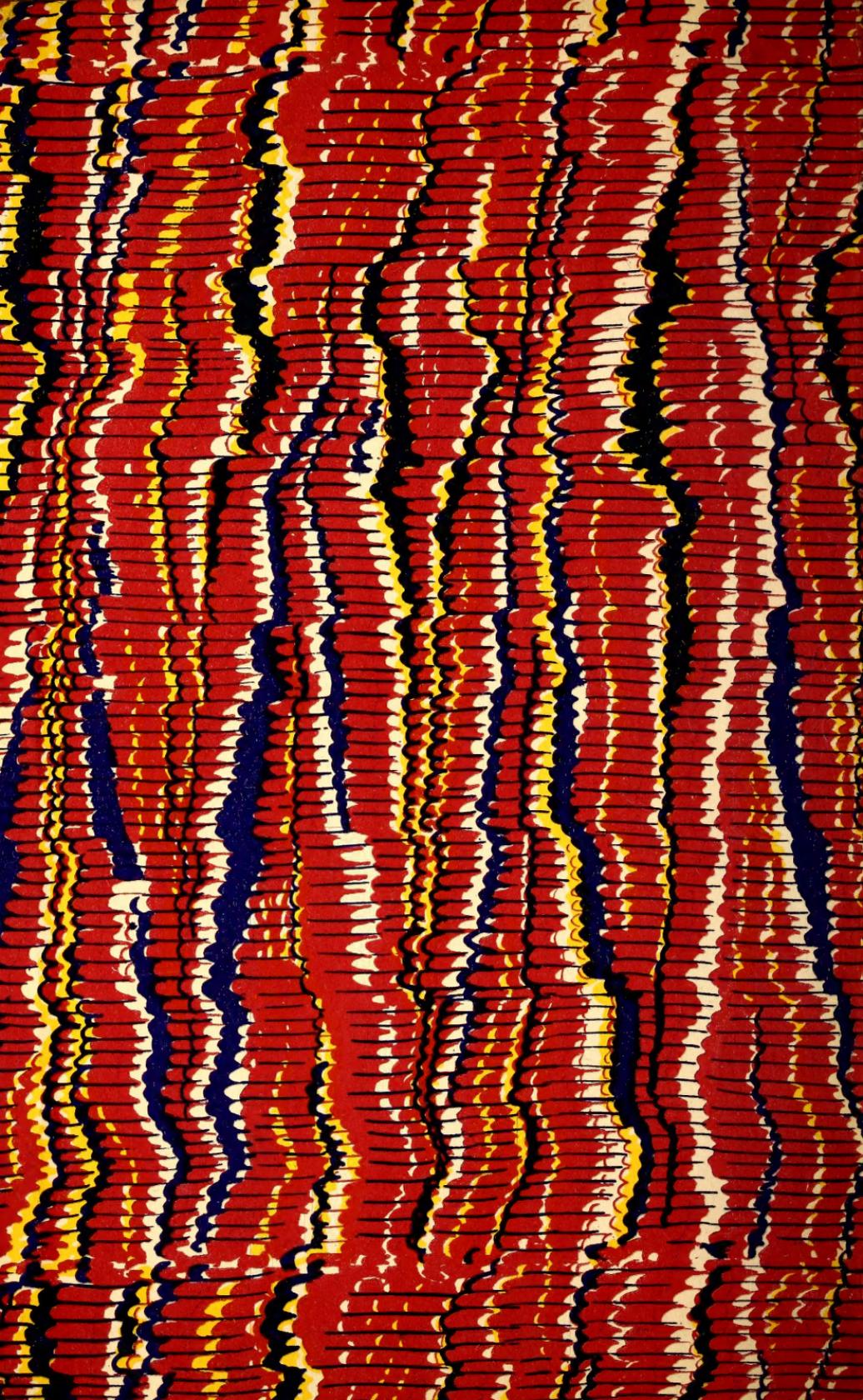


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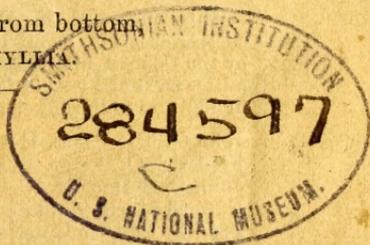
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A Revision of the Families and Genera of the Sclerodermic Zoantharia, *D. & H.*, or Madreporaria (M. Rugosa excepted).

By Professor P. MARTIN DUNCAN, F.R.S., F.G.S., Vice-President  
Linnean Society.

**Errata.**—Page 125, lines 13 and 16 from bottom,  
for CORMOPHYLLIA read COMOPHYLLIA.



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A Revision of the Families and Genera of the Sclerodermic Zoantharia, Ed. & H., or Madreporaria (M. Rugosa excepted). — Chapters I.—VI. By Professor P. MARTIN DUNCAN, F.R.S., F.G.S., Vice-Pres. Linnean Society.

[Read April 3, 1884.]

CHAPTER I.

**Introduction.** The necessity for a revision of the great groups, families, and genera of the Madreporaria, Ed. & H. The changes necessitated by the discoveries of late years, especially those of H. N. Moseley. The classification of Milne-Edwards and Jules Haime. The proposed alterations. The sections of the Sclerodermic Zoantharia, the Madreporaria Rugosa excepted. The new Families. The section Madreporaria Aporosa. The Families. Family Turbinolidæ, its subfamilies, alliances, and genera. Lists.

*Introduction.*—The state of confusion of the classification of the Sclerodermic Zoantharia, or the Stony Corals (the Madreporaria of Edwards and Haime), has become very intense during the last few years, and a revision of the great groups, families, and genera is really required.

No work dealing with the classification of this important Sub-order, as a whole, has appeared since the 'Histoire Naturelle des Coralliaires' by Milne-Edwards and Jules Haime, in 1860. That great work, following that of Dana on the Zoophytes of the Wilkes Exploring Expedition (1846), formed an epoch in the zoology of the Corals. It was a work of vast labour, and its

merits have been recognized by every competent critic. It revised the genera up to the date of 1857-1860, and contained descriptions of every species and its synonymy.

Since the publication of this standard work M. de Fromentel has brought out a book\* which relates to fossil forms only; but all the other additions to the knowledge of the suborder have appeared in reports, monographs, and multitudes of essays, which are scattered amongst the scientific publications of Europe, America, India, and Australia. The number of new genera and species recorded has been great; and although those relating to the deep-sea and reef-building faunas have been numerous, they have been surpassed by the forms from nearly every geological formation in every quarter of the globe.

Careful morphological investigations have increased the knowledge of the minute structures of the Madreporaria; and Dana, J. Haime, L. Agassiz, Verrill, Lacaze-Duthiers, and especially H. N. Moseley, have so enlightened the views of naturalists, that very considerable changes have already been made in the primary classificatory groups of the Corals. Palæontologists and naturalists have endeavoured to assist classification by examining the solid structures; and the researches of Pourtalès, E. Pratz, Lindström, Klunzinger, and Koch have necessitated serious revision of old conceptions. It is evident, however, that the purely classificatory work has too often been attempted by some palæontologists who have not studied the recent faunas, and occasionally by naturalists who have not had experience in the details of the extinct forms.

It is proposed in this revision to omit all reference to the group of Corals called the Rugosa by Edwards and Haime.

As the synonymy of the genera which had been described up to 1860 was given by Edwards and Haime in their great work, this revision will only take it up from that date.

Only the principal sections, families, and genera are considered in this revision; species are not included. A few subgenera are admitted in the classification, and the plan of linking genera under alliances has been adopted. A certain number of alliances will be found in each subfamily or family, and usually they are fairly natural, and rarely too artificial in their nature. It will be found that some of the great groups of the Madreporaria

\* 'Introduction à l'étude des Polypiers fossiles,' Paris, 1858-61

disappear, and that a very considerable number of genera are abolished.

The reasons for altering or abolishing generic diagnoses are usually stated. Some liberty has been taken with many generic descriptions; they have been rewritten, rearranged in details, and often shortened\*.

The word colony has been used to describe a compound corallum.

An explanation of the morphological and structural terminology is placed at the close of the revision.

### The Suborder ZOANTHARIA SCLERODERMATA, Ed. & H.

The Sclerodermic Zoantharia of Milne-Edwards and Jules Haime † are a suborder of the class Anthozoa, type Cœlenterata. According to the authors just mentioned, there are five sections of the suborder:—The MADREPORARIA APOROSA, PERFORATA, TUBULOSA, TABULATA, and RUGOSA.

It must be admitted that there is no difficulty in accepting two of these sections, with certain new limits to them, namely the Madreporaria Aporosa and the Madreporaria Perforata. The section Tubulosa no longer exists, and the section Tabulata has been eliminated by H. N. Moseley. The section "Rugosa" is not considered in this memoir.

#### Section MADREPORARIA APOROSA, Ed. & H.

In typical forms of this section the walls of the corallites are solid and the greater part or all of the septal laminae also. There is no communication between the visceral cavities of neighbouring corallites through the theca or wall.

#### Section MADREPORARIA PERFORATA.

In typical forms of this section the walls and sometimes the septa are perforate, and the soft parts of one corallite

\* Genera date from their time of description, not from that of simple delineation. Hypothetical genera are not recorded.

† 'Histoire naturelle des Coralliaires' (Paris, 1857-1860), vol. i.

communicate with those of their neighbours through the wall or with the outside medium.

The arrangement of the soft parts of both of these sections is not very different, and it presents a very close resemblance in most instances.

According to Milne-Edwards and Jules Haime the great family Fungidæ (Dana) is intermediate between the two sections mentioned above, and it was classified with the Aporosa. Here the difficulty of the classification of the great group begins, and I make the family Fungidæ into a section Fungida.

Dana's beautiful illustrations \* and Moseley's investigations † show that the soft parts of the Fungidæ differ from those of the Aporosa and Perforata; and many years since L. Agassiz stated that a genus of the Astræidæ, according to Edwards and Haime, and one of the Aporosa had the soft structures of a Fungid and part of the hard ones also. This genus *Siderastræa* has tentacles unlike normal Astræidæ and endothecal dissepiments in addition to synaptacula, and in this last respect only does it link the Aporosa and the Fungida proper together. Palæontology has shown that the genus *Thamnastræa* and others must be linked with *Siderastræa*. Hence a group of old Aporosa is placed with the section Fungida. Moreover, a genus of the recent Perforata, *Coscinaria*, has been shown to have synaptacula, and many fossil forms require to be dissociated from the Perforata and placed in a group amongst the Fungida.

Hence the former family Fungidæ of Edwards and Haime becomes a section Fungida, and has associated with it two transitional families—one the Siderastræan group, or the family Plesiofungidæ, and the other the *Cyclolites* and *Microsolena* group, the family Plesioporitidæ. Zittel ‡ and E. Pratz § have paved the way largely for this suggested classification.

#### Section MADREPORARIA TUBULOSA, *M.-Edw. & Haime.*

The third section of the Madreporaria, according to Milne-Edwards and Jules Haime, is that of the Madrepo-

\* Dana, Zoophytes, Exploring Expedition, 1846.

† Prof. H. N. Moseley, F.R.S., Report on the Corals, 'Challenger' Expedition.

‡ Zittel, 'Handbuch Palæontol.'

§ E. Pratz, 'Palæontographica,' 1882.

rariora Tubulosa. Jules Haime established it in 1850, and it was fully considered by Milne-Edwards in the last volume of the 'Histoire Naturelle des Coralliaires,' 1860.

Milne-Edwards evidently had great doubts about the affinities of the two genera which were included in this section, namely *Aulopora* and *Pyrgia*, and he noticed their structural resemblances to certain Bryozoa. In 1871, after due consideration, I removed these genera out of the Zoantharia Sclerodermata, and I still hold that they are not corals\*.

#### Section MADREPORARIA TABULATA, *Ed. & Haime.*

The fourth section of the Madreporaria, according to MM. Milne-Edwards and Jules Haime, is that of the Tabulata. The researches of L. Agassiz and H. N. Moseley † have eliminated the majority of the genera of this section, and have ranged them amongst the Hydrozoa and Alcyonaria. Some genera remain, but cannot form a homogeneous group, and require consideration. Milne-Edwards divided the Tabulata into four families—the Milleporidæ, Seriatoporidaæ, Favositidæ, and Thecidæ. Of the first family the genus *Battersbyia* was eliminated by myself in 1867 ‡; and H. N. Moseley, during the voyage of the 'Challenger,' and in the publication of the Report on the Corals in 1876–1879, completely revolutionized the zoology of the remainder. His researches render it necessary to eliminate all the nine remaining genera.

The Favositidæ, criticized upon the data given by H. N. Moseley, have all their genera removed from the Madreporaria except some of those of the subfamily *Pocilloporinæ*.

The family Seriatoporidaæ has to be broken up, and the genus *Seriatopora* is removed from the Tabulata.

Finally the Thecidæ, although the genus *Columnaria* has well-formed septa, must follow the Tabulata in the direction urged by H. N. Moseley.

So the great section Tabulata disappears, and such evidently Aporose genera of it as *Pocillopora* and *Seriatopora* should enter, according to Verrill, the Oculinidæ, or rather form a family of

\* Third Report Brit. Foss. Corals, Brit. Assoc. Adv. Science (P. Martin Duncan).

† Prof. H. N. Moseley, Report on the Corals, 'Challenger' Expedition.

‡ Phil. Trans. 1867, p. 643 (P. Martin Duncan).

the Aporosa, in consequence of Moseley's discoveries of their remarkable mesenteries. Research has shown that many Madreporaria Aporosa and Perforata have tabulæ, with or without ordinary dissepiments, for instance species of *Lophohelia*, *Cyathophora*, *Astræopora*, *Favositipora*, *Alveopora*, and *Madrepora*.

With regard to the section Madreporaria Rugosa, it is necessary to eliminate certain genera of deep-sea corals, and some genera from the Secondary rocks, and to place them in the Aporosa and Perforata.

After considering the relations of the Madreporaria Aporosa, Madreporaria Perforata, and the old family of the Fungidæ, I have no hesitation in classifying the Sclerodermic Zoantharia as follows:—

- Section I. MADREPORARIA APOROSA.  
 „ II. MADREPORARIA FUNGIDA.  
 „ III. MADREPORARIA PERFORATA.  
 „ IV. MADREPORARIA RUGOSA\*.

*The Great Divisions of the Sclerodermic Zoantharia or  
 Madreporaria.*

Class ANTHOZOA. Suborder ZOANTHARIA SCLERODERMATA  
 OR MADREPORARIA.

*Sections*:—Madreporaria Aporosa, Fungida, Perforata.

Section MADREPORARIA APOROSA.

- I. Family TURBINOLIDÆ (pars), Ed. & H.  
 II. „ OCULINIDÆ (pars), Ed. & H.  
 III. „ POCILLOPORIDÆ.  
 IV. „ ASTRÆIDÆ, Ed. & H., amended.

Section MADREPORARIA FUNGIDA.

- I. Family PLESIOFUNGIDÆ.  
 II. „ FUNGIDÆ, Daba (pars).  
 III. „ LPHOSERIDÆ.  
 IV. „ ANABACIADÆ.  
 V. „ PLESIOPORITIDÆ.

Section MADREPORARIA PERFORATA.

- I. Family EUPSAMMIDÆ.  
 II. „ MADREPORIDÆ, Ed. & H.  
 III. „ PORITIDÆ, Ed. & H.

\* This section is not considered, and probably most of its genera are not Madreporarian.

*Description of the Section Madreporaria Aporosa.*

Section I. MADREPORARIA APOROSA, Milne-Edwards and Jules Haime, *Hist. Nat. des Corall.* vol. ii. p. 3 (1857-60).

The diagnosis given by these authors is positive and negative in its characters, and this was necessary, for the sections *Tabulata* and *Tubulosa* were defined at that time.

They state :—“The corals of this section are of all the *Madreporaria* those in which the corallum is the most perfect. A complete wall is always associated in them with a well-developed septal apparatus. The sclerenchyma which composes the corallum grows in a continuous manner, and forms laminae of a compact tissue, in which the points corresponding with elementary nodules often project more than the rest, but are hardly ever separated by spaces even of the narrowest kind. The calices are distinctly stellate, and only present six septa when young. During development the rays formed by the upper edges of the septa become twelve in number, subsequently twenty-four, &c. ; but the hexamerous type remains almost always recognizable by the predominant size of the early or first septa over those of later age. The interseptal loculi are either open down their whole depth or more or less completely closed by synapticula and ‘traverses.’ These last may subdivide and form a series of superimposed loculi, but each one is independent of the others and they never unite to form disk-shaped laminae, which may extend across the visceral cavity and shut it off in a series of stories as in the *Madreporaria Tabulata* and *Rugosa*”\*.

Now it is evident that in some genera of this section, the septa are cribriform, and that the calices of many are polygonal or serial, or unsymmetrical in shape. Moreover the hexamerous arrangement of the septa is not constant ; it may be pentamerous, heptamerous, octamerous, or decamerous. It is true that tabulæ are found in a few species and genera, and that synapticula exist in genera which were not thought to have them by Edwards & Haime.

The following is the diagnosis of the MADREPORARIA APOROSA as now limited :—

*Madreporaria* with simple or colonial forms. Hard structures

\* *Hist. Nat. des Corall.* vol. ii. p. 5.

usually solid and imperforate. Theca or wall solid, may be epithecate. Septa solid near the wall, and usually, but not invariably, solid at the further part. Interseptal loculi open throughout, or closed more or less by endotheca in the form of dissepiments, tabulæ, and stereoplasm. Calices of different shapes.

Soft parts:—One or more rows of tentacles in relation to the septa and interseptal loculi. The disk with one or more oral openings or mouths; a mesentery usually in each interseptal loculus. Septa usually in multiples of six, or variable in the number of their orders.

---

The sclerenchyma, or hard calcareous part of the Madreporaria Aporosa, may consist of the theca or wall of the corallite, sometimes of a common colonial wall, of septa, pali, costæ, of a columella, of endotheca or dissepiments, tabulæ or synaptacula, or stereoplasm, and of exotheca, epitheca, and peritheca. There may be basal expansions or mural or epithelial rootlets. The epitheca may be free or united to the wall, or may be indistinguishable from it.

Reproduction by ova, also by gemmation from different parts of the corallum or colony, and increase may occur by fissiparity and serial growth.

Milne-Edwards and Jules Haime divided the section Madreporaria Aporosa into eight families—the Turbinolidæ, Dasmidæ, Oculinidæ, Stylophoridæ, Astræidæ, Echinoporidæ, Merulinaceæ, and the Fungidæ.

Of these families the Turbinolidæ, Oculinidæ, and Astræidæ are retained. The first includes the old Dasmidæ; the second takes in those Stylophoridæ which remain after the elimination of the true Stylasters according to H. N. Moseley. The Astræidæ absorb part of the Echinoporidæ and the Merulinaceæ.

Another family is required, that of the Pocilloporidæ, which includes the genera *Pocillopora* and *Seriatopora* of the old Tabulata, and is established upon the work of H. N. Moseley and Verrill.

The subfamilies of the Turbinolidæ of Milne-Edwards and Jules Haime, depending on the presence or absence of pali, are absorbed in this revision, and so are the two great divisions of the Astræidæ, which only depend upon the entire or dentated condition of the edges of the septa.

Section MADREPORARIA APOROSA, *Ed. & H.*

I. Family TURBINOLIDÆ\*, *MM. Milne-Edwards & Jules Haime, Hist. Nat. des Corall. vol. ii. 1848, amended.*

Corallum simple or in colonies, in the first instance reproducing by ova and in the second by gemmation from the wall or from an expansion of the basal structures. Wall solid. Septal loculi open to the base. Endotheca very rarely present.

I. Subfamily *Turbinolidæ simplices.*

Corallum simple, reproducing by ova, rarely by deciduous buds.

II. Subfamily *Turbinolidæ gemmantes.*

Colony increasing by gemmation; buds free above their origin; no exotheca uniting the corallites.

III. Subfamily *Turbinolidæ reptantes.*

Colony growing from basal expansions or stoloniferous growths; exotheca absent.

The following are the alliances of the family Turbinolidæ:—

*Alliances*:—Smilotrochoida, Flabelloida, Placotrochoida, Turbinoloida, Trochocyathoida, Discoocyathoida, Haplophylloida.

The genus *Dasmia* stands alone.

Subfam. *Turbinolidæ simplices.*

I. Alliance SMILOTROCHOIDA.

Simple Turbinolidæ with a wall, costæ, and septa, rarely with pali. Columella absent. Epitheca present or absent.

Genus SMILOTROCHUS, *Ed. & H.*

Subgenus BLAGROVIA, *Duncan.*

Genus ONCHOTROCHUS, *Duncan.*

Genus DESMOPHYLLUM, *Ehr.*

Subgenus JAVANIA, *Duncan.*

Genus SCHIZOCYATHUS, *Portalès.*

Genus absorbed:—

MICROTROCHUS, *T. Woods.*

Genera becoming subgenera:—

BLAGROVIA, *Duncan*; JAVANIA, *Duncan.*

---

\* This family was divided into two subfamilies by Milne-Edwards and Jules Haime on account of the presumed morphological value of pali or paluli. The presence of pali having been shown not to be of primary importance (for they

The generic characters of *Smilotrochus*, according to Milne-Edwards and Jules Haime, were too specific. The shape of the corallum and the nature of the ornamentation are most variable quantities. The genus includes the simplest corals, and the corallite consists of a wall, costæ, and septa only; sometimes there is an epitheca.

Genus *SMILOTROCHUS*, *Milne-Edwards & Jules Haime*,  
*Hist. Nat. des Corall.* vol. ii. p. 70 (1857), amended.

The corallum is simple, free in adult age, very variable in shape, base small; body straight or curved, cylindrical or conical, or cuneiform, or turbinate, compressed or not. Septa slightly exsert and free at their inner edge. Axial space vacant, there being no columella. Costæ well developed, not cristate. Epitheca usually does not exist.

*Distribution.*—*Fossil.* Cretaceous: England and Europe. Eocene: Europe, Asia. Cainozoic: Australia.

Subgenus *BLAGROVIA*, *Duncan*.

The corallum is turbinate or subturbinate, adherent; the calicular fossa is very deep; the costæ are covered with an epitheca, and the septa are very numerous.

*Distribution.*—*Fossil.* Eocene of Sind.

This subgenus absorbs the genus *Blagrovia*, nobis, *Pal. Ind.* ser. xiv., *Foss. Corals and Alcyonaria of Sind*, p. 28 (1880).

Genus *ONCHOTROCHUS*, *Duncan, Monog. Brit. Fossil Corals*,  
*Pal. Soc.* part ii. n. 1, p. 4.

The corallum is simple, adherent when young, free when adult, tall, slender, tubuliform, straight or hooked, or clavate. The septa are few in number, and some unite axially. The costæ are small and almost rudimentary. The epitheca is pellicular and striated. There is no columella.

*Distribution.*—*Fossil.* Cambridge Upper Greensand: Grey and White Chalk, England.

exist in corals otherwise exceedingly closely allied, and do not appear to be of physiological importance), the subfamily Caryophyllinæ of Milne-Edwards and Jules Haime is absorbed and abolished.

About 67 genera have been arranged in this family. On revising them I find it necessary to reduce to subgenera or abolish 25, so that this family now consists of 42 genera.

The genus *Desmophyllum* was established by Ehrenberg, Corall. des Roth. Meer. p. 76 (1834). It contains many recent and fossil species, and is eminently Smilatrochoid. There is great variation in the shape of individuals of some of the species, and abnormal growths are produced around the base and from the wall by the irritation of parasites and any instability of the surface of attachment. The forms may grow to a considerable size, may adhere by their sides and form groups, and the same species will present short, long, broad-based, narrow-based, large and small caliced, costulate or non-costulate individuals.

In some instances the base extends as a film of hard matter on the supporting body, and in others there are rootlets.

The majority of species have no epitheca; but a recent form which cannot be separated from the genus has it. Moseley notices that his great *Desmophyllum ingens* is covered with an abundant dense epitheca\*; and some forms of *Desmophyllum crista galli*, Ehr., sp.†, have it and others have not. But the epitheca is not separable from the wall.

Ehrenberg's definition, as given by MM. Milne-Edwards and Jules Haime‡, is too contracted in some parts, and not sufficiently elaborate in others. As amended the genus may stand as follows:—

Genus *DESMOPHYLLUM*, Ehr. 1834, amended.

The corallum is fixed by a large or small base; the body may be long or short, straight, or slightly curved and twisted, with or without "rootlets" springing from the wall. Calice widely open, fossa deep; axial space vacant. Septa numerous, exsert, unequal in height, often overhanging the margin. Costæ visible near the calice, irregular, often as crests, nodules, or ridges here and there on the wall. Epitheca may or may not exist. Surface usually smooth or granular.

*Distribution*.—*Recent*. Atlantic and Pacific Oceans, Australia, Western Patagonian seas, and Mediterranean.—*Fossil*. Upper Tertiary strata of Europe.

Subgenus *JAVANIA*, Duncan, Proc. Zool. Soc. Lond. 1876,  
p. 434.

The base is broad, the calice compressed, the larger septa are

\* Moseley, 'Challenger' Report, p. 61.

† Duncan, Proc. Royal Society, p. 133 (1877).

‡ Hist. Nat. des Corall. vol. ii. p. 76.

exsert; the tertiaries have costæ larger than they are. The epitheca is dense near the base and pellicular near the calice, and festooned.

*Locality.* Japanese seas.

There is no coral closely resembling a *Smilotrochus*, *Onchotrochus*, or *Desmophyllum* which has pali. But the genus *Schizocyathus*, Pourtalès, so interesting from its budding within the calice and producing the death of the parent, comes within this Alliance.

Genus SCHIZOCYATHUS, *Portalès, Deep-Sea Corals, Zool.*

*Results of the Hasslar Exped.* 1874, p. 36.

Corallum simple, without epitheca or costæ; no columella; pali in front of the last cycle of septa, united in front of the penultimate; propagating by internal gemmation.

*Locality.*—*Recent.* Caribbean sea: Atlantic, Josephine Bank, 100–760 fms.

This remarkable genus has but one species, *Schizocyathus fissilis*, in which the growth of the bud splits the parent.

The shape of the solitary species is long, conical, almost cylindrical, and the wall is marked outside by lines corresponding to the primary septa and by rows of dots corresponding to the interseptal chambers.

Lindström has described a specimen of *Schizocyathus fissilis*, Pourt., which he states has an epitheca. He states "that the wall proper between the septa consists entirely of the same sort of thin epitheca which surrounds the whole outside of the coral, or, in other words, there exists no wall as a separate formation distinct from the epitheca." It appears that there is a wall which every Turbinolian must have, and that it resembles epitheca, there being, however, no true epitheca. There is more or less stereoplasm in the interseptal loculi. The same author states that the growth is not a gemmation but an interrupted and then continued growth of the same individual\*.

The genus *Microtrochus*, T. Woods, was founded upon one specimen of a very young coral. It can hardly remain in the classification, and had better drop until further evidence comes to hand regarding its mature form.

\* "Contributions to the Actinology of the Atlantic Ocean," 1877, p. 18, K. Svenska Vetenskaps-Akad. Handl. xiv. No. 6.

## II. Alliance FLABELLOIDA.

Simple Turbinolidæ, fixed or free, with or without rootlets, more or less compressed and flabelliform or cuneiform. Calice elongate elliptical or short. Septa large, exsert or not. Columella parietal. Costæ variable, often crested or spined. Epitheca pellicular or membranous. Rarely increasing by deciduous gemmation from the wall.

Genus FLABELLUM, Lesson.

Subgenus BLASTOTROCHUS, Ed. & H.

Genus RHIZOTROCHUS, Ed. & H.

Genus THYSANUS, Duncan.

Genera absorbed:—

VASILIUM, T. Woods; PHYLLODES, Philippi; ULOCYATHUS, Sars.

Genus placed as a subgenus:—

BLASTOTROCHUS, Ed. & H.

Genus FLABELLUM, Lesson, *Illustr. de Zool.* 1831, amended.

Syn. *Vasilium*, T. Woods; *Phyllodes*, Philippi; *Ulocyathus*, Sars.

The corallum is simple, straight or bent, more or less compressed, fan-shaped. The calicular fossa is narrow and deep, usually long, rarely widely open. The columella consists of a few trabeculæ from the inner ends of the septa. The septa are numerous, and reach up to or beyond the wall. The costæ may be crested, spined, or simple. The base may be attached or may become free, broad or pedunculate. Rootlets from the wall occasional. Epitheca pellicular, rarely dense.

*Distribution.*—*Recent.* Almost universal.—*Fossil.* Eocene: Europe, Asia. Miocene: Europe, West Indies. Cainozoic: Australia and New Zealand. Pliocene: England and Europe.

This large genus is closely allied to the compressed forms of *Desmophyllum*. It may be divided into sections, which are *not* of subgeneric value however:—

1. Corallum flabelliform, subpedicellate, and becoming free. Wall nearly smooth on the two faces, and with small crests on the sides.
2. Faces of the wall with crests as well as the sides.
3. Wall with smooth faces, but with stout spines on the sides of the corallum.
4. Wall smooth, neither crests nor spines.

5. Largely fixed when young and becoming free ; having spines on the sides.

6. Corallum always fixed.

Some of the deep-sea species described by Moseley have widely open calices and angular outlines. The Eocene forms ally the genus to *Smilotrochus*. *Vasilium*, Tension Woods, a genus with one species, appears to be so closely allied to *Flabellum* that it should be absorbed\*.

Subgenus BLASTOTROCHUS, (genus) *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 99 (1857).

Corallum simple and fixed ; calice elliptical ; columella rudimentary and produced by trabeculæ from the septal ends. Septa non-exsert. Epitheca smooth. Soft parts pink and red. Budding occurs at the sides between the calicular margin and the base, and the buds fall off and grow.

*Distribution*.—*Recent*. Philippines.

The parent seems to be fixed, and probably the buds get fixed after separation.

The species which have been included in the next genus are rather difficult to classify satisfactorily.

In 1848 MM. Milne-Edwards and Jules Haime described the genus *Rhizotrochus* as follows :—The corallum is simple, subpedicellated, and adheres by the means of root-like prolongations, which come from the surface of the epitheca and reach down after the fashion of adventitious roots. There is no columella. The septa are broad and not exsert, and they unite with those of the opposite side of the calice by their inner ends.

The typical species was *Rhizotrochus typus*, Ed. & H., from Singapore (*op. cit.* vol. ii. p. 98). It has a succession of hollow rootlets, an epitheca which permits the costæ to be seen under it, and a very deep compressed calice.

In *Rhizotrochus affinis*, nobis (Madrep. Deep-Sea, H.M.S. 'Porcupine,' Trans. Zool. Soc. Lond. vol. viii. pt. v. p. 323, 1873), the epitheca comes up to the very margin, is striated and coarse, yet is inseparable from the wall and, indeed, not to be distinguished from it. The radicles are large and are offshoots of the epitheca. The coral without the radicles is very closely allied to the broad-based, slightly compressed *Flabellum rubrum* from New Zealand.

\* T. Woods, Proc. Linn. Soc. New South Wales, vol. iii. 1878-79, p. 43.

*Rhizotrochus fragilis*, Pourtalès (Deep-Sea Corals, Illustr. Cat. Mus. Comp. Zool. Harvard, 1871, No. iv. p. 17). The septa of the 1st and 2nd orders meet in the centre of the deep fossa, and the corallum has an exquisitely fine pellicular epitheca ornamented with curves and vandykes, which is not to be distinguished from a wall. There is no theca in the ordinary sense. The rootlets are small, and their cavities are continuous with those of the interseptal loculi.

*Rhizotrochus tulipa* of the same author (Hasslar Corals, 1874, p. 39) has exsert septa besides the rootlets; otherwise it resembles the other species.

Now the species are clearly divisible into those with a well-developed rough epitheca and those without one, and in the latter instance the wall is really epithecate. It is by no means sure that the rough epitheca is not mural.

Genus RHIZOTROCHUS, *MM. Milne-Edwards & Jules Haime*,  
*Hist. Nat. des Corall.* vol. ii. p. 97 (1857), amended.

Corallum simple, tall or short, cylindrical, compressed more or less, and with a compressed or circular calice. Calice with a deep fossa and thin septa, which are usually not exsert and never much so. The columella is absent, and the septa either unite by a few trabeculæ or join across the axial space. The wall is very thin, and resembles pellicular or opaque epitheca. Costæ rudimentary or absent. The epithecate wall is produced in the form of rootlets, which are hollow and communicate with the visceral cavity. Corallum attached by the rootlets and base.

*Localities.*—Recent. Mediterranean; Florida seas; Pacific.

Genus THYSANUS, *Duncan, Quart. Journ. Geol. Soc.* vol. xix.  
1863, p. 430, amended.

Corallum simple, becoming free with age. Elongate, compressed, low, pedicellate at one end of the long base. Calice long, narrow, shallow, elongate, elliptical. Septa numerous, radiating more or less from the end of the calice, which corresponds with the basal pedicel, granular, minutely spinulose. Columella small, parietal. Costæ well developed, converging to pedicel, granular, minutely spined. A groove may or may not traverse the base. Epitheca variable.

*Distribution.*—Fossil. Miocene: West Indies.

## III. Alliance PLACOTROCHOIDA.

Simple Turbinolidæ, free or attached, compressed, with an essential, more or less lamellar or elongate columella, rarely with pali.

Genus PLACOTROCHUS, Ed. & H.

Genus SPHENOTROCHUS, Ed. & H.

Genus NOTOTROCHUS, Duncan.

Genus PLACOCYATHUS, Ed. & H.

Genus PLATYTROCHUS, Ed. & H.

Genus PLACOTROCHUS, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 282 (1848), amended.

The corallum is simple, straight, cuneiform, flabelliform, and compressed or cornute, or more or less cylindrical and compressed. The columella is essential and is lamellar, horizontal, sharp, and entire at the surface, or crenulated. Septa exsert or not. Costæ developed, and often in crests or spinulose.

*Localities.*—*Recent.* Chinese seas, Philippines, N. Australia.—*Fossil.* Miocene of West Indies, Australia, Europe.

This is a well-marked genus, and some of the species are much compressed and extended laterally; others are deltoid and compressed; and one Sicilian form is cornute, with an epitheca. The lamellar and essential columella is very characteristic.

Genus SPHENOTROCHUS, *MM. Milne-Edwards & Jules Haime*,  
*Hist. Nat. des Corall.* vol. ii. p. 65.

The corallum is free, straight, cuneiform, compressed. Septa exsert or not; the principal reach the essential lamellar columella, which is lobed or knobbed at the free surface on the floor of the elliptical calice. Base bluntly pointed, truncate, or emarginate. Costæ projecting straight or more or less in zig-zag. Lateral costæ crested or not.

*Localities.*—*Recent.* Mediterranean and N. Africa; coast of Brazil; European coasts of N. Atlantic; S. Australian coasts.—*Fossil.* Cretaceous: Germany. Eocene of France, Belgium, and Alabama. Miocene of France and Germany. Pliocene of England. Cainozoic: Australia and New Zealand.

The species described by M. de Fromentel from the Cretaceous of France would appear to be more like a *Placotrochus* than a *Sphenotrochus*.

There is a common little simple coral in the Tertiaries of Australia which has given the Rev. T. Woods and myself much

trouble. It was at first placed in the genus *Turbinolia*, then in *Caryophyllia*, then in *Deltocyathus* and in a new genus of Mr. Wood's, *Notocyathus*\*. Fortunately some excellent specimens have lately come to hand, and there is no doubt that the projection of the tertiary septa in front of the secondaries is not a palus but a paliform lobe. There is a decided columella with nodules upon it. The form *Caryophyllia viola*, Woods and Duncan, must come under a new genus, *Nototrochus*.

#### Genus NOTOTROCHUS, gen. nov.

Syn. *Notocyathus*, Woods.

The corallum is cuneiform, compressed, free, with a widely open elliptical calice. Columella formed by the septal ends and by intermediate solid tissue, elongate, more or less lobed or nodular where free. Septa unequal, arched near the margin; primaries longest; secondaries shorter than tertiaries, joining these last by lateral processes and by inner end also. Tertiaries uniting in front of secondaries, and joining with an offshoot of the columella, which is produced as a paliform lobe. Paliform lobe before primaries also. Costæ vary in length, trifurcating low down, subequal at the calice; interseptal spaces wide.

*Distribution*.—*Fossil*. Tertiary: Australia, New Zealand.

Genus PLACOCYATHUS, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 328 (1848), amended.

The corallum is simple, free or fixed, pedicellate, or with a broad adherent base. Shape more or less flabellar, curved or straight, compressed. Septa exsert or not. Columella lamellar. Pali in more than one crown, usually only before the penultimate and antepenultimate cycles, but occasionally only before the larger septa, and before all the cycles except the last. Costæ visible or not; with or without epitheca.

*Distribution*.—*Recent*. Position unknown.—*Fossil*. Eocene of Sind, Asia. Miocene of Antilles.

The genus, as amended, combines all the species of *Placocyathus* very naturally.

\* Palæont. of New Zealand (Wellington), Cat. Mus. Geol. Survey Dep. pt. iv. (1880).

Genus *PLATYTROCHUS*, *MM. Milne-Edwards & Jules Haime, Ann. des Sci. Nat.* 3<sup>e</sup> sér, t. ix. p. 246 (1848).

The corallum is simple, straight, cuneiform, and non-adherent. The collumella is essential, elongate, and fascicular, and has a free papillary edge. The septa are broad and exsert. The wall is naked, and there are two kinds of costæ: those on the middle of the broad surfaces of the corallum enlarge towards the calice, and those on the edges of the corallum near the base are extended and large. The compressed base is with or without a conical point.

*Distribution.*—*Fossil.* Eocene: Alabama.—*Recent.* Australian seas?

This genus was founded to include two species from Alabama which had been placed by Lea amongst the Turbinolians, and one of them in the genus *Endopachys* by Lonsdale. The forms are remarkable, and very Placotrochoid in appearance. There is, however, a lamellar fascicular columella, and the extension of the costæ is almost unique.

#### IV. Alliance TURBINOLOIDA.

Simple Turbinolidæ, free or attached, straight, conico-cylindrical, rarely cornute. Septa uniting more or less with a styliform columella which projects. Some forms with pali, with or without a columella.

Genus *TURBINOLIA*, Ed. & H.

Subgenus *STYLOTROCHUS*, E. de From.

Genus *STYLOCYATHUS*, d'Orb.

Genus *CONOCYATHUS*, d'Orb.

Genus *BISTYLIA*, Tonnison Woods.

Genus *TREMATOTROCHUS*, Tonnison Woods.

Genera absorbed:—*PLEUROCYATHUS*, Keferstein, by *STYLOCYATHUS*, d'Orb.; *STYLOCYATHUS*, Reuss, = *STYLOCYATHUS*, d'Orb.

*Stylotrochus* becomes a subgenus.

Genus *TURBINOLIA*, *MM. Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 60.

The corallum is simple, free, straight, and conical, rarely curved or cornute. The calice is circular in outline. The columella is essential, and projects in the calice like a stylet. The septa are exsert. The costæ are lamellar and project, are straight and perfect. Intercostal spaces with or without fossettes.

*Distribution.*—*Fossil.* Eocene: England, France. Oligocene: Germany.—*Recent.* Caribbean Sea?

There is a very marked facies in all the species of *Turbinolia*, which are eighteen in number, eleven having lived on the English area during the Eocene. There are three species recorded from the Lower Oligocene of Germany.

The number of septa is not great, and the species may be grouped under four heads:—Those with four cycles incomplete; those with three cycles; those with three cycles of septa and the costæ of a fourth cycle; and those with the third cycle of septa incomplete. The columella is a styloid process arising from the base within, and some septa always unite with it.

The genus is comparatively isolated; some species of the genus *Sphenotrochus* resemble some of the *Turbinoliæ* with stout costæ, but the other distinctions are evident.

There is a genus of M. de Fromentel's, which was established from a single specimen of one species. It only differs from *Turbinolia* in having a curved cornute corallum and no "fossettes" between the costæ. This last character is not invariable in the genus *Turbinolia*. This genus *Stylotrochus* (Pal. Franç., Zooph. Crét. pl. viii.) is of Cretaceous age, and I place it as a subgenus.

Sismondi names a species from the Italian Tertiaries.

Genus *STYLOCYATHUS*, *d'Orbigny, Note sur les Polyp. foss.*  
p. 5 (1849).

Syn. *Pleurocyathus*, Kefst. (de Fromentel, Pal. Franç., Zooph. Terr. Crét. pl. viii.).

The corallum is subturbinate, subpedicellate, curved, and free. The columella is styloform or compressed. The septa are exsert, and there are pali before all the cycles except the last. An epitheca is well developed, and extends more or less to the calicular margin.

*Distribution.*—*Fossil.* Cretaceous, Eocene, Oligocene: Europe.

*Pleurocyathus*, Kefst., is not generically distinct from the above. It is straight, free, has costæ which are smooth, and a styloid columella. The only distinction is the presence of the epitheca in *Stylocyathus*, d'Orb. Reuss named *Pleurocyathus Stylocyathus*, having been unaware of d'Orbigny's genus (see also pages 26 and 27 of this Revision).

There is a great difficulty in placing the next genus with any of the alliances of the Turbinolidæ; and it had better come in as one of the Turbinolian alliance.

GENUS CONOCYATHUS, *d'Orbigny*, 1849.

The corallum is free, conical, trochoid, straight, the costæ are sublamellar, the septa are exsert and strongly echinulate on the sides. The columella is absent; and there are pali before the penultimate cycle of septa.

*Distribution.*—*Fossil.* Miocene of Mayence; Cainozoic, Australia.—*Recent.* South-Australian and New-Zealand seas.

GENUS BISTYLIA, *Tennison Woods*, *Trans. Phil. Soc. Adelaide*, *S. Australia*, 1877-78, p. 114.

Corallum simple, conico-cylindrical, attached. Columella a double style.

*Distribution.*—*Fossil.* Tertiary deposits of Australia.

There is much difficulty in placing the next genus; and indeed it would be insuperable were it not for the admirable drawing of one of the species. The description of the genus *Trematotrochus* by Tennison Woods is very short; but the light thrown on it by the illustration is very, but not perfectly, explanatory.

Mr. Tennison Woods differentiates as follows:—

GENUS TREMATOTROCHUS, *T. Woods*, *Proc. Royal Soc. New South Wales*, vol. xii. 1878, p. 59, fig. 2.

“Corallum free; visceral chambers free. Septa distinct, only united in the middle. Pali exsert. No endotheca or synapticula. Wall perforated.”

The figure and the description of the species indicate that the septa are stout, not perforate, and that the perforations are perfectly symmetrical, and in the intercostal spaces only. The “pali” are not more than paliform lobes or dentations around the circular axial space which is bounded by the united inner (not middle) ends of the septa. The appearance is that of a species of *Turbinolia* or *Conocyathus*, with the costæ not so projecting as is usual. The intercostal dimples of the *Turbinoliæ* of the Eocene of Bracklesham do not perforate; and they are on either side of a line running down the intercostal spaces; but the wall is very thin, and often wears away during fossilization. The arrangement of the septa in *Trematotrochus* is, however, different from that of any species of *Turbinolia*.

The form described by Mr. Tennison Woods may then be thus described generically :—

Genus TREMATOTROCHUS, *T. Woods, amended.*

Corallum simple, regularly conical, elongated, free. Calice circular, with a well-developed margin. Columella none. Septa few, short; those which are large and equal extend close to the axial space, and form a tube-like space. A cycle of rudimentary septa corresponds to costæ which are nearly as large as those of the other septa. Paliform nodules on the primary septa. Intercostal spaces regularly fenestrated? Neither endotheca nor synapticula exist.

*Distribution.*—*Fossil.* Miocene or Cainozoic: Australia.

V. Alliance TROCHOCYATHOIDA.

Simple Turbinolidæ, with wall, costæ with or without epitheca. Pali in one or several crowns, or absent. Columella fasciculate. Shape variable.

Genus TROCHOCYATHUS, Ed. & H.

Subgenus TROPIDOCYATHUS, Ed. & H.

Subgenus THECOCYATHUS, Ed. & H.

Subgenus BLANFORDIA, Duncan.

Genus DELTOCYATHUS, Ed. & H.

Genus ODONTOCYATHUS, Moseley.

Genus LEPTOCYATHUS, Ed. & H.

Genus PARACYATHUS, Ed. & H.

Genus HETEROCYATHUS, Ed. & H.

Genus CARYOPHYLLIA, Lmk.

Subgenus ACANTHOCYATHUS, Ed. & H.

Genus STENOCYATHUS, Pourtalès.

Genus CERATOTROCHUS, Ed. & H.

Genera absorbed :—

APLOCYATHUS, d'Orb.; STEPHANOCYATHUS, Seguenza;  
 PLATYCYATHUS, E. de From.; BATHYCYATHUS, Ed.  
 & H.; DUNOCYATHUS, T. Woods; BLASTOCYATHUS,  
 Reuss; CONOTROCHUS, Seguenza; EPITROCHUS, E. de  
 From.; PLEUROCYATHUS, Moseley, Keferstein, and  
 E. de Fromentel; CRISPATOTROCHUS, T. Woods.

The genera *Tropidocyathus*, Ed. & H., *Thecocyathus*, Ed. & H., *Blanfordia*, Dunc., and *Acanthocyathus*, Ed. & H., become subgenera.

The Trochocyathoid alliance is a large one, and contains genera which have persisted from the age of the Lias to the present time;

others which have endured from the Cretaceous age to the present day, and some which flourished during the Eocene and still exist. Some genera are dwellers in the deep sea. Any turbinated-shaped species of the genus *Trochocyathus* and any form of the genus *Ceratotrochus* may be taken as the types of the two great groups of the alliance, the one with and the other without pali.

Genus TROCHOCYATHUS, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 300 (1848), *amended*.

Syn. *Aplocyathus*, d'Orb.; *Stephanocyathus*, Seguenza; *Platy-  
cyathus*, E. de From.

The corallum is simple, pedunculate or subpedicellate, or merely shows the trace of a former adhesion. The shape may be elongate, turbinated, subturbinated, straight, curved, compressed or not, or more or less discoid and flat. The calice is deep or widely open. The septa are long and usually some are exsert. The pali are in two crowns. The columella is formed of trabeculæ, is essential, and may or may not be papillary. The costæ may or may not be well developed, crested, spined, or simply projecting. Epitheca variable.

*Distribution*.—*Fossil*. Lias to Recent. *Fossil forms* world-wide.—*Recent*. West Indies, South-Australian seas.

The genus is a large one, and should include some subgenera. Its species have been divided into the following groups by Milne-Edwards and Jules Haime:—*Trochocyathi striati*, with the wall marked with but slightly projecting costæ; and *Trochocyathi armigeri*, with the costæ well developed, crested, spined, or warty. In both of these divisions the shape of the coral is very variable.

#### Subgenus TROPIDOCYATHUS, *Ed. & H.*

The corallum is compressed; the wall is naked, and has a basal expansion. Pali before all the cycles except the last, and they form more or less marked chevrons.

#### Subgenus THECOCYATHUS, *Ed. & H.*

The epitheca surrounds the wall and reaches the calicula margin. Corallum with a fixed and broad base, or not fixed.

Subgenus BLANFORDIA, (genus) *Duncan, Fossil Corals and Alcyonaria of Sind, Pal. Indica*, Sect. xiv. pt. 2, p. 73 (1880).

Corallum cyclolitoid or nummiform in shape, with a flat base. Calice open, axial space shallow, and columella deep and small. Septa numerous, close. Pali before all the septa except those of the last order, small; union of the septa very usual, on both sides of a long primary. Epitheca pellicular, binding the costæ to the discoid base.

*Distribution*.—*Fossil*. Eocene: Sind, Asia.

This subgenus includes a remarkable form which commences upon a Nummulite, and the epitheca is very pronounced.

Genus DELTOCYATHUS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 56 (1857).

Corallum simple, discoid or cup-shaped, free, and without trace of former adhesion; calice subplane; columella fasciculate. Pali well developed, exsert, unequal, before the cycle of septa except the last, arranged in chevrons or deltas. Septa usually exsert except the last cycle. Costæ exceedingly variable in their development, especially the primaries spined or not.

*Distribution*.—*Fossil*. Miocene, Pliocene: Europe, Australia?—*Recent*. Caribbean Sea, N., E., and S. Atlantic, Korean Sea, Pacific.

Genus ODONTOCYATHUS, *Moseley, Report on Corals 'Challenger' Exped.* p. 148 (1881).

Corallum deep saucer-shaped, with straight sloping sides and a broad flat base, free, but with a scar of former adhesion. Columella fasciculate. Pali in three crowns. The broad base is composed of fused radiating tuberculate spines, which project like the spokes of a wheel all round the base of the wall.

*Distribution*.—*Recent*. West Indies.

Genus LEPTOCYATHUS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 50 (1857).

Syn. *Ecmesus*, Phil.

Corallum simple, very short, subdiscoid, free, and without trace of former adhesion. Wall with simple costæ. Calice circular and excavated in the centre. Columella papillary. Septa exsert; and there are denticulate pali before all the septa.

*Distribution*.—*Fossil*. Eocene: England, Europe, India?—*Recent*. Caribbean Sea, Azores, Josephine Bank?

GENUS *PARACYATHUS*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 52 (1857).

Corallum simple, subturbinate or variable in shape, fixed with a broad base; calice circular or elliptical, open. Columella fasciculate, papillary at the surface, depressed centrally, raised where its outer papillæ are with difficulty distinguished from the pali. These are numerous, and before all the cycles of septa except the last, and the youngest are the largest, often bilobed and projecting, often granular. Septa close, subequal, not very exsert, granulated. Costæ indistinct or fairly developed. Rudimentary epitheca rarely present.

*Distribution.*—*Fossil.* Eocene: Europe, England. Miocene, Pliocene: Europe.—*Recent.* Mediterranean, Indian Ocean, Pacific, California (Pearl Islands), Caribbean Sea, N. Atlantic, Josephine Bank.

The genus *Platycyathus*, E. de From. Pal. Franç., Terr. crét., is a discoid *Trochocyathus*, and is therefore absorbed.

GENUS *HETEROCYATHUS*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 51 (1857).

Corallum simple, the base growing more or less entirely over a small shell upon which it is fixed. Calice as large as the base, subcircular. Columella feebly developed, and composed of slender points. Septa very exsert, thick, and unequal, in four cycles with an incomplete fifth. The septa of the last cycle more developed than the penultimate septa; and they diverge slightly from their neighbours of the higher orders. Pali very slender, denticulate, before all the septa. Wall with distinct equal costæ. No epitheca.

*Distribution.*—*Recent.* Philippine, Corean, and East-African seas.

Semper states that there are fossil species (*Die natur. Existenz der Thiere*, pt. ii. p. 167, 1880).

The figure given by the authors of the genus indicates that a Sipunculid worm lives in the base of the coral, communicating with the outside by means of small openings. Some forms grow upon dead *Cerithium*-shells which are occupied by a Sipunculid.

GENUS *CARYOPHYLLIA*, *Lamarck, Syst. Anim. sans Vertèb.* 1801, p. 370, amended.

Corallum simple, with a broad or narrow adherent base, or

bluntly or sharply pointed at the non-adherent base; shape variable, low and broad, cornute, compressed or not, cuneiform, turbinate, subturbinate, elongate, often enlarging near the calice. Calice circular or elliptical, deep or moderately deep. Septa variable in the number of cycles. Pali well developed in one crown. Columella fascicular, twisted, often ending in blunt processes. Costæ distinct or not, crested or spined rarely. Epitheca pellicular or absent or dense. Endotheca very rarely exists.

*Distribution.*—*Fossil.* Cretaceous: England, Europe, Southern India. Eocene: Europe and Asia. Miocene, Pliocene: Europe.—*Recent.* Littoral and deep sea, very general.

The essential generic attributes are the simple corallum, fascicular trabeculate columella, and a single crown of pali. Groups of individuals are sometimes found; but the apparent compound corallum is produced by the accidental adhesion of ova to the outside of the corallum of the parent.

Subgenus *ACANTHOCYATHUS*. Forms with spines on the lateral or larger costæ.

The genus *Bathycyathus*, Ed. & H., is absorbed in *Caryophyllia*.

*Blastocyathus*, Reuss, is a *Caryophyllia* with accidentally adherent buds.

*Dunocyathus*, T. Woods, Proc. Linn. Soc. New South Wales, vol. ii. 1878, p. 305:—"Corallum simple, parasitic; base and side immersed in a calcareous organism. One row of pali."

In the determination of the species it is mentioned that the edges of the septa are denticulate, or set with irregular lobes and points. Columella papillary. Diameter 2 millim.

*Distribution.* Port Jackson.

I think that the description of the solitary specimen of the very small coral can hardly be of sufficient value, and that the genus must be absorbed.

Genus *STENOCYATHUS*, *Pourtalès, Illustr. Cat. Mus. Comp. Zool. Harvard, No. iv.; Deep-Sea Corals, 1871, p. 9.*

Corallum simple, free, very elongated, and of nearly equal dimensions throughout. A single crown of pali. A columella of one or more twisted processes. Epitheca absent.

*Distribution.*—*Recent.* Caribbean Sea and Azores.

The genus has some of the features of *Onchotrochus*, but

differs decidedly. The costal tubercles are hollow, and communicate with the visceral cavity. There is some doubt about the epitheca, some specimens having it according to Lindström (see his elaborate morphological description, *op. cit.* p. 19.)

Genus CERATOTROCHUS, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 248 (1848), amended.

Syn. *Conotrochus*, Seguenza; *Epitrochus*, E. de Fromentel; *Crispatotrochus*, T. Woods; *Pleurocyathus*, Moseley; *Koilotrochus*, Woods.

The corallum is simple, subpedicellate, and free in the adult state, cornute, long or short, compressed or not; calice circular or elliptical. Septa large and usually exsert, or not appearing above the calicular margin. Columella fasciculate. The costæ are distinct to the base, and are ornamented or spined or plain, or are hidden and are not ornamented. Epitheca present or absent.

*Distribution.*—*Fossil.* Eocene, Miocene, Pliocene: Europe.—*Recent*, widely distributed.

This genus is a Smilotrochoid with a columella fasciculate in character; and it would resemble many *Trochocyathi* were their pali removed.

*Conotrochus*, Seguenza, is merged into *Ceratotrochus* by general consent.

The genus *Epitrochus*, E. de From., Pal. Franç., Zooph. Crét., diagnosed to receive a single specimen of one species, appears to be a young *Ceratotrochus*, and should lapse.

*Crispatotrochus*, T. Woods, is probably a *Ceratotrochus*.

*Koilotrochus*, T. Woods, Proc. Linn. Soc. New South Wales, vol. ii. p. 313 (1878):—Corallum simple, free, without trace of adherence; no epitheca. Costæ distinct, simple, prominent. Columella rudimentary, confined to a few papillary projections at the base of the deep and wide calicular fossa. Septa four, slightly exsert.

The calicular fossa is deep and wide.

*Locality* not given by Rev. T. Woods; but as he refers a form called *Smilotrochus vacuus*, T. Woods, to this genus, probably it is a fossil form. Australian Tertiary.

It appears that this is an aberrant type of *Ceratotrochus*.

Moseley gives the generic name *Pleurocyathus* to a form from

Banda Island, East Indies, 60 fms., which he allies with *Duncania*. The species was described from one specimen only\*, which, however, is well preserved. The following is the generic diagnosis:—"Corallum conical, attached by its side; entirely covered by a thin, plicated, coloured, bark-like epitheca, which rises higher than the margin of the calicle. Wall of the calicle very thin, except near the margin, where a zone of stereoplasma is developed, soldering together the outer regions of the septa where they arise from the wall. The lower part of the calicle devoid of stereoplasma or other filling. The columella composed of several flattened pillars."

In the description of the species we learn that the epitheca, in its upper region, is thrown into a series of longitudinal costal folds, which are equally developed and only very slightly prominent. The rounded edges of the primary and secondary septa can just be seen above the level of the margin of the calicle. The wall is very thin. The columella is formed of four flattened pillars, fused together below, but free at their tips, and it projects in the fossa. Height of specimen 8 millim.

Stereoplasma is a name given by Lindström to a substance which connects septa (environing their free edges in some Palæozoic corals), stretches across interseptal loculi irregularly, and sometimes fills up the lower part of the inside of the corallum, constituting a solid mass there. It is to be distinguished from the true endotheca. Its presence as thin, solid, membrane-looking layers is excessively variable in the same species, and it is only of classificatory importance when it fills up the bases of corallites or accumulates near the wall in the interseptal loculi, to diminish the calibre of the coral within, and to add to the strength and thickness of the walls.

The presence of an epitheca is not of generic value; and the longitudinal folds mentioned in the description of the species above are in the position of costæ.

The adhesion by one side is remarkable, and is often the case in *Gynnia*, but it is not generic.

Keferstein and E. de Fromentel have both utilized this generic name.

The generic characters of the form are the conical and pedun-

\* Report on Corals, Deep-Sea Madreporaria, 'Challenger,' Zool. vol. ii. p. 159 (1881). The provisional title to this beautiful volume does not give the name of the author, H. N. Moseley, F.R.S.

culate shape, the barely exert numerous septa without pali, and the essential fasciculate columella. It is not separable from *Conotrochus*; and one of the species of this genus, now merged into *Ceratotrochus*, has in some of its individuals stereoplasma joining the septa near the margin, and a bark-like epitheca. The reasons for joining *Conotrochus* and *Ceratotrochus* are evident; and I place Moseley's interesting form, so beautifully figured by him, in *Ceratotrochus*, Ed. & H.

#### VI. Alliance DISCOCYATHOIDA.

Simple Turbinolidæ, discoid in shape, not increasing much in height with growth. Free or not. With or without pali in one crown. Columella variable; epitheca also.

Genus DISCOCYATHUS, Ed. & H.

Genus BRACHYTROCHUS, Duncan.

Genus SABINOTROCHUS, Duncan.

Genus STEPHANOTROCHUS, Moseley.

Genus DISCOTROCHUS, Ed. & H.

Genus CYCLOCYATHUS, Ed. & H.

Genus BRACHYCYATHUS, Ed. & H.

Genus ANTHEMIPHYLLIA, Pourtalès.

Genus FUNGIACYATHUS, Sars.

Genera absorbed :—PATEROCYATHUS, Duch. & Mich.; BRACHY-  
TROCHUS, Reuss.

Whilst admitting the necessity of recognizing discoid species of the genus *Trochocyathus*, there are still several genera which can hardly come within that genus or its alliance, and which contain discoid, low, cup-shaped forms, with and without pali in one row.

The genera *Discocyathus*, *Cyclocyathus*, *Discotrochus*, *Brachy-  
cyathus*, *Brachytrochus*, *Sabinotrochus*, and *Stephanotrochus* form an alliance, the Discocyathoid; and their very common facies is not interfered with by the fact that one genus has no columella and another a lamellar one, three others having them essential and fasciculate.

Genus DISCOCYATHUS, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 296 (1848).

The corallum is simple, free, and discoid, with a flat horizontal wall covered with a concentrically folded epitheca. The septa

are broad and exsert; the pali are in one crown; and the columella is essential and lamellar.

*Distribution.*—*Fossil.* Inferior Oolite: England and France.

In 1865 Reuss found a small broad-based coral in the Oligocene sands of Nieder Kaufungen, for which he proposed a new genus, *Brachytrochus* ("Zur Fauna des Deutschen Oberoligocäns," Sitzungsber. der math.-naturwiss. Classe der kais. Akad. der Wiss. Wien, 1865, p. 619). The specimens were not of mature forms, and were very small; so that *Brachytrochus Speyeri*, Reuss, is a doubtful species, and the genus must lapse. I have utilized the name, however, as follows:—

GENUS BRACHYTROCHUS, *Duncan (non Reuss), Proc. Zool. Soc. Lond.* 1876, p. 436.

The columella is short and shallow, cup-shaped, with a rounded free base. The calice is circular in outline, widely open and deep centrally. The septa are close, moderately exsert, and papillose near the axial space, and slightly dentated on the free margin. There is no columella. The costæ, profusely granular, are moderately developed, and are not seen on the centre of the base. The base is usually deformed and perforated, as it is the home of an annelid.

*Distribution.*—*Recent.* Gaspar Straits, 12 fms.

The papillary endings to some of the septa in this genus simulate pali, and the costæ are not very prominent structures.

GENUS SABINOTROCHUS, *Duncan, Madrep. of Deep Sea, Trans. Zool. Soc.* vol. viii. pt. v. p. 320, pl. xli. figs. 6–9 (1871).

Corallum simple, flatly turbinate, adherent by a delicate peduncle. Calice open, circular, fossa shallow, margin festooned by the projecting septa. Columella formed by growths from the septal ends. Septa exsert, granular; tertiaries usually unite with the secondaries close to the columella. Costæ unequal, extending mostly to the peduncle, more numerous than the septa.

*Distribution.*—*Recent.* Atlantic, 994 fms.

GENUS STEPHANOTROCHUS, *Moseley, Report on Corals, 'Challenger' Expedition*, p. 151 (1881).

Corallum dense and compact in substance, cup-shaped or saucer-shaped, with a trace of early attachment, usually with

well-developed costæ, bearing a succession of small spines with widely open capacious fossa. Septa usually extremely exsert, the exsert quinaries, or quaternaries where these are not present, lying next to the primaries, higher than the tertiaries, or equal to them. Columella short, or little prominent.

*Distribution.*—*Recent.* South Atlantic, Azores, Sydney.

This well-marked genus has very decided spines on the costæ in some species, and it has shallow forms and moderately tall ones. It is allied to the two genera *Brachytrochus* and *Sabinotrochus*, but is distinct.

Genus *DISCOTROCHUS*, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 251 (1848).

The corallum is simple, free, discoid. The calice is subplane; and the columella is fascicular and papillary. The septa are slightly exsert beyond the calice. The wall is horizontal and costulated.

*Distribution.*—*Fossil.* Eocene of Alabama; Miocene of Turin.

Genus *CYCLOCYATHUS*, *MM. Milne-Edwards & Jules Haime*,  
*Brit. Foss. Corals*, p. xiv, 1850 (*Pal. Soc. Lond.*).

The corallum is simple, free, adherent when young, with a horizontal wall and very thin epitheca. The septa are subcrenulate, and the pali are large and before the penultimate cycle. The columella is fasciculate and papillary.

*Distribution.*—*Fossil.* Gault: England.

Genus *BRACHYCYATHUS*, *MM. Milne-Edwards & Jules Haime*,  
*Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 295 (1848).

The corallum is simple, very short, subpedicellate, and free. The septa are exsert and narrow; and the pali, in one crown, are large, broad, and entire. Calice circular and subplane. Columella fasciculate, and of cylindrical processes, papillary. Costæ indistinct.

*Distribution.*—*Fossil.* Neocomian: Hautes Alpes.

The West-Indian Miocene form is not of the genus.

Genus *ANTHEMIPHYLLIA*, *Pourtalès, reconsidered*, 'Blake' *Corals*,  
1878-79, p. 112.

Corallum flat or low, free or pedicellate. Columella spongy and coarse, flat above, and fasciculate. Spines of septa trans-

versely flattened. Wall dense. Epithea well developed, concealing the costæ up to the calicular margin.

*Distribution.*—*Recent.* West-Indian Seas.

The late M. de Pourtalès placed this genus near *Discotrochus*.

The remarkable genus *Fungiacyathus* of G. O. Sars comes in here, in spite of its Fungoid appearance.

GENUS FUNGIACYATHUS, Sars, *Remarkable Forms of Animal Life from the Great Deeps off the Norwegian Coast*: Christiania, 1872, p. 58, pl. 5.

Corallum simple, free, without trace of former adhesion. Base discoid, nearly circular in outline, thin, nearly horizontal. The septa rise from the base, forming a convex calice, and there is a wide and deep central cavity bounded by the inner ends of the septa. Septa numerous, thin, brittle, often wavy at the free edge, more or less vertical, arched above, tallest externally, lowest near the central depression, converging from the calicular edge inwards, not anastomosing; in six systems, with 6 to 8 orders in each system. Columella formed by septal ends, small. There are no pali. Edge of basal margin with dentations, each one corresponding to a septum. Costæ small, radiating from the centre of the imperforate base. There is no epithea. In the soft parts, which are of brilliant vermilion colour in the species, numerous small tentacles surround the mouth near the inner edge of the septa.

*Distribution.*—*Recent.* Lofoten Islands, 300 fms.

The species of this genus resembles a *Stephanophyllia* or *Bathyactis* in shape, but the septa do not anastomose. There is only a basal wall, and there do not appear to be endotheca or synapticula. The genus is evidently one of the Turbinolidæ, or simple corals without endotheca.

#### VII. Alliance HAPLOPHYLLOIDA.

Small simple Turbinolidæ, with irregular or more or less quadrate septal arrangement. With or without stereoplasma.

Genus GUYNIA, Duncan.

Genus DUNCANIA, Pourtalès.

Genus HAPLOPHYLLIA, Pourtalès.

These are three genera of corals which belong to the fauna of the recent deep sea, and which have given much trouble to the classificatory zoologist. They present some affinities with the

indefinite group of Palæozoic corals called the Rugosa, and especially with the Cyathaxonidæ. Writing in 1850, MM. Milne-Edwards and Jules Haime (see also *Hist. Nat. des Corall.* vol. iii. p. 329) state that the little group of Cyathaxonidæ recalls the family Turbinolidæ of the Aporose Madreporaria. The Cyathaxonidæ have, however, a septal fossula and a styliiform columella. The genus *Polycælia*, King, = *Calophyllum*, is also simulated. It is a Permian group. Nevertheless there are many points about the genera *Guynia*, *Duncania*, and *Haplophyllia* which ally them to the Aporose Madreporaria, amongst which they are here included as an Alliance.

Genus *GUYNIA*, *Duncan, Madreporaria of Deep Sea, Trans. Zool. Soc.* vol. viii. pt. 5, p. 335 (1873), amended.

The corallum is simple, attached, long and narrow. The wall is thick and solid, and has a delicate epitheca and flat costæ. The septa are well developed, unequal, and extend from base to calice. There are four systems of septa; one septum may be longer and larger than the others. The columella is essential, and may be attached to the larger septa. Growth-rings occur. Occasionally the hexamerous arrangement of septa occurs, or it may happen in the same corallum with the quadrate.

*Distribution.*—*Recent.* Mediterranean and West-Indian seas.

Genus *DUNCANIA*, *Pourtalès, Zool. Results of Hasslar Exped.* 1874, p. 44\*.

Corallum attached, cylindrical, covered with a thick wrinkled epitheca, rising over the border of the calice. Interseptal chambers filling up solidly from the bottom; septa showing no definite systems; pali sometimes present; a multiple-pillared columella.

*Distribution.*—*Recent.* West-Indian seas.

The septa are 18, 20, 21 in number, and the tentacles are about 25 to 30 in number. The length of the species is 20–25 millim., diameter 10–11 millim.

Genus *HAPLOPHYLLIA*, *Pourtalès, Bull. Mus. Comp. Zool.* No. 7, and *Illustr. Cat. Harvard Coll.* No. 4; *Deep-Sea Corals*, p. 51.

Corallum simple, fixed by a broad base covered with a thick epithelium. Columella styliiform, strong, very thick at the base.

\* Lindström, *op. cit.* p. 13.

Interseptal chambers deep, uninterrupted by dissepiments or tabulæ, but filling up solid at the bottom.

In the description of the species, Pourtalès notices that the columella is formed of two smooth conical processes, and that they tend to fill up the coral. There are eight large septa uniting with the columella, and eight smaller reach it at a lower level, and there is a further cycle. 16 tentacles. Height of specimen 1.5 centim., diameter 1.2 centim.

*Distribution*.—Florida sea, 324 fms.

The next genus to be considered is unique, and its species are usually stated to have each septum divided into three parts. I cannot agree to this view, and believe that the septa are in sets of three. It forms a group.

Genus *DASMIA*, *MM. Milne-Edwards & Jules Haime, Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 329, pl. 7. fig. 8 (1848), *amended*.

The corallum is simple, free, subturbinate, pedicellate. The costæ are very broad and separated by deep grooves. Septa in groups of three, with projecting granular ornamentation. Each costa corresponds to three septa.

*Distribution*.—*Fossil*. Neocomian: Europe. Eocene: England and Europe.

*Dasmia* is represented in the Neocomian of France, and De Fromentel figures *Dasmia Neocomiensis* from Saint-Dizier (Haute Marne). The appearance of the calice is as if there were 12 groups of 3 septa and a septum between each group ('Polyp. de l'étage Néocomien,' pl. 1. figs. 1 & 2, Paris 1857).

The type of the genus is *Dasmia Sowerbyi*, Ed. & H., from the London Clay.

## 2. Subfam. *Turbinolidæ gemmantes*.

In the genus *Cænocyathus*, Ed. & H., gemmation occurs from the living parent and from the buds arising from it also. The budding is not like that of the subgenus *Blastotrochus*, or like that which may be seen in *Caryophyllia*, where the ova have accidentally settled upon the parent, for each bud in the species under consideration communicates by its base, or has communicated with the visceral cavity of its parent through the wall. A bush-shaped corallum or colony results; and in the instance of the genus *Cænocyathus* it attains a considerable size and grows symmetrically.

Genus CÆNOCYATHUS, *MM. Milne-Edwards & Jules Haime, Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. ix. p. 299 (1848).

Colony bush-shaped, more or less ramified; corallites long, conico-cylindrical; calices circular, deep. Columella small, and consists of a few twisted processes. Pali in one crown. Wall thick and smooth, or granular or costulate.

*Distribution.*—*Fossil.* Oligocene, Miocene, Pliocene: Europe.—*Recent.* Mediterranean.

Genus GEMMULATROCHUS, *Duncan, Madrep. of Deep Sea, Trans. Zool. Soc.* vol. x. pt. 5, p. 243 (1878), *amended.*

Colony small and bush-shaped. Parent conico-cylindrical, with a broad adherent base. Calice deep; columella rudimentary. Septa stout, not reaching far inwards. Costæ hidden by a well-developed epitheca. Buds ascend in growth, and join others by their epitheca.

*Distribution.*—*Recent.* Northern shores of the Mediterranean, littoral.

### 3. Subfam. *Turbinolidæ reptantes.*

The corallites of the colony grow from an expansion of the basal structures of the parent or assemblage. There is no endotheca, and the septa are plain.

The forms thus differentiated represent the Astrangiaceæ of *MM. Milne-Edwards and Jules Haime* of their group Astræaceæ.

Genus POLYCYATHUS, *Duncan, Proc. Zool. Soc.* 1876, p. 433, *amended.*

Colony of close or rather distant corallites, cylindro-conical in shape. Calicular margin wavy or angular. Septa irregular, exsert. Pali before the secondaries and tertiaries larger than the ends of the small septa, bilobed or not. Columella deeply seated, small, papillary or spinulose. Costæ subequal, granular. Epitheca well developed.

*Distribution.*—*Recent.* South Atlantic, St. Helena.

Subgenus AGELECYATHUS, (genus) *Duncan, Proc. Zool. Soc.* 1876, p. 434.

There is no epitheca. The costæ are well developed. The colony incrusts, or the stoloniferous expansions are large.

*Distribution.*—*Recent.* St. Helena and Persian Gulf.

This subgenus is taken from the genus *Agelecyathus*, nobis.

## CHAPTER II.

The family Oculinidæ restricted to its definite limits. The discoveries of Milne-Edwards and J. Haime, Verrill, and H. N. Moseley. The necessary abolition of the Stylasteridæ as a group of Zoantharia Sclerodermata. The soft parts of typical Oculinidæ. Alliances of the family. Descriptions of genera. The family Pocilloporidæ. The necessity for its foundation. The genera *Pocillopora* and *Seriatopora*.

Family OCULINIDÆ, *Ed. & H.* (pars).

The next group of the Madreporaria Aporosa to be considered is one which has been greatly extended by Verrill\* and restricted by Milne-Edwards and Jules Haime†, and which requires great modification in consequence of the discoveries of Prof. H. N. Moseley, F.R.S.‡

The Oculinacea of Verrill cover much more ground than the Oculinidæ of Milne-Edwards and Jules Haime, and the family of the Oculinidæ now to be established is very restricted, the Hydrocorallinæ of Moseley having been of course removed. Verrill considers his Oculinacea a suborder; but the group as now restricted can only be of family importance.

Verrill § includes seven families in a suborder—the Oculinacea, some of which can hardly remain thus associated owing to recent advances in morphology. He gives some most valuable information regarding the soft parts of the corals, and very aptly places the genus *Pocillopora*, generally classified with the Tabulata, in his suborder. He also associates the genus *Stylophora* with the suborder.

Milne-Edwards and Jules Haime|| described a group of genera which they formed into a family, the Oculinidæ, and it contained three subgroups, one of which now belongs to the Hydrocorallinæ, Moseley, and it omitted some of the groups included subsequently by Verrill.

In the suborder Oculinacea of Verrill the polyps, when expanded, rise above the calice, and may be long and exsert, the

\* 'Notes on Radiata,' 1868-71, p. 512.

† Hist. Nat. des Corall. vol. ii. p. 102 (1857).

‡ 'Challenger' Report, 1880, and Quart. Journ. Micr. Sci. no. 88, p. 391 (1883).

§ 'Notes on Radiata,' 1868, p. 512.

|| Hist. Nat. des Corall. vol. ii. p. 102 (1857), and previously in 'Comptes Rendus,' 1849

mouth protruding. The tentacles are from 10 to 48 and sometimes more in number, elongated, the tips usually, if not always, swollen or capitate, their surface being covered with small wart-like clusters of urticating cells (*op. cit.* p. 512). This structure of the tentacles is much relied upon by Verrill.

For a good representation of a *Caryophyllia*, which would be included by Verrill, drawn from nature by Peach, see 'Monog. Brit. Foss. Corals,' 2nd ser., Pal. Soc. Lond., 1866, Duncan, plate ii. figs. 9-20. The swollen ends of the tentacles are shown, but they are not persistent characters in the genus.

It is clear that the Oculinidæ (*Stylasters* omitted) of Milne-Edwards and Jules Haime are closely allied to the family Turbinolidæ, and, although I cannot associate them in one family, they are neighbours. The family (not suborder) which should now be admitted, must exclude the Stylasteridæ, the Stylinidæ, Astrangidæ, and Caryophyllidæ, which were included by Verrill in his suborder, and should include the Oculinidæ proper of Edwards and Haime and some Stylophoridæ, Ed. & H.

The examination of a large series of specimens of the Oculinidæ of Milne-Edwards and Jules Haime has impressed me with the general truth of their assertion that the visceral chambers fill up by a deposit within, and are intruded upon by the growth of the wall. The growth of the mural structure, which is difficult to distinguish from a solid cœnenchyma, is very characteristic and is often excessive.

## II. Family OCULINIDÆ, *Milne-Edwards & Jules Haime* (pars).

Oculinacea, *Verrill* (pars).

Corallites in colonies in the form of branches, espaliers, irregular ramifications on a thick stem, or massive, or incrusting. Increase by gemmation, which is usually lateral and often symmetrical; fissiparity very rare. Interseptal loculi usually open to the base, but dissepiments or tabulæ sometimes occur. Internal space diminishing on account of growth of stereoplasm. Walls of corallites often increasing in thickness, exogenously, with age and becoming a solid mass by union with others. Solid intercalicular or intercorallite cœnenchyma usually present. Septa entire or not at their free edges, sometimes rudimentary. Polyps, when expanded, rising above the wall, or long and exsert, the mouth protruding; the tentacles 10 to 48 or more, elongated, tips usually swollen or capitate.

The very considerable changes in the definition of the family Oculinidæ prevent its being a large one in spite of the additions made by palæontologists and those naturalists who have described the corals of the deep sea.

There are, after revision, 21 genera. Eleven genera disappear and one becomes a subgenus. A genus is relegated to the Astræidæ.

The 21 genera are included in 5 Alliances—the Baryhelioida, the Lophohelioida, the Oculinoida, the Prohelioida, and the Stylophoroida.

#### I. Alliance BARYHELIOIDA.

Oculinidæ with massive or incrusting colonies. Columella absent and pali also, or a false columella may be present. Septa variable in arrangement. Cœnenchyma well developed between the calices.

Genus BARYHELIA, Ed. & H.

Genus NEOHELIA, H. N. Moseley.

Genus DIBLASUS, Lonsdale.

Genus BARYHELIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 125 (1857).

Colony massive. Calices slightly projecting or not, small. Septa few, entire, thick and short. Columella and pali absent; a large open fossa existing in the axis of the corallites. Cœnenchyma moderately developed, smooth or finely granulated. Dissepiments rudimentary.

*Distribution.*—*Fossil.* Cretaceous: Europe, England.

Genus NEOHELIA, *Moseley, Report on 'Challenger' Corals,* p. 176, plate x. figs. 7, 7a (1881).

Colony with a very abundant and diffuse cœnenchyma incrusting the stems of Gorgonoids with very short branches only. Calices with the septa arranged in five systems, which are often fused together by the cœnenchyma; a deep fossa exists, but no columella. Gemmation irregularly dichotomous.

*Distribution.*—*Recent.* Pacific; off Api Island, New Hebrides.

It may be noticed that the surface of the cœnenchyma which separates the calices is marked by very slightly elevated rounded ridges, which traverse it irregularly but with a general longitudinal direction, and are continuous at the margins of the calices with the short costæ. The primary and secondary septa meet in the fossa.

Genus *DIBLASUS*, *Lonsdale in Dixon's Geol. Sussex*, 1850, p. 248 ;  
*Duncan, Brit. Foss. Corals, Supp., Pal. Soc., Part ii. No. 1,*  
 1869, p. 14.

Colony incrusts and is very irregular in shape. The calices are wide apart and project; the columella is formed by the junction of the larger septa, and is parietal and rudimentary. The septa are dentated, crowded and granular laterally. Pali absent. The costæ are granular, equal or subequal, and often extend across the cœnenchyma to neighbouring calices.

Gemmation marginal and intercalicinal.

*Distribution.*—*Fossil.* Upper Cretaceous: England.

## II. Alliance LOPHOHELIOIDA.

Oculinidæ with dendroid and bunch-shaped colonies. Corallites often coalescing; gemmation alternate. Septal arrangement irregular. Columella absent or rudimentary, tubercular, or spongy, or styliform. Tabulæ or dissepiments present or not. Mural structures thickening with age. Septa entire or subentire, often exsert.

Genus *LOPHOHELIA*, Ed. & H.

Genus *AMPHIHELIA*, Ed. & H.

Genus *ENALLOHELIA*, d'Orb.

Genus *EUHELIA*, Ed. & H.

Genus *ACROHELIA* Ed. & H.

Genus *ASTROHELIA*, Ed. & H.

Genus *DENDROHELIA*, Etallon.

Genus *LOPHOHELIA*, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci. t. xxix. p. 69 (1849); P. Martin Duncan, Trans. Zool. Soc. Lond. vol. viii. pt. 5, p. 330 (1873).*

The colony is dendroid, and its gemmation is subterminal and irregularly alternate; the granulated wall is thick and increases in thickness with age. The calices are very deep; the septa are well developed, exsert, entire, and unite more or less at the bottom of the calicular fossa. Arrangement of septal orders irregular. Columella absent or false; costæ near the calicular margin. Dissepiments may exist, and often well-developed tabulæ, which close in the calice inferiorly. Internal cavity not filling up much with age.

*Distribution.*—*Fossil.* Miocene, Pliocene: Europe.—*Recent.* Atlantic, N. & S.; Caribbean Sea; Mediterranean; East Indies; Philippines.

This genus has given much trouble in its classification, and some time since I was disposed to place it in the Astræidæ; but its proper position appears to be here.

Genus AMPHIELIA, *Milne-Edwards & Jules Haime*, 1849 (pars);  
*P. Martin Duncan, Trans. Zool. Soc. Lond.* vol. viii. pt. 5,  
 p. 326 (1873), amended.

Syn. *Diplohelix*, Ed. & H.

The colony is bush-shaped, and the gemmation is alternate, marginal, and often double. The wall, with or without cœnenchyma, increases in thickness at the lower part of the colony, and often includes formerly free corallites. Corallites free, immersed or coalescent. Columella exists. The septa are entire or subentire, in six systems; but there are few cycles. Costal striæ very variable in amount and direction. Ornamentation of the wall granular or absent. Internal cavities do not fill up; dissepiments absent.

*Distribution.*—*Fossil.* Eocene, Miocene, Pliocene: Europe. Cainozoic: Australia.—*Recent.* Atlantic, Mediterranean, Caribbean, Australian seas; Formosa.

This genus absorbs *Diplohelix*, *Milne-Edwards & Jules Haime*, 1850.

The genus *Enallhelix*, d'Orbigny, 1848, was insufficiently diagnosed as follows:—"Ce sont des Oculines, dont des calices saillants sont latéraux et alternes de chaque côté des branches. Calices pourvus de côtés en dehors." This description is not distinctive. MM. *Milne-Edwards* and *Jules Haime* added to the description, and slightly altered the name; and M. de *Fromentel* has made some very important additions to the characters of some species. The presence of paliform lobes on some septa, and the subentire condition of the septa were asserted by M. de *Fromentel*, but they are doubtful points. The existence of hexamerous, octamerous, and decamerous types in the genus is extremely interesting.

Genus ENALLOHELIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 123 (1857), amended.

Colony dendroid or bushy, or low compressed, and branches uniting; gemmation alternate and distichous. Calices small and shallow, often oblique. Columella styliform, but often small and even rudimentary. Septa few, slightly exsert, subentire, some swollen at inner end, arranged in systems of six or eight or ten. Costæ visible near the calice; wall-cœnenchyma considerably developed.

*Distribution.*—*Fossil.* Oolitic: Europe, England? Cretaceous: Europe.

Genus *EUHELIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 124 (1857), amended.

Colony dendroid; gemmation distichous and at right angles with the margins of the parent calice. Corallites subturbinate. Septa entire where free. Columella rudimentary. Costæ subequal and project near the calice. Surface granular. Often one bud aborts.

*Distribution.*—*Fossil.* Jurassic: Europe.

Genus *ACROHELIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 115 (1857).

Colony dendroid. Calices with extremely exsert septa, entire, lanceolate in shape, and they unite by their inner margins at the bottom of the calicular fossa. Columella and pali absent. Costæ in the neighbourhood of the calices only. Gemmation regularly spiral in direction.

*Distribution.*—*Recent.* Fiji.

Genus *ASTROHELIA*, *Milne-Edwards & Jules Haime, Comptes Rendus de l'Acad. des Sci.* t. xxix. p. 68 (1849), amended.

Colony subdendroid, with more or less coalescing branches or incrusting. Calices unequal, not projecting much, moderately deep. Columella rudimentary, very small, parietal. No pali. Septa dentated. Costæ extending down but slightly. Gemmation irregular. Cœnenchyma granular, thin. Bases of corallites not increasing much in density during growth.

*Distribution.*—*Fossil.* Miocene: Europe, North America.

There is no doubt that the genus *Dendrohelia* of Etallon ('*Lethæa Bruntrutana*,' p. 358, 1860) is unsatisfactory. Milne-Edwards and Jules Haime considered the typical species of Etallon to be a doubtful member of the genus *Stylina*. The balance of evidence is in favour of the species *Dendrohelia coalescens*, Etall., being one of the Oculinidæ. But Etallon is very much in error when he compares the genus with the modern *Acrohelia*, to which it has only a remote family likeness.

Etallon considers the genus *Dendrohelia* to include some species of *Helicœnia*=*Stylina*; but it must be remembered that the species of the genera just noticed are represented by much-worn or considerably altered specimens.

Genus DENDROHELIA, *Etallon, Lethæa Bruntrutana*, 1864,  
p. 358, pl. 1. fig. 4.

Colony mammillated or branched, coalescing. Cœnenchyma well developed and compact, especially on the parent stem. Calices irregularly placed, sometimes in a subspiral manner, costulate near the margin. Stem granular. Columella styliform. Septa unequal, entire, or non-exsert. Gemmation irregular.

*Distribution.*—*Fossil.* Oolite of Europe.

### III. Alliance OCULINOIDA.

Oculinidæ with arborescent or tufted, alternately, oppositely, or dichotomously gemmating colonies. Gemmation rarely from one side only. Septa entire, subentire, or spinulose where free. Pali before one or more sets of septa. Columella various. Fissiparity very rare.

Genus OCULINA, Ed. & H.

Subgenus AGATHELIA, Reuss.

Genus CYATHOHELIA, Ed. & H.

Genus SYNHELIA, Ed. & H.

Genus TRYMOHELIA, Ed. & H.

Genus SCLEROHELIA, Ed. & H.

Genus BATHELIA, H. N. Moseley.

Genus HAPLOHELIA, Reuss.

Genus OCULINA, *Milne-Edwards & Jules Haime, Comptes Rend. de l'Acad. des Sci.* t. xxix. p. 68 (1849), *amended.*

Colony arborescent or in tufts. Corallites arranged more or less distinctly in ascending spiral series, or scattered irregularly, prominent or sunken, often arising from an incrusting base. Cœnenchyma solid and smooth or finely papillose. Calices circular, oval, prominent or depressed. The columella either well developed and papillary at the surface, compact at the base, or rudimentary. The septa are well developed, entire or slightly spinulose where free, some exsert. Pali exist before all the septa except those of the last cycle. Costæ as striations, or decided projections extending a short distance from the calicular margin. In rapidly growing forms there is no cœnenchyma independent of the buds. Endotheca may exist.

There are two sections of the genus. In the first, which contains the majority of the recent forms, the growth is by gemmation; and in the second, which contains recent and fossil forms, there is also fissiparous division.

*Distribution.*—*Fossil.* Eocene: Europe, Asia. Miocene:

Europe and America.—*Recent*. Indian Ocean, Pacific (?), Florida and Caribbean seas, Bermudas.

The Rev. Tennyson Woods founded a new genus, *Platyhelix*, for Oculinacea with the usual compact dermic tissue and with pali, but spreading and incrusting instead of growing in a ramose tuft (Palæont. New Zealand, Corals and Bryozoa, p. 15, 1880).

There is one specimen of a species only, and it is so probable that further research will relegate the form to the genus *Oculina* that it is recorded here but not formally placed. The bases of some pali-bearing Oculinacea spread out and incrust before the upward growth occurs.

Subgenus AGATHELIA, (genus) *Reuss*, "*Beiträge zur Char. der Kreid. in den Ostalpen*," 1854, *Denks. der Kais. Akad. der Wiss. Wien*, p. 82.

Colony covering some space, gibbous and lamellar, with the corallites widely and unsymmetrically scattered. Cœnenchyma compact and granular at the surface and noncostulate. Calices conical, projecting, deep. Septa thin, unequal, denticulate, barely exsert. Columella of very delicate trabeculæ (Stäbchen). Pali before the first two cycles out of the three.

*Distribution*.—*Fossil*. Cretaceous: Europe.

Genus CYATHOHELIA, *Milne-Edwards & Jules Haime*, *Comptes Rendus de l'Acad. des Sci.* t. xxix. p. 68 (1849), *amended*.

Colony dendroid, like a dichotomous cyme. Corallites free to a considerable extent except on the side, whence they bud, subturbinate or subcylindrical. Parent corallites compressed between the bases of the buds. Calices elliptical, shallow, compressed laterally. Columella well developed, papillose, elongate rather. Septa subentire, numerous, exsert. Pali large, distinct, higher than the columella, in two crowns, the outer in front of the tertiaries, absent before the last cycle of septa. Costæ visible near the calicular margins only. Surface of the greatly thickened walls granular. Gemmation opposite.

*Distribution*.—*Recent*. Japanese and Corean seas, Moluccas, to 825 fms.

Genus SYNHELIA, *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vii. p. 113 (1857), *amended*.

Colony dendroid, gibbous on the surface. Calices irregular

on the stem, more or less spirally placed on the branchlets, superficial and circular. Columella solid, with a solitary styli-form tubercle. Septa crenulated and stout; some of the smaller septa unite, and before them are pali or paliform lobes. Costæ well marked, radiating and often uniting with those of other calices.

*Distribution.*—*Fossil.* Cretaceous: Europe, England.

Genus TRYMOHELIA, *Milne-Edwards & Jules Haime, Comptes Rend. de l'Acad. des Sci.* t. xxix. p. 68 (1849).

Colony dendroid. Calices arranged in more or less spiral lines, shallow, and with a low margin. There is no columella. Septa thick externally, subentire at the free edge. Pali before the primaries and secondaries, and these last the largest; they unite laterally to form a vertical tube with thick walls, which fills up below. Costæ equal and in striations, which are directed towards the base of the colony. Cœnenchyma greatly developed, granular.

*Distribution.*—*Fossil.* Miocene: Europe. *Recent.* Pacific.

Genus SCLEROHELIA, *Milne-Edwards & Jules Haime, Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. xiii. p. 75 (1850); *P. Martin Duncan, Proc. Zool. Soc. Lond.* 1876, p. 437.

Colony dendroid, branches often coalescing, incrusting often at first. Calices circular, immersed or slightly prominent on the stem, or projecting and gemmating, situated irregularly on the numerous terminal branchlets. Cœnenchyma well developed on the stems, glistening or very minutely granular, marked but little by costal striæ. Columella solid in three or many lobes, often consolidated together. Septa well developed, subentire, laterally granular, unequal. Pali moderately developed and placed before the secondary septa, often irregular. Dissepiments occur.

*Distribution.*—*Recent.* South Atlantic, St. Helena.

Genus BATHELIA, *Moseley, Report on 'Challenger' Corals,* p. 177, pl. viii. figs. 1-6 (1881).

Colony arborescent; calices disposed alternately in nearly straight rows on either sides of the several branches, with very prominent margins. Cœnenchyma white, compact, and dense, with its surface covered entirely by curved striæ continuous with

the costæ. Calices deep and widely open, with four cycles of septa and a single crown of pali. Columella large, composed of numerous trabeculæ. Gemmation alternate.

*Distribution.*—*Recent.* Off Rio de la Plata, 600 fms.

Genus HAPLOHELIA, Reuss, "*Anth. und Bryoz. des Mainzer Tertiär.*," *Sitzungsb. der Kais. Akad. der Wiss. Wien*, 1865, p. 202.

Colony branching. Calices on one side of the stem. Columella small, papillary. Septa in three cycles, and papillose pali before the primaries and secondaries. Costæ as long lines of long granules with intermediate depressions running along the whole branch.

*Distribution.*—*Fossil.* Miocene: Europe.

#### IV. Alliance PROHELIOIDA.

Oculinidæ with branched espalier-like colonies. Corallites projecting and twisted. Columella styliform. No pali. Septa entire. Cœnenchyma well developed.

Genus PROHELIA, E. de Fromentel.

Genus absorbed:—STYLANGIA.

Genus PROHELIA, E. de Fromentel, *Introd. à l'étude des Polyp. foss.* p. 177 (1861).

Syn. *Stylangia*, E. de From.

Colony branched, espalier-like. Calices projecting, placed in two parallel series along the sides of each branch, and all are directed forwards; they spring from the posterior part of the branches and twist to the right or left to come to the front. Columella styliform. Septa entire. Costæ rudimentary. Cœnenchyma very developed, compact and strongly granulated.

*Distribution.*—*Fossil.* Jurassic and Cretaceous: Europe.

This genus absorbs, according to M. de Fromentel, his genus *Stylangia*.

#### V. Alliance STYLOPHOROIDA.

Oculinidæ with arborescent, palmate, or incrusting colonies. Septa few, 10 or 12 or 24, unequal. Columella styliform. Cœnenchyma subcompact, compact, or cellular, granular. Costæ developed, short or absent. Dissepiments present. Gemmation irregular.

Genus *STYLOPHORA*, Ed. & H.

Genus *STYLOHELIA*, E. de From.

Genus *MADRACIS*, Ed. & H.

The genera *PSAMMOHELIA*, E. de From., and *PHYLLOPORA*, Tonnison Woods, are absorbed in *Stylophora*; *AXOHELIA*, Ed. & H., *PENTALOPHORA*, Kent, *REUSSIA*, Duch. et Mich., in *Madracis*; *AREACIS*, Ed. & H., is removed to the *Astræidæ*.

Genus *STYLOPHORA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 133 (1857).

Syn. *Psammohelia*, E. de From.; *Phyllopora*, T. Woods.

Colony arborescent, or palmate, or incrusting. The calices are rather deep, and present a styliform columella. The septa are unequal, six being well developed and six rudimentary. Cœnenchyma between the corallites subcompact and granulated, and often ridged. The costæ are rudimentary. Dissepimental endotheca present, and the internal cavity often obliterated. Gemmation irregular and lateral.

*Distribution.*—*Fossil.* Eocene: Europe, West Indies, Sind in Asia. Miocene and Pliocene: Europe. Miocene: Sind in Asia.—*Recent.* Red Sea, Indian Ocean, Cape of Good Hope, Chinese seas, Australian seas?

Genus *STYLOHELIA*, *E. de Fromentel, Introd. à l'étude des Polyp. Foss.* 1858–60, p. 180.

Colony massive or dendroid. Calices very projecting as truncated cones, strongly costulate near the calices, but granular over the rest of the cœnenchyma, which is foliated and more or less dense. Columella strong and styliform. The larger septa unite with the columella by means of horizontal trabeculæ regularly placed. Septa in three cycles, the last rudimentary.

*Distribution.*—*Fossil.* Oolite: Europe.

Genus *MADRACIS*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 139 (1857), amended.

Syn. *Axohelia*, Ed. & H.

Colony arborescent or incrusting more or less. Calices small, shallow, with a sharp styliform, sometimes compressed columella, and ten or twelve equal, exsert, subentire septa. Gemmation spiral more or less, or irregular. Cœnenchyma nearly compact

and strongly echinulate or cellular, often with an intercalicular ridge. Costæ absent. Internal cavities filling up more or less.

*Distribution.*—*Recent.* Madeira, Florida, Caribbean sea, Brazils, Isle de Bourbon, Indian Ocean, (Adriatic?).

This genus absorbs *Axohelia*, Milne-Edwards & Jules Haime, 1849, which was placed by those authors in the Styliasteraceæ (Hist. Nat. des Corall. vol. ii. p. 126); and as the other Styliasteraceæ have been shown by Moseley to be Hydrocorallinæ, the subfamily disappears entirely from the Zoantharia Sclerodermata.

Milne-Edwards and Jules Haime introduced their genus *Areacis* into the group which associated *Stylophora* and *Madracis*; but its species must be relegated to the Astræidæ with a cellular cœnenchyma and ill-developed visceral tabulæ.

In this arrangement of the Oculinidæ the following genera are absorbed or are not considered, in consequence of unsatisfactory definition or evident synonymy:—

|                          |                          |
|--------------------------|--------------------------|
| DIPLOHELIA, Ed. & H.     | PLACOHELIA, E. de From.  |
| STYLANGIA, E. de From.   | PHYLLOHELIA, E. de From. |
| PSAMMOHELIA, E. de From. | PLATYHELIA, T. Woods.    |
| AXOHELIA, Ed. & H.       | PENTALOPHORA, Kent.      |
| PHYLLOPORA, T. Woods.    | REUSSIA, Duch. et Mich.  |
| TIARADENDRON, Quenst.    |                          |

The genus *Aagthelia*, Reuss, becomes a subgenus of *Oculina*. The genus *Areacis*, Ed. & H., is removed to the Astræidæ.

### III. Family POCILLOPORIDÆ.

Colonial Aporose Madreporaria with tabulæ, septa small and rudimentary. Columella well or ill developed. Corallites filling up with steroplasm. Intercorallite structure cœnenchymal and solid. Animal with disk, tentacles, and a single pair of long mesenterial filaments.

Verrill stated, in his 'Notes on Radiata,' p. 523, that *Pocillopora*, although a tabulate coral, must enter the section in which he placed the Oculinidæ. He satisfied himself of the correctness of Mr. Bradley's observations that *Pocillopora* had twelve tentacles, six being upright and six held horizontally, and that it was not a Hydroid. The arrangement and form of the tentacles resemble those of the Perforate coral *Porites*, but the tissues are solid.

Moseley (Quart. Journ. Micr. Sci. lxxxviii. p. 391, "Notes on the Structure of *Seriatopora*," &c.) states that *Seriatopora* is Madreporarian. The polyps bear twelve short tentacles with rounded knobs in two series. The cavities of the polyps are in communication by means of a canal-system forming a network, which traverses the entire area at the surface between the polyps. The polyps of *Seriatopora* and *Pocillopora* possess only a single pair of long mesenterial filaments, and these belong to the central mesenteries of the lateral chambers. Both of the genera differ from other Madreporaria in not having their mesenteries arranged in pairs.

Genus POCILLOPORA, Lamarck & Verrill.

Genus SERIATOPORA, Lamarck.

Genus POCILLOPORA, *Lamarck* (pars); *Verrill*, *Notes on Radiata*, p. 519 (1870).

Colony of clusters of branches, or lobes, or fronds of various dimensions, which arise from a more or less compact incrusting base. Branches often with rudimentary branchlets or verrucose. Corallites crowded terminally, angular, and closely united by their walls; on the sides of branches they are more or less separated by compact cœnenchyma which is sharply spinulose or granular. Calices small, may be deep or shallow, circular or angular, often filled, below the surface, by a solid deposit. The corallites are crossed by tabulæ. Septa narrow, often rudimentary, especially in the crowded calices at the ends of branches, in others longer, usually twelve in number, six larger than the others. Columella when present small, solid, little prominent on the upper tabulæ. Tabulæ often incomplete in middle. Increase by gemmation. Fissiparity very rare. Polyps with 12 tentacles, and a single pair of long mesenterial filaments.

*Distribution*.—*Fossil*. Miocene: West Indies.—*Recent*. Pacific, Indian Ocean, Red Sea.

Genus SERIATOPORA, *Lamarck*, *Hist. Anim. sans Vertèb.* t. ii. p. 282 (1816).

Colony arborescent. Cœnenchyma compact and abundant, finely echinulate. Calices placed in ascending series. Septa rudimentary and barely visible. Columella large, compact.

Internal cavities obliterating almost completely with the growth of the base of the columella and walls. Traces of tabulæ.

*Distribution.*—*Recent.* Red Sea, Indian Ocean, Pacific.

If *Seriatopora* is admitted into the Oculinidæ with *Pocillopora* the question occurs, what is to be done with *Dendropora*, *MicHELIN*, *Rhabdopora*, Milne-Edwards & Jules Haime, and *Trachypora*. They are associated with *Seriatopora* by Milne-Edwards and Jules Haime in a family of Tabulata; and before I had read Nicholson's excellent analysis of the genera (Nicholson, 'Tabulate Corals,' p. 105, 1879), I agreed with the great French zoophytologists, but now I see the necessity of placing those genera amongst the Favositidæ.

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### CHAPTER III.

Family Astræidæ, definition. The necessity for the union of the old subfamilies Eusmilinæ and Astræinæ. The condition of the upper edge of the septa not of physiological or subfamily importance. Subfamilies determined by the method of 'growth. List of the seven subfamilies:—I. Subfamily ASTRÆIDÆ SIMPLICES: the Alliances and Tribes; description of the Genera, lists.—II. Subfamily ASTRÆIDÆ REPTANTES: Alliances, Genera, lists.—III. Subfamily ASTRÆIDÆ GEMMANTES: definition, Alliances, Genera, list. IV. Subfamily ASTRÆIDÆ CÆSPITOSÆ: Alliances, Genera.—V. Subfamily ASTRÆIDÆ CONFLUENTES: Alliances, Genera.—VI. Subfamily ASTRÆIDÆ AGGLOMERATÆ FISSIPARANTES: Alliances, Genera.—VII. Subfamily ASTRÆIDÆ AGGLOMERATÆ GEMMANTES: Alliances, Genera, Lists.

Family ASTRÆIDÆ, *Dana* (pars), 1846; *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 142 (1857).

Simple or colonial Aporose Madreporaria, multiplying by ova, rarely by deciduous buds; increasing in bulk by gemmation and by fissiparous division and serial growth. Interseptal loculi containing dissepimental endotheca, rarely tabulæ. Septa smooth or entire at the free edge, or dentate, ragged or spinulose. Soft parts closely resembling those of the Turbinolidæ: the long serial calices have several mouths in the limited disk, which is surrounded by tentacles. Tentacles contract and are hidden by the edge of the disk. A mesentery projects downwards in each interseptal loculus as far as the upper dessepiment, and sustains the ovarial organ. Corallites may unite by their walls, or costæ, or exotheca, or a vesicular peritheca may exist, but true intermural solid cœnenchyma is rarely seen.

The subfamily Eusmilinæ and the subfamily Astræinæ of *Dana*

and Edwards and Haime are united, and the whole *Astræidæ* are subdivided into seven subfamilies.

Although it is proposed to abolish the classificatory distinction between the *Astræidæ* with entire and with dentated or ragged septal edges, it is necessary to keep in view the method of growth and increase of the forms. Milne-Edwards and Jules Haime founded their classification of both of the groups, now united, upon the principles of their gemmation and growth. Thus the *Eusmilinæ*, Ed. & H., or the *Astræidæ* with entire septa, were classified as Simple, Cæspitose, Confluent, and Agglomerate; and the *Astræidæ* with dentate septa, the *Lithophylliaceæ*, Ed. & H., were grouped almost after the same manner into Simple, Cæspitose, Meandroid, Fissiparous, and to these was added the agèle of the budding *Astræaceæ*. These divisions or "agèles" are fairly natural, and it is only rarely that some hard and fast lines of distinction oppose the truth. Fissiparity is the rule amongst the cæspitose and confluent *Eusmilinæ*, and amongst the cæspitose and meandroid *Lithophylliaceæ*; but it is accompanied by more budding than has been hitherto admitted. Moreover the long serial calices of the confluent and meandroid forms seem to develop by simple growth from the calicular ends quite as much as by an indefinite fissiparity. The great break was between the Cæspitose and Meandroid *Lithophylliaceæ* with dentate and ragged septa. Thus the genera *Mussa*, Oken, and *Symphyllia*, Ed. & H., are very closely allied, and at one stage they must belong to the Meandroid group; but the early life of the *Mussæ* is often passed in a cæspitose condition of growth. It is necessary to place these genera, the one at the close of the Cæspitose and the other at the commencement of the Meandroid group.

In the present classification, the *Eusmilinæ*, *Lithophylliaceæ*, and *Astræaceæ*, being absorbed in the family *Astræidæ*, the agèles of Milne-Edwards and Jules Haime become subfamilies, and their sections also. The simple forms of both groups are united in a subfamily *Astræidæ simplices*. The cæspitose genera of the *Lithophylliaceæ* and *Eusmilinæ* become cæspitose *Astræidæ*; and the meandroid *Lithophylliaceæ* and the confluent *Eusmilinæ* become confluent *Astræidæ*. The *Astræaceæ* or massive budding group become *Astræidæ agglomeratæ gemmantes*.

It is evident that the genera which increase by stoloniferous gemmation must form a subfamily, and that the dendroid forms

with simple gemmation, their close allies, must belong to another. Hence the three original great groups of Edwards and Haime form one family, the Astræidæ, and it is divided into seven Subfamilies.

The Subfamilies are divided into Alliances, the genera of which have their species divided into tribes which are distinguished by the presence or absence of entire septa.

#### IV. Family ASTRÆIDÆ.

##### Subfamily 1. *Astræidæ simplices.*

- |   |    |   |                                   |
|---|----|---|-----------------------------------|
| „ | 2. | „ | <i>reptantes.</i>                 |
| „ | 3. | „ | <i>gemmantes.</i>                 |
| „ | 4. | „ | <i>cæspitosæ.</i>                 |
| „ | 5. | „ | <i>confluentes.</i>               |
| „ | 6. | „ | <i>agglomeratæ fissiparantes.</i> |
| „ | 7. | „ | <i>agglomeratæ gemmantes.</i>     |

##### 1. Subfamily *Astræidæ simplices.*

Simple solitary Astræidæ with entire or incised, dentate or spinulose septal edges. Propagation by ova and rarely by deciduous buds. Pali may or may not exist. Endotheca always present, but variable in amount.

##### Alliance I. TROCHOSMILIOIDA.

##### II. PLACOSMILIOIDA.

##### III. LITHOPHYLLIOIDA.

##### IV. ASTEROSMILIOIDA.

##### Group V. Genus AXOSMILIA.

Each of these Alliances is divided into two tribes, one of which receives genera with entire septa, and the other contains genera with dentate septa.

There are six genera which become subgenera, and fifteen genera are absorbed.

##### I. Alliance TROCHOSMILIOIDA.

Simple corals with entire or dentated, incised, ragged, or spined septa. Endotheca. Columella absent or rudimentary. Costæ distinct. With or without epitheca. Pali absent.

Tribe I. With entire septa.

„ II. With dentate, incised, ragged, or spined septa.

I. Genus TROCHOSMILIA, Ed. & H.

Subgenus EPISMILIA, E. de From.

Subgenus CÆLOSMILIA, Ed. & H.

Genus DIPLOCTENIUM, Goldfuss.

II. Genus *MONTLIVALTIA*, Lamouroux.Subgenus *LEPTOMUSSA*, d'Achiardi.Subgenus *OPPELISMILIA*, Duncan.Subgenus *CERATOPHYLLIA*, v. Fritsch.Genus *FEDDENIA*, Duncan.

Genera absorbed:—

*ELLIPSOSMILIA*, d'Orb.; *PSAMMOSMILIA*, E. de From.

Genera becoming subgenera:—

*Epismilia*, *Cælosmilia*, *Leptomussa*, *Oppelismilia*, and *Ceratophyllia*.

## Tribe I.

Genus *TROCHOSMILIA*, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 467 (1848).Syn. *Ellipsosmilia*, d'Orb.

The corallum is simple, and either subpedicellate or fixed by a broad base, compressed or not, often deformed. Calice circular, elliptical, elongate, or deformed. Columella absent. Septa entire, numerous, exsert or not, often lobed. Costæ distinct. Endotheca present. Epitheca absent or rudimentary.

*Distribution.*—*Fossil.* Jurassic, Cretaceous: Europe, North America, Asia. Eocene: Europe, Asia. Miocene: Europe.

D'Orbigny founded the genus *Ellipsosmilia*, which he described as *Trochosmilia* with an oval calice and slightly enlarged base. The septa do not meet at the centre, but leave a hollow space there transverse to the columella (*Éléments Zoologiques*, p. 160; *Cours élémentaire de Paléontologie &c.*, 1851; genus founded in 1848).

Milne-Edwards and Jules Haime decided not to admit the genus, and referred the species to other genera, such as *Trochosmilia* and *Montlivaltia*. Etallon resuscitated *Ellipsosmilia* in 'Études Paléont. sur le Haut Jura;' and M. de Fromentel pointed out in his 'Introd. à l'Étude des polyps. foss.' the error into which Etallon had fallen.

There appeared to be some reasons for the establishment of a genus which should absorb *Ellipsosmilia* and certain *Montlivaltiæ* which were supposed to have entire septa. But the influence of fossilization and of weathering on *Montlivaltiæ*, in wearing down their denticulate septal edges, does not seem to have entered the thoughts of any palæontologists who have described species of this genus, *Epismilia*. It is remarkable that whilst *Montlivaltia* has survived to the present day, *Epismilia* did not enter the

later Tertiary faunas. I do not consider *Epismilia* otherwise than a subgenus.

Subgenus EPISMILIA, (genus) *E. de Fromentel*, *Introd. à l'étude des Polyp. foss.* p. 104 (1861).

Syn. *Psammosmilia*, E. de From.

Corallum free or adherent, trochoid or subcylindrical. Septa large and entire. No columella; columellary space elongate. An epitheca, membraniform and complete, forming transverse ridges. Endotheca abundant.

*Distribution.*—*Fossil.* Jurassic: Europe. Cretaceous: India and Europe. Eocene: Europe.

It is to be noticed that in the typical species, *Epismilia Haime*, E. de From., the septa are exceedingly numerous; that the septa of the 1st, 2nd, and 3rd cycles have the upper free edge sharp and entire, their inner edge being slightly swollen and undulating; and that the septa of the other orders have regular dentations on their inner edge. The species have large individuals as a rule. The only distinction between this genus and *Trochosmilia*, Ed. & H., 1848, is that this last has the wall covered with costæ, and a rudimentary epitheca in some instances. This last structure is not mentioned in the diagnosis of Milne-Edwards and Jules Haime, but it is as evident as it is in some Caryophylliæ.

As it is of great importance that the genera should be well defined, it is impossible to retain both of these; and hence I place *Trochosmilia*, Ed. & H., 1848, as the genus which contains, amongst others, certain species with a well-developed epitheca, belonging to a subgenus, *Epismilia*.

*Psammosmilia*, E. de From. Pal. Franç., Terr. cré. 1863, differs from *Epismilia* in having a broad base, which is not generic. It must be absorbed.

The genus *Cælosmilia*, Milne-Edwards and Jules Haime, has a considerable number of species with a well-defined facies, but its alliance with *Trochosmilia* is exceedingly close. Formerly I had absorbed *Cælosmilia* in *Trochosmilia*, but now I propose to consider it as a subgenus. The main distinction between the two types only relates to the amount of endotheca.

Subgenus CÆLOSMILIA, (genus) *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. ii. p. 175 (1857).

The corallum is simple, fixed or pedicellate, subturbinate,

slightly or not compressed. Columella absent. Septa large and exsert. Costæ straight, simple. Wall naked. Endotheca scanty.

*Distribution.*—*Fossil.* Cretaceous: England, Europe. Eocene: Europe.

*Cælosmilium fecunda*, Pourtalès, from the Florida seas, was placed by him in the genus *Parasmilium* ('Corals of the Blake Expedition,' p. 109).

The genus *Brevismilium*, Bölsche, was founded on a figure given by Roemer of his *Lithodendron nanum*. It can hardly stand.

GENUS DIPLOCTENIUM, *Goldfuss, Petrefacta Germaniæ*, t. i. p. 50 (1826); *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 166 (1857).

Corallum simple, exceedingly compressed, subflabelliform, with the flanks directed downwards; free, pedicellate. Wall naked, with numerous close subequal costæ, which divide and subdivide. The very long calice has its axes very unequal; it is narrow and deep. Columella absent. Septa very numerous, slightly exsert, nearly equal. Endotheca well developed.

*Distribution.*—*Fossil.* Cretaceous: Europe.

## Tribe II.

GENUS MONTLIVALTIA, *Lamouroux, Exp. méth. des genres des polyp.* p. 79 (1821); *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 296 (1857).

The corallum is simple, and either fixed by a broad base or free, and in this last case pedicellate, or with a scar of former adhesion. Variable in shape, some being turbinate, subturbinate, cylindro-conical, or discoid. Wall feebly developed, covered with a well-developed epitheca. Calice circular, subcircular, elliptical, deep or shallow, or convex in some discoid forms. No columella. Septa stout and numerous, dentate or spiny, or nodulose or lobed, often exsert. Endotheca abundant.

*Distribution.*—*Fossil.* Trias to Eocene: Europe. Jurassic, Cretaceous, Eocene, Miocene: Asia. Jurassic: England.—*Recent.* Caribbean Sea.

*Montlivaltia discus*, Wood (Australia, recent), is not a species of the genus. It has clearly synapticula, and is one of the Fungidæ.

Subgenera:—*Leptomussa*; *Oppelismilia*; *Ceratophyllia*.

Subgenus *LEPTOMUSSA*, *d' Achiardi, Monogr. der Vicentenischen Korallen.*

(Quoted by A. E. Reuss, Pal. stud. über die ält. Tertiärsch. der Alpen, II. Abtheil., Wien, 1869, p. 24.)

Corallum variable in shape, often cylindro-conical, compressed, with large costæ, which are crested and spined. Epitheca scarcely developed. Septa double, very numerous and mostly equal. Endotheca abundant. There is no columella.

*Distribution.*—*Fossil.* Eocene: Europe, Asia.

Subgenus *OPPELISMILIA*, *Duncan, Brit. Foss. Corals, Supp.*  
pt. iv. no. 1, p. 39 (1867).

Corallum simple, attached, conical. Calice shallow. Columella absent. Septa numerous, close and unequal. The epitheca is well marked, and reaches the calicular margin. Gemmation occurs within the calice, and the bud has an epitheca.

*Distribution.*—*Fossil.* Lias: Ireland. Oolite: England, Europe.

Milaschewitsch has described some of these forms as *Montlivaltia*, and considers the gemmation only a rejuvenescence, which it is not. The coral he describes as *Montlivaltia turbata* shows two buds from the calice, and is one of the subgenus.

Subgenus *CERATOPHYLLIA*, (genus) *K. v. Fritsch, "Foss. Korall. d. Numm. v. Borneo," Palæontographica, Supp. Band iii. 1878.*

This is a *Montlivaltia* with paliform lobes.

*Distribution.*—*Fossil.* Eocene: Borneo.

Genus *FEDDENIA*, *Duncan, Fossil Corals and Alcyonaria of Sind, Pal. Indica, ser. xiv. pt. 2, p. 36 (1880).*

The corallum is simple, free, with an irregularly-shaped base, which has enclosed a foreign body. Calice usually constricted, crowded with uniting dentate septa, ending in paliform lobes. Columella absent. Costæ not directed to the sharp end of the base, but passing straightly and parallel down the sides of the wall, sometimes keeled. Epitheca, when it exists, variable, and often in broken mosaic or granular. Endotheca scanty. Granules of the septa unite here and there, forming false synapticala.

*Distribution.*—*Fossil.* Ranikot group, Eocene: Sind.

## II. Alliance PLACOSMILIOIDA.

Simple corals, with entire or denticulate septa. A lamellar columella. Endotheca in variable quantity. Epitheca present or absent. Without pali.

- Tribe I. With entire septa.  
 ,, II. With denticulate septa.

- I. Genus PLACOSMILIA, Ed. & H.  
 Genus LOPHOSMILIA, Ed. & H.  
 Subgenus PLESIOSMILIA, Milasch.  
 Genus PLEUROSOMILIA, E. de From.  
 Genus PEPLOSOMILIA, Ed. & H.  
 Genus BLASTOSMILIA, Etallon.
- II. Genus SPENOPHYLLIA, Moseley.

Genera absorbed:—

PHYLLOSOMILIA, E. de From. ; OXYSMILIA, Duchass.

*Trismilia*, E. de From., a very interesting form, is placed here provisionally. *Lophosmilia* becomes a subgenus.

Tribe I.

Genus PLACOSMILIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 467 (1848), amended.

Syn. *Phyllosmilia*, E. de From.

Corallum simple, free, subpedicellate, compressed. Calice elliptical, long or short. Columella lamellar. Septa numerous, slightly exsert or not, entire, granular laterally. Costæ well developed or fine, simple or ramified. Endotheca abundant. Exotheca variable, membranous, may be absent.

*Distribution*.—*Fossil*. Cretaceous: England, Europe. Eocene: Europe.

Genus LOPHOSMILIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 467 (1848).

Syn. *Oxysmilia*, Duchass.

The corallum is simple, fixed, subturbinate, straight or curved. Calice nearly circular, or slightly oval and elliptical; fossa shallow. Columella lamellar, lobed more or less, or entire. Septa entire, exsert, unequal, granulated on the sides. Costæ distinct to the base. Endotheca scanty. Epitheca absent or rudimentary.

*Distribution*.—*Fossil*. Cretaceous: Europe.—*Recent*. Caribbean Sea.

Subgenus PLESIOSMILIA, (genus) *Milaschewitsh, Palæontographica*, vol. xxi. p. 189 (1876).

Corallum simple, cylindro-conical, with circular accretion-ridges, free or adherent. Calice circular, or slightly elliptical, deep

centrally. Columella small, lamellar. Septa numerous, exsert at the margin, upwardly curved, and sloping to the columella, entire, granulate, granules in rows parallel with the free edge. Endotheca abundant. Epitheca membranous, smooth, covering the costæ here and there, not perfect.

*Distribution.*—*Fossil.* Oolite: Nattheim, Europe.

This genus is too closely allied to *Lophosmilia* to stand. It is clearly an epithecate subgenus.

GENUS PLEUOSMILIA, *E. de Fromentel, Bull. Soc. Géol. de France, 2<sup>e</sup> sér. t. xiii. p. 853 (1858).*

Corallum simple, variable in shape and height, tall or short, subturbinate, conico-cylindrical. Calice circular or elliptical. Columella lamellar, projecting or not, united to a large septum, which is more developed than the others. Septa numerous, entire. Endotheca exists. Epitheca strong, covering the wall.

*Distribution.*—*Fossil.* Jurassic: Europe.

The genus *Trismilia*, *E. de Fromentel, Introd. à l'étude &c. p. 106*, is stated to be "très voisin des Pleurosmities," but to differ by having only three primaries developed, and a columella pyramidal and triangular in shape. One species, from the Portland Oolite of France, is noticed.

At present this genus had better be associated with *Pleurosmitia*.

GENUS PEPLOSMILIA, *Milne-Edwards & Jules Haime, Brit. Foss. Corals, Pal. Soc., Introd. 1848, p. xxv.*

Corallum simple, adherent by a large base, and is cylindrical. Calice circular or suboval; fossa well developed, with a lamellar columella at the bottom. Septa entire, broad, arched, but very slightly exsert at the margin, striated, entire. Endotheca abundant. Epitheca strong, membraniform, complete.

*Distribution.*—*Fossil.* Cretaceous: England. Laube places the genus in the St. Cassian strata of Europe.

GENUS BLASTOSMILIA, *Etallon, in E. de Fromentel, Introd. à l'étude des polyp. foss. p. 107 (1858-1861) (non Duncan).*

Corallum simple, elongate, slightly bent at the base, and sub-cylindrical. Calice round and deep. Columella strong and compressed. Septa in four cycles, moderately thick and slightly

exsert. Costæ close and subequal. Endotheca moderately abundant. Epitheca complete, with accretion-ridges hiding the costæ.

Gemination from the everted margin of the calice at certain epochs of growth. Buds become detached and leave a scar.

*Distribution.*—*Fossil.* Oolite: Europe.

### Tribe II.

Genus SPHENOPHYLLIA, *Moseley, Report on Corals 'Challenger' Expedition, 1879, p. 182, pl. x. fig. 1.*

Corallum solitary, free, pedicellate, compressed, with septa finely denticulate at the summits, and numerous wedge-shaped costæ, which are denticulate, rendering the corallum exceedingly rough. A scanty epitheca at the base; no endotheca or exotheca. A well-developed lamellar columella.

*Distribution.*—*Recent.* Locality unknown.

Moseley places this form amongst the Astræidæ of Dana, in spite of his not observing endotheca. After much consideration I agree, but I am not satisfied that some endotheca does not exist near the columella.

### III. Alliance LITHOPHYLLIOIDA.

Simple corals, with entire or dentate; incised or spined septa, endotheca, and a spongy or trabeculate columella. Wall costulate and naked, or with an epitheca.

Tribe I. With entire septa.

„ II. With dentate septa.

I. Genus PARASMILIA, Ed. & H.

Genus DASMOSMILIA, de Pourtalès.

Genus CONOSMILIA, Duncan.

II. Genus LITHOPHYLLIA, Ed. & H.

Genus CIRCOPHYLLIA, Ed. & H.

Subgenus LEPTAXIS, Reuss.

Subgenus ANTILLIA, Duncan.

Genera absorbed:—

CYLIOSMILIA, Ed. & H.; CÆNOSMILIA, de Pourtalès;

ANOMOCORA, Studer; CYATHOPHYLLIA, E. de From.;

SMILOPHYLLIA, E. de From.; SYZYGOPHYLLIA,

Reuss; CYNARINA, Brügg.; SCOLYMIA, Haime;

HOMOPHYLLIA, Brügg.

*Leptaxis* and *Antillia* become subgenera.

Amongst the Simple Corals with plain entire septa are some which have been grouped generically, according to the presence of abundant endotheca or its comparative absence. This is not a sufficiently important distinction. Thus the genus *Cylicosmilia*, Milne-Edwards and Jules Haime, 1848, really only differs from *Parasmilia* of the same authors by its more numerous septa and well-developed endotheca. The first-named genus is of Eocene age and the other is Cretaceous.

It is necessary to absorb *Cylicosmilia* in *Parasmilia*, and to alter the generic diagnosis of the latter slightly.

Pourtalès originated the genus *Cænosmilia*, 'Deep-sea Corals Hasslar Expedition,' p. 39 (1874), but in the description of the corals of the 'Blake' Expedition he withdrew it, and placed the species in *Parasmilia*.

#### Tribe I.

GENUS PARASMILIA, *Milne-Edwards & Jules Haime (Compt. rend. 1848)*, and *Brit. Foss. Corals, Introd., Pal. Soc. Lond. 1849*, p. xxv, amended.

Syn. *Cænosmilia*, Pourtalès; *Anomocora*, Studer; *Cylicosmilia*, Ed. & H.

The corallum is simple, fixed, subturbinate, or conico-cylindrical. Calice circular in outline. Columella spongy. Septa entire, exsert, well developed, granular laterally. The wall is naked and costulate. Endotheca exists.

*Distribution*.—*Fossil*. Cretaceous and Eocene: Europe. Cretaceous: England.—*Recent*. Caribbean Sea, Philippines.

Pourtalès named the species *Parasmilia Lymani* and *P. variegata*, from the Florida seas; but in his last work, on the 'Blake' corals, he considered them very abnormal, and therefore established the genus *Dasmosmilia* for them. But he retains *Parasmilia fecunda*, Lindström (Pourtales, sp.), and notices that the gemmation is not real, but that the young forms have settled on a dead one.

GENUS DASMOSMILIA, *Pourtalès, Bull. Mus. Comp. Zool., Report on Corals dredged by 'Blake' Expedition*, p. 108, pl. ii. figs. 11 & 12 (1880).

Corallum turbinate, with very thin wall and false pali. Columella formed by lobes of the septa. Rudimentary epitheca.

*Distribution*.—*Recent*. Off Grenada, in 164 fms.

The species *Dasmosmilia variegata*, Pourtalès, has for its synonyms *Parasmilia variegata*, Pourt., and *Bathycyathus elegans*, Studer.

GENUS CONOSMILIA, *Duncan, Fossil Corals from the Australian Tertiaries, Ann. & Mag. Nat. Hist.*, Sept. 1865, p. 3, pl. viii. figs. 3-5. 3 species.

Corallum simple, pedicellate, conical. Calice elliptical. Columella of one or two twisted laminae, essential. Septa entire, octamerous or hexamerous in arrangement, arise at the margin between the costae. Costae broad, ornamented or sharp at the margin, and broad below. Endotheca sparingly developed. Epitheca absent or pellicular and ornamented.

*Distribution.*—*Fossil.* Australian Tertiaries.

This genus I now place amongst the Trochosmiliaceae instead of amongst the Madreporaria Rugosa.

### Tribe II.

GENUS LITHOPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 290 (1857).

Syn. *Scolymia*, Haime; *Cynarina*, Brügg.

The corallum is simple and largely fixed, turbinate, subturbinate, cylindro-turbinate, cylindrical, or even prismatic in shape. The wall has well-developed spined costae. The calice is shallow, circular or subcircular. The septa are well developed, broad, numerous, very granulated on the sides, spinulose on the free edge. Columella well developed, spongy, flat above and a little sunken; its trabeculae are lamellar and twisted. Epitheca absent. Endotheca largely developed.

*Distribution.*—*Fossil.* Miocene: West Indies and Europe.—*Recent.* Caribbean Sea.

GENUS CIRCOPHYLLIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 491 (1848).

The corallum is simple, turbinate, or tall and pedunculated. The wall has fine, close, simple granular costae and a rudimentary epitheca. The calice is circular and shallow; the septa very numerous, broad, exsert, and have the free surface more or less lobed. The columella is large and papillary. The endothecal dissepiments are numerous.

*Distribution.*—*Fossil.* Eocene: Europe, West Indies.

The genus *Leptaxis*, Reuss, appears to be a *Circophyllia* with

an elongate columella. It is from the Lower Tertiaries and Oligocene of Europe. It requires further study. It merits the position of a subgenus.

Subgenera :—*Leptaxis*, Reuss ; *Antillia*, Duncan.

Subgenus ANTILLIA, *Duncan, Quart. Journ. Geol. Soc.* 1863, vol. xix. p. 28.

Syn. *Cyathophyllia*, E. de From. ; *Smilophyllia*, E. de From. ; *Syzygophyllia*, Reuss ; *Homophyllia*, Brügg.

Corallum simple, variable in shape, with more or less dentate and lobed, or simply dentate or simply lobed septa. A well-developed columella. Costæ variously granulated, tuberculated or crested. Endotheca developed ; sometimes some exotheca between the costæ. Epitheca strong, folded, and reaching to various heights.

*Distribution*.—*Fossil*. Jurassic : England and Europe. Eocene : Europe, Asia. Miocene : West Indies, Asia.—*Recent*. Caribbean Sea, Indian Ocean, Red Sea, Japanese seas, N. Australia.

This subgenus has a well-marked facies which separates it from typical *Circophylliæ*.

M. de Fromental mistakes my definition of *Antillia* ('Pal. Franc., Terr. crét.' tom. viii. livr. 24, p. 293), and gives *Antillia* a lamellar columella. Having established *Smilophyllia* for Lithophylliaceæ with lamellar columellæ, he withdraws it into *Antillia*. This is an error. In no place have I given *Antillia* a lamellar columella ; it has nothing of the kind. The genus *Smilophyllia* must therefore lapse in the subgenus *Antillia*, Duncan\*. M. de Fromental's genus *Cyathophyllia* is the same as *Antillia*, which has the preference from age. The first-named genus lapses therefore.

*Syzygophyllia*, a genus established by Reuss, is the same thing as *Antillia*, and must be absorbed. Zittel unfortunately has not seen the original diagnosis of *Antillia*, and has abstracted from M. de Fromental's translation.

The free or attached condition of corals having the other specific or generic characters in common is not sufficient to establish a distinction. The genus *Caryophyllia* has free and adherent species ; and the species *Caryophyllia clavus* has free, pedunculate, and broad-based and adherent individuals. Hence

\* Zittel, 'Handb. Palæont.' p. 650, mentions *Smilophyllia*, Fromental, as a synonym of *Antillia*.

in dealing with the present group of Simple Corals genera must not be admitted on the fact of the forms they might include being fixed, when the other structural details resemble those of well-known genera whose species are free. Hence *Cynarina* of Brüggemann, 1877, is a free *Lithophyllia*, and *Homophyllia*, Brüggemann, 1877, is a fixed *Antillia* or a young compound coral or colony.

#### IV. Alliance ASTEROSMILIOIDA.

Simple Astræadæ, turbinate, horn-shaped. Calice elliptical or circular. Wall costulate. One or more rows of pali. Columella variable, elongate, spongy or lamellary or fasciculate, or none. Endotheca exists.

Tribe I. Septa entire.

„ II. Septa denticulated.

I. Genus ASTEROSMILIA, Duncan.

Genus STEPHANOSMILIA, E. de From.

Genus CYATHOSMILIA, T. Woods.

II. Genus PATTALOPHYLLIA, d'Achiardi.

#### Tribe I.

Genus ASTEROSMILIA, *Duncan, Phil. Trans.* 1867, p. 653.

The corallum is simple, long, cornute more or less. Calice elliptical or circular. Columella solid, essential, compressed, lamellar, short. Septa numerous, entire, and exsert. Costæ irregular and often crested. Pali exsert, in several crowns, before all septa except the last cycle. Endothecal dissepiments distinct, tolerably numerous, and curved.

*Distribution.*—*Fossil.* Eocene, Miocene: West Indies.—*Recent.* Florida and Atlantic.

This genus was placed as *Trochocyathus* even after the endothecal dissepiments were discovered by Lonsdale (*Quart. Journ. Geol. Soc.* vol. xx. 1864, p. 26). In May 1867 the generic diagnosis was read before the Royal Society.

The next genus, *Stephanosmilia*, E. de Fromentel, is allied to *Asterosmilia*, Dunc., the generic distinctions being that the first named has a fasciculate columella and two crowns of pali; whilst the other has pali before all the septa except those of the last cycle, and there are four and often five cycles of septa.

There is a very remarkable manner of founding a genus illustrated in the 'Paléontologie Française.' A species is named and

figured years before the letterpress relating to it and the genus is published. Zoologists have long since decided against any such proceeding. The genus dates from the time of reading in or publication by a Society, or periodical, or book. Another method is more remarkable, and consists of diagnosing genera the species of which have not been found.

STEPHANOSMILIA, *E. de Fromentel, Pal. Franç., Terr. crét. (non Reuss)*, t. viii. Livr. 22, p. 242, 1867 (pl. 26, date 1862, without letterpress).

Corallum trochoid and pedicellate. Wall naked. Costæ well developed, nodular. Columella fasciculate. Septa exsert. Pali well developed, and placed before the septa of the first two cycles. Endothecal dissepiments rather distant.

*Distribution.*—*Fossil.* Gault: Europe. Eocene: Borneo.

M. de Fromentel really published the genus in 1867, having figured it only, five years before. He placed it at first amongst styliform columellate *Trochosmilieæ*.

*Stephanosmilium*, Reuss, is a synonym of *Trochocyathus*.

The following genus is thoroughly Australian in its strangeness.

Genus CYATHOSMILIA, *Tennison Woods, Trans. Phil. Soc. Adelaide, S. Australia*, 1877-78, viii. p. 113.

Corallum simple, pedicellate. Calice elliptical. Columella absent. Pali present. Costæ exsert. Endotheca plentiful.

*Distribution.*—*Fossil.* Australian Tertiary deposits.

## Tribe II.

Genus PATTALOPHYLLIA, *d'Achiardi, Mem. della Soc. Italia di Sci. Nat. Milano*, tom. iv. no. 1, 1868, p. 3.

Corallum simple, free, cornute. Pali before the antepenultimate cycle of septa. Columella absent. The septal laminae finely and regularly denticulated. Endothecal dissepiments not very abundant.

*Distribution.*—*Fossil.* Eocene: Europe.

The figures given by d'Achiardi in vol. ii. no. 4 of the above work show a coral with a narrow pedicellate end, curving and swelling to the long elliptical calice. The costæ are seen; and there is no epitheca. The pali form a crown of lobes within the septal edges, and there is no columella.

## Group-Genus AXOSMILIA.

Simple corals with entire septa, an essential styliform columella, a well-developed epitheca and endotheca.

Genus AXOSMILIA, Ed. & H.

Genus AXOSMILIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 467 (1848).

The corallum is simple, free in adult age, tall, turbinate or conical. Calice circular and deep. Columella essential, styliform. Septa entire, not exsert, and some unite with the columella. Epitheca complete and membraniform. Endotheca moderately developed in the deep interseptal loculi.

*Distribution.*—*Fossil.* Oolitic, Jurassic: Europe.

2. Subfamily *Astræidæ reptantes*.

(The *Astrangiaceæ*, Ed. & H.)

Colony composed of short corallites which arise by gemmation from stolons or basal expansions, which may or may not contain sclerenchyma. Endotheca moderately abundant. Septa both entire and denticulate. Rarely gemmation from the corallite wall.

The living polypes of a form belonging to this group, *Cylicia rubeola*, Quoy & Gaimard, stand up higher than the calices, and the disk is well rayed, and within the margin are little slender tentacles surrounding a long mouth with incised margins (Milne-Edwards & Jules Haime, *Hist. Nat. des Corall.* vol. ii. p. 607, 1857-60, from Quoy & Gaimard, *Voy. de l'Astrolabe, Zooph.*). Verrill states ('Notes on Radiata,' p. 526) that *Astrangia pali-fera*, Verrill, has subpellucid polyps which rise considerably above the calices: the tentacles are long, slender, and covered with white verrucæ, with a knob at the end.

The corallites may be close or rather distant; and in the first instance the bases often overlap, and the gemmation seems to have been from the very basal edge. In one group (*Cænangia*) the gemmation is partly as in *Cladocora*, and is from the wall of the parent corallite, and the cavities of the bud and parent communicate.

The small colonies of the *Astræidæ reptantes* are readily distinguished from any other forms of the family by their method

of growth. Eight genera were included in the subfamily by Milne-Edwards & Jules Haime; Gosse, de Fromental, d'Orbigny, Verrill, Reuss, Keferstein, T. Woods, and de Pourtalès added others to the group. Some of the genera were established on morphological data which were not of more than specific classificatory value; and they have been absorbed.

The *Astræidæ reptantes* correspond to the *Turbinolidæ reptantes* of the family Turbinolidæ; and they have great affinities with the Oculinidæ. No division can be made between the "Alliances" of the subfamily from the morphology of the septal edges; for some septa may be smooth and others denticulate in the same calice in many genera. It is an important consideration, for it lays the foundation of a doubt regarding the value of the Eusmiline and Astræid groups of Milne-Edwards and J. Haime.

The subfamily *Astræidæ reptantes* (Astrangiaceæ, Ed. & H.) contained nineteen genera. But after revision eleven genera and two subgenera remain, which arrange themselves under two Alliances. Four genera are removed to other groups.

#### Alliances.

- I. RHIZANGIOIDA.
- II. ASTRANGIOIDA.

#### I. Alliance RHIZANGIOIDA.

Astræidæ reptantes with a complete epitheca, with or without pali. Septa denticulate on the free edge, the primaries sometimes with a subentire edge.

- Genus CYLICIA, Ed. & H.
- Genus SCOLANGIA, T. Woods.
- Genus CRYPTANGIA, Ed. & H.
- Genus RHIZANGIA, Ed. & H.
- Genus BATHANGIA, Keferst.

Genus CYLICIA, *Milne-Edwards & Jules Haime, Polyp. foss. des terr. paléoz.* p. 116 (1851); *Hist. Nat. des Corall.* vol. ii. p. 606, 1857-60 (*Culicia*, Dana, 1846).

Colony spread over surfaces, and composed of close or rather distant but independent corallites. These are short, subcylindrical, often oblique, with a large base: Calices subcircular and rather deep. Columella papillary and well developed. Septa thin, close, not exsert, the principal with a subentire margin, the others very

dentated. Epitheca complete. Endotheca exists. Gemmation from the base or from a short or long calcareous stolon of the parent corallite.

*Distribution.*—*Recent.* Cape of Good Hope, Natal, Australian seas, New-Zealand seas, Singapore.

It is probable that *Solenastræa Prestwichi*, Duncan, of the Crag, is a crowded *Cylicia* with an abnormal growth of exotheca.

GENUS SCOLANGIA, *Tennison Woods, Palæont. New Zealand, Corals and Bryozoa*, p. 18 (1880).

Astrangiaceæ united by a calcareous stolon which covers the wall with concentric layers. Corallites inclined. No spiniform processes on the septa. No columella.

*Distribution.*—*Fossil.* Tertiary: New Zealand.

In the solitary specimen of the solitary species there does not appear to be a complete calice in the delineation given. The fossa was wide. It may be supposed that the stolon mentioned above means epitheca.

GENUS CRYPTANGIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 609 (1857).

Colony budding by stolons which do not become calcareous. Corallites quite free amongst themselves, elongate, cylindro-turbinate, and with a complete epitheca. Calices circular or sub-circular; fossette well marked, deep. Columella papillary and well developed. Septa thin, dentate, moderately close. Endotheca exists. Habit: surrounded by and immersed in *Celleporæ*.

*Distribution.*—*Fossil.* Miocene: Europe. Pliocene: England.

The species of this genus are always found immersed in *Celleporæ*; and this and their corallite shape and dentate septa of all ages separate it from *Cylicia*.

GENUS RHIZANGIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci. Nat.* t. xxvii. p. 496 (1848).

Colony forming expansions of calcareous basal structures from which corallites arise. Corallites rather close, short, sometimes very much so, subcylindrical, largely fixed by the base. Calices circular, almost superficial. Columella papillary, the outer part resembling the inner teeth of the septa. Septa numerous, rarely exsert, large, thin, subequal, granular, close, minutely denticulate where free. Epitheca complete. Endotheca exists.

*Distribution.*—*Fossil.* Cretaceous, Eocene, Miocene: Europe. Eocene: Borneo.

Lütken having found a recent species of *Cladangia*, states that when it is young it resembles *Rhizangia*, and that the stability of this last genus is lost. But it is necessary to compare adult forms in zoological argument; and the adults of the two genera differ materially.

Genus BATHANGIA, *Keferstein, quoted in Zittel, Handb. der Palæont.* 1879.

Corallites short, united to a permanent basal enlargement. Calices round and very deep; wall thick, covered with a granular folded epitheca. Columella spongy, well developed, filling the lower part of the corallites. Septa narrow. Pali in one crown.

*Distribution.*—*Fossil.* Oligocene: Europe.

It is presumed that endotheca exists. Otherwise the genus will belong to the *Turbinolidæ reptantes, nobis*.

## II. Alliance ASTRANGIOIDA.

Astræidæ reptantes with a naked and costulate wall.

Genus ASTRANGIA, Ed. & H.

Subgenus CÆNANGIA, Verrill.

Subgenus PHYLLANGIA, Ed. & H.

Genus ULANGIA, Ed. & H.

Genus STYLANGIA, Reuss.

Genus COLANGIA, Pourtalès.

Genus CLADANGIA, Ed. & H.

Genus LATUSASTRÆA, d'Orb.

Genera absorbed:—

HOPLANGIA, Gosse; PLEUROCCENIA, d'Orb.

Genera becoming subgenera:—

CÆNANGIA and PHYLLANGIA.

Genera removed:—

PSAMMOPHORA, PLACOPHORA, HOLANGIA, and STYLANGIA, E. de From.

Genus ASTRANGIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 496 (1848).

Colony incrusting. Corallites short, arising from calcareous basal expansions, close, more or less turbinate or cylindrical. Calice circular, deep, and large. Columella papillary, and formed of a network of trabeculæ with additions from the septal ends; outer papillæ resembling those of the septa, or differing in consequence of a large paliform tooth being on some septa. Septa

unequal, not exsert, some united, granular at the sides, denticulate, and often with a paliform tooth. Costæ visible on the wall near the calice especially. Epitheca absent. Dissepiments few and distant.

*Distribution.*—*Recent.* East Indies, Florida, Central America, Panama Bay, east and west coasts of North America, Str. of Magellan.—*Fossil.* Eocene: Europe, Borneo. Miocene: N. America.

There is no doubt that the species formerly classified with *Astrangia*, and which are found in the Miocene or later Tertiaries of the United States (eastern coast) vary in their method of gemmation. The corallites may entirely arise from the basal expansion, or some may come from the angles between corallites, and even from the wall anywhere below the calice. Some of these buds are accidentally placed, and have no intimate union with the parent; but others appear to be true infracalicular gemmations. Verrill has formed a subgenus *Cænangia* for these forms and for *Astrangia Danæ* of the Virginian fauna.

Subgenus CÆNANGIA, *Verrill, Notes on Radiata*, p. 530 (1869).

Syn. *Pleiadia*, Dana.

Corallites united together laterally, forming small *Astræa*-like incrusting masses, sometimes rising into lobes in the middle. Calicles angular and crowded. Septa without distinct paliferous teeth at base, those of the last cycles curved towards and usually united to those of preceding cycle. Columella small, scarcely papillose. Budding between corallites and around or below calicular margin.

*Distribution.*—*Recent.* Guaymas; E. coast N. America as far north as Long Island Sound.—*Fossil.* Miocene; Maryland.

*Pleiadia*, Dana, is not mentioned in Verrill's revision of the names of the genera used in the great work on Zoophytes, Wilkes Expedition; and Dana observes ('Corals and Coral Islands,' 1872, p. 68) that it is synonymous with *Astrangia*.

The genus *Phyllangia* of Milne-Edwards and Jules Haime only differs from *Astrangia* in having exsert septa, some of which are not denticulate, others being so, with a smaller and more variable columella. It is at the most only a subgenus.

Subgenus PHYLLANGIA, (genus) *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 497 (1848); *Verrill, Notes on Radiata*, p. 531.

Syn. *Hoplangia*, Gosse.

Colony incrusting, forming clusters of moderately large turbi-

nate corallites, close or rather distant. Corallites rather short. Calices circular, except where crowded, deep. Columella small or well developed, trabeculate from the septal ends; with from one to three or four pillars rising from the base and uniting and joining the trabeculæ; upper surface ragged or papillose. Septa well developed, numerous, unequal, some exsert, entire or minutely denticulated, granular, with or without paliform lobe. Costæ usually well developed. Epitheca wanting. Endotheca moderate. Basal expansion spreading, calcareous.

*Distribution.*—*Recent.* West Indies, Panama, Florida, British Channel? Malacca, W. coast of North and Central America.—*Fossil.* Eocene, Miocene: Europe.

Mr. S. O. Ridley has shown that *Phyllangia*, like *Cænangia*, Verrill, may sometimes bud from the wall of the parent corallite.

I believe that *Hoplangia*, Gosse, Actin. Brit. p. 338 (1860), is synonymous with *Phyllangia*.

Genus *ULANGIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 617 (1857); corrected in accord with Verrill, *Notes on Radiata*, p. 533 (1868).

Colony scattered, basal expansion not developing sclerenchyma. Corallites distant, very low and broad, with a well-developed papillary columella and very numerous septa, the higher orders of which are very denticulate, and the others exsert and partly plain. Costæ near the calice, and an epitheca near the base. Endotheca exists.

*Distribution.*—*Recent.* Panama and Philippines.

Genus *STYLANGIA*, *Reuss, Pal. Stud. über die alt. Tert., Denksch. der Kais. Akad. der Wiss. Wien*, 1874, p. 11.

Colony incrusting. Corallites short, united by basal expansions. Calice circular, moderately deep. Columella styliform. Septa unequal, not exsert. Costæ visible on the wall. Epitheca and endotheca exist.

*Distribution.*—*Fossil.* Eocene: Europe.

Genus *COLANGIA*, *Pourtalès, Illust. Cat. Mus. Comp. Zool. Harvard*, No. iv. 1871, *Deep-Sea Corals*, p. 31.

Corallum immersed in an expanded basal epithelial membrane, forming several successive storeys following the growth of the

coral. Primary and secondary septa entire and exsert; those of the higher orders denticulate and not exsert. Well-developed pali in front of the tertiaries. Columella lamellar or papillose, and not much developed.

*Distribution.*—*Recent.* Florida seas and off Havana.

GENUS CLADANGIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 618 (1857).

The colony arises from a common basal expansion. Corallites with septa having lobed margins. Columella parietal. An exotheca extends from corallite to corallite, giving the appearance of a vertical series of folia.

*Distribution.*—*Fossil.* Miocene: France.—*Recent.* India (*Lütken*).

There are two genera of this subfamily which are exceedingly unsatisfactory owing to the paucity of species and the very indifferent specimens. They are *Latusastræa*, d'Orb., and *Pleurocœnia*, d'Orb. Milne-Edwards and Jules Haime unite these genera.

Now *Latusastræa* has a species from the Oolite of Nattheim, and the specimen figured by Becker and Milaschewitsch, 'Palæontographica,' vol. xxi. plate 40. fig. 1, shows sufficient structure to prove that the genus under which it should be arranged is not *Pleurocœnia*. On the other hand, this last-named genus is not sufficiently defined.

GENUS LATUSASTRÆA, d'Orb. *Note sur des Polyp. foss.* p. 7 (1849). (Amended after Becker and Milaschewitsch, 'Palæontographica,' vol. xxi. p. 166.)

Colony in disk-like or crateriform masses, thin and spreading. Base covered with a stout concentrically-folded epitheca. Corallites close, inclined in one direction, low. Calices with a projecting lip, otherwise circular. Columella absent. Septa very irregular in size and distribution. A long columellary septum reaching two thirds of the distance from one side of the calice to the other. Costæ as delicate striations down the wall. Gemmation close to the bases of the corallites from the common basal structure.

*Distribution.*—*Fossil.* Jurassic: Europe. Cretaceous: Europe?

The genus *Pleurocœnia* is therefore abolished, and is probably synonymous with the above.

3. Subfamily *Astræidæ gemmantes*.

(Subgroup *Stylinaceæ independentes*, Ed. & H., and  
Subfamily *Cladocoraceæ*, Ed. & H., combined.)

*Astræidæ* increasing by gemmation from the wall below the calicular margin. Buds free more or less by their sides. Septa dentate or entire. Endotheca dissepimental.

The subfamily unites the former *Eusmilinæ*, which were grouped with the *Stylinæ*, with the *Cladocoraceæ* of the *Astræidæ*. Five tolerably well-marked Alliances may be mentioned, and there are some genera which cannot be placed in Alliances.

Fourteen genera are retained and one lapses. The Alliances are the *Cladocoroida*, *Goniocoroida*, *Dendrosmilioida*, *Stylosmilioida*, *Palæastræoida*, and a solitary genus.

## I. Alliance CLADOCOROIDA.

*Cladocoraceæ* or *Astræidæ gemmantes* bush-, or branch-shaped, or fasciculate, with a papillary columella and pali. Endotheca present.

Genus CLADOCORA, Ed. & H.

Genus PLEUROCORA, Ed. & H.

The genus *Anomocora*, Studer, placed by that author in the *Cladocoraceæ*, is, according to E. Pourtalès, a *Parasmilia* with buds on a dead parent. This may be the case, but the genus is described by Studer, *Obersicht der Steinkorallen &c. Gazelle Reise, Monatsber. Berlin, 1877, p. 641, pl. 9.*

Genus CLADOCORA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall. vol. ii. p. 588 (1857).*

Colony bush-shaped or branched or fasciculate. Corallites variable in length, erect, often flexuous, cylindrical, and free laterally. Calices circular and shallow. Columella well developed. Septa exsert, subequal, rounded, and finely dentated and granulated laterally. Pali exist before all the cycles except the last. Wall compact, moderately thick. Costæ simple, granular, or finely echinulate, straight. An incomplete epitheca, which often gives rise to horizontal collarettes, may extend from one corallite to another. Endotheca scanty. Gemmation lateral and often in pairs from the same height on the stem.

*Distribution.*—*Fossil.* Jurassic, Cretaceous, Miocene, Pliocene: Europe. Cainozoic: Australia.—*Recent.* West Indies, Mediterranean, Madeira.

GENUS PLEUROCORA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 601 (1857).

Colony subdendroid, espalier-like, or massive. Corallites cylindrical, short, united to the stems, whence they bud for a distance, free at their summits for a variable extent. Calices circular and shallow. Columella papillary, and there are pali before all the septa except those of the last cycle. Septa hardly exsert, subequal, thin, close, denticulate, and granular. The wall is compact, very thick, and the costæ are distinct along the whole height, and are close, separated by deepish grooves, straight near the calice and more or less vermiculate elsewhere. Gemmation lateral. Endotheca exists. Epitheca absent.

*Distribution.*—*Fossil.* Cretaceous: Europe.

## II. Alliance GONIOCOROIDA.

Astræidæ gemmantes with a dendroid or fasciculate form. Columella rudimentary, granular costæ. No epitheca. Endotheca exists.

GENUS GONIOCORA, Ed. & H.

GENUS RHABDOCORA, E. de From.

GENUS GONIOCORA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 604 (1857).

The colony is dendroid. Parent corallites tall, cylindrical. Offshoots by gemmation free laterally, and forming different angles with the parent according to the species. Calices circular and columella rudimentary. Septa not numerous, spinulose. The wall is naked and has granular costæ, straight and distinct over the whole surface.

*Distribution.*—*Fossil.* Trias, Lias: Europe. Oolite: Europe and England.

GENUS RHABDOCORA, *E. de Fromentel, Pal. Franç., Terr. cré.* p. 432 (1872).

Colony dendroid, in close bush-shapes. Corallites free to a variable extent and generally well costulated. The calice is circular and shallow. There is neither columella nor pali. Septa dented.

*Distribution.*—*Fossil.* Cretaceous: Europe.

## III. Alliance DENDROSMILIOIDA.

Astræidæ gemmantes with small subdendroid forms. The corallites short. Columella spongy or parietal. Septa entire. Endotheca present.

Genus *POURTALOSMILIA*, Duncan.

Genus *DENDROSMILIA*, Ed. & H.

Genus *POURTALOSMILIA*, *Duncan*.

Syn. *Blastosmilia*, Duncan (a name preoccupied), *Madrepuraria* of the Deep Sea, *Trans. Zool. Soc.* vol. x. pt. 5, 1878, p. 244.

Colony formed by repeated gemmations from the wall of the parent corallite, and occasionally from the walls of buds. Corallites conico-cylindrical, long, bent, except the straight parent, and parallel with this last. Calices circular, deep. Columella rudimentary, or as trabeculæ from the septal ends. Septa entire, thin, slightly exsert; they project but slightly into the calice, except the primaries and secondaries. Costæ rudimentary and only exist near the calices. Wall thin, with a granular epitheca closely attached. Dissepiments wide apart.

*Distribution*.—*Recent*. Mediterranean.

It must be noticed that the parent corallite survives with the buds and does not die, as in *Anomocora* and *Cænosmilia*.

Genus *DENDROSMILIA*, *Milne-Edwards & Jules Haime*, *Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 468 (1848).

Colony small, subdendroid, increasing by lateral and alternate gemmation. Corallites subturbinate, short, free by their sides. Calices suboval. Columella spongy, well developed. Septa entire, thin, close, very unequal and granulated on their sides. Costæ broad, simple, and granular. Endotheca present. No epitheca.

*Distribution*.—*Fossil*. Cretaceous and Eocene: Europe.

## IV. Alliance STYLOSMILIOIDA.

Astræidæ gemmantes with fasciculate, tufted, dendroid forms. The septa entire or dentated. The columella stout, styloform, or papillary.

Genus *STYLOSMILIA*, Ed. & H.

Genus *STYLOCORA*, Reuss.

Genus *STYLOCORA*, E. de From., 1872.

Genus *PLACOPHYLLIA*, d'Orb.

Genus *DONACOSMILIA*, E. de From.

Genus *STYLOSMILIA*, *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. ii. p. 220 (1857).

Colony in tufts which are fasciculate. Gemmation lateral.

Corallites cylindrical, close, long, flexuous, and coalescent in places, free elsewhere. Calices circular. Columella well developed, styliform and projecting. Septa entire, few, slightly exsert, joining the columella by means of horizontal spiniform projections. Epitheca present or not. Endotheca simple and scarce.

*Distribution.*—*Fossil.* Oolite, Cretaceous: Europe.

Genus *STYLOCORA*, *Reuss, Zittel, Palæontol.* p. 256.

Colony subdendroid. Corallites cylindrical, short, free at the sides. Calices circular. Columella styliform. Septa denticulate, unequal; the primaries the largest, exsert and granulate laterally. The inner ends of the larger septa with a paliiform lobe in contact with the columella.

*Distribution.*—*Fossil.* Cretaceous and Miocene: Europe.

It is a misfortune that M. de Fromentel should have chosen the name *Stylocora* for a genus with a papillary columella. I have not been able to find *Stylocora*, Reuss, and do not therefore know the date of its diagnosis and publication.

Genus *STYLOCORA*, *E. de Fromentel, Pal. Franç., Terr. cré.*  
p. 430 (1872).

Colony dendroid, with slender branches, free to a great extent. Calice circular. Columella well developed and papillary. Pali absent. Costæ well pronounced. Septa dentate, well developed and close.

*Distribution.*—*Fossil.* Cretaceous: Europe.

Genus *PLACOPHYLLIA*, *d'Orbigny, Note sur les Polyp. foss.*  
p. 8 (1849).

Colony fasciculate or astræiform, increasing by sub-basilar or lateral gemmation. Corallites nearly entirely enveloped in a strong folded epitheca, and often united together without the presence of costæ or exotheca. The columella is strong and styliform. Septa well developed. Endotheca abundant.

*Distribution.*—*Fossil.* Oolite: Europe.

The next genus is a very doubtful one, the specimens being in a very miserable condition, and I place it here provisionally.

Genus *DONACOSMILIA*, *E. de Fromentel, Introd. à l'étude des Polyp. foss.* p. 146 (1858-61).

Colony fasciculate, reaching to a considerable height. Wall

covered with a complete epitheca, forming strong circular ridges, wanting here and there: Calices round. No columella (?). Septa broad, slightly exsert, uniting at the axis. Endotheca well developed. Gemmation lateral, and buds pass up parallel with the parent.

*Distribution.*—*Fossil.* Oolite: Europe, England?

#### V. Alliance PALÆASTRÆOIDA.

Astræidæ which increase by gemmation from the wall of the parent, and also from the calice. Septal number irregular. Costæ occasionally remarkably developed.

Genus HETEROPHYLLIA, M'Coy.

Genus BATTERSBYIA, Ed. & H.

Genus HETEROPHYLLIA, *M'Coy, amended in Phil. Trans. Royal Soc.* 1867, p. 648.

Colony of long and slender corallites, free. Gemmation around the calicular margin. Septa either irregular in number and arrangement, or are only six in number and regularly placed. Costæ well developed, may be tubercular, spined, and flexuous. Wall thick. Endotheca dissepimental. Epitheca absent. Columella absent or produced by junction of the septa.

*Distribution.*—*Fossil.* Carboniferous limestone: United Kingdom.

Genus BATTERSBYIA, *Ed. & H., amended in Phil. Trans. Royal Soc.* 1867, p. 648.

Colony fasciculate. Corallites tall, distant, or close and crowded, free, except when arising from a parent, very variable in dimensions in the same colony, or else subequal. Calices and corallites, on section, circular in outline. Columella absent or produced by union of septa. Septa very unequal in size and number, from 6, 12, to 52 in number. Endotheca vesicular and abundant. Gemmation from the walls of corallites, and the buds have five septa or more; also by budding from the interseptal spaces of those buds, of gemmules which develop six septa. There is no epitheca. Corallites without cœnenchyma around them, but often surrounded by *Stromatopora*.

*Distribution.*—*Fossil.* Devonian: England.

## Solitary genus.

Genus *HEXASMILIA*, *E. de Fromental, Pal. Franç., Terr. crét.*  
p. 423 (1871).

Colony fasciculate in close tufts. Corallites free to a great extent, but usually close and polygonal in outline. There are only six septa, which start from the angles of the walls, and one more developed than the others reaches the centre of the calice. Epitheca strong, folded, and reaching to the summit of the colony.

*Distribution.*—*Fossil.* Cretaceous: Europe.

The genus *Isocora*, Etallon, is insufficiently determined, and should lapse.

In 1867 a division of the *Astræidæ* was suggested in order to receive the two Palæozoic genera *Heterophyllia*, M'Coy, and *Battersbyia*, Ed. & H.\* I now place this division as an Alliance in those *Astræidæ* which bud between the calicular margin and the base.

4. Subfamily *Astræidæ cæspitosæ*.

(*Euphylliaceæ cæspitosæ*, Ed. & H. (pars), and *Astræaceæ cæspitosæ*, Ed. & H., combined.)

*Astræidæ* in which the corallites are isolated in all their terminal portions, being free at their sides, springing from a common parent, increasing by fissiparity, separation occurring rapidly or serial growth persisting. Septa entire or dentate, spined or lobed. Endotheca abundant. Colonies in *cæspitose* tufts, often more or less foliaceous. Gemmation rare, but it exists more frequently than has been thought hitherto.

The insufficient morphological distinction between the Sections *Lithophylliacées cæspiteuses* and the *Euphylliacées cæspiteuses* of Milne-Edwards and Jules Haime, *Hist. Nat. des Corall.* vol. ii. pp. 288 & 184, has been intensified by the fact that there is not a very great difference between the soft structures of the groups. The first section belongs to the *Astræinæ*, Ed. & H., with spined and dentated free septal edges, and the last to the *Eusmilinæ*, with smooth septal edges. These conditions of the septal edge, as already noticed, cannot be of physiological importance, and they are found combined in the calices of species of other groups of the corals. Again, the *Cæspitose Euphylliaceæ*,

\* P. Martin Duncan, *Phil. Trans. Roy. Soc.* 1867, pp. 643, 651.

the second of the sections mentioned above, run into the Euphylliacées confluentes; and this want of definition is observable in the *Astræinæ cæspitosæ* and confluentes.

It does not seem possible to separate such genera as *Eusmilia*, *Aplosmilia*, and *Euphyllia* from *Dasyphyllia*, *Trachyphyllia*, and *Mussa*, and their subfamily relationship is evident. The genus *Plocophyllia*, Reuss, is an Eusmiline *Mussa* in habit of growth.

In both of the sections the corallites spring from a small base or parent, either by budding or by fissiparity. They then increase by fissiparous division. The divided parts grow upwards, become separate, and do not unite at the sides. Sometimes this fissiparous division does not take place until the calice has become very long, and even gyrose, so that a kind of serial growth occurs before separation, and it may persist in some parts of the colony, or universally. One part of a fissiparous calice may grow faster than the other, and the calicular centres of the new corallites become evident sooner or later in all conditions, except in the long serial gyroid calices seen in *Euphyllia* for instance.

Seventeen genera have been noticed, but thirteen only remain after revision. Two become subgenera.

#### Alliances.

- I. CALAMOPHYLLIOIDA.
- II. THECOSMILIOIDA.
- III. MUSSAOIDA.

#### I. Alliance CALAMOPHYLLIOIDA.

Cæspitose *Astræidæ* in colonies, the corallites of which speedily become separate, except at their lower and originally attached part. Calices more or less circular, very rarely forming short series.

Tribe I. With entire septa.

„ II. With dentated and spined septa.

#### Tribe I.

Genus *EUSMILIA*, Ed. & H.

Subgenus *CAULASTRÆA*, Dana.

Genus *APLOSMILIA*, d'Orbigny.

Genus *SOLENOSMILIA*, Duncan.

#### Tribe II.

Genus *DASYPHYLLIA*, Ed. & H.

Genus *CALAMOPHYLLIA*, Ed. & H.

Genus PLEUROPHYLLIA, E. de From.

Genus DENDROCORA, Duncan.

Genus DACTYLOSMILIA, d'Orb.

Genus HYMENOPHYLLIA, Ed. & H.

Genus RHABDOPHYLLIA, Ed. & H.

Genera absorbed :—

APLOPHYLLIA, d'Orb. ; CAULASTRÆA becomes a subgenus.

### Tribe I.

Genus EUSMILIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 186 (1857 ; founded 1848) ; amended.

The colony is cæspitose in shape, and the branches are dichotomous or trichotomous. The base increases but slightly with age, and the subcylindrical corallites increase in height, multiply fissiparously, and speedily become separate. The calices are large, somewhat irregular in outline owing to fission, but are generally elliptical. The columella is composed of a lax, broad tissue, and is at the bottom of a deep fossa. The septa are entire at their upper edge, are well developed, thin, narrow, and slightly granular. The costæ are subcrestiform near the calices, and may become more or less indistinct towards the base. The endotheca is moderately developed, and there is a pellicular epitheca, which does not pass far up the colony.

*Distribution.*—*Fossil.* Antillian Pliocene.—*Recent.* Caribbean Sea.

*Eusmilia alticostata*, Ed. & H., has the costæ distinct at the base.

Subgenus CAULASTRÆA, *Dana, Zoophytes, Wilkes's Explor. Exped.* p. 196 (1846).

Colony cæspitose, with the stems straight or twisted, subcylindrical. Calices subcircular, deep. Septa unequal, exsert, subentire, rather numerous. The outer surface of the stems striated or denticulate.

*Distribution.*—*Recent.* Pacific, West Indies ?

The three species included in *Caulastræa*, Dana, form a very natural subgenus of *Eusmilia*.

Genus APLOSMILIA, *d'Orbigny, Note sur les Polyp. foss.* p. 6 (1849), and *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 189 ; amended.

The colony is cæspitose, and the branches are dichotomous or

trichotomous. The base increases but slightly with age, and the corallites grow high, subcylindrical, and increase by fissiparity, separating soon. The calices are large and do not form series. The columella is lamellary. The septa are large, thin, and entire. The costæ are crestiform, and are visible to the base. There is an endotheca, but the epitheca is absent.

*Distribution.*—*Fossil.* Oolite of Europe.

Genus SOLENOSMILIA, *Duncan, Madreporaria of Deep Sea, Trans. Zool. Soc.* vol. viii. pt. 5, p. 327 (1871).

The colony is bush-shaped, and the corallites, which rarely unite, are cylindrical and bifurcate. Budding occurs, and afterwards fission of the terminal calices: their fossæ and columellæ are in common. The tissue between these calices is costulate, and that over the rest of the corallum granular and without epitheca. The calices increase by fissiparity, and occasionally form short series. Columella formed of laminæ and of the paliform ends of septa, and is deeply situate. Septa variable in number; many reach the columella and have paliform lobes. Dissepiments common. Wall often thick.

*Distribution.*—*Recent.* N.E. and S. Atlantic, Caribbean Sea, South Indian Ocean, Philippines, Japan. To 1098 fms.

#### Tribe II.

Genus DASYPHYLLIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 432 (1848); *Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. x. pl. 8. fig. 5 (1849).

The colony is fasciculate, and resembles a more or less hemispherical, dichotomous cyme in shape. The corallites grow upwards, divide fissiparously, and become free to a considerable extent rapidly. The calices are circular, suboval, or deformed, moderately deep, and there is a spongy columella. The septa are exsert and dentate, the inner teeth being larger than the outer ones. The endotheca is well developed. The wall is echinulate and costulate, and gives rise to circular expansions. The epitheca is rudimentary.

*Distribution.*—*Fossil.* Tertiary of Sind and Miocene of Europe.—*Recent.* East Indies, Malacca.

Genus CALAMOPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 342 (1857).

The colony is fasciculate, and the corallites are long and

dichotomous, free soon or almost entirely so. The calices have an irregular margin, and are more or less circular or subcircular, and they are shallow. The columella is rudimentary, or absent. The septa are numerous, and nearly equidistant. The endothecal dissepiments are oblique and well developed. The wall is naked, or may have a rudimentary epitheca, and is covered with equal or subequal granular costæ. Circular expansions of the wall occur at different heights, and may or may not unite with those of other corallites.

*Distribution.*—*Fossil.* Trias: Europe. Jurassic: England and Europe. Secondary: Europe. Tertiary: Europe, Sind, Australia?

Genus PLEUROPHYLLIA, *E. de Fromentel, Introd. à l'étude des polyf. foss.* p. 140 (1858–60).

Colony with small dichotomous or trichotomous branches. Corallites cylindrical, multiplying fissiparously. Calices with the septa arranged on the heptamerous type, one of the seven large septa being the most developed, and reaches the axis without diminishing in thickness, and replaces a columella. The wall is covered with a thick epitheca, swollen in bourrelets here and there.

*Distribution.*—*Fossil.* Portland Oolite: Europe.

Genus DENDROCORA, *Duncan, Deep-Sea and Littoral Corals, Proc. Zool. Soc.* 1876, p. 438.

Colony bushy, branching from all parts, frequently in one plane. Branches different in length, slender. Calices terminal, round, shallow or elongate when undergoing fissiparity. Columella lax and trabecular. Septa denticulate, with pali before those of the third cycle. Costæ distinct, broader than the septa of the calicular margin, and are sharply granular over the all. Wall thick. Endotheca tolerably abundant. Epitheca absent. In some branches the fissiparity is repeated to form short series.

*Distribution.*—*Recent.* Atlantic, West coast of Africa.

Genus DACTYLOSMILIA, *d'Orbigny, Note sur les Polyf. foss.* p. 6 (1849).

The colony is dendroid, and has dichotomous corallites. The columella is spongy and well developed. The septa are dentate and in three or four cycles, and there are pali before all, with the

exception of the last. The walls are naked, and have distinct granular costæ along their whole length.

*Distribution.*—*Fossil.* Cretaceous: Europe.

Genus HYMENOPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 368 (1857).

Colony in the form of a fasciculate tuft. Corallites free at their sides, and environed by a complete epitheca, which is attached to the extremity of the costæ at a little distance from the wall, giving an appearance of a double wall. Calices broad, more or less deformed. Columella rudimentary or none. Septa in irregular cycles, with a paliform lobe. Endotheca very developed.

*Distribution.*—*Fossil.* Cretaceous: Europe.

Genus RHABDOPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 348 (1857), *amended.*

Colony in the shape of a dendroid tuft; the corallites long and cylindrical in shape, bifurcating fissiparously and at different angles. The calices have rather irregular shapes, and the columella is spongy and well developed. The septa are dentate and granular. The costæ are continued over the wall to the base, and are distinct and granular, may be restricted to the neighbourhood of the calice, or some are very distinct low down. The endotheca is developed, and there is no epitheca.

*Distribution.*—*Fossil.* Trias, Cretaceous: Europe. Jurassic: England and Europe. Eocene: Europe and Asia.

This genus absorbs *Aplophyllia*, d'Orbigny, 1849, which, being less well known, had better not receive the usual priority.

## II. Alliance THECOSMILIOIDA.

Astræidæ more or less cæspitose, sometimes submassive. Corallites united to some extent, increasing by fissiparity, speedily separating, showing short series rarely; gemmation may occur.

Genus THECOSMILIA, Ed. & H.

Subgenus CLADOPHYLLIA, Ed. & H.

The genus *Cladophyllia* becomes a subgenus, and *Cænotheca*, Quenstedt, is abolished.

Some of the genera now about to be considered are very difficult to classify, especially *Thecosmilia*, Ed. & H. The young

of most *Thecosmilians* were simple forms resembling *Montlivaltia*, and growth proceeded for some time without increase, or the reverse happened. The increase was clearly not invariably by fissiparity of the parent; subdivision and upward growth from more than two centres may be noticed; and the method is indistinguishable from the results of gemmation. As growth proceeded the calice either remained unaltered, or fissiparity, or even something like serial growth, developed.

The result in these last two instances was to produce calices as varied in shape as in *Mussa* and *Symphylia*.

Mr. Tomes, F.G.S., has introduced the genus *Chorisastræa*, E. de Fromentel, to absorb the *Thecosmilieæ* which grow at first by budding and then by fissiparity. In his essay on the Lower-Oolite Madreporaria (Quart. Journ. Geol. Soc. vol. xxxviii. p. 428, 1882), the diagnosis of *Chorisastræa* is not introduced. A figure is given of *Chorisastræa gregaria* on plate xviii. figs. 1-3, the *Thecosmilieæ gregaria* of Ed. & H., and M'Coy's *Montlivaltia gregaria*.

The figure, however, does not represent the characteristic groove or deep space between the walls of adjoining calices, which is the special generic character of *Chorisastræa* according to the founder of the genus, M. de Fromentel. *Chorisastræa* will be considered in its proper place.

Genus THECOSMILIA, *Milne-Edwards and Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 354 (1857).

This colony is usually cæspitose, but sometimes becomes submassive, expanding at the top in consequence of the more or less complete union of a certain number of corallites together. Usually the corallites tend to isolate rapidly by and after fissiparity, and their base develops but little with age. The calicular margins are irregular. The columella is rudimentary or none. The septa are strong, more or less exsert, regularly dentate above and granular laterally. The endotheca is well developed, and the epitheca is stout and strongly folded and reaches close to the calices. Growth by fissiparity and rapid isolation, or by gemmation and subsequent fissiparity.

*Distribution.*—*Fossil.* Trias, Jurassic, Cretaceous, Tertiary: Europe. Jurassic: England.

Subgenus CLADOPHYLLIA, (genus) *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 363 (1857).

Colony in the form of cæspitose tufts. Corallites elongate,  
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cylindroid, covered with a well-developed complete epitheca. The calices are circular in outline and rather deep. Septa not numerous. The columella is rudimentary or absent. Endotheca not abundant.

*Distribution.*—*Fossil.* Trias, Jurassic: Europe. Jurassic: England.

This was formerly a genus, but it is clearly only a division of that called *Thecosmilia*.

The genus *Cænotheca*, Quenst., is ill defined, and relates, in all probability, to peduncles of *Thecosmilioida*.

### III. Alliance MUSSAOIDA.

Cæspitose Astræidæ with very dentated or spined septa. Growth by fissiparity. Corallites free at their sides or slightly joined. Calices unsymmetrical, rarely solitary, usually in series, free.

Genus TRACHYPHYLLIA, Ed. & H.

Genus MUSSA, Oken.

Genus TRACHYPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 340 (1857).

Colony fixed, not very tall, composed of corallites which are free amongst themselves, wavy and swollen and contracted here and there. Calices as long valleys, much twisted and deep. Columella well developed, spongy, and lax. Septa numerous, exsert, striated, and highly granular on their sides; the free edge of the larger finely dentate, and lobed towards the columella, and the smaller have larger and narrower dentations. Endotheca exists. The wall has costæ, which are strong, echinulate, and sublamellar. Epitheca rudimentary or incomplete.

*Distribution.*—*Recent.* Chinese, Indian, and Red Seas.

This genus = *Manicina*, according to Dana, *Zooph.* 1846, pl. 9. fig. 1.

Genus MUSSA, Oken, 1815, amended in *Milne-Edwards & Jules Haime's Hist. Nat. des Corall.* vol. ii. p. 328 (1857).

The colony is tall, more or less cæspitose. The corallites are united in short or long series, or free, and have the walls either quite ununited or very slightly united. Calices serial or circumscribed, unsymmetrical, and their centres are distinct and deep. The columella is spongy and well developed. The septa large,

numerous, exsert, are spined or strongly toothed, especially near the calicular margin, and the systems are irregularly developed. Costæ spined. Walls striated, and either naked or presenting a rudimentary epitheca. Endotheca well developed.

*Distribution*.—*Recent*. West Indies, East Indies, Red Sea, Pacific, China.

The young individuals cannot be distinguished from simple *Astræidæ* of the *Antillia* type. It is a large genus, and may be divided into those with the corallites free and with calices circumscribed—*Mussæ cymosæ*; and those in which serial growth preponderates—*Mussæ gyrosæ*.

The principal distinction of *Mussa* from the genus *Symphyllia* consists in the perfect union of the walls in this last-named genus.

#### 5. Subfamily *Astræidæ confluentes*.

*Astræidæ* with entire or dentate, ragged, and spined septa, increasing by fissiparity and having excess of serial growth. Gemmation may occur. Corallites united by their walls, costæ, or by intermediate tissue, or free.

Alliances.

I. EUPHYLLIOIDA.

II. EUGYROIDA.

III. SYMPHYLLIOIDA.

IV. MONTICULOIDA.

Forty genera have been recorded, and revision leaves thirty-three. One old genus becomes a subgenus, and six lapse.

#### I. Alliance EUPHYLLIOIDA.

Colony cæspitose, foliaceous, or flabelliform. Septa dentate or entire. Calices in long series, sinuous or not; not united by their walls or costæ, but free.

Genus EUPHYLLIA, Ed. & H.

Genus GLYPHOPHYLLIA, E. de From.

Genus RHIPIDOGYRA, Ed. & H.

Genus TELEIOPHYLLIA, Duncan.

Genus DESMOCLADIA, Reuss.

Genera absorbed:—

PLOCOPHYLLIA, Reuss; STENOGYRA, E. de From.;

FROMNTELIA, Ferry.

Genus EUPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 191 (1857).

Syn. *Plocophyllia*, Reuss; *Stenogyra*, E. de From.; *Fromentelia*, Ferry.

The colony is cæspitose or subfoliaceous. The base increasing but little with age. The corallites increase fissiparously, and either some separate or others remain united in series of greater or less length. These series are always free at their sides and their calicinal centres remain distinct, except in very long series, where they are indistinct. There is no columella. The septa are very numerous, very thin and exsert, long from the axis to the margin, and often folded a little; their sides are smooth, and the free upper edge is entire. The wall is thin, naked, almost smooth inferiorly, and costulate near the calices. The endotheca is abundant, low down, and vesicular.

The genus is divided into two groups. In the first the colony is in the shape of a cæspitose bush or tuft.

*Distribution*.—*Recent*. Pacific, N. Australian seas, and Singapore.

The second group has the colony in the shape of meandroid laminae of greater or less length.

*Distribution*.—*Fossil*. Jurassic, Cretaceous, Eocene, Miocene: Europe, Asia.—*Recent*. Chinese and Indian seas.

M. de Fromentel founded the genus *Stenogyra*, *Introd. à l'étude des Polyp. foss.* p. 153 (1858); but it does not appear to differ from the second group of *Euphyllia* except in the thickness and granulation of the septa. I propose to absorb it in *Euphyllia*; and therefore the antiquity of the genus is put back to the Jurassic age. Reuss's genus *Plocophyllia* is absorbed in the second group of *Euphyllia*, the species having well-marked costæ to the base.

Genus GLYPHOPHYLLIA, *E. de Fromentel, Pal. Franç., Terr. cré.* p. 463 (1877).

Colony in rather thin laminae, flabelliform, and free at the sides. Calice of one large, shallow series, straight or slightly bent, broad. Columella absent. Septa large and thick, dentate or lobed, thin towards the axis, and usually alternately large and small. Costæ dentate and granular, more or less covered with epitheca.

*Distribution*.—*Fossil*. Cretaceous: Europe.

This genus is doubtfully separable from *Euphyllia*.

Genus RHIPIDOGYRA, *Milne-Edwards & Jules Haime, Pol. foss. des Terr. paléoz. p. 57 (1851).*

Colony flabelliform and lamellar, and folded more or less. The corallites are in one narrow flexuous series, and their calices are confluent and not distinguishable. The wall of the series is free. The columella is lamellar. The valley formed by the series is shallow, and the septa are exsert, close, and entire at their free edge. The costæ are straight, and often subcristiform near the calicular margin. Near the base, the wall is either naked or has a rudimentary epitheca. Endotheca abundant.

*Distribution.*—*Fossil.* Jurassic and Cretaceous of Europe.

Genus TELEIOPHYLLIA, *Duncan, Proc. Geol. Soc. Lond. Nov. 18, 1863, p. 34, pl. iii. figs. 5a, b.*

Corallum long, low, narrow, and pedicellate. Calices confluent, forming a nearly straight series. Columella long, lamellar. Septa numerous, close, granular, serrate above. Costæ free and granular. Endotheca and epitheca well developed, and some exotheca between the costæ.

*Distribution.*—*Fossil.* Miocene: West Indies.

Genus DESMOCLADIA, *Reuss, Denkschr. der Kais. Akad. der Wiss. Wien, 1874, Bd. xxxiii. p. 37.*

Colony large, massive, bushy or fasciculate. Corallites very long, spring from small bases, and enlarge in series upwards. Series long, gyrose, narrow, not united by their walls. Costæ small. Columella parietal and spongy. Calicinal centres not distinct.

*Distribution.*—*Fossil.* Eocene: Europe.

## II. Alliance EUGYROIDA.

Fissiparous Astræidæ with confluent serial calices; calicinal centres indistinct, except when young. Walls united directly, or indirectly by exothecal structures, forming a massive colony.

Tribe I. With entire septa.

Tribe II. With dentate or denticulate septa.

I. Genus DENDROGYRA, Ehr.

Genus PECTINIA, Oken.

Genus EUGYRA, E. de From.

Genus PACHYGYRA, Ed. & H.

II. Genus DIPLORIA, Ed. & H.

Genus STIBORIA, Etallon.

Genus MANICINA, Ed. & H.

Genus MÆANDRINA, Ed. & H.

Subgenus CÆLORIA, Ed. & H.

Genus LEPTORIA, Ed. & H.

Genus MÆANDRASTRÆA, Ed. & H.

Genus BRACHYMÆANDRINA, Duncan.

Genus STELLORIA, d'Orb.

Genus PLATYGYRA, Ehr., absorbed. CÆLORIA becomes a subgenus.

### Tribe I.

Genus DENDROGYRA, *Ehrenberg, Corall. des roth. Meer.*  
p. 100 (1834).

The colony is massive and often columnar in shape, or simply convex. The corallites form tortuous series which are completely united by their walls. The calices are confluent and subdistinct in series, and are in shallow valleys between broad, flat, compact collines or ridges. The columella is formed of a series of compact swellings, or of small interrupted laminae, and is sometimes rudimentary. The septa are very thick, unequal, and close; they are entire. The walls on the ridges are very stout, and sometimes there is a slight depression along the axis of the ridge. Endotheca exists largely. The columns appear to be prong-shaped growths from large hemispherical masses.

*Distribution.*—*Recent.* Antilles. Other localities unknown.

The genus *Pectinia* of Oken (1815) in part, and the genus *Ctenophyllia*, Dana, 1846, merged into the genus *Pectinia* of Milne-Edwards & Jules Haime in 1857. The synonymy of the genus and species is given in the 'Hist. Nat. des Corall.' vol. ii. pp. 206-210 (1857).

Genus PECTINIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 206 (1857).

The colony is pedunculate or sessile, grows but little at the base, and presents a large calicular surface. The corallites are united by their walls, and sometimes with some cœnenchyma. The calices are in series, are indistinct; their valleys are very long and broad; and the columella is lamellary, and reaches from one end of the calicular series to the other. The septa are entire, stout, granular, and exsert. There are accessory laminae (pali?) before the septa of the last cycle attached to the columella. Ridges (collines) well developed, may show inter-

mediate structure, united walls not very stout. Costæ subequal, crested, bifurcating or plain near the base, and more cristiform near the calicular surface. Epitheca rudimentary and inferior Endotheca exists.

*Distribution.*—*Recent.* West Indies, Brazils.

Genus EUGYRA, *E. de Fromental, Desc. des Pol. foss. de l'étage Néocomien*, p. 30 (1857).

Colony pedicellate inferiorly, convex on the upper and enlarged surface. Corallites in series, intimately united by their walls. Calicinal valleys meandroid in the centre of the colony, and radiating and straight towards the circumference. Calices indistinct. Columella absent. Septa entire, arched above. Endotheca well developed. A folded and complete epitheca.

*Distribution.*—*Fossil.* Cretaceous : Europe.

Genus PACHYGYRA, *Milne-Edwards & Jules Haime, Compt.*

*Rend. de l'Acad. des Sci.* t. xxvii. p. 468 (1848).

The colony is fixed by a thick peduncle, and is enlarged above. It is composed of corallites united by a costal and exothecal cœnenchyma, which is dense and greatly developed, and reaches up to a certain distance below the summit of the walls. Calices in long, flexuous, narrow, shallow series. The columella is lamellary, very thin, and continuous. Septa are entire, thin, close; and the costæ are fine, subplane, and granular. The ridges have a space along their axis, which presents the top of the intermural tissue. Epitheca rudimentary or none. Endotheca exists.

*Distribution.*—*Fossil.* Cretaceous and Oolitic : Europe.

## Tribe II.

Genus DIPLORIA, *Milne-Edwards & Jules Haime, Hist. Nat.*

*des Corall.* vol. ii. p. 401 (1857).

Colony massive, spheroidal, hemispherical, or convex, with a large fixed base. Corallites in long series, united by their costæ, which are greatly developed, and between which there is some exotheca. The walls are thick, and in sections their upper edges are free and distinct from those of the neighbouring series. Hence the calicular valleys are separated by rather broad, convex, depressed collines marked on either side by costæ. The calicinal centres are quite indistinct in the very sinuous valley-series, which are deep.

The columella is spongy, essential, and well developed. The septa are stout and exsert, and their dentations are close, subequal.

*Distribution*.—*Fossil*. Cretaceous: Europe. Eocene: Asia.—*Recent*. Caribbean Sea, Bermuda, and Chinese seas.

Genus STIBORIA, *Etallon*, *Lethæa Bruntrutana* (Zurich 1864), p. 386.

Colony massive, adherent by a small surface, and in the form of thin laminae. Corallites in short series, which are more or less flexuous, united below, and separated above by a groove on top of the intercalicular ridge. Ridge resulting from the incomplete fusion of the corallite-walls. Calicinal centres indistinct. Columella absent. Septa dentate near the axis. An epitheca exists covering costæ of the common plateau.

*Distribution*.—*Fossil*. Oolitic: Europe.

Genus MANICINA, *Ehrenberg*, amended by *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. ii. p. 397 (1857).

Colony massive, free or pedunculate, broad-based, subhemispherical, tall, and convex or subconical or short. Corallites with their walls fused with those of their neighbours, except in young forms. Calicinal valleys long, broad and deep, united by simple or broad and furrowed collines. Calices with indistinct centres. Columella spongy, essential. Septa close, thin, strongly granulated laterally, the principal with a paliform lobe, and with the free edge divided by fine teeth, which are regular, close, and largest near the columella. The common plateau is furnished with costæ, which are delicate and dentate, and are partly covered by an epitheca, which is readily detached. Endotheca abundant, unequal.

*Distribution*.—*Recent*. Caribbean Sea.

Genus MÆANDRINA (pars, *Lamarck*), *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. ii. p. 388 (1857).

Colony massive, dense, convex, gibbose, subplane or subspheroidal, largely fixed by its base. The series of corallites unite by their walls, which are compact, and produce long, simple ridged collines. The valleys are sinuous, long, but vary in length, depth, breadth, and meandroid nature. Calices mostly indistinct, some may be circumscribed. Columella formed by masses of spongy tissue well developed. The septa are close, parallel, their inner edge thickened and enlarged transversely; upper margin denti-

culate, moderately granular laterally. Union of the transverse enlargements of neighbouring septa near the columella often occurs, and gives a paliform appearance. Endotheca and epitheca exist.

*Distribution.*—*Fossil.* Oolite: Europe. Cretaceous: Europe. Miocene: Europe; W. Indies; Raised beaches, E. Africa.—*Recent.* Indian seas, E. American seas, Caribbean, Pacific.

A group of forms possessing very variably-shaped calices was once scattered amongst four genera, namely, *Mæandrina*, Lmk., *Platyggyra*, Ehr., *Astroria*, Ed. & H., and *Cæloria*, Ed. & H.

Milne-Edwards and Jules Haime united the last two genera, abolished the genus *Platyggyra*, and explained the distinct character of *Mæandrina*.

Hence in the 'Histoire Naturelle des Coralliaires' the forms are all placed under the genus *Cæloria*. This is correct, because the characters of *Astroria* and *Cæloria* may be recognized on the same colony. M. de Pourtalès notices how difficult it is to distinguish forms of this genus which have very long calices from *Mæandrina*. He proves that some *Cæloriæ* must come within the genus *Mæandrina*. On the other hand, I have shown that the internal structures of *Cæloria pachychila* do not permit it to remain in the genus (Journ. Linn. Soc. vol. xvii. p. 361, 1884).

There does not appear to be any satisfactory reason for separating the genera *Mæandrina* and *Cæloria*; and I consider the latter to be a subgenus of the former. But there is no warrant, as the late Dr. Brüggemann (Phil. Trans. vol. clxviii. p. 571) thought, for resuscitating the name *Platyggyra*, Ehr.

Subgenus CÆLORIA, (genus) *Milne-Edwards & Jules Haime*,  
*Hist. Nat. des Corall.* vol. ii. p. 411 (1857).

Colony massive, light, largely fixed at the base, hemispherical, convex, rarely subplane. The corallites in series are united by their walls, forming simple interserial ridges. The length of the valleys, which are usually deep, varies greatly, even in the same colony, from that of a simple bud in which the calicinal centre is distinct to that of several centimetres. In the series the centres are indistinct. Columella parietal, and formed by trabeculæ from the ends of the septa, may be spongy. Septa thin, minutely dentate, and granular laterally. Endotheca abundant. In sections the fused walls are slender.

*Distribution.*—*Fossil.* Miocene: West Indies.—*Recent.* Red Sea, East Indies, Pacific.

Genus LEPTORIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 405 (1857).

Colony massive, very largely fixed. Corallite series unite by their walls, and the ridges at the surface are always simple, usually thin. The valleys are long, straight, or very sinuous, or both in the same colony. Calicinal centres perfectly indistinct. Columella lamellar, lobed, and projects where free in the series. The septa are slightly exsert, unite to the columella by means of trabeculæ, and their dentations are small and irregular. Endotheca exists.

*Distribution.*—*Fossil.* Cretaceous: Europe. Eocene, Oligocene, Miocene: Asia.—*Recent.* Indian Ocean, Pacific, Seychelles, Rodriguez, Red Sea.

Genus MÆANDRASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 452 (1857).

Colony massive, convex. Corallites in series united by their costæ or by their walls. Corallite ridges (or collines) at the surface rather broad, with or without a delicate groove. Valleys numerous, short. Calicinal centres distinct, but united by septo-costæ. Columella small, lamellary.

*Distribution.*—*Fossil.* Cretaceous: Europe.

Genus BRACHYMÆANDRINA, *Duncan.*

Syn. *Cæloria* (pars), Ehr.

Colony large, low, attached, but extending beyond fixed point, slightly convex above. Corallites in long series, mainly radiating from the centre. Wall between the series rudimentary, discontinuous, and consisting of series of knob-like projections. Upper surface of ridges with exsert septo-costæ, spined and dentate, the upper wall-projections being visible. Calicinal centres not distinct. Columella small, essential, and receiving trabeculæ from the septal ends, projecting as little processes between the septal ends. Septa stout, short, exsert, angular in outline. Endotheca well developed, and often extending between the discontinuous parts of the walls. Common plateau without a true wall, and with a strong folded epitheca, from which spring the septa and columella.

*Distribution.*—*Recent.* Red Sea, Mergui, Ascension.

Genus STELLORIA, *d'Orbigny, Note sur les Polyp. foss.*  
p. 9 (1849).

Colony massive. Corallites in series united by their walls,

producing ridges at the calicular surface; these are simple, and are arranged in a radiating manner, and commence and end at the centres of star-like areas. The series are narrow, and the calicinal centres are almost completely indistinct. Columella absent or rudimentary.

*Distribution.*—*Fossil.* Cretaceous: Europe and England.

### III. Alliance SYMPHYLLIOIDA.

Fissiparous Astræidæ, with corallites in linear series with distinct calicinal centres. Walls united directly or by costæ, or only free to a certain extent. Septa dentate or spined or entire.

Tribe I. With dentated septa.

Tribe II. With entire septa.

#### I. Genus SYMPHYLLIA, Ed. & H.

Genus PHYLLOGYRA, Tomes.

Genus DIMORPHOPHYLLIA, Reuss.

Genus STIBASTRÆA, Etallon.

Genus LATIPHYLLIA, E. de From.

Genus MYCETOPHYLLIA, Ed. & H.

Genus ULOPHYLLIA, Ed. & H.

Genus TRIDACOPHYLLIA, Blainville.

Genus COLPOPHYLLIA, Ed. & H.

Genus SCAPOPHYLLIA, Ed. & H.

#### II. Genus PLEROGYRA, Ed. & H.

Genus PHYSOGYRA, Quelch.

Genus PHYTOGYRA, d'Orb.

The genera ISOPHYLLIA, Ed. & H., and GYROSMILIA, Ed. & H., are absorbed.

#### Tribe I.

Genus SYMPHYLLIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 369 (1857).

Syn. *Isophyllia*, Ed. & H.

The colony is massive, convex above or subplane. The corallites are in short or long linear series, which are united by their walls completely, or having a slight groove between them, or united below by the walls and close to the surface by costæ and exotheca. Calicular centres distinct in the series. Columella spongy. Septa numerous, much spined. Collines stout, tall, may be furrowed on the top. Endotheca abundant.

The genus is divided into groups of species characterized by the amount of mural fusion. In one group the walls are so united that no groove is seen on the "collines" between the corallites. In the second there is a narrow groove there; and in the third

group the corallites are united below by their walls, and near the calices by *costæ* and *exotheca*.

*Distribution.*—*Fossil.* Jurassic: England. Eocene, Miocene: Europe.—*Recent.* Indian Ocean, New Holland, north of Caribbean Sea.

In thus limiting *Symphyllia*, the genus is differentiated from *Mussa*.

M. de Pourtalès has shown that the genus *Isophyllia*, Milne-Edwards & Jules Haime, Pol. foss. des Terr. paléoz. &c. p. 87 (1851), is not separable from *Symphyllia*. It really only differs in that the dentations of the septa are subequal instead of being larger near the calicular margin. The species of *Isophyllia* must therefore be considered to belong to the genus *Symphyllia*.

After due consideration, it appears that the coral named *Symphyllia Etheridgii*, nobis, Suppl. Brit. Foss. Corals, pt. 3, p. 19, pl. vi. figs. 5–8, Oolitic Corals (Pal. Soc. Lond.), is correctly placed within the genus *Symphyllia* and not in the following.

Genus PHYLLOGYRA, *Tomes, Quart. Journ. Geol. Soc.* 1882, vol. xxxviii. p. 430.

“The corallum has a more or less depressed and massive form, and is composed of a series of leaf-like expansions, proceeding laterally from a parent corallite, the curled-up margins of which unite and form sinuous cristiform ridges, the line of union of which is very distinct in the younger examples, but much less so in the older ones. Gemmations take place successively amongst the elongated septa (which must be regarded as *costæ* rather than septa), and generally towards the extremity of the leaf, and a more or less distinct line of calices is produced. There appears to be no intercalicular gemmation. . . . When lateral gemmation has ceased, the corallum only increases in height by the growth of the single or serial corallites upwards. There is a common basal wall, which is either naked or costulate, or has bands of rudimentary epitheca. It is by the folding inwards of this outer wall, and not by the growth of inner walls, as in *Isastræa* and *Latimæandra*, that the sinuous ridges are formed.”

*Distribution.*—*Fossil.* Oolite: England.

This genus, according to its author, contains some remarkable anomalies. A study of the figures given (*op. cit.* pl. xviii. figs. 5–7) of a species shows its eminently *Symphyllian* aspect, and the visible calices are the result of fissiparity. I introduce the genus here with doubt as to its value. Portions of a colony only have been found.

Genus DIMORPHOPHYLLIA, *Reuss*, " *Foss. Foram., Anthozoen von Oberburg in Steiermark*," *Denks. d. Kais. Akad. der Wiss. Wien*, Bd. xxiii. p. 16, *altered*.

Colony low, narrowly pedunculate, thin, with an undulating margin. A central calice, with numerous septa which are confluent with those of other calices in eccentric circles; short or long, straight or curved ridge-shaped elevations pass from the margin of the colony, and are marked with costæ. The ridges enclose valleys with the eccentric calices, which do not appear to have columellæ. Costæ distinct.

*Distribution*.—*Fossil*. Jurassic, Eocene: Europe.

Genus STIBASTRÆA, *Etallon*, *Etudes Pal. sur le Haut Jura*, 1858; *E. de Fromentel*, *Introd. à l'étude des Polyp. foss.* p. 164.

Colony expanded, pedunculate. Calices disposed in series, more or less regular and long, around a central calice, directed to the circumference of the corallum. Series tolerably distant and united by their costæ. Septa thick and dentated. Columella papillary. Epithea strong and folded.

*Distribution*.—*Fossil*. Jurassic: Europe.

Genus LATIPHYLLIA, *E. de From. Introd. à l'étude des Polyp. foss.* p. 164 (1858–61).

Colony large, pedunculate, increasing fissiparously. Calices large, in series radiating from a central calice to the edge of the corallum, separate, and covered with epithea. Columella absent. Septa large and distant. Costæ exist. Endotheca abundant.

*Distribution*.—*Fossil*. Jurassic: Europe.

Genus MYCETOPHYLLIA, *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. ii. p. 375 (1857).

The colony is massive and fixed. The corallites are united by their very thin walls. The calices are in series in valleys, which are shallow and more or less sinuous, the interseptal loculi being almost superficial; the calicinal centres are especially indicated by the direction of the septa, which are not numerous, barely exert, wide apart, and strongly and unequally dentated. Columella rudimentary or absent. Endotheca vesicular and very abundant. Common plateau lobed, spinulose, and has a rudimentary epithea.

*Distribution*.—*Fossil*. Cretaceous: Europe. Eocene: Europe. Miocene: Europe.—*Recent*. Eastern seas.

Genus *ULOPHYLLIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 377 (1857).

Syn. *Oulophyllia*, Ed. & H.

Colony massive, convex, low, or subplane above. Corallites united by their walls completely, and presenting narrow ridges between the long sinuous valleys of the calices, which are not very distinct. Columella spongy and slightly developed. Septa close, slightly exsert, granulated laterally, and deeply incised at the edge with long sharp dentations, which are largest near the columella. The endotheca is well developed, and the interseptal loculi are deep. The common wall has a more or less complete epitheca.

*Distribution.*—*Fossil.* Jurassic, Cretaceous, Eocene, and Miocene: Europe.—*Recent.* Indian Ocean, Banda.

Genus *TRIDACOPHYLLIA*, *Blainville, Dict. des Sci. Nat.* t. lx. p. 327 (1830).

Colony tall, structures exceedingly thin. Corallites completely united by their very thin and often incomplete walls. Calicinal valleys subsinuous, long, broad, and very deep, separated by very thin, tall, irregular ridges. Calicinal centres fairly distinct. Columella absent or very rudimentary. Septa very narrow above, slightly exsert, not close, subequal, and dentated. The dentations are delicate, ascending and subequal; those near the centre of the calices are the largest. Common wall broken or festooned where free, with distinct, slightly projecting sinuous and spinose costæ. Dissepiments very oblique, convex, abundant, forming large vesicles; but the interseptal loculi are rather shallow.

*Distribution.*—*Recent.* American seas, Indian Ocean, Amboyna, Banda, China, Pacific.

Genus *COLPOPHYLLIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 383 (1857).

Colony massive, light and fragile, with a broad base, or pedunculate. Corallites united by their costæ, the walls never fusing at the calicular surface, where they are very slender. Calicinal valleys moderately long, flexuous, large, deep, with the calicinal centres more or less distinct. Columella rudimentary or none. Septa excessively thin, long, slightly exsert, and striated laterally; their free margin is delicately toothed and slightly excised near the middle. The common plateau has small lamellar costæ, broken up by dentations which are horizontal.

*Distribution.*—*Recent.* Caribbean Sea.

Genus *SCAPOPHYLLIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 386, pl. 8. fig. 8 (1857); *Ann. des Sci. Nat.* t. x. sér. 3 (1849).

Colony massive, tall, cylindro-conical, erect, dense. Corallites united by their walls. Valleys short, very flexuous and shallow, and their calicular centres distinct. Occasionally simple calices present. Columella small, deep. Septa few in number, exsert, very echinulate laterally, the larger enlarged towards the columella, where the dentitions are the longest. Interseptal loculi deep. Dissepiments simple and wide apart. Collines variable in length, costulated, broad.

*Distribution.*—*Recent.* Chinese seas, Japan.

### Tribe II.

Genus *PLEROGYRA*, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 468 (1848).

Syn. *Gyrosmlia*, Ed. & H.

The colony is composed of a series of long, thick, sinuous corallites, which unite more or less completely by their walls. The calicular centres are moderately distinct. There is no columella. The entire septa are exsert, large, distant, nearly smooth, and often folded a little. The interseptal loculi are broad, almost superficial, or deep, and are closed below by large vesicular dissepiments. The costæ project but little, and disappear under a great development of mural vesicular tissue. Epitheca absent or rudimentary.

The genus may be divided into three groups of species :—

1. Species in which the walls are incompletely soldered.
2. Species in which the walls are completely united.
3. Species with subcristiform costæ, a rudimentary epitheca, and endotheca deep down in the interseptal loculi.  
This group includes the species of *Gyrosmlia*, Ed. & H., 1857, which is therefore absorbed.

*Distribution.*—*Fossil.* Cretaceous; Europe.—*Recent.* Singapore, Banda, East Indies, Red Sea.

Genus *PHYSOGYRA*, *Quelch, Ann. & Mag. Nat. Hist.* 1884, xiii. p. 293.

Corallum compound, form massive, of very light structure, having the calicles in long, sinuous, more or less meandroid

series, with their walls fused throughout, so as to form a simple, very thin line of separation between the series. Calicinal centres generally distinct, indicated by the curving of the septa. Costæ almost entirely absent. Epitheca very slightly developed. Septa thin, fragile, very prominent, distant, edge entire. Columella absent. Endotheca well developed, vesicular; the dissepiments continuous between the septa from the centre of the calicle to the wall, very convex above, rather far apart above each other, thus forming wide interseptal chambers. Owing to this great development of vesicular endotheca, the series of calicinal centres are separated by wide ridges formed entirely by the thin wall and by the convex dissepiments which stretch from the centre to this thin wall.

*Distribution.*—*Recent.* Banda.

Genus PHYTOGYRA, *d'Orbigny, Note sur les Polyp. foss.* p. 6 (1849);  
*Cours Élément. de Pal.* t. ii. p. 163, fig. 301 (1852).

Colony formed of rather thick, low, horizontal branches, free at the sides and below, composed of series of short corallites, whose calicinal centres are indistinct, and whose wall is naked and costulate. The columella is lamellar and continuous. The septa are entire and unequal, large. Increase by fissiparity.

*Distribution.*—*Fossil.* Jurassic: Europe.

D'Orbigny considers this genus to be a *Plerogyra* from its large alternate septa, but it has a lamellar columella. The figure given by him shows a trifurcate branch.

#### IV. Alliance MONTICULOIDA.

Astræidæ with fissiparous and serial corallites, united by their walls, which form prominent collines radiating more or less, or monticules marked by costæ.

Genus ASPIDISCUS, Kœnig.

Genus HYDNOPHORA, Ed. & H.

Genus MONTICULASTRÆA, Duncan.

Genus ASPIDISCUS, *Kœnig*, 1825; *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 386 (1857), *amended.*

Colony subhemispherical, free. Under surface concave, and marked by a well-developed concentrically folded epitheca. Series of corallites radiating from a short, straight, polar colline to above the margin of the base; some series long, others between them

shorter. Corallites united by their walls, which form superficial, convex, radiating collines, with the septo-costæ on their flanks, and crossing over the top, which is a semiridge. Septa denticulate, not in distinct cycles, close, small, moderately unequal. Calices indistinct. Columella absent. Costæ bound the margin of the base superiorly, being directed radially.

*Distribution.*—*Fossil.* Cretaceous: North Africa, Europe?

Genus HYDNOPHORA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 419 (1857).

Colony massive and largely adherent. Corallites in series, united by their walls; their surface-ridges are simple, stout, compact, and their continuity is frequently, and often regularly, interrupted, giving an appearance of monticules separated by longitudinal and transverse valleys. Monticules marked with prominent costæ. Calicinal centres indistinct. Columella absent. Septa barely exsert, thin, rather close, denticulated, meeting those of the opposite side of the series at their inner end, which is slightly enlarged and bifurcate. Dentations strongest near the axis of the valleys. Interseptal loculi rather deep. Endotheca simple, nearly transverse.

*Distribution.*—*Fossil.* Cretaceous, Eocene, and Miocene: Europe. Eocene, Miocene: Asia.—*Recent.* Red Sea, Indian Ocean, Pacific.

Genus MONTICULASTRÆA, *Duncan, Fossil Corals and Alcyonaria of Sind, Pal. Ind.* Ser. xiv. p. 87 (1880).

Colony massive or foliated, sometimes pedunculate, irregular at its upper surface, and the base is covered with crowded radiating costæ. Collines small, short or long, often very irregular and costulate. Columella continuous around the collines, lamellar, separating the septal ends. Endotheca highly developed.

*Distribution.*—*Fossil.* Miocene: Sind, Asia.

#### 6. Subfamily *Astræidæ agglomeratæ fissiparantes.*

*Faviaceæ* (pars), *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 426 (1857).

*Astræidæ* forming massive or incrusting colonies. Corallites increasing by fissiparity, and sometimes by gemmation also, united by costæ or cœenchyma, or both, or by the walls only, not forming long series, or non-serial.

Milne-Edwards and Jules Haime formed a subgroup of compound or colonial corals, which they placed between the *Astræidæ* which multiply by successive fissiparity and those which increase by gemmation only, the corallites in both instances being united by their walls or by intermediate structures. This group, the *Faviaceæ*, has genera the individuals of whose species increase by fissiparous division, and do not form series or have meandroid calices, but grow upwards independently so soon as to give the appearance of budding having taken place. The septa are always dentated and not entire. Now this group has greater affinities with the fissiparous *Astræidæ* than with those which increase by budding, and, moreover, a critical examination of its genera shows that it is not homogeneous.

The genus *Mæandrastræa*, d'Orb., clearly belongs to the alliance in which *Cæloria*, *Mæandrina*, and *Leptoria* are placed, and it has been noticed therein.

The genus *Favia*, Oken, with its intermural cœnenchyma and fissiparous and almost serial calices, is an ally of *Dichocœnia*, the distinction of the septal-edge structure being insufficient to separate the genera into subfamilies.

On the other hand, *Goniastrea*, *Septastrea*, and *Aphrastræa* should form an alliance, and be placed amongst the fissiparous *Astræidæ*.

Eighteen genera are recorded, but only thirteen remain after revision.

*Alliances* :—Favioida, Goniastreaïda.

#### I. Alliance FAVIOIDA.

Massive fissiparous *Astræidæ*. Corallites united by costæ and cœnenchyma. Calices projecting but slightly or not at all above the common surface. Series very short, or only due to imperfect separation of the fissiparity. Septa entire or not.

Tribe I. Septa entire.

„ II. Septa dentated.

- I. Genus *DICHOCŒNIA*, Ed. & H.
- Genus *BARYSMILIA*, Ed. & H.
- Genus *STENOSMILIA*, E. de From.
- II. Genus *FAVIA*, Oken.
- Genus *FAVOIDEA*, Reuss.
- Genus *BARYPHYLLIA*, E. de From.
- Genus *SPINELLIA*, D'Achiardi.

Genus PHYLLASTRÆA, E. de From.

Genus D'ACHIARDIA, Duncan.

Genera absorbed :—

FISCICELLA, Dana; OVALASTRÆA, d'Orb.; ELLIPSO-CŒNIA, d'Orb.; THALAMOCŒNIA, d'Orb.; PARASTRÆA, Ed. & H.

### Tribe I.

Genus DICHOCŒNIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 199 (1857).

The colony is massive, pedunculate, hemispherical, lobed, or plane, and the large upper surface presents numerous low calices, some circular in outline, others united in short series. Columella small, sublamellar, or subpapillary. Septa well developed, entire, usually exsert. Pali before most of the septa. Costæ rather large, spinulose, and merging into the granular, dense, and highly developed intercalicular cœnenchyma, and they are seen to the base. Epitheca rudimentary. Endotheca exists. Increase by fissiparity and upward growth, accompanied by cœnenchymal development.

*Distribution.*—*Fossil.* Miocene : West Indies.—*Recent.* East and West Indies.

Genus BARYSMILIA, *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 468 (1848), *amended.*

The colony consists of a basal peduncle, or stout, tall trunk, on the top of which are variable numbers of corallites, separated by a cœnenchyma which consists of layers of mural and costal growth. Calices slightly projecting, free, in more or less transverse, straight, and parallel series; they are subelliptical in shape, and the long axis is perpendicular to the direction of the series. Columella rudimentary or absent. Septa close and slightly exsert, entire. Costæ visible from the base and largest near the calices. Epitheca absent. Endotheca present. Increase by fissiparity and upward growth.

*Distribution.*—*Fossil.* Cretaceous : Europe. Miocene : West Indies.

Genus STENOSMILIA, *E. de Fromentel, Pal. Franç., Terr. cré.* p. 383 (1870).

Colony massive, pedunculate, large, and convex above. Calices oval, often serial and unsymmetrical, distant, free to a slight

extent. Columella lamellary. Septa non-exsert, irregular, entire. Costæ visible near the calices and over the common wall of the peduncle. Peduncle growing by accumulation of layers of cœnenchyma, by which the corallites are separated. Endotheca exists. Increase by fissiparity.

*Distribution.*—*Fossil.* Cretaceous: Europe.

### Tribe II.

Genus *FAYIA*, Oken, *Lehrb. der Naturg.* t. i. p. 67 (1813), amended; Milne-Edwards & Jules Haime, *Hist. Nat. des Corall.* vol. ii. p. 426 (1857).

Syn. *Fiscicella*, Dana; *Ovalastræa*, d'Orb.; *Ellipsocœnia*, d'Orb.; *Thalamocœnia*, d'Orb.; *Parastræa*, Ed. & H.

Colony hemispherical, convex, lobed, rarely subplane, fixed, free or incrusting. Corallites united by their costæ and by a cellular exotheca. Calices variable in distance, with free margins, subcircular, oval, deformed in outline. The columella is spongy. The septa are exsert, cross the wall, and the septo-costæ unite with those of other calices, or are separated by a groove. The septa are dentate, and the inner teeth simulate pali. Endotheca well developed. Epitheca often exists. Increase by fissiparity, the resulting corallites soon becoming separate.

*Distribution.*—*Fossil.* Jurassic: Europe, England. Cretaceous: Europe, England. Eocene and Miocene: Europe.—*Recent.* Atlantic, Caribbean, Red Sea, Indian Ocean, Pacific, Australian seas.

Genus *FAVOIDEA*, Reuss, *Foss. Korall. von der Insel Java*, 'Novara' Expedition, p. 168.

Colony gibbous or flat on the free surface, massive. Calices rather distant and irregular in shape, shallow. Columella absent. Septa not numerous, unequal, spinulose, and usually thin; they extend beyond the calicular margin as costæ, and gradually merge into the cœnenchymal surface, not uniting with those of other calices. A cellular exotheca between the corallites. Endotheca exists. Increase by fissiparity of the corallites at the calices.

*Distribution.*—*Fossil.* Tertiary of Java; and Miocene, West Indies.

Genus *BARYPHYLLIA*, E. de Fromentel, *Introd. à l'étude des Polyp.* foss. p. 139 (1858-60).

Colony having a tall trunk, on the top of which the corallites

are free only for a small space. Wall naked, and covered with granular costæ. The trunk grows by the superposition of layers derived from the costæ of the corallites. Columella none. Septa slightly exsert, and regularly dentate.

*Distribution.*—*Fossil.* Jurassic and Cretaceous: Europe.

This genus corresponds to *Barysmilia*, but has dentate septa.

GENUS SPINELLIA, *d'Achiardi*, "*Corall. foss. dell' alpi Veneti*,"  
*Mem. della Soc. Italia di sci. nat.* tom. iv. no. 1, pt. 2, p. 16  
(Milan, 1868).

Colony in the form of a pedunculate lamina, attached, upper surface slightly convex. Corallites in long or short series, sometimes flexuous, not united by their walls above. Columella absent. Calicular centres distinct. Epitheca well developed. Intercorallite cœnenchyma developed and uniting the corallites.

*Distribution.*—*Fossil.* Eocene: Europe.

GENUS PHYLLASTRÆA (*non Dana*), *E. de Fromentel*, *Pal. Franç.*,  
*Terr. crét.* p. 483 (1879).

Colony tall, in the form of dendroid tufts. Corallites united together by a well-developed exotheca. Calices oval, often deformed by fissiparity. Columella lamellar and short. Septa large, in six cycles, and continued beyond the calices as short costæ, which lose themselves in a granular cœnenchyma, which fills the intercalicinal spaces.

*Distribution.*—*Fossil.* Cretaceous: Europe.

GENUS D'ACHIARDIA, *Duncan*, *Fossil Corals and Alcyonaria of*  
*Sind, Pal. Ind.* ser. xiv. p. 92 (1880).

Colony large, massive, cylindrical or lobate. Corallites separated by a dense cœnenchyma, which is granulate or semilamellar at the surface. Calices separate, circular or deformed, rising slightly above the cœnenchyma, shallow. Columella flat, variable in development, papillary or not. Septa alternately large and small, barely exsert, dentated. Pali small and before the large septa. Costæ rudimentary on the calices, not found over the cœnenchyma, but occasionally existing on the flanks of the colony. Cœnenchyma cellular, dense. Endotheca exists. Increase by extracalicular gemmation and sometimes by fissiparity.

*Distribution.*—*Fossil.* Miocene: Sind, Asia.

## II. Alliance GONIASTRÆOIDA.

Massive fissiparous Astræidæ. Corallites united by their walls, without cœnenchyma, not forming serial calices. Septa dentated.

Genus GONIASTRÆA, Ed. & H.

Genus LAMELLASTRÆA, Duncan.

Genus APHRASTRÆA, Ed. & H.

Genus SEPTASTRÆA, d'Orb.

Genus GONIASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 444 (1857).

Colony massive, convex or lobed, dense. Corallites prismatic, and intimately united by their walls, which are simple, compact, and thick. Calices polygonal, rather deep. Columella spongy. Septa rather exsert, denticulate. Pali before all the septa, except those of the last cycle, denticulate. Endotheca abundant. Common plateau covered by a thin and complete epitheca. Increase by fissiparity and also by gemmation.

*Distribution.*—*Fossil.* Cretaceous: Europe. Tertiary.—*Recent.* Red Sea, Indian Ocean, North-Australian seas, Pacific.

Genus LAMELLASTRÆA, *Duncan, Quarterly Journal of the Geological Society* ("Fossil Corals of the West-India Islands"), vol. xxiii. p. 19, pl. i. figs. 2 a, 2 b (1867).

Colony massive. Corallites united by their walls, and polygonal in transverse outline. Calices polygonal. Columella essential and lamellar, stout. Septa unequal, dentated. Pali absent. Endotheca scanty. Reproduction by fissiparity through the columella, a portion of it remaining as a large septum; also by marginal gemmation.

*Distribution.*—*Fossil.* Miocene: West Indies.

Genus APHRASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 451 (1857).

Colony convex and very light and cellular. Calices with simple margins, polygonal. Walls very thick, but entirely vesicular. Columella spongy. Septa exsert, dentate, with pali or paliform lobes before all the cycles of septa except the last. Endotheca vesicular and very developed. Increase by fissiparity. Common plateau with a complete epitheca.

*Distribution.*—*Recent.* Indian Ocean.

Genus SEPTASTRÆA, *d'Orbigny, Note sur les Polyp. foss. p. 9*  
(1849).

Colony massive, subplane, convex or subdendroid. Corallites united by their walls. Calices polygonal, and their margins soldered to those of their neighbours, forming simple ridges, or showing a delicate furrow of separation. Septa large. Columella rudimentary or absent. Pali absent. Fissiparity of calices.

*Distribution.* — *Fossil.* Lias : England, Europe. Eocene : Europe. Miocene : America, Europe.

## CHAPTER IV.

Subfamily ASTRÆIDÆ AGGLOMERATÆ GEMMANTES. Alliances. Genera.

### 7. Subfamily *Astræidæ agglomeratæ gemmantes.*

Syn. *Stylinaceæ agglomeratæ*, Ed. & H. ; *Astræaceæ*, Ed. & H. ; *Merulinaceæ*, Ed. & H. ; *Echinoporidæ* (pars), Ed. & H. : combined.

Massive and foliaceous colonies. Corallites increasing by gemmation from the wall, from within the calice, and from intercorallite tissue. Corallites joined by costæ, exotheca, or peritheca, or fused by their walls. Septa entire or dentated. Endotheca vesicular, rarely tabulate.

The Agglomerate Stylinæ of Milne-Edwards and Jules Haime (*op. cit.* vol. ii. p. 232) were separated from their Astræaceæ, or massive budding Astræidæ, because these last had dentate septa.

In joining these groups into a subfamily no violence is done. As a subfamily the genera collect very naturally into two groups of Alliances. In one the corallites are separate, by their walls being united by costæ, exotheca, or peritheca ; and in the other the walls are fused entirely, sometimes not joined at the calicular surface.

Alliance I. ORBICELLOIDA.

„ II. PLACOCENIOIDA.

„ III. STYLINOIDA.

„ IV. PHYLLOCENIOIDA.

„ V. CYATHOPHORIDA.

„ VI. PENTACENIOIDA.

„ VII. ELASMOCENIOIDA.

„ VIII. ECHINOPOROIDA.

Group-Genus GALAXEA, Oken.

„ LEPTASTRÆA, Ed. & H.

- Alliance IX. BARYASTRÆOIDA.  
 „ X. ASTROCCENIOIDA.  
 „ XI. ISASTRÆOIDA.  
 „ XII. LATIMÆANDROIDA.  
 Group-Genus MERULINA.  
 Alliance XIII. PLERASTRÆOIDA.  
 „ XIV. TABULOIDA.  
 Group-Genus MOSELEYA.  
 „ DICTYOPHYLLIA.

Sixty-eight genera are recorded, but revision admits of fifty-five only.

### I. Alliance ORBICELLOIDA.

Massive budding Astræidæ, with the corallites united by costæ, exotheca or intermediate tissue. Columella spongy or papillary. Septa dentated. With or without pali.

Genus HELIASTRÆA, Ed. & H.

Subgenus ULASTRÆA, Ed. & H.

Genus BRACHYPHYLLIA, Reuss.

Genus CYATHOMORPHA, Reuss.

Genus SOLENASTRÆA, Ed. & H.

Subgenus CYPHASTRÆA, Ed. & H.

Genus PHYMASTRÆA, Ed. & H.

Genus PLESIASTRÆA, Ed. & H.

Genus ANTILLASTRÆA, Duncan.

Genera *Ulastræa*, Ed. & H., and *Cyphastræa*, Ed. & H., become subgenera.

The genera AGATHIPHYLLIA, Reuss, and AMPHIASTRÆA, Etallon, are absorbed.

Genus HELIASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 456 (1857).

Colony of various shapes, convex, subspherical, subplane, short or tall, adherent, incrusting, or free. Corallites united by continuation of the exotheca, which exists between and beyond the costæ beneath the surface, rarely by the costæ themselves. Walls usually, but not invariably, stout. Calices with free circular margins, more or less crateriform and elevated. Columella well developed, spongy, and not projecting, with a plane free surface. Septa exsert or not, with well-developed laminæ, thicker near the margins than near the columella, where there is often a paliform tooth, dentate. Costæ well developed, passing over the surface for some distance; where seen on the wall of a corallite,

they are lamellar and well developed, often spiny. Endotheca well developed. Exotheca between and usually beyond the costæ, well developed. Epitheca may or may not exist. Gemmation inframarginal, and from the area between the calices.

*Distribution.*—*Fossil.* Oolitic, Cretaceous, Eocene: Europe, India, Borneo. Miocene, Pliocene: Europe, Asia, West Indies. —*Recent.* Red Sea, Indian Ocean, Pacific, Caribbean Sea.

Subgenus *ULASTRÆA*, (genus) *Milne-Edwards & Jules Haime*, *Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. x. pl. 9. fig. 4, et t. xii. p. 116 (1850).

This genus has but one species, which has all the characters of *Heliastrea*, and its septa and costæ are exceedingly echinulate. The species is *Orbicella crispata*, Dana, = *Ulastræa crispata*, Ed. & H., and these are now the synonyms of *Heliastrea crispata*, Dana, sp. The species is recent, and from the Indian Ocean.

Genus *BRACHYPHYLLIA*, *Reuss*, *Denksch. der Wien. Akad. der Wiss.* t. vii. p. 103 (1854); *M.-Ed. & Jules Haime*, *Hist. Nat. des Corall.* t. ii. p. 479 (1857).

Colony massive, short, convex, or subplane, fixed by a large base. Corallites large, united by their well-developed costæ. Calices projecting above a common surface, which is formed of much exotheca; and the costæ, large, separate, shallow, circular in outline. Columella well developed and spongy, or small and papillary where free. Septa numerous and regularly crenulated. Costæ well developed, crenulated, confluent. Endotheca and exotheca well developed. Epitheca absent. Gemmation lateral and subbasilar, the colony increasing at its circumference.

*Distribution.*—*Fossil.* Cretaceous, Eocene: Europe. Miocene: West Indies, Trinidad.

Genus *CYATHOMORPHA*, *Reuss*, "*Pal. Stud. über die ält. tertiärsch. der Alpen*," *Denks. der K. Akad. der Wiss. Wien*, 1869, p. 243, and indefinitely, 1868, p. 14.

Syn. *Agathiphyllia*, *Reuss*.

Colony increasing by extracalicular budding, massive. Calices circular or broadly elliptical, projecting, well separated, margins rounded. Fossa large, shallow; columellary area circular and deeper than rest of fossula. Columella papillary, not projecting. Septa numerous, close; primaries and secondaries with an inner and outer paliform lobe; tertiaries with the same in a modified

degree. Costæ continuous with the septa, passing over the outer surface of the wall, rarely confluent. A marked depression between the corallites. Endotheca exists. Epitheca often in bands. The young colony consists of a few corallites comparatively without union, except by the base of the beds.

*Distribution.*—*Fossil.* Eocene: Europe.

This genus supersedes *Agathiphyllia*, Reuss.

Genus PHYMASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 499 (1857), amended; *Duncan, Proc. Zool. Soc.* 1883, p. 408 (June 19).

Syn. *Amphiastræa*, Etallon.

Colony massive, tall or very short, with a convex or plane free surface. Corallites more or less prismatic, increase by extracalicular gemmation, and are joined together by short growths from costæ or from the wall, which are placed with some regularity in vertical series; elsewhere they are separate. An epitheca exists, which may environ the growths. Calices separate, unsymmetrical. Columella present. Septa variable in number, dentated. Costæ may or may not be apparent.

*Distribution.*—*Fossil.* Jura: Europe.—*Recent.* Indian Ocean; Mergui.

M. Etallon described the genus *Amphiastræa* in 1858, and M. de Fromental introduced it in his 'Introd. à l'étude des Polyp. foss. ;' but neither had studied the recent fauna; had they done so they would have found their fossil form to be of the same genus as *Phymastræa*, Ed. & H., 1848. *Amphiastræa* is absorbed.

Klunzinger, in his excellent work on the Corals of the Red Sea, unites the genera *Cyphastræa* and *Solenastræa* of Milne-Edwards and Jules Haime. *Cyphastræa*, Ed. & H., has all the characters of *Solenastræa*, and in addition the septal laminæ are perforate, trabeculate, and cribriform, except close to the wall, where they are solid. Some modern *Solenastræans* have this character, and hence the proposed union. The fossil *Cyphastræa costata*, nobis, of the West-Indian Miocene has exceedingly cribriform septa, so that the distinction is not modern. The character has nothing to do with fossilization or with wearing, and it is general over the whole of the corallites of the species. But some fossil *Solenastræans* have solid, non-cribriform septa. There is not a generic distinction between the two forms; but *Cyphastræa*, which is more recent than *Solenastræa*, had better become a subgenus.

Genus SOLENASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 495 (1857), *altered*.

Colony massive but light, convex above, incrusting or tall, often gibbous, rarely plane. Corallites long or short, united by a well-developed exotheca, which extends beyond the small costæ. Calices with free margins, which are usually circular, but sometimes unsymmetrical in outline. Columella spongy or feebly developed. Septa thin or stout, imperforate, dentate. Endotheca fairly developed. Gemmation extracalicular.

*Distribution*.—*Fossil*. Eocene: Europe, Borneo. Oligocene: England. Miocene: Europe and West Indies. Crag: England (?).—*Subfossil*. Red Sea.—*Recent*. Red Sea, Indian Ocean, Singapore, Caribbean Sea.

Subgenus CYPHASTRÆA, (genus) *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 484 (1857).

The generic characters are as in *Solenastræa*, but the septa are cribriform.

All so-called Solenastræans with cribriform septa must enter this subgenus, and all the recorded species of the genus, according to Milne-Edwards and Jules Haime.

*Distribution*.—*Fossil*. Miocene: West Indies.—*Recent*. Red Sea, Caribbean Sea, Pacific, Australian seas.

Genus PLESIASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 489, pl. D 7. fig. 5 (1857).

Colony variable in shape, massive, convex or subplane above, with a naked and costulate common wall. The corallites may have thick or thin walls, be close or distant, and in the first instance may fuse inferiorly, and in the last may have a feeble exotheca between them. Calices shallow, circular and free. Columella spongy. Septa well developed, exsert, denticulate near the calicular edge. Pali well developed and in contact with all the septa which precede those of the last cycle. Endotheca very feebly developed. Costæ and exotheca usually well developed. Epitheca absent. Gemmation occurs in the intercalicular areas.

*Distribution*. — *Fossil*. Eocene: India (Sind). Miocene: Europe, Sind, Asia.—*Recent*. Pacific, North-Australian seas, Indian Ocean, Caribbean Sea.

In the Tertiary deposits of San Domingo are several species of *Plesiastræa*-looking corals (Duncan, "West-Indian Corals," Proc. Geol. Soc., Nov. 1863, p. 37 *et seq.* and pls. iv. & v.). There are

the usual attributes of *Plesiastræa* present, but the exotheca is in excess and there is an epitheca. The columella is papillary and more concentrated than is shown in the drawing (pl. iv. figs. 4a & 5).

This group includes *Plesiastræa distans*, *P. globosa*, and *P. ranea*, nobis.

Another species, *Plesiastræa spongiformis*, Duncan, *op. cit.* p. 39, pl. iv. figs. 6a, 6b, requires a new generic environment.

#### Genus ANTILLASTRÆA, gen. nov.

Colony very convex above, pedunculate and attached. Calices close, barely projecting; fossula shallow. Columella cylindrical and flattened in young, styliform in old calices. Septa subequal, few, well developed. Pali before all cycles except the last. Costæ subequal, projecting, ending in exotheca, which is cellular and well developed. Endotheca scanty. Epitheca rudimentary.

*Distribution.*—*Fossil.* Miocene: San Domingo.

## II. Alliance PLACOCENIOIDA.

Massive budding *Astræidæ*, with corallites united by costæ or by exotheca. Septa entire. Columella lamellary, or a septum reaches the axial space.

Genus PLACOCENIA, d'Orb.

Genus PLACOPHORA, E. de From.

Genus PLEUROSTYLINA, E. de From.

Genus PLACOCENIA, d'Orbigny, *Note sur les Polyp. foss.* p. 7 (1849); *Goldfuss, Petr. Germ.* pl. 24. fig. 2.

Colony massive. Calices large, circular, or oval, rather distant, united by costæ. Columella lamellar and well developed, or in three papillæ. Septa entire, unequal, of the decamerall or of hexamerall type. Costæ thick and well developed, cristiform or granular. Gemmation between the calices.

*Distribution.*—*Fossil.* Oolite and Cretaceous: Europe.

Genus PLACOPHORA, E. de Fromentel, *Pal. Franç., Zooph. Terr. cré.* p. 495 (1879).

Colony expanded, with a subplane surface formed by close laminae, slightly granular on the surface, on which the calices are free to a slight extent. Calices round or slightly oval, distant (5–8 mm.). Columella large, lamellar. Septa well developed

and slightly undulating (entire ?). There are 36 septa, unequal according to cycles.

*Distribution.*—*Fossil.* Cretaceous : Europe.

Genus PLEUROSTYLINA, *E. de Fromentel, Introd. à l'étude des Polyp. foss.* p. 201 (1858–61).

Colony in a convex mass or in extended laminæ. Calices circular or polygonal in places. Septa entire, few ; one large septum reaches the centre of the calice and swells there, after the fashion of a columella. Corallites united by their walls or by epitheca, which covers the walls. Common plateau naked and costulate, or presenting a slightly developed epitheca.

*Distribution.*—*Fossil.* Oolite : Europe.

There is much that is unsatisfactory about this genus. The epitheca uniting the corallites and not covering the “plateau commun” is difficult to understand. Perhaps the author of the genus meant exotheca uniting the corallites.

### III. Alliance STYLINOIDA.

Massive budding Astræidæ, with corallites united by their costæ or by exotheca. Columella styliform. Septa entire and dentated. Pali may be present or not.

#### Tribe I. With entire septa.

Genus STYLINA, Lmk.

Genus PSAMMOCÆNIA, Ed. & H.

#### Tribe II. With dentate septa.

Genus COLUMNASTRÆA, Ed. & H.

Genus STYLASTRÆA, E. de From.

HELIOCÆNIA, Etallon, appears to be a subgenus of *Stylina*.

#### Tribe I.

Genus STYLINA, *Lamarck*, 1816 ; *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 233, amended.

Colony in the form of subplane, convex, gibbous masses, or dendroid. The corallites are united by their costæ and well-developed exotheca, or only here and there, and terminate at the free surface in little conical elevations more or less projecting. The calices on these elevations are for the most part circular, free at their margins, and usually distant. The columella is styliform and projects. The septa are exsert, well developed,

and numerous or few. Occasionally some primaries are larger than others. Cycles hexamerous, or octamerous, or decamerous. The walls are thick. Costæ well developed. The endothecal dissepiments are simple or subvesicular. Gemmation is from the wall outside of the calice and from the intercalicular space.

*Distribution.*—*Fossil.* Trias: Europe. Oolite: England and Europe. Cretaceous: Europe.

*Heliocœnia*, Etallon (genus), appears to differ from *Stylina* in having costæ which do not extend far from the calicular margins. The columella is sometimes a little compressed. These are hardly generic distinctions, and I propose to consider *Heliocœnia* as a subgenus.

Genus PSAMMOCœNIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 285 (1857).

Colony massive. Corallites separated by exotheca. Calices unequally close and irregularly projecting, small. Columella styliform. Septa divided into six simple systems and there are six pali. Intercalicular area granular, and hardly striated with costæ.

*Distribution.*—*Fossil.* Ligsdorf (Haut Rhin), Europe.

## Tribe II.

Genus COLUMNASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 262 (1857). Illustrated by Reuss, *Denkschr. der Wien. Akad. der Wiss.* t. vii. pl. 14. figs. 1 & 2 (1854), and Duncan, "West-Indian Corals," *Proc. Geol. Soc.*, Dec. 1867, pl. v. figs. 1 a & 1 b (by error the word "stoniform" was printed for "styliform," p. 18).

Colony massive, convex, lobed, or subdendroid. Corallites united by costæ. The calices are moderately deep, circular, and projecting, and have their margins free. The columella is styliform and not much developed. The septa are thin, arched where free, denticulate. There are pali which form a single crown. The costæ are well developed. The gemmation occurs from the intercorallite tissue.

*Distribution.*—*Fossil.* Cretaceous: Europe. Eocene: West Indies. Pliocene: Europe.

E. Pratz has shown that the septa of the species of this genus are not entire at the free edge.

The following genus is not satisfactory in the face of the possibility of *Stylina* having dentate septa:—

Genus *STYLASTRÆA*, *E. de Fromentel, Introd. à l'étude des Polyp. foss.* p. 223 (1858–61).

Colony convex, massive. Corallites circular in outline and united by a considerable development of the costæ. Calices projecting, circular. Columella round, styliform, and well developed. Septa strongly and regularly dentated. Costæ well developed, and pass towards those of the neighbouring calices without being actually confluent. Gemmation between the calices.

*Distribution.*—*Fossil.* Cretaceous: Europe.

#### IV. Alliance PHYLLOCÆNIOIDA.

Massive budding *Astræidæ*. Corallites united by their costæ, with or without the intervention of exotheca. Columella absent. Endotheca vesicular or tabulate.

Tribe I. With entire septa.

Genus *PHYLLOCÆNIA*, Ed. & H.

Genus *CONVEXASTRÆA*, d'Orb.

Tribe II. With dentate septa.

Genus *ADELASTRÆA*, Reuss = *CONFUSASTRÆA*, Ed. & H.

#### Tribe I.

Genus *PHYLLOCÆNIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 272, 1857 (*non Laube*), amended.

Colony convex, subspherical, with a large base, or pedunculate, or subplane. Corallites costulate and united by much exotheca, parallel or divergent. Calices circular or deformed, free at the margins, and projecting. Columella absent or rudimentary. Septa large, entire, exsert, and well developed. Costæ well developed, prominent, uniting calices. Endotheca abundant and often vesicular. Gemmation occurs between the calices.

*Distribution.*—*Fossil.* Cretaceous: Europe. Eocene: Europe, Sind in Asia. Miocene: San Domingo.

The form described by Laube from St. Cassian is not of this genus. This is proved by the magnified view of the section. There is a double wall to the calice, one marginal and the other beyond. Neither is the form a species of *Cyathocœnia*, Duncan. It comes within the Elasmocœnioid alliance (see p. 115).

Genus CONVEXASTRÆA, *d'Orbigny, Note sur les Polyp. foss.* p. 9 (1849). Illustrated by Milne-Edwards & Jules Haime, *Brit. Foss. Corals*, Pal. Soc. pl. 23. figs. 5 & 6, and *Hist. Nat. des Corall.* vol. ii. p. 277 (1857).

Colony convex, gibbous, or dendroid. Corallites united by their well-developed costæ. The walls are cylindrical, and their calicinal margin is hidden by the septo-costæ, which are few in number, straight, exsert, and slightly granular. The septa are few in number, continuous with the costæ, and these last do not all reach from calice to calice, and there is often an intercalicular furrow. There is no columella.

*Distribution.*—*Fossil.* Trias: Europe. Oolite: England and Europe.

#### Tribe II.

Genus ADELASTRÆA, *Reuss, Denkschr. der Wien. Akad. der Wiss.* t. vii. p. 115 (1854), correcting the name *Confusastræa*, *d'Orb.*; and Milne-Edwards & Jules Haime, *Pol. foss. des Terr. pal.* p. 98 (1831).

Syn. *Confusastræa*, *d'Orb.*

Colony massive, with a plane or convex surface. Corallites intimately united by their costæ, which sometimes are confluent. Calices large and very slightly projecting, shallow, with margins rounded off, resembling circular bourrelets. Walls of calices rudimentary. Polygonal grooves between the calices indicating the junction of corallites. Septa well developed and uniting by their inner edges without the intervention of a columella.

*Distribution.*—*Fossil.* Trias: Europe. Oolite: Europe, England? Cretaceous: Europe.

The unclassical word *Confusastræa* was abolished by Reuss.

#### V. Alliance CYATHOPHOROIDA.

Massive Astræidæ, increasing by gemmation. Corallites separated by cœnenchyma or exotheca. Columella absent or present. Dissepiments or transverse tabulæ.

Genus CYATHOPHORA, Mich.

Genus AREACIS, Ed. & H.

Genus PSAMMOPHORA, E. de From.

Genus CYATHOPHORA, *Michelin, Icon. Zooph.* p. 104 (1843),  
*amended.*

Colony massive, convex. Corallites united by their costæ and

exotheca. Calices slightly projecting, circular, united by costæ. Columella absent. Septa unequal, but not numerous. Endothecal dissepiments stretching across the internal cavities of the corallites like tabulæ.

*Distribution.*—*Fossil.* Oolite: England, Europe. Cretaceous: Europe.

Genus AREACIS, *Milne-Edwards & Jules Haime, Comptes Rend. de l'Acad. des Sci. t. xxix. p. 70 (1849).*

Colony massive and Astræiform. Calices circular or deformed, separated by cœnenchyma. Cœnenchyma spongy and echinulate on the surface. Walls of corallites distinct from the surrounding cœnenchyma. Septa unequal, entire, principal uniting in the axis. No columella. Endotheca rudimentary, or as well-developed horizontal tabuliform processes.

*Distribution.*—*Fossil.* Eocene: Europe, Borneo.

Genus PSAMMOPHORA, *E. de Fromentel, Pal. Franç., Zooph. Terr. créét. p. 494 (1879).*

This genus was created for Stylophorinæ with a papillary columella, before such a thing was found. M. de Fromentel subsequently found a coral in the d'Orbigny museum which presented the characters of the Stylophorinæ and also a papillary columella.

The figures given (pl. 90. fig. 4) show a wretched specimen. However it has a compressed, thin, laminate form with calices on both sides. There are four cycles of septa and fine costæ. Calices wide apart.

It is not one of the Stylophorinæ, and I place it here with some doubt.

*Distribution.*—*Fossil.* Cretaceous: Europe.

#### VI. Alliance PENTACENIOIDA.

Agglomerate Astræidæ, increasing by gemmation. Corallites united by the costæ, more or less free above. Primary septa five in number.

Genus PENTACENIA, d'Orb.

Genus ACANTHOCENIA, d'Orb.

Genus PENTACENIA, *d'Orbigny, Rev. et Mag. de Zool. p. 175 (1850).*

Calices with their margins either subcircular and free, or poly-

gonal and united. Five principal septa. No columella. Calices from 1 to 2 millim. broad.

*Distribution.*—*Fossil.* Cretaceous (Neocomian): Europe.

Genus ACANTHOCÆNIA, *d'Orbigny, Rev. et Mag. de Zool.*  
p. 175 (1850).

Colony massive. Calices circular, with free margins and a styliform columella. Septa in three cycles, but there are only five primaries.

*Distribution.*—*Fossil.* Cretaceous (Neocomian): Europe.

#### VII. Alliance ELASMOCÆNIOIDA.

Agglomerate Astræidæ, increasing by gemmation between the calices. Corallites united by a second wall, with or without exothecal cœnenchyma.

Genus DIPLOCÆNIA, E. de From.

Genus DIPLOCÆNIASTRÆA, D'Achiardi.

Genus DIPLOTHECASTRÆA, Duncan.

Genus KOILOCÆNIA, Duncan.

Genus ANISOCÆNIA, Reuss.

Genus HETEROCÆNIA, Ed. & H.

Genus ELASMOCÆNIA, Ed. & H.

Genus DIPLOCÆNIA, *E. de Fromentel, Notes à l'étude des Polyp. foss.* p. 183 (1858-61); *Descrip. des Polyp. foss. de l'étage Néocom.* p. 39, pl. v. figs. 7, 8, 9 (1857).

Colony tall, or in a rounded mass. Corallites with two walls—one projecting and hidden by the septa, but indicated by a circular bourrelet; the other united to the walls of the neighbouring corallites separating the costæ, and variable in its outline. Columella styliform and strong. Septa entire, thick, and continuous with the costæ. Gemmation?

*Distribution.*—*Fossil.* Oolite and Neocomian: Europe.

Genus DIPLOCÆNIASTRÆA, *D'Achiardi, Coralli Giurassici dell'Italia Settent.* (Pisa, 1880).

Colony in thick laminae. Corallites immersed in the cœnenchyma, which is compact. Calices circular, filling up below. Columella small, spongy. Septa spinulose, straight, the larger joining the columella, continuous with costæ which occupy the outer calicular spaces, and merge into those of neighbouring calices. Gemmation peripheral.

*Distribution.*—*Fossil.* European Oolite.

D'Achiardi describes a single species from one specimen, which he considers the type of this genus, *Diplocœniastrœa*. He considers that this genus, by having denticulate septa and a spongy columella, differs from *Diplocœnia*. Unfortunately the internal structures of M. d'Achiardi's specimen are not visible, notwithstanding the perfection of the superficial septa, costæ, and columella. The form is described in 'Coralli Giurassici dell' Italia Settentrionale,' Pisa 1881, p. 41. I introduce the genus into the Alliance with a little doubt.

#### Genus DIPLOTHECASTRÆA.

Syn. *Diplocœnia* (non E. de Fromental), Duncan, West-Indian Corals, Quart. Journ. Geol. Soc. vol. xxiv. (1867), p. 20, pl. i. fig. 3.

The colony is massive. Corallites tall, crowded, polygonal, united by a well-developed common wall which projects at the calicular surface. Within the polygonal wall is a space occupied by cœnenchyma of oblique vesicular dissepiments, and within that an internal wall, whence arise the septa. This calicular wall is circular in transverse outline, wavy and thin. Columella lamellar, and often joined to one of the septa. Septa wide apart, unequal; cycles imperfect. Endotheca slight, within the inner wall. Gemmation occurs from the cœnenchymal space.

*Distribution*.—*Fossil*. Miocene: West Indies.

#### Genus KOILOCÆNIA, Duncan.

Syn. *Phyllocœnia*, Laube.

Colony convex or subplane above, massive, low. Corallites with an intermediate structure which is usually a second wall to each, and which may fuse with those of others. Here and there intermediate exotheca. Calices with well-developed costæ, which in section do not touch those of other calices. Septa well developed, but short. Axial space large, hollow, and without a columella.

*Distribution*.—*Fossil*. Trias (St. Cassian): Europe.

This genus is founded to receive *Phyllocœnia decipiens*, Laube. It is very well defined by the absence of columella, the short septa, and the double wall, as seen in sections. Mr. Tomes mistook the superficial view for *Cyathocœnia*, nobis, in a paper read before the Geological Society of London and not yet published.

Genus ANISOCÆNIA, *Reuss, Foss. Korallen von der Insel Java, 'Novara' Expedition, p. 166.*

Colony in stumpy or finger-shaped masses. Calices irregularly shaped and sized, surrounded by cœnenchyma, on which the margins are raised and often grooved. Columella none. Septa unequal, some very thick and others very thin, entire, non-exsert, feebly granular. Cœnenchyma cellular, apparently of exotheca forming the ends of feeble costæ. Endotheca well developed, oblique, and uniting the ends of the larger septa around the axial space. Gemmation extracalicular.

*Distribution.*—*Fossil.* Eocene: Java.

Genus HETEROCÆNIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 282 (1857). Illustrated by Reuss, *Denkschr. der Wien. Akad. der Wiss.* t. vii. pl. 10 (1854).

The colony is convex and gibbous, or dendroid. The corallites are united by an abundant cœnenchyma formed of mural expansions and exothecal dissepiments. The calices are distant, circular, and projecting. There is no columella. Septa exert and well developed; but there are never more than 12, and often only 6, and they are unequal, there appearing to be three simple systems of them.

*Distribution.*—*Fossil.* Cretaceous: Europe.

Genus ELASMOCÆNIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 279 (1857). Illustrated by Michelin, *Icon. Zooph.* pl. 51. fig. 3 (1845), as *Oculina explanata*.

Colony convex, more or less massive, or sublamellar. Corallites wide apart, and united by mural expansions which are granulated and feebly striated where free, and which are formed by layers of vesicular exotheca or cœnenchyma. The walls are thick; the septa are irregular and very granular. There is neither columella nor pali. Calices circular or subelliptical. Costæ feebly developed.

*Distribution.*—*Fossil.* Cretaceous: Europe.

#### VIII. Alliance ECHINOPOROIDA.

Massive, budding, rarely fissiparous Astræidæ, foliaceous. Corallites short, united by an echinulate cœnenchyma. Septa spinulose.

Genus ECHINOPORA (pars), Dana.

Genus ACANTHOPORA, Verrill.

Genus PHYSOPHYLLIA, Duncan.

Milne-Edwards and Jules Haime introduced a subfamily of Astræidæ to receive the genus *Echinopora*, Lamarck and Dana. Verrill has shown that this genus is not homogeneous, and that some species should be associated with the family Fungidæ, and one with the Astræidæ proper.

The following is the diagnosis of Dana as given by Milne-Edwards and Jules Haime, in whose work the early synonymy is given.

Genus ECHINOPORA (*pars*), Dana, *Wilkes Exploring Expedition, Zoophytes*, p. 278 (1846).

The colony is thin, adhering in the middle, and extending on all sides in foliaceous laminæ which are ordinarily lobed. The common plateau is costulate radially, and has a rudimentary epitheca. Corallites very short and greatly spined, united by an echinulate cœnenchyma. The calicular margins have the shape of circular and more or less projecting bourrelets. The free edges of the septa are very spined, the strongest teeth being near the columella, where they frequently simulate pali. Columella spongy. Endotheca slightly developed.

*Distribution*.—*Fossil*. Miocene: Sind, Asia.—*Recent*. Indian Ocean, Indo-Pacific, Red Sea.—*Subfossil*. Red Sea.

This diagnosis still holds good for some species which should, however, enter the Astræidæ.

But *Echinopora aspera*, Ellis & Solander, has been shown by Verrill to belong to the Fungidæ; and he has established the genus *Trachypora* for it. It appears that this name had been already applied to other forms before Verrill gave it; and Klunzinger suggests the name *Echinophyllia* instead. *Echinopora horrida*, Dana, which Milne-Edwards and Jules Haime state to be a dendroid variety of *Echinopora hirsutissima*, Ed. & H., 1850, has been made the type of the genus *Acanthopora*, Verrill, because its polyps differ from those of other *Echinopora*, and because the calices become filled up as in *Oculina*.

Genus ACANTHOPORA, Verrill, *Bull. Mus. Comp. Zool. Camb. Mass.* 1864, No. 3, p. 54.

Colony ramose, solid, the cells being filled as in *Oculina*. Costæ represented by series of spines.

This short diagnosis hardly suffices. The corallites are short, having the shape of large and strongly spined button-shaped prominences. Costæ very thick, subequal, separated by deep

spaces in which there may be small costæ. Very spinulose. Calicular fossa moderately deep. Columella subpapillary. Septa exsert, with the free edge very incised. Steroplasma filling much of the calice with age.

*Distribution.*—*Recent.* Indian Ocean.

#### Genus PHYSOPHYLLIA.

Colony large, spreading, pedunculate, foliaceous, folia united and presenting faint broad ridges, which are crossed by septo-costæ. Corallites low, wide apart, arranged more or less in concentric circles. Calices distant, large, sunken, deep, elongate, forming series of 2 to 4, or circular. Fossa large and deep. Columella small, trabeculate. Septa large, exsert, spinulose, especially near the axis, unequal, wide apart; ending in septo-costæ which are confluent with those of the calices on either side, and some of which pass over broad ridges radially. Intercalicular surface large, gibbous or ridged, formed of convex vesicular endotheca; this endotheca fills up the interseptal loculi also, and is greatly developed. Calices on one side of the colony only. Common wall inferior, costulate to the base. Costæ distinct, spinulose. No epitheca. Fissiparity occurs, and also gemmation.

*Distribution.*—*Recent.* Locality?

There is but one specimen in the British Museum of this genus, but it is a very marked form. The late Mr. Brüggemann gave the form a manuscript name, but did not describe it. The classificatory position is doubtful, but I place it here.

GROUP. Massive budding *Astræidæ*. Corallites united by peritheca.

Genus GALAXEA, *Oken* (1815); amended in *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 223 (1857).

Colony fasciculate and submassive. Corallites elongate, with stout walls marked with feeble costæ. Calices circular or deformed. Columella absent or rudimentary. Septa usually very exsert, lanceolate, often slightly granular on their sides, entire. Endotheca moderately abundant. A peritheca or vesicular intercorallite growth is abundant, and joins the corallites and their ends together. It reaches up to different distances from the calicular margin, so that the upper ends of the corallites project above. Gemmation subbasilar and from the wall.

*Distribution.*—*Recent.* Red Sea, Indian Ocean, Pacific.—*Subfossil* in raised beaches.

## Group-Genus LEPTASTRÆA.

Genus LEPTASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 493 (1857).

The colony is massive, or else incrusts, and is subplane or convex at the free surface. Corallites short, with very dense muro-costal structures, which become compact and fused. Calices with distinct margins, close, shallow. Columella papillary. Septa thin, close, exsert, margin subentire, granular; inner edge trabeculate, with ascending denticles. Costæ small, visible between the calices. Endotheca feeble. Gemmation extracalicular; sometimes fissiparity occurs.

*Distribution.*—*Recent.* Indian Ocean and Red Sea.

It appears that the incrusting species extends by a kind of stoloniferous gemmation.—*Duncan, Proc. Linn. Soc.* 1884.

## IX. Alliance BARYSASTRÆOIDA.

Agglomerate Astræidæ, increasing by marginal and submarginal (within the calice) gemmation. Walls fused, but thick, and often subcellular. Septa denticulate.

Genus BARYSASTRÆA, Ed. & H.

Genus ACANTHASTRÆA, Ed. & H.

Genus BARYSASTRÆA, *Milne-Edwards and Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 312, pl. D 8. fig. 2 (1857).

The colony is convex or subgibbous, very dense and compact. The corallites are united by their very thick and solid walls. Calices shallow, close, small, polygonal, and barely separated by shallow grooves. Columella subpapillary above, compact and large low down. Septa very thick, close, and not much toothed. Endotheca slightly developed. Internal cavity gradually filling up inferiorly. Gemmation submarginal.

*Distribution.*—*Recent.* Locality?

Genus ACANTHASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 501, pl. D 6. fig. 1 (1857).

The colony is in the shape of a subplane or convex mass. The corallites, short or tall and broad, are united by their walls which are subcellular. Calices subpolygonal, with broad spinous margins, with or without irregular superficial grooves. Columella parietal or rudimentary. Septa exsert, stout, and much spined, the largest of the spines being the most external. The upper part of the lamina is trabeculate below the spinous teeth. Endo-

theca greatly developed. Epitheca complete. Gemmation sub-marginal and marginal.

*Distribution.*—*Subfossil.* Red Sea.—*Recent.* Red Sea, Indian Ocean, Pacific.

#### X. Alliance ASTROCÆNIOIDA.

Agglomerate Astræidæ, increasing by extracalicular, marginal, and lateral gemmation. Columella variable. Pali may or may not exist. Corallites united by their walls, with sometimes a cœnenchymal development. Septa denticulate or entire.

Tribe I. With denticulate septa.

Genus ASTROCÆNIA, Ed. & H.

Genus CYATHOCÆNIA, Duncan.

Genus STEPHANOCÆNIA, Ed. & H.

Genus NARCISSASTRÆA, E. Pratz.

Tribe II. With entire septa.

Genus STYLOCÆNIA, Ed. & H.

Genus HALDONIA, Duncan.

Genera absorbed :—CÆNASTRÆA, Etallon; STEPHANASTRÆA, Etallon.

Genus described and not placed :—BATHYCÆNIA, Tomes, probably = STYLOCÆNIA.

#### Tribe I.

Genus ASTROCÆNIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 254, amended.

Syn. *Cænastræa*, Etallon (1864).

Colony variable in shape, massive, gibbous, lamellar, dendroid or discoid, compact, sometimes incrusting. Corallites prismatic or cylindrical, uniting by their walls, which are thick and simple; cœnenchyma rare between them. The calices are polygonal, irregular or regular in shape and size, and their margins are ordinarily simple. The columella is styliform and more or less projecting. The septa are dentated minutely, few in number, and often irregular in their cyclical arrangement. Gemmation marginal and lateral, or marginal and circumferential only.

*Distribution.*—*Fossil.* Trias: Europe. Infra-Lias: England and Europe. Lias, Oolite: Europe, England? Cretaceous, Eocene: England and Europe, Asia. Eocene: Borneo. Miocene: Europe, West Indies; Sind, Asia.—*Recent.* Caribbean Sea.

Genus CYATHOCÆNIA, *Duncan, Brit. Foss. Corals (Zone of Amm. angulatus), Pal. Soc. Lond.* 1867, pt. iv. no. 1, p. 27.

Colony fasciculate or gibbous, or incrusting. Corallites

united by their walls and by more or less cœnenchyma, polygonal, and often cylindrical. Calices small. Columella absent. Septa finely dentate. Costæ not confluent. Gemmation superior and marginal.

*Distribution.*—*Fossil.* Infra-Lias: England.

The presence of structure between the walls is decided; but it is very slight, and not sufficient, considering the other characters, to remove the genus out of this Alliance. The nature of the calicinal walls and the irregular septal distribution of the genera *Aplocœnia* and *Pentacœnia* distinguish them from the above. The genus is distinct from *Koilocœnia*.

Genus STEPHANOCŒNIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 264 (1857).

Syn. *Stephanustrœa*, Etallon, 1864.

Colony massive, convex, lobed, or pedunculate, or incrusting or dendroid. Corallites united by their walls, which are compact and thick. Calices generally polygonal, with simple margins. The columella is styliform and slightly projecting, but always well developed. The septa are slightly exsert, denticulate slightly, well developed, granular at the sides. There are pali before all the septa except those of the last cycle. Gemmation marginal and lateral.

*Distribution.*—*Fossil.* Jurassic: Europe. Cretaceous: Europe and England. Eocene: Europe. Eocene and Miocene: Sind, Asia, West Indies.—*Recent.* Locality?

Genus NARCISSASTRÆA, *E. Pratz, Eocene Korallen aus der Libyschen Wüste und Aegypten* (1883), p. 228.

Colony massive, composed of long, polygonal corallites united by their walls, without costæ and cœnenchyma. Calices more or less deep. Septa toothed. Pali in one crown. Columella? Dissepiments abundant.

*Distribution.*—*Fossil.* Eocene: N.E. Africa.

The genus will be better understood when other types of it are found. It is allied to *Stephanocœnia*.

## Tribe II.

Genus HALDONIA, *Duncan, Quart. Journ. Geol. Soc.* vol. xxxv. (1879), p. 91.

Colony massive, incrusting, convex above. Corallites united by their walls. Calices small, circular in outline, raised, deep, and widely open, separated by a slight depression. Columella

absent. Septa unequal, slender, not exsert, low vertically, entire. Pali just within the primaries, small, distinct, narrow, granular, ridged. Costæ well developed, and do not unite with those of other calices. Endotheca abundant, closing the calicular fossa as if by tabulæ.

*Distribution.*—*Fossil.* Cretaceous: England.

GENUS *STYLOCŒNIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 250, amended. (See Pal. Indica, ser. xiv. Corals of Sind, for illustrations.)

The colony is in the form of a thick lamina with the base covered with a well-developed epitheca. The corallites are united by their walls, which are thin and prismatic. The calices are polygonal, with simple margins. The columella is styliform and projecting. The septa are thin, not numerous. At some of the angles where calices join, there are erect columns, narrow-grooved and various in height according to the species. In perfect forms these columns are either pointed at the top, or bear an aborted calice, the groovings and intermediate ridges being the intercostal spaces and costæ. Gemmation marginal.

*Distribution.*—*Fossil.* Oolite: England. Eocene: England, Europe, Sind in Asia, West Indies. Miocene: Europe.

Mr. Tomes has described two species of a genus which he has diagnosed and named *Bathycœnia*. The habit of the forms is that of *Stylocœnia*; and the nodular elevations between the calices are clearly in relation to gemmation. The descriptions and figures of the Stylocœnians from Sind, Pal. Indica, ser. xiv. ('Fossil Corals and Alcyonaria from Sind,' 1882), were doubtless unknown to Mr. Tomes. The worn condition of the calices of the *Bathycœniæ*, which are very rare corals, is evident; but the columella, although ragged in transverse outline, may have been styliform.

I mention the genus, but do not place it definitely.

GENUS *BATHYCŒNIA*, *Tomes, Quart. Journ. Geol. Soc.* 1883, p. 176.

Colony turbinate, attached. Corallites united intimately by their walls. Investing common wall costulated, and has epitheca. Calicular surface convex. Calices more or less pentagonal, or rounded and deep. Septa entire, thin, project but little into the calice, rise in obtuse points where they meet those of other calices on the wall. Primaries meet to form a ragged columella. Calicular angles with obtuse points. Gemmation at obtuse points.

*Distribution.*—*Fossil.* Oolite: England.

## XI. Alliance ISASTRÆOIDA.

Agglomerate Astræidæ, increasing by gemmation within the calice Walls of corallites fused. Occasionally the fusion is deficient near the calice or low down. Septa denticulate or entire.

## Tribe I. Septa denticulate.

Genus ISASTRÆA, Ed. & H.

Genus PRIONASTRÆA, Ed. & H.

Genus PLACASTRÆA, Stol.

Genus ELYSASTRÆA, Laube.

Genus LEPIDOPHYLLIA, Duncan.

## Tribe II. With entire septa.

Genus APLOCENIA, Ed. & H.

Genus absorbed :—

METASTRÆA, Ed. & H.

## Tribe I.

Genus ISASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 526 (1857).

Colony massive, convex, gibbous, subdendroid or incrusting. Corallites prismatic, and intimately united by their walls, which are simple throughout. The calices have a polygonal outline, which is simple and ridge-like. The columella is rudimentary or absent. The septa are thin, close, granular, denticulate. Endotheca fairly well developed. The common base is marked with fascicles of costæ, and has a thin epitheca. Gemmation calicinal and submarginal. Occasionally the calicular walls are slightly apart near the calice.

*Distribution.*—*Fossil.* Trias: Europe. Infra-Lias, Lias, Oolites: England and Europe. Cretaceous: England, Europe, India. Eocene: Europe, India (Sind). Miocene: West-India Islands.

Genus PRIONASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 513, pl. D 8. fig 1 (1857).

Syn. *Metastræa*, Ed. & H.

Colony large, massive, convex, with or without ascending lobes, subplane, hemispherical, gibbous. Corallites close, prismatic; their walls are united above but usually not below. Calices polygonal and deep, or not large; margins simple or in crests. Columella spongy, variable in development. Septa thin, narrow above, close, granular, and very finely serrate, the longest teeth

being near the columella. Endotheca well developed. Epitheca thin and complete.

*Distribution.*—*Fossil.* Oligocene: India (Sind). Miocene: Europe.—*Recent.* Indian Ocean, Red Sea, Pacific, Australian seas, West Indies.

The genus *Metastræa*, Milne-Edwards and Jules Haime, Hist. Nat. des Corall. vol. ii. p. 525, cannot be considered in the light of a genus when contrasted with *Prionastræa*. The only distinction is one of growth, and in *Metastræa* the walls are compact in their whole height. This compactness is seen in portions of species of *Prionastræa*.

*Metastræa* is absorbed in *Prionastræa*.

GENUS PLACASTRÆA, *Stoliczka, Cretaceous Corals of Southern India, Palæontographica Indica*, vol. iv. (4) 1873, p. 33, pl. vii. fig. 1.

Colony massive, convex. Corallites united by their walls, which are fused. Calices irregularly disposed, close, polygonal, separated by ridges. Columella lamellar, solid, with a finely granulated upper edge. Septa numerous, close, finely denticulate and granular, confluent over the narrow calicular wall.

*Distribution.*—*Fossil.* Cretaceous of Southern India.

This genus resembles *Isastræa*, but there is the addition of a lamellar columella. The method of increase is not given by Stoliczka; but it certainly was not fissiparous, as in *Lamellastræa*, Duncan.

GENUS ELYSASTRÆA, *Laube, "Faune der Schicht. von St. Cassian," Denks. der Kais. Akad. der Wiss. Wien*, 1864, Bd. xxiv. p. 261.

Colony cæspitose, subplane above, composed of corallites springing from a base of greater or less width, united by their walls or by costæ to a certain extent high up. Calices irregular in shape, usually united to their neighbours by a broad surface. Columella rudimentary or spongy. Septa unequal, flexuous, serrate. Endotheca abundant. Gemmation within the calices. Epitheca exists.

*Distribution.*—*Fossil.* St. Cassian deposits: Europe. Infra-Lias: England.

Genus *LEPIDOPHYLLIA*, *Duncan, Brit. Foss. Corals, Pal. Soc.*  
pt. iv. no. 2, p. 53 (1868).

Colony flat or tall, with corallites overlapping but joined by their walls. Calices more or less circular and deformed, widely open. Columella absent. Septa dentate. Gemmation in the centre of the calices. Epitheca distinct. Endotheca present.

*Distribution.*—*Fossil.* Jurassic: England.

#### Tribe II.

Genus *APLOCÆNIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 281, pl. D 3. fig. 1 (1857), *more defined.*

Colony thin, with a convex surface. Corallites united by their walls, and prismatic. Calicinal walls very thin, and in zigzags. Calices superficial, unequal, large. Axial space empty and small. Septa thick, unequal, straight, smaller internally, entire; systems irregular.

*Distribution.*—*Fossil.* Eocene: Europe.

### XII. Alliance LATIMÆANDROIDA.

Agglomerate *Astræidæ*, increasing by calicular gemmation. Calices single or multiple, in valleys. Corallites united by their walls completely or incompletely at the surface. Septa denticulate. Endotheca present.

Genus *LATIMÆANDRA*, Ed. & H.

Genus *HETEROGYRA*, Reuss.

Genera absorbed:—*CHORISASTRÆA*, E. de From.; *MICROPHYLLIA*, d'Orb.; *CORMOPHYLLIA*, d'Orb.

Genus *LATIMÆANDRA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 543 (1857).

Syn. *Microphyllia*, d'Orb.; *Cormophyllia*, d'Orb.; *Chorisastræa*, E. de From.

Colony massive, variable, convex, with a broad or narrow base, or pedunculate or subturbinate, subplane, or subdendroid. Corallites united by their walls, fusion not always perfect. Calices some circumscribed, others in short series with their centres distinct. Columella rudimentary. Septa numerous, thin, close, laterally granulate; dentations fine and subequal. Common wall costulate, without epitheca. Endotheca scanty. Gemmation calicinal and submarginal.

*Distribution.*—*Fossil.* Trias, Jurassic: Europe and England. Cretaceous, Eocene: Europe. Eocene: Sind, Asia, and Borneo. Miocene: Sind.

The genus *Latimæandra* is a very large one, and follows the rule which is noticed under such circumstances; it is ill defined from some others. During the growth of vigorous individuals remarkable changes occur in the arrangement and relation of the calices. The union of the elongate calices by their walls with their neighbours is the completion of the generic definition; but it sometimes does not occur everywhere in the same large corallum or colony, and here and there the walls are not united, there being a distinct crevice between them. Were a fossil specimen to be broken and part of it to retain the true *Latimæandroid* structure and the rest to show the incomplete union, the latter would be considered generically distinct from the former by M. de Fromentel, and would be called *Chorisastræa*.

Now A. E. von Reuss described and figured, in his description of the Fossil Anthozoa of the strata of Castalgomberto\*, beautiful specimens of *Latimæandra circumscripta*, *L. marchelloides*, and *L. dædalæa*, in which the true character is present; and also equally well-preserved types of *L. discrepans* and *L. dimorpha*, in which the walls are separate (plates 5-8). No one can doubt that all these forms belong to one genus, and that there is no necessity for the experiment of introducing *Chorisastræa* to separate the last from the first.

The same author carried the matter further, for he describes (*op. cit.* p. 20, pl. v. figs. 2-3) a type in which there are calices of the true *Latimæandroid* type, others separate and *Chorisastræan*, and many others which are circular in outline and free all round to a considerable depth, looking like a combination of *Thecosmilia*, *Latimæandra*, and *Chorisastræa*. The specimens are large, and their habit of irregular growth and irregular calicular junction is most suggestive in a classificatory sense, because there is a constant springing up of independent buds which sooner or later become serial in their calices, and at last unite by their walls. The colony is never entirely *Latimæandran*, *Chorisastræan*, or *Thecosmilian*.

It is the independence of the circular calices, which is so unlike anything *Latimæandran*, that characterizes amongst other things *Heterogyra*, Reuss. The type *H. lobata*, Reuss, cannot possibly come within the genera already mentioned.

\* "Pal. Stud. über die ält. tertiärsch. der Alpen," Denkschr. d. Kais. Akad. Wiss. Wien, 1867-68, p. 21 *et seq.*

M. de Fromentel writes ('Introd. à l'étude des Polyp. foss.' p. 163), "Nous avons séparé des Latiméandras des fossiles qui présentent bien comme celles-ci *des calices réunis en séries*, mais dont les séries restent libres par leur côté et ne sont même pas unies des côtés. Nous avons réuni les quelques espèces qui présentent ce caractère sous le nom générique de *Chorisastræa*."

Hence it is only to corals with serial calices that *Chorisastræa* can apply.

In the Pal. Franç., Zooph. Terr. créat. p. 445, M. de Fromentel states that the genus *Chorisastræa*, E. de F., 1858, includes the Syrrastræans which increase by budding, but whose series rest free at the summit, and are not united dorsally or by their costæ.

It is remarkable that M. de Fromentel should classify *Latimæandra* with corals having serial calices. E. Pratz has pointed out that this is an error. *Latimæandra* has not what M. de Fromentel calls a Syrrastræan type of growth, but a Disastræan or Polyastræan (see *Latimæandra Flemingi*, Ed. & H.). *Latimæandræ* are modified Isastræans; and these last, like *Latimæandra*, often have their calicular walls separated for a short distance downwards.

Many genera have the walls united, except close to the calices, and during growth union takes place there.

*Heterogyra*, Reuss, cannot be included in the so-called genus *Chorisastræa*. I do not think it advisable to retain this last genus.

Genus HETEROGYRA, Reuss, *Pal. Stud. ü. die ält. tertiärsch. der Alpen*, Abth. i., *Anthoz. v. Castelgomberto*, Wien, 1868, p. 20.

Colony massive. Corallites increasing by gemmation and irregular serial calicinal growth, united inferiorly, free superiorly. Calicular surface irregular, showing nearly circular and very deformed calices, free from the calicinal margin down to a certain depth. Septa numerous, denticulate. Columella absent. Endotheca exists, but an epitheca does not cover the costæ.

*Distribution.*—*Fossil.* Eocene: Europe.

The alliance of this form is with the Latimæandroids and not with the Symphyllioida. Its importance is considerable in relation to the so-called genus *Chorisastræa*, E. de From., and the morphology of *Latimæandra* also.

The genus *Merulina* was placed by Milne-Edwards and Jules

Haime as a unique genus or a group of Pseudo-Fungidæ, because of the *Agaricia*-like appearance and perforated wall. Dana placed the genus in the Astræidæ, and I think that is its proper position; for the perforations are not more than growth-apertures and do not always exist; and in forms where there are calices on both sides of the common wall there are no perforations. I do not retain the group Pseudo-Fungidæ in the sense of M.-Edwards and Haime.

Group-Genus MERULINA.

Genus MERULINA, *Ehrenberg, Corall. des Roth. Meer.* p. 104 (1834), *amended.*

Colony fixed, foliaceous, frondiform, folded, or subdendroid. Corallites in linear series with fused walls, having simple ridges crossed by septo-costæ. Calices with centres distinct, in small series, confluent by their septo-costæ. Columella slightly developed, spongy or tubercular. Septa stout, sharply denticulate, trabeculate, here and there few, granular at the sides. Common plateau, when it exists, is striate and echinulate along long and somewhat diverging lines, bound as it were in long groups, between which are perfect foramina near the edge of the colony, and deep depressions like slits elsewhere. Where the colony is not foliaceous and is solid, there is no common plateau, and there are no perforations, the calices being on all sides. Endotheca scanty, often only seen at the columella. Gemmation submarginal and calicinal.

*Distribution.*—*Recent.* Indo-Pacific, Pacific Ocean.

XIII. Alliance PLERASTRÆOIDA.

Agglomerate Astræidæ increasing by calicular or extra-calicular gemmation. Septo-costæ confluent. Dissepiments present. No synapticula. Septa denticulate and entire.

Genus PLERASTRÆA, Ed. & H.

Genus HOLOCÆNIA, Ed. & H.

There is some difficulty in placing the next genus, *Plerastræa*, in its proper classificatory position. According to Milne-Edwards and Jules Haime its position is next to the genus *Clausastræa*, d'Orb., in the Astræidæ. But in a species I described from the Eocene of Sind I found synapticula. (By a printer's error this form has been termed *Pterastræa*.) The figure given by Milne-Edwards and Jules Haime in the *Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. x. pl. 9. fig. 12, leaves no doubt about the

Astræid nature of their type species, *Plerastræa Savignyi*. *Clausastræa* has now to be removed from the true Astræidæ, for it has synaptacula. *Plerastræa mirabilis*, nobis, Foss. Corals &c. of Sind, Pal. Indica, p. 65 (1880), cannot remain in its genus as determined by Milne-Edwards and Jules Haime. It is now *Pratzia mirabilis*, and a Lophoserine.

Genus PLERASTRÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 553 (1857).

Colony massive, turbinata, or flat, with a convex or subplane upper surface. Corallites limited by walls which are simple, united, and well developed. Calices superficial. Columella papillary. The septa few and subconfluent with those of the neighbouring calices, dentated, uniting more or less. Dissepiments well developed and abundant. An epitheca may exist and be strong and folded.

*Distribution.*—*Fossil.* Trias: Europe. Jurassic: England. Eocene: France.—*Subfossil.* Red Sea.—*Recent.* Red Sea?

The next genus is a doubtful one. If it has no synaptacula it must remain; but if it has, it is synonymous with *Centrastræa*, a subgenus of *Thamnastræa*, Lesauvage.

Genus HOLOCENIA, *Milne-Edwards & Jules Haime, Brit. Foss. Corals, Pal. Soc.* p. 99 (1851).

Colony massive, gibbous. Corallites united by their costæ, which are slightly developed, or by their walls. The septa are entire, have their upper edge nearly horizontal, and merge into those of the neighbouring calices by means of the costæ, with which they are continuous. These septo-costæ hide the summit of the walls of the calices. The columella is styliform.

*Distribution.*—*Fossil.* Cretaceous: Europe, S. India. Eocene: Borneo.

This is not a satisfactory genus; see the admirable remarks of its founders (*op. cit.* p. 99, 1851). The South-Indian Cretaceous species has ragged septa and no synaptacula.

#### XIV. Alliance TABULOIDA.

Agglomerate Astræidæ increasing by gemmation. Corallites united by their walls. Dissepiments in the form of tabulæ. Septa variable, in cyclical arrangement.

Genus HOLOCYSTIS, Lonsdale.

Genus COCCOPHYLLUM, Reuss.

Genus absorbed:—TETRACENIA, d'Orb.

Genus HOLOCYSTIS, *Lonsdale, Quart. Journ. Geol. Soc. t. v. p. 83* (1849); *Milne-Edwards & Jules Haime, Brit. Foss. Corals, p. 70, pl. x. fig. 5* (1850).

Syn. *Tetracænia*, d'Orb.

Colony in a convex mass, increasing by extra-calicular gemmation. Corallites united directly by their walls or by costæ, which are thick and usually well developed. Calices subpolygonal, either united by their margins or separated by a broad groove; fossula deep. Columella very small, styliform. Septa entire, in three complete cycles; four primaries much more developed than any other septa, exsert, close, thick at the margin and beyond, feebly granular, and very unequal according to their orders. Dissepiments of one kind, simple, horizontal, equidistant, and corresponding in height in the different interseptal loculi, forming tabulæ, which are traversed by the primaries.

*Distribution.*—*Fossil.* Lower Cretaceous: England. Aptien: Europe.

Genus COCCOPHYLLUM, *Reuss, "Anthozoen der Kössenerschichten und der alpinen Trias," Sitzungsber. der Kais. Akad. der Wiss. Wien, 1865, p. 167.*

Colony broad, convex. Corallites united by their irregular-shaped walls. Calices of various sizes, polygonal. Columella absent. Septa projecting but little into the calice, distinctly granular at their free edge. Tabulæ abundant, stretching across the interior of the cylindrical corallite, and often with a concave upper surface. Gemmation from the calicular wall.

*Distribution.*—*Fossil.* Trias: Europe.

The next genus stands much alone. The young calices surround the larger parent, and arise by marginal budding. The walls are thin, and almost rudimentary where the buds join. The endotheca is very abundant, coming high up, and centrally there are tabulæ. A rudimentary columella exists.

It must form a group with affinities with the Rugosa, like the Alliance just noticed.

Group-genus MOSELEYA, *Quelch.*

Genus MOSELEYA, *Quelch, Ann. & Mag. Nat. Hist. 1884, vol. xiii. p. 292.*

Corallum compound (colony), flattened, or slightly and broadly convex. Young calicles developing by calicinal marginal budding

around a very large median calicle, which has very numerous septal orders, the calicles becoming polygonal and deep at the centre. Epitheca very slight; wall very thin and almost rudimentary, but developed so as to give a distinct simple line of separation to the calicles on the surface, often interrupted; seen in section in a very rudimentary state separating the calicinal centres. Costæ very distinct, thin, and finely denticulate. Septa often confluent and continuous, from centre to centre, in the line of union between adjoining calicles, very thin and close, finely toothed above, and having the teeth subequal or slightly larger near the centre. Endothecal dissepiments vesicular, very abundantly developed, leaving but a very small portion of the septa free exteriorly; seen in transverse section forming nearly concentric lines, and more or less complete tabulæ at the centre. A false columella present, seen exteriorly to be formed by the trabeculate and vermiform nature of the innermost upper part of the septa, entirely or almost absent in transverse section, where the septa are seen to meet almost at a point.

*Distribution.*—*Recent.* Torres Straits.

The next and last genus of this family is placed at the close of it provisionally. It will not conform to any Alliance, although it has some Latimæandroid characters of growth.

Group-genus *DICTYOPHYLLIA*, *Blainville*.

Genus *DICTYOPHYLLIA*, *Blainville*, *Man. d'Actin.* p. 360, pl. 53.

fig. 4; *Dict. des Sci. Nat.* t. lx. p. 523 (1830), *amended*.

Colony incrusting, covering considerable space. Surface sub-plane. Corallites low, separated by very narrow grooves at the calicular surface, variable in size. Calices more or less polygonal or circular, or long, nearly or quite straight, narrow, looking like a series with perfectly indistinct centres. In a polygonal calice (one of a bud) are numerous subequal, close, short septa projecting from the wall a little way inwards, and within these, towards the calicular centre and occupying a large space, is a columella—a mass of trabeculæ, reticulate and slightly convex; trabeculæ connected, here and there, by cross bars. The long calices show the same structures as the others—a wall with short subapical septa projecting a little, and a large long axial mass of trabeculæ—the columella. The columella appears to rise from a flat floor, which is presumably the base of the colony. Costæ absent. Calicular walls separated.

*Distribution.*—*Fossil.* Upper Cretaceous: Maestricht, Europe.

There are several very perfect specimens of the only species of this remarkable genus in the British Museum. Their appearance and structural characters are, to a certain extent, those of the serial *Astræidæ*.

## CHAPTER V.

The Section *Fungida* of the *Madreporaria*, definition, families. The family *Plesiofungidæ*, its groups and alliances and genera. The family *Fungidæ*, alliances and genera. The family *Lophoseridæ*, alliances and genera. The family *Anabaciadæ*, and genera. The family *Plesioporitidæ*, alliances and genera.

### II. Section MADREPORARIA FUNGIDA\*.

*Madreporaria* solitary or in colonies. Septa and septo-costæ with synaptacula which cross the interseptal and intercostal loculi. An endotheca may or may not exist. Septal laminæ solid or presenting degrees of fenestration. Basal structures perforate or imperforate. Soft structures with short, lobe-like, scattered, sometimes obsolete, tentacles, not covered when contracted; disks not circumscribed, and in colonial forms confluent.

The reasons for adding two families to this section have been given in a former page (4).

#### *Families.*

(Transition-group.) I. PLESIOFUNGIDÆ.

II. FUNGIDÆ.

III. LOPHOSERIDÆ.

IV. ANABACIADÆ.

(Transition-group.) V. PLESIOPORITIDÆ.

The family *Plesiofungidæ* contains 13 genera, of which 10 are taken from the family *Astræidæ* of Edwards and Haime. The *Fungidæ* contain 10 genera. Two new genera enter, and the old form, *Zoopilus*, finds a place. *Haliglossa* becomes a subgenus; and *Podabacia* is synonymous with *Halomitra*.

\* Verrill makes a suborder *Fungacea*, and foreshadowed the present amplification of the *Fungida* in 1865 (see Verrill, 'Notes on Radiata,' a work full of valuable information)

The Lophoseridæ become a very important family, and there are 35 genera and 2 subgenera. Out of the 19 genera of Milne-Edwards and Haime, 3 are passed on to the Plesioporitidæ, so that there are 19 new genera added.

The Anabaciadæ remain as they were, 2 genera.

The Plesioporitidæ have 13 genera; 1 was formerly an Astræid, 3 were Lophoseridæ of Ed. & H.; 9 genera are thus added.

The section Fungida contains therefore 73 genera and several subgenera.

Besides these 73 genera, 23 have been recorded, and either abolished in revision, or in some instances made subgenera.

### Transitional Family.

#### 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.

This Family contains five groups. One genus can hardly be satisfactorily placed, because nothing is known regarding the nature of the septa; but, provisionally, I place it in a group by itself. This is *Epistreptophyllum*, Milaschewitsch.

E. Pratz unites *Siderastræa*, *Astræomorpha*, and *Mesomorpha* in a group; but I cannot agree to the union of the last two with the first-named. Hence *Siderastræa* stands as a genus alone. The Thamnastroid group is fairly well defined.

#### Group-Genus EPISTREPTOPHYLLUM.

A simple Plesiofungid.

Genus EPISTREPTOPHYLLUM, *Milaschewitsch*, "*Korallen der Nattheimerschichten*," ii. Abtheil., *Palæontographica*, xxi. p. 210 (1875).

Corallum simple, adherent, conical or cylindrical. Calice sunken. Columella well developed and spongy. Septa numerous, not exsert. Wall ornamented with subequal costæ. Deeply in the interseptal loculi are endothecal dissepiments, and, besides,

\* See Verrill, 'Notes on Radiata,' p. 540, E. Pratz, '*Palæontographica*,' 1882, and Zittel, *Palæontology*, foreshadowing this group.

numerous synaptica; but in the upper parts there are only numerous sharp-pointed wart-shaped granules on the sides of the lamellæ.

*Distribution.*—*Fossil.* Jurassic: Europe.

#### Group-Genus SIDERASTRÆA, Blainv.

GENUS SIDERASTRÆA (pars), *Blainville, Dict. des Sci. Nat.* t. lx. (1830); *Milne-Edwards & Jules Haime, Compt. Rend. de l'Acad. des Sci.* t. xxvii. p. 445 (1848); amended after *Pourtalès*.

Syn. *Astræa*, Ed. & H. (1857).

Colony massive, convex or plane, dense, incrusting. Corallites united by thin and often indistinct walls. Calices subpolygonal, deep, margins rounded. Columella small, papillary, made up of ascending trabeculæ, which often fuse, here and there, into a mass. Septa solid, rather close, thin, denticulate where free, often uniting. Two rows of synaptica close to the wall unite the opposed septal lamellæ, and tend to fill up the interseptal loculi near the wall. Septa imperforate. Endothecal dissepiments few. Gemmation submarginal.

*Distribution.*—*Fossil.* Eocene: Europe, Asia. Miocene: Europe, West Indies.—*Subfossil.* Red Sea.—*Recent.* Red Sea, Indian Ocean, islands off West coast of Africa, Caribbean Sea.

L. Agassiz states that the soft parts of *Siderastræa* are those of the Fungida and not those of the *Astræidæ*, and the tentacles drawn by *Pourtalès* prove this.

#### Group-Genus POLYARÆA.

GENUS POLYARÆA, *K. v. Fritsch, "Foss. Korall. der Nummulit. v. Borneo," Palæontographica*, Supp. Band iii. (1878).

Colony massive, with projecting calices. Corallites free above, united by wall and costæ below. Septa numerous, arched, uniting, perforate. Columella spongy and well developed. Dissepiments vesicular. Synaptica present. Epithea well developed, uniting approximated corallites, wrinkled and striated. Gemmation lateral and basilar. Colony increases circumferentially.

*Distribution.*—*Fossil.* Eocene: Borneo.

K. v. Fritsch states that the colony has the habit of *Brachyphyllia*, Reuss.

## I. Alliance ASTRÆOMORPHOIDA.

Colonial Plesiofungidæ. Calices small, more or less confluent by costæ. Walls absent. Septa trabeculate, but solid. Columella styli-form.

Genus ASTRÆOMORPHA, Reuss.

Genus MESOMORPHA, Pratz.

Genus ASTRÆOMORPHA, Reuss, "*Beiträge zur Charak. d. Kreid. in den Ostalpen,*" *Denks. d. Kais. Akad. Wiss. Wien*, 1854, Band vii. p. 127.

The colony is flat, with small irregular calices, having only from 6 to 16 thick dissimilar irregular septo-costæ only slightly geniculate. The central septa unite with a compact styli-form, but sometimes rudimentary, columella. Septa not united directly with the columella along their entire height, but by trabeculæ occurring at regular intervals from .5 to .75 millim. apart, so that a series of openings exists on the boundary between septum and axis. Tolerably stout, transverse or slightly oblique dissepiments stretch across the interseptal loculi, agreeing with the axial trabeculæ in number, but alternating with them. Hence a number of superimposed cavities occur in the interseptal loculi.

Reuss notices the affinity of the genus to *Clausastræa*, and how it is distinguished from that genus and *Thamnastræa*.

E. Pratz (*Palæontographica*, 1882, p. 103 *et seq.*) analyses the species of this genus, and states that the genus is essentially Triassic, the specimens studied by Reuss from supposed Cretaceous rocks being derived fossils. The species described by Milaschewitsch from Nattheim are *Thamnastræans*, and differ in their morphology from *Astræomorpha*. The Eocene species is a *Thamnastræa*.

E. Pratz remarks on the morphology. The septa, instead of being formed of many trabeculæ passing from the internal base of the corallite upwards and inwards, give the impression of being formed by an independent irregularly-formed trabecule composed of many nodules running upwards and outwards. The granulations group themselves at tolerably regular intervals, and form more or less horizontally placed enlargements, which run in the same plane around each septum. In transverse sections, calcareous threads are seen to radiate from the middle of a septum to the periphery. A vertical section shows that they are directed upwards and outwards. The dissepiments resemble tabulæ. The

septa are compact, and are united by tabulæ and synapticula. There is no intercalicular wall.

*Distribution.*—*Fossil.* Trias: Europe.

Genus MESOMORPHA, Pratz, *Palæontogr.* xxix. (1882), p. 118.

Syn. *Porites* (pars).

Colony massive, branching, gibbous, sometimes incrusting. Calices small, shallow, not defined by ridges, but confluent with septo-costæ running in low curves over a flat surface. Septa compact, with spinules on the sides and edge, indicating a trabeculate construction. Columella styliform. No true wall. Synapticula stout, and when in the sclerenchyma between the corallites giving a cœnenchymatous appearance. Dissepiments exist.

*Distribution.*—*Fossil.* Cretaceous: Europe.

## II. Alliance THAMNASTROIDA.

Colonial Plesiofingidæ, varying in shape, massive, foliaceous, dendroid, incrusting or not. Confluent septo-costæ well developed, usually solid, trabeculate. Calices superficial, widely open, large.

Genus THAMNASTRÆA, Lesauvage.

Subgenus CENTRASTRÆA, d'Orb.

Genus CLAUSASTRÆA, d'Orb.

Genus PSEUDASTRÆA, Reuss.

Genus PIRONASTRÆA, d'Achiardi.

Genus REUSSASTRÆA, d'Achiardi.

Genus DIMORPHASTRÆA, d'Orb.

Genus DIMORPHOCŒNIA, E. de From.

Genus STYLOMÆANDRA, E. de From. ?

Genus THAMNASTRÆA, Lesauvage, *Ann. des Sci. Nat.* 1<sup>e</sup> sér.

t. xxvi. p. 328 (1832).

The synonymy of this great genus has been correctly given by Milne-Edwards and Jules Haime, 'Hist. Nat. des Corall.' vol. ii. p. 555 (1857), and carried down by them to 1851. M. de Fromentel's 'Introd. à l'étude des Polyp. foss.' (p. 211), published 1858-1860, is unfortunate in not bringing in the synonymy published by Milne-Edwards and Jules Haime, and in not noticing their able work.

Lesauvage, Goldfuss, Blainville, d'Orbigny, Lamouroux, and Defrance differed in their views regarding the genus; and Milne-Edwards and Jules Haime, criticizing the results of these naturalists, and having an immense amount of original matter at hand,

established a new generic diagnosis. Later on Etallon, Reuss, and myself decided that the genus must enter the Fungida; and since that time it has been placed in the Poritidæ by Milaschewitsch and R. Tomes, and replaced by the latter in the Fungida. The careful researches of E. Pratz enable me to place the genus in the transitional group between the Astræidæ and Fungida—in the family Plesiofungidæ.

Milaschewitsch, noticing the perforate condition of the septa of *Thamnastræans* from Nattheim, was led away to believe that this condition was invariable in the genus. Moreover, he thought that a perforate septum necessitated a Porosa alliance. There are perforate septa in *Cyphastræa*, an aporose form, and solid septa in most species of *Madrepora*, a perforate genus. Perforation may be noticed in some English *Thamnastræans* that have been much weathered, but in parts of the colony only. The condition is not universal in specimens from Nattheim, and is the result of destructive siliceous fossilization and weathering.

The trabeculæ of the septa do not always leave spaces between them like lattice-work; such a condition is local and exceptional. At the same time the thinnest part of the septum is between the nodular masses of the trabecules. There is no doubt that the septa are united by growths which are not exaggerated granules, and which are synapticula. These not only interfere with the open condition of the interseptal loculi, but make the position occupied by any thing like a mesenteric fold very shallow. The existence of endotheca is decided, and especially in some Oolitic species. It was noticed by Milne-Edwards and Jules Haime, and figured in my *Monog. Brit. Foss. Corals*, Pal. Soc. 1872, Pt. iii. pl. 4. fig. 9, and has been recognized in continental forms.

The presence of a wall bounding the corallites has been debated. I do not find a true wall, but that synapticula are often placed in vertical series and act as a wall, which, however, is not complete. Often no trace of such a limiting series can be found. On the other hand, the existence of a wall has been stated by De Fromental. The columella is variable in the genus, and has been used to establish subgenera. Finally, the colony is sometimes convex, plane, and nodulose, or decidedly branched. The structures in these forms are identical, and therefore the old plan of making the branched forms into a new genus or subgenus has been abolished.

The subgenera are not very satisfactory, on account of the influence of fossilization and wear and tear in destroying the columella or in modifying it. But if it can be established that a species has had no columella, or has a papillary one, or one which is essential and styliform or knobbed, it is right to put it in the characteristic subgenus. Thus the true *Thamnastræans*, according to Milne-Edwards and Jules Haime, have a papillary columella (*Hist. Nat. des Corall.* vol. ii. p. 555). The *Thamnastrææ* with a knob or styliform process for columellæ belong to the subgenus *Centrastræa*, d'Orbigny. In most cases sections show the relics of the columella.

Mr. R. Tomes, F.G.S., follows M. de Fromental in his classification (*Quart. Journ. Geol. Soc.* 1882, p. 434), and gives him the authorship of *Synastræa* as well as *Centrastræa*, the first being a creation of Milne-Edwards and Jules Haime, and the last of d'Orbigny! As the subject has been now thoroughly discussed, it is only necessary to revise the genus *Thamnastræa* after Milne-Edwards and J. Haime, and to admit, for the sake of convenience, *Centrastræa* as a subgenus. Mr. R. Tomes suggests the term *septal-costæ* for the costæ which join the septa of different calices in *Thamnastræa*. The term *septo-costæ* was used half a century ago, and has been employed ever since, and is the better term of the two.

Genus THAMNASTRÆA, *Lesauvage, amended; post. Ed. & H.* (1857),  
*Hist. Nat. des Corall.* vol. ii. p. 555.

Syn. *Synastræa*.

Colony massive, convex, subplane, or gibbous, or thin and expanding, or in layers, pedunculate or with a broad base, or incrusting, or more or less dendroid in shape. Corallites indistinctly defined. They are united by costæ or by an ill-developed wall. Calices superficial, centres distinct, and the intercalicular space variable in extent. Columella variable, papillary, nodular, small, styloid. Septa merging into septo-costæ which are confluent with those of neighbouring calices, usually flat on the free border, dentate, the minute projections being the tops of lines of trabeculæ, stout or thin, solid or perforate here and there; straight, wavy, curved, or geniculate, long or short, often uniting or not. Dissepiments rudimentary or decidedly developed. Synapticula numerous, small. Gemmation submarginal. Common colonial wall, when it exists, costulate, epithecate, and with synapticula.

*Distribution.*—*Fossil.* Trias: Europe. Lias: England and Europe. Oolitic: England and Europe. Cretaceous: England, Europe, Asia. Eocene: Europe, Asia. Miocene: Tasmania.

Subgenus *CENTRASTRÆA*, (genus) *d'Orb.* (1847).

*Thamnastræa* with an almost styliform columella.

In recognizing this group care must be taken not to be deceived by the results of fossilization.

Genus *CLAUSASTRÆA*, *d'Orbigny, Note sur les Polyp. foss.* p. 9 (1849), *amended.*

Colony massive, with a plane or convex upper surface and broad base. Corallites large, without definite walls, which are replaced by a cellular endotheca. Calices superficial, shallow, widely open. Columella absent. Septa large, dentate, few, some confluent with the septo-costæ of the calices close by and others traversing the intercorallite space to reach somewhat distant calices, straight, or geniculate, or curved here and there. Laminae short, solid. Endotheca replacing walls here and there, and stretching across the interseptal loculi high up like tabulae, but not passing over the axial space. Synapticula small, short, stout, numerous. Gemmation submarginal.

*Distribution.*—*Fossil.* Jurassic: Europe, England.

Genus *PSEUDASTRÆA*, *Reuss, "Foss. Foram. Anthoz. von Oberburg," Denks. d. Kais. Akad. der Wiss. Wien, Bd. xxiii.* p. 24 (1864).

Colony massive. Calices crowded, irregular, rather deep in the centre, environed by a shallow groove, so that only occasional septa become continuous with those of other calices. Septa dentate and numerous. Columella ends in a small irregular pimple (*Höcker*). Pali in one crown. Synapticula exist, being placed very regularly. (Endotheca does not exist, according to *Reuss.*)

*Distribution.*—*Fossil.* Eocene: Europe.

Genus *PIRONASTRÆA*, *d'Achiardi, Corall. Eocen. del Friuli (Pisa, 1875), p. 76.*

Colony lamello-discoid. Calices in concentric circles, confluent, centres distinct and small. Columella absent, or as one papilla. Septo-costæ very large. Synapticula numerous. Endotheca scarce. Epithea well developed.

*Distribution.*—*Fossil.* Eocene: Europe, Sind, Asia.

GENUS *REUSSASTRÆA*, *d'Achiardi, Coralli Eocen. del Friuli*  
(Pisa, 1875), p. 67, tav. 13. fig. 2; *amended*.

Colony in the shape of a lamina more or less thick. Calices distinct, numerous, varying in their distances, shallow. Septa confluent with those of neighbouring calices. Columella lamellar and essential. Calicular wall ill defined. Dissepiments well developed, arched. Synapticula exist; and the solid septal laminae are very granular.

*Distribution*.—*Fossil*. Eocene: Europe, Sind, Asia.

GENUS *DIMORPHASTRÆA*, *d'Orbigny, Rev. et Mag. de Zool.* p. 177  
(1850), *amended*; *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. ii. p. 585 (1857).

The colony is pedunculate or not, flat on the upper surface, rarely convex, more or less circular in outline. Corallites arranged around a large central parent in distant concentric circles. Columella papillary and small. Septo-costæ confluent. Synapticula exist. Common wall striated or not, naked.

*Distribution*.—*Fossil*. Cretaceous: Europe, Hindostan, Asia.

GENUS *DIMORPHOCÆNIA*, *de Fromentel, Polyp. foss. de l'étage Néocomien*, p. 55 (1857).

Colony in a tolerably thin lamina. Corallites disposed in concentric rows around a central parent. Plateau naked and costulated. The septa are entire, and almost all radiating from the centre to the circumference. There is no columella.

M. de Fromentel states that this genus corresponds in the Eusmilian family with the genus *Dimorphastræa*, the distinction being the entire nature of the septa in the first-named genus and the absence of a columella. There are synapticula.

GENUS *STYLOMÆANDRA*, *E. de Fromentel, Pal. Franç., Terr. créét.* p. 457 (1877).

The genus *Stylomæandra*, according to M. de Fromentel, is clearly allied to the genus *Latimæandra*, and is only really distinguished by having a styliform columella in the centre of the calices.

The figure shows (pl. 113. fig. 3) a broad colline covered by confluent costæ. It appears that this genus is hardly near *Latimæandra*, and that it is possibly one of the *Thamnastræan* alliance, where it is placed with doubt.

## II. Family FUNGIDÆ.

(Subfamily *Funginæ* (pars), Ed. & H. Hist. Nat. des Corall. vol. iii. p. 4, 1860.)

Simple or colonial forms, usually depressed, with the septa solid or occasionally porous. Synapticula crossing the interseptal loculi and uniting the septa without the presence of dissepimental endotheca. Wall more or less synapticulate 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.

The Alliances are fairly natural, and are the

- I. FUNGIOIDA.
- II. CRYPTABACIOIDA.
- III. HERPOLITHOIDA.

## I. Alliance FUNGIOIDA.

Simple Fungidæ, more or less discoid.

Genus FUNGIA, Dana.

Subgenus HALIGLOSSA, Ehr.

Genus DIAFUNGIA, Duncan.

Genus MICRABACIA, Ed. & H.

Genus FUNGIA, Dana, *Zooph.* p. 318 (1846), altered by Milne-Edwards & Jules Haime, *Hist. Nat. des Corall.* vol. iii. p. 5 (1860), amended; Duncan, *Proc. Linn. Soc., Zool.* vol. xvii. p. 137.

Syn. *Lobactis*, Agass.; *Pleuractis*, Agass.; *Ctenactis*, Agass.

The corallum is simple and free in adult age, circular, subcircular, elliptical, lobed, or angular in outline; depressed or hemispherical, with a horizontal or dome-shaped base, which is costulate and perforate more or less. The calice conforms to the shape of the superficies of the corallum. Septa numerous, plain, lobed, dentate or spinulose on their free edge, the smaller uniting with the larger, which reach from the axial space to the more or less turned-down calicular edge. Small septa trabecular, the large solid. The columella trabecular and rudimentary. Interseptal loculi deep, and occupied by vertical or slanting rows of stout

synapticula, which form, with the sides of the septa, canals leading to the base, and sometimes communicating with the outside through the basal openings. Costæ on the bases of the septa, and united by synapticula, which constitute a false basal wall. Young corals adherent, subturbinate and pedicellate.

*Distribution.*—*Recent* and *Sub-fossil*. Pacific, Red Sea, Indian seas, Pacific coast of America.

The genus is a large one, and may be rather artificially divided into groups of species as follows:—

- Group 1. *Fungia lacerantes*. *Fungia* with spiniform septal teeth.
- „ 2. *Fungia subintegræ*. *Fungia* with very small dentations.
- „ 3. *Fungia lobiferæ*. *Fungia* with the septa terminating above in angular lobes.

The genus *Hali glossa*, Ehrenberg, may be considered a sub-genus of *Fungia*, and it includes elongate forms with a discontinuous axial space, and links the *Fungia* on to the genus *Herpolitha*.

Genus DIAFUNGIA, *Duncan, Journ. Linn. Soc., Zool.* 1884, vol. xvii. p. 417.

Corallum discoid, free, without trace of adhesion, not quite circular in outline, much broader than high. Base with a primary triangular piece extending beyond the centre, slightly projecting downwards, the rest of the coral grouping from its nodes and apex, so that there is an appearance of former fracture and subsequent growth. Calice unsymmetrical from the prolongation of the larger septa of the primary piece beyond the centre, and from the radiation of septa from the sides and apex of the primary piece to the edge of the disk or the margin.

Columella absent. Septa numerous, order confused, many join others near and remote from the margin. Larger septa exert, 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, with the corresponding offshoot of the next costa, a septum. Hence the septa correspond with the intercostal spaces. Inter-

costal spaces regularly furnished with equidistant synapticula, presenting a regularly perforated appearance. Synapticula strongly developed between the septa, some reaching high up in the interseptal loculi. There is no true wall, the septo-costal structure being united by synapticula alone.

*Distribution.*—*Recent.* Korean Sea.

Were there symmetrical growth, and did the costæ radiate from a common centre, the form would come within the genus *Micrabacia* (Edwards and Haime, *Hist. Nat. des Corall.* vol. iii. p. 30, 1860). The genus is therefore a very interesting addition to the family Fungidæ, and must be placed between the genera *Fungia* and *Micrabacia*.

It is mimetic of the genus *Diaseris* of the Lophoserinæ.

The genus *Micrabacia*, Milne-Edwards & Jules Haime, requires some amendment; and having had the opportunity of studying some good specimens, I give the following amended diagnosis:—

Genus MICRABACIA, *Milne-Edwards & Jules Haime, Hist. Nat. Corall.* vol. iii. p. 29 (1860), *amended.*

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 higher orders towards 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.

*Distribution.*—*Fossil.* Cretaceous: England, Europe.

## II. Alliance CRYPTABACIOIDA.

Colonial Fungidæ. Calices all distinctly radiating.

Genus HALOMITRA, Dana.

Genus SANDALOLITHA, Quelch.

Genus CRYPTABACIA, Ed. & H.

Genus HALOMITRA, *Dana, Expl. Exped.* 1846, *Zoophytes*, p. 311 ;  
*P. Martin Duncan, Journ. Linn. Soc., Zool.* vol. xiii. p. 155  
 (1883).

Syn. *Podabacia*, Ed. & H.

Corallum compound, free or attached, convex or folded. Upper surface with a circular, funnel-shaped, large calice, surrounded with a ring of smaller calices. Septo-costal rays continuous from central calice to others and to the thin margin. Septa numerous, unequal, denticulate, some trabeculate in parts, solid otherwise. Synapticula long or short, vertical. Costæ marked on the perforate and echinulate base.

*Distribution.*—*Recent.* Red Sea and Indian Ocean, Oceania.

This genus absorbs *Podabacia*, Milne-Edwards and J. Haime, and therefore has a wider distribution.

Genus SANDALOLITHA, *Quelch, Ann. & Mag. Nat. Hist.* 1884,  
 xiii. p. 293.

Corallum compound, flattened, free, much elongated, and very thin. Wall sparsely porous, and extremely reduced. Distinct costæ, closely granulated or very finely and bluntly echinulate, curving towards the short axis. Calices few, in the long diameter of the corallum ; parent calicle very large, occupying the centre, forming almost the entire corallum, with very numerous septa, there being about seven complete cycles, but a much larger number of cycles incompletely developed on the long axis ; smaller calicles very few, distinctly radiate, developing on the course of and interrupting the larger septa in the long axis of the parent calicle. Septa very long, crowded, curving towards the short axis, and of more or less equal vertical extent, very low, giving an even laminate appearance to the corallum. Synapticula well developed, and forming strong connexions at the basal parts of the septa. Columella rudimentary and trabeculate.

*Distribution.*—*Recent.* Tahiti.

Genus CRYPTABACIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 22 (1860).

Corallum compound, free, oblong, convex above and concave beneath. Calices with radiating septo-costæ, some calices occupying the central axial line and there are others on either side. Septo-costæ short and not numerous. Inferior surface echinulate and perforate.

*Distribution.*—*Recent.* Indian Ocean, Manilla, Pacific.

## III. Alliance HERPOLITHOIDA.

Colonial Fungidæ, with some or all the calices incomplete and not radiating.

Genus HERPOLITHA, Eschholtz.

Genus POLYPHYLLIA, Quoy.

Genus LITHACTINIA, Lesson.

Genus ZOOPIIUS, Dana.

Genus HERPOLITHA, *Eschholtz, Isis*, p. 746 (1825), *amended*;  
*Duncan, Journ. Linn. Soc., Zool.* vol. xvii. p. 152 (1883).

The corallum is free, long, narrow, and compound. The upper surface has calices of two kinds—one set occupy a long central axial line and are multilamellar, and the other set are placed irregularly, have few lamellæ, and are small. The septo-costal rays are long and stout, and alternately thick and thin, and all are entire. No rays reach from the axial furrow to the circumference. The base is concave, perforated and echinulated. Synapticala regular, numerous, oblique, tall, and wanting here and there. Columella trabecular.

*Distribution.*—*Recent.* Red Sea, Indian Ocean to east.

This genus has been called *Herpolithus* by Leuckart subsequent to Eschholtz (see *Hist. Nat. des Corall.*, Milne-Edwards & Jules Haime, vol. iii. p. 24); and Klunzinger has restored the proper name ('Korallenthiere des Rothen Meeres,' p. 68).

Genus POLYPHYLLIA, *Quoy et Gaimard, Voy. de l'Astrolabe (Zooph.)*, p. 185, pl. 20 (1833); *Dana, Explor. Exped., Zooph.* p. 316 (1846).

Corallum compound, free, oblong, and convex above and concave below, or discoid. Calices incomplete; some, which are sub-radiant, occupy the central axis in the long coralla, and are associated with rudimentary calices placed on either side, with short septo-costal rays very unequal in size, separated by transverse laminae, which are the prolongations of a lower set of septa. Or the surface is covered with undeveloped calices with non-radiant septo-costæ. The base is echinulate and perforate. Synapticala well developed. Principal septa very thick.

*Distribution.*—*Recent.* Pacific, Red Sea.

There are no perfectly radiating calices in the genus *Polyphyllia*—that is to say, the centre of a calice has not septa radiating from it, as in *Halomitra* for instance. The radiation is

interrupted. Besides, there are what may be called false calices, in which a large septum is covered over for a short distance by a kind of hood coming from some of the higher orders next to it. This structure appears to have one large fleshy tentacle upon it.

In the genus *Lithactinia* there are no subradiating calices in the median line, and all are of the false kind. This appears to be of generic importance, and I retain the genus. The genera *Herpolitha*, *Polyphyllia*, and *Lithactinia* form an Alliance on account of the presence of false calices in their compound coralla.

Genus LITHACTINIA, *Lesson, Illustr. Zool.* 1833; *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 28 (1860).

Colony free and thin, hemispherical, cap-shaped, or almost plane above, and echinulate and perforated at the concave base. Costæ not distinct. Calices of one kind, nonradiate, and formed by short septo-costal laminae, which are separated from those before and behind by thin transverse processes, which arch over them, and come from inferior septa. There are no true calices. Synaptacula present.

*Distribution.*—*Recent.* Pacific islands, Oceania.

Genus ZOOPILUS, *Dana, Zoophytes, U. S. Exploring Exped.* 1846, p. 51.

Colony free, budding and explanate. Polyps everywhere scattered; mouths radiately seriate. Coralla with the larger lamellæ radially prolonged quite to the margin, the intermediate much smaller and short, and these alone interrupted by the oririmes (small depressions or centres of radiation = polyp-mouths). Polyp-mouths in the intervals between the large lamellæ.

*Distribution.*—*Recent.* Pacific.

### III. Family LOPHOSERIDÆ.

#### (Subfamily *Lophoserinæ*, Ed. & H.)

Fungidæ in which the wall is neither perforated nor echinulate. Synaptacula 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*.

1. Subfamily *Lophoseridæ simplices*.

I. Alliance TROCHOSERIOIDA.

Lophoseridæ with simple coralla, trochoid, turbinate, conico-cylindrical, or subturbinate. Calices shallow, rarely deep. Septa very numerous, some uniting, close, imperforate, and united by synapticula. Columella variable or absent. Pali may exist. Epitheca may or may not exist.

Genus TROCHOSERIS, Ed. & H.

Genus GYROSERIS, Reuss.

Genus TURBINOSERIS, Duncan.

Subgenus PALÆOSERIS, Duncan.

Genus PHRAGMATOSERIS, Milaschewitsch.

Genus OMPHALOPHYLLIA, Laube.

Genus PLACOSERIS, E. de From.

Genus ELLIPTOSERIS, Duncan.

Genus TROCHOSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 57 (1860), *date of description in Compt. Rend.* t. xxix. (1849).

Corallum simple, trochoid or cylindroid, adherent; wall naked, and with delicate costal striations. Calices circular, or lobed at the margin, and irregular, shallow. Columella papillary. Septa very numerous, strongly granulated laterally, uniting. Synapticula numerous.

*Distribution.*—*Fossil.* Cretaceous: Europe. Eocene: Europe, Asia.—*Recent.* Philippines.

Genus GYROSERIS, *Reuss; Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 54 (1860).

Corallum simple, free, pedunculate, trochoid. Calice shallow, with thick margins, circular. Costal fossette large. Columella large and papillary. Septa not exsert. Wall imperforate. Synapticula exist.

*Distribution.*—*Fossil.* Cretaceous: Europe.

The morphology of the septa separates the following genus from *Leptophyllia* and its allies, which belong to the Plesioporitidæ.

GENUS *TURBINOSERIS*, *Duncan, Pal. Soc., Supp. Brit. Foss. Corals, Cretaceous Corals*, pt. ii. p. 42 (1870); *amended in Quart. Journ. Geol. Soc.* 1873, p. 558.

Corallum simple, turbinate, or conical, compressed a little, with a broad base, having a mark of former adhesion, or a narrow and free base. Epitheca rudimentary or absent. Calice shallow, usually elliptical. Septa numerous, solid, often uniting or not. Columella absent. Costæ well developed. Wall stout. Septa united by synapticula, and sometimes the costæ also.

*Distribution.*—*Fossil.* Lower Greensand : England. Eocene : West Indies ; Sind, Asia.

Subgenus *PALÆOSERIS*, (genus) *Duncan, Quart. Journ. Geol. Soc.* vol. xxvi. (1870), p. 301, pl. xx. fig. 7.

Corallum simple, turbinate, and pedicellate. Calice widely open. Septa numerous, crowded, the smaller uniting with the larger, which reach the central fossula. Columella rudimentary. Synapticula numerous. Costæ covered by a complete and dense epitheca.

*Distribution.*—*Fossil.* Cainozoic, probably Miocene : Australia.

The stout epitheca distinguishes this form from *Turbinoseris*, of which it is a subgenus.

GENUS *PHRAGMATOSERIS*, *Milaschewitsch, "Korallen der Nattheimerschicht," Palæontographica*, xxi. (1878), p. 212.

Corallum simple, adherent, pedunculate, fan-shaped. Calice elongate. Columella absent. Septa numerous, not exsert. Synapticula exist low down in the interseptal loculi ; higher up there are long, oval-outlined granules projecting from the septal lamellæ. Wall aporose, and furnished with costæ which are continuous with the septa.

*Distribution.*—*Fossil.* Jurassic : Europe.

This genus is closely allied to *Turbinoseris* (if the septa are imperforate).

GENUS *OMPHALOPHYLLIA*, *Laube, "Die Fauna der Schicht. St. Cassian," Denks. der Kais. Akad. der Wiss. Wien*, 1864, Bd. xxiv. p. 251.

Syn. *Cnemidium*, *Quenst.* ; *Montlivaltia*, *Lam.* ; *Thecophyllia*, *d'Orb.*

Corallum simple, adherent, turbinate, cylindrical or almost

cyclolitoid in shape. Calice shallow, subplane, circular in outline. Columella styliform, prominent. The septa are numerous, close, unequal, uniting, bifurcating and trifurcating, exsert, granulate, and serrate. Epithea strong and well developed.

*Distribution.*—*Fossil.* Trias: Europe.

Genus PLACOSERIS, *E. de Fromentel, Pal. Franç., Terr. crét. Zooph.* p. 329 (1867).

Corallum largely fixed, with a cylindrical wall. Calice round and deep. Columella elongate, and composed of a series of trabeculæ soldered together and strongly spinulose at the sides. Septa numerous, unequal, and synapticate.

*Distribution.*—*Fossil.* Cretaceous: Europe.

In the drawing (pl. 49. fig. 4 a, b) the columella is very small.

Genus ELLIPTOSERIS, *Duncan, Fossil Corals &c. of Sind, Pal. Ind.* Ser. xiv. p. 48, pl. viii. (1880).

Corallum simple, pedunculate, conical, compressed, with a widely open elliptical calice. Columella absent. Axial space elongate and deep. Septa numerous, uniting. Pali exist on the united septa. Costæ developed. Synapticula are common. Epithea none.

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

## II. Alliance CYCLOSERIOIDA.

Simple Lophoseridæ more or less discoid or plano-convex in shape, with nearly flat basal walls and numerous septa, many of which unite. Pali may occur. Columella variable. Epithea exists or not.

Genus CYCLOSERIS, Ed. & H.

Genus DIASERIS, Ed. & H.

Genus ZITTELOFUNGIA, Duncan.

Genus BATHYACTIS, Moseley.

Genus ASTEROSERIS, E. de From.

Genus MICROSERIS, E. de From.

The genus *Tricycloseris*, Tomes, is too doubtful, and is absorbed. See E. Pratz, 'Palæontographica,' 1882.

Genus CYCLOSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 49 (1860), pl. D 12. fig. 3.

The corallum is simple, free, circular, elliptical, or angular in

outline, more or less horizontal or concave below, flat, nummiform, convex, semihemispherical above. Wall flat, costulate, imperforate. Central fossette narrow elongate or circular. Columella rudimentary or papillary, and slightly developed. Septa very numerous, uniting, denticulate at the free edge, exceedingly granular at the sides, imperforate. Synapticula abundant, and variable in their length.

*Distribution*.—*Fossil*. Cretaceous: Europe. Eocene: Europe; Sind, Asia. Miocene: Sind, Asia.—*Recent*. Red Sea, Chinese seas, Pacific.—*Subfossil*. Red Sea.

The genus *Ericycloseris*, Tomes (Quart. Journ. Geol. Soc.), places itself in the proximity of *Cycloseris*, as the name indicates. E. Pratz remarks (Palæontographica, xxix. p. 108) that the solitary specimen of the genus may be an abnormal form, and brings before our notice that occasionally simple forms have exceptionally developed more than one calicular centre, as may be observed in *Montlivaltia* and *Omphalophyllia*.

GENUS DIASERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 54 (1860), pl. D 12. fig. 4.

Syn. *Ecmesus*, Phil.; *Hemicyathus*, Seguenza.

Corallum simple, free, discoid, low. Wall naked and costulate, imperforate; margin lobed, irregular. In the young state composed of separate pieces or lobes which unite irregularly during growth. Septa irregular, uniting, numerous, serrate or dentate. Synapticula exist. Columella rudimentary or absent.

*Distribution*.—*Fossil*. Miocene, Pliocene: Europe.—*Recent*. Florida, Barbadoes, North Atlantic, Pacific, Australia.

Many species of *Cyclolites* were described by me in the "Fossil Corals and Alcyonaria of Sind," 'Palæontologia Indica,' Series xiv. (1880), pp. 52-55. E. Pratz considers that the forms should pass into another genus, and presumably because the septa are imperforate and there is no endotheca. Certainly now that it is clear that the typical *Cyclolites* had perforate septa and dissepiments, the species from the Eocene of Sind differ generically from it. I have founded the genus *Zittelofungia* to meet the want caused by the necessary removal of *Cyclolites* into the Plesioporitidæ.

GENUS ZITTELOFUNGIA, *Duncan*.

Syn. *Cyclolites*, Lmk.

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.

The genus differs from *Cyclolites*, as amended by Pratz, in having imperforate septa and no dissepiments. The species are described in the "Fossil Corals and Alcyonaria of Sind," Pal. Indica, Ser. xiv., 1880. The French Eocene *Cyclolites* probably belong here.

Genus BATHYACTIS, *Moseley, Report on Corals, 'Challenger'*  
*Voyage*, p. 185, pl. xi. (1881).

Syn. *Montlivaltia*, Tonnison Woods; *Fungia*, Pourtalès, non Dana.

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 continuations. Upper margins of septa usually coalescent over the apices of the deltas. Septa deeply toothed. Synapticula sometimes abundant, sometimes few, arranged in a series of concentric circles. Columella well developed. Base costulate. No epitheca.

*Distribution.*—*Recent.* Deep water, from 30 fathoms to 3 miles, North and South Atlantic, Caribbean Sea, South-Indian Ocean, Malay Archipelago, West and East Pacific, Australian seas.

The specimens show that the columella is often reduced to the junction of septa only.

Moseley makes some most valuable remarks on the influence of growth and nutrition on the species of *Bathyactis*:—"In some specimens, dredged on a siliceous bottom composed of Diatom skeletons, the wall is excessively thin, and towards its marginal region is perforated by a series of apertures on either side of the costæ." "When a specimen hardened in spirit is decalcified, the wall of the corallum in dissolving in the acid becomes perforated by a similar series of apertures, yielding first at these spots."

Genus ASTEROSERIS, *E. de Fromentel, Pal. Franç., Terr. crét.*  
tom. viii. p. 328 (1867).

Syn. *Stephanoseris*, E. de From., non Ed. & H.

Corallum hemispherical, with an imperforate basal plateau, which is discoid and covered with granulations which are in radiating lines near the edge. Columella slightly developed, and reduced to three or four slightly visible points. The septa are large, unequal, and strongly granulated where free. Pali well developed before the tertiary septa. Synaptacula present.

*Distribution.*—*Fossil.* Cretaceous: Europe.

M. de Fromentel does not say anything about the dissepiments or the condition of the septa.

Genus MICROSERIS, *E. de Fromentel, Pal. Franç., Terr. crét.*  
No. 23 (1870), p. 367.

Corallum hemispherical. Wall horizontal, naked, and covered with sparsely distributed granulations which do not simulate costæ. Septa large, arched, uniting in joining at the centre of the calice, where there is a little rounded fossula. Synaptacula rare, but well developed.

*Distribution.*—*Fossil.* Cretaceous: Europe.

This genus requires further consideration.

### III. Alliance PSAMMOSERIOIDA.

Simple Lophoseridæ with the base containing a Sipunculid worm or growing on univalve shells, low. Penultimate septa well developed. With or without pali. No epitheca.

Genus PSAMMOSERIS, Ed. & H.

Genus STEPHANOSERIS, Ed. & H.

Genus PSAMMOSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 55 (1880), pl. x. figs. 9, 9a; *Ann. des Sci. Nat.* 1848-49, *Zool.* tom. 9; *amended.*

Corallum simple, low; base broad, containing a Sipunculid worm; sides perforated with several apertures. The wall is thick, naked, strongly granulate, and barely striated below, costulate elsewhere. Calice circular. Columella spinulose, papillary. Septa low, thick, close, granular; primaries and secondaries longest and largest; the septa of the fourth cycle next in length, and uniting axially in front of the tertiaries.

*Distribution.*—*Recent.* Chinese seas, Malacca.

Genus STEPHANOSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 56 (1860).

The corallum is short, with an unsymmetrical tumid base, which is larger than the calice. Base containing a Sipunculid worm, and perforated with large and small apertures, or fixed on a Gastropod shell. Calice circular or subcircular, open. Septa numerous, well developed, arched, tall, subentire, denticulate axially. Septa of first and second orders tallest; those of last cycle close to and nearly as high as their neighbours of the earlier cycles. Pali before all septa except the last cycle, small, arched. Columella trabeculate, and minutely papillary at the surface. Costæ large, unequal, granular, with deep narrow intercostal spaces. Underpart of base smooth or granular, not costulate except at the edge. Wall very thick, solid. Granules on septa numerous, elongate, radiating.

*Distribution.*—*Recent.* Indian Ocean, Corean sea, Philippines, Zanzibar.

This last genus was placed by Gray amongst the Heterocyathi, and separated by Jules Haime on account of its internal structures. I place it here with much doubt; for I have not found synaptacula in any specimens, and the details of the soft parts are not known. Indeed this Alliance is unsatisfactorily placed, and requires greater revision than materials will at present permit of.

#### IV. Alliance PODOSERIOIDA.

Simple Lophoseridæ with a wide base of attachment. Calice convex, with a central fossula. Costæ distinct, and covered or not with epitheca.

Genus PODOSERIS, Duncan.

Genus EPISERIS, E. de From.

Genus PODOSERIS, *Duncan, Supp. Brit. Foss. Corals, Pal. Soc. Lond.* Pt. ii. No. 1, p. 25 (1869), *amended in* Pt. iii. p. 24.

The corallum has a wide or pedunculate base of attachment; the height varies, but the calice is generally narrower than the base, and is convex. Its central fossula is circular and small. The columella is formed by the septal ends; and the septa are numerous, close, unequal, uniting. The costæ are distinct, straight, and covered more or less by epitheca. Synaptacula numerous.

*Distribution.*—*Fossil.* Oolite and Cretaceous: England.

Genus EPISERIS, *E. de Fromentel, Introd. à l'étude des Polyp. foss.*  
p. 123 (1859).

Corallum tall, at first horizontal and then cylindrical. Epitheca strongly developed and folded. Septa very exsert, finely dentate. Columellary fossula very elongate.

*Distribution.*—*Fossil.* Cretaceous : Europe.

The typical species, *Episeris macrostoma*, is a very large coral, and is not without its affinities with *Podoseris*, nobis.

#### Group-Genus GONIOSERIS, *Duncan.*

Genus GONIOSERIS, *Duncan, Pal. Soc., Supp. Brit. Foss. Corals,*  
Ser. 2, Pt. iii. p. 21, pl. vii. (1872).

Corallum simple and free. Base polygonal, projecting angles formed by groups of costæ ending in septa. Margin concave between the angles. Centre of base concave. Costæ numerous, covering the base and converging in groups at each angle along a line leading from a large septum to the centre. Upper surface convex, divided by masses of septa continuous with the costæ from the base of the angles. They are exsert externally, and reach the axial space, where they meet. There is a large prominent primary septum in each mass. The calicular wall is not seen from without. Synapticula broad and numerous.

*Distribution.*—*Fossil.* Inferior Oolite · England.

## 2. Subfamily *Lophoseridæ aggregatæ.*

### I. Alliance CYATHOSERIOIDA.

Colonial Lophoseridæ, trochoid or depressed turbinate in shape. Common wall naked and costulate. Calices superficial, radiating, and with confluent septo-costæ.

Genus CYATHOSERIS, Ed. & H.

Genus CRATEROSERIS, Tomes.

Genus THAMNOSERIS, Etallon.

Genus CYATHOSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 59 (1860).

Colony trochoid, adherent. Calices superficial and tolerably distinctly radiating. Septa long, thick, granulate laterally and confluent. Columella papillary or rudimentary. Wall of the colony naked and striated, and sometimes folded so as to

produce lobes or collines at the articular surface. Synapticula exist.

*Distribution.*—*Fossil.* Cretaceous: Europe. Eocene: Europe, Asia.

GENUS CRATEROSERIS, *Tomes, Quart. Journ. Geol. Soc.*  
vol. xxxix. p. 560 (1883).

Corallum composite, massive, depressed turbinate; calicular surface superior and convex. There is a common wall which is naked and costulated. The calices are evenly distributed, round and prominent, but depressed in the middle; and they have a well-defined fossula. The intercalicular spaces are depressed. The septa are imperforate; margins moniliform and continuous with septo-costæ, which pass from one calice to another without interruption. Septa and septo-costa have synapticula attached to them. Increase by gemmation between the calices at the outer margin.

*Distribution.*—*Fossil.* Portland Oolite: England.

No section is given of this form; and in the description of the species the synapticula are said to be rather small.

There is some doubt about the next genus, and regarding its proper alliance. M. de Fromentel notices ('*Introd. à l'étude,*' p. 241) a species of a genus called *Thamnoseris* which had been communicated to him by Etallon; and this author remarks on M. de Fromentel, and gives a correct generic diagnosis of the genus in his '*Lethæa Bruntrutana,*' Zurich, 1864, p. 406.

GENUS THAMNOSERIS, *Etallon, Lethæa Bruntrutana,*  
p. 406 (1864).

Colony in rounded masses or in thin laminæ. Epitheca thin and complete. Columella papillary. Septa confluent, thick, covered on their free edge and flanks with very projecting granules which are close together, and constitute more or less numerous synapticula.

In a description of a species, *Thamnoseris Froteana*, Etallon, *op. cit.* p. 406, pl. lvii. fig. 10, it is stated that the corallum is conical and turbinate, with growth-rings on the inferior plateau, and sometimes even on the circumference of the corallum. Upper surface subplane, or a little convex and irregular. Calices subequal, usually polygonal, with a well-marked centre. Septa unequal according to the orders, of slightly different thickness;

three cycles and part of the fourth. Synapticula rare. Columella fasciculate, vermiculate, and distinct.

The delineation of the species is a mere sketch; but it shows that the calices are close and separated by a mere ridge, over which, from the description, we may presume the septa are confluent with their neighbours. The calices are deepish.

Now in the species noticed by De Fromentel the calices are also deep; the septa are confluent and in bundles. Neither Etallon nor De Fromentel writes anything about the structure of the septa, whether they are perforate or merely trabeculate or solid.

Etallon lays stress on the fact that there are no dissepiments between the septa.

The generic diagnosis might now be stated as:—

Colony variable in shape, amorphous and convex, turbinate and conical, or in lamellæ. Corallites low and small, polygonal, close. Calices rather deep, polygonal, separated by narrow margins, over which the septa pass. Columella fasciculate and papillary, fused. Septa in three or four incomplete cycles, well-developed, often uniting, thickish, but diminishing in width in the higher orders, granulate on the free edge and on the flanks, close. Synapticula small, variable in number. Dissepiments wanting. Epitheca exists; and it and the colony may be marked with growth-rings.

*Distribution.*—*Fossil.* Jurassic: Europe.

## II. Alliance PAVONIOIDA.

Colonial Lophoseridæ in thin, frondiform, curled, adherent laminæ, crested or not. With an imperfect or synapticulate calicular wall. Calices numerous, distinct or indistinct; on one or on both sides of the fronds. Collines or crest-like ridges exist. Septa occasionally more or less trabeculate and perforate, or solid.

Genus *LOPHOSERIS*, Ed. & H.

Genus *TICHOSERIS*, Quelch.

Genus *MYCEDIUM*, Oken.

Genus *PHYLLASTRÆA*, Dana.

Genus *TRACHYPORA*, Verrill.

Genus *LEPTOSERIS*, Ed. & H.

Subgenus *HALOSERIS*, Ed. & H.

Genus *PROTOSERIS*, Ed. & H.

Subgenus *PHYLLOSERIS*, Tomes.

Genera absorbed:—

*PAVONIA*, Lamarck; *ECHINOPHYLLIA*, Klunzinger.

*Phylloseris*, Tomes, and *Haloseris*, Ed. & H., become subgenera.

Genus *LOPHOSERIS*, *Milne-Edwards & Jules Haime*, 1849; *Lamarck, Hist. Anim. sans Vertéb.* t. ii. p. 238 (1816); amended *Journ. Linn. Soc., Zool.* vol. xvii. (1883), p. 313, pl. xiii. figs. 7-12.

Syn. *Pavonia*, Lmk.

Colony adherent, thin, foliaceous, erect, in lobes or crests, irregular in shape, with radiating calices, confluent by their septo-costæ; on one or both surfaces and between and on low crests placed more or less vertically, over which septo-costæ pass. Columella tubercular or rudimentary, deep. Common plateau naked and striated. Septa solid or trabecular in parts. Calices rather elongate, circular when young, surrounded by a wall or by synapticula fused into a mural condition. Synapticula well developed, and distinguishable from ornamental granulation. Gemmation occurs between the calices and amongst the septo-costæ.

*Distribution.*—*Recent.* Pacific, from west coast of America to Australia, east of China, Japan, Hong Kong, Indian Ocean, Red Sea, Burmese seas.

Verrill states that it does not exist in the Atlantic.

Subgenus *HALOSERIS*, (genus) *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. iii. p. 77 (1860); *L. Rousseau, Voy. au Pôle Sud* (1834).

Colony fixed, forming small frondescant folded laminae, much incised at the edges, and crispate. Calices indistinct on the internal surface, which is covered with very long septo-costal rays, which are very granulated. Columella rudimentary. External surface delicately striated. Synapticula exist.

*Distribution.*—*Recent.* Philippines.

Genus *TICHOSERIS*, *Quech, Ann. & Mag. Nat. Hist.* 1884, vol. xiii. p. 295.

Corallum compound, massive, columnar or lobate, with neither transverse calicinal ridges nor longitudinal crests, astræiform. Calicles with distinct solid walls, which are thin at their edges but thick at their basal parts; calicinal centres arranged either singly within their own wall, or united in more or less irregular and sinuous groups of two or more, incompletely separated from each other and surrounded by the common wall of the calicle from which they are developed. New calicles arise either by

direct fission of a single calicle forming two separate ones with distinctly raised walls, or by the upgrowth of the synapticula at different parts of the calicle to form new walls, the resulting centres often forming mæandroid series, until the development of their own wall isolates them. Septa not at all confluent, entire, those of adjoining calicles quite separated by the raised walls. Columella absent or forming a very small styliiform projection at the point of coalescence of the septa. Synapticula distant, very unequally and irregularly developed, being generally rather thick interseptal outgrowths of the wall.

*Distribution.*—*Recent.* Fiji Islands.

Genus MYCEDIUM, Oken, *Lehrb. der Natur.*, Zool. 1815; Milne-Edwards & Jules Haime, *Hist. Nat. des Corall.* vol. iii. p. 72 (1860), pl. D 12. fig. 2; Pourtalès, *Deep-Sea Corals*, p. 48.

Colony frondiform. Calices well developed, circumscribed, usually a central one surrounded by concentric series of others, inclined and submammillate, projecting or flat. Columella variable, papillary, compressed, tubercular, or absent. Septo-costæ long, continuous. Synapticula exist. Common under-surface naked and variably costulate.

*Distribution.* — *Recent.* Caribbean Sea, East-Indian seas, Pacific.

Reuss noticed the genus in the Eocene, but probably the form was a *Thamnastræa*.

The variation in the species of this genus has been commented upon by Pourtalès, and it is evident that it is but slightly removed from *Lophoseris*.

Dana introduced the genus *Phyllastræa* to include *Mycedium Okeni*.

Genus PHYLLASTRÆA, Dana, *Zoophytes U. S. Explor. Exped.* 1846, p. 40; see *Hist. Nat. des Corall.* vol. iii. p. 75, pl. D 12. fig. 1.

Syn. *Oxypora*, Kent.

Colony foliaceous; polypes prominent and opening upward. Coralla striated, scarcely echinulate. Costal striæ coarse, unequal and scabrous. Calices large, margins projecting, and attached laterally to the folia. Septa thin and spinulose. Columella spongy.

*Distribution.*—*Recent.* Amboyna, Pacific.

GENUS TRACHYPORA, *Verrill, Bull. Mus. Comp. Zool., Camb. Mass., 1864, No. 3, p. 53.*

Syn. *Echinophyllia*, Klunzinger, *Corall. des Roth. Meer. p. 69 (1879).*

Colony explanate, thin; below echinate and coarsely costate; above with scattered polyp-centres destitute of walls, with one or two cycles of septa radiating at the centres, but becoming subparallel between them, as in *Halomitra*, strongly dentate or lacerately lobed. The strongest lobes surround the polyp-centres. Columella loose, trabecular.

*Distribution.*—Includes *Echinopora aspera*, Ellis and Solander, of the East Indies.

Klunzinger places the genus between *Halomitra* and *Mycedium* and *Echinopora*. It looks like a Thamnastræan amongst the *Echinopora*.

GENUS LEPTOSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall. vol. iii. p. 76 (1860).*

Colony adherent, in very thin laminæ, often folded or irregularly twisted, pedunculate or not. Calices not numerous; a large central one surrounded by small ill-defined but radiating concentric calices. Septo-costæ very long. Columella tubercular. Beneath, the surface is naked and delicately striated.

*Distribution.*—*Recent.* Ile de Bourbon.—? *Fossil.* Eocene: Europe.

The genus *Protoseris*, Milne-Edwards & Jules Haime, *Brit. Foss. Corals, Oolitic (Pal. Soc. Lond. 1851), p. 103, tab. xx.*, is clearly closely allied to *Lophoseris*, Lamarck (1816). The distinction is the papillary columella, for the frondescent shape is found in *Lophoseris*. In this last genus the columella is tuberculous or rudimentary. It is interesting to find the genus *Lophoseris* foreshadowed in the Jurassic age.

GENUS PROTOSERIS, *Milne-Edwards & Jules Haime.*

Colony foliaceous, ascending, folded, and lobed, more or less funnel-shaped. Calices superficial and distant, separated neither by crests nor by ridges. The columella is papillary. The septa are flexuous and confluent. The lower surface of the laminæ is costulate and without epitheca. Synapticula exist.

*Distribution.*—*Fossil.* Jurassic: England.

Subgenus PHYLLOSERIS, (genus) *Tomes, Quart. Journ. Geol. Soc.* vol. xxxviii. p. 447 (1883).

Differs according to its describer wholly in the way in which the fronds are produced (? developed), and in the presence of a strongly developed epitheca, from *Protoseris*. The only distinction is the presence of an epitheca, which is not generic. Hence the species *Phylloseris rugosa*, Tomes, must come within the scope of the genus *Protoseris*. I place *Phylloseris* as a subgenus of *Protoseris*. Its sole locality is in the Lower Oolite of England.

### III. Alliance STEPHANARIOIDA.

Colonial Lophoseridæ, massive, incrusting, or lobate and subdendroid. Septo-costæ confluent and well developed. Walls absent or indistinct. No collines.

Genus STEPHANARIA, Verrill.

Genus PRATZIA, Duncan.

GENUS STEPHANARIA, *Verrill, Trans. Connect. Acad. i.* p. 340 (1867).

Colony in short lobe-like branches. Calices moderately large, with two or three cycles of septa, denticulate on the edge, well developed and confluent. Walls indistinct or wanting; the division between the calices indicated only by small granular points, which sometimes interrupt the septa of adjoining calices. Columella papillose. Paliform papillæ before all the principal septa, the inner ones becoming confounded with the columella.

*Distribution.*—*Recent.* West-American coast.

### Genus PRATZIA.

Syn. *Plerastræa*, Duncan, *Foss. Corals &c. of Sind*, 1880, p. 65, *Pal. Indica*, Ser. xiv.

The colony is massive, incrusting. Calices superficial. Columella substyloid, produced by the septal ends. Septa solid, arranged in several lozenge-shaped or triangular groups, confluent, crowded. Walls absent. Synapticula abundant, close, and reach high up in the interseptal loculi. Endotheca absent. Epitheca absent.

*Distribution.*—*Fossil.* Eocene of Sind, Asia.

## IV. Alliance AGARICIOIDA.

Colonial Lophoseridæ, foliaceous or massive, or incrusting. Calices distinct or indistinct, in series separated by collines. Septo-costæ confluent and extending over the collines.

Genus AGARICIA, Lamarck.

Genus PLESIOSERIS, Duncan.

Genus PACHYSERIS, Ed. & H.

Genus COMOSERIS, d'Orb.

Subgenus OROSERIS, Ed. & H.

Genus HYDNOPHORABACIA, d'Achiardi.

Genus COSCINARÆA, Ed. & H.

The genus *Oroseris* becomes a subgenus.

Genus AGARICIA, *Lamarck, Syst. des Anim. sans Vertèb.* (1801);  
*Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii.  
p. 80 (1860).

Syn. *Undaria*, Dana.

Colony foliaceous and irregular in shape. Calices on one or both surfaces, circumscribed or limited at least on two sides, in transverse or concentric series, which are separated by unequal ridges (collines), over which the confluent septo-costæ pass. Columella tuberculous, papillose, or compressed. Septa confluent, not numerous. Common plateau striated and naked. Synapticula exist.

*Distribution*.—*Fossil*. Miocene of Sind, Asia; Europe.—*Sub-fossil*. Red Sea.—*Recent*. Caribbean Sea, Indian Ocean, Red Sea.

Genus PLESIOSERIS, *Duncan, Journ. Linn. Soc., Zoology*,  
vol. xvii. p. 309 (1883).

Syn. *Mæandroseris*, Rousseau (pars).

Colony massive, adherent, and without epitheca. Surface irregular and nodular. Calices in short series, confluent by their septo-costæ and with distinct centres. Septa often uniting, solid, except near axial space, where they are trabeculate with ascending processes; granular on the sides, warty and spinulose on the free edges. Columella well developed and papillary. Synapticula of two kinds:—1, long, broad, and vertical, in two rows near the true calicular wall; 2, small and nodular, near the axial space. Eminences between the series of calices covered by septo-costæ, and having a true wall. Growth by gemmation beyond and between the calices.

*Distribution*.—*Recent*. Pacific.

This genus, characterized by its solid septa, walls, and synapticula, and serial calices, includes *Mæandroseris*, now *Plesioseris*, *australiæ*, Rousseau, sp.

Genus PACHYSERIS, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 85 (1860); *Duncan, Journ. Linn. Soc., Zool.* vol. xvii. p. 309 (1883), and *Pal. Indica*, Series xiv. *Foss. Corals &c. of Sind*; amended.

Colony adherent, foliaceous, very variable in shape. Base a thin solid wall, which is costulate. Upper surface presenting long concentric eminences or collines and intermediate valleys, the first crossed by parallel septo-costæ, the latter showing an axial space, with or without a projecting columella close to the end of the septa. No distinct calices or radiating series of septa. The series of septa in the valleys are long and very bifurcate. Columellary space very long and filled up by series of tabulate dissepiments. Septa close, finely dentate and granular on their sides, rarely perforate. Synapticula long vertically, and occupying the position of a colline-wall, and small and nodular, and placed on the septa close to the columellary space.

*Distribution.*—*Fossil.* Lower Eocene of Sind, Miocene of Sind. —*Recent.* Pacific and Indian Oceans.

Genus COMOSERIS, *d'Orbigny, Note sur les Polyp. foss.* p. 12 (1849).

Colony thick, attached or free, base covered with a stout epitheca. Upper surface with calices more or less close, distinct at their centres, and with confluent septa, separated at certain points by collines, over which the septo-costæ pass. Collines long or short, narrow or broad, straight or curved, radiating from the centre of the upper surface or not. A rudimentary columella. Septa united by synapticula. No wall around the calices or in the collines. A basal wall, which is solid and marked with costæ, underlies the dense epitheca.

*Distribution.*—*Fossil.* Jurassic: Europe. Cretaceous: India.

There is a very fine specimen of *Comoseris irradians*, Ed. & H., in the Museum of the Geological Survey in Jermyn Street, which shows the construction of the septa and synapticula very well. The septa are slender, trabeculate, but imperforate, and there are the same kind of endothecal processes as are seen in *Thamnastræa*.

The epitheca is worn off, and the striated, costulate, basal wall

is well shown; it is imperforate. Before *Thamnastræa* was shown to have synapticula, the distinction of the two genera was evident, and *Comoseris* was the solitary example of a fossil Fungid with confluent calices and an epitheca. It is now closely allied to the endothebate *Thamnastrææ*, the sole distinction being the presence of collines in *Comoseris*.

In introducing several new species of *Oroseris* to the Oolitic coral-fauna of England, Mr. R. Tomes, F.G.S., asserts (Quart. Journ. Geol. Soc. vol. xxxviii. p. 440) that the genus really bears but a faint resemblance to the genus *Comoseris*. He seems to have misunderstood the diagnoses of the genera, for it must appear on reading them that *Oroseris* can hardly stand as a genus distinct from *Comoseris*. The only distinction is the length of the ridges bounding the calicinal valleys.

In many parts of the corals of both genera, there are no ridges for a certain space, every calice not being thus separated, so that such areas dismembered would resemble species of *Thamnastræa*. It is this fact which brings the forms so closely together. The presence of the ridges or collines, so continuous in the species, cannot be put on one side in classification, and especially in the face of the allied genera *Mæandroseris* and *Plesioseris*.

In placing *Oroseris* as a subgenus of *Comoseris* it must be admitted that the first-named form has a more varied shape than was given to it by Milne-Edwards and Jules Haime. Mr. Tomes has delineated an incrusting form and a semi-massive, irregular one, and also a species massive and with a lobed outline. He has shown also that the epitheca may be strong and wrinkled, indeed as much so as in *Comoseris*.

Subgenus OROSERIS, (genus) *Milne-Edwards & Jules Haime*,  
*Pol. Foss. des terr. Pal.* p. 130 (1851).

Colony in rather thin laminae, and the basal wall is either naked or covered with a rudimentary, or strong and wrinkled epitheca. The calices are subconfluent and separated irregularly by transverse subcristiform eminences (collines), which usually, but not invariably, limit simple series of calices and do not extend the length of the colony. The columella is rudimentary.

*Distribution.*—*Fossil.* Jurassic? England, Europe. Neocomian? : Europe. Cretaceous: England. Eocene: Europe. Miocene of Italy.

Genus *HYDNOPHORABACIA*, *d'Achiardi, Corall. Eocenici del Friuli, Pisa, 1875, p. 72, tav. xiii. figs. 3, 4, 5.*

Colony frondiform. Calices distributed over the upper surface and having conical eminences between them. Septa confluent, granular where free. Columella papillary. Synapticula well developed. Base of colony echinulated and finely vermiculate.

*Distribution.*—*Fossil.* Eocene: Europe.

There is an undescribed genus, represented by two specimens in the British Museum, in which the collines are irregular, longer than in the above, covered by close septa-costæ. The columella is styliform. Colony massive. It is clearly allied to the above, but yet distinct.

Genus *COSCINARÆA*, *Milne-Edwards & Jules Haime, Monogr. des Poritides, p. 48; Compt. Rend. t. xxvii. p. 496 (1848); amended; Duncan, Journ. Linn. Soc., Zool. vol. xvii. p. 314 (1883).*

Colony massive, partly incrusting, convex above, with irregular-shaped, rather deep calices in short series, with slightly projecting intermediate eminences. Calicular centres usually distinct; septa uniting with those of neighbouring calices and extending over the eminences. Some septa are simple and others unite by their sides with larger ones; spinulose at the free edge, perforate and trabeculate, except near the solid basal wall, which is very thin and costulate. Columella deep, small and papillary. Synapticula more or less in vertical series, discontinuous and stout. No walls between the calices. Gemmation between the calices, on the eminences, and intervening spaces.

*Distribution.*—*Fossil.* Cretaceous: India?—*Recent.* Red Sea; Mauritius; Burmese seas.

A careful examination of numerous specimens of species in the British Museum and in my own collection, has not enabled me to discover endothecal dissepiments. Milne-Edwards and Jules Haime drew them, but Klunzinger's photographs do not show them. Probably the stereoplasm-looking endotheca in Milne-Edwards's plate is the result of irritation from parasitic growth. The thin basal wall in the specimens from Mergui resembles epitheca more than theca.

## IV. Family ANABACIADÆ.

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

Genus ANABACIA, d'Orb.

Genus GENABACIA, Ed. & H.

Genus ANABACIA, *d'Orbigny, Note sur les Polyp. foss.* p. 11 (1849).

Corallum simple, free and without a trace of adherence, plano-convex or biconvex in shape. The upper surface has a central shallow fossette without a true columella. The septa are very numerous, close, uniting, and are continued over the edge to the base, where their free edges are in the position of costæ. They extend from the base vertically to the upper surface, are trabeculate and perforate, and delicately spined or crenulate at their free edge. There is no basal wall, and the septa unite by synapticula.

*Distribution.*—*Fossil.* Jurassic: England and Europe.

Genus GENABACIA, *Milne-Edwards & Jules Haime, Compt. Rend. Acad. des Sci.* t. xxix. p. 71 (1849).

Colony sublenticular, base naked and perforate. A central calice surrounded by one or two circles of smaller size with confluent septo-costæ. Septa trabeculate, perforate, thin, close rather numerous, crenulated where free. Calicular fossette not, deep. No basal wall.

*Distribution.*—*Fossil.* Middle and Inferior Oolite: Europe.

Transitional group.

## V. Family PLESIOPORITIDÆ.

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

## Alliances.

## I. LEPTOPHYLLIOIDA.

## II. MICROSOLENOIDA.

## Groups CYCLOLITES and MYCETARÆA.

## I. Alliance LEPTOPHYLLIOIDA.

Simple Plesioporitidæ, turbinate, conico-cylindrical, fixed or not. Epithea present or absent. Septa very numerous, trabeculate, perforate, uniting, joined by synapticula.

Genus LEPTOPHYLLIA, Reuss.

Subgenus THECOSERIS, E. de From.

Subgenus TROCHARÆA, Etallon.

The genera *Thecoseris* and *Trocharæa* become subgenera; *Haplaræa* is not placed.

Genus LEPTOPHYLLIA, *Reuss, Denkschr. der Wiener Akad. der Wiss.* t. vii. p. 101 (1854); *Pratz, Palæontographica*, p. 90 (1882).

Syn. *Haplaræa*, Milas.

The corallum is simple, fixed, and pedunculated; the wall is naked and marked with close costæ, which are numerous and granular. The calice is circular or subovular or elliptical in outline. The columella is absent. The septa are very numerous, close, thin, often uniting, and are composed of vertical trabeculæ with vertical rows of perforations between them. Synapticula occur in abundance, and are found high up in the interseptal loculi. Dissepiments occur in the interseptal loculi. Epithea absent.

*Distribution.*—*Fossil.* Jurassic, Cretaceous: Europe.

It is not possible to retain the genus *Haplaræa*, as its distinction from *Leptophyllia* is having an epithea, and this is not generic in importance.

Subgenus THECOSERIS, (genus) *E. de Fromentel, Pal. Franç., Zooph., Terr. cré.* p. 367 (1869).

Corallum elevated and regularly turbinate. Calice concave, and the fossa round. Septa thin, numerous, not exsert, often anastomosing and finely denticulated, the larger usually meeting in the centre of the calice and forming a false columella. Wall thin, costæ numerous, covered to the margin of the calice by a strong folded epithea. Synapticula feebly developed.

*Distribution.*—*Fossil.* Oolitic: England. Cretaceous: Europe, India.

Subgenus TROCHARÆA, (genus) Etallon, *Lethæa Bruntrutana* (Zurich, 1864), p. 411.

Corallum simple, largely fixed, having the structure of *Microsolena*. It approaches the genus *Anabacia*, but has more distinct (latticework-like) septa and is broadly adherent. No epitheca.

The species described and delineated by Etallon (*op. cit.* p. 411, pl. lviii. fig. 4) is *Trocharæa actiniformis*. A small short corallite, cylindrical, and hemispherical above, largely fixed, the base being broader than the calice. Calicinal central fossette narrow and deep. Septa latticework-like, stout, in five cycles, the last being more or less incomplete. Columella indistinct. Height 7 millim.

*Distribution.*—*Fossil.* Jurassic: Europe.

I give the diagnosis of *Haplaræa*, but do not place the genus.

Genus HAPLARÆA, Milaschewitsch, *Nattheim. Korallen*, Abtheil. ii., *Palæontographica*, xxi. p. 228 (1875).

Corallum simple, cylindrical, tall, deeply indented with broad circular growth-rings, and furnished with a smooth epitheca (here and there). The calice is shallow and elliptical. There is no columella. The septa are very numerous, well developed, and perforated by large apertures distributed without order. The younger septa unite with the others, and all are united by numerous well-developed synapticula.

*Distribution.*—*Fossil.* Jurassic: Europe.

#### Group-Genus CYCLOLITES, Lamk.

Genus CYCLOLITES, *Lamarck, Syst. des Anim. sans vertèb.* p. 369 (1801); *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 37 (1860); *E. Pratz, Palæontographica*, xxix. 1882, p. 7, Taf. xiv. figs. 1-8; *amended.*

The corallum is simple, free, circular, elliptical, or slightly angular in outline, flat or slightly concave at the base, where there is a well-developed concentrically folded epitheca, convex more or less above. Fossula circular or elongate. Columella

rudimentary or absent. Septa very numerous, close, unequal, often uniting, denticulate where free, trabeculate in construction, with regular nodules, partly solid and often perforate, then forming a latticework. Synapticula feebly developed, or elongate and visible. Dissepiments exist.

*Distribution.*—*Fossil.* Jurassic, Cretaceous: Europe, India.

## II. Alliance MICROSOLENOIDA.

Colonial Plesioporitidæ, polymorphous, massive, dendroid, lobed or subplane. A wall often present, with costæ. Septa trabeculate and perforate. Synapticula present.

Genus MICROSOLENA, Lamour.

Genus POLYPHYLLOSERIS, E. de From.

Genus THAMNARÆA, Etallon.

Genus DIPLARÆA, Milas.

Genus DISARÆA, E. de From.

Genus DIMORPHARÆA, E. de From.

Genus LATIMÆANDRARÆA, E. de From.

Genus MEANDROSERIS, Rousseau.

The genera DENDRARÆA, d'Orb., ACTINARÆA, d'Orb., DIMORPHOSERIS, Duncan, and MEANDRARÆA, Etallon, are absorbed.

Genus MICROSOLENA, *Lamouroux, Exp. Méthod. des genres des Polyp.* p. 65 (1821); *amended.*

Syn. *Dendraræa*, d'Orb.; *Actinaræa*, d'Orb.

Colony massive, polymorphous, mamilliform, conical, with a broad base, nearly spherical, turbinata and pedunculate, and lobed, gibbous, lamelliform, or digitiform and subramose. Basal wall with delicate costæ covered with a strong epitheca. Calices shallow, close or distant without order. Septo-costæ straight or curved, delicate, close, confluent, in groups or not, minutely pointed with small spinules above, and formed by vertical trabeculæ swollen regularly and forming a regular latticework of perforations. Columella very small or absent. Synapticula abundant, small. No calicular walls.

*Distribution.*—*Fossil.* Jurassic: England, Europe. Trias: ? Europe.

Genus POLYPHYLLOSERIS, *de Fromentel, Pol. Foss. de l'étage Néocomien*, p. 67 (1857).

Colony massive and convex. Corallites united by a costal

development. Calices circular on dome-like projections, with a central, circular, well-marked fossette. The septa are numerous, toothed, uniting and joined by well-developed synapticula. The basal epitheca well developed, and hiding delicate and numerous costæ.

*Distribution.*—*Fossil.* Cretaceous: Europe.

Genus THAMNARÆA, *Etallon, Lethæa Bruntrutana*, p. 411 (1864).

Colony branched or elongate, dense, strongly perforate as if vermiculate. Calices superficial. Columella sometimes tubercular. Septa confluent, irregular, more or less bent and echinulate (perforate in the delineation). Wall absent. Synapticula?

*Distribution.*—*Fossil.* Jurassic: Europe.

This genus, with a very Microsolenian facies, is allied to the Perforate genus *Psammocora* by Etallon. E. Pratz places it, however, in the neighbourhood of *Microsolena*.

Genus DIPLARÆA, *Milaschewitsch, Nattheim. Korallen*, Abth. ii., *Palæontographica*, xxi. p. 299 (1875).

Colony dendroid, with a broad basal stem; branchlets more or less vertical. Calices more or less oval in outline, rounded off at the margin, and shallow. Columella spongy. Septa numerous, anastomosing, thick at the wall, thin near the centre of the calice; they are perforate near their inner ends. Synapticula well developed.

*Distribution.*—*Fossil.* Jurassic: Europe.

The illustration shows costæ, and probably there was an epitheca.

Genus DISARÆA, *de Fromentel, Introd. Polyp. foss.* p. 245 (1858–1861).

The colony is branched and in low bush-shaped forms, and the corallites arise low in the primary stem, and grow upwards, not separating much. There is no wall to the corallites, and the calicinal parts are convex and rounded, the calices having a circular fossette in their axis. The septa are very numerous and delicate, being composed of nodules and processes, the first being joined to the corresponding structures of the neighbouring septa. The costæ are covered with a delicate epitheca.

The author of this genus states that the internal construction

of the corallum closely resembles that of *Microsolena*. Gemination occurs on the margin of the calices or within them.

*Distribution*.—*Fossil*. Jurassic: Europe.

Genus DIMORPHARÆA, de Fromentel, *Introd. Polyp. foss.* p. 254 (1858-61).

Syn. *Dimorphoseris*, Duncan.

Colony polymorphous in a convex mass, or laminate. Calices shallow, a central larger one surrounded by others placed circumferentially. Septo-costæ continuous from the central calice to the others and between them. Septo-costæ numerous, and close or few. Free edge of the septa minutely punctate, and the rest of the structure as in *Microsolena*. An epitheca.

*Distribution*.—*Fossil*. Jurassic: England, Europe.

Genus LATIMÆANDRARÆA, de Fromentel, 1856, *Introd. Polyp. foss.* p. 247 (1858-61).

Syn. *Meandraræa*, Etallon.

Colony in a lobed and subplane form (laminate). Calices not very deep, distinct, and situated between rather high collines with rounded tops. Septa trabecular, spinulose, and confluent. Wall absent. Columella rudimentary. A thin but well-developed epitheca.

*Distribution*.—*Fossil*. Corallien of England, Europe.

The founder of this genus states that the septa resemble those of *Microsolena*, Lamouroux, and *Disaræa*, de Fromentel.

It appears that in some species the valleys are long, twisted at the centre, and straight at the circumference of the colony. The septo-costæ pass over the collines except in one instance, *L. Cotteaui*, E. de From., which is exceptional.

Genus MEANDROSERIS (pars), L. Rousseau in *d'Urville's Voy. au Pôle Sud*, t. v. p. 121, amended.

The colony is partly adherent and rather thick, has a basal imperforate costulate wall, which is naked and more or less sublobed. The calices are shallow, distinct, and are grouped in long or short linear series, which are separated by low collines or eminences. Septa extend from one calice to another and over the eminences, are dentate, trabecular, and perforate; perforation less low down. Columella small and papillary. Eminences low, long or short, and more or less radiating from the

centre. Synapticula, both small and large, occupying the place of a corallite-wall, and of that of the eminences also. Gemmation between the calices.

*Distribution*.—*Recent*. Red Sea, Indian Ocean.

This diagnosis refers to *Meandroseris* so far as it includes *M. Bottæ*.

Group-Genus MYCETARÆA, Pratz.

Genus MYCETARÆA, Pratz, *Palæontographica*, xxix. Band, Lieferug 2, p. 111 (1882).

Corallum simple, or composed of two or more confluent calices, growing in a succession of alternating oval, irregularly trochoid to cylindrical shapes. The young individuals either remain united close to the parent as they grow, or become separated and distinct in the upper portion, forming angular projections. Epitheca exists. Septa projecting, numerous, finely toothed, subequal, and built up of regular series of trabeculæ. Intertrabecular areas slightly or not filled in. Septal laminæ united by more or less regular synapticula.

*Distribution*.—*Fossil*. Jurassic: Europe.

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CHAPTER VI.

The Section Madreporaria Perforata, definition, and families. Family Eusammidæ, alliances and genera. Family Madreporidæ, alliances and genera. Family Poritidæ, alliances and genera.

III. Section MADREPORARIA PERFORATA, Ed. & H.

This section is thus described in the *Hist. Nat. des Corall.* vol. iii. p. 88, 1860, and was established in 1850.

“Corallum entirely or almost entirely composed of porous or reticulate cœnenchyma. Septal apparatus well characterized and primitively composed of six elements, but sometimes being represented only by series of trabeculæ. Dissepiments rudimentary. Tabulæ absent.”

This definition is correct as far as the end of the last sentence but one; but it requires some additions and alterations.

Section MADREPORARIA PERFORATA, *Ed. & H., amended.*

Corallum composed entirely or nearly entirely of porous or reticulate cœnenchyma. Visceral cavities intercommunicating, and not shut off from the surrounding medium. Septa either well developed, solid or slightly or much perforated, or represented by trabeculæ only. Dissepiments may or may not exist, and tabulæ also. Soft parts filling the porose sclerenchyma. Calices with a disk, tentacles, and interseptal mesenteries.

There are three families of the Madreporaria Perforata:—

- I. The EUPSAMMIDÆ (subfam. Ed. & H.).
- II. The MADREPORIDÆ, Ed. & H. (pars).
- III. The PORITIDÆ, Ed. & H.

Forty-two genera and five subgenera are included in these families. Twelve genera have been eliminated, but five become subgenera.

## I. Family EUPSAMMIDÆ.

This family includes the very important and now very large group which was considered to be only worthy of the position of a subfamily by Milne-Edwards and Jules Haime (*Eupsamminæ*, *Hist. Nat. des Corall.* vol. iii. p. 90, 1860).

The genera included have a very characteristic facies; and although their structures, both hard and soft, ally them most definitely with the Madreporaria Perforata, they are not without some affinities with the Fungida. The soft parts differ from the corresponding structures of the Fungida.

This distinction of the soft parts is important, for some of the species of Eupsammidæ have hard structures, which act as synaptacula, and resemble, to a certain extent, the corresponding structures of some of the Plesiofungidæ. Notably this is the case in *Eupsammia* and *Stephanophyllia*. Moseley's researches indicate that this last very fungoid-looking genus is clearly not one of the Fungida, for the soft parts differ (*Report on Corals*, H.M.S. 'Challenger,' p. 203).

## Family EUPSAMMIDÆ.

Syn. *Eupsamminæ*, Ed. & H.

Perforate Madreporaria, simple or in colonies. The corallite walls usually have costæ formed of sclerenchymatous nodules

joined by vertical and transverse processes, and having apertures in the intercostal spaces. Calices well developed. Septa in several cycles, some orders uniting with others, directly or by trabeculæ, to form symmetrical star-like patterns. Septal laminæ stout, and the principal ones entire and imperforate, except sometimes near the wall; the higher orders more trabeculate and perforate. Endotheca scanty. Sclerenchyma may exist. Epitheca occasional. Increase by gemmation and fissiparity.

Although there is a great family likeness amongst the genera now recorded, it is very difficult or impossible to place them all in definite Alliances. Some groups of single genera are therefore established.

But the Eupsammidæ indicate their right to be considered a family by having varieties of form which are noticed in other great families. There are simple and colonial types, and the forms are turbinate, discoid, incrusting and massive, dendroid, &c.; and there are types which undergo fissiparity, gemmation from the sides, and also from stolons.

There are the following Alliances in this family:—Stephanophyllioida, Balanophyllioida, Dendrophyllioida, Leptopsammioida.

#### I. Alliance STEPHANOPHYLLIOIDA.

Simple Eupsammidæ, with a discoid, basal, horizontal wall.

Genus STEPHANOPHYLLIA, Michelin.

Subgenus DISCOPSAMMIA, d'Orb.

Genus LEPTOPENUS, Moseley.

Genus CYCLOBACIA, Bölsche.

*Discopsammia*, d'Orb., becomes a subgenus.

Genus STEPHANOPHYLLIA, Michelin, *Article Astrée, Dict. des Sci. Nat., Supp. t. i. p. 484* (1841); *Icones Zooph. p. 32, pl. 8*; Moseley, '*Challenger*' *Report on Corals*, p. 198 *et seq.* (1881).

The corallum is simple, free, discoid, with a horizontal wall. Calice circular, with five cycles of septa, and some of a sixth, not projecting outwards, but large, high, thin, and close, uniting by their upper or internal borders, the primaries only being free, with conical projecting points on their sides. Septal edges dentate more or less near the axial space, and the laminæ are of fused trabeculæ more or less perforate. Columella distinct, in a well-marked calicular fossa. Costæ straight, delicate, and radi-

ating regularly from the centre of the base to the circumference, and formed of granules moderately distinct. Wall regularly perforate.

*Distribution.*—*Fossil.* Cretaceous, Eocene, Miocene, Pliocene: Europe and England. Tertiary: Asia.—*Recent.* Pacific, Philippines, and Ké Islands.

Subgenus DISCOPSAMMIA, *d'Orbigny, Note sur les Polyp. foss.*  
p. 10 (1849).

Corallum plano-convex, with a superficial calicular fossette, a rudimentary columella, and the free edges of the septa rounded and slightly denticulate.

*Distribution.*—*Fossil.* Cretaceous series of Europe.

This subgenus corresponds to the Lenticular *Stephanophylliæ* of Milne-Edwards and Jules Haime.

Genus LEPTOPENUS, *Moseley, Report on 'Challenger' Corals,*  
1879 (pub. 1881), p. 204.

Corallum discoid, excessively thin and fragile, with the wall so completely covered by perforations as to resemble lacework, being built up of a network of delicate radiating and circumferentially-directed trabeculæ. Perforations placed at regular intervals between the costæ, and each divided into two by the septa, which alternate with the costæ. Septa, except the primaries, which are free, coalescing successively according to order, and forming deltoïd figures beset with a series of long, outwardly-directed spines on their free margins; attached beneath to the transverse trabeculæ, which separate from one another the perforations of the wall by a series of short processes, in the intervals between which their lower margin is free. Columella large, spinous. Tentacles knob-bearing.

*Distribution.*—*Recent.* Sea-floor of Southern Hemisphere, deep water (over 1500 fms.), South Atlantic, South Indian Ocean, and off Valparaiso.

Genus CYCLOBACIA, *Bölsche, Zeitschr. deutsch. Geol. Gesell.*  
Band xviii. p. 473 (1866).

This is probably identical with *Fungia*, and is therefore a link between *Micrabacia* and *Fungia*. I do not place the genus.

*Distribution.*—*Fossil.* Cretaceous: Europe.

## II. Alliance BALANOPHYLLIOIDA.

Eupsammidæ with simple coralla, rarely budding, well-developed calices. Columella variable; and fully-developed septal orders. Costæ variable.

Genus BALANOPHYLLIA, S. Wood.

Subgenus THECOPSAMMIA, Pourtalès.

Genus EUPSAMMIA, Ed. & H.

Genus ENDOPACHYS, Lonsdale.

Genus HETEROPSAMMIA, Ed. & H.

*Thecopsammia*, Pourtalès, becomes a subgenus.

Genus BALANOPHYLLIA, *Searles Wood, Ann. & Mag. Nat. Hist.* vol. xiii. p. 11 (1844), *amended*.

Corallum simple, or budding around the base, but never forming true colonies or dendroid masses; fixed by a broad or narrow base, or pedicellate and becoming free, very variable in shape, and may be turbinate, straight, or curved, subturbinate, conico-cylindrical, and curved. Calice elliptical, rarely circular, sometimes deformed. Columella not projecting at the bottom of the calice, variably developed—long, narrow, wide or large, and finely spongy. Septa thin, close, numerous, perforate near the wall, the highest curve towards the penultimate, and larger than these; granular at the sides, and joining by the granules. Wall porous, variably stout. Costæ well developed, distinct, subequal. Epitheca present or absent.

*Distribution*.—*Fossil*. Eocene: England and Europe. Miocene: Europe. Pliocene: England and Europe.—*Recent*. Mediterranean, English Channel (*B. regia*), St. Helena, Madeira, Philippines, Fiji, Japan, Corea, Chinese seas, Australian seas, California, Caribbean Sea.

Subgenus THECOPSAMMIA, (genus) *Portalès, Deep-Sea Corals*, p. 43 (1871).

Corallum simple, attached, pedunculate, turbinate, or subcylindrical. Wall thick, very porous and vermiculated. Calice slightly elliptical, deep. Septa well developed, not exsert, granular; those of the 4th and 5th orders bend towards the tertiaries or unite in front of them. Columella papillose, porous or sublamellar and compact, and forming three masses. Costæ

obscure. Epitheca well developed, coming up not far from the calicular edge, marked with ridges or not, and its substance penetrating the porose wall.

*Distribution.*—*Fossil.* Pliocene: England (specimen in York Museum).—*Recent.* Philippines, Admiralty Islands, Florida, North Atlantic. Deep water.

Genus EUPSAMMIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 94 (1860).

Corallum simple, subturbinate, free in adult age, when the traces of adherence gradually disappear, compressed or not. Calice elliptical or suboval, deep and narrow centrally. Columella variably developed, of twisted processes, tubercular or papillary, or spongy, or barely existing. Septa solid or roughly perforated, numerous, close, well developed, slightly exsert, strongly granular on their sides, and uniting by the granules here and there; the septa of the last cycle more developed than the penultimate, and curving towards and joining or not the septa of the cycle preceding them in age. Wall porous, naked, showing simple, close, unequal verrucellate, distinctly granular costæ.

*Distribution.*—*Fossil.* Eocene, Oligocene, Miocene: Europe.—*Recent.* Chinese seas.

Synaptacula are often seen near the calicular margin, between septa.

Genus ENDOPACHYS, *Lonsdale, Quart. Journ. Geol. Soc. Lond.* vol. i. p. 214 (1845).

Corallum simple, straight, free, compressed and keeled along the narrow base and sides, where there are also costal wing-shaped appendices. Calice with unequal axes on different planes; the fossette long and narrow. Columella spongy, slightly developed. Septa in five cycles, narrow, slightly exsert, close, the higher cycle joining the preceding, sides granular.

*Distribution.*—*Fossil.* Eocene: Alabama.—*Recent.* Australian seas?

Genus HETEROPSAMMIA, *Milne-Edwards & Jules Haime, Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. x. p. 89 (1848); *Hist. Nat. des Corall.* vol. iii. p. 105.

Corallum simple, straight, low, increasing fissiparously so as

to form a compound corallum with two or more calices. The base broad, flat, unsymmetrical, tumid, containing a Sipunculid worm, and perforated for it. Calice circular, close, or a figure of 8, or round, open, shallow. Columella spongy, well developed, deep. Septa numerous, many joining near the columella. Wall stout, porous, often enlarged at certain spots around the calice. Costæ not present, but replaced by series of very small granules, coalescing into papillæ or small striæ.

*Distribution.*—*Recent.* Chinese seas, Burmese seas, North-Australian seas, Philippines, E. Africa and islands.

The porosity of the wall, the relations of the septa, and the absence of pali separate the genus decidedly from *Stephanoseris*.

### III. Alliance DENDROPHYLLIOIDA.

Colonial Eupsammidæ, with well-developed calices and septa. Columella variable in development, spongy, lamellar, or absent. Cœnenchyma variable. Dissepiments rare.

Genus DENDROPHYLLIA, Ed. & H.

Subgenus CŒNOPSAMMIA, Ed. & H.

Genus PLACOPSAMMIA, Reuss.

Genus ASTROPSAMMIA, Verrill.

Genus PACHYPSAMMIA, Verrill.

Genus STEREOPSAMMIA, Ed. & H.

Genus CALOSTYLIS, Lindström.

Genus absorbed:—

BRASSYIA, B. Wright.

CŒNOPSAMMIA, Ed. & H., becomes a subgenus. AULOPSAMMIA, Reuss, is not a Madreporarian.

Genus DENDROPHYLLIA, *Milne-Edwards & Jules Haime, Hist.*

*Nat. des Corall.* vol. iii. p. 112 (1860).

Syn. *Brassyia*, B. Wright.

Colony generally dendroid and high or low, corymbose or cæspitose, or forming clumps; increasing by gemmation, which is lateral or subbasal. Corallites rather large, cylindrical, cylindroturbinate, more or less elongate. Calice subcircular, deep. Columella more or less developed, often large. Septa barely exert or not, thin, close, those of the fourth cycle well developed, and the septa of the last cycle or cycles bending to their predecessors and uniting or not to them. Walls subcostate near the calices, covered with rough vermiculate grains in rows, with irregular spaces between.

Milne-Edwards and Jules Haime divide this genus into groups of species :—

1. Arborescent *Dendrophyllia*. With an arborescent trunk, branches arising from it in vertical series, and ramifying in their turn in an alternate and distichous manner.
2. Branching *Dendrophyllia*. The parent occupies the axis of the corallum or colony, and the secondary branches arise around it, forming several vertical series, some uniting when they come in contact.
3. Incrusting *Dendrophyllia*. Not developing much in height by budding, and resembling an Astræiform mass, with some cœnenchyma. Corallites often uniting about the base.

*Distribution*.—*Fossil*. Eocene: England and Europe. Miocene: Europe.—*Recent*. Atlantic, Cape Verd, Madeira, Mediterranean, Pacific, Arafura Sea, Chinese and Australian seas, Bay of Panama, Caribbean Sea.

The genus *Brassyia*, B. Wright, Ann. & Mag. Nat. Hist. 1852, ix. p. 77, was established for specimens of one species. It is a stumpy, broad-based coral, clearly colonial, from the buds upon it, although it is stated to be simple. The only interesting point is that the septa are said not to unite.

It is synonymous with *Dendrophyllia*, and is in no way intermediate between *Dendrophyllia* and *Balanophyllia*.

Subgenus CŒNOPSAMMIA, (genus) *Milne-Edwards & Jules Haime*, *Hist. Nat. des Corall.* vol. iii. p. 125 (1860), amended.

Colony in tufts, or fasciculate or dendroid, rarely massive. Corallites more or less cylindrical, free or surrounded by cœnenchyma. Calices subcircular. Columella well developed. Septa not exsert, in three complete cycles, and whenever there are higher orders they are rudimentary. Costæ delicate, subvermiculate inferiorly, simply granular near the calice. Gemmation lateral and subbasal. Septa and wall differing in the amount of perforation.

*Distribution*.—*Fossil*. Pliocene: Europe. — *Recent*. Indian Ocean, Red Sea, Pacific, North-Australian seas, New Zealand, Panama, Cape Verd Islands.

Genus *PLACOPSAMMIA*, *Reuss, Sitzungsab. der Kais. Akad. der Wiss. Wien*, Bd. xxxv. p. 486, pl. 2. fig. 16 (1859); *Duncan, "Deep-Sea and Littoral Corals," Proc. Zool. Soc.* 1876, p. 441.

Colony with a broad base, and short stunted projections, ending in elliptical calices. Columella long and lamellary, compact. Septa in four cycles, and with some of the orders uniting, as is usual in the *Eupsammidæ*. Costæ visible to the base, often wavy and inosculating.

*Distribution.*—*Fossil.* Miocene, Oligocene: Europe.—*Recent.* Galapagos?

Genus *ASTROPSAMMIA*, *Verrill, Notes on Radiata*, p. 509 (1868-70).

Colony massive. Corallites united to their summits by an abundant, very porous cœnenchyma. Walls scarcely distinct from the cœnenchyma, very porous. Septa in four cycles, with some orders of the fifth; those of the fourth unite to the tertiaries. Columella usually well developed, composed of loose, convoluted, and twisted lamellæ and trabeculæ. Interseptal spaces cut off below by thin transverse dissepiments, which often coincide in all the chambers. Calices shallow. Gemmation chiefly marginal and interstitial. Fissiparity may occur.

*Distribution.*—*Recent.* Mergui, Burmah; Gulf of California.

Some forms considered to be *Cœnopsammia*, and which have cœnenchyma, belong to the next genus.

Genus *PACHYPSAMMIA*, *Verrill, Proc. Essex Institute*, vol. v. (1866-67).

Colony massive and incrusting. Corallites united near their summits by a massive cœnenchyma. Four complete cycles of septa. Columella rudimentary or trabecular, not salient. Surface of the cœnenchyma with waving ribs. Gemmation lateral, irregular.

*Distribution.*—*Recent.* Chinese seas.

This genus approaches *Stereopsammia*, but has a solid cœnenchyma. It differs from *Dendrophyllia* in not having a distinct columella.

Genus *STEREOPSAMMIA*, *Milne-Edwards & Jules Haime, Brit. Foss. Corals, Introd. Pal. Soc.* p. 43 (1850).

Colony incrusting, glomerulate. Corallites short, united at the base, free near the calice. Calices circular, rather deep.

Columella absent or rudimentary. Septa hardly exsert, those of the last cycle less developed than those of the penultimate. Costæ fine, close, frequently discontinuous and vermiculate. Gemmation irregular, and from the base.

*Distribution.*—*Fossil.* Eocene: England.

Pourtalès considered his *Amphelia rostrata* to belong to this genus; but it can hardly be included.

Lindström has described, with his usual care, a remarkable coral, which he considers to be one of the Eupsammidæ, from the Silurian strata of Gothland. The description and figures carry conviction that this genus, *Calostylis*, is one of the Perforata, and that it should be placed in the Eupsammidæ. The resemblance of the thick mural structure of the calices to that of *Thecopsammia*, Pourtalès, is very striking.

Genus CALOSTYLIS, Lindström, *Öfversigt af K. Vetensk.-Akad. Förhandl.* p. 421 (1868).

Colony cylindro-conical, uniserial, budding between the calice and the base. Septa numerous, thin, coalescing, irregularly perforated, ragged at the upper free edge, and forming a trabeculate columella with their inner ends. Columella broad, convex. Dissepiments few. Costæ extend from the calice to the base, and are covered here and there by a smooth thin epitheca.

*Distribution.*—*Fossil.* Silurian: Gothland.

The above diagnosis is compiled from Lindström's generic diagnosis, and from the description of the species, *Calostylis cribraria*. Lindström's diagnosis is rather too short for the purposes of comparison with other Eupsammidæ:—"Polyparium compositum, gemmatio uniserialis, lateralis, septa numerosissima, interdum inter se coalescentia, columella trabecularis, epitheca incompleta."

#### IV. Alliance LEPTOPSAMMIOIDA.

Simple Eupsammidæ with irregular septal development.

Genus LEPTOPSAMMIA, Ed. & H.

Genus ENDOPSAMMIA, Ed. & H.

There are two genera, each established for one species only, which are exceedingly unsatisfactory. They are *Leptopsammia* and *Endopsammia* of Milne-Edwards and Jules Haime. They are closely allied, and in both there is an imperfection of the

fourth cycle, and a deficiency of that lateral junction of the septa which is so generally characteristic of the family.

Genus *LEPTOPSAMMIA*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 106 (1860).

Corallum simple, adherent, tall, subturbinate, narrow at the base. Calice elliptical, with a large and deep fossa. Columella very developed, projecting. Septa not exsert, moderately close, very thin, barely granulated; the septa of the first and second cycles nearly equal, the septa of the fourth order curved towards the tertiaries, which they reach at a little distance from the columella. The septa of the fifth order perforatè, denticulate, projecting barely from the wall. Epitheca rudimentary near the base. Costæ distinct.

*Distribution.*—*Recent.* Philippines.

Genus *ENDOPSAMMIA*, *Milne-Edwards & Jules Haime, Ann. des Sci. Nat.* 3<sup>e</sup> sér. t. x. p. 92, pl. 1 (1848).

Corallum short, straight, adherent by a broad base. Calice circular, with a deep fossa. Columella spongy, well developed and projecting. Septa stout, exsert, very largely granular. The fifth order rudimentary, the fourth curving towards the tertiaries; these and the primaries large and nearly equal. Costæ well developed. Wall thick and porous. A pellicular epitheca.

*Distribution.*—*Recent.* Philippines.

The following genera cannot be placed in Alliances:—

Group. Incrusting colonial Eupsammidæ.

Genus *ASTROIDES*, Blainville.

Group. Fissiparous colonial Eupsammidæ.

Genus *LOBOPSAMMIA*, Ed. & H.

Group. Simple Eupsammidæ, budding from the wall.

Genus *RHODOPSAMMIA*, Semper.

Group. Colonial Eupsammidæ, budding from stolons.

Genus *RHIZOPSAMMIA*, Verrill.

Genus *ASTROIDES*, *Blainville, Dict. des Sci. Nat.* t. lx. p. 332, in *Hist. Nat. des Corall.* vol. iii. p. 131 (1860).

Colony incrusting, massive. Corallites imperfectly united, or free at their sides. Wall spongy, but dense. Calices circular or polygonal, free or united by their edges. Columella very deve-

loped, projecting, spongy. Septa moderately developed, very thin, not exsert, finely and unequally dentate, those of the last cycle less developed than those of the penultimate. Endotheca scarce. Epitheca surrounding the corallites thin and compact.

*Distribution.*—*Recent.* Mediterranean.

GENUS LOBOPSAMMIA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 123 (1860).

Colony dendroid and very short and dichotomous, short branches directed outwards. Calices with irregular-shaped margins, increasing by fissiparity. Four cycles of septa well developed, and some of the fifth; higher orders bending to and joining the penultimates. Columella spongy. Costæ delicate, with indistinct granules.

*Distribution.*—*Fossil.* Oligocene: Europe.

GENUS RHODOPSAMMIA, *Semper, "Generationswechsel bei Steinkorallen," Zeitschr. für wiss. Zool., Leipzig,* vol. xxii. p. 257 (1872).

Corallum simple or colonial, free or attached, with lateral buds, cylindro-conical or compressed. Calice elliptical, rather deep. Columella more or less projecting, composed of convoluted "leaflets." Septa narrow, sharp at the edge, hardly exsert; first and second cycles extending to the columella, unequal; succeeding cycles joined with those of preceding cycle. Costæ simple, distinct from the base, close, subequal, granular. Epitheca absent or rudimentary.

*Distribution.*—*Recent.* Philippines.

Several species of this interesting genus are described by Semper and beautifully figured. The budding is below the calicular margin, and some buds may bud again. The parent is clearly alive after this process, and the whole colony is a pale pink in colour when alive, and the tentacles, which are long, are of a deeper tint. Some coralla are attached, others are free; and some have buds, others have not. In one instance there is a bud with a quadrangular transverse outline springing from the calicular margin.

GENUS RHIZOPSAMMIA, *Verrill, Notes on Radiata,* p. 510 (1868-70).

Colony low, incrusting, extending by stolon-like expansions of

the base, from which buds arise. Corallites cylindrical or nearly so, connected by thin creeping expansions, which have the same texture as the wall. Calices subcircular or elliptical. Septa thin, crowded, a little projecting, arranged in four or five cycles; last cycle well developed, uniting to those of the preceding cycle, which rise up in the form of prominent paliform lobes, beyond which the central region of the calice is deep. Columella very porous and its surface papillose. Wall very porous. No epitheca. Costæ scarcely distinct, represented by series of rough granules.

*Distribution.*—*Recent.* Pacific, Pearl Islands.

## II. Family MADREPORIDÆ (*pars*), Ed. & H.

This family corresponds to the subfamily Madreporinæ, Ed. & H. It is necessary to give the subfamily the position of a family, not only because the Eupsammidæ have become a family, but also because it is evident that the great genus *Madrepora* will eventually be largely subdivided. The subfamily Turbinarinæ, Ed. & H., is included in this family.

Colonial perforate Madreporaria, increasing by gemmation; cœnenchyma more or less abundant, spongy, and reticulate, slightly or not distinct from the porous corallite-walls. Septa lamellar, slightly porous, or else solid, variable in number and size. Calices prominent or sunken.

Alliances:—Madreporoida, Turbinaroida. These alliances were subfamilies according to Milne-Edwards and Jules Haime.

### I. Alliance MADREPOROIDA.

Madreporidæ with diverse shapes, usually ramose or foliaceous or incrusting. Cœnenchyma moderate or considerable. Septa with two opposite primaries larger than others. Interseptal loculi with dissepiments. Gemmation symmetrical or not, extracalicular. Calices more or less prominent and variable in shape.

Genus MADREPORA, Linnaeus.

Subgenus ISOPORA, Studer.

Genus MADREPORA, *Linnaeus, Syst. Nat.* edit. x. p. 793,  
*amended.*

Colony very variable in shape, branching, bush-shaped,

expanding, flat, corymbiform, or foliaceous, pedunculate or in-crusting. Gemmation around the parent corallite and from the side of other calices. Cœnenchyma abundant, spongy, reticulate, spinulose, growing exogenously from the porous walls of the corallites. Calices variable in shape, projecting or immersed, but never all so; terminal calices, or some amongst the mass, longest or largest (parents). Septa distinct, variable in solidity, two opposite primaries largest and nearly meeting. Twelve tentacles, and one larger than the others. No columella. An endotheca may exist, which occasionally becomes tabulate.

*Distribution.*—*Fossil.* Eocene: Europe, India. Oligocene: England and Europe. Miocene: Europe; Sind, Asia.—*Recent.* Red Sea, Indian Ocean, Oceania, Pacific, Caribbean Sea.

Subgenus ISOPORA, *Studer, Monatsbericht der König. Preuss.*

*Akad. der Wiss. Berlin, 1878, p. 535 (Gazelle Corals).*

Colony leaf-shaped or lobate. Calices equally prominent, and distributed over the whole surface. The apical calices are wanting.

*Distribution.*—*Recent.* Philippines.

## II. Alliance TURBINARIOIDA.

Madreporidæ in colonies, with an abundant cœnenchyma between the corallites, which is distinct from the mural structures, spongy and reticulate. Increase by gemmation.

Genus TURBINARIA, Oken.

Genus ASTRÆOPORA, Blainville.

Genus DENDRACIS, Ed. & H.

Genus ACTINACIS, d'Orbigny.

Genus PALÆACIS, Haime.

Genus PRISCITURBEN, Kunth.

Genus STYLARÆA, Seebach.

Genus TURBINARIA, *Oken, 1815; Milne-Edwards & Jules Haime, Polyp. des terr. Paléoz. p. 141.*

The colony is usually crateriform or foliaceous and twisted. There is an abundant cœnenchyma between the corallites, and it is dense and also echinulate at the surface. The calices are more or less projecting. The septa are nearly all of the same size; and there is a well-developed spongy columella.

*Distribution.*—*Fossil.* Miocene of France, Sind, Asia.—*Recent.* Red Sea, Indian Ocean, Pacific.

This genus was shown by Milne-Edwards and Jules Haime to absorb *Gemmipora*, Blainville, and *Explanaria* (pars), Lamarck.

GENUS *ASTRÆOPORA*, *Blainville, Dict. des Sci. Nat.* t. ix. p. 348 (1830).

The colony is massive in shape, adherent or incrusting. The cœnenchyma is lax, and decidedly echinulate at the surface. The septa are unequally developed on the small calices. There is no columella. Tabulæ are seen in some specimens.

*Distribution.*—*Fossil.* Eocene of Europe and West Indies. Miocene: Sind, Asia.—*Recent.* Red Sea, Indian and Pacific Oceans.

GENUS *DENDRACIS*, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 169 (1860).

The colony is arborescent, and the cœnenchyma is very dense and granulated at the surface. Calices submammiform. Septa few in number, subequal. No columella.

*Distribution.*—*Fossil.* Eocene of Europe.

GENUS *ACTINACIS*, *d'Orbigny, Note sur les Polyp. foss.* p. 11 (1849).

Colony subdendroid, with a greatly developed cœnenchyma, which is rather dense and granulated, and not very perforated. Calices circular, small, distant. Septa few in number, subequal, somewhat exsert. A columella, which is papillose. Pali exist before all the septa.

*Distribution.*—*Fossil.* Cretaceous of Europe.

GENUS *PALÆACIS*, *J. Haime, 1860.* (Amended by Seebach, *Zeits. der Deutsch. Geol. Gesellsch.* Bd. xviii. p. 308, Berlin, 1866.)

Syn. *Sphenopoterium*, Meek and Worthen.

Colony pedunculate, cuneiform. Calices immersed in a vermiform perforate cœnenchyma, marked with anastomosing striations. Calice-walls of the same structure as the cœnenchyma, thick, but porous. Calicular margins circular in outline. Calices widely open. Septal system of fine, numerous, unequal striations (30). Gemmation intercalicular, and producing occasionally by pressure polygonal calicular margins.

*Distribution.*—*Fossil.* Carboniferous: America.

Genus PRISCITURBEN, *Kunth, Zeits. der Deutsch. Geol. Gesellsch.*  
Bd. xxii. p. 25 (Berlin, 1870).

Colony low, expanding, attached by the whole base. Cœnenchyma well developed, compact, and composed of a sponge-like structure. Calices projecting, rather inclined, differing in size, nearly or quite circular in outline, surrounded by cœnenchyma. Septa variable, both thick and thin. Columella spongy.

*Distribution.*—*Fossil.* Silurian: Oeland.

This is a very puzzling genus, and its characters have been very ably described and delineated by Kunth. Its position is probably amongst the Turbinarinæ.

Genus STYLARÆA, *Seebach, Zeits. der Deutsch. Geol. Gesellsch.*  
Bd. xviii. p. 306 (Berlin, 1866).

Colony low, covering some space, with a crust-like, vermiculate, perforated cœnenchyma and a basal epitheca. Calices polygonal, moderately deep, with a stout, projecting, spongy columella. Septa strongly crenulate, in two cycles. Walls moderately stout, bearing points in the angles of the calices.

*Distribution.*—*Fossil.* Lower Silurian: Europe (Wesenberg).

### III. Family PORITIDÆ, *Ed. & H.*

Perforate Madreporaria composed of reticulate and trabeculate sclerenchyma. Septa never completely lamellary, but trabecular and fenestrated, or as series of discontinuous trabeculæ. Walls very porose. Corallites increasing by gemmation, and united directly or by intervening porous sclerenchyma. Dissepiments and tabulæ may exist.

There are two Alliances—the Poritinoïda and the Montiporoïda.

#### I. Alliance PORITINOÏDA.

Corallites united by their trabeculate walls without intervening cœnenchyma, or with some of very rudimentary kind.

Genus PORITES, *Ed. & H.*

Genus SYNARÆA, *Verrill.*

Genus NAPOPORA, *Quelech.*

Genus DICTYARÆA, *Reuss.*

Genus RHODARÆA, *Ed. & H.*

Genus GONIOPORA, *Quoy et Gaimard.*

Genus LITHARÆA, *Ed. & H.*

Genus PROTARÆA, Ed. & H.

Genus ALVEOPORA, Quoy et Gaimard.

Subgenus FAVOSITIPORA, S. Kent.

Genus SOMPHOPHORA, Lindström.

Genus DICHORÆA, T. Woods.

Genera absorbed:—STYLARÆA, Ed. & H., non Seebach; ME-  
ANDRARÆA, Etallon.

FAVOSITIPORA, S. Kent, becomes a subgenus; KONINCKIA,  
Ed. & H., a doubtful genus.

Genera removed:—MICROSOLENA, Lamour.; COSCINARÆA, Ed.  
& H.; DICTYOPHYLLIA, Blainville; PLEURODICTYUM, Gold-  
fuss; HOLARÆA, Ed. & H.; CÆNOSTROMA, Winchell.

Genus PORITES, *Milne-Edwards & Jules Haime, Hist. Nat. des  
Corall.* vol. iii. p. 173, *altered.*

Colony ramifying, or in tufts, or foliaceous, often massive, and lobed or low, incrusting or not. A basal epitheca invariable in the last instance, frequent in all. Corallites with trabeculate and perforate walls, not distinct from those of their neighbours, and therefore without intermediate cœnenchyma. Calices small, pentagonal. Septa twelve or less, feebly developed, trabecular or spinulose. A small columella, forming at its free end a knob or a trabecular point or a style. Pali five or six, and not very distinct from the septal ends, in a circle around the columella. Endotheca exists sparingly, and may be dissepimental or tabulate, or may be mere stereoplasm.

*Distribution.*—*Fossil.* Eocene: Europe, Sind, Asia. Mio-  
cene: West Indies and Europe, Sind, Asia.—*Recent.* Red Sea,  
Indian Ocean, Pacific, West Indies.

This genus absorbs *Stylaræa*, Ed. & H., 1851.

The absence of any intercorallite reticular tissue or cœnen-  
chyma is invariable in the recent forms; but in the Eocene  
*Porites panicea*, Lonsdale, there is a small quantity in some parts  
of a colony, but not in all (Supp. Brit. Foss. Corals, Pal. Soc.  
1866, p. 63; P. M. Duncan).

Genus SYNARÆA, *Verrill, Bull. Mus. Comp. Zool. Cambridge,  
Mass.* 1864, No. 3, p. 42.

Corallum irregularly branched or glomerate. Corallites with-  
out distinct walls. The septa rudimentary. Six prominent and  
paliform lobes surround the central cavity, which has a small  
rudimentary tubercular columella. Outside of the pali are other

similar points or granulations scattered between the cells (corallites), which are not distinctly circumscribed, but often separated for some distance by a porous cœnenchyma.

*Synaræa* includes *Porites conformis*, *P. monticulosa* of Dana; also *Porites antiqua*, Dana, = *P. Danæ*, Ed. & H.

*Distribution.*—*Recent.* Pacific.

Genus NAPOFORA, *Quelch, Ann. & Mag. Nat. Hist.* 1884, xiii. p. 296.

Corallum compound, porous. Gemmation intracalicular, the developing buds with distinct centres almost destitute of distinct walls, at first united in groups of 2–6, and surrounded by the common wall of the parent calicle; but as development proceeds they are separated off by a narrow, raised, distinct wall. Calicular depressions very variable in size and shape, according to the number, position, and degree of development of the buds. Walls of the older calicles porous, distinctly raised, and angular. Septa generally of two cycles, rudimentary. Pali six, sometimes one smaller than the others or absent, generally well developed, and distinctly marking the position of the calicular centres. Columella rudimentary, represented by small papilliform projections, often absent.

*Distribution.*—*Recent.* Tahiti.

Genus DICTYARÆA, *Reuss, Foss. Korallen aus der Insel Java, Novara Exped., Geolog. Theil*, p. 175, pl. ii. fig. 6.

The colony is in knotty branchlets. The calices are rather irregular in shape, generally pentagonal, separated by a slight ridge. Septa few, about 6 to 12, uniting around the axis by false pali-form lobes. Columella absent. Considerable distinction between the size of the calices and the dimension of the septa.

*Distribution.*—*Fossil.* Eocene: Java, Asia, Europe.

Genus RHODARÆA, *Milne-Edwards & Jules Haime, Compt. Rend.* t. xxix. p. 259 (1849).

The colony is massive; the calices are deep and pentagonal; the trabeculæ of the walls of the corallites are well developed, but they retain their spongy appearance. Septa trabecular, not much developed, and in three cycles. Columella absent or rudimentary. Pali six in number and very large, placed before the secondary septa.

*Distribution.*—*Fossil.* Miocene of West Indies and France.—*Recent.* Australian and Chinese seas, Indian Ocean.

Genus GONIOPORA, *Quoy & Gaimard, Voy. de l' Astrolabe, Zooph.*  
p. 218 (1833).

Colony attached or free, lobed or hemispherical, or in tall blunt cylindrical masses. Corallites with distinct trabecular walls joining those of their neighbours, without intermediate tissue. Calices unequal in size, and shallow or deep, pentagonal. Septa projecting but little in the upper part of the calices and ragged, extending towards the columella as porose trabecular laminae. Columella well developed, spongy. No pali. Gemmation between the calices. Endotheca exists.

*Distribution.*—*Recent.* Red Sea, Indian Ocean, Pacific.

Genus LITHARÆA, *Milne-Edwards & Jules Haime, Comptes Rendus*, t. xxix. p. 258 (1848), *amended*.

Colony low, free or incrusting, lobed, or dendroid, or discoid, with an imperfect or well-developed epitheca. Corallites with trabecular porose walls adherent to, or fused with those of their neighbours. Calices polygonal or irregular. Septa well developed, and subperforate and echinulate. Columella trabecular, and formed by the septal ends. No pali.

*Distribution.*—*Fossil.* Cretaceous (Upper): Europe. Eocene: Europe, Sind, Java. Oligocene: Europe. Miocene: France.

The septa approach those of the Astræidæ, and the genus is closely allied to the recent *Goniopora*.

Some comparatively late researches on the next genus have modified the generic diagnosis, and have given a higher distributional range to the species.

Genus PROTARÆA, *Milne-Edwards & Jules Haime, Hist. Nat. des Corall.* vol. iii. p. 184 (1860), *amended*.

Colony incrusting and massive. Corallites polygonal, with simple perforated walls, which at the calicular surface are narrower than the calice by one half, and are ornamented with points. Calices shallow. Septa 6–12 to 24 in number, pass a little way in and are sublamellary and dentated. No columella.

*Distribution.*—*Fossil.* Silurian: America. Devonian: Europe.

Genus *ALVEOPORA*, Quoy & Gaimard, *Voy. de l'Astrolabe*, *Zooph.* p. 394 (1834).

Colony lobed, convex, foliaceous or dendroid. Corallites united by very largely fenestrated trabecular walls. Calices polygonal, deep, usually unequal. Septa as simple series of distant spiniform trabeculæ, which may ramify near the axial space, and form a false columella or not. Epitheca basal or pellicular.

*Distribution.*—*Fossil.* Oligocene: Java. Miocene: West Indies, Europe.—*Recent.* Red Sea, Pacific, Indian Ocean.

In some specimens of *Alveopora viridis*, Quoy (*A. spongiosa*, Dana), there are tabulæ; but there are twelve tentacles, which are short and cylindrical. They have been placed in the following subgenus.

Subgenus *FAVOSITIPORA*, Saville Kent, *Ann. & Mag. Nat. Hist.* ser. 4, vol. vi. (1870), p. 386, pls. 17, 18.

The corallum resembles that of *Alveopora*, and has tabulæ.

*Distribution.*—*Fossil.* Palæozoic: America.—*Recent.* Locality unknown.

This type belongs to the *Alveopora-viridis* group, and can hardly be separated from *Alveopora* generically. It had better include the tabulate *Alveopora* for the future, which are nevertheless true *Perforata*.

The genus *Koninckia*, Ed. & H. *Hist. Nat. des Corall.* vol. iii. p. 263, is one of the *Alveopora-Favositipora* group, and is ill-defined. It is from the White Chalk of Royan.

Genus *SOMPHOPHORA*, Lindström, *Richthofen's China*, vol. iv. p. 51 (1883).

Colony with deep polygonal calices. Wall thick, indistinctly fenestrate with large spaces. Six septa, rather distant, having pointed dentations, not uniting together nor reaching the centre of the calice. Dissepiments (tabulate) irregularly distant one from another.

*Distribution.*—*Fossil.* Silurian: China.

Lindström, with his usual perspicuity, places this genus in the neighbourhood of *Alveopora* and *Favositipora*.

Genus *DICHORÆA*, T. Woods, *Proc. Linn. Soc. New South Wales*, vol. iii. (1879), p. 96.

Colony turbinate, pedunculate, broadly attached. Calices

polygonal, numerous, minute, irregular. Septa a series of needle-shaped points. Wall of corallites thickly studded with short, stout, and very conical points, swollen at the base, and pointing towards the interior of the fossa. A common epitheca in very thick folds. Gemmation intracalicular.

*Distribution.*—*Recent.* Pacific.

The Rev. T. Woods gives a delineation of the species; and there is no intermediate cœnenchyma shown between the calices.

M. de Fromentel, *op. cit.* p. 256, places the genus *Pleurodictyum*, Goldfuss, in the group Perforata, which includes *Porites*. This genus finds no place amongst the Madreporaria Perforata, as it is founded on a cast of a species of the genus *Michelinia*, a Palæozoic tabulate form which in all probability belonged to the Alcyonaria.

M. de Fromentel\* places the genus *Holaræa*, which was founded by Milne-Edwards and Jules Haime to receive *Alveolites parisiensis*, Michelin, amongst the Perforata in the neighbourhood of *Porites*. The condition of the specimens on which the above-named species was established is very defective. Milne-Edwards and Jules Haime, in 1860, in their 'Hist. Nat. des Corall.' vol. iii. p. 244, place *Holaræa* as a synonym of *Axopora*, a genus with tabulæ, and certainly not one of the Madreporaria, but an Alcyonarian. *Holaræa* is therefore no longer a genus.

The genus *Cœnostroma*, Winchell, is probably an ally of *Stromatopora*, and not a coral.

## II. Alliance MONTIPOROIDA.

Poritidæ with a more or less abundant spongy cœnenchyma.

Genus MONTIPORA, Quoy & Gaim.

Genus ANACROPORA, Ridley.

Genus MONTIPORA, Quoy et Gaimard, *Voy. 'Astrolabe,' Zooph.* p. 247 (1833); Verrill, *Notes on Radiata, Revision of Corals of West Coast of America* (1868-70), p. 502.

Colony various in form, glomerate, massive, incrusting, foliaceous, lobate or branching. Cœnenchyma abundant, porous, or spongy, usually echinulate at the surface, and often rising into ridges, papilliform eminences, and crests between the corallites;

\* 'Introd. à l'Etude des Polyp. foss.,' Paris, 1858-60.

usually very different on the base. Corallites small, wide apart, separated by cœnenchyma in which they are immersed, or else the calicular margin is raised, lacerate, and spinulose. Calices deep, with columella and pali. Septa little developed, six or twelve, and often trabecular. Secondaries smaller than the primaries.

*Distribution.*—*Recent.* Red Sea, Indian Ocean, Pacific.

Mr. S. O. Ridley has investigated and described a very interesting form, which he places in a new genus, *Anacropora*. The aspect of the species is that of one of the Madreporidæ, and the two large primaries add to this character; but the gemmation differs. The septa are trabecular, but are fairly developed.

GENUS ANACROPORA, *Ridley, Ann. & Mag. Nat. Hist.* ser. 5, vol. xiii. p. 287 (1884).

Colony ramose. Axis and apex of branches formed by a spongy cœnenchyma. New calicles formed centripetally, *i. e.* from the base towards the apex; no calicle of any kind at the apex. Calices equally distributed all round stem and branches, with a tendency to arrangement in longitudinal series. Septa trabeculate, comprising two cycles of six septa each, two (approximately upper and lower) primaries being larger than the four lateral primaries.

*Distribution.*—*Recent.* Keeling Islands.

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The proper position of *Psammocora* is with the Lophoserinæ, p. 161. I have only been able to study this genus after going to press.

GENUS PSAMMOCORA, *Dana, Zooph. Wilkes Exped.* (1846), p. 344, *amended*.

Colony in ramose tufts; branchlets often lobed, or in convex masses, or foliated and lobed. Surface more or less irregular, from gibbous humps or linear elevations. Cœnenchyma exists in places, especially on the gibbousities, which, however, just as frequently are covered with calices. Calices small, centres distinct, but margins ill-defined, usually circular, shallow, with a small central fossa with a minute papilla, the top of the columella. Septa 6-9-12 in number, very variable in thickness; sometimes one half of them reach the columellary space, and form a ring of tissue around the columella, the other septa having previously united to them; or several septa are club- or boss-shaped at their free margins, and are much larger than the others which environ them. These larger septa

appear isolated, but are continuous with laminæ that extend downwards. Sometimes these boss- or club-shaped septa are found beyond the calices and between sets of them, and thus resemble the tentacular septa of the family Fungidæ. Here and there great confusion of calices and these septa is apparent. The costæ are indefinite, but they are continuous with the septa, and reach over linear elevations, and sometimes cover much space. They often bifurcate. Septa solid, spinulose, connected by numerous small synapticula. Wall formed by synapticula, which exist between the costæ also. Gemmation and rarely fissiparity.

*Distribution.*—*Recent.* Indian Ocean, Chinese seas, Pacific.

*Psammocora*, Dana, was splendidly illustrated by Dana in his great work, and the remarkable superficial views given, are often strikingly correct. But with age and after death deposit of carbonate of lime occurs, in the first instance consolidating the tissues, and in the other adding to their density. Sections, or rather fractures, made longitudinally and transversely, prove that the septa are solid, stout, spinulose at the free surface, and that synapticula abound. There is some cœenchyma between corallites here and there, sometimes forming monticules; and it is evident that fissiparity may occur, but it is rare. Under the circumstances the genus must be removed from the section *Perforata* into that of the Fungida, family Lophoseridæ, near *Plesioseris*, nobis.

The following nine genera are new:—

Antillastræa, p. 108.

Brachymæandrina, p. 90.

Diplothecastræa, p. 115.

Koilocœnia, p. 115.

Nototrochus, p. 17.

Physophyllia, p. 118.

Pourtalosmilia, p. 72.

Pratzia, p. 160.

Zittelofungia, p. 150.

Total number of genera recorded, after revision, 343 out of 478.

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| I. Family TURBINOLIDÆ, p. 9.      | III. " LOPHOSERIDÆ, p. 146.     |
| II. " OCULINIDÆ, p. 36.           | IV. " ANABACIADÆ, p. 165.       |
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*List of Genera &c.*

## I. Section MADREPORARIA APOROSA.

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|--|--|
| I. Family TURBINOLIDÆ.   | Subgenus <i>Blanfordia</i> , <i>Dunc.</i> , p. 23.     |
| Subfamily <i>Turbinolidæ simplices</i> .                               | <i>Deltocyathus</i> , <i>Ed. &amp; H.</i> , p. 23.     |
| Alliance SMILOTROCHOIDA.   | <i>Odontocyathus</i> , <i>Moseley</i> , p. 23.         |
| Genus  | <i>Leptocyathus</i> , <i>Ed. &amp; H.</i> , p. 23.     |
| <i>Smilotrochus</i> , <i>Ed. &amp; H.</i> , p. 10.                     | <i>Paraocyathus</i> , <i>Ed. &amp; H.</i> , p. 24.     |
| Subgenus <i>Blagrovia</i> , <i>Dunc.</i> , p. 10.                      | <i>Heterocyathus</i> , <i>Ed. &amp; H.</i> , p. 24.    |
| <i>Onchotrochus</i> , <i>Dunc.</i> , p. 10.                            | <i>Caryophyllia</i> , <i>Lmk.</i> , p. 25. [p. 25.]    |
| <i>Desmophyllum</i> , <i>Ehr.</i> , p. 11.                             | Subgenus <i>Acanthocyathus</i> , <i>Ed. &amp; H.</i> , |
| Subgenus <i>Javana</i> , <i>Dunc.</i> , p. 11.                         | <i>Stenocyathus</i> , <i>Pourt.</i> , p. 25.           |
| <i>Schizocyathus</i> , <i>Pourt.</i> , p. 12.                          | <i>Ceratotrochus</i> , <i>Ed. &amp; H.</i> , p. 26.    |
| Alliance FLABELLOIDA.  |  |
| Genus  | Alliance DISCOCYATHOIDA.                               |
| <i>Flabellum</i> , <i>Lesson</i> , p. 13.                              | Genus  |
| Subgenus <i>Blastotrochus</i> , <i>Ed. &amp; H.</i> ,                  | <i>Discocyathus</i> , <i>Ed. &amp; H.</i> , p. 28.     |
| <i>Rhizotrochus</i> , <i>Ed. &amp; H.</i> , p. 15. [p. 14.]            | <i>Brachytrochus</i> , <i>Dunc.</i> , p. 29.           |
| <i>Thysanus</i> , <i>Dunc.</i> , p. 15.                                | <i>Sabinotrochus</i> , <i>Dunc.</i> , p. 29.           |
| Alliance PLACOTROCHOIDA.   | <i>Stephanotrochus</i> , <i>Moseley</i> , p. 29.       |
| Genus  | <i>Discotrochus</i> , <i>Ed. &amp; H.</i> , p. 30.     |
| <i>Placotrochus</i> , <i>Ed. &amp; H.</i> , p. 16.                     | <i>Cycloocyathus</i> , <i>Ed. &amp; H.</i> , p. 30.    |
| <i>Sphenotrochus</i> , <i>Ed. &amp; H.</i> , p. 16.                    | <i>Brachyocyathus</i> , <i>Ed. &amp; H.</i> , p. 30.   |
| <i>Nototrochus</i> , <i>Dunc.</i> , p. 17.                             | <i>Anthemiphyllia</i> , <i>Pourt.</i> , p. 30.         |
| <i>Placocyathus</i> , <i>Ed. &amp; H.</i> , p. 17.                     | <i>Fungiacyathus</i> , <i>Sars</i> , p. 31.            |
| <i>Platytrichus</i> , <i>Ed. &amp; H.</i> , p. 18.                     |  |
| Alliance TURBINOLOIDA.   | Alliance HAPLOPHYLLLOIDA.                              |
| Genus  | Genus  |
| <i>Turbinolia</i> , <i>Ed. &amp; H.</i> , p. 18.                       | <i>Guynia</i> , <i>Dunc.</i> , p. 32.                  |
| Subgenus <i>Stylotrochus</i> , <i>E. de From.</i> ,                    | <i>Duncania</i> , <i>Pourt.</i> , p. 32.               |
| <i>Stylocyathus</i> , <i>d' Orb.</i> , p. 19. [p. 19.]                 | <i>Haplophyllia</i> , <i>Pourt.</i> , p. 32.           |
| <i>Conocyathus</i> , <i>d' Orb.</i> , p. 20.                           | Group-genus  |
| <i>Bistylia</i> , <i>T. Woods</i> , p. 20.                             | <i>Dasmia</i> , <i>Ed. &amp; H.</i> , p. 33.           |
| <i>Trematotrochus</i> , <i>T. Woods</i> , p. 21.                       |  |
| Alliance TROCHOCYATHOIDA.  | Subfamily <i>Turbinolidæ gemmantæ</i> .                |
| Genus  | Genus  |
| <i>Trochocyathus</i> , <i>Ed. &amp; H.</i> , p. 22.                    | <i>Cœnocyathus</i> , <i>Ed. &amp; H.</i> , p. 34.      |
| Subgenus <i>Tropidocyathus</i> , <i>Ed. &amp; H.</i> , p. 22. [p. 22.] | <i>Gemmulatrochus</i> , <i>Dunc.</i> , p. 34.          |
| " <i>Theocyathus</i> , <i>Ed. &amp; H.</i> ,                           |  |
|  | Subfamily <i>Turbinolidæ reptantæ</i> .                |
|  | Genus  |
|  | <i>Polycyathus</i> , <i>Dunc.</i> , p. 34. [p. 34.]    |
|  | Subgenus <i>Agelecyathus</i> , <i>Dunc.</i> ,          |

## II. Family OCULINIDÆ.

## Alliance BARYHELIOIDA.

## Genus

- Baryhelio, *Ed. & H.*, p. 37.  
 Neohelio, *Moseley*, p. 37.  
 Diblasus, *Lonsdale*, p. 38.

## Alliance LOPHOHELIOIDA.

## Genus

- Lophohelio, *Ed. & H.*, p. 38.  
 Amphihelio, *Ed. & H.*, p. 39.  
 Enallohelio, *Ed. & H.*, p. 39.  
 Euhelio, *Ed. & H.*, p. 40.  
 X Acrohelio, *Ed. & H.*, p. 40.  
 Astrohelio, *Ed. & H.*, p. 40.  
 Dendrohelio, *Etallon*, p. 41.

## Alliance OCULINOIDA.

## Genus

- X Oculina, *Ed. & H.*, p. 41.  
 Subgenus Agathelio, *Reuss*, p. 42.  
 Cyathohelio, *Ed. & H.*, p. 42.  
 Synhelio, *Ed. & H.*, p. 42.  
 Trymohelio, *Ed. & H.*, p. 43.  
 Sclerohelio, *Ed. & H.*, p. 43.  
 Bathelio, *Moseley*, p. 43.  
 Haplohelio, *Reuss*, p. 44.

## Alliance PROHELIOIDA.

## Genus

- Prohelio, *E. de From.*, p. 44.

## Alliance STYLOPHOROIDA.

## Genus

- X Stylophora, *Ed. & H.*, p. 45.  
 X Stylohelio, *E. de From.*, p. 45.  
 Madracis, *Ed. & H.*, p. 45.

## III. Family POCILLOPORIDÆ.

## Genus

- X Pocillopora, *Verrill*, p. 47.  
 X Seriatopora, *Lmk.*, p. 47.

## IV. Family ASTRÆIDÆ.

Subfamily *Astræidæ simplices.*

## Alliance TROCHOSMILIOIDA.

## Genus

- Trochosmia, *Ed. & H.*, p. 51. [p. 52.  
 Subgenus Epismilia, *E. de From.*,  
 " Cœlosmia, *Ed. & H.*,  
 Diploctenium, *Goldfuss*, p. 53. [p. 52.  
 Montlivaltia, *Lamour.*, p. 53.  
 Subgenus Leptomussa, *d' Ach.*, p. 54.  
 " Opelismilia, *Dunc.*, p. 54.  
 " Ceratophyllia, *K. v.*  
*Fritsch*, p. 54.

Feddenia, *Dunc.*, p. 54.

## Alliance PLACOSMILIOIDA.

## Genus

Placosmia, *Ed. & H.*, p. 55.

Lophosmia, *Ed. & H.*, p. 55.

Subgenus Plesiosmia, *Milas.*,  
 p. 55.

Pleurosomia, *E. de From.*, p. 56.

Peplosomia, *Ed. & H.*, p. 56.

Blastosomia, *Etallon*, p. 56.

Sphenophyllia, *Moseley*, p. 57.

## Alliance LITHOPHYLLIOIDA.

## Genus

- Parasmilia, *Ed. & H.*, p. 58.  
 Dasmosmia, *Pourt.*, p. 58.  
 Conosmia, *Dunc.*, p. 59.

## Genus

- Lithophyllia, *Ed. & H.*, p. 59.  
 Circophyllia, *Ed. & H.*, p. 59.  
 Subgenus Leptaxis, *Reuss*, p. 60.  
 " Antillia, *Dunc.*, p. 60.

## Alliance ASTEROSMILIOIDA.

## Genus

- Asterosmia, *Dunc.*, p. 61.  
 Stephanosmia, *E. de From.*, p. 62.  
 Cyathosmia, *T. Woods*, p. 62.  
 Pattalophyllia, *d' Ach.*, p. 62.  
 Group-genus  
 Axosmia, *Ed. & H.*, p. 63.

Subfamily *Astræidæ reptantes.*

## Alliance RHIZANGIOIDA.

## Genus

- X Cylicia, *Ed. & H.*, p. 64.  
 Scolangia, *T. Woods*, p. 65.  
 Cryptangia, *Ed. & H.*, p. 65.  
 Rhizangia, *Ed. & H.*, p. 65.  
 Bathangia, *Keferst.*, p. 66.

## Alliance ASTRANGIOIDA.

## Genus

- X Astrangia, *Ed. & H.*, p. 66.  
 Subgenus Cœnangia, *Pourt.*, p. 67.  
 " Phyllangia, *Ed. & H.*,  
 p. 67.  
 Ulangia, *Ed. & H.*, p. 68.  
 Stylangia, *Reuss*, p. 68.  
 Colangia, *Pourt.*, p. 68.  
 Cladangia, *Ed. & H.*, p. 69.  
 Latusastræa, *d' Orb.*, p. 69.

Subfamily *Astræidæ gemmantes.*

## Alliance CLADOCOROIDA.

## Genus

- Cladocora, *Ed. & H.*, p. 70.  
 Pleurocora, *Ed. & H.*, p. 71.

## Alliance GONIOCOROIDA.

## Genus

- Goniocora, *Ed. & H.*, p. 71.  
 Rhabdocora, *Ed. & H.*, p. 71.

## Alliance DENDROSMILIOIDA.

## Genus

- Dendrosmilia, *Ed. & H.*, p. 72.  
 Pourtalesmilia, *Dunc.*, p. 72.

## Alliance STYLOSMILIOIDA.

## Genus

- Stylosmilia, *Ed. & H.*, p. 72.  
 Stylocora, *Reuss*, p. 73.  
 Stylocora, *E. de From.*, p. 73.  
 Placophyllia, *d'Orb.*, p. 73.  
 Donacosmilia, *E. de From.*, p. 73.

## Alliance PALEASTREOIDA.

## Genus

- Heterophyllia, *M. Coy*, p. 74.  
 Battersbyia, *Ed. & H.*, p. 74.

## Group-genus

- Hexasmilia, *E. de From.*, p. 75.

Subfamily *Astræidæ cæspitosæ*.

## Alliance CALAMOPHYLLIOIDA.

## Genus

- Eusmilia, *Ed. & H.*, p. 77.  
 Subgenus Caulastræa, *Dana*, p. 77.  
 Aplosmilia, *d'Orb.*, p. 77.  
 Solenosmilia, *Dunc.*, p. 78.  
 Dasyphyllia, *Ed. & H.*, p. 78.  
 Calamophyllia, *Ed. & H.*, p. 78.  
 Pleurophyllia, *E. de From.*, p. 79.  
 Dendrocora, *Dunc.*, p. 79.  
 Dactylosmilia, *d'Orb.*, p. 79.  
 Hymenophyllia, *Ed. & H.*, p. 80.  
 Rhabdophyllia, *Ed. & H.*, p. 80.

## Alliance THECOSMILIOIDA.

## Genus

- Thecosmilia, *Ed. & H.*, p. 81.  
 Subgenus Cladophyllia, *Ed. & H.*,  
 p. 81.

## Alliance MUSSAOIDA.

## Genus

- Trachyphyllia, *Ed. & H.*, p. 82.  
 Mussa, *Oken*, p. 82.

Subfamily *Astræidæ confluentes*.

## Alliance EUPHYLLIOIDA.

## Genus

- Euphyllia, *Ed. & H.*, p. 84.  
 Glyphophyllia, *E. de From.*, p. 84.  
 Rhipidogyra, *Ed. & H.*, p. 85.  
 Teleiophyllia, *Dunc.*, p. 85.  
 Desmocladia, *Reuss*, p. 85.

## Alliance EUGYROIDA.

## Genus

- Dendrogyra, *Ehr.*, p. 86.

Pectinia, *Oken*, p. 86.

Eugyra, *E. de From.*, p. 87.

Pachygyra, *Ed. & H.*, p. 87.

Diploria, *Ed. & H.*, p. 87.

Stiboria, *Etallon*, p. 88.

Manicina, *Ehr.*, p. 88.

Mæandrina, *Ed. & H.*, p. 88.

Subgenus Cœloria, *Ed. & H.*,

Leptoria, *Ed. & H.*, p. 90. [p. 89.]

Mæandrastræa, *Ed. & H.*, p. 90.

Brachymæandrina, *Dunc.*, p. 90.

Stelloria, *d'Orb.*, p. 90.

## Alliance SYMPHYLLIOIDA.

## Genus

- Symphyllia, *Ed. & H.*, p. 91.  
 Phyllogyra, *Tomes*, p. 92.  
 Dimorphophyllia, *Reuss*, p. 93.  
 Stibastræa, *Etallon*, p. 93.  
 Latiphyllia, *E. de From.*, p. 93.  
 Mycetophyllia, *Ed. & H.*, p. 93.  
 Ulrophyllia, *Ed. & H.*, p. 94.  
 Tridacophyllia, *Blainv.*, p. 94.  
 Colpophyllia, *Ed. & H.*, p. 94.  
 Scapophyllia, *Ed. & H.*, p. 95.  
 Plerogyra, *Ed. & H.*, p. 95.  
 Physogyra, *Quelch*, p. 95.  
 Phytogyra, *d'Orb.*, p. 96.

## Alliance MONTICULOIDA.

## Genus

- Aspidiscus, *Kœnig*, p. 96.  
 Hydnophora, *Ed. & H.*, p. 97.  
 Monticulastræa, *Dunc.*, p. 97.

Subfamily *Astræidæ agglomeratæ fissiparantes*.

## Alliance FAVIOIDA.

## Genus

- Dichocœnia, *Ed. & H.*, p. 99.  
 Barysmillia, *Ed. & H.*, p. 99.  
 Stenosmilia, *E. de From.*, p. 99.  
 Favia, *Oken*, p. 100.  
 Favoidea, *Reuss*, p. 100.  
 Baryphyllia, *E. de From.*, p. 100.  
 Spinellia, *d'Achiardi*, p. 101.  
 Phyllastræa, *E. de From.*, p. 101.  
 D'Achiardia, *Dunc.*, p. 101.

## Alliance GONIASTRÆOIDA.

## Genus

- Goniastræa, *Ed. & H.*, p. 102.  
 Lamellastræa, *Dunc.*, p. 102.  
 Aphrastræa, *Ed. & H.*, p. 102.  
 Septastræa, *d'Orb.*, p. 103.

Subfamily *Astræidæ agglomeratæ gemmantæ*.

Alliance ORBICELLOIDA.

Genus

- Heliastræa, *Ed. & H.*, p. 104.  
 Subgenus Ulastræa, *Ed. & H.*,  
 Brachyphyllia, *Reuss*, p. 105. [p. 105.  
 Cyathomorpha, *Reuss*, p. 105.  
 Phymastræa, *Ed. & H.*, p. 106.  
 Solenastræa, *Ed. & H.*, p. 107.  
 Subgenus Cyphastræa, *Ed. & H.*,  
 p. 107.

- × Plesiastræa, *Ed. & H.*, p. 107.  
 Antillastræa, *Dunc.*, p. 108.

Alliance PLACOCENIOIDA.

Genus

- Placocœnia, *d'Orb.*, p. 108.  
 Placophora, *E. de From.*, p. 108.  
 Pleurostyliina, *E. de From.*, p. 109.

Alliance STYLINOIDA.

Genus

- Styliina, *Ed. & H.*, p. 109. [p. 110.  
 Subgenus Heliocœnia, *Etallon*,  
 Psammocœnia, *Ed. & H.*, p. 110.  
 Columnastræa, *Ed. & H.*, p. 110.  
 Stylastræa, *E. de From.*, p. 111.

Alliance PHYLLOCENIOIDA.

Genus

- Phyllocœnia, *Ed. & H.*, p. 111.  
 Convexastræa, *d'Orb.*, p. 112.  
 Adelastræa, *Reuss*, p. 112.

Alliance CYATHOPHOROIDA.

Genus

- Cyathophora, *Mich.*, p. 112.  
 Areacis, *Ed. & H.*, p. 113.  
 Psammophora, *E. de From.*, p. 113.

Alliance PENTACENIOIDA.

Genus

- Pentacœnia, *d'Orb.*, p. 113.  
 Acanthocœnia, *d'Orb.*, p. 114.

Alliance ELASMOCCENIOIDA.

Genus

- Diplocœnia, *E. de From.*, p. 114.  
 Diplocœniastræa, *d'Ach.*, p. 114.  
 Diplotheastræa, *Dunc.*, p. 115.  
 Koilocœnia, *Dunc.*, p. 115.  
 Anisocœnia, *Reuss*, p. 116.

- Heterocœnia, *Ed. & H.*, p. 116.  
 Elasmocœnia, *Ed. & H.*, p. 116.

Alliance ECHINOPOROIDA.

Genus

- × Echinopora (pars), *Dana*, p. 117.  
 × Acanthopora, *Verrill*, p. 117.  
 Physophyllia, *Dunc.*, p. 118.  
 Group-genus  
 × Galaxea, *Oken*, p. 118.  
 Group-genus  
 Leptastræa, *Ed. & H.*, p. 119.

Alliance BARYSASTRÆOIDA.

Genus

- Barysstræa, *Ed. & H.*, p. 119.  
 × Acanthastræa, *Ed. & H.*, p. 119.

Alliance ASTROCENIOIDA.

Genus

- Astroccœnia, *Ed. & H.*, p. 120.  
 Cyathocœnia, *Dunc.*, p. 120.  
 Stephanocœnia, *Ed. & H.*, p. 121.  
 Narcissastræa, *E. Pratz*, p. 121.  
 Haldonia, *Dunc.*, p. 121.  
 Stylocœnia, *Ed. & H.*, p. 122.  
 Bathycœnia, *Tomes*, p. 122.

Alliance ISASTRÆOIDA.

Genus

- Isastræa, *Ed. & H.*, p. 123.  
 Prionastræa, *Ed. & H.*, p. 123.  
 Placastræa, *Stolic.*, p. 124.  
 Elyastræa, *Larube*, p. 124.  
 Lepidophyllia, *Dunc.*, p. 125.  
 Aplocœnia, *Ed. & H.*, p. 125.

Alliance LATIMÆANDROIDA.

Genus

- Latimæandra, *Ed. & H.*, p. 125.  
 Heterogyra, *Reuss*, p. 127.  
 Group-genus  
 × Merulina, *Ehr.*, p. 128.

Alliance PLERASTRÆOIDA.

Genus

- Plerastræa, *Ed. & H.*, p. 129.  
 Holocœnia, *Ed. & H.*, p. 129.

Alliance TABULOIDA.

Genus

- Holocystis, *Lonsd.*, p. 130.  
 Coccophyllum, *Reuss*, p. 130.  
 Group-genus  
 Moseleya, *Quelch*, p. 130.  
 Group-genus  
 Dietyophyllia, *Blainv.*, p. 131.

## II. Section MADREPORARIA FUNGIDA.

## I. Family PLESIOFUNGIDÆ.

## Group-genus

Epistreptophyllum, *Milas.*, p. 133.

## Group-genus

Siderastræa, *Blainv.*, p. 134.

## Group-genus

Polyaræa, *K. v. Fritsch*, p. 134.

## Alliance ASTRÆOMORPHOIDA.

## Genus

Astræomorpha, *Reuss*, p. 135.Mesomorpha, *E. Pratz*, p. 136.

## Alliance THAMNASTRÆOIDA.

## Genus

Thamnastræa, *Lesauv.*, p. 138.Subgenus Centrastræa, *d'Orb.*,Clausastræa, *d'Orb.*, p. 139. [p. 139.]Pseudastræa, *Reuss*, p. 139.Pironastræa, *d'Ach.*, p. 139.Reussastræa, *d'Ach.*, p. 140.Dimorphastræa, *d'Orb.*, p. 140.Dimorphocœnia, *E. de From.*, p. 140.Stylomæandra, *E. de From.*, p. 140.

## II. Family FUNGIDÆ.

## Alliance FUNGIOIDA.

## Genus

Fungia, *Dana*, p. 141.Subgenus Haliglossa, *Ehr.*, p. 142.Diafungia, *Dunc.*, p. 142.Micrabacia, *Ed. & H.*, p. 143.

## Alliance CRYPTABACIOIDA.

## Genus

Halomitra, *Dana*, p. 144.Sandalolitha, *Quelch*, p. 144.Cryptabacia, *Ed. & H.*, p. 144.

## Alliance HERPOLITHOIDA.

## Genus

Herpolitha, *Esch.*, p. 145.Polyphyllia, *Quoy*, p. 145.Lithactinia, *Less.*, p. 146.Zoopilus, *Dana*, p. 146.

## III. Family LOPHOSERIDÆ.

Subfamily *Lophoserinæ simplices*.

## Alliance TROCHOSERIOIDA.

## Genus

Trochoseris, *Ed. & H.*, p. 147.Gyroses, *Reuss*, p. 147.Turbinoseris, *Dunc.*, p. 148.Subgenus Palæoseris, *Dunc.*, p. 148.Phragmatoseris, *Milas.*, p. 148.Omphalophyllia, *Laube*, p. 148.Placoseris, *E. de From.*, p. 149.Elliptoseris, *Dunc.*, p. 149.

## Alliance CYCLOSERIOIDA.

## Genus

Cycloseris, *Ed. & H.*, p. 149.Diaseris, *Ed. & H.*, p. 150.Zittelofungia, *Dunc.*, p. 150.Bathyactis, *Moseley*, p. 151.Astroses, *E. de From.*, p. 152.Microses, *E. de From.*, p. 152.

## Alliance PSAMMOSERIOIDA.

## Genus

Psammoseris, *Ed. & H.*, p. 152.Stephanoseris, *Ed. & H.*, p. 153.

## Alliance PODOSERIOIDA.

## Genus

Podoseris, *Dunc.*, p. 153.Episeris, *E. de From.*, p. 154.

## Group-genus

Gonioseris, *Dunc.*, p. 154.Subfamily *Lophoserinæ aggregatæ*.

## Alliance CYATHOSERIOIDA.

## Genus

Cyathoseris, *Ed. & H.*, p. 154.Crateroseris, *Tomes*, p. 155.Thamnoseres, *Etallon*, p. 155.

## Alliance PAVONIOIDA.

## Genus

Lophoseris, *Ed. & H.*, p. 157.Subgenus Haloseris, *Ed. & H.*,

p. 157.

Tichoseris, *Quelch*, p. 157.Mycedium, *Oken*, p. 158.Phyllastræa, *Dana*, p. 158.Trachypora, *Verrill*, p. 159.Leptoseres, *Ed. & H.*, p. 159.Protoseris, *Ed. & H.*, p. 159. [p. 160.]Subgenus Phylloseris, *Tomes*,

## Alliance STEPHANARIOIDA.

## Genus

Stephanaria, *Verrill*, p. 160.Pratzia, *Dunc.*, p. 160.

## Alliance AGARICIOIDA.

## Genus

Agaricia, *Lmk.*, p. 161.Plesioseres, *Dunc.*, p. 161.Psammocora, *Dana*, p. 192.Pachyseris, *Ed. & H.*, p. 162.Comoseris, *Ed. & H.*, p. 162. [p. 163.]Subgenus Oroseres, *Ed. & H.*,Hydnophorabacia, *d'Ach.*, p. 164.Coscinaræa, *Ed. & H.*, p. 164.

## IV. Family ANABACIADÆ.

## Genus

Anabacia, *d'Orb.*, p. 165.Genabacia, *Ed. & H.*, p. 165.

## V. Family PLESIOPORITIDÆ.

## Alliance LEPTOPHYLLIOIDA.

## Genus

Leptophyllia, *Reuss*, p. 166.Subgenus Thecoseris, *E. de From.*,  
p. 166.Trocharæa, *Etallon*, p. 167.Haplaræa, *Milas.*, p. 167.

## Group-genus

Cyclolites, *Lmk.*, p. 167.

## Alliance MICROSOLENOIDA.

## Genus

Microsolena, *Lamour.*, p. 168.Polyphylloseris, *E. de From.*, p. 168.Thamnaraea, *Etallon*, p. 169.Diplaræa, *Milas.*, p. 169.Disaræa, *E. de From.*, p. 169.Dimorpharæa, *E. de From.*, p. 170.Latimæandaræa, *E. de From.*, p. 170.Mæandroseris, *Rouss.*, p. 170.

## Group-genus

Mycetaræa, *Pratz*, p. 171.

## III. Section MADREPORARIA PERFORATA.

## I. Family EUPSAMMIDÆ.

## Alliance STEPHANOPHYLLIOIDA.

## Genus

Stephanophyllia, *Mich.*, p. 173.Subgenus Discopsammia, *d'Orb.*,  
p. 174.Leptopenus, *Moseley*, p. 174.Cyclobacia, *Bölsche*, p. 174.

## Alliance BALANOPHYLLIOIDA.

## Genus

Balanophyllia, *S. Wood*, p. 175.Subgenus Thecopsammia, *Pourt.*,  
p. 175.Eupsammia, *Ed. & H.*, p. 176.Endopachys, *Londs.*, p. 176.Heteropsammia, *Ed. & H.*, p. 176.

## Alliance DENDROPHYLLIOIDA.

## Genus

Dendrophyllia, *Ed. & H.*, p. 177.Subgenus Cænopsammia, *Ed. & H.*,  
p. 178.Placopsammia, *Reuss*, p. 179.Astropsammia, *Verrill*, p. 179.Pachypsammia, *Verrill*, p. 179.Stereopsammia, *Ed. & H.*, p. 179.Calostylis, *Lindstr.*, p. 180.

## Alliance LEPTOPSAMMIOIDA.

## Genus

Leptopsammia, *Ed. & H.*, p. 181.Endopsammia, *Ed. & H.*, p. 181.

## Group-genera

Astroides, *Blainv.*, p. 181.Lobopsammia, *Ed. & H.*, p. 182.Rhodopsammia, *Semper*, p. 182.Rhizopsammia, *Verrill*, p. 182.

## II. Family MADREPORIDÆ.

*Ed. & H. (pars).*

## Alliance MADREPOROIDA.

## Genus

Madrepora, *Linn.*, p. 183.Subgenus Isopora, *Studer*, p. 184.

## Alliance TURBINARIOIDA.

## Genus

Turbinaria, *Oken*, p. 184.Astræopora, *Blainv.*, p. 185.Dendracis, *Ed. & H.*, p. 185.Actinacis, *d'Orb.*, p. 185.Palæacis, *Haimé*, p. 185.Prisciturben, *Kunth*, p. 186.Stylaræa, *Seebach*, p. 186.

## III. Family PORITIDÆ.

## Alliance PORITINOIDA.

## Genus

Porites, *Ed. & H.*, p. 187.Synaræa, *Verrill*, p. 187.Napotora, *Quelch*, p. 188.Dictyaræa, *Reuss*, p. 188.Rhodaræa, *Ed. & H.*, p. 188.Goniopora, *Quoy & Gaim.*, p. 189.Litharæa, *Ed. & H.*, p. 189.Protaræa, *Ed. & H.*, p. 189.Alveopora, *Quoy*, p. 190.Subgenus Favositipora, *Kent*,  
p. 190.Somphophora, *Lindst.*, p. 190.Dichoræa, *T. Woods*, p. 190.

## Alliance MONTIPOROIDA.

## Genus

Montipora, *Quoy*, p. 191.Anaeropora, *Ridley*, p. 192.

## EXPLANATION OF TERMS.

*Corallum.* An entire solitary or individual coral.

*Colony.* A compound corallum of authors. A number of individuals united together. A number of corallites springing from a common stock.

*Corallite.* An individual member of a colony.

*Common wall* or *colonial theca* or *common plateau.* The structure which often environs the colony at the sides, or is at the base. It may be only found as a basal structure.

*Corallite-wall* or *Theca.* The external structure which gives the corallite its shape, bounds the visceral cavity and interseptal loculi, and to which septa are attached within and often costæ without. It is solid in the Aporosa, perforated in the Perforata and in some Fungida. Walls may be separate or fused together.

*Calice.* The upper opening of the corallite or corallum. A calice may be circular, elliptical, oval, elongate, deformed, or polygonal in outline. It may be separate from other calices in a colony, or more or less united with others by fusion of the walls of the adjacent corallites. The margin of the calice is the top of the corallite-wall.

The parts of the calice are—the septa, pali, the columella, the fossa, and interseptal loculi.

*Septum.* A typical septum is a lamina or plate, which reaches from the inner surface of the corallite-wall near or quite to the centre of the calice. It may reach any distance towards a central axial line. The upper edge is free at the calice, whilst the lower edge is fused with the lowest part of the corallite's cavity.

Septa may be few in number or very numerous. They may be solid, fenestrated, or perforated here and there, or reduced to mere trabeculae and points. They may be entire at the upper edge, or ragged and denticulate there. They may unite with their fellows laterally or by means of the inner edge, but usually this is either free; or it may be united, directly or indirectly, with a columella or with pali. The spaces between the septa are interseptal loculi.

Septa are arranged in systems, and appear in cycles or orders. A typical Aporose coral has six systems, and the same number of septa in each.

The first septa which appear are the primaries, and there are six of them, so that a system is between two primaries. Next come the secondaries, six in number, one between each primary pair; so that there are then 12 septa, or each system has two cycles of septa, one composed of primaries and the other of secondaries. The tertiary septa appear between each secondary and a primary, in every system; so that there are 6 primaries, 6 secondaries, and 12 tertiaries, making three cycles, or 24 septa in all. The next cycle has its septa in the interval between the tertiaries and secondaries and tertiaries and primaries. The new septa are therefore 4

to each system, and in all 24. These, added to the previously existing 24, make 48 as the number of the entire four cycles of septa.

The fifth cycle has its septa in the intervals between the already existing septa, and when it is complete the number of all the septa in the corallite is 96. The sixth cycle, if complete, gives 192 septa.

The septa which arise simultaneously, in the different systems, are of the same *order*. There is not much occasion for this term until the fourth cycle of septa is considered. The septa often do not all arise spontaneously, and then the fourth and fifth orders become of importance.

There is some discrepancy of opinion regarding the exactitude of the statements of Milne-Edwards and Jules Haime, but this succession is in the main true, and especially in calices which are symmetrical and circular in outline. Ellipticity of outline appears to interfere with the normal increase of the septa, or abnormality develops the ellipticity.

In some genera the six systems do not occur, and the septa may be in 3, 4, 5, 6, 7, 8, 10 systems. In each of these systems, however, there may be a normal succession of septa. Occasionally septa abort; and, on the other hand, one or more may be unusually large.

*Pali*. Pali or paluli are laminae or plate-like growths which extend upwards from the bottom of the corallite to the calice, where they usually project between the inner edge of certain septa and the columella or the axial space. They are placed before certain cycles or orders of septa only. There may be one or two sets or crowns or even more of them, as they are placed before (or between the centre of the corallite and the septal end) several cycles of septa. They differ in structure from the septa.

*Columella*. A structure which fills the axis of the corallite more or less. It may be solid, and may arise from the base of the corallite within, and reach up to the calice and end in a knob or point. It is then essential and styliform.

It may arise from the base, and be formed of ribbon-shaped laminae more or less intertwined, and reaching up to the bottom of the calice. Such a one is essential and trabeculate.

It may be made up of trabeculae springing from the base and ending upwards with a spongy or papillary top. It is then essential, spongy, or papillary. Sometimes the columella arises from the junction in the middle line of processes or trabeculae from the ends of the septa. It is then *not essential, but parietal*. This form may be very slight or rudimentary.

The essential columella may sometimes be a long solid lamella, and then the columella is said to be lamellar.

It may happen that there is no columella, and then the central axis is vacant.

*Calicular axial fossa* may be wide or narrow, circular or elongate. *Calicular fossa* is the depth of the whole calice.

*Costae*. Projections upon the corallite or colonial wall or plateau-base with intercostal depressions or spaces. Usually the costae correspond with the septa; but sometimes they relate to the interseptal space or differ in number. The costae may be directly continuous with the septa at the calicular

margin, and may pass from calice to calice. When there is continuity, the costæ are termed septo-costæ. These may pass over the common wall and base.

Costæ do not exist in some genera; and, when they are developed, may be spinulose, moniliform, or smooth and lamellar. Some are crested and spined.

*Endotheca* or *Dissepiments*. Thin plate-like structures, oblique, arched, and more or less distant, one above the other, in the interseptal loculi, and sometimes, when there is no columella, in the axial space. They unite septa, close the loculi, enable the coral to grow in height and strength, and limit the growth downwards of the mesenteries and soft parts.

*Tabulæ*. Horizontal stout dissepiments, crossing much or all of the space within the corallite-walls.

*Synapticula*. Special growths from the septal sides, reaching over the interseptal loculi to the other septa. They occlude much of the interseptal loculi, often form a false basal wall to the corallite, and tend to form the mural and basal structures in some genera. They are false when they only consist of granular or papillary ornamentation united across the interspaces.

*Exotheca*. A cellular structure stretching between neighbouring costæ and filling up the intercostal spaces, and often extending beyond the costæ and uniting neighbouring corallites. When abundant, it forms a cœnenchyma. It may be in bands, or may be very thick, and yet vesicular; in this last instance it is termed *peritheca*.

*Epitheca*. A basal structure covering all the outer structures of a colony or corallum. It may reach close to the calice or only a little way from the base. It may resemble the wall itself, or be membranous or pellicular, and may be extended into radicles. It may be either smooth or transversely wrinkled.

*Gemmation*. This is rarely deciduous, and may arise from the calice—calicular gemmation. If from between the axis and the calicular margin—intercalicular gemmation; from the margin—marginal gemmation. Between calices—intracalicular gemmation. It may occur from any part of the wall of a corallite, from the calicular margin to the base—infra-marginal or lateral gemmation. It may be close to or at the base—basal gemmation. Sometimes it occurs from stolons, or soft or solid growths from the base.

*Fissiparity*. Union of septa across a calice and division of the corallite into two or more parts, which become separate individuals, or by a continuance of the process develop *series*.

*Collines* or *Ridges*. The raised parts of a colony between series of calices, usually covered by septo-costæ.

*Stereoplasm*. A term usefully introduced by Lindström. Delicate endothecal structure occupying different positions in the corallite, often forming vertical processes in the interseptal loculi, or encircling septa, or acting as true endotheca. Often filling up the base within, and then more solid.

The following 40 genera are now considered to be subgenera :—

|                                     |                                     |
|-------------------------------------|-------------------------------------|
| Acanthocyathus, <i>Ed. &amp; H.</i> | Haplaræa, <i>Milas.</i>             |
| Agathelia, <i>Reuss.</i>            | Heliocœnia, <i>Etallon.</i>         |
| Agelecyathus, <i>Dunc.</i>          | Isopora, <i>Studer.</i>             |
| Antillia, <i>Dunc.</i>              | Javania, <i>Dunc.</i>               |
| Blagrovia, <i>Dunc.</i>             | Leptaxis, <i>Reuss.</i>             |
| Blanfordia, <i>Dunc.</i>            | Leptomussa, <i>d' Ach.</i>          |
| Blastotrochus, <i>Ed. &amp; H.</i>  | Oppelismilia, <i>Dunc.</i>          |
| > Caulastræa, <i>Dana.</i>          | Orosaris, <i>Ed. &amp; H.</i>       |
| Ceratophyllia, <i>v. Fr.</i>        | Palæoseris, <i>Dunc.</i>            |
| Cladophyllia, <i>Ed. &amp; H.</i>   | Phyllangia, <i>Ed. &amp; H.</i>     |
| > Cœloria, <i>Ed. &amp; H.</i>      | Phylloseris, <i>Tomes.</i>          |
| Cœlosmilia, <i>Ed. &amp; H.</i>     | Plesiosmilia, <i>Milas.</i>         |
| Cœnangia, <i>Verrill.</i>           | Rhizotrochus, <i>Ed. &amp; H.</i>   |
| Cœnopsammia, <i>Ed. &amp; H.</i>    | Stephanocyathus, <i>Seg.</i>        |
| Cyphastræa, <i>Ed. &amp; H.</i>     | Stylotrochus, <i>E. de From.</i>    |
| Discopsammia, <i>d' Orb.</i>        | Theocyathus, <i>Ed. &amp; H.</i>    |
| Epismilia, <i>E. de From.</i>       | Thecosaris, <i>Ed. &amp; H.</i>     |
| Favositipora, <i>S. Kent.</i>       | Trocharæa, <i>Etall.</i>            |
| Haliglossa, <i>Ehr.</i>             | Tropidocyathus, <i>Ed. &amp; H.</i> |
| Haloseris, <i>Ed. &amp; H.</i>      | Ulastræa, <i>Ed. &amp; H.</i>       |

The following 95 genera are either synonymous with others, or are necessarily absorbed, or of deficient value :—

|                                   |   |
|-----------------------------------|---|
| Actinaræa, <i>d' Orb.</i>         | Cœnosmilia, <i>Pourt.</i>                   |
| Agathiphyllia, <i>Reuss.</i>      | Cœnotheca, <i>Quenst.</i>                   |
| Amphiastræa, <i>Etall.</i>        | Comophyllia, <i>d' Orb.</i>                 |
| Anomocora, <i>Stud.</i>           | Confusastræa, <i>d' Orb.</i>                |
| Aplocyathus, <i>d' Orb.</i>       | Conotrochus, <i>Seg.</i>                    |
| Aplophyllia, <i>d' Orb.</i>       | Crispatotrochus, <i>T. Woods.</i>           |
| Aulopsammia, <i>Reuss.</i>        | Cyathophyllia, <i>E. de From.</i>           |
| Axohelia, <i>E. de From.</i>      | Cyclobacia, <i>Bölsche.</i>                 |
| Bathycyathus, <i>Ed. &amp; H.</i> | Cylicosmilia, <i>Ed. &amp; H.</i>           |
| Blastocyathus, <i>Reuss.</i>      | Cynarina, <i>Brügg.</i>                     |
| Blastosmilia, <i>Dunc.</i>        | Dendraræa, <i>d' Orb.</i>                   |
| Brachytrachus, <i>Reuss.</i>      | Dimorphoseris, <i>Dunc.</i>                 |
| Brassia, <i>Wright.</i>           | Diplocœnia, <i>Dunc. (non E. de From.).</i> |
| Brevismilia, <i>Bölsche.</i>      | Diplohelix, <i>Ed. &amp; H.</i>             |
| Chorisastræa, <i>E. de From.</i>  | Echinophyllia, <i>Klunz.</i>                |
| Clemactis, <i>Agass.</i>          | Ecmesus, <i>Phil.</i>                       |
| Cnemidium, <i>Quenst.</i>         | Ellipsocœnia, <i>d' Orb.</i>                |
| Cœnastræa, <i>Etall.</i>          |   |

*Ellipsosmilia*, *d'Orb.*  
*Epitrochus*, *E. de From.*  
*Fiscicella*, *Dana.*  
*Gyrosmlia*, *E. de From.*  
*Hemicyathus*, *Seg.*  
*Homophyllia*, *Brügg.*  
*Hoplangia*, *Gosse.*  
*Isocora*, *Etall.*  
*Isophyllia*, *Ed. & H.*  
*Koilotrochus*, *T. Woods.*  
*Koninckia*, *Ed. & H.*  
*Lobactis*, *Agass.*  
*Meandraræa*, *Etall.*  
*Metastræa*, *Ed. & H.*  
*Microphyllia*, *d'Orb.*  
*Microtrochus*, *T. Woods.*  
*Notocyathus*, *T. Woods.*  
*Oulophyllia*, *Ed. & H.*  
*Ovalastræa*, *d'Orb.*  
*Oxypora*, *S. Kent.*  
*Oxysmlia*, *Duch.*  
*Parastræa*, *Ed. & H.*  
*Paterocyathus*, *Duch. et Mich.*  
*Pavonia*, *Lmk.*  
*Pentalophora*, *S. Kent.*  
*Phyllodes*, *Phil.*  
*Phyllogyra*, *Tomes.*  
*Phyllopora*, *T. Woods.*  
*Phyllosmlia*, *E. de From.*  
*Placohelia*, *E. de From.*  
*Platyeyathus*, *E. de From.*

*Platygyra*, *Ehr.*  
*Platyhelia*, *E. de From.*  
*× Pleuractis*, *Agass.*  
*Pleurocœnia*, *d'Orb.*  
*Pleurocyathus*, *E. de From.,*  
*Moseley, Keferst., Reuss.*  
*Plocophyllia*, *Reuss.*  
*× Podobacia*, *Ed. & H.*  
*Psammohelia*, *E. de From.*  
*Psammosmlia*, *E. de From.*  
*Reussia*, *Duch. et Mich.*  
*Scolymia*, *Haime.*  
*Smilophyllia*, *E. de From.*  
*Sphenopterium*, *Meek.*  
*Stenogyra*, *E. de From.*  
*Stephanastræa*, *Etall.*  
*Stephanoseris*, *E. de From.*  
*Stephanosmlia*, *Reuss.*  
*Stylangia*, *E. de From.*  
*Stylaræa*, *Ed. & H. (non See-*  
*bach).*  
*Stylocyathus*, *Reuss.*  
*Syzygophyllia*, *Reuss.*  
*Tetracœnia*, *d'Orb.*  
*Thalamocœnia*, *d'Orb.*  
*Tiaradendron*, *Quenst.*  
*Tricycloseris*, *Tomes.*  
*Trismilia*, *E. de From.*  
*Ulocyathus*, *Sars.*  
*× Undaria*, *Dana.*  
*Vasiliium*, *T. Woods.*

|                                |     |
|--------------------------------|-----|
| Total genera as subgenera..... | 40  |
| " " abolished .....            | 95  |
| Total.....                     | 135 |



# LINNEAN SOCIETY.

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## NOTICES.

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**The Library and Reading-Room will be closed,** for cleaning, revision of Books, and putting up additional shelving, during August. The Rooms will be reopened to the Fellows on Monday, 1st September.

Fellows who have had Books on Loan previous to the Recess are requested to return them at earliest convenience. Parcels may be left with the Housekeeper or Hall-Porter.

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### **New List, Subscriptions, and Delivery of Publications.**

The New List of Fellows is now being prepared for Press; therefore all changes of Address, alteration in titles, &c., should be sent in early, otherwise they cannot be entered in this year's List, which will be issued towards the end of October.

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Fellows are reminded that *Subscriptions for 1884 were due on the 24th May last.*

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Intimation of irregularities in the delivery of the Society's publications will oblige, and especially in the cases of Members resident abroad, whether packets be sent through agents or otherwise. It is also desirable that Fellows *resident abroad* should send notice of the best mode of transit. If desired by post, a small sum must be sent in advance to defray prepayment of packets.

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### **EVENING MEETINGS, SESSION 1884-85.**

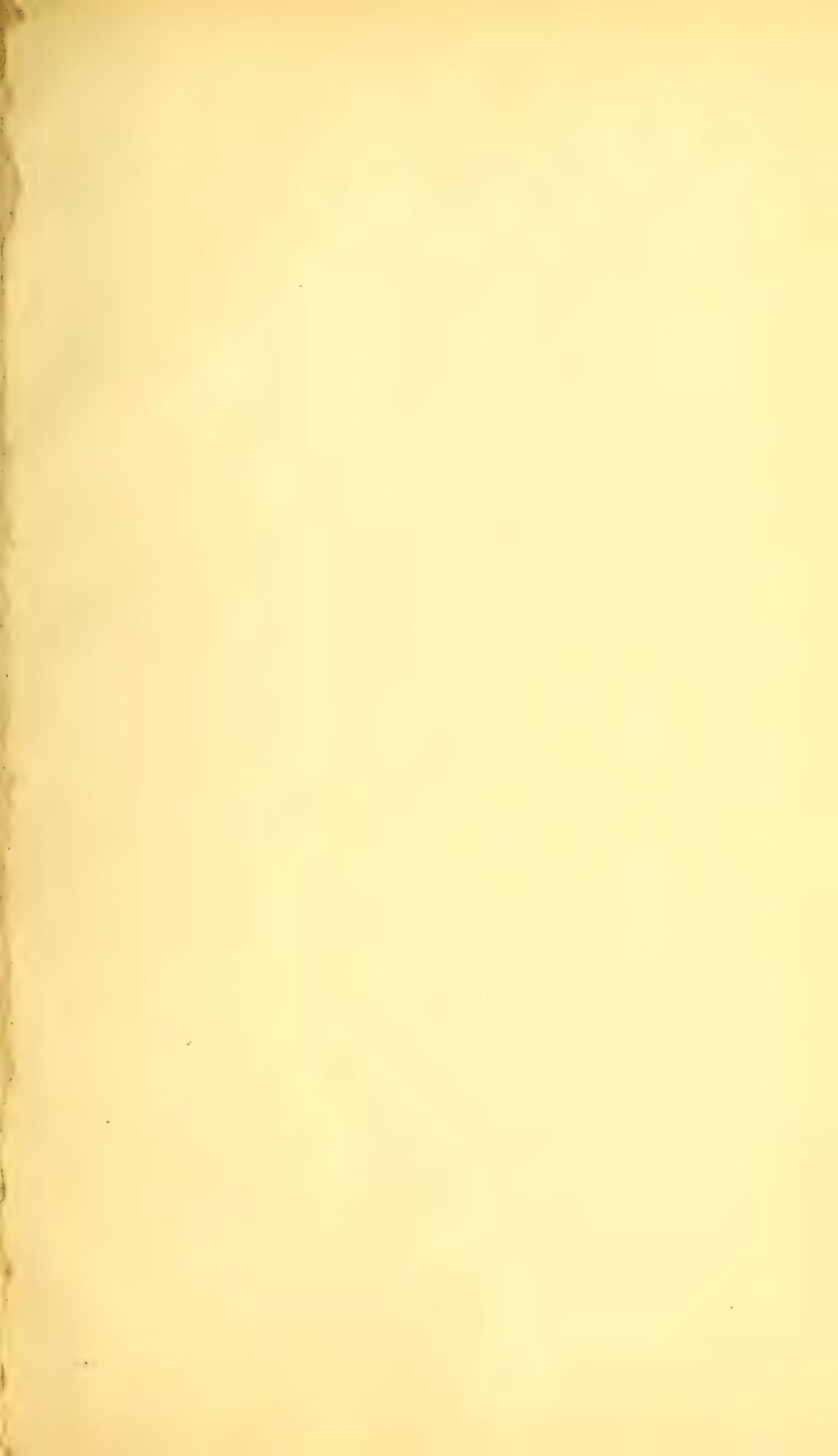
TO BE HELD AT BURLINGTON HOUSE,

On Thursday Evenings, as undermentioned, the Chair being taken at 8 P.M.

|                   |                |
|-------------------|----------------|
| 1884. November 6. | 1885. March 5. |
| "    20.          | "    "    19.  |
| "    December 4.  | "    April 2.  |
| "    "    18.     | "    "    16.  |
| 1885. January 15. | "    May 7.    |
| "    February 5.  | "    June 4.   |
| "    "    19.     | "    "    18.  |

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The Anniversary Meeting takes place on MONDAY,  
25th MAY, 1885, at 3 P.M.







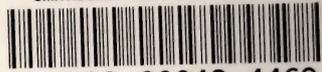








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