of the last cycle unite by their inner margins to the neighboring primaries.

"The *Anabaciæ* differ from the other species of this subfamily [*Funginæ*], the *Fungiæ* and *Micrabaciæ*, by the absence of a wall, properly speaking, and the much less perfectly developed septa."

The septa of *Anabracia* are formed by palissades of small rods (trabeculæ) connected with one another so as to form a regularly fenestrated network. Duncan makes the genus the type of his family *Anabaciadæ*.<sup>c</sup> Gregory places it in his *Microsolenidæ*.<sup>d</sup>

## 2. Genus TROCHOPHLEGMA Gregory.

1900. *Trochophlegma* GREGORY, Jurassic Fauna of Cutch, the Corals, p. 179.

*Original generic diagnosis*.—"Microsolenidæ, in which the corallum is simple or composed of a few corallites united by lateral gemmation; it is fixed or free, and may be pedunculate or have a rounded convex base. Calice small, but well marked. Columella absent; the calicular fossa is small, but rather deep; it is central or excentric in position. Septa very numerous; trabicular. The septal elements consist of upright rods, which slope slightly outward as they are followed from the base; they are connected by two sets of cross rods at right angles to each other. The concentric horizontal bars are very conspicuous

<sup>a</sup> Hist. nat. Corall., III, pp. 31, 32.

<sup>b</sup> Dict. Sci. nat., XVII, 1820, p. 217.

<sup>c</sup> Jour. Linn. Soc. London, Zool., XVII, 1884, p. 165.

<sup>d</sup> Jurassic Fauna of Cutch, the Corals, 1900, p. 174.



in vertical sections. The rods are often connected by stereoplasmic deposits, which give rise to an appearance of continuous plates in transverse sections (Plate XXIII, figs. 9c and 9d)."

*Type species*.—*Trochophlegma tenuilamellosa* Gregory, Jurassic Fauna of Cutch, p. 180, pl. XXIII, figs. 3–10.

*Distribution*.—Jurassic, Upper Putschum beds, Kach, India.

*Remarks*.—Gregory says: "*Trochophlegma* is nearer to *Cyclolites* [than to *Leptophyllia*], in which I first placed it. But the type species of *Cyclolites* is *C. elliptica* Lamarck, with which the characteristic species of the genus such as *C. undulata* (Goldfuss), *C. polymorpha* (Goldfuss), and *C. discoidea* (Goldfuss) agree in all essential particulars. The main difference between *Trochophlegma* and *Cyclolites* is that in the latter the septa are not subequal. In *C. elliptica*, for example, after every four or five equal thin septa, there is one much thicker than the rest. This feature is conspicuous both on the external surface and in thin horizontal sections. The feature is stated in Edwards and Haime's diagnosis of the type species and illustrated in Pratz's figures. It is true that in transverse sections of *Trochophlegma* an apparent inequality of the septa is produced by stereoplasmic union of some lines of trabeculae; but in all the Indian specimens the septa externally appear subequal, as shown on Plate XXXIII, fig. 3a or 4c. In *Cyclolites*, moreover, the calicular fossa is a deep, elongated trench, extending nearly across the corallum, whereas in *Trochophlegma* it is small and circular. The more lamellar aspect of the septa of *Cyclolites* is illustrated by Duncan's figures<sup>a</sup> of the Sind series of corals belonging to this genus. The same character separates *Procyclolites* Frech, in which the septa are said to develop 'ziemlich schnell zu compacten lamellen; die Zahl der offen bleibenden Poren ist sehr gering und auf die jüngsten Theile der Septa beschränkt.'"

### 3. Genus CYCLOLITES Lamarck.

1801. *Cyclolites* LAMARCK, Syst. Anim. sans Vert., p. 369.

*Original generic diagnosis*.—"Corallum free, orbicular or elliptical, convex and lamellate above, flattened below, with concentric circular lines.

"It forms a single lamellate star."

*Type species*.—*Cyclolites elliptica* Lamarck, Hist. Nat. Anim. sans Vert., II, p. 234.

The following species are placed in the genus:

1. *Cyclolites numismalis* Lamarck.
2. *Cyclolites hemisphaerica* Lamarck.
3. *Cyclolites elliptica* Lamarck.

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<sup>a</sup> Gregory overlooked that Duncan, because of the imperforate septa of these corals, erected a new genus, *Zittelo fungia*, for them. See *Zittelo fungia*, p. 408, of the present paper.



4. *Cyclolites cristata* Lamarck.

However, they are first described in 1816.<sup>a</sup>

Of these species Milne Edwards and Haime left *C. numismalis*, *C. hemisphærica*, and *C. elliptica* in the genus *Cyclolites*, referring *C. hemisphærica* to the synonymy of *C. elliptica*.<sup>b</sup>

The fourth species, *C. cristata*, belongs to an entirely different genus, *Aspidiscus* Koenig,<sup>c</sup> 1825. Therefore the type-species must be *C. numismalis* or *C. elliptica*. Milne Edwards and Haime in 1849<sup>d</sup> selected the latter.

*Distribution*.—Upper Cretaceous, Senonian of Europe.

*Remarks*.—Pratz in his *Verwandschaftliche Beziehungen einiger Korallengattungen* describes in detail the septal structure of a coral said to be a *Cyclolites*, but unfortunately does not give the name of the species nor does he give any clue by which it can be determined. I broke a specimen of *C. elliptica*, from Gosau, identified by Prof. J. Felix, and find that the septal structure, so far as can be distinguished by means of a hand lens, agrees with Pratz's figure, Plate XIV, fig. 1.<sup>e</sup> Therefore I believe that the structure given by Pratz for *Cyclolites* is correct.

The septa of *Cyclolites (elliptica)* are composed of quite small trabeculæ, that in general run at right angles to the free edge of the septum. The trabeculæ show equally spaced thickenings, those of neighboring trabeculæ fusing, leaving regularly arranged pores between them; the septa present a strikingly regular mesh-work appearance. Apparently very near the base the pores tend to be filled. According to Pratz, the pores may be obliterated in the thicker septa. Unfortunately the specimens at my disposition do not permit so thorough a study as I should like to make, but examination of the edges of the thicker septa leads me to believe that this part of the description of Pratz also applies to *C. elliptica*.

The basal wall of *C. elliptica* is perforate and synapticulate beneath the epitheca.

According to Pratz,<sup>f</sup> the genus possesses "ausserordentlich feine und sehr zahlreiche Traversen."

The following is a synonym of *Cyclolites*:

EPISERIS de Fromentel, *Introd. à l'Étude Polyp. foss.*, 1858–1861, p. 125.

*Original diagnosis*.—"The fossil to which Mr. Reuss has given the name *C[yclolites] macrostoma* differs from *Cyclolites* by having a wall at first horizontal, but which later becomes vertical, thus assuming the

<sup>a</sup> Hist. nat. Anim. sans Vert., II, pp. 233, 234.

<sup>b</sup> See Hist. nat. Corall., III, pp. 40, 44.

<sup>c</sup> See Idem, II, p. 387.

<sup>d</sup> Comptes rend. Acad. Paris, XXIX, p. 71.

<sup>e</sup> Palaeontographica, XXIX, pl. XIV.

<sup>f</sup> Idem, XXIX.



form of certain *Montlivaultiæ*; therefore we believe that this species belongs to a different genus. This fossil has a height of 60 mm., a length of about 70 mm. Its sides are covered by bands of epitheca, through which the costæ can be seen here and there. There are about 380 rather strong and thick costæ."

*Type species*.—*Cyclolites macrostoma* Reuss.

*Distribution*.—Cretaceous, Turonian of Gosau.

Felix, in his *Anthozoën der Gosauschichten in den Ostalpen*,<sup>a</sup> takes no notice of *Episeris* de Fromentel, leaving *Cyclolites macrostoma* Reuss in the genus to which it was originally referred.

#### 4. Genus TROCHARÆA Étallon.

1864. *Trocharæa* ÉTALLON, *Lethæa bruntrutana*, p. 411.

*Original generic diagnosis*.—"Corallum simple, without epitheca, with the structure of *Microsolena*.

"Very near the genus *Anabacea*; but its septa are more distinctly trabecular, and it differs further by the large attachment of its base."

*Type species*.—*Trocharæa actiniformis* Étallon, *Lethæa bruntrutana*, p. 411, pl. LVIII, fig. 4.

*Distribution*.—Jurassic (Hypovirgulian), Switzerland.

*Remarks*.—Apparently only two species have been referred to this genus, the type species of Étallon and *T. patelliformis* Gregory,<sup>b</sup> from the Jurassic, Upper Putschum beds, northwest of Jumara, India. Gregory rediagnoses the genus as follows: "*Microsolenidæ* with corallum simple, pedunculate, or sessile, with a broad base. Septa numerous, thin; the trabeculæ are isolated above, but united near the base into short series. Calice superficial. Columella parietal; may be well developed." Under the heading "Affinities," he remarks: "This genus is allied to *Anabacia* by its simple corallum, but differs in its shape and in the character of the septa. The trabeculæ fuse near the base to a greater extent than in *Anabacia*."

#### GENERA NOT REFERRED TO FAMILIES.

The data obtainable concerning quite a number of genera are not sufficient to refer them to families. The type-species of each of these genera must be subjected to thorough study. I have divided them into four groups.

I. WALL SOLID, CONDITION OF SEPTA UNKNOWN.

II. SEPTA SOLID, CONDITION OF WALL UNKNOWN.

III. WALL PERFORATE, CONDITION OF SEPTA UNKNOWN.

IV. CONDITION OF NEITHER WALL NOR SEPTA KNOWN.

<sup>a</sup> *Palæontographica*, XLIX, 1903, p. 189.

<sup>b</sup> *Jurassic Corals of Cutch*, p. 178, pl. II A, figs. 15-20.



## I. WALL SOLID, CONDITION OF SEPTA UNKNOWN.

1. *Phegmatozeris*.
2. *Microzeris*.
3. *Asterozeris*.

1. Genus PHEGMATOSERIS Milaschewitz.<sup>a</sup>

1876. *Phegmatozeris* MILASCHEWITZ, Palæontograph, XXI, p. 212. Genus referred to the "*Lophoserina*."

*Original generic diagnosis*.—"Corallum simple, fan-shaped, pedicellate attached by a narrow base. Calice longitudinally compressed, septa not exsert. Columella absent. The wall is not porous, but beginning at the base is covered with ribs, which correspond to the septa."

*Type species*.—*Phegmatozeris flabelliformis* Milaschewitz, Palæontographica, XXI, p. 212, pl. I, figs. 5, 5a.

*Geologic horizon and locality*.—Jurassic of Nattheim.

*Remarks*.—I have been unable to find a more detailed account of this genus than that given in the original diagnosis and in the description of the type species.

## 2. Genus MICROSERIS de Fromentel.

1870. *Microceris* DE FROMENTEL, Paléontol. franç., Crétacé, VIII, Pt. 25, p. 367.

*Original generic diagnosis*.—"Corallum hemispherical; the wall horizontal, naked, covered with scattered granulations which are not arranged so as to form ribs. Septa large, arched, uniting, fusing in the center, where there is a small, round columellar fossa. Synaptacula rare, but well developed."

*Type species*.—*Microzeris hemispherica* de Fromentel, Paléontol. franç., Crétacé, VIII, p. 368, pl. LXXX, figs. 1-1d.

*Distribution*.—Cretaceous, Cenomanian, Mans, France.

*Remarks*.—This genus, according to de Fromentel, differs from *Cycloseris* "by its general appearance and the absence of costæ on the lower surface, they being replaced by scattered granulations." He gives no data on the structure of the wall or septa, but his considering it so closely related to *Cycloseris* would indicate an imperforate wall and imperforate septa. The irregularly arranged granulations on the base could scarcely occur on a perforate wall, where the granulations would naturally follow the courses of the septa.

<sup>a</sup> Duncan, Jour. Linn. Soc. London, Zool., XVII, p. 148, misspells this name, giving it as *Phragmatozeris*.



## 3. Genus ASTEROSERIS de Fromentel.

1867. *Asteroseris* DE FROMENTEL, Paléontol. franç., Crétacé, VIII, Zooph., Pt. 24, p. 328.

*Original generic diagnosis.*—"The corallum is hemispherical, basal wall imperforate, discoid, slightly concave and covered with granulations, which are radially arranged on the margins. The columella but slightly developed, reduced to three or four scarcely visible points. Septa large, unequal, strongly granulated on their upper margins. Pali well developed."

*Type species.*—*Asteroseris coronula* de Fromentel, Paléontol. franç., Crétacé, VIII, Zooph., Pt. 24, p. 328, pl. XLVIII, figs. 3-3c.

*Distribution.*—Neocomian of Mans, France.

*Remarks.*—By a mistake, the name is given at the bottom of Plate XLVIII (which was published in Livraison 12) as *Stephanoseris*.

De Fromentel does not describe the structure of the septa. It can only be inferred from the character of the septal margins—such an inference, of course, is doubtful.

## II. SEPTA SOLID, CONDITION OF WALL UNKNOWN.

## Zittelofungia.

## Genus ZITTELOFUNGIA Duncan.

1884. *Zittelofungia* DUNCAN, Jour. Linn. Soc. London, Zool., XVIII, p. 150.

*Original generic diagnosis.*—"Corallum free, plano-convex, circular or elliptical in outline, with a flat or slightly concave base, and a convex calice with a circular or oval fossa. Columella absent. Septa very numerous, close, thin, unequal, uniting, crested denticulate or moniliform at the free edge, granular at the sides, imperforate. Synapticula numerous. Dissepiments wanting. Epitheca of base in concentric folds, stout or thin.

*"Distribution.*—Fossil. Eocene: Sind."

Duncan in his Sind fossil corals and Alcyonaria, pp. 52-55, describes nine species which he refers to *Cyclolites*, namely: *C. alpina* (d'Orbigny), *C. ranikoti* Duncan, *C. crenulata* Duncan, *C. vicaryi* Haime, *C. anomala* Duncan, *C. superba* Duncan, *C. haimeii* Duncan, *C. altavillensis* Defrance, and *C. striata* Duncan. Duncan separated these corals from *Cyclolites* because of their imperforate septa, and proposed for them the generic name *Zittelofungia*. But no type species was designated. The septal structure of not even one of the species is described. Whether it is the same for all can be determined only from an examination of his original material. Until this is done a type species that will fit the original generic diagnosis can not be selected with certainty.

## III. WALL PERFORATE, CONDITION OF SEPTA UNKNOWN.

## Cyclabacia.



## Genus CYCLABACIA.

1866. *Cyclabacia* BÖLSCHÉ, Zeitsch. deutsch. geolog. Gesellsch., XVIII, p. 473.

*Original generic diagnosis.*—"Corallum simple, free, discoid, arched above, underside more or less flat. Wall perforate. Ribs radiating from the center outward, granulate; the separate granulations sometimes fuse with one another, forming concentric striations. Costæ not alternating at the margin with the septa, but passing directly into them. Epitheca absent. Septa of the first and second cycles straight; those of the other cycles more or less curved and to a great extent uniting with one another. Septal margins dentate. Septal faces strongly granulate, the granulations drawn out into fine points, which show a tendency to unite with those of the neighboring septa. Columella strongly developed or rudimentary."

*Type species.*—*Cyclabacia stellifera* Bölsche, Zeitsch. deutsch. geolog. Gesellsch., XVIII, p. 474, pl. ix, fig. 3.

*Distribution.*—Cretaceous, Senonian, North Germany.

*Remarks.*—Bölsche states that *Cyclabacia* is separated from *Anabacia* by the presence of a perforate wall;<sup>a</sup> from *Micrabacia* by the costæ not alternating with the septa, i. e., the costæ and septa are continuous in *Cyclabacia*.

Three species, *Cyclabacia semiglobosa*, *C. stellifera*, and *C. fromenteli*, all of Bölsche, were described and placed in the genus at the time of its publication, and no type species was designated. I have selected the second as the geno-type, because both the description and the figures are satisfactory.

Bölsche unfortunately does not describe the septal structure.

Duncan,<sup>b</sup> in his Revision of the Genera and Families of the Madreporaria, placed *Cyclabacia* in the "*Stephanophyllioida*" of the *Eupsammidæ*, remarking that "This is probably identical with *Fungia*, and is therefore a link between *Micrabacia* and *Fungia*." It is difficult to see why he should have placed it systematically so far from where he says it belongs.

## IV. CONDITION OF NEITHER THE WALL NOR THE SEPTA KNOWN.

1. Turbinoseris.
2. Elliptoseris.
3. Gonioseris.
4. Epistreptophyllum.
5. Thecoseris.

<sup>a</sup> "Von Anabacia trennt diese Gattung das Vorhandensein einer durchborten Mauer." This supposed difference is of no value, as the wall of *Anabacia* is synapticular, abundantly perforate. See p. 403.

<sup>b</sup> Jour. Linn. Soc. London, Zool., XVIII, p. 174.



## 1. Genus TURBINOSERIS Duncan.

1870. *Turbinoseris* DUNCAN, Palæontograph. Soc., Monog. Brit. Foss. Corals, Sup., Pt. 2, No. 2, p. 42.

*Original generic diagnosis*.—"The corallum is simple, more or less turbinate, or constricted midway between the base and calice. The base is either broad and adherent or small and free.

"There is no epitheca, and the costæ are distinct.

"There is no columella, and the septa unite literally [*sic*] and are very numerous."

*Type species*.—*Turbinoseris defromenteli* Duncan, Palæontograph. Soc., Monog. Brit. Foss. corals, Sup., Pt. 2, No. 2, p. 43, pl. xv, figs. 13-18.

*Geologic horizon and locality*.—Atherfield, England, in the Lower Greensand.

*Remarks*.—The following additional characters apparently can be deduced from Duncan's description and figures of *T. defromenteli*. He says "the synapticulæ are well developed, and the costæ are well developed, and often not continuous with the septal ends." The septa are not positively stated to be imperforate, but figures 15 and 18 so represent them. No discussion of the wall is given, but both figures 13 and 14 represent it as of perforate or synapticulæ composition. Figure 18 illustrates what Duncan says is "the unusual appearance of septa ending in intercostal spaces, magnified." Figure 16, natural size of a calice, shows an apparently imperforate wall, though not of uniform thickness, and the septa in most instances correspond in position with the costæ. Although Duncan says there is no columella, one would judge from his figure that a poorly developed, false one is present. A comparison is made with *Trochoseris* in the following words: "The necessity for forming a new genus for this species is obvious. It is the neighbor of *Trochoseris* in the subfamily of the *Lophoserinae*. This last genus has a columella and the new has none."

There is quite a large literature on *Turbinoseris*, but no one has as yet published an account of the structure of the type species. The following is a review of the literature:

Duncan, in his *On the Older Tertiary Formations of the West Indies*,<sup>a</sup> republishes his original description, adds a note to the effect that it is separated from *Trochoseris* by the absence of a columella, and describes seven new species from the Tertiary of St. Bartholomew.

In his *Sind fossil Corals and Alcyonaria*,<sup>b</sup> he describes four more species that he places in *Turbinoseris*, but gives no additional information on the characters of the genus.

<sup>a</sup> Quart. Jour. Geol. Soc. London, XXIX, 1873, pp. 558-561.

<sup>b</sup> Palæontol. Indica, Ser. XIV, I, 1880, Pt. 2, pp. 49-51.



In his Revision of the Families and Genera of the Madreporaria,<sup>a</sup> it is stated that the septa are solid and that the wall is stout, but whether those characters are based on the type species or on a species subsequently referred to the genus can not be determined.

R. F. Tomes, in an article entitled Observations on some imperfectly known *Madreporaria* from the Cretaceous Formation of England,<sup>b</sup> declares that *Turbinoseris* is a synonym of *Leptophyllia* Reuss, but as he does not describe the structural details of the wall or septa, he can not be considered to have proven his contention.

Duncan, in the next volume of the same journal, published An Answer to Observations on some imperfectly known Madreporaria, etc., by Tomes, in which he denies the identity of *Turbinoseris* and *Leptophyllia*, and says positively that "the septa [of the former] are solid."<sup>c</sup> But Duncan does not state explicitly that this is the condition in *Turbinoseris defromenteli*.

In July, 1899, Mr. Tomes published an article, Observations on some British Cretaceous Madreporaria, with the Description of two new Species, in which<sup>d</sup> he not only places *Turbinoseris* in the synonymy of *Leptophyllia*, but refers *Turbinoseris defromenteli* to the synonymy of *Leptophyllia clavata* Reuss, the type species of the latter genus, but he does not present evidence of a convincing kind to sustain his conclusion. Tomes identifies another specimen from the Lower Greensand, at Sandown, Isle of Wight, with *Leptophyllia irregularis* Reuss.

In September, 1899, my paper on Some Cretaceous and Eocene Corals from Jamaica was published. In it<sup>e</sup> I pointed out the unsatisfactory definition of the genus, and added a few remarks based on Duncan's original figures. Two additional species, closely related to those from St. Bartholomew, were described. There I made the statement, "I have referred the two Jamaican corals to *Turbinoseris* on the strength of their resemblance to the species from St. Bartholomew, but whether Duncan was correct in referring the latter corals to that genus must be left to future work."

Gregory, in The Corals, Jurassic Fauna of Cutch,<sup>f</sup> makes some remarks on *Turbinoseris*, basing them on Duncan's description, figures and subsequent notes. He contributes no observations of his own.

Felix, in his Anthozoen der Gosauschichten in den Ostalpen,<sup>g</sup> expresses doubt as to the correctness of Tomes's identification of the

<sup>a</sup> Jour. Linn. Soc. London, Zool., XVII, 1884, p. 148.

<sup>b</sup> Geol. Mag., New Ser., Dec. III, II, 1885, pp. 550, 551.

<sup>c</sup> Idem, Dec. III, III, 1886, pp. 54, 55.

<sup>d</sup> Idem, Dec. IV, VI, 1899, p. 306.

<sup>e</sup> Bull. Mus. Comp. Zool., XXXIV, pp. 243, 244.

<sup>f</sup> Palæontol. Indica, Ser. IX, II, Pt. 2, 1900, p. 163.

<sup>g</sup> Palæontographica, XLIX, 1903, pp. 201, 202.



English Lower Greensand species with the Austrian Gosau forms. Felix says:

Tomes is inclined to refer to *Leptoph. clavata* Rs., the species first described by Duncan as *Turbinoseris defromenteli* from the Lower Greensand of Atherton, and later designated by himself [Tomes] as *Leptophyllia anglica*. He determines still another coral from the Lower Greensand of the Isle of Wight as *Leptophyllia irregularis* Rs., which is separable from the Gosau form only by its somewhat thicker septa and costæ; but unfortunately the number of these is not given. However, one obtains the impression, from an inspection of the accompanying figure, that the number of septa would be essentially smaller than on a specimen of the same size of *L. irregularis* from Gosau. Furthermore, the specific identity of the forms would be very surprising when there is so much difference in geological horizon and so great a distance between the localities.

The genus *Turbinoseris* has been discussed in the literature at least ten different times, but as yet no adequate description of it has been published. A detailed description of the septal and mural structure of *Turbinoseris defromenteli* must be published, and should be accompanied by figures, before it can be known whether the genus should be considered valid or should be referred to the synonymy of some other.

## 2. Genus ELLIPTOSERIS Duncan.

1880. *Elliptoseris* DUNCAN, Sind foss. Corals and Alcyonaria, Palæontol. Indica, Ser. XIV, I, p. 48.

Genus referred to *Lophoserinæ*.

*Original generic diagnosis*.—"The corallum is simple, conical, compressed, with a largely open, elliptical calice. There are costæ, but no epitheca; there is no columella, but an elongate and deep axial space. The septa are numerous, and the smaller join those between them near the axial space. There are pali before the joined septa. Synapticulæ are numerous in the calice."

*Type species*.—*Elliptoseris aperta* Duncan, Sind foss. Corals and Alcyonaria, Palæontol. Indica, Ser. XIV, I, p. 48, pl. VIII, figs. 3-6.

*Geologic horizon and locality*.—Lower Eocene (Ranikot group), Jhirk, India.

## 3. Genus GONIOSERIS Duncan.

1872. *Gonioseris* DUNCAN, Brit. foss. Corals, Sup., Pt. 3, p. 21.

*Original generic diagnosis*.—"The corallum is simple and free. The base is polygonal in outline and the projecting angles are formed by groups of costæ terminating in septa. Between the angles the margin is concave externally. The center of the base is concave. The costæ are numerous and they cover the base. Many converge at each angle along a line leading from the large septum to the center. The upper surface of the corallum is convex, and is divided by masses of septa which are continuous with the angles of the base, and which,



after projecting there, become exsert and pass to the axial space where they meet. There is a large, prominent, primary septum in each mass. The calicular wall is invisible. The synapticulæ are broad and numerous."

*Type species*.—*Gonioseris angulata* Duncan, Brit. foss. Corals, Sup., Pt. 3, p. 21, pl. VII, figs. 1-5.

*Distribution*.—Jurassic, Inferior Oolitic, Cloughton Wyke, near Scarborough, England.

*Remarks*.—Duncan does not give any detailed information regarding the character of the wall or the structure of the septa. His figure (Plate VII, fig. 5) of *G. angulata* represents the septa as solid. The type species of this genus needs a thorough investigation.

#### 4. Genus EPISTREPTOPHYLLUM Milaschewitz.

1876. *Epistreptophyllum* MILASCHEWITZ, Palæontographica, XXI, p. 211.

*Original generic diagnosis*.—"Corallum simple, conical or cylindrical, firmly attached to some object, columella well developed, spongy. Calice excavated, septa numerous, not exsert. Outer surface of the wall covered with equal ribs. Low down in the interseptal loculi besides endothecal dissepiments are numerous synapticula; in the upper part numerous pointed or wart-shaped granulations occur on the septal faces."

Milaschewitz remarks: "This remarkable genus can be referred either to the family *Astræidæ* or the *Fungidæ*, as it unites the characteristic features of both families. In consequence of the presence of synapticula it would belong to the *Fungidæ*; because of the presence of endothecal dissepiments, also because of its tall, sometimes perfectly cylindrical form and its excavated calice it appears more nearly related to the *Astræidæ*. However, according to the rows of granulations on the septal faces being parallel to the free margins of the septa, instead of being vertical as in the *Fungidæ*, the genus shows a greater relationship to the subfamily *Eusmilinæ*, which have septa with entire margins, than with the subfamily *Astræinæ*, which have dentate septa with vertical rows of granulations."

*Type species*.—Three species are referred to *Epistreptophyllum* by its author, *E. commune* Milaschewitz, *E. cylindratum* Milaschewitz, and *E. tenue* Milaschewitz, all from the Jurassic of Nattheim. No species is designated as the geno-type, nor are the details of the structure of the wall or of the septa given. Without making a careful study of Milaschewitz's original material it is not safe to designate a type species.

*Epistreptophyllum* was made by Zittel<sup>a</sup> the type of his *Epistreptophyllinæ*, a subfamily of the *Astræidæ*.

<sup>a</sup>Handb. Paläontologie, I, 1880, p. 249.



Ogilvie in her *Korallen der Stramberger Schichten*<sup>a</sup> attempted to give more detail concerning the genus. She remarks (p. 252):

Unfortunately the Nattheim specimens of *Epistreptophyllum* do not permit a minute, microscopical investigation. However, many conclusions concerning the finer septal structure can always be drawn from the superficial sculpture of the septa. It is important that the septa are often interrupted and that the separated pieces form in the center a spongy columella. The synapticala likewise occur irregularly and give to the septa more often a Eupsammid septal appearance. The Stramberg specimens, which agree in all external characters with the Nattheim forms, are better preserved and show the finer septal structure characteristic for the *Eupsammidae*. Thus the systematic position of the genus *Epistreptophyllum* is made clear, and at the same time its near relation to the synchronous simple *Haplaræa* and the compound *Diplaræa* is shown.

Ogilvie does not mention on which of Milaschewitz's species she based her remarks. However, she identified one of her Stramberg species with *E. commune*. If we could assume her identification as correct, *E. commune* would become the geno-type.

Ogilvie's recharacterization of the genus:

Corallum simple, conical or cylindrical, calice rather deep; septa very numerous and thin, separated now and then into individual trabecular members. Granulations on the septal faces not regularly arranged and of very dissimilar size, many developed as pseudosynapticula. True synapticula and numerous vesicular dissepiments present. Columella spongy, large, composed of free and interlacing trabecular members of the longer septa. No true wall, only a pseudothecal thickening of the septal and interseptal skeletal parts near the outer edge. Epitheca thin, wrinkled, extending to margin of the calice.

Ogilvie regards *Lithoseris* Koby as a synonym of *Epistreptophyllum*. Gregory thinks her opinion "probably correct." For a fuller discussion see *Lithoseris*, p. 398.

### 5. Genus THECOSERIS de Fromentel.

1870. *Thecoseris* DE FROMENTEL, Paléontol. franç., Crétacé, VIII, Pt. 25, p. 367.

*Original generic diagnosis*.—"Corallum elevated and regularly turbinate; columellar fossa, when present, round; usually the septa meet in the center, where they fuse and simulate a papillary columella, but which really does not exist. The septa are thin, numerous, often anastomosing and finely denticulate; they are never exsert, and the calice is usually concave. The epitheca is strong, well developed, much folded, and extends to the edge of the calice."

*Type species*.—*Thecoseris patellata* de Fromentel and Ferry, Paléontol. franç., 1st ser., Jurassique, Pt. 18, pl. LVIII, fig. 2, 1869.

*Distribution*.—Jurassic, Lias, France.

*Remarks*.—The structure of neither the wall nor the septa is described. The figures of the type species indicate an imperfect,

<sup>a</sup>Palæontogr., Sup., II, 1897, pp. 248-255.



synapticulate wall, and the septa probably are somewhat perforate near their upper edges. But to determine these points positively the type species must be restudied.

M. Koby,<sup>a</sup> in his *Monographie des Polypiers jurassiques de la Suisse*, refers six species to this genus, but gives no data based on the type species.

#### GENERA PROBABLY ERRONEOUSLY PLACED IN THE FUNGIDA.

Corallum discoid or low (*with a parasitic worm in the base*); columella papillary, no epitheca:

With pali (before all septa except the last cycle).

*Stephanoseris* Milne Edwards and Haime

Without pali..... *Psammoseris* Milne Edwards and Haime

#### 1. Genus STEPHANOSERIS Milne Edwards and Haime.

1851. *Stephanoseris* MILNE EDWARDS and HAIME, Arch. Mus. Hist. Nat. Paris, V, p. 127.

Placed in the *Lophoserinae*.

*Original generic diagnosis*.—"Corallum short, attached to a shell which it completely surrounds; wall naked, strongly granulated, scarcely striate below; columella papillary, slightly developed; septa much elevated, subentire, very granulated laterally, those of the penultimate cycle more developed than those of the last; pali before all the cycles except the last."

*Type species*.—*Heterocyathus roussæanus* Milne Edwards and Haime, Ann. Sc. nat., 3d ser., IX, p. 324, pl. x, figs. 9, 9a.

*Distribution*.—Recent, Zanzibar

*Remarks*.—Von Marenzeller<sup>b</sup> says, in his Ueber einige Japanische Turbinoliden, that "The investigation of the preceding *Heterocyathus* [*H. japonicus* (Verrill) v. Marenz. = *Stephanoseris japonica* Verrill] leads me to make some remarks on the earlier described species. It should be emphasized that the genus *Stephanoseris*, erected by Milne Edwards<sup>c</sup> for *Heterocyathus roussæanus*<sup>d</sup> because it possesses synapticula, is not valid. It must be assumed that the pointed granules of two neighboring septa fuse and produce the impression of synapticula. The whole structure of the corallum, which is reported to be attached to a gastropod shell indicates *Heterocyathus*. Tenison-Woods<sup>e</sup> and Moseley<sup>f</sup> are of the same opinion, and it is surely only a *lapsus calami* when the latter says in another place<sup>g</sup> that *Heteropsammia* and *Stephanoseris* should be united in one genus. Certainly, instead of

<sup>a</sup>Schweiz. pal. Gesellsch., Abhand., XIII, 1886, pp. 332-338.

<sup>b</sup>K. K. Naturhist. Hof-Museum, Wien, Ann., III, 1888, pp. 17-18.

<sup>c</sup>Hist. nat. Corall., III, p. 56.

<sup>d</sup>Ann. Sci. nat., 3d ser., zool., IX, 1848, p. 324, pl. x, fig. 8.

<sup>e</sup>Proc. Linn. Soc. New South Wales, II, 1878, p. 297.

<sup>f</sup>Deep Sea Cor., Challenger Repts., 1880, p. 145.

<sup>g</sup>Idem., p. 197.



*Stephanoseris* it should be '*Psammoseris*.' *Psammoseris* bears the same relation to the Eupsammid genus *Heteropsammia* as *Stephanoseris* to the Turbinolid genus *Heterocyathus*. In this genus, also, only false syntacticula are present, and it, also, must fall."

Von Marenzeller considers that two of Milne-Edwards and Haime's species belong to *Heterocyathus*, namely, *H. aequicostatus* and *H.* [*Stephanoseris*] *roussaeanus*. Verrill added one species of *Heterocyathus*,<sup>a</sup> *H. alternatus*; and von Marenzeller places the three species of *Stephanoseris*, *S. lamellosa*,<sup>b</sup> *S. japonica*,<sup>c</sup> and *S. sulcata*,<sup>d</sup> in the same genus. Other species of *Heterocyathus* have been described, but they need not be noticed here.

From an examination of the literature, I am inclined to believe that Tenison-Woods, Moseley, and von Marenzeller are correct in considering the type species of *Stephanoseris* a *Heterocyathus*, but unfortunately the studies on the relations of these genera are based only on literature; before certainty can be obtained the type species must be studied.

Professor Verrill says, concerning *Stephanoseris lamellosa*, "Wall rudimentary, represented near the margin only by trabicular processes." As Professor Verrill described one species of *Heterocyathus*, and differentiated his species of "*Stephanoseris*" from that genus, I am inclined to believe that none of the species referred by him to the latter genus belong to the former. I strongly suspect that von Marenzeller's *Heterocyathus japonicus* (Verrill) is incorrectly identified. What final disposition must be made of the Verrill species must be left to future work.<sup>e</sup>

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<sup>a</sup> Proc. Essex Inst., IV, 1865, p. 149; also, V, 1866, p. 41, pl. II, figs. 6, 6a.

<sup>b</sup> Idem, IV, p. 149; V, p. 46, pl. II, figs. 4, 4a.

<sup>c</sup> Idem, V, p. 47.

<sup>d</sup> Idem, V, p. 48.

<sup>e</sup> Since this manuscript was sent to press I have been able to study in the Yale University Museum the types of Professor Verrill's species of *Stephanoseris*. I made the following notes:

*Stephanoseris japonica* Verrill. Type, No. 767, Yale Univ. Mus. Wall perforate, distinctly costate, costae alternating in size. Septa perforate, with typical Eupsammid arrangement.

*Stephanoseris sulcata* Verrill. Type, No. 764, Yale Univ. Mus. Wall perforate, distinctly costate, costae alternating in size. Septa perforate, with typical Eupsammid arrangement.

*Stephanoseris lamellosa* Verrill. Type, No. 766, Yale Univ. Mus. Wall perforate, distinctly costate, costae alternating in size. Septa perforate, with typical Eupsammid arrangement.

The genus, to which these species belong, is not closely related to *Heterocyathus*. They are Eupsammids, very close to *Balanophyllia*, from which they are separated by their apparent commensalism with a Sipunculid worm. Every specimen is attached to a small gastropod shell, and has a small wormhole in its base. The genus is separated from *Heteropsammia* by its well-developed costae. Most probably Verrill's *Stephanoseris* is not the *Stephanoseris* of Milne Edwards and Haime, it may be an undescribed genus.



## 2. Genus PSAMMOSERIS Milne Edwards and Haime.

1851. *Psammoseris* MILNE EDWARDS and HAIME, Arch. Mus. Hist. Nat. Paris, V, p. 127.

Placed in the *Lophoserinæ*.

*Original generic diagnosis*.—"Corallum discoid, attached to a shell which it completely surrounds; wall naked, strongly granulate, scarcely striate below; columella papillary; septa slightly elevated, very thick, covered on their free edges and their faces with very prominent and extremely crowded granulations, those of the penultimate cycle much more developed than those of the last."

*Type-species*.—*Heterocyathus hemisphæricus* J. E. Gray, Proc. Zool. Soc. London, for 1849, p. 77, *Radiata*, pl. II, figs. 3, 3a, 4; also Ann. and Mag. Nat. Hist., 2d ser., V, 1850, p. 410.

*Distribution*.—Recent, China seas.

*Remarks*.—The systematic position of this genus is in doubt. Moseley was evidently of the opinion that *Heteropsammia* and *Psammoseris* should be united,<sup>a</sup> although, probably by a *lapsus calami*, he says *Heteropsammia* and *Stephanoseris*. Von Marenzeller has expressed the same opinion.<sup>b</sup>

Family STYLOPHYLLIDÆ Volz.<sup>c</sup>

1896. *Stylophyllidæ* VOLZ, Palæontographica, XLIII, pp. 85, 86.

Volz gives<sup>d</sup> a careful description of the septa, endotheca, wall, and mode of growth. His description will not be repeated here.

The following two genera, *Stylophyllum* Reuss and *Stylophyllopsis* Frech, can scarcely be referred to the *Fungida*, but, as they are very interesting forms to study in connection with a possible phylogeny of the Fungids and Eupsammids, they are included in this paper.

## 1. Genus STYLOPHYLLUM Reuss.

1854. *Stylophyllum*, REUSS, Denksch. Akad. Wissensch. Wien, Mat. Naturhist. Cl., VII, p. 132.

*Original generic diagnosis*.—"The form of the corallum unknown; but its upper surface must have been plain or only slightly arched.

"The thick prismatic, irregularly polygonal corallites are directly grown together. The thick walls are compact and entire, without a trace of pores or perforations. In both the transverse and longitudinal sections the line along which the walls of neighboring corallites have fused can be seen.

<sup>a</sup> Deep Sea Corals, Challenger Reports, p. 197.

<sup>b</sup> K. K. Naturhist. Hof-Museum, Wien. Ann., III, 1888, p. 18.

<sup>c</sup> These corals are not considered to belong to the *Fungida*. They are included because of the interest in comparing them with the *Fungida* and the *Eupsammidæ*.

<sup>d</sup> Palæontographica, XLIII, pp. 85-86.



“The corallites are divided by numerous thin tabulæ, which are close together and are not horizontal, but concave upward and bowl-shaped. The tabulæ are not regular, but are curved and crumpled, the vertical section (Plate XXI, fig. 3) and the horizontal cross section (Plate XXI, fig. 2) show their irregular form. From the tabulæ, shorter and still thinner partitions originate, which run irregularly, obliquely from one tabula to another, joining them together, and thus forming smaller vesicular spaces.

“The development of the radial lamellæ is very rudimentary. They are built up of thin spine-like pillars of very uneven height, which stand in numerous, but in only slightly regular radial rows on the tabulæ. Some of these stand so near together in the same row that they fuse; others are so long that they extend through several platforms of the tabulæ, the latter appearing to be spread out between them.”

Ogilvie, in her *Korallen der Stramberger Schichten*,<sup>a</sup> expresses the opinion that *Stylophyllum* and *Stylophylloopsis* are probably related to the *Eupsammidæ*. She says: “*Eupsammia* is, because of the irregular structure and arrangement of the trabeculæ especially remarkable. Pratz has already described a similar irregularity of the trabeculæ in the Jurassic genera *Haplaræa* and *Diplaræa*, also in the recent *Coscinaræa*. Also the Triassic genera *Stylophyllum* and *Stylophylloopsis* show in their septal structure great agreement with *Haplaræa*, etc., i. e., the single trabecula-members are separated more and more toward the center of the calice and form there a loose, spongy tissue.”

Volz, in his *Korallen der Schichten von St. Cassian in Süd-Tirol*,<sup>b</sup> elevates Frech's *Stylophyllinæ* to family rank, calling them the *Stylophyllidæ*. He describes a new compound genus, *Hexastræa*,<sup>c</sup> which he places in that family, and also refers to it Duncan's *Cyathocoenia*.<sup>d</sup>

This family of the *Stylophyllidæ* shows some suggestive resemblances to the simple fungid genera, such as *Frechia* Gregory. *Frechia*, however, has no dissepiments and a few synapticula.

*Type species*.—*Stylophyllum polycanthum* Reuss, Denksch. Akad. Wissensch. Wien, Mat. Naturhist. Cl., VII, p. 133, pl. XXI, figs. 1-3.

*Distribution*.—Triassic, Gosau district, Austria.

*Remarks*.—Frech, in his *Korallen Fauna der Trias*,<sup>e</sup> referred *Stylophyllum* to his *Astræidæ* and placed it with *Stylophylloopsis* Frech (new genus) in a subfamily, the *Stylophyllinæ*. He emended *Stylophyllum* as follows: “The corallum forms simple calices, with or without lateral buds, as well as massive stocks, which possess a simi-

<sup>a</sup> Palæontographica, Supp., II, p. 85.

<sup>b</sup> Idem, XLIII, 1896, p. 85.

<sup>c</sup> Idem, p. 90.

<sup>d</sup> Idem, p. 92.

<sup>e</sup> Idem, XXXVII, 1890, p. 42.



larly developed internal structure. Septa proper are not present. The septal spines grow together at the bottom, but they are free above. Traces of a bilateral arrangement of the septal spines was sometimes observed in the simple corals. The endotheca is in the form of concave, rather regular dissepiments or convex vesicles, without there being a distinct boundary between the two forms of development. In the case of small species (also in those of large species that have remained small) the dissepiments appear as tabulæ."

The stratigraphic distribution is given as "Upper Muschelchalk, Zlambach beds, Hallstätter Chalk, Hauptdolomit, and the Rhaetic."

## 2. Genus *STYLOPHYLLOPSIS* Frech.

1890. *Stylophyllopsis* FRECH, Palæontographica, XXXVII, p. 48.

*Original generic diagnosis.*—"Simple or only slightly branched; in cross-section agreeing quite closely with *Montlivaltia*, in longitudinal section agreeing with *Stylophyllum*."

*Distribution.*—Norian stage, Rhaetic, lower and middle Lias.

*Type species.*—*Stylophyllopsis polyactis* Frech, Palæontographica, XXXVII, p. 48, pl. XII, fig. 3, pl. XIV, figs. 17–23, text fig., p. 49. Frech refers six species to this genus: *Stylophyllopsis polyactis* Frech, *S. zittelli* Frech, *S. rudis* (Emmerich) (as *Fungia*), *S. caespitosa* Frech, *S. mojsvari* Frech, and *S. lindströmi* Frech, but designated no type species.

*Remarks.*—Regarding this genus, Frech says: "The septa form a transition between the isolated spines of *Stylophyllum* and the compact lamellæ of *Montlivaltia* (bezw. *Thecosmilia*). The septal spines in a cross-section are seen near the center (Plate x, figs. 10a, 12), quite exceptionally in other places. In a longitudinal section they appear in an isolated condition in the same place; furthermore, as can be especially well seen on weathered surfaces, the spines of the upper portions of the septa are only loosely fused with one another. The upper margins of the septa are distinctly and deeply toothed."

## OUTLINE OF THE CLASSIFICATION.

The following outline, which is accompanied by page references, will, it is hoped, facilitate the use of the classification.

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