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EXPLORING EXPEDITION.

UNITED STATES  
EXPLORING EXPEDITION.

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UNDER THE COMMAND OF

CHARLES WILKES, U. S. N.

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ZOOPHYTES.

BY

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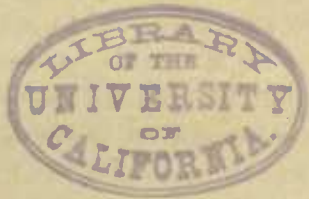
WITH A FOLIO ATLAS OF SIXTY-ONE PLATES.



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PHILADELPHIA:  
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## P R E F A C E.

THE cruise of the Exploring Expedition afforded unusual opportunities for the study of Coral Zoophytes. Nearly all the groups of islands west of the latitude of the New Hebrides, both north and south of the equator, were visited by vessels of the squadron; and these Pacific wanderings were followed up by a rapid passage among the reefs of the East Indies. The attention of the author was first directed to this subject in the Feejee Group, the department during a previous summer having been in the hands of Mr. J. P. Couthouy. The field for geological investigation there offered, was limited, as we were shut out from the interior of the islands by the character of the natives: at the same time, coral reefs spread out an inviting field for observation, hundreds of square miles in extent. The three months, therefore, of our stay in that group were principally devoted to exploring the groves of the ocean, where flowers bloomed no less beautiful than those of the forbidden lands, and rocks of coral growth afforded instruction of deep interest. The specimens were obtained by wading over the reefs at low tide, with one or more buckets at hand to receive the gathered clumps: or, where too deep for this, by floating slowly along in a canoe with two or three natives, and, through the clear waters, pointing out any desired coral to one of them, who would glide to the bottom, and soon return with his hands loaded, lay down his treasures, and prepare for another descent. When taken out of its element, the coral often appears as if lifeless; but placing it in a basin of seawater, the polyps after a while expand, and cover the branches like flowers. Four-fifths of the observations in this department were made at the Feejee Group.

The number of species collected in the course of the cruise, exclusive of the Hydroidea and the Bryozoa, amounts to two hundred and sixty-one, of which two hundred and three are here described as new. The animals of seventy species were figured from the living specimens; yet minute dissections were necessarily few where the time was so short, and the novelties so numerous.

Investigations, with such advantages, were calculated to throw much light upon a department less thoroughly understood than any other in the Animal Kingdom. The minute Hydroidea, and some Caryophylliæ and Alcyonaria are found in the European

seas; and this part of the subject has been wrought out with great beauty and minuteness by different investigators since the time of Trembley and Ellis. But the vast majority of the larger coral zoophytes are in remote regions, and require a patient residence upon the spot to study out their living forms. The voyages of Peron and Lesueur, and Quoy and Gaymard, together with the journey of Ehrenberg to the Red Sea, give nearly all hitherto known with regard to them. It is, therefore, no presumption on the part of the author to say that a large amount of new information was obtained, nor a fact which might not have been anticipated, that such information has detected numerous errors in the received systems or suggested changes of fundamental importance. In making out the Report, it was found impossible, in many genera, to describe the discovered species without giving new and more definite characters to the old; and the genera themselves sometimes required a modification of their limits, and changes in their associations. In every part of the subject, a thorough revision seemed desirable; for only by such a course could the facts obtained be clearly or satisfactorily set forth. The Report, therefore, has necessarily become a Treatise on Zoophytes. Various collections in our country have been consulted in the course of its preparation, among which are Peale's Museum, at Philadelphia; the Cabinet of the Academy of Natural Sciences, in the same city; and that of the Natural History Society at Boston: all were liberally thrown open, and every convenience given to aid in the researches. It will appear, from the results, that the plan adopted was the only one that could have done justice to the department of Zoophytes in the Expedition, and honour to the country which had contributed so largely in her appropriations to the promotion of science. Out of the four hundred and eighty-three species of zoophytes in the tribe Actinaria, (exclusive of the Actiniæ,) which the Report contains, but two hundred and fifty-four, or little more than half, are to be found in previous works. The asterisked names in the catalogues of species, under each genus, show how large a proportion of the whole have been described anew, from specimens examined by the author.

The Report is indebted to the Journal of Mr. J. P. Couthouy for drawings and descriptions of a species of each of the genera, *Fungia*, *Tubularia*, and *Renilla*. Drawings and notes of several of the Hydroidea have been contributed by Dr. C. Pickering.

The coloured figures of the Actiniæ, with two or three exceptions, are from the skilful pencil of Mr. J. Drayton, by whom the descriptions of the species have been drawn up for the volume, from the notes of Mr. J. P. Couthouy, and from his own observations.

In the preparation of the following pages, Lamarck's Treatise has been a book of constant reference, together with the more recent works of Blainville and Ehrenberg. The Memoir by the latter in the Berlin Transactions for 1832, is especially valuable for its original views on the nature and growth of coral zoophytes, and contains, besides, a large contribution of new species. The labours of Milne Edwards, both through his separate Memoirs, and his Notes and Additions to the last edition of the *Animaux sans Vertèbres*,

P R E F A C E.

vii

have been of essential aid. Lamouroux, Ellis, and the numerous older authors, have been freely consulted, wherever a new fact could be obtained, or doubt and obscurity removed; and all figures have been cited, and full references given to descriptions. In few instances have these references been derived from any but the original works.

The subject of Corals, in this volume, is treated of exclusively in a zoological point of view. The geological questions with regard to the formation and structure of coral-reefs and islands, will come up for discussion in the author's Geological Report.

JAMES D. DANA.

New Haven, January 1, 1846.



## CONTENTS.

	PAGE.
CHAP. I. INTRODUCTION .....	7
II. GENERAL STRUCTURE OF ZOOPHYTES.....	11
III. HYDROIDEA.....	19
IV. ACTINOIDEA .....	29
GENERAL STRUCTURE.....	30
SUBDIVISION OF THE ACTINOIDEA.....	45
ACTINARIA .....	46
ALCYONARIA.....	50
SECRETION OF THE CORALLUM.....	50
REPRODUCTION BY BUDS—THE COMPOUND STRUCTURE .....	57
FORMS OF ACTINOID ZOOPHYTES.....	59
MODES OF GROWTH .....	62
COALESCENCE OF BRANCHES.....	65
MODES OF BUDDING AND THEIR CONNEXION WITH THE MODES OF GROWTH.....	66
V. THEORY OF ZOOPHYTIC GROWTH AND REPRODUCTION, AND OF ORGANIC DE- VELOPEMENT IN GENERAL.....	85
VI. GENERAL REMARKS ON THE GEOGRAPHICAL DISTRIBUTION OF ZOOPHYTES..	101
VII. CLASSIFICATION OF ZOOPHYTES.....	105
TABULAR VIEW OF THE CLASSIFICATION OF ZOOPHYTES.....	113

## DESCRIPTION OF SPECIES.

ORDER I.—ACTINOIDEA.....	121
SUBORDER I.—ACTINARIA.....	121
TRIBE I.—ASTREACEA .....	121

	PAGE.
FAMILY I.—ACTINIDÆ.....	122
II.—ASTRÆIDÆ.....	154
III.—FUNGIDÆ.....	283
TRIBE ASTRÆACEA; APPENDIX.....	349
TRIBE II.—CARYOPHYLLACEA.....	350
FAMILY I.—CYATHOPHYLLIDÆ.....	352
II.—CARYOPHYLLIDÆ.....	364
III.—GEMMIPORIDÆ.....	407
IV.—ZOANTHIDÆ.....	417
TRIBE III.—MADREPORACEA.....	428
FAMILY I.—MADREPORIDÆ.....	431
II.—FAVOSITIDÆ.....	509
III.—PORITIDÆ.....	549
TRIBE MADREPORACEA; APPENDIX.....	570
TRIBE IV.—ANTIPATHACEA.....	574
SUBORDER II.—ALCYONARIA.....	586
FAMILY I.—PENNATULIDÆ.....	587
II.—ALCYONIDÆ.....	599
III.—CORNUULARIDÆ.....	627
IV.—TUBIPORIDÆ.....	629
V.—GORGONIDÆ.....	637
ORDER II.—HYDROIDEA.....	685
FAMILY I.—HYDRIDÆ.....	685
II.—SERTULARIDÆ.....	686
III.—CAMPANULARIDÆ.....	688
IV.—TUBULARIDÆ.....	690
SUPPLEMENT TO THE DESCRIPTION OF ZOOPHYTES.....	693
APPENDIX.....	709
ADDENDA AND ANNOTATIONS.....	709
STRUCTURE OF CORALLA.....	710
CHEMICAL COMPOSITION OF CORALLA.....	712
GLOSSARY.....	723
CATALOGUE OF WORKS REFERRED TO IN THE VOLUME.....	725
INDEX.....	731



# ZOO PHYTES.

## CHAPTER I.

### INTRODUCTION.

1. THE forms of life, under consideration in the following pages, are appropriately styled *flower-animals*.\* In external figure, the individual animals closely resemble flowers, and no less so in brilliancy and variety of colouring. Moreover, a large number of zoophytes are so like the trees and shrubs of land vegetation, as to have deceived even the philosopher till near a century since.† The mosses and ferns of

\* The word *zoophyte* is from the Greek ζῶον, *animal*, and φυτόν, *to grow like a plant*. Blainville states that the term was introduced by Sextus Empiricus and by Isodore of Seville in the sixth century. It has been differently restricted in its use by authors, and, on account of its various applications, is wholly rejected by Lamarck. Although the species have little of the implied resemblance to vegetables in their internal structure, yet in external appearance, the compound forms as well as simple animals are so closely like plants and flowers, that we have deemed it best to retain the term. It is the popular designation, and is moreover used by some of the latest scientific writers on the subject.

Ehrenberg has proposed to substitute *phytozoa*, derived from the same roots. But the science requires a name that will apply to the whole compound structure,—the coral-tree, sea-fan, or mass of whatever shape ;—and phytozoum refers only to a *single* polyp ; or phytozoa, the plural, to *polyps in general*. These cannot supply the place of the very convenient terms zoophyte and zoophytes. Moreover, the term phytozoa (phytozoaires)—plant-animals—has been applied to the minute cellules—monad-like in their motions, and supposed to be animalcules or plant-entozoa—detected in the tissues or organs of some plants.

† All the early authors, till the commencement of the last century,—among whom are Dioscorides, Cæsalpin, Bauhin, Ray, Geoffroy, Tournefort, and Marsigli,—arranged corals



our woods—the lichen and mushroom—the clump of piuks—the twig and spreading shrub—have all their counterpart among the productions of the sea. The ocean-grove is without verdure, yet there is

along with marine plants; and the last-mentioned author was thought to have removed the only remaining doubt when he published to the world his discovery of the “*fleurs du corail*,”—the coral flowers,—since shown to be coral animals.<sup>a</sup> Peyssonel,<sup>b</sup> one of the first investigators that ventured to combat the prevalent opinion, was treated even with derision by the scientific men of the day; and the distinguished Reaumur gave a laboured reply to his essay, setting down the vegetable nature of zoophytes as too well ascertained to be made a subject of discussion. This took place so late as 1727. The subsequent discoveries of Trembley, in 1741, who published elaborate descriptions and figures of certain fresh-water polyps, with an accuracy of detail that has hardly been exceeded, opened anew the dispute on this subject, and Jussieu and Guettard undertook investigations in order to settle the point at issue. The coasts of France were searched, and several species of zoophytes found and figured. Reaumur was not slow to change his ground, and, in an able memoir, he reviewed the investigations of Peyssonel and Jussieu; and, with slight modifications, advocated their views. Yet, in general, philosophers were still incredulous. Dr. Parsons, in 1752, took the palm from Peyssonel before the Royal Society, and again it was believed, on grounds that were deemed satisfactory—Dr. Parsons’s limited conceptions and not direct investigation—that corals were plants; for, says Dr. Parsons, “It would seem to me much more difficult to conceive that so fine an arrangement of parts, such masses as these bodies consist of, and such regular ramifications in some, and such well-contrived organs to serve for vegetation in others, should be the operations of poor, helpless, jelly-like animals, rather than the work of more sure vegetation, which carries on the growth of the tallest and largest trees with the same natural ease and influence as the minutest plant.”<sup>c</sup>

Ellis appeared soon after, and by his accurate figures and descriptions of corals and coral animals, presented with philosophical minuteness and precision, the scientific world were arrested in their judgment. The mineral theory of Boccone<sup>d</sup> and Guison, and the crystallization theory of Baker,<sup>e</sup> were checked in their progress, and the vegetable theory at the same time began to lose its popularity.

Linnæus, then the umpire in science, received the new opinions cautiously. He was unwilling to adopt at once the views of Ellis, and finally satisfied himself, or his fancy, with the theory that zoophytes were intermediate in their nature between plants and animals, possessing the functions of animal and vegetable life combined. Excepting the

<sup>a</sup> Marsigli, *Physique de la Mer*, Amsterdam, 1725. Marsigli’s first observations were made in 1706.

<sup>b</sup> Peyssonel was anticipated only by Ferrante Imperato, who published a “*Historia Naturale*,” at Naples, in 1599. See Blainville, *Man. d’Act.*, p. 14.

<sup>c</sup> Peyssonel’s Memoir covers 400 pages of manuscript, and was the result of a long series of observations in the West Indies. It was sent to the Royal Society in 1751, and an abstract of it was read, which appeared in the *Transactions*, for 1753 (vol. x. of Abridgment). The Memoir is still extant in the Library of the Museum, at Paris, and a late notice of it by M. Flourens may be found in the *Annales des Sciences Naturelles*, ix. 334, 2d Ser., 1838. Dr. J. Parsons’s reply to Peyssonel followed soon after the communication of his discoveries, in 1752.

<sup>d</sup> P. Boccone, *Museo di Fisica*, &c., Venice, 1694, 1 vol., 4to., with figures.

<sup>e</sup> *Employment for the Microscope*, pp. 218–220. London, 1753.



full compensation in its perpetual bloom; for each coral branch is every where covered with its star-shaped animals, the "coral-blossoms."

Although the external resemblance to objects of the vegetable kingdom is so striking, there is little similarity in actual structure. Each of these flower-animals has a mouth, and a cavity to receive and digest food; and the appendages that look like petals are organs fitted either for securing their prey or for some other animal function. Some species have actually been fed, and the process of digestion watched by the naturalist. They are not always invisible animalcules, as has been the common impression; on the contrary, many of the most common varieties are half an inch in diameter, while others are one, two, or three inches, and still others are a foot to eighteen inches. Neither have they "the consistence of jelly," for the texture is usually more like flesh, and the exterior is sometimes quite firm and even leathery.

2. The growth of coral has been considered one of the mysteries in science, and so few years have elapsed since the facts were first made known, that it remains to the many a mystery still. How the tree of stone grows and spreads its branches—what its connexion with the coral polyps which blossom over its surface, and whence the lime that constitutes it, are points which have been but lately explained; and there is still room for additional and corrected information. In

earlier publications of Dr. Job Baster, of Zurichsee, in Zealand, exhibiting singular ignorance of the subject discussed, and inaccuracy in facts, the complete animality of corals has been since admitted without opposition.<sup>a</sup>

The sponges have often been improperly classed with corals. There is still doubt as to their animality. The latest investigations seem to establish their vegetable nature.<sup>b</sup>

<sup>a</sup> A more extended history of this science in our own language may be found in Johnston's *British Zoophytes*, 8vo., Edinburgh, 1838; a work distinguished for its literary as well as scientific excellence: also, in French in Blainville's *Man. d'Actinologie*, 1834.

<sup>b</sup> Of recent authors, Grant, Audouin, Milne Edwards, Bowerbank, Dujardin, and Laurent, consider sponges as animal; while Link, Blumenbach, Owen, Hogg, and G. Johnston, have inclined to place them in the vegetable kingdom. See Grant, *Edinb. Phil. Jour.* xiii. xiv.; Dujardin, *Ann. des Sci. Nat.* x. 5, 2d ser. 1838, in which he endeavours to show, by minute microscopic research, that they are compound infusoria; Laurent, on the *Spongillæ*, *L'Institut*, 1840, pp. 223, 231, 240, and the *Microscop. Jour.* i. 78, who describes the reproductive organs of the supposed animals; Hogg, on the *Spongilla*, *Linn. Trans.* xviii. 390, who sums up the results of his laboured investigations in the following language,—“They have no tentacles, no cilia, no mouth, no œsophagus, no stomach or gastric sac, no gizzard, no alimentary canal, no intestine, no anus, no ovaria, no ova, no muscles or muscular fibres, no nerves or ganglia, no irritability or powers of contraction and dilatation, no palpitation, and no sensation whatever. Surely, then, we cannot any longer esteem these natural substances to be individual animals, or even groups of animals, in which not one organ, or a single function or property peculiar to an animal can be detected.”

treating of these subjects, we shall dwell with some minuteness on the structure of coral animals—their habits and modes of growth and development; and it will be our aim to give such simple explanations as will be intelligible to the general reader, although it may require the stating of some principles well known to those versed in science.

The mind should be disabused of the idea that all polyps form coral. There are many species identical in general structure with coral animals by which no coral is secreted. Among these, are the *Actiniæ*,—common on some parts of our own coasts,—many of which are richly coloured and occasionally measure several inches in diameter, as is well shown by the drawings of Mr. Drayton on the first five plates of the Atlas. Other species contain scattered granules of lime. Thus there is a gradual passage up to the coral-making species, whose secretions form a solid framework to the animal.

Another simple fact should be here understood. On examining any piece of coral, the surface is found to be covered either with prominent cells, or concave depressions; hundreds, perhaps, to a single branch. Each of these cells marks the position of a polyp, and counting them we may ascertain the number of flower-animals that together constructed the branch. But this compound structure is not universal. Some coral-polyps are single animals, each a separate individual like the soft *Actinia*; and this is apparent in the coral, for it presents but a single cell or depression. From the solitary polyp, there are all possible varieties among zoophytes, up to living masses, in which hundreds of thousands are congregated, all the progeny of a single germ.

Coral is above called the framework of the polyp. It is not a collection of cells in which polyps may conceal themselves, though so stated till a recent date. On the contrary, the coral is generally concealed within the polyp or polyps, and is literally an internal framework, having many analogies to a skeleton.

With these few introductory explanations, we may enter upon the subject before us—the Structure, Habits, Classification, and Description of Zoophytes.

## CHAPTER II.

### GENERAL STRUCTURE OF ZOOPHYTES.

3. THE term *zoophyte* is applied to the whole animal structure, whether a single animal, or consisting of a large number of animals, as in most corals; while the several individuals are called *polyps*.

In view of their general radiated structure,—the arrangement of the tentacles around a disk as a centre, and a corresponding circular structure within,\*—these animals are placed in the Fourth grand division of the Animal Kingdom—the RADIATA. The distinguishing characteristics of the simple polyp, are as follows:

*An inarticulate fleshy body, nearly cylindrical, having a circular or elliptical summit called the disk, bordered by one or more series of tentacles, and an opening or mouth at the centre of the disk; internally, a visceral cavity closed below, no distinct vascular system, an imperfect nervous system or none, and no senses but those of taste and touch.* The body, and, in most instances, the tentacles also are expanded by means of water, which is ejected on contraction.

Polyps are thus among the simplest of animals, being even less complex in structure than the minuter Rotifers. A simple visceral cavity, and a single opening to it placed at the centre above, with traces of a radiated structure around it, are the only essential points; for even the tentacles are sometimes wanting. They have no intestine, no glands to aid in digestion, separate from the general walls of the internal cavity,—no system of vessels in any part for circulation,—an imperfect nervous system, if any,—no distinction of sex,—and no senses but those of taste and touch, with the latter of which the former may properly be included. Moreover they are mostly dependent on the fluid in which they live for the means of expanding their tenta-

\* Some of these animals are represented in figures 1, 6, and 12 beyond, and numerous species are given in the Atlas.

cles, and distending the body for the reception of food. A few have powers of locomotion; but they are commonly attached by their lower surface or extremity to the rocks or some other support, where they live on such chance-bits as are thrown in their way.

4. The internal cavity, which we here style the *visceral cavity*, occupies the whole interior of the polyp. In some minute species (Hydræ) it is a mere tubular sac, so simple in its nature, that the animal may be turned inside out, and still eat, digest, and perform all the functions of life as before. In other species it is divided vertically by thin fleshy lamellæ growing from the sides, and the mouth opens first into a cylindrical organ, called the stomach, and thence into the general internal or visceral cavity. Within this cavity the water is received, by which the polyp distends by injection its body and tentacles; here also the animal fluids are aerated by air taken up from the imbibed water; and in the walls of the same cavity, or the fleshy lamellæ when these exist, the germs or ovules are produced. In the lowest grade of these animals, the Hydra, we have then the simplest form of an internal cavity, so complex in many other animals; and in the fleshy lamellæ possessing germinal functions, that proceed in the higher grades from its walls, we see represented the system of glands and the viscera generally, which have an analogous connexion, where present, with the walls of the internal cavity of the body.

5. The mouth is a simple opening through the fleshy disk; and as there are no organs for trituration, the process of digestion consists in the unaided action of the gastric fluid, or what corresponds thereto in these animals. The refuse is ejected through the mouth after digestion, this being the only opening to the internal cavity. What may be the separate functions of the stomach and visceral cavity in the process of digestion is not definitely known; but it is probable that the appropriation of the chyle to the nourishment of the polyp takes place through the latter, and the lacunal passages or openings communicating with it.

6. The existence of nerves, or at least of something acting the part of nervous matter, is necessary, in order that these animals should possess the sense of touch; but examinations hitherto have detected no centre of nervous action and no distinct nervous cords.\* The sensibilities of polyps are feeble, and their movements slow.

\* It has been stated that in the Actinia a nervous thread may be traced around the mouth, which sends fibrils into the tentacles. This requires farther confirmation.

7. Reproduction takes place both by means of *ovules* and *buds*.

The *ovules* form as above stated, and either pullulate from the sides of the animal, or find exit through the mouth. Soon after ejection (and sometimes before), each ovule produces a young polyp, which swims free for a while, and then, with few exceptions, attaches itself to some support, where, in very many species, it passes the rest of its existence.

The mode of *budding*, bears some analogy with the budding of leaves or flowers from a plant. In many instances, the bud first appears as a slight swelling on the side of a polyp; after enlarging for awhile, a new polyp is finally developed, with tentacles and visceral cavity complete; this cavity is sometimes continuous with that of the parent; at others, it becomes separated at base, and, at others, still, the whole young polyp becomes entirely detached from the parent. There is some variety in this mode of reproduction which will be noticed when treating separately of the different orders of zoophytes.

Buds open from different parts of polyps, either laterally from the base, the sides above, just exterior to the tentacles, or from the disk. Disk-buds, though similar to the others, in principle, are peculiar in the changes they produce and the appearances presented. For since the disk covers the top of the visceral cavity, the new bud which opens, shares in this cavity with the parent, and the two become separate only by gradual growth upward. It appears like a spontaneous subdivision of a polyp, and is so in the result, though quite different from the spontaneous fission of a monad (§§ 77-79).

Besides these modes of increase, polyps may be multiplied from sections artificially made. Some species may be cut into a dozen or more parts, and will make as many perfect polyps, each part possessing within itself the power of reconstructing a complete animal. A wound on the side of some budding species (Hydras), instead of being an injury, only opens the way for a cluster of new polyps which soon after sprout from the spot.

There are thus the following different modes of reproduction:—

I. OVIPAROUS.—1. By ovules proceeding outward from the side of the polyps, singly or in clusters.

2. By ovules formed from vertical lamellæ in the visceral cavity, and ejected through the mouth. The *viviparous* is but an accident in the oviparous mode; the eggs within develop in the same



manner as externally, and for like reasons, as the external waters have free admission.

II. GEMMIPAROUS.—1. By single buds, developing young, which afterwards become free and independent animals.

2. By buds, which become developed and remain persistent,—and these may be either lateral or terminal.

### III. BY ARTIFICIAL SECTIONS.

This mode may depend on the same cause as the general distribution of the *budding* function, and may be properly an analogous process,—both depending on the imperfect character of the nervous system, or its absence.

These modes of reproduction, as they are presented by the different tribes of zoophytes, will be farther explained in the following pages.

8. *Compound Zoophytes.* It has been stated that zoophytes are either simple or compound, the simple being a solitary animal, with a single mouth and its visceral cavity; the *compound*, a cluster, presenting as many mouths externally as there are polyps combined, and within, as many visceral cavities. This compound structure proceeds from the capability, above explained, of increasing by buds; for every coral, however large and numerous the colony, commenced from a single polyp. In some species the bud grows out as a distinct branch from the side of the parent, and branch is thus added to branch by successive buddings from the forming polyps. In other cases, the young continues attached by one side to the parent, instead of forming a prominent shoot, and only their upper extremities appear separate. Large zoophytes are thus formed, consisting of myriads of polyps united to one another by the tissues that surround the visceral cavity of each.

The several polyps in a compound zoophyte eat and digest separately, and generally carry on as individuals the processes of reproduction and aëration; yet all aid in the growth of the common mass, though each contributes more especially to its own nutriment and the part immediately adjoining. Although their visceral cavities are distinct, there are numerous communications between those of adjoining polyps, and the fluids may pass more or less freely from one to the other. An injury to one part of a zoophyte is felt by the polyps some distance around, but not always through the whole mass. On pressing the tip of a branch of a large Alcyonium, in the Feejees, there was an immediate contraction of every polyp

through the whole zoophyte, although extending to a breadth of four feet.

9. *Secretion of the Corallum.\** Coral secretions take place either from the interior tissues of the polyps, or from the foot or base, and in a few species only, in the exterior cuticle. The corallum in the live zoophyte is therefore in general wholly concealed within the polyps, and is in no part external.

No peculiarities of structure, external or internal, have been observed distinguishing the coral-secreting polyps from those which do not secrete coral. Animals of both kinds belong to the same family, and hence this peculiarity affords at the highest only a generic distinction† (§ 109).

\* Coral has been variously designated in both ancient and modern times. The terms *Corallium*, *Corallum*, and *Curalium*, were all used by the ancients, and their derivations and use are discussed at length by Theophrastus in his work on plants, Book iv. Κουραλλιον is the ancient Greek form, as says Dionysius, “παντη γαρ λιθος εστιν ερυθρου κουραλλιοιο.”—The more recent Greeks, among whom are Dioscorides and Hesychius, wrote the word κοραλλιον. Among the Latins, Ovid says, “Sic et *Curalium*, quo primum contigit auras tempore durescit.” Avienus uses *Corallum*: “Fulvo tamen invenire *Corallo*, quærere vivendi commercia.” Among the derivations suggested, that of κορη, damsel, and αλς, sea, appears the most probable.

The word *Corallium* has been in most general use; but as it is now the name of a particular genus, it has of late been rejected for *polyppifer*, *polyppary*, and *polyppidom*, signifying *polyp-bearer*, or a *hive* or *house of polyps*. These terms are all objectionable, for the reason that the polyps contain the coral, instead of the coral containing the polyps. On this ground neither of them has been adopted here, but instead the old word *Corallum*, which is sufficiently distinct from the name of the genus *Corallium*.

We have then the term *Zoophyte* for the whole polyp mass, whether simple or compound, coral-making or not; the term *polyp* for the individual animals; and *Corallum* for the framework or skeleton secreted by polyps. To express the fact that certain polyps secrete a corallum, we use the expression *coral-forming* or *coralligenous*. The animals of a coral zoophyte are *coral-animals* or *coral-polyps*.

† The definition of Zoophytes excludes the Flustroid tribe of polyps, called *Bryozoa* by Ehrenberg.<sup>a</sup> The peculiarities of these animals were first pointed out by Milne Edwards and Audouin,<sup>b</sup> who showed that in place of the simple digestive sac of the Sertularidæ, to which they had been thought allied, they have a regular stomach, and an intestine which curves upon itself and terminates in the disk; and besides, their arms or

<sup>a</sup> Berlin Trans., 1832.—The name *Bryozoa* is derived from βρυον, *moss*, and ζωον, *animal*. The other zoophytes Ehrenberg calls *Anthozoa*, meaning *flower-animal*,—excepting the Sertularidæ and the allied species, which he subsequently named *Dimorphæa*.

<sup>b</sup> Annales des Sei. Nat. xv. 1828.—Edwards and Audouin here point out the relations of these animals to the Ascidiæ.



10. *General Divisions of Zoophytes.* Zoophytes constitute naturally two distinct groups, differing in mode of reproduction and in internal structure. The visceral cavity in some of them is, as described, a simple tubular sac. In others, it is divided vertically by fleshy lamellæ, proceeding from the walls and forming a radiate series around the cavity. Connected with these peculiarities, we observe striking differences in the mode of ejecting the ovules. When there are lamellæ in the cavity, the ovules are formed by them, and appear in clusters attached to the margin, from which they are finally detached, and make their escape out of the mouth. But when there are no lamellæ, the ovules are produced in the walls of the visceral cavity, and make their readiest escape outward through the sides of the polyp, instead of the more indirect route, into the visceral cavity and out of the mouth.

The following are the divisions based on the characters mentioned:\*

#### ORDER HYDROIDEA.

Visceral cavity, a simple tubular sac; reproductive functions residing only in the walls of the cavity; young or ovules pullulating from the sides of the parent.

#### ORDER ACTINOIDEA.

Visceral cavity, divided vertically by fleshy lamellæ, which possess reproductive functions; ovules formed within the cavity from some of the lamellæ and ejected through the mouth.

The polyps of the order HYDROIDEA are mostly minute, and the coralla, when any are formed, are either horny or membranous; they are very delicate, and, when compound, usually consist of minute calicles† (or little cups), arranged in series along a tubular axis.

tentacles are furnished with vibratile cilia. Excepting their calcareous secretions and mode of budding, they are widely removed from true zoophytes. (See farther §§ 106-8.)

The definition also excludes sponges, as already intimated, which, excepting the most general attribute of animal matter (if they are animals), possess nothing in common with the polyp. No single character, except their forms, has ever been pointed out which indicates a relationship.

\* The names below have the following derivations:—*Hydroidea* is from the included genus *Hydra*, and *Actinoidea* from the included genus *Actinia*. This last name (from *ακτιν*, *ray of the sun*,) alludes to the radiated character of the animals.

† The term *calicle* (from *caliculus*, *a little cup*,) is used for the prominences which contain the cells in many corals; and *cell* is restricted to the cavity itself. By *cellule*, as hereafter used, the minute pores of the corallum will be referred to.

From each cup the extremity of a polyp protrudes itself with its coronet of slender tentacles.

The ACTINOIDEA, which comprise all the common coral-forming species together with the tribe of Actinias, include polyps of various sizes, from the microscopic point to a diameter of eighteen inches. The presence of internal reproductive lamellæ, and the fact of their ejecting the ovules by the mouth, separate them widely from the Hydroidea. The tentacles are in one or more series, or scattered. The coralla may be either calcareous or horny; but the calicles, when any exist, are always calcareous.

In the remarks which follow, I shall be brief with the first order, as my own observations can contribute little to what is already known. Some general account of these animals is required in this place, to serve for comparison with the Actinoidea, on which I shall dwell more at length.



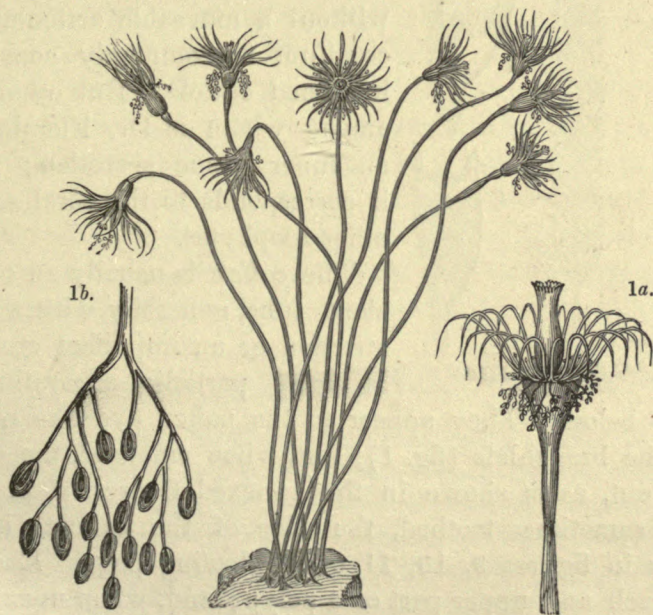


## CHAPTER III.

### HYDROIDEA.

11. THE Hydroidea are minute polyps, of extreme simplicity of structure and delicacy of form. Though sometimes single animals, swimming at large, like the Hydra, they usually constitute compound zoophytes, hundreds and often thousands to a cluster. Some, as in

Fig. 1.

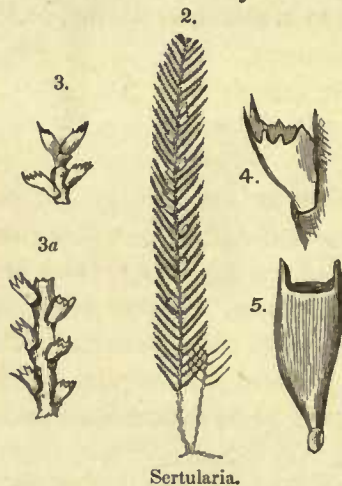


the annexed figures,\* grow in crowded tufts of thread-like stems; many are much branched, and each branch is tipped with a star of

\* These figures are by J. P. Couthouy, and represent a *Tubularia* from Rio de Janeiro, which he designates *T. ornata*. Figure 1 shows the natural size of the animals.

tentacles (fig. 6). In the greater part of the species, minute calicles, or little cups, but indistinctly visible to the naked eye, are arranged in one or more series along the branchlets, and the cluster is a neat imitation of the most delicate plumes (fig. 2), trailing vines, or mossy tufts; and, when alive, every calicle is the site of a polyp-flower. They are occasionally but a few lines high; yet others, no less minute in their cells and polyps, attain a length of several feet. Quite a variety of species may be gathered along our sea-shores, upon sea-weeds, shells, or the rocks of the coast; and Hydras are common among the duck-weed in almost any stagnant waters.

12. The species are sometimes fleshy throughout, forming no *cells* or *corallum*; but, in general, the zoophytes have a very delicate corneous or cartilaginous exterior, nearly or quite transparent, and the same kind of horny membrane constitutes the calicle. In the Hydroidea, having sessile calicles along the branches, faint joint-like divisions may be distinguished in the stem, yet without a moveable articulation. The corallum is commonly considered the hardened cuticle. But other observers, among whom is Dr. Fleming, make it an inner tissue secretion; and, if so, it corresponds to the coral secretions of other zoophytes.



Sertularia.

The *calicle* is usually an open cup, or short tube, generally with a slight constriction or an imperfect cross partition at base, partially separating it from the stem below. They appear to the naked eye like mere points, edging the branchlets (fig. 1); but, when enlarged, the cup-form is brought out, as is shown in the annexed figures, 2, 3, 3a, and 4. Though sometimes toothed, the edge of the calicles is generally entire, as in figures 9, 10, 11, on a following page. Each contains the stomach and upper part of a polyp; and, when unexpanded, the circlet of tentacles is here withdrawn and concealed. The calicles are arranged on one or more sides of the branch, and are either opposite or alternate, though generally the latter.

13. The tentacles are mostly slender tubular organs, arranged, in a single series, around a small disk containing the mouth, and the mouth, or the centre of the disk, is sometimes quite prominent, as is

13. The tentacles are mostly slender tubular organs, arranged, in a single series, around a small disk containing the mouth, and the mouth, or the centre of the disk, is sometimes quite prominent, as is

represented in figure 6. The circle of tentacles is commonly symmetrical, yet is sometimes oblique. In the Tubularia group, the tentacles are often short and sluggish, and are in one or more series, or irregularly scattered. The disk is prolonged into a high cone, as in figure 1*a*, and is tipped with a row of oral tentacles immediately about the mouth opening. The tentacles of the Tubulariæ and Campanularidæ, are described as differing from those of the Sertularidæ and Hydræ, in not being properly tubular organs.

The stems and branches of these zoophytes are tubular; and the stomachs of all the several polyps—which are simple cavities directly beneath the mouth—communicate more or less freely with one another through this common tubular axis, which ramifies from the main stem into all the branchlets. Thus the polyps of a cluster are united, not only by their external envelope, but also through this internal communication. The annexed figure exhibits this character in one of the Campanularidæ from the Feejee Islands; and the same is seen in the other compound Hydroidea.

Fig. 6.



The axis is described by some as pulpy or medullary. In the author's examinations of one of the Sertularidæ (fig. 9), a vibrating motion of the contents of the tubular axis was distinctly observed, and the pulp, which had a greenish tint, appeared to have been derived in part at least from the digested food of the stomach. The investigations of J. J. Lister,\* since seen, confirm this opinion. The pulpy fluid was found by this able observer to vibrate occasionally

\* J. J. Lister, Philosophical Transactions, 1834, p. 369, with fine illustrations on plates ix. and x.

We quote the following from his very interesting observations. The current "flowed in one channel, alternately backwards and forwards, through the main stem and lateral branches of a plume, and through the root, as far as the opacity admitted of its being traced; sometimes it was seen to continue into the cells. The stream was throughout in one direction at one time; it might be compared to the running of sand in an hour-glass, and was sometimes so rapid in mid-tide that the particles were hardly distinguishable; but it became much slower when near the change. Sometimes it returned almost without a pause; but at other times it was quiet for awhile, or the particles took a confused whirling motion for a few seconds; the current afterwards appearing to set the stronger for the suspension." "Five ebbs and five flows occupied fifteen minutes and a half; the same average time being spent in the ebb as in the flow." Lister states that the vibrating motion of the internal axial fluids were first observed by Cavolini, and are described in his *Memorie per servire alla Storia de' Polipi Marini*, published at Naples, in 1785.

*into the stomach.* It appears then that this is the means by which the results of digestion, or the nutrient juices, are distributed through the zoophyte; and that the sides of the visceral cavity have throughout the power of appropriating these chyloid fluids, thus kept in circulation. There appears to be no system of circulation independent of this chyle distribution.

In certain filiform species (the Tubulariæ, fig. 1), Lister distinguished a similar motion in the pulpy fluids of the axis, except that, instead of vibrating, it was circulatory, part of the fluids moving up and part descending by a simultaneous action. They often passed into the stomach, and were continuous in their motions with the movements of this organ. It appears therefore that the tubular axis of these species corresponds with the visceral cavity in the higher zoophytes.

The visceral cavity in the Hydroidea differs widely from the same in the Actinoidea, in the absence of vertical fleshy lamellæ around the sides. Rudiments of these lamellæ appear however to have been detected by Lister in a Tubularia. It is due to this simplicity of structure that the Hydra will live and eat when turned inside out.

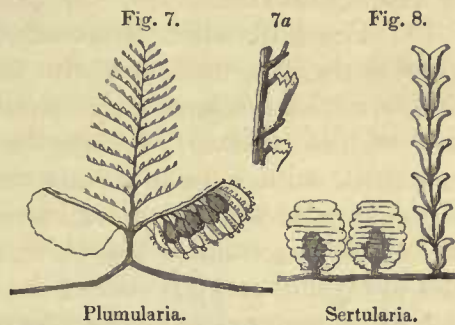
The food of these animals consists of minute animalcules or worms, or whatever of animal life is sufficiently small to become their prey. The prey is secured usually by means of the tentacles, which entwine around it, or together enclose it, and convey it to the mouth.

14. *Reproduction* takes place either (1) by ovules proceeding out from the sides of the polyps; (2) by lateral buds developing young, which, on arriving at maturity, separate from the parent; (3) by lateral buds which are persistent; (4) by artificial sections.

The ovules appear either single or in naked branched clusters; or, clustered and enveloped within a common receptacle or ovarian vesicle. The figure heading this chapter (1*b*) represents a branched cluster as they sometimes appear in the Tubulariæ. Single ovules also are presented by many species of this family: they characterize moreover the Hydræ.

The ovarian vesicles, in which a number of ovules are enclosed under a common envelope, belong to the Sertularia and Campanularia families. Some of these vesicles are represented in the following figures, and others in figure 2, or enlarged in figure 5. They gradually develop from the side of a branch, or at times from a creeping root-like shoot, which grows outward, like the creeper of a plant, sending up its buds and flowers at intervals (fig. 8). The ovules

may be early distinguished within them, and are often arranged along a central axis, each communicating, according to Lister, with the common axis of the zoophyte.\* My associate, Dr. Charles Pickering, first pointed out to me, while at sea, in 1838, that a close analogy subsists between the arrangement of the ovules in a vesicle and a contracted branchlet of the zoophyte.† The same subject has been thoroughly investigated by Professor E. Forbes, and the fact of this arrangement fully ascertained.‡ In consequence of the communication with the axial cavity of the zoophyte, the pulpy chyloid fluid of the main stem and branches is carried into the



vesicle and to each ovule, and the development of the whole promoted. On arriving at maturity, the ovules pass out in succession from the sac, which, now empty, falls off. They are carried about for awhile by means of their vibratile cilia, and then—perhaps in two or three days—they affix themselves. Each now grows and buds, till shortly “a whole grove of Corallines” is formed.

According to Van Beneden, the Campanularidæ, when first developed from the ovule, are like minute Medusæ in shape, and have eight eyes, which are lost as the animal attaches itself. In this state, it has no vibratile cilia.§ This same author has very minutely investigated the Tubularidæ, and finds in them the same mode of development, and eight eyes to the medusa-shaped young, at the base of the tentacles. Dalyell seems to have observed similar facts. He states that the ovules, which in this group are collected about the bases of the tentacles, drop from their attachment for evolution below. Slight prominences soon denote incipient tentacles; next the nascent animal reversing itself, enjoys the faculty of progression by means of the inverted tentacula, as on so many feet, apparently to select a site; when again resuming the natural direction, with the extremities upwards, the lower surface fixes itself below and roots there for ever.||

\* J. J. Lister, *Phil. Trans.*, 1834, pp. 365–388, pl. ix. and x.

† Figures 7 and 8 are by Dr. Pickering; they were drawn from gulf-weed species, in September of 1838, at the time the above-mentioned observation was made.

‡ *Proceedings of the British Association*, for 1844.

§ Van Beneden, *Mém. sur les Campanulaires, &c.* Brussels, 1844.

|| *Rep. Brit. Assoc.*, for 1834, p. 600.



The vesicle of ovules in the Sertularidæ may generally be traced to a particular polyp, from which it is developed; in other instances, it so grows from the stem, that it seems rather to belong to the colony than to any distinct animal in it. The connexion between the polyps through the tubular cavity is such, that individuality cannot always be distinguished.

15. The pullulation of young from the sides of a parent is the usual mode of reproduction with the Hydra, though at certain seasons simple ovules are produced. A minute protuberance first begins to rise on the surface; it lengthens and becomes a rudimentary branchlet, with a tubular axis connecting with the tubular cavity of the parent; shortly one or more tentacles begin to appear at the summit of the forming branchlet, and soon the number is completed, and the young polyp is perfected. It remains for a while attached; but when matured, the young leaves the parent to swim at large and give birth to other young. They breed rapidly, and frequently new shoots commence before the animal is detached from the parent; and occasionally sprout on sprout is thus added, till a small compound group is formed. These animals also bud out tentacles without previous tubercles, which finally become complete animals.

16. Very similar to the above, in general principle, is the formation of *persistent buds*, by the successive production of which the branching zoophyte finally results. There is at first a protuberance in which the chylid fluids gain access, and either move by vibration, or have a kind of *circulation* up along the sides and down the axis; after a while the calicle forms, and the polyp extends its arms, and begins its contributions to the body-coralline. The first polyp with which the zoophyte commences thus gives out a bud, and this another; and so a succession is formed, and the little stem is gradually lengthened; branchlets grow out, and the plume or miniature tree (fig. 2) is finally completed. The whole may be the work of a few weeks, or months, though they usually continue budding and growing for some years. Before the zoophyte has reached its limits in size, the number of polyps sometimes becomes immensely large. In a single specimen of Plumularia (*P. angulosa*), collected by the author in the East Indies, there are about twelve thousand polyps to each plumose branch; and, as the whole zoophyte, three feet long, bears these plumes, on an average, every half inch, on opposite sides, the whole number of polyps is not short of eight millions; all the offspring of a single germ, and produced by successive buddings.

But to understand better this process, we may refer to one or two enlarged figures of species. Figures 3, 3*a*, 9, 10, and 11, represent the principal varieties among the Sertularidæ. In figure 9, there is a single range of calicles on the stem, the polyps of which are connected with the tubular cavity within. The polyp *c* is a bud 'from *B*, and *B* from *A*. We perceive from the figure that the first step here in the budding process, is a lengthening upward of the tubular axis, from the polyp below: after elongating to a certain distance, the bud commences to form, and finally, from the side of the ascending shoot, the new polyp *B* starts out. The main trunk continues elongating, and, after a similar interval, another bud forms in like manner. The same process is illustrated in figures 3 and 10; the only difference consists in the formation of two buds on opposite sides of the axis, almost simultaneously.



Figure 3 represents the apex of a branch, with the two buds, developed at the extremity of the tubular axis, and, in figure 10, the tubular axis is elongated between the buds, preparatory to a continuation of the budding process. Although nearly opposite, the polyps often become alternate afterward, as is seen in figure 3*a*, which represents a lower part of a branchlet. Moreover, the apparent jointing above, often becomes afterwards quite indistinct. In figure 11, we have an example of a periodicity in the budding process.

The formation of the young Hydra seems at first to be a very different process from the budding of a Sertularia, yet is closely analogous: the only essential peculiarity consists in the young polyp's detaching itself and becoming free instead of being persistent. The apparent discrepancies are owing to the absence of calicles or a corallum, and the *erect* mode of growth in the parent, instead of *oblique*; in the Hydra the buds form as lateral shoots from any part of the lateral surface; while in the species above explained, with oblique polyps, the upper part of one side of the visceral cavity gradually lengthens and buds. Some little variety in the budding process is exhibited in other groups among the Hydroidea; but the above will suffice to explain

the general principles. The subject of reproduction will be discussed more at length under the *Actinoidea*.

17. Reproduction by artificial sections may require a few words in this place, as it is one of the most remarkable characters of polyps, and is strikingly exhibited in the Hydra, as was long since shown by Trembley in a series of investigations pursued with wonderful skill and perseverance.\* They were cut into halves, and soon each was a perfect Hydra; one was divided into three parts, and in three or four days in summer, the tail had produced a head, the head a tail, and the middle part a head at one end and a tail at the other: and even before completion they sometimes gave out buds. From forty parts as many Hydras were soon formed. The body slit open soon reunites, even if previously laid out flat like a membrane; and new tentacles in a short time replace those that may be cut off. Two polyps may be made to change heads, for one may be engrafted on the body of another; and if the tail of a polyp is put into the mouth of another, they unite—heads and tails. It might be somewhat puzzling to decide the question of personal identity among such animals. Every portion of the animal,—unless we except the tentacles, which failed to reproduce a polyp in the hands of Trembley and Baker,—is capable of forming a perfect Hydra. And this is a consequence of the fact that there is no general nervous centre, but each part contains a complete system in itself. No distinct nerves have hitherto been distinguished.

18. Connected with the process of growth and reproduction, there is a corresponding process of dying often going on in the older parts of a zoophyte: the polyps disappear, and the lower branches often drop off, leaving the trunk in this part bare. These zoophytes are thus dying and budding in different parts at the same time. In the large species, the main stem or midrib of the zoophyte becomes lifeless, or a mere support for the numerous lateral plumes or branchlets.

Besides this mode of limiting the existence of these polyps, some Hydroidea are said to be absorbed in their cells, and after a while to reappear again; and this has been observed to take place at nearly regular intervals. All the polyp cells of a living group have been found, after a certain period, empty, or with only the remains of the

\* A. Trembley, on Freshwater Polyyps, 1 vol. 4to., Leyden, 1744; and Phil. Trans., vol. viii. of the Abridgment, 1742.—See also Baker's Natural History of the Polype, 8vo. London, 1743.

wasted polyps, the fluid of the trunk showing the only evidence of vitality by its continued vibration. And in the course of a few days other polyps have appeared in the vacated cells, with the same perfection of form and the same activity and life as their predecessors. The polyp heads, as Dalyell states respecting a *Tubularia*, sometimes seem to drop off like a deciduous flower, and again, after ten days or more, are reproduced. Harvey observes, that after he had kept his specimens two days, they began to look unhealthy; and on the third "the heads were all thrown off, and lay on the bottom of the vessel." After another three days, changing the water in the mean time, the polyps were entirely renewed, with no essential difference, except absence of colour. The cold of winter is said sometimes to strip a corallum of its polyps, which remains thus apparently dead till spring, when it is warmed anew to life, and the polyp-flowers once more appear.\*

In conclusion, the Hydroidea are animals with no *external* organs but tentacles and a mouth, and no *internal*, but a simple stomach cavity and its prolongation below in the form of a tube or tubular axis. *Without any special glandular system, and but a single opening to the alimentary cavity,*—the food is digested by the gastric fluid of the stomach, and the refuse matter ejected by the mouth. *Without a special absorbent or a circulating system or branchiæ,*—the digested material of the stomach passes downward into the tubular axis, where it has a vibratory or cyclosis movement; and here it is farther elaborated by the action of air from the admitted water, and becomes absorbed and assimilated by the surface of the cavity, or of the tubular organs, cavities, or pores, connected with it—these chyloid fluids acting in place of a proper circulating fluid; aeration of the same also takes place through the tentacles and the exterior surface of the animal, which receive air from the waters about them. *Without ovarian glands,* almost any part of the polyp possesses the reproductive function, excepting the tentacles; and buds or ovules are formed, and pass out directly from the sides of the animal. *Without a distinct nervous system,* in addition to the above negative characters, every part seems equally a centre of organic forces (unless we except the tentacles), and consequently sections made almost indefinitely still live and complete the entire polyp again.

\* J. G. Dalyell, *Edinb. New Phil. Journ.* xvii. 411; Harvey, *Proceed. Zool. Soc.* No. 41, p. 55; Lister, *Phil. Trans.* 1834, 374, 376.



## CHAPTER IV.

### ORDER ACTINOIDEA.

19. THE minute zoophytes, hitherto considered, constitute, along with corallines, the mosses of the coral landscape; while the Actinoidea are the larger plants and shrubs. Among the species of this group, the solitary Actinias, from their size, form, and frequently brilliant colouring, may be called the Asters, Carnations, and Anemonies,\* of the sub-marine garden. The Tubipores and Alcyonia form literally its pink-beds. Here and there the scene is decorated with clusters of tinted twigs or rushes, sometimes, fancifully shaped into fans and coral network; these are the Melitæas and Gorgoniæ. The Madrepores are crowded around in turfy clumps and miniature trees in bloom, or imitate spreading leaves and gracefully-shaped vases filled with flowers; while Astreas build up, among the shrubbery, large domes, embellished with green and purple blossoms studing the surface like gems.

Words, however extravagant they may appear, convey no exaggerated impression; for Fancy's work could not be more strangely beautiful. While wondering at the grandeur of the results proceeding from means so small, the ocean-island reared by coral polyps, we are also led to contemplate and adore the wisdom and goodness of Him who createth, in mingling such beauty in all his works.

Among the animals which produce these varied results, we find a great uniformity of structure, as already exhibited in the few general remarks on the Actinoidea (§ 3). The common Actinia is a type of a large class of them, and we may commence our observations on the Actinoid polyps by a concise account of the structure and habits of these animals. This will lead the way to a description of some

\* Sea-anemone is the common name applied to the Actinia.

related species, which are the types of other divisions of the order. The compound structure, the mode of growth, and the formation of the corallum, in the several groups, will come next under consideration.

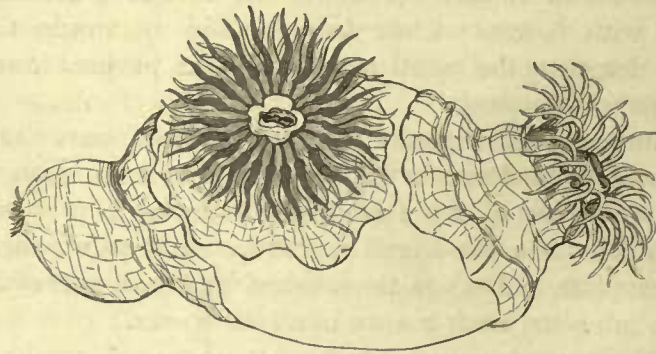
#### I. GENERAL STRUCTURE OF THE ACTINOIDEA.

20. The polyps of the Actinoidea correspond well with the character drawn on a preceding page. A circular disk, fringed with tentacles,—in shape much like an Aster with its petals,—and having a mouth at its centre, forms the upper part or extremity of the polyp. The mouth opens through a nearly cylindrical stomach into a large visceral cavity closed at bottom. The mouth receives the food and also gives exit to what remains after digestion.

##### *The Actinia.*

21. The Actinia is commonly met with attached by its flat under surface to rocks along the sea-shores. When unexpanded, it looks like a rounded lump of animal matter, somewhat leathery in appearance, plastered on the rock; it shows nothing of the mouth, and none of the fringing tentacles, these being concealed by the involuted margin of the summit. As the animal expands, the central opening at the top gradually widens,—the margin slowly rolls

Fig. 12.



Actinia.

back, and the tentacles it concealed now begin to show their tips. As the expansion goes on, the tentacles continue to enlarge, and the margin to spread outward, till finally the disk with the mouth at centre, is laid open, and the tentacles, like petals, fringe it around. Such is the general appearance of an Actinia, and such also are the greater part of coral polyps, which are nothing but Actinias, possess-

ing the single additional function of secreting a Corallum. The preceding cut represents the closed and expanded condition of the Actinia. Their various and gorgeous hues are finely exhibited in the coloured engravings on plates 1 to 5.

Although these animals are usually attached at bottom, many of them may detach themselves and float through the water to a new resting-place; or, they will slide along slowly over the rocks, by the action of the base or foot; and some are said to turn over and walk on the extremities of the tentacles, which affix themselves by a sucker-like action. There is a small group of Actiniæ (Actinectæ), which are fitted expressly for an ocean life, by means of an air-cavity in the base, containing a vesicular or spongy disk, made up of air-cells, to serve as a float. The animal lies in the water with its base uppermost, and mouth and tentacles below, and is thus carried about by the winds and currents.

22. *Structure.\** The exterior of the Actinia is fleshy, or more or less coriaceous in texture. Though frequently smooth, the lateral surface is sometimes covered with minute warty prominences or tubercles; occasionally it is furnished with small cup-vesicles, which adhere by suction like the cups of a cuttle-fish, and, by means of them, the animal fixes about it sand and fragments of shells, or aids itself in its progressive motions. The tubercles are sometimes distinctly perforated, and Lesueur and others have seen the water, from within the animal, spurted out through these perforations. Dr. C. Pickering compares the ejections of one seen by him abroad, to a shower from a watering-pot. Whether these perforations are general in Actiniæ without vesicles, has not hitherto been determined. Evidence of their existence, however, has been distinctly observed in the *A. marginata* of the Boston Harbour, by Dr. Wyman, and this species has not the slightest trace of tubercles; the skin is fleshy and smooth. They were detected by direct observation with the microscope, after having seen currents of water pass from them

\* Dissections and descriptions of Actiniæ have been made and published by Spix, Delle Chiaje, Lesueur, Rathke, Teale, and Quatrefages. In the account here given, the facts have been mostly verified by the author's observations, or by the skilful dissections of Dr. Jeffries Wyman, of Boston. For views of the structure of the spermatie cords, and other interesting particulars respecting the *Actinia marginata* (Lesueur), of the harbour of Boston, he is indebted to Dr. Wyman's microscopic researches, many of which were made the past summer, during a short residence of the author in that city; and wherever reference is made above to this species, the observations are those of Dr. Wyman.





during the animal's contraction. In a papillose species, from the Peruvian coast, examined by the author after preservation in alcohol, each papilla contained a dark oval cavity, which communicated with the interior by a distinct duct opening in a minute puncture between the fleshy lamellæ of the visceral cavity.

As in other animals, a proper epidermis may be distinguished over the exterior skin; and the colours, which are often brilliant and various, are distributed in patches, according to Teale, below the epidermis, and do not form a separate layer.\* Different individuals of the same species are often very unlike in their tints.

The only external organs in these animals are the mouth and tentacles.

23. The *mouth*, as in the preceding order, is a simple opening through the fleshy disk. It is usually oblong, and sometimes the inner surface is raised into vertical folds or lobes. While the animal is expanded, it remains open, and is usually much protruded, so as to be quite prominent.

24. The *tentacles* are slender organs, having generally a smooth or simply granulous exterior, and terminating in a minute puncture. They are tubular, and are inflated by water injected into them by the animal. The interior cavity opens into the visceral cavity between the visceral lamellæ, and it is through this cavity and its compartments that the distending water reaches the tentacles. On contraction, the water passes out again through the puncture at the extremity of some or all of these organs. The tubular interior, as observed by Dr. Wyman, in the *A. marginata*, is constricted near the apex of the organ, and then undergoes a slight enlargement before it terminates in the apical puncture. In the upper portion, the tissues contain great numbers of microscopic spicules of the form represented in figure 13. They are pellucid, like the body of the spermatozoa, but are only one-third as large.

Fig. 13.



The tentacles are seldom arranged in regular series, although usually forming together a circle around the disk. On close examination, they are seen to differ in size and to be placed a little irregularly; and in some species they are scattered over the surface of the disk nearly or quite to the mouth. They have some relation in

\* On the anatomy of the *A. coriacea*, by T. P. Teale, Trans. Leeds Phil. and Lit. Soc., vol. i. I have seen only the abstract given in Johnston's British Zoophytes.

number to the intervals between the fleshy lamellæ of the visceral cavity, and often equal them; and when these lamellæ, in the latter case, increase in number, as they do with the growth of the animal, the new interval has soon its new tentacle, with which it communicates.

The tentacles are commonly described as *prehensile* in their nature. In some species, they are long and flexible, and are well adapted to render aid in capturing the food of the polyp. They sometimes have the power of stinging the hand, and when without this power, they frequently stick closely to the fingers if handled; and when their prey comes within reach, they close upon it, and force it into the mouth, usually open for its victim. In many species, the tentacles are quite short, or are reduced to mere tubercles;\* and it is, therefore, probable that the passage of the imbibed water, contributing to the aeration of the fluids within, is often their more important function: in some instances they appear to subserve this purpose alone, being well adapted by their texture both to act on the external waters and upon the internal that may find passage through them.

The tentacle, as above described, is the most common variety. There are others, both simple and branched, that are furnished with suctorial vesicles, like the cup-suckers of the sides, which seem to aid them in clinging as well as sometimes in their movements. There are still others, which have a minutely divided or lobed surface, and look as if covered with delicate embroidery, as shown on plate 5. This peculiar structure seems intended to enlarge the surface of these organs, and fit them more perfectly to aid in aeration. The circle of them has much resemblance to the branchial rosettes of a *Holothuria*.

25. The *stomach* and *visceral cavity* occupy together the whole interior of the animal. The stomach is nearly cylindrical, and extends generally about three-fourths of the way to the base of the expanded animal. It has often a plaited or striated inner surface, and may be closed or opened by a muscular arrangement at bottom, where it communicates with the visceral cavity. Under the microscope, the surface in the *A. marginata* appeared smooth and covered with vibratile cilia; it was also invested with small slightly-projecting points, which become detached, on slight pressure, in the form of vesicles.

\* This is the case in the *Actiniæ*, plate 2, fig. 16, and plate 4, fig. 32; and in many species of the genus *Fungia*, as shown on plates 18 and 19.

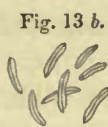
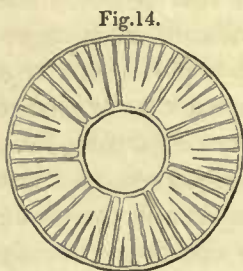


Fig. 13 b. The coats of the stomach, in this species, contain the same minute spicules as the tentacles; and, in the general integuments of the body, they are still more abundant.

The *visceral cavity* is divided vertically by numerous lamellæ attached to its walls, the larger of which are united by their inner margin to the exterior of the stomach, and serve to fix it in its place, and at the same time to vary its shape by their muscular action. This structure is exhibited in the annexed cut of an ideal



transverse section through the centre of an Actinia. The central ring is a section of the stomach, exterior to which the radiating lamellæ are shown of various sizes. All the lamellæ, large and small, extend along the under surface of the disk to the stomach; but only certain lamellæ at intervals retain this width and continue connected with the stomach to its lower extremity; the greater part narrow at once, and are of various widths, as in the figure annexed. Below the stomach, the larger lamellæ also are abruptly narrowed, so as to leave here an open space or chamber; the lamellæ afterwards extend inward again along the base of the polyp, and coalesce at centre, or are lost in the general structure of the base. The cavity or visceral chamber below the stomach is sometimes nearly bisected by the union of opposite lamellæ.

In the *Actinia marginata*, the lamellæ, as seen through the skin, have the arrangement in figure 15, two stouter lamellæ with a broader interval alternating with two thinner lamellæ and three narrower intervals. The same fact is indicated by the vertical linings on the *Actinia*, figure 22, plate 3; and, from some facts hereafter to be stated, it will be shown to be a very common arrangement in these animals. The vertical markings of *Actiniæ*, as well as the radiations of the disk, are all connected with the position of the fleshy lamellæ within. The above figure also shows that these lamellæ are very numerous,—*six* or *seven* being included in a breadth of a quarter of an inch. They are not as distant as in figure 14, which is drawn for general illustration, and is not strictly accurate.

The number of lamellæ in a certain breadth of interval is the same in different individuals of the same species. As a polyp enlarges by growth, new lamellæ form between the others, in the widening inter-

vals, and thus a degree of uniformity obtains between the young and adult individuals, which is indicated in their coralla.

26. The process of *digestion* appears to be extremely simple. The food is retained for a while in the stomach, and there acted upon by the gastric juice supplied from its walls, after which the refuse matter is ejected by the mouth. The farther change to chyle probably takes place below in the visceral cavity, where a part of the nutrient fluid is absorbed, while another portion is distributed for assimilation throughout the various cavities, lacunes, or pores in the tissues of the animal. Thus the processes of aeration and assimilation go on together throughout the whole structure of the Actinia, and there is a water-and-chyle circulation, nearly in the same manner as we have described with regard to the Hydroidea. No proper circulating fluid independent of this, and no branchiæ, have been observed in these animals. Whether there are any excrementary secretions attending this assimilating process, as in other animals, has not been directly proved. Yet it is probable that the tissues about the visceral cavity, among their many functions, include the means of performing this part in the economy of the animal; and the waters expelled, in different ways, by the polyp, may carry off such secretions. It is remarkable, that while the biliary glands are of unusual size in the lower animals generally, in the Actiniæ they are wanting; and this is no doubt connected with the fact that these animals are bathed so freely inside and out by the sea-water, which renders special organs unnecessary. If the above supposition be true, it is not proper to consider the mouth of a polyp as alone the only passage for the excrements. It ejects the refuse indigestible matters from the stomach, but only in part the proper excrements of the animal.

The Actiniæ receive almost any animal food that falls in their way. Crabs, molluscs, the smaller fish, and other marine animals, are their common prey. They have been seen with a large bivalve in their stomachs, from which the animal had been removed by their powerful gastric solvents.

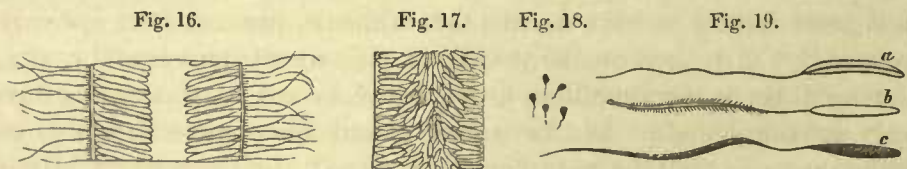
27. The function of *reproduction* belongs to the visceral lamellæ (§ 25), part of which are spermatic and part ovarian.

The spermatic lamellæ are distinguished by being margined by a white capillary cord. This cord is much convoluted, and is attached to the lamellæ by a thin and extensile membrane, which has a mesentery-like appearance.\* The quantity of these cords in an

\* Similar to figures 3*b*, 3*c*, 3*f*, plate 30.

Actinia is very large. When the animal is contracting, they are often protruded in folds from the mouth, having come up from the visceral chamber, through the stomach (plate 2, figs. 12, 15, 16); and if the skin be fractured in any part, they escape in large bunches. These cords are sometimes seen to pass out through the perforations in the sides of the animal (§ 22), as was long since ascertained by Dicquemare.\* The same fact was observed in the species examined by Dr. Wyman.

The white spermatic cords are semitransparent or nearly opaque, and are furnished with vibratile cilia. On subjecting them to slight pressure between plates of glass, slender filaments extrude, in length a little exceeding half the diameter of the cord; and, with a high magnifying power, a fragment of the cord thus under pressure presents the appearance in figure 16, exhibiting pellucid spicula, like



radii to the cord; the long filaments pertain to the spicula, and were extruded by the pressure. Figure 16 is properly a flattened transverse section; figure 17, a camera lucida sketch, by Dr. A. A. Gould, represents their position, as they were somewhat deranged by the pressure. These spiculiform organs, as observed by Dr. Wyman under one of the best English microscopes, are of three kinds, represented in figures 19 *a*, *b*, *c*. In *a*, the body is slightly curved and transparent, but with a more pellucid medial line, and the filament is a simple naked thread, two or three times its length. In *b*, the body is transparent, nearly as in *a*, but the filament is slightly enlarged through the latter two-thirds of its length, and this enlarged part is bristled, with the bristles reversed; the extremity moreover is obtuse. In *c*, the body appears to be filled with granulous matter; the filament is enlarged as in *b*, but it is lengthened out to a very delicately attenuated extremity; and the enlarged part, which is half its whole length, appeared spotted or chequered. These singular forms were seen frequently in cords taken from many individuals. Besides these organs, he detected minute oval points, with very short filaments,

\* Phil. Trans. Abridg., xiii. 639, 1775.

as represented in figure 18, which had spontaneous motions. They were not frequently seen, and some doubt remained as to their origin.

The nature of these cords has long been a subject of speculation. The most prevalent opinion has been that they were connected with the process of digestion, and they have been called biliary vessels and cæca. They have also been considered oviducts\* and ovaries.† Wagner first ascertained their spermatic character, and the general structure of the filaments:‡ yet Dicquemare distinctly states their resemblance to "spermatic vessels," and says, that they probably contain bulbs or buds, "which open in time, and, cleaving to the bodies in which these threads are extended, produce small anemonies."§ Dr. Wyman has the honour of originality in his researches, and the remarkable results throw some new light upon the structure of these spermatic organs. There is still uncertainty with regard to the functions of the parts observed. The forms represented in figures 19 *a, b, c*, have nearly the ordinary appearance of spermatozoa. But if the last-mentioned (figure 18) are the true spermatozoa, of which there is much doubt, the others, he suggests, may possibly be Spermatophora, as they have some resemblance (especially *b, c*) to the organs of this nature in the Cephalopoda, represented by Milne Edwards: but he ventures no decided opinion without farther investigation.

These spermatic cords appear to undergo a periodical increase and absorption, as is the case with the spermatic organs of most animals; for, at times, their length is very much less than at others.

28. Between the spermatic lamellæ are others of similar situation, which are *ovarian*. Like the "white cords," the ovaries grow from the margin, and form a series of clusters in two ranges, which fringe the lamellæ, or, when large, fold back and lie in the spaces between them. Figure 20 shows the double line of clusters, as they were seen attached to the margin of an ovarian lamella in the *Actinia marginata*.

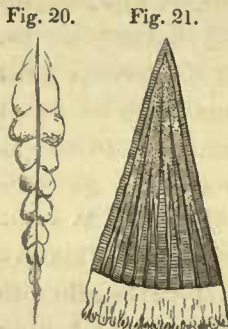
\* Sharpey, *Cyclop. Anat. and Physiol.*, i. 416.

† Cuvier's *Reg. Anim.*, iii. 290; *Amer. Ed.*, iv. 388. Also, A. de Quatrefages, *Sur les Edwardsies*, *Ann. des Sci. Nat.*, xviii. (1842) 65. The spermatic cords and spermatozoa are well figured.

‡ Wagner, *Sur la Generation*, *Ann. des Sciences Nat.*, viii. (1837) 282, and Wiggemann's *Archives*, ii. 215 (1835). Also, Milne Edwards, *Ann. des Sci. Nat.*, xiii. (1840) 196, on the Structure and Sexual Organs of the *Dendrophyllia*.

§ *Phil. Trans. Abridg.*, xiii., 639, 1775.

This margin is very thin, and in folds, mesentery-like, similar to that supporting a spermatic cord. The ovules are enveloped in an extension of it, and a narrow projection of the same may be observed at the line of junction between the two series of clusters. Figure 21 represents part of a transverse section enlarged, of the *Actinia florida* (p. 131), from near the base of the animal, examined after contraction in alcohol; the dotted portion represents the position of the ovarian clusters, which lie between the lamellæ, although distinctly attached to the margin. The adjoining ovaries of different lamellæ appear, in some instances, to coalesce.



The ejection of the ovules appears to take place by the mouth. The extremity of the tentacles,\* and supposed openings near the base of the same, have been stated to give them exit. But the existence of these openings is not proved; and the punctures at the extremities of the tentacles are certainly too small for that purpose, in the majority of species, if not in all. The visceral cavity in which they are formed, communicates freely with the exterior waters through the stomach, affording them a direct and open passage. The mouth is made the place of exit by Spix;† and Dalyell also asserts that, according to his frequent observations, they are “produced by the mouth.” Both ovules and living young, in the course of his investigations, were often disgorged by the parent in numbers along with the half-digested food.

As the tubular interior of the tentacles communicates freely with the interseptal spaces of the visceral cavity, it is no anomaly that ovules should be found within the tentacles, as stated by the last-mentioned observer. By amputation, he frequently obtained them from these organs; and one ovule thus procured, became a mature animal, began to “breed in fourteen months, and survived nearly five years.”‡

\* Delle Chiaje, Bull. des Sciences Nat., xvii. 471. See farther on this subject, in Johnston's Zoophytes, from whom this citation is made, p. 201.

† Carus Comp. Anat. Trans., ii. 308, pl. 1, figure 10.

‡ Dalyell states, that “fourteen animated beings” were produced at once by an *Actinia equina*, or mesembryanthemum, in his possession. Six were young with tentacles, and eight, ovules undeveloped. “All were sufficiently vivacious, sometimes moving, sometimes reposing.” In eight days the vibratile cilia disappeared from the ovules, and they became stationary; in eleven days incipient tentacles were distinguished in one; and in

The development of young from the ovules before their ejection, has been for a long time asserted, and Dalyell and others have shown that it is of common occurrence. The ovules being bathed by the sea-water, which gains access to the visceral cavity, there is little occasion for the doubt with which the statement has been by many received. The ovules have a white milky appearance, and are of various sizes in the same cluster. They have usually a globular form, but are often a little oblong or of irregular shapes. Wagner has shown that they have the characters of true eggs. On leaving the parent, they are said to move about by means of the vibratile cilia with which they are provided. After a short time the young Actinia appears, and generally fixes itself shortly after to some object at hand. When first produced, the tentacles are scarcely apparent; a single series gradually develops, and afterwards they go on increasing as the animal grows, and do not attain their full number until it is a perfect adult.

29. The Actiniæ have the same power of reproduction from artificial sections as the Hydra. Portions cut or torn off are soon resupplied, and the parts separated develop what is needed to become perfect animals. The process of budding has been observed only in the coral-making species.

*The Zoanthidæ.*

30. The dissections, by which this division of the Actinoidea is here illustrated, were made on a living specimen of the *Palythoa cæsia*, at the Feejee Islands, representations of which are given on plate 30. This species grows in rounded attached masses, of the size of the fist, which consist of a large number of united polyps. When unexpanded, the mass has externally a grayish leathery appearance, with small

nineteen days eight or nine could be enumerated in another, which now "affixed itself as a young Actinia by the base." (Jameson's Journal, xxi., 1836, p. 89.) "In the course of six years, a specimen preserved by the author produced above two hundred and seventy-six young, some pale, like mere specks, with only eight tentacula, others florid, and with twenty. They are frequently disgorged along with the half-digested food, thirty-eight appearing thus at a single litter. An embryo extracted artificially from the amputated tip of a tentaculum, began to breed in fourteen months, and survived nearly five years. Monstrosities by excess are not uncommon among the young: one produced naturally consisted of two perfect bodies and their parts, sustained by a single base, exhibited embryos in the tentacula at ten months, bred in twelve, and lived above five years. While one body was gorged with food, the other remained ravenous." (Dalyell, in 4th Rep. Brit. Assoc., 1834, p. 599.)



openings scattered over it, each of which is the centre of a slightly-raised prominence. On expanding, these openings enlarge, the margin of each rolls back, and finally the whole mass, before seeming lifeless, is covered with radiated disks, half an inch broad, having a lilac centre, and bordered with a fringe of short tentacles. These are the flower-animals—the polyps—of the *Palythoa*. They are represented of the natural size in figure 3. Some of the polyps on the right are yet closed, while others are partly, and others wholly, expanded. An enlarged view of the expanded polyp is shown in figure 3 *a*, exhibiting the circular disk—the fringe of short tumid tentacles, in two series, one directed more upward than the other—and, upon the disk, elevated greenish lines, extending, like radii, from each tentacle to the convex centre in which the mouth is situated. The texture of the general mass of the zoophyte is peculiar, in consisting of coral sand agglutinated by animal matter; particles of various colours are here mingled,—white, red, and black. The sand, as it falls upon the growing zoophyte, is enclosed by the slimy secretions of the surface, and is finally introduced into its texture; and thus firmness is secured by calcareous granules from a foreign source. This is imperfectly represented in the figures 3 *b* and 3 *c*.

31. The *tentacles* are naked—that is, without papillæ—as in the *Actiniæ*, and each has a minute puncture at apex. These organs are tubular, and they communicate internally with the visceral cavity through a duct concealed under the radiated lines of the disk. The mode of expansion by injection with water is the same as in the animals above described. The *mouth* is without appendages of any kind—a simple opening through the fleshy disk.

32. The *visceral cavity* is cylindrical, and extends down below the disk, into the polyp-mass, to its base. Its form and size, as compared with the expanded animal, is shown in figure 3 *a*. The mouth opens into this cavity, through an oblong *stomach*, which is about one-fifth the length of the cavity, and is connected with its walls by a series of radiating fleshy lamellæ, as in the *Actinia*. There is also another series of smaller lamellæ intermediate between these. The stomach has a vertically striated or plaited structure within, and closes at bottom at the will of the animal. Figure 3 *b* is a vertical section of the unexpanded polyp, through the mouth (opposite *b'*) and stomach (*b'* to *c'*), and the general visceral cavity; and figure 3 *d* is a transverse section, cutting across the œsophagus a little

obliquely, and showing the radiating visceral lamellæ, which connect it with the sides of the visceral cavity. In figure 3*b*, only two opposite lamellæ are in view, while in figure 3*c*, which is an oblique section, crossing the cavity *below* the stomach, the edges of several of the intersected lamellæ are exposed. In the last-mentioned figure, the stomach is seen to terminate in a kind of disk, which is the muscular arrangement for closing its lower extremity. The oblique position of this disk is unnatural, and resulted from the section of part of the lamellæ and their consequent unequal contraction; the animal is drawn just as it was presented in the dissection. In 3*b*, the upper extremity shows the tentacles as they are concealed in the contracted animal. It thus appears that the visceral cavity is divided by the lamellæ into a series of compartments, as in the Actinia. A second series of narrower lamellæ lies between the larger, as is shown in figure 3*d*. These narrower lamellæ, however, are prolonged on the under side of the disk to the stomach, so that in making the section here referred to, the upper portion removed, presented below twice as many radiating compartments as were seen in the part figured. There is hence a close analogy with the Actinia, although the animals differ so strikingly in the relative sizes of the stomach and visceral cavity. This resemblance is seen farther in the position of the spermatic cords.

33. *Spermatic* cords border the larger lamellæ, and extend from below the stomach nearly to the bottom of the visceral cavity. They are convoluted throughout their length, as is shown in figures 3*b*, 3*c*, and 3*f*. It is remarkable, that in one of the specimens, the convolutions are very few, and the cord stops far short of the bottom. This fact may be accounted for on the principle that they are periodically developed.\*

Spermatozoa were not observed in these cords, yet it is altogether probable that on farther examination they will be detected, as in the Actinia. Vibratile cilia were distinct on the cords, but were not seen on the lamellæ to which they were attached.

The specimens examined contained no ovules. From analogy, we should expect that in the proper season they would be found in clusters, attached to the intermediate series of narrow lamellæ.

34. Besides the spermatic cords, there is attached to the edge of each larger lamella, immediately below the stomach, a pair of flat

\* The season when these observations were made was the month of August, 1840.

branchia-like organs. In figure 3*b*, they are seen in profile in their natural position (*c'* to *d'*), and in the vertical view in 3*d*, one appears either side of each lamella; this is shown still more distinct in figure 3*e*. These organs are enlarged in figure 3*f*. They are transparent, and are transversely divided into narrow compartments, each about  $\frac{1}{16}$  of an inch in breadth. The margin is crenated, corresponding with the compartments. Each compartment, as is more distinctly exhibited in figure 3*g*, is traversed along its middle by a distinct vessel, which terminates in a small process on the margin. Vibratile cilia were apparent on these organs, as is represented in figure 3*g*, and they were observed to continue in motion for an hour after separation from the animal. These cilia were about  $\frac{1}{300}$  of an inch in length.

The two organs of each pair were united to a common duct, which, in the specimen examined, had a bluish colour, as shown in figure 3*f*; and by this duct they were attached to the margin of the lamella—one being situated either side—and thus their surfaces were free to be bathed by the water with which the animal distends itself.

35. The structure of these organs is such that we can hardly doubt their branchial nature: yet no circulating fluid was detected within them. Lesueur, who observed them in his excellent dissections of West India species, calls them arcuated organs, and supposes them to "perform the functions of the liver."\*

The modes of nutrition in the Zoanthidæ, are the same as in the Actinia.

#### *The Tubipora.*

36. The structure of the Tubipora has been illustrated by Quoy and Gaymard, in the voyages of the Uranie and Astrolabe. The dissections made by the author confirm in general their observations, yet differ in some points of interest.

The Tubipora is a cylindrical animal, expanding above a star of eight tentacles. The animals are often of a lilac or rose tint, and grow in large clusters; and, as they appear beneath the water about the reefs, they are as perfect beds of pinks as those of our gardens. Figure 1, on plate 59, represents some of these polyps of the natural size; and figures 1*a* and 2, two individuals of the same genus enlarged. The eight tentacles are fringed on either side by small papillæ, each of which has a minute puncture at apex. Both the papillæ and the

\* Jour. Acad. Nat. Sci., Philad., i. 183, 184, 185, and plate viii., fig's. 1, 5, 9.



tentacles are tubular, and expansion takes place, as in the species before described, by means of water, received from without, and injected into these organs and other parts of the animal. The Tubipore secretes a calcareous tube, or corallum, which is stiff and firm below; but near the extremity it is still flexible, and the animal contracts by drawing its head and tentacles into the tube, like turning in the end of the finger of a glove. Figure 1*b* represents one of the contracted animals, with the tube laid open by a longitudinal section, showing the interior structure. The pear-shaped part above contains the withdrawn and contracted tentacles; and the dark spots, near the bottom of the same, are the openings into four of the tentacles, by which water enters from the visceral cavity, when the animal expands itself.

37. The visceral cavity is long, tubular, and contains eight fleshy lamellæ. These lamellæ aid, by their muscles, both in the contraction and expansion of the polyp, in a manner which will be understood without explanation, by a glance at figure 1*b*. The stomach is cylindrical and very short compared with the whole length of the visceral cavity; and, as in the preceding species described, it is connected with the sides of the cavity by the visceral lamellæ.

Six of these lamellæ were spermatic, being bordered below by the white convoluted cord, while the other two gave origin to large clusters of milk-white ovules, which occupied nearly the whole diameter of the cavity. These ovules were of various sizes, and spherical in shape, or nearly so. Figure 1*b* shows their position in the tube, and 1*c* the appearance in profile of one of the lamellæ with the attached ovules.

Some observers have found all the lamellæ bordered with the white filament, and others describe them as all bearing clusters of ovules. In these instances, it would seem that the sexes were distinct, in one case the animal being *male*, and in the other *female*. The subject requires farther investigation.

In the characters of the Tubipore we have the characters of the Alcyonaria generally, a large tribe of zoophytes. The eight fringed tentacles, and the eight visceral lamellæ attaching the stomach to the sides of the cavity, and extending below to the bottom of a tubular visceral cavity, distinguish them at once from other Actinoid polyps. The ovules in some species have been seen to escape by the mouth, and this therefore appears to be the general mode in all the Acti-

noidea.\* We have nothing to add on the processes of digestion and circulation in these animals, in addition to what has been already presented, in our remarks on the Actinia and Palythoa. Nothing like branchiæ were observed in the Tubipore examined.

*General characteristics of the animals above described.*

38. The species described in the preceding pages, have been selected from the most widely-separated groups among the Actinoidea, and are types of important divisions. The points of agreement constitute the characteristics of this order, and may be here enumerated.

1. The Actinoid polyp contains a large cul-de-sac visceral cavity, divided radiately into compartments by fleshy lamellæ, and a stomach suspended in it beneath the centre of the disk. Several lamellæ are united by their inner margins to the stomach, and aid, by their muscular action, in the expansion of the stomach and the expansion and contraction of the whole animal.

2. The *stomach* communicates below with the visceral cavity, through an opening which may be closed by muscles. Its walls are muscular, and the organ admits of great dilatation, or may be contracted, at the will of the animal, to a slender tube.

3. *Digestion* takes place in the stomach; and thence, after excluding the refuse matter by the mouth, the results of digestion pass into the visceral cavity, to be aerated and elaborated through the air in both the external and the admitted waters, at the same time that these fluids are distributed, by an imperfect circulation, throughout the animal, and assimilated wherever needed for changes in progress. It is probable that excretions take place through the sides of the polyp, and by the waters which the animal ejects elsewhere on contraction.

4. *Reproductive* functions reside in the visceral lamellæ, part of which are *spermatic* and part *ovarian*. All of these lamellæ are thus genital, excepting probably the upper portions of the larger lamellæ, which are attached to the stomach, and in this part are muscular. The testes or spermatic organs have the form of white convoluted cords, and are attached to the margin of the lamellæ. The ovarian

\* This has been observed in certain species of the tribe, by Professor Grant and Milne Edwards.—For an interesting account of the development of the ova, see a paper by Dr. Grant, in Jameson's Edinburgh New Philosophical Journal, vol. i. p. 152; and also on the general structure and reproduction of the Alcyonida, a memoir by Milne Edwards, in the Annales des Sci. Nat., 2d ser., iv. (1835), p. 321.

clusters are attached in a corresponding manner to the margin of the ovarian lamellæ. The ovules, though sometimes retained in the cavity till they are developed, generally pass out before, and, in either case, escape takes place through the stomach and mouth.

The similarity between these animals and the Hydroidea is hence very close. The localisation of the genital functions in distinct organs appears to be the character upon which their principal differences depend. The relation of the visceral cavity of these animals to the tubular axis of the Sertularia is obvious. Though extremely short in the Actinia, we find it several times longer than the stomach in the Zoanthidæ, and still longer, and taking the form of a slender tube, in the Tubiporæ and Alcyonia.

*Subdivision of the Actinoidea.*

39. The facts considered lead to a natural subdivision of the group Actinoidea. In the Actinia and Palythoa the tentacles are numerous and naked, and have a puncture at apex, while, in the Tubipora and allied species, these organs are but eight in number, and are fringed with papillæ, each with its minute puncture, and none at the extremity of the tentacle. The Actinoidea are hence naturally subdivided into the two following groups:

I. ACTINARIA.—*Tentacles, (with few exceptions,) naked or not papillose, six, twelve, or more in number.* This division includes the Actinias, Madreporæ, Astræas, &c. (The cells in the coral-making species are more or less perfectly radiate within.)

II. ALCYONARIA. *Tentacles fringed with papillæ, eight in number.* This division includes the Tubiporæ, Gorgonias, Alcyonia, &c. (The cells of the coral-making species are never radiate or striate within.)\*

\* The fact that in a compound Alcyonium the tubular visceral cavities of the several polyps branch from one another, with a free intercommunication, has been considered as widely separating the Alcyonaria from the Actinaria. In the Tubiporæ among the former, however, this connexion is not more perfect than in the Zoanthidæ, and the same is true of the young state of the polyp-bud in many species. The seriate polyps in a Meandrina have even a more open communication, and in some of the compound Fungidæ adjacent polyps have scarcely any thing but a mouth that can be said to be private property. The peculiar character of this connexion between polyps in certain Alcyonaria merits notice, but not the importance which has been attached to it.

We glance at some of the principal varieties of structure in each of these divisions.

I. ACTINARIA. 40. In one of the divisions of this group—the *Antipathacea*—the polyps have but six tentacles.\* In the tentacles and the general appearance and habit of the polyp, they resemble the Madrepores, but no dissection has yet been made of them.

41. The polyps of the *Madreporacea*, another division of the Actinaria, are distinguished by twelve tentacles in a single series.† There is among them but little variety of structure. In a few species the alternate tentacles are of unequal size, and it is probable that the visceral lamellæ have the same inequality: and in some Madrepores one of the tentacles is elongated and more flexible than the others:‡ again, all are sometimes obsolete.

The character of the cells formed by Madrepores show that in many of them two opposite interlamellar spaces in the visceral cavity are generally broader than the others, as in the Actiniæ, and usually these two are very unequal.

The only fleshy species known, which has the twelve tentacles of the Madrepores, is the *Actinia clavus* of Quoy and Gaymard,§ found by them entangled in the tentacles of a Medusa, off the coast of New Holland. By their dissections, the stomach and visceral lamellæ are shown to have nearly the characters of those in the Palythoa, except that the lamellæ are equal and are twelve in number, corresponding to the tentacles. The appearance of this Actinia expanded is very similar to that of a madreporé polyp.

The most marked variation from the usual character of the Madreporacea is found in the Porites family. In these the visceral cavity does not extend to the base of the animal, as in the other species of the group, and the visceral lamellæ cannot be traced through the tissues of this portion. This structure is indicated by the porous coral secretions formed by this part of the polyp. In external characters these polyps present few peculiarities. A few allied species (Gonioporæ) appear to have more than twelve tentacles, though all are in a single series, as in others of the Madreporacea.

42. The polyps of the *Caryophyllia* and *Astræa* tribes have more than twelve tentacles, and they are in two or more series or scattered.

\* Plate 56, figures 1 and 2.

† Plate 31, figure 1.

‡ Plate 33, figure 1.

§ Voyage de l'Astrolabe, iv. 150, pl. 10, figs. 6 to 11. It is yet doubtful whether this species was actually an adult with its full number of tentacles. Several individuals were seen, which were about three-fourths of an inch long when expanded.

Here belong the Actiniæ and the Zoanthidæ, and a large part of coral animals. The Zoanthidæ are closely related to one division of the coral-making Caryophyllacea—the family Gemmiporidæ. They spread a wide disk, with a somewhat convex centre, and sometimes the margin of the disk, bearing the fringe of tentacles, becomes much reflexed by expansion, curving downward towards the base of the polyp, so as to appear like a cap over the extremity. The tentacles are short, and correspond each to a radiate line on the disk; and in some species I have found one of these rays to have a different colour and size from the others, evincing some peculiarity of function in the tentacle, corresponding, apparently, to the long finger-tentacle in some madrepores. The Gemmipores\* resemble these in general form and in their fringe of short tentacles, but the disk is not striated. In another division of the Caryophyllia tribe—the Caryophyllidæ—the tentacles are much like those of the common Actinia; and in external form we distinguish no important peculiarity, except that the disk containing the mouth becomes more prominent, when the animal is fully expanded,† sometimes having nearly the shape of an oblong inverted cone.

The polyps of the Astræa tribe of zoophytes have numerous unequal tentacles, and a flat or simply convex disk. The distinction between the Astræa and Caryophyllia tribes depends on a different mode of *budding*, as is pointed out in a following chapter. The visceral lamellæ in the Astræas appear to retain their identity through the side tissues or walls of the polyp, and, in compound species, these lamellæ may be traced by their secretions through the intermediate spaces between adjoining polyps. These characters are strongly marked in the coralla of the different animals, although not so apparent, as far as I have examined, in the recent Actiniæ (§§ 48 and 76, fig. 34).

43. The only variation from the Actinia type which we here notice is presented by the Fungiæ and other allied zoophytes. The Fungiæ‡ are the largest of known polyps, some species attaining a diameter of eighteen inches. The form of the animal, instead of being cylindrical, as in the Actinia, is that of a large disk, an inch or two thick, circular or elliptical in outline, and either flat or convex above. A large oblong mouth occupies the centre, and from the mouth narrow ridges radiate, with regular intervals, to the circumference—a few

\* See plate 30, figure 4.

† Plate 27, figure 1.

‡ See plates 18 and 19.



commencing immediately at the mouth, and others rising to fill up the spaces between them as these diverge. Although so unlike the type in external shape, yet the actual structure is closely similar, for the *Fungia* is nothing but an *Actinia* spread out laterally into a broad flat disk. The inequality in the lamellæ is much greater, though of the same character, and the tentacles are more widely scattered, so as to lose all appearance of being in series. The connexion between the formation of a tentacle and a new lamella within the animal, is finely exemplified in the *Fungia*; for each tentacle rises where a new ridge reaches the surface, and their formation is constantly going on as the animal enlarges and new ridges rise. This may be seen by reference to the figures of *Fungiæ* on plates 18 and 19, where the small prominent tubercles scattered over the surface are the tentacles.\*

The close relation of the *Fungia* to the common *Actinia* is thus evident; yet in the actual form of the visceral cavity they are quite unlike. Instead of a cylindrical space, divided into shallow compartments by erect fleshy lamellæ, we have here long horizontal compartments, commencing at the mouth, and as they enlarge outward, constantly subdividing by the growth of new lamellæ: these lamellæ, for a while before rising to the disk, range along the bottom of the cavity. Unlike the *Astræas*, the *Fungiæ* never cover the contracted tentacles by the involution over them of the margin or surface from which they rise; there is actually no margin to the disk in these animals: moreover, in compound species, the visceral lamellæ of adjoining polyps are continuous from one to the other, and it is probable that the subdivisions of the visceral cavity are also directly continuous, so that in these compound *Fungiæ* we appear to have a community of visceral cavities, as in the *Hydroidea*, differing from the latter, however, in having the communications by lateral or interseptal spaces, instead of by the lower extremity of the cavity. In the *Astræas*, the same communication in effect takes place, though less perfect, through the open pores or lacunes, which pass laterally from one polyp to another. The *Fungiæ* afford the nearest approach, among zoophytes, to the *Acalephæ*.

There is often in a *Fungia*, a line running from one or more sides of the oblong mouth to the circumference, along which some of the

\* On account of the small size of these organs, it has been denied that they are tentacles. Yet, whether so called or not, they correspond to the tentacles of the *Actiniæ*; and in some species of *Actinia* they are as short and scattered (see plate 4, figure 32).

lamellæ meet at a small angle and coalesce. This proceeds from a slight distortion of the circular animal, and is most common in species which have the lamellæ undulated, by which irregularity they are often brought into contact. When the *Fungia* retains a perfectly circular form, this union of lamellæ is seldom observed. It is not unusual for the lamellæ in an *Actinia* to grow together by their edges when in contact.

b. The number of tentacles in this group, or the number of lamellæ, is very commonly a multiple of six. In one division of the *Astræas* (the *Orbicellæ*), we find the numbers 18, 24, 36, 48; in other species of the genus, the mode of indefinite increase and subdivision, prevents our ascertaining how nearly they correspond. The *Oculinæ*, *Dendrophylliæ*, and *Caryophylliæ* conform generally to the same series, and so also the *Madrepores* and *Antipathi*, which contain twelve and six tentacles respectively.

In many instances, however, *four* is a submultiple, and this is shown by the lobed margin of the *Lucernariæ*, and the divisions in the mouth of some *Actiniæ*. That this should often be the fact is apparent from figure 15, † 25, in which *one* larger and *three* smaller intervals alternate; and it appears that generally when a multiple of *six*, the numbers are also multiples of *four*.

While, therefore, the *Alcyonaria* have *eight equal lamellæ*, the *Actinaria* may have *six* or *twelve equal lamellæ*, or a number of *unequal lamellæ, exceeding twelve*, which is a multiple of *four* or *six*. The mouth and margin of some *Actiniæ* is *five* lobed; but these may still conform to this principle. In the *Antipathi*, there are six equal tentacles; in the *Madreporacea*, twelve tentacles, with six alternate, often distinctly larger than the others: and the calcareous lamellæ of the cells, in other species, are usually either alternately large and small, or one large alternates with three smaller, or one with five smaller.

There is, moreover, in the *Actinaria*, a relation between the size of a polyp and the number of its internal lamellæ. In many *Astræas*, there are fourteen or fifteen—large and small—to a breadth of a quarter of an inch; and, where the number has the above relation, 18, 24, 36, 48, there is nearly the same relation in the diameter of the cells of the corallum. This relation admits of considerable variation, which is sometimes seen to be dependent on a part of the lamellæ being obsolescent. The *Astræa hyades* and *A. pleiades* both have twenty-four lamellæ to the cells; but in the former, which has the

larger cells, they are nearly equal; while in the latter, half are obsolete. In the Merulinas, there are seven or eight larger lamellæ to a fourth of an inch, with three or four intermediate nearly obsolete, making in all ten or eleven in this breadth. The same is generally true of the Euphyllia and Meandrina. In the Mussæ, much larger species, there are seven or eight to a fourth of an inch, as in the *Actinia marginata* (§ 25), and half of these are quite small or obsolete. It appears, therefore, that the number varies, in different species, from seven to fifteen. The last number is seldom exceeded, yet instances of this are found in some Meandrinæ and many of the attached Fungidæ.

II. ALCYONARIA. 44. The simple polyps, among the Alcyonaria, have a great similarity throughout. The number of tentacles being fixed, there is not room for the same diversity of form as in the Actinaria. The principal varieties in external appearance proceed from variations in the length and position of the papillæ. These appendages to the tentacles are sometimes quite long, and give a graceful delicacy to the flower, scarcely exceeded in the vegetable kingdom.\* Usually, they form a short fringe in two or three series on either side of the rays, as shown in the *Tubipora*, already described.† In one of the species of this genus (*T. syringa*), they are so evenly laid together that the fringe seems to be wanting. In one of the Xeninæ, found at the Feejee Islands,‡ the papillæ are minute wart-like prominences, scattered over the surface of the ray. Each little prominence has the minute puncture at apex, which is characteristic of the Alcyonia group.

## II. SECRETION OF THE CORALLUM IN THE ACTINOIDEA.

45. The corallum has been described as in general an internal secretion, formed within the polyp, and not a covering enclosing the same, as in the Mollusca.§ We may examine more particularly the mode of its secretion and its relations to the animal.

There appear to be two kinds of coral secretions among the Actinoidea:—

1. Secretions formed within the animal which are mostly *calcareous*.

\* See plate 59, figure 3. † See plate 59, figures 1, 2. ‡ See plate 57, figure 2.

§ This character of these secretions was first pointed out by Ehrenberg, in his Memoir on the Corals of the Red Sea, in the Transactions of the Berlin Academy, for 1832. Since then, they have been more fully explained by Milne Edwards, in the Annales des Sciences Naturelles, for 1838, x., 2d series, 321.

2. Secretions, from the foot or base of the polyp, which are either *calcareous* or *horny*, or of an intermediate nature, and rarely siliceous.

The former may be called *tissue-secretions*, the latter *foot-secretions*.

46. *Tissue-secretions*. These secretions take place from the tissues of the sides and the base of the polyp. In a few species—the coral-ligenous *Alcyonaria*—even the skin often adds to these secretions by depositions of lime in its texture; but in the other Actinoidea, the exterior of the polyp remains soft and fleshy, so that every portion of the Corallum, even to each spine and lamella, is entirely concealed within the polyp, as completely as the skull of an animal beneath its fleshy covering. All corals are more or less cellular, and through these cellules the animal tissues extend, forming, together with the exterior, a complete animal structure, corresponding closely with the coral structure. Even the most solid plates of the latter are more or less penetrated by fibres of animal tissue.\* By comparing the radiated cell of a coral,† with the radiated visceral cavity of the *Actinia* or *Palythoa*, as described in §§ 25 and 32, the relations of the two will be as apparent as they can be made by any explanations. The radiated calcareous plates of the one alternate with the radiated visceral lamellæ of the other.

These secretions do not take place from all parts of a polyp. The disk, the stomach, and the upper portions generally of the animal, remain fleshy, as well as the interior of the visceral cavity, in order that the polyp may be free to expand or contract, and perform the various functions essential to life. The tentacles, however, may secrete lime, and not unfrequently the calcareous lamellæ of a cell project by this means into these organs; and, in the same way, some corals are covered throughout with short spines.

The corallum has a close correspondence, therefore, to an internal skeleton. It is not a collection of cells containing polyps, like the cells of a bee-hive, but is contained itself wholly within the polyps.

\* This has been shown by Hatchett, and also by Milne Edwards and Bowerbank, and may be easily verified by dropping a piece of compact coral into a dilute acid. These tissues may be distinctly seen on examining with a high magnifying power, thin fragments polished down, till they admit the passage of light. A minutely reticulated structure may be distinguished, though much irregular; and it appears probable that the tissues consist in part of the animal cellules within which the lime was secreted. The results of some microscopic examinations by the author upon different species of corals, will be given in the Appendix to this volume.

† See plates 10, 11, 12, and others; also, figure 34, § 76.

The existence of surface-cells on a corallum, is due simply to this,—that the upper and interior parts of the animal do not secrete lime. In some species, these secretions are confined to the basal portions of the polyp below the visceral cavity, as in many *Porites*, and consequently these zoophytes have no cells to the corallum. The terms *polypary*, *polypidom*, given to coral, are, therefore, in every respect, inapplicable.

Where cells occur, there is some appearance of a retreat into them by the contracting polyp. But it is only the upper part or disk of the animal that is thus withdrawn; and this happens only because the projecting part of the animal, on contraction, will necessarily collapse upon the solid part below, and into a cavity, if there be one. Figure 1*a*, on plate 6, represents one of the contracted coral-polyps, and some parts of figure 1, on plate 7, represent others. There is here no retreat into a cell: indeed, from the external appearance, even the existence of coral within would hardly be suspected, so closely do the separate polyps resemble some of the *Actiniæ*. In a *Fungia*, there is no cell whatever, but the small cavity at the centre below the mouth, and contraction produces no change in the appearance of the animal, except that the tentacles collapse and are not seen; the mouth falls a little, and the fleshy exterior, owing to the expulsion of the inflating water, lies somewhat more closely upon the coral plates beneath.\*

The calcareous secretions begin to form in the young animal after the last metamorphosis, which takes place when the animal leaves its free swimming state and attaches itself to some support. The rays of the cell in this state indicate the number of visceral lamellæ, and generally of the tentacles; and as these increase in number, so also do the calcareous lamellæ. It has been stated that in the growing *Actinia* new visceral lamellæ are developed to fill up the enlarging intervals, and at such a rate that there is always the same number in a certain interval. The same is true of the calcareous lamellæ; there is a remarkable degree of similarity between the cell of a young and adult polyp; it is very rare that the lamellæ in the former are more crowded than in the latter, and generally, when quite young, they appear more open.

\* Where the polyps have most perfectly the appearance of withdrawing into a cell, as in the *Sertularias*, it is still no more the case than that a turtle retreats into its shell when it draws in its head.

The secretion of a calcareous lamella or plate takes place between two visceral lamellæ, but whether from the surfaces of these fleshy lamellæ, or from a prolongation inward of the membrane forming the walls of the visceral cavity, has not been ascertained. The secretion does not always commence at the central plane of the plate, but often either side of it; for they are sometimes hollow within. In some species the spines of the surface are tubular, as in the *Echinopora reflexa*. We have observed, with regard to the visceral lamellæ, exhibited in figure 15, § 25, that a large compartment alternates with three narrower; and also that the large calcareous lamellæ in the *Dendrophylliæ* and many other species, alternate with three smaller: it appears therefore that the larger rays of a cell are formed between a pair of large visceral lamellæ, and the smaller in the narrower spaces which are intermediate.

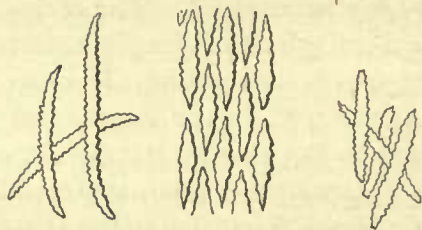
The calcareous secretions forming these corals are often deposited at successive intervals or as layers in the zoöphyte. In a *Madrepora* the surface between the cells becomes covered with minute points by the continued secretions, and then a layer forms, connected with the preceding by these points or columns. The interior usually becomes, afterwards, nearly solid by additional secretions. This variety of structure may be observed also in the *Dendrophylliæ*; and even the compact species, in which there are no traces of cellules, will often show evidence of having been deposited in layers. I have seen it brought out with singular distinctness in a specimen half fossilized, the layers easily peeling off from one another. In many corals, however, we fail to detect this deposition in layers. This is the case in the *Astræa* tribe. The *Pocilloporæ*, and some allied corals, have transverse plates crossing the cells internally, which are intermitted secretions from the lower part of the polyp; but no appearance of layers has been detected in the spaces between the cells. The *Favosites* and many *Cyathophyllidæ* are examples of similar interrupted secretions across the cells.

47. Our explanations thus far, apply more especially to the *Actinaria*. The *Alcyonaria* secrete no rays within the cells, nor even striate the inner surface of the same, while rays or striating lamellæ belong to the cells of all the *Actinaria*. Moreover, in the *Alcyonia* group, the secretions, instead of forming layers, constitute disseminated granules or spiculæ, some of which are represented in figure 22, and there is every gradation, from the purely fleshy species to those which are quite firm, from the secreted calcareous grains. These



secretions are nearly or quite absent immediately about each polypore, in order that these parts may be flexible to admit of the animal's

Fig. 22.



contracting and expanding itself; elsewhere they are more or less abundant, according to the species. In the genus *Tubipora*, the species form a thin calcareous tube for each polyp, smooth within, as well as without, yet perforated by minute pores.

48. Among the *Actinaria*, the principle, that the calcareous and fleshy lamellæ have a general correspondence in number, leads to important distinctions in the coralla. Madreporcs, on this principle, can never have over twelve rays to their cells, and the number is usually from six to twelve; while the *Caryophyllia* and *Astræa* tribes have an indefinite number. The two tribes just mentioned are distinguished in their coralla by another character depending on the structure of the animals, as explained in § 42. The lamellæ of the stars in an *Astræa*, and the allied corals, extend through the interstitial spaces between the cells, striating lamellately the surface; while in the recent species of the *Caryophyllia* group (and also the Madreporcs), these spaces are smooth, granulous, or irregularly porous, instead of lamello-striate. Besides, in the *former*, the calcareous lamellæ are united by numerous transverse dissepiments, which, when oblique, as in plate 11, figure 4c (showing a vertical section of an *Astræa*), they cause the star in a transverse section to be divided into numerous cellules (fig. 4d); but, if horizontal, or nearly so, as in plate 10, figure 2a, they do not show their edges in a transverse view, and the star appears simple. In the recent *Caryophyllidæ*, there are seldom any cross dissepiments, and in the few cases in which they are observed, they are distant, being separated by longer intervals than the breadth of a lamella.

49. *Foot-secretions*. The foot-secretions appear to be entirely independent of the tissue-secretions. The former are often horny, when the latter are calcareous, and when they occur together they constitute separable layers, one enveloping the other.

The united polyps of a branch have their mouths opening outward on every side, while the bases are directed inward towards a common central or axial line. The simultaneous secretions of the bases, therefore, must necessarily produce a solid axis to the branch.



Thus is produced the horny stem of the sea-fan (*Gorgonia*), which was long considered of vegetable origin. The polyps, which, in these corals, form a coating around the horny axis, often secrete, within their tissues, lime enough to give considerable firmness to the coating, making it a crust to the axis: yet in some species this crust, when dry, so readily peels off, that the specimens in cabinets are often the mere black branching axis of a *Gorgonia*. The coating of polyps, in other species, remains entirely fleshy, and in these, the axis is always stripped of the polyp-exterior, after drying and washing: the *Antipathes* are examples of this, in which the axis is corneous—and the red or noble coral of the Mediterranean (*Corallium*), an example, with a calcareous axis.

The texture of these secretions in *Gorgoniæ*, was long since well illustrated by Ellis; and plates ii. and ix., of his posthumous work, contain illustrations of some of the principal varieties. Sometimes they are solid throughout, with but slight indications of a concentric structure. In other species, the interior is less firm, and appears like a pith to the stem,—a peculiarity easily accounted for by the fact that this portion is the production of the *young* or apical polyps alone (§§ 70, 74). Occasionally, they consist of an aggregate of short fibres, placed longitudinally, and compacted more or less firmly together.

From a general survey of the facts, it is evident that these secretions are epidermic: moreover, they appear to be generally elaborated in short fibres, successively applied to one another, and form thus successive layers, which may occasionally be distinguished. They have a relation in origin, use, and composition, to the fibrous *byssus*, secreted by the foot of certain molluscs, and are formed like the epidermic appendages generally (nails, &c.) of the higher animals.

The common *Actinia* is said to attach itself at base by means of a glutinous secretion, which may be analogous to those of the *Gorgoniæ*, although differing in not admitting of accumulation. It seems probable, as was suggested to me by my valued associate, Dr. C. Pickering, that the *Velella* and *Porpita* are closely allied to the *Actiniæ*; and the structure of the tentacles and mouth seems to confirm this opinion. If this be true, the cartilaginous shield, with the thin process called *the sail*, corresponds to the foot-secretions here described. The animal floats with the tentacles downward, and the sail raised to the wind, by which it is wafted over the surface of the ocean. The air-disk in the base of the *Actinectæ*, acting as a float for the animal, is apparently similar in origin to the disk of the



Porpita and Velella, though different in its cellular texture. Excluding these doubtful instances, foot-secretions are confined to the group Alcyonaria, and the single genus Antipathes among the Actinaria.

50. *Chemical Constitution of Coral Secretions.* We find as early as in Marsigli, the results of some experimentings on corals, in the rude chemical methods of the day; but the first examinations of any value, are those by Charles Hatchett, in the Philosophical Transactions; for 1800;\* and these give us at the present time the most definite information hitherto published with regard to these secretions.

Mr. Hatchett found the stony corals, as far as he examined them, to consist of carbonate of lime, with some fibrous membranes or "loose gelatinous substance," which, in certain species (*Dendrophyllia ramea*, *Myriozone truncatum*), retained, in some degree, the form of the coral after its digestion in nitric acid. In a *Nullipora*, (now classed with the vegetable kingdom,) he found, besides carbónic acid, a small proportion of phosphoric acid, together with a substance retaining the form of the nullipore, "of which a strong white opaque membrane formed the external part, and a transparent gelatinous substance the interior."

His observations were most extensive with the Alcyonia tribe. The horny axis of the Gorgonidæ afforded him generally a large proportion of cartilage, with some phosphate and carbonate of lime. In the *Gorgonia ceratophyta*, and flabellum, the proportion of phosphate was large, and, in one species, the composition was very near that of stag-horn. While in others, the *G. umbraculum*, *verrucosa*, &c., he found no phosphate. The cortex in these zoophytes consists largely of animal membrane, with much carbonate of lime, and, in some instances, a trace of phosphate. The tubes of a *Tubipora* afforded a like constitution without phosphoric acid, and the *Corallium*, the same, with a small portion of phosphate. The red colour of these species was destroyed by the acid, but that of a *Melitæa* was precipitated in nitric acid as a fine red powder.

Mr. Hatchett concludes, from his investigations, that corals, bone, and horn, have an analogous constitution differing only in the proportion of the ossifying ingredients.

Mr. J. E. Gray has shown that the interior of some Gorgonidæ

\* Philosophical Transactions abridged, vol. xviii., pp. 706, 725.

consists of siliceous spiculæ, and has founded upon this character his genus *Hyalonema*.\*

51. Mr. B. Silliman, Jr., has been engaged in a series of analyses for this work, the detailed results of which will be given in the Appendix. We merely state here, that he has found in most of the calcareous corals examined, a small per-centage of magnesia, alumina, iron, silica, phosphoric acid, and fluorine, besides the carbonate of lime, which constitutes, after separating the animal matter, from ninety-seven to ninety-nine per cent. The horny stem of the *Gorgonia setosa* afforded him a considerable proportion of alumina, besides phosphoric acid, some carbonate of lime, and ninety-three per cent. of animal matter.

We have a sufficient source for the elements of these ingredients in the food of the polyps united with the waters of the ocean. Through their animal functions, such changes and recompositions take place, in the material thus received, as are required for the coral secretions.

### III. REPRODUCTION BY BUDS—THE COMPOUND STRUCTURE.

52. In the preceding pages, on the Actinoidea, we have considered merely the simple polyp, in which reproduction takes place only by ovules, produced from the internal lamellæ, and escaping by the mouth of the parent-animal. These polyps, in very many species, increase also by *buds*, and thus, from the single parent, perhaps but a fraction of an inch in size, zoophytes may spread their branches to a height of many feet. As we find the origin of the various forms of corals, in this power of developing buds, connected with some peculiarities in the animals themselves and their mode of growth, this subject is one of prominent interest. We may first consider simply the process of budding, and afterwards point out the different modes by which the budding process gives rise to the forms of zoophytes.

1. THE PROCESS OF BUDDING. 53. Buds proceed from different parts of a parent-polyp: those from the sides are called *lateral* or *inferior* buds; and those from the upper extremity, either just exterior to the tentacles, or from the disk, are *terminal* or *superior* buds.

The nature of the process is, in general, very similar to that described under the Hydroidea (§§ 15, 16). In lateral budding, a small protuberance appears on the side of the parent, into which the visce-

\* Proceedings of the Zoological Society of London, 1835, p. 62.

ral cavity of the same is usually prolonged: developement goes on, and shortly a mouth and a circling of tentacles appear at the extremity. In some cases, the visceral cavity of the young continues afterward to open into that of the parent; yet, generally, the communication gradually closes as the young grows, leaving usually an imperfect cellular connexion.

In other instances, especially when the buds appear outside of the disks (a variety of terminal budding), there is not at any time a connexion with the visceral cavity of the parent, except through the intermediate lateral pores or lacunal spaces.

In disk-budding, a new mouth opens in the disk, without any previous external indication of the changes in progress; and, as the disk is situated over the visceral cavity, the new polyp for awhile, at least, shares with the parent in this cavity: in many instances, the two animals subsequently become separate by a process of growth, hereafter to be described (§§ 77, 79). There is no satisfactory evidence, as yet, that the budding polyp divides the stomach of the parent as well as the visceral cavity.

The budding process goes on without any necessary connexion with coral secretions. These secretions, however, are usually in progress at the same time within.

The buds, both inferior and superior, in many instances, become nearly adult polyps, before they give out other buds. Very frequently, however, a budding *shoot* continues lengthening uninterruptedly, like the creeper of a plant, and gives out buds at intervals. These shoots are called *stolons* or creepers by Ehrenberg, who first laid down the distinction among zoophytes. Broad plates of polyps, and the margins of many massive species, increase in this manner, by a gradual extension outward, and an accompanying production of buds.

54. Milne Edwards has shown, that the lateral buds in an Alcyonium are developed from one of the visceral lamellæ—the same parts that produce ovules. He found that the new visceral cavity, where it opened into that of the parent, intersected a lamella, and that this bisected lamella was deflected into the cavity of the young polyp. It would hence seem, as Edwards suggests, that the bud is the developement of a germ or germinating cellule laterally through the sides of an animal, instead of its maturing within and escaping through the mouth. This indeed should be inferred from the nature of germination. The general result is the same, whether a cellule develops an ovule, or a bud; for it is an animal with like powers and

structure in the two cases. The germinating power required is, therefore, similar, and might be expected to belong to the same reproductive organs. It hence appears, that while the margins of the ovarian lamellæ develop ovules, the inner portions often develop buds. Milne Edwards farther states, that the side of a visceral cavity which gives out buds, does not produce ovules within. The formation and growth of the bud absorbs, for the time, the general reproductive powers of that part of the parent-polyp.

The disk-buds, like the lateral, probably proceed from one of the same lamellæ, and they differ from the latter principally in the position of the budding-point, which is immediately below the disk, instead of from an inferior *lateral* origin.

2. INFLUENCE OF THE POSITION AND CHARACTER OF THE BUDS, AND MODE OF GROWTH, ON THE RESULTING FORMS OF ZOOPHYTES. In the exposition of this interesting subject, it is important in the first place that some idea be given of the various forms which zoophytes assume. We shall next consider how far modes of growth influence these forms, and then to what extent they depend upon the additional function of gemmation, and proceed from the positions, character, or periodicity of buds.

#### A. FORMS OF ACTINOID ZOOPHYTES.

55. Many of the various shapes which these zoophytes assume, are familiarly known. Madrepore shrubs and trees, and the sea-fan and other Gorgoniæ, from the West and East Indies, are common in collections. The hemispheres of *brain-coral* (*Meandrina*), and also of *star-coral* (*Astræa*), are often met with. It is very generally supposed, that these are by far the most frequent, if not the only shapes presented; but, on the contrary, the varieties are extremely numerous, as we have already intimated. Some species grow up in the form of large leaves rolled around one another like an open cabbage, and *cabbage-coral* would be no inapt designation for such species. Another foliated kind consists of leaves more crisped and of more delicate texture, irregularly clustered;—*lettuce-coral* would be a significant name. Each leaf has a surface covered with polyp-flowers, and was formed by the growth and secretion of these polyps. Clustered leaves of the acanthus and oak, are at once called to mind by other species; a sprouting asparagus-bed by others. The mushroom is here imitated in very many of its fantastic shapes, and other fungi, with mosses and lichens, add to the variety.

The vases of flowers, to which allusion is made on a preceding

page, are common about the reefs of the Pacific. They stand on a cylindrical base, which is enveloped in flowers when alive, and consist of a network of branches and branchlets, spreading gracefully from a centre, covered above with crowded sprigs of tinted polyps. The vases in the collections of the Expedition, at Washington, will bear out this description, although but the lifeless coral.

The domes of *Astræas* are of perfect symmetry, and often grow to a diameter of ten or twelve feet without a blemish. The ruder hillocks of *Porites* are sometimes twenty feet across. Besides these, we might describe columns, Hercules' clubs, and various strange shapes which are like nothing but themselves.

56. Each one of these compound zoophytes commenced from a single polyp; bud followed bud, and so the germ grew up into the coral tree or dome. Calculating the number of polyps that are united in a single *Astræa* dome, twelve feet in diameter,—each covering a square half inch,—we find it exceeding one hundred thousand; and in a *Porites*, of the same dimensions, in which the animals are under a line in breadth, the number exceeds five and a half millions; there are here, consequently, five and a half millions of mouths and stomachs to a single zoophyte, contributing together to the growth of the mass, by eating, and growing, and budding, and connected with one another by their lateral tissues and an imperfect cellular or lacunal communication. There is hence every variety, as to number, among compound zoophytes, down to the simple polyp, which never buds at all, and has, for its corallum, a simple calicle;—it may be a tiny goblet, with a stellate cell, as in the *Cyathina*—a cylindrical cup, as in some *Dendrophyllias*—or a radiated disk, as in the *Fungias* and *Cyclolites*.

57. To give a more complete survey of the subject, the following varieties of form are here enumerated.

1. A simple cylindrical or turbate calicle: *Cyathinæ*, some *Caryophylliæ* and *Cyathophylla*.

2. A simple radiated disk: *Fungia*, *Cyclolites*.

3. A conical cap, or inverted basin or cup: *Polyphyllia*, *Zoopili*, *Halomitæ*, some *Fungia*.

4. An upright basin or cup on a short pedicel: some *Pavonia* and *Manopora*.

5. Solid hemispherical domes: many *Astrææ* and *Meandrina*. These are sometimes nearly or quite globular. In some *Cyathophyllidæ*, these masses consist of separable columns.

6. Rude hillocks, gibbous or nodular masses : many *Porites*, *Alveopora*, and some *Astræa*, *Meandrina*, *Gemmipora*, and *Manopora*.

7. Plates incrusting dead corals, in some species, sending up rude branchings : many *Manopora*, *Millepora*, *Agaricia*.

8. Simple and branched columns and club-shaped masses : many *Porites*, *Goniopora*.

9. Clustered leaves or folia, which may be erect, as in some *Millepora*, *Pavonia*, and *Echinopora*; or, spreading from a base, and rolled round one another, as in certain *Gemmipora*, *Manopora*, *Echinopora*; or, clustered into convex or hemispherical clumps by upward and horizontal growth from a centre, as in many *Merulina*, *Pavonia*, *Tridacophyllia*.

10. Clumps of clustered branches from a common base; a mode of growth described as *cespitose*, and often producing very regular hemispherical zoophytes, as in many *Mussa*, *Euphyllia*, *Caulastræa*, *Caryophyllia*, *Porites*, and *Madrepora*. In many species of the last two genera, the branches often grow together by coalescence.

11. A horizontal network of branches spreading outward and bearing erect branchlets : many *Madrepores*.

12. A horizontal plate produced by a complete coalescence of horizontal branches, and bearing above short finger-like branchlets : many *Madrepores*.

13. The spreading tree, a mode of growth styled arborescent : many *Madrepora*, *Dendrophyllia*, *Gorgonida*, and *Antipathes*.

14. The slender twig, either clustered or simple, straight or twisted : many *Gorgonida* and *Antipathes*.

15. Fan-shape, or with the branches spreading in a single plane, a form styled flabellate : many *Gorgonia*.

16. Reticulate; produced by a coalescence of branches and branchlets into a kind of network : some fan-shaped *Gorgonia* and the *Aulopora*; also, less perfectly in some horizontally-growing *Madrepora*.

17. Pinnate, where the branchlets proceed regularly from opposite sides of the branches : some *Gorgonida* and *Antipathes*.

18. Clumps of clustered parallel tubes, united or not at intervals by transverse plates or processes : *Tubipora*, *Cornularia*, *Syringopora*.

19. Similar to the last, but the tubes embedded below in a loose calcareous mass : *Anthophylla*.

These varieties of form are illustrated in the accompanying Atlas.

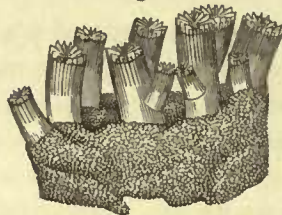


## B. MODES OF GROWTH.

58. There are several ways in which the mode of growth affects the forms of zoophytes, depending on the two following considerations:—1. The mode of connexion between the bud and parent; 2. The mode of growth of the parent and its budding polyps.

a. 59. The union between the bud and the parent may be simply basal: the young starts out from the sides of the parent and forms finally a prominent branch. Such is the case with the species here

Fig. 23.



Anthophyllum cespitosum.

Fig. 24.



Caryophyllia arbuscula.

figured. In figure 24, the branches thus formed are all distinct; but in figure 23, representing an *Anthophyllum*, the polyps are united below in a common base, which gradually increases, as the whole grows upward, and surrounds the lower part of the cells.

60. In other instances, the bud and parent have a lateral connexion nearly or quite to their summits, as is illustrated in the *Astræas*, *Porites*, and the massive corals generally. When this connexion extends to the very summit, the polyps appear embedded throughout: but otherwise they are more or less prominent above the general surface; and when the prominent part of a polyp secretes lime, the corallum is covered with *calicles*, as in the *Madreporæ*, *Dendrophyllia*, *Oculinæ*, *Gemmiporæ*, and some *Astrææ*.\* But if no calcareous secretions take place in this part, as in the *Porites* and *Gonioporæ* (§ 46), the cells are immersed, as in the case of immersed polyps. The *Gonioporæ*, and many *Porites*, when alive and expanded, have the polyps standing prominent over the whole surface of the

\* See the figures 27, 28, 29, 31, and 34, as well as those of these genera in the Atlas.

zoophyte, arising from the fact that the coral secretions take place only from the lower parts of the polyps.

It is hence apparent, that by this single difference in growth, the same mode of budding may produce either massive forms—globular or ramose—or a branched zoophyte, in which each branchlet is the growth of a separate polyp. The former mode of growth produces what may be styled *aggregate* zoophytes, as is exemplified in figure 23, and in the various genera just referred to. The latter gives rise to *segregate* zoophytes, the polyps being separate from one another, excepting a basal connexion. The coralla, in the latter case, may be described as *calicularly* branched. This subject will be farther illustrated when treating of the modes of budding.

b. 61. Germ-polyps differ essentially in their mode of increase,—a process intimately connected with that of budding. The adult animal, commencing a zoophyte, sometimes seems to raise itself on the coral it secretes, and, although but a fraction of an inch in height itself, gives rise to stems many times its own length. This is the case with the species represented in figure 24, in which only the tips of the branches, for a line or less, are alive. The part below dies as growth proceeds above, and so growth and death go on at equal pace till the small polyp is finally supported upon a long pedicel of dead coral. This is styled an *acrogenous\** mode of increase. In the example referred to, and many others among coral zoophytes, there is no connexion whatever between the several polyps of the group, except for a short time after a bud first starts, the process of growth causing after awhile a complete separation between each bud and its parent.

Other species are incapable of this indefinite upward growth; and these consequently scarcely exceed their adult size in height, above the point from which they start into existence. Yet many of these give origin to large zoophytes. Instead of increasing upward, they extend themselves laterally, or *widen* by growth and budding. This result may be connected both with *lateral* and *terminal* budding, as shown in figures 27 and 33.

62. The singular process of dying below, while upward increase goes on, is illustrated by nearly the whole class of coral zoophytes, and may receive here some farther illustration.

An *Astræa* dome, twelve feet in diameter, although solid coral through its interior, is alive for only half or three-fourths of an inch

\* From *αρον*, top, and *γινωσκω*, to increase.



from the surface; so that the live portion, could it be separated, would form a thin hollow hemisphere. The depth to which life extends, may, in general, be estimated from the diameter of one of the polyps; for in the Actiniæ, as well as the Astræas and Caryophylliæ, the depth (or height) often exceeds but little the diameter, and very seldom, in any species, three diameters.

Even the branching Madreporæ are usually lifeless along the axis of the branches; and in the Porites, whether forming a branch half an inch in diameter, or a glomerate mass of twenty feet, the polyps do not extend within, beyond two lines. The interior is dead coral, the former animal tissues of which have dried up.

The branching or columnar coral zoophytes are not only dead along the axis, but they become *throughout* dead at bottom, after attaining a certain height. The addition of an inch at apex is death to an inch below. Some Goniopores, which grow in columns, two feet or more in height, have a head of live polyps—a capital to the column—of only two or three inches.

Upon this principle of growing and dying, depends the vast power and geological influence of the coral polyp. But a few lines in height themselves, they would otherwise be limited in their coral-making to as many inches at the most, and what is now styled the coral-garden, would be but a bed of mosses or incrusting lichens. Like the sphagnous moss of a peat-swamp, coral zoophytes continue growing at top, with none the less luxuriance, though supported on several feet of lifeless trunk. Death follows on “*æquo pulsat pede*” up the stem of a zoophyte “*regumque turres.*”

The nature of this dying process seems to be simply this: that circulation loses its activity below, as growth proceeds above, and, consequently, the parts dry up in the pores of the corallum. In the Astræas, this takes place continuously, at the same rate as increase above, and produces a gradual change of the animal. In some Cyathophyllidæ, the same process goes on interruptedly, as explained by Ehrenberg. The tissues of the polyp disappear at intervals from the sides, leaving a row of unoccupied cellules; and the animal afterwards goes on to increase from its contracted size, without refilling the cellules, which are, therefore, left vacant, though usually closed above at the time of the retraction. Thus the surface of the zoophyte becomes covered with encircling ridges, and the corallum appears to consist of a series of inverted cones inserted one in the other. There is a gradual transition from species, in which these



interrupting ridges are prominent and large, to others, where the surface is smooth. Some traces of them are seen in the recent *Mussæ* and *Euphylliæ*.\*

The transverse dissepiments secreted across the cells of the *Pocilloporæ*, *Favosites*, and many *Cyathophyllidæ* (§ 46), appear to be connected, as suggested by Ehrenberg, with this process of dying or removal below. The base of the polyp, or, at least, the central part of it, is withdrawn at intervals, and after each withdrawal, a new plate is secreted by the base of the animal.

It is obvious from the preceding, that the polyp, which is the germ of a compound zoophyte, loses its identity, and cannot be said, in any proper sense, to have the long life which is attributed to the full-grown zoophyte itself; or else, we might have, among the huge *Astræas* of the Red Sea, polyps that were cotemporaries with the builders of the pyramids.

#### C. COALESCENCE OF BRANCHES.

63. The forms of zoophytes are farther modified by the frequent coalescence or growing together of branches. A clump is sometimes so united in this way, that only the branchlets at the extremities are entirely free; and occasionally a branching corallum finally becomes nearly solid, a few holes intersecting or riddling the mass, being the only indications within that it was a ramose species. When the species ramifies in a plane, the coalescing branchlets sometimes produce a complete network, as in the sea-fan (*Gorgonia flabellum*) of the West Indies. The vase *Madrepores* are other examples of the same. This coalescence is so complete in some of the horizontally growing *Madrepores* (*M. palmata* and *flabellum*), that they form broad solid plates or folia, with perhaps an inch or so of the coalesced branches, free at the margin of the plate.

In foliaceous zoophytes, the same coalescence may take place. In certain species, the folia curve around until the edges meet and grow together, and produce a chimney or tubular form, as in the *Echinopora reflexa*. Again, a plate folds upon itself, and the parts unite, back to back, so that a species, which usually has polyps only on one surface,—unifacial,—may change its character and resemble *bifacial* species, in which polyps open on both sides.

A broken piece of live coral, placed against another of the same species, will soon grow to it and continue its existence as if unin-

\* See plate 6, figure 3b.

jured. Or, if fixed upon a piece of dead coral-rock, where it will not be disturbed, it attaches itself, in a short time, at base, to the rock, and becomes the germ of a future clump or tree.

D. ON THE MODES OF BUDDING AND THEIR CONNEXION WITH THE MODES OF GROWTH.

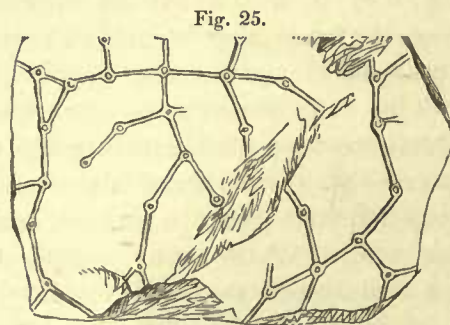
64. In the preceding pages it has been explained, that budding-polyps may have either an *acrogenous* or a *prolate* mode of increase, or that *the two modes may be combined*; and also that buds may be either *lateral* or *terminal*—in other words, *inferior* or *superior*;—and, farther, that the new polyps may be united to the parent at base only, or *segregately*; or they may be united by their lateral tissues also,—that is, *aggregately*.

The distinction of inferior and superior buds, is of fundamental importance, and may receive separate consideration. The latter characterize the *Astræa* tribe of zoophytes, and the former, all other species.

I. INFERIOR OR LATERAL BUDDING.

1. *Lateral budding, without acrogenous growth, in the polyps.*

65. When the bud proceeds from the base of the polyp, and in lines, the form represented in the following figures\* may result. In the *Aulopora*, of which figure 25 represents the corallum of a recent



*Aulopora filiformis.*



*Zoanthus Ellisii.*

species, the polyp sends out a root-like tubular fibre from its base, which, after creeping along over the supporting rock to a certain distance, sends up a bud,—a young polyp,—which becomes, after

\* See tab. 1, figures 1 and 2, of the Natural History of Zoophytes, by Ellis and Solander, from which the above figure of the *Zoanthus Ellisii* is taken.

The *Aulopora* encrusts dead coral. The corallum is a delicate red tube, with small round cells at intervals, from which the polyps expanded themselves when alive.

awhile, an adult, and continues the mode of propagation, until lines of polyps are formed; and these coalesce at intervals, and form a network. The creeping-shoot, in many species, continues growing indefinitely, and sending up buds at intervals, as in fig. 26.

It is plain, that if the buds passing out from the different sides of the base of each polyp should all coalesce by lateral extension, we should have an incrusting plate instead of a simple thread network. And, moreover, when these animals coalesce also by their sides above, as often takes place, the plate would have a thickness equal to the height of a polyp. These different varieties are all well illustrated among the Zoanthidæ, and the last is exemplified in the Palythoa, described in § 30.

66. The same process is also illustrated in the following figure of a Gemmipora, in which the budding is lateral from near the base of the polyps. The buds open at the margin of the growing plate, and each young animal may be traced within to the preceding, as is indicated by the lines of the cells on the broken edge forming the

Fig. 27.



Gemmipora.

front of the figure. Other instances are found in the genus Manopora. Such forms have been called *explanate* or *foliaceous*.

67. Very different forms result when the buds are not confined to a single side of the parent, as in the Gemmipora, just described. In the Oculinæ, they pass out obliquely from different sides; each one gives out a bud, and that another, and so on successively, somewhat like the budding of the Sertularidæ (§ 16); and the zoophyte, proceeding from the process, is an erect or ascending stem, as in the annexed figures of the coralla of two species of this genus. Each bud is for a time at the apex, but it gradually becomes lateral and then gives off another bud from its upper side. Thus bud follows bud, and the stem slowly lengthens. In these corals there is often a distinct spiral



Oculina.

arrangement of the polyps around the branch, especially apparent at the apex. The spire, in some species, goes around by the right, and, in others, by the left; and a single circuit of the spire appears to contain five polyps, though with some irregularity. In figure 31, this mode of arrangement is seen in an end view of a branch enlarged. The calicles are numbered, to show their relative positions, commencing with the apical as number 1. At the same time that the figures exhibit the spiral order, they also indicate the fact stated, that there is some irregularity in this arrangement.

2. *Lateral budding, with acrogenous growth, in the polyps.*

68. When polyps have the upward mode of growth, different forms result; according as the budding power is general throughout the zoophyte, or belongs only to a limited number of polyps,—the older individuals losing the power by age.

69. *Unlimited symmetrical budding.* If each polyp, as soon as produced, buds like the parent, and retains this power indefinitely, or without limit, the zoophyte will necessarily take on globular or hemispherical forms; for increase, in such a case, takes place equally in every direction. There are certain species among the massive Porites, in which these forms thus result. Yet, owing to a slight irregularity, or the more rapid developement of buds in some parts than others, these zoophytes have generally a form irregularly glomerate, rather than symmetrically globular.

Globular or hemispherical forms are produced in the same manner among the *segregate*, as the massive or *aggregate* zoophytes. The Columnariæ are examples of species consisting of adnate prisms. In the Tubipores, the polyps form, by their secretions, parallel tubes, which, as they grow and give out buds from their sides, necessarily diverge a little, and a convex or hemispherical form is the result. The tubes are united at intervals by transverse plates, which are formed at the budding process, as is apparent from the fact that the buds proceed from these plates; and the internal cavity may be traced into them, though very much reduced in size. The process of budding is similar to that of the Aulopora, except that the polyps have an acrogenous growth, and bud periodically as they grow upward; and, moreover, the buds, at the time they are given out, coalesce laterally into a plate, like the Xeniæ, instead of forming a network: after this coalescence, they lengthen upward between the other polyps, and thus add new tubes to this "organ-pipe" coral-zoophyte.

The Caryophylliæ\* afford still other examples of *segregate* zoophytes, with convex forms, arising from the budding function being received equally and retained indefinitely by each polyp. The multiplication of lateral buds causes the ascending stems to diverge, and the clump becomes rounded above. Yet the outer portions of the clump, owing perhaps to their receiving first the waters around, often extend a little the most rapidly, and the form becomes thus flattened convex, rather than regularly hemispherical. The spaces between the branches are quite uniform in the same species, as well as the length of interval between successive buds from the same branch.

70. *A budding cluster.* But when with an acrogenous mode of growth, the polyps, after a certain age, lose the function of budding, the zoophyte, commencing as a small hemisphere, lengthens upward into a cylinder, whose diameter is determined by the breadth of the *budding cluster*. This cluster constitutes the extremity of the stem or branch, and, as it is constantly forming new buds, the older polyps of the cluster, at the same rate, are turned out, and joined to the lateral non-budding polyps of the branch. By this process, the branch continues to elongate. The Porites, Sideroporæ, and Pocilloporæ, afford examples.

Stems produced from a budding cluster have generally rounded or flattened summits. Exceptions to this are found in some Seriatoporæ. In these species, the budding cluster is quite small, containing but six or eight polyps; the three or four alternate push out buds nearly simultaneously at the very apex, and then the others, another set beyond these, each set constituting successively the apex, which is consequently pointed. In some Gorgoniæ, also, in which the budding cluster is very small, the stems are pointed.

71. *Budding from an apical or parent-polyp.* Instead of a budding cluster, the Madreporæ and Dendrophylliæ have a single *budding* or *parent-polyp* at the apex of each branch, from the sides of which the lateral buds are given out.

This is shown in the following figure of a Dendrophyllia. The terminal polyp is the parent from which all the polyps of the branch have proceeded.

Each branch of a Madrepora, in the same manner, has its parent-polyp. In these genera, the branches have a conical or tapering extremity, while in those which grow and bud from a *cluster*,

\* The Cladocoræ of Ehrenberg.



the branches have no one polyp at apex more prominent than the others. In the Madrepores, a spiral arrangement of the polyps may sometimes be distinguished, resulting from some regularity in the development of buds, in turn, from the different sides of a parent-polyp.

Fig. 31.



Dendrophyllia.

72. A periodicity in the budding process is well illustrated in the jointed corals of the Gorgonia family. The Melitæas form *foot* and *tissue* secretions, like the true Gorgoniæ; but, instead of having the former as an axis, within the others, the two appear to constitute alternating joints. This may be accounted for by supposing the budding to be periodical at the apex of the branch, the new buds adding to the extremity, first, their foot-secretions, and then their tissue-secretions.

73. It is obvious that the form and position of the growing stems must also depend on the *symmetrical* or *unsymmetrical* production of buds. The stem will be cylindrical when the buds are equal and open alike in every direction. If they form only in two opposite directions, in a single series, we have a zoophyte with two-edged branches, as in some Pterogorgiæ.\* Or if the buds opening in two directions spread sidewise, instead of forming a simple vertical series, the zoophyte produced is an erect plate, with polyps opening on the opposite surfaces, as in some Milleporæ.

When the budding is *unsymmetrical*, the zoophytes formed are oblique or horizontal. The buds, having an oblique tendency, may pass off at a different angle on opposite sides, or elongate more rapidly on one side than the other, or they may be confined to one side alone.

Cylindrical stems, in consequence of this oblique or unsymmetrical mode of budding, become horizontal, as in many Madrepores; the buds open equally in every direction, but elongate most rapidly on one side of the branch in a horizontal direction. By this mode of increase, the vase Madrepores are produced,† some of which are several feet in diameter.

A few remarks may be added upon *the mode of branching* in these

\* The Gorgonia anceps and other species with seriate polyps. † See plates 32 and 33.

corals, before we proceed to consider the peculiarities of growth connected with *terminal* budding.

74. There are two modes of branching:—1. *By a simple furcation of the extremity of a branch*; and, 2. *By the sprouting of a branch from the side of a stem or branch.*

*a. Branching by furcation.* Furcation of the summits occurs in species which grow by means of a parent-cluster of polyps. It generally proceeds from the accumulation of buds, and the consequent enlargement of the extremity. The budding of polyps in the midst of a budding cluster causes a slight divergence between them, inasmuch as the budding goes on more rapidly than the elongation of the branch. The extremity consequently enlarges a little, and, beginning in this way to exceed the normal breadth of the budding-cluster, furcation commences. The central polyps at the apex lose their budding powers after attaining a certain age, and, as the cluster is thus divided, each part goes on lengthening independently. This effect may be due to the fact that the zoophyte is able to sustain only a budding cluster of a certain size; a variation in the amount of nutriment or other causes affecting the vitality of a species, appear, however, to vary this size, and many irregularities in the same specimen may be traced apparently to this cause (§§ 84, 85). It is not possible generally to detect a periodicity in the development of buds causing the furcation. Yet it is apparent in some instances in which the stem retains its cylindrical form for a considerable length, and then rather abruptly enlarges and subdivides. In all instances, there is much uniformity in the frequency of furcation, or the length of a branch before the process begins. The forms resulting from this mode of branching are crowded cespitose clumps, and have rarely the arborescent shapes, common where branching takes place by lateral shoots.

When the polyps of a parent-cluster rapidly elongate, the cluster does not enlarge at apex, and such species, therefore, cannot branch by furcation. The *Gorgoniæ* afford illustrations of this.

Other examples of furcation are connected with terminal budding.

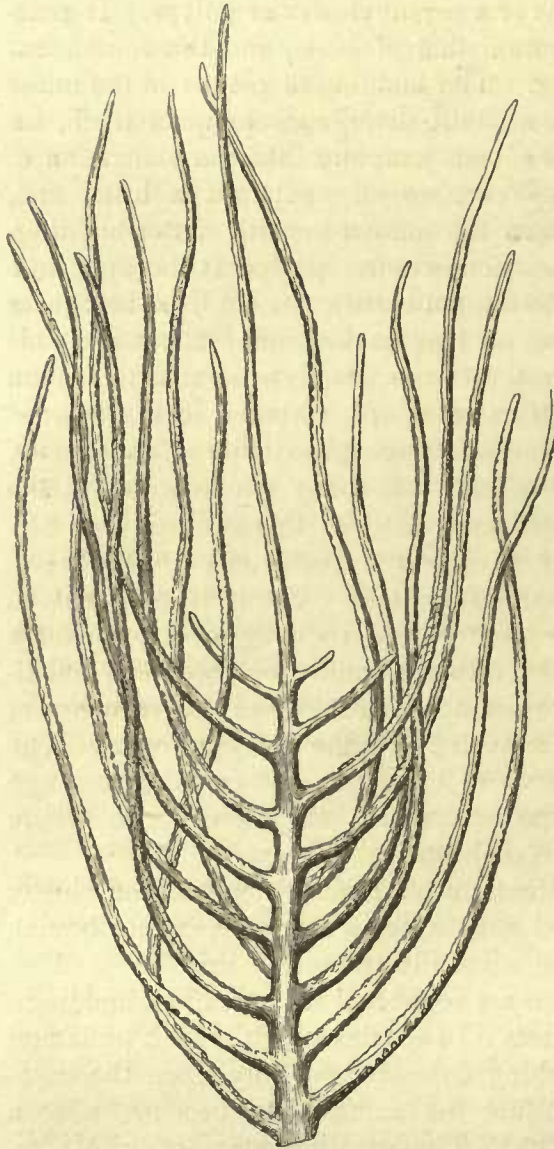
*b. Branching by lateral shoots.* In species which branch by lateral shoots, the process of branching depends generally upon the capability of certain polyps, below the summit, to become, after a certain time, budding polyps. The growing stem of a *Madrepore* would retain unchanged its simple cylindrical form, were it not possible that some of the polyps below should develop gemmating



functions. This actually takes place. A polyp from those of the lateral surface commences to enlarge, and then to bud and lengthen, till finally a branch is formed, the new budding polyp being the parent-polyp of the branch.

c. This change occurs at certain intervals upon the branch, though

Fig. 32.



with considerable irregularity, depending on exposure, position, food, and other circumstances. The uniformity is, however, so general that a particular mode of branching is characteristic of each species, and is readily distinguished. In some Madrepores, the branches are distant and long, and often between the large branches, are others, short and rudimentary, at nearly regular intervals. The gemmating powers of the apical polyp in these smaller branchlets are soon exhausted, and only at considerable distances can one of them continue to bud and become one of the larger branches. The lateral polyps sometimes assume budding functions very early, and then the branchlets are numerous, and crowded.

d. In certain species, the gemmating polyps are developed only on a particular side of a branch. In the horizontally growing

Madrepores,\* the new budding polyps on the main branches are con-

\* See plates 32, 33, and 34.

fined to the side which faces obliquely outward and downward; and it is by this means that the horizontal growth is carried on.

*e.* Again, the budding polyps are sometimes confined to two opposite sides of a branch, and pinnate forms result—that is, branches, with two opposite rows of branchlets, as shown in figure 32, representing part of a branch of the *Gorgonia setosa*. In this species, there are one or two rows of minute polyps on one side of a branch, and one on the other; the branch elongates by a succession of buds, the new buds opening at the very apex. Branchlets—or pinnules, as they are called—bud from both sides, and from either of the rows, on the side which has two, but from only one at a time. There is usually an interval of five or six polyps on each side between the pinnules, and owing to this they are mostly about one-third of an inch apart. The buds are sometimes alternately from the two rows, but often continue in one for some distance, and then change to the other, or alternate again. Owing to this want of perfect uniformity, and sometimes a spiral twist in the stem, the pinnules are somewhat irregular, or a little zigzag in position. The pinnules elongate by apical budding to a certain length, without any increase in diameter; but they sometimes give out lateral pinnules below, and thus commence to become branches. In the change of a pinnule to a branch, one or two from among the lower polyps begin to bud: the growing pinnule goes on elongating, and shortly, on the other side of the same, another polyp, or pair of polyps, buds, and originates a second branchlet; and then, when lengthened at apex a little farther, another starts on the opposite side, each new budding-point being at a nearly uniform distance from the apex. In this manner, the lengthening pinnule becomes a pinnate branch.

*f.* The positions of branches, as well as their size, are strikingly alike in different specimens of the same species. The angle which the polyps make with the axis of the stem, is the angle with which the new branch begins. This angle varies little in the same species; it is sometimes quite small, and the branchlets are then nearly erect and crowded together; but sixty degrees is the more common angle, and in some instances it is ninety degrees, or the branch is even reversed a little. The branches, when spreading, usually curve upward as they elongate themselves, and sometimes become vertical, an effect which appears to proceed in part from the influence of light; that is, the propensity of the polyp to grow upward towards the light. The horizontal Madrepores (plates 32, 33) follow the same principle,

and every new branchlet, though at first nearly horizontal, soon becomes erect. The *Madrepora prostrata*, plate 33, figure 1, is a good example of this process, as well as the other corals of the same plate, and all the vase *Madrepores*. Were it not that the new budding-polyps were developed on the *outer* side of the branches, the zoophyte would at once lose its horizontal position. The branchlets in these species, after becoming erect, are symmetrical in their mode of growth. The formation of parent-polyps, on the outer side of the main branches, is favoured by the more perfect exposure to the fresh ocean waters than is enjoyed in any other part of the zoophyte.

This mode of branching produces generally arborescent forms, and is mostly confined to species budding from a parent-polyp. Yet the *Gorgoniæ*, *Seriatoporæ*, and *Porites*, afford examples of the same result, from parent-clusters. The wart-like prominences over the surface of a *Pocillopora*, may be produced by an analogous process. As the budding-cluster of the apex enlarges by growth, and the older polyps join those of the lateral surface, small clusters of two or three in each, at nearly regular intervals, retain the budding power, until these prominences have a certain length, usually not exceeding two lines.

*Budding of a branch.*

75. Besides the budding of a single polyp, there are some species which form a group at a single budding process. This fact is pointed out by Milne Edwards, in his description of an *Alcyonium*.\* A knob or protuberance swells out from the surface, which, on dissection, is found to be penetrated by tubes branching and subdividing towards the surface, and all proceeding from a common trunk, or a collection of trunks, which branch from one or more, as the case may be, of the old polyps. The young polyps were distinguishable at the extremities of the tubes before they made their appearance externally; and finally a cluster of animals was developed, and a new branch added to the zoophyte. This process appears to be confined to this division of the Actinoidea.

II. SUPERIOR OR TERMINAL BUDDING.

76. While in *lateral* budding, increase, in the prolate growth of a zoophyte, takes place from the extension of the lower part of the polyps, in *terminal* budding it proceeds from the extension of the summits. This process of widening in the budding-polyps may be confined to the parts exterior to the disk and visceral cavity below, or

\* Ann. des Sci. Nat., 2d Ser., iv. (1835.)

the disk and cavity may continuously enlarge; in the latter case, the buds open in the disks, the process of budding being the cause of their enlargement.

*b.* The following figure of a foliaceous *Echinopora* illustrates the process where the growth is a simple marginal prolongation not extending to the disks.

Fig. 33.



Echinopora.

By the prolate mode of growth, the polyps gradually extend outward, and new buds open, from time to time, a short distance from the edge, and have no connexion at base with the preceding polyps. The corals of these species have the upper surface striated, indicating the presence of visceral lamellæ within the extending part, from which buds may proceed. The contrast between this and the *Gemipora* (§ 66), in each of the above particulars, is made apparent by a simple comparison of the figures; for in the latter, the buds, besides opening at the very margin, may be traced within to a preceding polyp, from which each is a lateral shoot: and, moreover, the surface is not striated.

*c.* The above *Echinopora*, and other foliaceous corals among the *Astræidæ*, are examples of *prolate* growth without the *acrogenous*. But the massive *Astræas* are produced by the united action of these two modes of growth, and their hemispherical forms result from the perfect regularity and symmetry in the process of budding.

*d.* Several species of *Astræas* afford examples of the mode of gemmation, illustrated in the *Echinopora*, among which is the *Astræa argus*. While the margin of the hemisphere is extending by the multiplication of buds, precisely similar to that above, the whole surface is also gradually enlarging by a widening of the intervals between the polyp-disks. But this widening is kept within limits by the appearance of new buds in these intervals when they begin to exceed

Fig. 34.



Astræa argus.

a certain breadth. In the annexed figure, a small cell between four polyps belonged to a young polyp, which was one of these new buds. The young continue enlarging, till the adult size is attained, and then the intervals going on to increase, other buds open. The elevated lines, which striate radiately the spaces between the cells or stars, indicate what we have before stated, that the visceral lamellæ are prolonged beyond the visceral cavity, through the interstitial spaces between adjoining polyps; and it is possible that the new bud proceeds from one of these lamellæ, though appearing at the middle of the interstitial space.

77. When the prolate growth is attended by a widening of the *disks*, the buds, as stated, open in the widening disk. In the Meandrine zoophytes (plate 8, fig. 1, and plate 14), bud follows bud, and the widening continues, until the disk, instead of being circular, as in the *Astræa argus*, or in the germ-polyp with which the Meandrina commenced, has at last a long linear form, often very flexuous, and contains a large number of polyp mouths; and, *beneath*, as many polyp stomachs, all communicating apparently with the same visceral cavity, or connected with one another by a system of large interlamellar spaces. In the Merulinæ, we have *foliaceous* corals illustrating well this mode of growth; and they are the analogues, in this division of the Astræidæ, of the Echinopores, among the preceding. The lines of polyp mouths continue extending outward, separated by narrow lamellate ridges, and the new buds open near the margin of the folium, on the surface of the extending disks (plate 15).

b. The length of these meandering disks, and their flexuous furcations, seem sometimes to be indefinite. Yet in other species they have their limits. After elongating for a while, a ridge forms across, and a subdivision is produced. The proper Astræas, with prolate disks, differ from the Meandrinæ in this subdivision taking place after the opening of each new mouth in the disk, in consequence of which, the form may become a little oblong, but is soon restored to a circular shape again. This is illustrated in the following figures, which show the progress of external changes.

The simple disk becomes oblong (fig. 36), and a new mouth opens. A subdivision commences (fig. 37) as growth goes on, and finally the disk entirely subdivides (fig. 38), and each part is surrounded by its own circle of tentacles. This division appears to commence whenever the number of lamellæ—which is constantly increasing—has reached the



limits that belongs to the adult animals. In the corallum, it may be seen to begin by the union of two opposite calcareous lamellæ, and the gradual formation of other lamellæ, each side of the united pair, in completion of the circle in each cell.



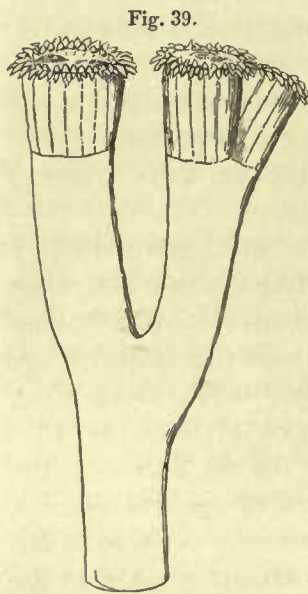
This process resembles somewhat the spontaneous fission of the monad, and is compared to it by Ehrenberg. From the illustrations given, it appears to be altogether analogous to budding exterior to the disks, and differs only in the position of the point from which budding commences. This subdivision, though sometimes apparently central, yet often separates only a small portion of the parent; and, instead of being a fission of an individual, it results by a slow divergent growth of the parent and bud. In the *Meandrinæ*, *Merulinæ*, and others, the disk-buds open successively in long series, *without* any proper subdivision of the polyps. Moreover, the *Astræa stellulata*, *A. stelligera*, and *A. intersepta*, bud exterior to the disks, and sometimes also within the disks. The *Merulinæ* occasionally exhibit a few cells very similar to those of the *Echinoporæ*, thus bringing together these two divisions in the *Astræa* family.

c. In the *Monticulariæ*, the elongating lines of disks are united by cross-lines, so that the whole surface appears like a single reticulate disk, with numerous polyp-mouths distributed over it, and having small scattered conical prominences, around which the tentacles are clustered. These species are thus closely related to the *Meandrinæ*, and the prominences are the remains of the ridges (plate 13, fig. 13).

78. *Relation of the Fungidæ to the Astræidæ.* In the *Astræidæ*, the lamellæ of the cells, which striate the interstices in massive species, are generally interrupted half-way between adjoining cells, as in fig. 34: in other words, each polyp has its limits distinctly marked in the corallum. But in the *Fungidæ*, which are closely allied species, there are no cells, and the lamellæ are continuous from centre to centre. We are aided in understanding the relation of the two families, by observing that in some *Meandrine* species, there are along the bottom of the trench, one to three narrow lamellæ, running

*uninterruptedly* from one polyp-centre to another. If the polyp-disks, therefore, should be coalescent in a plane in all directions, instead of in simple meandering lines, there would be no proper interstices between the polyps, and no cells, and the lamellæ would be continuous in every direction, from one centre to another. It hence appears, that the peculiarities of the Fungidæ consist in the absence of all interstices between the stars, and a uniform continuation of a single compound disk-surface over the whole. The *process of budding*, therefore, although seemingly like that of the Echinoporæ, is actually identical with that of the Merulinæ, in which buds open in the extending disks. The compound free Fungidæ, the Agariciæ, the Pavonæ, are equally good examples of the characters here explained. In the Polyphylliæ, the union of adjacent polyps is so close, that there is not even a separate series of tentacles to each polyp-mouth, and this character separates these species from the allied Herpetolithi.

79. *Modes of branching.* In species of Astræidæ, which form circularly-branched coralla, the disks widen and subdivision takes place as in the Astræa above explained, except that the subdivision continues in progress until the two polyps are



distinct at base, and each forms a separate branch. The annexed figure represents the whole process. On one branch, two polyp-mouths already exist in the enlarged disk, and at the extremity of the other, furcation has commenced; the furcation seen below, is an example of the subdivision completed. The difference between separation by this divergent growth, and the spontaneous fission of a monad, is obvious. The Mussæ, Euphylliæ, Caulastrææ, grow, and bud, and branch, in this manner; and the process goes on so regularly that the zoophytes are usually perfect hemispheres; the size of the branches, their length before furcation, and the intervals between them, being very uniform in the same species.

This mode of branching by furcation is analogous in many respects to that which proceeds from the growth of a budding-cluster.

*b.* Branches also form by a successive accumulation of buds, nearly as in the Oculinæ. The foliaceous species result from prolate growth,

new series of polyps developing successively near the margin: the same foliaceous corals often form elongating processes or stems. One or more polyps at a point in a folium begin to bud and grow prolately *upward*; and bud follows bud, until the protuberance becomes a branch. This may be seen in some foliaceous *Merulinæ*,\* and the ramose species are other examples of the same.

c. These ramose species branch, either by furcation or by lateral shoots. The latter process does not differ from that just described. In the former, the polyps at apex commence simultaneously two or more lines of buds, which lengthen out in the cumulate manner elucidated. This same principle is illustrated in many Meandrine corals. The lines of polyps, as above stated, result from a succession of buds in a single series. These lines frequently furcate or give out lateral branches; the polyp, at the extremity of a line, by originating side-buds, each commencing a separate series, produces thus the furcation. The margin of almost any Meandrina, or of the folium of a *Merulina*, affords examples of this. The process is connected with the increasing breadth of the margin, like the marginal growth and budding of an *Astræa*.

In the foliate corals, the folia are constantly subdividing or becoming lobed, on the principle explained in the latter part of § 74 a.†

80. *Relation of the Astræidæ to the recent Caryophyllidæ.* The distinction in the mode of budding, and the prominent peculiarities of their coralla, as laid down (§ 48), seem to draw a wide line of division between the *Astræidæ* and *Caryophyllidæ*. Yet, as in other departments of nature, there are in fact no such lines; gradual transitions, much to the annoyance of the systematist, link the whole together. By observing the transitions, we may distinguish more definitely where the distinctions actually lie. The *Astræas*, which commence this transition, instead of budding from near the centre of the parent, or its summit disk, give out buds exterior to the same, as in the *A. argus*. The polyps differ commonly from those of other *Astræas*, in being more prominent above the general surface, and the aggregated individuals are not coalescent so nearly to their summits. The interstices are lamello-striate as before, though hardly as prominently so. Following down the transition, we find certain species (*A. microphthalma* and *A. ocellina*) in which the polyps stand their diameter in height above the general surface. The union of the

\* Plate 15, figure 1.

† See the remarks under the genus *Pavonia*.



polyps in these is much less near the summits than in the *A. argus*; and budding, therefore, from the extending margin, approaches inferior budding in position and in character. Moreover, the striæ of the surface, which are prominent lamellæ in the dichastic *Astræas* (in which the lateral union is most complete), become almost obsolete in these species; and they have, therefore, very nearly the characters of the *Oculinæ* among the *Caryophyllidæ*. The *Echinopores* are other examples of *prominent* polyps, and *obsolescent* striæ to the coralla. The transition is thus so gradual that scarcely a line of demarcation can be laid down: and, in the *A. ocellina*, although the buds open *near* the extending margin on the upper surface, as in the *Astræas* and *Echinopore*, the cell has generally a porous connexion internally with a preceding one.

Yet, in separating the *A. argus* and allied species from the *Astræas*, and placing them with the *Caryophylliæ* and *Gemmiporæ*, as proposed by Ehrenberg, we should overlook the prominent affinities of the animals themselves as well as of their coralla; and even also the true relations indicated by the mode of budding.

In view of the above, it appears that the *Caryophyllidæ* ought to have prominent polyps, which is almost invariably the case; this is shown by their prominent calicles, except in certain species (*Astroites*), in which only the *bases* of the polyps secrete lime.

81. Among the *Cyathophyllidæ*, there is exemplified a mode of terminal budding, which should properly be classed with lateral budding, as it is not connected with a prolate growth of the upper part of the polyp, and the buds proceed actually from the lower part of the animal, although opening upward. It is illustrated in the following outline figures, made as long ago as 1749, by Fougts.\*

Fig. 40.



Fig. 41.



Fig. 42.



Although old, they illustrate sufficiently well the mode of budding to which we refer. In figure 40, each succeeding polyp seems to come from the centre or mouth of the one below, the parent yielding its

\* Linn. Amœn. Acad., i., tab. i.

existence at the developement of the young, which thus starts from it. In figure 33, three polyps proceed together from the centre of the parent; and, in 34, the new polyps sprout just exterior to the centre.

Nothing in the history of corals seems more remarkable than this strange mode of reproduction. Yet the fact, that the Tubulariæ and some Sertularidæ, drop their flowers, and renew them at intervals, as explained in § 18, appears to be quite analogous. In these Cyathophyllidæ, the parent, at the budding period, appears to lose its tentacles and disk, as in the Tubulariæ, which may disappear by the withdrawal of nutriment, needed for the new developements in progress; life remains only about the centre, and from this part, the germ rises and the young is produced, the parent surrendering its existence at the birth of its successor, or soon afterward. In the second of the above figures, three young proceed from the ashes of the parent, instead of one. The third figure shows that many germs may exist and grow out from different parts of the summit in the same course of changes. This process is closely related to the interrupted mode of increase explained in § 62.

82. From the preceding discussions, we perceive that glomerate, foliaceous, and ramose forms may occur under each mode of budding and growth. Yet glomerate zoophytes are most common among the Astræacea, and here alone they assume hemispherical or globular shapes of perfect symmetry; branching and foliaceous species are few in number in this tribe, and are distinguished by having the buds open a little below the apex, as well as by their lamello-striate surface. The Madreporacea and Caryophyllacea present occasional glomerate forms, usually of rude shape; but generally they are ramose, and often foliaceous. The branches are not lamello-striate, and the buds open at the extreme apex or margin. The Alcyonaria may produce branching coralla through their foot-secretions, and occasional segregate forms, like the Tubipores; but none are yet known which are properly massive.

Both massive, foliate, and ramose species often belong to the same genus, and in some instances, as before stated, a coral is thin foliaceous in one part, and glomerate in another, or covered with rudimentary branches.

In conclusion, the principal distinctions, as to modes of growth among zoophytes, are as follows:

1. *Acrogenous*, when polyps grow upward indefinitely, death taking place at a corresponding rate below; and the reverse, *non-acrogenous*.

2. *Aggregate*, when the polyps of a compound zoophyte are united to one another by their sides.

3. *Segregate*, when the buds are separate from the parent, except at base, each forming a distinct shoot or branch.

Aggregate corals are covered with calicles when the polyps secrete lime to their summits, but are united to one another laterally only by the lower part of the body.

In *aggregate* zoophytes, *without acrogenous* growth in the polyps, when (*a*) budding takes place in a single extending plane, more or less oblique, *explanate* forms are produced, as in the *Gemmipora* and *Echinopora*, the former by *inferior*, the latter by *superior* budding; (*b*) when budding takes place upward, in an ascending cumulate series, more or less cylindrical stems are formed, as in the *Oculinæ*, branching *Echinopores*, and also the branch-like processes on the *Merulinæ*.

In *aggregate* zoophytes, *with acrogenous* growth in the polyps, when (*c*) budding is not limited to certain polyps, nor lost by age, glomerate forms are produced, often regularly hemispherical or globular;—(*d*) when the polyps, after a certain age, lose the function of budding, and consequently this budding power is limited to a number of the younger polyps,—a budding-cluster,—ascending stems are formed, as in the cumulate process;—(*e*) when the function of budding is limited to a particular polyp (*parent-polyp*), similar ascending stems are formed.

Branching takes place by *furcation* (*f*), through the *gradual* accumulation of buds from a parent-cluster, which widens the cluster beyond its normal limits;—or (*g*), through a *periodical* development of buds in a parent-cluster at apex, widening in the same manner the extremity, and, for the same reason, leading to a subdivision;—or (*h*), where there is no proper parent-cluster, as is exemplified in the cumulate process, by a periodical budding at apex, each bud giving origin to a separate branch. The two last, are but varieties of the same process, and the first is closely allied to the second.

Branching takes place by lateral shoots (*i*), when a polyp on the side of a branch receives budding functions and becomes a parent-polyp;—or (*k*), when a cluster of polyps, on the side of a branch or stem, become gemmating.

In *segregate* species, *without acrogenous* growth, when (*l*) the buds proceed as shoots from the base of the polyps, the zoophyte forms single lines of individuals, which, by coalescence, often become reticulated, as in the *Aulopora*;—or, *with acrogenous* growth (*m*),

the polyp forms an ascending stem, either cylindrical or turbate. Branching takes place (*n*) either by lateral shoots, as in the Caryophylliæ, or (*o*) by subdivision or furcation at apex, as in the Mussæ, Euphylliæ, &c.; and the coralla of these species are, in both instances, styled *caliculato-ramose*. When (*p*) the branches are laterally in contact, as in the Columinariæ, or are united transversely at intervals, as in the Tubipores, *fasciculate* forms result.

83. We thus perceive the principal steps by which corals take on their specific forms, and see reason for the fact that these forms are constant in the same species. The many varied shapes of zoophytes,—the tree, the shrub, the clustered leaves, globes and hemispheres, clubs, twigs, and coral network,—require for their explanation only the few principles here adduced. The germ-polyp, growing upward and budding as it grows, gives rise to the various branching and nodular zoophytes, while by growth laterally, the *explanate* or oblique foliated species originate. In the upward mode of growth, when all the polyps bud equally, globes and hemispheres are produced; but if the gemmating power is retained only by the recent polyps, the zoophyte lengthens into stems and cylinders. When, in this last process, budding takes place symmetrically, the zoophyte is erect; if unsymmetrical, it is oblique or horizontal; and the zoophyte, when erect, is cylindrical or a flattened plate, according as buds form alike on all sides of a centre, or open in two opposite directions. In some acrogenous species, there is a terminal polyp,—*parent-polyp*,—from which the buds proceed; in others, a terminal *cluster of polyps*. The *former*, ramify by lateral shoots, common polyps changing to parent-polyps, and thus becoming the germs of branches, which take their direction from the position of the budding-polyp; the *latter*, branch generally by furcation at summit, the size of the terminal cluster determining the diameter of the branch, and indirectly occasioning the furcation.

In other species still, each polyp gives out its single polyp in succession, and the continued accumulation produces the rising stem, which ramifies either by the processes just mentioned, or from buds at apex, forming periodically and becoming the germs of branches.

There is much to surprise and interest us in tracing out the simple causes of results so remarkable. The small polyp, incapable even of extending its arms without a drop of water to inject them, is enabled, by means of a simple secretion in its texture, in connexion with the process of budding, to rise from the rock and spread wide its branches, or erect, with solid masonry, the coral domes, in defiance of the waves



that break over them. The microscopic germ of a *Gorgonia* develops a polyp barely visible to the naked eye, which has the power of producing a secretion from its base. The polyp buds, and finally the growing shrub is covered with branches and branchlets, many a mere thread in thickness, which stand and wave unhurt in the agitated waters. The same secretions fix it to its support, and so strongly, that even the rock comes away before the zoophyte will break from its attachment. Tens of thousands of polyps cover the branches, like so many flowers, spreading their tinted petals in the genial sunshine, and quiet seas, but withdrawing when the clouds betoken a storm.

“Excelsior” is the grave motto of the zoophyte. Ever upward, they continue growing and elongating, although death is at work below, with as rapid progress. A beautiful provision protects the branching coral-tree—often the work of ages—from being destroyed by the dissolving waters, when exposed, on the death and removal of the polyps. Certain minute incrusting corals—the *Bryozoa* and *Sertularidæ*, together with *Nullipores*—make the surface their resting-place, as soon as it is laid bare, and go on spreading and covering the dead trunk, and so prevent the wearing action of the sea. The *Madrepore* may thus continue to enlarge beyond its adult size; the *Caryophyllia* may multiply almost endlessly its cylindrical branchings, although the living animal but tips the extremities of each; for protection is given at once, when needed, and the polyps die, only to leave the surface to other forms of life, more varied and no less strange.

Finally, the coral becomes subservient to a still higher purpose than the support of polyps and nullipores. The debris, produced by the waves over a reef, settles into the many crevices among the dead trunks, and fills up the intervals, often large, between the scattered coral-patches; and, by this combined action of living growth and detritus accumulations, a solid rocky basement is formed, and kept in constant increase. In this way the coral-reef gradually nears the surface, and finally becomes the foundation of one of the fairest of

“The sea-girt isles,  
That, like to rich and various gems, inlay  
The unadorned bosom of the deep,”

the coral polyps now yielding place to the flowers and groves of the land, which fulfil their end in promoting the comfort and happiness of man.



## CHAPTER V.

### THEORY OF ZOOPHYTIC GROWTH AND REPRODUCTION, AND OF ORGANIC DEVELOPEMENT IN GENERAL.

In the preceding pages, we have dwelt upon the structure of the simple polyp, and traced out the principal steps in its germinating and gemmating processes, to the production of the various compound forms of life, which this class of animals presents. We propose to inquire into some of the relations which the several individuals in a compound mass, sustain to one another, and to illustrate the structure of these animals, and the nature of the organic forces within them.

The process of budding opens to us an illustration of the laws or principles of growth and reproduction, in actual and visible progress, and requires, therefore, our first consideration in these investigations; and since vegetation affords us parallel facts, there will be occasion in these discussions, to recur often, and at length, to the vegetable kingdom, and not so much to exhibit merely the relations of plants to zoophytes, as to elucidate, by means of the facts which both present, *the general laws of organic developement.*

84. The reader has already perceived the relation between the position of buds and the form of the zoophyte, and that in connexion with the mode of growth, they determine its character even to the size and direction of each branch, and the number and length of the branchings. The facts have shown, moreover, that there is a simple law governing the formation of buds, and a *system* in their developement. In the Madrepores, which bud from a parent-polyp,—the apical one of each branch,—new branchlets form at certain intervals; of the hundreds of polyps, on the lateral surface of the branches, only here and there one at nearly regular intervals, becomes capable of budding, and so gives origin to a branchlet: and of the budding-polyps, which are thus developed, the most of their branchlets are often short;

gemmation soon ceasing, except in certain shoots, at still longer intervals, which continue growing and lengthen out into large branches. This principle admits of some irregularity, arising from an unequal amount of nourishment, or a difference of exposure, but in general there is a remarkable uniformity. And it is due to this fact, that species have their specific characters displayed in their modes of branching; that some species spread widely, with long even branches, and others, with numerous crowded ramifications; and, moreover, the individuals of a species are alike in their general forms.

This principle determines the distance of a lateral polyp from the apex of a branch, before it can commence to bud, as well as the distance separating branches. The *Gorgonia setosa*, the subject of our illustrations, in § 74, is a beautiful exemplification of this subject, and well merits farther remark. In this species, the lateral polyps rarely bud and form branchlets nearer than six to nine inches from the apex,—eight inches is the average distance,—and, as there are about eighty polyps on the lateral surface to an inch in length, it follows, that generally more than six hundred polyps are situated above the first branchlet. And, moreover, as the branchlets are about a third of an inch apart on each side, polyps enough are added, by budding, to lengthen the apex correspondingly before another side-polyp buds, and another branchlet starts.

What is here indicated, but that the process of budding exerts an inductive influence for some distance from the centre of action,—that there is a concentration of nutriment and of forces required, measured by the interval between the budding centres? In the *Gorgonia*, just alluded to, some hundreds of polyps are thus, in one sense, tributary to the budding polyps at the extremity; for, until the budding apex has grown beyond to a certain distance, one of the side-polyps, though ready to bud, cannot summon gemmating force enough to develop buds; but when the former is so far removed, that the required nutriment and vital force are supplied, then the excess, which goes on increasing, concentrates upon one of the side-polyps below. The lateral polyp, which becomes a new centre of gemmation, is a certain distance above the preceding branchlet, owing to the fact, that this branchlet exerts its influence for a short distance around itself, though already considerably elongated. The same principle is illustrated even in the irregularities or apparent exceptions. When side branches form low on the stem, the intervals are often much larger than above stated, owing to the less amount of nutriment

which these half-covered polyps receive; while at the extremity, in the purer waters, with a large supply of nutriment and more active vitality, the intervals are short.

This principle is not limited to zoophytes: there is evidence that it prevails throughout the animal kingdom; and most decidedly and beautifully is it exhibited in the vegetable kingdom.

85. In the vegetable kingdom, we have, in general, compound individuals, analogous to those among zoophytes. The plant commences with a single bud—a simple individual rises from the ground, the germ of the tree which is in time developed. This parent-individual enlarges and lengthens, and, after a while, buds shoot out from its sides, which become new lateral individuals. Some of these lateral buds, as the stem lengthens, begin themselves to bud and form branchlets, and, at still longer intervals, now and then one continues budding and growing, till a large branch is formed. There is thus a perfect parallelism with the mode of growth in the zoophyte; the same law, with regard to *interval*, holds, and the same general principle with reference to a *gemmating influence*. The terminal bud is analogous to the apical polyp, and the lateral buds to the lateral polyps; moreover, the branchlets and branches are formed by the continued gemmation of certain of the lateral buds, the particular bud, which becomes a parent-individual, depending, in each case, on its distance from other parent-individuals; for, only within such certain distances, is sufficient vital force and nutriment concentrated on any centre or budding point.\*

The distinction in plants of *budding* and *ova-bearing* individuals, should be here remembered, as it leads us to still closer analogies between plants and zoophytes. The former produce leaves, and lengthen out the extremity of the branch, as the summit polyp of the growing Madrepore or Oculina. The latter take the form of a flower, and develop ovules or seeds.

It is altogether probable that buds alone proceed from the budding polyps at the extremity of a branch in zoophytes. It is definitely stated, by Milne Edwards, with regard to an Alcyonium (§ 54), that the side of a polyp, which gave out buds, produced no ovules; and, as all sides of an apical or parent-polyp in a Madrepore

\* The other modes of branching among zoophytes are illustrated among plants; but it is sufficient for our present purpose to refer particularly to the above. Branching, by periodical budding at apex (§ 82, *h*), is exemplified in some species, and the same principle, depending on intervals, holds, as has been explained.





bud alike, though successively, there are certainly strong reasons for admitting the above supposition. In the Sertularia tribe of zoophytes, the analogy is perfect; for, it is well known that buds and ovules are never simultaneously produced by an individual polyp. Budding lengthens the branches, and vesicles of ovules proceed like a cluster of flowers from the side of some polyp on the branch, that long before had ceased to bud.

86. We may glance here at a few interesting relations between the structure of a *flower* and of an *Actinia*, which, although not essential to the subject before us, may suggest some deductions in illustration of each. The flower or plant individual, has, in general, its radiate series of sepals and petals,—one or both,—for the elaboration of the parts within: so has the polyp its star or coronet of tentacles, which often contribute to the aeration of the nutrient fluids. The flower contains, in other internal series, stamens and pistils (spermatic and ovarian organs), concentric with the sepals and petals: the Actinoid polyp includes within, corresponding series of organs around the centre, part of which are ovarian, and part spermatic, and these organs have some relation in number to the number of tentacles. The clusters of ovules, which form from the ovarian lamellæ, have, therefore a very similar situation in the polyp to the ovules or seeds of a common flower; the circular series of ovarian lamellæ corresponding to the circular series of carpels or the placenta within, and the ovules they form to the seed produced within the carpels. The coincidences are as near as are consistent with the different modes of nutrition in the two kingdoms of nature, and they may be received as sufficient evidence, if such were needed, that the flower is a simple plant-individual.

Between the budding individuals in plants and the budding Actinoid polyp, there seems to be a less perfect resemblance; for the budding polyps in these zoophytes are similar to the oviparous polyps in external form and in the number and character of their tentacles. Yet, as it has been shown by physiologists, that the green leaves of the leaf-bud and the petals of the flower, are nearly identical organs in origin and structure,—the latter being only a variety of the former,—the discrepancy is more apparent than real. The parts of a flower, though seemingly in circles, have a spiral arrangement, as well as the leaves of the leaf-bud; and the difference in general form arises from the fact that the leaf-spire is long drawn out, owing to the continued and rapid elongation of the bud, while in the flower, the

spires are extremely short, great concentration being required for the new developements which are to take place. The spiral arrangement, observed in the vegetable kingdom, has not been detected in the tentacles of an Actinia. Yet as this arrangement is due merely to developements taking place successively from the different sides or reproductive points of an individual, in regular order, it is altogether probable that something similar to it may yet be made out. Reproduction is an exhausting process, and on this account it does not take place twice successively from the same side.\*

In the developement of polyps in the Oculina, a spiral arrangement is apparent (§ 67); but, as the number of budding points in these polyps is twenty-four, and only five in very many plants, as great a regularity cannot be expected in the former as in the latter; for the intervals between the budding points are so small, that slight causes, especially a freer exposure to the external waters from being less crowded by the polyps in one part than another, will affect the position of the point from which the next bud proceeds.†

\* Since this work was put to press, the author has found that Agassiz describes the plates of the Echini, as developed in a spiral order. See Agassiz on the Echinodermata.

† From the above analogies, it would seem that the *gemmating* individuals in plants, as well as the *oviparous*, consist of several leaves combined, and, therefore, that we cannot properly speak of each leaf as a complete individual in itself. Yet the conclusions we would deduce, follow equally well whichever view be adopted. A few other analogies between the plant and zoophyte may be noticed here, on account of their bearing upon the point just discussed.

The developement of flowers exhausts the energies of a plant, sometimes so far as to lead to immediate decline and death. There is a species of palm, which flowers, and soon after dies.<sup>a</sup> The Century Plant is another remarkable example.<sup>b</sup> Have we not an analogous fact in the strange mode of reproduction in certain Cyathophyllidæ, represented in the figures, to § 81? The parent, in this case, surrenders its existence soon after the developement of a young bud, which, when completed, actually stands upon the dead remains of its progenitor, preparing to make the same self-sacrifice. A still more perfect analogy to this process is found in the growth of the Colchicum and some allied plants, in which the root of one year dies as it develops the bud of the next. And the general process of growing and dying, in corresponding progress (§ 62), has frequent illustrations in the vegetable kingdom; for instances of which, we may refer to the Botanical Text-book, by Dr. A. Gray,<sup>c</sup> or other Treatises on Vegetable Physiology. In

<sup>a</sup> The Corypha or Talipot tree. Gray's Botanical Text-book, 2d edit., New York, 1845, p. 165.

<sup>b</sup> Ibid., p. 168.

<sup>c</sup> See Botanical Text-book, p. 63, § 86. "The Solomon's Seal and Diphylla offer simple illustrations. They make an annual growth by the developement of a bud, which, rising into the air, forms the flowering stalk of the season; this falls away in autumn, leaving a broad sear, and meanwhile a new bud is

87. We pursue the subject by looking more minutely into the elements engaged in the process of budding, to ascertain how the principles drawn from the visible bud or polyp bear upon the internal structure of the same. Plants afford us examples that illustrate the facts in both kingdoms of nature. Growth, in its simplest condition in plants, takes place by the budding of minute cellules, each in succession from a preceding; and although vascular tissue and woody fibre are added to the higher species, to give strength, yet, in all

the interrupted surface of other Cyathophyllidæ (§ 62), a similar effect appears to be indicated, but dependent probably upon the development of ovules rather than buds, (and the preceding case may possibly be the same), the narrowing of the polyp being consequent, as Ehrenberg suggests, on reproduction. This exhaustion is a well-known fact in the animal kingdom; the peculiarity in the case in question, is only in the mode of exhibiting it, and the extent to which it is carried. There is an analogy in the polyps of certain zoophytes, dropping off and reappearing at intervals (§ 18), to the fall of the flowers and leaves of a plant. Moreover, some species (Sertularidæ) lose, from age, their lower branches like vegetation, the trunk or stem, as in the vegetable kingdom, still remaining alive. Buds often spring from a wound in a plant in greater numbers than elsewhere; and the Hydra affords an example of the same fact among polyps.

The growth of palms has some resemblance to increase, among zoophytes, from a terminal cluster; while budding from a parent-polyp, and the consequent lateral branching, produces forms more like those of our common trees. In the former, the buds proceed from the summit alone, and produce a lengthening cylinder, whose size depends on the size of the cluster; and, as the polyps lose the power of budding, they are turned out from the summit cluster to join those of the lateral surface, just like the bases of the falling leaves in the palm. This mode of increase, is still more like that in the *Lycopodium*; for, in this genus, there is no internal growth, as there is in the palms: it is simply *acrogenous*, like the elongating coral stem.

The explanate corals appear to be represented in the incrusting or foliaceous lichen, and the massive hemispheres and globes in the globular Cacti; and not only in external form, but in actual constitution, for the Cactus consists of an aggregation of plant-individuals, as the *Astræa* is composed of individual polyps united.

Farther, we state that the modes of reproduction are as varied in the zoophyte as in the plant. As we may obtain a perfect plant from a section, which includes, with a leaf, its budding axil, so we may cut up a polyp, and, almost to the same extent, form perfect individuals from sections: and, as the leaf will sometimes grow without the axil, so in the rare instance of the Hydra, the tentacle alone is said to develop a complete individual.

Moreover, the mode of aeration, in many species, by the general surface, instead of by special organs, affords another striking analogy to the vegetable kingdom.

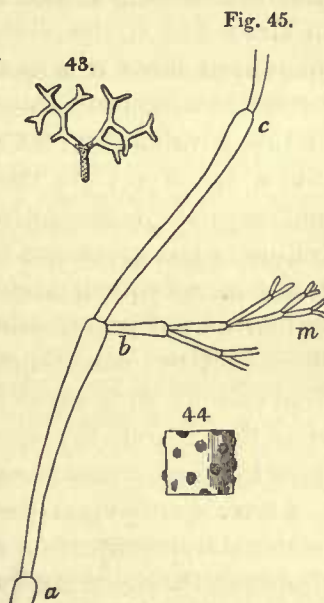
produced at apex, to form the stalk of the next season, and so on. In this manner, the rhizoma slowly moves onward, from year to year, the scars marking the annual growth, and the *more ancient portions gradually decaying, as new parts are formed at the other extremity.*"

instances, the budding leaf-bud or flower proceeds from some one or more of these cellules, which develop new powers of secretion within themselves. These gemmating cellules go on developing new cellules in lines, which frequently subdivide, until, in connexion with the other attending conditions of growth, the bud forms and develops, and the branch commences.

88. The principal steps in the process, are exemplified in the annexed figures. Figure 43, is a branch of the natural size, of one of the coralline Algæ, taken from a clump, an inch and a half high, and three or four inches through.\* The lower part is covered with minute dots about  $\frac{1}{100}$  of an inch in diameter, which are magnified in figure 44. Figure 45 represents one of the longitudinal vessels of the interior, magnified one hundred and fifty diameters, consisting of oblong cellules, *a b*, *b c*. These cellules are  $\frac{1}{100}$ — $\frac{1}{150}$  of an inch long. From the summit of one (at *b*), a cellule proceeds laterally, which gives out two smaller cellules, and these two others, and so on, and the last connect with the sporules (not here figured), which constitute the surface dots alluded to: about five hundred sporules being clustered in a single one of these dots. These sporules are each about  $\frac{1}{2000}$  of an inch long. Thus we trace out the beginning of the germinant process in the first cell which takes its outward course, and follow the progress of developement, till prepared to form sporules at the extremity.

With reference to the germinant process, in this case, it should be remarked first, that it is not apparent within a third to half an inch from the extremity of a branch, for sporules are formed only below this distance: above this, the necessary nutriment is drawn off by the growing summits, the younger parts of the coralline; as in the zoophyte, germination does not take place, except where the parts are beyond the influence of the reproductive force at the budding apex. As the alga lengthens above, the sporidia form below successively, at nearly equal distances, in analogy with the branching of zoophytes.

\* I have illustrated this point from dissections of a species of *Liagora* (*L. rubriceps*, D.), obtained in the Feejees.



89. In the process of germination, above illustrated, a cellule forms laterally from the apex of a longitudinal cellule (*b*, figure 45). This new germ-cellule enlarges, until that reproductive agency, whose over-accumulation started its existence, has attained its maximum in the new cellule; and, going on to accumulate from the vital action within, new cellules bud out from that now formed: and so cellules bud from one another, two from each preceding, till they are prepared to form the sporules at the extremity. The cellules decrease in size; and if the view just expressed is correct,—that the same amount of force causes the successive buddings,—the process in the formation of sporules consists, in part, in the successive condensation of the germinating material of the future sporule, until it is collected into a space not  $\frac{1}{10}$  the size of the ordinary cellules in the plant, and a gradual concentration of its germinant powers. The final cellule at last gives rise to one or more sporules: apparently the mere result of continued budding, and a farther elaboration and concentration of the germinating product. Some facts, however, seem to show that the consummating change may consist in the union of a final cellule, with some other which is antheridial in its nature; and after this union, the sporules bud out from the combined cellule, or form by mere spontaneous fission of the same.\*

I have dwelt upon this example, not because there is any novelty in this developement of successive cellules, but from its affording so simple and apposite an illustration of the germinant process. The same, in the opinion of the best physiologists, is the general mode of developement in other plants, except that anthers intervene to afford material to aid in the final elaborations. And in animals, the process of growth by cellules, and the modes of developement, are quite analogous.

90. The germinating process may be illustrated by a few more comparisons between plants and zoophytes. The *Aulopora* has been described (§ 65) as sending out slender creeping shoots at base, which, after reaching to a certain length, develop a polyp, from

\* The character of the sporules and their position, as observed, are shown on the last plate of the Atlas: figure 1*a*, the *Liagora rubriceps* natural size; *b*, a branch magnified with the sporidia below; *c*, sporidia magnified one hundred and fifty diameters; *d*, part of transverse section of stem, showing the internal cellules cut across and partly disarranged; *e*, *e'*, longitudinal cellules magnified one hundred and fifty diameters; *f*, longitudinal cellules, with the lateral branch of cellules, and the sporules at apex; *g*, one of the sporules magnified four hundred diameters.

which, when adult, similar shoots proceed. Compare this with the strawberry and its creeper, which, in like manner, after growing to a certain length, develops a bud of leaves,—the plant-individual,—again to send out other creepers, and form, at intervals, other leaves. Here we see that the bud acquires a certain length before it is finally perfected; the line of cellules, with which the forming bud began, was gradually acquiring the requisite elaborations, and concentration within, to develop the new individual. And after the distance is reached, the process is still gradual in both cases. The polyp rises first as a small protuberance, which gradually lengthens into its tubular cylindrical base, and finally the polyp-flower is formed at apex. Very similar, as is well known, is the fact with the strawberry.\*

91. The production of a branch in zoophytes, at a single budding process (§ 70), is another of those singular facts, which appear to find their analogies rather among vegetables than animals; and we see it exhibited on a large scale in the thyrses of lilac blossoms. The general principles of the process are shown in the figures of the Alga, on page 91. The budding cellules, from *b* to *m*, if viewed as separated from the coralline, form together a similarly ramose branch: and if, instead of each cellule, there were elongated series, and the whole, with accompanying tissues and fibres, formed a prominent ramose branch, instead of being embedded, as in the coralline, we should have a clump of flowers like the lilac blossom: or, if still partly embedded, the cluster would resemble that of the Alcyonium. This subdivision of the flower stems in the lilac, takes place at nearly regular intervals, and these intervals decrease towards the flowers, as in the cellules of the Alga. The process appears to be similar, except, that instead of one cellule, we have a series of them before subdivision, precisely as we have a series in the

\* There is little doubt that were the cases equally well brought out to view in all the steps, we should find as much reason to say that the ovarian lamellæ of the polyp are altered tentacles, as that the seed-vessels and petals of a flower are altered leaves. The same kind of cellules, under different circumstances, originate both. Excessive nourishment is known to cause the production of leaf-buds in place of flowers, and also to make a petal from a stamen; and for the reason, as has been explained, that the latter, in each instance, differs from the other only in requiring, for the production of its few peculiar characters, a slower and more quiet and concentrated action of the forces at work, while the former may result from a less delicate process of vital chemistry. Only under circumstances in the utmost degree favourable, will certain chemical compositions take place, and here, in like manner,—for the difference is in the resulting combinations,—the forces must be nicely balanced and not of too rapid application.

Aulopora and strawberry-creepers, before the final development of the complete individual. This budding of cellules, moreover, is closely analogous to the budding of polyps and branches in the zoophyte.

92. The ovarian vesicles, which pullulate from the sides of a branching Sertularia (§ 14), contain the ovules arranged on the same general plan as the polyps of a branch formed by the process of budding, though much contracted. They communicate internally with an axis, branching from the trunk of the zoophyte, just as the several polyps of a branchlet communicate internally with its tubular axis. There is the same condition of things in this case as in the last-mentioned,—the same process of branch development:—and all cases of the production of numerous ova in animals, appear to be analogous. The fact, that the kind of ramification is similar to that of the zoophyte, as a whole, is not peculiar; for the same is true of the lilac thyrse: and generally among plants, the mode of branching in the flower clump, is but a miniature representation of that which characterizes the whole plant.\*

\* Professor E. Forbes has drawn a comparison between the vesicle of a Sertularia and a flower, in which he compares each ovule of the vesicle to the carpels or parts generally of the flower-bud (§ 14). The analogy, as exhibited by this distinguished physiologist, is highly interesting, and was the result of much minute research. But, while admitting the correctness of the analogy, in a certain light, we may doubt if the comparison gives us a correct idea of the actual nature of these vesicles. In the Actinia, with its circle of tentacles, and its inner series of ovaries and spermatocysts, we appear to have the true analogue of the flower, as perfect as can be presented by animal life. And in the vesicle of the Sertularia, we see the analogue simply of one of the clusters of ovules in an Actinia. These clusters project into the interior cavity in the Actinia, as the animal has ovarian lamellæ there, but become external in the Sertularia; in other respects, the cases are wholly identical. It is, therefore, more in accordance with the developments in other zoophytes, to consider the vesicle as the analogue of a cluster of flower-buds; and we may, with much justice, compare it to the branching clump of flowers proceeding from a single budding-point,—the axil of a single leaf. Professor Forbes's comparison holds only on the ground of the general analogy which subsists between all reproductions; the same principle presiding over the origin of a flower, or a leaf, or the cellules that give origin to the leaf. The cluster of seed attached to a placenta, of ovules to an ovarian lamella, the external vesicle of a Sertularia, and a compound flower-bud, are therefore proper analogues.

The observations afford exemplifications of the fact, that each ovule is connected in origin with the production of a certain part of the general ovarian envelope; and this is as true of the internal clusters of an Actinia, as the external of a Sertularia. In the latter, the fact becomes apparent, through the horny secretions of the exterior, which conform to certain principles, exhibited in the production of a calicle.

It is a just conclusion, therefore, that while the polyp, by its form, and its mode and direction of growth, and mode of budding, determines the general form of the zoophyte; or, the bud, that of the plant,—the cellule, by its form, mode, and direction of growth and mode of reproduction, determines the general form of both flower-bud and polyp, plant and zoophyte.

93. The analogy between plants and zoophytes is, therefore, not one calculated to embarrass us by suggesting false affinities. On the contrary, the two orders afford interesting and important illustrations of the organic processes in each. We may say farther, that the modes of developement throughout the animal kingdom are here elucidated, and, also, with no less truth, that the principles which flow from these facts, bear upon all the elaborations in organic beings.

The tentacles of an Actinia, as also the lamellæ, which correspond, are often but eight or ten in number in the young when first developed; but afterwards, as the Actinia grows, and the interval between two lamellæ increases beyond the normal breadth (for the species), a new lamella begins to form; and so other lamellæ, in succession, appear. Here the same law depending on breadth of interval holds, as in the developement of branches on a tree or a zoophyte. As these intervals widen by growth, there is unappropriated nutriment and vital force, and these acting upon the cellules intermediate commence the formation of a lamella. So, also, this principle, which determines the scattered character of the leaves on a tree, or of processes or branchlets over a coral branch, determines the closer or more scattered distribution of the hairs on a leaf or an animal. A certain space around the reproductive point, is tributary to each hair, and the size of this space is determined by the distance to which the reproductive centre can exert an influence. This space is measured by the intervals between adjacent hairs. But let this interval enlarge, by the growth of the part, beyond this amount, and immediately there is an excess of force and nutriment, which commences the formation of a new hair. We might add illustrations, but this will suffice. Reproduction proceeds on the same principles, whether a hair or an animal is the result. The same is admitted with respect to the developement of germinating functions in animals; for it is a recognised fact, that while the growth of the body is in progress, the vital forces and nutrition are dispersed in every direction; but, on reaching the limits of growth,—that is, the limit in radiate extent, to which the peculiar structure of the animal is



able to carry on the reproductive processes of growth,—the vital forces and nutriment become directed within, and the new function of germination is developed. The whole animal and vegetable kingdoms contain throughout illustrations of this principle.

94. We have thus prepared the way for the following law, which holds equally, whether the germ-cellule be that of an organ of an animal or plant, or that from which a living being itself proceeds:—*The developement of a germ, from a cellule or cluster of cellules, requires the concentration of a specific amount of vital force, and a certain tributary space where this force exists; proper nutrition being afforded, reproduction necessarily takes place; and, when existing reproductive centres cannot appropriate all the reproductive force and nutriment, new reproductions commence.\**

\* The existence of vital force as a cause has been of late doubted, and its supposed effects attributed to mere chemical forces. This is not the place for a display of argument upon this subject: neither does the point seem to require it. The single fact, often urged, that inorganic matter takes on *angular* forms, and organic *rounded*, seems to decide the question. The perfect individual in the former, has plain faces of fixed angular dimensions, and proceeds from attractions in straight lines, having fixed mathematical relations. Solidification is in fact only the union of particles by these axes, which are assumed generally at the time the change of condition commences. Crystallization and solidification are, therefore, one and the same process; for the particles of a solid are always possessed of this crystalline attraction, although they may constitute together an amorphous mass. Even those so-called *organic* substances, which the chemist claims to have made, still show the same powers of crystallization on becoming solid.

But in the tissues of plants and animals, there are no planes or solid angles, except such as may result from pressure. Where, indeed, is there the slightest analogy to a crystal in an oblong cellule filled with fluids? And in the budding of cellules from one another, and the formation of linear series, what resemblance to a solid filament of crystals? Crystals or crystalline masses are secreted by organic life; but these proceed from, and never take the place of, living cellules. There must, therefore, be some controlling influence, which prevents the particles from uniting into crystal shapes, and moulds them into growing cellules,—some power which makes the curving outline as characteristic of the organic kingdom, as straight lines and fixed angles of the crystal kingdom. This power or influence is called vitality. By it, the constituent molecules of a germ are themselves controlled, and are enabled also to bring other molecules into the same living state.

The functions of a germ, however, are not simply its vitality; chemical attractions are a principal source of the various compositions and decompositions in progress; and all those causes that influence chemical combinations, such as light, heat, and electricity, and the various laws under which such combinations take place, are here in action. Chemical *inertia* plays an important part in continuing processes which have been begun. It is possible that some compounds are formed, which chemistry, without vitality, would

95. The applications of the law laid down, seem to extend even to determining the number of germs which may proceed from different animals, and afford some data for ascertaining the amount of germi-  
nant force in each. We observe that the centres of reproduction are more numerous as the nervous system is smaller or less concentrated. The production of hair from the epidermis illustrates this fact; but a small portion of force and nutrition is brought to bear upon any one point, and these points are often exceedingly near, although varying according to the amount of vital force and nutrition. In the lowest animals, consisting of cellular tissue mostly, a concentrated nervous

not effect, and this is generally admitted; and, if so, vitality must be considered one of the causes influencing chemical combinations.

But it may be a question whether this vital influence admits of accumulation in an organized structure, as electricity, for example, may be accumulated under certain circumstances, in a properly constructed machine:—whether we may speak of vital *force*, as in the case supposed, of electrical force;—and whether the former, by accumulation, effects changes in a manner corresponding to what the latter is known to do. Although analogy is a dangerous basis for argument, yet we may venture an affirmative reply to the above queries. In animals, nerves convey and serve to concentrate the vital force, and the levers of the organic structure are thus, through the muscles, put in action. In late investigations by Matteucci, the force of electricity, applied as a moving power to the muscles of limbs, has been calculated; and why not, in like manner, estimate the force of vitality? The same distinguished investigator has ascertained, by direct experiment, that no electric currents circulate along the nervous cords of living animals.\* Admitting that this accumulation of vital force is possible, we may understand why certain chemical combinations take place only in more advanced states of an organic structure, when its organization is more complete. Its concentration may be required for other purposes than muscular action, and, if any where, would be especially so in the function of reproduction.

In the discussions in this chapter, the principle here urged, with regard to vital force, has been assumed, as seemingly most consonant with the various operations to be explained; it has appeared more satisfactory, than to refer the developements or changes simply to the abundance or absence of proper nutriment, as is done by many physiologists. If the latter proves still to be a true and complete statement of the case in living beings, or if the force in action is some other known power, the principles adduced in the preceding and following pages will no less stand, although some modification may be required of the mode of expressing them. The whole subject is beset with difficulties, and it certainly becomes one venturing upon it to move with caution. This chapter will hardly be perused by a reader more ready to doubt the views presented, than the author, when its first lines were written. The results have gradually forced themselves upon his mind from the developement of the various facts, which the study of the structure and growth of zoophytes gradually opened to view.

\* See Electrical Magazine, 1845, 490, 495, 497.

system cannot exist, but if muscular fibre be added, the nervous may receive its different degrees of developement.

There is abundant reason, therefore, in their constitution, for the larger number of ovules in the inferior animals; for, from their nature, they can concentrate only a small amount of reproductive force on any centre; and, as the cellular tissue produces myriads of hairs, so animals of this composition may produce immense numbers of small ovules. Add muscular and nervous tissue, and the animal system may concentrate a much larger amount of force and nutriment, proceeding from a wider sphere of action.

As the species among the inferior grades diminish in size, there is also a consequent decrease—the general constitution being the same—in the number of germs they produce; and, in the simple monad, we appear to have a single isolated sphere of reproduction, producing its single germ: the texture is mostly cellular tissue, and the size must be just that required to give vital force enough for a single germ; for when this animal enlarges, by nutriment received, so as to exceed its normal size, there is a tendency at once to form two centres; and, as enlargement goes on, subdivision actually takes place, and two animals are formed of the one. The enlarged size produces more vital force than can belong to a single animal so constituted.\* In larger animals, of similar constitution with the monad, the number of ovules produced is very large, for the reason, that the animal can concentrate on any single cellule only a small amount of vital force, and, as there is a large amount present, the germs must be numerous. As we ascend in the scale of being, the number of young diminishes.

In the higher species, where a large nervous system is to result from the germinant cellule, the force required is greater than when this cellule is the germ of an inferior species, with an imperfect nervous system. The physical structure of the animal must therefore be larger to produce the vital power needed for the elaborations that originate the germinant cellule of an animal of the higher grades. Size is, therefore, an important element in the system of organic life.

96. Although the question is complicated by many circumstances

\* The relation between the number of germs and *size* is still farther illustrated by the visceral lamellæ in different species of *Astræas*, as exhibited in the closing paragraph of § 43 *b*.

in action influencing the amount of vital force produced by the individual and its concentrating energies, which cannot be estimated; yet there is reason to conclude, that, for the production of a single germ, there is required a determinate amount of force, characteristic of each species, which is equivalent to that which the animal can bring to bear upon a single germinant cellule. This amount being fixed, may be one element at the basis of species, of specific characters and specific distinctions. It aids in producing the elaborated cellule or cellules, which, with the envelopes (constituting thus an ovum or ovule), give origin to the young individual. It is possible that some mode of designating this force may yet be ascertained.

97. In view of these considerations, we are led to conclude that the law of developement laid down, determines not only the intervals between the polyps, branchlets, and branches of zoophytes, or the leaves and ramifications of trees, but presides over the whole animal and vegetable economy, limiting the number of reproductive centres, and the extent of their sphere of influence, equally in the formation of ordinary cellules, or the production of germs or individual animals.

It appears farther that a cellule—the germ of a species—has certain powers distinct from, though perhaps connected with, their powers of secretion; and these are different for different species. They are—1. A *specific budding force*, which fixes the size and frequency of buds, each cellule enlarging, till this force has reached its maximum, and then budding from the excess afterwards accumulating. 2. A *specific number of budding points*, which determines the number and relative position of the cellules that may bud from a preceding cellule. 3. A *specific budding angle*, which fixes the angular divergence that a budding cellule may make with a preceding. These powers are wholly independent of any thing like catalysis, or any known chemical forces, and there is no reason to believe that any but creative energy can change them.

98. From the facts brought forward, it is obvious that although zoophytes are so much like plants in their forms and flowers that we might almost fancy them to have been modelled after the trees and shrubbery of the land; although as simple in their system of aeration, and similar in the position of their reproductive organs, and in the character of the budding process; yet the two classes of objects have nothing essential in common, except in those points, which depend upon the general principles of organic life, and in which all animals are equally allied to plants. The nature of their tissues and their



mode of developement,—the character of their food, it consisting of organized and not unorganized matter—the peculiarities of the process of digestion and the ejection of excrementitious matter—the influence exerted on the atmosphere by the aeration of the circulating fluid—as well as their voluntary motions, remove zoophytes far from the vegetable kingdom. The fact of an imperfect nervous system, explains the apparent resemblances. The simplicity of their internal organization is due to this ; and it also accounts for the great number of possible organic centres in a polyp, each exerting an influence around only to a very limited extent, capable of budding out a young animal, either while connected with other parts of a polyp, or when separated as an artificial section. It is even probable that the radiate form, characteristic of the lower orders of animals, and also of a great part of the vegetable kingdom, is due to the simple laws of organic developement, which, in these cases, are either uncontrolled by other directing forces that act through the developing nervous system, or are so controlled only to a very limited degree.\*

\* See farther, the note to § 108.

## CHAPTER VI.

### GENERAL REMARKS ON THE GEOGRAPHICAL DISTRIBUTION OF ZOOPHYTES.

99. HEAT, light, pressure, and means of subsistence, influence more or less the distribution of all animals; and to these causes should be added, for water species, the nature or condition of the water, whether fresh or marine, pure or impure, still or agitated. Next to the character of the water, heat is the most prominent limiting agent for marine animals, especially as regards latitudinal extent, while light and hydraulic pressure have much influence in determining their limits in depth.

Although these causes fix bounds to species and families, they do not necessarily confine tribes of species to as small limits. This is sometimes the case, and is nearly so with a large group of zoophytes; yet other tribes and orders include species whose united range comprises all the zones, from the equator to the polar ices, and every depth, to the lowest affording traces of life which man has explored.

#### *Order Hydroidea.*

100. The Hydroidea are met with in all seas and at great depths, as well as at the surface. The tropics, and the cold waters of the frigid zone, have their peculiar species, and a few are found in fresh waters. The rocks and common marine plants of the sea-coast, the dead or living shell, or the floating Fucus of the ocean, are often covered with these feathery corals; and, about reefs, they occasionally implant themselves upon the dead zoophyte, forming a mossy covering, taking the place of the faded coral blossom.

The species are most abundant, however, in the waters of the

temperate zone, and are common upon some portions of our own coast.

*Order Actinoidea.*

101. The Actinoidea are marine zoophytes. All oceans have their species, yet in the torrid zone they more especially abound, and display most variedly their colours and singular forms.

The soft Actinidæ and the Alcyonaria have the widest range, occurring both among the coral reefs of the equatorial regions, and, to the north and south, beyond the temperate zone. The Mediterranean affords species of *Gorgonia*, *Corallium*, and *Alcyonium*, besides numerous Actiniæ. The coasts of Britain have also their *Alcyonia* and *Actinias*, and from far in the northern seas, come the *Umbellularia*, and some other species of the *Pennatula* family.

Among the coral-making Actinaria, the *Madrepore* and *Astræa* tribes are almost exclusively confined to the coral-reef seas,—a region included between the parallels of 28° north and south of the equator, —while the *Caryophyllia* family are spread as widely as the species of *Actinia*. Several species of *Caryophyllidæ* occur in the Mediterranean, and others in the high northern seas, and they are met with at depths of several hundred feet. They are also common among the coral-reefs of the tropics.

The *Madreporacea* and *Astræacea*, with the *Gemmiporidæ*, are the principal constituents of coral reefs. The temperature limiting their geographical range is about 68° F., this being the winter temperature of the ocean on the outskirts of the reef-growing seas. The waters sometimes sink to 66° or even 64°, but this appears to be a temperature which they can endure, and not that in which they germinate. The extremes which they will survive prove only their powers of endurance, and do not affect the above statement; for their geographical distribution will be determined by the temperature which limits their powers of germination.

The temperature in the warmest parts of the Pacific varies from 80° to 85°, and here *Astræas*, *Meandrinæ*, *Madrepores*, &c., are developed with peculiar luxuriance, along with thousands of other strange and beautiful forms of tropic life. From the above temperature to 72°, does not appear to be too great a range for the most fastidious species. At the Sandwich Islands, which are near the northern limits of the coral seas, *Porites* and *Pocilloporæ* prevail, and there are very few species of the genera *Astræa*, *Mussa*, and *Meandrina*, which are common nearer the equator.



102. The range of these reef-forming corals in depth is singularly small. Twenty or perhaps *sixteen* fathoms will include very nearly all the species of the Madrepora and *Astræa* tribes.\* Temperature has little or no influence in occasioning this limit, as 68° F. will not be found under the equator short of a depth of one hundred fathoms. Light and pressure, the latter affecting the amount of air for aeration, are probably the principal causes. The waves, moreover, not reaching, when most powerful, to a greater depth than fifteen or twenty fathoms, cannot aid in renewing the expended air below, as they do at the surface.

In recapitulation we state that the *Astræacea*, *Madreporacea*, and the *Gemmiporidae* among the *Caryophyllacea*, are, with few exceptions, confined to the coral-reef seas,† and to within twenty fathoms of the surface. The *Caryophyllidæ* extend from the equator to the frigid zone, and some species occur at a depth of two hundred fathoms or more. The *Alcyonaria* have an equally wide range with the *Caryophyllidæ*, and probably reach still farther towards the poles. The *Hydroidea* range from the equator to the polar regions, but are most abundant in the waters of the temperate zone.

103. Besides the above-mentioned limiting causes, there are others of importance, one of which only may be alluded to in this place, the remaining belonging more properly to the Geological Report on Coral Reefs and Islands. The cause referred to, is that proceeding from original sites or centres of distribution. There is sufficient evidence that such centres of distribution, as regards zoophytes, are to be recognised. The species of corals in the West Indies are, in many respects, peculiar, and not one can with certainty be identified with any of the East Indies. The central parts of the Pacific Ocean appear to be almost as peculiar in the corals they afford. But few from the Feejees have been found to be identical with those of the Indian Ocean. A more complete acquaintance with the corals of these different seas may multiply the number of identical species; but observations, thus far made, seem sufficient to establish as a fact that a large part of zoophytes are confined to a small longitudinal range. This will be seen from the following table, exhibiting, in a general manner, as far as known, their geographical distribution. Each column gives the number *peculiar* to the region specified at top.

\* The evidences on this point will be presented in the Report on Coral Islands.

† The exceptions belong mostly to the genus *Euphyllia*.



	East Indies, Indian Ocean, or Red Sea.	Pacific Ocean.	West Indies.	Pacific and the East Indies, or Indian Ocean.	Extra-tropical.	Doubtful.	Total.
TRIBE ASTREACEA.							
Fam. Astræidæ, . . . .	37	50	29	4	3	16	139
Fungidæ, . . . .	14	29	6	6	0	10	65
TRIBE CARYOPHYLLACEA.							
Fam. Caryophyllidæ, . .	13	7	9	2	13	5	49
Gemmiporidæ, . .	4	5	1?	2	0	2	14
TRIBE MADREPORACEA.							
Fam. Madreporidæ, . . .	30	42	4	8	1?	7	92
Favositidæ, . . . .	14	15	5	3	0	4	41
Poritidæ, . . . .	5	14	6	2	0	1	28
	117	162	60	27	17	45	428

From this table, it appears that only twenty-seven species out of three hundred and six are known to be common to the East Indies and Pacific Ocean. With regard to those common to the East and West Indies, for which no column is assigned, there is but one,—the *Meandrina labyrinthica*,—about which much doubt remains.

104. We have no authority for accrediting to the West Indies any species of the genera *Fungia*, *Pavonia*, *Herpetolithus*, *Merulina*, *Monticularia*, *Gemmipora*, *Anthophyllum*, *Pocillopora*, *Sideropora*, or *Seriatopora*, all of which are common in the opposite hemisphere. The *Agariciæ*, with the exception of a single osculant species, are confined to the sub-genus *Mycedia*, exclusively West Indian, which contains very firm compact corals, with an *Astræa*-like character. The Millepores are the only known *Favositidæ*, and but half a dozen Madreporæ have yet been distinguished. The *Manicinæ*, *Caryophylliæ*, and *Oculinæ*, are more numerous in the West Indies than elsewhere, and the *Ctenophylliæ* (*Meandrinæ*, with stout entire lamellæ,) have been found only in the West Indies. The genus *Porites* contains several species, but they are uniformly more fragile and more porous species than those I have seen from the Pacific and Indian Oceans; and the polyps, as figured by Lesueur, are more exsertile, approaching, in this particular, the *Gonioporaæ*.

## CHAPTER VII.

### CLASSIFICATION OF ZOOPHYTES.

105. ZOOPHYTES constitute an order of the group or sub-kingdom RADIATA. The limits of this sub-kingdom have of late been the occasion of much discussion. In order to explain their relations to other animals, a few remarks upon the general system of arrangement in the animal kingdom are here offered.

In Cuvier's Classification of Animals, the division Radiata includes all invertebrate animals not comprised in either of the other sub-kingdoms, Articulata and Mollusca. Consisting thus only of refuse species, and not limited by positive characters, as Owen states, we should not expect that the group could be a *natural* assemblage. No line of subdivision, however, has yet been made out, which has met with general favour; yet greater precision has been given to our views of the affinities that run through the animal kingdom, by appealing to the nerves, the seat of sensibility and sentiment, as a basis in classification; and, in this manner, the subdivisions have been characterized as follows by Dr. Grant.

I. The *Vertebrata*, having a brain and a spinal cord, constitute the SPINI-CEREBRATA;—II. The *Mollusca*, having the nerves forming generally a transverse series of ganglia disposed around the esophagus, the CYCLO-GANGLIATA;—III. The *Articulata*, having no proper brain, and the main cords, which run the length of the body, double, the DIPLO-NEURA;—IV. The *Radiata*, having a radiate structure in the body, and the nervous ganglia arranged in a circle, the CYCLO-NEURA. The orders of these sub-kingdoms are given as follows:

I. SPINI-CEREBRATA OR VERTEBRATA. Mammalia, Aves, Reptilia, Amphibia, Pisces.

II. CYCLO-GANGLIATA or MOLLUSCA. Cephalopoda, Pteropoda, Gasteropoda, Conchifera, Tunicata.

III. DIPLO-NEURA or ARTICULATA. Crustacea, Arachnida, Insecta, Myriapoda, Annelida, Rotifera, Entozoa.

IV. CYCLO-NEURA or RADIATA. Echinoderma, Acalephæ, Polypiphora (zoophytes), Poriphora (sponges), Polygastrica.

An objection might be made to this system, on the ground of the apparent absence of nerves in some of the lower orders. But a real absence can hardly be concluded, from our inability to distinguish them. Many of these animals show by their voluntary motions and sensibility that nervous influences traverse the body: moreover, nervous matter is secreted only in lines. We can, therefore, only infer the indistinctness, and not the absence of nerves, from our ineffectual efforts to trace them out; and we must consequently be guided by general structure, in determining the relations of groups, when the nerves fail of giving aid.

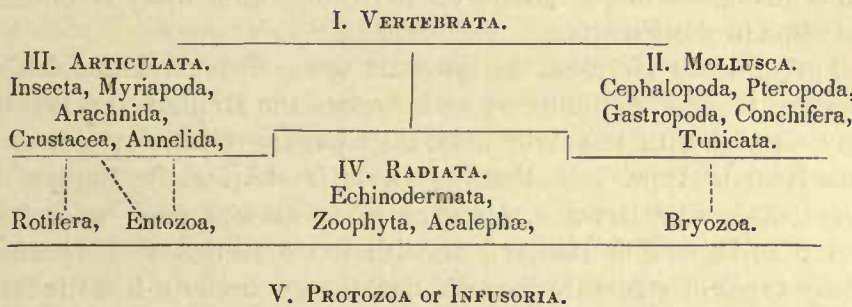
106. The above arrangement fails, in some respects, of presenting a clear idea of the system in nature, although highly philosophical in its general features. A study of the animal kingdom, as has been lately shown, brings to light, lines or general systems of development branching up from the lowest infusoria to the higher grades of life. It is not true that the forms among the *lower* grades are actually copied in any of the imperfectly developed young of the *superior*; yet there is some general analogy, sufficient to indicate that the former commence on the same system of development with some of the latter, although carried essentially out of the direct upward line by the peculiar vital forces of the species. The Rotifera are decidedly Crustacean in type. The stout mandibles are precisely those of some of the Cyclopidæ, even in position, and also in general form; and in certain peculiarities in the mode of reproduction, the animals are closely similar; yet no young Crustacean is ever a Rotifer. The latter belongs to the same system of development with the former, but is a distinct branch, from the regular line, characterized by peculiar natatory organs, which appear to be analogues of the branchial or basal appendages to the feet in Crustacea. The Bryozoa,\* or Flus-

\* The Bryozoa have been placed near the Rotifera; but the absence of mandibles, as well as their peculiar type of structure, separates them widely from these crustaceoid species and allies them as closely to the Tunicata, with which they were first associated by Thomson, under the name of Polyzoa. Lister has a finely illustrated article on this subject, in the Philosophical Transactions, for 1834, p. 365.

troid polyps, illustrate the same principles, and are as nearly allied to the Tunicata as the Rotifers to the Crustacea. It is a side-development from the imaginary line, which connects the Infusoria with the Tunicated Molluscs. The Entozoa afford other examples, one branch of them passing into Crustacea, through the Lernæidæ and Caligidæ, and the other into the Annelida. The Lernæoid division appears to reach the Polygastrics in the Acephalocyst.

These remarks are intended to support no monad or Lamarckian theory, but only to elucidate the established principle that there are in nature certain distinct systems or types of development. Each species is developed with some reference to one or the other of these systems, but, through the agency of the vital forces peculiar to it,—forces which, there is reason to believe, only creative power can change.

107. In accordance with these principles, the several orders of animals may be arranged as follows :



108. A radiated structure characterizes the simplest form of animal life.\* Passing up from the monad globule, this structure has its

\* As suggested in the close of § 98, it appears to be more than a plausible conjecture, that we may attribute the radiated structure to the ordinary uncontrolled principles of cellule budding; the results of which are seen in the varied forms of zoophytes and vegetation. It gives origin to the radiated form of the flower; and the spiral arrangement of the leaflets,—the result of a succession in the developments,—is one of the consequences of it (§ 86). The nervous system, in its lowest condition, conforms to this character; but, as it becomes more perfect, it has a peculiar mode and direction of development,—as the zoophyte has its peculiar characteristics in this respect,—and thus developing, it guides all the other elaborations; for it seems to be the channel along which vital influences operate. The development of nerves, therefore, carries the animal structure more or less widely from the radiate type. This is well illustrated in the relation of the Rotifers and Crustacea, the former, as shown above, having the general structure of the latter under a radiate form. The Rotifers have, as organs of motions, a series of plates arranged in a circular series around the mouth at one extremity of the animal. In the

highest developement in the Echinoderms. Among zoophytes, the Hydra forms the first step upward, in which the digestive cavity is a mere sac, which will work equally well turned inside out, and the mode of reproduction is extremely simple. From this group, we pass to the Actinia, in which there is a distinct stomach and a series of fleshy lamellæ around the internal cavity,—the first rudiments of an isolation of the functions of digestion and generation,—but the circulating fluid is only the elaborated chyle, mingled with more or less water from without. A step farther, and we find the development of separate organs for the functions of the liver and of generation in the Echinoderms, and in some species a circulating system.

Whether the Acalephæ or Zoophyta are highest in the scale, we do not intend to indicate above. The young of some zoophytes are acalephs in form, even to organs of sight, and the young of some acalephs are much like polyps: moreover, the adult acaleph is often quite analogous in its radiately subdividing alimentary channels, to the same in the Fungia.

Through the Bryozoa, the infusoria are connected with the Tunicata and the other Molluscs; and through the Rotifera and Entozoa, they connect with the Articulata, thus passing each way, out of the true Radiate type, into that which characterizes the higher sub-kingdoms. The Bryozoa, Rotifera, and Entozoa, may be arranged in the sub-kingdom Radiata, or with the Mollusca and Articulata, whose types of structure they exhibit, though under a Radiate form.

The Echinoderms, although so strikingly peculiar in some species,—the Echini,—yet, through the Holothuriæ, bear closely upon the Articulata; while the Acalephs incline toward the Mollusca.

The animal kingdom is throughout a network of affiliations, yet there are main trunks and larger branches, to which the smaller anastomosing ramifications are subordinate. Systems of 3s and 5s, look pretty to the mathematical eye, and have some foundation in nature; yet, in tracing affinities, it is better first actually to ascertain

Crustacea, the same or analogous organs, together with the mouth, become lateral, owing to the development and projection of the cephalic ganglion—and its accompaniments constituting the head—beyond to one side of the circular series of the natatory plates; these natatory plates, about the Rotifer's mouth, becoming, at the same time, the branchiæ and the attached maxillary organs about the Crustacean's mouth. The transition from the Crustacean to the Radiate type is also shown in the passage of the Caligi into the Epizoa. This subject admits of a long series of illustrations, which are reserved for another place.

relations, and then to map them out, rather than force the devious windings of nature into circles large and small.\*

109. *Subdivisions of Zoophytes.* The orders Hydroidea and Actinoidea, have already been laid down as the primary subdivisions of zoophytes. The order Actinoidea has been again divided into the sub-orders Actinaria and Alcyonaria. The Alcyonaria, according to most authors, constitute one of the grand divisions equivalent to Hydroidea and Actinoidea. But the general identity in structure and mode of reproduction, and other coincidences stated in the preceding pages, seem fully to justify the arrangement adopted. In the subordinate groupings, the actual character of the animals has been considered of superior importance to the mere absence or presence of coral secretions. Olivi long ago correctly stated that the consideration of the presence or absence of calcareous secretions was of no more importance in zoophytes, than in the Mollusca.†

110. The farther subdivision of the sub-order Actinaria, into the four tribes Astræacea, Caryophyllacea, Madreporacea, and Antipathacea, is based upon the structure of the polyps and their mode of budding. The fleshy Actiniæ belong to this sub-order, and possibly we may yet find among them representations of all the several tribes. Yet, as they are not budding species, excepting the Zoanthidæ, and their distinctive internal characters have not been laid down, they have all been retained for the present in the same tribe, Astræacea. The Antipathi have been arranged by some with the Gorgoniæ, and by others of late, with the Bryozoa.‡ They have no relation to the latter, and but little to the former; their tentacles are quite similar in appearance to those of the Madrepores, although but six in number. The family Fungidæ has not hitherto been recognised as a distinct

\* The Bryozoa, Rotifera, and Entozoa, are by no means the only links between the Protozoa and the other sub-kingdoms; on the contrary, the direct affiliations, and the analogical connexions which arise from parallel gradations of developements in separate and often distant groups, are numerous, and a long series of investigations will be required before they can be fully made out. In the Baccillariæ, and others of the Pseudopoda, we appear to distinguish the Echinoderm and Acaleph form developed in an infusorial structure. The sponges, also, belong here, if animal, as Dujardin urges,<sup>a</sup> and seem, in like manner, to represent the Zoophyta.

† Zoologia Adriatica, Bassano, 1792. See Blainville's Man. d'Actin., p. 30.

‡ Ehrenberg, op. cit., 357; also, M. Perty, Allgemeine Naturgeschichte, as quoted in Oken's Isis, 1841, p. 371.

<sup>a</sup> Annales des Sci. Nat., x., 5, 1838.



group among the Astræacea, yet it rests on characters of striking importance (§§ 43, 78).

111. As the characters laid down for many of the received genera were not drawn from a study of the animals, it has been found necessary to vary their limits, restrict, extend, divide, or unite, according to the facts thus ascertained. These changes have been made cautiously, and no new names introduced, except after long deliberation. On account of the various uses of the same name, by different authors, it has been sometimes extremely difficult to decide on the one to be received and retained. The admirable principles published by the British Association, in 1843, have been followed in such cases. An instance of the difficulty alluded to, will be found illustrated in full under the family Caryophyllidæ, where the authorities for the different names of the genera adopted, are given, and the final reasons for restoring the name Caryophyllia to the Cladocoræ of Ehrenberg.

The genus Explanaria of Ehrenberg, made up in part of certain Astræas, and of some of Lamarck's Explanariæ and Gemmiporæ, has been disbanded, for reasons stated under the genus. The genus Porites, as employed by late authors, contains two distinct genera, or if we include fossil species, so called, *four* distinct genera. Its subdivision, therefore, was unavoidable. The Porites spumosa is the type of one of the recent genera, which I have called Manopora; the species are closely related to the Madreporæ. The Porites glomerata and clavata are types of the other genus (Porites), which is so decidedly peculiar in its characters, that it was necessary to establish it as the type of a separate family, Poritidæ (§ 40).

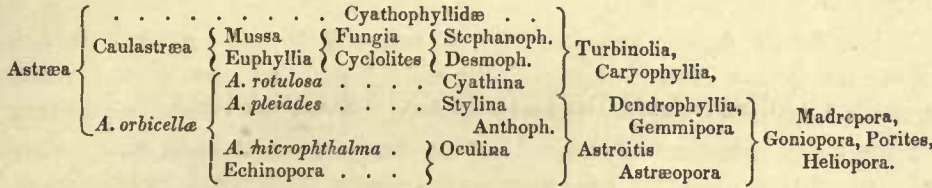
Other remarks, upon the changes that have been found unavoidable, will be made in the course of the following pages containing descriptions of the genera and species. Those genera, whose places in the system are not determined, are placed in an Appendix.

112. A few of the transitions among the genera are pointed out in the following tables :

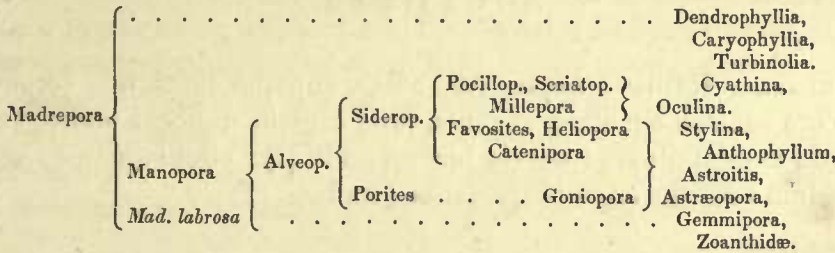
1. *Transitions of the Astræidæ to the Fungidæ.*

Astræa	{	Meandrina	{	Monticularia . . . . .	}	Pavonia	}	Herpetolithus	{	Fungia,
				Manicina, Tridacophyllia				Agaricia		Zoopilus,
				Merulina . . . . .						Polyphyllia.
		A. orbicellæ—Echinopora, Phyllastræa . . . . .								

2. *Transitions of the Astræidæ to the Caryophyllidæ and Madreporacea.*



3. *Transitions of the Madreporidæ to the Caryophyllidæ.*



It is impossible in tables, or in any manner *on a plane*, to give a correct and complete idea of all the interlinkings of genera ; circles give a regularity to the reticulations, which is not found in nature. The passage of the Madreporæ into the Manoporæ (table 3), and from these into the Alveoporæ, is almost a direct line ; from the last, the line branches either way into the Porites and the Sideroporæ, and the Sideroporæ pass into a network of species of the family Favositidæ, the Seriatoporæ of which appear to lead the way to the Oculinæ. The Porites, through the Gonioporæ, graduate into the Astræoporæ, and thence to the Astroites on one side and the Gemmiporæ on the other. The Madreporæ also pass into the Gemmiporæ, and likewise into the Dendrophyllia, which two groups are closely allied though distant in the table ; the four lines thus meet in the Caryophyllia family, the genera of which have their principal gradations, as shown above. By a study of the other tables, the relations of the groups will be made out without particular explanation. The Actinaria graduate towards the Alcyonaria, through certain Actiniæ, with four or eight lobed disks.

The following table contains a general view of the Classification of Zoophytes, to which the principles discussed appear to lead, together with the characteristics of the several subdivisions.



## CONSPECTUS DISTRIBUTIONIS ZOOPHYTORUM.

### ZOOPHYTA.

ANIMALIA RADIATA sæpius basi affixa, supernè tentaculis coronata cum ore centrali edentato, et intus, tubo cibario uniforo: androgyna; ovipara et gemmipara: nervis inconspicuis (?): circulatione ex corde laxissimâ: sensûs organis specialibus nullis.

#### ORDO I.—ACTINOIDEA.

Ventriculo stomachum includente lamellis radiatis generativis septato; ovulis ore ejectis.

#### SUB-ORDO I.—ACTINARIA.

Tentaculis 6, 12, aut pluribus, sæpissimè non papillosis et apice perforatis: sæpe coralligena; corallis calcareis, (rarissimè corneis,) cellis radiatis.

#### TRIBUS I.—ASTREACEA.

Multitentaculata, tentaculis subseriatis aut sparsis; sæpe gemmipara, gemmatione superiore, polypis supernè lateraliter prolatantibus: sæpe coralligena, corallis calcareis, cellis multi-radiatis, lamellis ultra cellas productis, itaque superficie corallorum aggregatorum lamellostriatâ.

FAMILIA I. ACTINIDÆ. Animalia non coralligena, sæpius affixa.

*Genera.* Actinia, Anthea, Adamsia, Edwardsia, Ilyanthus, Capnea, Actinecta, Epicystis, Actinodendrum, Lucernaria, Metridium, Actinaria, Heterodactyla, Epicladia.

FAMILIA II. ASTREIDÆ. Calcereo-coralligena; tentaculis margine disci dispositis, discis interdum seriatim tantummodo confluentibus: corallorum cellis excavatis, stellis circumscriptis, interdum lobatis aut lineatis; lamellis corallorum aggregatorum in medio septo sæpius interruptis.

## TABULAR VIEW OF THE CLASSIFICATION OF ZOOPHYTES.

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### ZOOPHYTES.

ANIMALS of the class Radiata : usually attached at base : having a coronet of tentacles above, and an edentate mouth at the centre : within, an alimentary cavity, to which the mouth is the only opening : androgynous ; gemmiparous and oviparous : nerves indistinct (?) : circulation very imperfect : no special organs of sense.

#### ORDER I.—ACTINOIDEA.

Visceral cavity enclosing the stomach, and divided into compartments by radiated lamellæ, having reproductive functions ; ovules ejected through the mouth.

#### SUBORDER I.—ACTINARIA.

Tentacles 6, 12, or more, in number, not papillose, (with few exceptions,) and perforate at apex : often coralligenous ; coralla calcareous, very rarely corneous, cells radiate with lamellæ.

#### TRIBE I.—ASTRÆACEA.

Tentacles many, in imperfect series or scattered ; when gemmiparous, gemmation superior, the polyps widening above : often coralligenous ; coralla calcareous, cells multiradiate, lamellæ prolonged outward beyond the cells, and hence the surface in aggregate coralla is lamello-striate.

FAMILY I. ACTINIDÆ. Not coralligenous, usually attached.

*Genera.* Actinia, Anthea, Adamsia, Edwardsia, Hyanthus, Capnea, Actinecta, Epicystis, Actinodendrum, Lucernaria, Metridium, Actinaria, Heterodactyla, Epicladia.

FAMILY II. ASTRÆIDÆ. Calcareo-coralligenous ; tentacles arranged along the margin of the disks ; disks sometimes confluent in simple series ; coralla, with excavate cells, stars circumscribed, sometimes lobed or linear ; lamellæ, in aggregate coralla, interrupted usually along the middle of the septa.

*Genera.* Euphyllia, Ctenophyllia, Mussa, Manicina, Caulastræa, Tridacophyllia, Astræa, Meandrina, Monticularia, Phyllastræa, Merulina, Echinopora.

FAMILIA III. FUNCIDÆ. Coralligena; discis non circumscriptis, tentaculis sparsis, brevibus et sæpe obsoletis: simplicissima et aggregato-gemmata; aggregatis, discis, undique confluentibus, interstitiis nullis: corallis superficie lamello-striatis et sæpius stellatis, cellis veris nullis; lamellis, aggregatis, ex uno ad alium centrum productis.

*Genera.* Fungia, Cyclolites, Herpetolithus, Halomitra, Polyphyllia, Zoopilus, Pavonia, Agaricia, Psammocora.

#### TRIBUS II.—CARYOPHYLLACEA.

Multitentaculata; sæpissimè gemmipara, gemmatione inferiore, gemmis lateralibus, raro (sicut in quibusdam Cyathophyllidis) sursum crescentibus, polypis supernè non prolatantibus: sæpe coralligena, corallis calcareis, cellis multiradiatis, superficie interstitiali non lamello-striatâ.

FAMILIA I. CYATHOPHYLLIDÆ. Coralligena; polyporum singulorum corallo internè ad medium sæpius transversè obliquè septato et celluloso.

*Genera.* Cyathophyllum, Calophyllum, Amplexus, Caninia, Arachnophyllum, Acerularia, Cystiophyllum, Clisiophyllum, Michelinia, Columnaria, Sarcinula.

FAMILIA II. CARYOPHYLLIDÆ. Coralligena; tentaculis confertis, elongatis; oribus longè exsertis: corallo internè non transversè septato, cellis multiradiatis (radiis duodecim superantibus), caliculis margine tenuibus; interstitiis nunquam lamello-striatis. (Lamellis fere integris.)

*Genera.* Ecmesus, Cyathina, Stephanophyllia, Turbinalia, Desmophyllum, Culicia, Caryophyllia, Dendrophyllia, Oculina, Anthophyllum, Styliina, Astroitis.

FAMILIA III. GEMMIPORIDÆ. Coralligena; tentaculis brevibus, marginalibus, 2-3 seriatis, disco lato, paulo convexo; corallis porosis, caliculis margine crassis, lamellis fere æqualibus, non exsertis.

*Genera.* Gemmipora, Astræopora (?).

FAMILIA IV. ZOANTHIDÆ. Non coralligena, extus subcoriacea; tentaculis brevibus, marginalibus, 2-3 seriatis, disco sæpe convexo, margine radiatè striato et interdum valde reflexo.

*Genera.* Isaura, Zoantha, Palythoa.

#### TRIBUS III.—MADREPORACEA.

Tentaculis uniseriatis, duodecim (raro pluribus), interdum obsoletis; gemmipara, gemmatione laterali: coralligena, corallis calcareis, cellis parvulis, radiis 6-12, aut obsoletis; superficie interstitiali non lamello-striatâ.

FAMILIA I. MADREPORIDÆ. Polypis 12-tentaculatis, basi medio non coralligenis; itaque cellis profundissimis, ad medium corallum usque productis.

*Genera.* Madrepora, Manopora.



*Genera.* Euphyllia, Ctenophyllia, Mussa, Manicina, Caulastræa, Tridacophyllia, Astræa, Meandrina, Monticularia, Phyllastræa, Merulina, Echinopora.

**FAMILY III. FUNGIDÆ.** Coralligenous; disks not circumscribed, tentacles scattered, short, and often obsolete: simple or aggregato-gemmate; when aggregate, the disks every way confluent without interstices: coralla, generally with a stellate surface, and without proper cells; lamellæ, in aggregate species, continuous between adjacent polyp-centres.

*Genera.* Fungia, Cyclolites, Herpetolithus, Halomitra, Polyphyllia, Zoopilus, Pavonia, Agaricia, Psammocora.

#### TRIBE II.—CARYOPHYLLACEA.

Polyps having numerous tentacles in two or more series: mostly gemmiparous, gemmation inferior, buds lateral; rarely (as in some Cyathophyllidæ) growing upward above the summit of the parent, but summits of polyps (the disks or adjoining margins) not prolate: generally coralligenous; coralla calcareous, cells many-rayed, interstitial surface not lamello-striate.

**FAMILY I. CYATHOPHYLLIDÆ.** Coralligenous, the corallum of each polyp internally at middle, usually transversely or obliquely cellular.

*Genera.* Cyathophyllum, Calophyllum, Amplexus, Caninia, Arachnophyllum, Acerularia, Cystiophyllum, Clisiophyllum, Michelinia, Columnaria, Sarcinula.

**FAMILY II. CARYOPHYLLIDÆ.** Coralligenous; tentacles crowded and long, mouths long exsert; corallum internally not transversely cellular; cells many-rayed (rays more than twelve), margin of calicles thin, interstices not lamello-striate. (Lamellæ nearly or quite entire.)

*Genera.* Ecomesus, Cyathina, Stephanophyllia, Turbinalia, Desmophyllum, Culicia, Caryophyllia, Dendrophyllia, Oculina, Anthophyllum, Styliina, Astroitis.

**FAMILY III. GEMMIPORIDÆ.** Coralligenous, tentacles short, marginal, in 2 to 3 series, disk broad and a little convex: coralla porous; calicles with a stout margin, lamellæ even and not exsert.

*Genera.* Gemmipora, Astræopora (?).

**FAMILY IV. ZOANTHIDÆ.** Not coralligenous, exterior subcoriaceous; tentacles short, marginal, in 2 or 3 series; disk often convex with the margin radiately striate and sometimes much reflexed.

*Genera.* Isaura, Zoantha, Palythoa.

#### TRIBE III.—MADREPORACEA.

Tentacles in a single series, 12 (rarely more), sometimes obsolete; gemmiparous, gemmation lateral: coralligenous, coralla calcareous, cells quite small, rays 6 to 12 or obsolete; interstitial surface not lamello-striate.

**FAMILY I. MADREPORIDÆ.** Polyps with 12 tentacles, not secreting lime at middle part of base; and hence the cells deep, extending to the centre of the corallum.

*Genera.* Madrepora, Manopora.

FAMILIA II. FAVOSITIDÆ. Polypis 12-tentaculatis, basi seriatim coralligenis, itaque cellis fundo calcareis, et medio corallo transversè septatis, raro solidis.

*Genera.* Alveopora (*Alveoporinæ*); Sideropora, Seriatopora, Pocillopora, Stenopora, Constellaria, Favosites, Catenipora (*Favositinæ*); Heliopora, Heliolites, Millepora (*Helio-porinæ*).

FAMILIA III. PORITIDÆ. Polypis tentaculis interdum duodecim superantibus, totâ basi omnino porosè coralligenis; corallis undique æqualiter porosis, cellis paulo profundis aut superficialibus et medio corallo vix dispiciendis, radiis fere obsoletis.

*Genera.* Porites, Goniopora.

#### TRIBUS IV.—ANTIPATHIACEA.

Animalia 6-tentaculata, secretiones corneas basi elaborantia.

FAMILIA I. ANTIPATHIDÆ. Animalia carnosâ, axem corneum spinulosum tegentia.

#### SUBORDO II.—ALCYONARIA.

Animalia 8-tentaculata, tentaculis papillosis, papillis apice perforatis: sæpe coralligena, corallis calcareis aut corneis, raro siliceis, cellis nunquam radiatis.

FAMILIA I. PENNATULIDÆ. Nunquam affixa, aut libera, aut basi defossa.

*Genera.* Renilla, Pennatula, Veretillum, Funiculina, Virgularia (*Pennatulinae*); Pavonaria, Umbellularia (*Pavonarinae*).

FAMILIA II. ALCYONIDÆ. Carnosa, penitus sæpe calcareo-spiculigera.

*Genera.* Rhizoxenia, Anthelia, Xenia (*Xeninae*); Ammothera, Sympodium, Nephthya, Alcyonium (*Alcyoninae*); Spoggodia (*Spoggodinae*).

FAMILIA III. CORNULARIDÆ. Corallis tubulatis, corneis.

*Genus.* Cornularia.

FAMILIA IV. TUBIPORIDÆ. Corallis tubulatis, calcareis.

*Genera.* Aulopora, Telesto, Tubipora, Syringopora.

FAMILIA V. GORGONIDÆ. Secretiones epidermicas basi elaborantia, et sæpissimè alias quoque calcareas internas.

*Genera.* Corallium (*Coralliinae*); Hyalonema, Briareum, Gorgonia, Primnoa, Beryce (*Gorgoninae*); Isis, Mopsea, Melitæa (*Isinae*).

#### ORDO II.—HYDROIDEA.

Ventriculo tubuliformi, simplicissimo; ovulis e lateribus externè enascentibus.

FAMILIA I. HYDRIDÆ. Ovulis singulis; gemmis lateralibus, et pullis maturis deciduis: corallis nullis.

*Genus.* Hydra.

FAMILY II. FAVOSITIDÆ. Polyps with 12 tentacles, secreting lime periodically at base, and hence the cells have a calcareous bottom and in the interior of the corallum are transversely septate, rarely solid.

*Genera.* Alveopora (*Alveoporinæ*); Sideropora, Seriatopora, Pocillopora, Stenopora, Constellaria, Favosites, Catenipora (*Favositinæ*); Heliopora, Heliolites, Millepora, (*Helioporinæ*).

FAMILY III. PORITIDÆ! Polyps with rarely more than 12 tentacles, forming porous calcareous secretions continuously at base; coralla every where equally fine-porous, cells shallow or superficial and scarcely traceable within the corallum, rays indistinct.

*Genera.* Porites, Goniopora.

#### TRIBE IV.—ANTIPATHACEA.

Animals with 6 tentacles, forming at base corneous secretions.

FAMILY I. ANTIPATHIDÆ. Animals fleshy, enveloping a corneous spinulous axis.

#### SUBORDER II.—ALCYONARIA.

Animals with 8 tentacles; tentacles papillose, papillæ perforate at apex: often coralligenous; coralla calcareous or corneous, rarely siliceous, cells never radiate within.

FAMILY I. PENNATULIDÆ. Never attached, but either free or with the base buried in the mud.

*Genera.* Renilla, Pennatula, Veretillum, Funiculina, Virgularia (*Pennatulinæ*); Pavonaria, Umbellularia (*Pavonarinæ*).

FAMILY II. ALCYONIDÆ. Fleshy, usually containing disseminated calcareous granules.

*Genera.* Rhizoxenia, Anthelia, Xenia (*Xeninæ*); Ammothea, Sympodium, Nephthya, Alcyonium (*Alcyoninæ*); Spoggodia (*Spoggodinæ*).

FAMILY III. CORNULARIDÆ. Forming corneous tubular coralla.

*Genus.* Cornularia.

FAMILY IV. TUBIPORIDÆ. Forming calcareous tubular coralla.

*Genera.* Aulopora, Telesto, Tubipora, Siringopora (?).

FAMILY V. GORGONIDÆ. Forming basal epidermic secretions, and often, also, other tissue secretions, the latter separable from the former.

*Genera.* Corallium (*Coralliinæ*); Hyalonema, Briareum, Gorgonia, Primnoa, Bebryce (*Gorgoninæ*); Isis, Mopsea, Melitæa (*Isinæ*).

#### ORDER II.—HYDROIDEA.

Animals with the internal cavity tubular and quite simple: ovules growing outward from the sides.

FAMILY I. HYDRIDÆ. Ovules single; buds lateral, young falling off when full grown; not coralligenous.

*Genus.* Hydra.

FAMILIA II. SERTULARIDÆ. Ovulis in vesiculo inclusis, gemmis lateralibus persistentibus: corallis corneis, caliculis sessilibus.

*Genera.* Antennularia, Plumularia, Sertularia, Thuiaria, Thoa, Pasythea.

FAMILIA III. CAMPANULARIDÆ. Ovulis in vesiculo inclusis, gemmis lateralibus persistentibus; corallis corneis, caliculis pedicellatis.

*Genera.* Laomedea, Campanularia.

FAMILIA IV. TUBULARIDÆ. Gemmulis nudis caduccis, juxta tentaculos enascentibus; animalia sæpe coralligena, corallis corneis, tubulatis.

*Genera.* Pennaria, Tubularia, Syncoryna, Corydendrium, Eudendrium, Coryna, Hydractinia.

A BRIEF REVIEW OF THE PRINCIPAL SYSTEMS OF CLASSIFICATION OF FORMER AUTHORS.

—The principal systems of classification in this department of Zoology, are those of Lamarck, Lamouroux, Schweigger, Blainville, Ehrenberg, and Milne Edwards.

LAMARCK.—This author included under the head of Polyps, the Infusoria and Rotifera, together with the Corallinæ (Algæ) and Sponges. The following are his subdivisions, as given in the second edition of his work on Invertebrate Animals, with their equivalents, where there are such, in the system adopted.

ORDO I. POLYPI CILIATI. Includes the Infusoria and Rotifera.

ORDO II. POLYPI DENUDATI, or naked polyps. A group of unrelated genera, comprising the Hydræ, part of the Zoanthidæ, and part of the Tubularidæ.

ORDO III. POLYPI VAGINATI, or coralligenous polyps, subdivided as follows:

1. "*Polypiers fluviatiles*," some *fresh-water* Bryozoa with the Spongillæ.
2. "*Polypiers vaginiformes*." The Hydroidea, excepting the Hydræ, together with some Bryozoa and Coralline Algæ.
3. "*Polypiers à réseau*." Mostly Bryozoa.
4. "*Polypiers foraminés*;" compact calcareous corals with small cells, without rays. The Tubiporæ of the Alcyonaria, and the Favosites, Cateniporæ and Milleporæ of the Madreporæ tribe, with some others.
5. "*Polypiers lamellifères*." Calcareous with rayed cells. The coralligenous Astræacea, Caryophyllacea, and the Madreporacea, excepting the Favosites, Cateniporæ, and Milleporæ.
6. "*Polypiers corticifères*." The Antipathi and Gorgonidæ, with many of the Coralline Algæ.
7. "*Polypiers empâtés*." The Sponges, with some of the Coralline Algæ.

ORDO IV. POLYPI TUBIFERI. The family Alcyonidæ.

ORDO V. POLYPI NATANTES. The Pennatulidæ from among the Alcyonaria, together with the family of Encrinites, which belong with Echinoderms.

LAMOUREUX.—Lamouroux, excluding the first order of Lamarck, arranges Zoophytes in three groups. 1. *Those that are flexible or not entirely stony*; 2. *Those that are stony and not flexible*; and 3. *Those that are fleshy (sarcoïd) without a central axis*. He included in the first division, the Hydroidea, part of the Bryozoa, the Corallinæ, Sponges, and Gorgonidæ; in the 2d. The remainder of the Bryozoa, the Caryophyllia, Astrea, and Madreporæ tribes, together with the "Foraminés" of Lamarck; and in the 3d. The Alcyonia, Zoanthidæ, and other unallied species.

SCHWEIGGER.—Schweigger divides Zoophytes into Z. MONOHILA, and Z. HETERO-

FAMILY II. SERTULARIDÆ. Ovules enclosed in ovarian vesicles; buds lateral, persistent; coralla corneous, calicles sessile.

*Genera.* Antemularia, Plumularia, Sertularia, Thuiaria, Thoa, Pasythea.

FAMILY III. CAMPANULARIDÆ. Ovules enclosed in ovarian vesicles; buds lateral, persistent; coralla corneous, calicles pedicellate.

*Genera.* Laomedea, Campanularia.

FAMILY IV. TUBULARIDÆ. Caducous gemmules growing from near the base of the tentacles, and naked; often coralligenous, coralla corneous, tubular.

*Genera.* Pennaria, Tubularia, Syncoryna, Corydendrium, Eudendrium, Coryna, Hydractinia.

HYLA, separating thus the fleshy species from the others; the former including Lamarek's orders, I., II., IV., and the latter, the remainder of his orders. The Zoophyta Heterohyla are subdivided as follows:

1. *Lithophyta nullipora.* Nullipores, lately shown to be of vegetable nature, secreting lime.
2. *Lithophyta porosa.* The Madreporæ tribe, excluding the Favosites and Cateniporæ.
3. *Lithophyta lamellosa.* The coralligenous Astræacea and Caryophyllacea.
4. *Lithophyta fistulosa.* Lamarck's "Polypiers foraminés."
5. *Ceratophyta spongiosa.* Sponges, and some Alcyonidæ.
6. *Ceratophyta tubulosa.* The Hydroidea (excluding the Hydridæ), the Tubularidæ in part, and some of the Bryozoa.
7. *Ceratophyta foliacea.* Bryozoa.
8. *Ceratophyta corticosa.* The Antipathi and Gorgonidæ.
9. *Pennæ marinæ.* The Pennatulidæ.

BLAINVILLE.—Blainville includes under the name Zoophytes, the fleshy Actiniæ as well as the coralligenous species, and also the Echinoderms, Acalephæ, and Sponges. The Sponges constitute his "*Amorphozoaires*," and the other species, the "*Actinozoaires*." The "*Actinozoaires*" are distributed as follows:

CLASS I. "*CIRRHODERMAIRES*," including the Echinoderms.

CLASS II. "*ARACHNODERMAIRES*." The Acalephæ.

CLASS III. "*ZOANTHAIRES*." The Actinidæ, Zoanthidæ, together with the coralligenous Astræacea, Caryophyllacea, and Madreporacea, excluding from the last the Antipathi, Milleporæ, and Favosites, nearly as was done by Lamarck.

CLASS IV. "*POLYPIAIRES*." Includes the Milleporæ, under which name Blainville follows Lamouroux in comprising various unallied genera, characterized by the small non-radiate cells of the corallum; and in other divisions, the Bryozoa and Hydroidea.

CLASS V. "*ZOOPIHYTAIRES*." Corresponding to the Alcyonaria.

We perceive in this classification a great advance beyond those preceding it. The Alcyonaria, before widely distributed, are here united in a single group: the Actinidæ are arranged with the coral polyps; the Bryozoa are mostly grouped together, and the Hydroidea are brought into close association, although still the Hydra forms a sub-class next to the Sertularidæ, instead of being united with them.

EHRENBERG.—Ehrenberg divides Zoophytes—his Anthozoa—into the two orders, Zoocorallia and Phytocorallia. The former, "*Animal Zoophytes*," contains the fleshy





species and unattached coralligenous species; and the latter, "*Plant Zoophytes*," the attached coralligenous species.<sup>a</sup>

The order ZOOCORALLIA includes the following subdivisions:

TRIBE I. ZOOCORALLIA POLYACTINIA. Comprises his families Actinina, Zoanthona, and Fungina, corresponding respectively to the families Actinidæ, Zoanthidæ, and the free Fungidæ, along with the genus Turbinalia of the Caryophyllia tribe.

TRIBE II. ZOOCORALLIA OCTACTINIA, or species with 8 rays to the polyps. Comprises his families Xenina, Tubiporina, Halcyonina, and Pennatulina, or all the Alcyonaria but the Gorgonidæ, which fall into his second order.

TRIBE III. ZOOCORALLIA OLIGACTINIA, corresponding to Hydroidea, and including his families Hydrina, Tubularina, and Sertularina.

The order PHYTCORALLIA, is subdivided as follows:

TRIBE IV. PHYTCORALLIA POLYACTINIA. Includes the families Ocellina, and Decalina; the former corresponding to the Caryophyllidæ and Cyathophyllidæ, except that the Turbinaliæ are excluded by Ehrenberg, and some Astræas are introduced under the genus Explanaria; and the latter corresponding nearly to the Astræidæ and Fungidæ, except that the free Fungidæ are separated.

TRIBE V. PHYTCORALLIA DODECACTINIA. Comprises the families Madreporina and Milleporina, the first including the Poritidæ and part of the Madreporidæ, and the second, the remainder of the Madreporidæ of the system adopted.

TRIBE VI. PHYTCORALLIA OCTACTINIA, including the families Isidea and Gorgonina, corresponding to the Gorgonidæ.

TRIBE VII. PHYTCORALLIA OLIGACTINIA, including the single genus Allopore.

This system removes the free Fungidæ far from the attached species, and the same principle carried out should place in different families the free and attached Cyathophylla, Euphyllia, and others. The natural group Alcyonaria is divided, and the parts are widely separated. Notwithstanding these singularities arising from the undue importance allowed to the characters of his Orders, the system exhibits throughout the comprehensive acumen of its distinguished author, and was the first that rested its distinctions solely on the structure of the animals, or the *living* zoophytes.

MILNE EDWARDS.—In the philosophical system of Milne Edwards, the Bryozoa constitute the order *Polypes tuniciens*; and other Zoophytes (our Zoophyta), his *Polypes parenchymatés*. This second order he subdivides as follows:

1. "*Sertulariens*." Corresponding to the Hydroidea.
2. "*Zoanthaires*." Corresponding to the Actinaria.
3. "*Alcyoniens*." Corresponding to the Alcyonaria.

The Alcyonia group, which is bound together by important characters, is thus kept united; and the other groups are equally well defined in their limits and characteristics. The "*Zoanthaires*" and "*Alcyoniens*," constitute together our Actinoidea, a group which is equivalent, as a whole, rather than its parts, to the "*Sertulariens*" (Hydroidea).

<sup>a</sup> These orders are characterized by Ehrenberg as follows (op. cit., pp. 255, and 299):

ZOOCORALLIA. Corpore aut omnino molli, aut Cephalopodum more intus lapidem generante (seccernente nec exccernente) hinc sæpe omnino libera et, præter formam, animalium characteres omnes perfectius servantia. PHYTCORALLIA, Corpore aut lapideam aut corneam materiam agglutinantem seccernente ac dorso (solea) exccernente ejusque ope semper adnato (Ostreorum more).

# Z O O P H Y T A.

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## ORDER I.—ACTINOIDEA.

### SUB-ORDER I.—ACTINARIA.

#### TRIBE I.—ASTRÆACEA.

*Zoophyta aut omnino carnosa, aut coralligena; tentaculis numerosis, multiseriatis, aut sparsis. Sæpe gemmata, gemmatione superiore, polypis supernè lateraliter prolatantibus. Coralligenis, corallis calcareis, cellis multiradiatis, lamellis ultra cellas productis, itaque superficie corallorum aggregatorum lamello-striatâ.*

Zoophytes, either wholly fleshy or coralligenous; tentacles numerous, in more than one series, or scattered. Often budding; buds terminal or sub-terminal, the polyps widening above by growth. Coralla calcareous, lamellæ of cells numerous, intersecting the interstices between cells in massive species.

The polyps of the Astræacea are described in the preceding pages (§§ 19, to 29, and 42). The general appearance of the corals usually distinguishes them at a glance from other species. When massive, the whole surface is marked with the radiating lamellæ, those of one cell extending and meeting those of the next, instead of being confined to the cell itself, as in the Madreporacea and recent Caryophyllacea (§§ 48, 76).

## FAMILY I.—ACTINIDÆ.

*Astræacea non coralligena, simplicissima, sæpius basi affixa.*

Non-coralligenous *Astræacea*, not budding, usually attached at base.

The appearance, general characters, and habits of the *Actiniæ* have been already considered, and little remains to be added here, except to mention some of the varieties of structure, and the groupings or genera in consequence adopted. The most common form is that of a cylindrical animal, with a coronet of simple slender tentacles encircling the mouth. The base, by which it attaches itself, is often much spreading, and the same is also true of the upper extremity or disk. The margin of the disk is very undulating in some species, or appears as if gathered into a few large folds; and that of the base is either entire, undulating, gash-lobed, or edged by shallow crenatures. The tentacles may be much longer than the body, or rudimentary,—in a dense circle, fringing the disk, or scattered over its whole surface,—either equal or very unequal, with sometimes the inner and sometimes the outer series much the longest: and in shape, they may be terete and pointed (subulate),—the usual shape,—or they may terminate in an obtuse point, or even rounded head. The exterior surface is either smooth, granulous, lined with striæ or simply with coloured markings, papillose, tuberculate, or covered with small suckers (suctorial vesicles), like those of the cuttle-fish: and often the margin of the disk is edged with a series of rather prominent tubercles, which seem to be rudimentary tentacles, or may at least correspond to these organs. Though usually in several series, there are a few species described, in which the tentacles appear to be in a single series. The tubercles of the surface are sometimes distinctly perforated; but this perforate character is not confined to the tuberculate species.

From this, the common variety, there is a passage to others, in which the tentacles are subdivided, branched, or papillose, or furnished with suctorial vesicles, and these sucker cups sometimes cover the surface of the disk. In some species, which bury themselves in the sand, and thus prevent the aeration of the body through the sides, one or more series of tentacles are often delicately lobed and frosted with mossy projections or papillæ, thus spreading a larger surface

than the ordinary tentacles could do, for the process of aeration: and these appendages may be either external and marginal, or they may be scattered among the other tentacles, or may take the place of all the ordinary tentacles, and cover a large part of the disk. Such species are usually furnished with suctorial vesicles, either upon the fringe-tentacles, disk, or sides, or both, which enable them to gather around them the sand, pebbles, and shells, beneath which they lie concealed. Nothing can exceed the beauty of the embroidery with which these species are decorated.\*

Besides the above modifications, there are some species which swim free in the ocean, and for this purpose have an air cavity in the base of the animal, formed by drawing together the sides of the base; and, within the cavity, there is a broad disk composed of air-cells, which answers as a float for the animal. This structure was first figured and accurately described by Lesueur. "This disk is formed of a multitude of small membranes, placed one on another, the largest at the upper part, the rest diminishing in size to the point where this disk is in contact with the bottom of the cavity; its membranes in this place are solid and pressed together, particularly towards the centre, where is a small conic, hard, opaque nucleus, whence these membranes seem to have their origin, and form the disk. This *air-bladder disk* is easily separated from the cavity which encloses it."†

\* It has been questioned whether these fringe-appendages, especially when marginal, should be considered the analogues of tentacles. The relation which has been shown to exist between the size of the animal, the number of its visceral lamellæ, and the number and position of its tentacles, affords some ground for deciding upon this point. From the facts stated in § 25, it appears that the normal number of tentacles in the Actiniæ is quite large, and each corresponds to an interval between the numerous visceral lamellæ, of which there are, in the species referred to, about seven to a breadth of a fourth of an inch. In species, therefore, which have, along with these fringe-appendages, *comparatively few* simple tentacles, as inner series, it is a fair inference, that the fringe is actually an analogue of the outer tentacles. The same conclusion also follows with regard to the tubercles of the margin, which characterize many species.

The elongate lobes to the disk, which distinguish the Lucernariæ, and which are furnished with suctorial vesicles without proper tentacles, may arise in part from the production of the tentacles in sets, instead of their separate development. And in the Alcyonaria, which have but eight tentacles, and appear to be related to the Actiniæ through the Lucernariæ, it is quite possible that each fringed tentacle should be viewed as the analogue, generally, of more than a single tentacle in an Actinia; this would be inferred from the usual relation between the size of the animals and the number of these organs.

† Lesueur, Jour. Acad. Nat. Sci., Philad. i. 182, and figure 6, pl. 7.

The genera of Actinidæ are characterized as follows :

I. Tentacles not in any part papillose or laciniately lobed.

A. *Tentacles simple, without suctorial vesicles.*

GENUS I. ACTINIA. (*Linn.*) Tentacles simple, retractile, sometimes obsolescent; attached at base. (Includes the Discosoma of Leuckart, the Actinoloba and Actinocereus of Blainville, the Cribrina of Ehrenberg.)

GENUS II. ANTHEA. (*Johnston.*) Resembling Actinia, but the tentacles not retractile. (*Johnston's British Zoophytes*, 220. The name is from *ανθος*, a flower.)

GENUS III. CAPNEA. (*Forbes.*) Body cylindrical and invested with a thick lobed epidermis, adhering by a broad base; tentacles simple, very short. (*E. Forbes, Esq., Mag. Zool. and Bot.* vii. (1840) 80. The genus is near the Zoanthidæ.) The name is from *καπνη*, chimney.

GENUS IV. ILYANTHUS. (*Forbes.*) Resembling Actinia, but body tapering to a point below, and probably free or buried in the mud: tentacles simple, retractile. (*E. Forbes, Esq., Mag. Zool. and Bot.* v. 180, (1840). The name is from *ιλος*, mud, and *ανθος*, flower.)

GENUS V. EDWARDSIA. (*Quatrefages.*) Free, vermiform, middle part covered with an epidermis more or less thick and opaque; lower extremity transparent, rounded, and this, as well as the upper extremity, retractile. (*A. de Quatrefages, Ann. des Sci. Nat.* xviii. (1842) 65. The genus may be near the Zoanthidæ. May be identical with the *Moschata* of Renieri?).

GENUS VI. ACTINECTA. (*Blainville.*) Near Actinia in general form, but free, and having an air cavity, and cellular float, in the base of the animal. (*Blainville, Man. d'Actin.* p. 318. The name of the genus is from *actinia* and *necto*, to swim. This genus includes the *Minyas* of Cuvier, which was incorrectly characterized. Ehrenberg also refers here the *Moschata* of Renieri, a free, vermiform Actinia, having many of the characters of the *Edwardsia* of Quatrefages.)

B. *With suctorial vesicles upon the tentacles or disk.*

1. *Margin of disk not deeply lobed.*

GENUS IV. EPICYSTIS. (*Ehrenberg.*) Tentacles not branched, part, or all of them, or the disk, furnished with suctorial vesicles. (*Ehrenberg, Berlin Trans.* 1832, p. 268. Includes the *Actinodendrum* of Ehrenberg, but not of Blainville.)

GENUS V. ACTINODENDRUM. (*Blainville.*) Tentacles branched, extremities enlarged and covered with numerous suctorial (?) vesicles (*Blainville, Man. d'Actin.* p. 320.)

2. *Upper margin of the animal 4 or 8 lobed.*

GENUS VI. LUCERNARIA. (*Müller.*) Suctorial appendages covering the extremities of the lobes. (*Müller, Zool. Dan. Prod. 232.*)

II. Some or all of the tentacles papillose or frondescently lobed; with or without suctorial vesicles.

GENUS VII. METRIDIUM. (*Oken.*) With numerous simple tentacles like those of the Actiniæ, and, besides, frondescent or papillose appendages, corresponding to other tentacles, or pertaining to the base of the simple ones. (Includes the Heterodactyla of Ehrenberg. The genus *Sarcorhinanthus* of Lesson, (from *σαρξ*, *flesh*, and the genus *Rhinanthus*, in botany,) falls in part here, or includes another genus with the inner tentacles clavate and vesiculigerous, for which Ehrenberg has proposed the name *Europala.*)

GENUS VIII. ACTINERIA. (*Blainville.*) All the tentacles either subdivided or more or less papillose, often very short. (*Blainville, Man. d'Actin. 322*; includes the Metridium, Epicladia, and Megalactis, of Ehrenberg, and probably the Thalassianthus of Leuckart.)

The number of genera here given is less than has been received, and it may be necessary to follow Ehrenberg in subdividing the last two groups, according as the tentacles are furnished or not with suctorial vesicles. The presence of these vesicles characterizes Ehrenberg's genera Heterodactyla and Epicladia.

#### GENUS I.—ACTINIA.\*

*Actinidæ basi sæpius affixæ; tentaculis simplicissimis et nudis, retractilibus.*

Actinidæ usually attached at base; tentacles simple and naked, retractile.

The species of Actiniæ are characterized with difficulty. Colour, the particular mention of which constitutes half of many descriptions, is generally of little importance, the same species presenting very different shades. Yet the arrangement of the colours, especially if in stripes, or bands, is often characteristic. It should be observed,

\* The descriptions of the species of Actinidæ beyond, have been prepared for this Report by Mr. Joseph Drayton, of the Expedition, by whom the drawings were made at sea. They are made out from the notes of Mr. J. P. Couthouy, who had charge of the department during the earlier part of the cruise, and also from his own observations.

moreover, that the smooth exterior sometimes graduates into the pustulate; moreover, the number of tentacles and of the series of tentacles, is less in young individuals.

The genus *Discosoma* of Leuckart, which comprised the depressed species with rudimentary or obsolete tentacles, is not retained, inasmuch as the length of the tentacles, considered as a generic character, is of slight importance. The flat disk shape belongs also to some species with prominent tentacles. The genus *Actinoloba* of Blainville is distinguished by an undulated or sublobate margin, a character which fades insensibly, as we trace it through the different species of *Actinia*.

Ehrenberg's *Cribrinæ* do not appear entitled to constitute a distinct genus; the lateral perforations which characterize them occurring in naked as well as tuberculate species. This author also subdivides the genus *Actinia* into the sub-genera, *Isacmæa*, those with equal tentacles; *Entacmæa*, those with the inner tentacles longest; *Ectacmæa*, those with the outer tentacles longest; and *Mesacmæa*, those with the medial longest.

The genus *Adamsia* has been instituted by E. Forbes, Esq., for the *Actinia maculata* of Adams, and is characterized as follows: body, when expanded, bilobate, adhering by a broad base; tentacles subtractile, simple.

#### I. TENTACULIS SUBÆQUIS.

1. Margine superno uniseriatim tuberculato.—(Upper margin uniseriatly tuberculate.)
  - a. *Tentaculis disci dimidio longioribus.*—(*Tentacles longer than half the disk.*)

#### 1. ACTINIA FLAGELLIFERA (*Drayton*).

*A. extus levis, medio 1¾" crassa, infra supraque valde dilatata (2¼" lata), basi latè lobata, margine superno uniseriatim tuberculata; tentaculis longissimis (2-3") flagelliformibus, 3-seriatis; ore prominulo, elliptico.*

Exterior smooth; 1¾ inches broad at middle, upper and lower extremities much dilated (2¼ inches broad), margin of the summit with a single series of rather large tubercles; tentacles very long (2 to 3 inches), flagelliform, in 3 series; mouth somewhat prominent, elliptical.

Plate 1, fig. 1. Animal, natural size; *a*, the same, with part of the tentacles removed showing the disk; *b*, *c*, *d*, extremities of the inner, middle, and outer tentacles, respectively, magnified about three diameters, from drawings by J. P. Couthouy; *e*, tentacles of another variety.

On rocks near Funchal and Camera de Lobos, Madeira.—*Ex. Ex.*

“Of an amber-brown colour; very contractile; when the animal is fully expanded, almost flat, and base irregularly lobed; three rows of tentacles of a delicate pea-green colour, two to three inches long, with the extremities of a beautiful lake colour, the inner row (*b*), under the microscope very delicately granulated, and furnished with a short fibrous penicillation at the ends, which the animal apparently withdraws or protrudes at pleasure, the middle row having the terminations gradually tapering and smooth, and the external row strongly marked with transverse striæ or rugæ, and pointed at tip. A single range of tubercles surrounds the upper edge of the disk outside of the tentacles. The mouth is elliptical, usually a little elevated, giving the appearance of a flat truncate cone to the upper surface, which is of a delicate purple, with lines radiating to the tentacles. The tentacles are never wholly contracted.

“A singular feature in the economy of this zoophyte, and one which, in connexion with the peculiar structure of its tentacles, might justify the formation of a new genus for it, is the remarkable peculiarity it exhibits of closing upon every object presented. On attempting to detach one from the rock, I was astonished to find that instead of contracting at the touch like the generality of Actiniæ, its tentacles immediately closed upon my fingers, adhering to them as if furnished with suckers; and this so strongly, that these organs were broken off—remaining on the hand—before relinquishing their hold. Subsequent attempts were made with the same results, and after continued irritation, the animal, in no instance, could be made wholly to contract them. A slight stinging sensation was produced by much handling them. Several specimens were taken on board and placed in a jar of water, but died in a short time, notwithstanding the water was frequently changed. After the first day, they lost nearly all their power of adhesion by the tentacles, and never fully expanded, although they fixed themselves very firmly by their base. They possess, like many of the family, a limited power of locomotion by



means of their base, which supplies the place of a foot; one of them, which was left at the bottom of a jar at night had ascended about six inches on the side by the next morning. The only organs which could be discovered apparently connected with the faculty of attaching themselves to objects, were the delicate fibrous penicillations on the extremities of the inner series of tentacula. None of the others appeared to be tubular, yet all of them, more or less, possessed this power.

“Having a number of *Monodontas* too much crowded in a large jar of water, I took out half a dozen and placed them in a jar with the *Actinia*. On looking at them about three hours after, I found that instead of climbing like the others to the top of the water, they remained just where they had fallen, closely withdrawn into their shells. Supposing them dead, they were taken out, when they directly began to emerge; and when returned to the jar with the other *Monodontas*, they were all, in less than five minutes, clustered around its mouth. On placing them again in the jar with the *Actinia*, though kept there for two hours, they did not once show themselves out of the shell. Once more placing them along with the other shells, they exhibited their former signs of life and activity. The experiment was repeated several times with a large *Littorina* with the same results, evincing fear of the *Actinia* on the part of the molluscs.”—J. P. COUTHOUY.

## 2. *ACTINIA PUSTULATA* (*Couthouy*).

*A. extus pustulata, medio cylindrica et 2'' crassa, infra supraque valde dilatata (fere 3''), basi angustissimè (1-1½'') inciso-lobata, margine superno tuberculata, tuberculis remotis, breviter tentaculiformibus; tentaculis subæquis, prælongis (fere 2'') et validioribus, subulatis, biseriatis; ore oblongo (¾'') valde prominente, intus sex-partito: contractâ, cylindrico-hemisphericâ.*

Exterior pustulate, at middle cylindrical and 2 inches broad, upper and lower extremities very much spread (nearly 3 inches in breadth), base at margin inciso-lobate with the lobes very narrow (1 to 1½ lines), upper margin tuberculate, the tubercles remote and like rudimentary tentacles; tentacles nearly equal, quite long (nearly 2 inches) and stout subulate, in two series; mouth oblong (¾ of an



inch), very prominent, with six lobes within: animal, when contracted, of a cylindrico-hemispherical form.

Plate 1, fig. 2, animal, expanded, natural size; *a*, a view of the mouth and disk; *b*, animal contracted.

Common on rocks at low tide off Praya Grande fort, Rio de Janeiro.

Prevailing colour, of body, bronze; a line of dark ochreous red on upper edge of disk and outside of the tentacles; tentacles, dull pale yellow, approaching to ochre; rudimentary tentacles with tips white; mouth reddish-brown, interrupted by a ring of green, and terminating in a white orifice, the inner edge of which is marked with a bright vermilion hue; disk, from base of tentacles to mouth, olive-green.—  
J. DRAYTON.

“The contracted animal resembles the upper half of a fig. When expanded, the disk is sometimes three inches in diameter, and the whole exterior surface has a pustular appearance. The base is divided into numerous protuberant small lobes, and dilates very much at times. The upper margin of the animal just exterior to the tentacles is coarsely beaded, and surrounded by a range of short rudimentary tentacles, with white tips and ochreous base. The mouth is very protuberant, and the oblong opening is rendered sexpartite by as many deep rugæ: this was constant in some fifty species, examined. When fully expanded, the disk is spread out like a broad rim beyond the body, and the base dilated in like manner. The colours of this Actinia are very variable, but the prevailing hue appeared to be a very deep olive-green for the body. Some individuals had the body of a crimson or purple colour, and the tentacles a deep green; others, the body a light brown, and the tentacles bright red with yellow cloudings. In many places they were grouped together in clusters of hundreds, and through the clear water, when calm, they presented the appearance of beds of submarine flowers, whose depth and brilliancy of colour of innumerable shades, are not surpassed by any of the flowers of the land.”—J. P. COUTHOUY.

### 3. ACTINIA VERATRA. (Drayton.)

*A. extus papillosa*, medio  $2\frac{1}{2}$ " crassa, infra supraque valde ( $3\frac{1}{4}$ " ) dilatata, basis margine undulata, margine superno uniseriatim tubercu-

*lata*; *tentaculis subæquis, prælongis* ( $1\frac{3}{4}$ "'), *sparsis, fere 3-seriatis, subulatis, nullis marginalibus*; *ore 1' oblongo, prominente.*

Exterior papillose, at middle  $2\frac{1}{2}$  inches broad, upper and lower extremities very much dilated ( $3\frac{1}{4}$  inches in breadth), margin of base undulate, upper margin uniseriately tuberculate; tentacles subequal, quite long ( $1\frac{3}{4}$  inches), scattered, nearly in 3-series, subulate, none marginal; mouth an inch long, prominent.

Plate 1, figure 3, animal natural size.

On the rocks of the shores at Wollongong, N. S. Wales. *Exp. Exp.*

Body, deep green and covered with small tubercles or papillæ of same colour as body; tentacles, bright grass-green, and peculiar in being situated midway between the mouth and edge of disk; disk bright orange, and darker between the base of the tentacles and the mouth; somewhat in folds by the contraction of its edge, on which is a row of green tubercles; colour of mouth green; of the opening, flesh-colour.

Another variety of this species was seen with the body a dull grass-green: tentacles and disk, pale sage-green.—J. DRAYTON.

b. *Tentaculis disci dimidio brevioribus.*—(Tentacles shorter than half the disk.)

#### 4. ACTINIA CLEMATIS. (*Drayton.*)

*A. depressa, extus pustulata, medio 2½'' crassa, infra supraque valde dilatata, disco latiore (4''), plicato-lobato, margine uniseriatim tuberculato, tuberculis sesquilinearibus; tentaculis brevibus (¾''), validis, numerosis (fere 5-seriatis), disci portione nudâ dimidio latitudinis angustiore; ore oblongo (¾''), prominulo.*

Depressed, exterior pustulate, at middle  $2\frac{1}{2}$  inches broad, upper and lower extremities much dilated, the upper most so and 4 inches broad, with the margin lobed and uniseriately tuberculate, tubercles a line and a half broad; tentacles short and rather stout, numerous (nearly in 5 series), the uncovered portion of the disk less than half the whole diameter; mouth oblong ( $\frac{2}{3}$  of an inch), but little prominent.

Plate 1, figs. 4 and 5, different varieties, natural size.

Valparaiso, Chili. *Exp. Exp.*

In one variety, the body, with the disk and tentacles, is of a deep rich green colour; the centre of the disk a little paler, the marginal tubercles a bright yellow, and the under part of the foot yellow. In another, the body is a deep crimson, with the tubercles of the lateral surface deep green, and the marginal tubercles vermilion; the tentacles dark lake, and the central part of the disk, a paler lake; under surface of the base, a bright orange, approaching to vermilion. The disk is very broadly dilated, and forms four or five lobes or folds, by an upturning of the margin.—J. DRAYTON.

5. ACTINIA FLORIDA. (*Drayton.*)

*A. confertim papillosa*, 2–2½" alta, medio 2¼" crassa, infra supraque parcè dilatata (3"), basis margine undulata, margine superno uniseriatim tuberculata, subplicata; tentaculis brevibus (5–6") subæquis, subulatis, validis, confertis, 5-subseriatis; ore prominente.

Exterior crowdedly papillose, height 2 to 2½ inches, at middle 2¼ inches thick; lower and upper extremities sparingly dilated (3 inches in breadth), margin of base undulate, upper margin uniseriately tuberculate, somewhat plicate; tentacles short (about half an inch), nearly equal, subulate, stout, crowded, in 5 imperfect series; mouth prominent.

Plate 2, figs. 6, 7, 8, different varieties, natural size.

Shores of San Lorenzo, off Callao, Peru. *Exp. Exp.*

The disk of this species is usually in five folds, and the tentacles cover a breadth of half to three-fourths of an inch. The surface of the disk, between the tentacles and the mouth, is strongly marked by numerous radiating lines. One variety has a royal smalt colour, with the small papillæ of the surface a fine ultramarine, the disk a paler blue, and the marginal tubercles pearly white. Another is verdigris green, with the papillæ of the same colour, and the marginal tubercles yellow. Another (fig. 8), apparently the same species, though a little higher (near 3 inches), has the papillæ of the lateral surface of a sap-

green colour on a reddish ground, with the tentacles a dull purple, the disk between the tentacles and the mouth light grayish-green, the mouth flesh-colour, and the under surface of the base scarlet.—  
J. DRAYTON.

Figure 26 may be the young of the above species.—J. DRAYTON.

#### 6. ACTINIA TABELLA. (*Drayton*).

*A. extus levis, medio vix 1" crassa, infra supraque valde dilatata (fere 2"), basis margine latè lobata, margine superno uniseriatim tuberculata; tentaculis brevibus (4'''), subæquis, validis, subulatis, confertis, 4-subseriatis; ore oblongo, prominente: contractâ, subglobosâ.*

Exterior smooth, animal scarcely an inch thick at middle, with the upper and lower extremities very much dilated (nearly two inches in breadth), margin of base broad lobed, upper margin tuberculate; tentacles short (4 lines), sub-equal, stout, subulate, crowded, in 4 imperfect series; mouth oblong and prominent: form of animal, subglobose when contracted.

Plate 2, fig. 9, animal natural size; *a*, same, contracted.

On the rocks of False Bay, Porto Praya, Cape de Verds. *Exp. Exp.*

Colour of animal throughout, a deep crimson, except the marginal tubercles, which are rather large and of a bright violet colour. When contracted, the form is nearly pyriform or subglobose, and the tentacles wholly disappear; the surface has fine parallel linings running perpendicularly, which are hardly perceptible when expanded.—  
J. P. COUTHOUY.

#### ACTINIA GRAMINEA. (*Drayton*.)

*A. extus levis, basi valde dilatata (2''), profundè lobata, et margine uniseriatim pustulata; supra subcylindrica, 1" crassa; disco parcè latior, margine superno uniseriatim tuberculato; tentaculis brevibus (3-4'''), subæquis, subulatis, subvalidis, confertim 3-seriatis, ore prominulo, orbiculato: contractâ, plano-conicâ.*

Exterior smooth, base very much dilated (to 2 inches in breadth), and deeply lobed with the margin finely pustulate in a single line; above, nearly cylindrical and an inch thick, with the disk scarcely broader; upper margin uniseriately tuberculate; tentacles short (3 to 4 lines), subequal, subulate, rather stout, crowdedly in 3 series; mouth a little prominent, circular: form of contracted animal a very low cone.

Plate 2, fig. 10, animal natural size; *a*, disk and tentacles; *b*, the same, contracted.

False Bay, Porto Praya, island of St. Jago, Cape de Verdes, in crevices along the rocky shores. *Exp. Exp.*

The base of this species is deeply divided into about 10 lobes, and on the outer margin of each, there is a range of minute tubercles. The colour of the exterior is a light green, delicately lined vertically with straw colour; tentacles light yellowish green; disk greenish and finely radiated with light yellow; the prominent mouth bright blue, with white around the opening. The tubercles of the upper margin are much smaller than in the *A. tabella*.—J. P. COUTHOUY.

ACTINIA DIADEMA. (*Drayton.*)

*A. sparsim verrucosa, basi dilatata (1¼"), et latè lobata; supra, cylindrica, 1" crassa, disco non latiore, margine superno uniseriatim tuberculato; tuberculis prominentibus; tentaculis brevibus (3-4"), subæquis, subulatis, subvalidis, confertim 4-seriatis; ore sæpe elevato: contractâ, alto-hemisphericâ.*

Body covered with scattered verrucæ; base a little dilated (1¼ inches in breadth) and broad lobed; above, cylindrical, an inch thick and the disk not broader; superior margin, with a single series of prominent tubercles; tentacles short (3 to 4 lines), subequal, subulate, rather stout, crowdedly in 4 series; mouth often much elevated: form of animal when contracted a prolonged hemisphere.

Plate 2, fig. 11, animal expanded, natural size; *a*, a view of the disk and prominent mouth; *b*, the animal contracted.

Rocks exposed to the surf, Porto Praya, Cape de Verdes. *Exp. Exp.*

The tentacles cover nearly the whole face of the disk, and have a crimson or dark lake colour. The exterior surface is purplish, with the scattered verrucæ, and the base, which is divided into 10 lobes, bright blue. The tubercles of the upper margin are very prominent and of a pale red colour. The disk is pale pink, deepening towards the mouth. When contracted, the animal much resembles a thimble in shape, and the tentacles are not entirely concealed. — J. P. COUTHOUY.

ACTINIA PRIMULA. (*Drayton.*)

*A. pumila, vix 1" crassa et alta, infra supraque parcè dilatata, basi non lobata, margine superno tuberculata; tentaculis brevibus (2-3"') et exiguis, 3-seriatis; ore prominulo, 1/3" oblongo; latere lineis coloratis verticalibus picto, lineis sæpe interruptis.*

Small, scarcely an inch high and broad, sparingly dilatate at each extremity, at base not lobed, upper margin tuberculate; tentacles short (2 to 3 lines) and slender, in 3 series; mouth somewhat prominent, a third of an inch long; sides marked vertically with coloured lines, which are sometimes interrupted.

Plate 2, figs. 12, 13, 14, 15, different varieties, natural size.

Shores of San Lorenzo, in tide pools. *Exp. Exp.*

In one variety, the exterior is of a flesh colour, with many dark orange parallel vertical lines; the tentacles are white at base, with orange tips; disk yellowish brown; the margin of the same with its tubercles green; mouth pale flesh-colour. Another has the exterior of a pink colour at base, with bright green above and vertical dotted lines of carmine; a carmine disk, bright yellow tentacles, and the marginal tubercles dull green. In another, the outer range of tentacles is white and the others red, the disk and mouth light blue, and the tubercles white: in another, white, clouded with pink and green, and dotted with crimson; the outer tentacles are white, the others brilliant carmine, disk pale lake, marginal tubercles green.

Figure 15 appears to be the same species. The threads passing

from its mouth are the spermatic cords, which are often protruded in a relaxed or exhausted state of the animal.

Figure 16 is another individual, having the general characteristics of the above, with prominent green tubercles to the margin, but no distinct tentacles: it is probably another species.—J. DRAYTON.

2. Margine superno non tuberculato.—(Upper margin not tuberculate.)

a. *Tentaculis capitatis, longis*.—(*Tentacles long and capitate*.)

ACTINIA CLAVIGERA. (*Drayton*.)

*A. turgidè urceolata*,  $2\frac{1}{4}$ " crassa, verticaliter et transversè lineata, basis margine vix lobata; tentaculis 1" longis, crassimis, apice rotundato-capitatis, 3-seriatis; ore prominulo.

Turgid urceolate,  $2\frac{1}{4}$  inches through the middle, vertically and transversely lined; margin of base scarcely lobed; tentacles very stout, an inch long, round capitate, in 3 series; mouth a little prominent.

Plate 2, fig. 17, the animal natural size.

Wilson's Island, Paumotu Group, Pacific Ocean. *Exp. Exp.*

The general colour of the body is deep orange, marked with longitudinal double lines, which are crossed transversely by single ones. The tentacles are whitish, with a band of purple near the middle, and two smaller bands nearer the apex; they are nearly one-sixth of an inch thick at base, and terminate in a rounded head, which is an eighth of an inch in diameter. The disk is deep brown, with indistinct radiating lines. The mouth is whitish.—J. DRAYTON.

b. *Tentaculis subulatis aut filiformibus, disci dimidio longioribus*.—(*Tentacles subulate or filiform, longer than half the disk*.)

ACTINIA IMPATIENS. (*Couthouy*.)

*A. subcylindrica*,  $1-1\frac{1}{2}$ " crassa, interdum valde elongata et contorta; latere levis, et supra corrugato-striata et subtiliter tesselatè picta, basi





*parcè dilatata; tentaculis subæquis, 1" longis, validis, subulatis, 2-seriatis; ore prominente, intus 8-partito.*

Nearly cylindrical, 1 to 1½ inches in diameter and height, sometimes very much elongated and writhing; sides smooth, but somewhat corrugato-striate, and above, colour delicately tessellated; base sparingly dilated; tentacles subequal, an inch long, stout, subulate, in 2 series; mouth prominent, with 8 lobes within.

Plate 3, fig. 18, animal, natural size; *a*, the disk and tentacles; *b*, *c*, *d*, *e*, *f*, forms sometimes assumed by the animal, sketched by J. P. Couthouy.

Among the crevices of rocks, in tide-pools, Orange Harbour, Terra del Fuego. *Exp. Exp.*

The body has nearly a flesh colour, except near the summit, where it is finely chequered with green; the tentacles and disk are deep crimson; the mouth has a small opening and a pale yellow colour.—  
J. DRAYTON.

ACTINIA MONILIFERA. (*Drayton.*)

*A. extus levis, 1" crassa, infra supraque dilatata (1½"), basis margine crenulato et monilifero, prope marginem quoque supernum superficie pariter moniliferâ; tentaculis exiguis, fere 1" longis, 3-seriatis; ore prominente.*

Animal, with the exterior smooth, an inch in diameter, below and above dilated (to 1½ inches), margin of base crenulate, and the surface adjoining appearing beaded; the surface near the upper margin also beaded; tentacles quite slender, nearly an inch long, in 3 series; mouth prominent.

Plate 3, fig. 19, expanded animal, natural size.

Obtained at low tide, at upper extremity of Bay of Islands, New Zealand.

The colour of the body is pale dull brown, with lines or irregular cross markings of a deeper colour. The bead-like structure gives it

the appearance of a beautifully ornamented pedestal. The tentacles are coloured with eight or ten bands alternately white and brown. The disk is dull yellow, and mouth dark flesh colour.—J. DRAYTON.

ACTINIA PRETIOSA. (*Dana.*)

*A. cylindrica, oblonga, 1½–2''' crassa, tentaculis 2-seriatis, exiguis, 2''' longis, subæquis; extus levis, sed maculis minutis, floriformibus, quinquelobatis, remotè sparsis, aliis punctiformibus; ore prominulo, oblongo.*

Cylindrical, oblong, 1½ to 2 lines in diameter; tentacles in 2 series, slender, 2 lines long, subequal; exterior surface smooth, but here and there a minute prominent spot looking like a flower with a simple 5-lobed corolla, besides other scattered dots.

Plate 3, fig. 20, animal enlarged; *a*, natural size.

The Feejee Islands, Pacific Ocean. *Exp. Exp.*

This small species was found attached to a fragment of coral in Sandalwood Bay, in the Feejee Group, island of Vanua-levu. It may possibly be a young individual. It was nearly two-thirds of an inch long when fully expanded, and part of the slender tentacles were turned inward and part outward. The exterior is peculiar in having distantly distributed over the surface minute rosette-like spots, as exhibited in the figure. The general colour is faint flesh-tint; the rosettes are rich carmine, with a white border, and look like gems over the surface; the tentacles are yellowish, with orange bases, and a bright red spot within, just above the point of attachment.

Figure 21, represents a young animal of some species of Actinia, found swimming free at the Feejees.

ACTINIA LINEOLATA. (*Couthouy.*)

*A. hemispherico-conica, valde depressa, 1¼'' lata; latere levis, verticaliter brunneo-lineata; tentaculis 24, biseriatis, 6–8''' longis, subvalidis; disco parvulo, lineis pallidis radiato; ore parvulo, orbiculato, non prominulo.*

Animal a low depressed rounded cone,  $1\frac{1}{4}$  inches broad, sides smooth, vertically lined with brown; tentacles 24, in 2 series, 6 to 8 lines long, rather stout; disk small, radiated with whitish lines; mouth small, circular, not prominent.

Plate 3, fig. 22, animal natural size; *a*, view of disk and tentacles.

On small stones just below low water mark, Forge Cove, near Orange Harbour, Terra del Fuego. *Exp. Exp.*

The diameter of this species is sometimes one and a half inches, though rarely found over half an inch. The body becomes nearly flat on contraction. Colour a pale ochre, on which are disposed a number of longitudinal lines of an amber colour, and arranged in regular order, a broader one alternating with two narrower, so as to leave between each of the broader lines, three ochreous ones of the same width. Near the inferior margin, the colours are fainter, giving it the aspect of being surrounded by an indistinct zone. The tentacles have a pale flesh colour. The disk is purplish-brown, with flesh-coloured lines extending from base of tentacles to near the centre, of a pale ochre colour. Mouth retaining a circular form, even in contraction, with convex ridges on its margin, which correspond to the tentacles. The tentacles of this species were constantly and very actively in motion, and it shifted its position much more frequently than usual, gliding readily over the smooth surface of the jar in which it was kept, by the contractions and expansions of its base.

The young were observed in several instances to be ejected from the mouth. They were at first attached to the parent by a white filiform pedicel, about a quarter of an inch long, which appeared like an extension of the base. In about five minutes after the expulsion, they separated with the pedicel still attached: shortly after, it gradually contracted, disappeared, and in a quarter of an hour they attached themselves to the bottom, and fully expanded. They resembled the parent, but were paler and more transparent.—J. P. COUTHOUY.

ACTINIA CRUENTATA. (*Couthouy*)

*A. conico-subhemispherica, basi parvè dilatata, latere concentricè corrugata et tuberculata, tuberculis parvulis, suctoriis, verticaliter seriatis,*

*infra obsolete; tentaculis numerosis, fere 1" longis, subæquis, validis; ore prominente, intus 4-partito; disco lineis pallidis radiato.*

Conico-subhemispherical, sparingly dilated at base, sides concentrically wrinkled and tuberculate, tubercles small, suctorial, vertically seriate, obsolete below; tentacles numerous, nearly an inch long, subequal, stout; mouth prominent, four-cleft within; disk radiated with whitish lines.

Plate 3, fig. 23, natural size; *a*, disk with the tentacles.

Saddle Island, entrance of Orange Bay, Terra del Fuego. *Exp. Exp.*

This brilliant species, which for its colour may vie with any of its tropical congeners, was obtained at low water among the rocks, where it was buried in the sand, with its tentacles barely visible. When expanded, its form is subconical, the base being considerably more dilated than the disk. In contraction, it resembles in form the upper half of a fig. The ground colour is a faint purplish red, on which are numerous longitudinal lines of darker red, which toward the disk deepen into crimson, with a tinge of purple. Between these lines are a series of small perforate sucker-tubercles of a rose-white colour, most apparent near the disk, and disappearing wholly at the basal margin. To these suckers, the sand and small gravel adhered with considerable tenacity. They had a yellow colour when fully expanded, and were  $\frac{1}{8}$  of an inch in diameter. The tentacles are numerous, long, subulate, (about forty-six were counted,) of an intense blood-red. From their base to the mouth, the colour is a brownish purple, alternating with narrow pale ochreous lines. The mouth is orange-red at base, deepening towards the summit into the colour of the tentacles. When fully expanded, the mouth exhibits four distinct protuberances.—J. P. COUTHOUY.

ACTINIA DECORATA. (*Couthouy.*)

*A. subcylindrica, medio 1¼" crassa, basi latè dilatata et sinuosè lobata, lateribus supra nudis, infra tuberculiferis, tuberculis perforatis; margine superno non tuberculato; tentaculis ¾" longis, filiformibus, (vix ⅓" crassis), 3-seriatis, confertis, externis brevioribus: contractâ, conico-rotundatâ.*

Subcylindrical, at middle  $1\frac{1}{4}$  inches in diameter, base broadly dilated and sinuously lobed; sides naked above, below tuberculiferous and tubercles perforate; upper margin not tuberculate; tentacles  $\frac{2}{3}$  of an inch long, filiform (scarcely  $\frac{1}{3}$  of a line thick), in 3 series, crowded, the external a little shorter: when contracted, shape rounded-conical.

Plate 3, fig. 24, three individuals, one of them contracted and the other expanded, natural size.

Lagoon of Honden Island, attached to a dead *Natica*. *Exp. Exp.*

The body has a rich blood-red and orange colour, which is darkest at the middle, and is surrounded about one third up from the basal margin by an irregular zone of small white perforate tubercles, from which it occasionally protrudes a slender flesh-coloured vermiform organ to an inch in length [spermatic cords?]. From these tubercles to the margin of the spreading base, the body is veined longitudinally with purplish-brown lines, having dull blue broader ones between. The margin itself is reddish-brown. The tentacles are long and slender, with the outer shortest, which are finely maculated with purplish-brown and white. The margin of the disk is of an amber colour, inside of which there is a zone of white, then one of purplish-brown, then a second of white, then another of paler brown, and a third white zone around the prominent mouth. The edge of the mouth is rich orange; the aperture is linear. The white zones of the disk are crossed and interrupted by bands radiating from the mouth, and deepening from a light brown at middle, to purple at the margin and at the mouth. When fully expanded, the disk is cyathiform and not flat, as usual; and the tentacles lie spread out flat, so that it resembles a beautiful aster. It contracts very rapidly, but is slow in expansion. It is very sensitive to light. The body colour presents a streaky appearance, and has a downy look, difficult to represent in a drawing.—J. P. COUTHOUY.

The fact that the exterior tentacles are the shortest, might remove the species from this division; but the difference in length is small.

c. *Tentaculis disci dimidio brevioribus.*—(Tentacles shorter than half the disk.)

ACTINIA PAUMOTENSIS. (*Couthouy.*)

*A. depressa, extus levis, medio 6" crassa, supra latissimè dilatata (12"), margine superno sublobata aut plicato-undulata, non tuberculata; tentaculis numerosis, subæquis, fere 1½" longis, validis, subulatis, portionem disci majorem tegentibus; disco radiato, et subtus leviter tuberculato; ore prominulo.*

Depressed, exterior smooth, 6 inches thick at middle, above very widely dilated (12 inches), upper margin sublobate or plicato-undulate, not tuberculate; tentacles numerous, subequal, nearly 1½ inches long, stout, subulate, covering the larger part of the disk; disk rather strongly marked with radiating lines, and below faintly tuberculate; mouth but little prominent.

Plate 3, fig. 25, animal half the natural size.

From the coral reefs, island of Raraka, Paumotu Archipelago.

The colour of the body is light brown; disk, yellowish flesh colour; mouth flesh colour, and not very prominent. The tentacles are faint yellowish-white, tipped with lake, and marked with eight or nine transverse lines.—J. DRAYTON.

This species was truly magnificent when seen spread out in the water, the disk expanding at least a foot in diameter, and densely covered with large tentacles, tipped with bright lake; the margin undulating, so as to form numerous lobes, each of which had the appearance of being a separate Actinia, and the whole resembling a beautiful bouquet.—J. P. COUTHOUY.

ACTINIA MOLLIS. (*Couthouy.*)

*A. medio 1" crassa, basi parce dilatata, disco valde dilatata et inæqualiter 5-lobata, margine crenulato, tentaculis numerosis, brevissimis, clavatis, in triangula radiata 20 dispositis; ore 4-lobato.*

Body 1 inch in diameter at middle, at base sparingly dilated; disk much dilated, and unequally 5-lobed; margin crenulate, tentacles

numerous, very short, clavate, arranged in about 20 radiating triangular groups; mouth 4-lobed.

Plate 3, fig. 26, the expanded animal, natural size; 27, the same in one of its positions; *b*, outline of the mouth showing its form.

Lagoon of Clermont Tonnerre. *Exp. Exp.*

The body is very soft and easily injured. The colours sloughed off in forty-eight hours, but the specimen lived about six days, and in that time diminished its size full two-thirds. The sides of the fresh specimen were streaked with interrupted lines of a delicate lake, except near the margin of the base, which is colourless, and a zone of dark ochre above, where it is marked vertically by short dark brown lines. The margin of the disk forms five irregular lobes; it has a faint ochreous colour as far as the innermost tentacles, but thence to the mouth the colour is pale rose, with numerous radiating lines of lake like those on the body. The tentacles are colourless, except at their tips, which are opaque white. They are short, clavate, and, when contracted, resemble little pimples; they are not in concentric series, but constitute about twenty groups of a triangular form, the apex towards the centre.

This zoophyte was continually shifting its position by means of its foot or base, which it used almost precisely like the gasteropod molluscs. It also altered its form greatly, sometimes stretching into a long cylinder, or curving and contracting in every way, and sometimes it was almost flat.—J. P. COUTHOUY.

#### ACTINIA ACHATES. (*Drayton.*)

*A. subcylindrica*, medio 1" crassa, supra dilatata ( $1\frac{1}{3}$ " ) et profundè sinuoso-lobata, lobis quinque aut sex; extus levis; tentaculis 3-seriatis, brevibus (vix 2'' ) et exiguis ( $\frac{1}{3}$ '' ), submarginalibus, ore prominulo 6-partito.

Subcylindrical, about an inch through at middle, above dilated and profoundly sinuoso-lobate; lobes 5 or 6; exterior smooth; tentacles in 3 series, quite short (2 lines) and slender ( $\frac{1}{3}$  of a line), submarginal; mouth a little prominent, 6-partite.

Plate 3, fig. 28, expanded animal, natural size; *a*, the disk showing its lobed form.



Dredged up in thirty fathoms, off the east coast of Patagonia.

The general colour of the exterior is a light ochre. The disk has a brownish salmon tint, and the tentacles are a pale shade of the same, or slightly purplish.

ACTINIA PAPAVER. (Drayton.)

*A. extus levis; depressa, medio 2¼" crassa, infra supraque valde dilatata (3"); basis margine leviter crenulato, margine superno non tuberculato, vix undulato; tentaculis numerosis, ferè ¾" longis, validis, subulatis, 3-seriatis; ore ¾" oblongo, prominente.*

Animal, with the exterior smooth; body depressed, 2¼ inches thick at middle, much dilated above and below (3 inches in breadth); margin of base faintly crenulate, upper margin not tuberculate, scarcely undulate; tentacles numerous, nearly ¾ of an inch long, stout, subulate, in 3 series; mouth ¾ of an inch long, prominent.

Plate 4, fig. 29, animal natural size.

From the rocks exposed to the surf, Wollongong, Illawarra, New South Wales. *Exp. Exp.*

This species is found most abundant on rocks exposed to the surf, a little above low-water mark; they are, therefore, for a short time exposed out of water, at the receding of the waves, until the tide covers them again. The colour of the body is a rich brownish-purple, with regular longitudinal lines of a darker purple, crossed by finer transverse lines; tentacles red, the inner darkest; disk and sides of mouth a deep brownish-purple; mouth within, dark orange.

Another variety of this species was seen with a brownish-green body and disk, and tentacles of the same colour, but paler.—J. DRAYTON.

ACTINIA PLUVIA. (Drayton.)

*A. minutè tuberculata, medio (2½") crassa, infra supraque valde dilatata (3¼"), basis margine undulata, margine superno non tuberculata; tentaculis subconfertis, 3-seriatis, 6" longis, validis, subulatis; disco valde radiato; ore prominulo, 6-8" oblongo.*



Minutely tuberculate or papillose, at middle  $2\frac{1}{2}$  inches in diameter; upper and lower extremities much dilated ( $3\frac{1}{4}$  inches in breadth), margin of base undulate, upper margin not tuberculate; tentacles somewhat crowded, in 3 series, 6 lines long, stout, subulate; disk strongly marked with radiated lines; mouth a little prominent, 6 to 8 lines long.

Plate 4, fig. 30, animal natural size; *a*, part of the surface of one of the varieties.

From rocks, island of San Lorenzo, Callao, Peru.

This Actinia varies much in colour. Some are bright orange throughout, with the tentacles a little darker, and the disk paler. In others, the tentacles are of a dull red: others, a very pale red, with the mouth a very deep red. In others, the ground colour of the body is a dark brownish-green, papillæ bright orange, tipped with small white beads or dots (fig. 30 *b*). The tentacles are over a line thick at base. The orange or salmon-coloured species, on an attempt being made to detach it from the rocks, ejected the water from all its tentacles to a distance of 2 or 3 feet.—J. P. COUTHOUY.

ACTINIA RETICULATA. (*Couthouy*.)

*A. extus levis et reticulatè corrugata, subcylindrica, 1½'' alta et 2½'' crassa, cum disco valde dilatato (3½''), margine leviter 5-lobato, non tuberculato; tentaculis numerosis, brevibus (3''), non turgidis, portionemque disci majorem tegentibus, internis paululo majoribus, ore prominulo, 6-8'' oblongo.*

Exterior smooth and reticulately corrugate, subcylindrical, one and a half inches high, and two and a half thick, with the disk very much dilated ( $3\frac{1}{2}$  inches in breadth), and margin somewhat five-lobed, not tuberculate; tentacles very numerous, quite short (3 lines), not turgid, and covering the larger part of the disk, the inner a little the largest; mouth somewhat prominent, 6 to 8 lines long.

Plate 4, fig. 31, the expanded animal, natural size; *a*, the same contracted, of nearly a hemispherical form.

Orange Harbour, Terra del Fuego. *Exp. Exp.*

This Actinia was found near the watering cove, Orange Harbour, adhering to stones and shells. The body is of a fulvous orange (sometimes olive-brown), with an indistinct zone of black surrounding the superior margin, and covered with a sort of raised network, produced by the corrugations of the external envelope. This reticulation is most apparent and very regular, when the animal is fully expanded; but in a state of contraction (fig. 31, *a*) it disappears, and assumes a simple rugose appearance. The disk is broadly dilated, and the five lobes, or folds, are never effaced so as to leave the disk circular. Tentacles short, subulate, and disposed in nine or ten close alternate series; colour olivaceous; the inner ones largest, decreasing to marginal ones, which are mere papillæ. The prominent mouth is of a velvet purplish-black, coloured with olive at the margin of the opening. The disk from base of tentacles to the mouth, is of a bright ochreous colour, with strong radiating lines, crossed by others of a pale olive-green. The protuberant mouth is oblong and rigid.

In detaching the specimen from the rock, the base was lacerated so as to expose the ovaries. It was placed directly in a jar of water, and the next morning there were about fifty small ones adhering to the bottom of the jar, from the size of a pin's head to three-eighths of an inch in diameter. These little ones were observed to have the body proportionally much longer than the parent, with fewer series of tentacles—the smallest had but two, and the largest five. They seemed to be in full enjoyment of all the functions of life, attaching themselves quickly to the jar, shells, or even living animals, ten of them having crawled upon a *Sigaretus*, and fixed themselves on his back. This Actinia is remarkable for the opacity of all its parts; the colours are all soft and rich, but even in the young they lack that transparency usually met with in these zoophytes. A number of small crustacea (*Spheroma* and *Gammaridæ*) were found in the stomach, captured probably by means of the tentacles, to which every thing sticks that comes in contact with them.—J. P. COUTHOUY.

ACTINIA FUEGIENSIS. (*Couthouy.*)

*A. subcylindrica*, 2" crassa, extus levis, supra infraque parce dilatata, basis margine pauhum undulata; tentaculis undique remotèque sparsis, turgidis, 3" longis; ore parvulo, orbiculato, 5-partito: contractâ, valde depressâ, convexâ.

Subcylindrical, 2 inches in diameter, exterior smooth, upper and lower extremities sparingly dilated, margin of base slightly undulate; tentacles throughout remotely scattered, turgid, 3 lines long; mouth small, circular, 5-cleft: form of animal when contracted very much depressed, convex.

Plate 4, fig. 32, expanded animal, natural size; *a*, upper view of the disk; *b*, animal contracted.

From rocks, on the shores of Orange Harbour, Terra del Fuego.

The tentacles in this species have nearly "the form of a grain of wheat," and are of a grass-green colour; they are scattered over the disk about a line or a line and a half apart, and nearly in five series. The disk is of a bright orange colour, and the body externally a darker orange, with transverse parallel lines or markings of dark brown; the mouth is but little elevated, 5-lobed, and of a pale orange colour, with quite a small opening.—J. P. COUTHOUY.

ACTINIA NYMPHÆA. (*Drayton.*)

*A. pumila*, 8''' alta, extus levis, infra supraque dilatata (1''), basi bene crenata, crenaturis 1½''' latis, lateribusque pariter lineis verticalibus notata; tentaculis brevibus (2-2½'''), 3-seriatis, exiguis, ore prominulo, ⅙'' oblongo: contractâ, truncato-conicâ valde depressâ.

Small, 8 lines high, exterior smooth; upper and lower extremities dilated (1 inch in breadth); margin of base regularly crenate, crenatures a line and a half broad, sides correspondingly marked with vertical lines; tentacles short (2-2½ lines in length), in 3 series, slender; mouth a little prominent, and one-sixth of an inch long: the form of the contracted animal a very low depressed truncated cone.

Plate 4, fig. 33, expanded animal, natural size; *a*, the same contracted.

Valparaiso, Chili. *Exp. Exp.*

This species has a whitish exterior, marked vertically with pale ochreous lines, about a line and a half apart. The disk is of a pale

purplish tint, and the tentacles are yellow. It is near the *primula*, but the vertical lines are more distant, and the margin of the disk is not tuberculate.—J. DRAYTON.

ACTINIA RUBUS. (*Drayton.*)

*A. pumila*, 9''' alta, extus levis; infra, supraque dilatata (fere 1'' lata), basi crenata, crenaturis 1''' lata, lateribusque lineis verticalibus sæpe interruptis notata; tentaculis brevibus ( $2\frac{1}{2}$ '''), 2-seriatis; ore prominulo, fere  $\frac{1}{6}$ '' oblongo.

Small,  $\frac{3}{4}$  of an inch high, exterior smooth; upper and lower extremities dilated (nearly an inch broad), base crenated, and crenatures a line broad, sides marked with vertical interrupted lines; tentacles short ( $2\frac{1}{2}$  lines in length), in 2 series; mouth a little prominent, nearly a sixth of an inch long.

Plate 4, fig. 34, animal natural size; *a*, same, contracted.

Valparaiso, Chili. *Exp. Exp.*

The colour of the body is ash-brown, marked vertically with slate-coloured dotted lines. The tentacles are white; disk rich purple; mouth the same, except at the opening, which is whitish.—J. DRAYTON.

ACTINIA GEMMA. (*Drayton.*)

*A. pumila*, subcylindrica,  $\frac{1}{2}$ '' crassa, extus tuberculata, tuberculis contiguus; disco vix dilatato; tentaculis brevibus ( $2\frac{1}{2}$ '''), 2-seriatis, subexiguus: contractâ, pyriformi.

Small, nearly cylindrical,  $\frac{1}{2}$  an inch thick, exterior with contiguous tubercles; disk scarcely at all dilated; tentacles short ( $2\frac{1}{2}$  lines long), in 2 series, rather slender; animal, when contracted, pyriform.

Plate 4, fig. 35, the expanded animal, natural size; *a*, the same contracted.

False Bay, Porto Praya, Cape de Verdes. *Exp. Exp.*

The body, when contracted, is pyriform. The general colour of the exterior is a dusky gray or ash, with small tubercles of a pale blue, arranged in a regular series, with undulating longitudinal lines or wrinkles between. The disk scarcely extends beyond the body, and is irregularly indented. The two ranges of adhering tentacles have a pale yellow colour, faintly tipped with light carmine or rose, and wholly disappear on contraction. Only three individuals of this species were found, and these were adhering to a Buccinum.—J. P. COUTHOUY.

ACTINIA CURTA. (*Drayton*.)

*A. pumila, valde depressa, 6-8''' lata et vix 1½''' alta, basi dilatata et lobata, sed disco vix dilatato; tentaculis subæquis, 3''' longis, 2-seriatis, subvalidis.*

Small, very much depressed, 6 to 8 lines broad, and scarcely 1½ lines high, dilated at base and lobed, but disk scarcely at all spreading; tentacles subequal, 3 lines long, in 2 series, rather stout.

Plate 4, fig. 36, animal natural size; *a*, upper view of the same.

False Bay, Porto Praya, Cape de Verdes. *Exp. Exp.*

Only two specimens of this curious Actinia were found. One in a dead shell of *Cypræa Leonida*, and the other, inside of an empty shell of *Purpura neritoidea*. The colour of the body is green, clouded with dark brown; the dilated part of the base is rich blue; the tentacles yellowish-green, darker at base, and the disk ochreous yellow. The mouth is a little prominent and elliptical.—J. P. COUTHOUY.

II. TENTACULIS EXTERNIS VALDE MINORIBUS.

ACTINIA RHODORA. (*Couthouy*.)

*A. subhemispherica, 1½''' crassa, extus levis, basi dilatata et parcè lobata; tentaculis subulatis, 3-seriatis, internis 1''' longis, externis vix ½'', subvalidis, ore turgido valdeque eminente, 6-partito.*

Subhemispherical,  $1\frac{1}{2}$  inches thick, exterior smooth, base dilated and sparingly lobed; tentacles subulate, rather stout, in 3 series, the internal 1 inch long, the external a third of an inch; mouth very turgidly prominent, 6-cleft within.

Plate 4, fig. 37, expanded animal, natural size; *a*, upper view of the disk and tentacles.

Hospital Island, Rio de Janeiro. *Exp. Exp.*

The unequal tentacles and the almost globular projecting mouth, 6-cleft within, are striking characters of this species. The general colour of the body is a bright lake, with paler vertical lines; the tentacles have a reddish ochre tint, becoming bluish at base; and the disk, which is of a bright lake, is strongly marked with lines running from the base of the tentacles to the mouth prominence. The mouth is of a bright rose-red colour, deeper within. When expanded, the species presents a flat disk, having the appearance of a beautiful aster.—J. P. COUTHOUY.

### III. TENTACULIS INTERNIS VALDE MINORIBUS.

#### ACTINIA ARTEMISIA. (*Pickering.*)

*A. suburceolata*, medio  $2\frac{1}{4}$ " crassa et valde turgida, disco paulum dilatata, lateribus per tubercula seriata verticaliter notatis, tuberculis prominentibus, infra obsolete; tentaculis 3-seriatis, subulatis, validis, internis semipollicaribus, externis pollicaribus; disco leviter radiato; ore parvulo, lobato.

Suburceolate, at middle very turgid and  $2\frac{1}{4}$  inches through, disk somewhat dilated; sides studded with vertical series of prominent tubercles, which become obsolete below; tentacles in 3 series, stout, subulate, the inner half an inch, the exterior an inch, in length; disk faintly radiate; mouth small, lobate.

Plate 4, fig. 38, animal natural size; *a*, a view of the disk and tentacles.

Abundant in Discovery Harbour, Puget's Sound, Northwest Coast of America.

The general colour of the exterior of the body is a yellowish-green. The tubercles have a dark sap-green colour; they become obsolete below, yet the green line continues to the base of the animal. The colours of the tentacles are various and shaded like those of the prism; the disk is dull greenish, becoming darker towards the base of the tentacles, and the mouth is flesh-coloured.—J. DRAYTON.

This species occurs, buried in the sand, and also attached to pebbles or shells, two or three inches below the surface. When left by the tide, it is easy to mistake the hole in the sand which covers them, for the water-tubes of a Mya. On contracting, water spurts from various small lateral orifices, as from a watering-pot.—C. PICKERING.

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GENUS II.—METRIDIDIUM.—OKEN.

*Actinidæ basi affixæ, aliis tentaculis simplicissimis, nudis, et aliis tentaculis vel appendicibus frondescentibus, aut marginalibus, aut sparsis.*

Actinidæ attached at base, having some simple naked tentacles and other frondescent tentacles or appendages, either marginal or scattered over the disk.

METRIDIDIUM PRÆTEXTUM. (Couthouy.)

*M. cylindricum, maximum, 2½'' crassum et sæpe 6'' elongatum, extus leve, basi vix dilatatum et margine bene crenatum, crenaturis 2''' latis; tentaculis internis, 2-seriatis, longis (1¼'') et flagelliformibus, subvalidis; externis paulo brevioribus, 3''' latis, frondescenter laciniatis aut subtiliter lobatis, latere coalitis et apice tantum liberis, superficie poris tubulatis paucibus instructâ.*

Very large cylindrical, 2½ inches in diameter, and often 6 inches long, exterior smooth, base scarcely dilated and neatly crenate at margin, with the crenatures a sixth of an inch broad; inner tentacles long (1¼ inches) and flagelliform, rather stout; external a little shorter, 3 lines wide, frondescently lacinate or delicately lobed,

coalescing by their sides with only the apex free; a few tubulate pores over the surface.

Plate 5, fig. 39, animal natural size; *a*, under surface of exterior tentacular appendages; *b*, upper view of disk.

Harbour of Rio de Janeiro. *Exp. Exp.*

This splendid species has a flesh-red exterior, shading into orange above, and finally into a rich purple directly beneath the disk. The inner tentacles resemble those of the common Actiniæ. The external tentacular appendage extends around the summit of the animal like a ruffle or fringe, and consists of about fifty spatulate divisions, the margins of which are ornamented with numerous short frondescent lobes and tufts. These divisions adhere to one another to within rather more than a fourth of an inch from the extremity, and here, between each, there is an irregular indentation. Small tubular orifices are irregularly scattered over the surface of these lobes, which are for the most part surrounded by short mossy foliations. While the upper surface is nearly flat, the under surface of each division is convex, and over it are scattered small tubercle-like projections, apparently corresponding to the orifices above. This tentacular fringe is capable of great dilatation and contraction, the diameter varying at different times from two to four inches. Sometimes it is elevated nearly perpendicularly, and the summit has the shape of a cup or goblet; again it curves inward and nearly conceals the disk; again the fringe like the richest embroidery hangs gracefully drooping from the margin.

The foot or base of the animal is a bright vermilion, and the same colour is diffused in fine dots over the body on a light yellow ground, besides forming vertical lines or stripes of rather indistinct outline. These lines are continued into the crenatures or small prominences that margin the base, and the bottom of the base itself is radiately striated to correspond with the same. The upper surface of the tentacular fringe has the lobes alternately dark olive-green and brownish, clouded with a light ash tint. The disk is marked with alternate stripes of orange and brown radiating from the mouth to the tentacles, where these colours pass into a pale dull red: this shade characterizes the tentacles, which are also marked with ashy ocellations near their base, and sometimes near half way to their tips.

This species adheres to stones like other Actinidæ, but is found covered with sand, with its disk expanded just level with the surface.



The specimens affording this description were obtained in two fathoms water, off Santa Cruz. Smaller specimens were seen in sandy pools left by the tide among the rocks, on the north side of the harbour near Praya Grande. When molested, they conceal themselves entirely beneath the sand.

While kept confined, the form was constantly varying; at one moment, becoming a flat disk, and the next extended to a length of six inches. It moved about upon the sides of the glass with considerable ease, by means of its exterior tentacular fringe, crawling up the sides of the jar, a length of sixteen inches, in about five hours. No stinging sensation was perceptible while handling it; but when the disk was touched to the tongue or lips, it was very apparent, and the irritation lasted from twenty minutes to an hour.

Another allied species was observed by Dr. Pickering in the sand among the rocks outside of the harbour.—J. P. COUTHOUY.

METRIDIUM CONCINNATUM. (*Drayton.*)

*M. depressum, medio 2'' crassum, infra supraque dilatatum, disco 3'' lato, valde radiato, margine plicato-lobato; lateribus tuberculosis, tuberculis suctoriis; tentaculis internis subulatis, validis, sparsis, ½'' longis, canaliculatis, et fere triangulatis; fimbrio-tentaculis externis, fere ½'' longis et 1-1½'' latis, frondescenter laciniatis.*

Depressed, 2 inches in diameter at middle; upper and lower extremities dilated; disk 3 inches broad, strongly radiate, margin plicato-lobate; sides tuberculous, tubercles suctorial; inner tentacles half an inch long, stout, subulate, scattered, channelled and almost triangular; fringe-tentacles external, nearly ½ an inch long, and 1 to 1½ lines broad, frondescently lacinate.

Plate 5, fig. 40, animal natural size; *a*, one of the tentacles; *b*, a transverse section of the same. 41. The animal as it occurs half-concealed in the sand.

San Lorenzo, Callao, Peru. *Exp. Exp.*

The ground colour of the body is ochreous-olive, while the vesicles are olive-green. The inner tentacles have nearly the colour of the body, though paler, and are faintly striped with pale purple. The

disk is purple, with strong radiating lines; another variety has a green ground with ochreous tubercles.—J. DRAYTON.

This species resembles the *prætextum*, and was found, like that, burrowing in the sand. The body is covered with large tuberculiform suckers, to which fragments of shells and pebbles adhere; the delicate foliated appendages look like embroidery, and one of a brown tint alternates with three white ones. The tentacles are subtriangular, the outside being slightly concave. Specimens were seen extending to more than three inches in diameter.—J. P. COUTHOUY.

METRIDIUM MUSCOSUM. (*Drayton.*)

*M. valde depressum*, 1" altum, et 2½" crassum, lateribus per vesicula suctoria armatis; disco margine vix plicato, leviter radiato; tentaculis subulatis fere ¾" longis, validis, 3-seriatis, appendicibus frondescentibus undique sparsis, vix 3" superantibus.

Much depressed, an inch high, and 2½ inches in diameter; sides furnished with suctorial vesicles; disk faintly radiated, scarcely plicate at the margin; tentacles subulate, in three series, nearly ¾ of an inch long, stout, and scattered among them are numerous frondescent appendages, not over three lines in length.

Plate 5, fig. 42, the expanded animal of the natural size; 43, the same, as it lies embedded in the sand.

From sandy pools among the rocks, left by the tide, Wollongong, Illawarra, New South Wales. *Exp. Exp.*

The animal becomes quite thin when much dilated, and the base spreads to about two and a half inches in diameter. The body has a yellowish sage-green colour, with longitudinal and transverse markings of brown, and it is covered, not very thickly, with suckers, to which fragments of shells, pebbles, &c., adhere; the suckers project considerably, and are of a purplish-brown colour. There are three ranges of subulate tentacles, of the same colour as the body, and about three-fourths of an inch long; the middle range is opaque, and is marked by four white and four umber-coloured bands. Near the base of each tentacle, the animal is furnished with short leafy appendages, more

simple in form than those of the preceding species. The disk has a rich purplish-brown colour, and the mouth is bright green, with the interior vermilion.

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FAMILY II.—ASTRÆIDÆ.

*Animalia multitentaculata. Tentacula margine discorum disposita. Disci aut simplices, aut seriatim gemmantes et lineis confluentes. Coralla calcarea, cellis radiatis excavatis, lamellis, corallis aggregatis, ex uno ad alium centrum non productis, sed medio septi sæpius interruptis, itaque stellis circumscriptis.*

Animals with numerous tentacles arranged along the margin of the disks, and covered by the same on contraction. The disks either simple, or budding in lines and long-confluent. Coralla calcareous, with concave radiate cells; lamellæ, in aggregate species, not continuous from one centre to another, but generally interrupted half-way; the stars, therefore, circumscribed.

The Astræidæ are various in their forms and modes of growth. The massive species assume hemispherical shapes, rarely nodular, with the surface of the coralla, in some cases, pitted with concave stellate cells (Astrææ), and, in others, marked with meandering channels and ridges (Meandrinæ, some Mussæ, Ctenophylliæ, and some Manicinæ); in the former, each cell is covered, when alive, with a polyp-flower; and, in the latter, the confluent disks and tentacles of a series of polyps occupy the channels. In a few species, the cells are confluent also *across* the ridges (Monticulariæ), and, consequently, instead of ridges, conical prominences cover the surface, which have a stellated structure from the lamellæ that meet and constitute them (§ 77).

In many of the Astræidæ, the several calicles form distinct branches (§ 79) (Euphylliæ, Mussæ, Manicinæ, Caulastrææ); and in these, the

cells may be simple, belonging to a single polyp,—or a long line or series may be united, so as to form a meandering trench. There are thus the simple and meandrine forms of the calicularly branched species, as well as of the aggregate. Like the latter, these segregate zoophytes are usually hemispherical, remarkably perfect in symmetry, and often many feet in diameter.

Besides these, there are also foliated species. The folia are sometimes clustered in convex clumps (*Merulinæ*), and each leaf is gracefully and delicately modelled, the ridges of the surface constituting its nervures. The cells are indistinct, and lie in furrows between the ridges, and the species, therefore, are properly foliaceous *Meandrinæ*; the lamellæ of the ridges are a little oblique, owing to the mode of growth. Branching forms also occur of the same general character.

A few of the foliaceous *Astræidæ* (*Echinoporæ*) have the surface simply striated and spinulous, and the cells are circular and somewhat prominent (§ 76). A branching species of this genus is a connecting link between these corals and the *Oculinæ*.

Other foliate species (*Tridacophylliæ*) have large expanded cells, partially enclosed by ascending folia, which are striated with narrow and nearly entire lamellæ. The folia correspond to the septa of other species, which are here thin and leaf-like. Other cells often occur on the surfaces of the folia, in which case, they resemble the *Pavoniæ*.

Besides the instance of the branching *Echinopora* uniting this family to the *Caryophyllidæ*, through the *Oculinæ*, there are also certain tubular *Astrææ*, which approximate in their coralla closely to other *Caryophyllidæ*, and especially to the genus *Astreopora* and *Astroitis*, in which, as the species are massive, the mode of budding cannot always be easily determined. The many transverse dissepiments, uniting the lamellæ by their lateral surfaces, will seldom fail, however, to distinguish the *Astræas*. The characters separating them from the *Cyathophyllidæ*, will be stated in the remarks upon that family.

The corals of this family are confined, with rare exceptions, to the coral-reef seas.

The annexed table gives a view of the genera of *Astræidæ*, as used by different authors since Lamarck.



RECEIVED GENERA.	EHRENBERG.	BLAINVILLE.	SCHWIGGER.	OKEN.	LAMARCK.
	1832.	1830.	1820.	1816.	
Mussa, <i>Oken.</i>	} Caryophyllia.	} Lobophyllia.	} Lithodendrum ( <i>in part.</i> )	} Mussa.	} Caryophyllia (1801) ( <i>in part</i> ), with part of Turbinolia.
Euphyllia, <i>D.</i>					
Caulastræa, <i>D.</i>					
Astræa, <i>Lk.</i>	} Astræa. Favia, <i>Oken.</i> Explanaria ( <i>in part.</i> )	} Astræa.	} Astræa. Favia.	} Astræa (1801). (Astroites of Cuvier (1798)).	
Monticularia, <i>Lk.</i>					
Meandrina, <i>Lk.</i>					
Manicina, <i>Ehr.</i>	} Meandrina. Manicina.	} Meandrina.	} Meandrina.	} Meandrina (1801). (Meandrites of Cuvier (1798)).	
Ctenophyllia, <i>D.</i>					
Tridacophyllia, <i>Bl.</i>		Tridacophyllia.	Pavonia ( <i>in part.</i> ).	Pectinia ( <i>in part.</i> ).	Pavonia (1801) ( <i>in part.</i> ).
Merulina, <i>Ehr.</i>	Merulina.	Agaricia ( <i>in part.</i> ).	Agaricia ( <i>in part.</i> )	Myccidium ( <i>in part.</i> ).	Agaricia (1801) ( <i>in part.</i> ).
Echinopora, <i>Lk.</i>	Refd. to Madrepora.	Echinastrea, <i>Bl.</i>	Echinopora.		Echinopora (1812).
Phyllastræa, <i>D.</i>					

The genera of Astræidæ may be arranged and characterized from the coralla as follows :

I. *Lamellæ of the cells large, and entire or nearly so; coralla calicularly branched, or stipitate (explanato-glomerate).*

GENUS I. EUPHYLLIA. Coralla calicularly branched, calicles subturbinate, lamellæ thin, bottom of the cell very narrow and often concealed by the large lamellæ.

GENUS II. CTENOPHYLLIA. Coralla explanato-glomerate, meandrine; lamellæ very stout and remote.

II. *Lamellæ of the cells dentate or denticulate, rarely entire and then minute; coralla calicularly branched or glomerate, the septa rarely foliaceous.*

GENUS III. MUSSA. Calicularly branched or explanato-glomerate; calicles subturbinate, cells large and concave, sometimes meandrine; lamellæ coarse and dentate, very unequal and unequally exsert (6 or 7 in a breadth of a fourth of an inch, and half of these smaller).

GENUS IV. MANICINA. Calicularly branched or explanato-glomerate; cells large, meandrine; lamellæ very even and numerous, and neatly denticulate, rounded above.

GENUS V. CAULASTRÆA. Calicularly branched; cells small (hardly exceeding half an inch), concave, lamellæ unequally exsert, nearly entire; branches nearly cylindrical, calicles not turbinate.

GENUS VI. TRIDACOPHYLLIA. Cells large, septa thin foliaceous, prominent, cristate.

GENUS VII. ASTRÆA. Glomerate; cell nearly or quite circular, rarely lobed.

GENUS VIII. MEANDRINA. Glomerate, not stipitate; cell a narrow meandering trench (trench not exceeding a fourth of an inch in breadth).

GENUS IX. MONTICULARIA. Glomerate; no distinct cells; surface of coralla covered with small lamello-radiate cones; internal texture very cellular.

III. *Coralla explanate or foliaceous.*

GENUS X. PNYLLASTRÆA. Erect, calicles large and distinct, affixed laterally to the foliaceous corallum.

GENUS XI. MERULINA. Spreading-foliaceous or ramose; surface covered with oblique lamellar ridges or lamello-radiate prominences, with shallow trenches or cells between; internal texture very compact.

GENUS XII. ECHINOPORA. Foliaceous or ramose; surface finely echinulato-striate, calicles small, nearly hemispherical and echinulate.

GENUS I.—EUPHYLLIA.\*—DANA.

*Astræidæ simplicissimæ, aut segregato-gemmataæ, raro liberæ; zoophytis hemisphericis. Tentacula oblonga, subæqualia. Coralla caliculato-ramosa, caliculis subturbinatis, aut rotundatis aut valde compressis, interdum meandrinis; lamellis fere integris; cellâ fundo angustissimâ.*

\* From εὐ, *well* or *handsome*, and φύλλον, *leaf*, alluding to the neat entire lamellæ of the cells.

Quite simple or segregato-gemmate, rarely free; zoophytes hemispherical. Tentacles oblong, subequal. Coralla having the calicles subturbinate, either circular or much compressed, sometimes meandering; lamellæ nearly or quite entire; cell very narrow at bottom.

The Euphyllia grow either solitary or in large convex cespitose clumps, consisting of segregate polyps; and there is a gradual transition from the simple species to others with long sinuous cells (sometimes six inches in length), containing several confluent polyp-disks. No species are known in which the cells are much less than half an inch in their longest diameter, and their texture is generally firm, breaking with difficulty, except at the margin. The lamellæ are usually large and evenly thin, and either have a straight or convex margin; and when the latter, they often so fill the cell that the bottom is concealed from view: if the former, the bottom is still very narrow. The exterior of the calicles, although sometimes spinuloso-striate, is generally nearly or quite smooth. Even the free species are attached when quite young, and often the scar of the fracture by which they became free may be distinguished. Some of the species resemble the *Mussa* and *Caulastræa*, but they are distinguished from the former by their entire lamellæ, and from the latter by their firmer texture, and from both, by the large and broad lamellæ nearly filling the cell.

These zoophytes have a wider range than the other *Astræidæ*, some species occurring in different parts of the temperate zone.

The compound Euphyllia have been united hitherto, since the dismemberment of Lamarck's genus *Caryophyllia*, with the genus *Mussa*—the *Lobophyllia* of Blainville; and the simple species have constituted a part of the old genus *Turbinalia*. If a comparison be made of the animals of these zoophytes (plate 6) with those of the *Mussa* (plate 7), sufficient reason will be seen for the separation proposed, which is farther strengthened by the characters of the coralla. The genus *Flabellum* was instituted by Lesson for a recent free compressed species (*E. pavonina*), with a lunate outline. But the rotund shapes pass into the compressed by gradual transitions, both in this genus, and the genera *Mussa* and *Manicina*. The genus *Diploctenium*, of Goldfuss, has been referred by Blainville to this division of the genus.

The descriptions beyond, are preceded by an enumeration of the species, to show their arrangement, and also to indicate, by an asterisk, those that have been examined by the author.

*Arrangement of the Species.*

I. *Solitary or non-budding.*

- |                            |                          |
|----------------------------|--------------------------|
| *1. <i>E. pavonina.</i>    | 4. <i>E. rubra.</i>      |
| 2. <i>E. anthophyllum.</i> | *5. <i>E. spinulosa.</i> |
| *3. <i>E. spheniscus.</i>  |                          |

II. *Compound; cells simple or lobed.*

- |                           |                         |
|---------------------------|-------------------------|
| 6. <i>E. glahrescens.</i> | *9. <i>E. aperta.</i>   |
| *7. <i>E. gracilis.</i>   | *10. <i>E. rugosa.</i>  |
| *8. <i>E. aspera.</i>     | *11. <i>E. turgida.</i> |

III. *Compound; cells mostly long meandering.*

- |                           |                            |
|---------------------------|----------------------------|
| *12. <i>E. meandrina.</i> | *14. <i>E. cultrifera.</i> |
| *13. <i>E. sinuosa.</i>   |                            |

I. *Euphyllia simplicissimæ.*

1. *EUPHYLLIA PAVONINA.* (*Lesson.*) *Dana.*

*E. solitaria, libera, cuneiformis, supernè semicircularis; tentaculis numerosis, validis, ¾" longis, subæquis. Corallum infernè acutè carinatum, aut rectum aut obtuso-angulatum, medio leviter pedunculatum; extus leve, vix plicatum, radiatè substriatum; cellà 2" longâ, et ad aperturam 1" latâ, profundissimâ; lamellis non exsertis, subdenticulatis.*

Solitary, free, cuneiform, semicircular above in outline; tentacles numerous, stout, three-quarters of an inch long, subequal. Corallum below acutely carinate, edge either straight or forming an obtuse angle at centre, at middle a small pedicel; exterior smooth, scarcely plicate, radiately substriate; cell two inches long, and one broad at the aperture, very deep, lamellæ not exsert, subdenticulate.

Plate 6, fig. 5, corallum, natural size; 5 *a*, the animal expanded; fig. 6, the corallum of another variety; 6 *a*, profile of same.

Sandwich Islands, according to Lesson, who states that a large number of specimens were brought to England by the Blonde. The Expedition did not meet with it.

This species is one of the free cuneiform *Euphyllia*. Its flabellate



or fan-shaped form suggested to Lesson his generic name *Flabellum*, which was proposed for this species. The inferior edge is quite sharp, and forms, according to Lesson's figures, a very low obtuse angle (about  $150^\circ$ ) at the centre, where there is a small prominence, which is the remains of the pedicel. In some of the specimens examined by the author, the edge was often quite straight, and in others formed a re-entering angle at centre. The sides are flat or a little concave, and the exterior has a little the appearance of tortoise-shell. The lamellæ are regular, subdenticulate or finely plaited on each surface, and a little undulate near the bottom of the cell, which is very narrow linear.

The animal, as represented by Lesson, closely resembles in general characters our *E. rugosa*, evincing the propriety of uniting his genus *Flabellum* with *Euphyllia*. An outline is given from Lesson's plate, in order to show this resemblance.

*Flabellum pavoninum*, Lesson, *Illust. de Flabellum pavoninum*, Lamarek, 2d. ed., Zool., plate 14. ii. 365.

## 2. EUPHYLLIA ANTHOPHYLLUM. (*Ehrenberg.*) *Dana.*

*E. erecta, compressa, affixa*;  $4\frac{1}{2}$ " *lata et alta. Corallum margine integrum; aperturâ oblongâ; lamellis inclusis, denticulatis latere granulosis: extus obsoletè striatum.*

Erect compressed, attached,  $4\frac{1}{2}$  lines high and broad. Corallum with the margin entire; aperture oblong; lamellæ included, denticulate, with the lateral surface granulous: exterior obsoletely striate.

This species is arranged by Ehrenberg in his genus *Monomyces*, a notice of which is appended at the close of the *Astræacea*. The description is brief, but appears sufficient to warrant our referring the zoophyte to the genus *Euphyllia*, among the non-budding species. The specimen described belonged to the Royal Museum at Berlin.

*Monomyces anthophyllum*, Ehrenberg, *Gen.* xlvii., sp. 2.

## 3. EUPHYLLIA SPHENISCUS. (*Dana.*)

*E. simplicissima, libera, cuneiformis, inverso-deltaidea, supernè arcuata basi truncata; carnea et luteo-viridescens, ore valde elongato, disco*

*transversè rubro-vittato; tentaculis numerosis, attenuatis, diaphanis, apice carneis. Corallum extus leve, concentricè subplicatum; cellâ profundâ, oblongo-ellipticâ, aperturâ ad extremitates bene rotundatâ; lamellis integris, regularibus, inæqualibus, truncatis, non exsertis.*

Not budding, free, cuneiform, in outline inverted deltoid, with the summit arcuate, and truncate at base; flesh-coloured and greenish-yellow; mouth very long, disk transversely banded with red, tentacles numerous, attenuate, diaphanous, with flesh-coloured tips. Corallum smooth without, very faintly concentrically plicate; cell deep, oblong-elliptic, with the aperture regularly rounded at each end; lamellæ entire and regular, unequal, truncate, not exsert.

Plate 6, fig. 1 *a*, animal unexpanded, showing the partly-opened oblong mouth, with the vertically-plaited inner surface of the lips;—1 *b*, animal expanded;—1 *c*, one of the tentacles;—1 *d*, profile section of corallum;—1 *e*, a small specimen, with side processes.

Coral reefs, Singapore, East Indies, in two to three fathoms water.  
*Exp. Exp.*

This species is distinguished from the *rubra* by its very symmetrical outline; it is about one and a quarter inches by five lines in breadth at top, and the sides converge downward evenly to an edge at bottom half an inch long, this edge having been produced by a fracture of the pedicel when young.

The lamellæ have a straight margin, and three smaller lamellæ alternate with a larger. The exterior is smooth without vertical striæ. At bottom, the cell is a mere line.

This very common species has evidently been confounded with the *Turbinolia rubra* of Quoy and Gaymard, which was named *Caryophyllia compressa*, by Blainville; also, with the *Turbinolia compressa* of Lamarck, which is a fossil species, more oblong-triangular, and tapering below nearly to a point. (See Lamouroux, *Exp. Meth. des Polyp.* 51, pl. 74, figs. 22, 23.) The *Turbinolia cuneata* is distinguished from this species by nearly the same characters as the *compressa*. (See *Turbinolia cuneata*, Goldfuss, *Petref.* 53, pl. 15, fig. 9, *a, b*, and *Flabellum cuneatum*, Michelin, *Icon. Zooph.*, 45, pl. 9, fig. 13.)

#### 4. EUPHYLLIA RUBRA. (Q. & G.) Dana.

*E. simplicissima, affixa, subcuneiformis, infra paulo distorta, supernè*

*paulo arcuata, 1'' longa, basi ½'' et sæpe dilatata; disco subluteo, 4-rubro-vittato, oblongo-elliptico, ore valde elongato, roseo; tentaculis longis, albidis, diaphanis. Corallum extus vix striatum, lamellis non exsertis, regularibus, inæqualibus.*

Not budding, attached, subcuneiform, below somewhat distorted, above a little arcuate, 1 inch in greatest breadth, base ½ inch broad and often dilated; disk yellowish, with 4 transverse red bands, oblong-elliptic, mouth very long and rose-coloured; tentacles long, whitish, diaphanous. Corallum having the exterior faintly striate; lamellæ not exsert, regular, unequal.

Cook's Straits, New Zealand, in twenty-four fathoms.—*Quoy* and *Gaymard*.

This species resembles the preceding; but the corallum is attached and less regular in outline below, often being distorted and curved a little to one side, instead of evenly symmetrical. The lamellæ are described as alternately large and small. The figure of the animal, by *Quoy* and *Gaymard*, must be incorrect, as it represents but a single row of tentacles.

*Turbinolia rubra*, Q. & G., *Voy. de l'As-trolabe*, iv. 188, pl. 14, figs. 5-9. —, *Cuvier*, *Reg. Anim.*, Paris, 1837, pl. 82, fig. 5; copy from the *Astrolabe*.  
*Caryophyllia compressa*, *Blain. Man.* 344.

##### 5. EUPHYLLIA SPINULOSA. (*Dana*.)

*E. simplicissima, affixa, compresso-subturbinata, paulo distorta, apice vix convexa (10''' et 5''' lata), infra attenuata et basi ⅓'' crassa. Corallum aperturâ subellipticum, latere verticaliter subtiliter lamello-striatum et spinuloso-denticulatum; lamellis apice rotundatis, 1''' exsertis, subintegris.*

Not budding, attached, compressed subturbinate, a little distorted, scarcely convex at summit where it is 10 lines by 5 in breadth, below attenuate, and ⅓ of an inch thick at base. Corallum having a subelliptical aperture, sides fine lamello-striate vertically and spinuloso-denticulate; lamellæ rounded above, a line exsert, subentire.

Plate 6, fig. 2, corallum, natural size; *a*, profile of transverse section.

Cape Frio, entrance to the harbour of Rio de Janeiro. *Exp. Exp.*

The spinulous exterior of this species is characteristic. The cell has a linear bottom, and is about a fourth of an inch deep.

NOTE.—The *Turbinolia amicorum*, of Blainville, probably belongs near the above, but no description of it has yet been published. It is from the Friendly Islands, Pacific Ocean. (Man. d'Actin. 341.)

2. Euphyllia segregato-gemmatæ, non meandrinæ.

6. EUPHYLLIA GLABRESCENS. (*Chamisso and Eysenhardt.*)

*E. furcatè ramosa*, 2" alta; discis simplicibus, tentaculis plurimis, 1" longis, clavatis, flavis. Corallum ramis  $\frac{1}{2}$ " crassis, extus glabriusculis, caliculis angulosis, pollicaribus, centro profundissimo, margine integris vel obsoletè denticulatis.

Segregato-gemmate, furcately ramose, 2 inches in height; colour yellow; tentacles many, an inch long, clavate. Corallum with the branches  $\frac{1}{2}$  an inch thick, exterior nearly smooth; calicles angular, an inch wide, very deep at centre, margin entire or obsoletely denticulate.

The Radack Archipelago, Pacific Ocean.—*Chamisso.*

<i>Caryophyllia glabrescens</i> , Chamisso and Eysenhardt, Nov. Act. Nat. Curios., vol. x.	<i>Lobophyllia glabrescens</i> , Blainville, Man. d'Actin. 355. The reference by Blainville
—, Lamarck, 2d edit. ii. 356, No. 13 a.	to plate liii. fig. 3, of his Atlas, is wrong;
—, Ehrenberg, op. cit. Gen. lviii. sp. 4.	the figure represents the <i>L. angulosa</i> .

7. EUPHYLLIA GRACILIS. (*Dana.*)

*E. furcatè ramosa*, convexa, discis sæpius simplicibus. Corallum caliculis subturbinatis, viz 2" remotis, extus leviter striatulis, cellâ sæpius  $\frac{1}{2}$ " latâ, interdum 1" elongatâ; lamellis latissimis, tenuissimis, paululum exsertis.

Convex, furcato-ramose; disks mostly simple. Corallum having the calicles subturbinate, scarcely 2 lines distant, the exterior minutely striate; cell usually  $\frac{1}{2}$  an inch broad, sometimes 1 inch long; lamellæ very broad, extremely thin, a very little exsert.

Caribbean Sea. *Esper.*—West Indies, *Bost. Nat. Hist. Soc.*

The small size of this species readily distinguishes it. The lamellæ meet or overlap at the middle of the cell, and are very fragile. The exterior is finely striate, but not spinulose or properly denticulate.

*Madrepora fastigiata* (?), *Esper Pflanz. i.* 95, tab. 8. *Caryophyllia fastigiata* (?), *Ehren., op. cit. Gen. lviii. sp. 5.*  
 Esper's figure represents the branches a little too cylindrical, and the striæ somewhat denticulate. *Esper's tab. 8, A,* which he gives as a variety of the above, has the cells of the same breadth, but two inches long.

*Caryophyllia angulosa*, in part, *Lamarck,* 2d ed. ii. 355, No. 13.

#### 8. EUPHYLLIA ASPERA. (*Dana.*)

*E. furcato-ramosa, hemispherica; discis sæpius simplicibus et suborbiculatis. Corallum ramis subdivaricatis,  $\frac{1}{2}$ – $\frac{3}{4}$ " crassis, caliculis subturbinatis, crassè costato-striatis et spinulosis, infra fere levibus; lamellis inæqualibus, latis, exsertis, obliquè truncatis, majoribus  $\frac{1}{10}$ " remotis et 3 minoribus intermediis.*

Furcato-ramose, hemispherical; disks usually simple and nearly circular. Corallum with the branches subdivaricate,  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch thick, calicles subturbinate; coarsely ribbed-striate and spinulose, below nearly smooth; lamellæ unequal, very broad, exsert, obliquely truncate, the larger  $\frac{1}{10}$  of an inch apart, and with about 3 smaller intermediate.

Plate 9, fig. 7, part of corallum, natural size; 7 a, profile section showing the form of the lamellæ.

West Indies?

This species is remarkable for the strongly ribbed spinulose exterior of the calicles (allying it to the *Mussæ*), and the decided line of division between this live portion, and the smoother dead part below. The lamellæ are broad with the inner margin vertical; and the oppo-

site approach at the centre of a cell to within a sixteenth of an inch. The cells when simple but little exceed half an inch in breadth; but they often widen in one direction to nearly an inch. The branches are about an inch and a quarter long before furcation.

The *Madrepora capitata* of Esper, (Pflanz. Fortsetz., i. 102, tab. 81, fig. 1,) may be identical with the above. The branches are represented as longer (about one and a half inches) before furcating, and less divaricate; but in the size of the calicles and their ribbed and spinulous exterior, they are quite similar. Lamarek refers to Esper's figure and species as a variety of the "*Caryophyllia fastigiata*," a species of *Mussa*.

#### 9. EUPHYLLIA APERTA. (*Dana*.)

*E. furcato-ramosa, hemispherica, discis sæpius simplicibus. Corallum ramis  $\frac{3}{4}$ " crassis, subdivaricatis, brevibus, caliculis subturbinatis,  $\frac{3}{4}$ " longis et latis, remotè costatis, cum costis leviter denticulatis et infra obsolescentibus; lamellis paucis, tenuibus, 1" exsertis, majoribus valde latis  $\frac{1}{8}$ " remotis apice obliquè truncatis, et sæpius unâ angustissimâ intermediâ.*

Furcato-ramose, hemispherical, with the disks mostly simple. Corallum having the branches  $\frac{3}{4}$  of an inch thick, subdivaricate, short, calicles subturbinate,  $\frac{3}{4}$  of an inch long and broad, remotely costate, with the ridges somewhat denticulate and below becoming obsolescent; lamellæ few, thin, about 1 line exsert, the larger quite broad and obliquely truncate at top,  $\frac{1}{8}$  of an inch apart, and usually with one quite small intermediate lamella.

West Indies?

This species resembles much the *aspera*, but the lamellæ of the calicles, and the ridges of the exterior, are fewer and more distant; the appearance of the cell is much more open, and the internal texture consists of large open cellules.

NOTE.—The *Madrepora fastigiata* of Pallas (Elench. Zooph. No. 175), thus described, "M. dichotoma, fastigiata, stellis terminalibus, subturbinatis, lamellis integerrimis," Seba, tab. 109, fig. 1, is near the above, yet appears to be a distinct species. The lamellæ in Seba's figure are a little exsert, and the calicles are two-thirds of an inch in diameter, with the exterior striate, and the line between the live extremity and the part below, strongly marked. Seba says that the lamellæ are very thin "nequaquam serratæ sint, sed cuspidatæ et equabilem veluti cultri aciem abeant." Seba states that his specimen came from the shores of Curaçoa, in the Caribbean Sea.

## 10. EUPHYLLIA RUGOSA. (Dana.)

*E. furcato-ramosa, hemispherica; polypis griseo-rubidis, discis sæpius simplicibus, tentaculis numerosis, validis,  $\frac{2}{3}$ " longis, apice flavis. Corallum caliculis  $\frac{3}{4}$ -1" latis, interdum lobatis, 3-4" remotis, extus sæpe transversè rugosis et tenuiter carinato-striatis: lamellis latis, integris, vix minimè exsertis.*

Furcato-ramose, hemispherical; polyps pale grayish red, disks usually simple; tentacles numerous, stout,  $\frac{2}{3}$  of an inch long, with yellow tips. Corallum with the calicles  $\frac{3}{4}$  to 1 inch broad, sometimes lobed, 3 to 4 lines apart; exterior often transversely wrinkled and finely carinato-striate; lamellæ broad, entire, scarcely at all exsert.

Plate 6, fig. 3, a clump of the natural size, with most of the polyps fully expanded, a few partly so or closed; 3 a, a tentacle enlarged; 3 b, a separate calicle; 3 c, part of a transverse section of a branch; 3 d, one of the lamellæ; 3 e, corallum of a young individual, found growing from the side of one of the calicles.

The Feejee Islands, in shallow water about the reefs. *Exp. Exp.*

The character of the polyps and the larger size of the branches, separate this species from the *glabrescens*, to which it is in many points similar. The margin of the calicle is thin and fragile. The clump examined was five inches in diameter, and three high.

*Fungus marinus, &c., "lamellis tenuibus, erectis, non dentatis."* Seba, fig. 4, tab. 116. The figure, though rude, appears to belong to this species.

The *Lobophyllia angulosa* of Quoy and Gaymard (Voy. de l'Ast. iv. 193, pl. 15, figs. 1, 2), has some relations to the above, but if the forms of the lamellæ and cell are correctly represented, it belongs to the genus *Manicina*. The representation of the animals is wholly unsatisfactory.

## 11. EUPHYLLIA TURGIDA. (Dana.)

*E. hemispherica, furcato-ramosa, discis interdum parcè compositis. Corallum caliculis sæpius  $1\frac{1}{4}$ -2" latis, interdum 3" dilatatis et lobatis,*

*extus undulatis et subremotè leniter carinato-striatis; lamellis latis-  
simis numerosisque, integris, tenuibus, paululum exsertis.*

Hemispherical, furcato-ramose, disks sometimes sparingly compound. Corallum with the calicles mostly  $1\frac{1}{4}$  to 2 inches broad, at times 3 inches long, and lobed; exterior undulate and rather remotely faint carinato-striate; lamellæ very broad and numerous, entire, thin, a little exsert.

Plate 9, figs. 9 a, 9 b, outline of lamellæ.

Malacca, East Indies.

This species has much larger polyps than the last, and the carinæ of the exterior are more remote, and less distinct. The distance between adjacent calicles is moreover about half an inch. It is still nearer the *meandrina*, which, however, has narrower cells, generally much more sinuous and meandering. The specimen described belongs to the collections of the Academy of Natural Sciences at Philadelphia, and was deposited there by Dr. Burroughs.

Quoy and Gaymard, Voy. de l'Uranie, pl. 96, fig. 11. This figure may be the above species imperfectly represented.

*Caryophyllia angulosa*, in part, Lamarck, 2d ed. ii. 355, No. 13.

3. Euphyllia meandrinæ.

## 12. EUPHYLLIA MEANDRINA. (*Dana.*)

*E. maxima, hemispherica, discis sæpius compositis, lineatis et meandrinis. Corallum ramis raro cylindricis et  $\frac{3}{4}$ " crassis, sæpissimè compressis interdum 6" latis, 5-9" crassis; extus levibus seu partim subtiliter striatulis et interdum paulo undulatis, margine fragilibus; lamellis confertis, latis, integris, non exsertis.*

Very large, hemispherical, disks mostly compound, linear, and meandering. Corallum, with the branches rarely cylindrical, and  $\frac{3}{4}$  of an inch thick, generally laminato-compressed, sometimes 6 inches broad and 5 to 9 lines thick; exterior smooth or in some parts finely striate and sometimes surface a little undulate, margin fragile; lamellæ crowded, very broad, entire, not exsert.



Plate 6, figure 4, part of a corallum, natural size; 4 *a*, vertical section, showing the narrow bottom; 4 *b*, transverse section, showing the cellular texture of the interior.

East Indies. *Exp. Exp.*

The branches of this species are often broad sinuous plates, half to three-fourths of an inch thick; and again there are occasionally others, which are cylindrical, and belong to a single polyp. The last have often much resemblance to a single calicle in the *E. rugosa*, but are less strongly striated. The lamellæ are crowded and so fill the cell that its bottom is seldom apparent.

*Caryophyllia angulosa*, in part, Lamarck, 2d ed. ii. 355, No. 13.

*Madrepora fastigiata*, Esper, i. 95, tab. viii. A. This figure may have been made from a specimen of this species; yet is much too small, and the striæ are too decided. It is possibly a distinct species. He gives the Caribbean Sea as the probable locality. The calicles are one-third to half an inch thick, and half to two and a half wide, with the exterior striate. See *E. gracilis*.

### 13. EUPHYLLIA SINUOSA. (*Dana.*)

*E. maxima, hemispherica; discis compositis, lineatis, et elongatè meandrinis. Corallum meandrinæ affine, sed cellis sinuosis longioribus, ½" latis, et lamellis paucis, sæpius ⅓" remotis, integris, non exsertis.*

Very large, hemispherical; disks compound, linear, and long meandering. Corallum similar to that of the *meandrina*, but the sinuous cells longer, ½ an inch broad, and the lamellæ few and mostly ⅓ of an inch distant, entire, not exsert.

The few and remote lamellæ, and the very open cellular texture, distinguish this species readily from the preceding, with which it agrees in general habit. The intervals between the calicles, or the lobes of the same, are often an inch broad. A single meandering trench, with all its sinuous lobes, is sometimes two feet long. The specimen affording the description belongs to the collections of the Academy of Natural Sciences at Philadelphia, and there is another in the collections of the Boston Natural History Society. The locality is not known; it is probably from the East Indies.

14. EUPHYLLIA CULTRIFERA. (*Dana.*)

*E. grandis*, convexa, discis compositis, lineatis, meandrinis. Corallum cellâ  $\frac{2}{3}$ " latâ, interdum 5" elongatâ; extus subleve, vel parcè plicatum et leviter striatulum; lamellis longè exsertis (interdum  $\frac{3}{4}$ "') et sæpe  $\frac{1}{2}$ " latis.

Large, convex, disks compound, linear, meandering. Corallum, with the cell  $\frac{2}{3}$  of an inch broad, sometimes 5 inches long; exterior nearly smooth or sparingly plicate, and faintly striate; lamellæ long exsert (sometimes  $\frac{3}{4}$  of an inch), and often  $\frac{1}{2}$  an inch broad.

Plate 9, figure 8 *a*, 8 *b*, showing the form of the lamellæ.

East Indies. *Dr. A. A. Gould.*

The large projecting cultriform lamellæ give this species a very peculiar appearance. The specimen examined was placed in my hands for description by Dr. Gould, of Boston.

APPENDIX.—*Euphyllia Hemprichii*. The *Strombodes Hemprichii*, of Ehrenberg, from the Red Sea (op. cit. Gen. liii. sp. 1), appears to pertain to the genus *Euphyllia*, though, from the concise description, this opinion is expressed with hesitation. It is thus described:—“Pollicaris, solitaria, turbinata, disco semipollicari, parum excavato, stipite tereti curvo, annulis distantibus, membranaceis, concavis alato.” Owing to the rings of the exterior, it resembles some *Cyathophylla*, in appearing to consist of a series of cones inverted in one another.

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 GENUS II.—CTENOPHYLLIA.—DANA.

*Astræidæ explanato-glomeratæ*, discis seriatim gemmantibus, itaque sinuosè linearibus. Coralla substipitata, convexa; cellis, fossiformibus, meandrinis; lamellis crassimis, paucis, subæqualibus, fere integris.

Animals explanato-glomerate; disks seriatly budding, and hence linear and sinuous. Coralla substipitate, convex; cells trench-like and meandering; lamellæ very stout, few, subequal, entire or nearly so.

The Ctenophylliæ have long meandering cells like the Meandrinæ, but are stipitate species, peculiar in their stout, remote, entire lamellæ. The under surface of the corallum is crimped and striate, especially near the margin, where the living animal extended: where dead, the striæ are often obsolete and the surface is more or less incrustated with other corals. The species have some resemblance to the Manicinæ, but they differ decidedly in general habit; the lamellæ of the latter being thin, evenly crowded, and regularly denticulate. Moreover, the septum between adjacent cells in the Ctenophylliæ is thin, and nearly solid.

The name of this genus is derived from *κρησ*, a comb, referring to the appearance of the lamellæ along the septum, to which allusion is made in Lamarck's name, *M. pectinata*.

This group appears to be related to the Euphylliæ, and has been placed in the same subfamily with them; yet, as the animals have not been examined, some other arrangement may hereafter be required. The type of the genus is the *Meandrina pectinata* of Lamarck. Ehrenberg, in view of the substipitate character of the species, places them in his genus *Manicina*. The species appear to be confined to the West Indies.

#### *Arrangement of the Species.*

##### 1. *Ridges sulcate.*

\*1. *C. pectinata.*

\*2. *C. quadrata.*

##### 2. *Ridges entire.*

\*3. *C. pachyphylla.*

\*4. *C. profunda.*

#### 1. CTENOPHYLLIA PECTINATA. (*Lamarck.*) *Dana.*

*Corallum collibus sulcatis, 5-6''' latis, gyris sinuosis 6-7''' latis, lamellis rotundatis, fossis 3-4''' profundis; superficie inferiore levi sed prope marginem (ad  $\frac{1}{4}$ ') rugatâ et remotè striatâ.*



Corallum with the ridges sulcate, 5 to 6 lines wide; gyri sinuous, 6 to 7 lines broad, lamellæ rounded, fossæ 3 to 4 lines deep; inferior surface smooth, except within  $\frac{1}{4}$  of an inch of the margin, where it is rugose and remotely striate.

Plate 14, figure 13, outline of the lamellæ and trench.

West Indies.

The sulcate (or duplicate) ridges of this species, in connexion with the very broad gyri, distinguish it readily from the following. The septum is a line thick at top, an eighth of an inch below, and is a very little turgid. On the under surface, beyond a fourth of an inch from the margin, the corallum is smooth and mostly incrustated by other corals.

*Madrepora mæandrites*, Ellis and Solander, 161, tab. 48, fig. 1. The figure agrees with specimens examined by the author, even to the linear lamella at the bottom of the trench.

*Madrepora labyrinthica*, Pallas Elench. Zooph., p. 297.

*Meandrina pectinata*, Lamarck, 2d ed. ii. 387, No. 4.

*Meandrina pectinata*, Lamouroux, Exp. Meth. 55, tab. 48, fig. 1, and Encyc., pl. 485, fig. 1.

—, Blainville, Man. d'Actin., 357.

The *Manicina pectinata* of Ehrenberg (G. lxiii. sp. 3) is represented according to this author by Seba's fig. 8, tab. 111, (vol. iii.), which is a species with thin lamellæ. See *Mussa fragilis*.

2. CTENOPHYLLIA QUADRATA. (*Dana*.)

*Corallum collibus sæpius sulcatis, subquadratis, 3-4''' latis, gyris 4-5''' latis, fossis 3''' profundis; septo sæpe 1''' crasso; superficie inferiore, ad  $\frac{1}{4}$ '', rugatâ et striatâ.*

Corallum usually with sulcate subquadrate ridges, 3 to 4 lines broad; gyri 4 to 5 lines broad, fossæ 3 lines deep, septum often 1 line thick; lower surface for  $\frac{1}{4}$  inch crimped and striate.

Plate 14, figure 14, outline of the lamellæ and trenches.

The gyri are much narrower than in the *pectinata*, and the lamellæ smaller, though still very stout.

*Lapis corallites*, &c., Seba, iii. tab. 112, fig. 2. This figure agrees in the size of its gyri with the above, and is similar in its stout lamellæ.

### 3. CTENOPHYLLIA PACHYPHYLLA. (Ehrenberg.) Dana.

*C. collibus integris, Gothicis, rarò obsoletè sulcatis, 5-6''' latis; gyris 5-8''' latis; lamellis crassis; septo raro.*

Corallum with the ridges entire, Gothic, rarely obsoletely sulcate, 5 to 6 lines wide; gyri 5 to 8 lines broad; lamellæ stout; septum thin.

Plate 14, fig. 15, outline of lamellæ and trench.

The ridges are as broad as in the *pectinata*, but they are not sulcate. The lamellæ are about seven in number to half an inch of the fossa, and occasionally there is a small intermediate one; those of adjoining furrows seldom meet at the top of the septum, but pass one another, and in some instances there is an incipient sulcus. The lateral surfaces of the lamellæ are granulous.

*Lapis corallites*, &c., Seba, iii. tab. 112, fig. 3, represents a worn specimen; it agrees in the breadth of the gyri, stout lamellæ, and other characters.

*Manicina pachyphylla*, Ehrenberg, G. lxiii. sp. 5. This species is apparently identical with the above. Ehrenberg describes

it as having the gyri eight lines broad, and "lamellis crassis, latissimis, collium pariete interno membranaceo." Seba's figure 2, tab. 112, to which he refers, has much narrower gyri than stated in the description, and appears to represent the *quadrata*.

### 4. CTENOPHYLLIA PROFUNDA. (Dana.)

*Corallum collibus integris, Gothicis, angustis (4''' latis), gyris 5-6''' latis, fossis profundissimis (fere ½''), lamellis rarioribus.*

Corallum with the ridges entire, Gothic, narrow (4 lines wide), gyri 5 to 6 lines broad, fossæ very deep (nearly ½ an inch), lamellæ rather thin.

Plate 14, fig. 16, outline of lamellæ and trench.

Like the *pachyphylla*, this species has entire ridges, but they are much narrower, and the fossæ much deeper. Moreover the under

surface is striated, and when fresh is alive for an inch and a half from the margin : the lamellæ also are much thinner, and the septum hardly exceeds one-twentieth of an inch in thickness.

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GENUS III.—MUSSA.—OKEN.

*Astræidæ maximæ, gemmatione segregatæ et interdum explanato-glomeratæ. Tentacula numerosa, inæqualia, internis tumidis. Coralla caliculato-ramosa, aut explanato-glomerata; caliculis crassimis, subturbinatis aut latissimè compressis; cellis suborbiculatis aut elongatè meandrinis, extus crassè lamello-striatis et echinato-dentatis; lamellis dentatis vel inciso-dentatis, inæqualiter exsertis.*

Large *Astræidæ*, segregate, also explanato-glomerate; tentacles numerous, unequal, the inner tumid. Coralla calicularly branched or explanato-glomerate; calicles very stout, subturbinate, with orbiculate or lobed cells, sometimes very broadly compressed with the cells long meandering; exterior stoutly lamello-striate and echinato-dentate; lamellæ coarsely dentate or gash-toothed, unequally exsert.

This genus includes the largest coral animals of the *Astræa* family. Two inches in diameter is no unusual size, and when fully expanded they look like large *Actiniæ*. The broad-tinted disks fringed with crowded rows of tentacles, the inner differing generally in form and colour from the outer, make the most beautiful exhibition of living flowers in the coral seas, especially when a whole corymb or hemispherical group is in full expansion.

The coralla often form regular hemispheres, consisting of calicular branches. The calicles have large concave cells, and stout gashed lamellæ very unequal and unequally exsert, with the exterior ribbed with extensions of the same dentate lamellæ. There are only six or eight lamellæ in a breadth of a fourth of an inch, and half of these are usually obsolescent. In size, the *Mussæ* thus far known vary from three-quarters of an inch to three and a half inches in diameter. In a few species the cells are very long meandering, and belong to a large number of united polyps. The tentacles in these species margin

the meandering cell, through its whole length, and between, at intervals, are the polyp mouths. The calicularly branched species pass gradually into the massive, as in the genus *Manicina*, and these resemble the *Meandrinæ*, except in their larger size, the thicker and fewer lamellæ, coarser dentation, and in being usually stipitate.

These corals differ from the *Euphyllia* in their open concave cells, with a broad bottom, and their thicker gashed lamellæ. They pass into the *Caulastrææ*, which have smaller concave cells, and also more cylindrical and fragile branches, and more crowded, nearly entire, lamellæ.

The *Mussæ* are confined, as far as known, to the coral-reef seas. Species occur both in the East and West Indies, and in the Pacific.

The genus *Mussa* as established and characterized by Oken,\* a German author distinguished for the originality of his views, and his innovations in all branches of science, has nearly the limits of Lamarck's *Caryophyllia*, a name long prior in date. As the species, which Oken referred to his genus, belong, with one exception, to the group before us, it seems obligatory, *Caryophyllia* being otherwise used, to retain for it Oken's name, in preference to Blainville's *Lobophyllia*, subsequently given to these zoophytes. In mentioning Blainville's *Lobophyllia*, Ehrenberg significantly adds, "vox hybrida." This genus is the *Caryophyllia* of Ehrenberg, excepting that a few species are separated, which belong to the genus *Euphyllia*, and some massive meandering species are added.

#### *Arrangement of the Species.*

##### I. *Calicularly branched, cells simple or somewhat lobed.*

- |                          |                         |
|--------------------------|-------------------------|
| 1. <i>M. fastigiata.</i> | 4. <i>M. corymbosa.</i> |
| *2. <i>M. carduus.</i>   | *5. <i>M. cactus.</i>   |
| *3. <i>M. angulosa.</i>  | *6. <i>M. costata.</i>  |

##### II. *Calicularly branched, cells mostly sinuous or meandering.*

- |                            |                               |
|----------------------------|-------------------------------|
| *7. <i>M. sinuosa.</i>     | *10. <i>M. cerebriformis.</i> |
| *8. <i>M. cytherea.</i>    | *11. <i>M. regalis.</i>       |
| *9. <i>M. multilobata.</i> |                               |

##### III. *Massive, meandering.*

- |                          |                         |
|--------------------------|-------------------------|
| *12. <i>M. crispa.</i>   | *15. <i>M. gyrosa.</i>  |
| *13. <i>M. dipsacea.</i> | *16. <i>M. recta.</i>   |
| *14. <i>M. fragilis.</i> | *17. <i>M. sinuosa.</i> |

\* Oken's *Lehrbuch der Naturgeschichte, Zoologie* i. 73. Published at Jena in 1815.

I. Caliculato-ramosæ, cellis simplicibus aut paulum lobatis.

1. MUSSA FASTIGIATA. (Ellis.) Dana.

*M. fastigiata*, discis sæpius suborbiculatis. Corallum ramis crassis, caliculis remotè costato-angulatis, non dentato-echinatis,  $\frac{2}{3}$ –1" latis (raro  $\frac{1}{2}$ " ); lamellis vix dentatis, apice subacutis.

Fastigate; disks usually nearly circular. Corallum with the branches stout; calicles remotely ribbed-angular, not dentato-echinate,  $\frac{2}{3}$  to 1 inch broad (rarely  $\frac{1}{2}$  an inch), lamellæ scarcely toothed; subacute at apex.

West Indies. *Ellis*.

This species, here based on Ellis's figure, is peculiar in having pointed lamellæ but sparingly notched, and the exterior of the calicles angular or polygonal, without spines or teeth; though near the *Euphyllia*, it is represented with the open concave cell of a *Mussa*.

<i>Madrepora fastigiata</i> , Ellis and Solander, 152, tab. 33.	<i>Caryophyllia fastigiata</i> , Lamouroux, 50, tab. 33.
<i>Madrepora capitata</i> , var. Esper, Fortsetz. i. 102, tab. 82—copy of Ellis's figure.	<i>Lobophyllia fastigiata</i> , Blainv. Man. 356.
<i>Mussa capitata</i> , Oken, op. cit. 74.	The <i>Caryophyllia fastigiata</i> of Ehrenberg, is a much smaller species, and probably the <i>Euphyllia aspera</i> .
<i>Lithodendron capitatum</i> , Schw. Hand. 416.	
<i>Caryophyllia fastigiata</i> , Lamarck, 2d ed. ii. 355, No. 12. Two or three <i>Euphyllia</i> are here included.	The <i>M. fastigiata</i> of Pallas appears to be a <i>Euphyllia</i> (see note to page 165. Seba's No. 1, tab. 109, may be the above species.)

2. MUSSA CARDUUS. (Pallas.) Dana.

*M. maxima*, discis suborbiculatis. Corallum caliculis crassimis ( $2\frac{1}{2}$ – $3\frac{1}{2}$ " ) elongato-turbinatis, fere orbiculatis, extus undique valde lamello-striatis et serratis; cellâ concavâ, margine rotundatâ; lamellis crassè serrato-dentatis.

Very large; disks nearly circular. Corallum having the calicles very stout ( $2\frac{1}{2}$  to  $3\frac{1}{2}$  inches broad), very long turbinate, nearly circular; exterior every where (above and below) strongly lamello-striate and



sharp serrate; cell concave, margin rounded, lamellæ coarsely serrato-dentate.

Plate 8, fig. 8, section of cell showing the outline of lamellæ.

West Indies.

This large species is distinguished by the length and size of the calicles or calicular branches, and the serrate lamellæ that crowdedly striate the exterior for several inches from the summit. In Peale's Museum at Philadelphia, there is a single turbinate branch or calicle, which is four inches long and three broad at top, with a slightly elliptical outline.

*Madrepora carduus*, Ellis and Solander, 153, tab. 35. A good figure; specimen from the West Indies.

*Madrepora lacera*, Pallas, Zooph. No. 173.

—, Esper, i. 148, tab. 25, fig. 2. A young individual (?), a short cylindrical calicle, two and a half inches in diameter, and two-thirds of an inch high, and very similar to the extremity of a calicle in Ellis's figure.

*Caryophyllia carduus*, Lamarck, 2d ed. ii. 357, No. 15.

—, Lamouroux, Exp. Meth. 50, tab. 35.

*Mussa lacera*, Oken's Zool. i. 73.

*Lobophyllia carduus*, Blainv. Man. 356.

*Caryophyllia lacera*, Ehrenberg, op. cit. G. lviii. sp. 6.

Several of Seba's figures on tab. 108, 109, and 110 (Thes. iii.), are generally referred to as young of this species; but the correctness of these references may

be doubted. No. 2 and 4, tab. 108, representing specimens from "New Spain," look like attached Fungix: the first is two and a half inches in diameter, the second three and a half; and the pedicel in each is very short, and about one-third the diameter.

Seba's No. 2 and 3, tab. 109, appear to be figures of a branching species with shallow calicles one and two-third inches broad, and the height scarcely half their breadth. A specimen of this kind was obtained by the author in the Sooloo Sea, the calicle of which was one and a half inches wide, with the cell spreading and nearly one-third as deep, the lamellæ very unequal and remote, and the margin of the cell uneven from the unequal and unequally prolonged lamellæ. As the specimen is an imperfect one, it is not here named.

### 3. MUSSA ANGULOSA. (*Pallas.*) Oken.

*M. grandis*, *discis sæpius suborbiculatis, interdum lobatis. Corallum ramulis brevibus, caliculis 1-1½'' latis, interdum 4-5-lobatis extus undique lamello-striatis et dentato-echinatis; cellâ margine rotundatâ; lamellis tenuibus, bene serrato-dentatis.*

Large; disks usually nearly circular, sometimes lobed. Corallum large, branches short; calicles suborbicular, from 1 to 1½ inches broad, often lobed (sometimes with 4 to 5 lobes), exterior every where lamello-striate, and dentato-echinate; cell with a rounded margin; lamellæ thin, regularly serrato-dentate.

Plate 8, figure 4, section of cell showing the outline of lamellæ.

West Indies.

In many characters this species resembles the *carduus*, but the calicles are much smaller and shorter. It differs from the following in the thin lamellæ, and their teeth continuing regularly over the apex; also in the strong dentate lamello-striæ of the exterior, which are distinct far down the branch. There are eight or nine of these lamellæ on the exterior in half an inch of breadth.

- Fungus marinus foliolis erectis serratis*, &c., Seba, iii. 200, tab. 109, fig. 6. A fastigate clump eight inches high, and nearly as broad above, with the stem an inch or less in diameter below. The fastigate form may not be characteristic, as it probably grows in hemispherical clumps, like other species of the genus.
- Madrepora angulosa*, Esper, Pflanz. i. 92, tab. 7. Smaller but otherwise like Seba's. From "Curassao," Caribbean Sea. The calicles are strongly lamello-striate and serrate for two to three inches from the summit.
- , Pallas, Zooph. No. 174. "M. dichotoma fastigiata, stellis terminalibus, turbinato-angulosis, lamellis dentatis."
- Lithodendron angulosum*. Schw. Handb. 416.
- Caryophyllia angulosa*, in part, Lamarck, 2d ed. ii. 355, No. 13.
- , Lamouroux, Encyc., 173.
- , Ehrenberg, G. lviii. sp. 3.
- Mussa angulosa*, Oken, Zool., 73.
- Lobophyllia angulosa*, Blainv. Man. 355.
- The *Lobophyllia angulosa*, of Blainville, includes also one or two species of *Euphyllia*. The species so called by Quoy and Gaymard, Voyage de l'Astrolabe, iv. 193, pl. 15, figs. 1, 2, appears to be a *Manicina*. The *Caryophyllia angulosa* of the same authors, Voyage de l'Uranie, pl. 96, fig. 9, may be the *Euphyllia tumida*.

#### 4. MUSSA CORYMBOSA. (Forsk.) Dana.

*M. fastigiata, pallidè fuscescens; discis sæpius suborbiculatis, totis aureis, medio glabris, margine tumido, papilloso, papillis bursiformibus, vix lineam altis; tentaculis parvulis. Corallum, caliculis inæqualibus, 1-1½" latis, subturbinatis, sæpe compressis et angulosis; lamellis valde dentatis, margine caliculi non revoluti, subacuto.*

Fastigiate; pale fuscous, disk usually nearly circular, gold-yellow, centre smooth, margin tumid papillose, papillæ bursiform, scarcely a line high, tentacles small. Corallum erect, fastigiate; calicles unequal, 1 to  $1\frac{1}{2}$  inches broad, subturbinate, often compressed and angular; lamellæ strongly dentate; margin of calicle not revolute, subacute.

Red Sea. *Forskal, Ehrenberg.*

The above description is from Ehrenberg, who collected specimens in the Red Sea. He remarks that the calicles are less spinulose than in the *angulosa*, and longer.

*Madrepora corymbosa, corymbi ramis apice* *Caryophyllia corymbosa*, Lamarck, 2d ed. ii. 356, No. 13 b.  
*crassioribus, striato-aculeatis, stellis terminalibus, solitariis, repando-lobatis,* —, Ehrenb., op. cit., G. lviii. sp. 2.  
 Forskal, Desc. Anim. Eyp., p. 137. *Lobophyllia corymbosa*, Blainv. Man. 356.

#### 5. MUSSA CACTUS. (*Dana.*)

*M. bene hemispherica; discis virentibus, sæpius suborbiculatis; tentaculis internis bursiformibus, albis, et apice brunneis, externis paulum elongatis et brunneis. Corallum ramis crebris, caliculis suborbiculatis interdum 2-3-lobatis, 1-1¼" crassis, subturbinatis, extus irregulariter lamello-striatis et serratis; lamellis inæqualibus, valde dentatis, apice rotundatis, cum 3-5 dentibus subtriangulatis.*

Regularly hemispherical; disk usually suborbiculate, green; *inner* tentacles bursiform, pearl-white and brown at tip, *outer* a little elongate and brown. Corallum having the branches crowded, calicles sometimes 2 to 3-lobed, 1 to  $1\frac{1}{4}$  inches thick, subturbinate, exterior irregularly lamello-striate and serrate; lamellæ unequal, strongly dentate, rounded at apex, with 3 to 5 subtriangular teeth.

Plate 7, fig. 1, hemispherical clump natural size, with part of the polyps expanded; 1 *a*, tentacle enlarged; 1 *b*, vertical section of a calicle; 1 *c*, transverse section.

Feejee Islands. *Exp. Exp.*

This species differs from the *angulosa* in having the lamellæ thicker

and more coarsely toothed, and the exterior less regularly lamello-  
striate. The branches are more crowded, the calicles having intervals  
of about one-third of an inch between them. The larger lamellæ pro-  
ject about one-third of an inch above the margin of the cell. It  
appears to be near the *corymbosa*, but differs in its polyps.

6. MUSSA COSTATA. (*Dana.*)

*M. hemispherica*, discis sæpius suborbiculatis. Corallum ramis crebris  
caliculis  $\frac{2}{3}$ – $1\frac{1}{4}$ " latis, viz turbinatis, elongatis; extus, costato-angulatis,  
rarò dentatis; lamellis valde inæqualibus, dentatis, majoribus apice  
latè truncatis et sæpe 2–3-inciso-dentatis.

Hemispherical; disks usually suborbiculate. Corallum having the  
branches crowded; calicles  $\frac{2}{3}$  to  $1\frac{1}{4}$  inches broad, scarcely turbinate,  
elongate, exterior ribbed angular, with rarely a tooth; lamellæ very  
unequal, dentate, the larger broad, truncate at apex, and often  
2–3-gash-toothed.

Plate 7, fig. 2, a calicle natural size; 2 a, 2 b, lamellæ.

Tahiti, Society Islands. *Exp. Exp.*

This species differs from the preceding in its truncate lamellæ and  
ribbed calicles, rarely dentate on the exterior. The calicles are usually  
simple, and nearly straight, but sometimes one to three lobed, and are  
from two to three inches long, with intervals between of one-eighth to  
one-quarter of an inch. The larger lamellæ are exsert about one-third  
of an inch.

II. Caliculato-ramosæ; cellis sæpe elongatis et sinuosis.

7. MUSSA SINUOSA. (*Lamarck.*)

*M. hemispherica*, discis elongatis meandrinis. Corallum ramis  $\frac{3}{4}$ – $1\frac{1}{4}$ "  
crassis, sæpius valde compressis, extus striatis et longè serrato-dentatis;  
cellis interdum simplicibus, sæpe sinuosis et 2–5" elongatis, lamellis  
crassis, latè dentatis et inciso-dentatis,  $\frac{1}{4}$ – $\frac{1}{2}$ " exsertis; caliculis  $\frac{1}{2}$ " se-  
junctis.



Hemispherical; disks usually elongate and meandering. Corallum with the branches  $\frac{3}{4}$  to  $1\frac{1}{2}$  inches thick, usually much compressed, exterior striate and for an inch or more serrato-dentate; cells sometimes simple, but often sinuous and 2 to 5 inches long; lamellæ stout, broad dentate and inciso-dentate,  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch exsert; intervals between the calicles, nearly half an inch broad.

Plate 8, fig. 1 a, 1 b, 1 c, outline of cell and lamellæ.

East Indies, *Esper, Gmelin*.—Red Sea, *Ehrenberg*.

The frequent sinuous character of the cells at once distinguishes this species from the preceding; yet some single calicles are very similar to those of the *cactus*. The lamellæ are very unequal. The cells at bottom are finely convoluto-porous. The calicles are mostly about  $\frac{3}{4}$  of an inch broad at top; but they vary from  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches. They are larger, more irregular, and are separated by wider spaces than in the *cytherea*.

- Madrepora angulosa*, var.  $\gamma$ , Ellis and Solander, 153, tab. 34. The figure is good; it represents a convex clump nine inches in diameter.
- Madrepora cristata*, Esper, i. 150, tab. 26. Probably the same species, though the calicles are not quite so long and sinuous. The exterior though striate is but sparingly echinate. From the China Sea.
- Caryophyllia sinuosa*, Lamarck, 2d ed. ii. 357, No. 14.
- , Lamour., Exp. 50, pl. 34; Encyc., 173.
- Lithodendron cristatum*, Schweig. 416.
- Lobophyllia sinuosa*, Blainv. Man. 356.
- Caryophyllia cristata*, Ehrenberg, op. cit. G. lviii. sp. 1. The animal is stated to resemble that of the *M. corymbosa*.

#### 8. MUSSA CYTHEREA. (*Dana*.)

*M. bene hemispherica*, *discis sæpius linearibus et meandrinis. Corallum ramis sæpius valde compressis,  $\frac{1}{2}$ " crassis et  $\frac{2}{3}$ "–5" latis, creberrimis extus supernè striatulis et parce echinatis; cellâ sæpe elongato-sinuosa (5"); lamellis majoribus valde exsertis, cum 3–5 minoribus intermediis, apice latè subtruncatis et 2–3-incisis.*

Regularly hemispherical; disks mostly linear and meandering. Corallum having the branches usually much compressed,  $\frac{1}{2}$  an inch thick, and  $\frac{2}{3}$  to 5 inches broad, closely crowded; exterior striate above, and sparingly echinate; cell often 5 inches long and sinu-

ous; larger lamellæ much exsert with 3 to 5 smaller intermediate, subtruncate at apex and 2-3-gash-toothed.

Plate 7, fig. 3 *a*, 3 *b*, 3 *c*, section of cells showing the outline of the lamellæ.

Tahiti, Society Islands. *Exp. Exp.*

The sinuous cells ally this to the preceding species, but they are much narrower, and the intervals between are quite evenly one-fifth of an inch. The species is a peculiarly neat one, very evenly symmetrical in its hemispherical shape, and with the lamellæ very unequally prominent, the larger with subtruncate summits, standing at nearly equal distances considerably above the others.

#### 9. MUSSA MULTILOBATA. (*Dana.*)

*M. castanea*, *discis linearibus, sinuosis, multilobatis, lætè virentibus.*  
*Corallum meandrinum, caliculis  $\frac{2}{3}$ " crassis; cellâ valde gyrosâ, ad fundum 3-4 lamellis; lamellis rotundatis, crassè dentatis, minoribus alternis, dentibus subtriangulatis.*

Animal chestnut-brown; disks long, sinuous, and multilobate, bright green. Corallum meandrine, calicles  $\frac{2}{3}$  of an inch wide, cell very much gyrose, at bottom 3 or 4 longitudinal lamellæ; lamellæ with a convex apex coarsely toothed, teeth subtriangular, large and small lamellæ alternate.

Plate 8, fig. 2, the animal not fully expanded; 2 *a*, 2 *b*, profile of lamellæ.

Feejee Islands. *Exp. Exp.*

The specimen is a single turbinate calicle, four inches high; at base it is but half an inch in diameter, but above it spreads to a breadth of five inches by three, and contains a very sinuous trench, with several lobes, some two inches long, the whole including about twenty polyp mouths. The intervals between adjacent lobes are about one-eighth of an inch broad. The exterior is nearly smooth, somewhat striate above, with occasionally a few sharp teeth on the striæ. Along the bottom of the cell, extend three or four lamellæ, connecting the different polyp-centres.

*Fungus marinus lapideus foliolis erectis, serratis, &c.*, Seba, iii. tab. 109, fig. 4. An upper view of a calicle similar in its lobes to the above. The gyri are three-eighths to one inch broad, and the whole measures six inches by three in breadth; including all its sinuosities, the cell is about twelve inches long.

#### 10. MUSSA CEREBRIFORMIS. (Dana.)

*M. maxima, hemispherica, discis linearibus, sinuosis, longissimis. Corallum meandrinum, cellis  $\frac{3}{4}$ " latis, et longissimis, lobis sæpe rectis et 1' longis, ad cellæ fundum 1-2 lamellis; lamellis tenuioribus, vix rotundatis, dentatis.*

Very large, hemispherical; disks very long, linear, and sinuous. Corallum meandering; cells  $\frac{3}{4}$  of an inch broad and very long, the lobes often straight and a foot long; at bottom of cell one or two longitudinal lamellæ; lamellæ rather thin, scarcely rounded above, dentate.

Plate 8, figure 3, transverse section; 3 a, 3 b, profile of lamellæ and cell.

Feejee Islands. *Exp. Exp.*

This noble species grows in regular hemispheres several feet in diameter, consisting of very large sinuous meandering plates. It resembles the last, and might be an older specimen of the same; but the lamellæ are thinner, and, instead of three or four, there are only one or two longitudinal lamellæ connecting the polyp-centres at the bottom of the cell. The texture of this species, moreover, is more open, and its exterior less decidedly striate than in the *multilobata*; nine to twelve lamellæ meet at each polyp-centre, but they are scarcely convoluted at their junction.

#### 11. MUSSA REGALIS. (Dana.)

*M. subhemispherica, polypis grandibus, sæpe lateraliter coalitis, discis elongatis, sinuosis. Corallum meandrinum, caliculis 1-1 $\frac{1}{2}$ " latis, interdum  $\frac{1}{8}$ " sejunctis sed sæpe coalescentibus. extus striatis, non echinatis; cellis profundis (sæpe 1") interdum 6" elongatis; lamellis inæqualibus, dentatis, fere  $\frac{1}{2}$ " exsertis.*

Subhemispherical, polyps large, often laterally coalescing, disks forming long sinuous lines. Corallum meandrine, calicles 1 to  $1\frac{1}{2}$  inches broad, sometimes  $\frac{1}{8}$  of an inch apart, but often coalescing; exterior striate, not echinate; cells very deep (often 1 inch), sometimes 6 inches long; lamellæ unequal, dentate, nearly  $\frac{1}{2}$  an inch exsert.

Plate 8, fig. 5, section of cell, showing outline of lamellæ and cells.

East Indies.

This beautiful species is remarkable for the size and depth of its trenches, and the frequent lateral coalescence of adjoining calicles; the intervals, when any exist, are seldom over a line and a half wide, and these usually become less below, or disappear entirely, by a coalescence of the sides. The description is taken from a specimen kindly submitted to the author by Dr. Harris, of Cambridge, Mass.; it was brought from the East Indies by Captain John Codman, of Dorchester.

III. *Aggregatæ, meandrinæ.*

12. *MUSSA CRISPA.* (*Lamarck.*) *Dana.*

*M. stipitata, explanato-glomerata, effusa, conveza, discis lineatè sinuosis. Corallum margine tenui, crispo et sublobato; infra, striatum, plicatum, et parce spinulosum; supra, gyris sinuosis, prope  $\frac{3}{4}$ " latis (raro 1"), ad marginem dilatatis; collibus  $\frac{1}{2}$ — $\frac{2}{3}$ " latis; lamellis crassis, inæqualibus, valde serratis.*

Stipitate, explanato-glomerate, spreading, convex; disks linear and sinuous. Corallum with the margin thin, crispate, sublobate; below, striate, plicate, and sparingly spinulous; above, with sinuous gyri near  $\frac{3}{4}$  of an inch broad (rarely 1 inch), dilating at the border of the corallum; ridges  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch broad; lamellæ stout, unequal, strongly serrate.

Plate 8, fig. 6, view of the lamellæ.

Indian Ocean, *Lamarck.*—Singapore, *Exp. Exp.*



This is a subfoliaceous species, spreading outward from a central pedicel, and covered above with sinuous ridges formed of stout, coarsely-toothed lamellæ. Four or five of the larger lamellæ cover half an inch in breadth, and between these there are one to three smaller lamellæ. The fossæ are two-thirds of an inch deep, and along the bottom run two or three lamellæ which unite the convoluto-porous polyp-centres. The septa are thin. The specimen in the Expedition collections is eight inches in diameter.

*Meandrina crispera*, Lamarck, ii. 388, No. 6.

—, Blainville, Man., 357.

The figures by Seba, iii. tab. 108, No. 3 and

5, to which Lamarck refers as of this species, more probably represent the

*Manicina fissa*.

### 13. MUSSA DIPSACEA. (*Dana*.)

*M. brevissimè turbinata, convexa, discis breviter linearibus, fere simplicibus. Corallum valde robustum; cellis  $\frac{1}{2}$ – $\frac{2}{3}$ " latis,  $\frac{2}{3}$ –2" elongatis, sæpe lobatis, lamellis crassioribus, tenuiter dentatis, 1" exsertis, minoribus alternis; collibus interdum obsoletè sulcatis, septis angustissimis ( $\frac{1}{2}$ –1"), solidis.*

Very short, turbinate, convex, disks short, linear, and almost simple.

Corallum very firm; cells  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch broad, and  $\frac{2}{3}$  to 2 inches long, often lobed; lamellæ quite stout, slenderly and neatly dentate, 1 line exsert, alternately smaller; ridges sometimes obsoletely sulcate, septa very thin ( $\frac{1}{2}$  to 1 line), solid.

Plate 8, fig. 9, section of cell, showing outline of lamellæ.

This species has something of the habit of the *crispa*, but is smaller, with much shorter gyri, and finer dentations to the lamellæ. It differs from the *fragilis* in its shorter and narrower gyri, its scarcely sulcate ridges, and much stouter lamellæ. The specimen examined belongs to the collections of the Boston Natural History Society. It is about one and a quarter inches high, and two and a half in diameter.

The *Madrepora lactuca* of Esper, as figured in tab. 33, (Pflanz. Fortsetz. i.), appears to be the above species. There is a general resemblance, although the ridges are too broad and flat at top, and the cells appear too much obstructed by the lamellæ.

14. MUSSA FRAGILIS. (*Dana.*)

*M. glomerata*, vix stipitata aut partim incrustans, convexa. Corallum fragile, infra valde et acutè lamello-striatum; supra, gyris  $\frac{1}{2}$ – $\frac{2}{3}$ " latis, ad marginem dilatatis; collibus 4–5" latis, rotundatis et plerumque sulcatis; septo  $\frac{1}{8}$ " crasso et ad apicem duabus lineis calcareis longitudinalibus  $\frac{1}{10}$ " sejunctis; lamellis fragilibus, tenuiter dentatis et apice denticulatis.

Glomerate, scarcely stipitate or partly incrusting, convex. Corallum fragile; below, strongly and acutely lamello-striate; above, gyri  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch broad, dilating at the margin of the corallum; ridges 4 to 5 lines broad, rounded and somewhat sulcate; septum  $\frac{1}{8}$  of an inch thick, and at top two longitudinal calcareous lines  $\frac{1}{10}$  of an inch apart; lamellæ fragile, dentate, with the teeth slender, at apex denticulate.

Plate 8, fig. 7, outline of lamellæ and transverse profile of trench.

West Indies, Bermudas. *J. Redfield.*

The thin and fragile lamellæ, slenderly dentate, approximate this species to the *Manicina*. The trenches are nearly triangular in outline. The polyp-centres at the bottom of the trenches consist of aggregated points, but are hardly convolute. The specimen examined was furnished the author, for description, by Mr. J. Redfield of New York. It differs decidedly from the *crispa* in its more convex form, thinner lamellæ, sulcate ridges, and more numerous and slender dentations.

*Fungus marinus, foliolis erectis, pertenuibus, non dentatis, cui nomen est Brassica Pompeiana*, Seba, iii. tab. 109, No. 9. Represents a worn specimen probably of this species, and is a good figure of many specimens seen by the author (see plate 8, fig. 12). The two thread-like lines along the septum are  $\frac{1}{10}$  of an inch apart as in the above, and the gyri are of nearly uniform width. The coral being quite cellular, the ridges are often worn off nearly smooth, in beach specimens. Lamarck refers Seba's figure to his *Meandrina* (*Mussa*) *gyrosa*, which, as figured by Ellis, has very stout and firm septa, and is a much heavier and more solid species.

Another allied species is common in worn specimens in our collections, which has the gyri 5 to 9 lines broad, and less regular than in the preceding, and the two thread-like lines along the septum twice as near, with minuter cellules between them. It grows to a large size, at least a foot in diameter. Beach specimens have the ridges less worn off than in the *fragilis*. This is probably Seba's No. 10, tab. 109. The species may also

be Ehrenberg's *Manicina gyrosa* (G. lxiii. sp. 4), as his description agrees better with it than with Ellis's *gyrosa* (tab. 51, fig. 2), to which he refers. He describes it as follows:—"Quadripollicaris, turbinata, disco leviter convexo, stellis meandricis, gregatim collibus perfectius discretis, 6''' latis, lamellis tenuioribus, angustis, collibus perpendicularibus, pariete membranaceo, apice subacutis, leviter truncatis." He adds, "habitus, non character *Manicinae*. An novi generis prope *Polyastram* collocandi typus=*Polyastra stipitata*: *Podasteria*?"

Seba's No. 8, tab. 111, appears to be the *M. fragilis*; but he states that the lamellæ are not dentate: "Lamellis non dentatis, erectis, tenuissimis implicatis." May the edges have been broken? The ridges are more than half an inch broad, and resemble the above in form and appearance. Lamarck refers this figure to his *Meandrina pectinata*, and Ehrenberg to the same species (his *Manicina pectinata*): but the character "very thin lamellæ" removes it from that species.

#### 15. MUSSA GYROSA. (*Ellis.*) *Dana.*

*M. glomerata, convexa, discis longis, sinuosis. Corallum gyris  $\frac{1}{2}$ – $\frac{2}{3}$ " latis, septis crassis, medio fere solidis.*

Convex, glomerate, disks long and sinuous. Corallum with the gyri  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch broad, septa stout, at the centre nearly solid.

East Indies (?). *Esper.*

This large species is described by authors from worn specimens only. It is distinguished in this state by its stout and compact prominent rounded septa or ridges, and its sinuous gyri, which, in Ellis's figure, are scarcely more than half an inch wide.

*Madrepora gyrosa*, Ellis and Solander, 163, *Meandrina gyrosa*, in part, Lamarck, 2d tab. 51, fig. 2. From a worn specimen. ed. ii. 388, No. 7.  
 —, Esper, Fortsetz, i. 100, tab. 80, fig. 1. —, Lamouroux, Exp. 55, pl. 51, fig. 2.  
 A copy of Ellis's figure. —, Blainville, Man., 357.

#### 16. MUSSA RECTA. (*Dana.*)

*M. glomerata maxima, discis longissimis, sæpe rectis. Corallum gyris 1" latis; septis crassis, solidis, vix cellulosis; lamellis inæqualibus.*

Glomerate, very large, disks very long, and often straight. Corallum

with the gyri 1 inch broad; septa stout, solid, scarcely cellular; lamellæ unequal.

Plate 8, fig. 11, worn fragment of the corallum; 4 *a*, vertical section of the same.

Wake's Island, Pacific Ocean. *Exp. Exp.*

The long and often straight trenches, an inch wide, distinguish this species from the preceding, when in worn specimens, the only condition in which it was met with; four smaller lamellæ appear to intervene between the larger, and these last are a fourth to a third of an inch apart. The septum in the worn specimen is about an eighth of an inch wide, and obtusely rounded. The polyp-centres are convoluto-porous and a little prominent. In a vertical section, the transverse dissepiments on the lateral surface of a lamella are seen to be very numerous and delicate, forming neat lines, running obliquely across them.

#### 17. MUSSA NOBILIS. (*Dana.*)

*M. glomerata, subhemispherica, aut planiuscula, discis sinuosis, virentibus; ore albido; tentaculis brevissimis. Corallum gyris 1-1½" latis; lamellis inæqualibus, spinoso-dentatis, minoribus alternis; collibus integris.*

Glomerate, subhemispherical or nearly plane; disks long sinuous, green; mouth white; tentacles very short. Corallum, with the gyri 1-1½ inches broad; lamellæ unequal, spinoso-dentate, small and large alternating; ridges entire.

Plate 8, fig. 10, worn fragment of the corallum.

Port Carteret, New Ireland, *Quoy and Gaymard.*—Wake's Island, Pacific, *Exp. Exp.*

The above description is by Quoy and Gaymard. The size of the trenches is taken from their figure, which they state to be two-thirds the natural size. They represent the lamellæ as very coarsely dentate.

Worn specimens were obtained at Wake's Island, which have

the trenches one to one and a half inches wide, lamellæ stout, and apparently large and small alternate; ridges very stout (a fourth of an inch thick), nearly solid, with some transverse cellules. In a vertical section, the transverse dissepiments and cellules are very coarse.

The name *sinuosa*, being elsewhere in use, has above been changed.

*Meandrina sinuosa*, Quoy and Gaymard, *Meandrina sinuosa*, Lamarck, 2d ed. ii. Voy. de l'Ast., iv. 227, pl. 18, figs. 4, 5. 389, No. 10.

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GENUS IV.—MANICINA.—EHRENBERG.

*Astræidæ aut aggregatè aut segregatè gemmatæ, et explanato-glomeratæ; discis raro simplicibus, sæpissimè seriatim gemmantibus, et elongatè sinuosis. Coralla substipitata, convexa; cellis fossiformibus, meandrinis; margine bene rotundato; lamellis subæqualibus, tenuibus, et argutè denticulatis.*

Animals aggregate or segregate, and explanato-glomerate; disks rarely simple, very commonly seriately budding, and becoming long and sinuous. Coralla substipitate, convex; cells fossiform, meandering, with the margin rounded; lamellæ even, thin, neatly and distinctly denticulate.

The coralla of the Manicinæ are distinguished by their thin and very even lamellæ, finely denticulate both within the cells and over the exterior of the calicle, where they appear as neat and regular as within: there are ten to twelve lamellæ in a quarter of an inch, seven or eight of which are equally prominent, and the others obsolescent. The cells are large. Some species have the calicles separate branches, like the Mussæ; but from these, there is a gradual transition to species in which the adjacent calicles throughout are united by their lateral surfaces, with only a single ridge between the cells. In some of them only the inner parts of a group have the ridges thus duplicated, while the outer remain single. The bottom of the trenches are throughout finely porous.

The species differ from the Meandrinæ, in growing from a short pedicel or central point of attachment. Moreover they are larger species,

none having the gyri less than a third of an inch broad. The even and more crowded lamellæ, simply and regularly denticulate, and the porous bottom of the trenches, distinguish them from the Mussæ. They grow to a large size, but none, as far as is known, reach the gigantic dimensions of some Astræas.

Worn specimens of this genus are recognised by their stipitate form, evenly though faintly striate exterior, porous or semisolid line along the centre of the trench, and the regular lamellæ usually seven or eight to a quarter of an inch—though sometimes ten or eleven, especially at the margin of the trench.

The Manicinæ are confined to the coral-reef seas, and are most abundant in the West Indies.

This genus was instituted by Ehrenberg, for certain of Lamarck's Meandrinæ, characterized by growing from a pedicel or central attachment. Ehrenberg also included, though with an expression of doubt, some of the massive meandrine Mussæ, besides the groups Ctenophyllia and Tridacophyllia.

*Arrangement of the Species.*

I. *Calicles separated by open intervals. (Segregate species.)*

\*1. *M. amarantum.*

II. *Calicles coalescing laterally, and forming for the most part a single ridge, usually sulcate, between adjacent fossæ. (Aggregate species.)*

2. *M. fissa.*

\*5. *M. hispida.*

\*3. *M. areolata.*

\*6. *M. prærupta.*

\*4. *M. meandrites.*

\*7. *M. dilatata.*

1. MANICINA AMARANTUM. (*Dana.*)

*M. segregato-gemmata, grandis, convexa; discis sinuosis. Corallum caliculis meandrinis; fossis 1-1½'' profundis, sæpius perpendicularibus et ¼'' latis, sed margine 1'' dilatatis, fundo angustissimis et non porosis; collibus, fere 2''' crassis.*

Segregato-gemmate, large, convex; disks sinuous. Corallum having the calicles meandrine; fossa 1 to 1½ inches deep, usually perpendicular and ¼ of an inch broad, but often dilating to 1 inch towards the margin, at bottom very narrow and not porous; ridges rounded, near 2 lines thick.

Plate 9, fig. 1, part of a corallum, natural size.

East Indies. *Exp. Exp.*

This beautiful species is remarkable for the size and depth of its calicles, their never coalescing by their sides, and the neat regularity of the denticulate lamellæ. The lamellæ project about one-eighth of an inch above the septum, which is very thin; about three-fourths of an inch down in the cell, they abruptly enlarge, narrowing the cell, and then extend half an inch below this width with an entire margin. One specimen in the Expedition collections measures four inches in height and six in breadth. One meandering trench with its windings, is six inches long, and contains ten polyp mouths. It is probable that it grows in hemispherical forms.

*Amarantum sazeum*, Rumphius, Amb. vi. 244, tab. 87, fig. 1; probably a reduced figure of the above species.

This species appears to have been confounded with the *fissa* and *areolata*.

The *Turbinolia Geoffroyi* of Audouin (Savigny, fig. 1, pl. 4, Desc. de l'Égypte), is near this species, but has the exterior striate for half an inch only. Ehrenberg's *Manicina Hemprichii*, is referred by him to Savigny's figure; yet "lamellis validissimè spinosis," appears to be a distinctive character, as the lamellæ are denticulate in the figure by Savigny. Ehrenberg's description is as follows: "5-pollices lata, 3'' alta, breviter turbinata, margine sinuoso, leviter revoluta, sinubus maximis, nec margine coalitis, lamellis validissimè spinosis" (Gen. lxiii. sp. 1). A *Mussa*, allied to the *multilobata*?

NOTE.—Var. *stricta*. In the collections at Peale's Museum, Philadelphia, there is a specimen resembling the *amarantum*, but smaller. The following are its distinguishing characters (plate 9, figures 2 a, 2 b). Fossa one-sixth to one-eighth of an inch broad, and dilating near the margin to three-fourths of an inch; about three-fourths of an inch deep, and abruptly narrowed one-third to one half an inch from the top; ridges about one-eighth of an inch thick. The specimen is two inches high and three broad, and may have come from the West Indies.

## 2. MANICINA FISSA. (*Ehrenberg.*)

*M. stipitata*, convexa, sæpius aggregata; discis sinuosis. Corallum margine tenue, lobatum, et latè plicatum; collibus fere  $\frac{1}{2}$ '' latis, subtruncatis et sulcatis, septis laxè cellulosis,  $\frac{1}{8}$ '' crassis; fossis profundissimis (sæpe 1''), irregularibus, ad marginem dilatatis; lamellis laxis, foliaceis.

Stipitate, convex, mostly aggregate in structure; disks sinuous. Co-

rallum having the margin thin, lobate, broadly plicate; ridges nearly  $\frac{1}{2}$  an inch broad, subtruncate and sulcate; septa openly cellular,  $\frac{1}{8}$  of an inch thick, trenches very deep (often 1 inch), irregular, dilating at the margin; lamellæ lax, foliaceous.

West Indies (?).

The deep, irregular trenches, large duplicate ridges, and lax foliaceous lamellæ, make the species easily recognisable. Along the summit edge of the septum, run longitudinally two calcareous lines (edges of plates) about  $\frac{1}{8}$  of an inch apart with an open cellular space between. The species has the lax habit of a *Ctenophyllia*, and the lamellæ appear also from Ellis's figure to be entire. It may be found necessary on farther examination of specimens to transfer it to another genus.

Ellis and Solander, tab. 51, fig. 1.; but *Manicina fissa*, Ehrenberg, op. cit., G. without name or description. Lamarck lxiii. sp. 6. refers Ellis's figure to the *Meandrina Folia tenuissima fragilia, non dentata, pectinata*—our *Ctenophyllia pectinata*. Seba, iii. tab. 108, figs. 3 and 5.

### 3. MANICINA AREOLATA. (Ellis.) Ehrenberg.

*M. breviter turbinata, margine sinuoso-plicata, gyris  $\frac{1}{2}$ – $\frac{2}{3}$ " latis, parcè sinuosis, plicis plerumque coalitis. Corallum collibus sæpius duplicatis, latis, et valde concavis; fossis  $\frac{1}{3}$ " profundis, lamellis basi paulum dilatatis.*

Short turbinate, sinuoso-plicate at margin, gyri  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch broad, sparingly sinuous, folds for the most part coalescing. Corallum with the ridges generally duplicate, broad, and strongly concave; fossæ  $\frac{1}{3}$  of an inch deep, lamellæ a little dilated at base.

Plate 9, fig. 3, profile vertical section, natural size.

West Indies.

This species has not the entire or subentire ridges of the *prærupta* nor the deep fossæ of the *hispida*. The form and general character are well represented in Ellis's figure 5, plate 47. The fossæ are about two lines wide, except where dilated at the margin. The species undergoes a change of form as it enlarges by growth, and more study of it at the localities is necessary before its variations and all its distinc-



tive characters can be laid down. The following may be varieties, although presenting some striking peculiarities of habit.

*β. angusta.* Semi-globose; gyri very sinuous, half to two-thirds of an inch wide; ridges throughout stout and sulcate (often one-quarter to one-third of an inch broad), abrupt; fossæ one-third of an inch deep, mostly one and a half lines wide, lamellæ strongly dilatate at base. The most striking peculiarity is its more massive character, the ridges being in no part simple; the fossæ are narrower, much more sinuous than in the *areolata*.

*γ. gracilis.* Subturbinate, gyri sparingly sinuous, scarcely exceeding one-third of an inch in breadth; and ridges mostly simple instead of becoming duplicate by coalescence, one to one and a half lines thick; fossæ one to one and a half lines wide and dilating at the extremities of the folds. The specimens are often a simple sinuous calicle, with the folds seldom coalescing laterally. In this non-coalescent character, and the narrower gyri, it appears to differ from the *areolata* of Ellis.

- Madrepora areola*, Linn., ed. xii., p. 1274, —, Blainville, Man. 357.  
and Pallas's Zooph. 295. *Mæandra areola*, Oken, Zool. i. 70.  
—, Esper. i. 84, tab. 5. Indifferent *Manicina areolata*, Ehrenberg, G. lxiii. sp.  
figures of worn specimens. 11.  
*Madrepora areolata*, Ellis and Solander, —, Leuckart de Zoophytis coralliis, et  
161, tab. 47, fig. 5. A good figure. speciatim de genere Fungia, 4to. Friburg,  
Figure 4, of the same plate, is usually 1841, pl. iii. fig. 3.  
referred to as the same species; but it Seba's figure 7, tab. 111, usually referred to  
appears to be quite distinct. this, is another species without sulcate  
ridges, and appears to be the *prærupta*.  
*Meandrina areolata*, Lamarck, 2d ed. ii. Lesueur's figure of the *M. areolata*, Mém.  
388, No. 5. du Muséum, vi. tab. 16, fig. 11, may be  
—, Lamour., Exp. Meth. 55, tab. 47, this species, yet it is doubtful.  
fig. 5; Encyc. 508.

NOTE.—The figures 23 to 27, tab. 112, of Seba's Thes. iii., "fungi marini, oblongi, parietibus crassis, erectis compressis, &c.," represent worn specimens of perhaps more than one species of this genus, including the *areolata*. Ehrenberg has instituted the species *Manicina Manica* for specimens resembling Seba's, which he thus characterizes. "Bipollicaris, pollicem alta, turbinato-calycularis, supra plana, margine gyrosè plicato, meandrica, collibus præruptis, lamellis angustissimis, denticulatis, arenosis, sulcis latissimis, pallii margine tenui, diaphano, pedicello acuto." (G. lxiii. sp. 10.) The turbinate form is probably a young state of all the species.

4. MANICINA MEANDRITES. (*Esper.*) *Ehrenberg.*

*M. breviter turbinata, convexa, aggregata; gyris sinuosis, æqualibus, 3/4'' latis. Corallum fossis et collibus bene triangulatis, his fere subacutis, sæpius sulcatis.*

Short turbinate, convex, aggregate; gyri sinuous, and of nearly uniform width,  $\frac{3}{4}$  of an inch broad. Corallum with the fossæ and ridges triangular, the latter nearly subacute, and usually sulcate.

West Indies.

The even triangular ridges and trenches distinguish this species.

*Fungus lapideus, major, undulatus*, Hans *Meandrina pectinata*, Schweig. Hand. 420.  
Sloane's Jamaica, i. 56, tab. 18, fig. 5. *Manicina mæandrites*, Ehrenb., op. cit.  
*Madrepora mæandrites*, Esper, i. 79, tab. 4. Gen. lxiii. sp. 7.

5. MANICINA HISPIDA. (*Ehrenberg.*)

*M. brevissimè turbinata et semiglobosa; gyris 8-9''' latis. Corallum collibus 3-4''' latis, passim truncatis et concavis; fossis 1/2'' profundis; lamellis subito declivibus, basi dilatatis, latere hispidis; septis perpendicularibus.*

Very short, turbinate, and semiglobose; gyri sinuous  $\frac{2}{3}$  to  $\frac{3}{4}$  of an inch broad. Corallum with the ridges  $\frac{1}{4}$  to  $\frac{1}{3}$  of an inch wide, every where truncate and concave; lamellæ abruptly inclined, dilate at base, laterally hispid; septa perpendicular.

West Indies.

*Manicina hispida*, Ehrenberg, op. cit., G. lxiii. sp. 8.

6. MANICINA PRÆRUPTA. (*Ehrenberg.*)

*M. turbinato-semiglobosa, gyris fere 2/3'' latis. Corallum collibus fere perpendicularibus, et sæpius integris, lamellis basi parcè dilatatis, apice subtruncatis, latere arenosis; fossis 4-5''' profundis, 2-4''' latis.*



Turbinato-globose; gyri about  $\frac{2}{3}$  of an inch broad. Corallum, sparingly dilated at base; ridges nearly perpendicular, and mostly entire; lamellæ subtruncate at apex, lateral surfaces arenose; fossæ 4 to 5 lines deep, 2 to 4 lines broad.

West Indies. *Ehrenberg.*

This species is near the *areolata*, but has the ridges entire or nearly so, and not over two lines wide; the septa are about a line in width, and the texture is quite open cellular. The lamellæ are a little dilated at base.

*Manicina prærupta*, Ehrenberg, op. cit. *Fucus marinus*, &c., Seba, No. 7, tab. 111; Gen. lxiii. sp. 9. agrees with a specimen before the author.

APPENDIX.—*Manicina dilatata*. Ellis's figure 4, tab. 47, differs decidedly from the *areolata* in its more varying fossæ, dilating sometimes to an inch, and nearly half an inch deep. The species is here merely indicated, as only worn specimens have been seen by the author.

Esper's *Madrepora natans* (Pflanz. i. tab. 23) appears to be near the *Manicina hispida*. It is hemispherical in shape, and has high nearly perpendicular ridges, rounded and sulcate above, with the trenches irregular and averaging  $\frac{1}{3}$  of an inch wide. It is represented by Esper as light enough to float. He mentions a specimen a foot in diameter.

The *Manicina interrupta* of Ehrenberg, from the Red Sea, appears to belong to another genus. The description is as follows: "Lati- tudine disci quadripollicari, duplo latior quam alta, turbinata, tumida, collibus latis, sulco tenui medio lamellas latas, integras, granulatas truncatasque dividente, collium pariete angusto, membranaceo, recto, cristis 4'' distantibus." (Op. cit. G. lxiii. sp. 2.) In its broad entire lamellæ it seems to approach the *Euphyllia*.

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GENUS V.—TRIDACOPHYLLIA.—BLAINVILLE.

*Astræidæ aggregatæ; animalibus amplioribus, lateribus latè explanatis et assurgentibus; tentaculis minutis. Coralla substipitata, septis tenuis-*

*simè foliaceis, lamello-striatis, cellas amplas includentibus, sæpe paucis oririmis (sicut in Pavoniis) lateralibus.*

Aggregate Astræidæ; animals quite broad, with the sides expanded explanate, and assurgent; tentacles minute. Coralla substipitate; septa thin foliaceous, lamello-striate, enclosing broad cells, and often having on the lateral surface a few oririmes similar to those of the *Pavoniæ*.

The animals of the Tridacophylliæ are thin and broad, with the sides spreading widely, and rising into thin, erect, foliated crests. Deep among the folia, in the live specimens, lie the broad polyp-disks encircled by an irregular series of minute tentacles. The sides of the folia often bear other polyps, which more resemble those of the *Fungia* tribe than of the Astræidæ; and in the corallum, the radiated oririmes corresponding, are quite *Pavonia*-like. Thus, while these corals are closely related to the *Manicina* on one side, from which they differ principally in their foliaceous septa, they are also through the *Pavoniæ*, near the *Fungidæ*.

The Tridacophylliæ are confined to the warm coral-reef seas.

The genus Tridacophyllia was established by Blainville for the *Pavonia lactuca* of Lamarck. Ehrenberg places this species in his genus *Manicina*.

#### 1. TRIDACOPHYLLIA LACTUCA. (*Pallas.*) *Blainville.*

*T. subhemispherica.* Corallum septis foliaceis tenuissimis, sæpe 3-4" altis, profundissimè et fragiliter laciniatis; cellis amplis profundis, et paucis oririmis lateralibus; lamellis angustissimis, subdenticulatis, granulosis, supra obsolete: superficie inferiore remotè striatis.

Subhemispherical. Corallum, with very thin foliaceous septa, often 3 to 4 inches high, very deeply lacinate, and fragile; cells large and deep, with a few lateral oririmes; lamellæ very narrow, subdenticulate, granulous, becoming obsolete near the upper margin of the folia; under surface remotely striate.

Plate 9, figure 10.

East Indies. *Exp. Exp.*—West Indies (?). *Pallas, Ellis.*

This beautiful species grows in hemispherical clumps, often a foot in diameter. The slender laciniations of the upper margin of the crest-like folia are half or three-quarters of an inch long, and are extremely fragile. Owing to their brittleness, specimens in collections are often deprived of them. The large cells are mostly one to two inches in breadth.

According to Quoy and Gaymard, the animal has a grayish-green glaucous disk, *without tentacles*. The latter character is probably incorrect, as these organs were distinctly seen in the following species. They are very short, and often will not expand, except after being left quiet for a considerable time in pure ocean water.

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|---|--|
| <i>Permagna et valde elegans concha fungi-</i>        | —, Lamouroux, Exp. Meth. 53, tab. 44.                |
| <i>formis, &amp;c.</i> , Seba, iii. tab. 89, fig. 10. | <i>Tridacophyllia lactuca</i> , Blainville, Man.     |
| <i>Madrepora lactuca</i> , Pallas, Zooph. 289.        | 362, pl. 56, fig. 1—a much reduced                   |
| —, Ellis and Solander, tab. 44.                       | figure, with the crests broken.                      |
| —, Esper, Fortsetz, i. 7, tab. 33 A., a               | —, Quoy and Gaymard, Voy. de l'Ast.                  |
| copy of Seba's figure; 33 B. from Ellis.              | iv. 221, pl. 18, fig. 1—not good, unless             |
| <i>Pectinia lactuca</i> , Oken's Zool. i. 68.         | it belong to a different species with sub-           |
| <i>Pavonia lactuca</i> , Lamarck, ii. 377, No. 3.     | entire and not deeply lacinate crests.               |
| —, Schweig. Handb. 414.                               | <i>Manicina lactuca</i> , Ehrenb., G. lxiii. sp. 12. |

*Tridacophyllia manicina*.—The *Madrepora lactuca* of Ellis (Ellis and Solander, tab. 44, and Esper, tab. 33, B.), of which the West Indies is given as the locality, appears to be another species with the foliated crests scarcely lacinate. A worn specimen resembling it, belongs to the collections of the Boston Natural History Society. It is nine inches in diameter, and has a massive base four to five inches thick, with the foliate septa one to two inches high. When these ridges are worn away, the specimen resembles a light coarsely cellular *Manicina* or meandrine *Mussa*, with the cells one half to three-fourths of an inch wide. The *Manicina lactuca* of Ehrenberg (Gen. lxiii. sp. 12), though made identical with the *Tridacophyllia lactuca* of authors, appears to be Ellis's species.

## 2. TRIDACOPHYLLIA PÆONIA. (Dana.)

*T. convexa*, disco brunneo,  $\frac{1}{2}$ –1" lato, rugato, extra tentaculos griseo-virescente; tentaculis minimis. Corallum septis foliaceis validioribus, minoribusque, fere 2" altis; cellis sæpius 1" latis, rarissimè oririmis lateralibus; lamellis numerosis, supernè non obsoletis, paulum granulosis; superficie inferiore striatâ, striis densioribus.

Convex; disk brown,  $\frac{1}{2}$  to 1 inch broad, rugate, exterior to the tenta-

cles grayish-green; tentacles minute. Corallum with the foliaceous septa less thin and large than in the *lactuca*, about 2 inches high; cells usually 1 inch broad, very rarely with lateral oririmes; lamellæ numerous, and not becoming obsolete at the margin above, somewhat granulous; under surface with more crowded striæ than in the *lactuca*.

Plate 9, fig. 11, natural size; 11 *a*, section of corallum, with outline of lamellæ.

The Feejee Islands. *Exp. Exp.*

This species resembles the preceding, but is smaller, and the crests stouter and less deeply laciniate-lobed, with the striating lamellæ continued to the top edge, and not becoming obsolete. There are seldom if ever any lateral polyps to the folia, and the under surface of the corallum is more closely striated. The only specimen collected was a small convex clump, four inches broad and three high. Seba's figure, referred to under the *lactuca*, is near this species, and if not taken from a much worn specimen of the former, may be identical with it.

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GENUS VI.—CAULASTRÆA.—DANA.

*Astræidæ segregato-gemmatae, cespitosæ; caulibus polypisque subcylindricis. Coralla fragilia, extus striata, interdum denticulata; cellæ suborbiculatâ, latè excavatâ; lamellis inæqualiter exsertis, subintegris, valde numerosis.*

Segregato-gemmate, cespitose, with the stems and calicles subcylindrical. Coralla fragile, exterior striate, sometimes denticulate; cell nearly orbicular, broadly excavate; lamellæ unequally exsert, subentire, very numerous.

The corals of this genus grow in broad convex cespitose clumps, seldom regularly hemispherical like the *Mussæ*. Though near them in many characters, they are much smaller (about half an inch in diameter), more cylindrical, and have thin and nearly entire lamellæ

to the cell, of which there are about ten to a quarter of an inch in the species examined; moreover the stems break rather easily, while the *Mussæ* are very firm in texture. The broadly concave cell, as well as the last character mentioned, separates them from the *Euphyllia*. They approach the *Caryophyllia*, but increase by disk buds and subdivision; and besides, the coralla internally have the numerous transverse dissepiments of the *Astræidæ*. They differ from the *Manicinæ* in not having the lamellæ rounded above and regularly denticulate.

The polyps of the only live species examined, never fully expanded; they had a bright green disk, and appeared to be similar to the *Mussæ*.

The name of the genus is derived from *καυλος*, a stem, in allusion to the cylindrical stems which constitute the clump.

The species appear to be confined to the coral-reef seas.

The *Caulastrææ* fall within Lamarck's genus *Caryophyllia*, Oken's genus *Mussa*, and Schweigger's *Lithodendrum*. To this genus probably belong some of the *Lithodendra* of Michelin. Schweigger's name was introduced in place of Lamarck's *Caryophyllia* and *Oculina*, by him erroneously united, and has no claims to a place in the Science; and, besides, its signification (*stone-tree*) is inapplicable to any of the included species, except the *Dendrophyllia* and *Oculinæ*.

#### 1. CAULASTRÆA FURCATA. (Dana.)

*C. caulibus rectis, furcatis, vix undulatis, 3-5'' crassis; disco latè virente. Corallum undique obtusè striatum, leve; ramulis 1-2'' elongatis, 4-6''' animatis; caliculis sæpe tumidulis, ellipticis vel orbiculatis; lamellis numerosis, 1''' exsertis, subintegris, subæquis, supra sæpius angustatis.*

Stems straight, furcating, scarcely undulate, 3 to 5 lines thick; disk of the polyps bright green. Corallum every where obtusely striate, smooth; branchlets 1 to 2 inches long, alive for 4 to 6 lines; calicles often a little tumid, elliptical or orbicular; lamellæ numerous, 1 line exsert, subentire, subequal, usually narrowing upward.

Plate 9, fig. 4, animal unexpanded; 4 *a*, one of the calicles; 4 *b*, transverse section of the same; 4 *c*, an enlarged lamella.

The Feejee Islands, in shallow water on the coral-reefs. *Exp. Exp.*

The cespitose clumps are about four inches high, and consist of crowded, erect, furcating stems, which are nearly cylindrical, slightly undulate, and obtusely lamello-striate externally. There are hardly two lamello-striæ to a line in breadth. The stems break rather easily, and branch or furcate every inch or two, and the intervals between adjacent calicles are two to three lines broad; there are about thirty-six lamellæ to the cell, half of which extend to the centre of the bottom of the cell, which is much convolute.

## 2. CAULASTRÆA DISTORTA. (*Dana.*)

*C. caulibus contortis, 3-5''' crassis. Corallum extus undique striatum, ramulis brevioribus, 3-6''' animatis; caliculis scepe tumidis et distortis, extus lamello-striis spinulosis; lamellis numerosis subæqualibus, 1''' exsertis, latere subtiliter plicatis.*

Stems contorted, 3 to 5 lines in diameter. Corallum every where striate; branchlets shorter than in the preceding, alive for 3 to 6 lines; calicles often tumid and distorted with the exterior lamello-striæ finely spinulous; lamellæ numerous, subequal, 1 line exsert, their lateral surfaces finely plicate.

Plate 9, figure 5, corallum, natural size.

Feejee Islands. *Exp. Exp.*

There is a general resemblance in the size and habit of this species to the *furcata*; but the spinulous exterior to the calicles, and their distorted forms, appear to separate it from that species. Yet it is possible that the specimens may have formed the outer branches of a clump of the preceding.

## 3. CAULASTRÆA UNDULATA. (*Dana.*)

*C. hemispherica, caulibus arrectis, 6-7''' crassis, creberrimis ( $\frac{1}{8}$ '' remotis), subcylindricis, undulatis. Corallum longè rugatè striatum et denticulatum; caliculis  $\frac{1}{2}$ '' latis, interdum dilatatis; lamellis numerosis, triangulatis, apice subacutis, et paulo exsertis, subdenticulatis; cellâ conicâ, fundo angustâ.*



Hemispherical clumps, stems straight, crowded ( $\frac{1}{8}$  of an inch distant), subcylindrical, undulate. Corallum thick, throughout rugately striate and denticulate, calicles  $\frac{1}{2}$  an inch broad, sometimes dilated and compressed; lamellæ numerous, triangular, subacute at apex and a little exsert, subdenticulate; cell conical, bottom narrow, and of very open texture.

Plate 9, figure 6, profile section of calicle.

The long undulate stems, nearly cylindrical, are striate and finely denticulate over the exterior for several inches in length, and so closely and erectly branched that the intervals in the clump between the calicles are but one-eighth of an inch broad. The line of demarcation between the live and dead part of the calicle is scarcely distinct. The bottom of the conical cell is very open cellular, being formed of only a few entangled fibres. The clump examined is five inches high, and was probably from the West Indies.

This species approaches the *Madrepora fastigiata* of Esper (i. 95, tab. 8); but the cells are more open, the lamellæ less broad, and the branchlets, judging from Esper's figure, much more crowded.

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GENUS VII.—ASTRÆA.—LAMARCK.

*Astræidæ aggregatæ; discis simplicibus, raro distomatibus aut tristomatibus; tentaculis brevibus. Coralla convexa, sæpius bene hemispherica, interdum arrecto-gibbosa, aut glomerato-incrustantia; cellis excavatis, multi-radiatis, suborbiculatis, interdum angulatis, aut sublobatis; lamellis usque ad medium septi longiusve productis.*

Aggregate Astræidæ; disks simple, rarely two or three mouthed; tentacles short. Coralla convex, usually neat hemispherical, rarely erect-gibbous, or glomerato-incrusting; cells excavate, many-rayed, nearly circular, sometimes angular or somewhat lobed; lamellæ extending over the surface between the cells, and usually interrupted at the middle of the septum.

The Astrææ, though sometimes irregularly nodular or gibbous, usu-



ally grow in symmetrical hemispheres, often of large size. Six feet is a common size, and twenty feet is sometimes met with. The whole surface of these domes, as seen about the living reefs, is a continuous cluster of polyp-flowers. In some species each polyp or flower has a bright emerald centre, bordered by rays or tentacles of purple; in others the whole polyp is bright purple, or some shade of red, yellow, or brown. The prevailing colours are copper and emerald green, bright purple, deep brown, purplish-brown, and a reddish, yellowish, or dark umber, with intermediate tints. Some shade of umber usually characterizes the live coral, when unexpanded. A single species was observed with strongly spinous or echinate lamellæ (*A. echinata*), which appeared to have no tentacles, except the elevated fleshy points covering the spines; it is an instance of secretion of lime by the tentacles, and the production of spines or slender teeth by this process.

The most important characters distinguishing the *Astræas*, are, their mode of growth (§§ 76 to 79); their massive forms; their concave multiradiate cells covering uniformly the whole surface, the rays of which are prolonged out of the cells so as to striate the interstitial spaces—though interrupted near half way across; and the many transverse dissepiments which unite the lamellæ by their lateral surfaces to one another. These dissepiments, when oblique and very numerous, subdivide the cellules of the star, seen in a transverse section, as shown in figures 4 *c*, 4 *d*, plate 11; but when nearly horizontal or less crowded, they are hardly apparent, except in a vertical section (figures 2 *a*, 2 *b*, plate 10). This character of the transverse sections is important in the description of these corals, and when the cellules are subdivided they will be described as *decompound*; and otherwise as *simple*. The cells are either wholly immersed, or they stand a little prominent, with the intervening ridges more or less deeply sulcate instead of entire. They vary much in depth in different species,—in some the depth exceeding the diameter, while in others it is much less.\* In many, a number of prominent points encircles the porous bottom of the cell, forming a kind of corona. The points are appendages or teeth to the larger lamellæ; and cells characterized by them are described as *coronate* within.

In a transverse section of a corallum, as shown in figure 1 *c*,

\* We may use the term *profundior*, *quite deep*, when the depth exceeds the diameter; *profunda*, *deep*, when the depth about equals the diameter; *sub-profunda*, or *viz profunda*, *rather deep*, when less than the diameter, but more than half the same; and *paulo profunda*, *shallow*, when half the breadth or less.

plate 10, the lamellæ of the stars may be traced into the intervening septum, (except when it is very thin,) and the limits of the star may often be seen to be produced by a thickening of the lamellæ till they coalesce laterally; and when the septum is broad, the lamellæ often narrow again after this coalescence, leaving cellules between in the middle of the septum. In some species these cellules are linear or >-shaped, and in others they are polygonal and in two series. Occasionally they are entirely wanting, from the compactness of the corallum: yet even in these cases the lamellæ composing the septum may be usually distinguished.

The greater part of *Astræas* increase by disk buds, and spontaneous subdivision; the disk of the polyp, and the cell of the corallum, gradually widening by growth, and finally separating into two portions, which become independent (§ 79). A few widen only exterior to the disk or in the interstices, instead of the cells, and buds in this case open in the interstitial spaces between three or four cells (§ 76 *d.*)

Those species which increase in the latter way, are in general distinguished by having the calicles more distant and prominent than the others, or with wider and more concave interstices. The process as it goes on in the *Astræa argus*, may be easily studied. The lamellæ which intersect the septum, extending from either side half way across it, become separated a little at the middle of the septum, in consequence of this widening; and thus, in the medial point between three cells, these lamellæ actually begin to radiate around an open space. This is the commencement of a new star, and a new polyp; the bud soon after opens. There are some species, the *A. stellulata*, *stelligera*, *intersepta*, in which increase takes place both by these interstitial buds and by the dichastic process.

Though the cells of *Astræas* are usually simple, and contain only a single polyp mouth, except during the process of subdivision, yet in a few species they become elongated, so as to contain three or four mouths, and thus approach the *Meandrinæ*; and in the same specimen, simple and oblong linear cells are intermingled. The *A. deformis* is an example, and were it not that the simple cells are the most numerous, it should be placed near the *Meandrina dedalea*, and *M. spongiosa*. The *M. spongiosa* appears to be often a true *Astræa* in its characters, and the *A. varia* closely resembles some of its varieties.

These corals are confined, with rare exceptions, to the coral-reef seas, and contribute largely to the construction of reefs, both in the Pacific and in the East and West Indies.

The mode of budding separates the Astrææ from the Caryophyllia and Cyathophyllum families. Yet in some massive species the distinction is not readily observed, especially between the Astræas and certain Cyathophylla, which agree in the general character of the cells. When treating of the Cyathophyllidæ, the distinguishing characteristics will be more particularly dwelt upon. The lamello-striate surface of the Astrææ will afford an almost invariable character for distinguishing them from the recent species of the Caryophyllia tribe; and adding to this the many transverse dissepiments between the lamellæ, which are remote, if at all existing in the latter, and there will be little chance for confounding them. The Astrææ, however, graduate into the Caryophylliæ through the small *Orbicellæ*, the *A. ocellina* and *A. myriophthalma*, closely resembling *Oculinæ*, and hardly distinguishable, except by their glomerate or incrusting forms and general habit. (See farther under *Oculina*.) The same transition also takes place through the *A. pleiades* and the *Astroites*. These last species exhibit their Caryophyllia character, however, in the fact that the aggregated polyps are united only by the lower parts of the animals, as is evinced by their becoming long exsert when expanded: moreover, we perceive in their coralla that the new cells open in the interstices, although but a fraction of a line in breadth; while all Astræas, with similarly narrow interstices, bud in the disks. They are thus similar to the *Porites* among the *Madreporacea*.

The genus *Astræa* was so named by Lamarck, in allusion to the stellate cells, and was instituted with nearly the same limits as here adopted.\* The *Astræopora* were separated from it by Blainville, and the *A. palifera* was arranged by the same author with his genus *Gemmipora*; and these changes have been here adopted. A few other species, having the stars of the *Pavoniæ*, have been placed in this work with that genus: these are in part the *Siderastrææ* of Blainville, and are characterized by the absence of proper cells, and the lamellæ being uninterruptedly continuous between the polyp centres or oririmes.

\* *Astræa*, the goddess Justice in ancient mythology, "lived upon the earth, as the poets mention, during the golden age, which is often called the age of *Astræa*; but the wickedness and impiety of mankind, drove her to heaven in the brazen and iron ages, and she was placed among the constellations of the Zodiac under the name of *Virgo*."

— "Virgo cæde madentes  
Ultima cælestum terras *Astræa* reliquit."—*Ovid*, *Met.* i. 150.

The distinction alluded to, of species with short calicles or duplicate ridges, and those with the cells separated only by simple ridges, was first made the ground for a subdivision of this genus by Oken, who instituted for the former the genus *Favia*. Ehrenberg afterwards adopted the same subdivision, but with more accurately defined characters. But the two groups pass by gradual transitions into one another. Moreover, in the *Manicinæ*, the same specimen often shows both the simple and deeply sulcate ridge, according as the coalescence is more or less complete, evincing the little importance of this character as a generic distinction.

A more important subdivision is suggested by Blainville, who places the species with regular circular cells (a regularity arising from their not increasing by disk buds), in his genus *Tubastræa*. Ehrenberg, who first pointed out the source of their peculiarities, separates the same species under the generic name *Explanaria*, one of Lamarck's genera, but much changed in its application. This author, moreover, separates his *Explanariæ* from the *Astræa* tribe, and places them with the *Caryophyllacea*. While we fail to see the propriety of so wide a separation from the *Astræidæ* (§§ 67, 80), there is still some reason for a subdivision of the genus. As the two modes of increase by disk buds and interstitial buds, are sometimes presented by the same species, the groups are introduced only as *subgenera*. The subgenus including the *Tubastrææ* of Blainville, may be called *Orbicella*. The other *Astræa* simply; or *Fissicella*, alluding to the mode of growth and budding by subdivision, if a significant name be required. The name *Tubastræa* of Blainville, is rejected on account of its formation from words of different languages; as it has not been generally adopted, no inconvenience can result from this course, required as it is by usage and law.

The *Orbicellæ* have fixed limits to the size of the adult cells, and number of lamellæ and tentacles; the cells are circular or elliptical, and quite regular. The *Fissicellæ* increase constantly in the breadth of their disks and cells, and the number of lamellæ; the cells therefore are often oblong, and some may be seen in the progress of subdivision; occasionally they are a little flexuous and lobed, and thus pass into the *Meandrinæ*. The passage also into the *Echinoporæ*, may be distinguished in the erect-lobed species—the *tesserifera* and others allied—in which the young appear near the upper margin in the ascending cell.

Among the *Astræoid* corals increasing interstitially, there are some

species that have the interstices between the cells quite flat, and the lamellæ minute, closely crowded, and slightly prominent; they much resemble some of the aggregate species of the Fungia family, and are near the Psammocoræ. They may possibly be shown to have the essential characters of the Fungidæ, but are for the present arranged here, in the subgenus *Siderina*. They form part of the group *Siderastræa* of Blainville.

*Arrangement of the Species.*

**SUBGENUS 1. ORRICELLA.** Cells nearly circular, more or less prominent, not subdividing by growth, or rarely so; stars with distinct limits formed by the coalescence laterally of the lamellæ, and therefore cells appearing tubular and separated by interstices.

I. *Calicles prominent, cells more than 2 lines broad, lamellæ in adult cell, 36 or 48.*

- |                        |                       |
|------------------------|-----------------------|
| 1. A. Orb. radiata.    | *5. A. Orb. curta.    |
| *2. A. Orb. argus.     | 6. A. Orb. rotulosa.  |
| *3. A. Orb. glaucopis. | *7. A. Orb. coronata. |
| *4. A. Orb. patula.    |                       |

II. *Calicles more or less prominent, cells less than 2 lines broad, lamellæ in adult cell, 18 or 24.*

- |                          |                             |
|--------------------------|-----------------------------|
| *8. A. Orb. hyades.      | *13. A. Orb. stelligera.    |
| *9. A. Orb. excelsa.     | 14. A. Orb. crispata.       |
| *10. A. Orb. pleiades.   | *15. A. Orb. microphthalma. |
| *11. A. Orb. annularis.  | *16. A. Orb. ocellina.      |
| *12. A. Orb. stellulata. |                             |

**SUBGENUS 2. SIDERINA.** Cells not subdividing by growth, interstices flat, stars with limits along the middle of the interstices, and cells not appearing tubular; lamellæ minute and crowded.

- \*17. A. Sid. galaxea.

**SUBGENUS 3. FISSICELLA.** Cells subdividing by growth and budding.

A. CONVEX OR ROUNDED.

a. Cellules of the stars in a transverse section decompound, lamellæ even.

I. *Calicles prominent.*

- |                   |                    |
|-------------------|--------------------|
| *18. A. speciosa. | *21. A. pandanus.  |
| 19. A. uva.       | *22. A. puteolina. |
| 20. A. ananas.    | *23. A. pallida.   |

II. *Calicles immersed, ridges somewhat sulcate or entire.*

- |                   |                        |
|-------------------|------------------------|
| *24. A. dipsacea. | *27. A. fusco-viridis. |
| *25. A. porcata.  | *28. A. virens.        |
| *26. A. flexuosa. | *29. A. echinata.      |

- \*30. *A. fragilis* (cellules sparingly decomp.) \*32. *A. magnifica*.  
 \*31. *A. tenella*, \*33. *A. filicosa*.

*b.* Cellules of the stars in a transverse section scarcely decompound or not at all so.

I. *Ridges sulcate or entire, lamellæ unequally exsert.*

- \*34. *A. versipora*. \*37. *A. deformis*.  
 \*35. *A. denticulata*. \*38. *A. varia*.  
 \*36. *A. pectinata*.

II. *Ridges narrow, entire, nearly naked at summit, lamellæ unequal, but hardly at all exsert, cellules of stars sometimes sparingly decompound.*

- \*39. *A. rigida*.

III. *Ridges entire or sulcate, lamellæ even; cells not coronate within, cellules of stars not decompound or scarcely so.*

40. *A. reticularis*. \*42. *A. purpurea*.  
 \*41. *A. petrosa*. \*43. *A. pulchra*.

IV. *Ridges entire, lamellæ even, cells coronate within; cellules of stars simple (cells often very regularly polygonal).*

44. *A. pentagona*. \*49. *A. parvistella*.  
 \*45. *A. favistella*. \*50. *A. favulus*.  
 \*46. *A. eximia*. \*51. *A. cerium*.  
 \*47. *A. sinuosa*. \*52. *A. intersepta* (hardly coronate).  
 48. *A. melicerum*.

#### B. ERECT LOBED.

- \*53. *A. abdita*. \*55. *A. robusta*.  
 \*54. *A. tesserifera*.

#### C. UNARRANGED SPECIES.

56. *A. complanata*. 59. *A. halicora*.  
 57. *A. heliopora*. \*60. *A. cyclostra*.  
 58. *A. Hemprichii*. 61. *A. favosa*.

### SUBGENUS I.—ORBICELLA.

I. *Caliculis prominentibus, cellis 2''' latioribus.*

#### 1. *A. ORBICELLA RADIATA. (Ellis.)*

*A. convexa. Corallum caliculis 1-1½''' remotis, cylindricis, 5-6''' latis,*

*marginē rotundatis; interstitiis concavis, radiato-striatis; cellis profundis aut subprofundis; lamellis angustis.*

Convex. Corallum with the calicles 1 to  $1\frac{1}{2}$  lines distant, cylindrical, 5 to 6 lines broad, rounded at the margin; interstices concave, radiately striate; cells deep; lamellæ narrow.

West Indies. *Ellis and Solander. Lamarck.*

The very prominent calicles with wide concave interstices separate this species from its congeners. It resembles the *A. speciosa*; but differs in its more remote calicles, and also its interstitial mode of budding. The internal texture, as figured by Ellis, is quite coarsely cellular.

*Mad. radiata*, Ellis and Solander, 169, tab. —, Lamour., Exp. 57, tab. 47, fig. 8; 47, fig. 8. Encyc., 132.

*Mad. astroitis, var.* Pallas Zooph., 320. *A. Tubustræa radiata*, Blainville, Man. 368.

*Astræa radiata*, Lamarck, ii. 404, No. 1. *Explanaria radiata*, Ehrenberg, G. l. sp. 6.

## 2. A. ORBICELLA ARGUS. (*Lamarck.*)

*A. subhemispherica; polyypis 5''' latis, prominulis; lamellis 48.\* Corallum subsolidum, caliculis brevissimè conicis, polygonis, et 1''' altis, extus confertim regulariterque striatis et denticulatis; cellis orbiculatis, 3''' latis, paulo profundis, fundo latis; lamellis tenuibus, denticulatis: transversè secto, stellis multiradiatis, cellulis simplicibus; septis fere solidis, paucis cellulis lineatis vel >-formibus.*

Subhemispherical, polyyps mostly 5 lines broad, a little prominent, with 48 internal lamellæ. Corallum nearly solid; calicles very short, conical, polygonal, 1 line high, exterior crowdedly and very evenly striate and denticulate; cells circular, 3 lines broad, rather shallow, broad at bottom; lamellæ thin, denticulate: in a transverse section, stars multiradiate, with the cellules simple; septa nearly solid, with a few linear or >-form cellules.

Plate 10, fig. 1 *a*, transverse section; 1 *b*, vertical section; also, p. 75.

\* The number here given includes all the lamellæ, large and small, in the adult calicle, or what is equivalent, the number of striæ on the exterior of the calicle.



## West Indies.

The *argus* is a neat species, distinguished by its low conical calicles, rather less than half an inch across, finely striate, with forty-eight minutely denticulate lamello-striæ, when of adult size; the cells are nearly circular, and a fourth of an inch broad; the lamellæ are thin and about ten of them extend to the fundus, which is about one-third the breadth of the star. The septa present only occasional cellules, either in a vertical or transverse view. In a vertical section, the dissepiments on the surface of the lamellæ are seen to be numerous, quite fine, and nearly horizontal, a little oblique downward.

*Mad. cavernosa*, Esper, Fortsetz. i. 18, tab. 37. *Astrea argus*, Lamour., Encyc., 131.

*Astrea argus*, Lamarck, ii. 404, No. 2. *A. Tubastræa cavernosa*, Blainville, Man., 368.

3. A. ORBICELLA GLAUCOPIS. (*Dana.*)

*A. maxima, hemispherica; polypis prominulis; lamellis 48. Corallum subcellulosum: transversè secto, stellis suborbiculatis, 4-5'' latis, tenuiter 24-26-radiatis, cellulis simplicibus; septis subcellulosis, cellulis lineatis et >-formibus, numerosis.*

Very large, hemispherical; polyps a little prominent, with 48 lamellæ. Corallum subcellular: stars in a transverse section, suborbiculate, 4 to 5 lines broad, finely 24 to 26-rayed, with the cellules simple; septa subcellular; the cellules linear and >-shape, numerous.

Plate 10, figure 2 *a*, a vertical section; 2 *b*, transverse section; both natural size.

The Feejee Islands. *Exp. Exp.*

This coral, of which the author has seen only a worn specimen, grows in large hemispheres. The specimen measures fifteen inches in length, and is but a section of a larger mass, which, from the angle of divergence between the sides, must have been at least three feet in diameter. There is some resemblance in a transverse sectional view to the *argus*, but the stars are much larger, with a greater number of rays, and the septa have more numerous cellules, the la-

mellæ not being so completely united together. In a vertical section, the centre of the cell is subfilamentous, and the dissepiments on the surfaces of the lamellæ are few, minutely delicate, almost horizontal and nearly parallel.

4. A. ORBICELLA PATULA. (*Dana.*)

*A. maxima, hemispherica, fusco-umbrina; polytis 6-8'' latis, discis pallidè radiatèque griseis. Corallum cellulosum; caliculis polygonis, patulissimè conicis aut subplanis, bene confertimque striatis et denticulatis; cellis paululum excavatis, non coronatis, lamellis incrassatis, spinoso-denticulatis: transversè secto, stellis multiradiatis, radiis crassis, fere contiguis; septis subcellulosis, cum paucis cellulis angustis.*

Very large, hemispherical, dark-umber coloured; polyts 6 to 8 lines broad, with the disks radiated with pale gray. Corallum cellular; calicles polygonal, flat conical, or nearly flat, evenly and crowdedly striate without, and denticulate; cells very shallow, not coronate; lamellæ incrassate, spinoso-denticulate: in a transverse section, stars many-rayed, rays thick and nearly contiguous; septa with a few narrow cellules.

Plate 10, fig. 14, part of a corallum with the animals unexpanded; *a*, section showing outline of cells and ridges, and the dentation of the lamellæ; *b*, an enlarged view of the same; *c*, *d*, vertical sections, natural size; *e*, transverse section.

The Feejee Islands. *Exp. Exp.*

5. A. ORBICELLA CURTA. (*Dana.*)

*A. convexa; polytis prominulis, 3-4'' latis, lamellis 48. Corallum minutissimè cellulosum; caliculis breviter conico-rotundatis, extus confertim regulariterque striatis et subtiliter denticulatis; cellis orbiculatis, 2½'' latis, subprofundis, intus subcoronatis; lamellis fere æquè exsertis, denticulatis: transversè secto, stellis fere multiradiatis, cellulis parce subdivisis; septis sæpius minutè cellulosis, cellulis lineatis vel >-formibus.*

Convex; polyts a little prominent, 3 to 4 lines broad, with 48 internal

lamellæ. Corallum very minutely cellular; calicles short, round, conical, crowdedly and evenly striate and finely denticulate without; cells orbicular,  $2\frac{1}{2}$  lines broad, rather deep, subcoronate within; lamellæ almost equally exsert, denticulate: in a transverse section, stars with many rays, and cellules sparingly subdivided; septa usually minutely cellular, with the cellules linear or > - shape.

Plate 10, fig. 3, *a*, enlarged profile view of cell and lamellæ; *b*, enlarged transverse section; *c*, vertical section, natural size.

The Feejee Islands. *Exp. Exp.*

This species is smaller than the preceding, and the corallum is more minutely cellular within. The lamellæ are a little unequally prominent, approaching thus the *coronata*; but the *much less* inequality, and the cross partitions in the stars are distinguishing characters, as well as the more conical shape of the calicles and their more evenly-striated exterior. The striæ are forty-eight in number in adult calicles. The lamellæ are mostly hollow; and in a vertical section, they are often deeply pectinato-erose, or penetrated by oblong cellules, the pectinations and cellules being directed obliquely, a little upward and inward.

#### 6. A. ORBICELLA ROTULOSA. (*Ellis.*)

*A. subglobosa*; *polypis prominulis, lamellis 36 (?)*. *Corallum, caliculis brevissimè cylindricis; lamellis inæqualibus et valde inæqualiterque exsertis, paucis; cellis 2-2½''' latis, per 6-8 denticulos coronatis.*

Subglobose, polyps a little prominent, with 36 (?) internal lamellæ. Corallum with the calicles very short cylindrical; lamellæ unequal and very unequally exsert; cells 2 to  $2\frac{1}{2}$  lines broad, with a corona of 6 to 8 teeth.

West Indies. *Ellis, Lamarck.*

This is a handsome coral, with neat circular calicles, hardly a quarter of an inch in diameter, having the margin set around with unequally prominent lamellæ, the larger projecting about half a line. This character gives a bristly aspect to the surface. It differs from

the *coronata* in the fewer rays, rather larger cells, and more finely striate exterior to the calicles. Ellis represents the points of the corona within the cell as but six to eight in number, and the intermediate lamellæ between the larger, as obsolescent.

*Mad. rotulosa*, Ellis and Sol., 166, tab. 55. *Favia rotulosa*, Ehrenberg, G. lix. sp. 7.  
*Astræa rotulosa*, Lamarck, ii. 405, No. 4. Esper's *Madrepora acropora*, (Pflanz. Fort-  
 —, Lamouroux, Exp. Meth. 58, tab. 55; setz. i. tab. 38) may be this species  
 Encyc., 129. badly represented.

#### 7. A. ORBICELLA CORONATA. (Dana.)

*A. convexa*, subglobosa; polypis prominulis,  $2\frac{1}{2}$ –3''' latis, lamellis 36.  
 Corallum subcellulosum, caliculis breviter cylindricis; lamellis in-  
 æqualibus et inæqualiter exsertis, numerosis; cellis 2''' latis, orbicu-  
 latis, subprofundis, intus per 10–12 denticulos coronatis: transversè  
 secto, septis fere solidis, sæpe raris cellulis, interdum numerosis; stellis  
 multiradiatis, cellulis simplicibus.

Convex, subglobose; polyps a little prominent,  $2\frac{1}{2}$  to 3 lines broad, with 36 internal lamellæ. Corallum subcellular; calicles very short cylindrical with the lamellæ unequal and unequally exsert, numerous; cells 2 lines broad, circular, rather shallow, coronate within with 10 to 12 minute points: in a transverse section, septa nearly solid, often with delicate cellules, which are sometimes numerous; stars many-rayed, cellules simple.

Plate 10, fig. 4 *a*, part of corallum, natural size; *b*, calicle enlarged; *c*, outline of cell and lamellæ; *d*, vertical section natural size; *e*, transverse section, enlarged; *f*, the same, showing natural size.

Tahiti, and also the Feejee Islands, and Wake's Island, Pacific Ocean. *Exp. Exp.*

This species resembles the preceding; but the rays to the cells and the points of the corona are more numerous and crowded. The calicles are placed obliquely in the specimen examined, so that one side is often nearly a line higher than the other, which is sometimes almost lost in the sides of the next cell. In a vertical section the part below the cell is very fine cellular, while the septa, unless broad, are quite solid; when broad, there is a row of cellules along the middle.



II. Caliculis parvulis, 2''' angustioribus.

8. A. ORBICELLA HYADES. (Dana.)

*A. convexa, arrecto-glomerata; polypis vix 2''' latis, lamellis 24. Corallum percellulosum; cellis orbiculatis, 1½''' latis, margine annulato (sicut in pleiades); lamellis tenuissimis; interstitiis angustis, sæpius concavis: transversè secto, stellis 24-radiatis; septis valde cellulosis.*

Convex, erect glomerate and gibbous; polyps scarcely 2 lines broad, with 24 internal lamellæ. Corallum light cellular; cells circular, 1½ lines broad, with the margin annulate as in the *pleiades*; lamellæ very thin; interstices narrow, mostly concave: in a transverse section, stars with 24 rays, septa spongy cellular.

Plate 10, fig. 15, transverse view, natural size.

West Indies. *Boston Nat. Hist. Soc.*

This species resembles the *pleiades*, but the stars of the worn surface are larger, and have twenty-four nearly equal rays, the intermediate not being obsolete. The interstices in a vertical section are very delicately cellular and irregularly so, as the rays of the stars seem to be interrupted. In the transverse section, the septum contains generally a single imperfect series of delicate cellules which are seldom angular. In these last characters the species approaches the Caryophyllacea. The cellules of the stars are deep and never decompound. The rays meet in a very narrow fundus which is scarcely convoluted. The specimen affording this description is a subturbinate mass six inches high, four and a half wide at top, with the summit nearly flat.

9. A. ORBICELLA EXCELSA. (Dana.)

*A. arrecto-glomerata, 5" alta et 2" lata; polypis parvulis, (vix 2''' latis) lamellis 24. Corallum robustum; cellis orbiculatis, vix 1½''' latis, margine prominulo, 24 lamellis subæqualibus, denticulatis; interstitiis sæpius ½''' latis: transversè secto, stellis fere 24-radiatis; septis parçè cellulosis, interdum cellulis uniseriatis.*

Erect glomerate and gibbous, 5 inches high and 2 broad; polyps small (scarcely 2 lines broad), with 24 internal lamellæ. Corallum firm; cells circular, scarcely  $1\frac{1}{2}$  lines broad; margin a little prominent, with 24 subequal denticulate lamellæ; interstices usually  $\frac{1}{2}$  a line broad: in a transverse section, stars about 24-rayed; septa sparingly cellular, cellules sometimes uniseriate.

Plate 10, fig. 16, transverse view, natural size.

West Indies. *Bost. Nat. Hist. Soc.*

The erect mode of growth of this species is somewhat like the last, but the texture is more solid and the rays of the star less delicate and even. Only a worn specimen has been seen by the author. In this the interstices are flat or slightly concave, and have very faint radiated striæ. The lamellæ of the cells barely meet in the centre. This species differs from the *stellulata* and *annularis* in having the twelve *intermediate* lamellæ of the star nearly as prominent as the others; hence in a transverse section, about twenty-four rays may be distinguished in the larger cells. In a vertical section the transverse dissepiments are quite oblique, and occasionally the cellules of the stars in a transverse section are subdivided by them.

#### 10. A. ORBICELLA PLEIADES. (*Ellis.*)

*A. convexa*, polypis  $1\frac{1}{2}$ '' latis, lamellis 24. Corallum percellulosum, debile; cellis orbiculatis, fere  $1\frac{1}{2}$ '' latis, margine annulato, tenuissimo; interstitiis concavis, laxè cellulosis, angustis ( $\frac{1}{3}$ '' ): transversè secto, lamellis duodecim tenuissimis, aliis intermediis obsoletis.

Convex; polyps  $1\frac{1}{2}$  lines broad, with 24 internal lamellæ. Corallum very light and delicately cellular; cells orbiculate, nearly  $1\frac{1}{2}$  lines broad, margin annular and very thin; interstices concave, loose cellular, narrow (about  $\frac{1}{3}$  of a line): in a transverse section, lamellæ 12, very thin, the intermediate obsolete.

Plate 10, fig. 5 *a*, transverse section, natural size; 5 *b*, same enlarged; 5 *c*, vertical section, natural size.

East Indies. *Ellis, Lamarck.*—Wake's Island, Pacific Ocean.  
*Exp. Exp.*

This species is remarkable for its very light, almost spongy texture, and its regularly circular cells, with a neat and extremely thin border, as seen on a worn surface. The rays are delicate and about twelve in number. The porous centre of the star is about a third the whole diameter. Only a worn specimen has been seen by the author, and Ellis's figure was made from a similar one.

*Mad. pleiades*, Ellis and Sol., 169, tab. 53, —, Lamour., Exp. Meth. 58, tab. 53, figs. 7, 8. *A. Tubastræa pleiades*, Blainv., Man. 368.

#### 11. A. ORBICELLA ANNULARIS. (*Lamarck*.)

*A. polypis parvulis* ( $1\frac{1}{2}$ "), lamellis 24. *Corallum cellulosum; cellis orbiculatis, 1" vix superantibus, 10-12 radiis tenuibus et aliis intermediis obsoletis; interstitiis plano-concavis: transversè secto, septis cellulosis cum cellulis minutis in medio sæpissimè uniseriatis, raro biseriatis.*

Polyps small ( $1\frac{1}{2}$  lines broad), with 24 internal lamellæ. *Corallum* cellular; cells orbiculate, scarcely over a line broad, 10 to 12 slender rays, and others intermediate obsolete; interstices plano-concave: in a transverse section, septa cellular, with the cellules minute, usually in a single medial series, rarely in two series.

Plate 10, fig. 6, transverse section of corallum, natural size.

West Indies. *Ellis, Lamarck.*

This species has circular cells nearly of the size in the *pleiades*, but the texture is much heavier, and the cellules of the septa in a transverse section are mostly in a single series along the middle of the same, leaving a solid ring around the star nearly a quarter of a line thick. The porous centre of the star rather exceeds one-third the breadth of the same. The author has seen a worn specimen from the Barbadoes; it was three inches in diameter, and had a convex surface.

*Mad. annularis*, Ellis and Solander, 169, tab. 53, figs. 1, 2; a good figure of a worn specimen. *A. Tubastræa annularis*, Blainville, Man. 368. *Explanaria annulata*, Ehrenb., G. l., sp. 7. The *A. annularis*, of Quoy and Gaymard, (Voy. de l'Ast. iv. 209, pl. 17, figs. 17, 18.) is another species (sec *A. speciosa*).



## 12. A. ORBICELLA STELLULATA. (Ellis.)

*A. convexa et sæpe undulata; polyptis 1½" latis, discis raro gemmatis et dichasticis; lamellis 24. Corallum subcellulosum; cellis orbiculatis, 1" latis, raro oblongis, vix profundis; lamellis tenuibus, supra septum regulariter prominulis; interstitiis sæpius concavis: transversè secto, septis subsolidis, interdum cellulis interruptè uniseriatis, et rarissimè biseriatis; stellis 10-12 radiis et aliis intermediis obsoletis.*

Convex and often undulate; polyps 1½ lines broad, disks sometimes budding and dichastic; 24 internal lamellæ. Corallum subcellular; cells orbiculate, 1 line broad, rarely oblong; lamellæ thin, a little prominent above the septum, and evenly so; interstices usually concave, yet often entire: in a transverse section, septa solid or nearly so, sometimes with cellules interruptedly uniseriate, and occasionally biseriate; stars 10 to 12-rayed, other intermediate rays obsolete.

Plate 10, figure 7 *a*, transverse section, natural size; *b*, vertical section, do.

West Indies.

In a transverse sectional view, the *stellulata* has considerable resemblance to the *annularis*, but the septum is much more solid, and cellules are only occasionally observed. It resembles also the *stelligera*; but the lamellæ of the surface are alternately smaller, and the stars, in a transverse section, have more rays, and a less solid centre. From the *intersepta*, it differs in its even entire lamellæ, not truncate, and in its more solid texture.

This species grows to a breadth of five inches or more.

*Mad. stellulata*, Ellis and Solander, 165, —, Lamouroux, Exp. Meth. 58, pl. 53, tab. 53, figs. 3, 4, this figure is nearly correct. The texture is well shown in fig. 3, and the unequal lamellæ, with about ten larger, and a distinct, rather prominent bottom, in fig. 4. The cells are more distant in figure 3 than in the specimens met with. Ellis's specimen appears to have been partly worn. —, Lamouroux, Exp. Meth. 58, pl. 53, figs. 3 and 4; Encyc. 131, pl. 486, figs. 3 and 4. The *Astrea stellulata* of Lamarck (p. 408, No. 12), under which this author refers, with a query to Ellis's figure, is a different species, placed in the genus *Astræopora* by Blainville, and so described in this work.



13. A. ORBICELLA STELLIGERA. (*Dana.*)

*A. convexa et subgibbosa; polyptis 1½''' latis, discis raro gemmatis et dichasticis; lamellis 18. Corallum subcellulosum; cellis parvulis (¾''' latis), bene orbiculatis, interdum oblongis, vix profundis, intus minutè coronatis; interstitiis concavis; lamellis parcè prominulis, supra septum eleganter radiatis, intus abruptis: transversè secto, septis fere solidis, stellis pauciradiatis (6-8 radiis majoribus).*

Convex and subgibbous; polypts 1½ lines broad, disks rarely budding and dichastic; 18 internal lamellæ. Corallum subcellular; cells quite small (¾ of a line broad), neatly orbiculate, sometimes oblong and dichastic, rather shallow, within minutely coronate; interstices concave; lamellæ slightly prominent, neatly radiating upon the septum around the cell, abrupt within: in a transverse section, the septa nearly solid, stars few-rayed (6 to 8 larger).

Plate 10, fig. 9, surface of corallum, natural size; 9 *a*, profile of cell and lamellæ; *b*, lamella enlarged; *c*, vertical section, natural size; *d*, transverse do.; 9 *e*, transverse section enlarged.

Feejee Islands. *Exp. Exp.*

The neatly radiate lamellæ that form a border to each star, upon the septum, together with the very compact texture and the shallow coronate cell, abrupt within, form good characters for distinguishing this species. The circle of radiating lamellæ consists of fifteen to eighteen; they are quite even and have a gradual outward slope. The interstices are generally more than half the breadth of the cell.

14. A. ORBICELLA (?) CRISPATA. (*Lamarck.*)

*C. incrustans, cellis suborbiculatis, infundibuliformibus, margine separatis, multilamellosis, lamellis denticulatis.*

Corallum incrusting; cells nearly circular, infundibuliform, separated along the ridge, multilamellate; lamellæ denticulate.

Indian Ocean. *Peron and Lesueur.*

Lamarck, who gives the above description, states that the species is near the *A. heliopora*, and also resembles a little the *Madrepora astroites* of Esper (see *A. galaxea*). The stars are small and neat, a little unequal, and appear somewhat crispate.

*Astræa crispata*, Lamarck, ii. 416, No. 25. *Astræa crispata*, Blainville, Man. d'Actin.,  
—, Lamouroux, Encyc., 128. 370.

15. *A. ORBICELLA MICROPHTHALMA.* (*Lamarck.*)

*A. glomerata, fusco-virescens; polypis prominulis, 1-1½'' latis, tentaculis albidis, minutis; lamellis 24. Corallum subcellulosum; caliculis breviter globoso-cylindricis, extus granulatè striatis, sæpe contiguis; cellis ¾'' latis, subprofundis; lamellis minutis, sæpius 12 paulum exsertis et 6 vix majoribus; interstitiis subtilissimè granulosis; transversè secto, septis parcè cellulosis, stellis irregulariter pauciradiatis.*

Glomerate; greenish fuscous; tentacles whitish, minute; polyps a little prominent, 1 to 1½ lines broad; lamellæ 24. Corallum subcellular, having short globoso-cylindrical calicles, granulated-striate without, often contiguous; cells ¾ of a line broad, rather deep; lamellæ minute, usually about 12 somewhat exsert, and 6 a little the most so; interstices very finely granulous: in a transverse section, the septa with few cellules, stars irregularly few-rayed.

Plate 10, fig. 11, surface of corallum, natural size; 11 *a*, animal enlarged; 11 *b*, calicle enlarged; 11 *c*, vertical section enlarged; 11 *c'*, same, natural size; 11 *d*, transverse section, natural size; 11 *e*, same, enlarged.

New Holland Seas. *Peron* and *Lesueur*.—Feejee Islands. *Exp. Exp.*

The small, unequally prominent, globoso-cylindrical calicles of this species, with six of its minute lamellæ a little more exsert than the others, give the corallum a peculiar appearance. In a transverse section the septa are nearly compact, and often as broad as the stars. It is near the following species, but the calicles are a little larger, and besides, that has in general twelve of the lamellæ equally prominent, and the interstices nearly smooth.

- Astræa microphthalma*, Lamarck, ii. 408, *Astræa microphthalma*, Lamour., Encyc.,  
 No. 10. 130.  
 —, Blainville, Man., 370. *Favia microphthalma*, Ehreub. G. lix. sp. 1.

## 16. A. ORBICELLA OCELLINA. (Dana.)

*A. glomerata et lobata, sæpe incrustans; polypis vix 1''' superantibus, lamellis 24. Corallum caliculis globoso-cylindricis, minoribus, non lineam superantibus, et sæpius 12 lamellis minutis æquè exsertis, interstitiis fere nudis; cellâ profundâ: transversè secto, septis subsolidis et stellis pauciradiatis.*

Glomerate and lobed, often incrusting; polyps scarcely exceeding a line in breadth, lamellæ 24. Corallum with the calicles globoso-cylindrical, as in the *microphthalma*, but smaller, with 12 minute lamellæ equally exsert; interstices nearly naked; cell deep: in a transverse section, septa nearly solid, and stars few-rayed.

Plate 10, fig. 10.

Sandwich Islands.

This species forms lobed glomerate masses, having an ascending mode of growth. The calicles are unequal, and in the lower concave portions of the corallum, are almost wholly immersed, while in other parts they are sometimes nearly a line exsert. Like the preceding, the internal texture below the cells is very minutely cellular. It is sometimes found in thin incrusting plates, and thus forms a passage between the *Astræas* and the *Echinopores*.

This species and the preceding are also near the *Oculinæ* (§ 80).

## SUBGENUS II.—SIDERINA.

## 17. A. SIDERINA GALAXEA. (Ellis.)

*A. incrustans et glomerata, interdum subglobosa, polypis non prominulis. Corallum subcellulosum; cellis immersis subprofundis, sæpius 1½''' latis,*

(*raro 2'''*); *lamellis angustissimis et subtilissimè denticulatis*, 6–12 *prominulioribus*; *collibus planis, vix lineam latis, minutissimè et confertissimè lamello-striatis: transversè secto, stellis polygonis, sæpius 2''' latis, confertim multiradiatis, centro solidis.*

Incrusting and glomerate, sometimes subglobose. Corallum subcellular; cells immersed, rather deep, mostly  $1\frac{1}{2}$  lines broad, lamellæ very narrow, and very minutely denticulate, 6 to 10 a little more prominent than the others; septa plane, scarcely a line broad, very closely and finely lamello-striate: in a transverse section, stars polygonal, mostly 2 lines broad, crowdedly multiradiate, with the centre solid.

Plate 10, figure 12, surface of corallum natural size; 12 *a*, same, another variety; 12 *b*, transverse section of the variety fig. 12, natural size; 12 *c*, same enlarged; 12 *d*, transverse section of the variety fig. 12 *a*.

West Indies, Martinique. *Lamouroux*. — East Indies, *Lamarck*, *Acad. Nat. Sci., Philad.*

This species occurs in subglobose masses, and also as incrustations. Both varieties are common in the West Indies; one specimen of the former (part of the surface of which is represented in fig. 12.), is  $2\frac{1}{2}$  inches in diameter and appears to have had no point of attachment. The incrusting specimens (figure 12 *a*) are convex, and sometimes nearly hemispherical. The two varieties may possibly be different species, but the characters observed do not appear to be sufficient to distinguish them. The lamellæ of the cells are minute, and nearly in contact laterally, with about twelve a little prominent in the largest cells, and three smaller intermediate, making forty-eight in all. In the majority of the cells which are smaller, the number is less. The buds open in the interstices and the cells are never dichastic. The species has close relations to the *Mycedia* and *Psammocoræ*.

*Mad. galaxea*, Ellis and Sol., 168, tab. 47, fig. 7. *Astræa galaxea*, Lamour., Exp. 60, tab. 47, fig. 7; Encyc., 126.

*Mad. Astroites*, Esper, Pflanz. Fortsetz. i. —, Lamarck, ii. 418, No. 31.

12, tab. 35, an incrusting specimen; the cells are about the size above given; *A. Siderastræa galaxea*, Blainville, Man. 370.

Esper states that 4 or 5 of the lamellæ are a little larger than the others. *Astræa galaxea*, Lesueur, Mém. du Mus. vi. 285, pl. 16, fig. 13, Lesueur states that

Ellis's figure is very good, but gives quite a different one himself.

*Astræa astroites*, Ehrenberg, G. lx. sp. 1.

Ehrenberg's specimen was from the Antillas; he describes it as follows, referring to Ellis's figure, with a query: "inrus-

tans, effusa, parum pulvinata, 4-6''' alta, stellis contiguis, planis, radiatis, inæqualibus, 5-6-gonis, sesquilinearibus, interstitiis nullis." It is probably a different species; especially as he states that it increases by spontaneous fission.

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### SUBGENUS III.—FISSICELLA.

#### A. SUBGLOBOSA, AUT CONVEXA.

*a.* Stellarum cellulis, corallo transversè secto, decompositis; (lamellis regularibus.)

I. *Caliculis prominulis.*

#### 18. A. SPECIOSA. (*Dana.*)

*A. hemispherica*; *polypis prominulis*, 4-6''' *latis*. *Corallum percellulosum*; *caliculis sæpius subcylindricis et 1-1½''' prominulis, sæpe paulum remotis, margine bene rotundatis*; *cellis profundis, et abruptè declivis, intus vix coronatis*; *lamellis bene regularibus et denticulatis*; *transversè secto, stellis tenuissimè multiradiatis*; *cellulis decompositis, septis percellulosis.*

Hemispherical; polyps a little prominent, 4 to 6 lines broad. Corallum light cellular; calices usually subcylindrical, and 1 to 1½ lines prominent, often somewhat remote, margin neatly rounded; cells deep, abrupt within, and scarcely at all coronate; lamellæ neatly even and denticulate: in a transverse section, stars many-rayed; rays very thin and cellules decompound; septa very cellular.

Plate 11, fig. 1, part of the corallum, natural size; 1 *a*, vertical section of cell, and profile of lamellæ; 1 *b*, lamellæ enlarged; 1 *c*, transverse section of corallum, natural size; 1 *d*, vertical section, natural size.

East Indies. *Exp. Exp.*

This is a neat species, with large prominent subcylindrical calicles often a little distant, and deep cells. The texture is light cellular; the dissepiments within are extremely delicate, and on the lateral surface of the lamellæ they are quite oblique. The species resembles the *A. Orbicella radiata*, but besides being more light and delicate in texture, it increases by disk buds.

*Madrepora radiata*, Esper, Fortsetz. i. 74, tab. 61. A characteristic figure, though coarse. Esper alludes to the lightness of the coral, and its very cellular texture. The *Astræa annularis*, of Quoy and Gaimard (Voy. de l'Ast. iv. 209, pl. 17, figs. 17, 18), as described by them, is

near the *speciosa*, in having prominent, nearly cylindrical, circular calicles, with plano-convex interstices; but the figure they give as representing it, has the interstices a simple ridge, perhaps a little sulcate. The calicles are described as three or four lines in diameter.

19. ASTRÆA UVA. (*Esper.*)

*A. polypis prominulis, sæpe 9'' latis. Corallum caliculis 1½–2'' prominulis, subangulatis, rotundato-conicis, contiguous (itaque sulcis intermediis subacutis), extus confertim lamello-striatis et denticulatis; cellis 4–5'' latis, sæpe elongatis.*

Polyps prominent and often 9 lines broad. Corallum with the calicles 1½ to 2 lines prominent, subangular and rounded conical, contiguous (and hence the intermediate sulcus subacute); exterior crowdedly lamello-striate and denticulate; cells 4 to 5 lines broad, and often elongated.

China Sea. *Esper*, from M. Chemnitz.—Red Sea, *Ehrenberg*.

This coral resembles somewhat the *A. Orb. argus*, in its contiguous conical cells and striated exterior, but has much larger calicles, which elongate and subdivide. *Esper's* figure represents a convex mass 4½ inches across, with some of the calicles nearly an inch long. He states that the lamellæ within the cell are minutely appendiculate at base.

*Mad. uva*, *Esper*, Fortsetz. i. 32, tab. 43. *Favia uva*, *Ehrenberg*, G. lix., sp. 5; *Ehrenberg* states that the animal has a brown colour.  
*Astræa uva*, *Schweig.* Handb. 419.  
*Astræa ananas, β uva*, *Lamk.* ii. 406. No. 5.

20. *ASTRÆA ANANAS*. (Ellis.)

*A. subhemispherica*; polypis 3–5''' latis. Corallum caliculis rotundatis, subangulatis, sæpe oblongis, inæqualibus, contiguïs; interstitiis concavis; cellis 2–3''' latis; lamellis denticulatis.

Subhemispherical; polyps 3 to 5 lines broad. Corallum with rounded or convex calicles, subangular, often oblong, unequal, contiguous; interstices concave; cells 2 to 3 lines broad; lamellæ denticulate.

West Indies. *Ellis, Lamarck.*

The calicles are much smaller than in the preceding, and are convexly rounded instead of conical.

Lesueur describes a coral, which he refers to the species figured by Ellis, as having polyps without tentacles; but it is probable that they were only unexpanded in the specimen under examination. His figure agrees nearly with Ellis's, and he states that the cells are sometimes trilobed.

*Mad. ananas*, Ellis and Solander, 168, tab. 47, fig. 6.

*Astræa ananas*, Lamk. ii. 406, No. 5.

—, Schweig. Handb., 419.

—, Lamour., Exp. 59, tab. 47, fig. 6; Encyc. 127.

—, Lesueur, Mém. du Mus. vi. 285, pl. 16, fig. 12.

—, Blainville, Man. 369.

*Favia ananas*, Oken's Zool., i. 67.

*Favia porcata*, var. Ehrenb., G. lix. No. 6.

*Mad. ananas?* Linn. Syst. Nat., ed. xii. 1275.

Esper's *M. ananas* (i. tab. 19), has the

calicles a little distant, as in the *speciosa*, but more conical; cells four to five lines long, one and a half to two lines broad, and many-rayed. Ehrenberg refers this figure to his *Explanaria* (our *Orbicella*) *ananas*, which he makes identical with the *ananas* of Linnæus. From the very elongate calicles, the species probably represents one of the Fissicellæ.

The *Astræa ananas* of Quoy and Gaimard (Voy. de l'Ast. iv. 207, pl. 16, figs. 6, 7) appears to be the *porcata* of Esper. (See *A. porcata*.)

21. *ASTRÆA PANDANUS*. (Dana.)

*A. subglobosa*, brunneo-fuscescens; polypis  $\frac{1}{2}$ " latis. Corallum cellulosum; caliculis rotundatis, subangulatis, contiguïs, subæqualibus; cellis suborbiculatis, sæpe oblongis, 3–4''' latis, subprofundis, intus obsolete coronatis; lamellis æqualibus, utrinque subtiliter denticulatis: trans-

*versè secto, septis biseriatis cellulosis; stellis multiradiatis cum cellulis valde decompositis.*

Subglobose, colour dark brown; polyps  $\frac{1}{2}$  an inch broad. Corallum quite cellular, with rounded calicles (as in the *ananas*), subangular, contiguous, subequal; cells nearly circular, often oblong, 3 to 4 lines broad, rather shallow, obsolete coronate within; lamellæ even, finely denticulate within and without: in a transverse section, septa biserially cellular; stars many-rayed, with the cellules much decompound.

Plate 11, fig. 2, the polyps unexpanded; 2*a*, a few cells, natural size; 2*b*, vertical section of cell, with profile of the lamellæ, enlarged; 2*c*, vertical section of corallum, natural size; 2*d*, transverse section.

Feejee Islands. *Exp. Exp.*

This coral has the rounded prominent calicles of the *ananas* of Ellis, and is near that species. The specimen in the Expedition collections is nearly globular, and is about four inches in diameter.

## 22. ASTRÆA PUTEOLINA. (*Dana.*)

*A. hemispherica; polypis  $\frac{1}{2}$ " latis. Corallum percellulosum; caliculis subpolygonis, parçè prominulis; collibus  $2\frac{1}{2}$ " crassis, rotundatis et sulcatis; cellis profundioribus, et fere perpendicularibus, vix coronatis; lamellis regularibus, subtiliter denticulatis.*

Hemispherical; polyps  $\frac{1}{2}$  an inch broad. Corallum light cellular; calicles subpolygonal, a little prominent; ridges  $2\frac{1}{2}$  lines thick, rounded and sulcate; cells deeper than broad, nearly perpendicular, scarcely coronate within; lamellæ even, finely denticulate.

Plate 11, fig. 3, cells of corallum, natural size; 3*a*, section of cells, showing profile of lamellæ; 3*b*, vertical section, natural size.

East Indies. *Exp. Exp.*

This is a light species, with very deep cells, rounded sulcate ridges, and even, finely denticulate, lamellæ. It is near the *fragilis*, but





the calicles are larger and deeper, the ridges broader, and the texture more coarsely cellular within. As the calicles are but little distinct, it forms a connecting link between the preceding species and the next division.

23. *A. PALLIDA.* (Dana.)

*A. hemispherica*; polypis 6-8'' latis, discis pallidè cæsiis, tentaculis albidis, internis bursiformibus. Corallum apertè cellulosum, caliculis conico-cylindricis, 1-1½'' altis, contiguis, extus remotè lamello-striatis, et subtilissimè denticulatis; cellis 5-6'' latis, subprofundis, intus coronatis; lamellis tenuibus, apice angustis et paulo inæqualiter exsertis, parcè dentatis: transversè secto, septis 1-2-seriatim cellulosis; stellis vix multiradiatis cum cellulis parce decompositis.

Hemispherical; polyps 6 to 8 lines broad, disk pale bluish-gray, tentacles whitish, the interior bursiform. Corallum open cellular; calicles conico-cylindrical, 1-1½ lines high, contiguous, exterior remotely lamello-striate and finely denticulate; cells 5 to 6 lines broad, rather shallow, within coronate; lamellæ thin, narrow above and somewhat unequally exsert, sparingly dentate: in a transverse section, septa with large cellules in 1 or 2 series; stars scarcely multi-radiate with the cellules sparingly decompound.

Plate 10, fig. 13, natural size; 13 *a*, tentacles enlarged of the two series; 13 *b*, cells in outline; 13 *c*, vertical section of cell, with profile of lamellæ and ridges; 13 *c'*, same, natural size; 13 *d*, transverse section of corallum; 13 *e*, vertical section of same.

Feejee Islands. *Exp. Exp.*

This coral resembles the *denticulata*, but has a broader sulcus to the ridges, less unequal lamellæ, which are also thinner, narrower at apex and not vertical within the cell. The calicles are nearly cylindrical, and in the specimen seen, were placed obliquely against one another, like those of the *A. Orb. coronata*. The lamellæ over the exterior of the calicles are even, thin, nearly half a line apart, and almost as much prominent. It is possible that the species may be one of the Orbicellæ.

II. *Caliculis immersis; collibus aut paulum sulcatis, aut integris.*

24. ASTRÆA DIPSACEA. (*Lamarck.*)

*A. convexa, subhemispherica; polyphis sæpe 8''' latis. Corallum percellulosum, cellis 4-6''' latis, subangulatis et sæpe lobatis, vix profundis, intus non coronatis; collibus subtruncatis, interdum sulcatulis; lamellis tenuibus, lacerato-dentatis, non confertis, fere regularibus: transversè secto, stellis multiradiatis, cum cellulis decompositis; septis 1''' crassis, 1-2-seriatim largè cellulosis.*

Convex, subhemispherical; polyyps often 8 lines broad. Corallum light cellular; cells 4 to 6 lines broad, subangular and often lobed, rather deep, not coronate within; ridges subtruncate and sometimes slightly sulcate; lamellæ thin, lacerato-dentate, not crowded, nearly even: in a transverse section, stars many-rayed with the cellulæ decomposed; septa a line thick, cellular, cellulæ large and in one or two series.

Plate 11, fig. 4 *a*, vertical section of cell and ridges, showing profile of the lamellæ and internal cellulæ, natural size; 4 *b*, the same through the longer diameter of an oblong cell; 4 *c*, vertical section of corallum, natural size; 4 *d*, transverse section, natural size.

West Indies.

This species is remarkable for the size and irregular form of its cells (which are sometimes lobed and an inch long), the fragile lacerato-dentate lamellæ, and its coarse cellular texture. It approaches the *flexuosa*; but the texture is much more cellular, and the lamellæ more distant and more raggedly toothed.

*Mad. favosa*, Ellis and Sol., 167, tab. 50, fig. 1, the cells are a little too regular.

*Astræa dipsacea*, Lamk., ii. 411, No. 16.

—, Lamour., Exp. Meth. 59, tab. 50, fig. 1; Encyc., 129.

*A. Dipsastræa dipsacea*, Blainv. Man. 373.

The *A. dipsacea* of Ehrenberg, from the Red Sea (op. cit. G. lx., sp. 13), may be a different species. It is described as follows: "Sesquipedalis et bipedalis, subglobosa, superficie sæpius inæquali, stellis

magnis, 4-5''' latis, angulatis, margine lato, cchinato, lamellis serrato-dentatis, dentibus majoribus intus cavis (nec perforatis)."

The *Astræa abdita* of Quoy and Gaynard, as figured by them, comes near the *dipsacea* in internal texture and general size of the cells (Voy. de l'Ast. iv. 205, pl. 16, figs. 4 and 5), which are described as sometimes confluent, 9 or 10 lines long, rounded or polygonal, rather shallow,

with large and uniform lamellæ strongly denticulate. The animals are sulphur-yellow. The form of the tentacles given, flat and lanceolate, is altogether improbable, and their distant arrangement in a single series must be incorrect; the same

error occurs generally in their drawings. The *A. dipsacea* of Quoy and Gaymard (ibid. 210, pl. 17, figs. 1, 2) is a different species, too imperfectly figured to be recognised.

### 25. *ASTRÆA PORCATA*. (*Esper.*)

*A. convexa, subglobosa, fusco-castanea; polyypis 5-6'' latis. Corallum cellulolum, subrobustum; cellis 3-4'' latis, subprofundis, intus breviter coronatis; collibus fere planis, obsoletè sulcatis, 1-2'' crassis; lamellis regularibus, incrassatis, denticulatis, denticulis ad apicem subtilissimis: transversè secto, stellis multiradiatis cum cellulis decompositis; septis subcellulosis, cellulis minutis, sparsis.*

Convex, subglobose; dark chestnut-brown. Corallum cellular, rather firm; cells 3 to 4 lines broad, rather shallow, short coronate within; ridges nearly flat, obsoletely sulcate, 1 to 2 lines thick; lamellæ even, incrassate, denticulate and very finely so at apex: in a transverse section, stars many-rayed, with the cellules decomposed; septa subcellular, cellules minute and scattered.

Plate 11, fig. 5, polyyps unexpanded, natural size; 5 *a*, profile of the lamellæ and ridges, natural size; 5 *b*, same, enlarged; 5 *c*, vertical section of corallum, natural size; 5 *d*, transverse section, natural size.

East Indies. *Esper.*—Tongatabu. *Exp. Exp.*

The broad interstices nearly flat, and finely striated with an obsolescent sulcus, easily distinguish this species. The cells are about half as deep as their breadth, and the lamellæ which project a little unequally into the cell are short appendiculate at base, and a little thickened at the edges.

*Madrepora porcata*, Esper, Pflanz. Fortsetz. i. 88, tab. 71, figs. 1-3. "Mad. composita, globosa, stellis inæqualibus, immersis, interstitiis planis, porcis radiantibus granulatis." Esper's figure represents well the specimen in the Expedition collections.

Lamarck and Ehrenberg appear to have described other species under this name. Lamarck's description (No. 7.) is as follows: "A. subglobosa, stellis inæqualibus, irregularibus, oblongis, margine elevatis, interstitiis granulatis." Ehrenberg refers to Ellis's

*ananas* as the *porcata*, and also to Esper's *cellulosa*, tab. xl. (our *A. favistella*), besides the figure above referred to. His description is as follows: "Subglobosa, stellis inæqualibus, irregularibus, oblongis, sæpe dividuis, 2-3''' longis et latis, margine elevatis, interstitiis dilatatis, lamellosis, sulco depressis, denticulatisque, lamellis dentatis." (Op. cit. G. lix. sp. 6.)

The *A. ananas* of Quoy and Gaymard (Voy. de l'Ast. iv. pl. 16, fig. 6.), approaches this species in some of its characters, but is too imperfectly described and figured to be identified.

#### 26. ASTRÆA FLEXUOSA. (Dana.)

*A. flexuoso-convexa*; polypis 6-8''' latis, discis rubro-brunnescentibus, tentaculis pallidis apicemque flavis. Corallum robustum, subcellulosum; caliculis sæpe contortis, cellis 4-7''' latis, profundis, intus non coronatis; collibus 1½-2''' crassis, undulatis, rotundatis, obsolete sulcatis; lamellis bene regularibus, confertis, crassioribus, denticulatis: transversè secto, stellis multiradiatis cum cellulis decompositis; septis sæpe 1½''' superantibus, solidis, cellulis paucis.

*A. flexuoso-convex*; polyps 6 to 8 lines broad; disks brownish-red, tentacles pale, with the tips yellow. Corallum firm and subcellular; calicles often contorted; cells 4 to 7 lines broad, deep, not coronate within; ridges 1½ to 2 lines thick, undulate, rounded, obsoletely truncate; lamellæ even, crowded, rather stout, denticulate: in a transverse section, stars multiradiate, with the cellules decomposed; septa often exceeding 1½ lines, solid, with few cellules.

Plate 11, fig. 6, polyps partly expanded, natural size; 6 *a*, tentacle, enlarged; 6 *b*, another in outline; 6 *c*, view of opening of mouth, enlarged; 6 *d*, profile of cell, ridges and lamellæ; 6 *e*, vertical section of corallum, natural size.

Feejee Islands. *Exp. Exp.*

The firm subcellular corallum and even denticulate lamellæ distinguish this species from the *dipsacea*; and the flexuous ridges, often slightly sulcate, larger cells and coarser texture, from the *fusco-viridis*. It forms convex masses, four to five inches in diameter, with an uneven or flexuous surface.

27. *ASTRÆA FUSCO-VIRIDIS.* (Quoy & Gaymard.)

*A. convexa*; polypis 5-7''' latis; discis latè virentibus, interdum partim brunneis. Corallum robustum, subcellulosum; caliculis sæpius oblongis; cellis 4-6''' latis, vix profundis, intus obsoletè aut non coronatis; collibus rotundatis, integris; lamellis bene regularibus, confertis, denticulatis: transversè secto, stellis multiradiatis cum cellulis decompositis; septis fere solidis.

Convex; polyps 5 to 7 lines broad, disks bright green, sometimes partly brown. Corallum firm and subcellular; calicles usually oblong; cells 4 to 6 lines broad, rather deep, obsoletely or not at all coronate within; ridges rounded, entire; lamellæ even, crowded, denticulate: in a transverse section, stars many-rayed, with the cellules decomposed; septa nearly solid.

Plate 11, fig. 7, animal unexpanded; 7 *a*, another variety enlarged; 7 *b*, vertical section, natural size; 7 *c*, profile of cell, and lamellæ enlarged.

Tongatabu. Quoy and Gaymard.—Feejee Islands. *Exp. Exp.*

This common Pacific species resembles the last. The disks vary from green throughout to a small green centre, with the rest brown; and it is possible that there may be other varieties in which they are brown throughout. The live specimen examined expanded only so far as to show the tips of the crowded tentacles.

*Astræa fusco-viridis*, Quoy and Gaymard, Voy. de l'Ast. iv. pl. 17, figs. 8, 9. The figure may be recognised by the size and green disk; but the tentacles should be crowded and not in a single series.

28. *ASTRÆA VIRENS.* (Dana.)

*A. convexa*, undique latè virens, polypis  $\frac{1}{2}$ '' latis. Corallum cellulosum, vix robustum; cellis subprofundis, angulatis et sæpe oblongis (4-6'''), intus vix coronatis; collibus rotundatis integris, lamellis regularibus confertis, denticulatis, apice spinoso-denticulatis: transversè secto, stellis multiradiatis cum cellulis valde decompositis; septis  $\frac{1}{2}$ ''' crassis, fere solidis, cellulis minutis, sparsis.

Convex; whole surface bright green, polyps  $\frac{1}{2}$  an inch broad. Corallum cellular, not very firm; cells rather shallow, angular, and often oblong (4 to 6 lines), scarcely coronate within; ridges rounded, entire; lamellæ even, crowded, denticulate, at apex spinoso-denticulate: in a transverse section, stars many-rayed, with the cellules much decomposed; septa  $\frac{1}{2}$  a line thick, cellules minute and scattered.

Plate 11, fig. 8, polyps unexpanded; 8 *a*, portion of corallum, natural size; 8 *b*, profile of cell and lamellæ, enlarged; 8 *c*, vertical section of corallum, natural size; 8 *d*, transverse section of same.

Feejee Islands. *Exp. Exp.*

This species has some resemblance to the *favistella*, but the very numerous rays to the stars, and their decomposed cellules, distinguish it. The teeth at the summit of the ridge, though small, are usually acute and spiniform, and often the two central ones are smaller than the others, giving an appearance of a faint sulcus.

29. ASTRÆA ECHINATA. (*Dana.*)

*A. convexa, brunneo-nigrescens et undique papillosa; polytis 6-8'' latis, discis nigricantibus, viz depressis. Corallum cellulosum, valde echinatum; cellis subprofundis, suborbiculatis vel oblongis, 5'' latis, intus non bene coronatis; collibus rotundatis, non sulcatis; lamellis regularibus, infra 3-4-denticulatis, supra septum echinatis, (3-4 dentibus, 1-1½'' elongatis): transversè secto, stellis multiradiatis, cum cellulis decompositis; septis subcellulosis, cellulis oblongis sæpe interruptè uniseriatis.*

Convex; brownish-black, surface papillose; polyps 6 to 8 lines broad, disks nearly black. Corallum cellular, surface strongly echinate; cells rather shallow, nearly circular or oblong; 5 lines broad, not distinctly coronate; ridges rounded, not sulcate; lamellæ even, with 3 or 4 small teeth within the cell, and 3 or 4 spines 1 to 1½ lines long over the septum: in a transverse section, stars many-rayed, with the cellules decomposed; septa somewhat cellular, cellules oblong and often interruptedly uniseriate.

Plate 12, fig. 1, natural size; 1 *a*, vertical section of corallum and cells, with profile of lamellæ, natural size; 1 *b*, transverse section.

Feejee Islands. *Exp. Exp.*

The spiniform teeth which give the echinate character to this species, stand crowded over the whole surface, and are a line or more long. In a vertical section the coral has a strikingly lamellate structure throughout, and on the surface of the lamellæ the transverse dissepiments, which are quite oblique, arch over (though with some irregularity) from centre to centre, and are not lost in a solid septum, as in most *Astræas*.

The animals were not observed to have tentacles; and it is probable that the papillæ of the surface over the spiniform teeth correspond to those organs. The fleshy surface of the live zoophyte was quite thick, and lay in small folds around each disk.

### 30. *ASTRÆA FRAGILIS*. (*Dana.*)

*A. subglobosa*, polypis 4–5'' latis. Corallum percellulosum; cellis suborbiculatis et sæpe oblongis, profundis, intus breviter coronatis; collibus rotundatis, sulcatulis, 1'' crassis; lamellis regularibus, subtiliter eleganterque denticulatis, tenuissimis: transversè secto, stellis multi-radiatis cum cellulis parçè decompositis; septis  $\frac{3}{4}$ '' crassis, fragiliter cellulosis, cellulis sæpius uniseriatis.

Subglobose, polyps 4 to 5 lines broad. Corallum light cellular; cells circular or oblong, deep, short coronate within; ridges rounded, slightly sulcate, a line wide; lamellæ even, finely and neatly denticulate, very thin: in a transverse section, stars many-rayed, with the cellules sparingly decompound; septa  $\frac{3}{4}$  of a line thick, fragile cellular, cellules usually uniseriate.

Plate 12, figure 2 *a*, profile of cell, ridges and lamellæ, natural size; 2 *b*, same enlarged; 2 *c*, vertical section of corallum, natural size; 2 *d*, transverse section of the same.

East Indies. *Exp. Exp.*

This light cellular species with slightly sulcate ridges, is related to the *dipsacea*; but the cells are smaller, the lamellæ very even, thin,

and finely denticulate, and the cellules of the star in a transverse section are but sparingly decomposed. In a vertical section the lamellæ and lines of cells are irregularly curving.

31. ASTRÆA TENELLA. (*Dana.*)

*A. hemispherica, polytis 3-5'' latis. Corallum percellulosum, fere spongiosum; caliculis polygonatis, sæpe oblongis: transversè secto, stellis 14-16-radiatis, radiis tenuissimis, cellulis grandibus circum centrum porosum eleganter dispositis, et margine aliis parvulis sæpius biseriatas; septis angustissime filiformibus.*

Hemispherical; polyps 3 to 5 lines broad. Corallum very light cellular; calicles polygonal often oblong; in a transverse section, stars very slenderly 14 to 16 rayed, with large radiate cellules around the porous centre, and at the margin other small cellules in one or two series; septa delicately filiform.

Plate 13, fig. 1, transverse section of corallum, slightly enlarged (about a sixth); 1 *b*, vertical section of same, natural size.

Wake's Island, Pacific Ocean. *Exp. Exp.*

This coral was met with only in worn specimens. It is very light and cellular, and extremely neat in its stars and texture. It appears to have simple stars about a fourth of an inch in diameter, with septa a line or more wide, consisting of three or four series of minute subquadrate cellules; but the cellules properly belong to the stars, and the true septum is a delicate line. In a vertical section the transverse dissepiments are seen to be quite oblique and not very much crowded, and from this the appearance above described proceeds. The porous centre of the star is about a line broad.

32. ASTRÆA MAGNIFICA. (*Blainville.*)

*A. convexa, subhemispherica. Corallum percellulosum; cellis sæpe elongatis et paulo flexuosis, 2-3'' latis et interdum 8'' longis, angulatis, profundis, intus breviter coronatis; collibus angustis (vix 1'') integris obtusis, perpendicularibus; lamellis bene æqualibus, subtiliter elegan-*



*terque pectinato-denticulatis: transversè secto, stellis multiradiatis cum cellulis valde decompositis; septis  $\frac{1}{2}$ " crassis, uniseriatim apertèque cellulosis.*

A. convex, subhemispherical. Corallum light, cellular; cells often elongated and a little flexuous, 2 to 3 lines broad and sometimes 8 long; angular, deep, short coronate within; ridges narrow, scarcely a line thick, entire, obtuse, perpendicular; lamellæ neatly even, finely and elegantly pectinato-denticulate: in a transverse section, stars many-rayed, with the cellules much decomposed; septa  $\frac{1}{2}$  a line thick, with large cellules in a single series.

Plate 12, fig. 3 *a*, outline view of cells; 3 *b*, transverse section of corallum, natural size; 3 *c*, vertical section of same.

East Indies. *Exp. Exp.*

This is a light cellular coral, distinguished by its angular and frequent flexuous calicles, deep cells, narrow, entire, perpendicular ridges, with the lamellæ very even, minutely and beautifully denticulate. The specimen in the collections is a convex mass five inches in diameter. It appears to be the *A. magnifica*, of Blainville.

*Astræa (Favastræa) magnifica*, Blainville, The *Astræa halicora* of Ehrenberg may be  
Man. 374, plate 54, fig. 3; without de- near this species, but the description is  
scription. too concise to determine their identity.

### 33. ASTRÆA FILICOSA. (*Dana.*)

*Corallum percellulosum, subrobustum; cellis profundioribus, 5-8" latis, suborbiculatis, perpendicularibus; collibus lamellisque angustis: transversè secto, stellis multiradiatis, lamellis robustis, cellulis decompositis; septis subcellulosis, cellulis oblongis interruptè uniseriatis.*

Corallum quite cellular, yet firm; cells very deep, 5 to 8 lines broad, suborbiculate, perpendicular; ridges and lamellæ narrow: in a transverse section, stars multiradiate, lamellæ stout, cellules decomposed; septa somewhat cellular, cellules oblong, mostly in a single interrupted series.

Plate 12, fig. 4, cells of a worn corallum, natural size; 4 *a*, transverse section of corallum, natural size; 4 *b*, vertical section of same.

Wake's Island, Pacific Ocean. *Exp. Exp.*

This description is taken from a worn specimen, which is remarkable for the depth and size of the cells, looking like impressions made with the end of the finger. In a vertical section, the part below the centre of a cell for a width of a third of an inch, is extremely cellular or filamentous in structure; and in the septum, there is a vertical series of lunate cellules, about a line wide, convex upward. Although so cellular, the coral is still firm, owing to the stoutness of the lamellæ and of the parts of them which extend into the septa.

- b.* Cellulis stellarum, corallo transversè secto, aut parce aut minimè decompositis.  
*l.* *Collibus sulcatis aut integris; lamellis inæqualibus et inæqualiter exsertis.*

#### 34. ASTRÆA VERSIPORA. (*Lamarck.*)

*A. subglobosa.* *Corallum cellulosum, robustum; cellis profundioribus, subangulatis et sæpe oblongis (4-6'''), intus subcoronatis; collibus sulcatis; lamellis inæqualibus, et inæqualiter exsertis, asperè denticulatis, angustis, verticalibus.*

Subglobose. Corallum cellular, firm, surface rough; cells deeper than broad, subangular, and often oblong (4 to 6 lines), subcoronate within; ridges sulcate; lamellæ unequal and unequally exsert, roughly denticulate, narrow, vertical.

Plate 12, fig. 5 *a*, profile of cells, ridges, and lamellæ, natural size; 5 *b*, transverse section of corallum, natural size.

East Indies. *Lamarck.*—Red Sea. *Ehrenberg.*

This coral resembles the *denticulata* in its ragged surface; but the sulcus is broader or more distinct, the cells are less regular, usually smaller, and much deeper than their breadth.

A specimen from Singapore, in the Expedition collections, has a subglobose shape, and is four or five inches in diameter. The texture is coarse cellular, with two rows of large cellules (seen in a transverse section) along the septa. The stars are few-rayed, with rarely a cross partition dividing the cellules. The coronal teeth are less prominent and regular than in the *denticulata*, owing to the fact, that the lamellæ extend perpendicularly far below them before reaching the

bottom of the cell. These teeth are usually confined to six or eight of the larger lamellæ. The lamellæ are crowded together below, and the bottom of the cell is scarcely seen.

*Mad. cavernosa* (?) Forsk. Anim. Egypt. 132. *Astræa versipora*, Lamour., Encyc., 130.  
*Astræa versipora*, Lamk., ii. 414, No. 19. *Favia versipora*, Ehrenberg, op. cit. G.  
*A. Dipsastræa versipora*, Blainville, Man. lix. sp. 2.; states that the animal has a  
 373. pale-brown colour, with a green disk.

### 35. ASTRÆA DENTICULATA. (Ellis.)

*A. subglobosa.* *Corallum cellulosum; cellis suborbiculatis, semipollicaribus, subprofundis, intus coronatis; collibus leviter sulcatis; lamellis inæqualibus, et inæqualiter exsertis, verticalibus, apice subtruncatis.*

Subglobose. *Corallum* cellular; cells somewhat circular, half an inch wide, rather shallow, coronate within; ridges slightly sulcate; lamellæ unequal and unequally exsert, vertical, subtruncate at apex.

Plate 12, fig. 6, outline view of a cell, natural size; 6 *a*, profile of cell and lamellæ; 6 *b*, transverse section of corallum, natural size; 6 *c*, vertical section of the same.

East Indies.—Pacific Ocean. *Exp. Exp.*

The unequally exsert lamellæ give a ragged appearance to the surface and cells. The depth of the cells scarcely exceeds two-thirds the diameter.

A specimen from the Pacific Ocean, in the Expedition collections, answering to the description of this species, has a coarsely cellular texture; the septa, in a transverse section, consist partly of large cellules in a single series, and the stars are few-rayed, with rarely a cross partition to the cellules. The lamellæ are nearly entire on the inner vertical margin, but have often two or three teeth at apex.

*Mad. denticulata*, Ellis and Solander, tab. teeth within the cell is scarcely apparent.  
 49, fig. 1; corresponds with the specimens examined, except that the inequality of the exsert lamellæ is hardly distinct enough, and the corona or circle of  
*Astræa denticulata*, Lamk., ii. 413, No. 18.  
*Astræa denticulata*, Lamour., Exp. Meth. 59, tab. 49, fig. 1; Encyc., 130.

*A. Dipsastræa denticulata*, Blainville, The *A. dipsacea* of Quoy and Gaymard, Man. 373. may be this species.

*Favia denticulata*, Ehrenb., G. lix. sp. 4.

36. ASTRÆA PECTINATA. (*H. & Ehrenberg.*)

*A. subglobosa, brunnea. Corallum, cellis 3-6''' longis, sæpe oblongis et flexuosis, profundis, intus coronatis; collibus vix sulcatis; lamellis margine verticalibus. apice truncatis, asperis.*

Subglobose; brown. Corallum with the cells 3 to 6 lines long, often oblong and flexuous, deep, coronate within; ridges scarcely sulcate; lamellæ with the inner margin vertical, truncate at apex, rough.

Red Sea. *Ehrenberg.*

This description is taken from Ehrenberg. The species in its vertical and deep cells, coronate within, and the lamellæ truncate at apex, is near the *versipora*, from which it is separated by its entire or scarcely sulcate ridges.

*Astræa pectinata*, Ehrenb., G. lx., sp. 7. *Madrepora favus?* Forskal, Egyp., 132.  
—, Lamarck, 2d ed. ii. 412, No. 16 a. "Stellis margine coadunatis, rigidis."

37. ASTRÆA DEFORMIS. (*Lamarck.*)

*A. subglobosa. Corallum cellis 4-6''' longis, angulatis, interdum oblongis et irregularibus; collibus angustis, integris; lamellis alternis, asperis, truncatis, exsertis.*

Subglobose. Corallum with the cells 4 to 6 lines long, angular, sometimes oblong and irregular; ridges narrow, entire; lamellæ alternate, asperate, truncate, exsert.

Indian Ocean? *Lamarck.*—Red Sea. *Ehrenberg.*

Lamarck states that this species is near the *denticulata* in general habit, but differs in having no sulcus to the ridge, or rarely an obsolete sulcus.

Specimens obtained in the Feejees apparently of the above species, have the following characters (see plate 12, figs. 7, 7 a, 7 b, 7 c, 7 d).

Corallum cellular and rather light, and appearing coarse and rough from the unequally prominent triangular lamellæ; cells angular, often oblong and lobed; two and a half to three lines broad, and sometimes seven lines long, not coronate within; ridges subtriangular, entire; lamellæ very unequal, not crowded, narrow at apex, and often subacute, strongly denticulate: in a transverse section, septa not half a line thick, stars few-rayed, with the cellules simple. It is near the *Meandrina dedalea* in habit, and if distinct may be called the *A. dedalina*.

*Astræa deformis*, Lamk., ii. 414, No. 20. *Astræa deformis*, Lamouroux, Encyc., 129.  
 "Stellis majusculis inæqualibus, irregu- —, Ehrenberg, G. lx. sp. 8.  
 laribus, multilamellosis; lamellis supra *A. Dipsastræa deformis*, Blainv. Man.,  
 marginem elevatis; sulco nullo." 373.

### 38. ASTRÆA VARIA. (*Dana*.)

*A. hemispherica*, polypis sæpius 3''' latis, discis interdum distomatis aut tristomatis. Corallum percellulosum; cellis angulatis, subprofundis aut profundis; collibus lamellisque triangulatis et fere acutis; lamellis tenuibus, inæqualibus et inæqualiter exsertis, subtiliter denticulatis; septis vix  $\frac{1}{2}$ ''' crassis.

Hemispherical, polyps mostly 3 lines broad, disks sometimes 2 or 3 mouthed. Corallum light cellular; cells angular, deep or rather so, ridges and lamellæ triangular and nearly acute above; lamellæ thin, unequal and unequally exsert, finely denticulate; septa scarcely half a line thick.

Plate 12, figs. 13 a, 13 b, sections of cells of different varieties, giving profile of lamellæ.

West Indies.

This species resembles closely the *Meandrina spongiosa* in its lamellæ and ridges, and may be only a variety of that species. Yet large convex specimens present throughout the *Astræa* form of the cell, with only a few, here and there, oblong. It appears to have the same relation to the *M. spongiosa*, that the *A. dedalina* has to the *M.*

dedalea. The cells appear open, owing to the unequal lamellæ, and are sometimes slightly coronate within.

II. *Collibus angustis, integris, apice subnudis; lamellis vix exsertis sed valde inæqualibus.*

39. ASTRÆA RIGIDA. (*Dana.*)

*A. subglobosa; polypis 6–10''' latis. Corallum robustum; cellis angulatis, 5''' latis et interdum 8–10''' elongatis, sæpe lobatis, intus non coronatis; collibus apice fere nudis, integris, tenuibus; lamellis dentatis, valde inæqualibus, non confertis: transversè secto, septis solidis, 1''' crassis; stellis vix multiradiatis, cellulis latis, parcè decompositis.*

Subglobose; polyps 6 to 10 lines broad. Corallum firm; cells angular, 5 lines broad, and sometimes 8 to 10 long, often lobed, not coronate within; ridges thin, entire, and naked at summit; lamellæ dentate, very unequal, not crowded: in a transverse section, septa solid or with rarely a cellule, a line broad; stars hardly many-rayed, cellules large, and sparingly decompound.

Plate 12, fig. 8 *a*, section of cell and ridges, showing profile of lamellæ, natural size; 8 *b*, a cell bisected; 8 *c*, size and form of cells on surface of corallum; 8 *d*, transverse section, natural size.

West Indies.

The bare thin ridges, and distant unequal dentate lamellæ, with the large and often lobed cells, and thin but solid septa, are the prominent characteristics of this common West India species. The bottom of the cell is scarcely convoluted at centre, as the larger lamellæ almost meet.

III. *Collibus integris, aut subintegris; lamellis bene regularibus; cellis non coronatis; cellulis stellarum, corallo transversè secto, parcè aut non decompositis.*

40. ASTRÆA RETICULARIS. (*Lamarck.*)

*A. subglobosa. Corallum cellis angulatis, sæpe oblongis et subflexuosis, profundis, centro radiatis; collibus subnudis, apice levibus.*

Subglobose. Corallum with the cells angular, often oblong and subflexuous, deep, radiate from the centre; ridges nearly naked, smooth at apex.

Plate 12, figure 9 *a*, section of cells and ridges, with the lamellæ, natural size; 9 *b*, size and form of cells; 9 *c*, transverse section of corallum.

West Indies?

Lamarck, from whom this description is taken, farther remarks that the lamellæ are prominent only towards the bottom of the cell, the upper part of the ridges, as well as the top, being nearly bare. It approaches the *favosa*, but differs in the character just stated, and in its smaller stars.

To this species appears to belong the West India specimen figured on plate 12 (figure 9, *a*, *b*, *c*.) It is a firm and rather heavy species; the cells are angular, about a quarter of an inch broad, though often oblong, and half an inch long, with the depth scarcely two-thirds the breadth; the lamellæ are nearly even, very finely denticulate, and are barely distinguished over the top of the ridge with a magnifying glass: they are not appendiculate at base. In a transverse section the septa are half a line thick, and quite solid; the stars angular, sometimes lobed, with the cellules not decomposed. The specimen has some resemblance to the *rigida*, but the lamellæ are more even, closer, and not dentate.

*Astræa reticularis*, Lamk., ii. 414, No. 21. Linn. Amæn. Acad. i. tab. 4, fig. 16,  
Lamarck refers to the fossil, *Mad. favosa*, which is beyond doubt a distinct species.

#### 41. ASTRÆA PETROSA. (*Dana*.)

*A. convexa*. Corallum subcellulosum, robustum: transversè secto, stellis interdum orbiculatis sed sæpius oblongis  $1\frac{1}{2}$ – $2\frac{1}{2}$ '' latis, et  $1\frac{1}{2}$ –5'' longis, multiradiatis, radiis bene tenuibus, cellulis simplicibus; septis 1'' crassis et persolidis.

Convex. Corallum subcellular, firm: in a transverse section, the stars orbiculate, commonly oblong,  $1\frac{1}{2}$  to 3 lines broad, and  $1\frac{1}{2}$  to 5



lines long, many-rayed, rays very thin, with the cellules simple; septa a line thick and quite solid.

Plate 12, fig. 12 *a*, transverse section of corallum, natural size; 12 *b*, vertical section of same.

The very compact septa, and the neat thin rays and rather small star, readily distinguish this species from the others described. Besides, the cellules below the star, in a vertical section, are more than half a line long. The *nitida* is similar in its solid septa, but the cellules below the star are very minute. The ridges are sulcate.

*Mad. detrita*, Esper, Pflanz. Fortsetz. i. *Astræa detrita*, Blainv., Man. 367.

26, tab. 41, a figure of a worn specimen, An apology can hardly be required for from the China Seas, sent him by M. Chemnitz. changing a specific name derived merely from the fact that the specimen examined

*Astræa detrita*, Lamk., ii. 406, No. 6.

was a worn one (detritum).

#### 42. ASTRÆA PURPUREA. (*Dana.*)

*A. hemispherica*; polypis  $\frac{1}{2}$ " latis, discis lætè virentibus, tentaculis numerosis, purpureis. Corallum subcellulosum, robustum; cellis angulatis, subprofundis, 4-5" latis, intus non coronatis; collibus triangulatis, subtiliter sulcatis; lamellis confertis, æqualibus, subtilissimè denticulatis, apice fere integris et paululum prominulis: transversè secto, stellis suborbiculatis, multiradiatis, cellulis simplicibus, angustissimis; septis solidis, cellulis paucis, minutissimis.

Hemispherical; polyps half an inch broad, disks bright-green, tentacles numerous, purple. Corallum subcellular, firm; cells angular, rather shallow; 4 to 5 lines broad, not coronate within; ridges triangular, very delicately sulcate; lamellæ crowded, even, very finely denticulate, nearly entire, and but slightly prominent at apex; in a transverse section, stars nearly circular, many-rayed, cellules simple, very narrow; septa solid, cellules rare and very minute.

Plate 12, fig. 10, natural size; 10 *a*, cells, do.; 10 *b*, profile of cell and lamellæ, enlarged; 10 *b'*, same, natural size; 10 *c*, vertical section, enlarged; 10 *d*, same, natural size; 10 *e*, transverse section, enlarged four diameters, from a part of the corallum where the cells were small.



Feejee Islands. *Exp. Exp.*

The minute channel along the summit of the ridges is a striking character; and also the solid septa, and the crowded, even, minutely denticulate lamellæ. It approaches the *pentagona*, but the sulcus and the absence of the corona of teeth within the cell, distinguish it from that species.

43. *ASTRÆA PULCHRA.* (Dana.)

*A. convexa, umbrina; collibus apice pallidis, tentaculis brunneis. Corallum subsolidum, robustum; cellis angulatis, inæqualibus, sæpius 3-4'' latis, subprofundis, intus non coronatis; collibus triangulatis, integris; lamellis æqualibus, confertis, tenuibus, fere integris: transversè secto, stellis multiradiatis cum cellulis simplicibus; septis persolidis: verticaliter secto, porulis subtilissimis.*

Convex; umber-coloured, top of ridges pale, tentacles brown. Corallum subsolid, firm; cells angular, unequal, mostly 3 to 4 lines broad, rather shallow, not coronate within; ridges triangular, entire; lamellæ even, crowded, thin, nearly entire, but little prominent over the septum: in a transverse section, stars many-rayed, with the cellules simple: septa quite solid: in a vertical section cellules under the star very minute.

Plate 12, fig. 11, polyps partly expanded, natural size; 11 *a*, polyp enlarged; 11 *b*, section of cells, showing outline of lamellæ, enlarged two diameters; 11 *c*, same, natural size; 11 *d*, vertical section of corallum, enlarged; 11 *e*, same, natural size; 11 *f*, transverse section of corallum, enlarged three diameters.

Feejee Islands. *Exp. Exp.*

This species is near the *petrosa* in the size of its cells and its solid septa, but the stars are more angular, and the texture below the cells is very minutely cellular. It also resembles the *purpurea*, which differs, however, in the delicate channel along the middle of the ridges.

IV. *Collibus integris; lamellis æqualibus; cellis intus coronatis; corallo transversè secto, cellulis stellarum simplicibus.*

44. ASTRÆA PENTAGONA. (*Esper.*) *Ehrenberg.*

*A. semiglobosa.* *Corallum cellis angulatis sæpius pentagonis, 4½–5''' latis, inæqualibus, interdum oblongis, intus bene coronatis; centro, appendice columnari; collibus angustis, obtusis vel subacutis.*

Semiglobose. Corallum with the cells angular, usually pentagonal, 4½ to 5 lines broad, unequal, sometimes oblong, neatly coronate within, a columnar appendage at centre; ridges narrow, obtuse, or subacute.

East Indies. *Esper.*

*Ehrenberg* gives four and a half inches as the breadth of a specimen of this species. *Esper* describes the cells as rather shallow, and usually pentagonal in form, and the lamellæ as alternately large and small. His figure represents the corona within the cell as consisting of nine or ten teeth, and surrounding a prominent point at centre.

*Mad. pentagona*, *Esper*, Fortsetz. i. 13, *Astræa pentagona*, *Ehrenberg*, op. cit., G. tab. 39. The cells in the figure are badly shaded, and scarcely appear excavate. lx. sp. 5.

45. ASTRÆA FAVISTELLA. (*Dana.*)

*A. subhemispherica.* *Corallum cellulorum; cellis bene polygonatis, subprofundis, sæpius 3–4''' latis, intus coronatis; collibus fere 1''' crassis, integris, Gothicis, subacutis; lamellis subintegris, æqualibus: transversè secto, stellis vix multiradiatis, cum cellulis simplicibus; septis ½''' angustioribus, cellulis minutissimis, aut obsoletis, uniseriatis.*

Subhemispherical. Corallum cellular, rather light; cells neatly angular, rather shallow, mostly 3 to 4 lines broad, coronate within; ridges about a line thick, entire, Gothic, subacute; lamellæ subentire and very even, abrupt within: in a transverse section, stars scarcely many-rayed, with the cellules simple; septa not half a line thick, with very minute cellules, uniseriate, sometimes obsolete.

Plate 13, figure 2, cells of corallum, natural size; 2 *a*, 2 *b*, sections of cells; 2 *c*, transverse section of corallum, natural size; 2 *d*, vertical section of same, natural size.

Feejee Islands. *Exp. Exp.*

This species has not the columella of the *pentagona*, and moreover the lamellæ are very even. The depth of the cell is little more than half the diameter. The corona at the bottom of the cell consists of nine to twelve thin, prominent, rounded teeth. It approaches in its corona and angular cells the *magnifica*; but the cells are much less deep, less flexuous, and the cellules of the star are not decompound.

NOTE.—Plate 13, figures 3 *a*, 3 *b*, represent sections of a worn specimen of a light cellular coral from Wake's Island, which may be identical with the above. The stars are less angular, the septa a little more cellular, and the cross dissepiments on the lamellæ, as seen in a vertical section (figure 3 *b*), are a little more remote, being about half a line distant.

*Mad. cellulosa* (?), Esper, Pflanz. Fortsetz. i. 25, tab. 40; from a worn specimen.

#### 46. ASTRÆA EXIMIA. (*Dana.*)

*A. convexa.* *C. cellulorum, robustum*; cellis eleganter polygonatis, sæpius 2'' latis, vix profundis, intus coronatis; collibus  $\frac{1}{2}$ '' latis, abruptis, acutis; lamellis angustissimis, subintegris, non exsertis: transversè secto, septis vix  $\frac{1}{2}$ '' crassis, solidis; stellis multiradiatis, cum cellulis profundis, simplicibus.

Convex. Corallum cellular, firm; cells very neatly polygonal, mostly about 2 lines broad, rather deep, coronate within; ridges about half a line wide, abrupt, acute; lamellæ very narrow, subentire, not at all exsert: in a transverse section, septa scarcely  $\frac{1}{2}$  a line thick, solid, stars many-rayed, with simple, deep, cellules.

Plate 13, figure 4 *a*, section of cells and ridges, showing profile of lamellæ; 4 *b*, size and form of cells; 4 *c*, transverse section of corallum, natural size; 4 *d*, vertical section, natural size.

Pacific Ocean. *Exp. Exp.*

The cells are remarkably neat in their polygonal forms, with thin acute ridges and very narrow lamellæ, which striate with remarkable

regularity the nearly vertical sides of the cells. The corona consists of about ten prominent though small teeth. The process of subdivision in the cells is finely shown in this coral; the dividing partition cuts straight through the centre of the cell, without a converging or rounding of the sides, as in species which are not polygonal. The texture in a vertical section, is coarsely cellular below the stars, the cellules being more than half a line long, and it is owing to this that in a transverse section the cellules of the stars are deep; the septum is quite solid. The species resembles the last, but is smaller in its cells, thinner and neater in its ridges, and more completely solid in its septa.

47. *ASTRÆA SINUOSA.* (*Dana.*)

*A. convexa.* *Corallum subcellulosum, cellis subangulatis, vix 2'' latis, sæpe flexuosis et longis (6''), profundis, intus confertim coronatis; collibus 1-1½'' crassis, rotundatis, abruptis, integris: lamellis æqualibus, subintegris: transversè secto, stellis vix multiradiatis, cum cellulis simplicibus; septis ½'' latis, fere solidis.*

Convex. *Corallum* subcellular; cells subangular, hardly 2 lines broad, sometimes lobed and flexuous and 6 lines long, rather deep, crowdedly coronate within, ridges rounded, 1 to 1½ lines thick, abrupt, entire; lamellæ even, subentire: in a transverse section, stars scarcely many-rayed, with the cellules simple; septa ½ a line thick and nearly solid.

Plate 13, fig. 5, cells of corallum, natural size; 5 *a*, section of cells and ridges, showing profile of lamellæ, natural size; 5 *b*, transverse section of corallum; 5 *c*, vertical section of same.

Feejee Islands. *Exp. Exp.*

This species has thicker septa than the *favistella*, more rounded ridges, more irregular cells, and a closer texture within. The cells are usually quite narrow, and appear half closed below by the crowded corona.

48. *ASTRÆA MELICERUM*. (Ehrenberg.)

*A. effusa*, 3''' alta, pentagonæ affinis. Corallum cellis  $2\frac{1}{2}$ ''' latis, columellâ nullâ, interstitiis paulo latioribus, subtruncatis.

Effuse, 3 lines high, allied to the *pentagona*. Corallum with the cells  $2\frac{1}{2}$  lines broad, columella none, interstices a little broader, subtruncate.

This species forms an incrustation attached to a *strombus*; the locality is unknown.

*Astræa melicerum*, Ehrenberg, G. lx., sp. 6.

49. *ASTRÆA PARVISTELLA*. (Dana.)

*A. convexa*. Corallum cellulosum; cellis angulatis, 1''' latis, raro oblongis, paulo profundis, intus conspicuè coronatis; collibus vix  $\frac{1}{2}$ ''' crassis, rotundatis; lamellis minutis, æqualibus: transversè secto, stellis vix multiradiatis, cum cellulis simplicibus; septis subsolidis, vix  $\frac{1}{3}$ ''' crassis: texturâ sub cellis apertè cellulosâ.

Convex. Corallum cellular; cells angular, a line broad, rarely oblong, shallow, distinctly coronate within; ridges scarcely  $\frac{1}{2}$  a line thick, rounded; lamellæ minute, even: in a transverse section, stars scarcely many-rayed, with the cellules simple; septa nearly solid, scarcely  $\frac{1}{3}$  of a line thick: texture below the cells coarsely cellular.

Plate 13, fig. 6, cells of corallum, natural size; 6 *a*, transverse section of corallum, enlarged; 6 *b*, same, natural size; 6 *c*, vertical section, natural size.

Feejee Islands. *Exp. Exp.*

This species is singular, considering the small size of the polyps, in having the internal texture below the cells quite coarsely cellular. The corona of minute teeth nearly fills the cells. It is a rather heavy coral. In habit it resembles the *favistella*, though much smaller in its cells and ridges.

## 50. ASTRÆA FAVULUS. (Dana.)

*A. convexa.* Corallum subcellulosum; cellis 1<sup>m</sup> latis, angulatis, interdum 3<sup>m</sup> longis, vix profundis, intus obsolete coronatis; collibus vix 1<sup>m</sup> crassis, Gothicis vel rotundatis, abruptis, integris; lamellis fere æqualibus, subintegris: transversè secto, stellis vix multiradiatis, cum cellulis simplicibus; septis vix  $\frac{1}{2}$ <sup>m</sup> crassis, fere solidis, cellulis paucis: texturâ sub cellis subtilissimè cellulosa.

Convex. Corallum somewhat cellular, cells 1 line broad, angular, occasionally 3 lines long, rather deep, obsoletely coronate within; ridges scarcely a line thick, Gothic, or rounded, abrupt, entire; lamellæ nearly equal, subentire: in a transverse section, stars scarcely many-rayed, with the cellules simple; septa scarcely  $\frac{1}{2}$  a line thick, nearly solid, with occasional minute cellules: texture below the cells very minutely cellular.

Plate 13, fig. 7, cells of corallum, natural size; 7 *a*, section of cells and ridges, showing also profile of lamellæ; 7 *b*, transverse section of corallum, natural size; 7 *c*, vertical section of the same.

Feejee Islands. *Exp. Exp.*

This species has much smaller cells than the *sinuosa*, which it somewhat resembles, and they are scarcely coronate within; besides, the cellules internally below the cells are very minute, and singularly neat and regular. The lamellæ also are not so even, some few projecting a little more into the cells than others.

## 51. ASTRÆA CERIUM. (Dana.)

*A. convexa.* Corallum subcellulosum, robustum; cellis angulatis, 1 $\frac{1}{2}$ <sup>m</sup> latis; collibus angustis: transversè secto, stellis vix multiradiatis, (ferè 12 radiis majoribus) cum cellulis simplicibus, et apertis; septis solidis, fere  $\frac{1}{2}$ <sup>m</sup> crassis: verticaliter secto, cellulis bene æqualibus,  $\frac{1}{2}$ <sup>m</sup> latis, et septis solidis.

Corallum subcellular, firm; cells angular 1 $\frac{1}{2}$  lines broad; ridges quite narrow: in a transverse section, stars scarcely multiradiate (about

12 larger rays) with simple open cellules; septa solid, nearly  $\frac{1}{2}$  a line thick: in a vertical section, cellules neatly equal,  $\frac{1}{2}$  a line broad, and septa linear and solid.

Plate 13, fig. 8.

Wake's Island, Pacific Ocean. *Exp. Exp.*

This species, of which I have seen only worn specimens, resembles much the *parvula* in general appearance; but the cells are a little larger, and the internal texture neater and more regular in its cellules; the septa are one half broader in a transverse section, and the stars appear with less crowded rays. The masses break with a straight grain, and almost columnar surface, while in the *parvistella*, the texture is curved and irregular with more uneven cellules. Judging from the worn specimens, it may be inferred that the cells have a general resemblance to those of the species just mentioned, though somewhat larger and deeper.

#### 52. ASTRÆA INTERSEPTA. (*Esper.*)

*A. convexa, discis sæpius gemmatis et dichasticis. Corallum cellulosum, robustum; cellis parvulis (vix 1''' latis), suborbiculatis, subprofundis, intus vix coronatis; collibus planis, interdum duplicatis, lamellato-scabris; lamellis paululum exsertis, et circum cellas radiatis, apice truncatis, fragilibus, intus abruptis: transversè secto, stellis pauciradiatis, cum cellulis simplicibus; septis  $\frac{1}{4}$ – $\frac{1}{3}$ ''' crassis, subcellulosis, cellulis interruptè uniseriatis.*

Convex; disks often budding and dichastic. Corallum cellular, firm; cells minute, nearly circular, less than a line broad, rather shallow, scarcely coronate within; ridges flat, sometimes duplicate, lamello-scabrous; lamellæ a little exsert and radiate around the cells upon the septum, truncate at apex, fragile, abrupt within: in a transverse section, stars few-rayed, with the cellules simple; septa  $\frac{1}{4}$  to  $\frac{1}{3}$  of a line thick, subcellular, cellules interruptedly in a single series.

Plate 13, fig. 12, surface of corallum, natural size; 12*a*, cells enlarged; 12*b*, lamellæ and section of cell, natural size; 12*c*, lamellæ enlarged; 12*d*, transverse section, enlarged; 12*e*, vertical section, natural size.

East Indies. *Exp. Exp.*

This coral is remarkable for its very small cells and the rough appearance of the surface, owing to the arenose fragile lamellæ, which are prominent around the cell; these lamellæ are about one-third of a line wide at the truncate apex, and a quarter of a line high above the septum. The stars in a transverse section contain six or eight large lamellæ, with smaller intermediate.

This species buds both in the intervals and by subdivision of polyps. In habit, it appears to be near the *A. Orb. stellifera*, and the allied, rather than the *Fissicellæ*; yet it approaches the *A. parvistella* and *A. favulus*.

*Madrepora intersepta*, Esper, Pflanz. Fortsetz., i. 99, tab. 79. A recognisable figure, except that the interstices are more frequently duplicate in the specimen examined.

The *Astræa intersepta* of Lamarck (No. 28, ii., 417) appears to be another species. It is thus described: "A. incrustans, superficie reticulatâ, stellis subangulatis, contiguïs, margine mutico, lineolis notato; axe centrali." From the "Austral Seas."

The *Astræa galaxea* of Quoy and Gaymard (Voy. de l'Ast., iv. 216, pl. 17, figs. 10, 14) is a species from Port Royal, New Holland, near the above, but probably distinct. It is described as forming incrustations, either subglobose or plain, with circular multi-lamellate cells one and a half to two lines broad, rather shallow and minutely coronate within; the lamellæ are rounded, finely serrulate, and alternately larger. The figure represents upwards of thirty lamellæ to a cell.

B. LOBATO-RAMOSÆ ET ANGULATÆ.

53. ASTRÆA ABDITA. (*Ellis.*)

*A. glomerata et gibbosa aut lobato-ramosa, angulata. Corallum cellis angulatis, 4-6'' latis, paulo profundis, patulis; collibus acutis et sæpe tenuibus; lamellis crenulato-dentatis.*

Glomerate, gibbous or lobato-ramose and angular. Corallum with angular cells, 4 to 6 lines wide, shallow, patulous; ridges acute and often thin; lamellæ crenulato-dentate.

East Indies.

This irregularly lobed species is remarkable for the sharp ridges between the calicles, which are usually quite thin and trenchant.

*Mad. abdita*, Ellis and Solander, 162, tab. *Mad. favosa*, var. 2, Esper, Fortsetz. i. tab. 50, fig. 2; a characteristic figure. 45 A, fig. 2; from Ellis.





- Astræa abdita*, Lamarck, ii. 415, No. 22. —, Ehrenberg, G. lx. sp. 12.  
 —, Lamouroux, Exp. Meth., 59, tab. 50, fig. 2; Encyc., 128. The *A. abdita* of Quoy and Gaymard (Voy. de l'Ast. iv. 205, pl. 16, figs. 4, 5), is different species, near the *dipsacea*.  
 —, Blainville, Man. 373.

54. *ASTRÆA TESSERIFERA.* (H. & Ehrenberg.)

*A. glomerata et lobato-ramosa, polygonata; fusca. Corallum cellulosum; cellis angulatis, 5-6'' latis, paulo profundis, patulis, intus non coronatis; collibus subcrassis et triangulatis, apice tenuibus et sæpe pellucidis; lamellis valde denticulatis: transversè secto, stellis multiradiatis, septis fere solidis.*

Glomerate, erect, lobed and polygonal; fuscous. Corallum cellular, rather light; cells angular, 5-6 lines broad, shallow, patulous, not coronate within; ridges rather stout and triangular, apical thin and often pellucid; lamellæ strongly denticulate: in a transverse section, stars multiradiate, septa nearly solid.

Plate 13, fig. 9 *a, b, c*, sections of cells, natural size, showing profile of lamellæ; 9 *d*, transverse section of corallum, natural size.

Red Sea. (*Ehrenberg.*)

This species resembles in habit, the *abdita*, but the edges are less thin and more obtuse. The cells are not subdivided in the middle by the dichastic process; on the contrary, it is usually a small part from the upper side which is separated.

The edges at the upper extremity of the ascending lobes, are sometimes much prolonged and translucent.

- Astræa tesserifera*, Ehrenberg, G. lx. sp. 11; "stellis angulatis, patulis, semipollicaribus, margine rotundatis, lamellis valde denticulatis." Ehrenberg refers with a query to Esper's fig. 2, tab. xlv.

55. *ASTRÆA ROBUSTA.* (*Dana.*)

*A. lobato-glomerata et polygonata, tesseriferæ affinis. Corallum robustum, subcellulosum; cellis 4-6'' latis, angulatis, paulo profundis, patulis, intus breviter coronatis; collibus triangulatis; lamellis angus-*

*tissimis, spinoso-denticulatis: transversè secto, stellis multiradiatis, radiis confertis, cellulis minutis; septis fere solidis.*

Lobed glomerate, lobes ascending and polygonal, as in the *tesserifera*. Corallum firm and little cellular; cells 4 to 6 lines broad, angular, shallow, patulous, short coronate within; ridges triangular; lamellæ narrow, spinoso-denticulate: in a transverse section, stars multiradiate, and rays closely crowded, with minute cellules; septa nearly solid.

Plate 13, fig. 10, part of corallum, natural size; 10 *a*, section of cells, showing profile of lamellæ; 10 *b*, the same enlarged; 10 *c*, transverse section of corallum, natural size; 10 *d*, vertical section of same.

Feejee Islands. *Exp. Exp.*

The corallum is heavier and more solid than in the *tesserifera*. Within a line of the margin of a cell, the lamellæ are hardly one-fifth of a line wide, while they are twice this in the *tesserifera*. They appear as mere striations of the surface. The cellules between the lamellæ of the cell are much shorter; and the cell has a much closer and more compact appearance. The centre also is less loosely porous, and the cellules through the corallum are very minute, the rays of the star being crowded, and the transverse dissepiments numerous.

C. SUPPLEMENT: UNARRANGED SPECIES.

56. *ASTRÆA COMPLANATA*. (*H. & Ehrenberg.*)

*A. effusa, brunnea. Corallum pulvinatum, spinulosum; cellis magnis, 4½–5''' latis, subrotundis, planis; interstitiis angustis, depressis, passim obsoletis.*

Effuse; brown. Corallum pulvinate, spinulous; cells large, 4½ to 5 lines broad, nearly circular, plane; interstices narrow, depressed, every where obsolescent.

The Red Sea. (*Ehrenberg.*)

*Favia complanata*, Ehrenberg, G. lix. sp. 3.

57. *ASTRÆA HELIOPORA.* (*Lamarck.*)

*A. planulata.* *Corallum cellis orbiculatis, majusculis, multiradiatis, margine separatis; lamellis extus supernèque incrassatis; centro papilloso.*

Planulate. Corallum with the cells circular, rather large, many-rayed, the lamellæ separated along the ridges between the cells, incrassate above and without; centre papillose.

The "Austral Seas." *Lamarck.*

Lamarck states that this handsome species has the stars but little excavate, neatly rayed, with the lamellæ thickened above, especially towards the margin of the cells, and a furrow along the ridges.

*Astræa heliopora*, Lamarck, ii. 415, No. 24. *Astræa heliopora*, Blainville, Man. 369.

NOTE.—Figures 11 *a*, 11 *b*, pl. 13, represent sections (natural size) of a coral from Wakes Island, Pacific Ocean, which we have been unable to refer to any described species. May it be the above? It is a heavy coral, characterized by large stars, very stout lamellæ, and coarse cellules.

58. *ASTRÆA HEMPRICHII.* (*Ehrenberg.*)

*Corallum cellis inæqualibus, 5–5½''' latis, pentagonis aut hexagonis, subprofundis; interstitiis acutè cristatis; lamellis validè denticulatis.*

Corallum with the cells unequal, 5 to 5½ lines broad, pentagonal or hexagonal, rather shallow; interstices acutely cristate; lamellæ strongly denticulate.

The Red Sea. *Ehrenberg.*

*Astræa Hemprichii*, Ehrenberg, op. cit. G. lx. sp. 9.

59. *ASTRÆA HALICORA.* (*Ehrenberg.*)

*A. globosa.* *Corallum cellis 3½''' latis, sæpe pentagonis, subprofundis; lamellis stellarum contiguarum continuis, interdum alternis, interstitio nullo.*

Globose. Corallum, with cells  $3\frac{1}{2}$  lines broad, often pentagonal, somewhat shallow, lamellæ of contiguous stars continuous, sometimes alternate, interstices none.

The Red Sea.

This species, according to Ehrenberg, is near the *Hemprichii*, but has smaller cells and lamellæ more delicately toothed.

*Astræa halicora*, Ehrenberg, op. cit. G. lx. sp. 10.

60. ASTRÆA CYCLASTRA. (*Dana.*)

*A. flexuoso-convexa*, polypis 3–5''' latis. Corallum cellulosum; cellis orbiculatis, margine prominulis et collibus sæpius sulcatis: transversè secto, stellis multiradiatis, radiis 24–30 tenuibus, cellulis parcè decompositis; septis  $\frac{1}{2}$ –1''' crassis, medio cellulosis, cellulis 1–2-seriatis.

Flexuoso-convex, polyps 3 to 5 lines broad. Corallum cellular, cells circular, margin a little prominent and ridges usually sulcate: in a transverse section, stars many-rayed (24–30), rays thin, with the cellules sparingly decomposed; septa  $\frac{1}{2}$  to 1 line thick, cellular along the middle, cellules in 1 or 2 series.

The round cells resemble those of the Orbicellæ, and they have an oblique position, nearly as in the *coronata*; but, although closely allied to that division of the genus, it multiplies generally by disk-buds. In a worn specimen in the cabinet of Prof. C. U. Shepard, of New Haven, the cells are shallow tubes, one and a half to two lines deep, the lamellæ being worn off within. The convoluto-porous centre at bottom occupies about half the whole breadth; the lamellæ are very thin, and about twenty-four extend to the porous centre. In a vertical section the texture, though firm, appears very cellular; the transverse dissepiments on the lateral surface of a lamella are oblique, quite regular, and three or four to a line in length; the texture of the middle of a cell is minutely and irregularly porous; the cellules of the septa are distinct, and generally in a single vertical series. In a polished transverse section, the cellules are narrow, surrounded by a nearly solid ring, about a quarter of a line thick, and are confined to the middle of the septum.

61. ASTRÆA FAVOSA. (*Lamarck.*)

*A. subglobosa.* *Corallum cellis majusculis, inæqualibus, angulatis margine subacuto, parietibus lamellosis, lamellis dentatis.*

Subglobose. Corallum with the cells rather large, unequal, angular, margin subacute, sides lamellose, lamellæ dentate.

East Indies.

*Astræa favosa*, Lamarck, ii. 413, No. 17. Lamarck here separates Esper's *Madrepora favosa* (Fortsetz. i. tab. 45, fig. 1) from the *favosa* of Ellis, which he names *dipsacea*. He also unites with the *favosa* of Esper a fossil found near Givet in France. The recent specimens are described as having the cells a little smaller than in the *denticulata*, angular and strongly concave, with the margin nearly acute and not bristled with lamellæ. "Ces étoiles donnent à la masse l'aspect d'un gâteau alvéolaire." (Gault. Ind., back of tab. 19.—Schweig. Handb. 419.—Blainv. Man. 375.)

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 GENUS VIII.—MEANDRINA.—LAMARCK.

*Astræidæ aggregatæ; discis animalium seriatim gemmantibus et remotè vel haud dichasticis, itaque linearibus, sinuosis. Tentacula utroque disci margine seriata. Coralla cellis fossiformibus, et gyrosis; lamellis tenuibus, usque ad medium septi longiusve productis. (Gyris latitudine semipollicem non superantibus.)*

Aggregate *Astræidæ*; disks seriatly budding and remotely or not dichastic, and hence linear, sinuous; tentacles forming a series along either margin of the linear disk. Coralla, with trench-like, gyrose, cells; lamellæ thin, prolonged out of the cell to the middle of the septum or beyond. (Gyri not exceeding half an inch in breadth.)

The *Meandrinæ* are *Astræas*, in which the polyp disks—and consequently the cells—are confluent in sinuous lines. They increase by disk-buds, and differ from *Astræas* only in the formation of a succession of buds, without an attendant subdivision of the disks and a separation of the polyps. Those species of *Astræa*, in which the

disks become elongated, and sometimes sinuous, with two or three polyp mouths, show a transition to the Meandrinæ. This is exemplified in the *A. dipsacea*, *A. uva*, *A. deformis*, and *A. favosa*. The length of the trenches is often limited in the different species, inasmuch as the number of polyp-buds, which may thus form, without an external subdivision, has generally its limits.

The union of the polyps, which are contained in the same cell, or under the same disk, appears to be of the most intimate kind; there is a free internal communication from one polyp to another of the same series, in place of the imperfect cellular connexion, which separates two *Astræa* polyps (§ 77).

The Meandrinæ attain the same gigantic dimensions as the *Astrææ*, and with equal symmetry of form. The sinuous lines of polyps, presenting the same varied tints as in the preceding groups, give great beauty to the zoophyte when alive and expanded; the domes seem to be covered with a network of flowering vines.

These corals are confined to the warm coral-reef seas, and grow within twenty fathoms of the surface.

This genus was separated from the old *Madrepora* by Lamarck, to include the corals with meandering cells. Ehrenberg instituted the genus *Manicina* for the species which grow from a central attachment (explanato-glomerate), from which we have separated the *Ctenophylliæ* and the massive meandering *Mussæ*. The species retained as Meandrinæ are simply meandering *Astrææ*. Independently of the mode of growth, the *Mussæ* are readily distinguished from them by their larger size, the coarse dentation of the lamellæ, and having one or more lamellæ ranging along the bottom of the trench; the *Manicina*, by their larger size and neat denticulation; and the *Ctenophylliæ*, by their very stout, remote, and nearly entire, lamellæ.

The genus *Astræa* affiliates with the Meandrinæ along several lines. The *A. dipsacea* is thus related to *M. cerebriformis*; *A. favosa* and *reticularis*, to *M. labyrinthica* and *M. phrygia*; *A. deformis* to *M. dedalea*; and the *A. favulus* to *M. filograna*.

The species *dedalea* and *spongiosa* might be transferred without impropriety to the genus *Astræa*, as the trenches are very short, and many contain but a single cell.

*Arrangement of the Species.*

## A. CONVEX OR HEMISPHERICAL—NOT GIBBOUS OR CLAVATE.

## a. Septa acute or subacute at apex.

I. *Gyri short.*\*1. *M. dedalea.*\*2. *M. spongiosa.*II. *Gyri long.*\*3. *M. labyrinthica.*\*8. *M. phrygia.*\*4. *M. strigosa.*\*9. *M. gracilis.*\*5. *M. interrupta.*\*10. *M. tenuis.*\*6. *M. rustica.*\*11. *M. filograna.*\*7. *M. valida.*

## b. Septa stout and truncate at apex.

\*12. *M. cerebriformis.*\*13. *M. truncata.*

## B. GIBBOUS OR CLAVATE.

\*14. *M. mammosa.*16. *M. caudex.*15. *M. cylindrus.*

## A. M. CONVEXÆ, HEMISPHERICÆ, NON GIBBOSÆ NEC LOBATO-RAMOSÆ.

## a. Septis apice subacutis aut acutis.

I. *Gyris brevibus.*1. MEANDRINA DEDALEA. (*Ellis.*)

*M. hemispherica*; discis subgyrosis, brevibus, sæpius pollicem longitudine non superantibus; gyris 3''' latis. Corallum cellulosum; collibus acuto-triangulatis; fossis 3''' profundis; lamellis valde inæqualibus et inæqualiter exsertis, eroso-denticulatis; septis basi vix ½''' crassis.

Hemispherical; with the submeandering disks short, seldom over an inch long; gyri 3 lines broad. Corallum with the fossæ 3 lines deep, ridges acute-triangular; lamellæ much unequal and unequally exsert, eroso-denticulate; septa scarcely ½ a line thick at base.

Plate 14, figs. 12 *a*, 12 *b*, sections of cells, of a specimen from the Feejees, showing profile of lamellæ, natural size; 12 *c*, vertical section of the corallum, natural size.

East Indies.—Feejee Islands. *Exp. Exp.*

The short gyri and rather steep triangular lacerate ridges are striking characters of this species. The septa are not over half a line thick, and the erose lamellæ projecting above unequally, give the ridges a ragged appearance. The bottom of the cell is convoluted-porous, but very narrow. Of the larger lamellæ that reach the centre of the cell, there are about ten to half an inch; with the intermediate, there are about sixteen in all, in this distance: the corallum is consequently quite open cellular.

This species grows in hemispheres, which are sometimes six inches in diameter.

- Mad. dædalea*, Ellis and Solander, 163, tab. 46, fig. 1; a good figure.  
 —, Esper, Fortsetz. i. 63, tab. 57, figs. 1 and 2. Figure 1 is from Ellis.  
*Meandrina dædalea*, Lamk., ii. 387, No. 3.  
 —, Lamour., Exp. Meth., 55, tab. 46, fig. 1; Encyc., 508.  
 —, Blainville, Man., 357.

## 2. MEANDRINA SPONGIOSA. (*Dana.*)

*M. globosa aut hemispherica, discis interdum simplicissimis, sæpius linearibus et subgyrosis; gyris 3-4'' latis, raro 2'' longis. Corallum percellulosum, non robustum; collibus triangulatis; fossis profundis; septis tenuibus et interdum inflatis; lamellis subremotis, apice subacutis, subæqualibus, tenuissimis, leviter eroso-denticulatis.*

Globose or hemispherical; disks sometimes quite simple, but usually linear and subgyrose; gyri 3 to 4 lines broad, and rarely 2 inches long. Corallum very light cellular; ridges triangular; fossæ deep; septa thin, but also often inflated; lamellæ rather distant, subacute at apex, subequal, very thin, delicately eroso-denticulate.

Plate 14, figure 17 *a*, section of fossæ and profile of lamellæ.

West Indies? *Bost. Nat. Hist. Soc.*

This species has the general habit of the *dædalea*, but the texture is very cellular and more fragile, and the lamellæ thinner, more even, and less deeply denticulate. The cells are sometimes simple, even over a considerable surface, but in general they are from half to one inch in length, and sometimes two inches and a half. The bottom of the fossæ is very loosely convoluted; and the depth fully equals the breadth at top or even exceeds it. While the septa are quite thin



in some parts, they are below much inflated and spongy in others; the summits are usually very fragile, and often thinner than paper.

The *Mæandrina dædalea* of Lesueur, from Guadaloupe, (Mém. du Mus., vi. 281, pl. 16, fig. 9,) appears to be this species. He describes it as having either simple or compound disks, the longest containing seven or eight confluent polyps. The tentacles were in two ranges along the sides of the cells. Colour fine reddish-brown, with green and brown. Ridges of corallum angular, with the furrows either elongate or a simple star; the lamellæ denticulate, and alternating with those of the adjoining furrow, and so united as to form a zigzag line along the summit.—Esper, Fortsetz. ii. tab. 87 ?

The *Astræa varia* has the general habit of this species, excepting that the cells are simple.

## II. *Gyris valdè elongatis.*

### 3. MEANDRINA LABYRINTHICA. (*Ellis.*)

*M. hemispherica*; *discis linearibus longissimis, gyrosis; gyris 3-4''' latis.*  
*Corallum subcellulosum, robustum; collibus triangulatis, subacutis,*  
*apice fere nudis; septis vix turgidulis; lamellis subæqualibus, denti-*  
*culatis, basi paulum dilatatis; transversè secto, septis solidis, vix 1'''*  
*crassis, paucis cellulis.*

Hemispherical; linear disks very long and gyrose; gyri 3 to 4 lines broad. Corallum subcellular, firm; ridges triangular, subacute, nearly naked at top; septa very slightly turgid; lamellæ nearly even, denticulate, somewhat dilatate at base: in a transverse section, septa solid, with rarely a cellule, scarcely 1 line thick.

Plate 14, fig. 1, section of fossæ and profile of lamellæ.

The West Indies and Bermudas.—The Red Sea. *Ehrenberg.*

The *M. labyrinthica* is one of the largest and best-known species of the genus. Its hemispheres are sometimes six feet or more in diameter. The thickness of the solid septa, and the triangular ridges bare at top, are its most obvious characters. The bottom of the fossæ is narrow convolute-porous. The lamellæ are even and numerous, about sixteen being counted in half an inch. In worn specimens, the ridges, owing to the thick solid septa, always remain more or less prominent.

According to Lesueur, who examined a live specimen at St. Thomas

in the West Indies, the mouth has six vertical folds on each side, encircled with red and yellow mingled with green. The tentacles are long, red, with small white spots, and are eighteen to twenty in number to each polyp; the ridges between the disks are brownish-red.

- Lapis corallites globosus*, &c., Seba, Thes. iii. tab. 112, fig. 7; a figure of a worn specimen.
- Mad. labyrinthica*, Ellis and Solander, 160, tab. 46, fig. 3; a good figure.
- Madrepora mæandrites*, Esper, i. tab. 4 A.
- Meandrina labyrinthica*, Lamk. ii. 386, No. 1.
- , Lamour., Exp. Meth. 54, tab. 46, fig. 3; Encyc. 507.
- , Lesueur, Jour. Acad. Nat. Sci. of Philad., i. 180, pl. 8, fig. 11; figure and description of the polyyps.
- , Blainv., Man. 357, pl. 56, fig. 4; the figure is reduced, and imperfect.
- Mæandra labyrinthiformis*, Oken, Zool. i. 70.
- M. Platygyra labyrinthica*, Ehrenb., G. lxii. sp. 1. Ehrenberg's specimens were from the Red Sea. He refers to Savigny's figure 4, tab. 5 (Desc. de l'Égypte), as a representation of the species; and if the figure is correct, it may be distinct from the true *labyrinthica* of the West Indies: the gyri are rather narrower, and the ridges less prominent. The animals according to Ehrenberg have a bright green disk, with the ridges fuscous. This author also states that they have *no tentacles*.

4. MEANDRINA STRIGOSA. (*Dana*.)

*M. hemispherica*: *discis linearibus prælongis, gyrosis; gyris bene regularibus, 2½'' latis. Corallum cellulosum, subrobustum; fossis fundo porositis: transversè secto, septis filiformibus, vix ⅓'' crassis, lamellis æqualibus, tenuissimis, numerosis.*

Hemispherical; linear disks very long, gyrose; gyri evenly 2½ lines broad. Corallum cellular and rather light; bottom of trench convoluto-porous: in a transverse section, septa filiform, hardly ⅓ of a line thick; lamellæ equal, very thin, numerous.

Plate 14, figure 4 *a*, transverse section of corallum, natural size; 4 *b*, vertical section of same.

West Indies?

Only a worn specimen of this species has been seen by the author. This was part of a large hemisphere, probably several feet in diameter. The septa were not at all prominent, having been worn down even with the intermediate cell. The thin septa, less than a third of a line thick,

and the narrower gyri, distinguish it from the *labyrinthica*. There are twenty to twenty-two equal lamellæ to half an inch; and in a vertical section, obtained by fracture, these thin lamellæ form very delicate striations of the surface. Obsolescent intermediate lamellæ may be distinguished between some of the larger lamellæ.

#### 5. MEANDRINA INTERRUPTA. (Dana.)

*M. convexa et undulata*; discis linearibus sublongis (sive brevissimis, sive longis), sæpe lobatis, subgyrosis; gyris 2-2 $\frac{3}{4}$ '' latis, paulum inæqualibus. Corallum subcellulosum, robustum; septis solidis, triangulatis; fossis fundo porosis: transversè secto, septis irregularibus fere 1'' crassis, omnino solidis; lamellis tenuibus, majoribus alternis et confertis, minoribus obsolescentibus.

Surface convex and undulate; linear disks rather long (some very short and others long), often lobed and subgyrose, gyri 2-2 $\frac{3}{4}$  lines broad, somewhat unequal. Corallum firm; fossæ porous at bottom: in a transverse section, septa irregular, nearly a line thick, solid; lamellæ quite thin, alternately large and small, crowded, the smaller obsolescent.

Plate 14, figure 18, transverse section of corallum.

West Indies.

The breadth of the gyri is nearly the same as in the *strigosa* and *rustica*, but their irregularities and the alternately small lamellæ, regular, though nearly obsolete, distinguish the species. The septa, moreover, are much stouter than in the *strigosa*, and in worn specimens are triangular ridges, often quite uneven; the lamellæ are much thinner than in the *rustica*. The larger lamellæ, in a section, are even and about eighteen to half an inch; or counting the obsolescent intermediate lamellæ there are in all thirty-six to forty in this distance. In this particular the species differs widely from the *phrygia*.

#### 6. MEANDRINA RUSTICA. (Dana.)

*M. hemispherica*; discis linearibus vix longis, gyrosis; gyris 2 $\frac{1}{2}$ -3''



*latis. Corallum cellulosum, robustum; fossis fundo subcellulosis: transversè secto, septis  $\frac{3}{4}$ " crassis, lamellis subcrassis æqualibus.*

Hemispherical; linear disks not long, gyrose; gyri  $2\frac{1}{2}$  to 3 lines broad. Corallum cellular, firm; fossæ at bottom subcellular: in a transverse section, septa  $\frac{3}{4}$  of a line thick, lamellæ rather stout, equal.

Plate 14, figure 5 *a*, transverse section of corallum, natural size; 5 *b*, vertical section of same.

Wakes Island, Pacific Ocean. *Exp. Exp.*

In a beach specimen of this species, the only kind seen, the ridges are worn down, as in the last. The section of the cell presents a simple series of cellules alternating with stout lamellæ, of which there are about sixteen to half an inch. In a vertical section the surface is coarsely striate, owing to the stoutness of the lamellæ. This character distinguishes it from the *strigosa*, which it approaches in the breadth of its gyri: the septa are also thicker than in that species. It differs from the *labyrinthica* in its narrower and much shorter gyri, thinner septa, and the lamellæ not quite as crowded.

#### 7. MEANDRINA VALIDA. (*Dana.*)

*M. subhemispherica; gyris tortuosis et gyroso-lobatis, 3-4" latis. Corallum subcellulosum, robustum; septis medio subcellulosis, subacutis, fere triangulatis, 3" altis et basi  $\frac{1}{8}$ " crassis, lamellis tenuissimis.*

Subhemispherical; gyri tortuous and tortuously lobed, 3 to 4 lines broad. Corallum subcellular, firm; septa somewhat cellular at middle, subacute, nearly triangular,  $\frac{1}{4}$  of an inch high, and  $\frac{1}{8}$  thick at base; lamellæ quite thin.

Plate 14, fig. 11 *a*, worn surface, natural size; 11 *b*, outline of fossa and septa, do.

Worn specimens of this species have the septa very prominent, owing to their unusual thickness and texture, while at the same time, the lamellæ are very thin: the remains of the lamellæ of the ridges in some parts barely striate faintly the surfaces of the septa.

The bottom of the fossæ between the septa, is one-eighth or one-tenth of an inch broad, and contains on either side of a central porous line, a series of nearly square cellules alternating with the thin lamellæ, of which there are about seventeen to half an inch. The fossæ are larger and more irregular, and the septa much stouter, than in the *interrupta*.

8. MEANDRINA PHRYGIA. (*Ellis.*) *Lamarck.*

*M. subhemispherica*; *discis linearibus longis, nunc rectis nunc flexuosis; gyris 2-2½'' latis. Corallum cellulosum, robustum; collibus fere triangulatis; lamellis subacutis, eroso-denticulatis, remotis, valde inæqualibus, intermediis obsolescentibus; fossis triangulatis; fundo lamello-lineatis et non porosis cum lamellâ longitudinali interruptâ et pauulum crispâ: transversè secto, septis ⅓'' crassis.*

Subhemispherical; linear disks long, straight or flexuous in different parts; gyri 2 to 2½ lines broad. Corallum cellular, firm; ridges nearly triangular; lamellæ subacute, eroso-denticulate, remote, very unequal, the intermediate smaller lamellæ obsolescent; fossæ triangular, lamello-linear at bottom, and not porous, with the longitudinal lamella interrupted and somewhat crispate: in a transverse section, septa ⅓ of a line thick.

Plate 14, fig. 8, surface of corallum, natural size; 8 *a*, section of same, showing profilé of lamellæ; 8 *b*, vertical section.

East Indies. Ceylon.—*Rev. G. A. Aphorpe.*

The *phrygia* forms large convex masses, often a foot in diameter, characterized by rather narrow gyri, with the lamellæ lacerato-denticulate and triangular, the smaller obsolescent, and the larger remote, leaving large intervals and cells between, of which there are ten or twelve to half an inch. These characters give the corallum rather a jagged surface. The lamellæ project a little, and unequally, above the septum, nearly as in the *dedalea*. The internal texture is rather coarsely cellular.

*Mad. phrygia*, Ellis and Solander, 162, not made prominent above the septum, tab. 48, fig. 2. The septum is represented too thick, and the lamellæ are which consequently appears to be bare. *Mad. filograna?* Gualtieri Ind. Test. tab.

97; "Meandrinis costis tenuissimis, acutis, magis undosis et nonnihil concatenatis, lamellatis, interstitiis angustis." *Meandrina phrygia*, Lamouroux, Exp. Meth. 56, pl. 48, fig. 2.  
 —, Deslongch., Encyc. 509, pl. 485, fig. 2.  
*Meandrina phrygia*, Lamk., ii. 389, No. 8. —, Blainville, Man. 357.

9. MEANDRINA GRACILIS. (*Dana.*)

*M. convexa*; discis linearibus longis, rectis vel tortuosis (sicut phrygiâ); gyris fere 2''' latis. Corallum cellulosum, subrobustum; colibus Gothicis, abruptè declivibus, 1''' altis; lamellis subtiliter eroso-denticulatis, fere æqualibus, numerosis, vix exsertis; fossis angustissimis, fundo lamello-lineatis et non porosis: transversè secto, septis  $\frac{3}{4}$ —1''' latis, subcellulosis.

Convex; linear disks long, straight or tortuous (as in the *phrygia*); gyri nearly 2 lines broad. Corallum cellular, rather firm; ridges Gothic, abrupt, a line high; lamellæ finely eroso-denticulate, equal or nearly so, numerous, but little exsert; fossæ very narrow, lamello-linear at bottom and not porous: in a transverse section, septa  $\frac{3}{4}$  to 1 line broad, subcellular.

Plate 14, fig. 6, surface of corallum, natural size; 6 a, section of same, showing profile of lamellæ; 6 b, transverse section of same, natural size.

Feejee Islands. *Exp. Exp.*

This is a neat species, growing in irregularly convex masses, sometimes nearly hemispherical, with narrow gyri, and rather thick septa, though thin and acute at apex. There are twenty to twenty-four lamellæ to half an inch; and in this respect, as well as the equality of the lamellæ, and their less ragged edges, the species is very distinct from the *phrygia*. The septa are much thicker and more solid than in the *tenuis*, and the lamellæ, moreover, are more crowded, and the gyri less narrow.

Ellis's figure of the *phrygia* represents tolerably well this species, except that the lamellæ are not numerous enough. The *M. phrygia* of Ehrenberg (G. lxii. sp. 4), may belong here. He describes it as

follows, from a worn specimen in the Royal Museum, at Berlin: "Semipedalis, semiglobosa, anfractibus perangustis, longis, lamellis parvis, remotiusculis, perpendicularibus, colles referentibus."

10. MEANDRINA TENUIS. (*Dana.*)

*M. subhemispherica*; discis linearibus tortuosis, virentibus, tentaculis parvulis, brunnescentibus; gyris  $1\frac{1}{2}$ '' latis. Corallum percellulosum; collibus Gothicis, abruptis, 1'' altis; fossis angustissimis, fundo lamello-lineatis et non porosis; lamellis numerosis, æqualibus, subtiliter denticulatis: transversè secto, septis vix  $\frac{1}{3}$ '' latis, seriatim cellulosus.

Subhemispherical; linear disks tortuous, of a green colour; tentacles small, brownish; gyri  $1\frac{1}{2}$  lines broad. Corallum very cellular, rather light; ridges Gothic, abrupt, a line high; fossæ very narrow, lamello-lineate at bottom instead of porous; lamellæ numerous, even, finely denticulate: in a transverse section, septa hardly  $\frac{1}{3}$  of a line thick, seriatly cellular.

Plate 12, figure 7, enlarged view of part of the zoophyte; 7 *a*, one of the tentacles enlarged; 7 *b*, section of cells showing profile of lamellæ, natural size; 7 *c*, lamellæ of same, enlarged; 7 *d*, transverse section of corallum, natural size.

Feejee Islands. *Exp. Exp.*—Tongatabu. *Quoy & Gaymard.*

This species differs from the *gracilis*, which it most resembles, in its narrower and more sinuous gyri, and very thin cellular septa. The lamellæ also are not quite as close; there being about twenty to a half inch.

*Meandrina cerebriformis*, Quoy and Gaymard, *Voy. de l'Ast.* iv. 234, pl. 18, figs. 2, 3; the disk is represented of a slate-blue tint.

11. MEANDRINA FILOGRANA. (*Esper.*) *Dana.*

*M. convexa vel planiuscula*; discis linearibus subtortuosis; gyris  $1\frac{1}{2}$ '' latis. Corallum collibus rotundato-triangulatis, fere 1'' altis; lamellis subtilissimè denticulatis, confertissimis; fossis repandis, fundo convohuto-porosis.

Convex or nearly flat; linear disks subtortuous; gyri  $1\frac{1}{2}$  lines broad. Corallum with the ridges rounded, triangular, nearly a line high;

lamellæ very finely denticulate, and very much crowded; fossæ repand, at bottom convolute-porous.

West Indies.

The porous bottom of the cell, as well as the very much more crowded lamellæ, separates this species from the *gracilis* and *tenuis*. There are thirty-six to forty lamellæ to half an inch, and fifteen to twenty of these are slightly appendiculate at base. It grows to a breadth of two or three inches.

*Madrepora filigrana*, Esper, Pflanz. i. 139, tab. 22, fig. 1; the figure is characteristic, although coarse, and represents well, in an enlarged view, the porous bottom of the cell. The lamellæ are not sufficiently crowded. This is not the *M. filigrana*

of Lamarck, which he describes as follows: "Globosa, subgibbosa, anfractibus superficialibus, angustissimis, tortuosis; lamellis parvis, remotis, collibus filiformibus.—East Indies." (ii. 389, No. 9. Deslongchamps, Encyc., 509.)

b. Septis crassis, apice truncatis.

## 12. MEANDRINA CEREBRIFORMIS. (*Lamarck.*)

*M. hemispherica*; discis linearibus prælongis, tortuosis; gyris 5''' latis. Corallum cellulose, robustum; collibus 3''' latis, perpendicularibus, subrotundatis et obtusè sulcatis; septis apice  $\frac{1}{8}$ '' crassis; lamellis numerosis, denticulatis, tenuibus: transversè secto, septis subcellulosis.

Hemispherical; linear disks very long and tortuous; gyri 5 lines broad. Corallum cellular, firm; ridges 3 lines broad, perpendicular, somewhat rounded and obtusely sulcate above; septa  $\frac{1}{8}$  of an inch thick at apex; lamellæ numerous, denticulate, thin: in a transverse section, septa subcellular.

Plate 14, figure 2, section of trenches and ridges, showing also profile of lamellæ.

Bermudas and West Indies.

This species like the *labyrinthica* grows to a large size. It is the common *brain coral*. The ridges are broad, and usually somewhat sulcate at top, and perpendicular within the cell, with sometimes a constriction in the sides half way to the bottom, proceeding from an



indentation of the lamellæ. The lamellæ are thin and crowded (about twenty-one to half an inch), rounded above, and project a little above the septum. The septa when worn bare of the lamellæ are truncate, with an irregular line of small cellules along the centre of the top. The bottom of the fossæ is convolute-porous.

- Lapis corallinus globosus*, &c., Seba, Thes. iii. fig. 6, tab. 112, a figure of a fresh specimen, badly represented: figure 5 may be this species, or perhaps the *valida*; figure 1 is probably the following.
- Mad. labyrinthiformis*, Esper, Pflanz. i. 74, tab. 3; this figure is referred by Lamarek to his *labyrinthica*; yet it has the sulcate ridges and other characters of the *cerebriformis*.
- , Linn. ed. xii. 1274.
- Meandrina cerebriformis*, Lamk., ii. 386, No. 2.
- , Deslongchamps, Encyc., 508.
- , Blainville, Man. 357.
- M. Platygyra cerebriformis*, Ehrenb. Gen. lxii. sp. 3.
- Figure 8, plate 96, Voyage de l'Uranie, by Quoy and Gaymard, would hardly be recognised as a representation of a *Meandrina*. The *M. cerebriformis*, in the Voyage de l'Astrolabe, pl. 18, figs. 2, 3, is our *M. tenuis*.

### 13. MEANDRINA TRUNCATA. (*Dana*.)

*M. hemispherica*; *discis linearibus, longis et tortuosis*; *gyris 4-5'' latis*.  
*Corallum subcellulosum, robustum*; *septis apice truncatis et largè 1/8'' crassis, solidis*; *fossis paulo latioribus, fundo lineatis*.

Hemispherical; linear disks long and tortuous; gyri 4 to 5 lines broad. Corallum subcellular, firm; septa at apex truncate and full 1/8 of an inch thick, solid; fossæ a little broader, narrow-linear at bottom.

Plate 14, fig. 3, section of cells and ridges of worn specimen, natural size; 3 a, worn surface.

This description is taken from a worn hemispherical specimen, a foot in diameter, in the Boston Museum. The septa are bare at top and flat, and the cells deep triangular, with a very narrow linear bottom. It resembles much a worn specimen of the *M. cerebriformis*, but the septa have not a series of fine cellules along the centre, and they consequently wear flat instead of becoming a little depressed at middle.

- Lapis corallinus globosus, undulatus, plis crassis inter se convolutis, supernè glabris*, Seba, Thes. iii. tab. 112, fig. 1; from a worn specimen.

## B. GIBBOSÆ AUT CYLINDRICÆ.

14. MEANDRINA MAMMOSA. (*Dana.*)

*M. gibbosa et crassè mammillata, effusa; discis linearibus tortuosis; gyris  $\frac{1}{4}$ " latis. Corallum collibus triangulatis, apice subacutis et fere nudis; septis crassis et solidis; lamellis tenuibus, subintegris; fossis 2-3" profundis.*

Gibbous and coarsely mammillary, effuse; linear disks tortuous; gyri  $\frac{1}{4}$  of an inch broad. Corallum with the ridges triangular, subacute and nearly naked at apex; septa stout and solid; lamellæ thin, subentire; fossæ 2 to 3 lines deep.

Plate 14, fig. 10, section of trench and ridges; 10 *a*, outline sketch of surface of corallum.

This is a remarkable species, growing in broad spreading masses, with a very uneven mammillary surface, the rounded knobs being often two inches across. A specimen in the Boston City Museum, is a foot in breadth.

15. MEANDRINA CYLINDRUS. (*Ehrenberg.*)

*M. cylindrica, erecta. Corallum collibus convexis, obtusis, lineâ sæpe angustioribus, 2-3" distantibus, lamellis crassis, inæqualibus, distentis, alternis majoribus.*

Cylindrical, erect. Corallum with the ridges convex, obtuse, often narrower than a line, 2 to 3 lines distant, lamellæ stout, unequal, somewhat inflated, the alternate larger.

Ehrenberg established his subgenus *Dendrogyra*, for this species, from the Antillas, and another (the *caudex*) in the Berlin Museum. The cylinders are stated to be half a foot high and two inches in thickness.

*Meandrina Dendrogyra cylindrus*, Ehrenb., G. lxii. subgen. ii., sp. 1.

## 16. MEANDRINA CADEX. (Ehrenberg.)

*M. erecta, crassa, cylindrica.* Corallum collibus dilatatis, planis, lamellis crassis, paucis, paululum prominulis, alternis majoribus, fossis lineam latis.

Erect, stout, cylindrical. Corallum with the ridges dilatate, flat, lamellæ stout, few, a little prominent, the alternate larger, fossæ a line broad.

This species by Ehrenberg is his *Dendrogyra caudex*. The cylinders are four inches thick, and the sulci a little narrower than in the *cylindrus*.

*Meandrina Dendrogyra caudex*, Ehrenb., lxii. subgenus ii., sp. 2.

APPENDIX.—The two following species are imperfectly described by Ehrenberg.

*M. Platygyra lamellina.* “Quadripollicaris, subglobosa, lamellis denticulatis, dilatatis, cristis obtusis, 2–4” distantibus, 3” altis.” “Lamellis latis, cristis obtusis insigne.” Red Sea.

*M. Platygyra spatiosa.* “Novempollicare, incrustans, anfractibus angustis, parum angulosis, distantia 2½ linearum, lamellis crassis, spatiosis, latis, mediis fere contiguis, sulco angustissimo.” A worn specimen in the Berlin Museum.

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 GENUS IX.—MONTICULARIA.—LAMARCK.

*Astræidæ aggregatæ, discis seriatim reticulatimque gemmantibus et non dichasticis, interstitiis conicis; tentaculis basi conulorum dispositis. Coralla cellulosa, cellis nullis, superficie conulis lamello-radiatis tectâ.*

Aggregate *Astræidæ*; disks seriatly and reticulately budding, and not dichastic, with no interstices between the polyps, but small cones, around which the tentacles are arranged. Coralla cellular; cells none, surface covered with small lamello-radiate cones.

The Monticulariæ are Meandrinæ in which the polyps are confluent across the ridges, in consequence of which, the ridges are reduced to mere conical prominences, consisting of lamellæ radiating more or less regularly from the centre. The polyp mouths are situated in the intervals between the prominences, as is shown in plate 13, figure 13 *b*, and around these prominences the tentacles are clustered. The species form convex masses, either subglobose, incrusting, or gibbous, the last rising into knobs or rudimentary branches; and the texture within is cellular throughout. There are some explanate and branching corals which have the surface-cones of the Monticulariæ, but the internal solid texture of the *Merulinæ*, into which they graduate, and with which they are here arranged.

These corals are confined, as far as known, to the coral-reef seas, and within twenty fathoms of the surface.

This genus was instituted by Lamarck, and named in allusion to the little cones or monticles of the surface. The genus Hydnochora, of Fischer (Oryct. de Moscou), includes the same species, and some fossils of doubtful character (partly *Agaricioid*), which he unites with them.

*Arrangement of the Species.*

I. *Convex or subglobose.*

\*1. *M. microcona.*

II. *Gibbous.*

\*2. *M. lobata.*

\*3. *M. polygonata.*

1. MONTICULARIA MICROCONA. (*Lamarck.*)

*M. convexa, subhemispherica; discis cinnerascentibus; tentaculis numerosis, pallidè brunneis. Corallum cellulosum; conulis parvis, fere æqualibus, sæpius obsoletè compressis; lamellis subtiliter serrulatis.*

Convex, subhemispherical; disks ash-coloured, tentacles numerous, pale brown. Corallum cellular; conelets small, nearly equal, usually obsoletely compressed; lamellæ finely serrulate.

Plate 13, fig. 13 *a*, enlarged view of the surface of the corallum; 13 *b*, enlarged view of the live zoophyte; 13 *c*, transverse section of corallum, enlarged; 13 *d*, vertical section, enlarged; 13 *e*, polyps in-

jured, and part of the spermatic cords and lamellæ extruded; 13 *f*, the same extruded from the mouth.

East Indies and Pacific Ocean.—Feejee Islands. *Exp. Exp.*

Specimens of this species from the Feejees have the cones of the surface often quite regular and nearly cylindrical in outline, about a line and a half high, and a line in diameter, with the intervening spaces reticulate cellular, as represented in the figure referred to. It forms small subhemispherical masses incrusting below. In one specimen the cones are almost uniformly compressed and more conical, as described by Ellis and Lamarck. The texture of the corallum is very cellular.

*Mad. exesa*, Ellis and Solander, 161, tab. —, Deslongchamps, Encyc. 556.

49, fig. 3.

—, Blainville, Man. 363.

—, Pallas, Zooph. 290.

—, Ehrenberg, G. lxviii. sp. 1.

*Monticularia microconos*, Lamk. ii. 393, *Monticularia exesa*, Schweig., Handb. 420.

No. 4.

*Hydnophora Pallasii*, Fischer, Oryct. de

—, Lamour., Exp. Meth., 56, tab. 49, Mosc.

fig. 3.

NOTE.—The *Madrepora exesa*, of Esper (Pflanz. i. 163, tab. 31, figs. 1, 2), may be part of an *Agaricia*, as appears from the character of the surface, shown in his figure 2. This is, however, doubtful. It is the *Monticularia meandrina* of Lamarck (ii. 394, No. 5). Esper's figure 3 of this plate is the *Hydnophora Esperii* of Fischer, (Oryct. de Mosc. pl. 34, fig. 4.) Lamarck refers it to the *microcona*, from which it differs very essentially.

## 2. MONTICULARIA LOBATA. (*Lamarck.*)

*M. incrustans et crassè gibbosa aut gibboso-lobata, lobis erectis, ¾-2'' crassis, apice fere planis. Corallum percellulosum; conulis confertis, inæqualibus, compressis, præcipuè ad apicem et fere 2''' altis; lamellis subserrulatis.*

Incrusting and prominently gibbous or gibboso-lobate, with the lobes erect, ¾ to 2 inches thick, and nearly flat at top. Corallum light cellular; conelets crowded, unequal, compressed, especially so over the apex, where they are nearly 2 lines high; lamellæ subserrulate.

East Indies.

The large subangular knobs or lobes covered with compressed cones loosely lamello-radiate, afford a ready character for distinguishing this species. At the summits the cones are often a fourth of an inch in breadth, sometimes a little flexuous and quite thin. The general texture of the corallum is very cellular and light.

*Monticularia lobata*, Lamk., ii. 392, No. 2. —, Deslongchamps, Encyc. 556.  
—, Lamour., Exp. Meth. 56. —, Blainville, Man. 363.

### 3. MONTICULARIA POLYGONATA. (*Lamarck.*)

*M. glomerato-lobata, subramosa. Corallum conulis confertis, compressis, inæqualibus; lamellis serrulatis.*

Glomerato-lobate, subramose. Corallum with the conelets crowded, compressed, unequal; lamellæ serrulate.

Lamarck states that this species is strikingly different in shape from the preceding. Blainville mentions Japan as the locality.

*Monticularia polygonata*, Lamarck, ii. 393, —, Deslongchamps, Encyc. 556.  
No. 3. *Monticularia polygonalis*, Blainville, 363.

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### GENUS X.—PHYLLASTRÆA.—DANA.

*Astræidæ explanatæ, foliaceæ; polypis sursum spectantibus, prominentibus. Coralla striata, vix echinulata, caliculis grandibus lateraliter affixis.*

Explanate Astræidæ, foliaceous; polyps prominent and opening upward. Coralla striated, scarcely echinulate; calicles large and laterally attached to the folia.

The Phyllastrææ are peculiar, among the foliated Astræidæ, in having the polyps attached by one side, to the folia. In other respects they are near the Echinopores, especially the *E. aspera*. The calicles are quite prominent, and the surface of the corallum is striate, and

nearly smooth. The name alludes to the foliated character of the species, and the resemblance of the cells to those of the *Astrææ*, and is from the Greek φυλλον, *leaf*.

The only species observed was met with at the Feejees.

PHYLLASTRÆA TUBIFEX. (*Dana*.)

*P. foliacea, erecta, unifrons, sæpe lateraliter revoluta et marginibus coalita, itaque sæpe ampliter tubulata; fusca, discis lætè virentibus, tentaculis numerosis. Corallum apice fragile, extus verticaliter striatum, striis crassis, inæqualibus et scabriculis; caliculis valde prominentibus,  $\frac{1}{3}$ " latis, sursum spectantibus; lamellis paucis, crassis, sæpe distortis.*

Foliaceous, erect, unifacial, often laterally revolute and united by the vertical margins, thus forming large tubes; fuscous, disks bright-green, tentacles numerous. Corallum thin, margin fragile; surface vertically striate, striæ coarse, unequal, and scabrous; calicles very prominent,  $\frac{1}{3}$  of an inch broad, opening upward; lamellæ few and stout, often distorted.

Plate 16, fig. 4, the zoophyte, natural size, with the polyps unexpanded; 4 *a*, enlarged view of polyp, partly expanded; 4 *b*, cells and surface of corallum, natural size.

Feejee Islands. *Exp. Exp.*

The thin erect folia are sometimes curved and crested, but often form clustered tubes or hollow cylinders, flattened or irregular in shape. The upper margin of the coral is very fragile and eroso-dentate; and below it is in no part over a line and a half thick. The back surface is finely striate. The clusters grow to a height of six inches, and are five or six in breadth. The specimens when alive, had a fine chestnut-brown colour, to within half an inch of the margin; and this part was pale yellow. The calicles have some resemblance to the larger calicles on the incipient branches of the *Echinopora aspera*.

## GENUS XI.—MERULINA.—EHRENBERG.

*Astræidæ tenuiter explanatæ aut cumulato-ramosæ; polypis parvulis, discis sæpius seriatim gemmantibus (sicut Meandrinis), itaque discis collibusque lineatis, venosè furcatis, aut reticulatis. Coralla fere solida; lamellis parvulis obliquis.*

Thin explanate or cumulato-ramose; polyps very small, disks usually budding seriatly (as in the *Meandrinæ*), the disks and ridges therefore linear, venosely furcate, or reticulate. Coralla nearly solid; lamellæ quite small, oblique.

The *Merulinæ* are the most graceful of foliaceous corals. The folia are neatly curved and lobed, and through the ridges of the surface, they often appear to have even the neuration of a leaf. Though sometimes isolated, they usually grow in large clumps, consisting of leaves spread out one above the other, and the whole clustered into convex or hemispherical forms of perfect symmetry. The folia, though delicate and nearly as thin as paper at the margin, are still firm, owing to the solid compactness of their texture. The polyp mouths are usually confined to the upper surface. The mode of budding is that of the *Meandrinæ*: the margin extends through the prolate growth of the animals and opening of disk-buds, and as these new buds are formed in lines, which often give off other divergent lines of buds, the ridges are linear, and often furcating. But this *Meandrina* character passes imperceptibly into that of the *Monticularia*, in which lines of buds are reticulately coalescent, so that only small radiated cones cover the surface, instead of ridges. Again there is a passage on the other side into an *Astræoid* form, in which each cell instead of being long linear is very short. The explanate or ramosæ form, and the oblique position of the cells and of the lamellæ of the ridges, are the generic characteristics. The *Astræa abdita* and the allied species, approach the nearest among the *Astræas* to this genus. The foliaceous forms pass gradually into the ramosæ (§§ 77 and 79 *b*).

One or two branching species of the genus so resemble the *Monticulariæ* in the cones of the surface, that they should fall into that genus were it not for their mode of growth and very compact texture.

The *ampliata*, the species for which Ehrenberg instituted the genus *Merulina*, is one of the *Agariciæ* of Lamarck.





The species of this genus appear to be confined to the warm coral-reef seas.

*Arrangement of the Species.*

I. *Explanate.*

\*1. *M. ampliata.*

\*2. *M. regalis.*

\*3. *M. speciosa.*

\*4. *M. crispa.*

5. *M. folium.*

II. *Ramose.*

\*6. *M. scabricula.*

\*7. *M. laxa.*

\*8. *M. rigida.*

I. *Merulina explanata.*

1. MERULINA AMPLIATA. (*Lamarck.*) *Ehrenberg.*

*M. latè explanata, variè undata, margine lobata, unifrons. Corallum collibus rotundatis, vix 1'' altis, sæpe reticulato-coalitis et cellas obliquas includentibus; lamellis fere æqualibus, serrulatis.*

Broad explanate, variously undulate and with the margin lobed, unifacial. Corallum with the ridges rounded, scarcely a line high, often reticulately coalescent and enclosing oblique cells; lamellæ even, serrulate.

Plate 15, fig. 2, cells and ridges, enlarged; 2 a, lamellæ of surface, enlarged.

East Indies. *Exp. Exp.*

The fronds of this species are large and appear to be seldom clustered. The specimens are often eight or ten inches in breadth, and somewhat concave, with occasional nodular appendages or incipient branches rising from the surface and often coalescing. The thickness is hardly a line, yet the folia are strong and ring when struck. The ridges are round and more even or less ragged in appearance than in the following species; the septa also are rotund. The lamellæ are nearly even, and are distinct along the bottom of the cells or furrows.

*Mad. ampliata*, Ellis and Solander, 157, —, Esper, Fortsetz. i. 96, tab. 77. figs. tab. 41, figs. 1, 2; the under surface is better figured than the upper. 1, 2, 3; the enlarged view, figure 3, is good; the others are badly drawn.

- Agaricia ampliata*, Lamk. ii. 381, No. 4. —, Blainville, Man. 361: also *Pavonia*  
 —, Lamour., Encyc., 13; *A. flabellina*, *ampliata*, 365.  
 Exp. Meth. 54, tab. 41, figs. 1, 2. *Mycedium ampliatum*, Oken, Zool., i. 70.  
 —, Schweigger Handb. 415. *Merulina ampliata*, Ehrenb. G. lxiv. sp. 1.

2. MERULINA REGALIS. (Dana.)

*M. latè explanata, unifrons, variè lobata et plicata, et in hemispheram ampliter instructa, foliis 3-6" latis; umbrina, discis virescentibus, tentaculis, margine seriatis, minutis. Corallum collibus angustis, fere 1" altis; lamellis laxis.*

Broad explanate, unifacial, variously lobed and plicate, and forming a broad open hemispherical clump; folia 3 to 6 inches broad; umber-coloured, disks greenish, tentacles minute, forming a series along the margin of the disk. Corallum with the ridges narrow, nearly 1 line high; lamellæ lax.

Plate 15, fig. 1, outline sketch of part of the corallum, natural size; 1 *a*, part of the live zoophyte; 1 *b*, enlarged view, showing the tentacles; 1 *c*, view of the cells and the ridges enlarged; 1 *d*, 1 *e*, lamellæ enlarged.

Feejee Islands. *Exp. Exp.*

This species forms hemispherical clumps, sometimes four feet in diameter, consisting of large subimbricate folia, which are often coalescent. The ridges of the surface are more ragged than in the *ampliata*, and less neatly rounded and even, or a little compressed laterally. The under surface resembles that of the *ampliata*, but is less coarsely granulous.

3. MERULINA SPECIOSA. (Dana.)

*M. tenuissimè explanata, unifrons; foliis aggregatis, 1-3" latis, valde crispis, confertim implicatis, sæpe crenato-lobatis. Corallum collibus ½" altis, interdum obsoletis, lamellis subtilibus, confertis.*

Very thin explanate, unifacial; folia aggregated, and crowdedly im-

plicate, 1-3 inches broad, very much crispate, often crenato-lobate. Corallum with the ridges  $\frac{1}{2}$  a line high, sometimes obsolete, lamellæ minute and crowded.

Plate 16, fig. 1, part of corallum, natural size.

Feejee Islands. *Exp. Exp.*

This is a very delicate species, growing in clusters a foot or more across, with the leaves more rolled and crispate, and the ridges much smaller and less separate than in the preceding species. The adjacent folia are but little coalescent.

#### 4. MERULINA CRISPA. (*Dana.*)

*M. tenuissimè explanata, foliis crispis et undique coalitis, parvulis, sublaciniatis, interioribus bifrontibus. Corallum collibus lamellisque laxis, inæqualibus, valde asperis.*

Very thin explanate; folia crispate and every where coalescing, small, sublaciniate, the inner bifacial. Corallum with the ridges and lamellæ lax, uneven, and very rough.

Sooloo Sea, East Indies. *Exp. Exp.*

This small species is distinct in its frequent coalescence, and the bifacial character of the interior folia, arising from the union of two by their back surfaces, or from a single folia folding back upon itself, and the two approximated surfaces growing together. The lamellæ of the ridges are lax and uneven. Only a beach specimen was obtained by the author.

#### 5. MERULINA FOLIUM. (*Lamarck.*) *Dana.*

*M. tenui-explanata, paulo concava, latè orbiculato-lobata. Corallum subtus leviter radiato-striatum; supernè conulis inæqualibus, ad marginem extenuatis, et obsolescentibus.*

Thin explanate, somewhat concave, with broad rounded lobes. Corallum below, faint radiato-striate; above, the surface covered with unequal cones, diminishing and obsolescent at the margin.

East Indies. *Lamarck*.

This species is supposed to grow from a central attachment. It has the surface of a *Monticularia*, and is united with that genus by Lamarck. It is placed here on the ground of its compact texture and mode of growth.

*Monticularia folium*, Lamarck, ii. 392, *Monticularia folium*, Deslongchamps, Encyc. 556.

—, Blainville, Man. 363, pl. 57, fig. 1.

## II. *Merulina ramosa*.

### 6. MERULINA SCABRICULA. (*Dana*.)

*M. ramosa*, ramis subdivaricatis,  $\frac{1}{3}$ " crassis, sæpe coalitis; flavo-umbrina, virescens, tentaculis minutis. Corallum ramis subangulatis et obsolete compressis, apice truncatis; lamellis confertis et apice non laxioribus, transversis, subæqualibus, scabrosè serrulatis; collibus brevibus, obliquis, obtusis.

Ramose, branches subdivaricate, often coalescing,  $\frac{1}{3}$  of an inch thick; colour yellowish-umber, greenish; tentacles minute. Corallum with the branches subangular, and obsoletely compressed, truncate at apex, lamellæ crowded, and not becoming more lax at apex, transverse, even, scabrosely serrulate; ridges short, oblique, obtuse.

Plate 16, fig. 2, view of corallum; 2 *a*, view of the animals, enlarged; 2 *b*, transverse section of branch, enlarged.

Feejee Islands. *Exp. Exp.*

The clumps are even-topped, much branched, six to eight inches high, and a foot across, and the branches often coalescing, even at the tips. They are usually alive for three and a half inches. The neatly crowded transverse lamellæ of the small ridges, and the obtuse truncate extremities of the branches, as broad as below, and with the lamellæ as close and even, at once distinguish the species.

## 7. MERULINA LAXA. (Dana.)

*M. ramosa*, ramis divaricatis sæpe coalitis,  $1\frac{1}{2}$ –3''' crassis, sæpe alatis et compressis, interdum  $\frac{1}{2}$ " latis et subpalmatis. Corallum collibus parvulis, acutis, interdum elongato-conicis; lamellis laxis, valde obliquis et assurgentibus, apice valde laxioribus.

Ramose, branches divaricate, often coalescent, with the branches angular, often alate and compressed,  $1\frac{1}{2}$  to 3 lines thick, sometimes  $\frac{1}{2}$  an inch broad and subpalmate; ridges small, acute, sometimes elongato-conical; lamellæ lax, very oblique and ascending, much more lax at apex.

Plate 16, fig. 3, corallum, natural size.

Sooloo Sea, East Indies. *Exp. Exp.*

The specimens of this species seen by the author are apparently but fragments of the complete clump. They are arboriform in shape and about six inches in height. The loose oblique lamellæ and sharp angular branches distinguish it from the preceding. In one small specimen, possibly a distinct species, the branchlets were only a line to a line and a half in diameter.

*Corallum tenerum ramosum, plumatile, poris intus stellatis, &c.*, Seba, Thesaurus iii. tab. 116, fig. 5. This appears to be the above species. It resembles most nearly the slender variety mentioned.

## 8. MERULINA RIGIDA. (Dana.)

*M. valde ramosa*, ramis proliferis, interdum coalitis, 3–6''' crassis, conulos contiguos undique gerentibus; ramulis attenuatis sæpe curvatis; animalibus Monticulariis affinibus. Corallum conulis lamello-radiatis inæqualibus, vix compressis, apice ramulorum laxis, attenuatis, obsolescentibus; lamellis granulosis.

Very much ramose, branches proliferous and sometimes coalescent, 3 to 6 lines thick, covered with small contiguous cones; branchlets attenuate, often curved; animals like those of the *Monticulariæ*. Corallum with small lamello-radiate cones, which are unequal

and scarcely compressed, at apex of branchlets, lax and attenuated; lamellæ granulous.

Plate 17, fig. 1, corallum, natural size; 1 *a*, one of the conelets, enlarged; 1 *b*, animals, enlarged; 1 *c*, part of a transverse section of stem, enlarged.

Feejee Islands. *Exp. Exp.*

This species forms crowdedly branched clumps a foot high. The branches are irregularly angular, owing to the conical prominences that cover them. The cones are close in contact at base, and are nearly an eighth of an inch high, and the same in breadth. The branchlets are two or three inches long, and subacute, and the cones above become lengthened and oblique, and have a looser texture, resembling the preceding species. The branches are a third to half an inch in diameter. The corallum is very compact, and in this respect the species differs from the *Monticulariæ*, which it resembles in its surface and polyps.

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GENUS XII.—ECHINOPORA.—LAMARCK.

*Astræidæ explanatæ aut cumulato-ramosæ, polypis prominulis, perpendiculariter insitis, gemmatione marginibus (non discis) prolatantibus (Orbicellis affines). Coralla striata, et echinulata, fere solida; caliculis convexis, echinulatis.*

Explanate or cumulato-ramose; polyps a little prominent, placed perpendicularly with the surface of the zoophyte; the margin and not the disks widening by growth, in budding (as in the *Orbicellæ*). Coralla striate and echinulate, nearly solid; calicles convex, echinulate.

The *Echinoporæ* grow in much stouter folia than the *Merulinæ*, and have scattered cells over the surface instead of furrows, on account of their budding in the widening upper margin, instead of the disks, of the polyps. The coralla are distinguished by their finely echinulato-striate surface, and slightly prominent rounded calicles. The foliated species and ramose have the same relation as explained in the remarks

on the Merulinæ. The latter resemble somewhat the Oculinæ, but the summit of a branch is prolonged by the prolate mode of marginal growth, and the polyp appears some distance short of the apex; whereas in the Oculinæ the bud forms the extremity of the branch, and is immediately connected with one preceding.

The polyps in the species examined when alive, appeared to have no tentacles, except the prominences over the spines of the calicles. The calicles have a broad shallow cell and contain six to twenty lamellæ, more or less raggedly dentate or denticulate, which extend to the centre and are separated by deep cellules. The exterior animal tissue often dries over the cell, and reduces its aperture to one-third its actual diameter.

The Echinoporæ are but a step removed from the Merulinæ, bearing the same relation to them as the Orbicellæ to the other Astrææ. Occasionally we observe a cell subdividing from the opening of a disk-bud.

The Echinoporæ are confined to the coral-reef seas.

This genus was instituted by Lamarck for a single species brought by Peron and Lesueur from New Holland, and was named in allusion to the echinate surface of the corallum. Blainville unites it with some of Lamarck's Explanariæ, and names the genus *Echinastrea*. Ehrenberg suggests their arrangement along with the Madreporidæ, from which they are quite distinct, and appears to have placed one species in his genus *Explanaria*.

#### *Arrangement of the Species.*

I. *Foliaceous, bifacial.*

\*1. *E. undulata.*

II. *Foliaceous unifacial.*

2. *E. rosularia.*

3. *E. ringens.*

\*4. *E. reflexa.*

\*5. *E. aspera.*

III. *Ramose.*

\*6. *E. horrida.*

#### 1. ECHINOPORA UNDULATA. (*Dana.*)

*E. foliacea*; *erecta, bifrons, undulata.* *Corallum tenue, utraq̃ue superficie leviter striatum et spinuloso-asperum; cellis sparsis vix tumidis, 6-8-radiatis.*

Foliaceous, erect, bifacial, undulate. Corallum very thin, on each surface fine striate and spinuloso-asperate, with scattered cells scarcely tumid, 6 to 8 rayed.

Plate 17, fig. 3, corallum, natural size; 3 a, cell of the same.

Sooloo Sea, East Indies. *Exp. Exp.*

The specimen of this species in the collections is a single undulate folium, four inches high and five broad, in no part more than an eighth of an inch thick. It is very firm and solid in texture and rings when struck. The cells are on both surfaces and have a diameter of nearly one and a half lines. The spinules of the surface are solid. It was attached by one side.

## 2. ECHINOPORA ROSULARIA. (*Lamarck.*)

*E. explanato-foliacea, suborbiculata, unifrons.* Corallum suprà striato-asperum, caliculis echinatis; infrà, striatum.

Explanato-foliaceous, suborbiculate, unifacial. Corallum above striato-asperate, calicles echinate, below striate.

New Holland Seas. *Peron* and *Lesueur.*

Lamarck states that the species forms undulate expansions a foot or more broad, and appears to have been attached below by the middle.

*Echinopora rosularia*, Lamk., ii. 397, —, Lamouroux, Encyc., 297.

No. 1.

*Echinastræa rosularia*, Blainville, Man.,

—, Schweigger, Beobacht. tab. 7, fig. 379, pl. 56, fig. 2.

64; also, Handb., p. 415.

## 3. ECHINOPORA RINGENS. (*Lamarck.*) *Blainville.*

*E. subturbinatum, lobatum.* Corallum cellis irregularibus, subconfluentibus, sinuosis, contiguis; margine crasso, convexo.

Subturbinate, lobed. Corallum with irregular cells, subconfluent, sinuous, contiguous; margin thick, convex.



West Indies? *Lamarck*.

This species is remarkable, according to Lamarck, for the irregularity of its cellules, and for the numerous serrate and denticulate lamellæ which cover their sides; and also for the thick and convex border of the cells. The species is one of the *Explanariæ* of Lamarck, and was transferred by Blainville to his genus *Echinastræa*. It may be doubted whether it belongs here.

*Explanaria ringens*, Lamk., ii. 400, No. 5. *Echinastræa ringens*, Blainville, Man., —, Lamouroux, Encyc., 386. 378.

#### 4. ECHINOPORA REFLEXA. (*Dana*.)

*E. foliacea, unifrons; foliis suberectis, lateribus reflexis et sæpe marginibus coalitis (itaque sæpe tubulatis); umbrina, ore parvulo, tentaculis nullis (?). Corallum supra spinuloso-striatum, caliculis spinulosis, tumidis, 1½'' paulo superantibus, lamellis majoribus 10–15, denticulatis; extus, prope marginem obsolete striatum.*

Foliaceous, unifacial; folia suberect, sides reflexed and often coalescing by the margin (thus forming tubes); colour, umber; mouth quite small; tentacles none, except the minute tubercles over the spines. Corallum above finely spinuloso-striate; calicles spinulous, tumid, rather more than  $\frac{1}{3}$  of an inch broad; large lamellæ 10 to 15, denticulate; outer surface, near the margin only, obsoletely fine striate.

Plate 17, fig. 2, corallum, natural size; 2 *a*, animal enlarged; 2 *b*, transverse section of a folium, enlarged.

Feejee Islands. *Exp. Exp.*

This coral forms large clusters of somewhat spreading folia growing from a common base, to a height of ten inches or more. The folia are often contorted and reflexed. The upper edge is thin and acute, and for half an inch translucent; but below, the folia are one-third to half an inch thick. The spinules of the surface are seen to be tubular when broken across; they are less than a third of a line long. The exterior surface is dead and mostly incrustated by other corals to within half an inch of the margin, and on this part the fine striæ are scarcely perceptible without a glass.

*Madrepora lamellosa* (?) Esper, Pflanz. Fortsetz. i. tab. 58, "Mad. polymorpha, laminis latissimis, plicatis, sinuato-repandis, striis exasperatis, stellis sparsis, prominulis, denticulatis." Esper states that only the upper surface is spinulous.

Tab. 52 of Ellis and Solander resembles some specimens of this species in general form, but differs in its cells.

The *E. rosularia* of Lamarck approaches this species, but grows in spreading explanate fronds from a central attachment, instead of erect.

### 5. ECHINOPORA ASPERA. (*Ellis.*) *Dana.*

*E. explanata*, partim incrustans, margine tenuis et undulata; suprâ, sæpe gibbosa et cumulato-subramosa; polypis grandibus,  $\frac{1}{4}$ – $\frac{1}{2}$ " latis. Corallum suprâ crassè lamello-striatum et valde spinoso-dentatum, caliculis 3–6" latis, prominulis, sive hemisphericis sive obsoletis.

Explanate, partly incrusting, margin thin and undulate; sometimes gibbous above and cumulato-subramose; polyps large,  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch broad. Corallum above coarsely lamello-striate and strongly spinoso-dentate; calicles 3 to 6 lines broad, somewhat prominent, occasionally hemispherical, often wholly immersed.

East Indies.

The *aspera* is a broad explanate species with an undulate and usually convex upper surface, from which rise occasional irregular protuberances and stout incipient branches, consisting of several aggregated polyps. It grows to a large size and has a rough or echinate appearance from the prominent spinoso-dentate lamellæ that cover the surface. A specimen from Ceylon, examined by the author, had a thickness of three-quarters of an inch about the centre, but a thin and rather fragile reflexed margin. Over the surface the calicles are but little convex, and in the more concave parts they are quite obsolete; but on the protuberances and incipient branches, they are subglobose, and vary from one-fifth to half an inch in breadth. The lamellæ of the stars are very prominent, and have the exterior margin much thickened and jaggedly dentate. The centre of the cell is surrounded by a series of deep cellules, as in the other *Echinoporæ*.

*Mad. aspera*, Ellis and Solander, 156, tab. 39; the figure represents a specimen ten inches in breadth, with the calicles half to three-quarters of an inch distant.

*Agaricia aspera*, Schweig. Handb. 415. —, Lamouroux, Exp. Meth. 57, pl. 39;  
*Explanaria aspera*, Lamarck, ii. 399, Encyc. 385.  
 No. 4. *Tridacophyllia aspera*, Blain., Man. 362.

The *Explanaria gemmacea* of Lamarck appears to be a gibbous variety of the *aspera*. While part of the Ceylon specimen agrees well with Ellis's figure, another part, as described above, has the characters of the *gemmaea*, the calicles being more or less oblique, acervate, prominent, and tumid, often only a fourth of an inch in diameter, or even smaller. (Lamarck, ii. 399, No. 3.)

The *Explanaria Hemprichii* of Ehrenberg, from the Red Sea (op. cit. G. l. sp. 1), has many of the characters of this species, yet is probably distinct; he thus describes it: "Octopollicaris, membranacea, explanata, semi-orbicularis, libera, centro affixa nec stipitata, margine sublobata, stellis 3''' latis, tumidis, margine involuto, aperturâ lineam, rarius sesquilineam latâ, cum interstitiis rudius denticulato-asperis et lamelloso-sulcatis, sulcis lamellisque 12-24." "Animal tentaculis destitutum, disco lætè viridi, glabro pallio fusco."

The *Stephanocora Hemprichii* of Ehrenberg, a Red Sea species (op. cit. G. xlv. sp. 1), may be an Echinopora, judging from the brief description given; some specimens of the *aspera* answer nearly to his description, which is as follows: "Octopollicaris et pedalis, nunc explanata, effusa, nunc ramoso-fraticulosa, spinuloso-aspera, stellis tumidis, 3 lineas apertis, margine parum prominulis, parum profundis; formæ ramosæ ramulis divaricatis, stellato-nodosis. Animal tentaculis destitutum, fuscescens, disco æruginoso, glabro:" "lamellis cum spinularum discretarum corona media disci."

#### 6. ECHINOPORA HORRIDA. (Dana.)

*E. ramosa*, ramis crebris, tortuosis, interdum coalitis: umbrina, tentaculis nullis sed tuberculis minimis elongatis sparsis. Corallum ramis  $\frac{2}{3}$ - $\frac{1}{3}$ " crassis, ramulis ruditer attenuatis et apice sæpe laciniato-alatis; caliculis tumidis, 2''' latis, echinatis, cellis 15-18-radiatis; interstitiis vix striatis, sed spinulis sæpius sparsis.

Ramose, branches crowded, tortuous, sometimes coalescing; umber-coloured, without tentacles, but with small scattered elongate tubercles. Corallum with the branches  $\frac{2}{3}$ - $\frac{1}{3}$  of an inch thick, branchlets rudely attenuate and apex often lacinate and alate; calicles tumid, 2 lines broad, echinate; cells 15 to 18 rayed; interstices between cells scarcely striate, but mostly with scattered spines.

Plate 17, fig. 4, corallum, natural size; 4 *a*, animal enlarged; 4 *b*, transverse section, enlarged; 4 *c*, enlarged cell.

Feejee Islands. *Exp. Exp.*

The clumps are much branched and crowded, sometimes sixteen inches high. The branches are very uneven and rough, with unequal swelling echinate calicles. The texture of the corallum is very solid, with scarcely a cellule. The cell in a transverse section is seen to be more than a sixth of an inch deep, with a breadth little less than an eighth.

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FAMILY III.—FUNGIDÆ.

*Astræacea animalibus depressis, aut simplicissimis aut aggregato-gem-matis; discis non circumscriptis, et undique, zoophytis aggregatis, omninoque confluentibus, interstitiis nullis; tentaculis brevibus, sparsis, interdum obsoletis, contractis non tectis. Coralla cellis veris nullis; superficie lamello-striatâ, et sæpius stellatâ, stellis non circum-scriptis; corallorum aggregatorum lamellis ex uno centro ad alterum productis.*

Astræacea having depressed animals, either quite simple, or aggregato-gemmate; disks without circumscribed limits, and in aggregate species, all every way confluent, without interstices; tentacles short, scattered, sometimes obsolete, and when contracted, not covered. Coralla without true cells; surface lamello-striate, and usually stellately so, stars not circumscribed; in aggregate coralla, the lamellæ extending uninterruptedly from centre to centre.

The nature of the Fungidæ, and their relations to the other Astræacea, are explained in §§ 43, 46, 78. Their forms are among the most remarkable which corals present. The free or unattached species, when simple, are circular or elliptical disks, or conical caps, made up of radiating lamellæ; other compound species assume the shape of long narrow troughs inverted, rude caps, dishes, or cups; while the attached Fungidæ grow sometimes in simple leaves, to the side of other coral rocks, like a lichen against a dead stump, or in hemispherical clusters of leaves, or as vases, or massive columns. Calicularly branched species never occur in this family, on account of the absence

of proper limits to the disks of the animals. The surface is usually covered with stars, and a central pore or puncture (oririme\*), marking the position of the mouth, is all that exists of a cell. In some species there is an excavation, like the cell of an *Astræa*; but still they have the central pore, in connexion with the characteristic of the *Fungidæ*, the continuity of the lamellæ from centre to centre, instead of their interruption along the middle of the septum. The peculiar nature of these cells is explained in the remarks upon the genera *Agaricia* and *Psammocora*.

The animals of these corals were first figured by Forskal, who examined a *Fungia*, at the Red Sea, and has given an excellent representation of it. The tinted tentacles scattered over the surface, give a rich effect to the large umber disks, sometimes a foot or even eighteen inches in diameter. In some species the tentacles are nearly obsolete, and very generally, they appear only as inflations of the exterior membrane, over a lamella at its origin. They are seldom if ever sufficiently long to aid the animal in taking its food, and appear to be used simply for the expulsion of the included water, on contraction, and the aeration of the nutrient fluids, a function in which every part of the body, more or less, shares. On contraction they disappear by simple shrinkage, without being covered, as in the *Astræidæ*.

The generic divisions of this group, depend on the mode of growth and budding, and may be distinguished as follows :

*Arrangement of the genera of Fungidæ.*

I. *Free—not budding; a central oririme above.*

1. **FUNGIA.** Corallum lamello-radiate above, tuberculato-radiate below.
2. **CYCLOLITES.** Corallum lamello-radiate above, concentric lines of growth below.

II. *Free—explanato-gemmate.*

3. **HERPETOLITHUS.** A continuous medial line of large polyps, with others smaller, scattered either side; a distinct circle of tentacles to each polyp-mouth. Corallum with a long medial trench (compound oririme); surface consisting of short denticulate lamellæ scarcely at all radiate, half an inch to an inch long, none extending from the centre to the circumference.

4. **HALOMITRA.** Polyps all scattered; a distinct circle of tentacles to each polyp-mouth (?). Corallum without a medial trench; lamellæ nearly as in the preceding, but more radiate and coarsely toothed.

5. **POLYPHYLLIA.** Polyps all scattered, or an imperfect medial series; a single tentacle to each lamella, and not a separate circle to each polyp-mouth. Corallum without

\* From the Latin *os*, *mouth*, and *rima*, *a cleft* or fissure.

a proper medial trench; surface consisting of short denticulate lamellæ less than half an inch long, imperfectly or not at all radiate.

6. *ZOOPILUS*. Polyps all scattered. Corallum without a medial trench, surface consisting of long lamellæ, with thinner lamellæ intermediate; only the latter interrupted by oririmes and short, the polyp-mouths being situated in the intervals between the large lamellæ.

III. *Budding; attached.*

7. *PAVONIA*.—Foliaceous, unifacial or bifacial, sometimes glomerate or subramose; polyps not in distinct series, or imperfectly so. Coralla compact, surface plane or without parallel ridges; no excavate cells, lamellæ distinct, and nearly or quite entire.

8. *AGARICIA*. Foliaceous, unifacial or bifacial; polyps in more or less perfectly transverse series. Coralla with transverse ridges and fossæ, sometimes consisting of coalescent excavate cells, and irregular; lamellæ alternately smaller, nearly or quite entire.

9. *PSAMMOCORA*. Bifacial and foliaceous, or glomerate and columnar. Coralla with or without large excavate cells; lamellæ equal, and very minutely ragged-denticulate and granulous, indistinct.

The following table exhibits the relations of the genera here adopted, to those used by the authors whose names are placed above the several columns.

RECEIVED GENERA.	EHRENBERG.	BLAINVILLE.	SCHWEIGGER.	OKEN.	LAMARCK.
	1832.	1830.	1820.	1815.	
Cyclolites, <i>Lamk.</i>	Cyclolithas.	Cyclolites.	Cyclolites.		Cyclolites, 1801.
Fungia, <i>Lamk.</i>	Fungia.	} Fungia.	} Fungia.	} Fungia.	} Fungia, 1801.
Herpetolithus, <i>Esch.</i>	Haliglossa.				
Halomitra, <i>D.</i>					
Polyphyllia, <i>Q. &amp; G.</i>	Polyphyllia.	Polyphyllia.	} Agaricia.	} Pectinia ( <i>part.</i> ).	} Pavonia, 1801.
Pavonia, <i>Lamk.</i>	Pavonia.	Pavonia.			
Agaricia, <i>Lamk.</i>	Agaricia, <i>and</i>	Agaricia.	} Undaria.	} Mycedium.	} Agaricia, 1801.
	{ Polyastra ( <i>part.</i> ).				
Psammocora, <i>D.</i>		Pavonia ( <i>part.</i> ).			
Zoopilus, <i>D.</i>					Pavonia ( <i>part.</i> ).

1. *Fungidæ liberae, non gemmatae.*

## GENUS I.—FUNGIA.—LAMARCK.

*Fungidæ liberae non gemmatae, itaque simplicissimæ; orbiculares aut ellipticæ, interdum conicæ. Os oblongum. Tentacula sparsa. Corallum superficie supernâ profundè radiatâ, infernâ lamello-striatâ et tuberculatâ, radiatâ.*

Free *Fungidæ*, not budding, hence quite simple; orbicular or elliptic, sometimes conical. Mouth oblong. Tentacles scattered. Coralla with the upper surface and to some extent the under surface lamello-radiate, the latter tuberculate.

The coralla of the *Fungidæ* are the mushroom corals of popular language. Since the first figure by Forskal,\* the animals have been examined by Eschscholtz,† Quoy and Gaymard,‡ and Ehrenberg. The general colour is some shade of umber, occasionally verging towards purple, and the tentacles have usually a bright green or purplish tint, though sometimes nearly white or brownish. Quoy and Gaymard have represented these organs as sometimes an inch in length; but in the species examined by the author, and that figured by Forskal, they are less than half this size. There is sometimes a prominent tooth on each larger lamella beneath the tentacle corresponding. The mouth is large and long, and usually striped vertically with broad lines of different colours. The disk-shape coralla, consisting of radiating plates, resemble much a common *mushroom* inverted; and this fact suggested the name of the genus.

When young, the species are attached, as was first shown by Mr. Stutchbury,§ and sometimes to the under surface of the parent; as they enlarge, they break off, and the scar may often be distinguished in the adult corallum. The animals are said to be capable of progressive motion by means of the papillæ below, which, by expanding from the injected water, raise the coral and serve to push it on, much in the same manner as a star-fish crawls over a rock. When turned over

\* Descrip. Animalium, quæ in itinere orientali observavit, P. Forskal. Hauniæ, 1775, tab. 48.

† Oken's Isis, 1825, p. 746, tab. 5, fig. 19.

‡ Voyage de l'Astrolabe, Zoophytes, vol. iv. tab. 14. § Linn. Trans. vol. xvi. tab. 32.



they are unable to right themselves, unless aided by the motion of the sea-water about them. Stutchbury states that one inverted by him remained so for several weeks without change. They are usually found scattered over the reefs, mostly in holes or pools, their large radiate disks, spotted with the tinted tentacles, contrasting singularly with the sprigs of Madrepora, and the various massive and foliaceous species around. They differ from the *Herpetolithi* in having a single mouth at centre, and a single stomach, instead of many mouths and stomachs scattered throughout the whole zoophyte; in other words, they are large simple animals, not capable of growth by buds: while in all other *Fungidæ* the polyps are small, in no instance exceeding an inch and a half in diameter; and the large zoophytes which they form are the result of budding.

One or two of the elliptical *Fungia* have three or four mouths along the centre, after attaining considerable size, and form a passage to the compound species. The animals are still large, as in the *Fungia*, and the species are therefore retained with this genus, rather than transferred to the genus *Herpetolithus*, which is characterized by numerous small polyps. The extension of the lamellæ, which commence at the orifice, quite to the margin without interruption, affords an easy character for distinguishing the *Fungia*.

The genus *Fungia* was formed by Lamarck from the *Madrepora* of early authors, and included, as characterized by him, all the free *Fungidæ*, whether simple or compound. Eschscholtz instituted for the compound species (*F. limacina* and *F. talpa*), the genus *Herpetolithus*.\* Quoy and Gaymard, having examined a living specimen of an allied species, proposed for the *talpa*, the generic name *Polyphyllia*. Ehrenberg, in his Memoir on the corals of the Red Sea, formed the genus *Hali glossa*, with nearly the limits of Eschscholtz's *Herpetolithus*, after excluding the *Polyphyllia* of Quoy and Gaymard. The old genus *Fungia* includes, therefore, the recent divisions,—*Fungia*, *Polyphyllia*, and *Herpetolithus*; and still another, *Halomitra*, which it has been necessary to make for the *Mitra Polonica* of Rumphius, some noble specimens of which, though its existence has been doubted, belong to the Expedition collections. The genus *Fungia* has recently been made the subject of an elaborate memoir by Dr. F. S. Leuckart,

\* From ἐγπω, to creep, and λίθος, a stone. We have followed Leuckart in correcting the orthography of Eschscholtz, who wrote the name *Herpolitha*.

of Freiburg;\* and to him am I indebted for a knowledge of Eschscholtz's genus, which had been overlooked by Ehrenberg.

The *Ecmesus* of Philippi, placed by him near the Fungiæ, appears to be a flat Turbinolia, and belongs rather to the tribe Caryophyllacea, than to the Astræacea. The *Phyllodes* of this author includes cuneate species, and has the same relations.

*Arrangement of the Species.*

I. *Circular or but little elliptic.*

- |                              |                                  |
|------------------------------|----------------------------------|
| 1. <i>F. cyclolites.</i>     | *8. <i>F. repanda.</i>           |
| *2. <i>F. tenuis.</i>        | *9. <i>F. integra.</i>           |
| *3. <i>F. glans.</i>         | *10. <i>F. confertifolia.</i>    |
| *4. <i>F. discus.</i>        | *11. <i>F. horrida.</i>          |
| *5. <i>F. agariciformis.</i> | 12. <i>F. actiniformis.</i>      |
| *6. <i>F. dentata.</i>       | 13. <i>F. crassitentaculata.</i> |
| *7. <i>F. echinata.</i>      |                                  |

II. *Oblong elliptic.*

- |                             |                             |
|-----------------------------|-----------------------------|
| *14. <i>F. paumotensis.</i> | *18. <i>F. Ehrenbergii.</i> |
| *15. <i>F. dentigera.</i>   | *19. <i>F. asperata.</i>    |
| *16. <i>F. scutaria.</i>    | *20. <i>F. Ruppellii.</i>   |
| 17. <i>F. pectinata.</i>    | *21. <i>F. crassa.</i>      |

I. *Orbiculares, aut paulo ellipticæ.*

1. FUNGIA CYCLOLITES. (*Lamarck.*)

*F. pumila, orbicularis aut subelliptica, ore oblongo; suprâ convexum et infrâ concavum. Corallum subtus tenuissimè radiatum; suprâ lamellis inæqualibus, crenulatis, latere asperis.*

Small, orbicular, or subelliptical, mouth oblong; convex above and concave below. Corallum below very finely radiate; above, with the lamellæ unequal, crenulate, lateral surface rough.

Austral Seas. *Peron and Lesueur. Lamarck.*

Lamarck states that this is a neat species, very convex above and slightly concave below, resembling, in general aspect, the *agariciformis*. It may be a young specimen of some other species.

\* De Zoophytis coralliis et speciatim de Genere Fungia Observationes Zoologica; 60 pp. et iv. tab.; Friburg Brisigavorum, 1841.

*Fungia cyclolites*, Lamk., ii. 371, No. 3. —, Blainv., Dict. des Sci. Nat., xvii. 216,  
 —, Lamouroux, Encyc., 418. and Man. 337.  
 —, Leuckart, op. cit., 46.

## 2. FUNGIA TENUIS. (Dana.)

*F. pumila, orbicularis, planiuscula, undulata*,  $1\frac{1}{2}$ –2''' *crassa*. *Corallum tenue fragileque, margine subacutum; lamellis tenuissimis, subtilissimè denticulatis, inæqualibus; subtus, subtiliter radiato-striatum, scabriculum.*

Small, orbicular, nearly flat, and undulate,  $1\frac{1}{2}$  to 2 lines thick. Corallum thin and fragile, margin subacute, lamellæ very thin, very finely denticulate, unequal: below very minutely radiato-striate, and a little scabrous.

Plate 18, fig. 1, outline of a vertical section, natural size.

Pacific Ocean, and probably the Paumotu Archipelago. *Exp. Exp.*

The specimen is one and a quarter inches in diameter and quite thin, with a fragile margin. It may be a young individual, but differs in its very thin corallum from any known species; for the young of the species of *Fungia* are thicker in proportion than adult specimens. It is apparently near the *cyclolites*, but is not *very convex* above, and the lamellæ are not crenulate.

## 3. FUNGIA GLANS. (Dana.)

*F. pumila, orbicularis, excelsè conoido-rotundata*,  $1\frac{1}{3}$ " *lata et alta, subtus concava; medio crassima*. *Corallum lamellis confertis, subtiliter denticulatis: subtus subtiliter striatum et scabriculum.*

Small, orbicular, high conoido-rotundate,  $1\frac{1}{3}$  inches broad and as much in height, below neatly concave; very stout at middle. Corallum with crowded lamellæ, very finely denticulate: under surface very delicately striate and minutely scabrous.

Plate 18, fig. 2, outline of a vertical section, natural size.

This singular species is as high as broad, and has the concavity



below very regular and about one-third of an inch deep; the corallum is consequently three-fourths of an inch thick at middle.

4. FUNGIA DISCUS. (*Dana.*)

*F. orbicularis, vix undulata, utrinque planiuscula. Corallum lamellis tenuibus, inæqualibus, denticulatis; lamellis minimis intermediis crenulatis, deinde integris et unidentibus (dente tentaculato), nunc prominulioribus et postea crenulatis aut denticulatis; subtus radiatè lamello-striatum, et spinosum, sed medio striis obsoletis spinulisque acutis et subtilissimis.*

Orbicular, a little undulate, on both sides nearly flat. Corallum with thin lamellæ, unequal, denticulate, the intermediate crenulate, then entire, and bearing a single obtuse tooth, and afterwards becoming one of the larger lamellæ, and again crenulate or denticulate; below radiately lamello-striate and spinous, but about the middle, the striæ obsolete, and the spines acute and very minute.

Plate 18, fig. 3, outline of lamella, above and below; 3 *a*, one of the intermediate lamellæ, with the tentacular tooth.

Tahiti, Society Islands. *Exp. Exp.*

This species has the finely denticulate lamellæ of the *dentigera*, though a little coarser; but the form is circular, the lamellæ are not flexuous, and the tentacular tooth is not, as in that species, prominent above the general surface of the disk. The largest specimen is three and three-fourths inches in diameter, and a half to two-thirds of an inch thick. The spines below, near the margin, are about a line long, and are often bent or aggregated; but a central area, for nearly two inches, is merely rough scabrous, without striæ. In the smaller specimen, the spinulous striæ extend nearly to the centre, and are rather crowded. It is near the *agariciformis*, small specimens of which it resembles; but the lamellæ are more crowded, and the intermediate lamellæ in that species, deep between the larger, are scarcely crenulate.

Stutchbury, Linn. Trans. vol. xvi. tab. 32, figs. 5, *a*, *b*. The figures appear to represent the above species. Fig. 1 may be a larger specimen of the same.

5. FUNGIA AGARICIFORMIS. (*Lamarck.*)

*F. grandis, orbicularis, aut planiuscula aut valde convexa, sæpe paulo undulata; tentaculis  $\frac{1}{3}$ " longis. Corallum lamellis subtiliter denticulatis, tenuibus, inæqualibus, dente tentaculato obsoleto; subtus lamello-striatum, striis spinosis, subæqualibus, in medio spinulis raro seriatis, papilliformibus, minutis, interdum obsolescentibus.*

Large, orbicular, either nearly flat or much convex, often a little undulate; tentacles  $\frac{1}{3}$  of an inch long. Corallum with the lamellæ finely denticulate, thin, unequal, tentacular tooth obsolete; below, lamello-striate, striæ spinose, subequal, and about the centre, spines not in series, papilliform, minute, and sometimes obsolescent.

Plate 18, fig. 5, outline of a lamella, above and below.

The East Indies—Singapore and Sooloo Sea. *Exp. Exp.*—Red Sea. *Forsk.*

This very common species is distinguished by its finely denticulate lamellæ, not flexuous, and without a distinct tentacular tooth. The corallum is often undulate and nearly flat on both surfaces, and again is very convex, with a concavity below two inches deep. One large specimen in the Expedition collections is seven and a half inches in diameter, and averages three-fourths of an inch in thickness, with the centre one and a quarter inches thick. About the centre below, the spines or papillæ are scattered, except in quite small specimens.

*β. tenuifolia.* (Plate 18, fig. 6.) A small specimen from Tahiti, presenting the general characters of the *agariciformis*, but much more delicately denticulate. It is two and a half inches in diameter, and from one-third to two-thirds of an inch thick; the lamellæ are very thin, and the spines of the under surface are much finer and more acute than in the Singapore specimens; about the centre it is barely scabrous.

- |  |   |
|--|---|
| <i>Fungus marinus, lamellis tenuibus, subtiler dentatis, &amp;c.,</i> Seba, Thes. iii. tab. 111, No. 1.—No. 2 is a smaller specimen. | —, Esper, Pflanz., i. 66, tab. 1. A poor figure of a worn specimen.   |
| <i>Mad. fungites,</i> Forskal, Anim. Egypt., 134, tab. 42. An excellent figure of the animal, the first and best hitherto given.     | —, Ellis and Solander, 149, tab. 28, fig. 1.<br><i>Fungia agariciformis, (in part,)</i> Lamk. ii. 372, No. 5.<br>—, Lamour., Exp. 52, tab. 28, fig. 1; Encyc., 419. |

- , Oken's Zool., i. 74.  
 —, Blainville, Man. 337.  
 —, Ehrenberg, G. xiv. sp. 1.  
 —, Leuckart, op. cit. p. 42, and tab. 4, figs. 1-4. Leuckart cites, besides other figures, one by Eschscholtz, in Oken's Isis for 1825, tab. 5, fig. 19.  
 The *Fungia patellaris*, of Lamarck, as figured by Ellis, is probably the young of the *agariciformis*. It is thus described by Lamarck: *F. orbicularis*, planulata; subtus mutica, radiatim striata; lamellis inæqualibus, latere murieatis. The short pedicel may be often seen in small specimens of the above species. The lamellæ according to Ellis are denticulate.  
*Mad. patella*, Ellis and Solander, 148, tab. 28, figs. 1-4.  
 —, Esper, Fortsetz. i. tab. 62, figs. 1-6.  
*Fungia patellaris*, Lamk., ii. 372, No. 4.  
 —, Lamour., Exp. Meth., p. 52, tab. 28, figs. 1-4; Encyc. 419.  
 —, Blainv., Man., 337; pl. 51, fig. 2, represents apparently a beach worn specimen of *Fungia*.  
*Monomyces patella*, Ehrenb., G. xlvii. sp. 1.

6. FUNGIA DENTATA. (*Dana.*)

*F. grandis*, sæpe hemispherica, et subtus profundè concava. Corallum lamellis inæqualibus, inæqualiter dentatis; dentibus parvulis, subacutis, cum intervallis sæpius acutis; subtus superficie radiatâ, crassimè omninoque confertim echinatâ, spinis, corallo adulto, sæpe acervatis fere 2''' longis, in medio vix minoribus, et non seriatis.

Large, often hemispherical, and deeply concave below. Corallum with unequal lamellæ, unevenly dentate; teeth small and subacute, with usually acute intervals; below, coarsely and every where equally crowded echinate, the spines, in adult specimens, often acervate, and nearly 2 lines long, over the middle scarcely smaller, and not radiate.

Plate 18, fig. 7, outline of a lamella, above and below, showing a profile of a section of the corallum.

East Indies. *Exp. Exp.*

The more crowded teeth of the lamellæ, with acute interstices, and the long coarse spines below, nearly or quite as large at the centre as elsewhere, distinguish this species from the *repanda*. The spines of the under surface are pointed, and range in radiate series, two-thirds of the way to the centre, all closely crowded together, and alike prominent. A specimen in the Expedition collections measures seven inches in diameter, and four in height, and the corallum is one and a half inches thick at the centre, and two-thirds of an inch at the margin.

The teeth of the lamellæ are about three-fourths of a line long. Another specimen, of the same size and general form, is one and three-fourths inches thick at centre, with the lamellæ quite stout. The dentation is coarser than in the *agariciformis*, and the spines below much stouter.

Another specimen, probably of this species (Plate 20, fig. 1), was ten inches in diameter, with the lamellæ stout and very unequal, and the dentations a little larger than above stated; the spines below were often a sixth of an inch or more in length, and the series were unequal, with the larger nearly a fourth of an inch apart. Within an inch of the centre, the spines below were quite small.

*Madrepora Fungites variet.*, Esper, i. 66, tab. 2, fig. 2; this figure appears to have been made from a worn specimen of this species.

#### 7. FUNGIA ECHINATA. (*Esper.*) Dana.

*F. grandis, orbicularis, sæpe undulata et interdum convexa; umbrina, tentaculis bursiformibus, albidis, vix 3''' longis. Corallum lamellis inæqualibus, inciso-dentatis; dentibus oblongis, inæqualibus, sæpe compositis; subtus superficie remotè lamello-radiatâ et crassimè echinatâ, cum aliis spinis intermediis valde minoribus partim seriatis.*

Large, orbiculate, often undulate, and sometimes convex; umber-coloured, tentacles bursiform, whitish, scarcely 3 lines long. Corallum with unequal lamellæ, inciso-dentate; teeth oblong, irregular, often compound; below, remotely lamello-radiate and coarsely echinate, with other smaller spines intermediate, partly seriate.

Plate 18, fig. 9, the animal expanded; 9 *a*, a tentacle enlarged, with the animal integument broken through, as often happens, over the points or teeth of the lamellæ; 9 *b*, profile section of the corallum, showing outline of lamella; fig. 8, the same of another variety.

East Indies, and the Feejee Islands. *Exp. Exp.*

This species is readily distinguished by the remote radii of the under surface, very coarsely echinate, and varying from one-third to half an inch apart, with some smaller intermediate spines. The spines are often bent and long; about the centre they are smaller or nearly wanting, but radiated. The teeth of the inciso-dentate lamellæ, vary

from one to one and a half lines in length, and are often irregularly incised, and mostly with narrow acute intervals. A specimen from Singapore, in the Expedition collections, is six and three quarters inches across, with a thickness of half an inch at the margin, and one inch at the centre, and the larger radii below, one-third to half an inch apart: another, seen by the author, was seven inches in diameter, with a concavity below, one and a half inches deep.

The specimen represented by fig. 9, Plate 18, giving the animal, has some peculiarities distinguishing it from those of the East Indies (fig. 8), but yet, is probably identical with them; only a study of the animals can determine the fact. It is neatly circular and flat, with the lamellæ more deeply inciso-dentate (about one-eighth of an inch); and the dentation is as coarse where the lamellæ first rise to the surface, as afterwards; moreover, they rise more abruptly. Besides, the lamellæ are less unequal, and the corallum has not so open an appearance. Below, the large echinate radiating lamellæ are not so distant, and contrast less strongly with the surface between. The specimen measures five and three-fourths inches across, and two-thirds of an inch in thickness.

*Madrepora echinata*, Esper, Pflanz. i. tab. *Madrepora echinata*, Pallas, Zooph. 284. 2, fig. 1, a characteristic figure, showing the under surface.

#### 8. FUNGIA REPANDA. (*Dana.*)

*F. grandis, suborbicularis, convexa aut planiuscula; umbrina, tentaculis albidis, minutis. Corallum lamellis crassis, non confertis, dentatis, dentibus brevibus (non oblongis), sæpe repandis; subtus superficie confertim radiatâ et crassè papillosâ, papillis crassis, rotundatis, et medio non seriatis, confertis et minoribus.*

Large, suborbiculate, convex, and sometimes nearly flat; umber-coloured, tentacles whitish, minute. Corallum with stout lamellæ, dentate, teeth short and not oblong nor crowded, often repand-dentate; below crowdedly radiate and coarsely papillose, papillæ stout and rounded, and about the middle not seriate, crowded and smaller.

Plate 19, fig. 1, animal expanded; 1 *a*, profile of section, showing outline of lamellæ; 2, outline of a specimen from the Sooloo Sea; 3, a large specimen from the Feejees.



Feejee Islands and the East Indies. *Exp. Exp.*

This species, like the *agariciformis*, has a central area below, over which the papillæ are crowded, but not radiate; but these papillæ are much coarser, and in general rounded obtuse, and the lamellæ above are less even and not so crowded, giving the corallum a very open appearance; moreover they are not finely denticulate, although the short teeth sometimes become almost obsolete. There are no distinct tentacular teeth.

The smaller specimen, represented by figure 1, is from the Feejees. It is a double one, consisting of two united individuals, a kind of twin, measuring three and a half inches in diameter, and half to three quarters of an inch in thickness. The lamellæ are short dentate, and the papillæ below are stout and nearly globular. The rudimentary tentacles are quite peculiar. In another small specimen of the same size, and probably identical, from the Sooloo Sea (figure 2), the lamellæ are short dentate, and the papillæ below oblong and more slender than on the Feejee specimen. The lamellæ are much stouter than in specimens of the *agariciformis* of the same size. The large specimen from the Feejees (figure 3), appears to be the same species; the lamellæ are neatly repand-toothed, and a few undulating lines may be seen on the lateral surface parallel with the margin, as in both the smaller Feejee and the Sooloo specimens. The papillæ below are obtuse, the larger oblong and little exceeding a line in length; and they are in rather crowded radiating lines for two-thirds of the distance to the centre, beyond which they are shorter and scattered, but numerous. The specimen is concave below; it measures seven inches across, and two inches in height, and the corallum has a thickness of two-thirds of an inch at the margin and one and a quarter inches about the centre.

*Mad. Fungites*, Ellis and Solander, tab. 28, *Fungia agariciformis*, Lamouroux, tab. 28, fig. 5; the figure is characteristic. fig. 5; and Encyc. pl. 483, fig. 1.

#### 9. FUNGIA INTEGRÆ. (*Dana.*)

*F. grandis, orbicularis.* *Corallum lamellis inæqualibus, obsolete denticulatis; subtus superficie remotè et inæqualiter radiatâ, radiis crassimè echinatis, spinis sæpe acervatis, in medio parvulo minutis.*

Large, orbicular. Corallum with unequal lamellæ, obsoletely denticulate; below, remotely and unequally radiate, coarsely echinate, spines often clustered, minute over a small space at the centre.

Plate 19, fig. 4.

The nearly entire lamellæ, approximate this species to the *agariciformis*; but in the coarsely echinate remote radii of the under surface it is very unlike that species, and approaches most nearly the *echinata*. The large series of stout oblong spines below, are about one-third of an inch apart, and between them are others much smaller and crowded. The lateral surface of the lamellæ is very finely vertically plicate. A specimen examined by the author measured six inches in diameter, and was an inch thick at centre, with the oririme a little above an inch long.

#### 10. FUNGIA CONFERTIFOLIA. (*Dana.*)

*F. grandis, suborbicularis, convexa, subtus paulo concava. Corallum lamellis confertis, subæqualibus, undulatis, dentatis aut subrepandodentatis, dentibus brevibus et subacutis; dentibus tentaculatis obsoletis; subtus superficie lamello-radiatâ, confertim et crassè echinatâ, spinis oblongis, medio paucioribus.*

Large, suborbicular, convex, below a little concave. Corallum with the lamellæ crowded, subequal, undulate, dentate, or subrepandodentate; teeth short and subacute, tentacular teeth obsolete: below somewhat lamello-radiate, rays crowded and coarsely echinate, about the middle less crowded.

Plate 19, fig. 5.

Feejee Islands. *Exp. Exp.*

The crowded, nearly even, undulate lamellæ of this species at once distinguish it from all the preceding; it resembles most the *dentigera*, but has not the tentacular teeth of that species, and is not so finely denticulate. About seventeen large lamellæ may be counted in a breadth of an inch. One large specimen in the collections is slightly elliptical, and measures eleven inches by nine and a half, with a thickness of one and a quarter inches at centre and three-quarters of an inch

at the margin. The spines below are crowded and large throughout, except a small space about the centre. A smaller specimen (the one figured) is circular and five and a half inches across, one and one-eighth inches thick at centre, and half an inch thick at the margin. The lamellæ are undulate as in the larger specimens, but the teeth are more unequal. Below, the spines are often one-sixth of an inch long to within one inch of the centre. Both are nearly flat below and convex above.

Figure 6, plate 19, represents part of an animal of a *Fungia*, supposed to be this species, from the Samoan Islands. The specimen from which the drawing was made, was afterwards lost. The tentacles are green and bursiform, and the disk is purplish-umber.

#### 11. FUNGIA HORRIDA. (*Dana.*)

*F. orbicularis, planiuscula.* Corallum lamellis valde inæqualibus, remotis, ampliter eroso-dentatis; subtus, remotè lamello-radiatum, et crassimè echinatum.

Orbiculate, nearly flat. Corallum with the lamellæ very unequal, remote, very coarsely eroso-dentate: below, remotely lamello-radiate, and strongly echinate.

Plate 19, figure 7.

Feejee Islands. *Exp. Exp.*

This species is remarkable for its coarse and ragged look, the lamellæ being very unequal and distant, and raggedly eroso-dentate. Some of the teeth are a fourth of an inch broad, and the larger have sometimes a carinate process on the lateral surface. In a young specimen, four inches in diameter, the under surface is radiate from the centre, and the larger series of spines are about a quarter of an inch apart, with the spines themselves contorted, and over an eighth of an inch long; the intervals between them are finely striate (six to seven striæ), but not echinate. In an adult, six inches in diameter, and two-thirds of an inch thick, the larger series contain clustered spines; and between these are a few less prominent series. About the centre, for a breadth of two inches, the surface is scarcely radiate, and the spines are short papillæ and crowded.

This species has some resemblance to the two described by Quoy and Gaymard; but the character of the teeth and of the under surface, is quite different. The lamellæ also are more unequal and distant. It is possible, however, that it may prove to be the *crassitentaculata*, on a re-examination of that species.

12. FUNGIA ACTINIFORMIS. (Quoy & Gaymard.)

*F. orbicularis, convexa, subtus planiuscula; tentaculis longis, cylindricis, fuscis, apice subhuteis. Corallum lamellis subæqualibus, lobato-dentatis; subtus, lamello-striatum, striis tenuiter denticulatis.*

Orbiculate, convex, below nearly flat; tentacles long, cylindrical, fuscous, with yellowish tips. Corallum with subequal lobato-dentate lamellæ; below lamello-striate, with the striæ finely denticulate.

Island of Cocos. Quoy & Gaymard.

Quoy and Gaymard's figure represents the lamellæ with rounded teeth, often nearly a sixth of an inch broad, separated by narrow acute interstices. This coarse dentation, united with the fine denticulate striæ below, distinguishes the species from the others here described. The specimen measured four inches in diameter, was regularly convex above, an inch thick at middle. The tentacles according to the figure are about an inch long.

*Fungia actiniformis*, Quoy and Gaymard, —, Lamk., 2d ed. ii. 374, No. 10.

Voy. de l'Ast., iv. 180, pl. 14, figs. 1, 2. —, Leuckart, op. cit. 46.

13. FUNGIA CRASSITENTACULATA. (Quoy & Gaymard.)

*F. orbicularis, planulata; tentaculis conicis, crassis, apice luteo-virescentibus. Corallum lamellis inæqualibus, valde lobato-dentatis, majoribus alternis; subtus, regulariter striatum.*

Orbiculate, flat; tentacles conical, stout, greenish-yellow at tip. Corallum with unequal lamellæ, strongly lobato-dentate, the larger alternate; below, regularly striate.

Island of Vanicoro, Pacific Ocean. *Quoy and Gaymard.*

This species is remarkable for the very large teeth of the lamellæ, resembling the preceding, united with regular striations below. The specimen examined was two and a half inches in diameter, and seven lines in thickness. The tentacles as figured by Quoy and Gaymard, are over an inch long.

*Fungia crassitentaculata*, Quoy and Gay- —, Lamk., 2d ed. ii. 374, No. 11.  
 mard, Voy. de l'Ast., iv. 182, pl. 14, —, Leuckart, op. cit. p. 47.  
 figs. 3, 4. —, Cuvier, Reg. An., 1837, pl. 83, fig. 1.

II. *Oblongo-ellipticæ.*

14. FUNGIA PAUMOTENSIS. (*Stutchbury.*)

*F. pumila*, bene elliptica (2": 1½"), convexiuscula, subtus plana, aut undulata. Corallum lamellis æqualibus, confertissimis, fere integris, vel subtilissimè denticulatis; subtus leviter striatum et subtiliter spinulosum, in medio fere leve.

Small, neatly elliptic (2 inches by 1½), somewhat convex; below flat or undulate. Corallum with equal even lamellæ, much crowded, nearly entire or very finely denticulate; below finely striate and very minutely spinulous, nearly smooth at middle.

Plate 19, fig. 8, animal, drawn by J. P. Couthouy; 8 a, outline of corallum; 9, supposed to be corallum of a young individual.

The Paumotu Islands, Pacific Ocean. *Exp. Exp.*

The even nearly entire and crowded lamellæ and elliptic shape, are the distinguishing characters of this species. There are twenty-two to twenty-five lamellæ in a breadth of an inch. With the size above stated (the usual adult size), the thickness is about one-eighth of an inch at the margin, and nearly half an inch at centre. Young individuals of this species were found attached by Mr. Stutchbury, and also by my associate Dr. C. Pickering of the Expedition. The adult coralla usually have a scar below, a fourth of an inch in diameter, indicating the size of the pedicel at the time it was detached.

*Fungia paumotensis*, Stutchbury, Linn. Trans. xvi. tab. 32, figs. 6 a, 6 b. The figures are good.

15. FUNGIA DENTIGERA. (*Leuckart.*)

*F. elliptica aut oblongo-ovata, supra convexa, subtus concava. Corallum lamellis inæqualibus leviter flexuosis, subtiliter serrulatis; dentibus tentaculatis grandibus et prominentibus: subtus radiatim echinulatum, papillis confertis exiguis, obtusis.*

Elliptical or oblong-ovate, convex above, concave below. Corallum with the lamellæ unequal, gently flexuous, very delicately serrulate, tentacular tooth large and prominent: below radiately echinulate, with the teeth crowded, slender, and obtuse.

Plate 18, fig. 4, a lamella with the tentacular teeth of other lamellæ projecting above it.

Red Sea. *Rüppell.*—Sandwich Islands.

One of Rüppell's specimens measured three and a half inches in length, by two and two-thirds in breadth. The very finely serrulate, flexuous lamellæ, and the prominent tentacular tooth, to which the name *dentigera* alludes, are the distinguishing characteristics. A specimen from the Sandwich Islands was five and a half inches long, and three broad; another seen by the author measured four inches, by two and a half. The tentacular teeth in the Sandwich Island specimen, were very stout, and two lines long. Below, the margin, for a breadth of half an inch or more around, is sometimes in obsolescent folds half an inch or more in width.

In other specimens, similar in the delicately minute serrulations of the lamellæ, and the character of the under surface, the tentacular teeth are obsolete. Whether a distinct species or not, as is barely possible, can be determined only from a study of the living zoophytes.

*Fungia dentigera*, Leuckart, op. cit., p. 48, and tab. 3, fig. 1.

16. FUNGIA SCUTARIA. (*Lamarck.*)

*F. oblongo-elliptica (7½" : 4"), utrinque planiuscula. Corallum lamellis subæqualibus, leviter undulatis, subintegræ aut obsoletè crenulatis, oririmâ semilongitudine paulo minore, dentibus tentaculatis obsoletis: subtus, confertim et æqualiter papillosum, papillis parvulis, rotundatis.*

Oblong-elliptic ( $7\frac{1}{2}$  inches by 4), nearly flat on both sides. Corallum with the lamellæ subequal, a little undulate, subentire, or obsoletely crenulate; oririme nearly half as long as the corallum; tentacular teeth obsolete: below, crowdedly and evenly papillose; papillæ small rounded, scarcely  $\frac{1}{2}$  a line long.

Plate 19, fig. 10, outline of a section; 10 *a*, form of the disk.

East Indies. *Exp. Exp.*

One of the specimens in the Expedition collections measures seven and a half inches by four in breadth; and two others of half this length have similar characters. The lamellæ are nearly even, rather stout, scarcely crenulate, and the papillæ small and evenly crowded below. There are eleven or twelve large lamellæ in a breadth of an inch. The whole is a simple animal.

*Fungus marinus oblongus, lamellis tenuibus, erectis, non denticulatis.* Seba, ii., tab. 112, fig. 29; from a small specimen.  
*Fungia scutaria*, Lamarck, 372, No. 6.  
 —, Lamouroux, Encyc., 419.  
 —, Blainv., Man., 337.  
*Madrepora fungites*, Esper, i. 66; included with other species by Esper.  
 —, Ehrenberg, G. xiv., sp. 3.  
 —, Leuckart, op. cit., 49.

#### 17. FUNGIA PECTINATA. (*Ehrenberg.*)

*F. oblongo-elliptica, utrinque plana. Corallum lamellis rudius dentatis, oririmâ ad utrumque finem usque productâ.*

Oblong-elliptic, flat on both sides. Corallum with the lamellæ rudely dentate, oririme continued quite to each extremity.

Indian Ocean (?). *Ehrenberg.*

Ehrenberg, from whom this description is taken, states that this species grows to a length of six inches. A young state of the following?

*Fungia pectinata*, Ehrenb., G. xiv., sp. 2. figured by Seba, as having *non-denticulate* lamellæ.  
 Ehrenberg refers to Seba's fig. 29, No. 112, which has the general characters of the *scutaria*, and is both described and —, Leuckart, op. cit., 49.

18. FUNGIA EHRENBORGII. (*Leuckart.*) *Dana.*

*F. grandis*, oblongo-elliptica, interdum medio angustior, subtus sæpe concava. Corallum lamellis crassè dentatis, dentibus apice rotundatis et granulosis, intervallis sæpius subacutis; oririmâ ad utrumque finem fere productâ: subtus, confertim echinatum.

Large, oblong-elliptic, sometimes narrower at the middle, below concave. Corallum with the lamellæ coarsely dentate, teeth rounded at apex, and intervals usually subacute, granulous; oririme extending nearly to each extremity: below, crowdedly echinate.

Plate 19, fig. 11.

East Indies. *Exp. Exp.*

This species often attains a very large size. A specimen in the Expedition collections, answering very exactly to Leuckart's figure, but with a simple mouth, instead of three, as in his specimen, measures five inches in length, and two and a half in breadth. The teeth are a line long, obtuse and coarsely granulous at apex. Leuckart mentions one ten inches long, and another, six long and two and a half broad.

*β. gigantea* (Plate 19, fig. 12). Other specimens from the Feejees have many of the characters of the above, but differ in the teeth of the lamellæ not being granulous, and a little coarser, though of the same shape. One is fourteen inches long, six broad, and three in height. The oririme is nearly two-thirds the whole length of the corallum, and is not subdivided. It is probably distinct.

*Herpetolithus Ehrenbergii*, Leuckart, op. cit., 52, tab. 2.

19. FUNGIA ASPERATA. (*Dana.*)

*F. grandis*, oblongo-elliptica, latitudine triplo longior, subtus concava aut planiuscula. Corallum oririmâ medianâ semilongitudinem paulo superante, lamellis ruditer spinosèque inciso-dentatis.

Large, oblong-elliptical, length three times the breadth; below, concave or nearly plane. Corallum with the medial oririme a little more than half its length; lamellæ rudely and spinosely inciso-dentate.



Red Sea. *Ehrenberg.*

This species differs decidedly from the preceding in its sharper, more incised, and irregular dentation. The intervals between the teeth are usually very sharp and narrow; the teeth are often subacute and mostly about a line long (Plate 19, fig. 14). A specimen in the collections of the Academy of Natural Sciences, of Philadelphia, measures nearly fourteen inches in length, by four and a half in breadth. The oririme is subdivided once towards one side.

*Haliglossa echinata*, Ehrenberg, G. xv., *Fungus marinus*, Seba, iii., pl. 111, fig. 4; sp. 1. "lamellis subtiliter denticulatis." (!)

## 20. FUNGIA RÜPPELLII. (*Leuckart.*) *Dana.*

*F. grandis, elongata, latitudine duplo longior, convexa, subtus concava. Corallum lamellis inæqualibus, denticulatis, utrinque asperis; denticulis inæqualibus sæpius laceris, interdum subtruncatis, oririmâ ad utrumque finem fere productâ, indivisâ: subtus echinatum.*

Large, much elongate, twice as long as broad, convex, below concave. Corallum with unequal lamellæ, rough on both surfaces; denticulate, denticles unequal, usually lacerate, sometimes subtruncate; oririme continued nearly to each margin, undivided: below, echinate.

Indian Ocean. *Leuckart.*

The delicately lacerato-denticulate lamellæ separate this species from the others described. One of Leuckart's specimens measured four and a half inches in length and two and a quarter inches broad.

*Herpetolithus Rüppellii*, Leuckart, op. cit., 54, tab. 1.

The *Fungia echinata*, figured in the Reg. Anim., 1837, pl. 82, fig. 2, has the fine denticulation of the *Rüppellii*, but it is represented as crenato-denticulate. Its length is a little more than twice its breadth.

## 21. FUNGIA CRASSA. (*Dana.*)

*F. grandis, elongata, latitudine duplo longior, valde convexa et latere compressa, subtus profundè concava. Corallum crassimum, lamellis crassè dentatis, non granulosis, dentibus rotundatis, sæpe 1½-2'' latis, oririmâ 4-5-partitâ: subtus superficie confertissimè echinatâ.*

Large, much elongate, full twice as long as broad, strongly convex and laterally compressed; below deeply concave. Corallum very stout, lamellæ coarsely dentate, not granulous, teeth rounded, often  $1\frac{1}{2}$  to 2 lines broad, oririme 4 to 5 parted; below very crowdedly echinate.

Plate 19, fig. 13.

Feejee Islands. *Exp. Exp.*

This species resembles in its lamellæ the *gigantea*, of which I have suspected it to be a variety; but it is much compressed laterally, and often a little distorted, and the teeth are larger. One specimen measures ten inches long, three and a half broad, and three and a quarter high, with below a concavity two inches deep, and the corallum one and a half inches thick. The oririme moreover is subdivided.

Rumph. Amboyn. vi., fig. 2, tab. 88, may be this species.

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GENUS II.—CYCLOLITES.—LAMARCK.

*Fungidæ liberæ, non gemmatæ, itaque simplicissimæ; ore centrali. Coralla supernè centro depressa et lamellis radiata; subtus concentricè striata, nuda.*

Free Fungidæ, not budding, and therefore quite simple; mouth central. Coralla above, with a depression (oririme) at centre, and surface radiated with lamellæ; below, concentrically striate, naked.

The Cyclolites are fossil species of small size, resembling closely the Fungidæ; and some of the latter have distinct traces of concentric striæ below, or lines of growth, somewhat like the former. Yet the general habit of the two are different, and the Fungidæ are always papillose or echinate on the under surface, with the radiating lines far the most decided. This genus was established by Lamarck. Goldfuss unites it with the genus Fungia. Blainville states that the

Montlivaltia of Lamouroux is a Cyclolites, as he ascertained by an examination of the original specimen.

*Cyclolites*, Lamarek, ii. 367.  
 —, Blainville, Man. 335.  
*Fungia*, Goldfuss, Petref., 47.

*Montlivaltia*, Lamour., Exp. Meth., 78,  
 tab. 79, figs. 8, 10.  
*Cyclolithas*, Ehrenberg, Genus xvii.

II. *Fungidæ liberae, explanato-gemmatae.*

GENUS III.—HERPETOLITHUS.—ESCHSCHOLTZ.

*Fungidæ liberae, gemmatae, explanatae; polypis uniseratim medianis majoribus et aliis undique sparsis, utrisque tentaculatis, tentaculis brevibus aut obsoletis. Coralla oblonga, oririmâ medianâ compositâ, profundâ, aliisque simplicibus sparsis; lamellis denticulatis, per oririmas interruptis, itaque brevibus (semipollice non minoribus), vix radiatis; superficie inferiore echinatâ.*

Free *Fungidæ*, budding and explanate; a single medial series of large polyps, and others scattered, each with a separate circle of tentacles, which are quite short or obsolete. Coralla elongate, with a deep medial compound oririme, and others simple scattered; lamellæ interrupted at the scattered oririmes, and hence short (not less than half an inch), scarcely at all radiate, denticulate; under surface echinate.

The *Herpetolithi* have the general habit of the *Fungidæ*, with which they were associated till separated by Eschscholtz. The surface of the coralla, instead of consisting of long lamellæ radiating to the margin, as in the *Fungidæ* and *Zoopili*, is made up of short lamellæ, extending only from one oririme to another; and instead of having a single central mouth, polyp-mouths are scattered over the whole surface. They usually grow in oblong forms, more or less elliptical, either flat, or convex above, and concave below, and not unfrequently a little contorted; and, in allusion to their shape, they have been familiarly called sea-tongues; they have also some resemblance to a large slug, which suggested the generic name.\* Some, turned over, look like oblong

\* From *ερεπω*, to creep, and *λίθος*, stone. Ehrenberg's name, *Haliglossa*, given subsequently to Eschscholtz's, is from *αλς*, sea, and *γλωσση*, tongue.

troughs or basins. They occasionally attain a length of a foot or more. The whole surface is crowdedly echinate below. When alive the general umber tint above, in some species, appears sprinkled with bright green, from the mouths and short tentacles: the latter are mere inflations of the membrane over the lamellæ around each mouth.

The Herpetolithi are confined to the warm coral-reef seas.

*Arrangement of the Species.*

- |                           |                         |
|---------------------------|-------------------------|
| *1. <i>H. limacinus.</i>  | 4. <i>H. stellaris.</i> |
| 2. <i>H. interruptus.</i> | *5. <i>H. strictus.</i> |
| *3. <i>H. foliosus.</i>   | *6. <i>H. crassus.</i>  |

1. HERPETOLITHUS LIMACINUS. (*Lamarck.*) *Eschscholtz.*

*H. angusto-oblongus, planiusculus aut convexus. Corallum lamellis laxis, raro pollice longioribus, nec radiantibus.*

Narrow oblong, nearly flat or convex. Corallum with the lamellæ lax, rarely an inch long, not radiating.

Plate 20, fig. 2, profile of vertical section; 2 *a*, form of corallum; 2 *b*, *c*, *d*, outline of lamellæ.

East Indies. *Exp. Exp.*

The specimens in the Expedition collections from Singapore are nearly flat, undulate, and somewhat distorted. They measure ten inches in length, three in breadth, and half to three-quarters of an inch in thickness. The lamellæ are distant—nearly a line—as is well shown in Ellis's figure. The spines of the under surface are very short, and not in series except near the margin. One specimen examined is seventeen inches long, and deeply concave below (about one and a quarter inches). The spines below are slender points, which are every where crowded. Besides the medial line of oririmes, there are also two lateral imperfect series, near the middle of each lateral half of the corallum.

*Mad. pileus*, Ellis and Solander, 159, tab. *Fungia limax*, Oken, Zool. i. 74.

45; a good figure.

*Fungia limacina*, (in part,) Lamk., ii. 373;

*Mad. lima*, Esper, Fortsetz. i. 77, tab. 63; No. 7.

a reduced copy of Ellis's figure.

*Fungia limacina*, Lamouroux, Exp. Meth. 52, tab. 45; Encyc., 419. the oblong Fungiæ, the species of which is doubtful.  
 —, Blainville, Man., 337; his figure 3, *Haliglossa limacina*, Ehrenb., G. xv. sp. 2, pl. 51, is from a worn specimen of one of *Herpetolitha limacina*, Leuckart, op. cit. 56.

## 2. HERPETOLITHUS INTERRUPTUS. (*Ehrenberg.*) *Leuckart.*

*H. oblongus, convexus, subtus concavus. Corallum lamellis inæqualibus, fasciculatim interruptis, oririmâ medianâ nec mediâ.*

Oblong, convex, and below concave. Corallum with unequal lamellæ, fasciculately interrupted, the medial oririme not in the middle.

This species is described by Ehrenberg from a specimen, in the Royal Museum at Berlin, ten inches in length. He refers to figure 5, tab. 111, of Seba. This figure represents a very convex species, eleven inches long, and nearly six broad, with the margin undulate. The lamellæ are half to two-thirds of an inch long, and finely denticulate, and are much more crowded than in the *limacina*, from which it is distinguished also by its great breadth and convexity. The locality is not known.

*Fungus marinus, oblongus, grandis, lamellis tenuibus, parvis, erectis, subtiliter dentatis, squamosis; Pileus Neptuni dictus.* Seba, iii. tab. 111, fig. 5. *Fungia limacina*, (in part.) Lamk., ii. 373. *Haliglossa interrupta*, Ehrenb., G. xv. No. 3. *Herpetolitha interrupta*, Leuck., op. cit. 58.

## 3. HERPETOLITHUS FOLIOSUS. (*Ehrenberg.*) *Leuckart.*

*H. oblongus, concavus, subtus concavus. Corallum oririmâ compositâ medianâ, etiam serie utrinque laterali.*

Oblong, convex, below concave. Corallum with a medial compound oririme, and a lateral series on either side.

This description by Ehrenberg, from a specimen in the Royal Museum at Berlin, is insufficient for distinguishing it, as an imperfect lateral series may be observed in the *limacina*. The specimen was a foot in length. Fig. 3, tab. 111, of Seba, to which he refers, repre-

sents a specimen nine inches long and four broad, which is much wider in proportion to its length than the *limacina*.

*Fungus marinus obliquus, bractcolis valde tenuibus, subtiliter denticulatis, erectis, squamosis*, Seba, Thes. iii. tab. 111, fig. 3. *Haloglossa foliosa*, Ehrenb., G. xv. sp. 4. *Herpetolitha foliosa*, Leuckart, op. cit. 59.

Fig. 3, Plate 20, may be this species. It is from a specimen deeply concave below, eighteen inches long, and three and three-fourths wide, having the spines of the under surface very delicate points, and the lamellæ above, rarely three-fourths of an inch long.

4. HERPETOLITHUS STELLARIS. (*Ehrenberg.*) *Leuckart.*

*H. oblongus. Corallum radiatum, stellatum; oririmâ medianâ valde angustâ; lamellis interruptis, non apertè fasciculatis.*

Oblong. Corallum radiate, stellate; medial oririme very narrow, lamellæ interrupted, not distinctly fasciculate.

Ehrenberg adds that this species approaches the *limacina*, but has smaller lamellæ, and narrower and shallower oririmes, and the medial as oblique. The length given for a specimen at Berlin, is nine inches. He refers to Esper's figure, plate 73, which has the form of a three-rayed star, each ray about two and a quarter inches wide, and from two and a half to three and one-fourth inches long. The figure is copied by Esper, from Boddaert (*Lyst. d. Plantdieren*), and is very imperfect. Boddaert states that there are eight or nine small teeth on the upper edge of the lamellæ.

*Madrepora trilinguis*, Boddaert, *Lyst. d. Mad. Pileus*, var., Esper, Fortsetz. i. tab. 73. Plant. D. Anhangzel, p. 613, pl. 14, *Haloglossa stellaris*, Ehrenb., G. xv. sp. 5. (cited from Esper.) *Herpetolitha stellaris*, Leuckart, op. cit. 58.

5. HERPETOLITHUS STRICTUS. (*Dana.*)

*H. angusto-oblongus, crassus, utrinque attenuatus, convexus, subtus concavus aut planiusculus. Corallum lamellis tenuioribus, fragilibus, confertissimis, nec radiantibus, subtilissimè denticulatis, oririmâ medianâ usque ad utrumque finem productâ.*

Narrow oblong, thick, attenuate at either extremity, convex; below

concave or nearly flat. Corallum with thin fragile lamellæ, closely crowded, not radiate, very minutely denticulate; the medial oririme continued quite to each extremity.

Plate 21, fig. 1, profile of vertical cross section.

Tahiti, Society Islands. *Exp. Exp.*

The specimens in the collections are seven inches long, two and a half wide, and one inch thick at middle. One is nearly flat below, and the other has a concavity half an inch deep. The lamellæ are very thin and crowded, about twenty larger being counted in the breadth of an inch.

#### 6. HERPETOLITHUS CRASSUS. (*Dana.*)

*H. angusto-oblongus, crassimus (margine et medio 1¼-1½"), extremis latè rotundus, valde convexus et subtus concavus; umbrinus, tentaculis brevibus, latè virentibus. Corallum lamellis confertis, nec radiatis; subtus spinulosum, spinulis crassis.*

Narrow oblong, very stout (at margin and at middle 1¼ to 1½ inches thick), broadly rounded at each extremity, much convex, and below concave; colour umber, tentacles very short, bright green. Corallum with the lamellæ much crowded, not radiate; spines below stout.

Plate 20, fig. 5, zoophyte expanded, natural size; 5 *a*, profile of section of corallum; 5 *c*, outline of a lamella; 5 *b*, a marginal lamella.

Feejee Islands. *Exp. Exp.*

This is a large and heavy species, with the ends broadly rounded. One specimen is a foot long, somewhat distorted, three and a half inches broad and three high, with a concavity below an inch deep; thickness of the corallum one and a quarter inches. Another is seven and a half inches long by five broad, and three and a half high. The lamellæ are much crowded, not very thin, and vary from half an inch to an inch in length. The medial oririme does not extend to the extremities.

## GENUS IV.—HALOMITRA.—DANA.

*Fungidæ liberæ, gemmata, explanatæ, polypis omnino sparsis, (utrisque longè tentaculatis?). Coralla convexa; oririmis grandibus, undique sparsis; lamellis brevibus (semipollice non minoribus), crassimis, crassè dentatis, radiatis; superficie inferiori echinatâ.*

Free Fungidæ, budding and explanate; polyps throughout scattered (each with a separate circle of large tentacles?). Coralla convex, oririmes large, every where scattered; lamellæ short and stout (not less than half an inch), coarsely dentate, radiate; under surface echinate.

The coralla of the Halomitra, though like those of the Polyphylliæ in not having a medial compound oririme, are peculiar in their coarse and coarsely dentate radiated lamellæ. The only species known is conically cap-shape, and very stout and heavy. The polyps, as may be inferred from the corallum, appear to have each a distinct circle of tentacles, like those of the Herpetolithi, and these are probably of large size. This genus is made for the *Mitra Polonica* of Rumphius, the *Fungia Pileus* of Lamarck, as the coral has not the characters of either of the other generic groups. The name is from  $\alpha\lambda\varsigma$ , sea, and  $\mu\iota\tau\rho\alpha$ , mitre.

HALOMITRA PILEUS. (*Lamarck.*) Dana.

*H. maxima, hemispherico-conica. Corallum  $\frac{2}{3}$ –1 $\frac{1}{4}$ " crassum, lamellis crassis, valde inciso-dentatis, sæpius  $\frac{1}{2}$ – $\frac{3}{4}$ " longis (ad peripheriam fere 1 $\frac{1}{4}$ " ); subtus, crassè et confertissimè radiatim echinatâ.*

Very large, hemispherico-conical. Corallum  $\frac{2}{3}$  to 1 $\frac{1}{4}$  inches thick, lamellæ stout, strongly inciso-dentate, usually  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch long (nearly 1 $\frac{1}{4}$  at the margin); under surface stoutly and very crowdedly radiately echinate.

Plate 21, fig. 2, cross section; 2 *a*, outline of lamellæ; 2 *b*, another variety.

East Indies and Pacific.—The Feejees. *Exp. Exp.*



This species is called by the old authors, Neptune's Cap. One of the Expedition specimens is a foot in diameter at base, and eight inches high. The lamellæ are very stout, with irregular narrow incised dentations nearly an eighth of an inch long. They are every where more or less radiate, and not unfrequently a lateral process passes off from a lamella to an adjoining centre.

*Bonnet de Neptune*, Tournefort, Acad. R. *Mitra Polonica*, Rumph., vi. tab. 88, fig. 3.  
des Sciences, 1700, p. 27, with a plate *Fungia Pileus*, Lamarck, ii. 374, No. 9.  
facing p. 30. —, Lamouroux, Encyc., 420.

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GENUS V.—POLYPHYLLIA.—QUOY & GAYMARD.

*Fungidæ liberae, gemmatae, explanatae; polypis æqualiter et omnino sparsis (rarò medio remotè seriatis), confertis, oribus et tentaculis undique intermistis. Coralla lamellis brevissimis (semipollice minoribus) denticulatis, sparsis aut vix radiatis, oririmis sparsis, interdum inconspicuis.*

Free Fungidæ, budding and explanate; polyps equal and throughout scattered, rarely remotely seriate along the medial line, crowded, with mouths and tentacles every where interspersed. Coralla with very short lamellæ (less than half an inch long), denticulate, scattered or imperfectly radiate; oririmes scattered, sometimes indistinct.

The Polyphyllia resemble caps or inverted cups, oblong basins or troughs, the under surface being concave and the upper correspondingly convex; and they are often of large size, a length or diameter of a foot being common with some species. The upper surface of the corallum consists of a large number of very narrow denticulate lamellæ, and when alive, the whole is bristled with as many tentacles, a single tentacle corresponding to each; among the tentacles are scattered the small polyp-mouths. These species consequently differ from the Herpetolithi and Halomitrae, in being so closely aggregated that there is only a single tentacle between adjacent mouths; and it is due to this that the lamellæ are shorter than in any others of the free Fungidæ. They are also in general fragile species.

The Polyphyllia are confined to the warm coral-reef seas.

The animals of the Polyphyllia were first observed and figured by Quoy and Gaymard, by whom the genus was instituted. The name alludes to the small lamellæ of the surface, and is derived from πολυς, *many*, and φυλλον, *leaf*. The *Lithactinia* of Lesson pertains to this genus.

*Arrangement of the Species.*

I. *A medial interrupted series of oririmes.*

\*1. *P. talpa.*

\*2. *P. leptophylla.*

3. *P. sigmoides.*

4. *P. pelvis* (a medial series in adult, only).

II. *Oririmes very distinct, no medial series.*

\*5. *P. fungia.*

III. *Oririmes indistinct, no medial series.*

\*6. *P. pileiformis.*

\*7. *P. galeriformis.*

I. *Oririmis medianis longitudinaliter seriatis.*

1. POLYPHYLLIA TALPA. (*Blainville.*)

*P. angusto-oblonga, convexa, subtus concava. Corallum  $\frac{3}{4}$ " crassum, oririmis apertioribus, sæpe obliquè substellatis, medianis seriatis; lamellis brevibus, sæpius fermè  $\frac{1}{4}$ ", sed marginalibus  $\frac{2}{3}$ " longis.*

Narrow oblong, convex, below concave. Corallum  $\frac{3}{4}$  of an inch thick, oririmes quite distinct, often obliquely substellate, the medial seriate; lamellæ short, mostly about  $\frac{1}{4}$  of an inch, but the marginal  $\frac{2}{3}$  of an inch, long.

Plate 21, fig. 5 *a*, lamellæ as they radiate from one side of an oririme; 5 *b*, *c*, outline of lamellæ; 5 *d*, marginal lamella.

East Indies. (*Lamarck.*)

This is the *Talpa marina*, of the old authors. One specimen seen by the author, measures eight and a half inches in length, three and a half in breadth, and two and a half in height, with the thickness three-fourths of an inch. It agrees well with Seba's fig. 6, tab. 111. The under surface is finely scabrous. The oririmes are one-third to one-

half an inch apart, and the lamellæ of the stars are often obliquely stellate, and quite thin at the edge towards the oririme. Ehrenberg mentions a specimen a foot and a half long. This species is peculiar in its thickness and distinct oririmes, and often substellate lamellæ.

*Fungus marinus oblongus, lamellis minimis, squameis, subtiliter denticulatis, erectis, in medio dorso stellatis; cui nomen est Tulpa marina: ad oras Amboynæ*, Seba, Thes. iii. fig. 6, tab. 111; a good figure.  
*Fungia talpa*, Lamk., ii. 373, No. 8.

*Fungia talpa*, Oken, Zool. 74.  
*Herpolitha talpa*, Eschscholtz, Oken's Isis for 1825.  
*Polyphyllia talpa*, Blainv., Man. 339.  
 —, Ehrenberg, G. xvi. sp. 1.  
*Agaricia talpa*, Schweig., Handb. 415.

## 2. POLYPHYLLIA LEPTOPHYLLA. (Ehrenberg.)

*P. angusto-oblonga, convexa et subtus concava, extremitatibus rotundata. Corallum  $\frac{3}{4}$ " crassum; oririmis apertioribus, profundis, substellatis, medianis seriatis; lamellis brevioribus ( $1\frac{1}{2}$ –2"), prominentioribus tenuissimè denticulatis, et fragilibus, marginalibus 2–3" longis.*

Narrow oblong, above convex, and below concave, extremities rounded. Corallum  $\frac{3}{4}$  of an inch thick, oririmes very distinct and deep, often substellate, the medial seriate; lamellæ quite short ( $1\frac{1}{2}$  to 2 lines), much prominent, very slenderly denticulate and fragile, the marginal, 2 to 3 lines long.

Plate 20, fig. 6 *a*, form of the corallum; 6 *b*, *c*, outline of lamellæ.

With the general shape and thickness of the *talpa*, this species has smaller and more exsert lamellæ, very slenderly denticulate, and those of the margin are also very much shorter. A specimen in the collections of the Boston Natural History Society, is eleven and a half inches long, nearly four inches broad, and two in height. The lamellæ are very fragile, and project two and a half or nearly three lines above the bottom of the oririmes.

*Polyphyllia leptophylla*, Ehrenberg, G. xvi. sp. 2.

## 3. POLYPHYLLIA SIGMOIDES. (Ehrenberg.)

*P. angusto-oblonga, leviter sigmoides, utrinque attenuata. Corallum*

*lamellis subsolitariis, talpâ tenuioribus et brevioribus; oririmis medianis seriatis.*

Narrow oblong, curving slightly like the letter S, attenuate towards both extremities. Corallum with the lamellæ subsolitary, thinner and shorter than in the *talpa*; medial oririmes seriate.

According to Seba's figure, to which Ehrenberg refers, this species attains a length of five inches, with a breadth of but one and a quarter inches. Around the oririmes of the medial series, the lamellæ are substellate, but elsewhere they are subsolitary, and hardly a sixth of an inch long.

*Talpa marina*, &c., Seba, Thes. iii., fig. 31, *Fungia talpa*, (in part,) Lamarck, ii., 373, tab. 112. No. 8.  
*Agaricia talpa*, (in part,) Schweig. Handb. *Polyphyllia sigmoides*, Ehrenberg, G. xvi., 415. sp. 3.

#### 4. POLYPHYLLIA PELVIS. (*Quoy & Gaymard.*)

*P. plus minusve oblonga, convexa, subtus concava; tentaculis rubro-brunneis, apice albidis. Corallum tenue, fragile; lamellis solitariis inæqualibus, denticulatis, granulosis; oririmis medianis, corallis adultis, subseriatis.*

Somewhat oblong, convex, below concave; tentacles brownish-red, white at tip. Corallum thin, fragile; lamellæ unequal, denticulate, granulous; in large specimens the medial oririmes subseriate.

Port Carteret, New Holland, and also Vanikoro. *Quoy & Gaymard.*

The thin and fragile character of the corallum, as well as its shape, distinguishes this species from the preceding. Quoy and Gaymard describe it as having the form of a shallow basin inverted, either oval, round, or subquadrilateral. The series of medial oririmes, in the largest specimen seen by them, extended from one extremity to the other, along the longest diameter. The under surface they describe as undulato-striate. According to the figure given by these authors, the lamellæ are little over a third of an inch in length, and the tentacles, when expanded, are placed obliquely over them.

*Polyphyllia pelvis*, Quoy and Gaymard, Voy. de l'Ast. iv., 185, pl. 20, figs. 8-10. The specimen figured was from Port Carteret. Figure 8, which appears to be of the natural size, represents a small shallow basin, inverted, three inches long and three-quarters of an inch deep.

NOTE.—Quoy and Gaymard refer here, and with apparent reason, the *Lithactinia novæ-hiberniæ* of Lesson (Illust. de Zool. Pl. 6). It is described by Lesson as occurring in broad disks, measuring about five inches by four and three quarters, a little concave on one side. The corallum is thin, with the lamellæ about a fourth of an inch long and denticulate. Below, the margin, for nearly half an inch, appears, from the figure, to be striate, and beyond this the points are scattered, though arranged in successive zones (zones or wrinkles of growth?) The tentacles are described as of a bistre colour, irised or rose-coloured above, and bronze below: they are large and inflated, and sometimes ten to twelve lines long. From Lesson's figure A., which represents a mouth surrounded by tentacles, there appear to be some stellate oririmes, like those on the medial line in the *talpa*. This coral was obtained by Lesson at Port Praslin, New Ireland, upon the coral rocks, in one or two feet water, while in the Coquille, in August, 1823.

II. *Oririmis valde conspicuis, nullis medianis seriatis.*

5. POLYPHYLLIA FUNGIA. (*Dana.*)

*P. orbicularis, convexa et subtus concava, polypis omnino sparsis. Corallum subcrassum (4-6'''), oririmis profundis, 1-1½''' latis; lamellis non radiatis, valde prominentibus, tenuissimis, inciso-denticulatis, 3-5''' longis, margine sæpe 6-12''' ; subtus radiatè confertimque echinulatis.*

Circular, convex, and below concave; polyps throughout scattered. Corallum rather stout (4 to 6 lines thick); oririmes deep, 1 to 1½ lines broad; lamellæ not radiate, very prominent and thin, inciso-denticulate, 3 to 5 lines long, and those of the margin 6 to 12 lines; below crowdedly and throughout radiately echinulate.

The convex circular form of the specimen here described, is quite regular; it is about an inch in height, and half an inch thick at middle, and in diameter four inches. It belongs to the collections of the Academy of Natural Sciences at Philadelphia.

In the absence of a medial series of oririmes it resembles the following species; but it is very much stouter, and the oririmes are very distinct.

III. *Oririmis inconspicuis, nullis medianis seriatis.*

6. POLYPHYLLIA PILEIFORMIS. (*Dana.*)

*P. subhemispherica, pileiformis, supernè ampliter rotundata; juniore inversâ, latè patelliformi. Corallum tenue ( $\frac{1}{3}$ " ), fragile; lamellis undique solitariis, 2-3" longis; oririmis nullis nusquam conspicuis.*

Very large, nearly hemispherical or cap-shape, at top very broadly rounded; young specimens broad dish-shape. Corallum thin ( $\frac{1}{3}$  of an inch), fragile; lamellæ every where solitary, 2 to 3 lines long; no distinct oririmes in any part.

Plate 21, fig. 4, lamellæ, natural size.

Feejee Islands. *Exp. Exp.*

In one specimen, of this species, the top of the hemispherical cap is nearly flat for three or four inches in breadth, and hence, when young, it has at first the shape of a nearly flat disk. In this respect it resembles the *pelvis*, but there is no median trench, as in the adult specimens of that species: the lamellæ are throughout solitary. The largest individual in the collections is ten inches in one diameter and eight in the other, with a height of five inches: inverted it looks like a large dish of this depth. It is very fragile, and of quite even thickness throughout, with the under surface striate and strongly scabrous.

7. POLYPHYLLIA GALERIFORMIS. (*Dana.*)

*P. conico-hemispherica, pileiformis, supernè angustè rotundata; juniore inversâ, bene pocilliformi. Corallum tenuissimum ( $\frac{1}{4}$ " ), fragile; lamellis undique solitariis, 1½-2" longis, oririmis nullis nusquam conspicuis.*

*P.* conico-hemispherical, cap-shape, with the top narrow; young specimens inverted neat cup-shape, hemispherical. Corallum quite thin ( $\frac{1}{4}$  of an inch), and fragile; lamellæ every where solitary; 1½ to 2 lines long; no distinct oririmes in any part.



Plate 21, fig. 3, zoophyte expanded; 3 *a*, lamellæ, natural size; 3 *b*, same, enlarged.

Feejee Islands. *Exp. Exp.*

This species resembles the *pileiformis*, but is narrower above, and more conical in shape, when of large size, in consequence of its commencing as a small cup; the small cup of the young state is the top of the adult cap. The lamellæ are also smaller and uniformly so, and the corallum thinner. The small cup-shaped specimens, one of which is figured in the plate referred to, are about three inches in diameter and two in height, and when alive, they are bristled with tentacles, looking something like an Echinus. A large specimen measures ten inches in one diameter, seven inches in the other, and six in height. Excepting the difference of size, the small and large specimens are identical in their characters, and alike differ from the *pileiformis*.

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GENUS VI.—ZOOPIIUS.—DANA.

*Fungidæ liberæ, gemmatæ, explanatæ; polypis undique sparsis, oribus radiatè seriatis. Coralla lamellis majoribus usque ad peripheriam radiatè productis, intermediis minoribus et per oririmas interruptis.*

Free Fungidæ, budding and explanate; polyps every where scattered, mouths radiately seriate. Coralla with the larger lamellæ radiately prolonged quite to the margin, the intermediate much smaller, and these alone interrupted by the oririmes.

In general form and texture the Zoopili resemble the cap-shaped Polyphyllæ (*P. pileiformis*), but in structure they are quite different. The polyp-mouths lie between the large ridges of the surface, which radiate quite to the outer margin. In the corallum these ridges correspond to the larger lamellæ: the oririmes are situated between them, and interrupt the subordinate lamellæ at small intervals. These zoophytes are hence very unlike the other compound free Fungidæ. The animals are still unknown. From the deep dentations of the large lamellæ of the corallum, and the nearly entire margins of the smaller crowded lamellæ between, it may be conjectured that instead

of proper tentacles around the polyp-mouths, there is a series of tuberculiform organs corresponding to tentacles, arranged along over the teeth of the large lamellæ.

In allusion to the cap shapes produced by the species, the generic name is derived from ζῶον, *animal*, and πῖλος, *a cap*.

ZOOPILUS ECHINATUS. (*Dana*.)

*Z. pileiformis, aut inverso patelliformis.* Corallum tenue ( $\frac{1}{2}$ "'), fragile; lamellis majoribus  $\frac{1}{8}$ "' remotis, valde dentatis, dentibus angustis, inæqualibus, et apice granulosis; intermediis tenuissimis, confertissimis, denticulatis; oririmis non bene conspicuis, fermè  $\frac{1}{2}$ "' remotis.

Cap-shape or inverted dish-shape. Corallum thin ( $\frac{1}{2}$  inch), fragile, larger lamellæ  $\frac{1}{8}$  of an inch distant, strongly dentate, teeth narrow, unequal, and granulous at apex, the intermediate lamellæ very thin, much crowded, denticulate; oririmes not very distinct, about  $\frac{1}{2}$  an inch apart.

Plate 21, fig. 6, corallum, natural size; 6 a, outline of part of a section.

Feejee Islands. *Exp. Exp.*

One of the specimens in the Expedition collections is ten inches long, seven broad, and five high; another, more resembling an inverted platter, has nearly the same lateral dimensions, with a height of three inches. The depression at centre in the specimen figured, is an accidental distortion, and not the position of a medial oririme. The larger lamellæ project about one-eighth of an inch above the intermediate, which are three to six in number, nearly equal, very thin, and closely crowded.

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III. *Fungidæ gemmatæ affixæ.*

GENUS VII.—PAVONIA.—LAMARCK.

*Fungidæ affixæ, gemmatæ, explanatæ aut glomeratæ aut interdum subramosæ; polytis obsolescenter tentaculatis, sparsis, raro transversè*



*subseriatis. Coralla superficie stellata et plana, non plicata; oririmis conspicuis, sed cellis nullis; lamellis subintegris, alternis plus minusve minoribus.*

Attached Fungidæ, budding; explanate, glomerate or subramose; polyps obsolescently tentaculate, scattered, rarely transversely subseriate. Coralla having the surface plane and stellate, and not plicate; oririmes distinct, but cells none; lamellæ nearly or quite entire, the alternate somewhat smaller.

The Pavoniæ usually grow in aggregated crest-like folia. Some species consist of leaves, hardly a line thick, gracefully clustered into hemispherical clumps; and others of larger and thicker plates, aggregated so as to intersect and leave angular or polygonal spaces between. The folia usually coalesce by their margins wherever they come in contact.

The animals are like those of the Fungidæ in general character; they are quite small, each seldom exceeding three lines in breadth. When alive and expanded the tentacles appear as mere inflations of the exterior membrane around each polyp-mouth, and are extremely short. In the species examined, the general colour of the zoophyte was some shade of umber or brown, while the mouth and tentacles were the prevailing bright green. The surface of the corallum is covered with neat stars, consisting of minute, nearly entire lamellæ, which pass uninterruptedly from one centre to another, and are often nearly parallel in the intervals. These lamellæ are generally alternately smaller, though sometimes very nearly equal; when the latter they appear much more crowded and numerous. The number in a breadth of one-fourth of an inch, over the inner part of a folium, varies in different species (excluding the *P. explanulata*), from eighteen to twenty-eight, or generally from twenty-four to twenty-eight. Though commonly bifacial, they are sometimes unifacial.

Besides the foliaceous Pavoniæ described, there are also massive species, which should be properly included in this genus. They have been hitherto united with the genus *Astræa*, yet have all the characteristics of a *Pavonia* in their stars and polyps. A glomerate form is no ground for a generic separation.

The Pavoniæ have affinities with the *Astræidæ* through the *Tridacophylliæ*, in some species of which, the foliaceous septa are sparsely covered with oririmes closely resembling those of this genus. They

differ from the Agariciæ in not having the intervals between transverse series of polyps raised into ridges or folds, nor excavate cells like some of the subgenus Mycedia. The Psammocoræ sometimes resemble the Pavoniæ, but are distinct, in the lamellæ not being so regular and so nearly entire, and the stars much less neat, or even indistinct.

The species of this genus are confined to the warm coral-reef seas, and mostly to the Indian and Pacific Oceans.

The genus Pavonia was instituted by Lamarck for the bifacial foliaceous species here included, together with the Tridacophylliæ, of which Blainville made a distinct genus. Some unifacial species, having the essential characters of the genus, are here restored to it, which have been placed with the Agariciæ. Numerous instances,—the genera Echinopora, Merulina, for example,—evinced that the mere fact of the polyp-mouths being confined to one surface or not is comparatively unimportant, as the same species sometimes exemplifies in its different parts the two modes of growth. The glomerate species form part of the group Siderastræa, of Blainville. The Thamnasteriæ of Sauvage, may be in part here included.

The name of the genus alludes to the gracefully spreading forms often presented by the species, and is from the Latin *pavo*, peacock.

*Arrangement of the Species.*

I. *Unifacial; hypocrateriform.*

\*1. *P. explanulata.*

II. *Unifacial; foliaceous.*

2. *P. crispa.*

4. *P. elephantotus.*

\*3. *P. papyracea.*

III. *Bifacial; folia crispate.*

5. *P. cactus.*

\*8. *P. venusta.*

\*6. *P. prætorta.*

\*9. *P. divaricata.*

\*7. *P. formosa.*

\*10. *P. boletiformis.*

IV. *Bifacial; folia nearly flat and not crispate.*

\*11. *P. frondifera.*

\*13. *P. lata.*

\*12. *P. decussata.*

\*14. *P. crassa.*

V. *Glomerate or subramose.*

15. *P. siderea.*

\*17. *P. clavus.*

16. *P. latistella.*

I. *Pavonia unifrontes hypocrateriformes.*1. PAVONIA EXPLANULATA. (*Lamarck.*) *Dana.*

*P. hypocrateriformis*, sæpe distorta et lobata, centro affixa. Corallum  $\frac{1}{4}$ "– $\frac{1}{2}$ " crassum, lamellis confertis, subæqualibus, majoribus alternis, laciniato-denticulatis; oririmis remotè sparsis, sæpe 2" longis; superficie infernâ echinulato-striatâ et porosâ.

Hypocrateriform, often distorted and lobed when large, attached below at centre. Corallum  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch thick, lamellæ crowded, subequal, the larger alternate, laciniato-denticulate; oririmes remotely scattered, often 2 lines long; under surface echinulato-striate and porous.

East Indies. *Exp. Exp.*

A specimen of this species in the Expedition collections, has the shape of a broad somewhat conical disk, supported on a short pedicel; it measures six inches by four in breadth, and is two and a quarter inches deep. The lamellæ have a coarse appearance, quite different from the other *Pavoniæ*, there being but about six of the larger to half an inch in breadth; there is usually a ragged prominence on some of the lamellæ immediately above an oririme. Other specimens seen by the author, were three times the above size, and much contorted.

This species might well form a distinct genus. It looks much like an inverted pedicellate *Halomitra*.

*Mad. pileus*, Esper, vol. i. tab. 6; the figure, though indifferent, is easily recognised.

*Agaricia explanulata*, Lamk., ii. 383, No. 7.

*Agaricia explanata*, Lamouroux, Encyc. 14.

—, Blainville, Man. 361.

—, Schweig., Handb. 415.

II. *Pavonia unifrontes, foliacea.*2. PAVONIA CRISPA. (*Ehrenberg.*) *Dana.*

*P. pumila (sesquipollicaris)*, foliacea, hemispherica, frondibus parvis, 4" latis, distortis, apice rotundatis. Corallum oririmis crebris in facie stirpis inferiore, vix 1" latis.

Small ( $1\frac{1}{2}$  inches), foliaceous, hemispherical, fronds 4 lines broad, distorted, rounded at apex. Corallum with crowded oririmes on the under surface, scarcely a line broad.

This species, described by Ehrenberg, is near the *papyracea*, but is different in form and has smaller and more crowded oririmes.

*Agaricia crispera*, Ehrenb., G. lxvi., sp. 2; locality not known.

### 3. PAVONIA POPYRACEA. (Dana.)

*P. pumila*, foliacea, frondibus solitariis, erectis et valde crispis, tenuissimis (vix  $\frac{1}{3}$ " crassis), multilobatis. Corallum papyraceum; lamellis subtilibus, juxta oririmas prominulis; oririmis paucis et remotis,  $1\frac{1}{2}$ " latis; superficie infernâ obsoletè striatâ, vix scabriusculâ.

Small, foliaceous, fronds solitary, erect, strongly crispate, very thin (scarcely  $\frac{1}{3}$  of a line thick), multilobate. Corallum papyraceous, lamellæ very delicate, a little prominent near the oririmes; oririmes few and remote,  $1\frac{1}{2}$  lines broad; under surface obsoletely striate, very slightly scabrous.

Plate 22, figure 3, corallum, natural size.

The Sooloo Sea. *Exp. Exp.*

This extremely delicate species grows in small fronds, much crisped and lobed, and about one and a half inches high, and two broad. The lamellæ are very neat and minute, a little prominent around the oririmes. The few distant oririmes, of rather large size, and the general mode of growth, distinguish the species from the *crispa*.

### 4. PAVONIA ELEPHANTOTUS. (Pallas.) Dana.

*P. foliacea*, cespitosa, foliis tenuibus, amplis et ampliter crispis, interdum laceris et proliferè productis. Corallum oririmis remotis, grandibus; lamellis subtilibus, non confertis, denticulatis; superficie inferiore striatâ.

*P.* foliaceous, cespitose; folia thin, broad and broadly crispate, sometimes lacerate and proliferously extended. Corallum with the oririmes remote, large; lamellæ thin and delicate, not crowded, denticulate; under surface striate.

East Indies. *Esper.*

This coral, commonly called *elephant's ear*, forms clumps of spreading and erect leaves, crispately curving, having a finely lamello-striate surface, and distant scattered oririmes. The lamellæ are very narrow and even, and rather distant. *Esper* states that the leaves are thin, and even diaphanous. They frequently coalesce by their back surfaces, and thus become bifacial folia. The species is near the *Tridacophylliæ* in habit.

*Madrepora elephantotus*, Pallas, Zooph. 290.  
—, *Esper*, i. 126, tab. 18, figs. 1-4; a clump four and a half inches wide, and three high.

*Agaricia ampliata*, var., Lamk., ii. 381, No. 4.

*Mycedium elephantotus*, Oken, Zool. i. 69.

*Agaricia elephantopus*, Schweig. Handb. 415.

*Agaricia elephantotus*, Ehrenb. G. lxvi.,

sp. 1; *Ehrenberg* refers with a query to *Esper's* figure, and gives the following description: "Quadripollicaris, stellarum diffluentium labiis in frondes bipollicares, crispas et amplas, latè venosas, laceras, proliferasque productis, stellarum centro tumidulo, fere 6''' lato." Folia sometimes bifacial. *Ehrenberg* suggests that if distinct, the species may be named, *megastoma*.

III. *Pavoniæ bifrontes, foliis crispis.*

#### 5. PAVONIA CACTUS. (*Ehrenberg.*)

*P. erecta, lobata, bifrons, lobis foliaceis, crispis, margine rotundatis, crenulatis, sæpe excisis; polypis virentibus, tentaculis obsoletis. Corallum oririmis semilinearibus, seriebus sulco levi conjunctis, subconcentricis, collibus non omnino obsoletis; lamellis subtilibus, arenoso-asperis, obsoletè denticulatis.*

Erect and lobed, lobes foliaceous, crispate, with the margin rounded, crenulate, often excised; polyps green, tentacles obsolete. Corallum with the oririmes half a line broad, series united by a slight trench, subconcentric, separated by ridges not quite obsolete; lamellæ minute, arenoso-asperate, obsoletely denticulate.

Red Sea. *Ehrenberg.*

This description is from Ehrenberg. The species appears to be near the *formosa*, but grows very differently. Ehrenberg mentions that it attains a height of six inches.

*Pavonia cactus*, Ehrenberg, op. cit. G. lxx. *Pavonia cactus*, Lamarck, 2d ed., ii. 378.  
sp. 3. No. 4 a.

#### 6. PAVONIA PRÆTORTA. (*Dana.*)

*P. cespitoso-hemispherica*; foliis gracillimis, bifrontibus, lobato-subdivisis, undique valdè crispis et intortis. Corallum foliis tenuibus (infra 1-1½'''), margine fere papyraceis, oririmis minutis (vix ½'''), sæpius transversim subseriatis cum interstitiis vix minimè convexis; lamellis subtilissimis, confertissimis, alternis vix minoribus.

Cespitoso-hemispherical; folia bifacial, delicate, and lobato-subdivided, every where strongly crispate and contorted. Corallum with the folia quite thin (below 1 to 1½ lines), at the margin, nearly like paper in thickness; oririmes minute (scarcely ½ a line), mostly in imperfect transverse series, with the interstices scarcely at all convex; lamellæ very delicate and crowded, the alternate but little smaller.

Plate 22, fig. 5, part of a clump, natural size; 5 a, a separate folium.

Tahiti, Society Islands. *Exp. Exp.*

The hemispherical clumps of this species, consist of gracefully turned leaves, closely aggregated, and contorted in every direction, and very thin at the margin (hardly a fourth of a line for a fourth of an inch from the summit). The oririmes are much smaller than in the following species, to which it has some resemblance. This species and the following were obtained at Tahiti, by William L. Hudson, Esq., commander of the ship Peacock.

#### 7. PAVONIA FORMOSA. (*Dana.*)

*P. cespitoso-hemispherica*; foliis gracilibus, bifrontibus, lobato-subdivisis,

*curvatis et ampliter subcrispis. Corallum foliis tenuibus, (infra 1½–2"'), margine sæpius acutis; oririmis semilinearibus, sæpe transversim seriatis, interstitiis obsolete convexis, et 1–1½"') latis; lamellis subtilissimis, confertissimis, alternis vix minoribus.*

Cespitoso-hemispherical; folia thin, bifacial, lobato-subdivided, curved and broadly subcrispate. Corallum with the folia thin (below 1½ to 2 lines thick), at the margin usually acute; oririmes ½ a line long, often transversely seriate, with the interstices a little convex, and 1 to 1½ lines broad; lamellæ very delicate, much crowded, the alternate scarcely smaller.

Plate 24, fig. 2, part of a hemispherical clump, natural size.

Tahiti, Society Islands. *Exp. Exp.*

This species grows in hemispherical clumps, like the *prætorta*, but the folia are mostly straight radii to the clump, curving or crispate laterally, and not contorted in every direction; and the curves are large. The oririmes are also larger and more open, and the interstices between series, more raised. It appears to be near the *cactus* of Ehrenberg.

#### 8. PAVONIA VENUSTA. (Dana.)

*P. cespitoso-hemispherica; foliis gracilibus, bifrontibus, lobato-subdivisis, curvatis et valde crispis. Corallum foliis tenuioribus, oririmis parvulis sæpe ½"') superantibus, interstitiis omnino planis, sæpe 2½"') latis; lamellis subtilissimis alternis valde minoribus.*

Cespitoso-hemispherical; folia thin, bifacial, lobato-subdivided, curved and strongly crispate. Coralla with the folia thinner than in the *formosa*; oririmes quite small, often exceeding a little half a line; interstices throughout flat, often 2½ lines in breadth; lamellæ very delicate, the alternate much smaller.

This species in the general form of its folia is intermediate between the *formosa* and *prætorta*. The interstices between different oririmes or lines of oririmes are mostly broader and quite flat, with the alternate lamellæ so unequal that the smaller are scarcely seen without a

glass. These lamellæ are extremely neat, more finely granulous on the lateral surface than in the *formosa*, and much thinner than in the *prætorta*. The specimen affording the description belongs to the collections of the Boston Natural History Society.

9. PAVONIA DIVARICATA. (*Lamarck.*)

*P. cespitosa, plano-hemispherica; foliis bifrontibus, valde subdivisis, lobis carinato-angulatis, flexuoso-divaricatis, crebris et crassis, ¼–½'' latis. Corallum lamellis subconfertis, oririmis sæpe linearibus.*

Cespitose, plano-hemispherical; folia bifacial, very much subdivided, lobes carinato-angular, and flexuoso-divaricate, crowded and stout,  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch broad. Corallum with the lamellæ rather crowded, oririmes often a line long.

Plate 22, fig. 6, natural size.

Indian Ocean. *Lamarck.*—Feejee Islands. *Exp. Exp.*

The upper surface of a clump of this species, presents closely crowded angular lobes, with sharp edges and summits. A branch separated from the clump appears irregularly short-palmate and much crisped, the lobes twisting in every direction. The clumps are often a foot or more in diameter.

*Pavonia divaricata*, Lamk., ii. 378, No. 5. *Pavonia divaricata*, Blainv., Man., 365.  
—, Deslongchamps, Encyc., 665.

10. PAVONIA BOLETIFORMIS. (*Lamarck.*)

*P. subhemispherica; foliis bifrontibus, tenuibus, lobatis, undulatis, subcrispis, lobis 1'' raro superantibus, margine acutis et sæpius sinuosis. Corallum superficie non carinata; lamellis laxis; oririmis sæpe sesquilinearibus.*

Subhemispherical; folia bifacial, thin, undulate or somewhat crispate, lobed, lobes rarely exceeding an inch in breadth, with the margin acute and usually sinuous. Corallum with the surface even and not carinate; lamellæ lax; oririmes often  $1\frac{1}{2}$  lines long.



Plate 22, fig. 7, a single leaf of the corallum, natural size.

East Indies.—Sooloo Sea. *Exp. Exp.*

This is one of the small-leaved species. Their crimped form, and the lax appearance of the lamellæ (arising in part from the fact that the intermediate are so small as to be scarcely seen between the larger), and the non-carinate surface, are the distinguishing characteristics. The oririmes within a third of an inch of the margin are often short and rather indistinct; but others below are an eighth of an inch long.

- Mad. cristata*, Ellis and Solander, 158, tab. 31, figs. 3, 4; represent well the lamellæ of the general surface, but not their closer appearance near the margin. —, Lamouroux, *Exp. Meth.*, 53, pl. 31, figs. 3, 4.  
 —, Deslongchamps, *Encyc.*, 604.  
 —, Blainville, *Man.*, 365.  
*Mad. boletiformis*, Esper, *Fortsetz.* i. 61, tab. 56; a poor figure. —, Ehrenb., *G.* lxx. sp. 2; possibly a different species from that figured by Ellis.  
*Pavonia boletiformis*, Lamarck, ii. 378, No. 4. *Agaricia boletiformis*, Schweig., *Handb.*, 415.

IV. *Pavoniæ bifrontes, foliis planulatis.*

11. PAVONIA FRONDIFERA. (*Lamarck.*)

*P. subhemispherica*; foliis bifrontibus, lobatis, lobis 1–3" latis (sæpius 1½"), 1½" crassis, planulatis et non crispis, apice rotundatis, sæpe verticaliter coalitis et intersectis; margine acutis, tenuibus. Corallum superficie verticaliter carinatâ; lamellis confertis, oririmis vix linearibus, raro seriatis.

Subhemispherical; folia bifacial, lobed; lobes 1 to 3 inches broad (usually 1½ inches), and 1½ lines thick, flat and not crispate; rounded at apex, often vertically coalescent and intersecting one another; margin acute, thin. Corallum with the surface vertically carinate; lamellæ crowded, oririmes scarcely a line long, rarely seriate.

The "Austral Seas." *Peron & Lesueur.*—The Feejees and Singapore. *Exp. Exp.*

The *frondifera* grows in rounded clumps occasionally a foot across,

consisting of lobed folia, sometimes subpalmate, intersecting one another so as to leave between polygonal areas. This structure distinguishes it from the preceding species, and its small size, form, and vertically carinate surface, from the following. The carinæ are most prominent at or near the summit of the folia.

*β. brevicristata*, (Plate 24, figs. 3, 3 a.) A specimen, possibly a young state of the above, has the folia merely short crests a fourth of an inch high or less, arising from a solid base. The crests are carinate as above. The oririmes are very minute, and the stars scarcely half a line in diameter. The specimen is from the Feejee Islands.

## 12. PAVONIA DECUSSATA. (*Dana.*)

*P. subhemispherica*, foliis bifrontibus, subtenuibus, latè paucilobatis ( $\frac{1}{2}$ –4"), planulatis et erectis, sæpe transversim sese intersecantibus (decussatim aggregatis); umbrina, polypis obsoletè tentaculatis, tentaculis, latè virentibus. Corallum subfragile, superficie obsoletè carinatâ; lamellis laxis; oririmis sesquilinearibus, subseriatis.

Subhemispherical, folia bifacial, rather thin, broadly lobed ( $\frac{1}{2}$  to 4 inches), planulate and erect, often transversely coalescent or intersecting one another (decussately aggregated): colour umber, polyps with the tentacles obsolete, bright green. Corallum rather fragile, with the surface obsoletely carinate; lamellæ lax; oririmes  $1\frac{1}{2}$  lines long, subseriate.

Plate 22, fig. 4, corallum, natural size; 4 a, animals, enlarged; 4 b, section of a plate.

Feejee Islands. *Exp. Exp.*

The folia are nearly flat and few-lobed, and are so aggregated and united transversely by others, as to form an open cellular clump with subquadrangular spaces among the plates, from half an inch to two inches broad. The largest plate in the specimens obtained was four inches broad and nearly as high, sparingly lobed, with the margin a little curved. The carinæ of the surface are barely distinguishable, and rarely reach the upper margin; they are seldom seen in young specimens. Small nearly circular plates or folia often grow out as processes from the surface of a large plate. Under the micro-

scope the lamellæ appear very thin, with the lateral surface granulous.

The texture of the corallum is more porous than in most of the Pavoniæ, and at the margin it is consequently rather fragile. The thickness is generally about one-eighth of an inch, though two to three lines below. The less crowded lamellæ, large oblong oririmes, and scarcely carinate surface, distinguish this species from the *frondifera*.

### 13. PAVONIA LATA. (*Dana.*)

*P. maxima, foliis pedilibus, planulatis aut paulo undulatis, margine tenuibus et parcè lobatis, basi  $\frac{1}{2}$ – $\frac{3}{4}$ " crassis. Corallum margine fragile, superficie non minimè carinatum; lamellis laxis; oririmis sesquilinearibus et raro seriatis.*

Very large, folia a foot broad, planulate or slightly undulate; margin thin and sparingly lobed,  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch thick at base. Corallum with the margin fragile and surface not at all carinate; lamellæ lax; oririmes a line and a half long, and rarely in transverse series.

Plate 23, fig. 1, outline view of corallum; 1 *a*, part of the surface, natural size.

Feejee Islands. *Exp. Exp.*

A frond of this species, in the Expedition collections, measures fifteen inches broad and ten inches high; the margin is divided into a few low broad lobes. On one side there is a smaller curved plate attached nearly at right angles with the surface. Two inches from the upper margin the frond is about one-third of an inch thick. As the intermediate lamellæ are much smaller than the others, the stars have a very open appearance, as in the *decussata*, and even more strikingly so. This species has much larger oririmes, more lax lamellæ, and a thinner and a more fragile corallum, than the *crassa*; and besides its larger size, it differs from the *decussata* also in its coarser, stouter, and more open lamellæ, and a broader oririme, with a stony bottom distinctly in view.

14. PAVONIA CRASSA. (*Dana.*)

*P. maxima*, foliis 6–9" latis, crassimis, planulatis vel paulum undulatis aut curvatis, paucilobatis, erectis, decussatim aggregatis et coalitis; margine sæpius acutis. Corallum robustum, margine non fragile, superficie non carinatum; lamellis confertis; oririmis vix oblongis, interdum subseriatis.

Very large, folia 6 to 9 inches broad, very stout, nearly flat or somewhat undulate or curved, few-lobed, erect and decussately aggregated, margin usually acute. Corallum firm, margin not fragile, surface not carinate; lamellæ crowded; oririmes scarcely oblong, sometimes subseriate.

Plate 23, fig. 2, corallum, natural size; 2 *a*, surface of same, magnified; also, plate 24, 1, 1 *a*, another variety.

Feejee Islands, and Singapore. *Exp. Exp.*

This species is remarkable for its thick and stout plates, the close lamellæ, and small size of the stars. There are several varieties deserving mention.

*α. ascia* (Plate 23, fig. 2). Folia six inches broad, the same in height, scarcely lobed, a little curved, one inch thick at bottom, and the same to within three inches of the top, subacute above, a few obsolete carinæ.—*Feejees.*

*β. obtusa* (Plate 24, fig. 1). Folia of the same size as in the last, but much curved, and with an obtuse undulate margin, one-fourth of an inch thick; at bottom, three-fourths of an inch.—*Feejees.*

*γ. loculata*. Folia nine inches broad, eight high, nearly an inch through at base, and half an inch, two inches from the upper margin; the plates intersect vertically, leaving between, large subquadrangular spaces, often two to three inches wide.—*Singapore.*

III. *Pavonia glomerata.*15. PAVONIA SIDEREA. (*Ellis & Solander.*) *Dana.*

*Subglobosa*. Corallum oririmis 3–4" remotis, interstitiis vix elevatis; lamellis denticulatis.

Subglobose. Corallum with the oririmes 3 to 4 lines distant, interstices scarcely elevated; lamellæ denticulate.

West Indies?

This species, figured by Ellis, has the even stellate surface of a Pavonia. The distance of the oririmes above given, is taken from Ellis's figure.

*Mad. siderea*, Ellis and Sol., 168, tab. 49, fig. 2. *Siderastræa siderata*, Blainv., Man., 370.  
*Astræa siderea*, Lamk., ii. 417, No. 30. Lesueur's *A. siderea* (Mém. du Museum, vi. 286, pl. 16, fig. 14), appears to be a different species, and is probably a true *Astræa*.  
 —, Lamour., Exp. 60, tab. 49, fig. 2; Encyc., 126.

#### 16. PAVONIA LATISTELLA. Dana.

*Incrustans, planiuscula. Corallum oririmis fere ½" remotis, interstitiis planis; lamellis integris, undulatis.*

Incrusting, nearly flat. Corallum with the oririmes nearly ½ an inch distant, interstices flat; lamellæ entire, undulate.

Port Carteret, New Ireland. Quoy & Gaymard.

This species, described by Quoy and Gaymard as identical with the *Astræa diffluens* of Lamarck, is stated by them to have the flat radiate stars of a Fungia. It is near the *S. siderea*, but according to the figure given by these authors, the oririmes are more distant, and the interstices are not at all elevated or convex. It occurs in thin incrustations.

*Astræa diffluens*, Quoy and Gaymard, Voy. de l'Ast., iv. p. 212, pl. 17, figs. 15, 16; the animal here figured appears not to have been expanded.

#### 17. PAVONIA CLAVUS. (Dana.)

*P. arrecto-cylindrica, 1-3" crassa, interdum obsoletè compressa, apice rotundata, interdum lobato-furcata; polypis tentaculis obsoletis, lætè virentibus. Corallum oririmis 1-1½" remotis, et apice minoribus; lamellis integris.*

Erect cylindrical, 1 to 3 inches in diameter, sometimes a little compressed, rounded at apex, occasionally lobato-furcate; tentacles obsolete, bright green. Corallum with the oririmes 1 to 1½ lines distant, and smaller at apex; lamellæ entire.

Plate 24, fig. 4, corallum, natural size; 4 *a*, animal, enlarged; 4 *b*, star of corallum, magnified.

Feejee Islands. *Exp. Exp.*

This species grows in stout cylinders, attaining a height of six inches or more, and covering crowdedly areas of considerable extent. It resembles the *siderea*, but the stars are much smaller and its mode of growth quite different. The animals are similar in every respect to those of the *Pavoniæ*.

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GENUS VIII.—AGARICIA.—LAMARCK.

*Fungidæ affixæ, obliquè vel rectè explanatæ, unifrontes aut bifrontes; polypis transversè seriatis, latere externo valde turgido; interdum subseriatis et circum ora omnino elevatis; itaque oribus, in imis fossis transversis aut cellis, dispositis. Coralla sæpius collibus transversis rugata, interdum reticulata; lamellis minutis, subintegris confertissimis, minoribus alternis.*

Attached *Fungidæ*, oblique or erect explanate, unifacial or bifacial; polyps transversely seriate with the outer side prominent; sometimes subseriate with the parts around each mouth elevated; hence the mouths are arranged either at the bottom of transverse fossæ or of cells. Coralla transversely or reticulately colliculate; lamellæ minute, subentire, crowded, alternately smaller.

The genus *Agaricia* connects on the one side with the *Pavoniæ*, and on the other with the *Astrææ*, and includes properly two groups, which, however, are connected by gradual transitions. In one, the folia are unifacial, and grow against the sides of a reef-rock, like the

lichens against a stump. The outer surface in these consists of a series of parallel ridges, transversely striated with very minute lamellæ, and having puncture-like oririmes at the bottom of the valleys, and rarely upon the ridges. The wave-like appearance of the surface suggested the name *Undaria*, which Oken applied to the group, from *unda*, a *wave*; while the mode of growth and general appearance led to Lamarck's appellation *Agaricia*, from *Agaricus*, a mushroom. As the plates grow nearly erect, the formation of these ridges is nothing but the extension by growth of the outer or free sides of the seriate polyps, actually nearly horizontal in position. The under or back surface is very finely striated, and nearly flat. These *Agariciæ* are sometimes attached by a margin, and spread only upward; in other instances, they spread in every direction from the point of attachment, but more upward than downward, and thus assume reniform shapes.

In another group—the subgenus *Mycedia*,—the species are sometimes unifacial, and nearly resemble the preceding; but they are also often erect and bifacial. The polyps are generally more or less seriate, but many have distinct cells, or fossæ consisting of coalescing cells; the ridges, instead of being evenly transverse, have frequently a reticulate aspect. The texture of the corallum is peculiar in being very solid. In the species of *Mycedia* which connect the two groups, the transverse ridges are regular about the centre of the frond, but at the margin they consist distinctly of more or less coalescent cells. The name adopted for them was given by Oken to a genus including a characteristic species; the word is from  $\mu\upsilon\chi\eta$ , a *fungus*. The outer limits of the two groups are very distinct in their appearance, yet they so pass into one another that they are here retained as subgenera of one and the same genus.

The *Mycediæ* are peculiar to the West Indies, while the *Undariæ* are almost exclusively from the Pacific and Indian Oceans. The former sometimes resemble the *Astrææ* in their cells, but, as in the *Psammocoræ*, these cells arise only from an enlargement outward of the parts of the animals around the mouths. The lamellæ are much more minute and crowded than in the true *Astræas*, and the animals have no distinct disks, the whole surface being, properly, a single compound disk (as explained in § 78), which follows all the hills and valleys of the surface.

The *Agariciæ* resemble the *Pavoniæ*, but the latter have a plane or

flat surface, without valleys or cells. They approach also the *Psammocoræ*, but these have the lamellæ more or less indistinct and raggedly though minutely denticulate, giving the surface a sanded appearance.

The genus *Agaricia* of Lamarck included only the unifacial species of these two subgenera, together with some other unifacial corals, of the genus *Manopora*—Blainville's *Montipora*—and the *A. ampliata*. For the last, as already stated, Ehrenberg instituted the genus *Merulina*.

*Arrangement of the Species.*

SUBGENUS 1. *UNDARIA*. Unifacial, superior surface transversely rugate, with minute oririmes at the bottom of the furrows (rarely others on the ridges): no distinct cells in any part. (The species are arranged in the order of the prominence of the ridges, which, in the *planulata*, are obsolescent, with some nearly superficial cells.)

- |                          |                            |
|--------------------------|----------------------------|
| *1. <i>A. undata</i> .   | *4. <i>A. levicollis</i> . |
| *2. <i>A. rugosa</i> .   | *5. <i>A. planulata</i> .  |
| *3. <i>A. speciosa</i> . |                            |

SUBGENUS 2. *MYCEDIA*. Unifacial or bifacial; surface either transversely rugate with at least the marginal rugæ consisting of a series of cells, or else every where reticulate with fossæ made up of cells. Texture firm, lamellæ minute and neatly regular.

I. *Unifacial*.

- |                                  |                                 |
|----------------------------------|---------------------------------|
| *6. <i>A. Myced. cucullata</i> . | *8. <i>A. Myced. fragilis</i> . |
| 7. <i>A. Myced. purpurea</i> .   |                                 |

II. *Glomerate from an explanate base*.

- \*9. *A. Myced. gibbosa*.

III. *Foliaceous, bifacial*.

- |                                    |                                  |
|------------------------------------|----------------------------------|
| *10. <i>A. Myced. agaricites</i> . | *11. <i>A. Myced. cristata</i> . |
|------------------------------------|----------------------------------|

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SUBGENUS I—UNDARIA.

*Agariciæ transversè rugatæ; superficie nusquam cellis nullis excavatâ; oririmis minutis fossarum fundo dispositis.*

Transversely colliculate; no excavate cells in any part; oririmes minute and arranged along the bottom of the fossæ.



## 1. AGARICIA UNDATA. (Ellis.) Lamarck.

*A. latissimè explanata, et sæpe plano-subcucullata, vix lobata; margine tenui et non revoluto; collibus elongatis, et subæqualibus, maximis, sæpius  $\frac{1}{3}$ " latis, rotundato-triangulatis, ad extremum obsoletis.*

Very broad explanate, and often plano-subcucullate, scarcely lobed, margin thin and not revolute; ridges long and rather even, mostly  $\frac{1}{3}$  of an inch broad, rotundato-triangular, becoming obsolete at the margin.

Plate 21, fig. 8, surface of corallum, natural size.

West Indies.

A specimen of this species from Key West, in the American Museum, New York city, measures eighteen inches by twelve; it is flat cucullate, and nearly reniform in shape, with an undulate surface, and a thin subsinuuous margin. The ridges are concentric with the margin, and occasionally interrupted. The largest are about one-fourth of an inch high, with an obtuse angle at top. Those near the margin are very small and irregular. The oririmes are distinct in the furrows, and about a line long. Another specimen, in the collections of the Academy of Natural Sciences, at Philadelphia, measures fifteen inches by eight.

*Mad. undata*, Ellis and Sol., 157, tab. 40; *Agaricia undata*, Lamour., Exp. Meth. 54, a poor figure of part of a frond. pl. 40.  
 —, Esper, Fortsetz. i. 98, tab. 78; from —, Blainv., Man. 361; also *Pavonia* Ellis, *undata*, ibid., 365.  
*Agaricia undata*, Lamk., ii. 381, No. 2. *Undaria undata*, Oken, Zool. i. 69.

## 2. AGARICIA RUGOSA. (Lamarck.)

*A. latè explanata, crassa, parcè inciso-lobata et interdum amplissimè subpalmata; margine crasso, valde reflexo; collibus grandibus, sæpe interruptis et valde inæqualibus, basi 2-3" crassis, apicibus sæpe productis: polypis subrubidis, tentaculis obsoletis.*

Broad explanate, stout, sparingly inciso-lobate, and sometimes wide

subpalmate, margin strongly reflexed; ridges large, often interrupted and very unequal, 2 to 3 lines thick at base, with the summits often much prolonged; polyps reddish-brown, tentacles obsolete.

Plate 22, fig. 1, part of corallum, natural size; 1 *a*, the animals enlarged; 1 *b*, longitudinal cross-section, enlarged; 1 *c*, transverse, do.

“Austral Seas.” *Peron & Lesueur*.—Feejee Islands. *Exp. Exp.*

This species forms large plates, half an inch thick, attached by one edge to the side of a vertical rock, in one to three fathoms water; the upper margin is often deeply lobed, the lobes being two to three inches long and wide. It differs from the preceding, in its stout reflexed margin, and very uneven ridges, which have the summit much projecting, or in peaks, in many parts. The oririmes are numerous along the bottom of the furrow, and others are occasionally seen on the surfaces of the larger ridges.

*Agaricia rugosa*, Lamk., ii. 381, No. 3. *Agaricia rugosa*, Blainville, Man. 361.

### 3. AGARICIA SPECIOSA. (*Dana*.)

*A. cucullato-explanata, subreniformis, tenuis, et margine non reflexa; collibus prominentibus, angustis (1-1½''), subtriangulatis, subæqualibus. Corallum margine fragile, superficie inferiore subtiliter striatum.*

Cucullato-explanate; subreniform, thin, margin not reflexed; ridges prominent, narrow (1 to 1½ lines), subtriangular, nearly even. Corallum with the margin fragile, and under surface very finely striate.

Plate 21, fig. 7, corallum, natural size.

East Indies. *Exp. Exp.*

This is a neat species with even prominent narrow ridges, and the frond very thin for two inches from the margin. The lamellæ of the corallum are extremely minute, rendering the surface very delicately striate. The only specimen seen is nearly reniform in shape, and measures six inches by four in breadth, with the greatest thickness hardly a fourth of an inch.

## 4. AGARICIA LEVICOLLIS. (Dana.)

*A. latè explanata, paulo undulata, tenuis (1½–3'''); collibus elongatis, fere obsoletis, angustis (1–1½''). Corallum oririmis seriatis, inconspicuis; superficie inferiore subtiliter striatula.*

Broad explanate, a little undulate, thin (1½ to 3 lines); ridges elongate, nearly obsolete, narrow (1 to 1½ lines). Corallum with the oririmes seriate, indistinct; under surface finely striate.

Plate 22, fig. 2, part of corallum, natural size.

East Indies. *Exp. Exp.*

This species forms large thin fronds, with long narrow nearly obsolete ridges, very minute lamellæ, about equal under a microscope, and indistinct seriate oripores. A part of a frond in the Expedition collections measures six inches by twelve in breadth, and the whole when complete was probably not short of eighteen by twelve.

## 5. AGARICIA PLANULATA. (Dana.)

*A. latè explanata, subtus affixa, tenuis (1½''); polyphis sæpe seriatis, sæpe sparsis. Corallum collibus interstitialibus obsoletis, et sæpe cum cellis polygonis fere superficialibus sparsis, 1–2'' latis; superficie inferiore concentricè et radiatè plicatula, striis subtilissimis et paulo divergentibus.*

Broad explanate, attached by a point on the under surface; thin (1½ lines); polyps either seriate or scattered. Corallum with obsolete interstitial ridges, or with polygonal cells nearly superficial, and 1 to 2 lines broad; under surface concentrically and radiately faint plicate, striæ very fine and a little divergent.

This species is closely allied to the Mycediæ. The corallum is remarkable for its numerous scattered oririmes at the centre of polygonal cells nearly superficial, and for the obsolete ridges between the seriate oririmes. The radiate plicæ of the under surface are nearly a fourth of an inch wide, and give it a peculiar appearance; the striæ,

scarcely visible without a glass, appear slightly to diverge, so as to meet successively in the depressions. The specimen affording this description, belongs to the Lyceum of Natural History at Utica, New York. It is ten inches broad, with a thickness of about an eighth of an inch, and a thin margin.

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SUBGENUS II.—MYCEDIA.

*Agariciæ transversim aut reticulatè colliculatæ, fossis interdum regularibus, sed sæpius cellis distinctis compositis. Coralla robusta, vix minimè cellulosa.*

Surface with transverse or reticulate ridges; fossæ sometimes long and even, but usually consisting of separate excavate cells, clustered or seriate (cells sometimes distinct only along the fossæ near the margin). Coralla very compact.

I. *Mycediæ unifrontes.*

6. A. MYCEDIA CUCULLATA. (*Ellis.*) *Oken.*

*A. unifrons, stipitata, subturbinata; frondibus sæpe convolutis et basi coalitis; supra concava, transversè colliculata, collibus subflexuosis et irregularibus, etiam multis cellis profundis sparsis. Corallum robustum, subtus subtilissimè striatum.*

Unifacial, stipitate, subturbinate; fronds often convoluted and coalescing at base; above concave, with transverse ridges subflexuous and irregular, and frequent deep cells interspersed. Corallum very firm and compact, below very finely striate.

West Indies.

When young this coral forms a simple funnel-shaped frond supported below at centre; but when larger it consists of several involved fronds spreading from the same base, or cucullate in arrangement.

Though not thick the texture is very firm and compact, as in the other Mycediæ. The ridges are formed by the more or less perfect confluence of deep unequal cells in transverse or concentric series; they are irregular, but have a neatly striate surface. The cells are one and a half to two lines wide at top.

*Mad. cucullata*, Ellis and Sol., 157, tab. 42. —, Lamour. Exp. 54. tab. 42; Encyc. —, Esper, Fortsetz. i. tab. 67; from 12, pl. 484.  
 Ellis. —, Blain., Man. 360, pl. 56, fig. 3; bad.  
*Agaricia cucullata*, Lamk. ii. 380; No. 1. *Mycedium cucullatum*, Oken, Zool. i. 69.

#### 7. A. MYCEDIA PURPUREA. (*Lesueur.*)

*A. foliacea, unifrons, plerumque incrustans; supra concava, undulata; cellis profundis, nunc in sulcis irregularibus seriatis, nunc aggregatis, itaque superficie irregulariter aut reticulatè colliculatâ; polypis obsolete tentaculatis, labris luteolis, discis luteo-radiatis. Corallum marginè acutum; subtus, subtiliter striatum et concentricè undulatum.*

Foliaceous, unifacial, for the most part incrusting, concave above and undulate, with deep cells arranged either in series or irregularly grouped, and the surface therefore irregularly or reticulately colliculate; polyps with the tentacles obsolete; lip yellowish, and disks with yellow rays. Corallum with the margin acute; below finely striate and concentrically undulate.

St. Thomas, West Indies. *Lesueur.*

Lesueur describes this species as growing to a breadth of eight or twelve inches, incrusting whatever may be in its way. It is near the *cucullata*, but appears from this character to be distinct. According to the figure the cells are one and a half to two lines broad, and less frequently seriate than in the *cucullata*. The tentacles are described as replaced by mere expansions of the membrane. The mouth is oblong plicate within, and bordered by a circle of pale yellow, and exterior to this circle there are eight yellow points, from which proceed radii of a pale yellow colour, with two or three others much fainter, between the more distinct. The general colour is purple, passing into sienna-brown near the border of each polyp.

*Agaricia purpurea*, Lesueur, Mém. du Mus. vi. 276, pl. 15, figs. 3, a, b, c.

8. A. MYCEDIA FRAGILIS. (*Dana.*)

*A. unifrons, stipitata, latè explanata, et subhypocrateriformis, tenuissima; polyptis parvulis, sæpius transversè seriatis, seriebus per colles elongatas  $1\frac{1}{2}$ " latas separatis. Corallum margine subpapyraceo, longè pellucido et fragili; fossis vix  $\frac{3}{4}$ " profundis, et ad marginem caliculis seriatis instructis, cellis (oririmis)  $\frac{3}{4}$ " latis; subtus subtilissimè striatum et concentricè undulatum.*

Unifacial, stipitate, broadly explanate, and somewhat hypocrateriform, very thin; polypts small, mostly in series, which are separated by even ridges  $1\frac{1}{2}$  lines broad. Corallum with the margin subpapyraceous, and, for a considerable breadth, translucent and quite fragile; fossæ scarcely  $\frac{3}{4}$  of a line deep, and often near the margin composed of seriate calicles; cells (oririmes)  $\frac{3}{4}$  of a line broad; under surface very finely striate and concentrically undulate.

West Indies. *Boston Nat. Hist. Soc.*

This species has much the habit and appearance of an *Undaria*, and in size and thickness is near the *speciosa*; but the oririmes are like small cells, and the fossæ consist mostly of a series of them. Near the margin, there are distinct calicles, many isolated, others in lines, but each with its own convex exterior. The specimen examined was six inches by four and a half in breadth, with the concavity an inch deep; the corallum was about an eighth of an inch thick at centre, and hardly an eighth of this at the margin, which, for an inch, was translucent. In the centre of the frond, the ridges become nearly obsolete. This species has much of the habit of the *A. undata*, and might, with equal propriety, be placed among the *Undariæ*.

II. *Glomeratæ, sed basi explanatæ.*

9. A. MYCEDIA GIBBOSA. (*Dana.*)

*A. crassè gibboso-glomerata, et angulata, subtus latè planulata, parcè undulata et centro stipitata; polyptis sæpe reticulatè subseriatis, sæpius sparsis; collibus undique reticulatis, triangulatis, et fere acutis, fossis*

*brevibus, 1-3''' latis, et grandioribus fundo sæpe reticulatis. Corallum robustum, subtus subtilissimè striatum.*

Coarse gibboso-glomerate and angular, below broad planulate, sparingly undulate, and stipitate at centre; polyps often reticulately subseriate, but generally scattered; surface reticulate with ridges which are triangular and nearly acute; fossæ short, 1 to 3 lines broad, and the larger often reticulate at bottom. Corallum below very finely striate.

Barbadoes, West Indies.

The specimen affording the above description, has a nearly flat under surface, measuring seven inches by four in breadth, a little convex and undulate, and finely striate like the unifacial species. But above at middle it rises into a glomerate gibbous column, four inches high and one to three broad, with angular prominences, and the whole surface unevenly reticulate, the larger ridges often enclosing small polygonal or oblong areas, which are reticulate within with other smaller ridges. The lamellæ are alternately larger, and nearly entire; and under the microscope are very thin.

III. *Foliacea, bifrontes.*

#### 10. A. MYCEDIA AGARICITES.

*A. bifrons et erecta, frondibus sæpe aggregatis, crassis, semi-rotundis, polypis transversè seriatis; collibus transversis, subacutis, sæpe flexuosis; fossis 1½''' latis et 1''' profundis. Corallum robustum.*

Bifacial and erect, fronds often aggregated, stout, semicircular in outline; polyps transversely seriate; ridges transverse, subacute, often flexuous, fossæ 1½ lines broad and 1 deep. Corallum firm and compact.

West Indies.

A stout, very compact, hard coral, growing in sparse clusters of sparingly lobed fronds, rounded in outline, with a nearly acute edge, and a neatly rugate or ridged surface. The furrows are longer and more even than in the *cristata*, and not so broad.

- Mad. agaricites*, Linn. Ed. xii., 1274. —, Ellis and Solander, 159, tab. 63; the figure is not good, if intended to represent this species.
- , Pallas, Zooph., 287; the description by Pallas, and also that in Linnæus, applies even better to the *cristata* than to this species, to which Lamarck refers them.
- , Esper, i. 132, tab. 20; characteristic, with an enlarged view of the surface.
- Pavonia agaricites*, Lamk., ii. 376, No. 1.
- , Lamour., Exp. Meth. 53, tab. 63.
- , Deslongchamps, Encyc. 604.
- , Blainville, Man. 365.
- Pavonia cristata*, Ehrenb., G. lxx., sp. 1.

11. A. MYCEDIA CRISTATA. (*Lamarck.*)

*A. bifrons et erecta; frondibus elongatis et profundè lobatis, lobis rotundatis, cristatis; polyphis subseriatis et sæpe sparsis; collibus interdum transversis, sæpius sinuosis et reticulatis, subacutis aut obtusis, cellas 2-2½'' latas includentibus.*

Bifacial and erect; fronds long and deeply lobed, lobes rounded, cristate; polyyps subseriate and often scattered; ridges sometimes transverse, but generally sinuous and reticulate, subacute or obtuse, and including cells 2 to 2½ lines broad.

West Indies.

This species forms fronds, deeply lobed or even subpalmate, the lobes being often one to one and a half inches wide, two to three long, and one-fourth of an inch thick. The corallum has a very firm stony texture, with the edge of the lobes subacute and often cristate. The furrows of the surface are much meandering, and there are many scattered isolated cells, and others with definite outline in the furrows. This species appears to differ from the *agaricites* in its wider and deeper trenches, and its narrower and longer lobes.

*β. tenuifolia.* Another specimen examined has the folia more than one-half thinner, and somewhat crisped, with the polyyps scarcely seriate, except imperfectly so near the margin, the ridges low and rounded, and often obsolescent, and the oririmes three-fourths of a line wide, more coarsely stellate and scattered. It may be a different species. Ellis's figure, referred to under the *agaricites*, has much resemblance to it in its cells and surface.

- Pavonia cristata*, Lamk. ii. 377, No. 2. —, Deslongchamps, Encyc., 604.
- Pavonia cristata*, Blainv., Man., 365.



## GENUS IX.—PSAMMOCORA.—DANA.

*Fungidæ affixæ, glomeratæ, aut ramosæ; polypis obsoletè tentaculatis, non seriatis; interstitiis interdum planulatis, sæpius undique turgidè elevatis; itaque superficie cellis interdum excavatâ. Coralla porosa; oririmis minutis; lamellis subtilissimis, minutè arenoso-denticulatis, sæpius irregularibus, alternis non minoribus.*

Attached Fungidæ, glomerate or ramose; tentacles of polyps obsolete, polyps not seriate; interstices sometimes flat, usually throughout turgidly elevated, the surface, then, consisting of excavate cells. Coralla porous; oririmes minute; lamellæ very minute, often indistinct, and very minutely arenoso-denticulate, often irregular, not alternately smaller.

The large excavate cells, sometimes meandering, of many of the Psammocoræ, give them much the appearance of certain Astræas, or Meandrinæ, yet they have properly the characteristics of the Fungidæ. The lamellæ are very minute, even, and granulous, like the Agariciæ (though peculiar in not being entire), and the oririmes are distinct though small. Moreover, the polyps are without tentacles. A close examination of the animals shows that the cells arise merely from the growth or enlargement of the interstitial parts, above the level of the polyp-mouths. They do not correspond to the visceral cavity of the animal; for when expanded, there is no disk, as in the Astræas, rising above the bottom of the cell: the surface integument follows all the excavations and ridges of the surface, precisely as in the Agariciæ. Unlike the Mycediæ, the internal texture is quite porous. There are some branching corals that have the peculiar lamellæ of the Psammocoræ, but without excavate cells; as the former character appears to be of paramount importance, they are placed in this genus, rather than with the Pavoniæ, which have the lamellæ entire, or nearly so. As in the Pavoniæ, there are eighteen to twenty-eight lamellæ in a breadth of a quarter of an inch.

The Astræa galaxea is near the Psammocoræ in its fine lamellæ,

minutely (though more neatly) denticulate; and an examination of the animal may require its removal to this genus.

The name of the genus is from the Greek ψαμμος, sand, and alludes to the appearance of the surface. The group includes part of the *Thamnasteriæ* of Le Sauvage.

*Arrangement of the Species.*

I. *Cespitose.*

\*1. *P. obtusangula.*

\*2. *P. plicata.*

II. *Glomerate.*

\*3. *P. fossata.*

\*5. *P. exesa.*

\*4. *P. columna.*

I. *Psammocoræ cespitosæ.*

1. *PSAMMOCORA OBTUSANGULA.* (*Lamarck.*) *Dana.*

*P. cespitosa, subhemispherica, creberrimè ramosa; ramis multilobatis, flexuoso-plicatis, obtusis. Corallum oririmis conspicuis, rotundis,  $\frac{1}{3}$ " latis, stellis interdum paulo impressis, nusquam seriatis.*

In subhemispherical tufts, very closely branched; branches flexuoso-plicate, many-lobed, lobes short and obtuse. Corallum with the oririmes distinct, circular,  $\frac{1}{3}$  of a line broad, stars sometimes a little depressed, no where seriate.

Indian Ocean? *Lamarck.*

This species has the habit of the *Pavonia divaricata*, but the surface has a sanded appearance, owing to the minute scabrous denticulation of the hardly distinct crowded lamellæ, and the angles of the lobes are rounded: the lamellæ become irregular and often confluent or interrupted between the stars. In the comparatively large and distinct oririme, and the slightly depressed star, this species is very distinct from the following. The branches of the clump are crowded almost to contact. The stars are a line in diameter. The clump examined by the author was three inches across and two and a quarter high.

*Pavonia obtusangula*, Lamk., ii. 379, No. 7.

—, Deslongchamps, Encyc. 605.

—, Blainville, Man. 365.

The *Pavonia obtusangula* of Ehrenberg, (op. cit. Gen. lxx. sp. 4,) is thus described by this author, who queries whether it be Lamarck's species: "Bipolli-

caris, erecta, lobata, lobis rotundatis, planis, collibus prominulis nullis, stellis minimis,  $\frac{1}{3}$ " latis, planis, vix impressis, in series subconcentricas dispositis, lamellis subtilissimis, venoso-filiformibus."

The locality is not known.

## 2. PSAMMOCORA PLICATA. (*Dana.*)

*P. cespitosa, plano-convexa, crebrè ramosa, ramis  $\frac{1}{4}$ – $\frac{3}{4}$ " latis, flexuosis et flexuoso-plicatis, sæpe coalitis, undique obtusis; polypis umbrinis, tentaculis obsoletis, albido-virescentibus. Corallum oririmis minutissimis, vix conspicuis, in series longitudinales sæpe dispositis, stellis vix dispiciendis, non impressis.*

Cespitose, plano-convex, crowdedly ramose, branches  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch broad, flexuous and flexuoso-plicate, often coalescing below, obtuse; polyps umber-colour, tentacles obsolete, greenish-white. Corallum with very minute oririmes, scarcely visible, often arranged in longitudinal series; stars hardly distinguishable, not at all depressed.

Plate 25, fig. 2, corallum, natural size; 2 *a*, animals enlarged; 2 *b*, surface enlarged.

Feejee Islands. *Exp. Exp.*

The dense tufts which this species forms, are often ten inches or a foot across, and somewhat convex above. The branches are much plicate, as in the last, but the surface is smooth, without any appearance of a depression about the very minute and hardly distinguishable oririmes. The longitudinal series of oririmes are one to one and a half lines apart, and the oririmes of the same series about half a line. This species resembles the *Porites plicata*, but the plications are neater, and the cells have not six points about the centre, as characterizes the *Porites*.

Lamarck's *Pavonia plicata* (ii. 378, No. 6) may be identical with the above; but he refers to Esper's tab. 66 (Fortsetz. i.), which represents the *Porites plicata*, or an allied species.

II. *Psammocora glomerata*.3. PSAMMOCORA FOSSATA. (*Dana*.)

*P. subcylindrica*, 5" crassa, superficie fere planâ, apice plano-rotundatâ; superficie cellis sæpe 1" elongatis, submeandrinis et hexastomatis, aliis simplicibus,  $1\frac{1}{2}$ " profundis et  $1\frac{1}{2}$ –2" latis, excavatâ; collibus rotundatis.

Subcylindrical, 5 inches thick, surface nearly even, plano-rotund at top; surface with cells often an inch long and meandering, and containing 6 polyp-mouths, others simple,  $1\frac{1}{2}$  lines deep, and  $1\frac{1}{2}$  to 2 lines broad; ridges rounded.

Plate 26, fig. 2, outline view of corallum; 2 a, surface of the same, natural size.

Feejee Islands. *Exp. Exp.*

The only specimen of this species seen is five inches high, and the same in its longest diameter. It has some resemblance to the *columna*, but is not flat-topped, the cells are larger and deeper, and many elongate and lobed, or meandering.

The *Astræa Meandrina* of Ehrenberg, from the Red Sea (op. cit. Gen. lx. sp. 14.), has many of the characters of the above species, and is thus described: "Subpedalis (et orgyalis?), globosa, stellis contiguâs, inæqualibus, angustissimis, interdum pollicaribus, angulosis, polystomis, lamellis subtilissimis, confertissimis, denticulatis et arenoso-asperis, rotundatis, in crista non confluentibus; animal fuscum, tentaculis nullis." It is supposed by Ehrenberg, to be near the *Astræa diffluens* of Lamarck, which has entire lamellæ, and is incrusting and plano-undate.

4. PSAMMOCORA COLUMNA. (*Dana*.)

*P. erecta*; crassima, subdivisa, lobis erectis, et fere contiguâs, compresso-cylindricis, apice truncatis, 1–3" latis; superficie planâ, cellis profundis, subangulatis, interdum lobatis, 1" latis, raro 3" elongatis excavatâ; collibus rotundatis.

Erect, very stout, subdivided above, lobes erect and crowded, compressed-cylindrical, truncate at apex, 1 to 3 inches broad, surface

even, with deep cells, subangular, sometimes lobed, a line broad, sometimes 3 lines long (and then containing 3 polyps); ridges rounded.

Plate 25, fig. 1, corallum, natural size; 1 *a*, cell; 1 *b*, sectional view.

Feejee Islands. *Exp. Exp.*

A stout massive species, six inches through at base, growing to a height of two feet, with the erect branches or subdivisions often several inches long, the whole clump having a flat top. The smaller lobes not reaching the level of the top, are sometimes rounded above.

#### 5. PSAMMOCORA EXESA. (*Dana.*)

*P. erecta, crassima, subdivisa, lobis erectis et crebris, subcylindricis, 1-3'' crassis, superficie sæpe gibbosâ, apice rotundatâ vel subtruncatâ; cellis 1½'' latis, irregularibus, fere superficialibus et sæpe malè diffluentibus, excavatâ, collibus obsolescentibus: brunneo-purpurascens, tentaculis nullis.*

Erect, very stout, subdividing above, lobes erect and crowded, subcylindrical, 1 to 3 inches thick, surface uneven and often gibbous, apex rounded or subtruncate; cells 1½ lines broad, irregular, nearly superficial, often imperfectly diffluent, ridges obsolescent: colour purplish-brown, tentacles none.

Plate 26, fig. 1, corallum, natural size; 1 *a*, animals enlarged; 1 *b*, a cell magnified; 1 *c*, sectional view of interior.

Feejee Islands. *Exp. Exp.*

This species, in its massive columnar forms, resembles the last, but the surface is very uneven, the top less flattened, and the cells nearly superficial with less distinct limits. A specimen in the collections is four inches through at base, a foot high, with the erect lobes or subdivisions several inches long and one to three in diameter. Like the other *Psammocoræ*, the surface has an arenaceous or sanded appearance to the naked eye.

## TRIBE ASTRÆACEA:—APPENDIX.

## TURBINALOPSIS.—LAMOUROUX.

*Simplicissimæ, subconicæ aut pyriformes, basi non affixæ; corallis lamello-radiatis, supernè excavatis, lamellis alternis minoribus.*

Quite simple, subconical, or pyriform, not attached at base. Coralla lamello-radiate, excavate above: lamellæ alternately large and small.

These species have much resemblance to Fungia. They are oblong-conical in form (nearly like the *Fungia glans*), with the exterior striate as well as marked usually with concentric lines of growth. I have been unable to satisfy myself of the exact relations of these corals, and, therefore, place them in an Appendix.

The genus *Turbinalopsis* was introduced by Lamouroux, for a species which he describes as *inverted* conical and resembling a *Turbinalia*. The structure so closely resembles certain other species, that it has been inferred that he gave the wrong position to his specimen. The species have been placed by Goldfuss, and, after him, by Blainville, in Schweigger's genus *Anthophyllum*. Morris, in his Catalogue of British Fossils, describes them under the generic name *Petraia*, which Lonsdale had cited, as used by Count Münster, for these corals. But Phillips, who adopts, with Lonsdale, the name *Turbinalopsis*, states, in his *Palæozoic Fossils*, that in the *Beiträge* published by the Count in 1840, *Petraia* had received another application, and was given by him to a genus of Gasteropoda.

The name of the genus is a hybrid word, from *Turbinalia*, and  $\sigma\psi\iota\varsigma$ , *appearance*.

Lamouroux, *Exp. Meth.*, 84, tab. 82, fig. 4. *chison's Silurian Fossils*, 692, pl. 16  
Phillips, *Palæozoic Fossils*, p. 1. Blainville, *Man. d'Act.*, 343. Lonsdale, *Mur-*  
*bis*, fig. 6. Goldfuss, *Petref.*, pl. 13.

## MONOMYCES.—EHRENBERG.

The genus *Monomyces* of Ehrenberg (No. xlvi.) was instituted for *simple* (non-budding) *attached* species, which, excepting these particu-

lars, have the general characteristics of the Fungiæ, Mussæ, and Euphylliæ.\* Ehrenberg enumerates three species. The *M. patella* (*Fungia patellaris* of Lamarck, and *Madrepora patella* of Ellis and Solander) is probably a young *Fungia* (see p. 293). The *M. anthophyllum* appears to be one of the compressed Euphylliæ, and is described as follows:—"M. erectus, compressus, stellâ oblongâ, margine integro, lamellis inclusis, denticulatis, et latere granulosis;  $4\frac{1}{2}$ " latus et altus." The *M. ? eburneus* (*Fungus eburneus* of Shaw) is described as follows:—"M. pollicaris, basi dilatatus, stellâ 4-lineari, glaber, eburneus, obsolete striatus, interdum latere simpliciter gemmascens." A young *Dendrophyllia*?

As the animals of the Fungiæ, Mussæ, and Euphylliæ, have for each group, decided characteristics, it cannot be proper to disregard these characteristics, and aggregate the simple species merely on the ground of their not budding. We might, with as much propriety, in the botanical kingdom, separate from their congeners the simple species consisting of a single individual flower (instead of affording many by budding), and collect them into one genus.

A single specimen, having the characteristics of the Monomyces, was collected in the Feejees, which we believe to be probably the young of a *Tridacophyllia*. It consisted of a delicate fragile disk, an inch in diameter, stellate, with thin lamellæ above, and supported on a small pedicel three-fourths of an inch in height (plate 22, fig. 8).

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## TRIBE II.—CARYOPHYLLACEA.

*Actinaria multitentaculata, tentaculis in seriebus duabus aut pluribus dispositis. Sæpissimè gemmipara; gemmatione inferiore, polypis superne non prolatantibus. Sæpius coralligena; corallis calcareis, cellis multiradiatis; superficie corallorum aggregatorum interstitiali raro obsolete vel minimè lamello-striatâ.*

\* "Fungiæ et Caryophylliæ solitariæ fixæque."—EHRENB.

Actinaria with numerous tentacles, in two or more series. Mostly gemmiparous; gemmation inferior, the polyps not widening at summit. Generally coralligenous; coralla calcareous, cells many-rayed, surface between the cells in aggregate coralla, rarely absolutely lamello-striate, or not at all so.

The large number of tentacles of the polyps of this tribe, allies them to the *Astræacea*, and at the same time separates them from the following tribes of Actinaria: moreover, while the inferior gemmation of the species removes them from the former group, it affiliates them to the latter. The recent species are strongly marked in their characteristics: the interstices between the cells are not lamello-striate, but granulous or porous, or sometimes faintly channelled; the lamellæ are nearly or quite entire, or rarely denticulate; within the coral, the lamellæ are united to one another laterally only by very distant dissepiments, if any; the stars in a transverse section are always simple, the cellules being never crossed by dissepiments; the cells are very commonly cylindrical with narrow lamellæ arranged neatly around, and have often a broad bottom, generally porous and convex. These are their common characteristics, and in connexion with lateral budding, they afford an easy means of distinguishing the species, although some of these characters are also presented by some among the *Astræacea*. The distinction between the massive species and the *Astræidæ* is stated on page 203.

The fossil *Cyathophyllidæ* constitute an intermediate group, combining the inferior gemmation of the recent *Caryophyllacea* with the structure of the *Astræa* tribe, as is described in the remarks on that family. The mode of budding is the essential character by which these species are separated from the *Astræidæ*.

The recent *Caryophyllacea* pass into the calicularly branched *Astræacea* by the genus *Euphyllia* of the latter, in which the lamellæ of the cells are entire or nearly so, and the exterior of the calicles is often smooth; and moreover, like the former, they have a wide geographical range in latitude. Other transitions take place through the *Oculinæ*, *Astroites*, and *Anthophylla*.

A single group in this tribe, the *Zoanthidæ*, form no proper corallum. It is quite possible that some of the *Actiniæ* may also be discovered to present the characteristics of this group, although their relations to it are not made apparent by budding.



## FAMILY I.—CYATHOPHYLLIDÆ.

*Caryophyllacea calcareo-coralligena. Gemmata, gemmis inferioribus, aut lateralibus, aut apicalibus sursum nascentibus. Corallum medio sæpius transversè aut obliquè septatum, secretionibus animalium calcareis basi interruptè aut seriatim elaboratis.*

Caryophyllacea forming calcareous coralla. Gemmate, with the buds inferior, either lateral or growing upward from the summits. Corallum of a polyp usually transversely or obliquely septate at middle, the coral secretions forming at base seriately or interruptedly.

The species of this family are so nearly related to one another, and the transitions uniting together the widest variations from the type are so gradual, that they have generally been classed together, and originally, a large part constituted a single genus. Yet as the characteristics of the family can be drawn only from fossilized coralla, there is much difficulty in seizing those peculiarities which will satisfactorily exhibit its unity. Moreover, the early forms of organic life had generally a wider range of characters than those of the present day, and seem to have belonged rather to the system of the period, than to that now existing.

The coralla of the Cyathophyllidæ have usually the structure of the Astræidæ, with the inferior mode of budding of the Caryophyllidæ: in the general character of the stars, and the numerous intermediate dissepiments uniting the lamellæ, many of them are near the former, while others have the simple stars of the latter. The most striking characteristic in structure consists in the transverse septa and cellules, which constitute the middle of the corallum; in this respect, the species most Astræoid, differ widely from true Astræas. Many of the species are simple, and in consequence of their not budding, their connexion with the group is determined by analogies in general structure, and their transitions.

While, in a transverse section, the star of the Astræidæ and Caryophyllidæ, characterizes a large part of the group, there are others (Cystiophylla) closely allied, in which the lamellæ or rays, are barely traceable about the centre of the cell, and are lost outward, in a general cellular texture; and in some of the same group, the rays are

wholly wanting, and the texture of the corallum, in a transverse section, is simply porous or spumous. It is quite probable that this absence of distinct lamellæ, and the cellular texture instead, may depend, as in the *Porites* and *Gonioporæ*, on the polyps being long exsert when expanded, and only their lower portions, below the visceral cavity, secreting lime.

In a vertical section, the transverse septa are sometimes seen to extend quite across the whole interior, while in other species, they are confined to the middle portion, or become almost obsolete. They are seldom regular in their intervals, or in a single range; on the contrary, there is commonly a confusion of transverse cellules through the centre of the corallum. In several species, the septa, instead of crossing transversely, are oblique, and merely overlap about the medial line; while in others, they extend upwards very obliquely, from either side, and meet more or less perfectly, in an axis to the corallum. Something apparently analogous to this is seen in certain *Astræas*: the lamellæ instead of being finished out entire, have the inner edge pectinated obliquely upward, the pectinations extending towards a medial line. Yet the *Cyathophyllidæ* differ essentially in having, for these oblique lines, prolongations of the intermediate dissepiments which unite the lamellæ, and not of the lamellæ themselves. It appears to be a general principle that, while these intermediate dissepiments are altogether subordinate to the lamellæ in the *Astræidæ*, in the family under consideration, they are usually stouter than the lamellæ; the transverse septa alluded to, result from their continuation, and more or less perfect union, through the central portions of the corallum, where the radiating lamellæ are often wanting. The axis, in species with oblique ascending septa, is sometimes formed by a convolution of the septa or plates, as in some *Columnariæ*. In the *Sarcinulæ*, the septa extend quite from the sides, and appear like a series of funnels inverted upon one another, with a solid axis along the central line.

Michelin first pointed out that certain species have on one side of the cell a narrow triangular depression or cavity, with one or more of the lamellæ in part wanting, and designated the group *Caninia*. This structure cannot be considered altogether anomalous, when we consider that some *Madrepores* and *Zoanthidæ* have one tentacle different in size or colour from the others; and we need not look for an explanation of it, to an analogy with the siphuncle of the *Ammonite*.

We observe a farther difference between the coralla of the *Astrææ*

and Cyathophyllidæ. In the former, when the cells are *not contiguous*, the limits of the stars are formed by a thickening and lateral coalescence of the radiating lamellæ; and the interstices, in a transverse section, constitute a narrow band, often cellular, between the several stars: but, in the latter, although there may be broad interstices between the cells, there are none between the stars; they are separated only by a simple thread-like line. The lamellæ often become subdivided, and are united by numerous cross dissepiments. It appears therefore that there is a decided difference in the structure of the polyps. In Astræas with *contiguous* cells, we have in a transverse section nearly the same structure as in the Cyathophyllidæ; but, unlike the species of the group before us, they are dichastic in budding, the disks of the polyps gradually subdividing by growth. The interstitial buds of this family are in character like those of the Porites and Astroites, in which budding is lateral. The summit-buds of the Cyathophyllidæ (§ 81), differ decidedly from the disk-buds of the Astræas. Their production is attended with a sacrifice of the parent, and they consequently grow up as prominent young, like the lateral buds of a Caryophyllia; while in the Astræas, without the intermitted mode of growth and reproduction, and a prolate growth of the summits, the young and parent grow on together, with an equal rate of increase.

The Cyathophyllidæ afford examples of both aggregate and segregate zoophytes. Some species form clumps of branches like those of many Mussæ and Euphyllia; while, in others, the adjacent polyps coalesce and produce solid massive forms. In a few, the polyps are crowdedly in contact, without coalescing, and in consequence of the mutual pressure, have a prismatic form; and the coralla, though apparently solid, may be readily broken into prisms. The same genus, as in other departments of zoophytes, may contain both solid, branching, and also simple or non-budding species.

A study of the internal structure of these corals, has led the author to some changes in the received limits of groups, and also to the introduction of one or two new genera. The generic names of older authors have, in some instances of late, been misapplied: in obedience to the principles relating to nomenclature, digested and brought out by the British Association, a restoration to their original characters has been attempted; and where impracticable, their rejection seemed preferable to retaining them with altered characteristics.

Other errors have arisen from regarding, too implicitly, external forms, in drawing out generic distinctions. Thus the genera *Lithodendron* and *Columnaria*, as employed, include species which are true *Cyathophylla*; and some allied species have been referred to the genus *Caryophyllia* (*Cladocora* of Ehrenberg), although differing totally from them, and all others of the *Caryophyllidæ*, in their transverse structure.

The following are the genera of this family, with their characters. In presenting this review of them, the author is aware that the subject requires much farther study before its difficulties will be wholly removed.

We may subdivide them into the following groups.

1. Those with the cross septa transverse or but little oblique; sometimes nearly or quite obsolete. Includes the genera *Cyathophyllum*, *Calophyllum*, *Amplexus*, *Caninia*, *Acervularia*, *Arachnophyllum*, *Cystiophyllum*.

2. Those with the septa very oblique upward, and converging to a central line, with sometimes a distinct axis. Includes the genera *Clisiophyllum*, *Michelinia*, *Columnaria*, and *Sarcinula*.

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I. SEPTIS TRANSVERSIS RECTIS AUT PAULUM OBLIQUIS, INTERDUM OBSOLETIS.

GENUS I.—CYATHOPHYLLUM.

*Cyathophyllidæ simplicissimæ, ramosæ, aut glomeratæ. Corallum medio interno transversè septatum; cellis concavis, regulariter stellatis, intermediis dissepimentis numerosis lamellas conjungentibus, itaque laterum texturâ angulatè cellulosâ.*

Quite simple, ramose or glomerate. Corallum within transversely septate; cells concave, regularly stellate; numerous intermediate dissepiments uniting the lamellæ, and the outer portions of the corallum of a polyp consequently angularly cellular.

The type of this genus is the *Cyathophyllum dianthus*.\* The texture

\* See Murchison's *Silurian System*, pl. 16, figs. 12, 12 *b*; also figs. 9, 10, and 11 *a*.

of the middle is transversely septate, while either side of this medial portion the texture is cellular. In some species the cellular portion is very narrow, and these form a transition to the genus *Calophyllum*; this texture will in all instances be perceived on polishing down the exterior, when the surface will appear, as described, angulately cellular. The transverse septa are occasionally much convex above.

In the *dianthus*, the intermediate dissepiments run obliquely from above *downward* and inward; and the same is true of many other species. There are others in which these dissepiments run *upward* and inward, as represented in plate 26, figures 3, 4, 4*a*; and as the species have also some difference of habit, they constitute at least a subgenus, if not a wholly distinct group. The name *HELIOPHYLLUM*, has been applied by Mr. James Hall to a specimen of this kind in his cabinet, and may well be retained. It is represented in his N. Y. Geological Report, fig. 3, p. 209, and is probably near the *Cyathophyllum Helianthoides* of Goldfuss, plate 20, fig. 2.

The subgenus *Heliophyllum* will then contain species having generally the transverse septa of the *Cyathophylla*, but with the intermediate dissepiments running oblique *upward* and inward. Plate 26, figure 3, is a section of part of the same turbinated species, figured by Mr. Hall; and figs. 4, 4*a*, are views of sections of a massive *Astræoid* species.

Both solid, ramose, and simple species, are included among the *Cyathophylla*; and we do not deem it necessary to separate the cylindrical and prismatic species, which have a similar internal texture, although heretofore referred in part to the genera, *Lithodendron*, *Columnaria*, and *Caryophyllia*. Should they be separated, a new genus should be constituted, as they are not true *Caryophylliæ*, nor *Columnariæ*; neither do they belong to the *Lithodendrum* of Schweigger.

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GENUS II.—CALOPHYLLUM.—DANA.

*Caryophyllidæ simplicissimæ, caliculato-ramosæ, aut aggregatæ. Corallum penitus transversè septatum, cellis simpliciter concavis, regulariter stellatis; intermediis dissepimentis nullis, itaque laterum texturâ non cellulosâ.*

Quite simple, calculato-ramose or aggregate. Corallum within transversely septate, cells simply concave, regularly stellate; no intermediate dissepiments between the lamellæ, and the sides of the corallum, therefore, not cellular.

The Calophylla pass gradually into the Cyathophylla, but still may be readily distinguished by polishing down the exterior to a depth of a line, when the edges of the vertical lamellæ within are brought in view, and the absence of intermediate dissepiments is apparent. The lamellæ of the cell sometimes appear split open or subdivided towards the sides, and occasionally dissepiments may be distinguished between the separated parts, when not apparent between the several lamellæ themselves. The septa, as may be seen in a vertical section, extend quite across the interior.

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GENUS III.—AMPLEXUS.—SOWERBY.

*Cyathophyllidæ caulibus subcylindricis, leviter flexuosis. Corallum internè transverso-septatum; septis latissimis, fere rectis, usque ad latera productis; cellis multiradiatis, radiis interdum obsoletis.*

Cyathophyllidæ with the stems subcylindrical, slightly uneven. Corallum within transversely septate, septa very broad and nearly straight, extending quite to the sides; cells many-rayed.

The species of Amplexus are distinguished by their uneven cylindrical forms, having the internal septa extending quite across the whole interior. They are thus closely related to the Calophylla, and it may be a question whether the two genera should not be united in one, unless it is thought best to pursue the system, apparently impracticable, of forming separate groups of the cylindrical, columnar, and massive species of the genus Cyathophyllum.

The name *Cyathophora* has been applied by Michelin to fossil corals near the above, but massive in structure, and the rays obsolescent. They are often prismatic, like the Favosites, though larger. They may be viewed as massive species either of Amplexus or Calophyllum.

Sowerby, *Mineral Conchology*, i. 165, pl. 72.

Phillips, *Palaeozoic Fossils*, p. 7, pl. 3, fig. 8.

Michelin, *Icon. Zoophyt.*, 104, pl. 26, fig. 1;

Michelin's genus is thus characterized by him: "Fixum, glomerato-globosum vel

ramosum, tubulosum; superficiei cellis immersis; cellis sparsis, per diaphragmata transversa divisis, distinctis, obsolete stellatis; lamellis subnullis." The species here referred to the genus is from the Oolite.

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GENUS IV.—CANINIA.—MICHELIN.

*Cyathophyllidæ simplicissimæ aut aggregato-gemmatæ. Corallum penitus transversè septatum, cellis concavis; stellæ radiis uno vel pluribus proximis obsoletis, et infra, septis transversis ad infundibulum depressis; texturâ Calophyllis affine.*

Quite simple or aggregato-gemmate. Corallum within transversely septate; cells concave; one or more rays of the star, on one side, obsolete, and the transverse septa beneath this part having a funnel-shaped depression; general texture like that of the *Calophylla*.

This genus, instituted by Michelin, includes a few species of *Cyathophylla* with a depression on one side of the star and some appearance like a siphuncle. The depression is apparent in all the transverse septa below. Koninck doubts the grounds on which the genus is founded; but Michelin states that he has observed the characteristic in a large number of specimens. Good drawings of it are given in his *Iconographie Zoophytologique*, pl. 16. This peculiarity has not been observed in any massive species. (*Icon.*, p. 81.)

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GENUS V.—ACERVULARIA.—SCHWEIGGER.

*Cyathophyllidæ ramosæ aut aggregatæ. Corallum vix transversè septatum, cellis ad summitates acervatè proliferis.*

Ramose or aggregate. Corallum imperfectly transverse-septate, or not at all so; cells at summit acervately proliferous.

The Acervulariæ have a small cup-like cell, prominent within the summit, and forming its centre, and are very proliferous from the summits. The characters of the genus require more study before it can be considered as established on sufficient grounds.

This genus was instituted by Schweigger for the species figured by Foug't in the *Amœnitates Academicæ* (i., Corall. Balt., tab. 4, fig. 9, and No. 2), and thus described by him: "Madrepora composita, corporibus proliferis e centro pluribus, undique coadunatis; stella convexa, centro concava." The genus is characterized as follows by Schweigger (*Handbuch*, p. 418): "Stirps calcarea, e conis approximatis: conii e cellulis lamellosis acervati omnes cellula terminali medio protracta, e centro depresso prolifera;" which may be translated: "Calcareous and made up of approximate cones; cones acervate and proceeding from lamellate cells, which have a terminal cell at middle, and are proliferous from this depressed centre." He names the species *A. baltica*. The essential characters of Schweigger's genus are retained in the above generic description. The convexity of the summit exterior to the cup-like centre is not a universal character. The *Astræa ananas*, figured by Lonsdale (*Sil. System*, pl. 16, fig. 6), belongs to this group as here characterized; but his *Acervularia baltica*, which differs from Schweigger's, is the type of another genus.

The *Strombodes* of Schweigger may also fall in part into this genus. The peculiar structure attributed to the species, the formation of successive *layers* of cells, appears not to be of generic importance. He thus characterizes the genus: "Stirps calcarea, e cellulis lamellosis in conos acervatis, strata horizontalia constituentes. Coni paralleli, e cellula cyathiformi proliferi."—(*Handbuch*, p. 418; see also Goldfuss, *Petrefakten*, 62, pl. 21.) The name is from *στρομβος*, a *top*, and refers to the peculiar structure above alluded to. Blainville changes the name to *Strombastræa* (*Man. d'Actin.* p. 376). The *Strombodes* of Ehrenberg includes those solitary Cyathophylla of Goldfuss, which from their peculiar interrupted mode of growth appear to consist of a series of inverted cones ("tanquam conis e centro proliferis"). These species, "Ringel-Coralle," pass so gradually into others with a nearly smooth exterior, that the character can hardly be considered as of sufficient importance for founding a genus. The same principle carried out would require a subdivision of the genus *Cystiophyllum*. Ehrenberg includes in his genus a recent species from the Red Sea, which is referred to under *Euphyllia*.

Lonsdale and Phillips apply the name to species which have the





lamellæ twisted about the centre, deriving the name from στρεπω, to *twist*, thus departing widely from the original signification of the word and genus, as introduced by Schweigger (Pal. fossils, p. 10; Silur. System, 691, pl. 16 *bis*, fig. 4). If the genus, or its name, merits a place in the science, Schweigger's characteristics of it should be to some extent retained.

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GENUS VI.—ARACHNOPHYLLUM.—DANA.

*Cyathophyllidæ aggregatæ, cellis leviter radiatis; coralli texturâ cellulosâ, et lamellarum subtiliter cellulosâ.*

Aggregate Cyathophyllidæ, having the cells faintly radiate (the rays often obsolete towards the margin); texture of the corallum for the most part cellular; of the radiating lamellæ, very minutely cellular.

This genus includes the *Acervularia baltica*, of Lonsdale. The faint rays and the general texture, seem to show a relation to the Cystiophylla. The rays under a microscope appear very delicately cellular (Plate 26, fig. 5, 5 *a*), like the finest lace-work, instead of being solid plates. The stars or several polyps of a zoophyte, are without circumscribed limits, in the interior of the corallum. (Silurian System, pl. 16. fig. 8 to 8 *e*; Schweigger, Handb. p. 418).

It is possible that these species may prove to belong to the tribe Astræacea. The absence on a polished transverse section of circumscribed limits to the stars, which appears to be a general characteristic, shows some relation to the Fungidæ. The texture below the centre of a cell, is very imperfectly, if at all, transversely septate.

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GENUS VII.—CYSTIOPHYLLUM.—LONSDALE.

*Cyathophyllidæ simplicissimæ aut ramosæ. Coralla non radiata, aut*

*raro radiis circum aream mediam conspicuis ; laterum, sæpiusque toti coralli, texturâ, spumoso-cellulosâ.*

Quite simple or ramose Cyathophyllidæ. Corallum not radiate, or rarely with distinct rays about the central area ; texture of the sides and usually of the whole corallum spumoso-cellular.

The peculiar cellular structure of these species, may at once be detected in the character of the lateral surface, especially after polishing off the exterior, if not before, when the cellules will be found to differ strikingly from the rectangular cellules of the Cyathophylla. The species are usually without rays to the cells ; yet in some, faint lines may be perceived around the central area, and a transition may thus be traced to the Cyathophyllum structure. The absence of transverse septa along the middle of the corallum has been laid down as characteristic of the genus, yet it is not universal ; and we perceive here, also, progressive transitions towards the Cyathophylla.

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II. SEPTIS TRANSVERSIS SURSUM OBLIQUIS ET IN AXEM COEUNTIBUS.

GENUS VIII.—CLISIOPHYLLUM.—DANA.

*Cyathophyllidæ simplicissimæ, ramosæ, aut aggregato-glomeratæ. Corallum cellis radiatis, medio interno septis sursum convergentibus ; axe nullo ; lateribus omnino cellulosis.*

Quite simple, ramose or aggregato-glomerate. Corallum having the cells radiate, the middle within consisting of septa and cellules converging upward, but without a distinct axis ; texture exterior to this middle portion cellular.

This genus includes many of the so-called Cyathophylla, both simple and massive species. In internal structure they resemble the Michelinia, but differ in having the structure minutely cellular exterior to the central convergent portion. The bottom of the cell has usually a conical prominence, proceeding from the character of the septa within, and about this centre the lamellæ sometimes appear twisted.

These species with twisted lamellæ constitute, in part, the genus Strombodes, as this name is used by Phillips and Lonsdale. The name is from the Greek *κλισιον*, a tent, and alludes to the  $\Lambda$ -like figures which are made by the converging lamellæ about the centre, as seen in a vertical section.

Plate 26, figure 6, section of a simple turbinate species; figures 7, 7 a, section of a cell in a massive species; 7 a, represents the central portion of fig. 7, enlarged.

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GENUS IX.—MICHELINIA.—KONINCK.

*Cyathophyllidæ aggregatæ. Corallum cellis excavatis; septis obliquis irregularibus, e lateribus productis et sursum convergentibus, axe nullo.*

Aggregate Cyathophyllidæ. Corallum with excavate cells; the whole interior with oblique irregular septa, converging towards an axial line; axis none.

This genus was instituted by Koninck. The species have the internal texture of the Clisiophylla, except that there is no regularly cellular structure exterior to the central convergent portion. They differ from the Sarcinulæ in having no axis. In the *Michelinia tenuisepta*, (*Calamopora tenuisepta*, of Phillips) the general structure of the corallum is columnar.

Phillips, *Geol. of Yorkshire*, ii. 201, pl. 2, C. figs. 3 a, b; Michelin, *Icon. Zooph.*,  
fig. 30; Koninck, *Desc. des Anim. foss.* 83, pl. 16, fig. 3.  
*des terrains houillers de Belgique*, 31, pl.

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GENUS X.—COLUMNARIA.—GOLDFUSS.

*Cyathophyllidæ segregatæ, glomeratæ, polypis contiguis, itaque prismaticis. Corallum cellis radiatis, medio interno septis cellulisque sursum obliquis, axeque, composito; texturâ laterûm cellulosâ.*

Glomerate; polyps laterally in contact, and consequently prismatic.

Corallum having the cells radiate, the middle within consisting of oblique septa and cellules converging upward into an axis; texture exterior to this middle portion, cellular.

In a transverse section of the Columnariæ, the outer portions are cellular, as in the Cyathophylla and Clisiophylla, while the inner consist of oblique septa converging upward into an axis; and this axis appears to be made by a convolution of the septa, or their partial coalescence. Excepting the existence of an axis, the species are similar in their essential characters to the Clisiophylla. The columnar forms into which the coralla break, by a separation of the prismatic cells, are supposed to characterize all the species of the genus; yet as this is not necessarily of generic importance, it may prove otherwise.

The genus Columnaria, as given in treatises, comprises, beside the species here included, some that have the internal structure of the Cyathophylla, an error which has arisen from allowing too much importance to mere aggregation and external form. The character of the axis in some species is noticed by Fleming, Parkinson, Blainville, and others. The *Lithostrotion* of Lhywd is synonymous with the Columnaria of authors. The name is of prior date; but, besides its imperfect application—meaning *a stone pavement*—it was given previous to the Linnæan period without reference to system, and is therefore not entitled to authority.

Plate 26, fig. 9, part of transverse section; 9 *a*, lateral surface; 9 *b*, and 10, vertical section through the middle of different species.

Goldfuss, *Petref.* 72, pl. 24; Blainville, *Man.* 350; Lhywd, *Lithophylacii Britannici Iconographia*, Epist. v., tab. 23, *Lithostrotion*. Also Fleming's *Brit. Animals*, 508, and Parkinson's *Organic Remains*, ii. pl. 5, figs. 3 and 6.

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GENUS XI.—SARCINULA.—LAMARCK.

*Cyathophyllidæ cespitosæ aut fasciculatæ; caulibus cylindricis. Corallum cellis multiradiatis, septis internis simplicibus, sursum obliquis, conicis, e lateribus productis; axe conspicuo.*

Cespitose or fasciculate Cyathophyllidæ; stems cylindrical. Corallum having the cells multiradiate; internal septa simple, oblique upward, conical, and extending quite from the sides; axis distinct.

The internal texture in this genus, as seen in a vertical section, is quite open, without dissepiments, excepting the oblique septa which occupy the whole interior, and appear like a series of inverted cones traversed by a central axis (plate 20, fig. 11). The species are closely related to the Columnariæ: the principal difference consists in the extension of the septa quite across the interior to the sides, and the consequent absence of the exterior cellular texture; the septa moreover are more regular and sometimes constitute each a simple plate. The species have some resemblance to the Stylinæ and Caryophylliæ, but differ in internal structure.

This genus was instituted by Lamarck for a few unlike species, characterized by consisting of parallel stems or tubes. The Madrepora organum of Linnæus, is the best determined, and appears entitled to rank as the type of the genus, and has been so considered in this place. The characters have been drawn from Foug't's and Schweigger's figures, and from a specimen examined by the author. Other cylindrical fossil species, similar in external habit, belong to the genera Amplexus, Cyathophyllum, or some one of the preceding groups.

Foug't, *Amæn. Acad.* i. tab. 4, fig. 6, and ii. 340; Blainville, *Man.*, 348; Goldfuss, No. 1; Schweigger, *Beobacht.*, pl. 7, fig. *Petrefakten*, p. 73.  
66, and *Handb.*, 419; Lamarck, 2d ed.

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#### FAMILY II.—CARYOPHYLLIDÆ.

*Caryophyllacea coralligena; polyporum oribus longè exsertis, tentaculis oblongis. Coralla penitus non transversè septata, et superficie nunquam lamello-striatis; cellarum margine acutis et tenuibus; lamellis fere integris.*

Coralligenous Caryophyllacea; polyp-mouths long exsert, tentacles oblong. Coralla within not transversely septate, surface not lamello-striate; cells with the margin acute and thin; lamellæ nearly or quite entire.

Among the various forms of the Caryophyllidæ, we observe trees occasionally five or six feet in height—shrubs and bushy clumps of various dimensions—convex masses covered with cylindrical calicles—clusters of large leaf-like expansions enrolled in one another—and tiny cups of goblet shape. Hemispherical domes like those of the Astræas are not met with; and the folia are rather thick and cellular, with large curves and an obtuse polypiferous edge, instead of thin, sharp-edged, and compact, with the graceful arabesque forms of the Merulinæ.

The polyps of this group were first observed and figured, though incorrectly, by Donati. They have since been examined by Cavolini, Lesueur, Quoy and Gaymard, Ehrenberg, Broderip, Milne Edwards, and others. They are distinguished in most if not all instances, by having the mouth very much protruded when fully expanded, sometimes so as to form an inverted cone rising from the centre of the disk. The tentacles are clustered around the prominent mouth, in a crowded circlet.

This family includes a part of Lamarck's genus *Caryophyllia*, along with his *Oculinæ*, and *Turbinaliæ*, and some other fossil species. As the *Caryophylliæ* of this author have been variously distributed by different writers, a tabular view of the subdivisions proposed by the principal systematists in this department of science, is here given, with the genera adopted in this work. The genus *Oculina*, which has participated somewhat in the various changes, is also added, together with those genera of *Astræacea* which Lamarck's genus embraced.

RECEIVED GENERA.	EHRENBERG. 1832.	BLAINVILLE. 1830.	SCHWEIGGER. 1820.	OKEN. 1815.	LAMARCK.			
Oculina, <i>Lamk.</i>	} Oculina.	Oculina.	} Lithodendrum, (subgenus Oculina, and part of sub- genus Caryophyllia.)	} Matrepora.	Oculina, (1812.)			
Dendrophyllia, <i>Blainv.</i>		Dendrophyllia.						
Anthophyllum, <i>Schweig.</i>	Anthophyllum.	Sarcinula.	} Anthophyllum.	} Galaxea.	} Caryophyllia, (1801.)			
Caryophyllia, <i>Lamk.</i>	} Cladocora.	} Caryophyllia.						
Astroitis, <i>Boc.</i>								
Culicia, <i>D.</i>								
Cyathina, <i>Ehrenb.</i>	Cyathina.							
Desmophyllum, <i>Ehrenb.</i>	Desmophyllum.							
Astracæa.	} Mussa, <i>Oken.</i> } Caulastræa, <i>D.</i> } Euphyllia, <i>D.</i>	} Lobophyllia.	} Lithodendrum, (subgenus Caryophyllia.)	} Mussa.				



The Astræacea were first separated by Oken, whose *Mussæ* were characterized by the coarse lamello-striate surface of the calicles, a peculiarity which extends to the corolla of all except some *Euphyllia*, and is their most striking character. Oken's genera exhibit the independent spirit, or disregard for all previous authorities, which characterizes the whole of his *Natural History*. Schweigger's changes were unfortunate in every respect, as he united the *Oculinæ*, with a large part of the *Caryophyllia* of Lamarck (including Oken's *Mussæ*), into one group, which he called *Lithodendrum*; the remaining species of *Caryophyllia* formed his *Anthophyllum*: and to add to the confusion, more recent authors have adopted his names with a wholly different signification. *Lithodendrum* may better be rejected. We follow Ehrenberg in retaining the name *Anthophyllum* for the *Caryophyllia fasciculata* of Lamarck, and the allied species, a group which embraces half the species enumerated as *Anthophylla* by Schweigger. The others given by him, are the *Cyathina cyathus*, and the *Caryophyllia anthophyllum*, and *cespitosa*. Blainville's subdivisions were made with discrimination, and the name *Caryophyllia* was retained by him for the typical part of Lamarck's genus *Caryophyllia*, the same portion that contains the species to which the name was first applied.\* This author adopted the *Oculina* of Lamarck, and instituted the genus *Dendrophyllia* for the arborescent *Caryophyllia*. Ehrenberg proposed a farther subdivision of the group, and separated with good reason the *Cyathinæ* and *Desmophylla*. But the name *Caryophyllia* was applied by him to the group previously named *Lobophyllia* by Blainville, and *Mussa* by Oken. The *Oculinæ* and the *Dendrophyllia* of Blainville, were also united by him, although distinct in many points, and strikingly so in their mode of growth and budding (§§ 67, 71).

In concluding upon the genera which a proper regard for previous authorities required should be adopted, the genus *Cladocora* of Ehrenberg seemed entitled to the original name *Caryophyllia*. Besides containing one of the species to which the name was early applied, it constitutes the principal part of Blainville's *Caryophyllia*, and is the typical group of the family *Caryophyllidæ*, as well as of Lamarck's

\* The word *Caryophyllia* is from *καρυον*, a *walnut*, and alludes to a resemblance in the cup-like cell and its radiating plates, to the cavity of a halved walnut. The name was applied by Rumphius (1705) to one of the *Caryophyllidæ* as this term is here employed, and was so used by Pallas.



genus *Caryophyllia*. Oken's *Galaxea*, as it should have been *Caryophyllia*, after Lamarck, is not retained for any of the subdivisions.

The *Calamophylliæ* appear to be either *Caryophylliæ* or *Anthophylla*.

The remaining species of this family were placed by Lamarck in his genus *Turbinolia*, a group which embraced some simple *Euphyllia*, *free* species related to the groups *Cyathina*, *Caryophyllia* or *Dendrophyllia*, besides others, which will probably be made into a distinct genus. The *Stephanophyllia*, of Michelin, although near *Fungia* in form, appears to be related to *Turbinolia*; and the same is probably true of the *Ecmesus* and *Phyllodes*, of Philippi.

The genera of this family may be characterized as follows:

A. POLYPS NOT EXSERT; CALICLES PROMINENT: SOMETIMES SOLITARY.

a. Cells with a corona of points within, at the base of the lamellæ.

1. *ECMESUS*. Free; disk-shape.
2. *CYATHINA*. Attached; turbate.

b. Cells not coronate within.

I. *Zoophytes free when adult*.

3. *STEPHANOPHYLLIA*. Free; disk-shape; flat below, with prominent lamellæ.
4. *TURBINALIA*. Free; turbate, sometimes compressed.

II. *Zoophytes attached; simple or ramose*.

5. *DESMOPHYLLUM*. Simple; lamellæ arranged in groups or fascicles.
6. *CULICIA*. Simple; calicle smooth without, fragile; lamellæ inciso-denticulate.
7. *CARYOPHYLLIA*. Simple, or calicularly ramose, with only the tips of the branches alive; lamellæ nearly or quite entire.
8. *DENDROPHYLLIA*. Patrio-ramose, arborescent (each branch with an apical parent-polyp and an axial star); cells with the lamellæ nearly entire.
9. *OCULINA*. Cumulato-ramose, arborescent, branches without an axial star.

III. *Zoophytes attached; glomerate*.

10. *ANTHOPHYLLUM*. Calicular tubes united by a separable spongy base; the exterior smooth or faintly striate; cell with a depressed centre.
11. *STYLINA*. Calicular tubes united by a cellular base or by plates at intervals; the exterior striate; centre of cell becoming prominent and exsert.

B. POLYPS LONG EXSERT; CALICLES NEARLY OR QUITE OBSOLETE.

12. *ASTROITIS*. Corallum glomerate; cells concave.

A. POLYPIS NON SALIENTIBUS; ZOOPHYTORUM GEMMANTIUM CALICULIS PROMINENTIBUS.

a. Cellis intus coronatis.

GENUS I.—ECMESUS.—PHILIPPI.

*Caryophyllidæ non gemmatæ, liberæ; disciformes, subtus planiusculæ.  
Coralla supernè lamellis radiata et medio papillis coronata.*

Non-budding Caryophyllidæ, free; disk-shape, and nearly flat below. Coralla above radiate with lamellæ, and coronate with papillæ about the centre.

This genus includes certain fossil species, and was instituted by Philippi. As no specimens have fallen under the observation of the author, it is arranged here with some hesitation.

Philippi, Leonhard und Bronn's neues Jahrb., 1841, 662, Tert. Calabr. The genus is characterized by Philippi as follows: "Liberum, disciforme, eccentricum, subtus planiusculum, suborbiculare; pagina superior papillis centralibus lamellisque divergentibus, alternis majoribus, formatur; papillæ vero centrum non occupant, sed margini propiores sunt."

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GENUS II.—CYATHINA.—EHRENBERG.

*Caryophyllidæ non gemmatæ, affixæ; turbinatæ; polypis Caryophylliis affinibus. Caliculorum lamellis fere integris, cellis intus coronatis.*

Simple, attached, turbinate; polyps like those of the Caryophylliæ. Coralla with the lamellæ nearly or quite entire, cells coronate within.

The Cyathinæ are solitary polyps, subturbinate in form, and some of them two or three inches high. The calicle is either smooth or striate without, and nearly goblet shape. The bottom of the cell is broad and

either porous or tessellated, and around it at the base of the lamellæ there is a circle of small prominent points, similar in character to those in the *Astræa pentagona*. The species have hitherto been found only in the European seas.

This genus was instituted by Ehrenberg from the Caryophyllia of Lamarck. The name of the genus is from *κωδος*, *a cup*, alluding to their goblet shape.

*Arrangement of the Species.*

- |                         |                           |
|-------------------------|---------------------------|
| *1. <i>C. cyathus</i> . | 3. <i>C. Smithii</i> .    |
| 2. <i>C. pezita</i> .   | *4. <i>C. turbinata</i> . |

1. CYATHINA CYATHUS. (*Lamarck.*) *Ehrenberg.*

*C. clavato-turbinata*, 2' alta. Corallum vix striatum; lamellis fere integris, crassioribus, paulo exsertis, rotundatis; cellis profundis, fundo papilloso.

Clavato-turbinate, two inches high. Corallum nearly smooth without; lamellæ entire or nearly so, stout, a little exsert, rounded above; cells deep, papillose at bottom.

Mediterranean Sea, where, according to E. Forbes, it ranges in depth from five to ninety fathoms.

Ellis's figure represents the bottom of the calicle as consisting throughout of stout prominent papillæ.

In the *Mad. anthophyllum* of Esper, the bottom is composed of several stony pieces of various shapes fitted closely together, and forming a rounded prominence. A similar figure is given in Leach's Miscellany, i. 134. A specimen of this kind, examined by the author, was one and a half inches high, eight-tenths of an inch by six-tenths in breadth at top, diminishing to half this below; the exterior smooth; the lamellæ quite stout and rounded above, and projecting about an eighth of an inch above the margin of the cell; the larger, about thirty-two in number; at bottom, the papillæ of the corona, sixteen in number, a line high, and with obtusely rounded summits, surrounding a prominent convex centre, consisting of stony granulous pieces fitting together like a pavement. If a distinct species from Ellis's, this should be called, retaining Esper's name, the *C. anthophyllum*.

Another different specimen has the following characters: height one and three-fourths inches; breadth at top half an inch; exterior smooth; lamellæ thin, the larger, twenty-one in number, alternating with three smaller, of which the middle is the largest; corona consisting of nineteen thin lamellæ, pertaining each to the base of the medial one of the intermediate lamellæ; centre consisting of an aggregation of small ragged points (about sixteen) forming a convex top, much below the corona in elevation. A young individual of the *cyathus*?

- |   |  |
|---|--|
| Marsilli Phys., 122, tab. 28, fig. 128.             | <i>Caryophyllia cyathus</i> , Lamareck, ii. 346,   |
| <i>Mad. cyathus</i> , Ellis and Sol., 150, tab. 28, | No. 1.   |
| fig. 7.   | —, Lamour., 48, pl. 28, fig. 7; Encyc.             |
| <i>Mad. anthophyllum</i> , Esper, i. tab. 24.       | 167, pl. 482, fig. 2.                              |
| <i>Anthophyllum cyathus</i> , Schweig. Handb.       | —, Leach's Zool. Misc., i. 134, pl. 59.            |
| 417.  | —, Blainv., Man., 344, pl. 55, fig. 6.             |
| <i>Galaxea cyathus</i> , Oken's Zool., 72.          | <i>Cyathina cyathus</i> , Ehrenb. Gen. xlv. sp. 2. |

NOTE.—The *Cyathina flexuosa* of Ehrenberg is concisely described as follows: "Bipollicaris, disco subpollicari (minore quam in Desmophyllo diantho) planiore, lamellis non truncatis." The locality is not known.

## 2. CYATHINA PEZITA. (*Ehrenberg.*)

*C. pumila*, 3''' alta, 1''' crassa, subflexuosa. Corallum lamellis intus truncatis, stilis senis mediis, flexuosis, singularibus, nec lamellis maximis oppositis.

Three lines high, and 1 thick, subflexuous. Corallum having the lamellæ truncate within; six medial points, flexuous, single, not placed opposite the larger lamellæ.

This description is from Ehrenberg. The species is very much smaller than any other known. A young individual?

*Cyathina pezita*, Ehrenberg, op. cit., Gen. xlv. sp. 3.

## 3. CYATHINA SMITHIL. (*Broderip.*) Dana.

*C. subpumila*, fere cylindrica. Corallum extus bene striatum; lamellis

*inæqualibus, sæpius 3 intermediis minoribus, parcè plicatis et leviter crenulatis; fundo obsoletè tuberculato, particulis saxeis instructo.*

Rather small, nearly cylindrical. Corallum decidedly striate without; lamellæ unequal, mostly with 3 smaller intermediate, sparingly plicate and lightly crenulate; bottom obsoletely tuberculate, and consisting of stony pieces.

Coast of Devonshire, *T. Smith, Esq.*—Cornwall, *Mr. Couch.*

From the drawing by W. J. Broderip, the species is nearly cylindrical, a little larger above, half an inch high, and but little exceeding this in diameter. The lamellæ are but a little exsert, with the larger fourteen to twenty in number. Johnston states the size as varying from two-tenths to half an inch in height, with a diameter of from three-tenths to one inch. The animal has two or three crowded rows of tentacles, and a prominent mouth when expanded. The colour varies, being at times, according to Dr. Coldstream, either "white, yellowish, orange-brown, reddish or fine apple-green, with the tentacles usually paler."

*Caryophyllia cyathus*, W. J. Broderip, *Jameson's new Edinb. J.*, viii. (1830), 312.

*Caryophyllia Smithii*, Stokes and Broderip, *Zool. J.*, iii. 481, pl. 13, figs. 1-6.

—, Buckland, *Bridgewater Treatise*, pl. 54, figs. 9-11.

*Caryophyllia Smithii*, J. B. Harvey, *London's Mag. Nat. Hist.* new ser. i. 474, fig. 55; also *Proceed. Zool. Soc.* 1834, part ii. 28.

—, G. Johnston, *Brit. Zooph.* 207, fig. 30, on page 206.

The *Caryophyllia cyathus*, of Dr. Fleming (*Wernerian Trans.* ii. 249, and *British Animals*, p. 509), is described as containing 40 to 50 larger lamellæ; exterior striated; the bottom a prominent ridge "composed of curled plates on each side of a substance similar to the plates of the gills." The specimen was from the island of Papa Stour, Zetland. It requires farther examination.

#### 4. CYATHINA TURBINATA. (*Dana.*)

*C. pumila*, (6-9''' *alta*), *turbinata, infrà valde attenuata. Corallum subtiliter striatum; papillis fermè 12, parvulis, tenuissimis et fragilibus; lamellis vix exsertis, 3-5 intermediis minoribus.*

Small, turbinate, below much attenuated. Corallum finely striate, papillæ about 12, small, very thin and fragile, lamellæ scarcely exsert, with 3 to 5 intermediate smaller.

This small species occurs in curved turbinate forms, (and probably also erect,) seven lines high, four and a half by three and a half in breadth at top, and one line at base; it is finely striate to the base, with the exterior surface a little undulate. The larger lamellæ are hardly half a line exsert. The bottom is linear, and consists of ragged points. Young state of the *cyathus*?

The *Cyathina cyathus* of Leuckart (De Zooph. Coral. figs. 5-7, pl. 4), resembles this species. It is from the Mediterranean, is three-fourths of an inch high, seven by five lines in breadth above, and one and three-fourths lines at bottom; it is coronate, with sixteen thin papillæ, each papilla belonging to the middle lamella of the three intermediate. The striæ of the exterior are finely denticulate. Leuckart adds "An species diversæ?"

Philippi suggests that the *Monomyces eburneus* of Ehrenberg may be the young of the *C. cyathus*. (Wieg. Arch., viii. 44.)

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b. Cellis intus non coronatis.

1. *Zoophytis adultis liberis*.

GENUS III.—STEPHANOPHYLLIA.—MICHELIN.

*Cyathophyllidæ non gemmata, liberæ, disciformes, subtus planiusculæ.*  
*Coralla supernè lamellis prominentibus radiata.*

Non-budding Cyathophyllidæ, free and disciform; below, nearly flat.  
Coralla above, radiated with prominent lamellæ.

The lamellæ in the species which is the type of Michelin's genus stand quite prominent around the centre, and are somewhat dentate. The appearance is much like that of a *Fungia*. The name alludes to the crown-like corallum, and is from στεφανον, a *crown*. Some of the species referred here by Michelin, appear to belong to the *Ecmesus* of Philippi.

Michelin, Dict. des Sci. Nat. Sup., i. 484; also Iconog. Zooph., 31, pl. 8, fig. 1.

## GENUS IV.—TURBINALIA.—LAMARCK.

*Caryophyllidæ non gemmatæ, liberæ, turbinatæ, sæpe compressæ; cellæ coralli sæpius latè excavatâ.*

Non-budding Caryophyllidæ; free, turbinate, often compressed; cell of the corallum usually broad, excavate.

The Turbinaliæ are known only in the fossil state. Like the Fungiæ, they are attached when young. The form is usually turbinate, or compressed turbinate, and the exterior is commonly fine striate. The cell is more or less broadly concave, and the texture of the sides somewhat porous.

The genus *Phyllodes* has been proposed by Philippi for compressed cuneate species, with the base crenato-lobate. Still another distinct group appears to be contained in the genus, characterized by having a solid stellate bottom to the cell. The remainder are free Dendrophylliæ, with which group they agree in texture, the character of the cell, and the smooth or finely striated exterior.

This genus has included some of the free Euphylliæ; but the latter differ from them by the same characters, as from the simple or young Dendrophylliæ, viz.: the very narrow bottom of the cell (instead of broad and porous) often quite concealed by the lamellæ; the thin compact sides, scarcely at all cellular; and the exterior striatures of the calicles, corresponding to the lamellæ within. Moreover, we may conclude from analogy that, like the Dendrophylliæ, the animals of the Turbinaliæ differ in having a prominent subrostriform mouth. From the turbinate Cyathophyllidæ, they are removed by their texture below the cell, as they have nothing of the transverse septa characterizing those corals.

This genus was instituted by Lamarck. The name is from the Latin, *turbo*, a top, and alludes to the turbinate shape of the species. Ehrenberg suggested the change in the orthography from *Turbinolia* to *Turbinalia*, the former being incorrect.

*Turbinolia*, Lamarck, ii. 359.

*Turbinalia*, Ehrenberg, G. xviii.

The genus *Phyllodes* is thus characterized by Philippi (Leonhard und Bronn, neues Jahrb., 1841, 662), Tert, Calabr. "Liberum? explanatum, cuneatum, et in alterâ extremitate lobatum; pagina superior lamellis a basi truncatâ radiantibus medianis

erectis, literalibus obliquè incumbentibus, instructa." This arrangement of the lamellæ is common to the species here included, and the free cuneate Euphyllæ constituting the genus *Flabellum* of Lesson.

II. *Affixæ; simplicissimæ aut ramosæ.*

GENUS V.—DESMOPHYLLUM.—EHRENBERG.

*Caryophyllidæ non gemmatæ, simplicissimæ, affixæ. Coralla infundibuliformia; lamellis fere integris, in plures fasciculas dispositis.*

Not budding, quite simple, attached. Coralla infundibuliform; lamellæ nearly entire, and arranged in a series of groups or fascicles.

The Desmophylla are distinguished from the other species of this family by the grouping of the lamellæ, a character apparent over the exterior as well as within the broad shallow cell. The genus was instituted by Ehrenberg for the *Caryophyllia dianthus*, and named from *δεσμη*, *bundle*, and *φυλλον*, *leaf*.

DESMOPHYLLUM DIANTHUS. (*Esper.*) *Ehrenberg.*

*D. bipollicare, disco pollicari, basi flexuosâ. Corallum lamellis imparibus ternis, in 12 fasciculas approximatis, mediis solis majoribus fere 12, omnibus intus truncatis.*

Two inches in height, with the disk an inch broad, and at base flexuous. Corallum with the lamellæ in 12 groups of threes, the middle of each larger, all truncate within.

East Indies.

The description of the above species, as well as of the following, is by Ehrenberg, from specimens in the Royal Museum at Berlin.

*Mad. dianthus*, *Esper*, *Fortsetz.* i. 85, tab. 69.

*Mussa dianthus*, *Oken*, *Zool.* i. 73.

*Desmophyllum dianthus*, *Ehrenb.*, *G.* xlv.

*Caryophyllia dianthus*, *Blainv.*, *Man.* 344.

sp. 1.



DESMOPHYLLUM STELLARIA. (*Ehrenberg.*)

*D. pollicare, disco semipollicari. Corallum lamellis in 12 fasciculas dispositis, mediis ternis majoribus, subæqualibus.*

An inch in height, disk half an inch broad. Corallum with the lamellæ in 12 groups of threes, the middle one larger, all subequal.

*Desmophyllum stellaria*, Ehrenb., G. xlv., sp. 2.

## GENUS VI.—CULICIA.—DANA.

*Caryophyllidæ non gemmatæ, affixæ, pumilæ, subcylindricæ; polypis Caryophylliis affinibus. Coralla fragilia, extus non striata; lamellis inciso-denticulatis; cellâ paulo profundâ, interdum vix depressâ.*

Non-gemmate Caryophyllidæ, attached, quite small and subcylindrical; polyps like those of the Caryophylliæ. Coralla fragile and delicate, exterior not striate; lamellæ inciso-denticulate; cell shallow and sometimes scarcely at all excavate.

The Culiciæ have the rostriform mouth and tentacles of the Caryophylliæ; but the cells of the tiny cups (their coralla) contain minutely-incised lamellæ, the points of which, along with other points at the centre, sometimes fill the whole cell, or form its bottom and sides. The aspect is very peculiar, and united with other characters appear to authorize the institution of a new genus; in the established groups, the lamellæ are either entire, or nearly so. Six larger lamellæ sometimes stand a little prominent, giving an appearance of a six-rayed star within the cell. Three species were obtained, and the largest was hardly a line and a half in diameter.

The name of this genus is from *κωλικιον*, a little cup.

*Arrangement of the Species.*

\*1. *C. stellata.*

\*2. *C. tenella.*

\*3. *C. truncata.*

CULICIA STELLATA. (*Dana.*)

*C. simplicissima, cylindrica, fere 3''' alta et 1½''' lata; pallido-ochrea, tentaculis numerosis, subæqualibus. Corallum margine integrum; cellâ subprofundâ; lamellis 24, sex latioribus supernè integris stellæ instar, cum 3 intermèdiis valde minoribus subtiliter incisis.*

Quite simple, cylindrical, nearly 3 lines high, and 1½ broad; pale-ochreous in colour, tentacles numerous and subequal. Corallum with the margin thin and entire; cell rather deep; lamellæ 24 in number, 6 broader than the others, and above entire, having the arrangement and appearance of a star, with 3 smaller intermediate delicately incised.

Plate 28, fig. 5, calicles scattered over dead coral, natural size; 5 *a*, animal enlarged; 5 *b*, tentacle enlarged; 5 *c*, calicle enlarged; 5 *d*, two of the lamellæ enlarged.

Singapore. *Exp. Exp.*

This species is at once distinguished by the six larger lamellæ, broad above, and appearing like a star of six rays, while the intermediate are very narrow, and gradually widen towards the bottom. It occurred scattered quite thickly over the surface of a dead coral.

CULICIA TENELLA. (*Dana.*)

*C. simplicissima, cylindrica, 2''' alta et 1½''' lata. Corallum margine tenuissimum et acutum; cellâ subprofundâ; lamellis 24, subæqualibus, majoribus plerumque integris sed apice basique incisis, intermèdiis minoribus incisis.*

Quite simple, cylindrical, 2 lines high and 1½ broad. Corallum with a very thin and acute margin; cells rather deep; lamellæ 24, subequal, the larger for the most part entire, but incised at apex and at base, the smaller intermediate incised.

Plate 28, fig. 6, calicle enlarged, 6 *a*, natural size; 6 *b*, three of the lamellæ enlarged.

Port Jackson, New Holland, attached to the base of a Melitæa. *Exp. Exp.*

The lamellæ are more nearly equal than in the preceding species, and appear less crowded, and without a distinct star of six rays; the thin margin of the calicle, moreover, extends a little above them.

CULICIA TRUNCATA. (*Dana.*)

*C. simplicissima, fere cylindrica aut subturbinate, 1¼" alta et lata. Corallum apice planum, cellâ non excavatâ sed lamellis subtiliter laciniatis repletâ, majoribus alternis, 12.*

Quite simple, nearly cylindrical or subturbinate,  $1\frac{1}{4}$  lines high and as many in breadth. Corallum plane at top, cell not excavate, but filled with the minutely lacinate lamellæ, which are twenty-four in number, large and small alternate.

Plate 28, fig. 7, calicle enlarged; 7 a, same natural size.

The Feejee Islands, attached to the dead part of an Echinopora. *Exp. Exp.*

The lamellæ fill up the cell and give a flat top to the calicle; and the minute teeth, which appear like dots about the centre, are arranged symmetrically, six forming an inner circle, and twelve another circle around them.

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GENUS VII.—CARYOPHYLLIA.—LAMARCK.

*Caryophyllidæ affixæ, segregato-gemmatæ; polypis sæpius cylindricis, ore longè exserto, tentaculis numerosis. Coralla caliculato-ramosa; ramis apice animatis et striatis, quot lamellis tot striis; infrâ mortuis, striis obsolescentibus.*

Attached Caryophyllidæ with segregate growth and gemmation; polyps usually cylindrical, mouth long exsert, tentacles numerous.

Coralla caliculato-ramose; alive only at the tips of the branches, and in this part usually striate, with the striæ equalling the lamellæ in number; but below, where dead, the striæ becoming obsolete.

The Caryophylliæ form branched clumps, usually much crowded and cespitose, and rarely arborescent. They are distinguished by having only the tips of the branches alive; each polyp-bud forming a distinct branch, and lengthening it by gradual outward growth, the parts below becoming dead as it progresses. When alive they are all tipped with polyps, "les fleurs du corail." The coralla are rather fragile, and in this respect, as well as their mode of growth, they are distinct from the Oculinæ. The cells are concave, resembling much those of the Dendrophylliæ. The lamellæ are very slightly if at all exsert, and are generally crowded and subequal.

In the young state the Caryophylliæ are simple, cylindrical or turbinate polyps, and the calicles resemble much a Turbinalia. It is still doubtful whether there are actually any simple or non-budding species, as those so reported may have been the young of branching species. These remarks apply equally to the genus Dendrophyllia; and in this early state, the species of that genus can scarcely be distinguished from the Caryophylliæ, as the essential characteristics of these genera depend on the mode of budding and growth. It appears, however, that the calicles of the Caryophylliæ have the striæ of the exterior corresponding each to a lamella of the cell, while the Dendrophyllia are much more finely striated when at all so; and in general, moreover, the lamellæ of the Caryophylliæ appear more even and crowded, except in the large species.

The simple species will be thrown into an Appendix, either to this genus or Dendrophyllia, according as the striæ of the exterior surface correspond or not to the lamellæ of the cells.

*Arrangement of the Species.*

- |                          |                            |
|--------------------------|----------------------------|
| *1. <i>C. cespitosa.</i> | *4. <i>C. arbuscula.</i>   |
| *2. <i>C. conferta.</i>  | *5. <i>C. cornigera.</i>   |
| *3. <i>C. flexuosa.</i>  | 6. <i>C. anthophyllum.</i> |

1. CARYOPHYLLIA CESPITOSA. (*Lamarck.*)

*C. cespitosa, caulibus elongato-cylindricis, suberectis, confertim fasciculatis, vix 2''' crassis; polypis latè aurantiacis. Corallum ramis*



*striatis, scabriculis, interdum coalitis; cellis concavis; lamellis subæqualibus.*

Elongate cylindrical stems, nearly erect and crowdedly fasciculate, scarcely 2 lines in diameter; polyps bright orange. Corallum with the branches striate, slightly scabrous, sometimes coalescing; cells concave; lamellæ subequal.

The Mediterranean Sea; Ægean Sea, where, according to E. Forbes, it occurs in water not exceeding six or eight feet in depth.

- Acropora cespitosa*, &c., Gualtieri Ind., back of tab. 61. *Cladocora lævigata*, Ehrenb., G. li. sp. 4.  
*Mad. flexuosa*, Ellis and Sol., 151, tab. 31, figs. 5, 6. *Cladocora cespitosa*, E. Forbes, Rep. Brit. Assoc. for 1843, pp. 151, 153, 155.  
*Mad. fascicularis* (?), Esper, i. 157, tab. 29. Ehrenberg's *C. cespitosa*, is another species; Ellis's figure, tab. 31, is referred to under his *lævigata*, which he thus describes: "Bipollicaris, tubulis 2''' latis, fasciculatis, cylindricis, subæqualibus, extus substriatis, glabris, parè ramosis, rectiusculis, elongatis, ore oblongo, laminis internis, prope apicem concavis aut rectis, prole interdum coalescente."  
*Caryophyllia cespitosa*, Lamarck, ii. 352, No. 8.  
 —, Lamour., 49, tab. 31, figs. 5, 6; Encyc., 171.  
 —, Bertolonii, Amæn. Ital., 247.  
 —, Blainville, Man., 345.  
*Galaxea cespitosa*, Oken's Zool., i. 73.  
*Anthoph. cespitosum*, Schweig. Handb. 417.

## 2. CARYOPHYLLIA CONFERTA. (Dana.)

*C. breviter cespitosa, subconvexa, caulibus flexuosis valde confertis, fermè 2''' crassis, et 2''' animatis. Corallum caliculis subtiliter striatulis, fermè 36 lamellis subæqualibus, majoribus alternis, paululum exsertis.*

Short cespitose, somewhat convex, with the branches flexuous and much crowded, nearly 2 lines in diameter, alive for 2 lines. Corallum with the calicles very finely striate, about 36 subequal lamellæ, alternately larger, a very little exsert.

Plate 30, fig. 6, part of corallum, natural size.

This species has the flexuous branches of the *flexuosa*, but they are nearly as small as in the *cespitosa*.

The *Cladocora cespitosa*, of Ehrenberg may belong here; it is described as follows: "Tripollicaris, tubulis 2''' latis, fasciculato-glomeratis, cylindricis, subæqualibus, extus

distinctè striatis et arenoso-seabris, ramulosis, nec elongatis, ore rotundo; lamellis denticulatis, sub apice convexioribus." One variety of the species, with calicles scarcely two lines in diameter, was received by Ehrenberg from the West Indies.

Seba's fig. 9, tab. 108, *Madrepora tubulosa, tubulis discretis, in formam pileæ sphericæ concretis*; *aliis dicitur Acropora*, a West Indian species, may be the above.

3. CARYOPHYLLIA FLEXUOSA. *Lamarck.*

*C. cespitosa, ramis cylindricis, 3-4''' crassis, flexuosis, et confertis, sæpe coalitis. Corallum caliculis striatis, lamellis inæqualibus, 8-12 majoribus, 3-5 intermediis minoribus.*

Cespitose, branches cylindrical, 3 to 4 lines thick, flexuous and crowded, often coalescent. Corallum with the calicles striate, lamellæ unequal, 8 to 12 larger, 3-5 intermediate smaller.

Plate 30, fig. 5, part of corallum, natural size.

West Indies (?).

The specimens of this species agree well with Ellis's figure in the size and unequal lamellæ of the cells, in which characters it differs from the preceding. The branches are alive for a fourth or a third of an inch, and below this are scarcely striate, though very decidedly so above. The bottom of the cell is prominent or convex. The terminal branches seldom exceed two-thirds of an inch in length.

Ellis and Solander, tab. 32, fig. 1.

*Caryoph. flexuosa*, Lamk., ii. 352, No. 7.

—, Lamour. Exp. Meth., p. 49, tab. 32,

fig. 1; Eneye. 170, pl. 482, fig. 4.

*Cladocora flexuosa*, Ehrenb., G. li. sp. 3.

The *Madrepora flexuosa* of Linnæus, as

figured in the Amæn. Acad. i. 96, tab.

4, fig. 13, and Esper, iii. Pet. tab. 6,

is quite a different species, with smaller

branches, and if not identical with the

*cespitosa*, is intermediate in its characters

between that species and the *conferta*.

4. CARYOPHYLLIA ARBUSCULA. (*Lesueur.*)

*C. pumila, laxè ramosa et subarborescens; ramis divaricatis et sæpe flexuosis, cylindricis, 1½-2''' crassis; polypis 30-32-tentaculatis, tentaculis conicis in duas series dispositis, rufis et virentibus, et apice puncto albido. Corallum leviter striatulum, caliculis margine denticulatis, lamellis majoribus alternis.*

Small, loosely ramose and subarborescent; branches divaricate and often flexuous, cylindrical,  $1\frac{1}{2}$  to 2 lines thick; polyps with 30 to 32 tentacles, tentacles conical, in two series, rufous and greenish, with a white spot at apex. Corallum faint striate; calicles denticulate at the margin, larger lamellæ alternate.

Plate 30, fig. 7, corallum, natural size; also, fig. 24, p. 62.

St. Thomas, West Indies. *Lesueur*.

This small, neat species, grows differently from the preceding, in flexuously branched stems, sometimes six or seven inches high. The calicles at the extremity are only a line long; below this, the branches are dead and more or less incrustated over, and the striæ, though distinguishable, are nearly obsolete.

*Caryophyllia arbuscula*, Lesueur, Mém. du Mus. vi. 275, pl. 15, fig. 2.

—, Lamk., 2d ed. ii. 354; No. 11 b.

The *Cladocora candelabrum*, of Ehrenberg, from St. Thomas, appears to be near the above, yet is probably distinct. It has

the following characters: Verticillatim ramosa, erecta, squamosa, ramis striato-carinatis, subtilissimè scabris, caliculis turbinatis  $\frac{1}{6}$ " latis, sub apice tumentibus, ibique sæpe inflexis, aperturâ  $1-1\frac{1}{2}$ " latâ, lamellis 32-36.

##### 5. CARYOPHYLLIA CORNIGERA. (*Lamarck*.)

*C. maxima*, laxè ramosa, divaricata et flexuosa; ramis sæpe  $\frac{3}{4}$ " crassis, ramulis subcylindricis, 4-8" crassis, et 1-3" elongatis; polypis stramineis. Corallum striatum, sæpe undulatum.

Very large, loosely ramose and arborescent; branches often  $\frac{3}{4}$  of an inch thick, branchlets subcylindrical, 4 to 8 lines thick, and 1 to 3 inches long; polyps straw-yellow. Corallum striate and often undulate, margin of the calicles uneven.

Mediterranean Sea, near Marseilles, from a depth of 150 fathoms. *Marsilli*.

This species, well figured by Marsilli and Esper, is remarkable for its large and long branch-like calicles, with brown extremities for an inch or more, (dark coffee-colour, according to Marsilli), to which distance the live polyps extend; this colour is, however, lost on bleaching. Marsilli states that when first obtained the extremity was straw-

yellow. In a specimen in the Boston City Museum, the branchlets slightly taper towards their bases, and some of them are several inches long without lateral shoots. It is near the *anthophyllum* in habit. It also resembles somewhat the *Dendrophyllia*, but differs in each calicle becoming a distinct branch, and in only the tips of each branch being alive.

- Madrepore rameux à calices de substance* —, Esper. i. 98, tab. 10.  
*aisée de froisser*, Marsilli, Hist. Phys. de la Mer, 137, tab. 30, fig. 136-139. *Car. cornigera*, Lamk., ii. 353, No. 10.  
*Madrepore ramea*, var., Pallas, Zooph. No. 176; "stellis terminalibus cylindraceis." *Dendrophyllia cornigera*, Blainv., Man. 354.  
*Cladocora? anthophyllum*, Ehrenb. G. li. sp. 1.

6. CARYOPHYLLIA ANTHOPHYLLUM.

*C. cumulato-fasciculata*, polypis longè turbinatis; ramulis sæpe 3" elongatis; apice 6''' latis et infrà valde attenuatis. Corallum superficiei obsolete striatum et paulum undulatum.

Cumulato-fasciculate, polyps long turbate; branchlets often 3 inches long,  $\frac{1}{2}$  an inch wide at top, and very much attenuated below. Corallum with the surface obsoletely striate, and somewhat undulate.

East Indies. *Lamarck*.

Though resembling the preceding, the branchlets or calicles are very much more attenuate below, and the clump, as figured by Ellis, looks like a cluster of slender horns, branching from one another.

- Anthophyllum saxeam*, Rumph. Amb. vi., tab. 87, fig. 4; a reduced figure, perhaps of this species, to which it has been referred, yet as much like the *cornigera*. *Car. anthophyllum*, Lamk., ii. 353, No. 9.  
 —, Lamour., Exp. Meth., 49, tab. 29; Encyc., 172.  
 —, Blainville, Man. 344.  
*Mad. anthophyllites*, Ellis and Sol., 151, tab. 29. *Anthophyllum anthophyllites*, Schweig. Handb. 417.  
 —, Esper, Fortsetz. i. 89, tab. 72; much like Ellis's figure. *Galaxea anthophyllites*, Oken's Zool., i. 72.  
*Cladocora anthophyllum*, Ehr. G. li. sp. 1.

APPENDIX.—The following species have been observed only in the simple state, and may or may not be budding species.

*C. solitaria*. (*Lesueur*.) Cylindrical, three to four lines high, and scarcely three lines broad; tentacles twenty-two in number, in two



series, diaphanous, dotted with white. Calicle circular, margin entire or nearly so, above slightly striate without; fifteen to sixteen larger lamellæ alternating with smaller. Guadaloupe, West Indies (Lesueur, Jour. Acad. Nat. Sci. Philad., i. 179, pl. 8, fig. 10; Mém. du Mus., vi. 273, pl. 15, fig. 1; Lamk., 2d ed. ii. 350, No. 6 a.)

*C. pocillum.* (Dana.) Turbinato-cylindrical, four and a half lines broad at top, and three high; exterior striate half way to the base and granuloso-scabrous, lamello-striæ nearly equal; twelve lamellæ larger, very broad and exsert, rounded above, granulous; three intermediate smaller, and one-half narrower. West Indies. Plate 30, fig. 8, natural size.

*C. dilatata.* (Dana.) Turbinato-cylindrical, three lines high, and the same in breadth at summit; twelve lamellæ larger, quite broad, subacute at apex, a little exsert, and very prominent on the exterior half way to the base; the intermediate three, much narrower, nearly equal, and scarcely at all prominent on the exterior; the lateral surface of the calicle hence smooth, except the twelve large carinating lamellæ. Barbadoes, West Indies. Plate 30, fig. 9, calicle, natural size; 9 a, transverse section, showing profile of larger and smaller lamellæ.

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GENUS VIII.—DENDROPHYLLIA.—BLAINVILLE.

*Caryophyllidæ aggregato-gemmatæ, patrio-ramosæ, arborescentes; ore longè exserto. Coralla subcellulosa; caliculis cylindricis; lamellis inclusis inæqualibus; cellâ profundâ, fundo latâ; extus levibus aut subtiliter striatis.*

Aggregato-gemmate, patrio-ramose, arborescent; polyp-mouths long exsert. Coralla subcellular; calicles cylindrical; lamellæ included, unequal; cell deep, broad at bottom; exterior smooth or fine striate.

Like the Madreporæ, the Dendrophyllidæ bud from an apical polyp, and their forms are consequently *dendroid*, or in imitation of trees, as the name suggests.\* Some species attain a height of five or six feet.

\* From the Greek δένδρον, a tree.

The branches are covered rather remotely with large cylindrical calicles, or when alive, with prominent cylindrical polyps, each opening at summit a flower of many rays, often of emerald green, orange and scarlet tints.

Though closely similar to the Caryophylliæ, the Dendrophyllia produce much stronger and more durable coralla, owing to their mode of growth; the lateral polyps in the latter add by their secretions to the thickness and strength of the enlarging branch, while in the former, each branch is the sole production of a single lengthening polyp, and is nearly filled by its axial star. Only the summit of a branchlet is alive in a Caryophyllia, while in a Dendrophyllia, each branch is a colony of aggregated polyps. Moreover, the striæ on the exterior of the calicles, when they exist, are more numerous than the lamellæ of the cell, instead of corresponding to them, as in the Caryophylliæ. From the Oculinæ they differ widely in mode of growth; and a fragment of a branch may be distinguished by the central axial star, which does not exist in that genus; moreover, they form less compact coralla, the surface being either striate or sub-cellular, and the interior more or less porous. They have more distant and much larger polyps and calicles, and more numerous lamellæ to the cells than the Madreporæ.

The species of Dendrophyllia grow in waters of all temperatures, and to a depth of at least one hundred fathoms.

This genus was established by Blainville, from the Caryophyllia of Lamarck. Ehrenberg united it with the genus Oculina.

A few simple species, apparently of this genus, judging from the striæ and lamellæ; are thrown into an Appendix, as they may be young of ramose forms.

*Arrangement of the Species.*

I. *Arborescently ramose.*

\*1. *D. ramea.*

2. *D. micrantha.*

\*3. *D. nigrescens.*

II. *Sparingly ramose, or calicles simple clustered.*

4. *D. aurantiaca.*

\*5. *D. coccinea.*

\*6. *D. diaphana.*

7. *D. rubeola.*

## 1. DENDROPHYLLIA RAMEA. (Linn.) Blainville.

*D. arborescens, maxima, interdum 5' alta, ramis elongatis, teretibus, ramulis apice 4-5''' crassis. Corallum undique subtiliter undulato-striatum, caliculis 3-5''' latis et 4-8''' longis, paulo profundis.*

Large arborescent, sometimes 5 feet in height; branches long and terete, branchlets 4 to 5 lines thick at summit. Corallum throughout, finely undulato-striate; calicles 3 to 5 lines broad, and 4 to 8 long, rather shallow.

Mediterranean; Cape Negro, Coast of Africa.—Madeira. *Exp. Exp.*

This is one of the largest of arborescent corals, easily distinguished by its large, distant calicles, and undulato-striate surface (see fig. 31, page 70). The bottom of the cell is broad and usually convex and prominent. The lamellæ are unequal, and in the adult cell, they are forty-eight in number, of which twelve are large.

- Grand Madrepora rameux*, Marsilli, Hist. Phys. de la Mer., tab. 31, fig. 144, &c.  
*Madrepora maxima arborea*, Shaw's Travels, fol., Oxford, 1738, append. p. 48, with a figure of a specimen from the African coast, in the Mediterranean.  
 —, Tournefort's Inst., tab. 340.  
*Madrepora ramea*, Linn., ed. xii, 1280.  
 —, Pallas, Zooph., 302, No. 176.  
 —, Ellis and Solander, 155, tab. 38.  
 —, Esper, i. 98, tab. 9, and tab. 10, A.  
 —, Bertolonii Amæn. Ital., 249.  
*Caryophyllia ramea*, Lamk., ii. 354, No. 11.  
 —, Lamour., Exp. Meth., 50, pl. 38.  
*Matrepora ramea*, Oken, Zool. i. 71.
- Lithodendrum rameum*, Schweig., Handb. 416.  
*Dendrophyllia ramea*, Blainville, Man. 344, pl. 53, fig. 2.  
 —, Cuvier, Reg. Anim. 1837, pl. 83, fig. 1; the animal by Milne Edwards.  
*Oculina ramea*, Ehrenb., G. xlviii. sp. 8.  
 Donati's figure, plate 7, in his Natural History of the Adriatic, and also Phil. Trans. Abridg. x. 154, pl. 5, fig. A., is usually referred to this species, but appears to be a subarborescent Caryophyllia. For a copy of the animals and cells, see Ellis and Solander, tab. 32, figs. 3-8. The bifid tentacles must be an error.

## 2. DENDROPHYLLIA MICRANTHA. (Ehrenberg.) Dana.

*D. habitu rameæ. Corallum caliculis crebrioribus, cum ramis angustioribus (2½-3''' crassis); cellis profundioribus, interstitiis porosioribus.*

Resembling the *ramea* in habit. Corallum with the calicles more



crowded, branches smaller ( $2\frac{1}{2}$  to 3 lines), cells deeper, interstices more porous.

This description by Ehrenberg, was taken from a specimen eight inches in height, in the Royal Museum, at Berlin. The locality is not known.

*Oculina micranthus*, Ehrenberg, op. cit. G. xlvi. sp. 7.

### 3. DENDROPHYLLIA NIGRESCENS. (Dana.)

*D. arborescens*, 3' alta, ramis elongatis, fere in plano digestis; nigrescens, ore longè exserto, et apice radiatè striato, latè que virente cum margine brunneo, tentaculis pallido-brunnescentibus. Corallum superficie subcellulosum et non striatum, caliculis cylindricis vel subturbinate, fere 3''' latis et 3-4''' longis, subfragilibus, cellis profundis.

Arborescent, and 3 feet high, branches long, and nearly in a single plane; almost black, with the mouths of the polyps long exsert, green and radiately striate at summit, with a brown margin; tentacles pale-brownish. Corallum with scattered pores over the surface, and not striate, calicles cylindrical or subturbinate, nearly 3 lines broad, and 3 to 4 lines long, rather fragile, cells deep.

Plate 30, fig. 1, branch, natural size; 1 *a*, animal enlarged; 1 *b*, tentacle; 1 *c*, part of branch near extremity, showing the surface and a calicle; 1 *d*, vertical section of a calicle; 1 *e*, transverse section, near base of zoophyte; 1 *f*, ditto, near apex.

Feejee Islands. *Exp. Exp.*

This species has the general habit of the *ramea*, but the branches are more slender and flexuous, and not striate. It retains the black colour on drying, unless worn off by exposure, when it becomes white. The specimen is three feet high, two inches in diameter at base, and the upper branchlets one-fourth of an inch thick. The cells contain nine to twelve large lamellæ, and about three intermediate smaller, which last are nearly obsolete at the summit of the branches. The normal number of lamellæ is forty-eight. A large specimen was dredged up in fourteen fathoms water, by Lieutenant Emmons, and others smaller were found by the author near the surface.

## 4. DENDROPHYLLIA AURANTIACA. (Quoy &amp; Gaymard.) Dana.

*D. humilis, subramosa; aurantiaca.* Corallum tenuiter striatum, striis denticulatis; caliculis cylindricis vel paulo ellipticis; lamellis majoribus alternis, subdenticulatis.

Low, subramose; orange. Corallum finely striate, striæ denticulate, calices  $\frac{1}{2}$  an inch broad, cylindrical or a little elliptic, lamellæ alternately large and small, somewhat denticulate.

New Holland, at Port Royal George, and Port Jackson. Quoy & Gaymard.

The specimen as figured by Quoy and Gaymard, is a subramose cluster, an inch and a half high, consisting of a few large striated calicles, six to eight lines in diameter; but according to the description, the species is only half an inch in length—"n'a qu'un demi-pouce de longueur." As it is not stated how much the figure is enlarged, if at all, it is difficult to determine whether the species is identical or not, with the following, with which it has many points in common.

*Lobophyllia aurantiaca*, Quoy and Gaymard, Voy. de l'Ast. iv. 195, pl. 15, figs. 7, 11. The figure of the animal is bad. *Lobophyllia aurantiaca*, Blainv., Man. 355. *Caryophyllia aurantiaca*, Lamarck, 2d ed. ii. 354, No. 11 a.

## 5. DENDROPHYLLIA COCCINEA. (H. &amp; Ehrenberg.) Dana.

*D. humilis* ( $1\frac{1}{2}$ "), subramosa, coccineo-aurantiaca, polypis grandibus, 18-20-tentaculatis. Corallum striatulum, caliculis cylindricis, inæqualibus, aperturâ angulosâ, fere  $\frac{1}{2}$ " latâ.

Low subramose ( $1\frac{1}{2}$  inches high), yellowish-orange, polyps large, with 18 to 20 tentacles. Corallum finely striate, calicles cylindrical, unequal, aperture angular, nearly  $\frac{1}{2}$  an inch broad.

Plate 30, fig. 4, corallum of specimen from the Feejees, natural size.

The Red Sea. Ehrenberg. Singapore and Feejee Islands. Exp. Exp.

The specimens in the Expedition collections, agree nearly with the above description by Ehrenberg. They are about an inch and a half high, and consist of a few calicles half an inch in diameter, and smaller. In those of large size there are ten to twelve large lamellæ, with four to five narrower intermediate. The aperture is circular or elliptical instead of angular; the exterior is striate and a little scabrous, with the striæ punctate. The specimen from the Feejees has the calicles about half an inch long, while in that from Singapore they are from an inch to an inch and a half in length, and are arcuate.

*Oculina eoccinea*, Ehrenberg, G. xlvi. sp. 6.

#### 6. DENDROPHYLLIA DIAPHANA. (*Dana*.)

*D. humilis, subramosa, fusca, polypis 3-4'' latis. Corallum caliculis cylindricis, vix ellipticis, extus tenuissimè striatis et scabriculis, parietibus tenuibus et diaphanis, margine integris; cellâ profundiore (fere ½''); lamellis 6-10 majoribus et 2-3 intermediis valde minoribus.*

Low, subramose, fuscous, polyps 3 to 4 lines broad. Corallum a cluster of cylindrical or slightly elliptical calicles, very finely striate without, and somewhat scabrous, sides thin and diaphanous, margin entire; cell quite deep (nearly ½ an inch); 6 to 10 larger lamellæ, and 2 to 3 intermediate much smaller.

Plate 30, fig. 3, corallum, natural size.

Singapore, East Indies. *Exp. Exp.*

The thin diaphanous walls of the calicles are quite peculiar; the specimen seen is a cluster of seven or eight polyps, each about half an inch long. The cell appears peculiarly open, the large lamellæ being few in number, and the intermediate very much narrower.

#### 7. DENDROPHYLLIA RUBEOLA. (*Quoy & Gaymard*.)

*D. cespitosa, vix ramosa; polypis 2'' latis, subrubris, tentaculis tenuibus. Corallum caliculis cylindricis, 2-3'' longis, substriatis, apice truncatis, margine integris; cellâ conicâ; lamellis majoribus alternis.*

Cespitose, scarcely ramose; polyps about 2 lines broad, reddish; tentacles slender. Corallum with cylindrical calicles, 2 to 3 lines long, somewhat striate, truncate at summit, margin entire; cell conical; the larger lamellæ alternate with smaller.

New Zealand. *Quoy & Gaymard*.

According to the figure by Quoy and Gaymard, this species occurs in small groups of calicles. The exsert mouth when the animal is expanded is very prominent, and has the shape of a reversed cone. The edge of the calicle is described as very even and entire.

*Dendrophyllia rubeola*, Quoy and Gaymard, Voy. de l'Ast., iv. 197, pl. 15, figs. 12-15.

APPENDIX.—Species, observed only as a simple polyp.

*D. scabrosa*. (*Dana*.) Turbinato-cylindrical, half an inch high, and the same in breadth; exterior finely striate and villosa-scabrous or spinulous, margin nearly entire; cell deep (nearly half an inch) lamellæ very unequal, about twelve larger, and mostly three smaller intermediate, the latter denticulate. Colour, when fresh, nearly black. The sides are much thicker than in the *diaphana*, and cellular. The adult cell probably contains forty-eight lamellæ. Singapore. *Exp. Exp.* Plate 30, fig. 2, calicle natural size.

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GENUS IX.—OCULINA.—LAMARCK.

*Caryophyllidæ aggregato-gemmatæ; polypis uni-gemmatibus, gemmis singulis seriatim enascentibus et caules elongatas divaricatè ramosas cumulantibus. Coralla persolida, superficie levi; caliculis subcylindricis; lamellis integris, plus minusve exsertis.*

Aggregato-gemmate, one bud proceeding from each polyp, the succession forming elongating stems, divaricately ramose. Coralla solid with the exterior smooth; calicles subcylindrical; lamellæ entire, more or less exsert.

The Oculinæ are remarkable for the compactness of their coralla, there being scarcely a cellule within or without, excepting those of

the stars. The surface is smooth, or faintly striate about the calicles. The branches have not an axial star, like the *Dendrophyllia*; each polyp starts as the apical one, and becomes afterwards oblique and lateral. The cells vary in size from one line to three-fourths of an inch. The lamellæ, in some species, are slightly exsert, and very even, with the centre of the cell broad and convex; in others they are much exsert, and give the corallum a bristled aspect.

These species pass into the *Astræas* through the *A. microphalma*, a glomerate and incrusting species, whose cells have nearly the characters of those of this genus. They are also like the branching *Echinopores* among the *Astræidæ*, in their *cumulate* mode of budding and growth. The species with prominently exsert lamellæ resemble in their cells the *Anthophylla*.

The *Oculinæ* have a wide range, being found both in the tropics and the cold regions of the north. Some species have been brought up from a depth of one hundred and fifty fathoms. The known species are mostly confined to the West India and European seas.

The genus *Oculina* was made by Lamarek, from the *Madrepora* of early authors, for the species here included, and a few with minute polyps which are transferred to Ehrenberg's genus *Allopora*. It forms part of the *Lithodendrum* of Schweigger, and is the *Matrepora* of Oken. The *Dentipora* of Blainville belongs to this genus.

The *Alloporæ* are compact species, like the *Oculinæ*, but the cells are minute, and the lamellæ are marginal crenulations, not traceable to the bottom of the cell; moreover, they grow in flabellate forms.

#### *Arrangement of the Species.*

##### I. *Calicles with the lamellæ much exsert.*

1. *O. hirtella*.

\*2. *O. horrescens*.

##### II. *Calicles with the lamellæ but little exsert and even.*

3. *O. prolifera*.

\*7. *O. pallens*.

4. *O. axillaris*.

\*8. *O. virginea*.

\*5. *O. varicosa*.

\*9. *O. diffusa*.

\*6. *O. oculata*.



I. *Lamellis valde exsertis et inæqualibus.*

## 1. Oculina HIRTELLA. (Linn.) Lamarck.

*O. ramosa, crassa, ramis infernè interdum coalitis et sæpe 1" crassis, apice ¼". Corallum, caliculis fere 2''' latis, lamellis valde exsertis et inæqualibus, apice truncatis.*

Ramose, stout, branches below sometimes coalescing and often an inch thick, above at apex a fourth of an inch. Corallum with the calicles nearly 2 lines thick, lamellæ very much exsert and unequal, truncate at apex.

East Indies. Lamarck.

The unequal exsert lamellæ distinguish this species and the following from the other Oculinæ. The calicles are about one-sixth of an inch long.

*Mad. hirtella*, Pallas, Zooph., 313.

—, Ellis and Solander, 155, tab. 37.

*Oculina hirtella*, Lamk., ii. 455, No. 2.

—, Lamouroux, 63, tab. 37.

*Oculina hirtella*, Deslongchamps, Encyc., 574.

—, Blainville, Man., 380.

—, Ehrenberg, G. xviii. sp. 5.

## 2. Oculina HORRESCENS. (Dana.)

*O. cespitosa, ramosissima, ramis valde coalitis, ramulis brevibus, 2-3''' crassis. Corallum caliculis prominentibus, fere 1½''' latis, lamellis inæqualibus, 10-12 majoribus valde exsertis.*

Cespitose, much branched, branches much coalescing, branchlets short, 2 to 3 lines thick. Corallum with prominent calicles, nearly 1½ lines broad, lamellæ unequal, 10 to 12 larger, much exsert.

Plate 28, fig. 1, corallum, natural size; 1 a, section of stem and calicle, enlarged; 1 b, calicle, enlarged.

Feejee Islands. Exp. Exp.

This species, like the *hirtella*, has a bristled look, owing to the pro-

jecting lamellæ. It forms a clump eight or ten inches high, and a foot or more across, crowdedly branched. The upper branchlets are seldom over an inch long. Near the apex the calicles are very oblique. The larger lamellæ are cultriform, rounded at apex, and project over the outer surface of the calicle.

The *hirtella*, which it resembles, is coarser, and the calicles are twice stouter.

II. *Lamellis paululum exsertis et æqualibus.*

3. OCULINA PROLIFERA. (*Pallas.*) *Lamarck.*

*O. ramosa, subdichotoma, reticulato-coalescens; polypis maximis, axillaribus vel terminalibus et sæpe lateribus proliferis. Corallum caliculis turbinatis, sæpe 6''' crassis; lamellis paulum exsertis, subæqualibus, revolutis.*

Ramose and subdichotomous, reticulato-coalescent; polyps very large, axillary or terminal, and their sides often proliferous. Corallum with the calicles turbinate, often 6 lines thick; lamellæ a little exsert, subequal and somewhat revolute.

Norwegian Sea. *Pallas.*

A very coalescent species with large turbinate calicles, growing to a height of two feet or more. The species has some of the characters of the *Caryophyllia anthophyllum*.

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| <p><i>Corallium album, lapidosum, &amp;c.</i>, Seba, iii., tab. 116, No. 3; the branches are every where coalescent, and the calicles one-half to two-thirds of an inch in diameter, with a length of one to two inches.</p> <p><i>Madrepora prolifera</i>, Linn. Pall. Zooph., p. 307.</p> <p>—, Gmel. Syst. Nat., 3780.</p> <p>—, Ellis and Solander, tab. 32, fig. 2; in this figure, which is a simple branch, the calicles are one-third to one-half an</p> | <p>inch in diameter, and one-half to one inch in length.</p> <p>—, Esper, Pflanz. i. 104, tab. 11. Esper states that the calicles are very various in size, and sometimes an inch in diameter.</p> <p><i>Oculina prolifera</i>, Lamarck, 456, No. 5.</p> <p>—, Blainville, Man. d'Act., 380.</p> <p>—, Lamouroux, Exp. 64, pl. 32, fig. 2.</p> <p><i>Matrepora prolifera</i>, Oken, Lehrbuch der Zoologie, i. 71.</p> <p><i>Lith. proliferum</i>, Schweig. Handb., 416.</p> |
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## 4. OCULINA AXILLARIS. (Ellis.) Lamarck.

*O. ramosa, dichotoma, ramis brevibus, divaricatis; polyphis remotis, grandibus, terminalibus et axillaribus. Corallum caliculis turbinatis, 3-4''' crassis, lamellis paulum exsertis, æqualibus.*

Ramose, dichotomous; branches short, divaricate; polyps distant, large, terminal and axillary. Corallum with turbinate calicles, 3 to 4 lines in diameter, lamellæ a little exsert, even.

East Indies. (Lamarck.)

- Mad. axillaris*, Ellis and Sol., 153, tab. —, Lamour., Exp. Meth., 64, pl. 13, 13, fig. 5. fig. 5.  
*Oculina axillaris*, Lamarck, ii. 456, No. 4. —, Deslongchamps, Encyc., 575.  
 —, Blainville, Man., 380.

## 5. OCULINA VARICOSA. (Lesueur.)

*O. arborescens, 1' alta, laxè ramosa, ramulis elongatis, sæpe divaricatis. Corallum caliculis undique usque ad apicem divaricatis, brevibus, apice 1½''' latis, basi valde tumidâ seu hemisphericâ; fermè 24 lamellis subæqualibus, paulum exsertis.*

Arborescent, a foot high, loosely ramose; branchlets long and often divaricate. Corallum with the calicles every where, quite to the apex, at right angles with the axis of the branch, short, 1½ lines broad at top, the base much inflated or hemispherical; lamellæ about 24 in number, subequal and even; a little exsert.

Figure 28, page 67.

West Indies, St. Thomas. Lesueur.

The *varicosa* resembles the *pallens* in form, but is rather stouter, the branchlets being mostly a quarter of an inch in diameter; and the calicles are *erect*, even about the summits, instead of being very oblique. The swelling bases of the calicles, as seen on the larger

branches, also distinguish it. The cells are about a sixteenth of an inch deep. The branches are spreading, and seldom coalesce.

*Oculina varicosa*, Lesueur, Mém. du Muséum, vi. 291, pl. 17, fig. 19.

6. OCULINA OCULATA.

*O. ramosissima*, ramis tortuosis, implexis et valde coalitis, polypis parvulis. Corallum caliculis sparsis, sæpius obsolescentibus, sed prope apicem prominentibus et cylindricis, 1–1¼" latis, lamellis vix exsertis.

Very ramose, branches tortuous, implicate and much coalescing. Corallum with scattered calicles, mostly obsolescent, but towards the extremities of the branchlets prominent and cylindrical, 1 to 1¼ lines broad, lamellæ slightly exsert, or not at all so.

West Indies.

The much-coalesced branches, and the very short calicles of the general surface, and oblong cylindrical calicles of the extremities (sometimes one-fourth of an inch long), are the distinguishing peculiarities of this common species. It grows at times to a height of a foot and a half, and branches nearly in a plane.

This species is the *virginea*, in part, of Lamarck; the *virginea* of the older authors is a Mediterranean species, and appears to be distinct from the above.

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| <i>Corallium album</i> , Seba, Thes. iii., tab. 116,  | —, Lamour., Exp. Meth., p. 63, pl. 36.   |
| Nos. 1, 2; the calicles in No. 1 are a little larger than in No. 2, but they appear to be the same species. | —, Deslongchamps, Encyc., 574.   |
|   | —, Ehrenb., G. xlviii., sp. 1.   |
| <i>Madrepora oculata</i> (?), Pallas, Zooph., No. 179.  | <i>Matrepora oculata</i> , Oken. Zool., i. 72.   |
| —, Esper, i., tab. 12, 13; neither figure is characteristic.  | <i>Lithodendrum virgineum</i> , Schweig. Handb. 416.   |
| <i>Oculina virginea</i> , in part, Lamarck, ii. 455, No. 1.   | <i>Dentipora virginea</i> , Blainv., Man., 382, pl. 60, fig. 1; not a good figure; also, <i>Dentipora anastamozans</i> (?), 382. |

7. OCULINA PALLENS. (Ehrenberg.)

*O. arborescens* (1½' alta), laxè ramosa, interdum coalita, caule 6–8" crassâ, ramis et ramulis gracilibus, attenuatis, sæpe 2–4" longis, et

*supernè*  $\frac{1}{8}$ " *crassis*. *Corallum caliculis prominentibus*,  $1\frac{1}{4}$ " *latis*; *supernè obliquis et aperturâ ellipticis, et paulo prominulis, infernè erectis et rotundatis et ad basin superficie tumidâ radiatè striatâ circumdati*; *lamellis paululum exsertis*.

Arborescent, ( $1\frac{1}{2}$  feet high,) loosely ramose, sometimes coalescing; stem 6 to 8 inches thick, branches and branchlets slender, attenuate, often 2 to 4 inches long, and above  $\frac{1}{8}$  of an inch thick. Corallum with prominent calicles, about  $1\frac{1}{4}$  lines broad; towards the summits oblique, with an elliptical aperture, and but little prominent; below erect and circular, and surrounded at base with a tumid elevation, which is faintly radiate-striate.

Figure 29, page 67.

West Indies.—St. Thomas. *Ehrenberg*.

A neat arborescent species, with rather distant branchings, flexuous branchlets, and shallow calicles. On the branches the calicles are surrounded at base by a depression, and outside of this, a low elevation, which is marked radiately with faint striæ. This prominence sometimes looks like a low rounded ridge between adjoining calicles. The species is much larger than the *diffusa*, with the branchlets much longer. The oblique calicles at summit and more slender branchlets, distinguish it from the *varicosa*. The above description was taken from specimens examined by the author.

*Oculina pallens*, var.  $\beta$ . *Ehrenberg*, G. xlvi. sp. 4.

#### 8. OCULINA VIRGINEA. (*Linnæus*.) *Blainville*.

*O. ramosa, ramis gracilibus (1-3")*, *divaricatis et tortuosis*. *Corallum caliculis 1-1\frac{1}{4}" latis, paucis, sæpe alternatim dispositis, undique usque ad apicem, prominulis et erectis; lamellis subæqualibus, paululum exsertis*.

Ramose, branches slender (1 to 3 lines in diameter), divaricate and tortuous. Corallum with the calicles 1 to  $1\frac{1}{4}$  lines broad, often alternately arranged, every where even to the summits of the branches, prominent and erect; lamellæ nearly equal, a little exsert.

The Mediterranean Sea. *Esper.*—Off Marseilles, at a depth of 150 fathoms. *Marsilli.*

This slender branching species differs from the *diffusa* and *pallens*, in having the calicles towards the summit of the branchlets erect instead of oblique, and the alternate arrangement often gives the slender branches a zigzag form. The upper branchlets are about an eighth of an inch in diameter, and an inch to an inch and a half in length. It grows to a height of eight inches or more.

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| <p><i>Madrepore avec des rameaux à calices et blanc comme du corail</i>, Marsilli, Hist. Phys. de la Mer., 139, tab. 30, fig. 140, with enlarged details in figs. 141, 142, 143.</p> <p><i>Mad. virginea</i>, Linn., Syst. Nat., ed. xii. 1281: "M. caulescens, subdichotoma recta, solida, stellis alternis eminentibus."</p> <p>—, Pallas, Zooph., No. 180.</p> <p>—, Esper, i. 112, tab. 14. This figure is</p> | <p>very similar to that by Marsilli, presenting slender, divaricate, flexuous branches, with short erect calicles, faintly striate without, containing about twenty-four equal lamellæ, a little exsert.</p> <p><i>Acropora alba</i>, &amp;c. (?), Gualtieri Index, &amp;c., frontispiece.</p> <p><i>Matrepore virginea</i>, Oken, Zool., i. 72.</p> <p><i>Oculina virginea</i>, in part, Lamarck, 455.</p> <p>—, Blainv., Man., 380.</p> |
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9. OCULINA DIFFUSA. (*Lamarck.*)

*O. pumila*, ramosissima, diffusa, ramis divaricatis et sæpe coalitis, ramulis  $\frac{1}{2}$ –1" longis et  $1\frac{1}{4}$ " crassis. Corallum caliculis prominulis, 1" latis, numerosis, infernè erectis cum basi radiatè striatâ, supernè valde obliquis, minoribus, et aperturâ ellipticis; lamellis paululum exsertis, subæqualibus.

Small, much branched, branches divaricate, and often coalescing, upper branchlets  $\frac{1}{2}$  to 1 inch long,  $\frac{1}{10}$  of an inch thick. Corallum with the calicles a little prominent, 1 line broad, rather numerous, below, erect, with the base around radiately striate, above, very oblique, smaller and elliptical; lamellæ a little exsert, even.

West Indies. *Mauger.* *Lesueur.*

A small species, much branched, with the branchlets short, and calicles crowded at the summits.

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| <p><i>Oculina diffusa</i>, Lamk., ii. 456, No. 3.</p> <p>—, Blainv., Man., 380.</p> | <p><i>Oculina pallens</i>, var. <i>a.</i> Ehrenb., G. xlviij. sp. 4.</p> |
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III. *Glomeratæ, cellis tubulatis, laxè aggregatis.*

GENUS X.—ANTHOPHYLLUM.—SCHWEIGGER.

*Caryophyllidæ aggregatæ, glomeratæ. Coralla tubulos caliculatos massemque calcaream spongiosam interstitialem, composita; caliculis prominentibus, parietibus persolidis et sæpe leviter striatis; lamellis integris, sæpius exsertis.*

Aggregato-gemmate, glomerate. Coralla consisting of calicular tubes, and a separable spongy calcareous base; calicles prominent, with very solid sides, often faintly striate; lamellæ entire, generally exsert.

The Anthophylla form clusters of tubes, which project above the spongy base, by which they are surrounded below. The lamellæ are often very prominent, and bristle the surface of the corallum; and in the live zoophyte, each corresponds to a tentacle of the animal, and is formed by secretions, within one of these organs. In one species examined, a series of bright green tentacles surrounded the top of the tube, like a string of emerald beads, while above, was a corona of other erect tentacles, tipped with pale green. A large mass covered with these tubular polyps, each with its emerald necklace, is one of the most beautiful objects of coral growth. In other species the lamellæ are short, and the animals more resemble the ordinary coral polyp.

These species form rude masses, either nodular or subcylindrical, and more or less lobed or subdivided. The tubes in the species known, vary from an eighth to a third of an inch in diameter, and usually taper downward.

The Anthophylla, in the compact or solid walls of their tubes, as well as their frequent prominent lamellæ, approach more nearly to the Oculinæ, than to the Dendrophyllia and Caryophyllia, and might form a subfamily along with that genus, and the Stylinæ.

This group, which is part of the Caryophyllia of Lamarck, is referred to the Sarcinula of that author, by Blainville, as one of his Sarcinulæ is apparently of this genus. The species constitute the larger part of Schweigger's genus *Anthophyllum*; and Ehrenberg, in

consequence, adopted for it Schweigger's name. As the lamellæ are often much exsert, and the cell appears as if filled with a cluster of them, with their summits projecting out, the name (from *ανθος*, flower, and *φυλλον*, leaf) is not inappropriate. It is in part the *Acropora* and *Caryophyllites*, of early authors.

The fossil Anthophylla of Blainville, fall mostly into the genus Turbinalopsis of Lamouroux.

*Arrangement of the Species.*

I. *Glomerate, often lobed.*

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| 1. <i>A. musicale.</i>      | *4. <i>A. cespitosum.</i> |
| *2. <i>A. fasciculatum.</i> | *5. <i>A. hystrix.</i>    |
| 3. <i>A. astreatum.</i>     | 6. <i>A. cuspidatum.</i>  |

II. *Erect cylindrical or club-shaped stems.*

- \*7. *A. clavus.*

1. ANTHOPHYLLUM MUSICALE. (*Linnæus.*) *Schweigger.*

*A. coralli tubulis elongato-turbinatis, sæpe curvatis, striatis, raro 2''' latis, massâ spumosa laminisve spumosis connexis.*

Corallum consisting of long turbinate and often curved tubes, striate without, and hardly 2 lines in diameter, connected by a spongy mass or a series of spongy plates.

Indian Ocean.

This species differs from the other Anthophylla in the smaller size of its tubes. They are gradually attenuate below, and curved, and the paste in which they are embedded, is often in successive layers instead of being solid.

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| <i>Mad. musicalis</i> , Linn., ed. xii. 1278.          | <i>Galaxea musicalis</i> , Oken, Zool., i. 73.      |
| —, <i>in part</i> , Esper, i. 160, tab. 30, fig. 2.    | <i>Anthophyllum musicale</i> , Schweig. Handb. 418. |
| <i>Caryophyllia musicalis</i> , Lamk., ii. 350, No. 6. | —, Ehrenberg, G. lvi. sp. 4.                        |
| —, Lamouroux, Encyc., 170.                             | <i>Sarcinula musicalis</i> , Blainv., Man., 348.    |

2. ANTHOPHYLLUM FASCICULATUM. (*Linnæus.*) *Dana.*

*A. coralli tubulis clavato-turbinatis, sæpe curvatis, e massâ spongiosâ*



*surrectis*; *caliculis*  $\frac{1}{2}$ " *altis*, *compressiusculis*, *sæpius* 3" *latis*; *lamellis* 1- $1\frac{1}{4}$ " *exsertis*, *cultriformibus*.

Corallum consisting of clavato-turbinate and often curved tubes, rising from a spongy base; calicles half an inch high, a very little compressed, mostly a fourth of an inch broad; lamellæ 1 to  $1\frac{1}{4}$  lines exsert, cultriform.

East Indies.—Vanikoro. *Quoy & Gaymard*.—Sooloo Sea. *Exp. Exp.*

The calicles in this species vary from an eighth to a third of an inch in diameter, but are generally about a fourth of an inch. There are twenty-six to thirty lamellæ in the larger calicles, and about twelve of these are much the largest and nearly equal.

- Mad. caryophyllites*, Pallas, Zooph., 313, —, Lamour., *Exp. Meth.*, 48, tab. 30; No. 183. Encyc. 169.  
*Caryophyllum saxum* (?), Rumph., Amboyn., tab. 87, fig. 3. —, Blainv., *Man.*, 345.  
*Mad. fascicularis*, Linn., ed. xii. 1278. —, Quoy & Gaymard, *Voy. de l'Ast.*, iv. 190, pl. 15, figs. 3-6. The drawing of both the corallum and the animal is imperfect.  
*Caryophyllia fasciculata*, Lamk., ii. 349, No. 4. *Galaxea fascicularis*, Oken, *Zool.*, i. 73.

### 3. ANTHOPHYLLUM ASTREATUM. (*Lamarck*.)

*A. glomerato-globosum*. *Corallum caliculis brevissimis, truncatis, e massâ spumosa surrectis; lamellis margine eminentioribus*.

Glomerato-globose. Corallum with very short calicles, truncate, rising from a spumous base; lamellæ elevated above the margin of the cell.

Lamarck states that the tubes are not turbinate, and the calicles are very short. Described from a worn specimen of the *cespitosum*?

- Caryophyllia astreata*, Lamk., ii. 350, No. 5. He refers with a query to Esper's tab. 30, fig. 1, which appears to be a worn specimen of the *cespitosum*.  
 —, Lamouroux, *Encyc.*, 170.  
*Sarcinula astreata*, Blainv., *Man.*, 348.  
*Anthophyllum astreatum* (?), Ehrenb., *G.* lvi. sp. 2. "Tubulis striatis,  $2\frac{1}{2}$ " latis, indistinctè turbinatis, subcylindricis, pallii appendicibus celluloso-laminaribus, interruptis, subtilioribus."

4. ANTHOPHYLLUM CESPITOSUM. (*Esper.*) *Dana.*

*A. glomeratum, sæpe erectum et lobatum. Corallum caliculis prope 3''' latis, compressiusculis, supra leviter striatulis, e massâ spumosa ½'' surrectis; lamellis tenuissimis, papyraceis, paulum remotis, 6-9 valde latioribus, ½''' exsertis, obliquè truncatis.*

Glomerate, often erect and lobed. Corallum with the calicles about  $\frac{1}{4}$  of an inch in diameter, a little compressed, very faintly striate above, projecting  $\frac{1}{2}$  an inch from a spumous base; lamellæ very thin, papyraceous, rather remote, 6 to 9 much broader than the others;  $\frac{1}{2}$  a line exsert, obliquely truncate.

Plate 28, fig. 4, natural size; also fig. 23, page 62.

East Indies. *Exp. Exp.*

This common species forms large glomerate masses, a foot or more across, and more or less lobed or subdivided, occasionally rising into stout subcylindrical forms. The evenly thin, truncate, and slightly exsert lamellæ give the cell a neat, and also a peculiarly open appearance. The larger lamellæ almost meet at centre, leaving hardly a line of interval, and the cell is very shallow. When broken off near the bottom, the cell presents a distinct star of six or eight rays, meeting at the centre, with smaller lamellæ between. These characters distinguish the species from the *fasciculatum*, in which the lamellæ have not the paper-like thinness, and are more exsert. The calicles vary much in size; but they are generally a fourth of an inch in their longest diameter, with the exterior faintly striate above.

*Mad. cespitosa*, Esper, i. tab. 27. Esper *Anthophyllum Esperii*, Schweigger, Handb. seems to have incorrectly considered his 417. species the *Mad. cespitosa* of Linnæus.

5. ANTHOPHYLLUM HYSTRIX. (*Dana.*)

*A. glomeratum; tentaculis bursiformibus, lætè virentibus, et aliis apice pallidè virentibus, coralligenis, itaque erectis lamellam calcaream includentibus. Corallum caliculis 6-8''' altis, et sæpe 4-5''' latis, compressiusculis, extus remotè carinatis, e massâ spumosa surrectis; lamellis cultriformibus, sæpe 3''' exsertis, apice subacutis.*

Glomerate; a series of bursiform tentacles of a bright green colour, and others with pale green tips, which are coralligenous and therefore erect, and enclose a calcareous lamella. Corallum with the calicles 6 to 8 lines high, and often 4 to 5 broad, somewhat compressed, exterior remotely carinate, rising from a spongy base; lamellæ cultriform, often 3 lines exsert, apex subacute.

Plate 28, fig. 2, corallum, natural size; 2 *a*, animal, enlarged; 2 *b*, tentacle, enlarged; 2 *c*, calicle, natural size; 2 *d*, section of calicle; 2 *e*, texture of spongy part.

Feejee Islands. *Exp. Exp.*

The sharp projecting lamellæ give a bristled appearance to the corallum, as in the *cuspidatum*. It differs from that species in its smaller size, its calicles not turbinate, and crowded together with intervals between of but a line in width. The projecting lamellæ of the exterior are sharp and thin. The specimen is a convex mass, the margin of which is free and spreading, with small horizontal calicles.

#### 6. ANTHOPHYLLUM CUSPIDATUM. (*Esper.*) *Dana.*

*A. glomeratum*; tentaculis clavatis, purpurascens, apice albis, disco lætè viridi. Corallum tubulis compressiusculis, angulosis, caliculis turbinatis,  $\frac{1}{2}$ –1" latis, sæpe valde irregularibus, lamellis longè exsertis.

Glomerate; tentacles clavate, colour approaching purple, white at tips; disks bright green. Corallum with the tubes much compressed, angular; calicles turbinate,  $\frac{1}{2}$  to 1 inch broad, often very irregular, lamellæ long exsert.

Red Sea, *Ehrenberg*.—The China Seas, *Esper*, who received it from M. Chemnitz.

The large size of the calicles distinguishes this species from the other Anthophylla.

*Madrepora cuspidata*, *Esper*, i. 155, tab. 28; a species with long turbinate calicles of the size above mentioned, with the lamellæ one-third to one-half of an inch exsert, and nearly acute at apex. *Galaxea cuspidata*, *Oken*, *Zool.*, i. 73. *Anthophyllum fasciculare*, *Ehrenberg*, op. cit. Gen. lvi., sp. 1. "Tubulis compressis, angulosis, 4" altis, turbinatis, stellis  $\frac{1}{2}$ –1" latis, lamellis exsertis," &c.

7. ANTHOPHYLLUM CLAVUS. (*Dana.*)

*A. claviforme et subdivisum, erectum, 1½' altum. Corallum caliculis cylindricis, parvis, 2-3''' longis et 1½''' latis, et massâ spumosâ surrectis; lamellis paulum exsertis, truncatis.*

Claviform and subdivided above, erect, a foot and a half or more high. Corallum with small cylindrical calicles, 2 to 3 lines long, and 1½ broad, rising from a spongy base; lamellæ a little exsert, truncate.

Plate 28, fig. 3, corallum, natural size; 3 *a*, calicle, enlarged; 3 *a'*, natural size; 3 *b*, section of part of stem.

Feejee Islands. *Exp. Exp.*

This species is peculiar in its erect cylindrical or clavate forms, two to four inches in diameter, and in its small calicles. The tubes of the interior of the corallum, are flexuous and crowded, and may be easily separated from the spongy base which unites them. Large areas are covered by these coral stumps.

APPENDIX.—The *Anthophyllum spherula* of Ehrenberg, was described from a worn specimen in the Museum Nat. Cur. at Berlin, as follows: "Globosum, pollicare, tubulis 1'' nunquam latoribus, totis celluloso-concatenatis, ubi partim liberi cernuntur, substriatis, caliculis rotundis, margine paululum prominulis, radiis 12-24, interstitiis interdum profundius impressis, irregularibus." Op. cit. Gen. lvi., sp. 3.

The *Madrepora divergens* and *chalcidicum* of Forskal (op. cit. p. 136), are probably of this genus, as suggested by Blainville, and the *chalcidicum* may be identical with the *fasciculatum*.

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 GENUS XI.—STYLINA.—LAMARCK.

*Caryophyllidæ fasciculato-glomeratæ. Coralla tubulis cylindricis striatis, per dissepimenta transversa et sæpe massam cellulosa connexis stellarum centro exurgenti.*

Fasciculato-glomerate; tubes of the coralla cylindrical and striate, connected by transverse septa and often also by a cellular base; the centre of the cells exsurgent.

The Stylinæ, as Blainville suggests, resemble the smaller species of Orbicellæ, especially the *A. pleiades*; but they are distinct in the horizontal septa of the interstices, and the absence or paucity of transverse dissepiments in the tubes; and in this last respect they have the characters of the Caryophylliæ. The star in a transverse section is a simple series of rays radiating from a central spot, sometimes quite large; and in a vertical section, the same simple structure is seen. The centre of the cell is often observed to be quite prominent, and on this character the genus was first founded. Milne Edwards states that the exsert centre is not constant, but forms and disappears at intervals by a peculiar process of growth.\*

The Stylinæ are near the Anthophylla, but differ from them in the transverse plates of the interstitial material uniting the tubes; and, moreover, the tubes are in general decidedly striate, and minute dissepiments form cellules in the striæ. The mode of growth by which the centre of the cell becomes prominent is also peculiar.

The Sarcinulæ, according to Milne Edwards, differ but little from the Stylinæ; and Blainville unites them to the Anthophylla: but the *Sarcinula organum*, figured in the *Amæn. Acad.*, i. tab. 4, fig. 6, has no relation to either of these groups, and is allied to the Columnariæ. See the remarks upon the Cyathophyllidæ.

#### STYLINA ECHINULATA. (*Lamarck.*)

*S. crassa, fasciculata, sessilis, corallo stylis truncatis supernè echinato.*

Massive fasciculate, sessile. Corallum above echinate with truncate styliform prominences.

\* Speaking of the cells Milne Edwards says: "Elles sont d'abord tubiformes et lamelleuses comme des *Astrées*, mais bientôt elles se remplissent, s'étalent, et forment ainsi une cloison transversale surmontée d'un mamelon central, et dont la forme ressemble un peu à celle d'un chapeau de cardinal; de cette cloison horizontale s'élève un nouveau tube qui, à son tour éprouve des modifications analogues et ainsi de suite, de façon que le même Polypier présente tantôt les caractères d'un *Styline* tantôt ceux d'une *Sarcinule*."—*Lamarck*, 2d ed. ii. p. 339.

The "Austral Ocean." *Peron and Lesueur.*

Lamarck adds to this description that the species consists of vertical and parallel tubes, forming a thick mass, resembling a Tubipore or Favosite.

*Stylina echinulata*, Lamk., ii. 339, No. 1. —, Blainv., Man., 351, pl. 62, fig. 5.  
—, Schweig., Beobacht., tab. 7, fig. 63; —, Deulongchamps, Encyc., 708.  
Handb., p. 420.

APPENDIX.—The *Sarcinula perforata* was described by Lamarck from a specimen brought by Peron and Lesueur, from the "Austral Seas," and from the description, it appears to have been a beach-worn specimen, although not fossil. It consisted of an aggregation of straight, parallel tubes, nearly contiguous, with filled interstices, and open at both ends; they were striated by longitudinal laminae within, and, according to Blainville's figure, were an eighth of an inch in diameter. (Lamarck, ii., 340, *Sarcinula*, No. 1; Blainville, Man. d'Act., 348, pl. 62, fig. 6.) It is not a *Stylina*; neither does it seem entitled to form, of itself, a genus; and not being confident as to where it should be referred, it is simply noticed in this place.

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B. GLOMERATE; CALICULIS BREVISSIMIS, POLYPIS LONGE EXSERTIS.

GENUS XII.—ASTROITIS.—BOCCONE.

*Caryophyllidæ aggregatæ, polypis basi tantum coralligenis, itaque salientibus. Coralla caliculis vix prominulis, cellis concavis, fere contiguis, lamellis subæqualibus, inclusis.*

Aggregate Caryophyllidæ, forming coral secretions only at base; and polyps, hence, appearing to be long salient. Coralla with the calicles scarcely at all prominent; cells nearly contiguous, concave; lamellæ included and even.

The species of this genus are remarkable for their long salient polyps. The coralla are somewhat Astræoid, but they are formed by secretions only in the lower parts of the polyps. The Astrææ, with narrow interstices, bud in the disks by subdivision, while these

bud interstitially, like the Porites, and other massive species with lateral gemmation. They have but sparingly the transverse dissepiments between the lamellæ of the corallum, which belong to the Astrææ.

The typical species of this genus is included with Caryophyllia by Lamarck, with Astræa by Blainville, and with Cladocora by Ehrenberg, from all of which groups it is separated by its long salient polyps. Ehrenberg states that Boccone in his Museo di Fisica (Venice, 1694), called it *Astroites*. Quoy and Gaymard suggested the name *Astroidea*.

ASTROITIS CALICULARIS. (*Boccone*.)

*A. glomerata, incrustans, animalibus purpureis vel aurantiacis. Corallum tubulis 2½" latis, contiguis et interdum spumose connexis; cellis excavatis, orbiculatis et sæpe angulatis, fundo latis et prominulis.*

Glomerate, incrusting, animals purple or orange. Corallum with the tubes 2½ lines broad, contiguous, and sometimes with cellular interstices; cells excavate, circular or angular, bottom of cell broad, and somewhat prominent.

Mediterranean; Bay of Algeiras, off Algiers, and elsewhere.

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| <p><i>Mad. calicularis</i>, Cavolini, Pol., Mar. i. tab. 3, figs. 1-5; the polyps of this coral are figured by this author, who describes them as of a purple colour, and remarks upon their great beauty.</p> <p>—, Delle Chiaje, Anim. senza Vert. di Nap., ii. pl. 17, fig. 7.</p> <p>—, Pallas, Zooph., 314, No. 186.</p> <p>—, Esper, i. p. 117, tab. 16, figs. 1, 2; Esper figures a specimen with cells one-fourth to half an inch in diameter.</p> <p><i>Astroites calicularis</i>, Walch, Naturf., 49, No. 8.</p> <p>—, Boccone, Museo di Fisica, i. pl. 5.</p> | <p><i>Caryophyllia calicularis</i>, Lamk., ii. 348, No. 2.</p> <p>—, Lamouroux, Encyc., 169.</p> <p>—, Milne Edwards, Cuvier's Reg. Anim. 1837, pl. 83, fig. 2.</p> <p><i>Anthophyllum caliculare</i>, Schweig., H. 417.</p> <p><i>Astræa calicularis</i>, Blainv., Man., 367.</p> <p><i>Cladocora calicularis</i>, Ehrenb., G. li. sp. 2.</p> <p><i>Astroidea lutea</i>, Quoy and Gaymard, Ann. des Sciences Naturelles, x. pl. 9 B; and <i>Astræa calicularis</i>, Voyage de l'Astrolabe, iv. 200, pl. 15, figs. 10-23—including figures of the polyps, of an orange colour.</p> |
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ASTROITIS VIRIDIS. (*Quoy & Gaymard*.) *Dana*.

*A. subglobosa, polypis valde exsertis, griseis, tentaculis viridibus. Co-*

*rallum porosum, cellis immersis, 2'' latis, polygonis, compressis, conicis; lamellis æqualibus, denticulatis; margine rugosis.*

Subglobose, polyps much exsert, grayish, tentacles green. Corallum porous, with immersed cells, 2 lines broad, polygonal, compressed, conical; lamellæ even, denticulate; margin rugose.

Island of Vanikoro. *Quoy & Gaymard.*

This species is added to the genus with hesitation. Quoy and Gaymard describe it as occurring in rounded or ovoidal masses, as large as a pear; its cells quite deep, with the sides vertical. The polyps are salient, more than half an inch, with a prominent (*très-développé*), buccal disk. The species has much analogy with the Goniopores, but the deep cells with denticulate lamellæ are peculiar.

*Astræa viridis*, Quoy and Gaymard, *Voy. de l'Ast.*, iv. 204, pl. 16, figs. 1-3.

NOTE.—The genus *Goniopora* is placed in the family Poritidæ, on the ground of a general similarity of the polyps and their coralla, to those of the Porites. Yet it may be equally proper, if not more so, to add them in this place, and consider them the representatives among the Caryophyllacea, of the Porites, in the tribe Madreporacea.

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### FAMILY III.—GEMMIPORIDÆ.

*Caryophyllacea polyporum discis latis, sæpe convexis et margine tentaculatis, tentaculis brevibus. Coralla porosa, superficie non striatâ; cellis margine parietibusque crassis; lamellis inclusis, angustis et fere æqualibus.*

Caryophyllacea with broad, often convex, disks to the polyps, having the tentacles marginal and short. Coralla internally porous, surface granulous and not striate, margin and sides of the cells stout; lamellæ included, narrow and neatly even.



The Gemmiporidæ assume glomerate and broad foliaceous forms. The latter are often of large size, and consist of plates sometimes a foot or more in width, either standing like broad vases on a pedicel, or clustered and rolled around one another, resembling some large-leaved plants. The whole interior of the plates or vases is covered with polyp-flowers, and fresh buds are constantly appearing at the margin, as explained in § 66. The polyps have a broad convex disk, which is fringed around with short tentacles in two or more series.

The cells of the corallum are nearly cylindrical, and are evenly set around with narrow and entire lamellæ, appearing often like mere striæ of the inner surface. The calicles are thick with a granulous exterior like the whole corallum, and the margin, though sometimes subacute, is always stout. In a transverse section, the cells of the corallum consist of a neat star of cellules radiating from a porous centre.

The Gemmiporidæ are confined to the warm coral-reef seas.

This family includes but two genera :

*Gemmipora*. Calicles prominent, cylindrical or conico-cylindrical.

*Astreopora*. Calicles obsolete or nearly so.

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GENUS I.—GEMMIPORA.—BLAINVILLE.

*Gemmiporidæ foliaceæ aut glomeratæ. Coralla porosa, superficie granulosâ, caliculis cylindricis aut conico-cylindricis.*

Foliaceous or glomerate. Coralla porous, with a granulous surface and cylindrical or conico-cylindrical calicles.

The genus *Gemmipora* was established by Blainville from the *Explanaria* of Lamarck, a mixed group united only on the ground of their unifacial explanate form. The glomerate species were arranged by Lamarck with the *Astræas*. Ehrenberg, adopting the name *Explanaria* for the *Orbicellæ*, with which he united one or two of the *Gemmiporæ*, placed the remainder of the *Gemmiporæ* under *Turbinaria*, a name which was proposed for this group by Oken, previous to the introduction of Blainville's *Gemmipora*. The word is so near *Turbinaria*, one of Lamarck's genera, that Blainville's, which has been

generally adopted, may better be retained. Moreover, Oken's name was introduced without any reference to the previously formed genera of Lamarck.

*Arrangement of the Species.*

I. *Glomerate.*

\*1. *G. palifera.*

II. *Explanate from a central pedicel.*

\*2. *G. peltata.*

4. *G. crater.*

\*3. *G. patula.*

\*5. *G. cinerascens.*

III. *Foliaceous with the folia clustered.*

\*6. *G. frondens.*

\*7. *G. brassica.*

I. *Gemmipora glomerata.*

1. GEMMIPORA PALIFERA. (*Lamarck.*) *Blainville.*

*G. glomerata, sæpe subglobosa et lobata; polypis flavescentibus, tentaculis brevissimis. Corallum caliculis valde confertis, cylindricis, 1-3''' altis, et 1½''' crassis, apice paulo minoribus, margine crassis.*

Glomerate, often subglobose and lobed; polyps yellowish, tentacles very short. Corallum with the calicles much crowded, cylindrical, 1 to 3 lines high, and 1½ lines in diameter, and a little smaller at summit; margin thick and stout.

Plate 29, fig. 2, corallum; 2 *a*, transverse section, enlarged; 2 *b*, animal, enlarged.

The Austral Seas. *Lamarck.*—Feejee Islands. *Exp. Exp.*

Forms irregularly rounded masses, sometimes subdivided or lobed, and crowdedly covered with stout cylindrical calicles. One specimen in the Expedition collections is six inches in diameter and four thick. The cells contain about thirty even lamellæ, and are a line deep, with the bottom small and flat.

*Astræa palifera*, Lamk., ii. 409, No. 14.  
—, Lamouroux, Encyc., 130.

*Gemmipora palifera*, Blainv., Man. d'Act.,  
387.

II. *G. explanatæ, centro stipitatæ.*

2. GEMMIPORA PELTATA. (*Esper.*) *Blainville.*

*G. explanata; fronde stipitatâ, sæpe peltatâ et supernè concavâ, sæpe variè plicato-contortâ, margine 2-3''' crasso. Corallum caliculis cylindricis, interdum obsoletis, plerumque 3''' latis et margine crasso, lamellis fermè 32.*

Explanate; frond stipitate, often peltate, usually concave above, often variously plicato-contorted when of large size; margin 2 to 3 lines thick. Corallum with the calicles cylindrical, sometimes obsolete, mostly 3 lines broad, with a stout margin and about 32 lamellæ to the cell.

East Indies.—The Feejee Islands. *Exp. Exp.*

When of small size, or but four or five inches in breadth, the form of the species is that of a shallow basin supported below at centre; but on growing beyond this size, the margin becomes contorted in broad folds. One large specimen of this kind, obtained at the Feejees, measures sixteen inches in breadth, and twelve in height. The calicles are sometimes a third of an inch in diameter, and about the lower parts of the concavities are obsolete. The cells are two to three lines deep, and have a broad and somewhat convex bottom.

*Madrepora peltata*, Esper, Fortsetz., i. 27, *Explanaria crater*, Schweig., Handb., 419. and ii. p. 15, tab. 42, and 86, fig. 2; *Gemmipora peltata*, Blainv., Man., 387. characteristic figures: the first is nearly flat and peltate, the second is convex above instead of concave. The larger calicles are from three to four lines in diameter. *Turbinaria cupula*, Ehrenb., G. 49, sp. 1; Ehrenberg's *T. peltata* has smaller calicles than the *cupula*, and the description does not agree as well with Esper's figure.

3. GEMMIPORA PATULA. *Dana.*

*G. explanata; fronde stipitatâ, infundibuliformi, et sæpe variè plicato-contortâ, margine 1½-3''' crasso. Corallum caliculis brevibus, cylindricis, 2''' latis, margine subacutis, multis brevissimis aut obsoletis.*

Explanate; frond stipitate, infundibuliform, and often variously pli-

cato-contorted; 1 to  $1\frac{1}{2}$  lines thick at the margin. Corallum with the calicles short, cylindrical, 2 lines in diameter; margin subacute; many very short or obsolete.

This species has the general habit of the *peltata*, but grows in somewhat thinner fronds, with smaller calicles, which, at margin are nearly acute. It attains a breadth of ten or twelve inches. It appears to be the *peltata* of Ehrenberg, and, as that name is applied to another species, we have changed it as above.

*Turbinaria peltata*, Ehrenberg, G. xlix. sp. 2.

4. GEMMIPORA CRATER. (*Pallas.*) *Blainville.*

*G. explanata*; fronde stipitatá, infundibuliformi, margine 1''' crasso. Corallum caliculis brevibus, fere  $1\frac{1}{2}$ ''' latis.

Explanate; frond stipitate, infundibuliform, margin a line thick. Corallum with the calicles short, nearly  $1\frac{1}{2}$  lines in diameter.

East Indies.

This species has much smaller calicles than the preceding. The slightly larger calicles and thicker fronds distinguish it from the *cinerascens*. Esper and Pallas describe it as finely striate without.

<p><i>Madrepora crater</i>, infundibuliformis, striata, Pallas, Zooph., 332.</p> <p>—, Esper, Fortsetz., i. 91, tab. 74, and Fortsetz., ii., tab. 86, fig. 1; the first figure is cup-shaped, six inches broad, finely striate below, with a stout obconical pedicel, and scattered calicles within.</p>	<p><i>Explanaria infundibulum</i>, Lamk., ii. 398, No. 1.</p> <p>—, Lamouroux, Encyc., 385.</p> <p><i>Turbinaria crater</i>, Oken, Zool., i. 67.</p> <p><i>Explanaria crater</i>, Blainv., Man., 387, pl. 56, fig. 6; a reduced figure, badly drawn.</p>
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5. GEMMIPORA CINERASCENS. (*Ellis.*) *Dana.*

*G. explanata*; fronde stipitatá, latè hypocrateriformi, sæpe plicato-contortá, tenui, margine  $\frac{1}{2}$ ''' crasso. Corallum extus rugatum; intus caliculis brevibus, 1''' latis, conicis vel globoso-conicis, cellis  $\frac{2}{3}$ ''' latis et profundis.

Explanate; frond stipitate, broad, hypocateriform, often plicato-contorted, thin (margin but  $\frac{1}{2}$  a line thick). Corallum wrinkled without; within calicles short, a line in diameter, conical or globosconical, cells  $\frac{2}{3}$  of a line broad and deep.

Plate 30, fig. 11, surface of corallum magnified.

East Indies, Singapore. *Exp. Exp.*

The *cinerascens* in its very thin frond, approaches the following species, but grows from a central pedicel. The under surface is wrinkled for an inch or two from the margin. Under the microscope the surface of the corallum presents minute, irregular, distant granules, and pores still more distant, as shown in the figure. It grows to a height of a foot or more. The surface, when weathered, has usually a light bluish-ash colour.

*Mad. cinerascens*, Ellis and Sol., 157, tab. 43; a characteristic figure.

—, Esper, Fortsetz., i. 84, tab. 68.

*Explanaria mesenterina*, Lamk., ii., 399, No. 2; more than one species may be here included.

—, Lamouroux, Exp. Meth., 57, pl. 43.

*Turbinaria cinerascens*, Oken, Zool., i. 67.

*Explanaria cinerascens*, Schweig., Handb., 419.

*Gemmipora mesenterina*, Blainv., Man., 387.

The *Turbinaria microstoma*, of Ehrenberg,

Gen. xlix., sp. 3; appears to be identical with the *cinerascens* of Ellis, of which it may be a small specimen. His description is as follows: "Quadripollicaris, cinerascens, cyathiformis, stellulis (caliculis) apice angustioribus, subconicis,  $\frac{1}{2}$ ''' latis, interstitiis glabris, parcius exsistis." The locality is not given. The *Explanaria cinerascens* of Ehrenberg (op. cit. Gen. l. sp. 2) is another species, as indicated by its mode of growth, and the character of its surface; it may be the *G. brassica*.

3. *G. foliaceæ, frondibus aggregatis.*

#### 6. GEMMIPORA FRONDENS. (*Dana.*)

*G. explanata; frondibus aggregatis, suberectis, sinuatis, margine  $\frac{2}{3}$ ''' tenuibus, interdum lobatis; polypis flavis. Corallum extus non rugatum, intus caliculis confertis, brevibus, subcylindricis et globoso-conicis, cellis profundis, aperturâ  $\frac{1}{2}$ - $\frac{2}{3}$ ''' latâ.*

Explanate; fronds clustered, suberect, sinuate, margin  $\frac{2}{3}$  of a line thick, sometimes lobed; polyps yellow. Corallum not wrinkled

without; within, calicles crowded, short, subcylindrical or globosconical, cells deep, aperture  $\frac{1}{2}$  to  $\frac{2}{3}$  of a line wide.

Plate 30, fig. 10, corallum, showing its form, and a single lobe with the calicles, natural size; 10 *a*, appearance of an animal partly expanded; 10 *b*, section of folium enlarged; 10 *c*, surface magnified.

Feejee Islands. *Exp. Exp.*

This species grows in clusters of leaves nearly erect, some of which are six or eight inches high, and four or five broad, much bent and curved, and not unfrequently lobed. The thickness below is often one-third of an inch. The absence of wrinkles from the back surface, except perhaps faint traces within a fourth of an inch of the margin, and the structure of the surface under the microscope, distinguish the species from the following; and both of these characters, with the mode of growth, separate it from the preceding. The polyps of the specimen examined never fully expanded.

#### 7. GEMMIPORA BRASSICA. (*Dana.*)

*G. explanata*, frondibus basi cucullatè convolutis, tenuibus, maximis. Corallum extus omnino rugatum; intus caliculis sparsis, conico-cylindricis, cellis paulo profundis, apertura  $\frac{1}{2}$ " latis.

Explanate; fronds cucullately infolded with one another at base, thin, very large. Corallum with the exterior every where wrinkled; within, calicles rather remotely scattered, conico-cylindrical, cells shallow,  $\frac{1}{2}$  a line broad at the aperture.

Plate 29, fig. 1, corallum; 1 *b*, transverse section of calicle, seen from above, enlarged; 1 *c*, calicle enlarged.

Feejee Islands. *Exp. Exp.*

This species forms large clumps, consisting of leaves, rolled around one another, sometimes two and a half feet or more high, and two feet in breadth. The folia are nearly straight vertically, and very thin, scarcely exceeding an eighth of an inch in any part. The under surface is wrinkled for six inches or more from the margin, in which it differs strikingly from the two preceding species. The granules of

the surface, as seen under the microscope, are in much shorter series, and less crowded than in the *frondens*.

The *Explanaria cinerascens* of Ehrenberg (op. cit. Gen. l. sp. 2) is near the above, though probably distinct. It is described as follows:—"Subpedalis, variè plicata et sinuosa, processibus sæpius infundibuliformibus, intus sterilibus (nec extus), caliculis linearibus, semiglobosis, interstitiis gyrosè asperis; animalis pallii colore nigro-fusco." "Infundibula hujus formæ apertè non e gemmis sed e pallii plicis coalitis oriunda."

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GENUS II.—ASTRÆOPORA.—BLAINVILLE.

*Gemmiporidæ glomeratæ; polypis sparsis; coralli caliculis obsoletis, cellis profundioribus, cylindricis; interstitiis porosis.*

Gemmiporidæ, with glomerate mode of growth; polyps scattered; calicles of corallum obsolete, cells quite deep, cylindrical; interstices porous.

The Astræoporæ are massive corals with scattered cells hardly prominent, though sometimes nearly hemispherical. The lamellæ are narrow as in the Gemmiporæ. The texture of the corallum is porous, with no traces of a lamellar texture, in which respect, as well as in the deep cylindrical cells, the species are very distinct from the Astræas.

This genus contains two groups, which when the animals are studied may constitute different genera. In one of them the coralla have the fine porous (almost compact) texture and surface of a Gemmipora, and in the other, a coarser porous texture, with a decidedly echinulate surface.

From the absence of calicles it is probable that the polyps are salient when expanded.

These species are confined to the coral-reef seas.

The Astræoporæ were separated from the genus Astræa of Lamarck, by Blainville.

*Arrangement of the Species.*

- \*1. *A. pulvinaria.*
- 2. *A. punctifera.*

- 3. *A. fungiformis.*
- \*4. *A. stellulata.*

1. *ASTRÆOPORA PULVINARIA*. (*Lamarck.*) *Blainville.*

*A. glomerata*, sæpe globosa, incrustans; tentaculis 24 vel pluribus, brunnescentibus. Corallum valde porosum, undique pulvinato-echinulatum; caliculis fere hemisphericis et basi contiguïs, interdum obsolescentibus et remotis; cellis valde profundis,  $\frac{3}{4}$ ''' latis.

Glomerate, often globose, incrusting; tentacles 24 or more, brownish.

Corallum very porous, surface pulvinato-echinulate; calicles nearly hemispherical, and contiguous at base, sometimes nearly obsolete and distant; cells very deep,  $\frac{3}{4}$  of a line broad.

Plate 29, fig. 3, corallum, natural size; 3 *a*, animal, partly expanded, enlarged; 3 *b*, cell, enlarged; 3 *c*, animal, less expanded; 3 *d*, vertical section of corallum, enlarged.

The "Austral Seas." *Peron & Lesueur.* — The Feejee Islands. *Exp. Exp.*

The masses sometimes have an undulating surface, and occasionally are spheroidal or globular. One of the latter kind in the collections is four inches in diameter; and one of the former, six inches broad, with a thickness of two to three inches. The cells are mostly a line and a half deep, and the lamellæ are vertical, but much less crowded than in the *stellulata*. On different parts of the same specimen the calicles are crowded or distant, nearly obsolete or conoido-hemispherical.

The polyps of the specimen examined were but partly expanded, showing only the extremities of twenty-four tentacles in two series (3 *a*). When less expanded the cells were closed by a radiated membrane having an opening at centre, as shown in fig. 3 *c*.

*Astrea pulvinaria*, Lamk., ii. 409, No. 15.

—, Lamouroux, Encyc., 130.

*Astreopora pulvinaria*, Blainville, Man., 383.

The *Astrea myriophthalma* of Lamarck, is near the above. Lamarck states that he separated it with some hesitation from the *pulvinaria* on account of its less promi-

nent and less crowded calicles, an unimportant character, as our specimens show. Esper's tab. 54 B, fig. 2 (Pflanz. Fortsetz. i.), to which Lamarck refers with a query under *A. myriophthalma*, is a worn fragment of a *Madrepora* (ii. 407, No. 9. — *Astreopora myriophthalma*, Blainville, Man., 383).







Lamarck states that the cells are deep, with very finely striated sides, which is true of the specimens examined by the author. Blainville's figure well represents it, except that the lamellæ are not sufficiently numerous, the number varying from twenty-four to thirty in the Feejee specimens. The surface is nearly smooth, and the cells are about a line deep.

The masses collected were about five inches in breadth, with a thickness of two to three inches. The polyps had a yellowish colour.

*Astrea stellulata*, Lamarck., ii. 408, No. 12. *Astreopora stellulata*, Blainv., Man., 383, pl. 60, fig. 4.

## FAMILY IV.—ZOANTHIDÆ.

*Caryophyllacea simplicissima, aut gemmata; extus subcoriacea; polypis discis latis, convexis, margine radiatè striato et interdum valde reflexo; corallo nullo, sed zoophytis sæpe arenulas corallicas includentibus.*

Caryophyllacea either budding or simple; exterior subcoriaceous; polyps with broad convex disks having the margin radiately striate and sometimes much reflexed; no coral secretions, but coral sand often included in their texture by the growing zoophytes.

The coriaceous exterior with no corallum within, and the radiated margin of the disk, are the most striking peculiarities of the Zoanthidæ. The species grow either as simple animals, or by budding form compound zoophytes. The buds pass out from near the base of the polyps, producing either simple lines, incrusting plates, or thick masses (p. 65). The polyps are all large, the diameter of the disk varying from a third of an inch to an inch, and the height from half an inch to an inch and a half. (See farther, pp. 39-42.)

This family includes three genera, distinguished by their mode of budding and growth.

G. 1. ISAURA. Simple and not budding.

G. 2. ZOANTHA. Budding and forming lines of polyps.

G. 3. PALYTHOA. Budding, and forming incrusting plates or convex masses.

The species of Palythoa, in which the surface is very prominently mammillate when unexpanded, have been made into a separate genus; but the transitions from the species in which the union is basal, to those which coalesce by their sides to their very summits, is so gradual, that it is deemed preferable to retain all in a single genus.

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GENUS ISAURA.—SAVIGNY.

*Zoanthidæ non gemmatæ, simplicissimæ.*

Non-budding, simple, Zoanthidæ.

The genus Isaura, as instituted by Savigny, comprised also, in part, the budding Zoanthidæ. Ehrenberg considers the group identical with the genus Hughea of Lamouroux, and adopts this name, as Savigny's, though of earlier date, had been used for a genus of plants. Ellis's figure (Ellis and Solander, tab. 1, fig. 3), for which Lamouroux's genus was formed, represents a simple polyp, having a small disk and fifteen to twenty rays, without the radiated margin to the disk that characterizes the Zoanthidæ. Its characters are too little known to be received, without farther examination, as the type of the genus.

*Arrangement of the Species.*

1. I. Hemprichii.

2. I. Savignii.

\*3. I. aster.

\*4. I. speciosa.

1. ISAURA HEMPRICHII. (*Ehrenberg.*) Dana.

*I. semipollicaris, nigro-fusca; disci radiis* 20–24.

Half an inch high, nearly black; rays of the disk 20 to 24.

Red Sea, near Tor. *Ehrenberg.*

*Hughea Hemprichii*, Ehrenberg, G. x., sp. 1.

2. ISAURA SAVIGNII. (*Audouin.*) *Dana.*

*I. quadrilinearis, clavata, gracilior, pallidior.*

Four lines high, clavate, more slender than the *Hemprichii*, and paler in colour.

Red Sea. *Ehrenberg.*

*Hughea Savignyi*, Ehrenberg, G. x. sp. 2.      planches de Savigny, l'Egypte, Polypes,  
*Palythoa Savignii*, Audouin, Explic. des      tab. 2, fig. 1.

3. ISAURA ASTER. (*Dana.*)

*I. pollicaris, 2-3''' crassa, extus cinerascens disco, semipollicari, brunneo, radiis numerosis, pallidè luteo-virescentibus; tentaculis biseriatis, olivaceis.*

An inch high, and 2 to 3 lines thick, with the exterior ash-coloured, disk half an inch in diameter, brown, with numerous pale greenish-yellow rays; tentacles in two series, olive green.

Plate 30, fig. 2, zoophytes, natural size; 2 *a*, same, enlarged.

Feejee Islands. *Exp. Exp.*

The tentacles which fringe the broad disk are about a sixth of its diameter in length: those of the outer series have a pale greenish-gray colour; immediately around the mouth the disk is green.

4. ISAURA SPECIOSA. (*Dana.*)

*I. robusta, ¾'' alta et 2-4''' lata, pallida, disco 8''' lato, viridi, prope marginem brunnescente; tentaculis brevibus, triseriatis, serie externâ luteâ, intermediâ umbrino-virescente, internâ viridi.*

Stout, ¾ of an inch high, and 2 to 4 lines thick, pale; disk 8 lines broad, deep-green, but becoming brown near the margin; tentacles

short, in three series, the outer yellow, the intermediate umber, with a tinge of green, and the inner deep and rich green.

Plate 30, fig. 1, zoophytes, natural size; 1 *a*, same magnified.

The Balabac Passage, north of Borneo. *Exp. Exp.*

The fringe of tentacles margining the disk is very short. The green colour of the disk belongs to the radiated lines, these being separated by narrower lines of brown. A single one of these rays has a yellowish-white colour, indicating some peculiar function in the tentacle with which it communicates.

---

GENUS ZOANTHA.

*Zoanthidæ e stolonibus repentibus gemmatæ.*

Zoanthidæ budding from creeping shoots.

The Zoanthæ form long lines of polyps, rising from a creeping, root-like shoot, which is attached to some support.

This genus was instituted by Cuvier, in his *Elements of Zoology*, but was first restricted to the Zoanthidæ by Lamarck, who included in it all the known species of the family. Lesueur and Lamouroux, by introducing other genera, reduced it to its present limits. The name is derived from ζῷον, *animal*, and ἀνθος, *flower*.

*Arrangement of the Species.*

- |                        |                           |
|------------------------|---------------------------|
| 1. <i>Z. Ellisii.</i>  | 4. <i>Z. dubia.</i>       |
| 2. <i>Z. sociata.</i>  | 5. <i>Z. Bertholetii.</i> |
| 3. <i>Z. Solandri.</i> |                           |

1. ZOANTHA ELLISII. (*Bosc.*)

*Z. polypis elongatis (sæpe 2'') clavatis, tentaculis filiformibus.*

Polyps often 2 inches long, clavate, tentacles filiform.

West Indies. *Ellis.*

The long filiform tentacles of this species, if correctly given by Ellis, are quite unlike most of the Zoanthidæ. The breadth of the disk is but half the length of a tentacle, and the disk moreover is not radiated; the polyp expanded is nearly three-fourths of an inch broad. (See figure 26, p. 66.)

- Actinia sociata*, Ellis, Phil. Trans., 57, t. 19, figs. 1, 2. *Zoanthus Ellisii*, Bosc. ii. 224.  
 —, Ellis and Solander, 5, tab. 1, figs. 1, 2. —, Lamouroux, Exp. 89, pl. 1. figs. 1, 2.  
*Hydra sociata*, Gmel. Syst. Nat., 3868. *Zoanthus sociatus*, Ehrenb., G. xi., sp. 1.

2. ZOANTHA SOCIATA. (*Lesueur.*)

*Z. polypis* 2" *altis*, *subviolaceis disco semipollicari virescente; tentaculis tenuibus, brevibus, luteis.*

Polyps 2 inches high, and subviolaceous, disks half an inch in diameter, greenish; tentacles slender and short, yellowish.

Guadaloupe, West Indies. *Lesueur.*

The tentacles in this species, according to Lesueur, are sixty in number, and in two rows.

- Zoanthus sociata*, Lesueur, Jour. Acad. Nat. Sci. Philad., i. 176. —, Blainville, Man., 328. Lesueur suggests that this may be the *sociata* of Ellis.

3. ZOANTHA SOLANDRI. (*Lesueur.*)

*Z. polypis crassioribus*, 2" *altis*, *disco fusco-rubescente, tentaculis brevibus.*

Polyps stouter than in the *sociata*, 2 inches high, disks reddish-brown, tentacles short.

West Indies, St. Thomas. *Lesueur.*

The exterior colour is reddish-yellow; when the animal is contracted the summit is marked with deep-blue angular spots and white lines. Tentacles about sixty in number.

*Zoanthus Solandri*, Lesueur, op. cit., 177, pl. 8, fig. 1; well figured, with important dissections. *Zoanthus Solandri*, Lamk., 2d ed., ii. 78, No. 2. —, Blainv., Man., 329, pl. 50, fig. 2.

#### 4. ZOANTHA DUBIA. (*Lesueur.*)

*Z. polypis minoribus cylindricis, disco medio viridi; tentaculis oreque luteis; tentaculis biseriatis, numerosis.*

Smaller than the *sociata*, cylindrical; disk green at centre, tentacles and mouth yellow; tentacles in two series, very numerous.

Guadaloupe, West Indies. *Lesueur.*

Grows in close clusters or bunches upon marine bodies, as fuci, &c., and is about a third smaller than the *sociata*.

*Zoanthus dubia*, Lesueur, op. cit., 177. *Zoanthus dubia*, Blainville, Man., 329.

#### 5. ZOANTHA BERTHOLETII. (*Audouin.*) *Ehrenberg.*

*Z. reticularis, polypis quadrilinearibus et 1½-2'' latis, subcylindricis; tentaculis clavatis, contractis mammilliformibus.*

Reticulate; polyps 4 lines in height, and 1½ to 2 lines broad, subcylindrical, with the tentacles clavate; when contracted mammilliform.

Red Sea. *Savigny.*

*Palythoa Bertholetii*, Audouin, Explication des Planches de M. Savigny, l'Egypte, Polypes, pl. 2, fig. 3. *Zoanthus Bertholetii*, Ehrenb., G. xi., sp. 2. —, Lamarck, 2d ed., ii. 78, No. 3.

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#### GENUS PALYTHOA.—LAMOUROUX.

*Zoanthidæ explanato-gemmatæ; polypis latere coadunatis.*

Zoanthidæ with explanate gemmation; polyps united to one another laterally.

The Palythoæ form incrusting plates or convex masses. When the polyps are united by their bases only, the plates are thin, and the polyps when contracted form rounded or cylindrical prominences over the surface; but as the union becomes more general, and they coalesce by their sides above as well as at base, the plates are thicker and the polyps less prominent; and when the coalescence extends quite to their summits, the unexpanded zoophytes are convex, with nearly a flat surface.

The genus Palythoa was separated from Zoantha by Lamouroux. Lesueur subsequently subdividing the Zoanthæ, instituted the two genera *Mammillifera* and *Corticifera*, the first including the Palythoæ, with mammilliform prominences when contracted; and the second, those in which these prominences are obsolete or nearly so. Schweigger's genus *Cavolinia*, and Oken's *Tethya*, fall into this group.

*Arrangement of the Species.*

I. *Polyps united only at base, forming when contracted very prominent mammille over the surface.*

- |                        |                          |
|------------------------|--------------------------|
| 1. <i>P. denudata.</i> | 3. <i>P. nymphæa.</i>    |
| 2. <i>P. auricula.</i> | 4. <i>P. fuliginosa.</i> |

II. *Polyps united nearly to their summits; surface of the contracted zoophyte mammillate.*

- |                          |                        |
|--------------------------|------------------------|
| 5. <i>P. mammillosa.</i> | 6. <i>P. ocellata.</i> |
|--------------------------|------------------------|

III. *Polyps united quite to their summits; surface of the zoophyte scarcely at all mammillate.*

- |                             |                       |
|-----------------------------|-----------------------|
| 7. <i>P. glareola.</i>      | 9. <i>P. argus.</i>   |
| 8. <i>P. flavo-viridis.</i> | *10. <i>P. cæsia.</i> |

I. *Palythoæ basi tantum coadunatæ.*

1. *PALYTHOA DENUDATA. (Cavolini.) Dana.*

*P. purpurea, polypis basi tantum coadunatis, valde prominentibus, cylindricis et clavatis; 1-2''' crassis et 6-9''' longis; tentaculis triseriatis, serie extimâ minore.*

Purple; the polyps united only at base, very prominent, cylindrical, and clavate, 1 to 2 lines thick, and 6 to 9 high; tentacles in three series, the outer smallest.



Near Naples, Mediterranean Sea. *Cavolini*.

*Madrepora denudata*, Cavolini, Pol. Mar., *Mammillifera denudata*, Ehrenb., G. xii.  
tab. 3, fig. 6. sp. 1.

*Cavolinia rosea*, Schweig., Handb., 411.

## 2. PALYTHOA AURICULA. (*Lesueur*.) *Dana*.

*P. rubescens*; *polypis basi tantum coadunatis, prominentibus, turbinatis, 3'' latis, et 3-6'' altis; discis 4'' latis, virescentibus; tentaculis 26-30, rubescentibus.*

Reddish; polyps united only at base, prominent, turbinate, 3 lines broad, and 3 to 6 high; disks 4 lines broad, greenish; tentacles 26-30, reddish.

St. Vincent and Dominica, West Indies, covering the rocks at the entrance of the port. *Lesueur*.

*Mammillifera auricula*, Lesueur, Jour. *Mammillifera auricula*, Blainville, Man.,  
Acad. Nat. Sci. Philad., i. 178, tab. 8, 329, pl. 50, fig. 3.  
fig. 2.

## 3. PALYTHOA NYMPHÆA. (*Lesueur*.) *Dana*.

*P. auriculæ affinis, rubro-lutescens; discis luteis et tentaculorum basi virentibus, tentaculis fere 50 biseriatis pallidè brunneis, oribus prominentibus.*

Resembling the *auricula*, yellowish-red; disks yellow, with a green circle at the base of the tentacles; tentacles about 50 in number, in two series, and of a light brown colour; mouth prominent.

St. Christopher, West Indies. *Lesueur*.

*Mammillifera nymphæa*, Lesueur, Jour. *Mammillifera nymphæa*, Blainville, Man.,  
Acad. Nat. Sci. Philad., i. 178. Lesueur 329.  
states that "the mouth is divided on each side by four or five folds, and rises in the form of a button." The *Alcyonium mammillosum*, of Esper, Pflanz. iii., tab. 7, is near the *nymphæa*.

4. PALYTHOA FULIGINOSA. (H. & Ehrenberg.) Dana.

*P. flavo-fusca*, polypis basi tantum coadunatis; contractis  $2\frac{1}{2}$ " latis, altioribus; expansis 1" longis, clavatis, discis margine 32-dentatis, tentaculis clavatis, obtusis, fusco- et albo-fasciatis, fere 64 in serie duplici, internâ validiore.

Brownish-yellow, polyps united only at base, when contracted  $2\frac{1}{2}$  lines broad, and quite prominent; when expanded an inch high, clavate; disks with 32 teeth to the margin; tentacles clavate, obtuse, banded with brown and white, about 64 in 2 series, the inner larger.

The Red Sea. *Ehrenberg.*

*Mammillifera fuliginosa*, Ehrenberg, G. xii., fig. 3. Ehrenberg suggests that the *Palythoa Perii*, of Audouin, may be the above species.

II. *Palythoæ breviter mammillose*—polypis latere coadunatis, sed apice liberis.

5. PALYTHOA MAMMILLOSA. (Ellis.) Lamouroux.

*P. polypis latere coadunatis*, contractis apice prominentibus,  $\frac{1}{2}$ –1" altis, fere 3" latis.

Polyps laterally united, but with quite prominent summits when contracted,  $\frac{1}{2}$  to 1 inch high and nearly 3 lines broad.

Coasts of Jamaica.

- |   |  |
|---|--|
| <i>Alcyonium mammillosum</i> , Ellis and So-      | <i>Palythoa stellata</i> , Lamour., Exp., 70, tab. |
| lander, 179, No. 5, tab. 1, figs. 4, 5.           | 1, figs. 4, 5.                                     |
| —, Linn., Gmelin, 3815, No. 16.                   | <i>Tethya mammillosa</i> , Oken's Zool., i. 82.    |
| —, Lamk., ii. 601, No. 9.                         | <i>Cavotinia mammillosa</i> , Schweig., H. 411.    |
| Sloane's Jamaica, 1, tab. 21, figs. 2, 3.         | <i>Mammillifera mammillosa</i> , Blainv., Man.,    |
| <i>Palythoa mammillosa</i> , Lamour., Pol. flex., | 329.   |
| 361.  | —, Ehrenb., G. xii., sp. 2.                        |

## 6. Palythoa ocellata. (Ellis.) Lamouroux.

*P. mammillosæ affinis, ferruginea; polypis latere coadunatis, sed apice prominentibus, 3'' latis, lateribus rugosis.*

Similar to the *mammillosa*, rust-coloured; polyps united by their sides, but prominent above, 3 lines broad, sides wrinkled.

St. Domingo, West Indies. Ellis.

*Alcyonium ocellatum*, Ellis and Sol., 180, *Mummillifera ocellata*, Blainv., Man., 330.  
 tab. 1, fig. 6. *Palythoa ocellata*, Lamour., Exp., 70, tab.  
 —, Lamarck, ii. 601, No. 8. 1, fig. 6.  
 Sloane's Jamaica, i., tab. 21, fig. 1. —, Ehrenb., G. xiii., sp. 2.

III. *Palythoæ viz minimè mammillosæ, polypis usque ad apicem latere coadunatis.*

## 7. Palythoa glareola. (Lesueur.) Dana.

*P. polypis brevibus, latere usque ad apicem coadunatis, discis violaceis, centro albidis, tentaculis 20, quorum quatuor subrubidis.*

Polyps short, and united by their sides quite to the summits, disks deep violet, whitish at centre; tentacles 20, four of which are grayish-red.

Guadaloupe, on the volcanic rocks of Pointe Noire. Lesueur.

*Corticifera glareola*, Lesueur, Jour. Acad. longer, being three times as long as broad;  
 Nat. Sci. Philad., i. 178, pl. 8, figs. 6, 7. the tentacles and the centre of the disk  
 —, Blainville, Man., 331, pl. 50, fig. 1. are yellow; when not expanded, several  
 The *Corticifera flava*, of Lesueur (ibid. p. lines may be observed radiating from the  
 179) is described as closely resembling aperture.  
 the preceding, but the animals are much

## 8. Palythoa flavo-viridis. (H. &amp; Ehrenberg.)

*P. polypis usque ad apicem coadunatis. latè flavo-viridis; discis margine 16-crenatis et 16-tentaculatis; tentaculis hyalinis uniseriatis; lamellis internis 32.*

Polyps united to their summits, bright greenish-yellow; disks margined with 16 crenatures, and as many tentacles; tentacles hyaline, and in a single series; internal lamellæ 32 in number.

Red Sea. *Ehrenberg.*

*Palythoa flavo-viridis*, Ehrenberg, G. xiii., sp. 1; Ehrenberg suggests that this species may prove identical with the *flava*, which is imperfectly described by Lesueur. The *Alcyonium tuberosum*, of Esper (Pflanz., iii. 68, tab. 23), resembles this as well as the following species. It was received by him from the Indian Ocean.

#### 9. PALYTHOA ARGUS. (*H. & Ehrenberg.*)

*P. flavo-fusca*, sæpe subglobosa; polypis contractis 6–10'' latis; discis margine 20-crenatis, tentaculis 40, pallidè fuscis, in serie duplici, majoribus internis, obtusis, clavatis; lamellis internis 32.

Brownish-yellow, often subglobose; polyps, when contracted, 6 to 10 lines broad; disks with 20 crenatures to the margin; tentacles 40, pale brown, in two series, the internal larger, obtuse, clavate; visceral lamellæ 32 in number.

Red Sea. *Ehrenberg.*

*Palythoa argus*, Ehrenberg, G. xiii., sp. 3.

#### 10. PALYTHOA CÆSIA. (*Dana.*)

*P. convexa*, umbrina; polypis contractis 4–6'' latis; discis umbrinis, sed medio cæsiis aut pallidè violaceis, extus margine crenulatis; tentaculis valde numerosis in serie duplici umbrinis.

Convex; colour umber; polyps, when contracted, 4 to 6 lines broad; disks umber-coloured, except the centre, which is pale grayish-violet; outer margin of the disks crenulate; tentacles very numerous, in two series, umber-coloured.

Plate 30, fig. 3, and 3 a to 3 h.

Feejee Islands. *Exp. Exp.*

This species has been particularly described on pages 40–42.

*Corticifera aggregata* (?), Lesson, Coquille, Zooph., pl. 8, fig. 3; island of Bolabo'a.

## TRIBE III.—MADREPORACEA.

*Actinaria tentaculis duodecim (rarissimè pluribus) uniseriatis, alternis interdum minoribus: gemmipara; gemmatione inferiore: coralligena; corallis calcareis, cellis 6-12 radiatis aut lamellis obsoletis, superficie interstitiali non lamello-striatâ.*

Actinaria with the tentacles 12 in number (rarely more), in a single series, the alternate sometimes smaller: gemmiparous; gemmation inferior: coralligenous; coralla calcareous, with the rays of the cells 6 to 12 in number or obsolete, interstitial surface not striated with the prolonged lamellæ of the cells.

The polyp of the Madrepore tribe is a simple star-shaped animal of twelve rays, presenting generally bright green, red, or umber tints. The rays or tentacles are at times nearly obsolete, or are reduced to rounded crenations of the circular disk, and in species of this character, lilac, yellow, and green colours of different shades have been observed.

The corallum is at once recognised by the few rays to the cells, the number being twelve or less, and sometimes the whole are obsolete.

Among the forms of these zoophytes there is nearly every variety that occurs in the Actinaria; but the glomerate are never as neatly regular as among the Astræas, while the ramose forms are singularly varied and beautiful. Segregate ramose forms, like those of the Caryophylliæ, are never met with; and only among the fossil Favositidæ, do we find coralla consisting of separable columns—a structure arising from the fact that the polyps (as in the Columnariæ) are united laterally only by their outer non-secreting integuments.

This tribe includes three families, as already explained: the Madreporidae, the Favositidæ, and the Poritidæ.

The following table contains the received genera of this tribe, and exhibits their relations to the corresponding genera adopted by the distinguished authors whose names are placed above the several columns.

RECEIVED GENERA.	EHRENBURG. 1832.	BLAINVILLE. 1830.	SCHWEIGGER. 1820.	OKEN. 1816.	LAMARCK.
Madrepora, <i>Linn.</i>	Heteropora.	Madrepora.	Madrepora, divided into the subgenera Pocillopora, Madre- pora, and Porites.	Acropora.	Madrepora.
Porites, <i>Cuvier</i> , 1798.	} Madrepora, Subgenus, Porites.	} Porites, and Montipora. Alveopora. Sideropora.			Porites.
Manopora, <i>D.</i>			} Stylopora, <i>Schweig.</i>	Stylophora.	
Alveopora, <i>Blainv.</i>	Seriopora.	Seriopora.		Seriopora, 1812.	
Sideropora, <i>Blainv.</i>	Pocillopora.	Pocillopora.	Madrepora ( <i>part</i> ).	Pocillopora, 1816.	
Seriopora, <i>Lamk.</i>	} Calamopora, <i>Goldf.</i>	} Favosites, Alveolites ( <i>part</i> ).	} Favosites.	} Favosites, 1812. Alveolites, 1801, ( <i>part</i> ).	
Pocillopora, <i>Lamk.</i>					Catenipora.
Favosites, <i>Lamk.</i>	Catenipora.	Catenipora.	Catenipora.	Catenipora.	
Catenipora, <i>Lamk.</i>	Porites.	} Heliopora. Palmipora, and Millepora ( <i>part</i> ).	} Millepora.	Millepora.	Pocillopora ( <i>part</i> ).
Heliolites, <i>Guettard.</i>	} Millepora.				Goniopora.
Heliopora, <i>Blainv.</i>					
Millepora, <i>Linn.</i>					
Goniopora, <i>Q. &amp; G.</i>					

The characteristics of the coralla in the several genera, are as follows :

FAMILY I.—MADREPORIDÆ.

Cells deep and without cross septa.

GENUS 1. MADREPORA. Branches with an apical calicle, and distinct lateral calicles upon the branchlets. Cells deep, 6-12 radiating points within, which are sometimes obsolete.

GENUS 2. MANOPORA. No apical calicle; calicles all obsolete, or irregular; coralla quite porous; cells as in the Madreporæ.

FAMILY II.—FAVOSITIDÆ.

Cells with cross septa within the coralla; rarely, solid below.

SUBFAMILY 1. ALVEOPORINÆ. Coralla very light porous; cells deep, and with radiating points within, as in the Madreporæ.

GENUS 1. ALVEOPORA. Cells contiguous, with very thin cribrate parietes.

SUBFAMILY 2. FAVOSITINÆ. Cells with radiating *entire* lamellæ, often becoming obsolete; contiguous, at least at the summits of the coralla.

GENUS 2. SIDEROPORA. Coralla with obtuse branches; cells containing a distinct star of six rays, meeting in a short columella at centre—not seriate, distinctly traceable within the corallum.

GENUS 3. SERIATOPORA. Coralla with very slender terete branches, often pointed; cells seriate; texture very solid, and cells, therefore, not traceable within the coralla.

GENUS 4. POCILLOPORA. Coralla with the branches never terete; surface usually verrucose, and cells traceable within, except when quite slender; texture mostly very compact; lamellæ nearly obsolete.

GENUS 5. FAVOSITES. Coralla consisting of agglomerated prismatic cells.

GENUS 6. CATENIPORA. Coralla consisting of single lines of cells, forming meandering vertical plates, which plates often intersect one another.

SUBFAMILY 3. HELIOPORINÆ. Cells circular, not contiguous.

GENUS 7. HELIOPORA. Cells with narrow radiating lamellæ; texture of the interstices minute tubular.

GENUS 8. HELIOLITES. Cells with narrow lamellæ; interstices irregularly cellular.

GENUS 9. MILLEPORA. Cells very minute; rays obsolete; texture of the interstices quite compact or sparingly porous.

FAMILY III.—PORITIDÆ.

Cells shallow, hardly traceable within the coralla, which are throughout fine-porous.

GENUS 1. PORITES. Coralla glomerate or furcato-ramose; cells not over a line in diameter; (polyps with twelve short tentacles.)

GENUS 2. GONIOPORA. Coralla glomerate or columnar; cells over a line in diameter; (polyps with sixteen to twenty-four tentacles.)

## FAMILY I.—MADREPORIDÆ.

*Madreporacea polyporum basi medio non coralligena; itaque, corallorum cellis valdè profundis et penitus non transversè septatis.*

Polyps not coralligenous at middle of base; cells of the corallum therefore, very deep, and not crossed by septa within.

The Madreporidæ include the most common branching corals. As many of them bud from a parent or apical polyp, their forms are often arborescent, and among them are found some of the largest of coral trees. Besides these there are shrubby clumps, reticulate fronds, vases, and large foliated species, as elsewhere explained.

This family comprises but two genera, which are closely related, although separated widely by previous authors. The genus *Madrepora*, includes species which bud from a parent-polyp, with which each branch terminates. They have regular calicles, and the branches, although not always erect, are neat and cylindrical, except when this character is lost by their coalescence. But two or three species are known in which the apical polyp cannot be distinguished, and these form a connecting link between this genus and the following.

The genus *Manopora* comprises incrusting, glomerate, and foliaceous or branched Madrepores, in which there is no proper apical polyp, and the calicles are either obsolete or very irregular. The deep cell, traceable far within the corallum, without any cross divisions, separates these zoophytes from those of the following families. These cells are never over half a line in diameter.

The Madreporidæ, with one or two exceptions, have been found only in the coral-reef seas.

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 GENUS I.—MADREPORA.—LINN.

*Madreporidæ patrio-ramosæ; arborescentes, cespitosæ, interdum reticulatæ aut coalescenter foliaceæ. Coralla ramis teretibus; caliculis regularibus.*



Patrio-ramose; arborescent, cespitose, or through coalescence, reticulate or foliaceous. Coralla with the branches terete (very rarely compressed); calicles regular.

Madrepore corals are the most common species in collections, and are generally distinguished by their cylindrical branching forms, covered with small calicles, each of which contains a minute cell. The forms of the calicles are quite various. The principal are as follows (see plate 31):

1. *Tubiform*. Cylindrical in shape (figures 2 *a*, 3 *a*). The apex may be either transverse (figs. 3 *a*), or oblique (figs. 3 *b*, 11 *c*, 12 *b*, *c*, *d*), and when oblique the aperture is usually oblong. They may also be spreading, or close appressed to the branch (figs. 3 *a*, 9 *a*, 8 *a*).

2. *Nariform*. A compressed calicle, resembling in shape a nose inverted (fig. 4 *a*). It is triangular in profile, with the upper side, which contains the aperture, nearly at right angles with the stem. In some instances the outer lip of the calicle is elongate, producing a *rostrato-nariform* shape; and in others the nariform calicle is tubular at base—*tubo-nariform* (fig. 5 *a*, 4 *b*).

3. *Cochleariform*. A short, stout, erect, cylindrical calicle, with a broad apex, and the upper side partly wanting (fig. 10 *a*, 10 *b*).

4. *Dimidiate*. A tubular calicle bisected vertically nearly to its base (fig. 7 *a*).

*Labellate* (from *labellum*, the *lower lip*). Long-lipped, or in shape nearly like the blade of a shovel, the upper side of the calicle being entirely wanting, and the lower thin and nearly flat (fig. 6 *a*, 6 *b*, 6 *c*). It passes into the *dimidiate* form.

The cells are internally more or less perfectly radiated with minute teeth. Of the twelve lamellæ to which the teeth belong, half are often smaller, or quite obsolete; sometimes only two opposite, the inner and outer, can be distinguished, and of these the outer is usually largest: these last occasionally meet and bisect the cell vertically. Figures 2 *b*, 3 *c*, 4 *c*, and others on plate 31, represent some of the varieties.

The most important characters for distinguishing species are as follows:

1. The mode of growth: *a*, erect, arborescent, stems solitary; *b*, erect, arborescent, and clustered (*fruticose*); *c*, spreading obliquely upward, and much ramose, forming an even top elump (*corymbed* or *fastigate*); *d*, spreading nearly horizontally, and often from a pedicel, with the branchlets above nearly simple, digitiform, or spiciform, and forming

an even top clump (*cespitose*); spreading each way from a central pedicel, and concave above (*vasiform*, or vase shape); spreading horizontally or obliquely, and coalescing into a solid plate, without branchlets above (*foliate*). A few species grow in *erect plates* clustered on a common base, often incrusting, without any apical polyp, and these form the transition to the genus *Manopora*.

2. The size of the branches and branchlets: in adult specimens this character admits of but little variation; the size of the branchlets is quite uniform in the same species.

3. The frequency of branching: which determines whether the branchlets are short, or long and tapering, crowded or few (*confertim aut laxè ramosa*).

4. The angle of branching: when this angle is small, the branches and branchlets are closely ascending (*strictè ramosa*); when as great as  $60^\circ$ ,—the usual angle,—the clumps are quite open *ramose* (*latè ramosa*); when near  $90^\circ$  or reversed, they are *divaricate*.

5. The character of the branches and branchlets: whether terete or not, straight or curved, simple or proliferous, evenly or unevenly covered with calicles, coalescent or not, as well as their size and position as alluded to above.

6. The form and position of the calicles, and the character of their exterior surface, whether harsh and striate, or appearing smooth, and either very fine striate or simply minute granulous, under the microscope.

7. When the branches coalesce, as they sometimes do, into a solid plate, rudiments of the constituent branches or branchlets may generally be detected at the margin, and, as in other cases, the size of these free branchlets is an important distinctive character.

In describing the species, I have generally followed Ehrenberg, in giving the definite dimensions of the calicles and branches, having ascertained, by much study, the advantage to be derived in determining species, from a knowledge of the actual limits of variation in this respect.

The *cespitose* species appear to vary in shape somewhat according to the depth at which they grow. In those near the surface, the branches spread more nearly horizontally, and are consequently more crowded and more completely coalescent; while those at greater depths have a more ascending mode of growth, and the less coalescent branches appear longer and more subdivided. In the one case, the clump is nearly flat below, while in the other it is subturbi-

nate. All the cespitose species, however, are not subject to this variation.

Among the species of *Madrepora*, there are some in which one of the tentacles of the polyps is long and flexible. This was observed in a cespitose species (*M. prostrata*) having thin labellate calicles. But whether it belongs or not to all the horizontally growing species with similar calicles, remains to be determined. This character may hereafter lead to a subdivision of the genus, and a separation of the species having labellate calicles, (*M. conigera*, *efflorescens*, *cytherea*, *spicifera*, *hyacinthus*, *surculosa*, *millepora*, *prostrata*, *subulata*, *turbinata*, and *convexa*,) as a distinct group.

Madrepores are among the most important of reef-forming corals, and grow in great profusion about the outer reefs, as well as within the bays, channels, and lagoons, enclosed by coral barriers. Some species attain a large size, though compared with the forest trees of the land, trees of coral growth dwindle to mere nursery saplings. The staghorn Madrepore (*M. cervicornis*) is sometimes six to eight feet in height, and the vase corals spread to a diameter of four or five feet. Huge plates of a foliate Madrepore are often thrown on the shores of some of the Pacific islands, measuring six feet square and three to six inches in thickness, which are but portions of a zoophyte, probably three or four times as large. The species called Neptune's Chair (*M. palmata*), from the West Indies, grows in stout, deeply divided plates, spreading from a common footstalk or pedicel; and occasionally the whole coral plant is six or seven feet high and nearly as many broad, with the pedicel six or eight inches through.

The genus *Madrepora*\* of early authors included all coral zoophytes with stellate cells, and thus embraced the *Astræa* and *Caryophyllia* tribes, along with the *Madreporacea*. It was restricted by Lamarck to the limits here adopted.

The *Seriatoporæ*, *Sideroporæ*, and *Pocilloporæ*, differ from the *Madreporæ*, not only in the closed bottom of the cell, and the transverse septa within, but also in the absence of all calicles, the nearest approach to which is found in a slight vaulting above, or a prominence of the upper side of the cell.

\* *Madrepora* is an Italian word, from the Latin *mater*, *mother*, and *porus*, *pore*, used for a *porous stone*: because it produces stone? See a note by Ehrenberg, *op. cit.* Berlin. Trans., 1832, p. 345.

The species of this genus are multiplied in this treatise much beyond what is found in preceding works, the nine of Lamarck being increased to more than sixty. The author has had the advantage of a large collection of specimens from known and unknown regions; and these specimens, with but two or three exceptions, have been perfect, full-grown clumps, instead of mere fragments. Many of the species would be confounded if studied only from a detached branchlet: even the tall arborescent species, and the spreading cespitose frond, might, in many instances, be thus thrown together. A general survey and close investigation of the subject has rendered the multiplication unavoidable. Ehrenberg, in his Memoir on the Corals of the Red Sea, describes twenty-one species: but, in most instances, the descriptions are unfortunately concise; and, as they are unaccompanied by drawings, it has been a perplexing task to identify them, and the more so as the names of Lamarck's species have been given in several instances to species wholly different.

*Arrangement of the Species.*

A. Horizontal or oblique foliate, without proper branchlets above.

I. *Calicles tubiform.*

\*1. *M. palmata.*

\*3. *M. flabellum.*

\*2. *M. alces.*

\*4. *M. cyclopea.*

II. *Calicles labellate (surface of corallum covered with incipient conical branchlets).*

\*5. *M. conigera.*

B. Horizontal or oblique, with erect or ascending branchlets above, which form a clump with an evenly concave or convex top—vasiform or cespitose.

I. *Calicles thin labellate.*

\*6. *M. efflorescens.*

\*11. *M. millepora.*

\*7. *M. cytherea.*

\*12. *M. prostrata.*

\*8. *M. spicifera.*

\*13. *M. subulata.*

\*9. *M. hyacinthus.*

\*14. *M. convexa.*

\*10. *M. surculosa.*

II. *Calicles quite thin; round-nariform, or appressed-tubiform.*

\*15. *M. aculeus.*

\*17. *M. tubicinaria (suffruticose).*

\*16. *M. tenuis.*

III. *Calicles stout, nariform or tubiform.*

\*18. *M. paxilligera.*

\*21. *M. globiceps.*

\*19. *M. nasuta.*

\*22. *M. effusa.*

\*20. *M. digitifera.*

\*23. *M. corymbosa.*

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|-----------------------------|--------------------------|
| *24. <i>M. appressa.</i>    | *28. <i>M. acervata.</i> |
| *25. <i>M. echidnæa.</i>    | *29. <i>M. valida.</i>   |
| *26. <i>M. plantaginea.</i> | *30. <i>M. retusa.</i>   |
| *27. <i>M. cerealis.</i>    |                          |

C. Fastigate, calicles short, and round nariform; branches much and closely subdivided, erect.

- \*31. *M. ramiculosa.*

D. Arborescent, branches evenly covered with proliferous branchlets or clusters.

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|--------------------------|-------------------------|
| *32. <i>M. echinata.</i> | *34. <i>M. rosaria.</i> |
| *33. <i>M. carduus.</i>  | *35. <i>M. florida.</i> |

E. Arborescent or fruticose, branches either not proliferous, or unevenly so.

I. *Calicles thin and fragile, labellate, round nariform, or tubiform.*

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|-------------------------------------|----------------------------|
| *36. <i>M. implicata.</i>           | *41. <i>M. cribripora.</i> |
| *37. <i>M. tortuosa.</i>            | *42. <i>M. gravida.</i>    |
| *38. <i>M. aspera.</i>              | *43. <i>M. virgata.</i>    |
| *39. <i>M. hebes (cespitose ?).</i> | *44. <i>M. horrida.</i>    |
| *40. <i>M. exigua.</i>              |                            |

II. *Calicles stout, tubiform, dimidiate, or nariform.*

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|------------------------------|---|-----------------------------|--------------------------------------|
| *45. <i>M. formosa.</i>      | } Calicles mostly tubiform<br>or tubo-nariform. | *53. <i>M. cervicornis.</i> | } Calicles nariform or<br>dimidiate. |
| *46. <i>M. brachiata.</i>    |   | *54. <i>M. prolifera.</i>   |                                      |
| *47. <i>M. arbuscula.</i>    |   | *55. <i>M. nobilis.</i>     |                                      |
| *48. <i>M. robusta.</i>      |   | *56. <i>M. secunda.</i>     |                                      |
| *49. <i>M. hystrix.</i>      |   | *57. <i>M. gracilis.</i>    |                                      |
| *50. <i>M. divaricata.</i>   |   | *58. <i>M. humilis.</i>     |                                      |
| *51. <i>M. abrotanoides.</i> |   | *59. <i>M. pocillifera.</i> |                                      |
| *52. <i>M. austera.</i>      |   |                             |                                      |

F. A few long stems, simple, or rarely branched, from a common base.

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|--------------------------|---------------------------|
| *60. <i>M. deformis.</i> | *61. <i>M. cuspidata.</i> |
|--------------------------|---------------------------|

G. Erect plates in place of proper branches, and no distinct apical polyp.

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|-------------------------|-------------------------|
| *62. <i>M. labrosa.</i> | *64. <i>M. cuneata.</i> |
| *63. <i>M. securis.</i> |                         |

A. *Ramis ramulisque coalitis et laminas solidas expansas instruentibus.*

I. *Caliculis tubiformibus.*

### 1. MADREPORA PALMATA. (*Lamarck.*)

*M. ponderosa, latissimè foliata, frondibus obliquè expansis, basi subconvolutis, profundè lobatis; lobis sæpe 2-3' longis, 1-2' latis, et 1-2''*

*crassis*; *marginè extimo paulum laciniato*  $\frac{1}{2}$ " *crasso*. *Corallum infrà breviter caliculatis, caliculis nariformibus*; *suprà, caliculis cylindricis, valde inæqualibus, sæpe 2''' longis et 1½''' latis, et apice obliquis, aliis rotundo-nariformibus, aliis obsoletis*; *stellâ conspicuâ*.

Ponderous, very broad foliate; fronds spreading obliquely, subconvolute at base, deeply lobed; lobes often 2 to 3 feet long, and  $1\frac{1}{2}$  broad, with a thickness of 1 to 2 inches; outer margin a little lacinate,  $\frac{1}{2}$  an inch thick. Corallum below, short caliculate, calicles nariform; above, calicles cylindrical, with an oblique apex, very unequal, many 2 lines long and  $1\frac{1}{2}$  broad, others round nariform, and others obsolete; star distinct.

Plate 31, fig. 11 *a*, view of cell, enlarged; 11 *b, c, d, e*, different calicles, natural size.

West Indies, where it is a very common species.

This widely spreading foliate Madrepora, sometimes attains a height of six feet or more, with a pedicel nearly a foot in diameter. Other specimens are but one or two feet high, with a few spreading fronds 3 or 4 feet broad, and these have given rise to the familiar name of the species, *Neptune's Chair*. The calicles are larger and stouter, and more acervate than in the *alces*, the lobes are much broader, and the margin much thicker.

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| <p><i>Corallium porosum, album, latissimum, muricatum</i>, Sloane's Jam., i. tab. 17, fig. 3; a good figure.</p> <p><i>Mad. muricata, var.</i>, Esper, Fortsetz. i. tab. 51.</p> <p><i>Mad. palmata</i>, Lamk., ii. 446, No. 1.</p> <p>—, Deslongchamps, Encyc., 503.</p> <p>—, Blainville, Man., 389.</p> | <p>Seba's figure 3, tab. 113, and Esper's 81, which is a reduced copy of Seba's, belong to the <i>M. alces</i>, an East India species; and Ehrenberg appears to have derived his description of the <i>palmata</i>, in part at least, from specimens of that species.</p> |
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## 2. MADREPORA ALCES. (*Dana*.)

*M. crassè foliata, frondibus profundè digitato-lobatis; lobis angustolongatis, seu ligulatis, (sæpe 2' longis, 2-4' latis, et ½-1½' crassis). Corallum infrà caliculis brevibus confertis; suprà tubiformibus, inæqualibus, 2-2½''' longis et ¾''' latis, erectis, nunquam nariformibus,*

*multis obsoletis; stellâ conspicuâ, duabus lamellis infrâ fere conniventibus.*

Stout foliate, fronds deeply digitate lobed; lobes narrow, oblong, or ligulate, often 2 feet long, 2 to 4 inches wide, and  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches thick. Corallum below, with short crowded calicles; above, calicles tubiform, unequal, 2 to  $2\frac{1}{2}$  lines long, and  $\frac{3}{4}$  of a line broad, erect, never nariform, many obsolete; star distinct, two lamellæ nearly uniting below.

Plate 31, fig. 12 *a*, view of cell, enlarged; 12 *b, c, d, e, f*, different calicles, natural size.

East Indies. *Exp. Exp.*

The long narrow lobes of this spreading digitate species, at once distinguish it from the *palmata*. The calicles are less stout and none are nariform, although many are obsolescent, and others are reduced to immersed cells. They are also more distinctly stellate. The lobes are often convex below, and concave above, and at the extremity are about half an inch thick.

*Corallium grande, cornu cervini forma; Mad. muricata var.*, Esper, Fortsetz. i. *ramis latis, planis, poris immersis, tubu-* tab. 83; reduced from Seba.  
*latis, intus stellatis*, Seba, Thes. iii., tab. *Mad. palmata, in part*, of Lamarck.  
113; a good figure.

### 3. MADREPORA FLABELLUM. (*Lamarck.*)

*M. expansè foliata, frondibus subcrassis, basi convolutis, margine ramulis incipientibus vix  $\frac{1}{4}$ " crassis composito. Corallum infrâ caliculis brevibus confertis; suprâ tenuiter tubiformibus, sæpe  $1\frac{1}{2}$ " longis et  $\frac{1}{2}$ – $\frac{2}{3}$ " latis, nunquam nariformibus, totidem in seriebus acervatis, multis cellis immersis; stellâ vix conspicuâ.*

Spreading foliate, fronds rather stout, convoluted at base, the margin consisting of incipient branchlets scarcely  $\frac{1}{4}$  of an inch thick. Corallum below, with short crowded calicles; above, calicles slender tubiform, often  $1\frac{1}{2}$  lines long and  $\frac{1}{2}$  to  $\frac{2}{3}$  of a line broad, never nariform, sometimes acervate in lines, many immersed cells; star scarcely distinguishable.

Plate 31, fig. 13 *a*, view of cell, enlarged; 13 *b, c, d, e*, different calicles, natural size.

West Indies.

This species has the general habit of the *palmata*, but is much smaller and thinner. The margin is scarcely over an eighth of an inch thick, and the flattened incipient branchlets there apparent, show that the fronds are made by the coalescence of slender branches. The tubiform calicles are almost small enough to admit of being inserted into the cells of the *palmata*. The specimens seen by the author were from fifteen to twenty inches in height, and consisted of a few fronds, spreading nearly horizontally.

*Mad. flabellum*, Lamk., ii. 447, No. 2.

—, Blainville, Man., 390.

—, Deslongchamps, Encyc., 503.

The *Heteropora flabellum*, of Ehrenberg (Gen. lxi. sp. 2), appears to be a different species. The following is his description: "Pedem alta et lata, expla-

nata, flabellata, erecta, margine superiore non cristato, sed in ramulos teretes *pollicem crassos* subacutos, basi suâ mox in truncum compressum confluyente, diviso, stellulis (caliculis) inæqualibus crebro tubulosis, levibus." Perhaps the *conigera*?

#### 4. MADREPORA CYCLOPEA. (*Dana.*)

*M. latissimè foliata, ponderosissima, frondibus expansis, lobatis, 3-6" crassis, 6' vel plures latis, suprâ tuberculis rotundis grandibus (2-3" crassis) remotè sparsis. Corallum suprâ crebro caliculatum.*

Very broad foliate, and ponderous, fronds spreading, lobed, 3 to 6 inches thick, and 6 feet or more broad, with large, rounded, remotely scattered knobs (2 to 3 inches thick). Corallum above, having the calicles crowded.

Wake's Island, Pacific Ocean. *Exp. Exp.*

Only worn specimens of the corallum of this huge species of Madrepora have been seen by the author. These were massive plates, six feet square and four to six inches thick, which had been thrown up by the waves on the shores. They were parts of a large spreading species, which grew probably like the *palmata*, and attained a breadth of at least twenty feet. The knobs of the surface are incipient





branches, two or three inches thick, and the same in length, with a broadly rounded top.

II. *Caliculis labellatis* (*ramulis incipientibus, conuliformibus*).

5. MADREPORA CONIGERA. (*Dana.*)

*M. latè foliata, frondibus crassis, margine lobatis et totidem profundè subdigitatis; suprà, conos crassos subacutos undique ferentibus; infrà superficie planâ. Corallum infrà brevissimè caliculatum; suprà caliculis valde confertis, labellatis, labello elongato et fere erecto, subcomplanato; stellâ obsoletâ, duabus lamellis vix latioribus.*

Broad foliate, fronds stout, lobed at margin, and sometimes deeply subdigitate; above, covered with short and stout subacute cones; below, surface plane. Corallum below having very short calicles; above, calicles much crowded, labellate, lip elongate, nearly erect, and almost flat; star obsolete, two of the lamellæ scarcely broader.

Plate 32, fig. 1, part of corallum in outline, natural size; 1 a, one of the incipient branchlets, ditto.

Singapore. *Exp. Exp.*

The short stout cones—rudimentary branchlets—that cover the surface of this foliate Madreporæ, and its long-lipped erect calicles, at once distinguish it. The cones average an inch in height, and are half to three-fourths of an inch broad at base; but a few are two inches high and an inch at base. The calicles above are long and crowded. One frond in the Expedition collections measures twenty inches by twelve, and is over an inch and a half thick where stoutest, and half an inch or nearly so at margin; the plate is but a fragment of the complete zoophyte. Another specimen is a single lobe, fourteen inches long, two to three inches wide, and one and a quarter thick.

B. Vasiformes, aut cespitosæ.

I. *Caliculis fragilibus, labellatis.*

6. MADREPORA EFFLORESCENS. (*Dana.*)

*M. vasiformis* (?), ramis in laminam solidam  $\frac{1}{2}$ – $\frac{3}{4}$ " crassam coalitis, prope marginem, reticulatam et per ramos conjunctos costatam; infrà plana; suprà ramulis crebris brevissimis, marginalibus  $\frac{1}{2}$ " longis, et  $\frac{1}{8}$ " crassis, medianis nunquam teretibus  $\frac{1}{4}$ " longis, acervatis et proliferis. Corallum infrà breviter caliculatis; suprà ramulorum caliculis labellatis, labello elongato et erecto, apicali cylindrico 1" longo et  $\frac{1}{2}$ " lato.

Vasiform (?), branches coalescing into a solid plate  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch thick, which is reticulate only near the margin, and ribbed with the coalescing branches; below flat; above, having very short crowded branchlets, the marginal  $\frac{1}{2}$  an inch long and  $\frac{1}{8}$  of an inch in diameter, but those of the middle of the frond not terete, a fourth of an inch long, acervate and proliferous. Corallum below with short calicles; above, the calicles of the branchlets labellate, lip long and erect, the apical calicle cylindrical, a line long and  $\frac{1}{2}$  a line broad.

Plate 33, fig. 6, fragment of corallum, natural size.

Ceylon, East Indies. *Rev. G. A. Aphthorp.*

This species approaches the *cytherea* in the proliferous clusters of calicles about the middle of the frond in place of proper branchlets, but differs essentially in the branchlets being coalesced into a solid plate; and, moreover, the branchlets near the margin are much shorter and more slender. The largest specimen examined was a fragment six inches in breadth; in its stoutest part it was three-fourths of an inch in thickness. The solid frond resembles the *flabellum*; but that species is without branchlets above, and has tubular calicles.

7. MADREPORA CYTHEREA. (*Dana.*)

*M. vasiformis, pedicellata, fronde latissimâ, 1–2" crassâ, ramis reticulato-coalitis; infrà complanatis, ramulis nullis; suprà, ramulis con-*

*fertis, ½-1" longis, sæpe brevissimis et acervato-proliferis. Corallum ramulorum caliculis labellatis, labello elongato, vix complanato; apicali, elongatè cylindrico, 2-2½''' longo et ¾''' lato.*

Vasiform, pedicellate; frond very broad, 1 to 2 inches thick; branches reticulately coalescent; below complanate, without branchlets; above branchlets crowded, ½ to 1 inch long, often very short and acervato-proliferous. Corallum having the calicles labellate; lip long and scarcely at all flattened; the apical calicle long cylindrical; 2 to 2½ lines long and ¾ of a line broad.

Plate 32, figs. 3 a, 3 b, fragments of corallum, natural size; 3 a, weathered specimen.

Tahiti, Society Islands. *Exp. Exp.*

The vases are often four feet in breadth, and stand on a pedicel one to two feet in height. In one specimen the upper part is placed obliquely, arising from an oblique position in the pedicel while growing. The coalescing branches of the frond are not so far flattened and united as to lose their individuality; the open intervals are numerous, yet narrower than the branches. The squarrose appearance of the branchlets of the corallum, especially of those about the middle portion of the vase, resembling proliferous heaps of calicles, allies the species to the preceding. The branchlets, toward the margin, are about an inch long, and have long calicles; those of the margin itself are much clustered.

In weathered specimens (fig. 3 a), the calicles, just below the apex, are sometimes worn off, leaving the apical calicle apparently a third to half an inch in length.

#### 8. MADREPORA SPICIFERA. (*Dana.*)

*M. vasiformis, fronde latissimâ, ½-1¼" crassâ; \* infrâ strictè reticulatâ et complanatâ; suprâ ramulis subsimplicibus ½-1" longis, 2''' tenuibus, subacutis. Corallum ramulorum caliculis imbricatis, labellatis, labello subcomplanato, truncato, stellâ inconspicuâ.*

\* In stating the thickness of the frond in this, and other instances following, and also the preceding, the *whole thickness to the summits of the branchlets* is included.

Vase-shaped, fronds very broad,  $\frac{1}{2}$  to  $1\frac{1}{4}$  inches thick; below closely reticulate and complanate; above with nearly simple branchlets,  $\frac{1}{2}$  to 1 inch long, 2 lines in thickness, subacute. Corallum having the calicles of the branchlets imbricate, labellate; lip somewhat flattened, truncate; star indistinct.

Plate 33, fig. 4, specimen from the Feejees, natural size; 4 *a*, fragment of same; 4 *b*, and 5, fragments of specimens from Singapore: plate 31, figs. 6 *a*, *b*, *c*, calicle of Feejee variety, enlarged.

Singapore and the Feejee Islands. *Exp. Exp.*

This species forms shallow, fragile vases, sometimes three feet broad, raised on short pedicels, and bearing above small slender branchlets, covered closely with thin appressed calicles. The under surface of the corallum is naked, excepting a few appressed tubular calicles towards the margin. The delicate branchlets are neatly terete and not proliferous near the summit, though often furcate below, or two or more rising apparently from the same base. The terminal calicle is about three-fourths of a line broad, and not tumid, being an even prolongation of the body of the branchlet; the other calicles are nearly half a line broad, and about a line and a half long. On the main branches and the bases of the branchlets, the cells are immersed, without calicles, and the texture of the corallum is very spongy.

In a Feejee specimen, which is but seven inches across, the lip of the calicles is longer than in those from Singapore, and the intervals in the reticulate frond are few and about an eighth of an inch wide, while these intervals in the latter are more numerous and about a fourth of an inch in width. It may be a young specimen of the *cytherea*.

*β. abbreviata* (fig. 5). In some of the specimens from Singapore, which have the general habit of the preceding, the branchlets (which vary from a fourth of an inch to one inch in length) are much more obtuse, with the apical calicle scarcely at all prominent; the lateral calicles, moreover, are much shorter, and more closely crowded.

*γ. eucladia*. This name is applied to a specimen resembling, somewhat, the preceding; but presenting some peculiarities which may distinguish it as a separate species. The under surface of the frond is remarkable for being covered with stout obsolescent calicles, which are rather crowded, and render the surface uneven. The branchlets above are very neat, regularly tapering, and subacute, about three-fourths of

an inch long, one and three-fourths to two lines thick at base, with intervals between of but a fourth of an inch; and they are crowdedly and evenly covered with small thin calicles. The branches of the frond are very closely coalescent, with the open intervals about one-eighth of an inch wide. The specimen is a shallow vase, one foot in diameter, and belongs to the Boston Natural History Society.

*Lithodendrum calcareum sessile*, Rumph. Amboyn., pl. 86, fig. 2.

*Madrepora corymbosa*, in part, of Lamarck.

The *Heteropora microclados*, of Ehrenberg, (op. cit. Gen. lxi., sp. 4), as described, is not far from the above species; but his queried reference to Ellis's figure, plate 57,—a shrubby species,—would imply

that it is quite different. It is thus described: "Pedalis, prostrata, repens, ramosa, ramis reticulato-coalitis, horizontalibus, ramulis erectis, spiniformibus, semipollicaribus et pollicaribus, divisis, apice tubuloso-asperis, stellis levibus hispidisve, semilinearibus, myxatis, striatis, apicalibus  $\frac{3}{4}$ " latis, integris."

#### 9. MADREPORA HYACINTHUS. (*Dana.*)

*M. vasiformis, pedicellata, fronde 1-1 $\frac{1}{4}$ " crassâ, ramis parcè coalitis; infrâ ramulis crebris divaricatis,  $\frac{1}{3}$ - $\frac{1}{2}$ " longis, sæpe proliferis; suprâ ramulis gracilibus ( $\frac{1}{8}$ " ), fere simplicibus, totidem proliferis,  $\frac{1}{2}$ - $\frac{3}{4}$ " elongatis. Corallum caliculis tubo-labellatis, crassioribus, 1-1 $\frac{1}{2}$ " longis, labello non minimè complanato, cellis apertis; stellâ inconspicuâ; apicali cylindrico, prominulo.*

Vasiform, pedicellate, frond 1 to 1 $\frac{1}{4}$  inches thick, branches sparingly coalescent; below, branchlets crowded and spreading,  $\frac{1}{3}$  to  $\frac{1}{2}$  inch long, often proliferous; above, branchlets slender ( $\frac{1}{8}$  of an inch thick), nearly simple, sometimes proliferous,  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch long. Corallum having the calicles tubo-labellate, not fragile, 1 to 1 $\frac{1}{2}$  lines long, lip not at all flattened; cells open with an indistinct star, apical calicle cylindrical, prominent.

Plate 32, fig. 2, fragment of corallum, natural size, showing the character of the upper and under surface.

Feejee Islands. *Exp. Exp.*

This species has some resemblance to the *spicifera*, but the numerous branchlets of the under surface, directed obliquely downward, as well as the stouter calicles, somewhat tubiform, and much firmer, afford striking distinctive characters. The branchlets of the corallum

below, are muricate nearly like those above. The calicles near the apex are one to one and a half lines in length. The specimen in the collections is a vase five inches across, on a short stout pedicel. The tips of the branches when fresh have a violet tinge.

10. MADREPORA SURCULOSA. (*Dana.*)

*M. cespitosa, breviter crasso-pedicellata, lata, vix concava aut convexiuscula, fronde 1½–2" crassâ, ramis coalitis; infra, complanatis, ramulis nullis; suprâ, ramulis crebris, erectis, spiciformibus, et subacutis, 1–2" longis, saepe paulum angulosis, apice proliferis. Corallum ramulorum caliculis confertis vix labellatis, 1–1½" longis, labello elongato non complanato; subapicalibus minimis; apicali cylindrico ¾" lato; stellâ inconspicuâ.*

Short and stout pedicellate, broad, and slightly concave, flat or a little convex; frond 1½ to 2 inches thick, branches coalescing; below, flattened, and with no spreading branchlets; above, branchlets crowded, erect, spike-shape, tapering, and nearly acute, 1 to 2 inches long, often a little angular, proliferous at apex. Branchlets of the corallum with crowded calicles, 1 to 1½ lines long, scarcely labelate, elongated lip not flattened, the subapical calicles becoming very small, the apical cylindrical, and ¾ of a line broad; star indistinct.

Plate 32, fig. 4, corallum (small specimen), natural size; 4 a, branchlet, ditto; fig. 5, probably the same, from Tahiti.

Society and Feejee Islands, and East Indies. *Exp. Exp.*

The clumps of this very common species are nearly flat above, with a stout and short pedicel below. They grow to a breadth of eighteen inches or more. The pedicel enlarges upward, and often the frond is solid below for half its diameter. The branchlets are tapering and subacute, and near the summit very many are peculiarly proliferous with several rudimentary branchings or cylindrical calicles: at base they are often half an inch through and angular, appearing to consist of two or three coalesced branchlets. The branchlets of the margin are neatly tapering, and their calicles are scarcely more spreading than those of the inner branchlets. The under surface of the frond bears

numerous rather short tubular calicles, rendering the surface quite uneven.

*β. turbinata.* The corallum resembles closely the above, in its smaller branchlets, both as regards their tapering form, their calicles, and the proliferous extremities. But instead of spreading horizontally and forming a solid or reticulate frond, the branches spread obliquely upward, and are several inches in length. The specimen in the collections is a turbinate clump, twelve inches broad at top, and the same in height, and has nearly the form of an inverted cone. The branches are one half to three quarters of an inch thick below; the smaller branchlets are one to two inches long, nearly a fourth of an inch in diameter below, and often very proliferous at summits. The upper branchlets of the margin are as regular as those of the middle of the group, and the calicles not more spreading. The specimen is from Tahiti.

*γ. diffusa.* The branchlets are proliferous as above, and similar in size and form, but the branches are one half to three quarters of an inch thick, and distantly coalescent, with very large spaces; moreover the branchlets are more remote, the intervals between being often an inch. A specimen belonging to the Boston Natural History Society, appearing to be about a fourth of a whole frond, measures eighteen inches by fifteen in breadth. Though placed here as a variety of the *surculosa*, it has more of the habit of the *subulata* in the character of the frond, from which species it differs, however, in the length and characters of its branchlets. It is probable that the *surculosa* assumes the open character here described when it attains a large size.

*Lithodendrum calcareum sessile?* Rum- *Heteropora corymbosa* (?), Ehrenb., G. lxi.  
 phius, tab. 86, fig. 2; a reduced figure? sp. 16.  
*Mad. corymbosa, in part, Lamk.*

## 11. MADREPORA MILLEPORA. (Ehrenberg.) Dana.

*M. cespitosa, breviter pedicellata, lata, paulum convexa, ramis laxè reticulatim coalitis; infrà, ramulis paucis, nudis, appressis; suprà, ramulis bene teretibus, 2" longis, vix ¼" crassis, subsimplicibus. Corallum ramulis obtusis, caliculis breviter labellatis, confertim imbricatis, ½" latis; stellâ inconspicuâ, duabus lamellis valde latioribus; apicali, fere 1" lato et ½" exserto; ramulorum marginalium caliculis valde laxioribus.*

Short pedicellate cespitose, broad, a little convex, branches openly reticulato-coalescent; below, a few naked branchlets appressed into the plane of the frond; above, branchlets very evenly terete, 2 inches long and scarcely  $\frac{1}{4}$  of an inch thick, nearly simple. Corallum with the branchlets obtuse, calicles short labellate, crowded imbricate,  $\frac{1}{2}$  a line broad, star indistinct, two of the lamellæ very prominent; apical calicle nearly a line broad and  $\frac{1}{2}$  a line exsert; calicles of the marginal branchlets very much spreading.

Plate 33, fig. 2, part of corallum, natural size; 2 a, branchlet, ditto.

East Indies, where it is common. *Exp. Exp.*

This species is remarkable for its gracefully branched frond, its even cylindrical branchlets covered very neatly and closely with thin and fragile calicles. The spreading calicles of the outer branchlets contrast strongly with the close imbrication of those within. The fronds grow to a foot and a half or more in diameter; they are sometimes attached by one side, and at others have a broad central pedicel. The thickness from the under surface to the tips of the branchlets is about three inches.

The branchlets are not tapering, and have much closer calicles than the *surculosa*, and besides are not proliferous at apex; they are much longer and larger than in the *spicifera*. The frond is sometimes solid at centre below.

*Heteropora millepora*, Ehrenberg, G. lxix. *Madrepora corymbosa*, in part, Lamarck, sp. 5. No. 4.

## 12. MADREPORA PROSTRATA. (*Dana.*)

*M. cespitosa*, prostrata, summitate plana, ramis remotè coalitis; infra non complanatis, ramulis paucis, cellis immersis; supra ramulis bene cylindricis, subsimplicibus,  $\frac{1}{4}$ " crassis: polypis viridibus tentaculorum uno longiore. Corallum ramulis obtusis, caliculo apicali curto,  $\frac{2}{3}$ " lato; aliis confertis, labellatis, latis et patentibus, labello valde complanato, cellis stellatis, duabus lamellis paulo latioribus.

Cespitose, prostrate, with a flat top, branches remotely coalescing; below, not flattened, branchlets few, and cells all immersed; above, branchlets neatly cylindrical, nearly simple,  $\frac{1}{4}$  of an inch thick:



polyps green, and having one of the tentacles much longer than the others. Corallum having the branchlets obtuse, the apical calicle short,  $\frac{1}{2}$  of a line broad; other calicles crowded, labellate, broad and spreading, with the lip much flattened; cells stellate, two of the lamellæ a little the broadest.

Plate 33, fig. 1, part of corallum, natural size; 1 *a*, one of the polyps, enlarged; 1 *b*, same, partly expanded, an upper view; 1 *c*, branchlet, natural size; 1 *d*, calicles, enlarged; 1 *e*, same in profile; 1 *f*, transverse section of branch, enlarged.

Feejee Islands, and Sooloo Sea. *Exp. Exp.*

This species, as observed by the author, grows horizontally, from a lateral attachment. It is distinguished by its neatly terete branches and branchlets, and broad equal calicles closely crowded upon one another, and standing nearly erect on the surface of the branchlets. The branches are sometimes proliferous, but never acervate so as to lose their terete forms. Its stellate cells, as well as other characters, remove it from the *surculosa*.

*Madrepora pocillifera*, var., B. (?) Quoy and Gaymard, Voy. de l'Ast., iv. 238, pl. 19, fig. 8.

### 13. MADREPORA SUBULATA. (*Dana*.)

*M. prostrata*, plana, ramis laxè intricatis, remotè coalitis, ramosis,  $\frac{1}{2}$ " crassis; infrà, ramulis paucis subnudis et in frondem appressis; suprà, ramulis undique teretibus, subulatis, paulum undulatis, subacutis,  $2\frac{1}{2}$ " longis et 2-3" crassis, subsimplicibus. Corallum caliculis labellatis fere obsoletis, ramulorum marginalium caliculis diffusioribus et paulo grandioribus; stellâ obsoletâ, duabus lamellis valde latioribus; caliculo apicali valde exserto (1"), fere  $\frac{3}{4}$ " lato.

Prostrate, plane above; branches loosely intricate, and remotely coalescing, ramose,  $\frac{1}{2}$  an inch thick; below, branchlets few, nearly naked, and appressed into the plane of the frond; above, branchlets every where terete, subulate, a little undulate and subacute,  $2\frac{1}{2}$  inches long and 2 to 3 lines thick, nearly simple. Corallum having the calicles labellate, but quite small and very short or scarcely prominent, those of the marginal branchlets more spreading and

somewhat larger; star obsolete, two lamellæ quite broad; apical calicle very exsert (1 line), nearly or quite  $\frac{3}{4}$  of a line broad.

Plate 33, fig. 3, part of corallum, natural size; 3 a, branchlet, natural size.

The East Indies. *Exp. Exp.*

The specimen in the collections, is a large frond, measuring sixteen inches by twelve in breadth, with a short pedicel on one side, by which it was laterally attached. It is a neat species with *long* acicular, and nearly naked branchlets, evenly terete, and not proliferous above. It has something of the habit of a *Seriatopora* in the appearance of its branchlets. The cell is very small, and two large lamellæ bisect it deep within.

#### 14. MADREPORA CONVEXA. (*Dana.*)

*M. latè cespitosa, breviter pedicellata, supernè convexa, ramis fere horizontalibus reticulato-coalitibus; infrà complanatis cum paucis ramulis nudis subangulatis; suprà ramulis medianis teretibus, raro angulatis, subsimplicibus, totidem proliferis, 2-2½'' longis et ¼'' crassis, marginalibus ruditer acervato-proliferis. Corallum caliculo apicali curto, cylindrico, ⅔'' lato; aliis labellatis, fragilibus, labello lato et elongato, valde complanato, stellâ conspicuâ, 6-radiatâ, duabus lamellis latioribus.*

Broad cespitose and short pedicellate, convex above, branches nearly horizontal, reticulato-coalescent; below flattened with a few naked subangular branchlets; above branchlets of the central portions terete, rarely angular, nearly simple, sometimes proliferous, 2 to 2½ inches long, and  $\frac{1}{4}$  of an inch thick; the marginal branchlets rudely acervato-proliferous. Corallum with the apical calicle short, cylindrical,  $\frac{2}{3}$  of a line broad; other calicles labellate, fragile, lip broad and elongated, much flattened; star distinct, 6-rayed, two lamellæ broader than the others.

Singapore, East Indies. *Exp. Exp.*

This species forms low circular clumps, convex above, ten inches or more in diameter, supported on a stout pedicel. The corallum is

distinguished from that of the *surculosa*, by its terete medial branchlets, and rudely acervate marginal; and also by the distinct star of the cell.

II. *Caliculis tenuibus, orbiculato-nariformibus, aut appresso-tubiformibus.*

15. MADREPORA ACULEUS. (*Dana.*)

*M. prostrata, ramis crassis (1-3") et valde irregularibus, ad extremum valde et strictè subdivisis, infrà ramulis brevibus angulatis, horizontalibus, caliculis longè tubiformibus; suprà ramulis erectis et curvatè surgentibus, creberrimis, angulatis et attenuatis, 2''' crassis et sæpe 2" longis, subacutis. Corallum caliculo apicali prominente (sæpe 1'''); laterali-bus non confertis, parvulis, orbiculato-nariformibus, margine tenui; cellâ orbiculatâ, sursum apertâ, stellâ plerumque conspicuâ, duabus lamellis paulo latioribus.*

Prostrate, branches stout (1-3 inches thick), and very uneven, very much and very closely subdivided; below, branchlets short, angular, horizontal, and covered with long tubular calicles; above, branchlets erect, and rising with a curve, very crowded, angular, and attenuated, 2 lines thick, and often 2 inches long, subacute. Corallum with the apical calicle prominent (often a line); the lateral not crowded, small, round-nariform, with the edge thin; cell round, opening upward, star mostly distinct, two of the lamellæ a little the broadest.

Plate 32, fig. 6, part of corallum, natural size; 6 *a*, branchlet, ditto; 6 *b*, profile of calicles.

Feejee Islands. *Exp. Exp.*

The specimen in the collections is a single horizontal branch eight inches long. It is very much subdivided towards the apex, and bears, above, a crowd of slender spike-like branchlets, rising with a curve, and giving the corallum a bristled aspect. The branchlets, owing to the rather distant calicles, which are sometimes in series, are very uneven, or angular; they are separated by intervals of about half an inch. The calicles are about half a line wide, and a line long, and are striate, though not echinulately so.

16. MADREPORA TENUIS. (*Dana.*)

*M. cespitosa, rotundata, parcè diffusa, ramulis gracillimis, vix 2''' crassis, 3'' longis, subteretibus, proliferis. Corallum caliculo apicali parvulo ( $\frac{2}{3}$ '''), prominulo; lateralibus appresso-tubiformibus, elongatis ( $1\frac{1}{2}$ ''') et tenuibus, margine fragilibus, extus bene striatis et scabriculis, aperturâ orbiculatâ, stellâ inconspicuâ, duabus lamellis paulo prominentioribus.*

Cespitose, rounded, sparingly spreading; branchlets very slender, scarcely 2 lines thick, 3 inches long, subterete and proliferous. Corallum with the apical calicle small ( $\frac{2}{3}$  of a line broad), a little prominent; the lateral, appressed-tubiform, irregular, elongate ( $1\frac{1}{2}$  lines) and slender; margin fragile, exterior neatly striate and finely scabrous; aperture circular, star indistinct, two lamellæ a little prominent.

The very slender branchlets are not evenly terete, owing to some irregularity in the arrangement of the calicles, and a variation in their length. The calicles are about two-thirds of a line in diameter, and rather fragile; they are tubiform, and are attached, laterally, to the branch, not quite to their summits; the aperture is broad and open, without a distinct star.

17. MADREPORA TUBICINARIA. (*Dana.*)

*M. cespitosa, suffruticosa, rotundata, ramis paulum diffusis, strictè ramosis, ramulis fere teretibus, 3-4''' crassis, vix attenuatis, apice obtusis. Corallum porosum, caliculo apicali crassimo ( $1-1\frac{1}{2}$ '''), prominulo; lateralibus appresso-tubiformibus et regularibus,  $\frac{4}{5}$ ''' latis et  $1\frac{1}{2}$ -2''' longis, tenuibus et margine fragilibus, extus bene striatis; aperturâ latè orbiculatâ, sursum spectante, stellâ breviter sex-radiatâ.*

Cespitose, rounded, branches but little spreading, closely ramose, branchlets very nearly terete, 3 to 4 lines stout, scarcely at all tapering, apex obtuse. Corallum quite porous; apical calicles very stout (1 to  $1\frac{1}{2}$  lines broad), a little prominent; the lateral, appressed tubi-

form, and regular,  $\frac{1}{8}$  of a line broad and  $1\frac{1}{2}$  to 2 lines long, thin and fragile at the margin, exterior neatly striate, aperture broad and circular, opening upward; star short six-rayed.

Plate 32, fig. 7, corallum, natural size; 7 a, extremity of branch, natural size.

Feejee Islands. *Exp. Exp.*

This species grows in small rounded clumps, consisting of several branching stems rising from a common base. The long, large, and thin cylindrical calicles, are attached by one side to the branch, nearly, or quite to the aperture, and are evenly arranged and in contact. They have a broad, flaring mouth, opening upward, and a thin margin. The clump in the collections is five inches high.

In habit, this species is between the proper cespitose Madreporae, and the cespitose-arboriform, and might, with propriety, be arranged with the latter.

III. *Caliculis validis, nariformibus aut tubiformibus.*

18. MADREPORA PAXILLIGERA. (*Dana.*)

*M. latissima, pedicellato-cespitosa, plana, basi solida, disciformis, et crassa; infrù, vix convexa, nuda, medio pedicellata; suprù, ramulis digitiformibus 2½-3" longis, et ½-¾" crassis, erectis et subteretibus, raro furcatis, subacutis; margine squarroso, ramulis vix minimè liberis. Corallum caliculo apicali parvulo (1" angustiore), lateralibus paulum inæqualibus, confertissimis, prominulis, compresso-nariformibus, seu totidem dimidiatis, striatis, aperturâ oblongâ, stellâ vix conspicuâ.*

Very broad, pedicellate cespitose, plane above; base of the frond solid, disk-form, stout; below, scarcely convex, naked, pedicellate at middle; above, branchlets digitiform,  $2\frac{1}{2}$  to 3 inches long, and  $\frac{1}{2}$  to  $\frac{3}{8}$  of an inch thick, erect and subterete, rarely furcate, subacute; margin of the corallum squarrose, the branchlets being very short and incipient. Corallum having the apical calicle short and small (hardly a line broad); the lateral a little unequal, very crowded, a little prominent, compressed nariform, or sometimes dimidiate, striate, aperture oblong, star scarcely distinct.



Plate 34, fig. 1, part of corallum, natural size; 1 *a*, part of branchlet, ditto; 1 *b*, profile of calicles, ditto.

Tahiti, Society Islands. *Exp. Exp.*

The corallum is a circular stony plate, having the margin squarrosely incised or incipiently branching, and bearing above erect finger-shaped branchlets. One of the specimens is two feet in diameter, and the solid part is two inches thick at centre; it was attached below by a small and short pedicel. This species resembles the *nasuta*, but differs strikingly in having no distinct marginal branchlets.

19. MADREPORA NASUTA. (*Dana.*)

*M. latè cespitosa, breviter pedicellata, paulum convexa; basi solida et plano-obconica; infrà, complanata et subnuda, crasso-pedicellata; suprà ramulis crebris, digitiformibus, subsimplicibus, raro proliferis, subteretibus, 2-2½" longis, et 4-5" crassis, subacutis; margine ramulis horizontalibus elongatis. Corallum caliculis valde prominentibus, subtiliter striatulis, compresso-nariformibus, stellâ sæpe conspicuâ, duabus lamellis paulo latioribus.*

Broad cespitose, short pedicellate, a little convex, with a solid plano-obconical base; below, complanate and nearly naked, stout pedicellate; above, branchlets crowded, digitiform, nearly simple, rarely proliferous, subterete, 2 to 2½ inches long and 4 to 5 lines thick, subacute, branchlets of the margin horizontal and elongate. Corallum with the lateral calicles very prominent, compressed-nariform, very finely striate; star often distinct, two of the lamellæ a little the broadest.

Plate 34, fig. 2, corallum, natural size; 2 *a*, branchlet, ditto; 2 *b*, profile of calicles.

Tahiti, Society Islands. *Exp. Exp.*

The stony compact base, formed from the coalescing of horizontal branches, is six inches in diameter in a specimen which is twelve inches across: from the margin of the base horizontal branchlets extend out, which are a little ascending and subramose. The plate was attached below by a pedicel three and a half inches broad. The

calicles stand out very prominent, though much compressed, and sometimes range in longitudinal series; the striatures are very fine and minutely echinulate. The aperture of the cell is oblong and opens upward.

20. MADREPORA DIGITIFERA. (Dana.)

*M. latè cespitosa, planiuscula, frondis basi solidâ et disciformi; suprâ ramulis creberrimis digitiformibus, vix teretibus et subacutis, 2½-3" longis et 4-5" crassis, sæpe breviter proliferis. Corallum caliculo apicali prominulo, vix 1" lato; lateralibus, confertis, divaricatis et dimidiatis, non compressis, erectis, ¾" longis, labio subcrasso, cellis immersis sparsis, stellâ breviter 6-radiatâ, lamellâ exteriore prominente.*

Broad, nearly flat above, base of the frond solid and disk-form; above, branchlets crowded, digitiform, scarcely terete, and subacute, 2½ to 3 inches long and 4 to 5 lines thick, often short proliferous. Corallum with the apical calicle a little prominent, scarcely a line broad; the lateral crowded, divaricate, dimidiate, erect, and not at all compressed, ¾ of a line long, lip rather thick, with some scattered immersed cells; star short 6-rayed, exterior lamella quite prominent.

The corallum of this species has a solid circular base like the preceding; but the dimidiate calicles are not nariform, nor at all compressed, and they stand erect upon the branchlet, so that the under side is at right angles with it: they are neatly striate, and the striæ are nearly entire. There are some immersed cells, and about the lower part of the branchlets (as also in the preceding species) all the calicles are obsolescent. The branchlets are crowded together, with intervals only of a sixth of an inch. The specimen seen by the author belonged to the Boston Natural History Society: the locality is not known.

21. MADREPORA GLOBICEPS. (Dana.)

*M. latè cespitosa, supernè convexa, basi solida et disciformis, suprâ, ra-*

*mulis erectis digitiformibus, crebris, subangulatis, 2½'' longis et ½-⅔'' crassis, apice rotundatâ. Corallum caliculo apicali vix minimè prominente, 1''' lato; lateralibus confertis, breviter tubiformibus aut tubo-nariformibus, obsoletè striatulis, apice obliquis, aperturâ ellipticâ, stellâ, conspicuâ.*

Broad cespitose, convex above, with a solid disk-form base; above, branchlets erect digitiform, crowded, subangular, 2½ inches long and ½ to ⅔ of an inch thick, rounded at apex. Corallum having the apical calicle scarcely at all prominent, a line broad; the lateral crowded, short, tubiform or tubo-nariform, obsoletely striate, oblique at apex, aperture elliptical, star distinct.

Plate 34, fig. 3, branchlet, natural size.

Tahiti, Society Islands. *Exp. Exp.*

This species has the general habit of the *nasuta*, but the digitiform branchlets are very obtusely rounded or almost truncate at top; they are about a fourth of an inch apart, and somewhat angular. The solid base in the specimen in the collections is obconical below, and was attached at centre by a breadth of four inches; the whole clump is a foot in diameter and six inches high. The calicles are three-quarters of a line in diameter, and below are obsolescent.

The subangular form of the branchlets, in this and other cespitose species, arises apparently from the proximity of the branchlets to one another.

## 22. MADREPORA EFFUSA. (*Dana.*)

*M. latè cespitosa, convexa, basi fere solida et disciformis; suprâ, ramulis crebris, digitiformibus, 1½'' longis et 4-5''' crassis, ramulis marginalibus vix minimè liberis. Corallum caliculo apicali crasso, cylindrico, 1''' paululo latiore; lateralibus confertissimis et inæqualibus, compresso-nariformibus, 1½''' longis, interdum tubo-nariformibus et proliferis; subtus, confertim breviter calculatis.*

Broad cespitose, convex above, base nearly solid and disk-form; above, branchlets crowded, digitiform, 1½ inches long, and 4 to 5 lines thick; at the margin, the branchlets scarcely free. Corallum having



the apical calicle stout, cylindrical, rather more than a line broad, the lateral much crowded and unequal, compressed-nariform,  $1\frac{1}{2}$  lines long, sometimes tubo-nariform and proliferous: under surface crowdedly covered with short calicles.

Ceylon, Indian Ocean. *Rev. G. A. Apthorp.*

The clump resembles the *nasuta* in general appearance, but its calicles are more unequal, and the apical calicle is twice as broad; moreover, the branchlets are shorter and more unequal, the surface below is crowdedly muricate, and the marginal branchlets are coalescent and not free. The calicles are about a line and a half long, with many quite small interspersed, and others larger that are tubiform. The clump measures fourteen inches by eleven in breadth, and five inches in height. The pedicel below occupies two-thirds the whole breadth of the base.

### 23. MADREPORA CORYMBOSA. (*Lamarck.*)

*M. latè cespitosa, convexa; ramulis digitiformibus, subsimplicibus, 3-4'' latis et 2½-3'' longis, subteretibus. Corallum caliculo apicali lato (1-1¼''); lateralibus 1½-1¾'' longis, tubiformibus, apice obliquis, margine echinulatis, extus striatis et scabrosis, paucis caliculis minutis sparsis; stellâ brevissimâ aut inconspicuâ, duabus lamellis paulo prominulioribus.*

Broad cespitose, convex above; branchlets digitiform, subsimple, 3 to 4 lines broad and  $2\frac{1}{2}$  to 3 inches long, subterete. Corallum with the apical calicle large (1 to  $1\frac{1}{4}$  lines broad); the lateral  $1\frac{1}{2}$  to  $1\frac{3}{4}$  lines long, tubiform, with the summit oblique and margin echinulate; exterior striate and scabrous; a few minute calicles interspersed; star very short or indistinct; two of the lamellæ a little the most prominent.

East Indies, and Indian Ocean.

This species forms broad corymbed clumps, resembling the *nasuta* in form; but it has not the much-compressed, nariform calicles of that species, and the apical calicle is quite large. The under surface of the outer branchlets of the clump have a few large and stout tubular calicles. From those of the following species, to which it is allied, it

differs in having the calicles scabrous and striate, and not appressed to the branch.

*Madrepora corymbosa*, Lamk., ii. 447, No. 3. Many species are included by Lamarck under this name, of which the above corresponds nearly with his description, which is as follows: "M. ramosissima, orbiculata, ramis ascendentibus, ramulosis, ramulis creberrimis, in corymbum latissimum obliquum digestis." "Ses cellules tubuleuses sont inégales, serrées et striées en dehors." The figure by Rumphius (Amb. tab. 86, fig. 2), to which Lamarck refers, represents a vase-shape species, concave above, near the *M. spicifera* or *surculosa*.

#### 24. MADREPORA APPRESSA. (*Ehrenberg.*)

*M. prostrata*, ramis horizontalibus in laminam complanatam subintegram coalitis; infrà nuda; suprà, ramulis erectis crebris, spiciformibus, fere teretibus,  $2\frac{1}{2}$ –3" longis et 3" crassis. Corallum caliculo apicali prominulo; lateralibus confertis et æqualibus,  $1\frac{1}{2}$ " longis, appressis subimbricatis, rostrato-nariformibus, subtilissimè striatis, stellâ bene conspicuâ, duabus lamellis paulo prominulioribus, infrà conniventibus.

Prostrate, the horizontal branches coalescing into a plate which is nearly entire, flattened, and naked below; above, branchlets erect, crowded, spiciform, nearly terete,  $2\frac{1}{2}$  to 3 inches long and 3 lines thick. Corallum with the apical calicles a little prominent; the lateral crowded and equal,  $1\frac{1}{2}$  lines long, appressed and subimbricate, rostrato-nariform, very minutely striated; star very distinct, two of the lamellæ a little the most prominent, and meeting below.

Plate 34, fig. 3, branchlets of corallum, natural size; 3 a, calicle, natural size; plate 31, figs. 8 a, 8 b, different views of calicle, enlarged.

East Indies, Singapore. *Exp. Exp.*

This common species forms very broad, flat-top fronds, growing apparently from a lateral attachment. The under surface, formed by the coalesced branches, is nearly flat and naked, with here and there a break. Above, the slender branchlets are remarkably neat and even in their subimbricate calicles, which are minutely striate, and about one and a half lines long. One specimen in the collections is two

feet in breadth, quite horizontal above, and nearly flat below, with the whole frond (including branchlets) about five inches in thickness. In the following species, which this somewhat resembles, the calicles are much unequal, giving the branchlets a ragged look.

*Madrepora appressa* (?), Ehrenb., G. lxix., sp. 3: "Novempollicaris, prostrata, repens, ramosa, ramis reticulato-coalitis, horizontalibus, ramulis, angulo recto surgentibus obliquisve, pollicaribus, simplicioribus, tubuliferis, imbricatis, tubulis myxatis, arcetè appressis, amplis, hispidis, stellulis terminalibus tumidis, validius hispidis, obsolete striatis."

## 25. MADREPORA ECHIDNÆA. (Lamarck.) Dana.

*M. latè cespitosa* (?), ramulis proliferis et irregularibus, fermè 3-4'' crassis, tritico habitu affinibus sed gracilioribus. Corallum caliculo apicali valde elongato; lateralibus strictè appressis, inæqualibus, tubiformibus obtusè rostratis, sæpe 3-4'' longis, extus levibus; aperturâ minimâ, suborbiculatâ; stellâ bene conspicuâ, duabus lamellis infrâ fere conniventibus.

Broad cespitose (?), branchlets proliferous and irregular, about 3 or 4 lines thick; near the *triticum* in habit, but more slender. Corallum with the apical calicle much elongate; the lateral close appressed, unequal, tubular, obtusely rostrate, often 3 to 4 lines long, exterior smooth; aperture minute, nearly circular; star very distinct, two of the lamellæ nearly meeting below.

Plate 35, fig. 3, branch, natural size; 3 *a*, calicle, natural size; plate 31, figs. 9 *a*, 9 *b*, different views of calicle, enlarged.

The East Indies. Sooloo Sea. *Exp. Exp.*

Only a few fragments of this species were obtained by the author; but their oblique mode of growth appears sufficient to indicate that they belong to a horizontally growing zoophyte, resembling the *plantaginea*, and it may possibly come from the marginal portions of that species. The branchlets are very unevenly covered with long cylindrical calicles having a smooth appearance and an obtuse elongated lip, with the minute aperture situated a little below the apex.

*Mad. rosea*, Esper, i. 115, tab. 15.

*Heteropora echidnæa*, Ehrenb., G. lxix. sp.

*Oculina echidnæa*, Lamk., ii. 457, No. 6.

13.

26. MADREPORA PLANTAGINEA. (*Lamarck.*)

*M. latissimè cespitosa, supernè vix convexa, ramis horizontalibus, et in laminam complanatam subintegram infrà nudam coalitis; suprà ramulis spiciformibus, 4–6'' crassis et 2–2½'' longis, sæpe proliferis et irregularibus. Corallum caliculo apicali lato (1–1½''), prominulo; lateralibus tubiformibus, appressis, valde inæqualibus, sæpe 2'' longis et ¾'' crassis, validis, labio obtusis, extus subtiliter striatis, fere levibus, paucis brevissimis sparsis; aperturâ vix ellipticâ, stellâ conspicuâ, duabus lamellis prominulioribus infrâque fere conniventibus; subtus superficie levi, paucis cellis perforatâ.*

Very broad cespitose, slightly convex; branches horizontal, and coalescing into a flattened lamina nearly entire, naked below, and interrupted by an occasional break; above, branchlets spiciform, 4 to 6 lines thick, and 2 to 2½ inches long, and often proliferous and irregular. Corallum having the apical calicles a little prominent, and broad (1 to 1½ lines); the lateral, tubiform, appressed, very unequal, often 2 lines long, and ¾ of a line broad; stout, with an obtuse lip, exterior very finely striate, smooth; aperture scarcely elliptical; star quite distinct, two of the lamellæ most prominent, and nearly meeting below.

The East Indies, and Singapore. *Exp. Exp.*—Ceylon. *Rev. G. A. Apthorp.*

This species approaches the *cerealis*, which it resembles in its nearly smooth and unequal calicles, and general habit; but the calicles are much longer, and the apical calicle much larger. It grows to a breadth of eighteen inches or more. In the under surface of the frond it resembles the *appressa*, but not in its calicles, which are very unequal, and not distinctly imbricate. The *rudis* and *acervata* have much stouter calicles; the *echidnæa*, longer and smaller apical calicles, and longer calicles generally. The *corymbosa* has its calicles less appressed, scabrous, and distinctly striate, not thick-lipped, and not stellate within.

*Mad. plantaginea*, Lamk., ii. 447, No. 4.  
*Heteropora decurrens* (?), Ehrenb., G. lxix.,  
sp. 12.

The *Madrepora plantaginea* of Quoy and

Gaymard (*Voy. de l'Ast.* iv. 234, pl. 19, figs. 3) cannot be recognised from the description or figure, both of which are very imperfect.

## 27. MADREPORA CEREALIS. (Lamarck.)

*M. latè cespitosa, paulum convexa; suprà, ramulis numerosis erectis spiciformibus, 3-4'' crassis et 2'' longis, proliferis et non teretibus. Corallum caliculo apicali prominulo, parvulo (vix  $\frac{1}{4}$ '' ); lateralibus appressis, subtubiformibus inæqualibus, 1-1½'' longis, subrostratis, extus sublevibus, aperturâ ellipticâ, stellâ brevissimâ aut subconspiciuâ, duabus lamellis paulo prominulioribus.*

Broad cespitose, somewhat convex; above, branchlets numerous, erect, spiciform, 3 to 4 lines thick, and 2 inches long, proliferous, and not terete. Corallum having the apical calicles a little prominent, small (scarcely  $\frac{1}{4}$  of a line); the lateral, appressed subtubiform, unequal, 1 to 1½ lines long, subrostrate, exterior smooth, aperture elliptical, star very short or imperfectly distinct; two of the lamellæ a little prominent.

Plate 35, fig. 2, part of corallum, natural size; 2 a, branchlet, ditto.

The Sooloo Sea, East Indies. *Exp. Exp.*

This species has the habit of the *plantaginea*, but is smaller in its calicles, apical as well as lateral. The branchlets are very unevenly covered with calicles, some of which are long and proliferous. The specimen in the collections is five inches high and six in diameter; and the branchlets above are about a fourth of an inch thick: it is not complanate below; but this may be owing to its not being full grown.

In another specimen, from the same locality, apparently this species, the short calicles, low on the branchlets, have extremely minute cells, while in the above, they are about a third of a line in diameter.

*Mad. muricata, var.*, Esper, Fortsetz. i. 56, tab. 53; a tolerable figure of a specimen from the East Indies.

## 28. MADREPORA ACERVATA. (Dana.)

*M. latè cespitosa, paulum convexa, ramis exterioribus fere prostratis, et infrâ parcè complanatis; suprâ, ramulis 2'' altis et 5-8'' crassis,*

*apice valde proliferis sæpe acervatis, et subretusis. Corallum caliculo apicali latissimo ( $1\frac{1}{2}$ –2'''), vix exserto, lateralibus confertis, appresso-tubiformibus, 1–1 $\frac{1}{2}$ ''' longis, extus sublevibus, apice obliquis, labio incrassato, apertura elliptica, stellâ bene conspicuâ, duabus lamellis infra fere conniventibus.*

Broad cespitose, a little convex, exterior branches nearly prostrate, and somewhat flattened below; above, branchlets 2 inches high, 5 to 8 lines thick, very proliferous, often acervate at apex, and subretuse. Corallum with the apical calicles very broad ( $1\frac{1}{2}$  to 2 lines), scarcely exsert; the lateral crowded, appressed-tubiform, 1–1 $\frac{1}{2}$  lines long, exterior rather smooth; oblique at apex; lip thick, aperture elliptical; star very distinct, two of the lamellæ nearly meeting below.

Plate 34, fig. 43, branchlet, natural size.

Singapore, East Indies. *Exp. Exp.*

This species is low spreading cespitose, with the extremities of the branchlets often proliferous and much enlarged, or terminating in two, three, or more broad apical calicles. The apical calicles are scarcely at all exsert, and contain a cell hardly one-fourth the diameter; the texture appears spongy. The lateral calicles are much smaller than in the *valida*, and are distinctly striated.

#### 29. MADREPORA VALIDA. (Dana.)

*M. cespitosa, ramulis subdigitiformibus, irregularibus, 2 $\frac{1}{2}$ '' longis, et 6–8''' crassis, ruditer proliferis, polypis maximis. Corallum caliculis lateralibus inæqualibus, appresso-tubiformibus, crassimis et maximis, 2–4''' longis, et 1''' latis, extus levibus; stellâ paulum conspicuâ, duabus lamellis infra conniventibus.*

Cespitose, branchlets subdigitiform, very uneven, 2 $\frac{1}{2}$  inches long and 6 to 8 lines thick, rudely proliferous, polyps quite large. Corallum having the lateral calicles unequal, appressed-tubiform, very stout, and large, 2 to 4 lines long, and 1 line broad, exterior smooth; star rather distinct, two of the lamellæ meeting below.

Plate 35, fig. 1, corallum, natural size.

Feejee Islands. *Exp. Exp.*

The specimen in the collections is a small clump, four inches in diameter, consisting of short digitiform branchlets, covered unevenly with very large and stout appressed-tubiform calicles, having a smooth exterior. The under surface of the outer branchlets is much flattened and nearly naked.

*β. digitata* of Gualtieri. Under this name a fragment is alluded to belonging to the Boston Natural History Society, presenting many of the above-mentioned characters. It is branched, but whether cespitose or fruticose is not determinable from the specimen. The branches are from one-half to three-quarters of an inch thick, and are unevenly covered with very stout calicles one and a half to three lines long, appearing smooth and not at all striate, having a thick lip and a small circular aperture very neatly stellate. The summits of some of the branchlets are acervately proliferous, like the *acervata*, and terminate in two or more large and stout scarcely exert calicles; but the lateral calicles are larger, and have not the exterior striate. (*Madrepora albida digitata* of Gualtieri, figured in his index, on back of title page to part third.)

### 30. MADREPORA RETUSA. (*Dana.*)

*M. cespitosa, pumila, convexa, ramulis digitiformibus, ½" crassis, 2¼" longis, non teretibus, apice truncatis. Corallum caliculis lateralibus confertis, apiceque ramulorum acervatis, valde inæqualibus, aliis 3" longis, aliis sparsis obsoletis, appresso-tubiformibus et tenuibus, labio elongatis, extus levibus; aperturá sæpe oblongá, stellá vix conspicuá.*

Cespitose, small, convex, branchlets digitiform, ½ an inch thick, 2¼ inches long, not terete, truncate at summit. Corallum having the lateral calicles crowded and acervate at the summit of the branchlets, very unequal, some 3 lines long and others obsolete interspersed, appressed-tubiform and slender, lip elongate, exterior smooth; aperture often oblong, star scarcely distinct.

Feejee Islands. *Exp. Exp.*

The specimen in the collections is a small clump about four inches high and as many broad, consisting of a few irregular digitiform branches rising from a common base. The species is remarkable for

its unequal, tubiform, thin, though not fragile, calicles, and the flattened obtuse summits of the branches consisting of numerous crowded calicles, among which the apical calicle is sometimes with difficulty distinguished. It has the general habit of the *plantaginea*.

C. Fastigiatae; caliculis breviter orbiculato-narifformibus, subvalidis; ramis tenuiter valdeque subdivisis.

31. MADREPORA RAMICULOSA. (*Dana*.)

*M. subfastigiata, strictè ramosa et valdè ramiculosa, ramiculis, creberrimis, subteretibus, 1½-2" crassis. Corallum vix porosum, leve; caliculo apicali fere 2" exserto et 1" sæpe latiore; lateralibus, remotis, breviter orbiculato-narifformibus, subvalidis, ramorum cellis immersis cum stellâ conspicuâ.*

Subfastigiate, close ramose, and very minutely subdivided into branchlets; ramicles much crowded, subterete, 1½ to 2 lines thick. Corallum slightly porous, smooth; apical calicle nearly 2 lines prominent, and often over a line in breadth; the lateral, remote, short, round-narifform, rather stout; cells of the branches immersed, and having a very distinct star.

Plate 35, fig. 4, part of a branch of corallum, natural size; 4 a, extremity of a branchlet, natural size.

Feejee Islands. *Exp. Exp.*

Forms spreading clumps, very much subdivided into slender branchlets, and constituting together a zoophyte with an even top, or a little convex. The small calicles upon the upper branchlets are remote, and occasionally in short series. Upon the lower exterior branchlets of the clump, the calicles are nearly or quite obsolete. Under the microscope the surface appears very finely spinuloso-striate, and scarcely porous. One of the specimens obtained is about eight inches high, and a foot broad above, and is somewhat turbinate in shape, with the top a little convex.



D. M. arborescentes, ramis ramiculos proliferos regulariter undique gerentibus.

### 32. MADREPORA ECHINATA. (Dana.)

*M. arborescens*, latè remotèque ramosa, ramis  $\frac{1}{2}$ – $\frac{3}{4}$ " crassis, ramiculos polypiferos capillares undique crebroque gerentibus. Corallum ramiculis capillaribus echinatum, superficie vix porosum; ramiculis caliculatis tubulatis et vix  $\frac{3}{4}$ " longis, levibus, caliculis singulis  $\frac{1}{2}$ – $\frac{3}{4}$ " longis et  $\frac{3}{4}$ " latis; stellâ sex-radiatâ bene conspicuâ.

Arborescent, spreading, and remotely ramose, branches  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch thick, and covered evenly and crowdedly with capillary polyp-bearing ramicles. Corallum with the surface scarcely porous; ramicles nearly  $\frac{3}{4}$  of an inch long, and consisting of a few thin and smooth tubiform calicles; single calicles  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch long, and  $\frac{3}{4}$  of a line broad, star six-rayed, and very distinct.

Plate 36, fig. 1, corallum, natural size; 1 a, one of the ramiculi.

Feejee Islands, and Sooloo Sea. *Exp. Exp.*

The branches are very neatly bristled with the delicate branchlets, and thus covered, have an even cylindrical outline, and are about two inches in diameter. The whole zoophyte is sometimes two feet in height, and is but sparingly branched, the branches being often six inches long.

### 33. MADREPORA CARDUUS. (Dana.)

*M. arborescens*, echinatae affinis, ramis supernè strictè subdivisis, ramiculis lateralibus polypiferis longioribus (1"), et crassioribus (1–2"). Corallum ramiculorum caliculo apicali tubiformi 1–1 $\frac{1}{2}$ " longo, caliculis lateralibus appresso tubiformibus et orbiculato-nariformibus.

Arborescent, near the *echinata* in habit, branches above, very closely subdivided, lateral polypiferous ramicles longer (1 inch), and stouter (1 to 2 lines). Corallum with the tubiform apical calicle of the ramicles 1 to 1 $\frac{1}{2}$  lines long; the lateral calicles appressed-tubiform, or round-nariform.

Plate 36, fig. 2, corallum, natural size; 2 *a*, branchlets, ditto.

Feejee Islands. *Exp. Exp.*

This species resembles the *echinata* in habit; but the lateral branchlets that surround and bristle the branches, make them from two and a half to three inches in diameter, and the calicles which compose them are also much shorter. The branches are subdivided above, into a number of very close ascending branchlets. The surface of the calicles is very finely striate.

The specimens in the collections are eighteen inches in height, with a breadth of  $2\frac{1}{2}$  to 3 inches below, and widening above, where the branch subdivides, to 6 inches.

#### 34. MADREPORA ROSARIA. (*Dana.*)

*M. rectè arborescens, caulibus suprà strictè subdivisis, et lateraliter undique ramiculosis, ramiculis creberrimis, valde obtusis, 3-4''' usque ad apicem crassis, subteretibus, sæpe proliferis. Corallum ramiculorum caliculo apicali grandi (1-1½''' crasso), paululum exserto; lateralibus validis, breviter nariformibus, compressis, striatis, interdum subseriatis, stellâ 12-radiatâ conspicuâ.*

Erect arborescent, stem above closely subdivided, and throughout laterally ramiculose; ramicles much crowded, very obtuse, 3 to 4 lines thick even at apex, subterete, often proliferous. Corallum having the apical calicles of the ramicles large (1 to  $1\frac{1}{2}$  lines broad), a little exsert; the lateral stout, short, and compressed-nariform, striated, sometimes subseriate; star 12-rayed, distinct.

Plate 36, fig. 3, corallum, natural size; 3 *a*, branchlet, natural size.

Feejee Islands. *Exp. Exp.*

The crowded ramicles are so evenly clustered around the erect stem that the whole has a cylindrical shape, and is about fifteen inches high and four in diameter. The lateral calicles have a very thick margin, and many of them are proliferous. The ramicles are about as large at the obtuse apex as below, and the cluster of calicles which constitutes the extremity has a rosette appearance.

## 35. MADREPORA FLORIDA. (Dana.)

*M. arborescens, maxima, latè remotèque ramosa, ramis 1¼" crassis, sensim attenuatis, acervos polypiferos parvulos undique gerentibus. Corallum acervis caliculatis ¼" latis, caliculis inæqualibus, tubiformibus valde brevibus, et incrassatis, striatis, aliis tubo-nariformibus, cellis immersis interspersis; stellâ sex-radiatâ conspicuâ, duabus lamellis non prominulioribus.*

Arborescent, very large, broad and remotely ramose, branches 1¼ inches thick, gradually tapering, bearing over the surface small clusters of polyps. Corallum covered with calicular tubercles ¼ of an inch broad, calicles unequal, very short tubiform, rather stout, striated; some tubo-nariform, with immersed cells interspersed; star 6-rayed, distinct, two of the lamellæ not more prominent.

Plate 37, fig. 1, corallum, natural size.

Feejee Islands. *Exp. Exp.*

The specimen obtained at the Feejees is a very stout branch, eighteen inches high. The calicular tubercles or rosettes consist in general of six to ten very short calicles; and as they cover regularly the whole surface, they give a neat appearance to the corallum. Between these rosettes, the cells are mostly immersed.

E. Arborescentes, aut fruticosæ, ramis inæqualiter vel haud proliferis.

I. Caliculis fragilibus, labellatis, orbiculato-nariformibus, aut tubiformibus.

## 36. MADREPORA IMPLICATA. (Dana.)

*M. cespitoso-arborescens, strictè ramosa, ramis confertis, curvatis et tortuosè implicatis, sæpe coalitis, tenuiter attenuatis, caulibus crassitudine ⅓", ramulis ½". Corallum scabriculum, poris lineatis notatum, caliculo apicali cylindrico, ⅜" crasso; lateralibus, infra obsoletis, prope apicem brevibus et sparsis, orbiculato-nariformibus, fragilibus; stellâ obsolescente.*

Cespitoso-arborescent, closely ramose, branches crowded, curved, and

tortuously entangled, often coalescing, slenderly attenuate; stems  $\frac{1}{3}$  of an inch thick, branchlets  $\frac{1}{8}$  of an inch. Corallum scabrous and striated with linear pores; apical calicle cylindrical,  $\frac{4}{5}$  of a line in diameter; the lateral obsolete below two inches from the summit, above this, short, round, nariform, and fragile, scattered; star obsolete.

Plate 37, fig. 2, part of corallum, natural size; 2 a, part of section of branch, enlarged.

Feejee Islands. *Exp. Exp.*

This species forms crowded clumps six or eight inches high, consisting of slender tortuous branches and branchlets, bare of calicles except within one and a half to two inches of the summit. It resembles the *tortuosa*, but is more slender, more coalescent, and differs in the character of the surface and the calicles. The linear pores give rise to a wavyly striated surface.

### 37. MADREPORA TORTUOSA. (*Dana.*)

*M. cespitoso-arborescens, strictè ramosa, ramis confertis, sæpe coalitis, paulo tortuosis, infernè,  $\frac{1}{2}$ " crassis, ramulis sæpe 2" longis et 2-4" crassis, acuminatis et subacutis. Corallum scabriculum, non striatum; caliculo apicali  $\frac{3}{4}$ " longo et lato; lateralibus infra obsolete, suprà breviter orbiculato-nariformibus, fragilibus, stellâ obsolescente, duabus lamellis paululo prominulioribus.*

Cespitoso-arborescent, close-ramose, branches crowded, often coalescing, a little tortuous, below,  $\frac{1}{2}$  an inch thick, branchlets often 2 inches long, and 2 to 4 lines thick, acuminate and subacute. Corallum having the surface scabrous, but not at all striate; apical calicle  $\frac{3}{4}$  of a line long and broad; the lateral below 3 inches obsolete; above, short round-nariform, fragile; star obsolete, two of the lamellæ but slightly prominent.

Plate 37, fig. 3, part of corallum, natural size.

Feejee Islands. *Exp. Exp.*

The clumps of this species resemble those of the *implicata*, and are

of the same height. A specimen in the collections is eight inches high and five broad. The calicles are irregular in position, opening sometimes outward and downward, as well as upward. The branchlets taper gradually to a subacute apex. A fragment of the top of a branch resembles somewhat the corallum of the *M. scabricula*; but the apical calicle is very much smaller, and does not exceed in size the lateral calicles.

38. MADREPORA ASPERA. (*Dana.*)

*M. aborescens latè ramosa, ramis teretibus, ½" crassis, apice conicis, proliferis. Corallum porosissimum, scabriculum; caliculo apicali crasso (1½"), prominulo; lateralibus, breviter labellatis, fragilibus, divaricatis, non confertis, multis obsoletis, cellis grandibus, stellâ brevissimâ, duabus lamellis latioribus.*

Arborescent, spreading, ramose, branches terete, ½ an inch thick, summits conical and proliferous. Corallum quite porous, surface scabrous; apical calicle stout (1½ lines) a little prominent; the lateral short labellate, fragile, divaricate, not crowded, many obsolete, cells quite large, star very short-rayed, two of the lamellæ prominent.

Plate 38, fig. 1, branch, natural size; 1 *a*, polyp, enlarged; 1 *b*, part of section of branch, enlarged.

Feejee Islands. *Exp. Exp.*

The branches, though terete, have a somewhat ragged appearance, owing to the unequal calicles. The immersed cells below are about half a line broad. The specimen is a fragment three inches in height. The fragile, labellate, lateral calicles, unequal, with some obsolete interspersed, and the very large apical calicle, and quite porous texture, are its more striking characters.

39. MADREPORA HEBES. (*Dana.*)

*M. arborescens, latè ramosa, apice prolifera, ramis bene teretibus, ½" crassis, valde obtusis. Corallum caliculo apicali latissimo (1½-2")*

*tumidulo, vix exserto; lateralibus confertissimis, breviter labellatis æqualibus et divaricatis, fere  $\frac{2}{3}$ " latis; stellâ subconspicuâ, duabus lamellis prominulioribus.*

Arborescent, spreading ramose, proliferous at apex; branches neatly terete,  $\frac{1}{2}$  an inch thick, very obtuse. Corallum having the apical calicle very broad ( $1\frac{1}{2}$  to 2 lines), a little tumid, but scarcely exsert; the lateral very closely crowded, short labellate, equal and erect, nearly  $\frac{4}{5}$  of a line broad; stars rather distinct, two of the lamellæ most prominent.

Plate 35, fig. 5, corallum, natural size.

Feejee Islands. *Exp. Exp.*

This species is remarkable for its very short and closely crowded calicles, each standing erect upon the sides of the branch, and all forming, together, an even surface. The obtuse apices and very large apical calicle, as well as the size of the branches, are other characteristics.

In one specimen, the stem is a little curved, and it is possible that it may be part of a horizontally growing species, in which case it should rank near the *prostrata*.

#### 40. MADREPORA EXIGUA. (Dana.)

*M. arborescens, latè ramosa, gracilis, ramis teretibus, vix 3" crassis, acuminatis, curvatis. Corallum caliculis lateralibus brevissimis, orbiculato-nariformibus, vix  $\frac{3}{4}$ " latis, paulo confertis, cellâ orbiculatâ, sex-radiatâ, totidem duabus lamellis prominulioribus.*

Arborescent, spreading ramose, slender, branches terete, scarcely 3 lines thick, curved and acuminate. Corallum having the lateral calicles very short, round-nariform, hardly  $\frac{3}{4}$  of a line broad, a little crowded, cell round, six-rayed, sometimes two of the lamellæ a little prominent.

Plate 38, fig. 2, corallum, natural size; 2 a, extremity of a branch, ditto; 2 b, profile of calicles.

Feejee Islands. *Exp. Exp.*

This is a neat slender species, with very short calicles, the branches appearing almost naked. The specimen is about five inches high, and is sparingly branched.

41. MADREPORA CRIBRIPORA. (*Dana.*)

*M. arborescens, aut cespitoso-arborescens, latè ramosa, ramis bene teretibus, 4-5''' crassis, ramulis longis (interdum 3''), subacutis, attenuatis. Corallum scabriculum, porosissimum; caliculo apicali crasso (1-1½'''), prælongo, striato; lateralibus, brevissimè orbiculato-nariformibus, fragilibus, paulum confertis, cellâ apertâ, stellâ obsolescente, lamellâ unâ internâ conspicuâ.*

Arborescent or cespitoso-arborescent, spreading ramose, branches neatly terete, 4 to 5 lines thick, branchlets long (some 3 inches), attenuate, and subacute. Corallum scabrous, very porous; apical calicle stout (1 to 1½ lines), quite long, striate; the lateral very short, round-nariform, fragile, a little crowded, cell open; star obsolescent, one inner lamella prominent.

Plate 31, fig. 1, zoophyte expanded, natural size; 1 *a*, polyp enlarged; 1 *b*, extremity of branch of corallum; 1 *c*, surface of corallum, enlarged; transverse section of branch, enlarged.

Feejee Islands, about shallow parts of reefs. *Exp. Exp.*

This is a neat species, growing in spreading branched clusters, with long and terete branches and branchlets, very short fragile calicles, and a long and large striated apical calicle. It is very porous and breaks easily. It was found on a portion of the reef near Rewa (Viti Lebu), where the waters are much freshened by the river which empties near, and was almost the only species occurring on that part of the reef.

42. MADREPORA GRAVIDA. (*Dana.*)

*M. arborescens, maxima, latè remotèque ramosa, ramis crassimis (1-2'') teretibus, apice sensim conicis, ramiculos semipollices conicos undique gerentibus. Corallum caliculo apicali lato (1-1½''') tumidulo, non*

*exserto; ramicularum lateralibus parvulis et confertissimis, breviter labellatis et fragilibus; aliis totis obsolescentibus.*

Arborescent, very large, spreading and distant ramose, branches very stout (1 to 2 inches), terete, summits gradually becoming conical, and sides covered with oblong conical ramiculi,  $\frac{1}{2}$  an inch in length. Corallum having the apical calicles broad (1 to  $1\frac{1}{2}$  lines), a little tumid, but not prominent; the lateral calicles of the ramiculi quite small and very closely crowded, short labellate and fragile, the others throughout obsolescent.

A large and stout species, with distant branches, remarkable for the incipient conical branchlets, which are rather thickly and evenly scattered over the surface, and the very short contiguous calicles. A specimen belongs to the East India Museum, at Salem, Massachusetts, measuring two feet in length, and, where largest, two inches in diameter.

#### 43. MADREPORA VIRGATA. (*Dana.*)

*M. gracillimè arborescens, latè remotèque ramosa, ramis vix  $\frac{1}{2}$ " crassis, valde elongatis, bene teretibus, et æqualibus, subarcuatis, polypis non proliferis. Corallum vix porosum, subtiliter granulosum; caliculis lateralibus parvulis, subconfertis, prominulis, brevissimè tubiformibus tenuibus, margine acutis, cellâ orbiculatâ, stellâ breviter sex-radiatâ, duabus lamellis prominulioribus.*

Slender arborescent, spreading and remotely ramose, branches scarcely  $\frac{1}{2}$  an inch in diameter, very long, neatly terete and even, subarcuate, polyps not proliferous. Corallum scarcely porous, minutely granulous, lateral calicles small, rather crowded, very short and thin tubular, margin acute; cell circular, star with six short rays, two a little the most prominent.

Plate 39, fig. 1, corallum, natural size.

The Feejee Islands. *Exp. Exp.*

This species is remarkable for its very neat cylindrical wand-like branches, but little porous, and its very small and short, nearly smooth,



thin-lipped, or obsolescent, calicles. The terminal branches are often six inches long, and are very gradually tapering. The specimen in the collections is fifteen inches high, and the lower eight inches are without a branch.

44. MADREPORA HORRIDA. (*Dana.*)

*M. arborescens, maxima, divaricatè remotèque ramosa, ramis infrà 1-2'' crassis, fere teretibus, curvatis, sensim attenuatis, undique valde proliferis, ramculis divaricatis, 1-2½'' longis. Corallum horridè caliculatum, scabriculum; caliculo apicali tubiformi, non incrassato; lateralibus tenui-tubiformibus, divaricatis, totidem reflexis, valde inæqualibus, aliis ⅓'' longis, aliis sparsis obsolescentibus, aliis proliferis, extus striatis; stellâ sex-radiatâ.*

Arborescent, very large, divaricately and remotely branched, branches below 1 to 2 inches thick, nearly terete, curved, gradually attenuate, throughout very proliferous, with divaricate ramculi 1 to 2½ inches long. Corallum bristled with calicles and scabrous; apical calicle tubiform, not incrassate; the lateral, thin-tubiform, divaricate, and sometimes reversed; very unequal, some ⅓ of an inch long, others interspersed obsolescent, others proliferous; star six-rayed.

Plate 39, fig. 2, corallum, natural size; 2 a, extremity of branch, natural size.

Feejee Islands. *Exp. Exp.*

This species is remarkable for its size, and its few large and long branches, bristled with unequal tubiform calicles and short branchlets, which stand out on all sides nearly at right angles with the surface. The specimen in the collections is a branch sixteen inches high, bearing three or four lateral branches, and is but a part of the whole zoophyte; it is nearly two inches thick at base, and gradually diminishes upward.

II. *Caliculis validis; tubiformibus, dimidiatis aut nariformibus.*45. MADREPORA FORMOSA. (*Dana.*)

*M. arborescens, gracilis, latè valdèque ramosa, ramis vix bene teretibus, 3-6''' crassis, ramulis curvatis, attenuatis, proliferis. Corallum leve, caliculo apicali fere  $\frac{2}{3}$ ''' crasso et 1''' exserto; lateralibus erectis, tenuitubiformibus, validis, 1-1 $\frac{1}{2}$ ''' longis, vix confertis apice rotundatis; infrà minoribus sed nullis obsoletis, aperturá minutissimá orbiculatá, stellá conspicuá.*

Arborescent, spreading, and much ramose, slender; branches scarcely terete, 3 to 6 lines thick, branchlets curved, alternate, proliferous. Corallum smooth, apical calicle nearly  $\frac{2}{3}$  of a line broad, and 1 line exsert; the lateral, small, erect, and stout tubiform, erect, 1-1 $\frac{1}{2}$  lines long, scarcely crowded, rounded at summit; below much smaller, but none obsolete; cell very minute and circular; star distinct.

Plate 38, fig. 4, corallum, natural size; 4 *a*, extremity of branch; plate 31, figs. 2 *a*, 2 *b*, views of calicle, enlarged.

Feejee Islands, and Sooloo Sea, East Indies. *Exp. Exp.*

This species is one of the neatest and most graceful of the arborescent corals. It is distinguished by its rather crowded branchings, smooth surface, and small tubiform calicles. It resembles, somewhat, the *brachiata*, but is smaller and more ramose, and has a circular aperture to the cells. It is very near the *gracilis* in general appearance and size; but has not the nariform calicles of that species. The tiny trees are fifteen to eighteen inches high, and nearly as broad, and the branches above are quite proliferous.

*Mad. muricata*, Ellis and Solander, 171, tab. 57; Ellis's figure is a tolerably good representation of this species; his description is as follows: "Ramulosa, ramulis attenuatis, stellis prominentibus, cylindricis, obliquè truncatis." The figure is referred by Lamarck to the *M. abrotanoides*: but neither the figure nor description represent it as having *immersed* cells interspersed among the calicles.

The figure of the *Madrepora plantaginea* of Quoy and Gaymard (Voy. de l'Ast., iv. 234, pl. 19, fig. 3), presents nearly the characters of the extremity of a branch in this species.

The *Heteropora Hemprichii* of Ehrenberg, from the Red Sea, is near the *formosa*, but has larger calicles and appears to grow differently. See op. cit. Gen. lxix. sp. 6: "Semi-pedalis, brevius ramoso-cespitosa, subfastigiata aut irregularis, violacea, ramis undique

tubuloso-papillosis, tubulis cylindricis, bilinearibus, integris, apice obtusis, rotundatis et tenuiter perforatis, undique subtilissimè denticulatis, obsolete aut non striatis, terminalibus  $1\frac{1}{2}$ " latis, majoribus." He states that Esper's tab. 52 is near this species.

#### 46. MADREPORA BRACHIATA. (Dana.)

*M. arborescens, latè remotèque ramosa, ramis longis, rectis, bene teretibus, 6-8" crassis, ramulis extremis sæpe 3" longis, apice parcè proliferis. Corallum subleve, caliculis lateralibus, confertis, subæqualibus, erectis, tubiformibus, validis, compressis, obliquè truncatis, extus subtiliter striatis, aperturâ oblongâ, stellâ conspicuâ, duabus lamellis prominentioribus.*

Arborescent, spreading, and remotely ramose; branches long, straight, neatly terete, 6 to 8 lines thick, upper branchlets often 3 inches long, apex sparingly proliferous. Corallum rather smooth, lateral calicles crowded, subequal, erect, compressed tubiform, stout, obliquely truncated at apex; exterior very minutely striated, aperture oblong; star distinct, two of the lamellæ much the most prominent.

Plate 38, fig. 3, part of corallum, natural size; 3 *a*, extremity of branch; 3 *b*, profile of calicle, natural size.

The Sooloo Sea, East Indies. *Exp. Exp.*

This species is remarkable for its long straight, evenly cylindrical branchings; and its crowded, compressed, tubular calicles, with an oblong aperture, erect, except near the apex. The surface of the corallum and calicles is smooth, nearly like that of the *formosa*; in this character, and the oblong aperture of the cells, it differs from the *arbuscula*.

#### 47. MADREPORA ARBUSCULA. (Dana.)

*M. arborescens, latè ramosa, ramis teretibus, 6-9" crassis, ramulis extremis sæpe 3" longioribus, arcuatis, sensim attenuatis. Corallum scabriculum, caliculo apicali latissimo ( $1\frac{1}{2}$ " ), exserto, cellâ  $\frac{1}{2}$ " latâ; lateralibus æqualibus, subconfertis, tubiformibus, striatis obliquè paulum truncatis, erectis, non compressis,  $1-1\frac{1}{2}$ " longis sed ramorum latere inferiore brevissimis; stellâ valde conspicuâ.*

Arborescent, spreading ramose, branches terete, 6 to 9 lines thick, upper branchlets often more than 3 inches long, arcuate, gradually attenuate. Corallum somewhat scabrous, apical calicle quite broad ( $1\frac{1}{2}$  lines), exsert, cell  $\frac{1}{2}$  a line broad; the lateral equal, rather crowded, tubiform, and striate, truncated at apex a little obliquely, erect, not compressed, 1 to  $1\frac{1}{2}$  lines long, but on the inferior side of the branches very short; star very distinct.

Plate 40, fig. 2, extremity of branch, natural size.

Sooloo Sea, East Indies. *Exp. Exp.*

This species closely resembles the *secunda*, differing principally from it in its tubular calicles. It has the wide-spreading branches of the *cervicornis*, and has probably been referred to that species, though smaller and different in its calicles.

*Madrepora muricata*, Esper, Pflanz. Fortsetz. i. tab. 49. Esper states that his specimen was brought from Madagascar. The figure is referred to the *cervicornis* by Lamarck.

#### 48. MADREPORA ROBUSTA. (*Dana.*)

*M. arborescens, latè ramosa, ramis  $\frac{3}{4}$ –1" crassis, teretibus, ramulis extremis vix minoribus, sæpe 2–3" elongatis, apice subito acuminatis et conicis. Corallum caliculo apicali crasso ( $1\frac{1}{2}$ " lato), vix exserto; lateralibus undique confertissimis et divaricatis, paulum inæqualibus, sæpius tubiformibus et  $1\frac{1}{2}$ " longis, vix compressis, bene striatis, aliis minoribus apice valde obliquis; stellâ sex-radiatâ conspicuâ, duabus lamellis prominulioribus.*

Arborescent, spreading ramose, branches  $\frac{3}{4}$  to 1 inch thick, terete, branchlets but little smaller, 2 to 3 inches long, abruptly tapering at apex and conical. Corallum having the apical calicles stout ( $1\frac{1}{2}$  lines broad), but slightly exsert; the lateral every where much crowded, standing erect on the surface, a little unequal, mostly tubiform, and  $1\frac{1}{2}$  lines long, scarcely compressed, neatly striate, the smaller very oblique at summit; star 6-rayed, distinct, 2 of the rays most prominent.

Plate 39, fig. 3, part of corallum, natural size; 3 *a*, extremity of branch; plate 31, figs. 3 *a*, *b*, *c*, views of calicles, enlarged.

Feejee Islands. *Exp. Exp.*

A stout species, remarkable for the short-conical extremities of the cylindrical branches, and the crowded unequal calicles, mostly tubiform, and placed at right angles with the surface. The striatures of the calicles are neat and entire. The specimen in the collections is a branch six inches long. It resembles the *brachiata*, but differs in its stouter branches and branchlets, and its strongly striate calicles.

The *Heteropora cervicornis* of Ehrenberg (op. cit. G. lxix. sp. 10), which is far removed in its characters from Lamarck's *cervicornis*, a West India zoophyte, may be identical with the above species.

#### 49. MADREPORA HYSTRIX. (*Dana.*)

*M. humilis, fruticosa, latè ramosa, prolifera, ramis polypisque valde divaricatis, interdum reflexis. Corallum caliculo apicali oblongo lineamque lato; lateralibus inæqualibus, 1½-4'' longis, sparsis, divaricatis, tubiformibus, vel tubo-nariformibus, aliis obsolescentibus, aliis proliferis, subtilissimè scabro-striatis, totis validis sed margine non incrassatis.*

Low fruticose, spreading ramose, proliferous, branches and polyps very divaricate and sometimes reflexed. Corallum with the apical calicle oblong, a line broad; the lateral unequal (1½ to 4 lines long), divaricate, scattered, tubiform or tubo-nariform, some obsolescent, some proliferous, very finely scabro-striate, stout, but margin not thick.

Plate 40, fig. 1, corallum, natural size; plate 31, figs. 5, 5 a, view of calicle and cell, enlarged.

Feejee Islands.

The divaricate branches and the calicles standing at right angles with the branches or even reversed, varying much in length to a third of an inch, give a bristled aspect to the clump. Independent of the calicles, the branchlets are hardly more than a sixth of an inch thick, and the branches at base about half an inch. The specimens in the collections are four to five inches high, and five to six inches broad, and consist of several branched stems from the same base.

50. MADREPORA DIVARICATA. (*Dana.*)

*M. fruticosè arborescens, latè valdeque ramosa, paulum prolifera, ramis divaricatis, arcuatis, subteretibus,  $\frac{2}{3}$ " crassis, ramulis extremis attenuatis, 4-6" crassis. Corallum leve; caliculo apicali crasso ( $1\frac{1}{2}$ " ), exserto; lateralibus remotis, validissimis, divaricatis, vix striatis, plerumque elongato-tubiformibus (2" ), paucis grandioribus proliferis; multis brevibus et orbiculato-nariformibus; stellâ interdum conspicuâ, duabus lamellis prominulioribus.*

Shrubby arborescent, much and spreading ramose, a little proliferous; branches divaricate, arcuate, subterete,  $\frac{2}{3}$  of an inch thick; branchlets attenuate. 4 to 6 lines thick. Corallum smooth; apical calicle large ( $1\frac{1}{2}$  lines broad), exsert; the lateral remote, divaricate, very stout, scarcely striate, some long-tubiform (2 lines long), a few larger and proliferous, many short and round-nariform; star sometimes distinct, with two of the lamellæ most prominent.

Plate 41, fig. 2, part of corallum, natural size; 2 a, extremity of branch.

Feejee Islands. *Exp. Exp.*

The specimen of this species in the collections is a much-branched clump, about eight inches high and ten broad, remarkable for the remoteness, inequality, and stoutness of its calicles, which give the branches an uneven appearance. The larger tubiform calicles are from a line to a line and a half in diameter, and are placed nearly at right angles with the branch. The cells are all very large; those in the smaller obsolescent calicles are about two-thirds of a line broad, and contain a distinct star of six rays. The surface of the calicles is scarcely striate, though harsh to the feel.

51. MADREPORA ABROTANOIDES. (*Lamarck.*)

*M. fruticosa, latè ramosa, ramis vix teretibus,  $\frac{1}{2}$ - $\frac{2}{3}$ " crassis, ramulis extremis 3-4" crassis, arcuatis et pyramidato-attenuatis, valde breviterque proliferis. Corallum subleve, caliculo apicali 1" lato, exserto; lateralibus confertis, compresso-tubiformibus et tubo-nariformibus;*

*marginè crassis, valde inæqualibus, multis proliferis, multis sparsis obsolescentibus, aliis 2''' longis, et 4''' crassis, vix striatis; aperturâ oblongâ, stellâ conspicuâ, duabus lamellis prominulioribus.*

Fruticose, spreading ramose, branches scarcely terete,  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch thick, summit branchlets 3 to 4 lines thick, arcuate and pyramidato-attenuate, very proliferous, with short and unequal incipient branchlets. Corallum nearly smooth; apical calicle a line broad, exsert; the lateral, crowded, compressed, tubiform or tubo-nariform, with the margin stout, very unequal, many proliferous, many obsolescent; others 2 lines long and  $\frac{1}{2}$  of a line thick, scarcely striate; aperture oblong, star distinct, two of the lamellæ most prominent.

Plate 41, fig. 1, part of corallum, natural size; 1 a, extremity of branch.

Feejee Islands? *Exp. Exp.*

This species grows in clumps of much-branched stems, with the branches quite uneven from the unequal calicles and short incipient branchlets. The calicles are stout and have a nearly smooth exterior; though very unequal, none are wholly obsolete; the surface is scarcely striated. The specimen in the collections is a broad clump ten inches high.

*Mad. abrotanoides*, Lamk., ii. 448, No. 7. The *Madrepora abrotanoides*, of Quoy and —, Blainville, Man., 390. Gaynard (Voy. de l'Ast., iv. 232, pl. 19, figs. 1, 2), is probably a different species. The *Heteropora abrotanoides* of Ehrenberg, (G. lxix. sp. 19,) is another species.

## 52. MADREPORA AUSTERA. (Dana.)

*M. fruticosa, latè ramosa, et valde prolifera, ramis fere teretibus, et suprâ attenuatis, ramulis inæqualibus polypisque proliferis numerosis. Corallum scabriculum, caliculo apicali crasso (1-1½'''), exserto; lateralibus ascendentibus, subconfertis, tubiformibus, aut tubo-nariformibus, 1-2½''' longis, asperè striatis; aperturâ orbiculatâ, stellâ profundâ conspicuâ, sex-radiatâ, duabus lamellis prominulioribus.*

Fruticose, spreading ramose, and very proliferous, branches nearly terete, and tapering above, with numerous unequal lateral branch-

lets and proliferous polyyps. Corallum scabrous; apical calicle stout (1 to  $1\frac{1}{2}$  lines broad), exsert; the lateral ascending, rather crowded, tubiform and tubo-nariform, 1 to  $2\frac{1}{2}$  lines long, rough and striate; aperture circular, star distinct but deep, six-rayed, with two of the rays most prominent.

Grows in clumps six inches or more in height, consisting of several arborescent stems from the same base, all of which are very proliferous. The apical calicle is very large and stout; the upper lateral are minute (less than half a line), and gradually increase downward, and become tubiform with an oblique apex, the aperture opening inward and upward. Others still larger are regularly tubiform and proliferous, and commence to form branchlets. The species is near the *abrotanoides*, but differs in its harsher surface and strongly striate calicles; moreover, obsolescent calicles are rare.

53. MADREPORA CERVICORNIS. (*Lamarck.*)

*M. arborescens, maxima, latè et remotè ramosa, caule  $1\frac{1}{2}$ –2" crassa, ramulis prælongis,  $\frac{1}{2}$ – $\frac{2}{3}$ " crassis, arcuatis, teretibus, sensim attenuatis. Corallum scabriculum, caliculo apicali crasso ( $1\frac{1}{2}$ "'), elongato; lateralibus subæqualibus, orbiculato-nariformibus vix compressis,  $1\frac{1}{2}$ –2" longis, fere 1" crassis, valde striatis, margine non crasso, stellâ conspicuâ.*

Arborescent, very large, spreading and remotely ramose, below,  $1\frac{1}{2}$  to 2 inches thick, branchlets very long,  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch thick, arcuate, terete, gradually attenuate. Corallum scabrous, apical calicle stout ( $1\frac{1}{2}$  lines), and elongate; the lateral subequal, round-nariform, scarcely compressed,  $1\frac{1}{2}$  to 2 lines long, and nearly a line in diameter, strongly striate, margin not thick, star distinct.

West Indies.

This is a common species in the West Indies, where it grows six feet or more in height, with wide-spreading arcuate branches, every where covered with stout prominent calicles. It differs from the *prolifera* in its larger size, more distant and arcuate branches, rarely proliferous, and the distinctness of the entire striæ of the calicles.



- Corallium album, porosum, maximum, muricatum*, Sloane, Jam., i., tab. 18, fig. 3. The *Heteropora cervicornis*, of Ehrenberg (op. cit., sp. 10) is a Red Sea species, and may be the *M. robusta*.
- Corallium cornu cervini formâ*, Seba, Thes., tab. 114, fig. 1. Esper's *Mad. muricata*, tab. 49, referred here by Lamarck, is nearer the *M. arbuscula*.
- Mad. muricata*, in part, of early authors.
- Mad. cervicornis*, Lamk., ii. 449, No. 8.
- , Blainville, Man., 390.

54. MADREPORA PROLIFERA. (*Lamarck.*)

*M. arborescens, fruticosa, latè ramosa, ramis longis, teretibus, paulum arcuatis, ½–¾" crassis, (infrà raro 1"), suprâ, proliferis cum ramulis oppositis in plano sæpe instructis. Corallum scabriculum; caliculo apicali valde crasso (fere 2") et exserto; lateralibus subæqualibus confertis, elongato-narifformibus, compressiusculis, sæpius 1½" longis, bene striatis, aperturâ fere orbiculatâ.*

Arborescent, shrubby, spreading ramose, branches long, terete, a little arcuate, ½ to ¾ of an inch thick, (below rarely 1 inch), proliferous above, and the branchlets often in a plane. Corallum scabrous; apical calicle very stout (nearly 2 lines), and exsert; the lateral subequal, crowded, long-narifform, but little compressed, mostly 1½ lines long, neatly striated, aperture nearly circular.

West Indies.

The *prolifera* grows to a height and breadth of three or four feet, in large spreading clumps of arborescently branched stems, which are generally very proliferous above, and often have the side branchlets near the summit, in the same plane. The outer lip of the lateral calicles is often so prolonged that the aperture opens inward.

- Corallium album minus muricatum*, Sloane's Jam. Hist., i., tab. 17, fig. 2; a young clump. The *Heteropora prolifera*, of Ehrenberg (op. cit., G. lxix. sp. 17), is another species.
- Mad. muricata*, Esper, Fortsetz., i. 53, tab. 50. The *Madrepora prolifera*, of Quoy and Gaymard (Voy. de l'Ast., iv. 235, pl. 19, fig. 4), is also another species, too imperfectly figured and described to be determined.
- Mad. prolifera*, Lamk., ii. 449, No. 9.
- , Blainville, Man. d'Act., 390.

## 55. MADREPORA NOBILIS. (Dana.)

*M. fruticosè arborescens, maxima, latè et valde ramosa, subprolifera, ramis crassis (sæpe 1"), divaricatis, teretibus, ramulis extremis  $\frac{2}{3}$ –1" crassis, apice conicis. Corallum scabriculum, caliculo apicali crasso ( $1\frac{1}{2}$ " lato), vix exserto; lateralibus confertissimis, divaricatis, validiusculis, sæpius  $1\frac{1}{2}$ " longis, dimidiatis, non compressis, striatis, margine vix crasso, raro proliferis, aliis obsolescentibus; stellâ sex-radiatâ, valde conspicuâ, duabus lamellis prominulioribus.*

Shrubby arborescent, very large, spreading ramose, subproliferous; branches stout (often 1 inch thick), divaricate, terete, summit branchlets  $\frac{2}{3}$  to 1 inch in diameter, conical at apex. Corallum scabrous; apical calicles large ( $1\frac{1}{2}$  lines broad), scarcely exsert; the lateral much crowded, nearly erect, hardly stout, mostly  $1\frac{1}{2}$  lines long, (with others obsolescent), dimidiate, not compressed, margin scarcely thick, striate, rarely proliferous; star six-rayed and very distinct, two of the lamellæ the most prominent.

Plate 40, fig. 3, branch of corallum, natural size; 3 a, extremity of branch.

East Indies. Singapore. *Exp. Exp.*

This species forms spreading clumps, similar to those of the *prolifera*; but the branches are much stouter, more abruptly pointed, and less proliferous, and the calicles are very different.

## 56. MADREPORA SECUNDA. (Dana.)

*M. arborescens, latè ramosa, ramis numerosis, teretibus,  $\frac{1}{2}$ – $\frac{2}{3}$ " crassis, ramulis extremis  $\frac{1}{3}$ " crassis, sensim attenuatis. Corallum scabriculum, caliculo apicali lineam fere lato; lateralibus subconfertis, æqualibus, nariformibus et dimidiatis, valde compressis, validiusculis, 1– $1\frac{1}{2}$ " longis, margine non incrassato, ramorum latere inferiore obsolescentibus; aperturâ oblongâ, stellâ conspicuâ, duabus lamellis valde prominulis.*

Arborescent, spreading, ramose; branches numerous, terete,  $\frac{1}{2}$  to  $\frac{2}{3}$  of

an inch thick; summit branchlets  $\frac{1}{3}$  of an inch thick, gradually tapering. Corallum scabrous; apical calicle nearly a line broad; the lateral, rather crowded, equal, nariform, and dimidiate, and very much compressed, hardly stout, 1 to  $1\frac{1}{2}$  lines long, obsolescent on the inferior side of the branches; margin not incrassate; aperture oblong; star distinct, two of the lamellæ quite prominent.

Plate 40, fig. 4, part of corallum, natural size; 4 *a*, extremity of branch; 4 *b*, profile of calicle.

Singapore, East Indies. *Exp. Exp.*

This arborescent species resembles, somewhat, the *cervicornis*, but differs in its slender, narrow, lateral calicles, the small apical calicle, and in other particulars. It grows to a height of eighteen inches or more.

*Madrepora muricata*, Esper, Pflanz. Fortsetz. i. 55, tab. 52; the figure is tolerably good, and the description better. Esper alludes to the much smaller size of the calicles on the inferior side of the branches. His specimen was from the East Indies.

*Madrepora cervicornis*, in part, of Lamarck.

#### 57. MADREPORA GRACILIS. (*Dana.*)

*M. arborescens, latè ramosa, ramis gracilibus, bene teretibus, 3-5'' crassis, arcuatis, sensim attenuatis. Corallum leve, caliculo apicali lineam longo et lato; lateralibus æqualibus, subconfertis, validis, compresso-nariformibus, parvulis (1'' longis), aperturâ angustâ, stellâ conspicuâ, duabus lamellis prominulioribus.*

Arborescent, spreading ramose; branches slender, neatly terete, 3 to 5 lines thick, arcuate, gradually attenuate. Corallum smooth; apical calicle a line long and broad; the lateral equal, rather crowded, stout, compressed-nariform, small (1 line long); aperture narrow, star distinct, and two of the lamellæ most prominent.

Plate 41, fig. 3, part of corallum, natural size; 3 *a*, extremity of branch; 3 *b*, calicle, natural size.

The Feejee Islands and Sooloo Sea. *Exp. Exp.*

A very neat and graceful species, with small and equal nariform

calicles, and a smooth surface. The branches are about two-fifths of an inch in diameter, and the summit branchlets one-third to one-fourth of an inch. The calicles have a smooth appearance; but, under the microscope, are seen to be very finely striate, with the striatures entire. It grows a foot and a half, or more, high, and is alive for twelve or fourteen inches. The branchlets are numerous, from one to four inches long, with tapering apices. Below four inches, the calicles are quite short.

This species resembles the *formosa*, but is peculiar in its nariform calicles.

58. MADREPORA HUMILIS. (*Dana.*)

*M. humilis, fruticosa, crassa, latè ramosa, subprolifera, ramis teretibus, obtusis, fere ½" crassis. Corallum caliculo apicali crassimo (sæpe 2" lato), vix exserto; lateralibus æqualibus, et æqualiter subconfertis, validioribus, bene nariformibus, aperturâ oblongâ, stellâ vix conspicuâ, lamellis duabus prominulis infrâque fere conniventibus.*

Low fruticose, spreading and short ramose, stout, subproliferous; branches terete, obtuse, nearly  $\frac{1}{2}$  an inch thick. Corallum having the apical calicle very stout (often 2 lines broad), scarcely exsert; the lateral equal and even, somewhat crowded, very stout, neat nariform; aperture oblong; star scarcely distinct, two of the lamellæ most prominent, and nearly meeting below.

Plate 41, fig. 4, corallum, natural size; 4 *a*, profile of calicle; plate 31, fig. 4 *a*, *c*, *b*, views of calicles, enlarged.

Feejee Islands. *Exp. Exp.*

This very short and stout species is remarkable for its evenly terete and obtuse branches, and the neat regularity of its large and thick nariform calicles, which become gradually smaller under the apex. It grows in small clumps, five or six inches high, consisting of a few branched stems, from a common base. In one specimen, the branches are nearly two-thirds of an inch thick at base; and, in another, hardly half an inch.



59. MADREPORA POCILLIFERA. (*Lamarck.*)

*M. humilis, latè ramosa, crassa, subprolifera, ramis teretibus, brevibus, obtusis. Corallum caliculo apicali crassimo; lateralibus valde confertis, striatis, brevibus, latissimis, margine validissimè incrassatis, fere cochleariformibus.*

Low, spreading ramose, stout, short ramose, subproliferous; branches terete, obtuse. Corallum with the apical calicle very large; the lateral much crowded, striate, short, and very broad, cochleariform, with a very stout incrassate margin.

Tongatabu, Friendly Islands. *Quoy & Gaymard.*

This species, as described and figured by Quoy and Gaymard, grows in small clumps, consisting of a few branching stems, and is remarkable for the obtuse extremities of the branches, the very large apical calicle, and broad, thick, and short lateral calicles, which are almost in contact over the whole surface.

*Mad. pocillifera*, Lamk., ii. 448, No. 5.

—, Blainville, Man., 390.

—, Quoy and Gaymard, Voy. de l'Ast.,

iv. 236, pl. 19, fig. 5; not figs. 6-10,

which are other species, not determinable

from the description given of them.

F. Caulibus elongatis, simplicibus, aggregatis.

60. MADREPORA DEFORMIS. (*Dana.*)

*M. subcespitosa, ramis paucis, 1" crassis, simplicibus, sæpe irregulariter flexuosis, basi solido strictè surgentibus, ramis longis, subteretibus, obtusis et subproliferis, sæpe coalitis. Corallum caliculis inæqualibus, aliis tubiformibus 2-3" longis et 1" crassis, aliis proliferis et acervatis, aliis brevissimis, extus striatis.*

Subcespitose, a few simple branches, an inch or more thick, and often irregularly bent, rising from a solid base, branches long, subterete, obtuse and subproliferous, often coalescent. Corallum rough with unequal calicles, some tubiform, 2 to 3 lines long, and 1 line thick,

others proliferous and acervate, others very short, but none obsolete; exterior striate.

Plate 43, fig. 1, corallum, natural size; 1 *a*, extremity of branch; 1 *b*, profile of calicle.

Tahiti, Society Islands. *Exp. Exp.*

This species grows like the following. The branches below are more or less coalescent laterally, and look rough from the unequal calicles. Some of the branches are six inches long, and irregularly bent, but not tapering.

61. MADREPORA CUSPIDATA. (*Dana.*)

*M. subcespitosa*, ramis paucis, 1" crassis, subsimplicibus, 2-6" longis longè que cuspidatis, basi solido rectè surgentibus. Corallum ramis secundè caliculatis, caliculis breviter sublabellatis, fragilibus, divaricatis, aliis cellis immersis sparsis; stellâ sex-radiatâ, conspicuâ, duabus lamellis prominulioribus.

Subcespitose, several nearly simple, long cuspidate branches, an inch thick, and 2 to 6 inches long, rising from a common solid base. Corallum having the calicles prominent only on one side, short sublabellate, erect, and fragile, with immersed cells interspersed; star six-rayed, distinct, two of the lamellæ the most prominent.

Plate 42, fig. 1, corallum, natural size; 1 *a*, extremity of a branch.

Tahiti, Society Islands. *Exp. Exp.*

The specimen in the collections is a coarse clump of stout branches, nearly bare of calicles on the inferior side, and regularly tapering to an obtuse apex. It is about ten inches high, and eight broad, with the base three inches through. The cells of the calicles are round and about a third of a line broad; the immersed cells are one-fourth of a line or smaller.

G. caulibus erectis laminatis, crassis, non ramosis, polypo apicali nullo.

62. MADREPORA LABROSA. (Dana.)

*M. laminata, laminis latis, erectis,  $\frac{1}{2}$ -1 $\frac{1}{2}$ " crassis, lobatis, lobis 1-2" latis, margine rotundatis. Corallum caliculis lateralibus erectis et confertissimis, brevibus et crassimis, fere 1 $\frac{1}{2}$ " latis et 1-1 $\frac{1}{2}$ " longis, cochleariformibus, non striatis, margine  $\frac{1}{2}$ " crasso; stellâ conspicuâ, duabus lamellis prominulioribus; caliculis apicalibus vix angustioribus sed coalitis.*

Laminate, plates erect, obtuse, 1 to 2 inches broad, and  $\frac{1}{2}$  to 1 $\frac{1}{2}$  inches thick, margin rounded. Corallum having the lateral calicles very crowded, erect, short and very stout, nearly 1 $\frac{1}{2}$  lines broad, and 1 to 1 $\frac{1}{2}$  lines long, cochleariform, not striate, margin  $\frac{1}{2}$  a line thick; star distinct, two lamellæ a little the most prominent; apical calicles scarcely smaller but coalescent.

Plate 43, fig. 3, part of corallum, natural size; plate 31, figs. 10 *a*, 10 *b*, views of calicle, enlarged.

The Sooloo Sea. *Exp. Exp.*

The specimen in the collections is a broad, thick plate, eight inches wide, half an inch thick at the margin, and one and a half inches below. Its very large thick-lipped calicles, not striate, and the size of the plate, distinguish it from the two following species.

63. MADREPORA SECURIS. (Dana.)

*M. cespitosè laminata, laminis erectis, elongatis, apice quadratis et valde truncatis, 2-2 $\frac{1}{2}$ " latis, vix lobatis,  $\frac{1}{2}$ -1" crassis, superficie inæquali. Corallum caliculis lateralibus confertissimis, breviter tubiformibus, validis,  $\frac{3}{4}$ -1" latis, vix striatis, aperturâ integrâ, orbiculatâ, stellâ conspicuâ.*

Cespitose laminate, plates erect, oblong, quadrate at apex, and strongly truncate, scarcely lobed,  $\frac{1}{2}$  to 1 inch thick, surface uneven. Corallum with the lateral calicles very closely crowded, stout and short tubiform,  $\frac{3}{4}$  to 1 line broad, scarcely striate, aperture entire, circular, star distinct.

Plate 43, fig. 2, corallum, natural size; 2 a, extremity of a small branch.

East Indies (?). *Exp. Exp.*

This species differs from the *labrosa* in its cylindrical calicles, which have the margin entire, and not wanting on the upper side, as in that species; also in its narrower quadrate plates. The calicles are also broader at apex than below, somewhat scattered and very short. The specimen in the collections is six inches in breadth, and consists of a cluster of oblong plates from a common base, each three or four inches long, two to two and a half inches broad, and one-half to one inch thick.

64. MADREPORA CUNEATA. (*Dana.*)

*M. basi incrustans et diffusa, laminis lobisve erectis, latis, paucis, remotis, margine cuneatis et subacutis, superficie inæquali. Corallum caliculis confertissimis, subæqualibus, validis, tubiformibus, brevibus, 1-1½" longis et ¾" latis, non striatis.*

Incrusting and spreading, with a few distinct, erect, broad plates or lobes, cuneate above and subacute at margin, surface uneven. Corallum having the calicles closely crowded, subequal, stout, tubiform, 1 to 1½ lines long, and ¾ of a line broad; not striate.

Feejee Islands. *Exp. Exp.*

Occurs in coarse incrusting plates, often with the margin recurved, and bearing here and there, from the surface, short erect plates, two or three inches broad, having a trenchant margin. This last-mentioned character, the mode of growth and smaller calicles distinguish it from the *quadrata*. This species, as well as the two preceding, approximate to the *Manoporæ*, but have the firmer and heavier texture and regular calicles of the *Madreporæ*.

APPENDIX.—The *Madrepora laxa* of Lamarck, is not above included, as its place in the arrangement is not ascertained; it is thus described: *M. laxè ramosa, ramis teretibus, undique expansis apice proliferis. Corallum caliculis tubiformibus, inæqualibus, extus echinulatis.*



Loose ramose, branches terete, spreading, proliferous at apex. Corallum having the calicles tubiform, unequal, with the exterior echinulate.

Lamarck adds, that this species forms a broad and lax clump, consisting of numerous branches, which are covered with prominent calicles. Height about seven inches. From the "Austral Seas."

*Madrepora laxa*, Lamarck, No. 6.

—, Blainville, Man. d'Act., p. 390.

The *Heteropora laxa* of Ehrenberg, from the Red Sea, appears to be a different species. It is thus described: "Sesquipedalis, laxè ramosa, ramis intricatis, teretibus undique expansis, apice ramulosis, stellis inæqualibus, extus basi denticulato-asperis, supernè glabris, inferioribus margine tumido, superioribus longe tubulosis ( $1\frac{1}{2}$ —2'''), aperturâ obliquâ, terminalibus cylindricis,  $1-1\frac{1}{2}$ ''' latis." (Op. cit., G. lxix. sp. 9.)

Ehrenberg describes also the following species: "*H. tubulosa* (op. cit. sp. 7). Semipedalis, erecta, ramosa, breviter ramulosa, undique papilloso-tubulosa, tubulis longissimis (3''' longis), apertura terminali, rotunda, mediocri ( $\frac{1}{2}$ ''' lata), stellis [caliculis] terminalibus parumper majoribus, tubulis hispidis, substriatis." Described from two fragments in the Royal Museum at Berlin.

*H. regalis* (sp. 11). "Subpedalis, ramosa, ramis teretibus, sensim conicis, crassis, pollice angustioribus, passim ramosis, stellis tubulosis levibus, aperturâ obliquâ, interdum dimidiatis, terminalibus integris, maximis,  $1\frac{1}{2}$ ''' latis, interstitiis stellarum hispidis." Specimen in the Royal Museum at Berlin.

*H. decurrens* (sp. 12). "Quadripollicaris, habitu *squarrosæ*, ramulosa, gracilis, ramulis subfastigiatis, stellis apice rarioribus, arctius appressis, basi cariniformi in stirpe decurrentibus, hinc ramulorum apicibus subangulosis, tubulis totis glabris, parcius integris, tenuioribus quam in priore." Described from a fragment in the Royal Museum at Berlin.

*H. squarrosa* (sp. 14). "Octopollicaris, cespitosa, hemispherica, laxè ramoso-squarrosa, ramulis tenuibus, acutis, proliferatione spinosis, stellulis parum prominulis, myxo rotundo suffultus, totis asperis, nonnullis sub apice breviter tubulosis, aperturâ obliquâ, stellis terminalibus incrassatis, latius apertis." Red Sea.—Resembles somewhat Esper's tab. 54.

*H. seriata* (sp. 18). "Semipedalis, paulo latior quam alta, cespitosa, brevius ramosa, ramis crassis, conicis, stellulis parum prominulis, semitubulosis, hemisphericis, subæqualibus, series longitudi-

nales, sæpe obliquas formantibus, hispidis, extus striatis, aperturis patulis,  $\frac{3}{4}$ — $\frac{1}{2}$ ''' latis, terminalibus magnis parum prominulis." Specimens in the Royal Museum at Berlin.

*H. Forskali* (sp. 20). "9'' lata, 7'' alta, rubella, cespitosa, subturbinata, subfastigiata, densè ramulosa, stellulis exsertis, brevibus, subtus semitubulosis, hemisphericis, apertura ovata patula, totis hispidis, extus striatis, raro tubulosis, integris, ramis apice ramulosioribus, stellarum terminalium paullo majorum apertura, parva." General habit like that of the *Hemprichii*. Red Sea.

*H. tylostoma* (sp. 21). "Pedalis (an bipedalis?), ramosa, ramis crassis (9''') paucis, teretibus, non tubulosis, stellulis collo brevi suffultis, interdum reclinatis, glabriusculis, terminalibus  $1\frac{1}{4}$ ''' latis, majoribus." Several fragments in the Berlin Museum.

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GENUS II.—MANOPORA.—DANA.

*Madreporidæ foliaceæ, subramosæ aut glomeratæ, nunquam arborescentes nec ramis teretes; tentaculis brevibus, alternis sæpe majoribus, polypo apicali nullo. Coralla caliculis irregularibus, sæpe spinoso-laciniatis, sæpe omnino obsolete.*

Foliaceous, glomerate, or subramose, never arborescent, and branches not terete, having short tentacles, often alternately large and small, and no apical parent-polyp distinguishable. Corallum with the calicles irregular, often spinuloso-lacinate, often wholly obsolete.

The Manoporæ are Madreporæ in their cells, and animals; but they form more fragile coralla, and never grow in terete, arborescent forms. Many of them spread out in broad, fragile folia, which are sometimes clustered like the leaves of an opening plant. Others have a spreading base, but rise in rude subramose masses, angular or lobed; others are simply glomerate and incrusting, yet occasionally become branched by following up growing serpulæ; while a few are rather delicately ramose, and resemble Millepores, although unlike them in their cells.

The surface is seldom covered with regular calicles; and when so, the species differ from Madreporæ in being simply glomerate or explanate, and the calicles are mostly angular or somewhat irregular.

The cells in most Manoporæ are either wholly immersed or surrounded by a few ragged points, the rudiments of a calicle. These points are sometimes coalescent in series, and form small ridges over the surface. The surface in certain other species has scattered prominences—wart-like in shape—between the cells; and there is an imperceptible gradation, from these verrucose Manopores to those which are smooth, and also to others with a spinous surface. Among the species we may therefore follow out the Madrepore as it loses its distinct calicles, which become reduced to a cluster of ragged points, and finally are obsolete, and the surface smooth; or in another direction, the points coalescing into minute crests between the cells, or into long lines (*rugæ*) between series of cells; or uniting and forming *isolated* prominences, which either constitute the interstices, or are scattered over these interstitial spaces. In one species the cells are situated at the bottom of deep circular pits, a peculiarity which we may trace to a coalescence of the prominences of the interstices around the cells.

The polyps of the genus have twelve short tentacles, forming a narrow margin to the circular disk in which the mouth is situated; and in some species they are mere crenations to the disk. They are variously tinted; lilac, green, and yellow, are some of the colours observed, and the disk is often marked with radiating lines, or series of spots of different shades.

The species grow, occasionally, to a breadth of eighteen or twenty inches. The name of the genus is derived from the Greek *μασος*, *porous* and *fragile*.

This group is included by Lamarck and Ehrenberg along with the genus *Porites*, excepting two or three species, which are placed by the former in the genera *Agaricia*, *Millepora*, and *Explanaria*. Blainville is the only author who has formed for any of them a distinct genus; and this—*Montipora*—is based upon an unimportant character, the presence of *verruca* over the surface (to which his name alludes), and includes only a small part of the Manoporæ.



Explanate, contorto-foliaceous, near a Gemmipora in habit; folia clustered into a broad clump; thickness 1 to  $1\frac{1}{2}$  lines; calicles scattered, short subtubiform; cells very neatly 12-rayed, a little elliptical, the centre of the bottom a short thin line; outer surface smooth and not wrinkled.

This species is so near a Gemmipora in habit, that, excepting its twelve-rayed cells and smaller polyps, it would fall into that genus. It forms one of the transitions between these groups. The clumps are a foot broad and six inches high, and consist of gracefully clustered folia. The calicles are all regular, and differ thus from the larger part of the Manoporaë; they are about a sixteenth of an inch broad, and the cells are half a line in their longest diameter. Here, as well as in numerous other instances, the fact is pressed on the attention, that there are no such groups as *genera* in nature. The specimen belongs to the Academy of Natural Sciences of Philadelphia.

## 2. MANOPORA LICHEN. (*Dana.*)

*M. incrustans, explanata, undata seu contorta et sæpe lobata,  $\frac{1}{8}$ " crassa. Corallum caliculis tubiformibus, brevissimis seu obsolescentibus, cellis 6-radiatis, intermediis interdum conspicuis.*

Incrusting explanate, much contorted and uneven, often lobed,  $\frac{1}{8}$  of an inch thick. Corallum having very short or obsolescent tubiform calicles; cells 6-rayed, with the intermediate rays sometimes distinct.

Tahiti, Society Islands (?). *Exp. Exp.*

In the surface of the corallum, this species resembles the *caliculata*, but it differs in being thin explanate, and in having the calicles less angular, with the cells one-half smaller. The folia were not clustered as in the *gemmulata*, and the cells are smaller and 6-rayed.

## 3. MANOPORA CALICULATA. (*Dana.*)

*M. glomerata, subgibbosa. margine crasso et revoluto. Corallum poro-*

*sum, caliculis subtubiformibus, sæpe angulatis,  $\frac{3}{4}$ " latis, brevibus seu obsolescentibus, confertis; cellis 12-radiatis.*

Glomerate, subgibbous, with a thick revolute margin. Corallum porous; calicles subtubiform, often angular, crowded,  $\frac{3}{4}$  of a line broad, very short or obsolescent; cells 12-rayed.

Plate 44, fig. 1, corallum, natural size.

Feejee Islands. *Exp. Exp.*

One specimen obtained at the Feejees, measures four inches by three in breadth, and was attached at centre by a short pedicel. Its thickness is about two inches at centre and half an inch at the margin; the margin appears as if folded under, and contains immersed cells below for half an inch. The length of the calicles above is scarcely half their breadth: they are much crowded and angular, and give an uneven surface to the corallum.

II. *Caliculis nullis, coralli superficie spinuloso-asperâ.*

a. Laxè foliaceæ aut subramosæ.

#### 4. MANOPORA-PALMATA. (*Dana.*)

*M. pumila, ramosa, sæpe irregulariter palmata, ramis valde compressis, raro subteretibus et strictè digitatis, 2-3" crassis; polypis pallidè brunnescentibus, disco maculatis; tentaculis complanatis, alternis cærulescentibus, aliis brunnescentibus, maculâ pallidâ prope apicem. Corallum fragile, papilloso-asperatum; cellis numerosis, 6-12-radiatis.*

Small; ramose, often irregularly palmate, branches much compressed, rarely terete and close digitate, two to three lines thick; polyps of a pale brown colour, with the disk spotted, tentacles flattened, the alternate pale bluish or lilac, the others pale brown, with a whitish spot on the upper surface near the apex. Corallum fragile, papilloso-asperate, cells numerous, 6 to 12-rayed.

Plate 44, fig. 2, flabellate variety, natural size; 2 *b*, polyp, enlarged; 2 *c*, cells, showing also the surface, magnified 12 diameters; 2 *d*, surface of corallum, natural size; 2 *e*, transverse section of a branch mag-

nified 3 diameters; 2 *f*, part of a transverse section, enlarged 12 diameters; fig. 2 *a*, another variety.

Feejee Islands. *Exp. Exp.*

This is a small fragile ramose species, either spreading palmate, and obtuse, or divided into several crowded nearly terete branchlets, often tapering to a point. The cells are about one-fifth of a line in diameter, and the papillæ one-third of a line in length.

Figure 3 of the same plate, represents a specimen which is much more compact than the above, but is probably only a variety of it.

#### 5. MANOPORA COMPRESSA. (*Linn.*) *Dana.*

*M. caulescens, ramosa, subdichotoma et lobata, compressiuscula. Corallum fragile, granuloso-asperum; cellis undique prominulis, scabris, stellatis, plerumque 6-radiatis.*

Caulescient ramose, subdichotomous and lobate; somewhat compressed. Corallum fragile, granuloso-asperate; cells every where a little prominent, scabrous, stellate, and generally with 6 rays.

Mediterranean Sea?

*Corallium asperum*, &c., Marsilli, Hist. Phys., 143, tab. 31, fig. 149, and tab. 32, figs. 150, 151. The specimen was from near Marseilles, off the shores of Riou. The branches are from one-quarter to one-half an inch wide, and are described as rough-granulous like shagreen.

*Millepora compressa*, Linn., ed. xii. 1283.  
—, Esper, i. 203, tab. 10. In Esper's

figure the branches are half an inch wide, with the sides irregularly lobed. The six-rayed cells and granulous surface are represented in his figure 3.

This species is united by Lamarck, Ehrenberg, and others, with the "*Millepora aspera*," which differs decidedly in its "poris fissis," and has been made into the new genus *Errina*, by Gray.

#### 6. MANOPORA CRISTA-GALLI. (*H. & Ehrenberg.*) *Dana.*

*M. arrecto-subcespitosa, incisè lobata, compressa, angulosa vel alata, lobis sæpe cultratis. Corallum fragile, superficie partim spinuloso-asperâ; cellis per spinulos raro obvallatis, conspicuè 6-radiatis, cristis non celliferis.*



Erect-subcespitose, inciso-lobate, compressed, angular and alate, lobes often cultrate. Corallum fragile, surface partly spinuloso-asperate, cells rarely bordered by papillæ, very distinctly 6-rayed; crests without cells.

Plate 46, fig. 1, part of corallum, natural size.

Red Sea. *Ehrenberg*.—Singapore. *Exp. Exp.*

The clumps are often a foot high and the same in breadth, and consist of erect thin lamellate branches, having a sharp edge above; they are often vertically winged. The cells are generally nearly naked; but occasionally there are a few minute spinuliform papillæ about them, which sometimes run into thin longitudinal ridges. The cells are one-third to one-half a line broad. Under the microscope the surface is very neatly laciniate-porous, or consists of mossy points about the pores.

7. MANOPORA SPUMOSA. (*Lamarck.*) *Dana.*

*M. arrecto-subcespitosa, gibboso-subramosa, lobis brevibus, crassis, sæpe tuberculato-gibbosis, raro angulosis, apice interdum subclavato. Corallum fragile, confertim spinuloso-asperum, apice papillis crassioribus et obtusis; cellis immersis, margine non tumidis, stellâ 6-12-radiatâ.*

Subcespitose, erect, gibboso-subramose, lobes short, stout, often tuberculato-gibbous, rarely angular, sometimes subclavate at summit. Corallum fragile, crowdedly spinuloso-asperate, papillæ at apex much stouter than elsewhere and obtuse; cells immersed, margin not tumid, star 6 to 12-rayed.

Plate 44, fig. 4, corallum, natural size.

Singapore, East Indies. *Exp. Exp.*—Red Sea. *Ehrenberg.*

A coarse stout species, growing erect; the stems are very thick and irregular, often coalescing laterally, and have tuberculate ascending lobes rather than branchlets. The summits are usually a little angular, with stout papillæ or irregular incipient ridges, instead of spines. The spines of the lateral surface are crowded and slender, and about a line long. The cells have usually more than six rays. Under the



microscope the surface appears fine mossy granulous, but not very distinctly porous. The species resembles the *hispida*, but differs in the larger obtuse papillæ of the summits, and does not appear to be foliaceous at base. The specimen in the collections is ten inches high, and eight broad.

*Porites spumosa*, Lamarck, ii. 440, No. 16.  
The *M. P. spongiosa* of Ehrenberg (op. cit., Gen. lxx. sp. 4), with which he makes the *spumosa* synonymous, is probably a different species; he refers to Savigny's figure, pl. 4, fig. 4, but describes it with other characters, as follows: "Semi-

pedalis, cespitosa, ramuloso-subfoliacea, multilobata, ramulis angulosis, compressis, apice dilatatis, subcristatis lobatisque, stellulis immersis, sexangularibus, margine tumido, superficie ubique setuloso-hispida, spongiosa,  $\frac{1}{3}$ " latis." Red Sea.

#### 8. MANOPORA CIRCUMVALLATA. (H. & Ehrenberg.) Dana.

*M. cespitosa, semipedalis, ramulosa, irregularis, ramulis angulosis, irregularibus, lobato-ramulosis, apice rotundatis, nec cristatis. Corallum cellis inæqualibus, confertis, margine lobato (quadrilobato) subinfundibuliformi circumvallatis, interstitiis setulosè asperis.*

Cespitose, half a foot high, irregularly ramulose, branchlets angular, irregular, lobato-ramulose, rounded at summit and not crested. Corallum having the cells unequal, crowded, bordered by a lobed (quadrilobate) margin, making it subinfundibuliform; interstices setuloso-asperate.

Red Sea. *Ehrenberg.*

*M. Porites circumvallata*, H. & Ehrenberg, op. cit., Gen., lxx. sp. 5.

#### 9. MANOPORA HISPIDA. (Dana.)

*M. base latè foliato-explanata, parum convexa et margine sublobata aut undulata, et  $\frac{1}{3}$ " crassa, suprâ paucis caulibus crassimis, erectis, gibbosis et tuberosis, nunquam angulatis. Corallum fragile, undique usque ad apicem, densè spinuloso-asperum, spinulis fragilibus, 1" longis; cellis immersis  $\frac{1}{3}$ " latis, valde stellatis, 6-radiatis; superficie infernâ nudâ.*

Broad foliato-explanate at base, a little convex, with a somewhat lobed or undulated margin, and  $\frac{1}{3}$  of an inch thick; bearing above a few very stout erect stems, gibbously divided and tuberoso, never angular. Corallum fragile, every where densely spinuloso-asperate, even over the summits; spinules slender and fragile, a line long; cells immersed,  $\frac{1}{3}$  of a line broad, very distinctly 6-rayed; under surface of the corallum naked.

Plate 44, fig. 5, corallum, natural size.

Singapore, East Indies. *Exp. Exp.*

The foliate base in the specimen collected, measures fourteen inches by nine in breadth, and one of the glomerate branches rising from the upper surface is six inches high, and, where thickest, nearly three inches through. They are often smaller at base than some distance above. The coral is very porous and covered quite evenly with the spinuliform papillæ as well at apex as elsewhere.

*Porites spumosa*, in part, of Lamarck, ii. 440.

#### 10. MANOPORA FOLIOSA. (Ehrenberg.) Dana.

*M. explanata, concava, nunc convoluto-foliacea, nunc tuberculoso-subramosa, sæpius crispa. Corallum porosum, spinuloso-asperum, cellis exiguis, inæqualibus, obvallatis, interdum tubuli instar; superficie infernâ planâ, æquabili.*

Explanate, concave, either convoluted-foliate, or tuberculoso-subramose, usually crispate. Corallum porous, spinuloso-asperate; cells minute, unequal, surrounded by a prominent border, and sometimes subtubular; under surface plane and nearly even.

The Red Sea. *Ehrenberg.*

This species, as described by Ehrenberg, resembles the *hispida*; but differs in its obvallate cells, its more commonly foliaceous forms, concave above instead of convex.

*M. Porites foliosa*, Ehrenberg, op. cit., Gen. lxx., sp. 13.

The *Madrepora patiniiformis* of Esper (Pflanz. Fortsetz. i. 94, tab. 75, figs. 1, 2, 3, and 56, figs. 1, 2), is either identical with this species or still another *Manopora*. It is described by Esper as occurring in broad, concave, explanate, or foliaceous forms, with

a plicate margin. The fronds are porous, yet so firm as to ring when struck; they are mostly half an inch thick, but thin out to an edge one-sixth of an inch thick. The upper surface is covered with minute scabrous conical spines, and finely reticulate with meandering ridgelets partially enclosing the cells. The under surface is plicate, but nearly smooth, with numerous immersed cells for two and a half inches from the margin, and occasionally one a little raised. The cells above are six-rayed. The species was received by Esper, from the East Indies.

The *Madrepora foliosa* of Pallas, and *Porites rosacea* of Lamarck and other authors, are imperfectly known species. The *foliosa*, as figured by Ellis (Ellis and Solander, tab. 52), may be an *Echinopora*, and such also appears to be Pallas's species. Seba's *Corallium infundibuliforme* (Thes. iii., tab. 110, fig. 7), called *M. foliosa*, in Esper's work (tab. 58, A.), and placed by Lamarck as synonymous with *rosacea*, may be the *M. lima* (*Agaricia lima*, of Lamarck).

#### 11. MANOPORA EXPANSA. (Dana.)

*M. tenui-foliacea* ( $1\frac{1}{2}$ –2'' crassa), latè effusa et stolonifera, sæpe patiniformis, interdum partim incrustans, margine paulo undulata, vix plicata; subtus 2'' animata; tentaculis albis tuberculiformibus. Corallum fragile, spinuloso-asperum, cellis minutis (fere  $\frac{1}{4}$ '' latis), sæpe partim obvallatis; subtus caliculis tubiformibus, remotis, elongatis (3''') appressis, et cellis sparsis.

Thin foliaceous, ( $1\frac{1}{2}$  to 2 lines thick,) wide-spreading, and a little ascending, often broad dish-shape, sometimes incrusting in part; margin a little undulate, scarcely plicate; below, alive for 2 inches from the edge; tentacles white, tuberculiform. Corallum fragile, spinuloso-asperate; cells minute (nearly  $\frac{1}{4}$  of a line broad), often imperfectly obvallate; below, a few distant, long (3 lines), tubiform calicles, close appressed to the folium, and also a few scattered cells.

Plate 45, fig. 2, outline of a specimen, natural size; 2 a, polyp, enlarged; 2 a', natural size of the same; 2 b, part of a folium, showing the upper and under surfaces; 2 c, upper surface, with the cells magnified; 2 d, transverse section, magnified twelve diameters.

Singapore, East Indies. *Exp. Exp.*

This species grows in wide-spreading fronds, attached often at centre, and having a broad dish-shape. The folia are brittle, and are rough above, with slender spinules scarcely a line long. The under surface for two inches or so is smooth, and contains a few distantly

scattered cells, and long tubular appressed calicles. This last-mentioned character distinguishes the species from the *patiniiformis* of Esper, and also from the following. The specimen in the collections measures sixteen inches by twelve in breadth, and six inches in height.

12. MANOPORA GRANDIFOLIA. (*Dana.*)

*M. tenui-foliacea* ( $1\frac{1}{2}''$  crassa), fere erecta, lata et subflabellata, margine pauci-lobata; extus 5-6'' animata; tentaculis complanatis, brevibus, lutescentibus, disco pallidè cinereo, lineis 12 albis radiatim notato. Corallum fragile, spinuloso-asperum et expansæ affine; cellis minutis ( $\frac{1}{3}''$ ), sæpe sub-obvallatis; subtus, caliculis brevissimis, confertis, margine acutis.

Thin, foliaceous ( $1\frac{1}{2}$  lines thick), nearly erect, broad, and subflabellate; margin sparingly lobed; exterior alive for five or six inches from the edge; tentacles flattened, short, yellowish; disk pale ash-colour, and marked with 12 white radiating lines. Corallum fragile, spinuloso-asperate, and resembling that of the *expansa*; cells minute ( $\frac{1}{3}$  of a line), often imperfectly obvallate; outer surface covered crowdedly with very short obsolescent calicles, having acute margins.

Plate 45, fig. 1, natural size; 1 *a*, the animal enlarged; 1 *a'*, the natural size of the same; 1 *b*, upper and under surface of the corallum, natural size; 1 *c*, upper surface, magnified; 1 *d*, part of a transverse section of the corallum, magnified twelve diameters.

Singapore, East Indies. *Exp. Exp.*

The folia grow nearly erect, in clusters, and somewhat convoluted. In this respect, and in the cells of the exterior surface, the species differ decidedly from the *expansa*, although hardly distinguishable in the character of the upper surface. The polyps are quite different in form as well as colour. One of the specimens is fifteen inches high, and nine broad; it is very thin and fragile throughout, and thus differs from the *patiniiformis* of Esper.

b. *M. glomeratæ* aut *incrustantes*, nunquam bene *foliaceæ* aut *ramosæ*, (*serpulas* interdum *tegentes*, itaque *subramosæ*.)

### 13. MANOPORA EFFUSA. (*Dana*.)

*M. explanatim* *incrustans*, *marginè* *breviter* *libera*; sæpe *serpulas* *ascendentes* *tegens*, itaque *ramosa*, *ramis* *tortuosis* *cylindricis*,  $\frac{2}{3}$ " *crassis*. *Corallum* *papilloso-asperum*, *spinulis*  $\frac{1}{2}$ -1" *longis*, *interdum* *compressis* *et* *breviter* *confluentibus*, *cellis*  $\frac{1}{3}$ " *latis*, 12-*radiatis*.

Explanately incrusting, margin free for a short distance; often covering growing *serpulas*, and thus become ramose, with the branches tortuous, cylindrical,  $\frac{2}{3}$  of an inch thick. Corallum papilloso-asperate, spinules  $\frac{1}{2}$  to 1 line long, some compressed, and for very short distances confluent; cells  $\frac{1}{3}$  of a line broad; 12-rayed.

Plate 46, fig. 4, corallum, natural size; 4 a, view of surface, ditto.

Tahiti, Society Islands. *Exp. Exp.*

The corallum often consists of a series of plates partially united together. The branches formed by incrustation are sometimes six inches long and of nearly uniform size. The margin of the spreading plate was free for two or three inches from the edges, thin and turned up; and the surface below was alive for a fourth of an inch, though without cells. The cells above are from a line to a line and a half apart, and in some parts, the confluent spinules form an imperfect septa between two or three cells, or partially encircle them. The corallum is very porous, except the under surface, which, as the animals desert it, is rendered quite compact.

The *Explanaria cristata* of Peron and Lesueur, may belong near here, though a different species. The concise description of it given, is as follows: "Partly incrusting, and in part plicato-cristate, rising into crests more or less plicate; cells very minute, not prominent; under surface finely arenaceous, but not striate." Lamarck, ii. 400, sp. 6.

### 14. MANOPORA STILOSA. (*H. & Ehrenberg*.) *Dana*.

*M. effusa*, *glomerata*, *incrustans*, *rubella*, *superficie* *tuberculoso-convexa*; *polypis* *latè* *violaceis*, *aut* *rubescentibus*, *disco* *lineis* 12 *albis* *violaceis*

*que notato, tentaculis 12, papilliformibus, minimis. Corallum asperum, cellis exiguis ( $\frac{1}{2}$ ''' latis), immersis, per lamellulas asperas circumvallatis, interstitiis setosis, setis exiguis, asperis, obtusis, subæqualibus, juxta cellas lamellosis.*

Spreading glomerate, incrusting, reddish, surface convex and tuberculous; polyps bright violet, or verging towards red, disk marked with 12 white and violet lines, tentacles 12, papilliform, minute. Corallum asperate; cells minute ( $\frac{1}{2}$  a line), immersed, surrounded by rough minute lamellæ, interstices setose, setæ slender, rough, obtuse, subequal, lamellate about the cells.

Red Sea. *Ehrenberg.*

The above characters are from Ehrenberg's description of this species. It is stated to grow to the size of half a foot. The species agrees nearly in the character of the surface with the *effusa*, but differs from it in its glomerate mode of growth.

*M. Porites stilosa*, Ehrenberg, Gen. lxx., sp. 14.

15. MANOPORA VENOSA. (*H. & Ehrenberg.*) *Dana.*

*M. effusa, glomerata, gibbosa. Corallum asperum, scabritie subtilissimum, cellis majoribus (1''' latis), margine calloso reticulatim conjuncto, inæquali, (itaque superficie coralli venosâ); stellis conspicuè 12-radiatis.*

Spreading, glomerate, gibbous. Corallum rough with extremely minute points; cells quite large (1 line broad), with callous margins, which are reticulately united and uneven, giving a venose appearance to the surface; stars distinctly 12-rayed.

*M. Porites venosa*, Ehrenberg, Gen. lxx., sp. 15.

16. MANOPORA NODOSA. (*Dana.*)

*M. incrustans, glomerata, tuberculosa, tuberculis subconicis; polyphis pallidè violaceis, tentaculis obsoletis, disco 12-crenato, margine albo.*

*Corallum vix fragile, spinuloso-asperum, spinulis confertissimis, vix  $\frac{1}{2}$ " longis, paulo compressis et obtusis; cellis exiguis ( $\frac{1}{2}$ "'), 6-radiatis.*

Incrusting, glomerate; surface tuberculous, with the tubercles sub-conical; polyps pale lilac, tentacles obsolete, disk with 12 short crenations and a white margin. Corallum hardly fragile, spinuloso-asperate; spinules very much crowded, scarcely  $\frac{1}{2}$  a line long, a little compressed and obtuse; cells minute ( $\frac{1}{2}$  of a line broad), 6-rayed.

Plate 46, fig. 2, zoophyte, natural size; 2 *a*, part of surface and polyps, enlarged; 2 *b*, surface of corallum and cells, enlarged; 2 *c*, transverse section, enlarged.

Feejee Islands at Mathuata, Island of Venua Lebu. *Exp. Exp.*

Forms thick tuberculate masses, with the tubercles mostly conical, and like rudimentary branches. The margin of the incrusting corallum is rather thin, and sometimes free for an inch or so; it is a little turned up with the surface below smooth, and containing a few minute cells, which are slightly prominent.

#### 17. MANOPORA SCABRICULA. (*Dana.*)

*M. incrustans, glomerata, gibbosa, tuberculis superficiei; rotundatis; polypis olivaceis, tentaculis obsoletis, disco 12-radiato, 6 alternis prominentioribus. Corallum non fragile, undique subtilissimè spinuloso-asperum, spinulis vix  $\frac{1}{6}$ " longis, et nunquam lamellosis; cellis valde exiguis ( $\frac{1}{2}$ – $\frac{1}{6}$ "'), 6–12-radiatis.*

Incrusting, glomerate, gibbous, with the tubercles of the surface rounded; polyps olive-green, tentacles obsolete; disk 12-rayed, with 6 alternate rays larger, and most prominent. Corallum rather firm, every where very minutely spinuloso-asperate, spinules scarcely  $\frac{1}{6}$  of a line long, and never lamellate; cells very minute ( $\frac{1}{2}$  to  $\frac{1}{6}$  of a line broad), 6 to 12-rayed.

Plate 46, fig. 3, zoophyte, natural size; 3 *a*, part of surface with the polyps, enlarged; 3 *b*, surface of corallum, enlarged; 3 *c*, vertical section, ditto.

Feejee Islands, Mathuata, Island of Venua Lebu. *Exp. Exp.*

This species resembles the preceding, but is much more minutely spinulous, and the polyps are very different. The margin, moreover, is thick, and is folded under instead of being reflexed; and the cells near the margin are entirely immersed.

III. *Cellis coralli immersis, superficie non bene papillosâ, sed valde irregulari.*

18. MANOPORA INCRASSATA. (*Dana.*)

*M. crassè explanata* ( $\frac{1}{2}$ "'), *paulum undulata, parce lobata, superficie angulatè salebrosâ, et gibbosâ. Corallum vix fragile, non spinulosum, cellis numerosis,  $\frac{1}{3}$ "' latis, undique sparsis, interdum marginatis, 6-12-radiatis.*

Thick explanate ( $\frac{1}{2}$  an inch), a little undulate, sparingly lobed; surface angulately rough, or covered with very irregular polygonal prominences. Corallum hardly fragile, not spinulous, cells numerous,  $\frac{1}{3}$  of a line broad, every where scattered, some with an elevated margin, 6 to 12-rayed.

Plate 47, fig. 1, corallum, natural size.

Feejee Islands. *Exp. Exp.*

The broad plates are half an inch thick, nearly flat, and have a very uneven hackly surface; the angular prominences are from one to four lines high, but sometimes rise to an inch or two, with a breadth of an inch. The cells are rather large, and are about a line apart. The margin of the corallum is rounded; below it is alive for an inch or two from the edge, with a smooth surface and numerous immersed cells.

The *Montipora verrucosa*, of Quoy and Gaymard, *Voy. de l'Ast.*, iv. 247, pl. 20, fig. 11, may be identical with this species. The figure is a doubtful one.

The *Porites complanata*, of Lamarck (ii. 439), is imperfectly described as follows, and may be near the above: "In laminam partim liberam explanata; supernâ superficie subundatâ, stelliferâ; cellis exiguis, immarginatis." "Du voyage de Péron et Lesueur."



## 19. MANOPORA EROSA. (Dana.)

*M. glomerato-ramosa, erecta, caulibus subangulosis, crassis, acervatè, tuberculosi, erosis, obtusis. Corallum leve; cellis immersis, undique ad apicem usque sparsis, stellâ 6-radiatâ.*

Glomerato-ramose, erect, stems subangular, stout, acervately tuberculous, erose, obtuse. Corallum without papillæ, cells immersed, every where scattered, even at the summits; star 6-rayed.

Plate 46, fig. 5, corallum, natural size; 5 a, vertical section, enlarged.

Feejee Islands. *Exp. Exp.*

A rudely glomerato-ramose species growing in thick clumps, contracting and enlarging irregularly, and with a very uneven surface, porous, but not at all spinulous. The cell has a flaring aperture, and the star is situated rather deep within.

It resembles the *spumosa* in its massive mode of branching, but differs widely in not being spinulous. The specimen in the collections is six inches high and five broad, with the stems one-third of an inch to two or three inches through. It is incrusting below, but hardly foliaceous.

IV. *Cellis coralli immersis, superficie non spinuloso-asperâ, sed crassè papillosâ, aut verrucosâ aut longè rugosâ.*

## 20. MANOPORA CAPITATA. (Dana.)

*M. cespitoso-ramosa, ramis ½-1" crassis, sæpe irregulariter inflatis seu nodosis, et coalitis, apice rotundatis vel capitatis. Corallum undique usque ad apicem confertim papillosum, papillis oblongis, ½-1" crassis, obtusis; cellis immersis, minutis.*

Cespitoso-ramose, branches ½ to 1 inch thick, often irregularly inflated or nodose, and very frequently coalescing, rounded at apex or capitate. Corallum every where crowdedly papillose, even at apex, papillæ oblong, ½ to 1 line thick, obtuse; cells immersed, minute.

Plate 47, fig. 4, corallum, natural size.

Sandwich Islands, Hawaii, Hido Bay. *Exp. Exp.*

The clumps are a foot or more high, and consist of large and stout irregular branches much coalescing. At apex the branches are thick and rounded, the papillæ are less porous than the interstices. The zoophyte is alive for two or three inches from the summit.

21. MANOPORA NUDICEPS. *Dana.*

We notice under this name the species from the Red Sea, elegantly figured by Savigny, in the large work on Egypt (Plate iv. fig. 4, of Zoophytes), which has many of the characters of the above, yet is quite distinct in its more crowded and much smaller branches (one-third of an inch thick), and their naked summits. This is the *Madrepora abrotanoides* of Audouin.

22. MANOPORA LIMA. (*Lamarck.*) *Dana.*

*M. latè foliacea, subcucullata, extus 3'' animata. Corallum vix fragile, suprâ, confertim rugosum, rugis tenuibus (vix ½'''), interdum reticulatis.*

Broad foliaceous, subcucullate, exterior alive for 3 inches or so. Corallum scarcely fragile, above, crowdedly rugose, rugæ thin (hardly ½ a line thick), sometimes reticulate.

“Austral Seas.” *Peron & Lesueur.*—Sooloo Sea. *Exp. Exp.*

The cucullate folia are about one-eighth of an inch thick, and form clumps a foot or more in diameter. The thin prominent ridges of the surface are very uneven, scarcely half a line thick, and the intervals between, seldom broader.

*Corallium infundibuliforme*, &c. (?), *Seba*, *Agaricia lima*, *Lamarck*, ii. 382, No. 6.  
 iii. tab. 110, fig. 7. *Montipora lima*, *Blainville*, *Man.*, 389.  
*Madrepora foliosa* (?), *Esper*, *Fortsetz.* i.  
 tab. 58., A.

23. MANOPORA PAPILLOSA. (*Lamarck.*) *Dana.*

*M. foliacea, frondibus subflabellatis. Corallum supernè papillosum, papillis obtusis, rotundatis, 1''' crassis, ad marginem attenuatis, asperiusculis, longitudinaliter seriatis.*

Foliaceous, fronds subflabellate. Corallum above papillose, papillæ obtuse, rounded, a line thick, attenuate towards the margin, longitudinally seriate.

"Austral Seas." *Peron & Lesueur.*

*Agaricia papillosa*, Lamarck, ii. 382, *Montipora papillosa*, Blainville, Man., 389, No. 5. pl. 61, fig. 2.

24. MANOPORA VERRUCOSA. (*Lamarck.*) *Dana.*

*M. undato-gibbosa, explanata. Corallum cellis immersis, profundis, interstitiis verrucosis, verrucis convexis, variis.*

Undato-gibbous, explanate. Corallum with deep immersed cells, interstices verruciferous, verrucæ convex, and various in size.

Lamarck states that this species forms broad undulate expansions, and has deep pocilliform cells radiated within and very small at bottom. The wart-like prominences or verrucæ are sometimes quite large.

*Porites verrucosa*, Lamk., ii. 439, No. 12. The *M. verrucosa*, of Quoy and Gaymard, *Montipora verrucosa*, Blainville, Man., 388, Voy. de l'Ast., iv. 247, pl. 20, fig. 11, pl. 61, fig. 1. may belong here.

25. MANOPORA TUBERCULOSA. (*Lamarck.*) *Dana.*

*M. incrustans, rudis, indivisa. Corallum cellis exiguis, interstitiis tuberculatis; tuberculis echinatis, prominentibus, columniformibus, interdum in collinas confluentibus.*

Incrusting, irregular in form, not lobed. Corallum having the cells

minute, with the interstices tuberculate; tubercles echinate, prominent, columniform, sometimes confluent in ridges.

A specimen allied to this species, yet possibly distinct, was obtained at the Feejee Islands, and is represented on plate 47, figure 2. It is a glomerate mass covered with large rounded tubercles (two to three lines broad), some oblong and curving, and others nearly hemispherical. The cells are one-third of a line broad, and have a distinct star of six rays, with the six intermediate usually apparent. One specimen is three inches by four in breadth, and two to three thick. Figure 2 *a* represents the unexpanded animal; 2 *b*, the interior structure in a cross section, magnified twelve times.

*Porites tuberculosa*, Lamarck, ii. 439, No. 13.

26. MANOPORA PLANIUSCULA. (*Dana.*)

*M. glomerata, incrustans, supernè planiuscula; interstitiis 1-1½" latis, paulum convexis. Corallum porosum; cellis profundis, vix conspicuè 12-radiatis.*

Glomerate, incrusting, nearly plane above; interstices 1 to 1½ lines broad, a little convex. Corallum porous; cells deep, rather indistinctly 12-rayed.

Plate 47, fig. 3, corallum, natural size; 3 *a*, vertical section, enlarged.

Feejee Islands. *Exp. Exp.*

An incrusting species nearly one-third of an inch thick, distinguished by the naked and slightly convex interstices between the cells, seldom exceeding half a line in height. The cells are large and rather deeply seated.

V. *Cellis coralli in fundo fovearum profundarum immersis, interstitiis angustis, nudis.*

27. MANOPORA FOVEOLATA. (*Dana.*)

*M. glomerata, incrustans, supernè planiuscula, aut undulata. Corallum*

*profundè foveolatum; cellis radiatis in imis foveis dispositis, interstitiis tenuibus, interdum subacutis.*

Glomerate, incrusting, nearly plane or a little undulate above. Corallum profoundly alveolate, the radiated cells situated at the bottom of deep pits a line broad; interstices very thin and sometimes subacute.

Probably the Feejee Islands. *Exp. Exp.*

The pits of the surface are often subangular, and generally a line to a line and a half deep, and the cell at bottom is very distinctly twelve-rayed. The specimen in the collections is an incrusting mass, half an inch to three-quarters thick, and ten inches in breadth.

VI. *Cellis coralli immersis, superficie omnino levi, zoophytis ramosis.*

28. MANOPORA DIGITATA. (*Dana.*)

*M. pumila, ramosa, sæpe digitata, ramis subteretibus, compressiusculis, sæpe tortuosis, ¼" crassis, subæqualibus, obtusis; polypis flavis, tentaculis brevibus, æquis. Corallum omnino leve, cellis immersis, ½" latis.*

Small, ramose, often digitate, branches subterete, somewhat compressed, often tortuous, ¼ of an inch thick, subequal, obtuse; polyps yellow, tentacles short, equal. Corallum quite smooth, cells immersed, ½ of a line broad.

Plate 48, fig. 1, zoophyte, natural size; 1 *a*, polyp, enlarged; 1 *b*, extremity of branch, natural size; 1 *c*, cell and surface around, enlarged; 1 *d*, part of transverse section of branch, enlarged.

Feejee Islands. *Exp. Exp.*

The specimen is a ramose stem, three and a half inches high, having numerous crowded branches, two inches or so in length. In its smooth surface, it resembles a Millepore, but the cells are not internally crossed by septa. Towards the extremities of the branches, each cell is the centre of an obsolete depression, a line in diameter, and the surface consequently is faintly pitted.

29. MANOPORA TORTUOSA. (*Dana.*)

*M. ramosa*, ramis sæpe 4" longis,  $\frac{1}{4}$ " crassis, curvatis vel tortuosis, subteretibus, compressiusculis. Corallum omnino leve, cellis immersis,  $\frac{1}{4}$ " latis.

Ramose, branches often 4 inches long,  $\frac{1}{4}$  of an inch thick, curved or tortuous, subterete, somewhat compressed. Corallum quite smooth, cells immersed,  $\frac{1}{4}$  of a line broad.

Plate 48, fig. 2, corallum, natural size.

Singapore, East Indies. *Exp. Exp.*

This species resembles the *digitata*, in its *Millepore* habit and general size; but the branches are much longer and less crowded, and the cells are larger.

## FAMILY II.—FAVOSITIDÆ.

*Madreporacea polyporum basi seriatim coralligena, itaque cellis fundo solidis, et penitus, transversè septatis, aut raro solidescens; caliculis nullis.*

Polyps intermittedly coralligenous at base, cells, therefore, solid at bottom, and within the corallum crossed by septa, or quite closed by the secretions; calicles none.

The polyps of the Favositidæ, as far as examined, scarcely differ externally from the Madreporæ, except that the tentacles are shorter. Their coral secretions are at once distinguished by the transverse septa, or cross-partitions of the cells, a structure exhibited when the interior is laid open by a cross-fracture. In a few slender species, these secretions seem to lose their intermittent character, or, if it is

continued, they go on to accumulate, till it is lost by a complete coalescence of all the depositions and a filling of the cell internally, thus rendering the coral quite solid within. This is the case with the Seriatoporæ, and also with some of the smaller Pocilloporæ, although the larger species of this last genus contain the septa as distinct and regular as the fossil Favosites.

The cell is usually shallow, and is bordered around by six to twelve lamellæ, generally entire and often quite narrow, or even obsolete: their size varies from a mere point to a line and a half. There are no prominent calicles, and only a few branching species have the upper side of the cell a little projecting.

The Favositidæ grow in glomerate or massive forms, and in ramose shapes. The latter enlarge by the budding of a parent-cluster, and branching consequently takes place by furcation, producing crowded cespitose clumps, which are usually hemispherical in outline. In some species, the separate polyps are imperfectly coalescent, or are united laterally only by their non-secreting exterior integuments, and their secretions form separable columns or tubes.

The corals of this family, in the present seas, are confined to the coral-reef latitudes, and the known species are from the Pacific and Indian Oceans, and seas adjoining.

The Favositidæ may be divided into three subfamilies:—

I. ALVEOPORINÆ.—Cells contiguous, slenderly echinulate within; parietes cribrate.

II. FAVOSITINÆ.—Cells contiguous, at the summits at least; rays entire or obsolete.

III. HELIOPORINÆ.—Cells in no part contiguous, circular.

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SUBFAMILY I.—ALVEOPORINÆ.

*Favositidæ spongiosè coralligenæ; cellis angulatis, contiguis, intus tenuiter echinulatis.*

Favositidæ, forming spongy calcareous secretions; cells angular, contiguous, internally slenderly echinulate.

## GENUS I.—ALVEOPORA.—BLAINVILLE.

*Alveoporinæ glomeratæ aut furcato-ramosæ ; corallis spongiosis ; cellis contiguis parietibus tenuissimis et apertè cribratis ; septis transversis remotis.*

Glomerate or furcâto-ramose ; coralla spongy ; cells contiguous, with the sides very thin, and thickly pierced with holes ; transverse septa remote.

The Alveoporæ are either glomerate or ramose in their mode of growth, and attain a large size. The coralla are very light, and open cellular ; and the parietes of the polygonal cells, as exhibited by a vertical section, look much like lace-work. The lamellæ of the cells are represented by a few slender points or spicula.

The animals of the Alveoporæ were first accurately figured by Savigny, who found them prominent when expanded, with a circle of twelve tentacles around the mouth ; though near the Porites in this respect, as well as in the porous corallum, yet the deeper cell, traceable through the corallum, and its structure within, affiliates them more strongly to the species with which they are here associated. They are intermediate in character between the Manoporæ on the one side, and the Favositinæ on the other. They are confined to the coral-reef seas, and have been found only in the Pacific and Indian Oceans.

The genus Alveopora was instituted by Blainville, for some of the Porites of Lamarck, and certain Pacific corals obtained by Quoy and Gaymard, in their celebrated voyage of discovery. The name is derived from the Latin *alveum*, a bee-hive.

*Arrangement of the Species.*I. *Glomerate.*1. *A. retepora.*\*2. *A. dedalea.*\*3. *A. spongiosa.*II. *Branched.*4. *A. rubra.*5. *A. fenestrata.*



1. ALVEOPORA RETEPORA. (*Ellis.*) *Blainville.*

*A. glomerato-globosa.* *Corallum cellis angulatis, margine erecto, denticulisque scabro.*

Glomerato-globose. Corallum with the cells angular, and having an erect margin, scabrous with minute teeth.

The characters laid down for this species are insufficient to distinguish it from some of the following. According to Ellis's figure, which is probably natural size, the cells are nearly a sixth of an inch in diameter, and in this large size the species is peculiar. The locality is not given.

*Mad. retepora*, Ellis and Solander, 166, *Porites reticulata*, Deslongchamps, Encyc., tab. 54, figs. 3, 4, 5. 651.

*Porites reticulata*, Lamk., ii. 433, No. 1. *Porites Peronii*, Blainville, Dict. des Sci. Nat., xliii. pl. 39, fig. 3; and *Alveopora retepora*, Man., 394, pl. 59, fig. 3.

2. ALVEOPORA DEDALEA. (*Forskal.*) *Blainville.*

*A. lobato-glomerata*, 2-3" *animata*; *polypis expansis rufo-fuscis aut cinerascentibus, tentaculis filiformibus; contractis, æruginoso-virescentibus.* *Corallum tenerè spongiosum, cellis linearibus, raro latioribus, septis sursum spinulosis—itaque superficie totá hispidá.*

Lobato-glomerate; expanded polyps, brownish-umber, or ash-coloured, tentacles filiform; when contracted, greenish-bronze. Corallum spongy and tender; cells a line in diameter, rarely wider, septa spinulous above, and the surface of the corallum, therefore, throughout hispid.

Red Sea. *Forskal, Savigny, and Ehrenberg.*

According to Savigny's beautiful figures in the great work on Egypt, the specimens are alive for about an inch and a half or two inches at top, and the holes of the cribrate parietes are scarcely wider than the intervals between them; and in both of these characters as well as its rather firmer texture, the species differs from the *spongiosa*.

In the collections of the Expedition there are specimens apparently

of this species, supposed to have been obtained at the Sandwich Islands. They have an inverted pyriform shape (plate 48, fig. 4), having been attached by the smaller end, are about two and a half inches high, and alive for one and a half inches. In the size of the cells and internal texture, they agree with the figure by Savigny. Below the live part, the surface is covered with an incrusting Nulipore, which advances upward as the animal dies.

*Mad. dedalea*, Forskal, Anim. Eryp., 133, tab. 37, fig. B; the animal of this species was first imperfectly figured by Forskal. *Alcyonella Savignii*, Audouin, Explic. des planches de M. Savigny. *Porites dedalea*, Ehrenb., G. lxx., sp. 10. *Madrepora*, Savigny, l'Egypte Pol., tab. 3, fig. 4. *Alveopora dedalea*, Blainv., Man., 394.

3. ALVEOPORA SPONGIOSA. (*Dana.*)

*A. grandis, lobato-glomerata, 10-12" animata. Corallum tenerius spongiosum; cellis linearibus, vix profundis, apice valde minoribus; intus filiferis; parietibus tenuissimè cribratis, porulis angusto-oblongis.*

Large, lobato-glomerate, alive for 10 to 12 inches. Corallum spongy and very tender; cells a line in diameter, scarcely as deep as broad, filiferous within; at apex much smaller; parietes filamento-cribrate, porules narrow-oblong.

Plate 48, fig. 3, corallum, reduced two diameters; 3 a, part of same, natural size; 3 b, cells of surface, enlarged; 3 c, vertical section of a cell; 3 d, vertical section of corallum, enlarged.

Feejee Islands. *Exp. Exp.*

The specimen in the collections is a large sponge-like mass, fourteen inches high and six thick, with short rounded lobes above, and alive throughout, excepting three inches below. The oblong porules of the parietes are separated by thread-like intervals.

4. ALVEOPORA RUBRA. (*Quoy & Gaymard.*)

*A. furcato-ramosa, ramulis elongatis, erectis; polypis rubris, breviter crasso-tentaculatis. Corallum cellis spinosis, sex-dentatis.*

Furcato-ramose, branchlets long, erect; polyps red, with short and stout tentacles. Corallum with spinous cells, sex-dentate within.

Port Carteret, New Ireland. *Quoy & Gaymard.*

This species, according to Quoy and Gaymard, approaches the true Madreporae, and also the Porites. The specimen examined by them was two or three inches high, with dichotomous branchings, cylindrical or a little compressed, subacuminate, and covered with very small irregular crenulate cells, separated by porous partitions, the porosity of which is compared to "a confused crystallization."

*Alveopora rubra*, Quoy and Gaymard, Voy. de l'Ast., iv. 242, pl. 19, figs. 11-14.

#### 5. ALVEOPORA FENESTRATA. (*Lamarck.*) *Dana.*

*A. furcato-ramosa, ramis crassis, subgibbosis, obtusissimis. Corallum cellis profundis, subangulatis, intus filiferis, parietibus fenestratis.*

Furcato-ramose; branches stout, subgibbous, very obtuse. Corallum having the cells deep, subangular, filiferous within; parietes fenestrate.

"Austral Seas." *Peron & Lesueur.*

This species, which is referred to the genus Pocillopora by Lamarck, has the cells of an Alveopora; they are described as enclosed by cribrate parietes, with small calcareous threads within the cells, which coalesce at the bottom of the same.

*Pocillopora fenestrata*, Lamarck, ii. 443, No. 5.

NOTE.—The *Alveopora viridis*, of Quoy and Gaymard, as figured by them, has the cells and general habit of a Sideropora. The *A. rubra* also approaches that genus.

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#### SUBFAMILY II.—FAVOSITINÆ.

*Favositidæ cellis coralli ad summitates contiguis, angulatis; lamellis integris, sæpe angustissimis aut obsoletis.*

Cells of the corallum at the summits at least contiguous and angular; lamellæ entire, often very narrow or obsolete.

GENUS II.—SIDEROPORA.—BLAINVILLE.

*Favositinæ furcato-ramosæ; cellis bene stellatis, lamellis sex axi medio conjungentibus.*

Furcato-ramose; cells with 6 lamellæ meeting at centre in an axis, and forming a star of six rays.

The Sideroporæ form closely branched hemispherical clumps, consisting of flattened or nearly cylindrical branches, with obtuse summits. The cell is usually slightly vaulted, and the star within is very regular; often at centre where the lamellæ meet, there is a short point forming an axis or columella to the cell, which when broken is seen to be tubular in some species. In many of the Sideroporæ the inner half of each ray is quite deep within the cell, and the cell appears therefore six-toothed (sex-dentate). The polyps are simply regular stars of twelve short rays, and usually of some tint of bright green. In the species examined by the author, the tips of the tentacles were a rich green, with the bases brownish.

This genus is united with Porites by Lamarck and Ehrenberg. It was instituted by Blainville, and named in allusion to the star of the cell, from the Latin *sidus*, a star. It forms part of Oken's genus Acropora, and includes Schweigger's Stylophora, and Gray's Anthophora.

*Arrangement of the Species.*

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|---------------------------|------------------------|
| *1. <i>S. digitata.</i>   | *4. <i>S. palmata.</i> |
| 2. <i>S. elongata.</i>    | *5. <i>S. mordax.</i>  |
| 3. <i>S. subdigitata.</i> |                        |

1. SIDEROPORA DIGITATA. (*Pallas.*) *Blainville.*

*S. ramulis,  $\frac{1}{3}$ – $\frac{1}{2}$ " crassis, raro  $\frac{3}{4}$ ", obsoletè compressis, sæpe paulum tumidis.*



Branches  $\frac{1}{3}$  to  $\frac{1}{2}$  an inch thick, rarely  $\frac{3}{4}$  of an inch, obsoletely compressed, often a little tumid at intervals.

Red Sea and East Indies. Sooloo Sea. *Exp. Exp.*

Forms hemispherical clumps, six or eight inches in diameter, neatly branched; the branchlets are about half an inch apart, one-fourth to one-half an inch broad at top, and rarely one and a half inches long.

The following may be a variety of this species, yet it seems doubtful.

*β. coalescens.* Branches often nodose, a little compressed, frequently anastomosing, one-fourth to three-fourths of an inch thick, cells much vaulted, columella prominent, star sex-dentate. One specimen from the Feejees (plate 49, fig. 2), is eight inches high, with the branches coalescing every half inch to two inches. Another, a worn specimen from the Sooloo Sea, has smaller branches, but is otherwise similar.

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| <i>Millepora alcicornis</i> , Forskal. Anim. Egypt., 137.                    | <i>Anthophora cucullata</i> , Gray, Zool. Trans., 1835, p. 85.   |
| <i>Madrepora digitata</i> , Pallas, Zooph., 326.                             | <i>Alveopora viridis</i> (!), Quoy and Gaymard, Voy. de l'Ast., iv. 240, pl. 20, figs. 1-4;  |
| —, Ellis and Solander, No. 74.   | this species, imperfectly described, has, in the figure, the cells of a <i>Sideropora</i> , and the general form of the above species;   |
| Savigny, Egypt. Polyp, pl. 4, fig. 3; an excellent figure.                   | but it may be distinct. It is from Port Carteret, New Ireland. The branches are one-third to half an inch thick, and somewhat compressed; the cells are deep with crenulate margins, and thin fenestrate parietes; the polyps have green tips. |
| <i>Porites scabra</i> , Lamk., ii. 436, No. 6.                               |  |
| —, Deslongchamps, Encyc., 652.   |  |
| <i>Pocillopora Andreossyi</i> , Audouin, Explic. des planches de M. Savigny. |  |
| <i>Sideropora scabra</i> , Blainville, Man., 384, and                        |  |
| <i>Porites scabra</i> , 396.   |  |
| <i>M. Porites digitata</i> , Ehrenb., G. lxx., sp. 7.                        |  |

## 2. SIDEROPORA ELONGATA. (*Lamarck.*) *Blainville.*

*S. ramulis elongatis, cylindricis. Corallum cellis sex-dentatis, margine superiore prominulo.*

Branchlets elongate, cylindrical. Corallum with the cells sex-dentate; superior margin a little prominent.

The Indian Ocean? *Lamarck.*

*Lamarck* says that this species differs from the preceding in its general appearance and scarcely prominent cells.

*Porites elongata*, Lamk., ii. 437, No. 7.      *Sideropora elongata*, Blainville, Man., 384.  
—, Deslongchamps, Encyc., 652.

NOTE.—*S. pistillata*. Esper's *Madrepora pistillata* (the *Stylophora* of Schweigger, p. 413), is, beyond doubt, a *Sideropora*, and possibly a variety of this species. Pflanz. Fortsetz. i. 73, tab. 60.

Ehrenberg, placing the species with his *Porites*, as *Porites pistillata*, gives the following description of a specimen from the Red Sea, which he considers identical with it (G. lxx., sp. 3): "Ramulis teretibus, gracilibus, flexuosis, apice rotundatis (4'' crassis) ad dichotomiam incrassatis, stëllulis sexangularibus, columellâ inclusâ pistillatis, denticulo hispido, supero obsoletè fornicatis, interstitiis setuloso-hispidis, planis."

3. SIDEROPORA SUBDIGITATA. (*Lamarck.*) *Blainville.*

*S. lobato-ramulosa*, ramis brevibus, subdigitatis. Corallum stellis sex-dentatis; interstitiis prominulis et echinulatis.

Lobato-ramulose; branches short, subdigitate. Corallum with the stars sex-dentate; interstices a little prominent and echinulate.

The Indian or Austral Ocean. *Lamarck.*

*Porites subdigitata*, Lamk., ii. 438, No. 10.      *Sideropora subdigitata*, Blainv. Man., 384.  
—, Deslongchamps, Encycl., 653.

4. SIDEROPORA PALMATA. (*Blainville.*)

*S. ramis valde compressis et supernè rarioribus, flabellatis, parcè digitato-lobatis aut subpalmatis, sæpe 1-2'' latis, et apice 3-5'' crassis. Corallum cellis paulum marginatis, columellâ prominulâ.*

Branches much compressed and thinner above, flabellate, sparingly digitate lobed, or subpalmate, often 1 to 2 inches broad, and 3 to 5 lines thick at apex. Corallum having the cells slightly margined, and the columella a little prominent.

East Indies. *Exp. Exp.*

The clumps in the Expedition collections, which have afforded this description, are flattened hemispherical, about six inches high, and ten or twelve broad, and consist of flat branches thinning towards the apex. This last character and the less distinctly vaulted cells distin-

guish it from the *mordax*. The intervals between the branches are one-half to two-thirds of an inch, rarely an inch.

*Sideropora palmata*, Blainville, Man., 384, 385; the description by Blainville is imperfect, and the specimens are referred to his species with some hesitation.

#### 5. SIDEROPORA MORDAX. (*Dana*.)

*S. ramis subsimplicibus, valde compressis, supernè, non rarioribus, vix flabellatis, ½-1" latis, et ⅓" crassis; polypis disco lutescentibus, tentaculis brevibus, lætè virentibus, basi brunneis. Corallum cellis valde fornicatis, itaque superficie bene scabrosâ.*

Branches nearly simple, much compressed, not thinner at apex, scarcely flabellate, ½ to 1 inch broad, and ⅓ of an inch thick; polyps with a pale yellowish disk, and short tentacles of a bright green colour, deep brown at base. Corallum with the cells strongly vaulted, and the surface, therefore, decidedly scabrous.

Plate 49, fig. 1, zoophyte, natural size; 1 *a*, polyp, enlarged; 1 *b*, cells of surface, at summit, enlarged.

Feejee Islands. *Exp. Exp.*

This species resembles the *palmata*, but is smaller, with the branches not thinner above, and separated by intervals of but a third of an inch; the surface, moreover, is quite strongly scabrous. The clump in the collections is about four and a half inches across and three high.

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#### GENUS III.—SERIATOPORA.—LAMARCK.

*Favositidæ tenuiter ramosæ; ramis ramulisque teretibus, polypis verticaliter plus minusve seriatis. Corallum cellis obsoletè radiatis, non profundis et infrâ solidiscentibus.*

Slenderly ramose; branches and branchlets terete, polyps vertically more or less seriate, cells of corallum obsolescently rayed, not deep, and becoming filled and solid internally.

The Seriatopores form hemispherical clumps, and are remarkable for their slender graceful branches, and seriate polyps. The coralla are nearly or quite solid within, owing to the obliteration of the cell internally by solid calcareous secretions. The polyps resemble those of the Sideroporæ, but are sometimes of a rose or bright-red colour. The rays of the cell are scarcely distinguishable; yet there is often a distinct columella within, as in the Sideroporæ; and the upper margin of the cells, which is a little prominent, has a minute spinulous edging. The branches are sometimes acute, and often appear faintly winged at summit, owing to a slight prominence of the interstices between the adjoining series of cells. The seriate character is most regular towards the summits of the branches, and is often quite lost below. It is important to observe that the outer or lower branches of a hemispherical clump are often quite divaricately branched, inasmuch as the branches have room to spread; while those of the body of it are closely furcate.

These species are confined to the coral-reef seas, and have been found only in the Pacific and Indian Oceans. They graduate into the Sideropores on one side, and into the slender Pocillopores on the other; the latter frequently have the same solid texture, though less regularly terete and not distinctly seriate in their polyps.

The genus *Seriatopora* was instituted by Lamarck, for a part of the old genus *Madrepora*; but as it contained several unallied species, it was afterwards restricted to its present limits by Blainville, who assumed the *Seriatopora subulata*, the first of Lamarck's species, as the type of the genus.

*Arrangement of the Species.*

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|-------------------------|----------------------------|
| 1. <i>S. subulata</i> . | *4. <i>S. octoptera</i> .  |
| *2. <i>S. lineata</i> . | *5. <i>S. caliendrum</i> . |
| *3. <i>S. hystrix</i> . |                            |

1. *SERIATOPORA SUBULATA*. (*Lamarck*.)

*S. ramis validioribus* (2''', et basi totidem 4'''), raro coalitis; polypis 4-6-seriatis, virentibus. Corallum ramulis subulatis, supernè ramuloso-verrucosis, apice tetrapteris aut hexapteris.

In very ramose hemispherical clumps, branches quite stout (2 lines



thick and at base sometimes 4 lines), rarely coalescing; polyyps in 4 to 6 series, greenish. Corallum with the branchlets subulate, ramuloso-verrucose above, and 4 to 6-winged at summit.

The Red Sea and East Indies.

*Mad. seriata*, Pallas, Zooph., 336.

—, Ellis and Sol., 171, pl. 31, figs. 1, 2.

*Seriatopora subulata*, Lamk., ii. 401, No. 1.

—, Lamour., Exp., 61, pl. 31, figs. 1, 2.

—, Deslongchamps, Encyc., 678.

—, Blainville, Man., 397.

—, Ehrenberg, G. lxxiii., sp. 2.

The *Seriatopora ocellata*, of Ehrenberg, was described from a worn specimen in

the Berlin Museum. The following are the characters given by him: "Tripollicaris, ramulosa, ramis validis ( $3'''$  latis), coalescentibus, ramulis conico-spinescentibus, stellis longitudinaliter seriatis,  $\frac{1}{2}'''$  latis, nec prominulis, sed in lineâ tumidâ positâ, interstitiis osculisque glabris (an detritis?)." "Stellæ majores quam in *S. subulata*."

2. SERIATOPORA LINEATA. (*Esper.*) *Schweigger.*

*S. ramis validioribus, basi 3''' crassis, apice tenuiter subulatis et non verrucosis. Corallum apice hexapteris; cellis leviter fornicatis,  $\frac{1}{3}'''$  latis.*

Branches quite stout, 3 lines thick at base, slenderly subulate at apex, and not verrucose. Corallum six-winged at summit, cells slightly vaulted,  $\frac{1}{3}$  of a line broad.

Red Sea. *Ehrenberg.*

Ehrenberg refers to Esper's figure on plate 19, which represents part of a specimen very much anastomosing, with the summit branchlets quite slenderly pointed. A specimen very similar to that figured by Esper, is contained in the collections at Peale's Museum, Philadelphia. The branches are often coalescent, and not winged at apex; the cells are rather strongly vaulted, and in five or six series; the branchlets taper to a point from the size of a line at base. Esper states that the branches below are usually about the size of a quill.

*Lithodendrum litoreuni* (?), Rumph., Amboyn., tab. 86, fig. 3.

*Millepora lineata* (?), Linn., Ed. xii. 1283.

—, Esper, Fortsetz. 109, tab. 19.

*Seriatopora subulata*, var., Lamk., No. 1.

*Seriatopora lineata*, Schweig., Handb., 413.

—, Ehrenberg, G. lxxiii., sp. 3.

3. SERIATOPORA HYSTRIX. (*Dana.*)

*S. ramis validis, infrà 3''' crassis et sæpe coalitis, ramulis elongatis, acutè conico-subulatis, 2''' crassis; polypis 8-10-seriatis, tentaculis roseis. Corallum ramulis apice non alatis; cellis fornicatis,  $\frac{1}{3}$ ''' latis; infrà cellis interdum sparsis.*

Branches stout, below, 3 lines thick, often coalescing; branchlets conically subulate and acute, 2 lines thick; polyps in 8 to 10 series, tentacles rose-red. Corallum with the branchlets not winged at summit; cells vaulted,  $\frac{1}{3}$  of a line broad; below, cells sometimes scattered.

Plate 49, fig. 3, central part of a hemispherical clump, natural size; 3 *a*, from the outer part of the same; 3 *b*, part of a transverse section, enlarged.

Feejee Islands. *Exp. Exp.*

This species grows in regularly hemispherical clumps, ten or twelve inches in diameter. It is remarkable for its stout and neatly terete branches, tapering above to a point which is not winged, and covered with cells in eight to ten or sometimes twelve series. Near the apex, the cells are scarcely oblong or oblique. The lower branches of the clump are divaricately branched; but those above are more closely crowded, the branches forking at a small angle. The branchlets of this part are often three inches or more in length, while those below of the divaricate kind, are but an inch or so long. The cells are short stellate, with six lamellæ.

4. SERIATOPORA OCTOPTERA. (*H. & Ehrenberg.*)

*S. ramis validiusculis, (vix 2''' crassis); infrà, sæpe coalitis; polypis 6-8-seriatis, virentibus. Corallum ramulis apice subobtusis, hexapteris vel octopteris; cellis vix fornicatis, oblongis.*

Branches rather slender (scarcely 2 lines thick), below, often coalescing; polyps in 6 to 8 series, greenish. Corallum with the

branchlets rather obtuse at apex, 6 or 8-winged, cells slightly vaulted.

Red Sea. *Ehrenberg*.—Singapore and Sooloo Sea. *Exp. Exp.*

This is a more slender species than the *subulata*; the branches are seldom stouter at base than above, and are obtuse at apex, and distinctly winged. The cells are mostly in eight series, and are but slightly vaulted: a distinct columella may be seen within, but it is short. It grows in hemispherical clumps six to twelve inches high, consisting of crowded stems, neatly branched. In the smaller clumps the branches are seldom coalescent; but when they have attained a large size, the branches below are much united, even becoming laminate in some degree.

*Seriatopora octoptera*, Ehrenberg, op. cit., Gen. lxxiii., sp. 5.

#### 5. SERIATOPORA CALIENDRUM. (*H. and Ehrenberg.*)

*S. ramis basi bilinearibus, subtilius asperis, intricatis et coalescentibus, ramulis tenuissimis, apice gracillimè subulatis. Corallum cellis non fornicatis, ramulorum supremo apice hexapteris.*

Branches 2 lines thick at base, minutely asperate, intricate and coalescing; branchlets very slender, with finely subulate extremities. Corallum with the cells not vaulted; apex of the branchlets 6-winged.

Red Sea. *Ehrenberg*.

Ehrenberg observed specimens of this species two feet in breadth, and six to eight inches in height. It is a rather fragile species.

*β. gracilis.* The following are the characters of a large specimen obtained in the Sooloo Sea, near the above in many particulars, yet not agreeing wholly with the description. Branches and branchlets very slender, scarcely over a line in thickness, often intricately coalescing, but not into a lamina; above very slender subulate; polyps in four to six series. Corallum with the branches square, sometimes hexagonal, not winged at apex; cells minute (one-fifth of a line broad), vaulted, short 6-rayed, with a slender, prominent columella. (Plate 49, fig. 4, part of corallum, natural size.)

*Seriatopora caliendrum*, Ehrenberg, G. lxxiii., sp. 4.

The *S. valida* of Ehrenberg is described from a specimen in the Berlin Museum, as follows: "Ramulis arcuè complexis et sæpe in laminas compressas coalitis reticulatisque, ramulis flexuosis, conniventibus, apice acutis, hexapteris, stellulis subciliatis, non prominulis, scabritie tenui." "Habilus *caliendri*, sed ramuli paulo crassiores, magis conniventes et coalescentes. An specie diversa?" A variety of the *octoptera*?

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GENUS IV.—POCILLOPORA.—LAMARCK.

*Favositidæ furcato-ramosæ; polyptis breviter tentaculatis, tentaculis æqualibus; secretionibus corallicis interstitiorum fere solidis; ramis nunquam teretibus, sæpe verrucosis. Coralla cellis contiguis et apice angulatis, lamellis angustissimis sæpius vix conspicuis.*

Furcato-ramose; polypts with short equal tentacles; coral secretions of the interstices nearly solid; branches never terete, often verrucose. Coralla with the cells contiguous, and at apex angular, the lamellæ very narrow, and generally rather indistinct.

The cespitose clumps are generally hemispherical, as in the preceding genus, and often very neatly so; the size of the branches, and the intervals between, being quite regular. The polypts are like those of the Madreporæ. The coral secretions are very firm and solid, yet, on making a section by fracture, the cells, excepting in a few slender species, may be traced to the centre, and exhibit the transverse septa very regularly arranged. At the summits of the branches, the cells are contiguous and polygonal, with very thin interstices; but, below, they are a little more separated, though the intervals seldom exceed their diameters.

These cells are never over half a line in breadth. The lamellæ are generally very narrow or indistinct, except two opposite, in some species, which are enlarged so as to meet and form a partition across the cell, with a columella at centre; and in others of the Pocilloporæ, only one of these two lamellæ is distinguishable, extending from the side and terminating in the columella.

The branches are commonly somewhat flattened, occasionally three to four inches wide; and in all, except the more slender species, they are thickly covered with small prominences or *verruca*, consisting of

a few polyp-cells (§ 74f); and these prominences are sometimes lengthened into rudimentary branchlets.

These species are confined to the coral-reef seas, and hitherto have been found only in the Pacific and Indian Oceans.

At the Sandwich Islands they are, next to the Porites, the most abundant corals of the reefs; and, like the species of the genus just mentioned, they seem fitted for wider ranges of temperature than most of the reef-forming corals.

This genus was established by Lamarck, and still farther restricted by Blainville, who separated from it the genus Heliopora. The name is derived from the Latin *pocillum*, a little cup, and alludes to the cell. The Pocillopores pass into the Seriatopores and Sideropores, through the more slender species.

#### *Arrangement of the Species.*

##### I. *Slenderly branched, no verrucæ.*

\*1. *P. acuta.*

##### II. *Regularly cespitose, subdivided or branched, distinct verrucæ.*

\*2. *P. cespitosa.*

\*9. *P. squarrosa.*

\*3. *P. brevicornis.*

\*10. *P. elongata.*

\*4. *P. bulbosa.*

\*11. *P. ligulata.*

\*5. *P. damicornis.*

\*12. *P. elegans.*

\*6. *P. favosa.*

\*13. *P. meandrina.*

\*7. *P. verrucosa.*

\*14. *P. grandis.*

8. *P. clavaria.*

\*15. *P. plicata.*

##### III. *Glomerato-ramose.*

\*16. *P. informis.*

##### I. *Ramis gracilibus non verrucosis.*

#### 1. POCILLOPORA ACUTA. (*Lamarck.*)

*P. hemisphericè fruticulosa, ramosissima, ramis 2-4'' crassis, teretiusculis, flexuosis, ramulis extremis 1-1½'' crassis, subremotis, subacutis, ½'' longis.*

Hemispherically shrubby-cespitose, much branched; branches 2 to 4 lines thick, subterete, flexuous; upper branchlets 1 to 1½ lines thick, rather distant, subacute, half an inch long.

The Pacific and Indian Oceans.—Feejee Islands and Sooloo Sea.  
*Exp. Exp.*

A slenderly branched species, approaching the *Seriatopora* in general habit, but not evenly terete, nor seriate in its cells. It forms rather lax hemispherical clumps, six inches in diameter, the branches of which are about half an inch apart, and, except at base, are scarcely a fourth of an inch thick.

- Madrepora candida ramosa*, *Damæ cornua* —, Pallas, Zooph., 334, var.  $\gamma$ .  
*deferens foraminibus rotundatis in superficie insignita*, Gualtieri Ind., back of tab. 104. —, Deslongchamps, Encyc., 630.  
*Mad. damicornis*, Ellis and Sol., 170. —, Blainville, Man., 398.  
 —, Ehrenberg, G. lxxv., sp. 2.

The *Porites subseriata* of Ehrenberg, from the Red Sea (G. lxx., sp. 8), appears to belong to this genus, and to have some relations to the above. It is thus described: "Ramis attenuato-subulatis, subacutis (obtusis), teretiusculis, stellulis subseriatis, margine superiore parumper fornicato, nec dentato paulo prominulis, semilinearibus. Habitus *Seriatopora*."

A specimen from the Feejees agrees nearly with this description. It is more slenderly and more openly branched than the *acuta* of the East Indies, and moreover the cells are sometimes a little seriate. Yet it is probably only a variety.

II. *Bene cespitosæ, furcato-ramosæ aut subdivisæ; ramis verrucosis.*

2. *POCILLOPORA CESPITOSA.* (*Dana.*)

*P. humilis, cespitosa, crebro ramosissima, bene convexa, ramis brevioribus, tortuosis, 2-3''' crassis et basi grandioribus; ramulis extremis verruciformibus, 2''' longis et sæpe subacervatis. Corallum cellis grandibus (½'''), stellâ columellâque obsoletis.*

Low and even-topped cespitose, much and crowdedly branched, branches much shorter than in the *acuta*, tortuous, 2 to 3 lines thick, and stouter at base; summit branchlets verruciform, 2 lines long, and often subacervate. Corallum having the cells large ( $\frac{1}{2}$  a line broad), and without star or columella.

Plate 49, fig. 5, part of a clump, natural size; 5 a, extremity of a branch, natural size.

Sandwich Islands. *Exp. Exp.*

The clumps are neat, low-convex, and much branched. The branches are crowded to within one-third to half an inch of one another, and are mostly a fourth of an inch or less in thickness. The cell is large and shallow, and has a flat bottom; those low on the stem are rather distant, and a delicate line may be traced around them as in some *Seriatopora*. The species most resembles the *damicornis*, of which I had considered it a dwarf variety; but it is a much neater and more slender species, and has larger cells.

### 3. POCILLOPORA BREVICORNIS. (*Lamarck*.)

*P. humilis, latè cespitosa, convexa, breviter ramosa, ramis creberrimis, vix 2'' sejunctis, 4-6'' crassis, apice sæpe compressiusculis aut lobatis, valde obtusis et verrucosis, verrucis 1-1½'' longis, interdum acervatis. Corallum cellis ½-½'' latis, columellâ nullâ.*

Low and broad cespitose, convex, ramose, branches very short and much crowded, scarcely 2 lines apart, 4 to 6 lines thick, often somewhat compressed above or lobed at apex, very obtuse and verrucose, with the verrucæ 1 to 1½ lines long, and sometimes acervate. Corallum having the cells ½ to ½ a line broad, and without a columella.

Plate 49, fig. 8, outline sketch of part of a clump, natural size.

East Indies. *Peron & Lesueur*.—Feejees and Sandwich Islands. *Exp. Exp.*—Ceylon. *Rev. G. A. Apthorp*.

The low clumps are three inches to three and a half high, and five or six broad, and consist of short crowded stems with broad summits, rough with short verrucæ. The branches are sometimes an inch wide at top. The intervals between the branches are small and quite regular. The separated stems resemble a fragment from the *damicornis*, but in mode of growth and size, the species are wholly different.

*Pocillopora brevicornis*, Lamarck, ii. 443, *Pocillopora brevicornis*, Deslongchamps, No. 4.

Encyc., 631.

—, Blainville, Man., 393.

## 4. POCILLOPORA BULBOSA.

*P. cespitosa*, laxè ramosissima, ramis tortuosis, basi incrassatis ( $\frac{1}{2}$ – $\frac{3}{4}$ " ), supernè  $1\frac{1}{2}$ –3" crassis, apice sæpe palmato-digitatis, ramulis extremis 4–6" longis. Corallum cellis majusculis (prope  $\frac{1}{2}$ " ) stellâ vix conspicuâ, columellâ nullâ.

Cespitose, very ramosè, lax, branches tortuous, incrassate at base ( $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch), above  $\frac{1}{8}$  to  $\frac{1}{4}$  of an inch thick, apex often digitato-palmate, summit branchlets 4 to 6 lines long. Corallum with the cells rather large (nearly  $\frac{1}{2}$  a line), star scarcely distinct, columella none.

Plate 49, fig. 6, outline sketch of branch of corallum, natural size; 6 a, extremity of a branch, ditto.

Singapore, East Indies. *Exp. Exp.*

Grows in large ragged clumps. The small branchlets, corresponding to the verrucæ in other species, are often irregularly clustered at the extremities of the branches like short slender fingers. The branches are smaller and less crowded, than in the *damicornis*. The clumps are often a foot in diameter, and six or eight inches high.

*Mad. damicornis*, Esper, Pflanz. Fortsetz. *Pocillopora damicornis*, in part, of Lamarek. i. 38, tab. 46; a characteristic figure, —, Schweig., Handb., 413. though poor; tab. 46 A., represents a *Pocillopora bulbosa*, Ehrenb., G. lxxv., sp. 3. variety of the same species.

## 5. POCILLOPORA DAMICORNIS.

*P. cespitosa*, laxè ramosissima, ramis crassiusculis, infrâ  $\frac{1}{2}$ – $\frac{3}{4}$ " , suprâ 3–6" , et basi sæpe valde incrassatis; variè subdivisis, verrucosis, apice crassis et subdilatis, et verrucis  $1\frac{1}{2}$ –2" longis, acervatis. Corallum cellis majusculis, stellâ columellâque obsoletis.

Cespitose, very ramose and lax, branches rather stout,  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch below, 3 to 6 lines above, and at base often very much incrassate, variously subdivided, verrucose, subdilata at apex and covered with verrucæ  $1\frac{1}{2}$  to 2 lines long, more or less acervate. Corallum with the cells rather large; star and columella obsolete.



Plate 49, fig. 7, outline sketch of branch of corallum, natural size; 7 a, extremity of branch, ditto.

East Indies and Pacific Ocean.—Feejee Islands and Singapore.  
*Exp. Exp.*

A coarse-looking species, resembling somewhat the *bulbosa*, but much stouter and with the apical verrucæ not elongated and finger-like. It forms large clumps a foot or more in diameter, and eight inches or so high. The Feejee specimens are more slender than those from Singapore, but are otherwise similar.

*Mad. damicornis*, Pallas, Zooph., 334, No. 197, var. *a*.

—, Esper, Fortsetz. i., 38, tab. 47.

*Pocillopora damicornis*, Lamarck, ii., 442, No. 2.

—, in part, Schweig., Handb., 443.

—, Blainville, Man., 398; the figure referred to, pl. 59, fig. 1, if of the natural size, is nearer the *cespitosa*.

—, Quoy and Gaymard, Voy. de l'Ast., iv., 244, pl. 20, figs. 5-7.

*Acropora damicornis*, Oken, Zool., i., 66.

The *Pocillopora apiculata*, of Ehrenberg, is near the above. It is thus described (op. cit., G. lxxv., sp. 4): "Semipedalis, cespitoso-hemispherica, depressa, ramossissima, ramis crassis, tortuosis, compressis, angulosis, verrucoso-ramulosis, ramulis brevibus, acutis, ad apices acervatis ut in *bulbosa* (non ciliatis?)." Locality unknown.

#### 6. POCILLOPORA FAVOSA. (*Ehrenberg.*)

*P. fruticuloso-cespitosa*, ramis crassis, alternatim compressis, subflexuosis, apice clavato-incrassatis, verrucosis, lobatis aut sublobatis; polypis virescentibus.

Shrubby-cespitose, branches stout, alternately compressed, subtortuous, at apex clavato-incrassate, verrucose, lobate or sublobate; polyps green.

Plate 50, fig. 1, corallum, natural size.

Red Sea. *Ehrenberg.*—Feejee Islands and Sandwich Islands.  
*Exp. Exp.*

This species, according to Ehrenberg, forms clumps eight inches in breadth. It is stated to differ from his *Hemprichii* (the *verrucosa*), in the stouter verrucæ of the summits. In the specimen from the Feejees, supposed to be referable to this species, the branches vary mostly

from three-fourths to one inch in width at summit; occasionally they are only a third of an inch, especially the outer branches of the clump. The branches are less compressed, and the verrucæ more prominent at apex than in the *verrucosa*.

*Pocillopora favosa*, Ehrenberg, G. lxxv., sp. 5.

7. *POCILLOPORA VERRUCOSA*. (*Lamarck*.)

*P. hemisphericè cespitosa, ramis crassis, fere rectis, subdivisis, apice sæpe dilatatis, seu compressis,  $\frac{1}{3}$ — $\frac{1}{2}$ " crassis et  $\frac{3}{4}$ —2" latis, undique usque ad apicem bene verrucosis, verrucis brevibus simplicibus, apicalibus minoribus. Corallum cellis majusculis, columellâ obsoletâ.*

Hemispherically cespitose, branches stout, nearly straight, subdivided, often dilated or compressed at apex,  $\frac{1}{2}$  an inch thick, and 1 to 2 inches broad, every where neatly verrucose even over the summits, verrucæ short, simple, the apical a little smaller than the lateral. Corallum with the cells rather large; columella obsolete.

Plate 50, fig. 3, branch in outline, of specimen from the Sandwich Islands; 3 a, verrucæ, natural size.

East Indies and Pacific Ocean.—Sooloo Sea and Sandwich Islands.  
*Exp. Exp.*

A stout species, forming even, hemispherical clumps, often eight inches or more in diameter, consisting of compressed branches, separated by regular intervals of about half an inch. The verrucæ, though distinct at apex, are often obsolescent. The branches are thicker and more crowdedly and coarsely verrucose than in the following species; and, moreover, the cells have no distinct columella.

*Mad. verrucosa*, Ellis and Sol., 172, No. 78.      sis, apice subpollicaribus, dilatatis sublobatisque breviter et apice verrucosis, verrucis subglobosis, irregularibus, interdum in costas confluentibus, stellulis ciliatis, semilinearibus."—Red Sea.  
*Pocillopora verrucosa*, Lamk., ii. 443, No. 3.  
—, Deslongchamps, Encyc., 631.  
—, Blainville, Man., 398.  
*Pocillopora Hemprichii* (?), Ehrenb., G. lxxv., sp. 6. It is described as follows: The *Pocillopora verrucosa* of Ehrenberg "Semipedalis, suffruticosa, hemispherica, (G. lxxv., sp. 7), is another species.  
diviso-ramosa, ramis compressis,  $\frac{1}{4}$ " cras-

## 8. POCILLOPORA CLAVARIA. (Ehrenberg.)

*P. suffruticosa*, ramis subsimplicibus, dichotomè divisis,  $\frac{1}{2}$ " crassis, undique et apice obtusè ramuloso-verrucosis, verrucis subæqualibus, obtusis, subovatis, interdum lobatis et obsoletè proliferis, apice medio distinctius prolifero. Corallum cellis  $\frac{1}{2}$ – $\frac{1}{3}$ " latis, columellâ exiguâ.

Suffruticose, branches nearly simple, dichotomously subdivided,  $\frac{1}{2}$  an inch thick, lateral surface, and obtuse apex ramuloso-verrucose, verrucæ subequal, obtuse, subovate, sometimes lobed and obsoletely proliferous, middle of the apex more distinctly proliferous. Corallum having the cells  $\frac{1}{2}$  to  $\frac{1}{3}$  of a line broad, with a slender columella.

Ehrenberg remarks, that two opposite lamellæ of the cell are larger than the rest and nearly bisect it. The locality is unknown.

*Pocillopora clavaria*, Ehrenberg, G. lxxv., sp. 8.

## 9. POCILLOPORA SQUARROSA. (Dana.)

*P. ruditer hemispherica*, ramis valde crebris, crassis, fere rectis, inæqualiter compressis, apice rotundatis,  $\frac{1}{2}$ –1" crassis et  $\frac{3}{4}$ –2" latis, squarrosè verrucosis, verrucis crassis, subglobosis, valde irregularibus, apice extremo sæpe obsoletis. Corallum cellis parvulis ( $\frac{1}{3}$ " ); stellâ vix conspicuâ, unâ lamellâ latissimâ.

Rudely hemispherical, branches very closely crowded, stout, nearly straight, unequally compressed, and uneven, summits rounded,  $\frac{1}{2}$  to 1 inch thick, and  $\frac{3}{4}$  to 2 inches broad; surface coarsely verrucose, verrucæ stout, subglobose, very irregular, and sometimes like large tubercles; often obsolete at summit. Corallum having the cells small ( $\frac{1}{3}$  of a line); star scarcely distinct, with one lamella quite broad.

Plate 50, fig. 3, part of a branch, natural size; 5 a, extremity, showing surface, ditto.

Tahiti, Society Islands. *Exp. Exp.*

The rude-looking clumps are a foot or more in diameter, and consist of stout uneven branches, not rising quite to the same height. The verrucæ are irregular and large, and extend over the summits, excepting sometimes a small area at the very apex. The species is much coarser and stouter than the *verrucosa*, and is peculiar also in the one broad lamella of the cell. It resembles somewhat the *elongata*, but its clumps are far more closely crowded, the branchings shorter, and the cells but obsoletely stellate.

10. POCILLOPORA ELONGATA. (*Dana.*)

*P. hemispherica*, ramis remotis, fere rectis, valde elongatis, teretiusculis  $\frac{3}{4}$ " crassis, apice dilatatis ( $\frac{1}{2}$ " crassis et sæpe 2" latis) undique infernè supernèque sæpe ad extremum apicem verrucosis, verrucis æqualibus, obtusè conicis. Corallum cellis parvulis ( $\frac{1}{3}$ " latis), stellâ profundâ bene conspicuâ, interdum columellâ minutâ.

Hemispherical, branches widely separate, nearly straight, and very long, subterete,  $\frac{3}{4}$  of an inch thick, dilated at apex ( $\frac{1}{2}$  an inch thick and often 2 inches broad), every where below and above even to the very apex verrucose, verrucæ even, obtusely conical. Corallum having the cells small ( $\frac{1}{3}$  of a line broad), star neat and quite distinct, and situated rather deep within the cell; a minute columella sometimes seen.

Plate 50, fig. 4, branch in outline, natural size; 4 b, cells, enlarged.

Ceylon, Indian Ocean. *Rev. G. A. Apthorp.*

This species is remarkable for its long stout stems, in general but little compressed, and separated in the clump by intervals of an inch. Some of the simple undivided branches are six inches long; and the whole surface far from the summit, is quite evenly verrucose. The star of the cell is very neat and regular.

11. POCILLOPORA LIGULATA. (*Dana.*)

*P. hemispherica*, ramis subdivisis, paulo remotis, rectis, tenuibus (2-3"), valde compressis et complanatis,  $\frac{1}{4}$ -1 $\frac{1}{4}$ " latis, verrucis parvulis ascen-

*dentibus et appressis, apice obsoletis. Corallum cellis breviter stellatis, columellâ valde conspicuâ, per lamellam ad latus conjunctâ.*

Hemispherical, branches subdivided, rather remote, straight, thin (2 to 3 lines), much compressed and complanate,  $\frac{1}{4}$  to  $1\frac{1}{4}$  inches wide. verrucæ small, ascending, and appressed to the branch, obsolete at apex. Corallum having the cells short stellate, columella very distinct, and united by one of the lamellæ to the side of the cell.

Plate 50, fig. 2, branch, natural size; 2 a, surface and cells, enlarged.

Sandwich Islands.

This species is peculiar in its thin-compressed branches, and small appressed verrucæ, rather distant and sometimes running in longitudinal carinate lines. The intervals between the branches are from  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch wide, and give an open appearance to the clumps. It has the habit of the *plicata* in its distant verrucæ and cell, but the branches are very much narrower.

## 12. POCILLOPORA ELEGANS. (Dana.)

*P. bene hemispherica, caulibus lamellatis, subsimplicibus, 1-2½'' latis et ⅓'' crassis, æqualiter confertimque verrucosis, apice nudis; verrucis parvulis. Corallum cellis ⅓'' latis; stellâ columellâque inconspicuis.*

Neat hemispherical, branches lamellar, subsimple, 1 to  $2\frac{1}{2}$  inches broad, and  $\frac{1}{3}$  of an inch thick, evenly and crowdedly verrucose, summits naked, verrucæ small. Corallum having small cells ( $\frac{1}{3}$  of a line); star and columella indistinct.

Plate 51, fig. 1, corallum, natural size; 1 a, verrucæ, natural size.

Feejee Islands. *Exp. Exp.*

The clumps are ten or twelve inches in diameter, evenly convex or hemispherical, and consist of nearly simple stems, with neatly verrucose sides, and naked summits. The branches are half to one-third of an inch apart. They are much thinner and the verrucæ are smaller



than in the *grandifolia*; the *meandrina* has much larger cells, as well as thicker and broader lamellate branches.

The *P. verrucosa* of Ehrenberg (op. cit., G. lxxv., sp. 8), which, as remarked, is not the *verrucosa* of Lamarck, has close relations to the above. The following are the characters given: "Pedalis, cespitosa, subfoliacea, lobato-ramosa, ramis simplicibus, rectis, paucis, 1-2" latis, valde compressis, validis, apice dilatatis, cristâ levi, lateribus æqualiter verrucosis, verrucis a ramulis subglobosis, simplicibus formatis, stellulis  $\frac{1}{3}$ " latis, denticulato-ciliatis." Locality unknown.

### 13. POCILLOPORA MEANDRINA. (Dana.)

*P. cespitosa, bene hemispherica, ramis lamellatis, sæpe sinuosis, subsimplicibus,  $\frac{1}{3}$ - $\frac{1}{2}$ " crassis, 1-3" latis, bene verrucosis, apice nudis. Coralli verrucis paulo elongatis, angulatis, interdum proliferis, cum cellis earum maximis (sæpe  $\frac{3}{4}$ " ); stellâ columellâque inconspicuis.*

Cespitose, neatly hemispherical; branches lamellar, often sinuous, nearly simple,  $\frac{1}{3}$  to  $\frac{1}{2}$  an inch thick, 1 to 3 inches broad, neatly verrucose, summits naked. Corallum with the verrucæ a little oblong, angular, sometimes proliferous, with the cells of the same quite large (often  $\frac{3}{4}$  of a line); star and columella indistinct.

Plate 50, fig. 6, branch of corallum, natural size; 6 a, some of the verrucæ, ditto; 6 b, transverse section, ditto.

Sandwich Islands. Rev. Mr. Baldwin.

This species resembles the *grandis* and *elegans*, but has more angular verrucæ arising from the fewer and much larger cells that constitute them. The texture, moreover, is lighter and more cellular. It forms neat hemispherical clumps, six inches in diameter, with broad naked meandering summits to the folia, separated by intervals of about a third of an inch. The verrucæ are very nearly even, and cover the sides of the branches nearly or quite to their bases.

### 14. POCILLOPORA GRANDIS. (Dana.)

*P. bene hemispherica, caulibus laminatis,  $\frac{1}{2}$ " crassis (interdum  $\frac{3}{4}$ " ), 2-4" latis, æqualiter verrucosis, apice lato et nudo. Coralli verrucis fere*

*globosis, cum cellis parvulis,  $\frac{1}{3}$ " latis; stellâ inconspicuâ, columellâque obsolescente.*

Neat hemispherical; branches lamellar,  $\frac{1}{2}$  an inch thick (sometimes  $\frac{3}{4}$ ), 2 to 4 inches wide, evenly verrucose, apex broad and naked. Corallum having the verrucæ nearly globose, with the cells constituting them small,  $\frac{1}{3}$  of a line broad; star indistinct, columella obsolescent.

Plate 51, figure 2, outline sketch of part of corallum; 2 *a*, portion of a plate, natural size; 2 *b*, verrucæ, ditto; 2 *c*, surface and cells, enlarged.

Feejee and Society Islands. *Exp. Exp.*

The hemispherical clumps are neatly regular, and grow to a diameter of eighteen inches. The broad plates or folia are somewhat sinuous or meandering at summit, and very evenly distant. In a specimen from the Feejees, the folia are three-fourths of an inch thick; while, in one from Tahiti, they are about half an inch.

#### 15. POCILLOPORA PLICATA. (*Dana.*)

*P. cespitosa, bene hemispherica, caulibus latè laminatis,  $\frac{1}{3}$ " crassis et 1-5" latis, parcè subdivisis, apice truncatis et nudis, lateribus remotè verrucosis interdum subnudis sæpe plicatis aut verrucis in cristas digestis. Coralli cellis majusculis; stellâ columellâque conspicuis.*

Cespitose, neat hemispherical; branches broad laminate,  $\frac{1}{3}$  of an inch thick, and 1 to 5 inches broad, sparingly subdivided, truncate and naked at summit, sides remotely verrucose, often distantly plicate, or having the verrucæ arranged in crests. Corallum having the cells rather large; star and columella distinct.

Plate 50, figure 7, plate, natural size; 7 *a*, oblique view of surface, with cells enlarged; 7 *b*, same in vertical view; 7 *c*, vertical section, enlarged; 7 *d*, transverse section, ditto.

Feejee Islands. *Exp. Exp.*—Sandwich Islands. *Rev. Mr. Baldwin.*

The plates or folia which constitute the clumps in this species, are as broad as in the *grandis*, and much thinner, with few verrucæ on

their sides. The species has something of the habit of the *ligulata*, but has much broader folia. The specimen from the Sandwich Islands is very similar to that from the Feejees; the summits of the folia are lobed and meandering.

III. *Glomerato-cespitosæ*.

16. *POCILLOPORA INFORMIS*. (*Dana*.)

*P. glomerato-cespitosa*, basi solida, caulibus irregularibus, sæpe gibbosis et acervatis, partim nudis, partim remotè et irregulariter verrucosis. Coralli cellis parvulis ( $\frac{1}{3}$ "), columellâ exiguâ, lamellâque unâ conspicuis.

Glomerato-cespitose, solid at base, branching irregular, often gibbous and acervate, in part naked, in part remotely and irregularly verrucose. Corallum having the cells small ( $\frac{1}{3}$  of a line), a slender columella, and one lamella very distinct.

Plate 51, fig. 3, corallum, natural size; 3 a, view of surface and cells.

The Sandwich Islands.

Forms rough-looking clumps, often a foot through, which are massive at base, and very irregularly subdivided above. The surface is often bare of verrucæ in many parts, and, in others, is very uneven, and gives off rudimentary branchlets or protuberances of various shapes.

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GENUS V.—FAVOSITES.—LAMARCK.

*Favositidæ glomeratæ aut ramosæ; polyphis segregato-aggregatis; itaque corallis structurâ prismaticis aut basaltiformibus; cellis undique contiguis, subangulatis; lamellis 12 interdum latis, sæpissimè omnino obsoletis.*

Glomerate or ramose Favositidæ; polyyps segregato-aggregate, the



coralla therefore prismatic in structure or basaltiform; cells everywhere contiguous, subangular; lamellæ sometimes 12 and broad, but usually quite obsolete.

This genus comprises various fossil corals, which break with a neat prismatic structure, appearing something like a honeycomb, whence the name, from the Latin *favus*. A few species have stellate cells. The transverse septa are in general nearly straight, though sometimes irregular or concave. Excepting the prismatic character, they are very near the Pocilloporæ.

As here characterized, this genus corresponds to the *Calamopora* of Goldfuss, and embraces part of the *Alveolites* of Lamarck. It also includes some of the *Ceriporæ* of Goldfuss. It probably contains three or four distinct groups; yet it is difficult to draw the lines between them from the characters which the imperfect fossil coralla afford. The presence of lateral pores has been appealed to, as distinguishing the true Favosites; but this character is of uncertain application. The polyps of the genus, allowing it the whole extent, have a range of at least eighteen diameters, which is without a parallel in any recent genus of the tribe: there are species with much larger cells than in any recent coral of the Madrepora tribe, and others in which they are among the very smallest. In the Pocilloporæ the range is but three diameters; and in the Madreporæ about four.\* There is strong reason therefore for believing that a line of subdivision must somewhere be drawn. Without indicating its precise character, we here mention a group as it has been adopted by Lonsdale, under the name of Stenopora.

STENOPORA, *Lonsdale* (Chætetes? *Fischer*). Internal structure of corallum fine prismatic, cells of surface minute, subangular, contiguous; zoophytes glomerate or ramose, surface often small-verrucose.

In the verrucose character of the surface, and the flattened forms of the branches, they very closely resemble the Pocilloporæ; but the verrucæ are less prominent, and have the form of very small low conelets. The cells also are like those of that genus in being contiguous or nearly so, and angular, especially at the summits of the

\* In the genus *Astræa* the range is as great as above stated for the Favosites. But these polyps vary correspondingly in the number of the visceral lamellæ, which is not the case in the Madreporacea, twelve being the constant characteristic of the tribe. The large size of some Favosites might even lead us to doubt whether they really belong with the Madreporacea, were it not indicated by the character of the cells.

branches. The *Ceriporæ* of Goldfuss, which have a corresponding internal structure, belong to this genus.

Lonsdale rests his genus *Stenopora* on insufficient characters.\* Radiation of the cells from an imaginary axis is common to all ramose corals branching by furcation (§ 74); and their multiplication by interpolation is the usual mode in the *Favositidæ*, although less apparent in species with solid coralla. The constriction at intervals fails in some species, and also belongs to some *Favosites*: it is an accident of growth, (as its irregularity alone would indicate,) an intermitted mode of increase, not of generic importance. The cells are shallow and often angular; they close at bottom by the forming of septa, like other *Favositidæ*.

GENUS CONSTELLARIA. We separate under this name a species with the compressed branches, internal structure, and surface cells of many of the above genus, but having the verrucæ oblong and arranged in stellate groups over the surface, a character of physiological importance. Glomerate forms may also occur. A species of this genus is named *Ceripora constellata* on the plates of Western fossils by Van Cleve. The genera *Pelagia* and *Lichenopora*, described in the Appendix to the Madreporacea, have a similar stellate arrangement, but they are of doubtful character, and the last has been referred to the Bryozoa group. A recent species described by Michelin, *Lichenopora glomerata*, is quite similar to the *Constellaria* in its surface and the size of the cells; but there are no characters stated which decide that it belongs with the *Favositidæ*.

Lamarck's name *Alveolites* might be extended to the *Stenoporæ*; but the genus was based on a bad character, "a concentric structure, consisting of enveloping layers," and includes some Bryozoa. Fischer's name *Chætetes* should be substituted for *Stenopora*, if its characters admit of it. I know of no copy of the *Oryctology* of Moscow in this country, excepting a few loose numbers of late date.

Goldfuss's genus *Calamopora*, was introduced contrary to strict propriety: Lamarck's name *Favosites*, of prior date, should have re-

\* "A ramose spherical or amorphous tubular polypidom; tubes polygonal or cylindrical, radiated from a centre or an imaginary axis, contracted at irregular distances, but in planes parallel to the surface of the specimen; tubular mouths closed at final (?) period of growth; ridges bounding the mouths, granulated or tuberculated, additional tubes interpolated."—*Strzelecki's N. S. Wales*, p. 262.

ceived from him (if he deemed a change required), a more extended signification, instead of being rejected altogether.

**SUBGENUS FAVISTELLA.** This name is here applied to a part of the true Favosites, in which the cells are stellate with twelve distinct rays, which in some species are quite broad. A species of this subgenus is well figured by Van Cleve in one of his plates of Western fossils, and named *Columnaria alveolaris*.

- |   |   |
|---|---|
| <i>Favosites</i> , Lamarck, Extrait du Cours; Anim. Vert., 2d ed., ii. 319. | <i>Eunomia</i> , Lamour., Exp. Meth., 83; referred here by Blainville.                          |
| —, Blainv., Man. d'Actin., 402.   | <i>Chatetes</i> , Fischer, Oryct. de Moscou, tab. 36, 1830.                                     |
| <i>Alveolites</i> , in part, Lamk., ii. 285.                                | <i>Stenopora</i> , Lonsdale, in Darwin's Volc. Islands; also Strzelecki's New South Wales, 262. |
| —, Blainv., Man. d'Actin., 404.   |   |
| <i>Calamopora</i> , Goldfuss, Petref., 78, pl. 26.                          |   |
| —, Ehrenb., op. cit., G. lxxii.   |   |

#### GENUS VI.—CATENIPORA.

*Favositidæ, gemmis acrogenis uniseriatim latere aggregatis, corallo itaque laminis verticalibus uniseriatim celliferis sæpe sese intersecantibus instructo; septis internis transversis numerosis.*

Favositidæ with the buds acrogenous and aggregated laterally in a single series; the corallum, therefore, consisting of vertical laminæ, often intersecting one another, and containing a single series of cells; transverse septa numerous.

The term *chain coral*, by which the fossils here included are familiarly known, expresses well the appearance of the reticulated lines of oval cells which a transverse section of the corallum presents. The genus was named, by Lamarck, from the Latin *catena*, a chain. No rays have been distinguished in the cells, and this fact led Lamarck to place the group along with the Favosites, Milleporæ, Tubiporæ, and some other species, in his division "Polypiers foraminés." Ehrenberg first arranged it with the other Madreporacea. This genus is named *Halysites*, by Fischer, in his Oryctology of Moscow.

Lamarck, 2d ed., ii. 321; Blainville, Man. d'Actin., 352; Ehrenberg, op. cit., G. lxxi.

## SUBFAMILY III.—HELIOPORINÆ.

*Favositidæ polypis sparsis. Coralli cellis orbiculatis non contiguis, radiis angustis.*

Favositidæ, with scattered polyps; cells of the corallum circular, not contiguous, rays very narrow.

## GENUS VII.—HELIOPORA.—BLAINVILLE.

*Favositidæ glomeratæ aut ramosæ. Coralli cellis parvulis, inæqualibus, remotis, interstitiis minutè cellulosis et penitus subtiliter tubulatis.*

Glomerate or ramose. Corallum with the cells quite small and unequal, remote, interstices minutely cellular and internally fine tubular.

The Helioporæ occur either as glomerate masses, or lamellar and subramose. They are characterized by their small, unequal, pore-like cells, separated by minutely tubular interstices, each of which tubes opens in a pore at the surface. Only a single recent species has been described; and, in this, the surface is covered with smooth granules or points; among which the cells are about a fourth of a line in breadth, and each has a circle of twelve granules around the aperture. The transverse septa are quite distant. It is peculiar also in having a blue colour internally. This blue colour is of animal origin, and is lost on immersion in nitric acid.

This genus was instituted, by Blainville, for the *Pocillopora carulea* of Lamarck, and certain allied fossil species. These fossils, though similar, yet differ from the Helioporæ, in having the interstices irregularly cellular, instead of minute tubular.

The genus HETEROPORA of Blainville (imperfectly characterized by this author), includes some small branched fossils of cretaceous origin, with "two kinds of pores;" one set being three or four times larger

than the others. In this particular they agree with the Helioporæ. They constitute a part of the genus Ceriopora of Goldfuss. The species so called by Lonsdale in Murchison's Silurian System, pl. 15, fig. 14, appears to have the *internal* characters of this genus, except that the tubes are separable, nearly as in the Favosites.

The name Heliopora alludes to the circular cells, and is derived from ἡλιος, *sun*.

HELIOFORA CÆRULEA. (*Pallas.*) *Blainville.*

*H. glomerato-laminata, laminis erectis, variè lobatis aut digitatis, lobis interdum brevissimis; apice 1½-2''' crassis, basi sæpe 9''' superantibus; colore internâ cyaneâ.*

Glomerato-laminate, laminæ erect, variously lobed or digitate, lobes sometimes very short; summits 1½ to 2 lines thick, at base often over ¾ of an inch; internal colour blue.

East Indies. Balabac Passage, North of Borneo. *Exp. Exp.*

This species grows in spreading clumps, a foot or more across, consisting of an aggregate of erect plates, irregularly clustered, and unequally lobed or subdivided above. The plates are often several inches in height. The cells are hardly a fourth of a line in breadth, and the interstices are finely granulous, with rounded pores at the base of the granules.

*β. tuberosa* (plate 52, fig. 2). This name is applied to a tuberoso specimen three inches long, which had no point of attachment, and is covered on all sides with smooth rounded tubercles a third to half an inch in size.

*γ. meandrina.* This singular Heliopora is represented in figure 1, plate 52. It consists of erect meandering plates, of an even height and separated by uniform intervals. The plates are one-third to half an inch thick at top, and the same below. The whole clump is about six inches high and eight broad. If identical with the *cærulea*, the form might have resulted from its having grown near the surface of the water, in consequence of which all the plates became of the same height. It may, however, be distinct, although similar in the character of the surface; and the specimen probably came from the West Indies. Ellis has figured a fragment from the West Indies, on plate 12, fig. 2,

which might well be a fragment from the specimen here described, except that the cells are much too large. (Fig. 1, corallum, natural size; 1 *b*, tubes of a transverse section, enlarged; 1 *a*, surface, enlarged.)

- |   |   |
|---|---|
| <i>Coralloides cærulea Phillipensis</i> , Pettiver, Gazoph., tab. 10, figs. 1, 2.   | <i>Mad. cærulea</i> , Esper, Fortsetz., i. 3, tab. 32; an indifferent figure.   |
| <i>Millepora cærulea</i> , Ellis and Sol., 142, and <i>Mad. interstincta</i> , ibid., 167, tab. 56, figs. 1-3; a characteristic figure of one of its various forms: also, tab. 12, fig. 2, at bottom. | <i>Pocillopora cærulea</i> , Lamk., ii. 444, No. 7. —, Lamour., Exp., 62, pl. 56, figs. 1-3.  |
| <i>Millepora cærulea</i> , Pallas, Zooph., 256, No. 158.  | <i>Heliopora cærulea</i> , Blainville, Man., 392, pl. 61, fig. 3; a figure of a fragment. —, Quoy and Gaymard, Voy. de l'Ast., iv., 252, pl. 20, figs. 12-14; an indifferent figure of a fragment, with a representation of the polyps. |
| —, Ehrenb., G. lxxiv., sp. 1.   |   |

GENUS VIII.—HELIOLITES.—GUETTARD.

*Favositidæ glomeratæ; cellis coralli majusculis, remotis, interstitiis omnino cellulosis et non tubulatis.*

Glomerate; cells of the corallum rather large, distant; interstices cellular throughout, and not tubular.

The Heliolites are closely related to the Helioporæ, but the interstices are irregularly cellular, and, in some species, they wear away on exposure, leaving the tubular cells standing out, like cylindrical columns, quite disunited, except an occasional transverse plate. The cells contain twelve short rays or striations, and around the aperture twelve granules may generally be distinguished, situated like those of the Heliopores. The transverse septa are very numerous, as in the Favosites.

The species of Heliolites have been referred to the genera *Astræa*, *Porites*, and *Millepora*, from which they are far removed. Their distinctive peculiarities were long since understood and appreciated by Blainville, who instituted the genus *Heliopora* to receive them and the recent *H. cærulea*. The character of the interstices give them a different appearance and habit, sufficient, perhaps, to authorize our

retaining the group distinct under Guettard's name. The type of the genus is the *Astræa porosa* of Goldfuss.

Goldfuss, Petref., 64, tab. 21, fig. 73; *Millepora subrotunda*, poris minimis confertis, majoribusque crenatis remotis, Fougé, Linn. Amæn. Acad. i., 203, fig. 24; *Heliolithe pyriforme*, Guettard, Mém., iii. 454, pl. 22, fig. 13, 14; *Heliopora pyriformis*, of Blainville; *Porites pyriformis*, Lonsdale, Murchison's Silurian System, 686, pl. 15, fig. 2.

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GENUS IX.—MILLEPORA.

*Favositidæ incrustantes, glomeratæ, laminatæ aut ramosæ, ramis nunquam teretibus; polyphis sparsis. Corallorum cellis minutissimis et inæqualibus, non contiguis, radiis obsolete, interstitiis vix porosis.*

Incrusting, glomerate, laminate or ramose, with the branches never terete; polyphs scattered. Coralla with the cells very minute and unequal, not contiguous, rays obsolete, interstices scarcely porous.

The Millepores, though forming large zoophytes, consist of very minute polyphs; and the cells of the coralla are consequently extremely small, looking like pin-holes, and without distinct rays. Traces of teeth may sometimes be detected around the margin. Internally they are crossed by septa like the Pocillopores. The interstices are much more solid, and the cells more minute than in the Heliopores.

The animals of the Millepores have never been distinctly made out. The author often had them under the microscope, but detected only a simple disk without tentacles, and was not satisfied that they were fully expanded. Several species, when alive, produce a stinging sensation if the tongue be applied to the surface, and one in the West Indies has been hence called *Sea Ginger*.

The species grow either as simple incrustations or in branched and lamellar forms, often of large size. They are very common in the coral-reef seas, to which, like the Madreporæ, they are mostly confined.

This genus, as instituted by Linnæus, contained numerous corals, with small cells, which were essentially different in other respects. As restricted by Lamarek, it still embraced the Nullipores, in which no cells had been detected (now believed to be Algæ), besides other species, of which the genera *Polytrema*, and *Myrizoum*, have been

made. Blainville reduced it to its present limits, and placed the group near the Madreporæ, but applied to it the name Palmipora, in allusion to the palmate form of many species. Blainville's group Milleporidæ, embraced species of widely different characters.

There is much difficulty in characterizing the Millepores, on account of the variations of form a species undergoes, and the absence of any good distinctions in the cells. The branched species are often lamellate at base, owing to the coalescence of branches, and the lamellate species, as well as the branched, sometimes occur as simple incrustations. Weathered specimens often have the surface very crowdedly pitted with minute cells, which appeared distant before weathering, as but few of them reached the surface.

*Arrangement of the Species.*

I. *Ramose; or lamellate with a ramose or ramoso-lobate margin.*

\*1. *M. alcicornis.*

\*3. *M. pumila.*

\*2. *M. ramosa.*

\*4. *M. tortuosa.*

II. *Lamellate or glomerate incrusting, never digitate or ramose.*

\*5. *M. plicata.*

\*7. *M. squarrosa.*

\*6. *M. complanata.*

\*8. *M. platyphylla.*

I. *Ramosæ, sæpe lamellatæ, et suprâ ramoso-lobatæ.*

I. MILLEPORA ALCICORNIS. (*Pallas.*)

*M. grandis, sublamellata, basi incrustans, frondibus crassis, multifidis, laciniato-palmatis, et sæpe valde subdivisis seu ramosis, ramulis subacutis, superficie levi. Coralli cellis majusculis, numerosissimis.*

Large, sublamellate, incrusting at base, fronds stout, multifid, laciniato-palmate, and often much subdivided or ramose, branchlets subacute; surface smooth. Corallum having the cells rather large, and very numerous.

West Indies.

It is probable that more than one species have been here included by authors. The true *alcicornis* appears to be distinguished by growing in erect subdivided plates, having the margin digitate, or somewhat ramose. Instead of plates there are sometimes broad coalescing



branches. The branchlets are mostly a fourth of an inch or more in thickness. The species is much larger and coarser than the *humilis* or *tortuosa*.

*Sea Ginger, or Palmed Hart's Horn*, Hughes's Barbadoes, 289, with a plate, may be this species; it is from the shores of Antigua.

*Millepora alcicornis*, in part, Linn., Ed., xii. 1282.

—, Pallas, Zooph., No. 161.

—, Esper, i. tab. 6, variety *corniculata*; a characteristic figure of a specimen from the West Indies; tab. 9, variety *nodosa*; probably the same species irregularly ramose, the branches flattened and tuberoso, about a fourth of an inch thick; the extremities appear to have been broken; resembles specimens of the same variety seen by the author, from Barbadoes, in

which the cells are not so distinctly clustered as represented by Esper; it may be a distinct species as made by Ehrenberg; see below, *M. clavaria*.—Esper, tab. 5, variety *digitata*, represents a reticulate frond of coalescing branches, five inches broad, from the West Indies; it is near the *tortuosa* in the size of its branchlets and appearance.

*Millepora alcicornis*, Lamk., ii, 308, No. 3.

—, Oken's Zool., i. 62.

—, Ehrenb., G. lxxiv., sp. 7.

*Palmipora alcicornis*, Blainv., Man., 391, pl. 58, fig. 2; a reduced figure, but characteristic.

The *Millepora clavaria* of Ehrenberg, is, as he states, near Esper's tab. 9, but differs in not having the cells in clusters. It is described as follows: "Pedalis, lobato-divisa, ramosa, ramis brevibus, tuberculosus, clavatis, apice rotundatis, nec cristatis, poris (cellis) crebris, parum regularibus." Locality unknown.—Op. cit., G. lxxiv., sp. 5.

*M. moniliformis*. Under this name we notice a *Millepora* from the West Indies, which occurs incrusting axes of *Gorgonia*, forming a series of disjointed bead-like pieces, some of which are rounded, one to two lines thick, and others have a long process, on one or two sides, while others are broad and lobed. It is figured by Esper, on tab. Gorgon., 15, Pflanz. ii.

## 2. MILLEPORA RAMOSA. (*Pallas*.)

*M. laxè ramosa, ramis divaricatis et longè flexuosis, fere teretibus, ¼–½'' crassis, remotè coalitis, supernè attenuatis et apice acutiusculis. Coralli cellis minutissimis, sparsis.*

Lax ramose, branches every way divaricate and long flexuous, nearly terete,  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch thick, remotely coalescent, attenuated above, and subacute at apex. Corallum having the cells quite minute and scattered.

This species is described from a dendroid specimen in the coral collections of Peale's Museum, Philadelphia. It is remarkable for its

long, even, flexuous, divaricate, branchings. It is probably from the West Indies.

*Millepora alcicornis*, var.  $\beta$ . *ramosa*, Pallas, Zooph., sp. 15; Esper, Pflanz., i., 198, tab. 7; this figure represents a specimen from the West Indies, having nearly the

terete branches and size of that described above, but they are in a single plane; it may be only a variety of the *alcicornis*.

### 3. MILLEPORA PUMILA. (*Dana*.)

*M. pumila* (1-2"), *cespitosa*, *gracillimè palmato-ramosa*, *ramis fermè*  $1\frac{1}{2}$ " *latis*, *ramulis plerumque rectis et simplicibus*, *truncatis*, *tenuibus*, *sæpius*  $\frac{1}{2}$ " *longis*, *et brevioribus*.

Small (1 to 2 inches), cespitose, slenderly palmato-ramose, branches about one and a half lines broad; branchlets mostly straight and simple, truncate, slender, many  $\frac{1}{2}$  an inch long, others very short.

Plate 52, fig. 4, corallum, natural size.

The Harbour of Cartagena, East Coast of South America. *T. R. Peale*.

This is a small and neat species, forming wide-spreading clusters of flat palmate branches, nearly erect, an inch or two long, and delicately fingered.

### 4. MILLEPORA TORTUOSA. (*Dana*.)

*M. cespitosa*, *tenuiter ramosissima*, *ramis compressis*, *plerumque subdigitatis*, *sæpe crebro intricatis et tortuosis*, *interdum in laminas reticulatas digestis*; *ramulis flexuosis*  $1\frac{1}{2}$ -2" *latis*, *compressis*, *obtusis*, *non acuminatis*. *Coralli cellis minutissimis*.

Cespitose, much and slenderly ramose, branches compressed, mostly subdigitate, often crowdedly intricate and tortuous, sometimes in a single plane and reticulately coalescent; branchlets flexuous,  $1\frac{1}{2}$  to 2 lines broad, compressed, obtuse, not acuminate. Corallum with the cells very minute.

Plate 52, figs. 3, 3 *a*, different varieties, natural size; 3 *b*, extremity of branch, showing the minute cells.

Feejee Islands. *Exp. Exp.*

The clumps are tortuously branched, the branches sometimes widening and giving out a cluster of finger-like branchlets nearly in the same plane, and in other parts subdividing irregularly. Below, the branches are a fourth of an inch thick; but above they are generally a little more than an eighth, and at apex scarcely a line. If applied to the tongue or lips when first taken from the water, it produces a stinging sensation. This species is much more slender than the *alcicornis*, and has very minute cells.

The *Sea Ginger*, of Hughes, (Hist. of Barbadoes, p. 289,) appears to be another species, and is probably identical with the *alcicornis*. It is from the West Indies.

The *Millepora alcicornis*, figured by Esper, in his *Pflanz. Fortsetz. i.*, tab. 26, has nearly the size and habit of a variety of the above species, but is described as having quite large cells, for a species of the genus. The specimen was from the island of St. Thomas; it consists of several slender flattened stems about two inches high, which are subdigitate or furcate above, and rise, nearly in the same plane, from a sublamellar base.

II. *Lamellate aut glomerata, nunquam ramosa nec digitato-lobata.*

5. MILLEPORA PPLICATA. (*Esper.*)

*M. grandis, bene lamellatis, erectis, tenuibus, supernè per multas pollices  $\frac{1}{8}$ " crassis, apice acutis; inciso-lobatis, interdum coalitis; lateribus obsoletè rugosis verticaliterque carinatis.*

Large, neatly lamellate, erect, thin, above for several inches from the margin  $\frac{1}{8}$  of an inch thick, and at apex acute; inciso-lobate, sometimes coalescent; lateral surface minutely rugose, and vertically carinate.

The specimen affording this description is a clump of erect folia, some of which are fifteen inches high and six or eight wide, and remarkable for being quite thin, and for two inches from the margin more or less translucent. The surface is finely plicate or vertically carinate, especially near the summits.

*Millepora alcicornis*, variet. *plicata*, Esper, *Millepora complanata*, var. Lamarck, ii. i. 198, tab. 8. Esper alludes to one specimen from Surinam, two feet long. 307, No. 2.

6. MILLEPORA COMPLANATA. (*Lamarck.*)

*M. latissimè lamellata, levis; frondibus erectis, planis, apice paulum divisis, subplicatis, rotundato-truncatis.*

Very broad lamellate, smooth; fronds erect, surface plane, apex somewhat subdivided, subplicate, round-truncate.

West Indies. *Lamarck.*

According to Lamarck, this is a very large and broad foliaceous species. Milne Edwards states that it hardly differs from the *alcicornis*, except that the cells are more numerous and crowded.

*Millepora complanata*, Lamarck, ii. 307, *Palmipora complanata*, Blainv., Man., 391.  
No. 2. The *M. complanata*, of Ehrenberg, (G.  
*Millepora alcicornis*, var.  $\gamma$ , Pallas, Zooph. lxxiv., sp. 2,) from the Red Sea, is near  
261. this species.

7. MILLEPORA SQUARROSA. (*Lamarck.*)

*M. sublamellata, frondibus erectis, basi verrucosis; lateribus verticaliter lamellosis, lamellis subremotis.*

Sublamellate, fronds erect, verrucose at base; sides vertically lamelliferous, lamellæ subremote.

Lamarck states that this species differs widely from the *complanata* in having its fronds contorted, and with prominent longitudinal plates growing from the lateral surfaces. The American seas are mentioned as the probable locality.

$\beta$ . *incrassata*. Under this name we notice specimens obtained at Raraka, in the Paumotu Archipelago, Pacific Ocean, which may be a new species, though hardly distinguishable from Lamarck's species by the description given. The following are its characters (plate 53, figure 1).

Incrusting and forming erect sublamellate fronds, short and stout and subacute from a thick base (two to four inches high and two-thirds

of an inch thick), crowdedly aggregated, and often parallel-wise, with the surface very uneven, either with incipient ridges or tubercular prominences, and adjoining fronds often thus united to one another: the larger cells one-fifth of a line broad, with others smaller interspersed.—The large size of the cells will distinguish even incrusting varieties from the *platyphylla*; besides, the parallel position of the plates and their forms are peculiar. The specimens were collected by J. P. Couthouy. It grows over areas many feet in extent, covering dead corals, and is alive for six or eight inches from the summits. The plates often contain a nucleus of coral of some other species.

#### 8. MILLEPORA PLATYPHYLLA. (*Ehrenberg.*)

*M. basi effusa, frondibus lamellatis erectis, latissimis, 10'' altis, lateribus lamelliferis et coalitis (itaque reticulatis, intervallis 4-6'' latis), apice acutis; superficie levi, obsoletè tuberculosa, tuberculis hemisphericis, aequalioribus.*

Spreading at base, lamellate fronds erect, very broad, 10 inches high, sides lamelliferous and coalescent (and hence zoophytes reticulate with intervals 4 to 6 inches broad), acute at summit; surface smooth, obsoletely tuberculous, tubercles hemispherical, nearly equal.

Red Sea. *Ehrenberg.*—Feejees. *Exp. Exp.*

The above description is taken from Ehrenberg. He gives four feet as the breadth of a clump.

Figure 5, plate 52, represents a specimen from the Feejees, which appears to belong to this species. The larger cells are about one-eighth of a line in diameter. The upper edge of the frond is subacute, mostly a line or a line and a half thick; and below, it is about half an inch in thickness. (5 *a*, surface and cells, enlarged; 5 *b*, appearance of transverse section, natural size; 5 *c*, same, enlarged.)

*β. truncata.* Plate 53, fig. 2, represents another specimen from the Feejees, with the plates large, one-half to one inch thick, and with a flat truncate summit; larger cells about one-eighth of a line, and surrounded by five or six smaller. It may be doubted whether it is a variety of the above (2 *a*, surface and cells, natural size).

*Millepora platyphylla*, Ehrenberg, lxxiv.,  
No. 3.

The *M. porulosa* of Ehrenberg, may be, as he suggests, a variety of the above. It is described as follows: "Pedalis, effusa, efflorescens, foliacea, compressa, levis,

lobis erectis, variè plicatis costisque subreticulatis, cristis acutis, continuis, sublobatis, stellulis [cellis] creberrimis, ab interstitiorum poris non distinctis, prope basin minus frequentibus inæqualibus, medio majore poro [cellâ] minoribus cincto."

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FAMILY III.—PORITIDÆ.

*Madreporacea polypis creberrimis, basi omnino porosè coralligenis, et supernè non coralligenis—itaque polypis expansis sæpius eminentibus, coralli caliculis nullis, cellis contiguis, paulum profundis aut superficialibus, infrà vix dispiciendis.*

Polyps closely crowded, forming continuous porous coral secretions in their lower portions, and not coralligenous towards the summits, —when expanded, therefore, prominent above the surface, and the coralla without calicles, with the cells shallow or superficial and scarcely traceable through the interior of the corallum.

The animals of the Poritidæ, when expanded, often stand like pedicellate flowers over the surface of the zoophyte, and are of various shades of green, red, brown, and lilac. The coralla are equally porous throughout, with scarcely a trace of the cells distinguishable in the interior. The shallow cells of the surface are sometimes wanting entirely, excepting a point to mark their position; they are usually granulous over the interior and bottom; but there is, in most species, a stellate arrangement of the echinulate granules. This family includes the two genera *Porites* and *Goniopora*; the former with but twelve tentacles, and the polyps hardly a line in diameter; the latter with larger polyps and more than twelve tentacles. In the texture of the coralla, the irregularly radiate character of the shallow contiguous cells, and the frequently salient polyps, they are closely alike. (See note, page 407.)

## GENUS I.—PORITES.—CUVIER.

*Poritidæ polypis 12-tentaculatis, lineam latitudine non superantibus, zoo-phytis glomeratis et furcato-ramosis, ramis nunquam bene teretibus, apice obtusis. Coralla omnino porosa, cellis parvulum profundis aut superficialibus, intus radiatim granulosis.*

Polyps with 12 tentacles, and not exceeding a line in breadth; zoo-phytes glomerate and furcato-ramose; branches never neatly terete, obtuse at apex. Coralla throughout porous; cells shallow or superficial, radiately granulous within.

The Porites are among the most important of reef-forming zoophytes. They are various in their forms and sizes, occurring either as incrustations, or closely ramose, or glomerate in rude hillocks or rounded masses. Some of the latter, met with by the author, had a circumference of sixty feet. The branches are often coalescent, and sometimes into sublamellar forms; but foliated varieties have not been seen. The cells are never over a line in diameter, and rarely as deep as their breadth. They are either conical within, or very shallow cylindrical (fig. 5), and the septa are acute, and quite thin, or have some little breadth; but, when broadest, the septa or interstices do not exceed in breadth half the diameter of the cell. Figures 7 to 12, on plate 53, illustrate the principal forms, while figures 3 *a*, 5 *a*, on the same plate, and others, on the following, represent their interior structure. The form in figure 7, is found in the *P. favosa* and *P. mordax*; that in figure 8, in the *P. compressa*, *P. lobata*, and *P. conglomerata*; that in figure 9, in most specimens of the *P. nigrescens*, towards the extremities of the branches; that in figure 10, in the *P. punctata*; that in figure 11, in the *P. fragosa*; and that in figure 12, in the *P. astræoides*. Within the shallow cell, six points or irregular granules may commonly be distinguished around the central point or pore, and twelve others around the six; and often one of the six, with two of the twelve, form together an imperfect letter V. In some species (*P. astræoides*), with deeper cells, there are twelve distinct and nearly vertical lamellæ, with a short columella at centre.

The polyps of this genus were first examined and figured by Lesueur, and subsequently by Quoy and Gaymard. They approach those of the *Alveoporæ*, among the *Favositidæ*.

These zoophytes are confined to the coral-reef seas. They occur in the West Indies, as well as in the Pacific and Indian Oceans; but the branched species of the former region are generally remarkable for a less durable texture.

The genus *Porites*, as restricted by Lamarck, contained various unallied species, characterized by their minute cells. Blainville separated from it the genera *Sideropora*, *Alveopora*, and *Heliopora*, which a farther study of the animals has sustained; and to these, the genus *Manopora* is added in this work.

The *Porites pyriformis* of Lonsdale and other allied species, are related to the *Heliopora*, with which they were arranged by Blainville.

The genus *Porites*, as here received, contains the *Madrepora Porites*\* of Linnæus, Pallas, and other early authors, from which the name was derived.

This genus graduates into *Alveopora* and *Manopora*; yet the species of the latter groups are distinct, in their deeper and delicately stellate cells, which in the *Manopora* are not contiguous. When the cells of the *Manopora* are quite minute, the internal texture of the corallum approximates to that of the *Porites*, both in its general porous character, and the difficulty of tracing the cells through it. The *P. astræoides* has nearly the short twelve-rayed star and columella of some *Pocillopora*, though wholly different from them in the texture of the corallum.

#### *Arrangement of the Species.*

A. Ramose, branches often compressed, but not plicate.

I. *Cells excavate.*

\*1. *P. mordax.*

\*5. *P. furcata.*

\*2. *P. compressa.*

6. *P. recta.*

\*3. *P. clavaria.*

\*7. *P. divaricata.*

\*4. *P. flexuosa.*

II. *Cells superficial or none.*

\*8. *P. nigrescens.*

\*10. *P. levis.*

\*9. *P. palmata.*

\*11. *P. cylindrica.*

B. Branches plicate.

\*12. *P. contigua.*

\* The *Porites clavaria* of Lamarck.



## C. Glomerate or lobato-glomerate.

I. *Cells excavate.*

- |                              |                            |
|------------------------------|----------------------------|
| *13. <i>P. astræoides.</i>   | *17. <i>P. limosa.</i>     |
| *14. <i>P. conglomerata.</i> | *18. <i>P. favosa.</i>     |
| *15. <i>P. lobata.</i>       | *19. <i>P. cribripora.</i> |
| *16. <i>P. fragosa.</i>      |                            |

II. *Cells none.*

- |                          |                             |
|--------------------------|-----------------------------|
| *20. <i>P. informis.</i> | *22. <i>P. monticulosa.</i> |
| *21. <i>P. erosa.</i>    |                             |

## D. Thin incrusting.

- |                            |                         |
|----------------------------|-------------------------|
| *23. <i>P. lichen.</i>     | 25. <i>P. arenacea.</i> |
| *24. <i>P. reticulosa.</i> |                         |

A. *Ramosæ, ramis non plicatis.*I. *Cells excavatis.*1. PORITES MORDAX. (*Dana.*)

*P. cespitosa*, 3½–4" *animata*; *ramis subsimplicibus et compressiusculis, infrà in laminam sæpe coalitis; ramulis 1½–2" longis, ½" crassis, ½–1" latis, apice plano-rotundatis, non clavatis. Corallum robustum, valdè asperatum, cellis grandibus (¾"), profundis, et conicis, septo acuto, scabro.*

Cespitose, alive for 3½ to 4 inches; branches subsimple and somewhat compressed, below, often coalescing into a plate, branchlets 1½ to 2 inches long, ½ of an inch thick, and ½ to 1 inch broad, plano-rotund at apex, not clavate. Corallum strong and firm, with the surface harsh; cells large (¾ of a line), deep, and conical; septum acute, scabrous.

Plate 53, fig. 3, corallum, natural size; 3 a, cell, enlarged.

Sandwich Islands. *Exp. Exp.*

Forms rather open clumps, ten inches broad and six to eight high, consisting of stout branches, often united below into thick plates or cavernous masses. The texture is firm, and the surface peculiarly rough and harsh, being pitted with large and deep cells, having sharp septa, often with the angles prominent. There are seven or eight cells

in a breadth of half an inch. Some specimens are massive and sublamellar, with obtuse lobes above, instead of proper branches.

The species somewhat resembles the *Lesueurii*, in the large size of its cells, but differs in their conical shape, the acute septa, and, more strikingly still, in the corallum being strong instead of fragile.

*β. elongata.* (Plate 53, fig. 4.) This figure represents a specimen eight inches high, consisting of three or four stout stems from a common base, which is two inches through, and sparingly branched above. The upper branches are two to three inches long, an inch thick at base, and half an inch at apex. The cells are very similar to those of the above, yet a little smaller, about ten being counted in half an inch.

## 2. PORITES COMPRESSA. (*Dana.*)

*P. cespitosa*, 1½–2" *animata*, *sublamellata*, *et erecta*, *coalita*, *lobata seu lobato-ramosa*, *lobis compressis*, ½–¾" *latis* (*raro* 1½"), *brevibus* (½"), *apice subtruncatis et 3–4" crassis*, *non clavatis*. *Corallum robustum*; *cellis* ½" *latis*, *bene polygonis*, *paululum profundis*, *plano-conicis*; *septis acutis*, *tenuibus*.

Cespitose, alive for 1½ to 2 inches, sublamellate, and erect, coalescing below, lobed above or lobato-ramose, lobes compressed, ½ to ¾ of an inch broad (rarely 1½ inches), short (½ an inch), subtruncate at summit, and 3 to 4 lines thick, not at all clavate. Corallum firm; cells ½ a line broad, neatly polygonal, quite shallow, plano-conical; septa acute and very thin.

Plate 53, fig. 5, corallum, natural size; 5 *a*, cell, enlarged; fig. 8, outline of same.

Sandwich Islands. *Exp. Exp.*

The clumps are six inches or more broad, and four high, but are alive only at summit for two inches or less. Below, it is very coalescent, almost forming a solid mass, with a few large vacuities. In some specimens, the broad lamellate structure is scarcely apparent. The depth of the conical cells scarcely exceeds one-fourth the breadth; and the septa are very thin.

The texture is much firmer than in the West India species allied.



## 3. PORITES CLAVARIA. (Ellis.) Lamarck.

*P. breviter cespitosa*, 2" animata; ramis flexuosis et incrassatis, latè clavatis, apice compressis et lobatis, 1-2" latis et 6-9" crassis, interdum subflabellatis, valde obtusis; polypis valde salientibus; tentaculis albidis, brevibus, disco brunneo, oris margine albo. Corallum porosissimum, apice spongiosum, cellis paulum excavatis, subconicis aut fundo planis, majusculis, (fere  $\frac{3}{4}$ " latis); septis tenuibus, acutis.

Short cespitose, alive for 2 inches; branches flexuous, and quite stout, broad clavate, with the summits compressed and lobed, 1 to 2 inches broad, and  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch thick, sometimes subflabellate, very obtuse; polyps very salient; tentacles whitish, short, disk brown, margin of the mouth white. Corallum very porous, spongy at summit; cells shallow, subconical or plane within, rather large (nearly  $\frac{3}{4}$  of a line broad); septa thin and acute.

West Indies. Ellis. Lesueur.

This species is remarkable for its short and stout, flexuous, club-shaped branches, with the summits of the corallum spongy. They are scarcely over an inch in length, before furcation commences again. The cells are rather large (eight to nine being counted in half an inch), but they have not the broad and obtuse septa of the following species. The polyps were examined by Lesueur.

<i>Mad. porites</i> , Ellis and Solander, 172, tab. 47, fig. 1; a characteristic figure, but the cells are rather large, and too distant, and the line between the live and dead portion is not distinguished; the enlarged view is good.	<i>Porites clavaria</i> , in part, Lamk., ii. 435, No. 5. —, Lamour., Exp., 61, tab. 47, fig. 1. —, Lesueur, Mém. du Mus., vi., 289, fig. 17, pl. 17. —, Blainville, Man., 396.
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## 4. PORITES FLEXUOSA. (Dana.)

*P. breviter cespitosa*, 2 $\frac{1}{2}$ " animata; ramis flexuosis, divaricatis, brevibus,  $\frac{1}{2}$ - $\frac{2}{3}$ " crassis, apice dilatatis, valdè obtusis aut subtruncatis, interdum subflabellatis, 1" latis et lobatis. Corallum fere porosissimum, apicè spongiosum, cellis grandibus fere  $\frac{4}{5}$ " latis, paulum excavatis, fundo planis, septis obtusis.

Short cespitose, alive for  $2\frac{1}{2}$  inches; branches flexuous, divaricate, quite short,  $\frac{1}{2}$  to  $\frac{2}{3}$  of an inch thick, dilated at apex, very obtuse or subtruncate, sometimes subflabellate, 1 inch broad, and lobed. Corallum quite porous, spongy at apex; cells large (nearly  $\frac{1}{2}$  of a line broad), shallow, flat at bottom, septa obtuse.

Barbadoes, West Indies.

The habit of this species is much like that of the *clavaria*, but the branches are smaller, the cells of the corallum larger, the septa obtuse, and one-third as broad as the breadth of the cell. There are about seven cells to a breadth of half an inch.

#### 5. PORITES FURCATA. (*Lamarck.*)

*P. breviter cespitosa*, 1– $1\frac{1}{4}$ " *animata, tortuosè ramosa, ramis divaricatis, compressiusculis,  $\frac{1}{3}$ – $\frac{2}{3}$ " crassis, interdum 1" latis, et subflabellatis; apice subtruncatis, furcatis et tri-furcatis. Corallum porosius, apice subspongiosum; cellis parvulis, viz  $\frac{2}{3}$ " latis, paulum excavatis, subconicis aut fundo planis, septis tenuibus et acutis.*

Short cespitose, alive for 1 to  $1\frac{1}{4}$  inches, tortuously ramose, branches divaricate, somewhat compressed,  $\frac{1}{3}$  to  $\frac{1}{2}$  an inch thick, sometimes 1 inch broad, and subflabellate; apex subtruncate, furcate or trifurcate. Corallum quite porous, apex rather spongy; cells small, scarcely  $\frac{2}{3}$  of a line broad, a little excavate, subconical or flat at bottom; septa thin and acute.

West Indies.

This species has the habit of the *flexuosa*, but the cells of the corallum are much smaller, and the live part is but an inch or rarely an inch and a half in length. The above description is drawn from specimens from Barbadoes, and agrees with Lamarck's. The colour of the specimen is a dark brown, as far as alive; below this it is white with incrusting Nullipores.

*Porites furcata*, Lamk., ii. 437, No. 8.  
*Heliopora furcata*, Blainville, Man., 392.

The *Porites flabelliformis*, of Lesueur,  
(Mém. du Mus., vi. 289,) may be identical with the above.

6. PORITES RECTA. (*Lesueur.*)

*P. cespitosa*, 1-1 $\frac{1}{4}$ " *animata*; *ramis rectis, remotis, compressiusculis, divaricatè furcatis, rotundatis*; *polypis cylindricis salientibus, brunnescentibus*; *tentaculis brevibus*. *Corallum porosius, cellis parvulis, excavatis*; *radiis denticulatis*.

Cespitose, alive for 1 to 1 $\frac{1}{4}$  inches; branches straight, remote, somewhat compressed, divaricately furcate, rounded at summit; polyps salient, cylindrical, tinged with brown; tentacles short. *Corallum* rather porous, the cells small, excavate; rays denticulate.

St. Bartholomew and St. Christopher's, West Indies. *Lesueur.*

The above description is from Lesueur. He describes the species as occurring in tranquil waters in the sand, from which it is easily detached, and growing to a height of two or three inches. The polyps are salient about their diameter above the cells. The summits of the tentacles are white, with a semicircle of a deep sienna-brown. It has smaller and less tortuous branches than the *clavaria*.

*Porites recta*, Lesueur, Mém. du Muséum, *Corallium poris stellatis, crassum, nodosum, ramis fere teretibus, levibus* (?),  
vi. 287, pl. 17, fig. 16. Seba, Thes. iii., tab. 109, fig. 11.

7. PORITES DIVARICATA. (*Lesueur.*)

*P. cespitosa*, 1-1 $\frac{1}{2}$ " *animata*; *ramis valde gracilibus* (3-4"), *compressiusculis, divaricatis et flexuosis, interdum reflexis, apice rotundatis, saepe furcatis*. *Corallum fragile*; *cellis parvulis* ( $\frac{1}{2}$ "), *excavatis*.

Cespitose, alive for 1 to 1 $\frac{1}{2}$  inches; branches quite slender (3 to 4 lines thick), somewhat compressed, divaricate and flexuous, sometimes reflexed; apex rounded, often furcate. *Corallum* fragile; cells small ( $\frac{1}{2}$  a line broad), excavate.

Guadeloupe, West Indies. *Lesueur.*

This species is far more slender than either of the preceding, and has a very divaricate and flexuous mode of branching. The furcate

extremities are scarcely more than a third of an inch in breadth, and about two lines thick.

*Porites divaricata*, Lesueur, Mém. du Mus., vi. 288.

NOTE.—Esper figures, on plate 59, what appears to be another species, with *excavate* cells, differing from either of the preceding. This character of the cells is particularly mentioned in the description. It has in other respects the habit of the *cylindrica*, growing in a clump of slightly divergent crowded stems; the branches are, however, less regular, though nearly of the same size. His specimen was from Madagascar. It may be designated the *P. conferta*. *Madrepora conglomerata*, Esper, Fortsetz. i. 71, tab. 59.

II. *Cellis vix excavatis, aut omnino superficialibus.*

#### 8. PORITES NIGRESCENS. (*Dana.*)

*P. ramosa, cespitosa, 6–8'' animata; ramis elongatis, crebriusculis, sensim attenuatis, interdum coalitis, flexuosis, subteretibus, obtusis, caulibus basi interdum 1–1½'' crassis, ramulis ⅓–½'' crassis et 2–2½'' longis. Corallum subrobustum; cellis majusculis, vix excavatis aut superficialibus; septis latis granulosis.*

Ramose, cespitose, alive for 6 or 8 inches; branches elongate, rather crowded, sometimes coalescing, flexuous, subterete, gradually tapering, obtuse; stems occasionally 1 to 1½ inches thick at base, branchlets ⅓ to ½ an inch thick and 2 to 2½ inches long. Corallum firm; cells rather large, scarcely excavate or superficial; septa broad and granulous.

Plate 54, fig. 1, corallum, natural size; 1 *a*, surface with the cells enlarged; 1 *b*, transverse section, enlarged.

Feejee Islands. *Exp. Exp.*

The clumps are eight inches or more high, and much branched, and become black or nearly so on the death of the polyps. The subterete branches are long and somewhat tapering, a little flexuous and distantly coalescent. Above, the cells are a little excavate, but below, they are superficial; they are usually black, with the septa dark brown, and there are about eight to a half inch. Under the microscope the surface appears granulous.

One specimen differs from the others in being a simple stem diva-

ricately branched, two inches thick below, and irregularly tapering to an apex of one-sixth of an inch; the cells and the septa are both of a very dark brown colour.

*β. mucronata.* (Plate 54, fig. 2.) The variety (?) thus designated, is from the Sooloo Sea. The clump is five inches or so across, of a very deep brown colour, and is divaricately branched, with stout tapering branches and branchlets, mostly terete, and below often compressed. The branchlets are about half an inch in diameter at base, and one to one and a half inches long, and are often coalescent. The cells are scarcely excavate, and there are about seven or seven and a half to half an inch; the septa are granulous and nearly half as broad as the cells. The *six* points around the centre of a cell are small but distinct, with the interstices large and deep, the deep shades of which set off the points and give a darker colour to the cell than is presented by the general surface of the corallum.

*Madrepora porites*, Esper, i. 133, tab. 21 A.—A passable figure of some specimens.

#### 9. PORITES PALMATA. (*Dana.*)

*P. cespitosa*, 3-4" *animata*; ramis latè flabellatis, interdum 2" latis et  $\frac{1}{4}$ " crassis, et apice breviter lobatis aut digitatis, infernè sæpe coalitis, lobis compressis,  $\frac{1}{2}$ -1" longis, obtusis, raro elongatis et teretibus. Corallum subfragile; cellis superficialibus aut vix excavatis, parvulis ( $\frac{1}{2}$ "), septis ramorum apice acutis.

Cespitose, alive for 3 or 4 inches; branches broad flabellate, sometimes 2 inches broad,  $\frac{1}{4}$  thick, and short-lobed or digitate at apex; below often coalescing, lobes compressed,  $\frac{1}{2}$  to 1 inch long, obtuse, occasionally elongate and terete. Corallum somewhat fragile; cells superficial or slightly excavate, small (half a line); septa about the upper parts of the branches acute.

Plate 54, fig. 3, corallum, natural size; 3 a, cells, enlarged.

Sooloo Sea, East Indies. *Exp. Exp.*

Occurs in large clumps much crowded and anastomosing below. Only a dead specimen was obtained, and this was partly covered with the variety *mucronata* of the *nigrescens*, from the same locality.

10. PORITES LEVIS. (*Dana.*)

*P. cespitosa*, 6'' vel plures animata; ramis elongatis, furcatis, subteretibus, vix compressis, irregulariter inflatis; infra, 1-1½'' crassis, apice obtusis et 3-4'' latis; polypis brevissimis, brunneis, tentaculis minutis, apice albidis. Corallum subrobustum; cellis omnino superficialibus, vix conspicuis.

Cespitose, alive for 6 inches or more; branches long, furcate, subterete, scarcely compressed, irregularly inflated, below, 1-1½ inches thick, obtuse at apex and 3 to 4 lines broad; polyps very short, brown; tentacles minute, with whitish tips. Corallum rather firm, surface smooth; cells wholly superficial, scarcely distinguishable.

Plate 54, fig. 5, part of zoophyte, natural size; 5 *a*, 5 *b*, polyps, enlarged; 5 *c*, surface, enlarged; 5 *d*, cross section, ditto.

Feejee Islands. *Exp. Exp.*

The *Madrepora porites*, of Esper, as figured on his plate 21, is near the above species. It is a branched stem, five inches high, nearly an inch broad below, subcompressed, obtuse, and often bilobate above, with superficial cells, and alive throughout. The stars as figured are more distinct than in the *levis*; in the enlarged figure (fig. 2), six points are represented surrounding a central one.

11. PORITES CYLINDRICA. (*Dana.*)

*P. cespitosa*, 1-2'' animata; caulibus erectis creberrimis, sæpe coalitis, bene cylindricis, infernè ½-⅔'' crassis, apice sæpe furcatis, rotundatis, ramulis 1'' longis et ⅓'' crassis. Corallum subrobustum; cellis omnino superficialibus, inconspicuis.

Cespitose, alive for 1 to 2 inches; branches erect and very much crowded together, often coalescing, neatly cylindrical, below ½ to ⅔ of an inch thick, often furcate at apex, and rounded; branchlets 1 inch long and ⅓ of an inch thick. Corallum rather firm; cells wholly superficial, indistinct.

Plate 54, fig. 4, corallum of part of a clump, natural size.

Feejee Islands (?). *Exp. Exp.*



Forms very closely crowded clumps of erect stems, six inches or more high, very slightly flexuous or straight, and neatly cylindrical. It is peculiar in being alive only for an inch or two, and in its indistinct stars without any appearance of cells. It has the general habit of the *conferta*, but differs in its more regular stems and in the absence of excavate cells.

B. Ramis plicatis aut crispis.

12. PORITES CONTIGUA. (*Esper.*) *Dana.*

*P. cespitosa, crebro ramosa, supernè convexa, 2½'' animata; ramis compressis, lobatis-crispis, et angulatis, apice 1½-3''' crassis, obtusis. Corallum robustum, cellis nullis, porâ minutissimâ inconspicuâ (lynceo inspectâ) per granulas subtilissimas sex circumdatâ, granulis aliis sparsis.*

Cespitose, crowdedly ramose, above convex, alive for 2½ inches; branches compressed, crispate, lobed and angular, 1½ to 3 lines thick at summits, obtuse. Corallum firm; cells none, a very minute indistinct pore (seen by a lens), surrounded by six granules, other granules scattered.

Plate 54, fig. 6, part of clump of corallum, natural size; 6 a, surface, enlarged.

Feejee Islands. *Exp. Exp.*

Forms low even-top clumps, a foot broad or more, and ten inches or so high, very crowdedly branched; the branches are angular, nodosely subdivided, and often subflabellate and plaited above. It resembles the *Psammocora obtusangula* (*Pavonia* of Lamarck), but differs in its less neatly plicate branches, and fundamentally in the six points which surround the polyp-pores of the corallum, and prove its connexion with the Madreporæ family.

*Mad. contigua*, *Esper*, *Fortsetz.* i. 81, *Pavonia plicata*, *Lamk.*, ii. 378, No. 6. tab. 66. —, *Blainville*, *Man.*, 365.

C. Glomeratæ, aut lobato-glomeratæ.

I. *Cellis excavatis*.

13. PORITES ASTRÆOIDES. (*Lesueur*.)

*P. incrustans, undato-gibbosa, crassa; polypis sulphureis; tentaculis brunneis, apice flavis puncturâ nigrâ notatis. Corallum robustum, cellis majusculis, subangulatis, aut orbiculatis, cylindricis et profundis, lamellis radiatis 12 verticalibus, centro columellâ brevissimâ, septis subacutis.*

Incrusting, undate and somewhat gibbous, polyps sulphur-yellow; tentacles brown, yellow at tip, with a black puncture at the extremity. Corallum firm, cells rather large, subangular or circular, cylindrical and deep, with 12 radiating lamellæ, nearly vertical and narrow, and at centre a very short columella.

Guadaloupe, West Indies. *Lesueur*.

The incrusting plates are thin when small, but often become quite thick, and have an irregularly undulate or subgibbous surface. The cells are peculiar in being distinctly 12-rayed, with the rays narrow and vertical.

*Porites astræoides*, *Lesueur*, *Mém. du Mus.*, —, *Blainville*, *Man.*, 395, pl. 61, fig. 5; vi. 287, pl. 16, fig. 15.

a recognisable figure.

*Porites astræoides*, *Lamk.*, ii. 435, No. 3.

14. PORITES CONGLOMERATA.

*P. subglobosa, gibboso-glomerata. Corallum cellis angulatis paulum excavatis, plano-conicis, vix majusculis ( $\frac{2}{3}$ "); septis tenuissimis, acutis.*

Subglobose, gibboso-glomerate. Corallum having the cells angular, quite shallow, flat-conical, rather small ( $\frac{2}{3}$  of a line); septa very thin and acute.

Plate 55, fig. 3, corallum, natural size; 3 a, cell, enlarged.

The Pacific and Indian Oceans.—Feejee Islands. *Exp. Exp.*

The above description is taken from a Feejee specimen, having a nearly globular form with an uneven or monticulose surface, and very shallow plano-conical cells, with acute interstices. There are about nine cells to half an inch.

The *Porites conglomerata* of Lamarck and others includes all the massive species of this genus. The name is applied to the above on the ground of Esper's fig., tab. 59 A.

The *Porites conglomerata*, of Ellis and Solander, tab. 41, fig. 4, which is usually referred to this species, has more resemblance to a dried Alcyonium, as was suggested by Ehrenberg.

The *P. conglomerata* of Quoy and Gaymard (Voy. de l'Ast., iv. 249, pl. 18, fig. 6-8), is some other species; but which, is not determinable from the indifferent figure and description.

The *P. conglomerata* of Ehrenberg, from the Red Sea, may be the above: "Semipedalis, et subpedalis, glomerata, globosa, gibbosa, sublobata, cellis parvis ( $\frac{1}{2}$ " latis) obsoletè hexagonis, contiguis, arenoso-scabris." "Esperi Icon. tab. 59, A. eongruit."

The *Madrepora solida* of Forskal (Icon. p. 131), is one of the massive Porites.

#### 15. PORITES LOBATA. (Dana.)

*P. lobato-glomerata, crasso-lamellosa et gibbosa. Corallum robustum cellis angulatis, paulum excavatis, plano-conicis, majusculis (fere  $\frac{3}{4}$ " ); septis tenuissimis, acutis.*

Lobato-glomerate, very thick lamellar, and gibbous. Corallum having the cells angular, plano-conical, rather large (nearly  $\frac{3}{4}$  of a line); septa very thin and acute.

Plate 55, fig. 1, corallum, natural size; 1 *a*, 1 *b*, cells, enlarged.

Sandwich Islands. *Exp. Exp.*

This species is very similar in its cells to the *conglomerata*, and may prove to be only a variety of that species. It, however, grows in deeply divided glomerate forms, not spheroidal, and sometimes rising into broad lamellar lobes or plates, an inch or more thick, or forming subcylindrical branchlets, half to one inch long. The mass below often consists of broad, compressed, coalescing plates, one to three inches thick. There are eight or nine neatly polygonal cells to a half inch, separated by very thin septa.

16. PORITES FRAGOSA. (*Dana.*)

*P. grandis*, arrecto-glomerata, superficie subangulata et crassè monticulosa. Corallum robustum, cellis subangulatis, paulum excavatis, vix majusculis ( $\frac{2}{3}$ "), fundo planis; septis obtusis.

Erect glomerate, with the surface subangular and coarsely monticulose. Corallum having the cells subangular, shallow, rather small ( $\frac{2}{3}$  of a line broad), plane at bottom; septa obtuse.

Plate 55, fig. 9, surface of corallum, natural size; 9 a, cells enlarged.

Feejee Islands. *Exp. Exp.*

The general form of this species is nearly that of the *conglomerata*, though higher in proportion to the breadth; the cells differ in being flat at bottom and separated by septa sometimes one-fourth the breadth of the cell. One specimen from the Feejees measures a foot in height and seven inches in diameter. There are nine or ten cells to half an inch in breadth. The interior is very finely compact, and evenly so, without more compact layers at intervals.

17. PORITES LIMOSA. (*Dana.*)

*P. gibboso-subglobosa*. Corallum robustum cellis paulum excavatis, grandioribus ( $\frac{4}{7}$ " latis), fundo planis; septis obtusis, tenuibus.

Gibboso-subglobose. Corallum having the cells shallow, large ( $\frac{4}{7}$  of a line broad), plane at bottom; septa obtuse, but thin.

Plate 55, fig. 2, corallum, natural size; 2 a, cells, enlarged.

The Feejee Islands, in shallow waters, near the shores, where often muddy. *Exp. Exp.*

The cells of the corallum, though resembling those of the *fragosa*, are much larger, about seven occupying an interval of half an inch. The six points around the centre of the cell are quite prominent. The specimen in the collections is a disk-shape mass, three inches thick, and eight in diameter, with lobed sides, and having the upper

surface dead, arising from the lodgment of dirt upon it, which had led to its growing laterally, without upward increase. The species appears to grow in more impure waters than most others of the genus.

18. PORITES FAVOSA. (*Dana.*)

*P. crasso-columniformis, superficie subgibbosa, apice truncata. Corallum robustum cellis profundis, majusculis, conicis; septis acutis.*

Stout columniform, surface subgibbous, summit truncate. Corallum having the cells deep, rather large, conical; septa acute and durable.

Plate 55, fig. 4, corallum, natural size; 4 a, cells, enlarged.

Feejee Islands. *Exp. Exp.*

This species resembles the *mordax* in its deep conical cells (as deep as their breadth), and strong acute interstices, and differs in this character from either of the preceding massive species. There are seven or eight cells to half an inch. The specimen in the collections is four inches in height, and three by two in breadth; it was alive throughout.

19. PORITES CRIBRIPORA. (*Dana.*)

*P. incrustans et glomerata, margine crasso et involuto, superficie gibbosa. Corallum robustum cellis parvulis, punctiformibus, seu conicis; septis obtusis.*

Incrusting and glomerate, margin of the incrusting mass stout, and involuted or folded under; surface small gibbous. Corallum having the cells quite small, punctiform or conical; septa obtuse.

Plate 55, fig. 5, corallum, natural size; 5 a, cell, enlarged.

Feejee Islands. *Exp. Exp.*

Incrusts dead coral, with a layer one-fourth to half an inch thick. The thick involuted margin and small puncture-like cells (about twelve to half an inch), are important characters. It has some resemblance to Ellis's figure 4, tab. 41.

II. *Cellis omnino superficialibus.*20. PORITES INFORMIS. (*Dana.*)

*P. arrecto-glomerata, gibbosa-lobata et parce erosa; polypis flavescens et brunneis, tentaculis obsoletis. Corallum cellis nullis, stellis non conspicuis, porâ centrali minutissimâ, inconspicuâ, sex granulis circumdatâ, exterioribus duodecim sparsis.*

Stout erect glomerate, gibbous lobed, and sparingly erose; polyps pale-yellow, surrounded by brown, tentacles obsolete. Corallum without cells, stars scarcely distinguishable, central pore very minute, and surrounded by six granules; the outer 12 granules scattered.

Plate 55, fig. 6, corallum, natural size; 6 *a*, polyps and surface of zoophyte, enlarged; 6 *b*, cells and surface of corallum, enlarged; 6 *c*, part of transverse section.

Feejee Islands. *Exp. Exp.*

This species differs from the *erosa*, in not growing in flat-top columnar forms, and also in its cells. The specimen is an irregular mass, three inches through, with a few nodular elevations.

21. PORITES EROSA. (*Dana.*)

*P. arrecto-glomerata, columniformis, 2½" animata; apice plano-truncata, erosa et profundè incisa; superficie laterali parcè monticulosâ et rarè subcarinatâ. Corallum cellis nullis, stellis paulum conspicuis, ad summitates inconspicuis, granulis sex et duodecim regularibus.*

Stout erect glomerate, columniform, alive for 2½ inches; truncate at summit, erose and deeply incised; lateral surface sparingly monticulose, and rarely subcarinate. Corallum without cells, stars rather distinct, except at apex, circles of 6 and 12 granules regular.

Plate 55, fig. 8, corallum, natural size; 8 *a*, cell, enlarged.

Sooloo Sea. *Exp. Exp.*

The columnar masses are lobed above, and deeply erose. The specimen in the collections is three inches high, and four in diameter, with a nearly flat summit. The sides are much less uneven than in the *monticulosa*, the summits more flat, and the granules of the intervals between the stars are not similar to the granules of the cells.

## 22. PORITES MONTICULOSA. (Dana.)

*P. arrecto-glomerata, columniformis, et lobata, apice rotundato-truncata; superficie undique angulatè erosâ aut monticulosâ, monticulis lateralibus crebris sæpe subtriangulatis et ascendentibus, nunquam in carinas digestis, apicalibus paulo minoribus; polyphis brunneis, labris semilunatè lutescentibus, tentaculis obsoletis albidis. Corallum cellis nullis, stellis vix conspicuis, porâ centrali minutissimâ.*

Stout erect glomerate, columniform or erect lobed, apex round-truncate; surface every where angularly erose or monticulate; lateral monticles crowded, often subtriangular and ascending, never coalescing into carinate ridges, the apical a little smaller; polyps brown, the lips semilunate and yellow, tentacles whitish, obsolete. Corallum with no cells, stars scarcely distinguishable, central pore very minute.

Plate 55, fig. 7, corallum, natural size; 7 *a*, polyps, enlarged; 7 *b*, cells, enlarged; 7 *c*, part of a transverse section, ditto.

Feejee Islands. *Exp. Exp.*

The specimen in the collections is five and a half inches high, and four and a half by three in breadth at base. The columniform lobes are one to three inches in diameter, and two inches or so long, and have nearly rounded summits.

D. Tenuiter incrustantes.

## 23. PORITES LICHEN. (Dana.)

*P. incrustans, 1/8'' crassa, undulata, margine subacuto, sæpe revoluta, et paulum libero, superficie infernâ levi aut obsoletè plicatâ. Corallum*

*cellis paulo excavatis, viz  $\frac{2}{3}$ " latis, fundo planis, septis tenuibus, filiformibus, sæpe supernè productis (superficie itaque reticulatâ).*

Incrusting,  $\frac{1}{8}$  of an inch thick, undulate, margin subacute, often flexed upward, and free for a third of an inch; under surface smooth, or obsoletely plicate. Corallum having the cells shallow, and often prominent in minute, thin ridges, which give the surface a reticulate appearance.

Plate 56, fig. 2, corallum, natural size.

Feejee Islands. *Exp. Exp.*

24. PORITES RETICULOSA. (*Dana.*)

*P. incrustans, undulata, margine vix libero, superficie mammillatâ, seu tuberosâ. Corallum porosissimum, cellis bene angulosis, paulum excavatis, grandioribus ( $\frac{3}{4}$ " ), fundo planis, septis tenuibus, sæpe supernè productis.*

Incrusting, undulate, margin scarcely at all free, surface mammillate and tuberose. Corallum very porous, cells neatly angular, shallow, rather large ( $\frac{3}{4}$  of a line), plane at bottom, septa thin, and often prominent in thin ridges, like the *lichen*.

Plate 55, fig. 1, corallum, natural size.

Feejee Islands. *Exp. Exp.*

25. PORITES ARENACEA. (*Lamarck.*)

*Incrustans, simplicissima. Corallum cellis superficialibus, subconcavis, perparvis.*

Incrusting, quite simple. Corallum having the cells superficial, subconcave, very small.

The Red Sea, incrusting the *Mytilus margaritiferus*. *Lamarck.*



*Madrepora arenosa* (?), Linn., ed. xii., 1276; *Porites arenacea*, Lamk., ii. 435, No. 4.

“*M. composita*, stellis contiguis, planiusculis, subarenaceis.” —, Blainville, Man., 395.

The *Mad. Porites arenacea*, of Ehrenberg, is described as follows: “Quadrilinearis, lineam alta, suborbicularis, effusa, incrustans, simplex, membranacea, stellis contiguis,  $\frac{1}{3}$ ” latis, immersis, interstitiis spinuloso-hispidis (detritis granulosis?). In Pinnâ turgidâ Maris Rubri. An pullus alius?”—Gen. lxx., sp. 20.—A Manopora?

NOTE.—The *Madrepora punctata*, of Linnæus, is an imperfectly described species, possibly of some other genus. It is stated to come from the European Ocean, and is described as follows: “*M. composita*, punctis stellaribus confertis, conflatis e punctis densis.”

The *M. punctata*, of Esper, tab. 70, is a true incrusting Porites, with shallow cells, and wide granulous interstices. It comes from the Moluccas.

The *M. Porites punctata*, of Ehrenberg (Gen. lxx., sp. 17), appears to be a different species, having much resemblance to the *P. lichen*. The following are some of its characters: “Stellis semilinearibus, margine non lamellosis, interstitiis venoso-turgidis, poroso-punctatis, denticulis nullis, stellarum lamellis basi denticulo columellam tenuem punctiformem reddente auctis.” “An. *M. Porites conglomerata juvenilis*?” Locality unknown.

*M. Porites armata*, H. and Ehrenberg (Gen. lxx., sp. 19): “Pollicaris, effusa, incrustans, stellarum semilinearium interstitiis scabris, nec lamellosis, singulo stellarum margine, dente crenato armato, columellæ vestigio obsoleto.” Red Sea. Probably a Sideropora.

*M. Porites stromatopora*, H. and Ehrenberg (Gen. lxx., sp. 21): “Semipedalis, effusa, 2” alta, stratum super stratum exstruendo pulvinata, stratis horizontalibus, 1” altis, discretis distinctisque (hinc exesa margine scalariformis evadit), stellulis singulis linea minoribus, parum profundis, lamellis 12, subæqualibus, ad centrum usque productis, interstitiis stellarum contiguarum minimis porosis.” Locality uncertain. A Manopora near the *effusa*?

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GENUS II.—GONIOPORA.—QUOY & GAYMARD.

*Poritidæ arrecto-glomeratæ, lobatæ; polypis 16–24-tentaculatis, 1–2” latis. Coralla omnino leviter porosa; cellis subprofundis, aut superficialibus, intus granulosis.*

Erect glomerate, and lobed; polyps with 16 to 24 tentacles, and 1 to 2 lines broad. Coralla throughout light porous; cells scarcely as deep as their breadth or superficial, granulous within.

The Goniopora resemble the Porites in habit and texture, but are

less finely porous, and have larger polyps and cells. The species often grow in club-shaped masses or rude cylinders, which become lobed above by furcation, and, like many *Porites*, only the top for one to three inches is alive. These cylinders grow to a height of two feet or more.

The species are confined to the coral-reef seas, and have been found only in the Pacific and Indian Oceans.

This genus was proposed by Quoy and Gaymard, by whom the polyps were first examined. The name alludes to the angular form of the cells, and is derived from *γωνία*, *an angle*.

1. GONIOPORA PEDUNCULATA. (*Quoy & Gaymard.*)

*G. glomerata*; *polypis 2-3'' salientibus, lætè virentibus; tentaculis oblongis, obtusis. Corallum porosissimum; cellis parvulis (1'' latis), polygonis; margine granulatis seu inæqualiter denticulatis.*

Glomerate; polyps 2 to 3 lines salient, bright green; tentacles oblong, obtuse. Corallum very porous; cells small (1 line broad), polygonal; margin granulate, or irregularly denticulate.

Port Dorey, New Guinea. *Quoy & Gaymard.*

This species is described by Quoy and Gaymard, as occurring in hemispherical masses as large as the fist. It may also grow erect like the following species.

*Goniopora pedunculata*, Quoy and Gaymard, *Voy. de l'Ast.*, iv., 218, pl. 16, figs. 9-11.

—, *Blainville, Man.*, 395.

*Astræa calycularis* (?), *Lamk.*, ii. 416, No.

27. "A. glomerata, superficie reticulata, cellis subpentagonis, contiguis, calyciformibus, ad parietes striatis, fundo papillis senis substellatis." Referred here by Quoy and Gaymard.

2. GONIOPORA COLUMNA. (*Dana*)

*G. erecta*, 1-2'' alta, compresso-cylindrica, et subclavata, 2-4'' crassa; apice rotundata, et divisa, 2-3'' animata; *polypis cylindricis, 2-3'' salientibus, pallidè purpureis, 18-24-tentaculatis. Corallum porosissimum; cellis angulatis, excavatis, 1½'' latis; margine acutis, granulatis; infrà cellis obsolete.*

Erect, 1 to 2 feet high, compressed cylindrical, and subclavate, 2 to 4 inches thick; summits rounded, furcately subdividing above; alive for 2 to 3 inches; polyps cylindrical, 2 to 3 lines salient, of a pale lilac tint, tentacles 18 to 24 in number. Corallum very porous; cells angular, excavate,  $1\frac{1}{2}$  lines broad; margin acute, granulate; cells below obsolete.

Plate 56, fig. 5, zoophyte, natural size; 5 *a*, polyp, enlarged; 5 *b*, part of summit, showing the cells, natural size.

Feejee Islands. *Exp. Exp.*

This species is near the preceding, yet the form of the polyps, judging from Quoy and Gaimard's figures, is quite different, the cells larger, and the mode of growth is peculiar. The large columns grow to a height of two feet or more, but only the tips for two or three inches are alive; the part below is incrustated with Nullipores, sponges, and various shells. The lower cells, or those towards the limits of the live portion, are quite superficial. No distinct lamellæ are seen in any of them.

NOTE.—*G. Savignii*. Savigny's figure 2, tab. 5, (Desc. de l'Egypte,) has much of the appearance of a Goniopora, and some resemblance to the preceding, though smaller. It represents a single stout stem, with several ascending clavate lobes, somewhat compressed, and two to four inches broad, with a subtruncate top. The whole clump is seven inches high, and has nearly the shape of an inverted cone. The cells are nearly circular, contiguous, or planulate, and about one-eighth of an inch broad. The summits are alive for about two inches.

Ehrenberg refers to this figure, with a query, under his *Astræa planulata*.

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#### TRIBE MADREPORACEA:—APPENDIX.

The animals of the following genera are unknown; and the species are so imperfectly understood, that their connexion with the tribe Madreporacea is uncertain.

#### ERRINA.—GRAY.

*Ramosæ*; *ramis muricatis, caliculis prominulis et infernè longitudinaliter fissis*; *Milleporæ habitu affines*.

Ramose; branches covered with calicles; calicles tubular, a little prominent, having a longitudinal fissure below; near *Millepora* in habit.

This genus was instituted by Gray for the *Millepora aspera* of Esper and Lamarck.

ERRINA ASPERA. (*Esper.*) Gray.

*E. ramosa*, 4" alta; subcompressa, paulo flabellata, ramulis brevibus, subacutis, caliculis ad apices et undique sparsis (superficie itaque asperatâ).

Ramose, 4 inches high; subcompressed, somewhat flabellate; branchlets short, subacute; calicles scattered every where, even over the summits, the surface, therefore, throughout rough.

Mediterranean Sea. Lamarck. *Esper.*

<i>Mad. densè surculosa</i> , &c., Gualt. Ind.	—, Deslongchamps, Encyc., 546.
Test., back of tab. 55.	<i>Errina aspera</i> , Gray, Zool. Soc. Trans.,
<i>Millepora aspera</i> , Linn., ed. xii., 1282.	1835, 85; Gray suggests, that the <i>Mille-</i>
—, Esper, Fortsetz. i. 106, tab. Mill., 18.	pora tubulifera and pinnata of Lamarck,
—, Lamk., ii. 308, No. 4.	may belong to this genus.

CERiopora.—BLAINVILLE.

*Pumilæ; glomeratæ aut lamellosæ. Coralla stratis concentricis instructa; cellis orbiculatis, minutissimis, irregulariter sparsis.*

Minute; glomerate or lamellose. Coralla consisting of concentric beds; surface covered with very minute circular cells, irregularly scattered.

This genus, as originally instituted by Goldfuss, on the ground of a stratified structure and minute cells, contained various species not properly related. The genus *Chrysaora*, of Lamouroux, embraces a large part, characterized by their angular or polygonal lobato-ramose forms, uneven surface, and pore-like cells, with nothing of a columnar structure. The species are minute, and may be Bryozoa. Blain-

ville instituted the genera *Spinopora*, *Ceripora*, *Heteropora*, and *Pustulopora*, from the remainder, placing, at the same time, some of the species with the *Alveolites* of Lamarck. The genus *Ceripora*, as restricted, has the circular cells of a *Millepora*, and the coralla consist of "concentric and enveloping" beds. The species referred by Blainville to the genus, are all from the chalk.

The genus *Spinopora*, of Blainville, comprises small glomerate species, having a spino-tuberculous surface, and minute irregular pore-like cells scattered over the intermediate spaces. The existence of tubercles is hardly a character of generic importance. The species reported to it are from the chalk. The genus *Heteropora* is referred to under *Heliopora*, page 539. The *Heteropora* of Ehrenberg corresponds to the *Madrepora* of other authors.

*Ceripora*, Goldfuss, Petref., 32.

*Chrysaora*, Lamouroux, Exp. Meth., 83,

pl. 81, figs. 6, 7; Goldf., tab. 11, figs.

5-11.

—, Blainville, Man., 414.

—, Lamk., 2d ed., ii. 315.

*Ceripora*, Blainv., Man., 413, pl. 70, fig.

2; Goldf., 33, pl. 10, figs. 4, 6, 7.

—, Lamarck, 2d ed., ii. 313.

*Spinopora*, Blainv., Man., 415, pl. 70, fig.

3; *Ceripora mitra*, Goldf., 39, pl. 30,

fig. 13.

NOTE.—The genus *Tilesia*, of Lamouroux, is but imperfectly known; it is supposed to fall near the above. The small coralla are ramose, with the branches cylindrical and verrucose, and having minute circular pore-like cells collected in polymorphous groups, with the intermediate surface smooth. The only species described is a fossil from near Caen. (Lamouroux, Exp., Meth., 42, tab. 74, figs. 5, 6.—Blainv., Man., 415, pl. 63, fig. 5.—Lamk., 2d ed., ii. 316.) Lamouroux's description of the genus will apply nearly as well to his *Theonea* (q. v.)

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#### TEREBELLARIA.—LAMOUROUX.

*Pumila*; *ramosæ*, *ramis elongatè conicis*, *et spiraliter annulatis*; *cellis minutis ovalibus*, *subtriangulatis*, *in quincuncem dispositis*.

Quite small; ramose; branches oblong conical, and spirally annulate; cells minute, oval, or subtriangular, and arranged in quincunx order.

The branches have a depression running spirally around from the base to the summit. This genus, established by Lamouroux, is arranged near the "*Alveolites*," by Blainville. He states that the cells

are not subtubular, as the figures appear to represent. The species referred to the genus are from the coral limestone at Caen.

Lamouroux, Exp. Meth., 84, pl. 82, fig. 1. Lamarck, 2d ed., ii., 318.

Blainville, Man., 409, pl. 67, fig. 5.

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APSENDESIA.—LAMOUROUX.

*Pumilæ.* *Coralla laminis aggregatis cristiformibus instructa, margine celliferis; cellis minutis, poriformibus, subangulatis, irregulariter sparsis.*

Quite small. Coralla consisting of aggregated crest-like plates, having the margin celliferous; cells minute, pore-like, subangular, irregularly scattered.

This genus was instituted by Lamouroux, and afterwards more correctly defined by Blainville. The species referred to the genus are from the Jurassic and tertiary limestones. The structure of the *A. cerebriformis*, as described by Milne Edwards, appears to be similar to that of the *Stenoporæ*.

Lamouroux, Exp. Meth., 81, pl. 80, figs. Blainville, Man., 408, pl. 65, fig. 3.

12-14.

Lamarck, 2d ed., ii., 289.

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PELAGIA.—LICHENOPORA.

The genus *Pelagia*, of Lamouroux, as more correctly described by Blainville, is a free disk-shape zoophyte, smooth and low conical below, and having the upper surface stellate, with small ridges or crests, which are covered above with minute subangular cells. The only known species is a fossil half an inch in diameter. Blainville places it near "Alveolites," and compares the upper surface to that of the *Lichenoporæ*. Whether it have or not the internal structure of the *Favositidæ*, is not ascertained.

Lamouroux, Exp. Meth., pl. 79, figs. 5-7. Blainville, Man., 410, pl. 69, fig. 13.

Defrance, Dict. des Sci. Nat., t. 38.

Lamarck, 2d ed., ii., 289.

The *Lichenopora*, according to Blainville, have a subturbinate form, with minute angular cells over the upper surface; this surface is concave, and covered with small, ridge-like prominences, stellately arranged, as in the *Pelagia*. Blainville, after an examination of the fossils upon which the genus was founded by DeFrance, suggests that they are probably young forms of Retepores. He added a Mediterranean species (*L. Mediterranea*) to the genus, but without describing it, only mentioning that it was a Retepore in structure, and near the genus *Froncipora*.

Michelin has described an incrusting species, of uncertain locality, which, from the character of the cells, and its small stars of verrucæ, he has referred to DeFrance's genus, calling it *Lichenopora glomerata*. It occurred around the axis of a dead *Antipathes*, forming an incrustation three-fourths of an inch long, and nearly half an inch thick; the stars of verrucæ are two to three lines in diameter, and the whole surface is covered with minute, contiguous, subangular cells, which, according to the figure, are hardly a twenty-fifth of a line in diameter. Michelin states that the cells are prolonged to the axis of the group. From this last character, and the size and appearance of the cells, it is possible that the species may be congeneric with the fossils of the genus *Constellaria*, mentioned under *Favosites*.

*Lichenopora*, DeFrance, Dict. des Sci. Nat., *Lichenopora*, Lamk., 2d ed., ii., 284.  
 xxvi., 257. *L. glomerata*, Michelin, Guer. Mag. de Zool.,  
 —, Blainville, Man., 407, pl. 68, fig. 4. 1840, Zooph., pl. 1.

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#### TRIBE IV.—ANTIPATHACEA.

*Actinaria sex-tentaculata; gemmipara, gemmatione inferiore.*

Actinaria having 6 equal tentacles; gemmiparous, with the gemmation inferior.

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#### FAMILY I.—ANTIPATHIDÆ.

*Zoophyta affixa, caulescentia et sæpius ramosa; secretiones corallicas internas nullas, sed basi epidermicas ramorum axem elaborantia.*



Attached zoophytes, caulescent, and usually ramose; forming no coral secretions, except epidermic foot-secretions, which constitute the axis of the branches.

The Antipathidæ, like many Gorgonidæ, secrete a corneous axis, which is surrounded by a fleshy covering of polyps; and on this account the two groups have hitherto been placed together. An examination of the animals of two species has led to an arrangement of them among the Actinoidea, as the tentacles have the naked character peculiar to this suborder, and the polyps closely resemble those of the Madreporæ in appearance and habit. The existence of genital lamellæ within the visceral cavity has not yet been proved by dissection, and as this is the deciding character, the propriety of the present arrangement, cannot be considered as fully established.

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GENUS ANTIPATHES.

*Antipathidæ axe corneo spinulosæ, polyporum crustâ omnino carnosâ.*

Antipathidæ having the corneous axis spinulous, and the polyp-covering wholly fleshy.

The Antipathes grow either in long stems, or branched in imitation of trees, spreading shrubs, or in fan-like fronds. The horny axis is covered with minute spinules, which character distinguish them from the axes of Gorgoniæ.

Though common in the tropics, they also occur in the temperate zone; they are not unfrequent in the Mediterranean, and have been found in the seas of Norway.

*Arrangement of the Species.*

I. Quite simple.

\*1. *A. spiralis.*

\*2. *A. anguina.*

II. Simple, with lateral pinnules.

3. *A. larix.*

4. *A. eupteridea.*



## III. Branching in a plane.

1. *Branches pinnate.*5. *A. pectinata.*7. *A. subpinnata.*6. *A. myriophylla.*8. *A. reticulata.*2. *Not pinnate.*9. *A. flabellum.*10. *A. ericoides.*

## IV. Not branched in a plane.

11. *A. mimosella.*\*17. *A. corticata.*12. *A. pinnatifida.*18. *A. lacerata.*\*13. *A. cupressus.*19. *A. pyramidata.*14. *A. pennacea.*20. *A. Boscii.*15. *A. scoparia.*21. *A. alopecuroides.*16. *A. fœniculum.*\*22. *A. arborea.*I. *Caulibus simplicissimis.*

## 1. ANTIPATHES SPIRALIS.

*A. simplicissima, subspiralis, polypis elongatè rostratis; axe corneo minutè spinuloso, spinulis confertis, aciculatis.*

Quite simple, somewhat spirally twisted, polyps with a long beak; the minute spinules of the axis acicular and very numerous.

The Mediterranean, and Indian Ocean.

*Palmiuncus anguinus*, Rumphius, Amb., —, Esper, Pflanz. ii. 154, tab. 8; a copy of Ellis's figure.

*Antipathes spiralis*, Pallas, Zooph., 217, —, Lamour., Pol. flex., 373; Exp., 31, pl. 19, figs. 1-6; Encyc., 68.

—, Gmelin, Linn., 3795.

—, Schweig., Handb., 432.

—, Ellis and Solander, 99, tab. 19, figs. 1-6. *Cirrhripates spiralis*, Blainv., Man., 512, pl. 88, fig. 2.

2. ANTIPATHES ANGUINA. (*Dana.*)

*A. simplicissima, paulum spirali-flexuosa, polypis viridescentibus vix rostratis, tentaculis basi fuscis; axi corneo longè subarticulato, spinulis subremotis, compressis, subacutis.*

Quite simple, somewhat spirally flexuous; polyps greenish, scarcely beaked; tentacles fuscous at base; axis with faint articulations at long distances; spinules rather remote, compressed, subacute.

Plate 56, fig. 1, extremity of zoophyte, natural size; 1 *a*, axis; 1 *b*, 1 *c*, polyps, enlarged; 1 *d*, section of axis, enlarged.

From the reefs off Mathuata, Venua Lebu, Feejee Islands. *Exp. Exp.*

This species resembles the preceding, but the polyps are not properly beaked, and the spinules of the surface are more distant, stouter, and hardly acute. Moreover, distinct nodes are apparent in the axis, every three or four inches, towards the upper extremity of the zoophyte. The whole stem was six feet long, and grew in five feet water, yet it was so twisted as not to reach the surface. The polyps were very sluggish in their motions (as the figures indicate), and about a sixth of an inch in diameter.

It is probable that this is the *Palmiuncus anguinus*, of Rumphius, and perhaps also the *Cirrhipates Sieboldi*, of Blainville (Man., 512).

II. *A. simplices, lateraliter longè pinnuliferis.*

3. ANTIPATHES LARIX. (*Esper.*)

*A. simplex, praelonga, ramulis longissimis (2-4''), undique sparsis, ramulorum axe setiformi.*

Simple, very long; branchlets very long (2 to 4 inches), pointing every way, and having a setiform axis.

The Mediterranean, Gulf of Venice. *Lamarck.*

*Antipathes larix*, Esper, Pflanz., ii. 147, *Antipathes larix*, Lamour., Pol. flex., 374; tab. 4. Encyc., 70.

—, Lamk., ii. 482, No. 11.

—, Blainville, Man., 511.

4. ANTIPATHES EUPTERIDEA. (*Lamarck.*)

*A. simplex, pinnata, pinnulis simplicibus eleganter incurvis; caulis axe subtriquetro, pinnularum setaceo.*

Simple, pinnate, pinnules simple, elegantly incurved; axis of the stem nearly triangular, of the pinnules setaceous.

Coast of Martinique. *Lamarck. Lamouroux.*

*Antipathes eupteridea*, Lamarck, ii. 483, No. 19. une belle plume de paon décolorée et brunnâtre."

—, Lamour., *Encycl.*, 71; "Resemble à

III. *In plano ramosæ.*

1. *Ramis pinnatis.*

5. ANTIPATHES PECTINATA. (*Lamarck.*)

*A. flabellata*, 9" alta; ramis pinnato-pectinatis; ramorum axe compresso, ramulorum filiformi, subulato; spinulis paucis.

Flabellate, 9 inches high; branches pinnato-pectinate, axis of the branches compressed; of the branchlets filiform, subulate; spinules few.

*Antipathes pectinata*, Lamk., ii. 480, No. —, Lamour., *Pol. flex.*, 381; *Encyc.*, 6.—Locality not given. 72.

6. ANTIPATHES MYRIOPHYLLA. (*Pallas.*)

*A. grandis* (18–20" alta), latè ramosissima, incurvata, in plano paniculata, subtripinnata, pinnulis brevibus (vix  $\frac{3}{4}$ "), crebris; pinnularum axe setaceo, scabro.

Large (18 to 20 inches high), much and spreading ramose, incurvate, paniculate in a plane, subtripinnate, pinnules short ( $\frac{3}{4}$  of an inch or less), much crowded; axis of the pinnules setaceous, scabrous.

Indian Ocean. *Ellis. Lamouroux.*

*Myriophyllum Indicum ramosissimum*, *Antipathes myriophylla*, Esper, *Fortsetz.*, *Pettiv. Gazoph.*, tab. 35, fig. 12. i., tab. 10.

*Antipathes myriophylla*, Pallas, *Zooph.*, —, Lamk., ii. 481, No. 9. 210.

—, Ellis and Sol., 102, tab. 19, figs. 11, pl. 19, figs. 11, 12; *Encyc.*, 71.

12.—From the Moluccas.

—, Blainv., *Man.*, 510, pl. 87, fig. 2.

7. ANTIPATHES SUBPINNATA.

*A. ramosa, pinnata, pinnulis alternis, vix 1' longis, aliis interdum transversè positis; pinnularum axe setaceo.*

Ramose, pinnate, pinnules alternate, scarcely an inch long, a few at right angles with the others; axis of the pinnules setaceous.

Mediterranean Sea. *Lamouroux.*

*Antipathes subpinnata*, Ellis and Solander, —, Lamouroux, Pol. flex., 379; Exp., 101, tab. 19, figs. 9, 10. 32, pl. 19, figs. 9, 10; Encyc., 72.  
—, Lamk., 2d ed., ii. 484, No. 20. —, Blainville, Man., 511.

8. ANTIPATHES RETICULATA. (*Esper.*)

*A. in plano ramosa, ramis inordinatè ascendentibus, crebris, sæpe bipinnatis, interdum coalitis, pinnulis divaricatis, 1½" remotis, brevibus et inæqualibus; ramorum ramulorumque axe filiformi et setaceo.*

Branching in a plane, branches irregularly ascending, crowded, often bipinnate, pinnules sometimes coalescing, divaricate, about 1½ lines distant, short and unequal; axis of branches and branchlets very slender, and of pinnules setaceous, scabrous.

East Indies (?).

*Antipathes reticulata*, Esper, Fortsetz., i. 183, tab. 11: "A. explanata, ramis inordinatè ascendentibus, ramulis clathratis, scaberrimis."

2. Ramis non pinnatis.

9. ANTIPATHES FLABELLUM. (*Pallas.*)

*A. flabellata, ramosissima, spatiosè reticulata; axe striato, ad latera compresso, subspinoso.*

Flabellate, much branched, coarse reticulate; axis striated, laterally compressed, somewhat spinous.

Indian Ocean.

- Flabellum marinum planum* (?), Rumph. Amb., vi. 205, tab. 79. culée;" Lamarck refers to Esper's *Ant. flabellum*, tab. 1, which is *not* scabrous, and is probably a decorticated Gorgonia (G. *Esperi*?).
- Antipathes flabellum*, Pallas, Zooph., iii., No. 136: "Tenerrima scabritie hispidum."
- , Lamarck, No. 16: "Grande et belle espèce, tout-a-fait flabelliforme et reti-

*Antipathes flabellum*, Lamouroux, Polyp. flex., 382; Encyc., 73.

## 10. ANTIPATHES ERICOIDES.

*A. flabellata, ramosissima, intertexta; ramorum ramulorumque axe filiformi, hispidulo; ramulis brevibus, setaceis.*

Flabellate, much branched, interwoven; axis of branches and branchlets filiform, finely hispid; branchlets short, and setaceous.

Indian Ocean (?). *Esper. Lamarck.*

- Antipathes ericoides* (?), Pallas, Zooph., 208. and *A. ericoides*, *ibid.*, tab. 6; the figure has some resemblance, in the slender axis, to that of the *reticulata*, but it is not pinnate branched, and has fewer branchlets.
- , Lamarck, 482, No. 13.
- , Lamouroux, Polyp. flex., 381; Encyc., 72.
- Antipathes myriophylla*, Esper, ii. 150,

NOTE.—The following flabellate species, judging from Esper's descriptions and figures, to which Lamarck refers, may be decorticated Gorgoniæ.

**A. RADIANIS** (*Lamarck*). Subflabellate, much branched, subspinous, branches divaricately radiating. Mediterranean.—*A. feniculacea*, Esper, ii. 152, tab. 7; *A. radians*, Lamk., ii. 482, No. 14; Lamour., Pol. flex., 380, and Encyc., 72; Blainv., Man., 511.

**A. CLATHRATA**. Flabellate, much and intricately branched, branchlets often coalescing, and hence coarse reticulate, the smaller quite short and subsetaceous. Indian Ocean (?).—*Antipathes clathrata* (?), Pallas, Zooph., 212; *A. clathrata*, Esper, ii. 141, tab. 2, according to whom the surface is smooth and shining; Lamarck, ii. 483, No. 15; Lamour., Polyp. flex., 382, and Encyc., 72.

**A. LIGULATA** (*Esper*). Flabellate, much branched, coalescent and delicately reticulate; axis of the branches compressed; of the branchlets ligulate, resembling somewhat the axis of a Gorgonia flabellum; *A. ligulata*, Esper, ii. 149, tab. 5; probably a decorticated Gorgonia flabellum or clathrus; Lamk., ii. 483, No. 17; Lamour., Polyp. flex., 381, and Encyc., 72.

IV. *Non flabellate, nec in plano ramosæ.*11. ANTIPATHES MIMOSELLA. (*Lamarck.*)

*A. ramosissima, 2' alta, paniculata, expansa; ramis patentibus, alter-*

*nis decomposito-pinnatis ; pinnulis distichis ; pinnularum axe setaceo, hispido.*

Much branched, 2 feet high, paniculate, spreading, branches open, alternate, decompound-pinnate, pinnules distichous; axis of the pinnules setaceous, hispid.

East Indies.

*Antipathes mimosella*, Lamarck, ii. 481, No. 8. flex., 377; Exp. Meth., 31, pl. 19, figs. 7, 8; Encyc., 70; Lamouroux describes the *ulex* as follows: "A ramosissima, ramis sparsis, patentibus, hispidissimis, attenuatis."  
 —, Lamouroux, Encyc., 71.  
*Antipathes ulex* (?), Ellis and Sol., 100, tab. 19, figs. 7, 8; and Lamour., Pol.

12. ANTIPATHES PINNATIFIDA. (*Lamouroux.*)

*A. ramosa, 2' alta, ramis patentibus, alternis, pinnatifidis, ramulis ramusculisque distichis vel subsparsis, rectis, anticè projectis ; ramusculorum axe rigido, echinato.*

Ramose, 2 feet high; branches open, alternate, pinnatifid, branchlets and pinnules distichous, or somewhat scattered, straight; the axis of the branchlets rigid, echinate.

East Indies.

*Antipathes pinnatifida*, Lamour., Pol. flex., 377, pl. 14, fig. 4; Encyc., 70. *Antipathes pinnatifida*, Lamarck, 2d ed., ii. 481, No. 8 a.

13. ANTIPATHES CUPRESSUS. (*Pallas.*)

*A. elongatè arborescens, ramulis lateralibus brevibus, creberrimis, paulum recurvatis, bipinnatis.*

Elongate arborescent, lateral branchlets quite short and crowded, a little recurved, bipinnate.

*Cupressus marina*, Seba, Thes., iii. tab. 106, fig. 1; a specimen sixteen inches high, and three and a half broad. *A. cupressina*, Pallas, Zooph., 213. —, Esper, Pflanz., ii. 143, tab. 3; a bad figure.  
 Rumphius, Amboyn., tab. 80, fig. 2. *A. cupressus*, Ellis and Solander, 103.

- A. cupressus*, Lamarck, ii. 481, No. 10. by Lamarck. Its mode of growth is similar, but its form is much broader, the lateral branches being three or four inches long, and stouter. It is described by Esper, as *ovato-paniculate*.  
 —, Lamour., Polyp. flex., 380; Encyc., 72.  
 Esper's *A. paniculata* (Fortsetz. i. tab. 12), is referred with a query to this species,

## 14. ANTIPATHES PENNACEA.

*A. ramosa, subincurva; pinnulis creberrimis; pinnularum axe setaceo, hispido.*

Ramose, somewhat incurved; pinnules much crowded; axis of the pinnules setaceous, hispid.

Indian Ocean. *Lamarck.*

- Rumph., Amboyn., vi. 209. *Antipathes pennacea*, Bosc., vers. iii., 40.  
*Antipathes pennacea*, Pallas, Zooph., 269. —, Lamour., Pol. flex., 379; Encyc. 71.  
 —, Lamk., 2d ed., ii. 483.

15. ANTIPATHES SCOPARIA. (*Lamarck.*)

*A. parcè ramosa, supernè paniculato-corymbosa; ramis ramulisque elonga tis gracilibus; ramulorum axe filiformi, hispidulo, scabro.*

Sparingly ramose, above paniculato-corymbose; branches and branchlets long and slender; axis of branchlets filiform, finely hispid, scabrous.

Mediterranean Sea. *Marsilli.*

- Antipathes scoparia*, Lamk., ii. 480, No. 7. *Antipathes scoparia*, Lamour., Pol. flex., 376; Encyc., 70.  
 —, Esper, Fortsetz., ii. tab. 14.

16. ANTIPATHES FÆNICULUM. (*Lamarck.*)

*A. ramosissima, laxa, subpaniculata; ramorum axe infernè subcompresso, spinoso, ramulorumque ultimorum setaceo, levigato.*

Much branched, lax, subpaniculate; axis of the branches somewhat compressed, spinous, of the terminal branchlets setaceous, smooth.

East Indies (?). *Lamarck.*

- Antipathes fasciculacea* (?), Pallas, Zooph., 207. *A. fasciculum*, Lamour., Pol. flex., 379; Encyc., 71; states that it grows to a height of seven or eight inches.  
Rumph. Amboyn., vi. 208, tab. 80, fig. 3. —, Blainville, Man., 511.  
*A. fasciculum*, Lamk., ii. 482, No. 12.

17. ANTIPATHES CORTICATA. (*Lamarck.*)

*A. caule parcè ramosa, 15'' alta, corticata, spinis numerosis echinata; corticis poris nullis.*

Stem sparingly ramose, 15 inches in height, corticate, echinate, with numerous spines; cortex without pores.

Indian Ocean.

The cortex is merely a thin animal coating, and its existence is not an essential characteristic.

*Antipathes corticata*, Lamk., ii. 480, No. 3. —, Lamour., Pol. flex., 374; Encyc. 69.

18. ANTIPATHES LACERATA. (*Lamarck.*)

*A. caule ramosa, fere 2' alta, ramusculis spiniformibus echinata; ramis sarmentosis, tortuosis, sensim attenuatis; ramulis lateralibus, tenuibus, sublaceris.*

Stem ramose, nearly 2 feet high, echinate with spiniform branchlets; branches sarmentose, tortuous, gradually attenuate; branchlets lateral, very numerous, slender, sublacerate.

Indian Ocean (?). *Lamarck.*

- Antipathes lacerata*, Lamarck, ii. 480, No. 4. Encycl., 70. "Ses branches s'entortillent les unes avec les autres comme pour se soutenir."  
*Ant. lacera*, Lamouroux, Pol. flex., 377;

19. ANTIPATHES PYRAMIDATA. (*Lamarck.*)

*A. caule rigida, indivisa; ramulis lateralibus, creberrimis, quaquaversim*





*sparsis, in pyramidam dispositis, dichotomis; axe nitidulo, olivaceo-lutescente.*

Stem rigid and undivided; branchlets lateral, much crowded, scattered, and pointing every way, forming together a pyramid, dichotomous; axis a little shining, yellowish-olive.

East Indies (?). *Lamarck.*

*A. pyramidata*, Lamarck, ii. 480, No. 5. —, Lamour., Pol. flex., 375; Encyc., 69.

#### 20. ANTIPATHES BOSCHII. (*Lamouroux.*)

*A. flexuosa, ramosa, ramulis numerosis divaricatis; ramulorum axe setaceo.*

Flexuous, ramose, branches numerous and divaricate; axis at summits setaceous.

Shores of Carolina. *Bosc.*

*Antipathes Boschii*, Lamour., Pol. flex., 375, pl. 14, fig. 5; Encyc., 69. Grows to a height of four inches, and its scattered branches have numerous very divergent branchlets. —, Lamarck, 2d ed., ii. 484.

#### 21. ANTIPATHES ALOPECUROIDES. (*Ellis.*)

*A. ramosa; ramis arcuè paniculatis; ramorum axe hispido; ramulorum setaceo, fragili.*

Ramose, branches close paniculate; axis hispid, setaceous, brittle.

Shores of South Carolina. *Ellis. Lamouroux.*

*Antipathes alopecuroides*, Ellis, Zooph., 102. rameaux assez nombreux, en forme de  
—, Lamour., Pol. flex., 375; Encyc., 69. panicule serrée, presque semblable à la  
“Elles se divisent, et se sous-divisent en queue de renard.”

#### 22. ANTIPATHES ARBOREA. (*Dana.*)

*A. arborescens, laxè ramosa, patens, maxima (3' alta); ramis sub-*

*flexuosis; axe undique hispido, ramulorum elongatè setiformi, fragili; polypis flavidis, ore prominente, ramulorum plerumque uniseriatis.*

Arborescent, lax and spreading ramose, very large (3 feet high); branches subflexuous; axis throughout hispid, of branchlets, long and slender setiform, fragile; polyps brownish-yellow, mouth prominent; on branchlets, nearly in a single series.

Plate 56, fig. 2, part of a branch, with the expanded polyps, natural size; 2 a, polyp, enlarged; 2 b, part of trunk, natural size.

Sandalwood Bay, Feejees, in ten fathoms. *Exp. Exp.*

This species appears to have much the habit of the *dichotoma* of the Mediterranean, but is more spreading in its branches. In the second position of the polyps, it also appears to be near that species. The trunk at base is nearly half an inch thick. It gives off stout branches, and subdivides above quite irregularly.

The *Antipathes compressa*, of Esper, (Fortsetz., i. tab. 13,) has the habit of this species, as far as figured.

APPENDIX.—*Antipathes dichotoma*, (Pallas.) This species is described from the figure and account by Marsilli (Lith., No. 9, fig. 101, tab. 21), who obtained his specimen near Marseilles, in one hundred and forty fathoms. It is rather sparingly branched, with the branches elongate and slender, and not in a plane. He describes it as two feet in height and one and a half lines thick at base; it was covered with minute globes on one side, when first obtained, which were the partially closed polyps. (Pallas, Zooph., 216. *A. dichotoma*, Lamour., Pol. flex., 374; Encyc., 69.)

The *Antipathes glaberrima*, of Esper (ii., tab. 9), may be a decorticated Gorgonia. It is described by Esper as follows: "*A. dichotoma* (raro reticulatim coalita), incurvato-flexuosa et contorta, ligno atro, extus glaberrimo, nitidissimo." It is a large stout species, having the stem at base a third of an inch thick. The figure, in form, resembles his *compressa*.

## SUBORDER II.—ALCYONARIA.

*Zoophyta aut omnino carnosa, aut coralligena, gemmipara. Polypi octo-tentaculati; tentaculis æqualibus papillois, papillis apice perforatis. Plicæ viscerales octo. Secretiones coralligenas pedibus integumentisque internis, sed non plicis visceralibus, elaborantia; internis, calcareis; e pedibus, corneis aut calcareis, raro siliceis.*

Zoophytes wholly fleshy or coralligenous, gemmiparous. Polyps having the tentacles eight in number, papillose, with the papillæ perforate at apex. Visceral lamellæ eight. Coral secretions formed from the foot of the polyps, or by the internal tissues, but never by the visceral lamellæ; the foot-secretions, for the most part, either corneous or calcareous, rarely siliceous; the tissue-secretions calcareous.

The general characteristics of this division of zoophytes have been given on pages 42 to 50. The eight tentacles, furnished with a fringe of perforate papillæ, and the eight lamellæ of the visceral cavity, constitute the prominent characters of the polyps.\* These eight lamellæ are sometimes part spermatic and part ovarian; but instances are also given of eggs being produced from all; and in a *Veretillum* figured by Milne Edwards, in the illustrated edition of Cuvier (pl. 91, fig. 1), the same lamellæ are spermatic above and ovarian below, in analogy with a Gynandrous plant in the vegetable kingdom; yet in this species, as in the *Tubipora* examined by the author, the spermatic cords were confined to six of the eight lamellæ.

The animals vary in size from a third of a line to nearly an inch. They appear to affiliate with the Actinaria through the *Lucernaria*, which have a four or eight-lobed summit. Yet the occurrence of only eight visceral lamellæ, corresponding to eight papillose tentacles, and alternating with them, forms a wide line of demarcation

\* Many of the published figures of the polyps of Alcyonaria, are drawn from the partly expanded zoophyte, in which state, the papillæ of the polyps are very short, or are not at all apparent.

(see p. 123). The coralla are sometimes tubular, and when so, the tubes are peculiar in being smooth within, without lamellar rays or striæ.

The Alcyonaria differ in being either free (or simply buried at base), or attached by growth. The former species constitute the family *Pennatulidæ*, and the latter the remaining families. It may be questioned, however, whether this distinction should not require the institution of the two groups as equivalent tribes. The *attached* species form either tissue-secretions alone, or separable foot and tissue-secretions. These last are the *Gorgonidæ*; the others, when the coral secretions are disseminated grains or spicules, belong to the family *Alcyonidæ*; and when they form tubular coralla, to the families *Cornularidæ* and *Tubiporidæ*. These families may be briefly characterized as follows:—

1. PENNATULIDÆ.—Free, or with the base buried.
2. ALCYONIDÆ.—Attached; no coral secretions, or only calcareous spicula within, and no axis.
3. CORNULARIDÆ.—Attached; coralla tubular, corneous.
4. TUBIPORIDÆ.—Attached; coralla tubular, calcareous.
5. GORGONIDÆ.—Attached; a separable axis to the branches.

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#### FAMILY I.—PENNATULIDÆ.

*Alcyonaria nunquam affixa, sive libera sive basi defossa.*

Unattached Alcyonaria, either free or with the base buried.

These zoophytes are either flat plates, simple stems, or plume-like fronds. The polyps occur on one or both sides of the stem or branches, and in a single genus form a cluster at the extremity. The base of the zoophyte is often somewhat enlarged, and some species, by means of it, are planted in the mud. The greater part of them secrete a slender solid axis along the main stem or midrib of the frond, which is either cartilaginous or calcareous. The polyps have the general characteristics of the Alcyonia.

This family may be subdivided as follows :

SUBFAMILY I. PENNATULINÆ. Polyyps retractile.

- G. 1. *Renilla*. Free, explanate, unifacial (reniform).
2. *Veretillum*. Very stout, oblong cylindrical, simple, with scattered polyyps.
3. *Virgularia*. Slender virgate, with very short pinnules or none.
4. *Pennatula*. Pinnate and stout, or plumiform, with long pinnules.

SUBFAMILY II. PAVONARINÆ. Polyyps not retractile.

5. *Pavonaria*. Virgate, polyyps secund.
6. *Umbellularia*. Virgate, polyyps in a terminal cluster.

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SUBFAMILY I.—PENNATULINÆ.

*Polypis retractilibus.*

Polyyps retractile.

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GENUS I.—RENILLA.

*Liberæ, explanatæ, unifrontes ; polypis sparsis retractilibus.*

Free, explanate, unifacial ; polyyps scattered, retractile.

I. RENILLA AMERICANA. (*Ellis.*)

*R. reniformis, margine acuto ; posticè caudata, caudâ subtus longitudinaliter sulcatâ.*

Reniform, margin acute ; behind caudate, with the caudal appendage, below, longitudinally sulcate.

West Indies.—Off Rio Janeiro. *Exp. Exp.*

Resembles a thick reniform leaf, with a stout pedicel. In the con-

tracted state the upper surface is sprinkled with minute white dots, and larger substellate spots, about three-fourths of a line in diameter: the former, under the microscope, consist of eight points, and are, probably, young budding polyps; the larger are the adult polyps, and are about a line apart. The general surface is filled with very minute calcareous spicula, seen only under a magnifier. Below, the zoophyte is venosely striate; and the caudal appendage is longitudinally sulcate and transversely fine rugate. The usual size of the specimens from the West Indies and Carolina coast, is about an inch in breadth, with the caudal appendage two-thirds of an inch long.

Specimens, probably of this species, were obtained by the Expedition at Rio Janeiro. They were collected by J. P. Couthouy, and figures 1, 1 *a*, plate 57, are from his drawings. The expanded polyps have the rays light yellow, with a row of red dots along the margin, at the base of the fringe of long papillæ. The general colour of the zoophyte is a dull reddish-purple. Only a more thorough examination of the polyps of the *R. americana*, will determinè the identity of these species. The author has examined a specimen from Rio, in alcohol, but it was in too imperfect a condition to decide the question.

- Alcyonium agaricum*, Linn, Gmel., 3811. —, Schweigger, Beobacht. pl. 2, figs. 10,  
*Pennatulula reniformis*, Ellis and Sol., 65. 11; giving dissections; and Handb., 435.  
 —, Pallas, Elenchus Zooph., 374. —, Blainville, Man. d'Actin., 518.  
 —, Shaw, Miscell., iv., tab. 139. —, Ehrenberg, op. cit., G. xxxiv., sp. 1.  
*Renilla americana*, Lamarck, ii. 646.

The *Renilla violacea*, of Quoy and Gaymard, may be a different species, but the only distinguishing character hitherto given is an emarginate or concave front margin. The polyps were of a yellow colour, with a very short fringe, and perhaps were not fully expanded. (Quoy and Gaymard, Voy. de l'Uranie, pl. 86, figs. 6-8. Regne Animal, Paris, 1837, pl. 91, fig. 3; a copy of Quoy and Gaymard's figure; Ehrenberg, op. cit., Gen. xxxiv., sp. 2.)

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GENUS II.—VERETILLUM.—CUVIER.

*Pennatulidæ crassæ, oblongo-cylindricæ, non ramosæ; polypis sparsis, retractilibus.*

Stout cylindrical, and not branched; polyps scattered, retractile.

The stout non-ramose form, and scattered polyps, distinguish the *Veretilla* from the species of the following genera. The eight polyps are fringed with papillæ, as in other *Alcyonaria*.

1. VERETILLUM CYNOMORIUM. (*Pallas.*) *Cuvier.*

*V. aurantiacum, crasso-cylindricum, stipite subgranulosum; polypis albicantibus; axe tenui.*

Orange-coloured, stout cylindrical ( $\frac{1}{2}$  an inch in diameter); base subgranulous, polyps whitish, axis very slender.

Mediterranean Sea. *Pallas. Lamarck. Edwards.*

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|---|--|
| <i>Pennatula cynomorium</i> , Pallas, Zooph., 373; Misc. Zool., tab. 13, fig. 1, 4.   | —, Ehrenberg, G. xxx., sp. 1.  |
| —, Ellis, Phil. Trans., liii., 434, tab. 21, figs. 3-5.                               | —, Milne Edwards, Reg. Anim., Cuvier, 1837, pl. 91, fig. 1; the animals from nature.   |
| —, Lamk., ii. 639, No. 2.   | The <i>Veretillum luteum</i> , of Quoy and Gaimard (Ann. des Sci. Nat., 1827, x. 188, pl. 9, fig. 4), is described as six inches long, and an inch and a half in diameter, of an orange colour, with whitish polyps. |
| —, Blainv., Faune française, Zooph., pl. 2, figs. 1 and 2; Man., 518, pl. 89, fig. 2. |  |
| —, Rapp, Nova Acta, Cæs. Leop. Car. Nat. Curios., t. 14, pl. 38.                      |  |

2. VERETILLUM PHALLOIDES. (*Pallas.*) *Cuvier.*

*V. cinerascens, vix digiti crassitie; fere 6" longum, cylindricum, subclavatum; axe subulato, quadrangulari.*

Cinereous, scarcely as large as the finger, nearly 6 inches long, cylindrical, subclavate; axis subulate, quadrangular.

East Indies, near Amboyna.

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| <i>Pennatula phalloides</i> , Pallas, Zooph., 373; Misc. Zool., 179, tab. 13, figs. 5-9. | <i>Veretillum phalloides</i> , Lamarck, ii. 638, No. 1. |
| <i>Veretillum phalloides</i> , Cuvier, Reg. Anim., 2d ed., iii. 319.                     | —, Blainville, Man., 518.                               |
|  | —, Ehrenberg, G. xxx., sp. 3.                           |

APPENDIX.—The *Pennatula stellifera*, of Müller (Zool. Dan., i. 133, No. 67, tab. 36, figs. 1-3), is referred with a query to the genus *Umbellularia*, by Blainville, to *Funiculina* by Lamarck, and to *Vere-*

tillum by Ehrenberg. It is filiform, three inches long, a line wide, five-flowered, with an oblong and slightly bulbous base, and a terete, clavate axis. It comes from the coast of Norway, where it is said to have been found implanted in the mud.

*Veretillum clavatum* is the name of a new species described by Leuckart, an account of which has not been seen by the author. (Leuck., Zool. Bruchst., ii. 120.)

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GENUS III.—VIRGULARIA.—LAMARCK.

*Pennatulidæ elongatè filiformes, pinnulis polypiferis brevibus aut obsoletis; axe sublapideo.*

Long filiform Pennatulidæ, having short or obsolete polypiferous pinnules; axis somewhat stony.

The Virgulariæ are near the Pennatulæ in general character; but have a slender form, and also very short pinnules, which embrace the stem and often half encircle it in preserved specimens, though spreading when alive. There are also no calcareous spicules in the fleshy portion. The polyps are in a single series along one margin of the pinnules, and have the eight fringed rays of other Alcyonaria. They usually occur with the base buried in the mud, and have been found both in the tropics and in the seas of Norway.

This genus was instituted by Lamarck, and named from the Latin *virgula*, a little rod, in allusion to the form of the species.

1. VIRGULARIA MIRABILIS. (Müller.) Lamarck.

*V. filiformis, 6-12' longa, pinnulis obliquis, arcuatis, laxis, sæpius alternis; axe calcareo, albido, terete, fragili.*

Filiform, 6 to 12 inches long; pinnules oblique, arcuate, lax, mostly alternate; axis calcareous, white, terete, fragile.

Seas of Norway and Britain.



This species is shorter and stouter than the following, with the pinnules, when unexpanded, imbricately crowded, and longer than the breadth of the rachis, and full three times this breadth when alive and expanded.

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|---|--|
| <i>Pennatula mirabilis</i> , Müller, Zool., Dan., tab. 11, figs. 1-3. | —, Ehrenberg, op. cit., G. xxv., sp. 1.                            |
| —, Linn. Syst. Nat., 1322.  | —, Johnston's Brit. Zooph., 179, pl. 24.                           |
| —, Ellis and Solander, 63.  | —, Cuvier, Reg. Anim., 1837, pl. 91, fig. 2; same as Müller's.     |
| —, Sowerby, Brit. Misc., 51, pl. 25.                                  | <i>Virgularia laxipinna</i> , Blainv., Man., 514, pl. 90, fig. 5.  |
| <i>Virgularia mirabilis</i> , Lamk., ii. 647, No. 1.                  | <i>Scirpearia mirabilis</i> , Templeton, Mag. Nat. Hist., ix. 470. |
| —, Deslongchamps, Encyc., 780.  |  |
| —, Grant, Edinb. Jour. of Sci., No. 14.                               |  |

## 2. VIRGULARIA JUNCEA. (Pallas.)

*V. filiformis, longissima* (2-3'), *stipite vermiformi*, 5-6" *longo, crassiore*; *pinnulis distichis brevissimis, contractis transversis et arcuè appressis et sæpe paulo remotis, rugiformibus*; *axe terete, calcareo, fragili*.

Filiform, very long (2 to 3 feet), base vermiform, 5 to 6 inches long, a little stouter than the rachis; pinnules arranged in two opposite series, very short; when contracted, transverse, close appressed, and often a little remote, resembling series of raised wrinkles; axis terete, calcareous, fragile.

The Indian Ocean. *Rumphius*. *Pallas*. *Esper*, who received his specimens from M. Chemnitz.

The shorter pinnules, like mere wrinkles to the stem, in the preserved specimen (shorter than the breadth of the rachis), distinguish this species from the preceding. It is found fixed in the mud, and is pulled up with some difficulty. The above description is taken from *Esper*.

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| <i>Sagitta marina alba</i> , Rumph. Mus. Belg., 43, No. 1, and Amb., vi. 258; the Malay name, according to Rumphius, is <i>Allang-laut</i> , or <i>Sasappo-laut</i> . | —, <i>Esper</i> , Pflanz., iii. 87, tab. Penn. 4, figs. 1-6. |
| <i>Pennatula juncea</i> , Pallas, Zooph., 371, and Gmel. Linn., 3866.   | —, Deslongchamps, Encyc., 781.                               |
|   | —, Cuvier, Reg. Anim., 2d ed., iii. 318.                     |
|   | —, Blainv., Man., 514, pl. 90, fig. 3.                       |
|   | —, Ehrenb., G. xxxv., sp. 2.                                 |

The *V. juncea*, of Lamarek, is described by him from specimens found in the "European Ocean;" yet he refers to *Esper's* figures as representing it, who expressly states,

“Ich habe es der Güte des verewigten Predigers Chemnitz zu danken, welcher mir verschiedene Exemplare, die von den Usern bey Trankenbar beygebracht worden, verlehret hat.” As the *juncea* of early authors is cited by them, as an East Indian species, the name can, properly, be only so applied. Whether the *V. juncea*, of the European seas, is a distinct species or not, is still uncertain. Lamarck states that the *juncea*, of Pallas, is different from his own. His description applies quite well to the above. “*V. stirpe filiformi, rectâ, longissimâ; basi vermiformi, crassiore; pinnis rugæformibus, obliquè transversis, minimis; creberrimis rachi appressis.*” He adds that his specimens were about a foot in length, and the base about one-fourth the whole. The pinnules were very short, and half encircled the stem. The axis was attenuated at each end. (Lamarck, 2d ed., ii. 648.)

The *V. australis*, of Lamarck, was described from a stony axis, which is represented as stouter than that of the *juncea*, tereto-subulate and truncate. Blainville doubts if this axis belonged to a Virgularia, and suggests that it might be from an Umbellularia. This author alludes to a specimen brought by Reinhart from the Moluccas, agreeing with Esper's figure of the *juncea*; and also to another, from the same source, which he describes as the *V. australis*.

The synonymy of this species may possibly be brought out of the confusion around it, if we take Esper's *juncea*, as the true *juncea*, leaving the European *juncea* to be farther determined and named anew, if distinct; and, rejecting the *australis*, of Lamarck, as founded on insufficient grounds, receive the *australis* of Blainville, which he describes as follows:

*Virgularia australis*. Much more slender than the *juncea* of Esper; polypiferous, pinnules on the lower part, short linear; higher up, small salient masses, and towards the summit becoming small wing-like appendages; section of axis quadrangular and radiated. Blainville refers here the *Pennatula juncea*, of Pallas, the description of which, however, applies quite well to the *juncea* of Esper; “*P. simplex, linearis, rachi truncata, rugis distichis transversis polypiferis.*—Loc. Oceanus Indicus.”

The genus *Funiculina*, of Lamarck, was instituted for a virgate species (*Pennatula mirabilis*, Linn.), near the Virgulariæ, having, instead of pinnules, a series of simple verrucæ, with a stellate opening. Blainville has shown that the species described by Lamarck (*F. cylindrica*), is a Gorgonia, and Ehrenberg alludes to a specimen in the Berlin Museum, of which he expresses the same opinion. (Lamarck, 2d ed., 639.—Desc. Mus. Adolph. Fred., 96, tab. 19, fig. 4, and Ellis, Phil. Trans., liii., 1764, tab. 20, fig. 17; Blainville, Man. d'Actin., 515; Ehrenberg, G. xxxiii.) The genus *Scirpearia*, of Cuvier, was made for the *Pennatula Scirpea* of Pallas, and with the same essential characters as the *Funiculina* of Lamarck. Fleming makes the *P. mirabilis*, of Pallas, identical with the *mirabilis* of Müller and Linnæus. (*Scirpearia*, Cuvier, Reg. Anim., 2d ed., iii., 319; Ehrenberg, G. xxxiii. *Pennatula Scirpea*, Pallas, Zooph., 372. *Pavonaria Scirpea*, Blainv., Man., 516. Fleming's Brit. Anim., 507.)

The *F. tetragona*, of Lamarck, is the type of the genus *Pavonaria*, and the *F. stellifera*, is referred to *Veretillum* by Ehrenberg.

## GENUS IV.—PENNATULA.—LINNÆUS.

*Pennatulidæ penniformes, pinnulis distichis, latis, et patentibus, margine superiore polypiferis; axe osseo.*

Penniform or plume-shape, pinnules on opposite sides, broad and spreading, with the upper margin polypiferous; axis osseous.

The Pennatulæ differ from the Virgulariæ in their stouter forms, and broad spreading pinnules, which give a plume shape to the zoophyte. The lower or posterior extremity is naked. The papillæ have generally a crenated anterior border, owing to the prominence of the polyps. The animals are similar in all essential points to the Alcyonia. The axis is cartilaginous, or almost like bone.

Several species of Pennatulæ have been observed to give off, when alive, a phosphorescence of considerable brilliancy.

This genus as used by Linnæus included all the Pennatulidæ; it was restricted to its present limits by Cuvier and Lamarck.

## 1. PENNATULA PHOSPHOREA.

*P. purpureo-rubra, stipite terete, carnosâ, longiusculâ, rachidis dorso papillis crebris scabro, medio sulcato; pinnularum margine caliculis dentato-setaceis pectinato.*

Reddish-purple, basal portion terete, fleshy, and rather long; back of the rachis crowdedly scabrous with papillæ, and sulcate down the middle; margin of the pinnules pectinate, with dentato-setaceous calicles.

European seas.

This is a common phosphorescent species, two to six inches long. The axis is smooth, slender, and quadrangular, tapering at each extremity, and often hooked. The plumose portion of the zoophyte is a little more than twice as long as its greatest breadth.

*Penna marina*, Bohadsch, Mar., Tab. 8, *Pennatula phosphorea*, Linn., ed. xii., fig. 5.

—, Sibbald, Scot., ii. lib. tert., 28.

sp. 2.  
—, Ellis, Phil. Trans., liii., tab. 19, figs.

- 1-5; and *Pennatula britannica*, Ellis —, Blainville, Man., 517.  
 and Solander, 61. —, Fleming, Brit. Anim., 507.  
 —, Esper, iii. 85, tab. 3; *Pennatula alba* —, Ehrenberg, G. xxxvi. fig. 3.  
 (?), *ibid.* 92, tab. 6. —, Johnston, in Trans. Newcastle. Soc.,  
 —, Cuvier, Reg. Anim., 2d ed., iii. 318. ii. 248, pl. 7; and Brit. Zooph., fig. 22,  
*Pennatula phosphorea*, Delle Chiaje, Anim. p. 175.  
 senza vert., iii. pl. 31, fig. 15. *Pennatula rubra*, Pallas, Zooph., No. 215.  
 —, Lamarck, ii. 643, No. 1.

## 2. PENNATULA RUBRA. (*Linnæus*.)

*P. 5'' longa, plumâ oblongo-ovali, stipite terete; rachidis dorso dilatato ad latera granulato, et medio sulcato; pinnularum margine caliculis dentato-setaceis pectinato.*

Five inches in length, base terete; back of the rachis dilated, with a sulcus along the middle, and the sides granulous; margin of the pinnules pectinated with dentato-setaceous calicles.

Mediterranean Sea.

This species is rather larger than the *phosphorea*. The back of the rachis is broader, and its middle smooth or nearly so. The colour, according to Lamarck, is sometimes whitish, and on this account he proposed to substitute the specific name *granulosa* in place of *rubra*. The basal portion of the zoophyte is nearly half the length of the whole, and the length of the plumose portion about two and a half times its breadth. The axis is terete and whitish. It has been suggested that this species is only a variety of the *phosphorea*.

- Red Sea Pen*, Ellis, Phil. Trans., liii. 1764, —, Esper, Pflanz., 83, iii., tab. 2, and *P.*  
 tab. 21, figs. 1-2, and *Pennatula italica*, *setacea* (?), *ibid.* 93, tab. 7.  
 Ellis and Solander, 61. —, Delle Chiaje, pl. 31, figs. 7-14.  
*Penna rubra*, Bohadsch, Mar., 101, tab. 8, —, Ehrenberg, G. xxxvi., sp. 5.  
 figs. 1-3. *Pennatula granulosa*, Lamk., ii. 644, No. 2.  
*Pennatula rubra*, Linn., ed. xii., sp. 4. —, Blainville, Man., 517.

## 3. PENNATULA GRISEA. (*Gmelin*.)

*P. cinerea, 8'' longa; rachide carnosâ, dorso levi; plumâ oblongo-ovata; pinnulis latioribus, contractis longius spinosis.*

Cinereous, 8 inches long; rachis fleshy, with the back smooth; plume oblong-ovate; pinnules quite broad, and when contracted long spinous.

Mediterranean Sea.

This species is distinguished by the smooth back to the rachis, and the broad pinnules becoming very spinous on contraction, owing to the protrusion of the cartilaginous spicules of the interior. The breadth of the plume is not far from half its length; and the basal portion is about a third of the whole length.

- Penna marina phosphorica*, Seba, iii. 39, —, Esper, iii. 81, tab. 1—tab. 1 A., the tab. 1b, figs. 8 a, 8 b. Lamarck refers this figure to the *spinosa*. same after contraction in alcohol, according to Esper.
- Penna marina grisea*, Bohadsch, Mar., 109, tab. 9, fig. 1, 2. —, Lamk., 2d ed., ii. 644, No. 3; also *P. spinosa* (?), No. 4.
- Grey Sea Pen*, Ellis, Phil. Trans., liii, 1764, tab. 21, figs. 6–10, and *P. spinosa*, Ellis and Solander, 62. —, Blainv., Man., 516, pl. 89, fig. 1; and Faune Francaise, Zooph., pl. 1.
- Pennatula grisea*, Linn., ed. xii., 1321. —, Delle Chiaje, Anim. senza vert., iii., pl. 31, figs. 1–3.

4. PENNATULA ARGENTEA. (*Ellis*)

*P. angusto-lanceolata, prælonga, (interdum 1½'), pinnulis creberrimis, imbricatis, brevibus, dentatis, argenteis.*

Narrow lanceolate and very long (sometimes a foot and a half); pinnules crowded imbricate, short and dentate, silvery in appearance.

East Indies.

- Pennatula argentea*, Ellis and Solander, 66; tab. 8, figs. 1–3. The foot, as represented, is about a third of the whole length, and the greatest breadth about a twelfth of the same. It is brilliantly phosphorescent. —, Esper, Pflanz., iii. 94, tab. 8.
- , Lamarck, ii. 645, No. 5.
- , Lamouroux, Exp. Meth., 90, tab. 8, figs. 1–3.
- , Shaw, Misc., iv., tab. 124.
- Penn. elongata*, Blainv., Man., 517.

APPENDIX.—Ehrenberg describes another species, under the name *Pennatula grandis*, as distinct from the *argentea* of Lamarck, and *elongata* of Blainville, and refers with a query to a figure in Shaw's Miscellanies, which appears to have been copied from Ellis. It is characterized by him as follows, from an imperfect specimen in the Royal

Museum at Berlin. "Subbipedalis, vexillo sesquipedali, stipite  $3\frac{1}{2}$ " longo (brevitate insigni), pinnulis apicem versus longis, basin versus minimis, ibique longe distantibus, nec imbricatis, stipite basi bulboso et coronato." In its very short foot, and remote non-imbricate pinules, it appears to be peculiar. No locality is given.

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SUBFAMILY II.—PAVONARINÆ.

*Polypis non retractilibus.*

Polyps not retractile.

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GENUS V.—PAVONARIA.—CUVIER.

*Pennatulidæ, virgatæ, secundæ, polypis non retractilibus.*

Virgate Pennatulidæ, having the polyps along one side of the stem, and not retractile.

The polyps of the Pavonariæ are confined to a single side of the stem, and cover it crowdedly.

This genus was established by Cuvier, but afterwards restricted by Blainville, to those in which the polyps were not retractile. There is but a single species known, and this was arranged with the Funiculinæ, by Lamarck and Lamouroux.

PAVONARIA QUADRANGULARIS. (*Pallas.*) *Blainville.*

*P. elongata* (2'), *gracilis*, *polypis confertis, longitudinaliter 3-seriatis, et in quincuncem dispositis.*

Long (2 feet), and slender; polyps crowded in three longitudinal series, arranged in quincunx order.

Mediterranean Sea.

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| Bohadsch, Mar., tab. 9, fig. 4.                                      | <i>Funiculina tetragona</i> , Lamarck, ii. 641, No. 2.  |
| <i>Pennatula quadrangularis</i> , Pallas, Zooph., 372.               | —, Lamour., Encyc., 423.  |
| <i>Pennatula antennina</i> , Linn., Gmel., 3865.                     | <i>Pavonaria antennina</i> , Cuvier, Reg. Anim., 2d ed. iii. 319.                               |
| —, Ellis and Solander, 63; Phil. Trans., liii. 431, tab. 20, fig. 4. | <i>Pavonaria quadrangularis</i> , Blainv., 516, pl. 90, fig. 1; and Dict. d'Hist. Nat., pl. 61. |
| —, Ehrenberg, G. xxxi.   |   |

GENUS VI.—UMBELLULARIA.—CUVIER.

*Pennatulidæ virgatæ, polypis terminalibus, non retractilibus.*

Virgate Pennatulidæ, having the polyps terminal, and not retractile.

Only a single specimen of this genus has hitherto been met with. The polyps, as figured by Ellis, closely resemble the other Alcyonaria in their fringed tentacles, and general form. They constitute a sessile umbel at the extremity of a long slender stem.

UMBELLULARIA GREENLANDICA. (*Lamarck.*)

*U. longissima* (6'), *supernè attenuata, polypis in umbellam congestis.*

Very long (6 feet) attenuate above; polyps forming an umbel.

Seas of Greenland.

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| <i>Zoophyton grænlandicum</i> , Mylius, Beschreib. grönl. Thierpfl. 1753.   | —, Linn., Gmelin., 3867.                                  |
| <i>Isis encrinus</i> , Linn., ed. x., 800; <i>Vorticella encrinus</i> , <i>ibid.</i> , ed. xii., 1317; Ellis's Corallines, 96, tab. 37, figs. <i>a, b, c</i> ; Phil. Trans., xlviii. 305, tab. 12; liii. 427. | <i>Umbellularia grænlandica</i> , Lamk., 2d ed., ii. 677. |
| <i>Pennatula encrinus</i> , <i>Cluster-polype</i> , Ellis and Solander, 67, No. 10.   | —, Esper, Pflanz., iii. 366, tab. Vort. 2.                |
|   | —, Blainv., Man., 513, pl. 90, fig. 2.                    |
|   | <i>Umbellularia encrinus</i> , Cuvier, Reg. Anim. iii.    |
|   | —, Ehrenb., G. xxxii., sp. 1.                             |

## FAMILY II.—ALCYONIDÆ.

*Alcyonaria affixa, carnosæ, penitus sæpe calcareo-spiculigera.*

Attached Alcyonaria, fleshy, often containing disseminated calcareous spicula.

The Alcyonidæ are fleshy zoophytes, and grow in clumps of short branches, or broad plates, spreading over the rocks. When alive, the whole is a mass of flowers, with fringed petals; but they are no sooner touched than the blossoms disappear, and nothing remains but clusters of pale grayish branches,—“dead men’s fingers” as one species has been significantly called. Some species, of rich colours, form long pendant clusters in the coral grottoes. Though a retraction and disappearance of the polyp-flowers usually take place when disturbed, there are a few species in which this is not the case.

The scattered granules of lime are so abundant in many species as to give considerable firmness to the zoophyte, and the natives of the South Sea Islands often use them in place of sand-paper for polishing their war-clubs.

These zoophytes abound in the tropics, and some species are found in the seas of Northern Europe.

This family includes the following subfamilies and genera :

SUBFAMILY I. XENINÆ. Texture carnosæ. Polyps not retractile.

G. 1. *Rhizoxenia*. Polyps attached in lines which are often reticulate.

G. 2. *Anthelia*. Forming spreading plates.

G. 3. *Xenia*. Forming thick lobed or subramose masses.

SUBFAMILY II. ALCYONINÆ. Texture carnosæ. Polyps partly or wholly retractile.

1. *Polyps semi-retractile, leaving wart-like prominences or verrucæ.*

G. 4. *Ammothea*. Ramose or fruticulose, verrucæ unarmed.

G. 5. *Sympodium*. Effuse, not stipitate, verrucæ unarmed.

G. 6. *Nephthya*. Verrucæ armed with calcareous spicula.

2. *Polyps wholly retractile.*

G. 7. *Alcyonium*. Lobed or branched; fringe of tentacles short.

SUBFAMILY III. SPOGGODINÆ. Texture membranous, and very open cellular within; polyps minute, not retractile, in clusters of calcareous spicula.

G. 8. *Spoggodia*.



## SUBFAMILY I.—XENINÆ.

*Carnosæ; polypis non retractilibus.*

Carnose, and surface not harsh; polyps not retractile.

## GENUS I.—RHIZOXENIA.—EHRENBERG.

*Alcyonidæ carnosæ, polypis non retractilibus, per stolones filiformes gemmantibus.*

Carnose Alcyonidæ; polyps not retractile and budding by means of creeping filiform shoots.

This genus was instituted by Ehrenberg for the *Zoantha thalassanthos*, of Lesson, an imperfectly described species, and probably a *Cornularia*, or near Quoy and Gaymard's *Clavularia*. Philippi has instituted the genus *Evagora*, with the same characteristics, proposing (we think unnecessarily) to substitute this name for Ehrenberg's, on the ground of the uncertainty with regard to the characters of Lesson's species. The name *Rhizoxenia*, is from  $\rho\acute{\iota}\zeta\alpha$ , a root, and *Xenia*, the name of a following genus, allied to this in its polyps.

## 1. RHIZOXENIA THALASSANTHA. (Lesson.) Ehrenberg.

*R. corpore claviformi, longitudinaliter striato, tentaculis filiformibus pinnatis.*

Body claviform, longitudinally striate, tentacles filiform, pinnate.

This species is referred to the genus *Cornularia*, by Blainville and Milne Edwards, with the species of which it agrees nearly in habit. It also resembles Quoy and Gaymard's *Clavularia viridis*.

- Zoantha thalassanthos*, Lesson, Voy. de —, Milne Edwards, Lamk., 2d ed., ii. la Coquille (1825), Zooph., pl. 1, fig. 2. 129.  
*Cornularia thalassianthoidea*, Blainville, *Rhizoxenia thalassantha*, Ehrenb., G. xxii. Man., 499; and Dict. d'Hist. Nat., 463. "An bene observata? Forsan Anthelia fuit."

## 2. RHIZOXENIA ROSEA. (*Philippi*.) *Dana*.

*R. polypis paucibus* (6–10) *consociatis*, 2''' *longis*, *roseis*, *tentaculis fimbriatis*.

Polyps of the zoophyte few (6 to 10), each about 2 lines long; colour rose-red; tentacles fringed with papillæ.

Near Naples, incrusting barnacles, &c. *Philippi*.

*Evagora rosea*, *Philippi*, *Wagner's Archiv.*, viii. 36.

## 3. RHIZOXENIA PRIMULA. (*Dana*.)

*R. pallidè rosea aut lilacina*, *polypis* 4–5''' *altis*, *tentaculis non fimbriatis*, *ferè* 1½''' *longis*, *papillis sparsis*, *obsolescentibus*, *verruciformibus*.

Pale rose or lilac; polyps 4 to 5 lines high, tentacles not fringed, each nearly 1½ lines long, papillæ scattered, obsolescent, verruciform.

Plate 57, fig. 2, polyps, natural size; 2 *a*, one of them, enlarged.

Ovolau, one of the Feejee Islands, along the shores, in shallow water. *Exp. Exp.*

This is a very neat species, and when fully expanded, the star of tentacles is over a fourth of an inch in diameter. The tentacles are peculiar in having, instead of a fringe of oblong papillæ, a few scattered verruciform prominences. The *stolon* uniting the polyps was not observed, and I am not satisfied that the polyps were not solitary, as was my impression when the drawings were made.

## GENUS II.—ANTHELIA.—SAVIGNY.

*Aleyonidæ carnosæ, explanato-gemmatæ ; polypis non retractilibus.*

Carnose, explanato-gemmate Aleyonidæ ; polyps not retractile.

The Antheliæ cover the rocks, or any solid support at hand, with thin fleshy plates, which consist of an aggregation of polyps united by their bases. They differ from the Xenidæ in budding only at the base, which gradually spreads outward by the process, producing finally the incrusting plate.

1. ANTHELIA GLAUCA. (*Savigny.*)

*A. glauca, cærulescens ; polypis infrà subventricosis, interdum coalescentibus.*

Glaucous, pale bluish ; polyps subventricose below, sometimes becoming coalescent.

Red Sea. *Savigny.*

*Anthelia glauca*, Savigny, *Egypt. Polypes*, *Anthelia glauca*, Schweig., *Handb.*, 411.  
 pl. 1, fig. 7. —, Blainv., *Man.*, 524.  
 —, Lamk., *ii.* 623, No. 1. —, Ehrenberg, *G.* *xxi.*, sp. 1.  
 —, Lamour., *Exp. Meth.*, 70.

2. ANTHELIA STRUMOSA. (*Ehrenberg.*)

*A. glauca ; polypis sub ore inflatis, strumosis, pollicaribus.*

Glaucous ; polyps inflated below the mouth, strumous, an inch in height.

Red Sea. *Ehrenberg.*

*Anthelia strumosa*, Ehrenb., *G.* *xxi.*, sp. 2. —, Lamk., *2d ed.*, *ii.* 623.

3. ANTHELIA PURPURASCENS. (*Ehrenberg.*)

*A. extus e violaceo albicans; tentaculis intus violaceo-purpurascens, papillis utrinque 3-seriatis.*

Exterior pale violet; tentacles purplish violet within; papillæ on each side in three series.

Red Sea. *Ehrenberg.*

*Anthelia purpurascens*, Ehrenberg, G. xxi., sp. 3. Savigny's pl. 1, fig. 5, Egypt. Polypes, is referred to this species with a query by Ehrenberg.

4. ANTHELIA DESJARDIANA. (*Templeton.*) *Dana.*

*A. pallidè livido-cærulea, latè effusa, basi  $\frac{1}{8}$ " crassâ; polyphis valde prominentibus, lateribus horizontaliter rugatis.*

Pale livid blue; widely spreading, with the base  $\frac{1}{8}$  of an inch thick; polyps very prominent, sides horizontally wrinkled.

Isle of France. *Templeton.*

The papillæ of the tentacles, as represented by Templeton, are very short, and the polyps are about half an inch in height. The animals, however, do not appear to have been fully expanded when figured, and to this may be owing the encircling wrinkles of the polyp.

*Xenia Desjardiana*, R. Templeton, Zool. Trans. of London, ii. 25, with a plate.

NOTE.—Savigny figures two other zoophytes resembling the Antheliæ in habit, which Ehrenberg suggests may be *Sympodia*.

The *Clavularia violacea*, of Quoy and Gaymard (Voy. de l'Ast., iv. 262, pl. 21, figs. 13-16), may be an Anthelia partly expanded. The *C. viridis* of the same (p. 260, pl. 21, figs. 10-12), resembles a Cornularia, as stated by Milne Edwards. But according to Quoy and Gaymard, these species have the *cornuous* tubes of the Cornulariæ, with the coalescence below into a plate which belongs to the Antheliæ, characters which would sustain the genus as proposed by them.

## GENUS III.—XENIA.—SAVIGNY.

*Alcyonidæ carnosæ, lobatæ et subramosæ, polypis subacrogenis, basi et latere gemmatis.*

Fleshy Alcyonidæ, erect lobed and subramose, polyps subacrogenous, budding both at base and from their sides.

Instead of the thin incrusting plate of the Antheliæ, the Xenie form lobed masses, each lobe a clump of polyps, owing to their acrogenous growth and lateral as well as basal budding. It appears, therefore, that the Xenie and Antheliæ, differ far more essentially than the Zoanthæ and Mammilliferæ, which we have thrown into a single genus; since in the latter case, there is simply a difference as to the extent of the lateral coalescence between the polyps. See p. 423. In some species the animals are nearly an inch across, when fully expanded, and resemble star-shaped pinks, with fringed petals, usually of some shade of blue, rose, or lilac. In the living group, as it appears beneath the water, some of the flowers are fully open, while others are half closed, and all are constantly changing their appearance from bud to blossom, and from opened flower to bud again.

This genus was instituted by Savigny, for a Red Sea species. The *Cornulariæ* of Quoy and Gaymard, are true Xenie.

1. XENIA UMBELLATA. (*Savigny.*)

*X. polypis cæruleo-glaucis, tentaculis longis, papillis longis, utrinque ter-  
seriatis, stirpe quadripollicari.*

Polyps bluish-glaucous, tentacles long, papillæ long, in three series; base 4 inches thick.

Red Sea. *Savigny. Ehrenberg.*

Ehrenberg states that Savigny's figure is erroneous in giving but two rows of papillæ on the sides of the tentacles. The characters mentioned are hardly sufficient to distinguish the species.

In Savigny's figure the tentacles are a third of an inch long, and

narrow. The papillæ in the upper view of a tentacle, are separated by an extremely narrow line, so that those of the two sides almost meet at base; they are long and slender, the length being full *eight* times the diameter.

*Xenia umbellata*, Savigny, *Egypt.*, polypes, figured from a preserved specimen from  
pl. 1, fig. 3. the Red Sea, may be this species or the  
—, Lamk., ii. 626, No. 1. following.  
—, Ehrenb., *G.* xx., sp. 1. *Xenia cærulea*, Lamour., *Exp. Meth.*, 69.  
The *Xenia umbellata* of Schweigger (Beobacht. taf., 5., fig. 48, and Handb., 411), —, Blainville, *Man.*, 523.

## 2. XENIA FUSCESCENS. (*H. & Ehrenberg.*)

*X. polypis fuscescentibus, tentaculorum papillis utrinque 4-seriatis.*

Polyps brownish, papillæ in 4 series on each side of the tentacles.

Red Sea. *Ehrenberg.*

*Xenia fuscescens*, Ehrenb., *G.* xx., sp. 2; *Xenia fuscescens*, Lamk., 2d. ed., ii. 626.  
“An prioris varietas, quam habitu exactè refert.”

## 3. XENIA CÆRULEA. (*H. & Ehrenberg.*)

*X. minor, gracilior, latè cærulea, tentaculorum papillis paucioribus; stipite brevior, basi pollicari.*

Small and more delicate than the preceding, blue; papillæ of the tentacles fewer; trunk shorter, an inch thick at base.

Red Sea. *Ehrenberg.*

*Xenia cærulea*, Ehrenb., *G.* xx., sp. 3. *Xenia cærulea*, Lamk., 2d. ed., ii. 627.

NOTE.—Figures 3, 3 *a*, and 3 *b*, plate 57, represent a species from the Feejees, which may be Ehrenberg's *cærulea*. It is a young group, though the polyps, as in other cases, are adults. The star is hardly half an inch broad; the tentacles slender; the papillæ in two or three series, and short, their length being about twice their breadth, and not exceeding the width of the intervening midrib of the tentacle as seen in an upper view. The colour is a pale rose. It has shorter and stouter papillæ than the *elongata*.

## 4. XENIA FLORIDA. (Lesson.) Dana.

*X. pallidè cæruleo-glaucæ, lobata; polypis*  $\frac{2}{3}$ " *latis,*  $\frac{1}{2}$ " *exsertis; tentaculis lanceolatis, papillis brevissimis (parcè oblongis), 3-seriatis.*

Pale bluish glaucous, lobed; polyps  $\frac{2}{3}$  of an inch broad,  $\frac{1}{2}$  an inch prominent when fully expanded; tentacles lanceolate; papillæ very short, but little longer than broad, in 3 series.

Plate 57, fig. 4, clump of polyps, natural size; 4 *a*, upper view of tentacles; 4 *b*, under view of the same.

Feejee Islands. *Exp. Exp.*

This species, apparently the *Actinantha florida* of Lesson, forms large clumps, sometimes six inches through, and occurs in shallow water, where it is often left uncovered by ebb tide. When fully expanded, the polyps are large and prominent; but they contract to half the full size when taken from the water, and are slow to expand again when returned to it. This fact will account for the bad figures published of some species of this genus. The very short papillæ and broader tentacles, distinguish this species from the *umbellata*. In an under view of the tentacles, the outer papillæ are seen to form a regular series, and their length is hardly twice their breadth.

*Actinantha florida*, Lesson, Voy. de la Coquille, pl. I, fig. 3.

*Cornularia floridea*, Blainville, Man., 499.

The *Cornularia subviridis*, variet., Quoy and Gaymard, Voy. de l'Ast., iv. 266, pl. 22, figs. 5-7, may be the above species; but both these, and the other figures and descriptions (pl. 22, figs. 1-4 and 8-10), are too imperfect to be recognised.

## 5. XENIA ELONGATA. (Dana.)

*X. lobata, fuscescens, polypis expansis 8-9''' latis, 1-1½'' salientibus; tentaculis angusto-oblongis, limbo pallido, intervallo superno fimbriá paulo angustiore; papillis brunneis 3-4-seriatis, confertis, tenui-elongatis, in serie externo 20-24.*

Lobate, brownish; polyp-stars 8 to 9 lines broad, 1 to 1½ inches salient; tentacles narrow oblong; limb pale, the interval above

between the papillæ a little narrower than the fringe; papillæ deep brown, in 3 to 4 series, crowded, slender and elongate, 20 to 24 in the outer series.

Plate 57, fig. 5, group, natural size; 5 *a*, under view of tentacles, enlarged; 5 *b*, upper view of the same.

The long, salient polyps, and the slender papillæ distinguish this species from the preceding. The interval above, between the opposite fringes of a tentacle, is very much broader than in the *umbellata*, and the papillæ are but four or five times longer than their breadth. The groups are more deeply lobed than in the *florida*.

NOTE.—The *Xenia purpurea*, of Lamarck, figured by Esper, is a species of the genus *Spoggodia*.

The *Alcyonium terminalis*, of Quoy and Gaymard, appears to be a young zoophyte of this genus, partly expanded (Voy. de l'Ast., iv. 282, pl. 23, figs. 15-17).

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SUBFAMILY II.—ALCYONINÆ.

*Carnosæ*; *polypis retractilibus*, *zoophytis contractis superficie sive levibus sive verrucosis*.

Carnose; polyps retractile; surface of contracted zoophytes, either smooth or verrucose.

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GENUS IV.—AMMOTHEA.—SAVIGNY.

*Alcyonidæ carnosæ*, *ramulosæ aut fruticulosæ*, *polypis in verrucas inermes retractilibus*.

Carnose Alcyonidæ, ramulous or fruticulose; polyps retracting into verrucæ not armed with spicula.

The verrucæ of the surface distinguish these species from the Alcyonia, the mode of growth from the Sympodia, and the absence of spicula about the verrucæ, from the Nephthya. The genus is named after one of the sea-nymphs.



1. AMMOTHEA VIRESCENS. (*Savigny.*)

*A. virescens, patula, subtilius et laxè ramulosa, mollis, tentaculis flavidis.*

Greenish, spreading, finely and lax ramulous, soft, tentacles yellowish.

Red Sea. *Savigny. Ehrenberg.*

- |   |   |
|---|---|
| <i>Ammothea virescens</i> , Savigny, <i>Egyp.</i> , <i>Polytypes</i> , pl. 2, fig. 6. | <i>Nephthea Cordieri</i> , Audouin, <i>Explic. des planches de Savigny.</i>                                     |
| —, Lamk., ii., 628, No. 1.  | <i>Neptæa Savignyi</i> , Blainville, <i>Man.</i> , 523, pl. 88, fig. 6, and <i>Ammothea virescens</i> , p. 522. |
| —, Lamour., <i>Exp. Meth.</i> , 69.   |   |
| —, Ehrenb., <i>G.</i> xxvi., sp. 1.   |   |

2. AMMOTHEA THYRSOIDES. (*H. & Ehrenberg.*)

*A. effusa, ramis cylindricis, pollicaribus, erectis, simpliciter carnosis, verrucosis.*

Spreading, branches cylindrical, an inch long, erect, simply carnose, verrucose.

Red Sea. *Ehrenberg.*

*Ammothea thyrsoïdes*, Ehrenb., *G.* xxvi., sp. 2. —, Lamk., ed. ii., 629, No. 3.

NOTE.—Milne Edwards adds to this genus (Lamarck, 2d ed. ii., p. 629) the following species, described and figured by Quoy and Gaynard: *A. imbricatum*, *Voy. de l'Ast.*, pl. 23, iv. 281, figs. 12-14; *A. ramosum*, *ibid.*, p. 275, figs. 8-11, and with a query, also, *A. amicorum*, *ibid.*, 276, pl. 22, figs. 13-15. There is so much uncertainty with regard to the figures, that a re-examination of them is necessary before the species can be satisfactorily characterized. The polyps are represented without papillæ to the tentacles, which sometimes appears to be the case when contracted, but not otherwise.

## GENUS V.—SYMPODIUM.—H. &amp; EHRENBURG.

*Alcyonidæ carnosæ, explanato-effusæ, incrustantes, non stipitatæ, polypis in verrucas inermes retractilibus.*

Carnose, forming spreading, incrusting plates, and not stipitate; polyps retracting into verrucæ which are not armed with spicula.

The *Sympodia* are incrusting *Ammonotheæ*, or resemble the *Antheliæ*, excepting that the polyps are retractile. Blainville covers the same ground, with the genus *Anthelia*, as used by him. The following species are referred to this genus by Ehrenberg.

1. *SYMPODIUM FULIGINOSUM.* (*H. & Ehrenberg.*)

*S. fuliginosum*, *bipollicare*; *tentaculis pallidioribus, brevioribus*; *polypis expansis 6''' longis et 3''' latis.*

Fuliginous, 2 inches; tentacles quite pale, short; polyps 6 lines long, and expanded star 3 lines broad.

Red Sea.

Savigny, *Egyp.*, *Polypes*, pl. 1, fig. 6.  
*S. fuliginosum*, Lamk., 2d ed., ii. 624.

*Sympodium fuliginosum*, Ehrenberg, G.  
xxviii., sp. 1.

2. *SYMPODIUM CÆRULEUM.* (*H. & Ehrenberg.*)

*S. fuliginosum*, *tentaculis lætè cæruleis, parvis, gracilibus.*

Fuliginous, tentacles bright blue, small, slender.

Red Sea.

*Sympodium cæruleum*, Ehrenb., G. xxviii., sp. 2. —, Lamk., 2d ed. ii. 624, No. 2.

3. *SYMPODIUM ROSEUM.* (*Ehrenberg.*)

*S. suberosum, varium, roseum, 2½–3''' crassum*; *verrucis paulum prominentibus aut oblitteratis*; *tentaculis albis.*

Suberose, of varying form, rose-coloured, 2½ to 3 lines thick; verrucæ but little prominent or obsolete; tentacles white.

St. Thomas, West Indies, incrusting axis of Gorgonia.

*Sympodium roseum*, Ehrenb., G. xxviii., sp. 3. —, Lamk., 2d ed., ii. 624, No. 3.

NOTE.—Ehrenberg also refers here the following species, which appear to be incrusting Alcyonia; and the *S. roseum* should probably be included in this list.

*Sympodium coralloides*, Ehrenberg (sp. 4); *Gorgonia coralloides* of Pallas, a red suberose incrustation around a Gorgonia, without verrucæ, and yellow tentacles to the polyps (Pallas, Zooph., p. 192; Esper, ii., tab. 32, who reports it from the Mediterranean).

*Sympodium rubrum* (sp. 5), *Alcyonium rubrum*, Müller, Icon. Zool. Dan., tab. 82, figs. 1-4, *Anthelia rubra*, Blainville. From the Norwegian Sea. Johnston, in his British Zoophytes (p. 190) states that this species is only an incrusting form of the *Alcyonium digitatum*.

*Sympodium ochraceum*, Ehrenb., sp. 6: "Obducens, suberosum, ochraceum, nodos in Gorgonia efficiens." West Indies. (Esper, Pflanz. ii. tab. 14.)

*Sympodium massa*, Ehrenberg, sp. 7. See *Alcyonium cydonium*.

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GENUS VI.—NEPHTHYA.—SAVIGNY.

*Alcyonidæ carnosæ, fruticulosæ; polypis in verrucas spiculo-armatas retractilibus.*

Carnose Alcyonidæ, fruticulose; polyps retracting into verrucæ armed with spicula.

The spicula of the surface, which are exsert about the polyps, ally the Nephthyæ to the Spoggodiaæ; but the latter have a membranous and very open cellular structure, and the polyps are minute and not retractile. Nephthy, was the name of an Egyptian goddess, and hence the name of the genus, which was applied by Savigny to a Red Sea species.

I. NEPHTHYA SAVIGNII. (H. & Ehrenberg.)

*N. virens, fruticulosa; tentaculis flavis, verrucarum spiculis pluribus viridibus.*

Greenish, fruticulose; tentacles yellow, spicula of the verrucæ green.

Red Sea. *Savigny. Ehrenberg.*

*Nephtheë*, Savigny, Eyp. Polyp., pl. 2, *Nephthya Savignyi*, Ehrenb., G. xxvii.,  
fig. 5. fig. 1.  
*Ammothæa Chabrolii*, Audouin, Explic. des The *Neptæa Savignyi*, of Blainville, is  
planches de Savigny. the *Ammothæa virescens*, of Savigny,  
*Neptæa innominata*, Blainv., Man., 523. which see.

NOTE.—Ehrenberg describes a second species, from the Red Sea, as the *Nephthya florida*, referring to it Esper's figure of the *Alcyonium floridum*. Esper's species is beyond doubt a Spoggodia, with the polyps not retractile. Ehrenberg's description is as follows:—"Lætè purpurea, fruticulosa, verrucarum spiculis inæqualibus, una longissima." This author also adds to the genus the *Gorgonia florida*, figured on tab. 137, of Zool. Dan. of Müller, proposing to name it *Nephthya Rathkiana*.

#### GENUS VII.—ALCYONIUM.

*Alcyonidæ carnosæ, fruticuloso-ramosæ, explanatæ et glomeratæ, sæpius crassè stipitatæ; polypis omnino retractilibus; zoophytis contractis superficie levibus; stipite polyporum tubulis visceralibus omnino perforato.*

Carnose Alcyonidæ, fruticuloso-ramose, explanate and glomerate, and usually very stout stipitate; polyps wholly retractile, and the zoophytes without verrucæ when contracted; pedicel perforated to its base with the visceral tubes of the polyps.

Ramose, explanate, and glomerate forms occur in this group, as in many other genera of zoophytes. The branching species have a very stout base or pedicel, consisting of aggregated visceral tubes, and bearing above a cluster of branches, lobes, or branched lobes, at summit, with the branches usually but little subdivided. The explanate species spread in broad plates, sometimes covering several square feet, and have a plaited border. The pedicel is perforated to its base with the tubular visceral cavities of the polyps. When contracted, the surface is smooth, and dotted over with minute points, sometimes appearing stellate; but on expansion, the body of the branches is entirely concealed by the polyp-flowers that cover them.

These animals have a fringe of papillæ on either margin of the tentacles. The figures by Quoy and Gaymard, which seem to be exceptions, were made from half-contracted polyps, as we are assured from frequent observation of some of the same and other species. Colour is not an important character in this genus. The texture varies from soft fleshy to harsh and rigid, according to the proportion of the calcareous secretions within.

The character of the pedicel separates this genus from some arborescent species, in which the tubes of the polyps do not extend along the axis to the base, and are, therefore, related to the Gorgoniæ.

The genus *Alcyonium*, of the early authors, embraced the species here included, together with some others, similar in general appearance, allied to the sponges. Lamarck restricted the use of the term to the latter division. But it has been restored by Milne Edwards and others to the *zoophytes* so named. Thus employed, it corresponds to the genus *Lobularia*, of Lamarck and Blainville, and to the *Lobularia* and *Halcyonium*, united, of Ehrenberg. It also includes those of the *Sympodia*, of Ehrenberg, which are without verrucæ on retraction. It may be doubted whether it is necessary to institute a new genus for the thin incrusting species which would be thus introduced.

Some subdivisions of the genus may be found necessary on a farther study of the animals, but it would be against analogy to separate the glomerate or explanate species from the ramose, as they are all similar in their general mode of growth.

Milne Edwards has given the generic name *Alcyonidia* to a species in which the surface of the pedicel becomes nearly solid from the thick dissemination of calcareous spicula, forming thus a case, into which the upper part of the polyp may retract itself. The term is so near *Alcyonidium*, a genus of Bryozoa, that it is to be hoped its distinguished author may suggest some substitute. As the variation of the species from the *Alcyonia* type is but small, it is here included in this genus.

#### *Arrangement of the Species.*

##### *I. Ramose or lobulose, not becoming more firm and solid below.*

- |                         |                            |
|-------------------------|----------------------------|
| 1. <i>A. digitatum.</i> | *5. <i>A. spherophora.</i> |
| 2. <i>A. cydonium.</i>  | 6. <i>A. pauciflorum.</i>  |
| 3. <i>A. palmatum.</i>  | 7. <i>A. polydactylum.</i> |
| 4. <i>A. stellatum.</i> | 8. <i>A. brachycladum.</i> |

- |                           |                               |
|---------------------------|-------------------------------|
| 9. <i>A. aurantiacum.</i> | *14. <i>A. trichanthinum.</i> |
| *10. <i>A. viride.</i>    | *15. <i>A. confertum.</i>     |
| *11. <i>A. flabellum.</i> | *16. <i>A. rigidum.</i>       |
| *12. <i>A. flexile.</i>   | *17. <i>A. murale.</i>        |
| 13. <i>A. flavum.</i>     |                               |

II. *Explanate, surface flat.*

- |                         |                       |
|-------------------------|-----------------------|
| *18. <i>A. glaucum.</i> | *19. <i>A. latum.</i> |
|-------------------------|-----------------------|

III. *Glomerate and not lobulose.*

20. *A. pulmo.*

IV. *Ramose, surface of pedicel becoming nearly solid from calcareous secretions, and zoophyte retractile into the same.*

21. *A. elegans.*

I. *Alcyonia ramosa aut elongato-arrecta.*

1. *ALCYONIUM DIGITATUM. (Linn.)*

*A. mammillosum aut digitatum, basi incrustans, lobis paucis, cylindricis et conoideis, sæpe  $\frac{1}{2}$ –1" crassis, et plures elongatis; extus subcoriaceum, griseum et aurantiacum; poris stellatis sparsis; polyphis expansis, 4–5" exsertis, et  $1\frac{1}{2}$ " latis.*

Mammillary or digitate, from an incrusting base; lobes few, cylindrical or conoid, often  $\frac{1}{2}$  to 1 inch thick, and several inches long: exterior subcoriaceous, grayish and orange, scattered over with stellate pores; polyps, when expanded, 4 to 5 lines exsert, and summit  $1\frac{1}{2}$  lines in breadth.

Coast of Britain and Northern Europe.

The common names of this species, *Dead Man's toes*, *Dead Man's hands*, and *Cow's paps*, are sufficiently descriptive of its forms. The polyps are unusually large for the genus; the size, as above given, is taken from a figure by Johnston, which he states to be natural size. This author, in his account of this species, describes some specimens as thin incrusting, and refers here the *Alcyonium rubrum*, of Müller, which is placed by Ehrenberg with the *Sympodia*.

*Dead Man's hand*, or *Dead Man's toes*, A. 2; *Alcyonium manus marina*, in Phil. Ellis, Corall. 83, No. 2, pl. 32, fig. a, A. Trans., liii. 431, tab. 20, figs. 10–13.



- Alcyonium digitatum*, Linn., 1294—Gmelin, 3812.  
 —, Ellis and Solander, 175, pl. 1, fig. 7—a polyp, badly figured.  
 —, Bosc, Vers, iii., 156, pl. 30, fig. 4, 5.  
 —, Fabricius, Faun. Grönl., 447.  
 —, Shaw's Misc., ix., pl. 326—bad figure.  
 —, Milne Edwards, Cuvier, Reg. Anim., 1837, pl. 94, fig. 3, and Ann. des Sci. Nat., 2d ser., t. iv.  
*Alcyonium lobatum*, Pallas, Zooph., 351.  
 —, Lamour., Pol. flex., 336, pl. 12, fig. 4, and plates 13 and 14, fig. 1.  
*Alcyonium exos*, Spix, Ann. du Mus., xiii. 451, pl. 33.  
*Lobularia digitata*, Lamk., ii. 631, No. 1.  
 —, Fleming's Brit. Anim., 515.  
 —, Blainville, Man., 521.  
 —, Ehrenb., G. xxv., sp. 3.  
 —, Johnston, Trans. Newcastle Soc., ii. 250, pl. 8, and Brit. Zooph., 188, pl. 26 and 26\*.  
 —, Grant, Edinb. Journ. of Sci., viii. 104.  
 —, Roget, Bridgewater Treatise, i. 162, fig. 56.  
 The *Lobularia grandiflora* of Chamisso, from the English Channel (Ehrenb., G. xxv., sp. 2), agrees in its description with the figure by Johnston.  
 Probably also:—  
*Alcyonium rubrum*, Müller, Zool., Dan. iii. pl. 82, figs. 1-4.  
*Anthelia rubra*, Blainv., Man., 524, pl. 88, fig. 7.  
*Sympodium rubrum*, Ehrenb., G. xxviii., sp. 5.  
*Alcyonium arenosum* (?), Shaw's Misc., viii., pl. 272.

## 2. ALCYONIUM CYDONIUM. (Müller.)

*A. glomeratum, sæpe conoideum, indivisum, extus coriaceum, rigidum, spiculis calcareis internis numerosis, et ad superficiem sæpe tricuspidatis.*

Glomerate, often conoid, not divided or lobate; exterior coriaceous and harsh; internal calcareous spicula very numerous, and often those at the surface tricuspidate.

Island of Fulah and Norst. *Jameson.*

- Alcyonium cydonium*, Müll., Zool. Dan., iii., 1, tab. 71, figs. 3, 4, represents an oblong subcylindrical zoophyte with a conoidal summit about an inch in diameter. The polyps are one and a half lines long, and the expanded star the same in diameter; in this respect the species differs decidedly from the *digitatum*. The holes represented by Müller in the disk, are very doubtful.  
 —, Lamour., Polyp. flex., 337.  
 —, Jameson, Mem. Wern. Soc., i. 563.  
*Lobularia conoidea*, Lamk., 632, No. 2.  
*Cydonium Mulleri*, Fleming, Brit. Anim., 516.  
 —, Blainv., Man., 525, pl. 92, fig. 2.  
 —, Grant., New Edinb. Phil. Jour., i. 195.  
 —, Johnston, Brit. Zooph., 191.  
*Lobularia digitata*, young (?), Ehrenb., G. xxv., sp. 3.  
 A *young* zoophyte is of smaller size than the full-grown, but does not consist of smaller polyps. On this principle, which is of general application, the *cydonium* must be distinct from the *digitatum*, if we may trust the figures given.

The *Alcyonium massa* of Müller, Zool. Dan., tab. 71, figs. 1, 2, is near the above in shape and mode of growth; it is represented with only five tentacles to the star, which must be incorrect, if it be a true zoophyte. Blainville instituted for it the provisory genus *Massarium* (Man., 526), and Ehrenberg places it with his *Sympodia* (op. cit., G. xxviii., sp. 7).

### 3. ALCYONIUM PALMATUM. (*Pallas.*)

*A. erectum, stipitatum, supernè irregulariter ramoso-palmatum; ramulis teretibus, vel subcompressis, inæqualibus, 1½–2''' crassis, paucis; polyphis 1½''' exsertis, stellâ expansâ lineari.*

Erect, stipitate, above irregularly ramoso-palmate; branchlets terete or subcompressed, unequal, 1½ to 2 lines thick, few; polyyps 1½ lines exsert, expanded star about a line in diameter.

Mediterranean Sea.

The branches of this "main de mer," or "main de Ladre," are irregular and not crowded, and the branchlets are short, seldom over two-thirds of an inch without branching again, and mostly a little less than two lines thick. The usual colour is red.

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|--|---|
| <i>Manus marina</i> , Aldrovandi, Hist. Nat., lib. vi., de Zoophytis, 593.                                 | <i>Alcyonium exos</i> , Gmelin, Linn., 3810.      |
| <i>Alcyonium palmatum</i> , Pallas, Zooph., 349, No. 203.  | —, Esper, Pflanz., iii., Alcyon., pl. 2.          |
| —, Lamour., Pol. flex., 335.   | <i>Lobularia palmata</i> , Lamk., ii. 632, No. 3. |
| —, Edwards, Ann. des Sci. Nat., 2d ser., iv., pl. 14 and 15; and G. Cuvier's Reg. Anim., 1837, pl. 93, 94. | —, Ehrenb., G. xxv., sp. 9.                       |
|  | —, Blainv., 522, pl. 91, fig. 1.                  |

### 4. ALCYONIUM STELLATUM. (*Milne Edwards.*)

*A. roseum, breviter ramosum, aut lobato-subdivisum, ramis 3–4''' crassis; polyphis sparsis, stellâ expansâ fere sesquilineari; superficie scabriculâ.*

Rose-red, short ramose or lobato-subdivided; branches 3 to 4 lines thick and rounded; polyyps scattered, the expanded star of tentacles nearly a line and a half in diameter; surface a little rough.

Island of Chaussey. *Milne Edwards.*



*Alcyonium stellatum*, Milne Edwards, Ann. des Sci. Nat., iv., 2d ser., 1835, pl. 16. The figure represents a specimen an inch and a half in height, a fourth of an inch at base, enlarging above, and with a few rounded lobes or short branches. The polyps are larger than in the *palmatum*; the species differs from that also in the spicula about the soft part of the polyps. Also, Cuvier, Reg. Anim., 1837, pl. 94, fig. 2.

5. *ALCYONIUM SPHEROPHORA*. (H. & Ehrenberg.) Dana.

*A. effusum, subhemisphericum, membranâ marginali sterili, superficie cerebriformi, brevissimè lobatâ, lobulis 2-3'' latis, semiglobosis, dividuis; pallidum, polypis fuscis.*

Effuse, subhemispherical, membrane of the margin sterile, surface cerebriform, very short lobed; lobes 2 to 3 lines broad, semiglobose, subdividing; pale, polyps fuscous.

Red Sea. *Ehrenberg.*

The cerebriform hemispherical surface, with short rounded lobes, two to three lines thick, are the peculiar characteristics of the species.

*Lobularia spherophora*, Ehrenberg, G. xxv., sp. 4.

The *Alcyonium tuberculosum*, of Quoy and Gaynard, (Voy. de l'Ast., iv. 274, pl. 23, figs. 4, 5,) as figured by them, is similar to the *spherophora* of Ehrenberg. They describe it as follows: "A. brevi-pedunculatum, incrustans, coriaceum, lutescens aut griseum; mamillis convexis, subrotundis; polypis sessilibus; tentaculis longis, gracilibus." "Espece dure, coriace, formée de mamelons arrondis, serrés, groupés sur un court pédicule, recouvrant les corps marins; forme des groupes qui n'excèdent pas de beaucoup la grosseur du poing." We suspect still that this may be identical with a Tonga species obtained by the Expedition, which we have referred to under the *A. brachycladum*.

The *Alcyonium spongiosum*, of Esper (Pflanz., iii. 20, tab. 3), is a *stipitate* species, having similar characters to Ehrenberg's *spherophora*. See farther, *A. brachycladum*.

6. *ALCYONIUM PAUCIFLORUM*. (H. & Ehrenberg.) Dana.

*A. substipitatum, supra lobatum, suberectum; lobis compressis, obtusis, 4'' crassis et fere ½'' altis; superficie subtilissimè areolatâ, glabrâ; polypis raris, sparsis; fuscum.*

Substipitate, lobately divided, suberect; lobes compressed, obtuse, 4

lines thick, and about  $\frac{1}{2}$  an inch long; surface very finely areolate, glabrous; polyps scattered and few; fuscous.

Red Sea. *Ehrenberg.*

Savigny, Egyp., tab. 1, fig. 8; represents a species having the polyps numerous, and not more than a line apart. *Lobularia pauciflora*, Ehrenb., G. xxv., sp. 5.

—, Lamk., 2d ed., ii. 632, No. 4.

*Ammonothea virescens*, Audouin, Explic. des planches de Savigny.

7. ALCYONIUM POLYDACTYLUM. (*H. & Ehrenberg.*) *Dana.*

*A. flavidum, carnosum, 4" fere altum et 6-12" latum, stipite brevi, supra lobulosum; lobis subramosis, fere pollicaribus, lobulis 4-5" longis, anguloso-gibbis; polypis creberrimis; rufo-fuscis, capite retracto  $\frac{1}{2}$ " fere latis.*

Yellowish, carnose, 4 inches high, and 6 to 12 broad, with a short base, lobulose above, lobes subramose, nearly an inch in size; lobules 4 to 5 lines long, anguloso-gibbous; polyps much crowded, reddish fuscous, with the head contracted nearly  $\frac{1}{2}$  a line broad.

Red Sea. *Ehrenberg.*

*Lobularia polydactyla*, Ehrenberg, G. xxv., sp. 6.

8. ALCYONIUM BRACHYCLADUM. (*H. & Ehrenberg.*) *Dana.*

*A. flavum, carnosum, 4" crassum, stipite sesquipollicari, supernè lobato-ramulosâ; ramis sesquipollicaribus, ramuloso-verrucosis, ramulis 3-4" crassis, obtusis, gibbis, brevioribus tenuioribusque; polypis crebris, rufo-fuscis.*

Yellowish, carnose, 4 inches thick, base  $1\frac{1}{2}$  inches; above lobato-ramulous, branches  $1\frac{1}{2}$  inches, ramuloso-verrucose, branchlets 3 to 4 lines thick, obtuse, gibbous, shorter and more slender than in the *polydactylum*; polyps crowded, reddish fuscous.

Red Sea. *Ehrenberg.*

*Lobularia brachyclados*, Ehrenb., G. xxv., sp. 7.

NOTE.—Here should probably be referred the species from Tongatabu, represented in fig. 8, plate 57. It grows in spreading clumps of stout lobes which are much and crowdedly lobulose, with the lobules short, three to five lines thick, somewhat angular or erose. The general colour is dull grayish-green. It is probable that this is the *A. tuberculosum* of Quoy and Gaymard, with which their description agrees better than their figure. (See under *A. spherophora*.)

9. *ALCYONIUM AURANTIACUM*. (*Quoy & Gaymard*.)

*A. molle, aurantiacum, erectum, parvè ramosum, ramis obtusis, oblongis 2''' crassis.*

Soft, orange-coloured, erect, sparingly ramose; branches obtuse, a little oblong, 2 lines thick.

New Zealand, in eight to ten fathoms. *Quoy & Gaymard*.

The figure by Quoy and Gaymard represents a dendroid specimen, three and a half inches high, with a few small branches, which appear to become about an inch in length before branching again. The polyps, as seen by these authors, were in a contracted state; and hence the *clavate form* of the polyps, and *short tentacles*, which they describe.

*Alcyonium aurantiacum*, Quoy and Gaymard, *Voy. de l'Ast.*, iv. 277, pl. 22, figs. 16-18. *Lobularia aurantiaca*, Lamarck, 2d ed., ii. 633, No. 5.

• 10. *ALCYONIUM VIRIDE*. (*Quoy & Gaymard*.)

*A. grande, crassum, submolle; ramis valdè compressis et latissimis (sæpe 3-4''), lobato-digitatis, 3-4''' crassis; lobis obtusis, 4-8''' latis.*

Large, stout, rather soft; branches much compressed, very broad, (often 3 to 4 inches), lobato-digitate, 3 to 4 lines thick; lobes obtuse, 4 to 8 lines broad.

Island of Vanikoro. *Quoy & Gaymard*.—Tongatabu. *Exp. Exp.*

Quoy and Gaymard represent the species as bright green. The

Tonga specimens were of a purplish-brown colour. The polyps were minute and about a line apart. There are no verrucæ when the animal is wholly retracted. The specimens consist of an aggregation of erect, broad, lobed plates, a fourth to a third of an inch thick, and they cover areas of several feet in extent.

*Alcyonium viride*, Quoy & Gaymard, Voy. de l'Ast., iv. 272, pl. 23, figs. 21-23. The figure represents a branch, separated from the base of the zoophyte.

#### 11. ALCYONIUM FLABELLUM. (*Quoy & Gaymard.*)

*A. grande*, submolle, ramis compressis, digitato-divisis, et ramosis, digitationibus sæpe 2-3" longis, teretibus aut compressis, subacutis aut obtusis, 3-5" crassis.

Large, rather soft; branches compressed, digitately subdivided and ramose; digitations often 2 to 3 inches long, terete or compressed, subacute or obtuse, 3 to 5 lines thick.

Port Carteret, New Ireland. *Quoy & Gaymard.* — Tongatabu. *Exp. Exp.*

The digitations in this species are much longer and more tapering, and the branches not nearly so broad as in the *viride*. New branches may be often seen to begin as small protuberances from the lateral surface. The colour is a dull purple, as represented by Quoy and Gaymard. The Tonga specimens were of a grayish flesh-colour, with the polyps about a line apart and yellowish-green. As in the preceding, there are no verrucæ when the polyps are contracted.

*Alcyonium flabellum*, Quoy and Gaymard, Voy. de l'Ast., iv. 273, pl. 23, figs. 18-20.

#### 12. ALCYONIUM FLEXILE. (*Quoy & Gaymard.*)

*A. grande*, permolle, pallidè fulvum, fruticosum, stipitatum; ramis numerosis, gracilibus, 2-2½" crassis, subsimplicibus, subattenuatis, flexilibus, sæpe 2-2½" longis, polypis parvulis, crebris.

Large, very soft, pale fulvous, fruticose, stipitate; branchlets nume-

rous, slender, 2 to  $2\frac{1}{2}$  lines thick, subattenuate, mostly simple, very flexible, often 2 to  $2\frac{1}{2}$  inches long, polyps small and crowded.

Plate 57, fig. 6, unexpanded, natural size.

Island of Vanikoro. *Quoy and Gaymard*.—Feejee Islands. *Exp. Exp.*

The singularly soft and flexible slender branches of this species readily distinguish it. They rise from a stout pedicel, an inch or more thick, and are crowded, and but little subdivided. Quoy and Gaymard, obtained their specimens "à d'assez grandes profondeurs," while those from the Feejees occurred near the surface. The polyps are represented by them as having a yellowish disk. In the Feejee specimens, the colour was pale yellowish flesh-colour, and the tentacles were bright yellowish-green, with the basal portion brown.

*Alcyonium flexibile*, Quoy and Gaymard, *Voy. de l'Ast.*, iv. 279, pl. 23, figs. 1-3.

### 13. *ALCYONIUM FLAVUM*. (*Quoy & Gaymard*.)

*A. coriaceum, subdendroideum, pumilum, basi compressum, flavum; ramis cylindricis, 1½''' crassis, 1-2'' longis, subacutis, simplicibus.*

Coriaceous, subdendroid, small, compressed at base, yellowish; branches cylindrical,  $1\frac{1}{2}$  lines thick, 1 to 2 inches long, subacute, simple.

Island of Vanikoro. *Quoy & Gaymard*.

This species has very slender branches, and is remarkable for its harsh surface.

*Alcyonium flavum*, Quoy and Gaymard, *Voy. de l'Ast.*, iv. 280, pl. 23, figs. 6-7. The polyps are described and figured from the contracted animal.

### 14. *ALCYONIUM TRICHANTHINUM*. (*Dana*.)

*A. molle, flexile, effusum, ramosum; ramis numerosis, teretibus, 3-4''' crassis et 6-9''' longis, obtusis; polypis crebris, tentaculis elongatis, tenuissimis.*



Soft, flexible, ramose; branches numerous, terete, 3 to 4 lines thick, and 6 to 9 long, obtuse; polyps crowded, tentacles long, very slender.

Plate 58, fig. 1, zoophyte as it appears expanded, and part unexpanded.

Feejee Islands. *Exp. Exp.*

This species spreads over the rocks, and sends up rather crowded, short and stout branches, which wave with the motion of the water. In this respect it is near the *flexilis*. The long slender tentacles also moving with the water, give a villous appearance to the expanded zoophyte. The colour was a pale umber.

15. ALCYONIUM CONFERTUM. (*Dana.*)

A. 4" altum, coriaceum, rigidum, erectum, crassè stipitatum ( $1\frac{1}{3}$ "); ramis supernè confertis, brevibus simplicibus aut parcè ramosis, terebibus, 2-2 $\frac{1}{2}$ " crassis et sæpius,  $\frac{1}{2}$ " longis, apice rotundatis; spiculis internis confertis; polypis minutis,  $\frac{3}{4}$ " remotis.

Four inches high, coriaceous, rigid, erect, very stout stipitate ( $1\frac{1}{3}$  inches); branches crowded above, short and simple, or sparingly ramose, terete, 2 to 2 $\frac{1}{2}$  lines thick, and about  $\frac{1}{2}$  an inch long, rounded at apex; internal spicula much crowded; polyps minute,  $\frac{3}{4}$  of a line apart.

Plate 57, fig. 7, unexpanded zoophyte, natural size; 7 a, some of the spicula; 7 b, polyp, partly expanded.

Feejee Islands. *Exp. Exp.*

The crowd of short cylindrical branches, mostly a sixth of an inch thick, are supported on a very stout pedicel over an inch in diameter. The colour of the specimen collected was a dull purplish-umber, and the half-expanded polyps appeared brown. The general surface is harsh coriaceous.

The representation of the *Alcyonium amicorum*, of Quoy and Gaymard, from Tongatabu (Voy. de l'Ast., iv. 276, pl. 22, figs. 13-15), has some resemblance to the above species, agreeing with it more nearly than with the description given, which is as fol-

lows: "A. carnosum, crassè pediculatum, arboreum, violacco-virescens; ramis explanatis, polypis paniculatis; tentaculis octonis, apice obtusis, virescentibus." It is probable that the granulations described are only the half-contracted polyps, as the same appearance (not well represented in the figure) has been seen by the author in the above and other species. The branches in the figure are larger and more ramose, but of the same thickness as in the *confertum*.

#### 16. ALCYONIUM RIGIDUM. (Dana.)

*A. rigidum, effusum, incrustans, subexplanatum, ramis sæpius simplicibus, breviter digitiformibus, vix 1" longis et 2-4''' crassis, obtusis, interdum valde remotis.*

Rigid, spreading, incrusting and subexplanate; branches usually simple, short digitiform, scarcely 1 inch long, and 2 to 4 lines thick, obtuse, frequently very remote.

Plate 58, fig. 2, the unexpanded zoophyte, natural size.

Feejee Islands, at Mathuata, Venua Lebu. *Exp. Exp.*

This stiff and rigid species forms flat or convex incrustations, with scattered digitiform branches, hardly an inch long, often separated by bare intervals of considerable width.

#### 17. ALCYONIUM MURALE. (Dana.)

*A. rigidum, coriaceum, crassum, effusum, ramis simplicibus, subremotis, crassè laminatis, erectis, sæpe 2" longis, ½-1" altis et ⅓" crassis, interdum sinuosis; polypis creberrimis, virentibus.*

Rigid coriaceous, stout, spreading, branches simple, subremote, stout lamellar, erect, often 2 inches long, ½ to 1 high, and ⅓ of an inch thick, sometimes sinuous; polyps much crowded, green.

Plate 58, fig. 3, the zoophyte unexpanded, natural size.

Tongatabu. *Exp. Exp.*

The narrow elevations of a rigid texture, which stand over the surface, are peculiar. The species has something of the habit of the *rigidum*, but not its short subterete digitiform branches. The pedicel

is thick and stout. The general colour is slate, with the summits dull grayish-yellow.

II. *Alcyonia explanata, superficie plana.*

18. ALCYONIUM GLAUCUM. (*Quoy & Gaymard.*)

*A. molle, stipitatum, latè explanatum, margine valdè undulatum, revolutum, et sæpe lobatum; polypis fere 1''' remotis, fuscis; tentaculis apice luteo-virentibus.*

Soft, stipitate, broad explanate, margin much undulate, revolute, and often lobed; polyps mostly a line distant, fuscous, tentacles at apex light yellowish-green.

Plate 58, figures 4, 5, and plate 59, fig. 6, unexpanded, natural size.

Tongatabu. *Quoy & Gaymard.*—Tongatabu and Feejees. *Exp. Exp.*

This zoophyte forms very broad plates, spreading from a stout pedicel. The figures are supposed to represent varieties of the same species; fig. 4 is dull brown, and the others bright copper-green.

*Alcyonium glaucum*, Quoy & Gaymard, Voy. de l'Ast., iv. 270, pl. 22, figs. 11 and 12.

19. ALCYONIUM LATUM. (*Dana.*)

*A. subrigidum, crassimè stipitatum et latissimè explanatum, margine ampliter sinuosè undulatum, vix revolutum; polypis fere 1''' remotis, punctis uni-seriatis circumscriptis.*

Rather rigid, very stout stipitate and very broad explanate, margin sinuously undulate, scarcely revolute; polyps about a line distant, and surrounded by a series of points.

Plate 58, figure 6 *a*, surface, magnified; 6 *b*, one of the polyps, magnified; 6 *b'*, same, natural size.

Feejee Islands. *Exp. Exp.*

This explanate species covers areas several feet square, and has a



broadly plaited margin. It is more rigid in texture than the *glaucum*, and grows to a much larger size. Fig. 7, plate 58, represents a specimen from Tongatabu, probably of this species.

III. *Alcyonia glomerata, non ramosa, nec lobato-ramosa.*

20. *ALCYONIUM PULMO.* (*Esper.*)

*A. carnosum, glomeratum, semipedale et pedale, superficie irregulari, et sublobatâ, stipite crasso; polypis 3''' longis, stellâ expansâ 3''' latâ, albâ.*

Carnose, glomerate, half a foot to one foot thick, surface uneven or sublobate, pedicel stout; polyps 3 lines long, expanded star 3 lines broad, white.

Red Sea. *Ehrenberg.*

*Alcyonium pulmo*, Esper, iii. 38, tab. 9, figs. 1, 2. Referred here by Ehrenberg. The *Alcyonium incrustans* of Esper (ibid. 47, tab. 15) is an allied glomerate species; and perhaps also his *bulbosum* (41, tab. 12).  
*Halcyonium pulmo*, Ehrenb., G. xxiv., sp. 1.

IV. *Alcyonia ramosa, stipitis superficie lapidescente.*

21. *ALCYONIUM ELEGANS.* (*Milne Edwards.*) *Dana.*

*A. ascendens, subramosum, infrâ cylindricum et superficie lapidescens.*

Ascending and erect, subramose, below cylindrical, and the surface becoming nearly solid by calcareous secretions.

Mediterranean, near Algiers. *Milne Edwards.*

*Alcyonidia elegans*, Milne Edwards, Ann. des Sci. Nat., 2d ser., iv. 323, pl. 12, 13; Lamarck, 2d ed., ii. 630. The figure represents a few clusters with a cylindrical stem or base, the lower half of which is very different in appearance and texture from that above; and Milne Edwards states that the soft parts above withdraw on contraction into the pedicel.

APPENDIX.—Ehrenberg describes from preserved specimens the following species of "Lobularia."

LOBULARIA RUBIFORMIS.—(A. rubiforme Pallas.) “Parva, sesquipollicaris et bipollicaris, rubra, lobis subglobosis, divisis, 3''' fere latis, angustioribus, stellulis crebris, punctiformibus.” (Ehrenberg, G. xxv., sp. 10.)

LOBULARIA CORIACEA.—(A. coriaceum, Esper.) “Semipedalis, nec stipitata (pede non sterili), compressa, carnosâ, inciso-lobata, lobis obtusis, pollicaribus et subpollicaribus, polypis 3''' fere longis, tenuibus ubique sparsis” (Esper, iii., tab. 17.—Ehrenb., G. xxv., sp. 1).

The *Lobularia arborea* (Ehrenberg, G. xxv., sp. 11—*A. arboreum*, Esper, iii., tab. 1) is a Gorgonoid species. See Genus Briareum, under the Gorgonidæ.

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SUBFAMILY III.—SPOGGODINÆ.

*Alcyonidæ membranaceæ, et internè spatiosè cellulosæ; polypis non retractilibus.*

Membranaceous and internally spatiosly cellular; polyps not retractile.

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GENUS SPOGGODIA.—LESSON.

*Alcyonidæ ramosæ, internè spatiosè cellulosæ; polypis minutis, non retractilibus, cocervatis, acervis spiculo-armatis.*

Ramose Alcyonidæ, internally very open cellular; polyps minute, not retractile, in clusters which are armed with calcareous spicula.

The texture of the stems and branches is very peculiar in the large open cells, separated by thin, semimembranous partitions. The exterior is stiffened by numerous long, calcareous spicula, which are exsertile about the little clusters of polyps, that are scattered over the

branches, and at their summits. The species sometimes grows to a length of fifteen or twenty inches, and is of crimson and orange colours, and also white. The zoophytes are flexible throughout, and they often hang from the rocks in the submarine caverns of the coral-reefs.

This genus was instituted by Lesson, and named from the Greek σπογγώδης, *spongy*. It is near *Nephthya*, and has been united to that genus by Ehrenberg; but if the characters of the genus *Nephthya* are correctly laid down, it differs in its *retractile* polyps, and armed *verrucae*, and in not having the peculiar, *open cellular texture* of the *Spogodiæ*,\* which separates them widely from all other *Alcyonidæ*.

#### 1. SPOGGODIA CELOSIA.

*S. albida, caule brevi et crasso, pluribus ramis partito, ramusculis polypigeris coccineis.*

White, stem short and stout, subdividing into several branches; the polypiferous ramuscules crimson.

One of the Moluccas, Bay of Cajeli, near New Guinea. *Lesson.*

*Spoggodes celosia*, Lesson, *Illust. de Zool.*, pl. 21. Lesson describes and figures the internal cellular structure, and states, that in the trunk, which is an inch in diameter, there are about twelve large cellules separated by thin partitions, radiating, though with some irregularity. The spicula of the surface are long and slender. The polyps are represented unexpanded, with the tentacles lying together, side by side. The trunk, in his specimen, was an inch long, and then subdivided into several (four or five) large branches. The ramuscules bearing the polyps, as represented, are two-thirds of an inch long, and one-fourth thick.

The *Alcyonium floridum*, as figured by Esper (iii., tab. 16, page 49), is evidently a species of this genus, figured from a dried specimen, in which state, owing to its open cellular texture, it is wholly deprived of the characteristic form it presents when growing, as the author has ascertained by observation. It is, therefore, difficult to say whether it be the above species or not. Esper's specimen was received by him from Tranquebar. (See under *Nephthya*, where Ehrenberg refers this figure; also, *Xenia purpurea*, Lamarek, 2d ed., ii. 626, No. 2, and 627; and Blainville, Man., *Neptæa florida*, 523; also, *Alc. botryoides*, Shaw's Miscel., x., pl. 376.)

The following are the characters of specimens from the Feejees, probably identical with the above.

\* The genus *Nephthya* is thus characterized by Ehrenberg: "Basi carnosa, ramulosa aut fruticulosa, polypis in verrucas spiculis armatas retractilibus."

*β. arborescens.* Dendroid, trunk stout and elongated, with many lateral branches; polyp-bearing ramuscles, one and a half to four lines thick; expanded polyp-star half a line broad, papillæ of the tentacles minute, in two or three series; spicula of the ramuscles one and a half lines exsert; colour, crimson or orange, also, white, with the ramuscles orange or crimson. (Plate 59, fig. 4, part of a zoophyte, natural size; 4 *a*, one of the polyps, magnified, and an exsert spiculum, &c.; 4 *b*, section of stem; 4 *c*, surface enlarged, showing the spicula; 4 *d*, spicula enlarged; 4 *e*, spicula polished down thin, and enlarged, showing internal texture.)

This species hangs in clusters, often a foot and a half in length, about the reefs, and is one of the most gorgeous objects of coral growth. The dried specimens often closely resemble Esper's figure. The colours are either white, orange, or crimson, and often the polyps are crimson, when the branches are of either of the other colours. The polyps are not at all retractile, and when unexpanded, the tentacles merely fall together, nearly as represented by Lesson.

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FAMILY III.—CORNULARIDÆ.

*Alcyonaria coralligena*; *corallis corneis tubulatis*.

Coralligenous Alcyonaria; the coralla corneous, tubular.

The Cornularidæ resemble the Xeninæ in their polyps, and are peculiar only in forming a corneous tube, into which the head of the polyp may be withdrawn. Only a single genus has been recognised, and that corresponds to the Rhizoxeniæ in its mode of budding from creeping filiform shoots or stolons. The genus *Clavularia* of Quoy and Gaymard, if correctly characterized, should form a second genus analogous to the Antheliæ, with which the *Zoantha thalassanthos* of Lesson, mentioned under Rhizoxenia, probably belongs.

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GENUS CORNULARIA.—LAMARCK.

*Cornularidæ corneo-coralligenæ, non acrogenæ, per stolones filiformes gemmatæ.*

Non-acrogenous Cornularidæ, producing corneous tubular coralla, and budding by means of creeping filiform shoots.

These zoophytes, as they appear expanded, consist of a series of polyps implanted upon a filiform root-like thread; and the coralla are prominent corneous tubes, more or less enlarged upward. The species hitherto seen have been found only in the temperate zone.

The Cornulariæ of Quoy and Gaymard, are true Xenia.

CORNULARIA RUGOSA. *Lamarck.*

*C. polypis luteis, tentaculis fimbriatis, papillis uniseriatis; tubulis 2-4''', longis, subclavatis, rugosis.*

Polyps pale yellowish; tentacles prominently fringed with papillæ, which are arranged in a single series; tubes 2 to 4 lines long, subclavate, rugose.

Mediterranean Sea.

The figures of this species represent the tubes as tapering rather regularly downward, with the base nearly half the diameter of the summit, and the polyp-star rather more than a line broad.

- La Tubulara cornucopia*, Cavolini, Mem. —, Blainville, Man., 499, pl. 82, fig. 4,  
de Polypi marini, 250, tab. ix., figs. 11, 12. (from Cavolini), and *Tubularia cornu-*  
*Tubularia cornucopia*, in part, Gmelin, *copiæ*, 470.  
Linn., 3830. —, Johnston, Brit. Zooph., 192, and fig.  
—, Esper, iii. 143, Tubul., tab. 27, 27 (from Cavolini), p. 187.  
(from Cavolini). *Cornularia cornucopiæ*, Cuvier, Reg. Anim.,  
—, Lamour., Pol. flex., 229, pl. 7, fig. 5. 2d ed., iii. 300.  
*Cornularia rugosa*, Lamk., ii. 129, No. 1. —, Schweigger, Handb., 425.  
—, Lamour., Exp., 17, pl. 78, fig. 4,  
(from Cavolini); Encyc., 219.

NOTE.—Johnston refers to this species, a *Cornularia* obtained at Weymouth, on the English coast, having "tubular vase-like cells from two to three lines in height," and also specimens which had been named by Dr. Fleming *Sertularia dumosa*, in which the tubes were hardly a line long. (See Brit. Zooph., p. 192, fig. 23, p. 181, and *Campanularia? dumosa*, ibid., 157, pl. 23, figs. 2-5, and fig. 24, p. 181; *Sertularia dumosa*, Fleming, Edinb. Phil. Jour., ii. 83, *Tub. tubifera*, Johnston, Edinb. Phil. Jour., xiii. 222, pl. 3, figs. 2, 3, and Transac. Newcastle Soc., ii. 254, pl. 11, fig. 1.) It is altogether pro-

bable that the polyps, on examination, will prove one or both of these supposed varieties to be distinct from the *rugosa*.

The genus *CLAVULARIA*, of Quoy and Gaymard, is thus characterized by them: "Animaux cylindriques à huit tentacules pinnés contenus dans des tubes claviformes, coriaces, striés, subpédiculés, fixes et agglomérés."

*Clavularia viridis*. "C. tubis coriaceis, clavulatis, rectis aut subcontortis, longitrorsum striatis, virescentibus; polypis striatis, fuscis, tentaculis planiusculis, pinnatis, violaceis." Length about two inches; exterior of the tubes containing subcalcareous spicules. Island of Vanikoro, incrusting dead corals. (Voy. de l'Ast., iv. 260, pl. 21, figs. 10-12; Blainville, Man. d'Act., 500.)

*Clavularia violacea*. "C. minima, tubis cylindricis, coriaceis, truncatis, canaliculatis, obscuro-violaceis." A few lines in height, and crowded together and forming quite large incrusting plates. "Ils sont couverts d'acicules qui sont aussi de couleur violette." The polyps, as seen by these authors, were nearly retracted. Island of Vanikoro, near low-tide level. (Voy. de l'Ast., iv. 262, pl. 21, figs. 13-16; Blainville, Man., 500.)

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#### FAMILY IV.—TUBIPORIDÆ.

*Alcyonaria coralligena, corallis tubulatis, calcareis, aut semicalcareis, tubulis penitus non striatis.*

Coralligenous Alcyonaria; coralla tubular, calcareous or semicalcareous; tubes not striate within.

The animals of the Tubiporidæ do not differ essentially, as regards structure, from those of the Alcyonidæ. The forms of the coralla vary much according to the mode of budding and growth. Budding by basal shoots without upward growth in the polyps produces the *Aulopora*, similar in character to the *Rhizoxeniæ*; while with acrogenous growth, the ramose forms of the *Telesto*, or the convex clusters of tubes presented by the *Tubipora*, are produced. The latter are united by cross plates formed at the budding process.

The genus of fossils, *Syringopora*, has been arranged near the Tubiporæ. The species are peculiar, principally, in having within the tubes a central tubular axis, which is united to the sides by a series of

plates, having the shape of inverted cones. A somewhat analogous structure is at times found in the Tubiporæ, which favours this view of the relations of the Syringoporæ; yet it is only a monstrosity in this genus, as it is of comparatively rare occurrence, being met with here and there in a tube or in a part of a tube of a zoophyte. It is simply a smaller tube within the larger, produced by a sudden narrowing of the interior, and as abrupt an enlargement again. Upward growth is attended by the death of the parts below, and in part their retraction, and this effect appears to be connected with this retraction, which in some instances may be delayed in its progress till the inner calcareous tube is completed. There are no conical plates, like those in the Syringoporæ, uniting the inner tube to the outer. The inner tube, moreover, is generally formed between two budding periods and terminates with the second. The Syringoporæ, if of this family, which seems probable, should form a distinct sub-family SYRINGOPORINÆ, characterized, as stated, by fasciculate tubular coralla, having an axial tube within, united to the outer tube by a series of inverted conical dissepiments.

GENUS I.—AULOPORA.

*Tubiporidæ non acrogenæ, stolonibus e basi repentibus. Coralla calcarea, tubulata, incrustantia, tubulis sæpe reticulatim anastomosantibus; cellis subremotis, interdum prominulis.*

Non-acrogenous Tubiporidæ, budding from a creeping filiform stolon. Coralla calcareous, tubular, incrusting, often reticulately anastomosing; cells subremote, sometimes a little prominent.

The tubular corallum of the Auloporæ, with rounded holes or cells at intervals, has considerable resemblance on a minute scale to a pipe or flute, and hence originated the name, from the Greek *αυλος*, a pipe. The filiform tube often forms a network over the rock to which it is attached. The species hitherto described are all fossils. A single recent species was obtained by the Expedition in the Pacific.

AULOPORA TENUIS. (*Dana.*)

*A. rubra*; corallo filiformi, reticulato, plerumque  $\frac{1}{3}$ " lato, cellis orbiculatis, non prominulis.

Red; tubular corallum filiform, reticulate, mostly  $\frac{1}{3}$  of a line broad; cells circular, not prominent.

Plate 59, figure 5, corallum, natural size.

The Paumotu Archipelago. *Exp. Exp.*

This species looks like an open network of red thread. The cells are situated at the intersections, and there the corallum is slightly enlarged and inflated; (see farther p. 66.) It occurs upon the dead portions of a large *Millepora* obtained at Raraka Island, by J. P. Couthouy.

## GENUS II.—TELESTO.—LAMOUROUX.

*Tubiporidae acrogenae, segregato-ramosae; polypis retractilibus; tubulis semicalcareis.*

Acrogenous, segregato-ramose; polyps retractile; tubes semicalcareous.

The species of *Telesto* branch more or less arborescently, and, as each branch is a simple tube, they are all slender. The polyp-flowers tip the branches, and on contraction the tentacles are withdrawn within the extremity.

This genus was instituted by Lamouroux, and placed near the *Tubulariæ*. Blainville suggested its affinity to the *Tubiporæ*, after examining Lamouroux's species, and finding eight striæ about the summits, indicating an Alcyonoid character. Lamarck, in the first edition of his treatise, united the species with the genus *Synoicum* of Phipps, which was afterwards found to belong with the *Ascidia*.





1. TELESTO AURANTIACA. *Lamouroux.*

*T. parvè ramosa, aurantiaca*; 1-1½" *alta, extus striata.*

Sparingly ramose, orange-coloured; 1 to 1½ inches high, exterior striate.

## Australia.

*Telesto aurantiaca*, Lamour., Pol. flex., 234, —, Blainv., Man., 498, pl. 82, fig. 3. pl. 7, fig. 6; Exp. Meth., 18, tab. 68, —, Deslongchamps, Encyc., 710. fig. 8.

NOTE.—Lamouroux also describes, under this genus, the following species:

*T. lutea.* Lax ramose, diffuse, scarcely striate; colour bright gold yellow. From Australasia. (Pol. flex., 234; Deslongchamps, Encyc., 710; Blainv., Man., 498.)

*T. pelagica.* Colour green. Atlantic Ocean, on floating Fucus, (Bosc. Vers., iii. pl. 30, figs. 6-7; Lamouroux, Pol. flex., 235, and Exp. Meth., 18; Deslongchamps, Encyc., 710; Blainville, Man., 498; *Synoicum pelagicum*, Lamarek.)

Blainville names another species from the Indian Ocean; *T. alburnum* (Man., 498).

2. TELESTO FRUTICULOSA. (*Dana.*)

*T. fruticulosa*, 3-4" *alta*; *polypis aurantiacis*; *ramulis numerosis, pluribus brevibus* (2-4'''),  $\frac{2}{3}$ ''' *latis, cylindricis.*

Fruticulose, 3 to 4 inches high; polyps orange; branchlets numerous, many short (2 to 4 lines),  $\frac{2}{3}$  of a line in diameter, cylindrical.

Charleston, South Carolina. *Prof. C. U. Shepard.*

This singular species is incrustated throughout with a sponge of close texture, increasing much the thickness and strength of its branches, and it is by this means, apparently, that it grows to so large a size; for the tubes are small, and quite tender. The contracted polyps show the tips of eight orange tentacles within the extremity of each branchlet. They appear as if they were the true animals of the sponge: but it is apparent that the latter is of extraneous growth, from its often lengthening out a branch beyond the tube of the polyp within, and also from its being separated without much difficulty; it contains very minute, slender spicula, besides others which consist of bent fibres, pointing in every direction.

The polyps of a branch form branchlets, two to four or five lines long; and, with the spongy covering, they are an eighth of an inch thick.

The specimen here described belongs to the cabinet of Prof. C. U. Shepard.

GENUS III.—TUBIPORA.

*Tubiporidae acrogenae, corallis calcareis tubulatis, tubulis fasciculatis; sepiementis internis nullis.*

Acrogenous Tubiporidae; coralla calcareous, tubular; tubes fasciculate; no internal dissepiments.

For an account of the structure and growth of these polyps, see §§ 36, 37, 69. The calcareous tubes are brittle, nearly smooth within and without, though somewhat porous, and when broken across, often appear to be striated, owing to the minute tubes or ducts that penetrate from the interior to the exterior surface. The polyps have fringed tentacles, and are from a fourth to half an inch in diameter. The species differ widely in the nature and breadth of the fringe of papillæ, and the size of the polyp-flower; but they are often distinguished with difficulty by means of their coralla. The diameter of the tubes, and the frequency or regularity of the transverse septa uniting them, afford almost the only characters.

The Tubiporæ have been found only in the coral-reef seas.

*Arrangement of the Species.*

- |                          |                           |
|--------------------------|---------------------------|
| *1. <i>T. musica.</i>    | 5. <i>T. Chamissonis.</i> |
| *2. <i>T. purpurea.</i>  | 6. <i>T. Hemprichii.</i>  |
| *3. <i>T. fimbriata.</i> | *7. <i>T. rubeola.</i>    |
| *4. <i>T. syringa.</i>   |                           |

I. TUBIPORA MUSICA.

*T. coralli tubis vix  $\frac{1}{2}$ " latis, densissimè confertis (in pollice 16-22), parallelis, septis creberrimis.*

Tubes of the corallum scarcely  $\frac{1}{2}$  a line broad, very densely crowded (16–22 in an inch), and parallel, septa much crowded.

Indian Ocean.

The animal of this species is not yet known.

Seba, Mus., iii., tab. 110, fig. 9.

—, Ehrenberg, G. xxiii., sp. 3.

*Tubipora musica*, in part, of Linnæus, —, Quoy and Gaymard, Voy. de l'Ast., Lamarck, and others.

pl. 21, fig. 9.

## 2. TUBIPORA PURPUREA. (*Lamarck.*)

*T. coralli tubis*  $\frac{2}{3}$ ''' *crassis, confertioribus, septis crebrioribus.*

Tubes of the corallum  $\frac{2}{3}$  of a line thick, much crowded, septa quite numerous.

Red Sea.

This very common species is larger than the *musica* in its tubes. It approaches in size the two following species; but the tubes are more regular and even.

*Tubipora musica*, Ellis and Sol., tab. 27.  
Seba, Thes. iii., tab. 110; fig. 8 (?).

*Tubipora purpurea*, Lamarck, 2d ed., ii.  
326.

## 3. TUBIPORA FIMBRIATA. (*Dana.*)

*T. polyporum disco rubro-brunnescente, ore flavo, tentaculis pallidè flavis, laxè fimbriatis, papillis violaceis 2–3-seriatis; coralli tubis vix  $\frac{2}{3}$ ''' crassis, confertissimis et irregularibus, septis crebrioribus.*

Disk of the polyps brownish-red, mouth yellow, tentacles pale yellow, loosely fringed, papillæ violet, in 2 or 3 series; tubes of the corallum scarcely  $\frac{2}{3}$  of a line thick, very much crowded and irregular, septa quite numerous.

Plate 59, fig. 2, polyp, enlarged; 2 a, part of tentacle.

Feejee Islands, on the outer reefs. *Exp. Exp.*

This species has the tubes of the corallum a very little larger than

in the *musica*, and not so regular. The papillæ are irregularly divaricate. The yellow ring around the mouth has eight small squares on its outer margin, one towards each tentacle, and the brownish-red portion is octagonal in outline, with the sides of the octagon a little concave.

#### 4. TUBIPORA SYRINGA. (*Dana.*)

*T. polypis pallidè violaceis, papillis approximatis et in planum integrum digestis; tubis coralli fimbriatæ affinis.*

Polyyps pale violet, papillæ in contact and arranged neatly in an even plane; tubes of the corallum as in the *fimbriata*.

Plate 59, fig. 1, part of zoophyte, expanded; 1 *a*, polyp, enlarged; 1 *b*, section of a polyp, showing the interior; 1 *c*, part of a visceral lamella, with clusters of ovules attached.

The Feejee Islands, in shallow waters along the shores. *Exp. Exp.*

This species can hardly be distinguished from the *fimbriata* by its corallum; yet in its polyyps it is very peculiar. Owing to the even arrangement of the papillæ, the tentacles appear at first to be destitute of the usual fringe. The margin, when examined with a high power, shows a series of punctures, one of which is at the extremity of each papilla.

#### 5. TUBIPORA CHAMISSONIS. (*Ehrenberg.*)

*T. tentaculorum papillis dupliciter seriatis; tubis coralli  $\frac{3}{4}$ " latis, densius confertis (in pollice 10-15); septis crebrioribus.*

Papillæ of the tentacles arranged in two series; tubes of the corallum  $\frac{3}{4}$  of a line broad, rather closely crowded (10 to 15 in an inch); septa quite numerous.

Radaack Archipelago, Pacific Ocean. *Chamisso.*—East Indies.

This species has larger tubes than the *musica*. The animals were first observed and figured by Chamisso.

- Tubipora musica*, Chamisso and Eysenhardt, Mém. de l'Acad. des Cur. Nat. de Bonn, x., pl. 33, fig. 3. *Tubipora Chamissonis*, Ehrenb., G. xxiii., sp. 2. —, Lamk., 2d ed., ii. 326.  
 —, Quoy & Gaymard, Voy. de l'Uranie, Zool., pl. 88.

#### 6. TUBIPORA HEMPRICHII. (*Ehrenberg.*)

*T. tentaculis cæruleis aut viridibus, simpliciter seriatis; coralli tubis  $\frac{4}{5}$ '' crassis (in pollice 9-12) laxioribus, septis remotis (3-5'').*

Tentacles bluish or greenish, in a simple series; tubes of the corallum  $\frac{4}{5}$  of a line thick (9 to 12 in an inch), rather lax, septa remote (3 to 5 lines).

Red Sea. *Ehrenberg.*

This species, described by Ehrenberg, exceeds much the preceding species in the size of its tubes.

- Tubipora Hemprichii*, Ehrenb., G. xxiii., sp. 1. *Tubipora Hemprichii*, Lamk., 2d ed., ii. 326.

#### 7. TUBIPORA RUBEOLA. (*Quoy & Gaymard.*)

*T. tentaculis rubescentibus, papillis dupliciter seriatis; coralli tubis longis, laxis et crassis, septis sæpe 1-3'' remotis.*

Tentacles reddish; papillæ in 2 series; tubes of the corallum long, lax and large, septa often 1 to 3 inches apart.

New Ireland. *Quoy & Gaymard.*—East Indies. *Exp. Exp.*

This species, described and figured by Quoy and Gaymard, has the large tubes of the Hemprichii, with the septa much more distant, and the papillæ of the tentacles in two series.

- Tubipora rubeola*, Quoy & Gaymard, Voy. de l'Ast., iv. 257, pl. 21, figs. 1-8. *Tubipora rubeola*, Lamk., 2d ed., ii. 327.

## GENUS IV.—SYRINGOPORA.—GOLDFUSS.

*Tubiporidæ acrogenæ, fasciculatæ, coralli tubis septis conicis transversis  
axeque tubulato penitus instructis.*

Acrogenous Tubiporidæ, fasciculate; the tubes of the corallum divided within by transverse conical septa and having a tubular axis.

No recent species are known; and the fossil species are confined to the older rocks. The tubes are without rays, and thus afford no decided evidence as to the number of tentacles to the polyps. Small processes connect them at intervals.

This genus was first indicated by Guettard, and named Calamites, for which Goldfuss substituted Syringopora. It corresponds to the Harmodites of Fischer: and Milne Edwards refers here with reason the Microsolena of Lamouroux, whose figure appears to represent a cast of a cluster of tubes.

*Calamites*, Guettard, Mem., iii. 532.

——, Lamarck, 2d ed., ii. 327.

*Tubiporites*, Parkinson, Org. Rem., ii. 18.

*Harmodites*, Fischer, Oryct. de Mosc.

*Syringopora*, Goldfuss, Petref., 76.

*Microsolena*, Lamouroux, Exp. Meth., 65,

——, Blainville, Man., 353.

pl. 74, fig. 24-26.

## FAMILY V.—GORGONIDÆ.

*Alcyonaria secretiones corallicas e pedibus elaborantia, et sæpius alias  
internas subcalcareas discretas.*

Alcyonaria forming foot-secretions, and usually other subcalcareous tissue-secretions, which are separable from the former.

The formation of foot-secretions easily separable from the animal layer which covers them, distinguishes the Gorgonidæ from the other Alcyonaria. The mode of growth is acrogenous, and budding takes place from a parent cluster. The stems lengthen cumulately by

gemination, buds forming at apex and lengthening rapidly as they are produced. Foot-secretions go on simultaneously, giving strength to the growing shrub; and by this means ramose zoophytes result, whose slender branches and branchlets contrast strongly with the clumsy forms of the *Alcyonia*.

The polyps may differ in their positions, and budding may be either uninterrupted or periodical. In most species the animals of a stem are situated obliquely, the polyp at its interior part diverging but little from the axis, and gradually turning outward, and becoming nearly at right angles with it at its outer extremity; and the new buds form successively above the preceding polyps, and nearly in the same position. Budding going on continuously, the basal secretions form a continuous axis to the stem, as in the *Gorgonias* and *Coralium*, in which there is no evidence of periodicity in its increase, excepting the appearance of successive layers in the axis.

In other cases there first forms a small group of polyps, in shape and structure like the lobe of a *Xenia*, the bases of the several polyps being in the same horizontal plane. The foot-secretions, in such a case, form at the bottom of the group, and can only accumulate in thickness; the tissues of the cluster by other secretions form a layer of a different character upon that below, which is sometimes more or less penetrated by the polyp-tubes. After a while, budding takes place above, and there is another succession of foot-secretions and tissue-secretions; and the process continued gives rise finally to a jointed stem, as in the *Melitæas*. The joints are at first very small and short, but the polyps constituting them continue to grow and bud for a while, until they are much enlarged. The genus *Isis* affords other examples of periodical budding, but with some peculiarity, as the calcareous and alternating corneous joints are alike separable from a polyp-crust, which covers the whole uninterruptedly. The crust in the *Melitæas* covering the calcareous joints, appears to be only the softer extremities of the united polyps, corresponding to the extremities of the tubes in the *Tubiporæ*. In the *Mopseæ*, the corneous joints are situated at the axils of the branches, and their production is connected with a periodical multiplication of buds, which produces the furcate mode of branching.

The hues of the *Gorgonidæ* are various and gorgeous. The brightest red, crimson, purple, orange, yellow, are common, besides white, brown, and black; and the polyps add other and more delicate tints, where these star-like flowers are in full blossom. It is not unusual to

find crimson, scarlet, orange, and various shades of yellow presented by the same species, and sometimes an orange variety, when unexpanded, is dotted over with crimson points, the bases of the several retracted polyps.

The following subdivisions of the Gorgonidæ adopted in this work, depend on the modes of budding and growth just explained, on the nature of the foot-secretions, and the consideration whether the polyps are retractile or not.

SUBFAMILY I. CORALLINÆ. Axis inarticulate, solid calcareous; polyp-crust fleshy, without coral-secretions.

G. 1. *Corallium*.

SUBFAMILY II. GORGONINÆ. Axis inarticulate, corneous, or semi-solid, with calcareous or siliceous secretions; tissue-secretions forming a persistent crust to the axis.

G. 2. *Hyalonema*. Axis not solid, consisting mostly of siliceous threads or spicula.

G. 3. *Briareum*. Axis not solid, suberose or containing calcareous spicula.

G. 4. *Gorgonia*. Axis solid, corneous; polyps retractile, with or without fixed verrucæ on the surface after retraction.

G. 5. *Primnoa*. Axis solid; polyps retractile into oblong movable verrucæ, imbricately squamous.

G. 6. *Bebryce*. Axis solid corneous; polyps not retractile.

SUBFAMILY III. ISINÆ. Axis jointed, budding being periodical.

G. 7. *Mopsea*. Joints alternately calcareous and corneous, furcato-ramose with corneous axils; cortex thin.

G. 8. *Isis*. Joints alternately calcareous and corneous; branches proceeding from the calcareous joints; cortex thick.

G. 9. *Melitæa*. Joints alternately calcareous and suberose; cortex thin.

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SUBFAMILY I.—CORALLINÆ.

*Gorgonidæ axem inarticulatum lapideum solidum elaborantes.*

Gorgonidæ forming an inarticulate solid stony axis.



## GENUS I.—CORALLIUM.

*Polyporum cortice carnosâ axem lapideum tegente.*

Stony axis covered with a fleshy polyp-crust.

## 1. CORALLIUM NOBILE.

*C. dichotomè laxèque ramosa, ramis flexuosis, interdum coalitis; polypis undique sparsis, disco tentaculisque albis; axe rubro, rarò albo.*

Dichotomously and lax ramose; branches flexuous, sometimes coalescent; polyps every where scattered; disk and tentacles white; axis red, rarely white.

Mediterranean Sea.

This species, the *precious* or *noble* coral of commerce, grows sometimes to a foot in height, with a thickness at base of an inch. It occurs at different depths, from fifteen to one hundred and thirty fathoms, but according to Risso, the best is obtained at a depth of about twenty-four fathoms. The polyps were first observed and figured by Marsilli, who has given in his *Physique de la Mer*, an elaborate account of the modes then used for fishing up the coral. He called the polyps *the flowers of the coral*, and considered them full proof of its vegetable nature.

- Marsilli, *Physique de la Mer* (1725), plate 40, fig. 180, represents the polyps or "*les fleurs du corail*," as Marsilli considered them. *Gorgonia nobilis*, Ellis and Solander, 90, tab. 13.  
*Corallium rubrum*, Cavolini, 32, pl. 2.  
 —, Lamk., ii. 470.  
 —, Lamouroux, Polyp. flex., 456; Exp. Meth. des Polyp., 37, pl. 13, figs. 3-4.  
 —, Risso, Merid. Europe, vol. v.  
 —, Schweig., Handb., 434.  
 —, Blainv., Man. d'Actin., 502, pl. 86, fig. 2.  
 —, Esper, Pflanz. i. 49, tab. 7, 8.  
 —, Tournefort, *Inst.*, tab., 339.  
 —, Seba, Thes., iii. 210, tab. 115, figs. 1-7.  
 —, Donati, *Storia Nat.*, 43; and Phil. Trans. Abridg., x. 154, with figures of the polyps on pl. 4.  
 —, Linn., *Syst. Nat.*, ed. xii., p. 1288.  
 —, Ehrenb., op. cit., Gen. lxxvi., sp. 1.  
 —, Isis (subgenus *Corallium*) *nobilis*, Regne Anim., Paris, 1837, Zoophytes, pl., 80; giving views and dissections of the polyps, by Milne Edwards.

2. CORALLIUM SECUNDUM. (*Dana.*)

*C. ramulosum, in plano expansum, polypis secundum, ad apice ramiculorum dispositis et sæpe binis; axe calcareo, levi, pallidè carneo aut albo, crustâque coccineâ.*

Ramulose, branching in a plane; polyps confined to one surface, mostly placed at the apex of very small branchlets and often in twos: axis calcareous, smooth, pale flesh-red or white, crust scarlet.

Plate 60, fig. 1, zoophyte, natural size.

This species is peculiar in having the branches arranged in a single plane, and the polyps confined to one surface. They open mostly at the extremities of slender calcareous processes. The only specimen seen by the author, was procured at the Sandwich Islands; but it may have been brought by shipping from some other locality. It is five inches high and eight broad, with the stem at base half an inch thick. The crust still remains dried on the axis, and the eight rays of the closed polyps may be easily distinguished.

## SUBFAMILY II.—GORGONINÆ.

*Gorgonidæ axem inarticulatum corneum sublapideumve, corticemque semi-calcaream, elaborantes.*

Gorgonidæ secreting an inarticulate corneous or sublapideous axis, and a semi-calcareous cortex.

## GENUS II.—HYALONEMA.—GRAY.

*Gorgonidæ axe filicoso, subsiliceo, inarticulato.*

Gorgonidæ secreting an inarticulate axis made up mostly of siliceous threads or spicula.

## HYALONEMA SIEBOLDI.

*H. simplex, subcylindricum, ad basin attenuatum, non affixum (?) sed in spongiam insitum; superficie granulose et verrucosum, verrucis grandibus, truncatis.*

Simple, subcylindrical, attenuate at base, and not attached (?) but planted in a sponge; surface granulous and verrucose, verrucæ large, truncate.

Japan. *Dr. Siebold.*

*Hyalonema Sieboldi*, Gray, Proceed. Zool. Soc., 1835, pp. 63-65.

## GENUS III.—BRIAREUM.—BLAINVILLE.

*Gorgonidæ axe inarticulato calcareo-spiculigero, aut suberoso; polypis sparsis.*

Gorgonidæ having a non-jointed axis, containing calcareous spicula, or suberose; polyps scattered.

The soft axis of these zoophytes appears to afford sufficient ground for a generic distinction. They are placed by Blainville and Ehrenberg on this account with the Alcyonia, and they actually form a connecting link between them and the Gorgoniæ. Like the latter, however, the polyps, instead of extending to the base of the zoophyte, as in the Alcyonia, extend inward and terminate against a central or axial line; and to this are due their arborescent forms, and the existence of an axis. This fact appears to be of more fundamental importance than the mere nature of the axis. The species *arboreum* and *suberosum* are, with hesitation, united with the other species which is properly the type of the genus. It is possible that they might better be arranged near the Spoggodia, which also seem to differ from the other Alcyonidæ in an arborescent mode of growth, and the non-extension of the polyp-visceral cavities to the base of the zoophyte.

1 BRIAREUM GORGONIDEUM. (*Blainville*.)

*B. cinereum*; subramosum, teres; ramis fere 1" crassis, elongatis; axe spiculis calcareis purpureis plerumque instructo.

Cinereous, subramose, terete; branches nearly an inch thick, elongate; axis consisting mostly of purple calcareous spicula.

West Indies. *Ellis*.

*Gorgonia briareus*, Ellis and Sol., 93, pl. 14, figs. 1, 2. Meth., 35, pl. 14, figs. 1, 2; Encyc., 447.  
 —, Gmel., Syst. Nat., 3808. *Briareum gorgonoidium*, Blainville, Man.,  
 —, Lamouroux, Pol. flex., 481; Exp. 521, pl. 88, fig. 2.

2. BRIAREUM SUBEROSUM. (*Ellis*.) *Dana*.

*B. 8" altum*; ramosum, subdichotomum; ramis crassis subsimplicibus, superficie levi, osculis substellatis; axe suberoso, pallidè rubro; cortice intus miniaceâ.

Eight inches high; ramose, subdichotomous; branches stout, subsimple; surface smooth; oscules substellate; axis suberose, pale red; cortex miniaceous within.

Indian Ocean.

Ellis, Corallines, tab. 26, figs. P, Q, R.  
*Gorgonia suberosa*, Ellis and Sol., 93, tab. 14, figs. 1, 2.  
 —, Lamarck, 2d ed., ii. 504, No. 39 a.  
*Plexaura suberosa*, Lamouroux, Pol. flex., 430; Encyc., 628.  
 —, Blainville, Man., 509, pl. 87, fig. 5.  
 The *Gorgonia suberosa* of Esper (ii., tab. xxx.), has a solid corneous axis, and is another species; see *G. papillosa*.  
 Ehrenberg makes the *Alcyonium asbestinum* of Pallas, identical with the *Gorgonia suberosa* of Ellis, and states that

the branches are half to one inch thick; in Ellis's figure of this species they are from one and a half to four lines. (Pallas, Zooph., 344; Esper, iii., tab. 5; Lamarck, 2d ed., 605: "A. carnosum, rigidum, rubrum, digitato-ramosum; ramis teretiusculis, erectis; osculis creberrimis, sparsis." Lamouroux, Pol. flex., 347; *Lobularia asbestina*, Ehrenb., Gen. xxv., sp. 12.) Dried specimens have the surface harsh with the spicula of which they are principally constituted.

3. BRIAREUM ARBOREUM. (*Pallas.*) *Dana.*

*B. carnososuberosum, grandis* (3'), *arborescens*; *laxè ramosa, ramis junioribus nodosis, nodis potissimum polypigeris*; *polypis magnis*; *extus rubrum aut flavidum, intus subflavidum et suberosum.*

Carnososuberosè; large (3 feet) and arborescent, sparingly and lax ramosè; younger branches nodosè, with the protuberances especially polypiferous; polyps large; exterior surface red or yellow; within yellowish and suberosè.

Norwegian Sea.

*Alcyonium arboreum*, Pallas. Zooph., 347. —, Lamour., Pol. flex., 335; Encyc., 23.  
 —, Esper, iii., tab. 1, 1 A, 1 B. *Lobularia arborea*, Ehrenberg, Gen. xxv.,  
 —, Lamk. ii. 506. sp. 11.

## GENUS IV.—GORGONIA. \*

*Gorgonidæ axem corneum inarticulatum elaborantes corticemque subcalcaream*; *polypis retractilibus, retractis, cortice sive levi sive verrucosâ*; *verrucis fixis.*

Gorgonidæ forming an inarticulate corneous axis and a subcalcareous cortex; polyps retractile, surface, on retraction, either smooth or verrucosè; verrucæ not movable.

*warty* -

The species differ much in the position of the polyps, and the persistence and thickness of the cortex, and the existence or not of verrucæ, when the polyps are retracted. The animals may be scattered irregularly over the whole surface, or they may range in series or bands on opposite sides only of the stems and branches; and some of the latter become, in consequence of this seriate arrangement, laterally winged, or have the branches much flattened. The cortex consists of the layer of polyps, with a variable proportion of calcareous matter, secreted within their texture: it is at times like paper in thinness, and in other species is thick and spongy. It sometimes falls off so

\* *Gorgonia* - a daughter of Phorcys - whose locks of hair were changed into serpents by Minerva



readily on drying, that certain species are rarely seen in cabinets with the cortex adhering; and the axis resembles much an *Antipathes*, though distinct in not having a spinulous surface.

As in the *Madreporidæ*, the *retracted* polyps are sometimes still prominent above the surface, and the branches, in this state, are covered with small verrucæ, corresponding to the calicles of a *Madrepore*. In other species the polyps are wholly retractile, and leave only a small polyp-pore or oscule, marking their position. The one kind pass by insensible gradations into the other.

The cortex under a magnifier shows numerous minute granules or spicules of lime, disseminated through it. These spicules become exsert in certain of these zoophytes, especially about the verrucæ, and give them an echinulate surface; and in some instances the verrucæ appear to be covered with imbricate spinules or scales.

The *Gorgoniæ* may be distributed into *three* parallel *subgenera*. The groups pass into one another in many points by insensible gradations; yet the distinctions are convenient. A farther study of the animals may require a different arrangement; but the characters now known are hardly sufficient to authorize the institution of *genera*, as proposed by Lamouroux. The subgenera are as follows:

SUBGEN. I. PTEROGORGIA. Polyps seriate, or bifarious, with a naked space between the ranges of polyps.

SUBGEN. II. GORGONIA. Polyps irregularly scattered, not bifarious; surface of zoophyte, after retraction of polyps, smooth or more or less verrucose, without exsert spicula.

SUBGEN. III. MURICEA. Polyps irregularly scattered, surface after retraction of polyps verrucose, and verrucæ armed with spicula or scales.

The *Gorgoniæ* and *Pterogorgiæ*, form a parallel series of species, with the cross gradations numerous and close. The *Muriceæ* constitute a much smaller group, a part related to the *Gorgoniæ*, with short verrucæ, and others to those with prominent imbricate verrucæ.

The genus *Gorgonia* was instituted by Linnæus for all the *Gorgoniæ*. Lamouroux subdivided the group by separating those with a thick smooth cortex, to form the genus *Plexaura*; those with prominent unarmed verrucæ, *Eunicea*; those with the verrucæ armed with spicula, *Muricea*; and those with the verrucæ armed with scales, *Primnoa*; the remainder, with a thin cortex and small verrucæ or none, constituted his genus *Gorgonia*. These genera, excepting the last

two, have been received by subsequent authors with much hesitation. The thickness of the cortex in the *Plexauræ* depends simply on the size or height of the polyps, and can hardly be admitted as a characteristic sufficiently important even for a *subgenus*. The occurrence of verrucæ is physiologically of as slight importance, as it arises merely from the polyps not being confluent so nearly to their summits.

Ehrenberg adopted Lamouroux's genera, but mostly under altered or more extended significations, and introduced also the genus *Pterogorgia*. In his system, *Pterogorgia* and *Gorgonia*, include the species with bifarious polyps, the first of these genera being distinguished from the other, by having the polyps distinctly in one or two series; *Eunicea* embraces all the species with scattered polyps, with or without verrucæ, and the verrucæ unarmed; *Muricea* and *Plexaura* have the same limits nearly as above.

The relations of the several systems are shown in the following table:

RECEIVED DIVISIONS.	EHRENBURG.	LAMOUREUX.	LINNÆUS AND LAMARCK.
Pterogorgia.	{ Pterogorgia. Gorgonia.	} Gorgonia.	} Gorgonia.
Gorgonia.	{ Eunicea. { <i>in part.</i> Plexaura. { <i>in part.</i>		
Muricea.	Muricea.	Muricea.	

As the genus *Gorgonia* has been but imperfectly revised, comparatively few of the species having been seen by the author, the descriptions are made out in a less extended form than in other parts of the work. A complete review of the subject has been attempted, as far as it could be done from a thorough study of previous authors and the examination of specimens at hand, and all important information will be found included, together with full references to authorities and figures.

## SUBGENUS I.—PTEROGORGIA.

*Polypis bifariis.*

Gorgoniæ with bifarious polyps.

The polyps of the Pterogorgiæ are occasionally in opposite simple series, and the branches are much flattened or winged. In general there is an irregular line or band of polyps on the two sides, separated by a narrow naked space, which is sometimes sulcate.

Among the Gorgoniæ the seriate character is imperfectly presented by the *G. clathrus*, *virgulata*, and *sanguinea*.

*Arrangement of the Species.*I. *Branches much flattened or two-edged.*

- |                                  |                                 |
|----------------------------------|---------------------------------|
| 1. <i>G. Pter. quercifolia.</i>  | *6. <i>G. Pter. acerosa.</i>    |
| *2. <i>G. Pter. anceps.</i>      | *7. <i>G. Pter. pinnata.</i>    |
| *3. <i>G. Pter. citrina.</i>     | 8. <i>G. Pter. petechizans.</i> |
| 4. <i>G. Pter. fasciolaris.</i>  | 9. <i>G. Pter. patula.</i>      |
| 5. <i>G. Pter. Thomasiensis.</i> |                                 |

II. *Branches terete or but slightly compressed.*A. *Ramose in a plane, or pinnate.*

- |                               |                                     |
|-------------------------------|-------------------------------------|
| *10. <i>G. Pter. setosa.</i>  | 15. <i>G. Pter. fusco-purpurea.</i> |
| 11. <i>G. Pter. turgida.</i>  | 16. <i>G. Pter. sulcifera.</i>      |
| 12. <i>G. Pter. violacea.</i> | *17. <i>G. Pter. pectinata.</i>     |
| 13. <i>G. Pter. laxa.</i>     | 18. <i>G. Pter. ochrostoma.</i>     |
| 14. <i>G. Pter. rosea.</i>    | 19. <i>G. Pter. leucostoma.</i>     |

B. *Not ramose in a plane, or simple.*

- |                                  |                               |
|----------------------------------|-------------------------------|
| *20. <i>G. Pter. sarmentosa.</i> | *21. <i>G. Pter. setacea.</i> |
|----------------------------------|-------------------------------|

III. *Appendix.*

- G. pustulosa.*

I. *Branches complanate or two-edged, sometimes three to four winged.*

1. *G. PTEROGORGIA QUERCIFOLIA.* (*Ehrenb.*) *Dana.*—Bright yellow; eight inches high and four broad, ramulous, complanate, flabellate and lobato-foliaceous, subdivided nearly like the lobations of an oak-leaf, lobes nearly an inch wide; nerves sterile, other parts polypiferous, oscules small (one-third of a line).

*Gorg. quercus folium*, Ehrenb., *G.* lxxxiv., *Gorg. dilatata?* Esper, Fortsetz. ii. 25, sp. 5. tab. 51, 56.



2. *G. PTEROGORGIA ANCEPS*. (Linn.) Ehrenb.—Violaceous, and also yellowish with purple margins; two feet high, paniculate; branches long linear, generally two to two and a half lines wide and often a foot long, two-edged or sometimes three to four winged, with a single series of oscules along the edge: axis black, slightly compressed, in the branchlets wax-yellow.

West Indies.

Hans Sloane's Jamaica, tab. 22, fig. 4.

*Gorgonia anceps*, Linn., ed. xii., 1292.

—, Pallas, Zooph., 183.

—, Ellis and Solander, 89.

—, Esper, ii. 38, tab. 7.

—, Lamarek, ii. 494, No. 18.

—, Lamour., Pol. flex., 395; Encyc., 437.

—, Fleming's Brit. Animals, 512.

—, Blainville, Man., 505.

*Pterogorgia anceps*, Ehrenb., G. lxxxv., sp. 6.

The *Gorgonia anceps*, plate 25, figure 3, of Johnston's Zoophytes, appears to be the *citrina*.

3. *G. PTEROGORGIA CITRINA*. (Esper) Dana.—Low (four inches); sulphur-yellow, with the margin dotted with purple; subpinnato-ramose and nearly flabellate; branches two-edged, branchlets one to two inches long and one line broad; polyps marginal in a single series; axis of branches black, of branchlets yellowish.

Near Cape Florida, West Indies, *Bost. Nat. Hist. Soc.*—British Coast?

*Gorg. citrina*, Esper, ii. 129, tab. 38,

"*G. ramosa*, subplana, ramis compressis brevibus, cortice flavescente, poris marginalibus vix prominulis." The figure and description agree with specimens seen by the author. The cortex is usually bright sulphur-yellow with a single row of purple dots along the margin of the flat pinnules, about twenty-four of them to an inch in length. The surface is smooth without a sulcus.

*Sea Willow*, Ellis's Corallines, 68, tab. 27, fig. g, mentions purple as well as yellow specimens.

*Gorg. anceps*, Johnston's Brit. Zooph., 184, pl. 25, fig. 3; from Ellis.

The *Gorgonia citrina*, Lamk., ii. 494, No. 19, is another species.—"*G. humilis*, ramosissima; ramulis cylindraceis, obsolete depressis, granulatis; cortice albidoflavescente, osculis prominulis." Lamouroux, Pol. flex., 412; Encyc., 444.

4. *G. PTEROGORGIA FASCIOLARIS*. (Ehrenberg.)—Low (five inches high and ten broad), sparingly ramose; branches erect, simple, much compressed and flat, throughout four and a half inches long, and one and a half lines broad; margin thin and uniseriately dotted with red, the polyps being uniseriate.

West Indies. Ehrenberg.

*Pterog. fasciolaris*, Ehrenberg, G. lxxxv., sp. 4.

A variety of the *citrina*?—It is described as having the habit of the *pectinata*.

5. G. PTEROGORGIA THOMASIENSIS. (*Ehrenberg*.)—Low (four inches high), violaceous; sparingly ramose; branches simple, two-edged, erect, uniformly three inches long, less than a line broad at apex.

Island of St. Thomas, West Indies. *Ehrenberg*.

*Pterogorgia Sancti Thomæ*, Ehrenberg, G. lxxxv., sp. 5, states that it differs from the *pinnata* in not being pinnate, and has the habit of the *fasciolaris*; moreover, there is a third series of polyps.

6. G. PTEROGORGIA ACEROSA. (*Esper*.) *Ehrenberg*.—Yellowish; ramulous, nearly flabellate, pinnate; pinnules subopposite, compressed, one to one and a half lines broad; polyps arranged seriatly along the margin, in either single or double series; oscules very minute (hardly one-fourth of a line long), and crowded; axis of branches and branchlets nearly black.

This species, though very similar to the *setosa* in its pendulous habit, when full grown, has its branchlets much more flattened. The polyps on the pinnules are sometimes nearly regularly uniseriate, and often in two distinct series. The oscules are minute and much crowded, three of them hardly occupying a line in length. The pinnules are very crowded, occurring every two to four lines, and are about a line wide and a third of a line thick.

West Indies.

*Gorgonia acerosa*, Esper, ii. 106, tab. 31.

*Pterogorgia acerosa*, Ehrenberg, G. lxxxv., sp. 2. "Quadripedalis, flava, ramuloso-pinnata, pinnis strictiusculis, flexuosis, nec planè oppositis, 6-7" longis, 1" latis, compressis, planis."

*Gorgonia pinnata*, in part, of Lamarck, Lamouroux, and Blainville (see the *setosa*).

7. G. PTEROGORGIA PINNATA. (*Ellis*.) Yellowish, ramulous, pinnate, pinnules subopposite, much compressed and complanate, one to one and a quarter lines broad, not pendulous, four to six inches long; polyps marginal, in one or two series, large; axis of branchlets of a very pale yellowish colour.

The branches as well as branchlets are very much flattened, more so than in the *acerosa*; the polyps are much larger than in that species, three in the same series, in the specimen examined by the author, occupying a length of nearly two lines. The axis of the branchlets is capillary and nearly colourless.

*Gorg. pinnata*, Ellis and Solander, 87, tab. 14, fig. 3. The branchlets are not sufficiently crowded, a little too broad, and the polyps rather too distant.

- Gorg. americana*, Gmelin, 3799. sp. 3. "Bipedalis, et tripedalis, 9'' lata, flava, pinnata, stricta, valida, pinnis 6'' longis, strictis, rarioribus, 1''' latis, com planatis."
- Gorgonia pinnata*, in part, of Lamarek, Lamouroux, and Blainville (see the *setosa*).  
*Pterogorgia stricta?* Ehrenb., G. lxxxv.,

8. G. PTEROGORGIA PETECHIZANS. (*Pallas.*) *Dana.*—Yellow, with the margin dotted with purple; one to two feet high; flabellate and ramuloso-pinnate; pinnules numerous, short (one to two inches), a line broad, nearly parallel, compressed; polyps scarcely prominent, mostly marginal, but not generally in regular series.

Atlantic and Coast of Africa. *Lamarck.*

- Gorg. petechizans*, Pallas, Zooph., 196. *Gorg. abietina*, Ellis and Sol., 95, tab. 16.  
 —, Esper, ii. 55, tab. 13. Coast of Africa.  
 —, Lamk., ii. 491, No. 10. *Gorg. sanguinolenta?* Pallas, Zooph., 175.  
 —, Lamour., Pol. flex., 398; Exp. Meth., "G. depressa, ramosissima, dichotomopinnata, corticis flavi poris distichis purpureis."  
 33, pl. 16; Encyc., 440.  
 —, Blainv., Man., 505.  
 —, Ehrenberg, G. lxxxiv., sp. 9.

9. G. PTEROGORGIA PATULA. (*Ellis.*) *Dana.*—Deep red; eight inches high; ramose, subpinnate, tortuous; branches compressed, not crowded; polyps subdistichous; axis fuscous.

Mediterranean Sea.

- Gorgonia patula*, 88, tab. 15, figs. 3, 4. *Gorgonia patula*, Lamour., Pol. flex., 399;  
 The branches and branchlets are flattened, not crowded, 1-1½ lines wide, and Exp. Meth., 33, tab. 15, figs. 3, 4;  
 3 lines below; the polyps are not confined to the margin. Encyc., 440.  
 —, Lamk., 2d ed., ii. 499, No. 35 a.

II. *Branchlets terete, or but slightly compressed.*

A. Pinnate or ramose in a plane.

10. G. PTEROGORGIA SETOSA. (*Linn.*)—Purple; very large, often five feet high; ramose and very densely ramulous; pinnules nearly opposite or somewhat scattered, subterete, very long filiform (two to six inches in length), and hardly one line thick, longitudinally faint sulcate along the middle, becoming pendulous when adult, not verrucose; polyps subseriate, the opposite series often double; axis black.

Figure 32, page 72, extremity of a branch.

West Indies, where it is common.—Var. *sericea*, West Indies. *Bost. Nat. Hist. Soc.*

This is the large purple pendulous species of the West Indies. When young, the branchlets are erect or nearly so, and the pinnate

character is less distinct than in adult specimens. There are either one or two rows of polyps on the opposite sides of the branchlets. The main branches towards the summits are often somewhat winged.

- Gorg. setosa*, Linn., ed. xii., 1292. G. —, in part, Lamour., Pol. flex., 396; teres, pinnata, ramulis sparsis, cortice purpurascente. Exp. Meth., 32; Encyc., 439.  
 —, Blainville, Man., 505.  
*Pterogorgia setosa*, Ehrenb., G. lxxxv., sp. 1.  
 —, Gmelin, Syst. Nat., 3807. Lamarck and Lamouroux include with this species the *pinnata*, of Ellis, and the  
 —, Esper, ii. 66, tab. 17. *sanguinolenta*, of Pallas.  
*Gorg. acerosa*, Pallas, Zooph., 172.  
*Gorg. pinnata*, in part, Lamk., ii. 493, No. 17.

11. G. PTEROGORGIA TURGIDA. (*Ehrenberg*.)—Yellow, with the habit of the *acerosa*; eight inches high, and seven broad; pinnules turgid, narrower and shorter (two inches long), with a double series of pores on the sides furnished with red papillæ.

St. Thomas, West Indies. *Ehrenberg*.

*Pterogorgia turgida*, Ehrenberg, G. lxxxv., sp. 7.

12. G. PTEROGORGIA VIOLACEA.—Violaceous; ramose in a plane, pinnate; polyps arranged for the most part in four series, and the branches therefore quadrangular; verrucæ nearly obsolete, contiguous. American Seas.

- Gorg. violacea*, Pallas, Zooph., 176. G. —, Lamour., Pol. flex., 408; Encyc., depressiuscula, ramoso-pinnata, cortice 443.  
*violacea*, poris prominulis quadrangulo. *Pterogorgia violacea*, Ehrenb., G. lxxxv.,  
 —, Esper, ii. 54, tab. 12. sp. 8.  
 —, Lamarck, ii. 497, No. 27.

13. G. PTEROGORGIA LAXA. (*Lamarck*.) Lax ramose, flabellate; branches somewhat depressed, smooth; branchlets crowded, a little curving; polyps submarginal.

*Gorg. laxa*, Lamk., ii. 490, No. 7; Milne Edwards adds that the polyps are lateral in several irregular series, with a naked medial space on opposite sides, but no sulcus along the principal stem.

—, Lamour., Pol. flex., 98; Encyc., 440.

14. G. PTEROGORGIA ROSEA. Rose-red; dichotomously branched, in a plane; branches subpinnate; branchlets terete, unequally ascending; polyps subseriate.

Mediterranean, and Atlantic Ocean. *Lamarck*.

*Gorg. rosea*, Lamarck, ii. 494, No. 20.

Marsilli, Lith. quatrième (?), tab. 19, fig. 83; from near Marseilles, in forty fathoms water, and having the polyps scattered; colour red; greatest height two feet, and very slender; thickness at base hardly an eighth of an inch.

—, Lamouroux, Pol. flex., 401; Encyc., 441.

*Gorgonia Ceratophyta* (?), Linn., ed. xii., 1290, and Pallas, Zooph., 117; Esper, ii. 78, tab. 19.

— (?), Ehrenberg, G. lxxxiv., sp. 8; "9" lata, 8" alta, roseo aut cinnabarino-purpurea, valde gracilis, depressa, laxè dichotomo-ranulosa, virgato-divaricata, ramis setaceis, supra  $\frac{1}{3}$ - $\frac{1}{4}$ " fere crassis, apice subverrucosis, polypis niveis."

15. *G. PTEROGORGIA FUSCO-PURPUREA*. (*Ehrenberg.*) *Dana*.—Dark brownish-purple, dichotomously branched, flabellate; branchlets parallel, compressed, the summit branchlets nearly terete (three-fourths of a line thick), flexuous at base, long before branching, and virgate; polyps forming two lateral bands.

*G. fusco-purpurea*, Ehrenberg, op. cit., G. lxxxiv., sp. 7.

16. *G. PTEROGORGIA SULCIFERA*. Reddish-yellow; very tall, and branching in a plane; branchlets mostly secund, ascending, obsoletely verrucose, every where with a medial sulcus; cortex thin.

Indian Ocean.

*Gorg. sulcifera*, Lamk., ii. 497, No. 30. *Gorg. suberosa* (?), Esper, Fortsetz., i. 170, —, Lamour., Pol. flex., 412; Encyc., tab. 49. 444.

17. *G. PTEROGORGIA PECTINATA*. Reddish; one to one and a half feet high and broad; stem dichotomising and bearing above nearly simple erect branchlets, long and pectinately arranged, one and a half lines thick, nearly terete, subverrucose; polyps sublateral, with a flat medial area naked.

The East Indies. *Lamarck*.

Seba, Thes. iii., tab. 105, fig. 1 a. *Gorgonia pectinata*, Lamk., ii. 498, *Gorgonia pectinata*, Gmel., Syst. Nat., 3808. No. 31. —, Pallas, Zooph., 179. —, Lamour., Pol. flex., 416; Encyc., —, Ellis and Solander, 85. 446.

18. *G. PTEROGORGIA OCHROSTOMA*. (*Ehrenberg.*) *Dana*.—Rose-red, with the margin yellow; very densely branched; branchlets flexuous, not coalescing, subflabellate, rather rigid, branchlets compressed, shorter, a little broader, and with somewhat larger polyps than in the *G. flabellum*.

*Gorg. ochrostoma*, Ehrenb., G. lxxxiv., sp. 2.

19. *G. PTEROGORGIA LEUCOSTOMA*. (*Ehrenberg.*) *Dana.*—Rose-red, with a whitish margin; a foot high and nine inches broad; densely ramulous, subflabellate, not coalescing, rigid; branches flexuous, nearly terete, half a line thick, margin polypiferous.

*Gorgonia leucostoma*, Ehrenb., G. lxxxiv., sp. 3.

B. Not pinnate, nor ramosc in a plane.

20. *G. PTEROGORGIA SARMENTOSA*. (*Esper.*)—Pale yellowish; large; lax paniculate, branchlets slender (half a line), and flexuous, nearly terete, often sulcate; polyps lateral, often in a single series, margin of branchlets uneven, with obsolescent verrucæ; cortex thin.

Mediterranean. *Esper.*

*Gorgonia sarmentosa*, Esper, ii. 85, tab. —, Lamour., Pol. flex., 415; Encyc., 21, and Fortsetz., 165, tab. 45; characteristic figures. —, Blainville, Man., 506.  
—, Lamk., ii. 498, No. 32.

21. *G. PTEROGORGIA SETACEA*. (*Pallas.*)—Whitish; simple, rigid, rarely with a single branch; surface subverruculose, verruculæ minute (one-third of a line) and obsolete, numerous and crowded, mostly on two opposite sides, with a narrow naked interval between.

The American Seas. *Pallas.*—Laguayra, S. A. *Z. Collins.*

A specimen of this species in the collections of the Academy of Natural Sciences, at Philadelphia, deposited by Z. Collins, is a simple rigid terete stem, not over two lines thick, four and a half feet long, with the axis pale brownish, the cortex thin, white and very persistent, and the minute verrucæ scarcely at all prominent; the narrow naked line is distinct. The polyps are in general hardly half a line apart.

*Gorgonia setacea*, Pallas, Zooph., 182. *Gorgonia setacea*, Lamarek, 2d ed., ii. 502, —, Lamouroux, Polyp. flex., 421; Encyc., 447. No. 35 n.

NOTE.—The *Gorgonia sanguinolenta* of Esper (tab. 22) is a closely branched species, resembling in its habit, the stoutness of its branches, and thickness of cortex, the *Gorgonia antipathes*, the branchlets being over one and a half lines thick near their summits. It is represented of a yellow colour, with two or more series of polyps on opposite sides of the branches, and is said to come from the American seas.

The *Gorgonia ceratophyta* of Ellis and Solander, tab. 12, is nearly as stout, with a somewhat similar habit, and a deep medial longitudinal furrow separating the polyps of the two sides. It was from the West Indies. The branches are full twice the diameter of the *ceratophyta* of Pallas.

The *Gorgonia pustulosa* of Lamouroux appears to belong with the Pterogorgiæ, and is described as follows:—Branches scattered, with verrucæ in two sublateral series, separated by a slightly prominent line; colour yellowish-red or miniateous; axis round. Pol. flex., 411, pl. 15; Encyc., 445.—According to Lamouroux's figure, the pustuliform verrucæ are rounded and unequal, and many are a line in diameter. It is eight to ten inches in height.

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SUBGENUS II.—GORGONIA.

*Polypis retractilibus; retractis, zoophytorum superficie sive levi sive verrucosâ, verrucis non armatis.*

Polyps retractile; when retracted, surface of zoophytes either smooth or verrucose, with the verrucæ, when any, unarmed with spicula or scales.

*Arrangement of the Species.*

A. Cortex thin, less than half a line in thickness. Polyps closely scattered.

I. *Flabellate, throughout reticulate, without any free branchlets.*

- |                           |                             |
|---------------------------|-----------------------------|
| *22. <i>G. flabellum.</i> | *25. <i>G. umbella.</i>     |
| *23. <i>G. clathrus.</i>  | 26. <i>G. ventilabrum.</i>  |
| *24. <i>G. reticulum.</i> | *27. <i>G. verriculata.</i> |

II. *Flabellate; in part reticulate or not at all so—not pinnate.*

- |                            |                             |
|----------------------------|-----------------------------|
| *28. <i>G. umbraculum.</i> | *34. <i>G. tuberculata.</i> |
| *29. <i>G. cancellata.</i> | 35. <i>G. granulata.</i>    |
| *30. <i>G. venusta.</i>    | *36. <i>G. flexuosa.</i>    |
| *31. <i>G. stricta.</i>    | *37. <i>G. verrucosa.</i>   |
| 32. <i>G. retellum.</i>    | 38. <i>G. apiculata.</i>    |
| 33. <i>G. tamarix.</i>     | 39. <i>G. nivea.</i>        |

III. *Flabellate; pinnate, not reticulate.*

- \*40. *G. flammea.*

IV. *Not flabellate; verrucæ none or very short.*

- |                           |                            |
|---------------------------|----------------------------|
| *41. <i>G. virgulata.</i> | 44. <i>G. graminea.</i>    |
| 42. <i>G. miniatea.</i>   | *45. <i>G. Bertolonii.</i> |
| *43. <i>G. sanguinea.</i> | 46. <i>G. sasappo.</i>     |

- |                         |                              |
|-------------------------|------------------------------|
| *47. <i>G. humilis.</i> | 51. <i>G. juncea.</i>        |
| *48. <i>G. furcata.</i> | *52. <i>G. suffruticosa.</i> |
| 49. <i>G. flavida.</i>  | 53. <i>G. ramulosa.</i>      |
| 50. <i>G. elongata.</i> | *54. <i>G. spicifera.</i>    |

B. Subflabellate or not at all so; polyps few and at distant intervals on the branches, subalternate.

- |                              |                        |
|------------------------------|------------------------|
| *55. <i>G. trichostemma.</i> | 56. <i>G. exserta.</i> |
|------------------------------|------------------------|

C. Cortex (including verrucæ) thick—half a line or more.

I. *Surface smooth or short verrucose.*—(*Plexauræ.*)

- |                            |                               |
|----------------------------|-------------------------------|
| *57. <i>G. antipathes.</i> | *61. <i>G. quincuncialis.</i> |
| *58. <i>G. homomalla.</i>  | *62. <i>G. dichotoma.</i>     |
| *59. <i>G. anguiculus.</i> | *63. <i>G. vermiculata.</i>   |
| 60. <i>G. olivacea.</i>    | *64. <i>G. crassa.</i>        |

II. *Verrucæ prominent.*—(*Eunicææ.*)

- |                                   |                            |
|-----------------------------------|----------------------------|
| *65. <i>G. papillosa.</i>         | 69. <i>G. plantaginea.</i> |
| 66. <i>G. clavaria.</i>           | 70. <i>G. lima.</i>        |
| *67. <i>G. pseudo-antipathes.</i> | 71. <i>G. mammosa.</i>     |
| *68. <i>G. madrepora.</i>         |                            |

D. Unarranged species.

- |                             |                            |
|-----------------------------|----------------------------|
| 72. <i>G. purpurea.</i>     | 76. <i>G. coccinea.</i>    |
| 73. <i>G. Richardii.</i>    | 77. <i>G. rhizomorpha.</i> |
| 74. <i>G. penna.</i>        | 78. <i>G. alba.</i>        |
| 75. <i>G. moniliformis.</i> |                            |

A. Cortex thin, not exceeding half a line in thickness, polyps crowded.

I. *Throughout reticulate, with no free branchlets.*

22. **GORGONIA FLABELLUM.**—Large, yellow or red; flabellate, and throughout finely reticulate; spaces one to two and a half lines in area, branchlets flattened, three-fourths to one and a half lines wide, sometimes very prominently winged; verrucæ obsolete, except about the margin of the frond, where they are often distinct but minute.

West Indies.

This common species grows to a large size; the fronds are sometimes two feet high and nearly as broad. The size of the spaces and flattened branchlets, and the absence of verrucæ, except upon the extreme branchlets, distinguish this species from those allied. Flat or rounded processes sometimes grow from the branchlets at right angles with the frond, which at times stand out one-fourth of an inch. The branchlets are generally much compressed, and the spaces are sometimes very small. The colour varies from an ash to a bright yellow, and is occasionally red. The polyps are every where scat-



tered, except where the wing-like processes commence to grow from the surface, and in that case they become lateral.

- Gorgonia flabellum*, Linn., xii. 1293. —, Lamour., Pol. flex., 403; Encyc., 441.  
 —, Ellis and Sol., 92.—*Flabellum venen-* —, Blainville, Man., 505.  
*ris*, Ellis, Coral., tab. 26, fig. A. —, Ehrenb., G. lxxxiv., sp. 1.  
 —, Pallas, Zooph., 169. —, Johnston's British Zoophytes, figure  
 —, Lamk., ii. 488, No. 1. p. 161—reduced drawing.

**GORGONIA CLATHRUS (23).**—The *Gorgonia clathrus*, of Pallas, characterized by terete branchlets, may be only a red variety of the *flabellum*, and this view is strengthened by their similarity of form, and by the occasional occurrence of red and yellow colours in the same specimen. Yet in some specimens with terete branchlets, examined by the author, the main branches are more regularly ascending than usual in the *flabellum*, and the polyps are more or less seriate, with the medial line of the branchlets bare. The cortex sometimes appears smooth, with even the oscules indistinct; and again, a series of granules (about eight to half an inch), range along each side of the medial space, as if the surface were minutely verruculose. These different appearances arise from the different states of retraction in the polyps at the time the zoophytes were dried, the latter condition being due to a partial retraction only. A yellowish-white specimen, of similar character, without verrucæ, but with the polyps in four series, belongs to the Nat. Hist. Society collections of Boston. (*G. clathrus*, Pallas, Zooph., 168; Lamarck, 2d ed., ii. 501, No. 35 h; Lamour., Pol. flex., 405; Encyc., 442.)

24. **GORGONIA RETICULUM.** (*Pallas.*) *Lamarck.* — Red, much branched, flabellate; throughout reticulate, branchlets nearly terete, decussately coalescent, obsoletely granulous.

Indian Ocean.

Milne Edwards adds that the oscules are in some parts seriate, but generally scattered.

There is much confusion in the books with regard to the *reticulum* of Pallas. Pallas (Elench. Zooph., 167) thus describes the species. "G. reticulata, ramulis creberrimis, teretibus, cortice rubro verrucoso." The figure given by Esper (tab. 44) is referred by Lamarck to the *flexuosa*; Ellis's *reticulata* is Lamarck's *verruculata*; Ehrenberg's *reticulum* (Eunicea) is stated to correspond with Esper's tab. 44, but appears to be a different species, with *free branchlets* ("omnibus liberis"). Lamarck mentions Esper's tab. 1, *Gorgonia ventalina*, as possibly the *reticulum*. (See *G. ventilabrum*.)

25. **GORGONIA UMBELLA.** (*Esper.*)—Red; flabellate, sometimes with the surfaces proliferous, height exceeding the breadth (twelve inches by nine), finely reticulate, spaces two to two and a half lines in area; branchlets subterete, nearly one line broad, irregularly rough, and sometimes appearing a little contorted, owing to the scattered verrucæ, which are unequally prominent and minute (one-fourth of a line); axis pale wood-brown.

East Indies. *Esper*.

This species, of which a specimen is contained in the collections of the Boston Natural History Society, has larger and more irregular branchlets, verrucæ, and spaces, than the *clathrus*. The branchlets are often very uneven, owing to the unequal scattering of the larger verrucæ; and the spaces are generally oblong upward, and many are half an inch in length.

*Gorgonia umbella*, *Esper*, *Pflanz. Fortsetz.*, ii. 30, tab. 53; the general habit is brought out; but the branchlets are a little too slender.

26. GORGONIA VENTILABRUM. (*Pallas*.)—Deep red, reticulate, branches compressed, verrucose.

East Indies.

This imperfectly described species is said to have the general habit of the *flabellum*. Its *verrucose* surface appears to distinguish it from that species, while the compressed branches separate it from the *reticulum* and *umbella*.

*Gorgonia ventilabrum*, *Pallas*, *Zooph.*, 165.

—, *Lamk.*, 2d ed., ii. 500, No. 35 f.

*Gorgonia ventalina*, *Gmelin*, *Linn.*, 3808.

—, *Lamour.*, *Pol. flex.*, 404, and *G. ventilabrum*, *Encyc.*, 442.

The *Gorgonia ventalina* of *Esper* (*Pflanz.*, ii. 20, tab. 1), which he makes identical

with the *ventilabrum* of *Pallas*, is, as represented by him, a small reddish species, broader than high, with a verrucose surface, and the spaces rather large (mostly a fourth to a third of an inch long). The branchlets are not compressed, and about half a line thick.

27. GORGONIA VERRICULATA. (*Esper*.)—Whitish; flabellate, large, throughout coarsely reticulate; spaces mostly six lines broad, branchlets subterete, nearly one line thick, verrucose and uneven.

Indian Ocean.

*Gorgonia reticulata*, *Ellis and Solander*, *G. verriculata*, *Lamarck*, 2d ed., ii. 489, tab. 17. No. 3.

*Gorgonia verriculata*, *Esper*, ii. 124, tab. 35. —, *Lamouroux*, *Polyp. flex.*, 404; *Exp. Meth.*, 33, pl. 17; *Encyc.*, 442.

NOTE.—The *Plexaura reticulata* of *Ehrenberg*, appears to belong to this division of the *Gorgoniæ*. It is thus described: "Quadripollicaris, alba, densissimè ramulosa et reticulata, irregulariter flabellata, parva, tenuis, rigida, ramulis sursum curvatis, flexuosis, compressis, 1''' crassis, cortice albo, undique poroso." (*Op. cit.*, *Gen. lxxxiii.*, sp. 4.)

II. *Flabellate, subreticulate, or not at all reticulate; branches not pinnate.*

28. GORGONIA UMBRACULUM. (*Lamarck*.)—Frond red; flabellate, nearly circular and densely ramulous, subreticulate, ribbed with subflexuous or nearly straight branches, about one-third of an inch apart;



branchlets two-thirds to one line thick, subterete; every where short verrucose.

The East Indies.

The frond is without any prominent midrib; the numerous branches are directed upward and outward, and lie at nearly even distances from one another, though somewhat flexuous and irregular; and are much united by branchlets, many of which are free. Coalescence takes place at intervals of one-fourth to two inches.

*Frutex lignosus, planus, instar ventilabri, Gorgonia umbraculum*, Ellis and Solander, *ramulis inter se concretis crusta tartarea* 80, tab. 10.  
*rubra*. Cape of Good Hope and African —, Lamk., 2d ed., ii. 489, No. 4.  
 Coast. Seba, Thes. iii., tab. 107, No. 6. —, Lamour., Exp. Meth., 34, tab. 10.

29. GORGONIA CANCELLATA. (*Dana*.)—Whitish; flabellate, nearly circular, very much branched throughout, for the most part coalescent, ribbed with nearly straight parallel branches, which are one-fourth to one-third of an inch apart, and are united at intervals of one-half to two inches by flexuous branchlets; branches and branchlets one to one and a half lines thick, every where small verrucose.

A frond of this species, seen by the author, measured a foot in height. The parallelism of the branches and the reticulation of the whole by means of cross flexuous branchlets, but few of which are free, are well represented by Esper. The branches in the specimen were a little closer than in his figure, though otherwise similar. The cortex is rather thick, and the verrucæ are quite small and scattered closely over the surface. The coalescence is rather more general, and the branches and branchlets stouter and more even, than in the *umbraculum*.

*Gorgonia pseudo-antipathes*, Esper, Pflanz. Fortsetz., ii. 32, tab. 54; and *Antipathes flabellum*, ii., Antip., tab. I.

30. GORGONIA VENUSTA. (*Dana*.)—Red or ochreous; flabellate and much reticulate, spaces often three lines long, but usually very much larger; branchlets terete, one line thick; cortex thick, and throughout entirely smooth; oscules scattered.

East Indies. *Esper*.—Isle of France. *J. S. Phillips*.

*Gorgonia sasappo*, Esper, ii., tab. 9 A. The smooth branches and branchlets and thick cortex are like those of the specimens examined by the author, in the collections of J. S. Phillips, of Philadelphia; but the fronds are much more closely reticulate, though very irregularly so. There is no proper midrib to the frond; and the stem at base is about one and a half lines thick.

31. GORGONIA STRICTA. (*Lamarck*.)—Red, flabellate, subreticulate, branches crowded and close, lateral branchlets short, and rather spreading; polypiferous granules minute, much crowded; cortex thin.

*Gorgonia stricta*, Lamarck, 2d ed., ii. 489, *Gorgonia stricta*, Lamouroux, Pol. flex., No. 6. 408; Encyc., 443.

32. GORGONIA RETELLUM. (*Lamarck*.)—Whitish; flabellate, subreticulate; lateral branchlets short, subtransverse, granulous.

Indian Ocean? *Lamarck*.

*Gorgonia retellum*, Lamarck, 2d ed., ii. 489, No. 5.

*Gorgonia furfuracea*? Esper, Forsetz., i., tab. 41. This figure, which Lamarck refers here with a query, represents a closely-branched frond, a little broader than its height, sparingly coalescent, without a prominent midrib, having the lateral branchlets along the main branches subdivaricate, mostly free, scarcely three-fourths of an inch long, and a line or a little more in diameter; the cortex is rather thick, the oscules numerous, and the surface is somewhat granulous.

*Muricea furfuracea*, Ehrenberg, G. lxxxii., sp. 6.

33. GORGONIA TAMARIX. (*Ehrenberg*.)—Isabella yellow; a little higher than broad; much branched, slender, subflabellate; branches flexuous, thin, short, setaceous, subreticulate, but mostly free; margin of the summit branchlets crenated, owing to slightly prominent verrucæ.

*Eunicea tamarix*, Ehrenberg, G. lxxxii., sp. 13.

34. GORGONIA TUBERCULATA. (*Esper?*) *Lamarck*.—Yellowish; flabellate, subreticulate, ramose, very large; branchlets lax, tortuous, often coalescing; tubercles scattered, unequal.

Mediterranean Sea.

Milne Edwards describes a gigantic specimen of this species, of which the trunk is as large as the arm; the verrucæ are large and depressed, and very unequal.

*Gorgonia tuberculata*, Lamarck, ii. 491, —, Lamour., Pol. flex., 409; Encyc., No. 11. 443.

—, Esper, ii. 127, tab. 37 (?). “*G. subreticulata*, plana, ligno depresso fusco, cortice albido, poris sparsis inæqualibus, hemisphericis, et tuberculatis.” Figure 2, represents a part of a branch enlarged, and if of natural size, it would answer well for the *tuberculata*, of Lamarck. —, Blainville, Man., 505. The *Eunicea arbuscula*, of Ehrenberg, has many characters in common with the *G. tuberculata* of Lamarck, but appears to be a distinct species, with more slender and even branchlets. “*Tripedalis*, elegantissima, isabellina, 2½' lata, frutes-

cens, flabellata, ramosissima, subreticulata, ramulis tenuissimis, laxis, flexuosis, verrucis  $\frac{1}{2}$ ''' longis et  $\frac{1}{3}$ ''' latis;" more

slender than the *papillosa*, with thinner cortex. Op. cit., G. lxxxii., sp. 11.

35. GORGONIA GRANULATA. (*Ehrenberg*).—Yellowish; flabellate, higher than broad (nine inches by four), much branched, subreticulate, slender, branches fragile, branchlets three-fourths of a line thick, verrucose; verrucæ one-third of a line broad, and one-fourth high; axis fuscous.

*Eunicea granulata*, Ehrenberg, op. cit., Gen. lxxxii., sp. 9.

36. GORGONIA FLEXUOSA. (*Lamarck*).—Orange; flabellate, much branched, branches and branchlets dichotomously divaricate, flexuous, remotely coalescing, verrucose.

Indian Ocean. *Esper*. *Lamarck*.

*Esper's* figure (tab. 44), to which *Lamarck* refers, represents an irregularly branched frond, with branches spreading widely and irregularly bent, and the branchlets coalescing at intervals of a half to two inches, leaving large open spaces.

A specimen closely resembling *Esper's* figure was obtained and figured by the author, at the Kingsmill Islands, and is represented on plate 60, fig. 2. The coalescence is rather less frequent than is represented by *Esper*, but the flexuous irregular branching is similar. The specimen was of a deep crimson colour, ten inches broad, and six high. The polyps were ochreous yellow, with the tentacles distinctly fringed (fig. 2 a), and the verrucæ are but little prominent.

*Gorgonia flexuosa*, Lamk., ii. 490, No. 8. —, *Esper*, Fortsetz. i. 161, tab. 44.

*Ehrenberg* makes of *Esper's* figure a distinct species, considering it the *reticulum* of *Pallas*; but his description does not agree with the figure, nor with *Pallas's* description: "Octopollicaris, violaceo-incarnata, 4'' alta, densissimè ramulosa, fruticulosa, irregulariter flabellata, parva, subtilissimè pruinosa, nec furfuracea, ramulis sæpe oppositis, flexuosis, omnibus liberis, ramulosis, summis apicibus distiche, mediis ubique, polypiferis,  $\frac{1}{4}$ ''' latis et altis; axe corneo, fusco" (*Eunicea reticulum*, *Ehrenb.*, G. lxxxii., sp. 6).

Tab. 79, of *Rumphius*, Amb., vi. 206, may be this species; the figure is fourteen inches high by twelve broad.

The *Gorgonia umbratica* of *Esper*, has something of the habit of the *flexuosa*; the figure is brownish-ash, a little higher than broad, openly branched, with no midrib, the branches more ascending, sparingly coalescent, a little compressed, hardly a line wide, and every where crowdedly short verrucose. *Esper's* specimen was from the East Indies. It has some resemblance to the *verrucosa*, but is more coalescent.—*Eunicea umbratica*, *Ehrenberg*, op. cit., Gen. lxxxii., sp. 10.

37. *GORGONIA VERRUCOSA*.—Whitish, flabellate, about six inches high and broad, loosely and sparingly ramose; branches flexuous, one to one and a quarter lines thick, rarely coalescing, verrucose, verrucæ one-half to two-thirds of a line broad.

Mediterranean, and seas of America.

- Gorgonia verrucosa*, Linn., ed. xii., 1291. rather few, and branchlets full one and a half lines broad. Another species?  
 —, Ellis and Solander, 89.  
 —, Larnk., ii. 491, No. 12. The *Gorgonia verrucosa* of the British coast (Johnston's Brit. Zooph., 182, pl. 25, fig. 1), is represented by Johnston as twelve inches high, by fifteen or sixteen broad, and branched in a plane, with a midrib, and the branchlets often coalescing; axis black, with a snow-white pith at centre.  
 —, Blainv., Man., 505, pl. 87, fig. 3.  
 —, Esper, Pflanz., ii. 61, tab. 16.  
 —, Bertolonii, Amæn. Ital. 260; "albisimo, undique exquisitè et inæqualiter verrucoso;" refers to Marsilli, tab. 21, fig. 97.  
*Eunicea verrucosa*, Ehrenb., G. lxxxii., sp. 4; Esper's figure is referred to as good. *Gorgonia viminalis*, Sowerby, Brit. Misc., 81, pl. 40; Fleming's Brit. Anim., 512; Borlase, Cornwall, 238, tab. 24, fig. 1; it has more of the habit of the *flexuosa*, but is more closely reticulate.  
 Seba, fig. 3, tab. 106, which Lamarck refers here, represents a large verrucose species, fourteen inches high by eleven broad, arborescently branched in a plane; branches

38. *GORGONIA APICULATA*. (*Ehrenb.*) *Dana*.—Ash-coloured; flabellate, three inches high and five broad; very densely ramulous, branches and branchlets nearly parallel, sometimes coalescing, often free, one-half a line broad; verrucæ conically acute, one-fourth to one-third of a line high, and broad, crowded.

*Eunicea apiculata*, Ehrenberg, G. lxxxii., sp. 8.

39. *GORGONIA NIVEA*. (*Ehrenberg.*) *Dana*.—Snow-white; flabellate, six inches, branchlets flexuous, opposite or alternate, subcompressed, one line thick at apex, with the verrucæ scattered, rather large, a line broad, and half a line high.

*Eunicea nivea*, Ehrenb., op. cit., Gen., lxxxii., sp. 14.

NOTE.—The *G. humosa* of Esper (tab. 6) is arborescently branched in a plane; branches not crowded, terete or subcompressed, one and a half to three lines in diameter, surface verrucose. It may be the *G. placomus*, yet as figured and described, has not the spicules of that species. Probably from the West Indies.

The *Eunicea antipathes* of Ehrenberg, is a flabellate species, described as follows: "Pedalis nigricans, dichotoma, ramosa, flabellata, valida, flexuosa, reticulata, caulibus a latere compressis, ramis subteretibus, polypis magnis, undique sparsis, contractis 1''' fere longis, ½''' fere latis, complanatis. Esper's Icon (tab. 28) hujus formam bene refert. An huc Esper, tab. 6?"

The *Gorgonia palma* of Esper, tab. 40, may be the *flammea*; but the form is simple

flabellate, the branches are digitately arranged, scarcely subdivided, and three to six inches long; they are much compressed and two to four lines wide; colour white, oscules scattered and numerous.

III. *Flabellate, subpinnate.*

40. GORGONIA FLAMMEA. (*Ellis.*)—Scarlet or purple; very large; arborescently flabellate, lax ramose, subpinnate, branches compressed, branchlets one and a half to two lines broad, not verrucose, polyps scattered.

Cape of Good Hope.

*G. flammea*, Ellis and Sol., 80, tab. 11.      *Gorgonia palma*, Ehrenberg, G. lxxxiv.,  
—, Lamk., ii. 490, No. 9.                              sp. 4.  
—, Lamour., Exp. Meth, 33, tab. 11;      —, Esper, Pflanz., ii., tab. 5.  
Pol. flex., 399; Encycl., 440.

IV. *Not flabellate; cortex thin; verrucæ none, or nearly obsolete.*

41. GORGONIA VIRGULATA. (*Lamarck.*)—Bright yellow, orange, or crimson; sparingly ramose and often nodding; branches long, (often a foot or more long,) even virgate, one to one and a half lines thick, often obsoletely compressed; polyps crowded, sometimes subseriate, verrucæ none, oscules minute and linear.

West Indies.

The branches are long and very slender without verrucæ, and passing off at a small angle they appear rather crowded together; they are often a foot or more in length, and become somewhat nodding when thus long.

*Corallina fruticosa*, &c., Catesby's Carolina, 13, pl. 13, red variety.

*Gorgonia viminalis*, Esper, Pflanz., ii. 51, tab. 11, the yellow variety. The branches as represented are too short.

*Gorgonia virgulata*, Lamk., ii. 495, No. 21.

The *Gorgonia viminalis*, of Lamouroux (Exp. Meth., 34, and Encyc., 445), and *Plexaura viminalis*, of Ehrenberg (op.

cit., G. lxxxiii., sp. 1), appear to have been described from specimens of Lamarck's *virgulata*. The *viminalis*, of Pallas, is described as ramoso-subpinnate, with divaricate, setaceous, branches, and distichous, somewhat prominent, oscules. The Mediterranean is given by him as its locality. Esper's *ceratophyta*, tab. 19, answers nearly to the description. See also *Pterogorgia rosea*.

NOTE.—42. *Gorgonia miniacea* (Esper).—This species is thus described by Ehrenberg, who names it *Plexaura miniacea*. "Sesquipedalis, miniacea, subflabellato-divisa, ramis virgatis, parcè dichotomis, nutantibus, leviter compressis, densè polypiferis, pedem fere longis." At base, three lines thick; summits a line. Op. cit., G. lxxxiii., sp. 2. Esper's specimen was from the East Indies. He describes it as subsecund in its branches, and ramose nearly in a plane. Pflanz., ii., tab. 36.—The figure by Rumphius, tab. 83, Am-

boyn., vi. 223, has the habit of the *virgulata*, but is from the East Indies, and may belong to this species. Seba's No. 3, tab. 107, represents an allied *Gorgonia*, received by him from the Cape of Good Hope; he says, "Cujus ramuli prælongi, tenues, parumque divisi, crustâ rubrâ oblecti sunt." "Crusta tartarea præcipuè circa summitates tuberculis minutisque veluti porulis conspicua est."

43. *GORGONIA SANGUINEA*. (*Lamarck*.)—Purple; ramose, subfasci-  
giate; branches erect, tereto-setaceous, polyps of the branchlets sub-  
seriate, of the branches every where scattered; axis nearly black.

Isle of France.

*Gorgonia sanguinea*, Lamk., ii. 495, No. —, Lamour., Pol. flex., 400; Encyc., 441.  
22. —, Ehrenb., G. lxxxiv., sp. 6.

44. *GORGONIA GRAMINEA*. (*Lamarck*.)—Whitish; ramose, branches  
erect, subfasciculate, slender, terete, rush-like; pores oblong, scattered.

Mediterranean Sea. *Lamarck*.

*Gorgonia graminea*, Lamk., ii. 496, No. 23.

45. *GORGONIA BERTOLONII*. (*Lamouroux*.)—Whitish; near the  
*virgulata* in habit, branches closely collected together, long and often  
nodding, rather stouter (one and a half lines), terete, and every where  
subverrucose.

Mediterranean Sea.

*Lithophyte premier*, Marsilli, Phys. de la Mer, tab. 16, fig. 80; specimens obtained  
in eight to thirty fathoms, near Marseilles. Colour ash, becoming white on drying.

*Gorgonia Bertolonii*, Lamour., Pol. flex.,  
414; Encyc., 445.

*Gorgonia stricta*, Bertolonii, Amæn. Ital.,  
260.

*Gorgonia viminalis*, Esper, ii., tab. 11, A. *Eunicca Bertolonii*, Ehrenb., G. lxxxii.,  
*Gorgonia graminea*, var. *subtuberculosa*, sp. 5.

Lamarck, ii. 496, No. 23.

46. *GORGONIA SASAPPO*. (*Pallas*.)—Red; sparingly ramose;  
branches terete, long virgate, often five inches long and nodding,  
close dichotomous, one and a half lines thick, surface every where  
subpilose and very slightly verrucose, polyps crowded, throughout  
scattered.

Indian Ocean. *Pallas*. *Esper*.

*Gorgonia sasappo*, Pallas, Zooph., 188; *Gorgonia sasappo*, Esper, ii. 46, tab. 9.

*Sasappo* is the Malayan name of this *Gorgonia*. —, Lamk., 2d ed., ii. 500, No. 35 d.

47. *GORGONIA HUMILIS*. (*Dana*.)—Whitish; two to three inches  
high, and short fruticulose, with the branches crowded, flexible,



branchlets short (one to six lines), one and one-third lines thick, not attenuate, surface verruculose, polyps crowdedly scattered.

West Indies?

Forms a small crowded clump, with the branches somewhat drooping, and the branchlets very short and uneven or short verrucose.

*Eunicea tuberculata*, Ehrenberg, Gen. lxxxii., sp. 15.

48. GORGONIA FURCATA. (*Lamarck.*)—White; low, lax ramose, dichotomous; branches terete, slender, variously curved, obsoletely verrucose.

The Mediterranean (?). *Lamarck.*

*Gorgonia furcata*, Lamk., 2d ed., ii. 493. *Gorgonia furcata*, Blainville, Man., 505.  
—, Lamour., Pol. flex., 410; Encyc., 444.

49. GORGONIA FLAVIDA. (*Lamarck.*)—Yellow; crowded cespitose, subpinnate; branchlets terete, numerous; polyps crowdedly scattered, cortex thick, not verrucose.

West Indies. *Seba. Mauger.*

*Keratophyton ramulis lateralibus brevibus conjugatis, crustâ obscurè luteâ tectum.* long, and the surface is scattered over with oscules. The whole specimen is about five inches in height.  
Locus Natalis Nova Hispania, *Seba, Thes. iii., tab. 107, fig. 8.* The pinnules are about a line thick, and nearly an inch  
*Gorgonia flavida*, Lamk., ii. 496, No. 26.  
—, Lamour., Pol. flex., 402; Encyc., 441.

50. GORGONIA ELONGATA. (*Pallas.*)—Reddish; very tall (often four feet); branches few, dichotomous, very long, short verrucose; axis pale.

West Indies. *Ellis. Esper.*

*Gorgonia elongata*, Pallas, Zooph., 179. *G. elongata*, Esper, Fortsetz., ii. 35, tab. 55.  
—, Ellis and Solander, 98.

51. GORGONIA JUNCEA. (*Pallas.*)—Colour subminiaceous; stem quite simple, very long, terete; surface crowdedly short-verrucose.

Indian Ocean. *Pallas. Esper.*—Amboyna. *Seba.*

*Keratophyton simplex, tantum constat vimine indiviso—crusta undiquaque tartarea nodosa; rubra utcumque in luteum vergente,* *Seba, Thes. iii., tab. 105, fig. 1 a.* ger. His name, *albus* (white), alludes to the pale colour of the axis; the crust is described as red.  
*Palmjuncus albus*, Rumph. Amb. vi. 226: *Gorgonia juncea*, Pallas, Zooph., 180: "Simplicissima, attenuata, subflexuosa, cortice crasso rubro verrucoso."  
Rumphius states that it is sometimes eleven feet long, and as thick as the fin-  
—, Esper, Fortsetz. ii., 26. tab. 52.

*Gorgonia juncea*, Lamk., 2d ed., ii. 499,  
No. 34.

The *Gorgonia juncea* of Ellis, was from the West Indies, where it was "found by Mr. Greg." It was three feet long, "a single rounded stem, smaller at each end. The

bone (axis) is of a dark-coloured horny consistence; this is covered with an orange-coloured flesh, full of longish little mouths." (Ellis and Solander, 81; Gmel. Linn. Syst. Nat., 3801.)

52. GORGONIA SUFFRUTICOSA. (*Dana*.)—Ash-coloured; fruticulose, very crowdedly ramulós; branches and branchlets flexuous and irregular, mostly terete, some nodose; branchlets one-half to one and a half inches long and one line thick; cortex rather thick, smooth, with punctiform oscules, minute and throughout crowdedly scattered; polyps quite small, yellowish, with the tentacles fringed and short.

Plate 59, fig. 7, part of zoophyte, natural size; 7 a, polyp, enlarged; 7 a', same, natural size.

The Feejee Islands, Mathuata reefs. *Exp. Exp.*

This is a rough-looking species with a Plexaura habit, very crowdedly and closely branched, and having the branches often bent and uneven. To add to its squarrose appearance, there are occasional tubercles a fourth of an inch in diameter, containing each a barnacle. There is not the slightest trace of verrucæ.

53. GORGONIA RAMULOSA. (*Ehrenberg*.) *Dana*.—Yellow; eight inches high and five broad, erect, dichotomous; branches virgate, densely subverticillate, with simple or sparingly divided branchlets, nearly an inch long, and one line thick; surface densely polypiferous, smooth, with the oscules like minute points.

West Indies. *Ehrenberg*.

*Eunicca ramulosa*, Ehrenberg, op. cit., Gen. lxxxii., sp. 18.

54. GORGONIA SPICIFERA. (*Dana*.)—Ash-coloured; eight inches high, subdichotomous; branches on all sides densely ramulous, with simple, rigid branchlets, one and a half to two inches long and nearly a line thick, terete, finely, crowdedly, and obsolescently verrucose; axis fuscous, cortex rather thick.

West Indies (?). *Boston Nat. Hist. Soc.*

The oscules are minute punctures, and are situated on the upper side of the small obsolescent verrucæ. Successive branchlets on the main stem, are scarcely one-fourth of an inch apart.

B. Polyps few, remote; zoophytes sometimes subflabellate.

55. GORGONIA TRICHOSTEMMA. (*Dana*)—Brown, summits flesh-

coloured; low, and sparingly ramose in a plane; branches coarsely nodulous, one to three lines thick; polyps few, very distant, tentacles long fimbriate, the papillæ being capillary and recurved; verrucæ irregularly tuberculiform, somewhat alternate, stout, suberose, above obsolescent.

Plate 59, fig. 3, natural size, polyps expanded; 3 *a*, one of the polyps, enlarged; 3 *b*, a papilla, more enlarged.

Feejee Islands, in ten fathoms. *Exp. Exp.*

The specimen consists of a few simple branches, having the surface rather distantly tuberculate, the rounded, suberose tubers being large (two lines or more), and belonging to separate polyps. At the summits, which are but a line thick for an inch or so, and pale flesh-coloured, the verrucæ are small and short, and two to three lines apart. The habit of the species is very peculiar, and may be the type of a new genus, distinguished by the long fringe of papillæ to the tentacles.

NOTE.—The *Gorgonia nodulifera* of Lamarek, appears to be near the above species. It is thus described: “Ramoso-paniculata, planulata, ramis ramulisque alternis, noduliferis; carne aurantiâ, squammulosâ; nodulis alternis, albis, subspongiosis.”—Seas of New Holland, Peron and Lesueur, 2d ed., ii. 496, No. 25; Lamouroux, Pol. flex., 416; Encyc., 446.

56. GORGONIA EXSERTA. (*Ellis*).—Whitish; low, sparingly ramose; branches alternate, a line thick; polyps few, and three or four lines remote, alternate; verrucæ tuberculiform, but little prominent, a line broad; axis corneous, fuscous.

American seas. *Ellis*.

This species has the distant polyps and habit of the *trichostemma*, and the specimen figured by Ellis resembles much the extremities of the branches in that species.

*Gorgonia exserta*, Ellis and Sol., 87, pl. figures 1, 2; Pol. flex., 408; Encyc., 443.  
15, figs. 1, 2.

—, Lamouroux, Exp. Meth., pl. 15, —, Lamk., 2d ed., ii. 501, No. 35 *j*.

C. Cortex (including the verrucæ when present) exceeding half a line in thickness.

I. Surface smooth or very short verrucose.\*

57. GORGONIA ANTIPATHES.—Very large (three feet); paniculato-ramose, branches terete; cortex thick, smooth; oscules large; axis

\* This division corresponds to the genus *Plexaura*, of Lamouroux. The *G. suffruticosa* (No. 52), *G. spicifera* (54), and probably also the *G. ramulosa* (53), are near them in habit.

black, flexuously striate, of branchlets setiform, of base often one to two inches thick.

Indian Ocean.

This species has been confounded with a smaller one from the West Indies. The *Eunicea antipathes*, of Ehrenberg, is described by him from a specimen there obtained, and Esper's tab. 23 may be from the same region. Its very stout trunk and much larger size are the only distinguishing characters which can be drawn from the descriptions given. The upper branchlets are very slender.

A specimen belonging to Dr. Gould, at Boston, answers well to the characters of the above. It is between three and four feet high, with the axis at base nearly two inches thick, and in the upper branchlets, which are six to eight inches long, slender setiform. The *axils* in the axis, as in Seba's figure, are not broad; the cortex is cinereous, and the size of the branchlets covered with it is one-eighth of an inch, six inches from the summit. The oscules are minute points, in which it agrees with Esper's account of his tab. 24, though not with Pallas, who describes them as large.

- |   |  |
|---|--|
| <i>Corallium nigrum</i> , Rumph., Amb., 2016,<br>tab. 77. From the Moluccas.  | <i>Gorgonia antipathes</i> , Linn., ed. xii., 1291.<br>—, Pallas, Zooph., 193. "Oceanus<br>Indicus solus."                             |
| <i>Frutex marinus, prægrandis</i> , &c., Seba,<br>Thes. iii., tab. 104, No. 2. "From<br>Amboyna and the Moluccas." Crust<br>ash-coloured or reddish, and very de-<br>ciduous. The figure represents a den-<br>droid specimen, with nearly erect branch-<br>lets, and even top, about two feet high. | —, Esper, ii. 90, tab. 24, 25.<br>—, Lamk., ii. 502, No. 36.<br><i>Plexaura antipathes</i> , Lamour., Pol. flex.,<br>434; Encyc., 380. |

58. GORGONIA HOMOMALIA. (*Esper.*)—Much branched; branches terete, dichotomous, ascending and somewhat nodding; cortex thick, oscules scattered.

Mediterranean? *Esper.*—West Indies. *Lamarck.*

In Esper's figure (tab. 29), the branch is curved and the branchlets are crowded on the inner side of it; the size of the branchlets is three to four inches in length, and one and a half to two lines in thickness; the cortex is black, and the oscules are round points.

*β. cinerea.* Reddish, yellowish, or ash-coloured, and nearly or quite erect, branches and branchlets much crowded, of the same size as above-mentioned, with the oscules similarly small punctures and crowded; axis of the branchlets retiform and yellowish-brown; axils compressed; cortex thick and caducous.

*Gorgonia homomalla*, Esper, Pflanz., ii. 104, tab. 29.

—, Lamarck, 2d ed., ii. 497, No. 28.

*Plexaura homomalla*, Lamouroux, Pol. flex., 430.

—, Deslongchamps, Encyc., 629.

—, Blainville, Man., 509.

The var. *cinerea* is common in the West Indies. It is the *Lithophyton Americanum maximum cinereum*, cortice punc-

tato of Tournefort, Mém. de l'Acad. Roy. des Sci., 1700, fig. p. 34, and Inst., p. 574; also *Frutex cornea natura*, Seba, Thes. iii., tab. 107, No. 4; and *Plexaura antipathes*, Ehrenberg, op. cit., Gen. lxxxiii., sp. 3; probably, also, Esper, Pflanz., ii. 90, tab. 23. Lamarck alludes to the West India specimens as a reddish and ash-coloured variety of the *G. homomalla*.

59. GORGONIA ANGUICULUS. (*Dana*).—Fulvous; ramose dichotomous; branches terete, branchlets one and a half to two lines thick, long; surface scarcely smooth, a little pitted; oscules very much crowded, nearly circular, quite small; axis fuscous, of the branchlets, very slender; axils compressed.

West Indies.

This species is rather more slender than the *vermiculata*, and has very much smaller and more numerous oscules. The branches, although terete and without verrucæ, have a slightly and minutely uneven surface, owing to the fact that the oscules are either situated in a slight depression of the cortex, or have the inferior side a little prominent. The length of the branchlets is often six inches. One specimen seen by the author had a dull fulvous colour, and another was purplish.

*Plexaura flexuosa*, Lamouroux, Exp. Meth., 35, tab. 70, fig. 1; a fragment or young specimen, giving imperfectly the characteristics of the species.

*Eunicea furcata*, Ehrenberg, G. lxxxii., sp. 2.

60. GORGONIA OLIVACEA. (*Lamouroux*.) *Lamarck*.—Much branched; branches scattered or subpinnate; branchlets one to one and a half lines thick; cortex thick, olivaceous, oscules scattered.

East Indies. *Lamouroux*.

*Plexaura olivacea*, Lamouroux, Pol. flex., 431, pl. 16; Deslongch., Encyc., 629. *Plexaura olivacea*, Lamarck, 2d ed., ii. 504, No. 39 b.

61. GORGONIA QUINCUNCIALIS. (*Ehrenberg*.) *Dana*.—Dark ash or reddish; two feet high; dichotomously branched, branches suberect, flexuous, crowded, one and a half lines thick at summits, terete; surface a little verrucose (and therefore rough), verrucæ appressed, opening upward, two-thirds of a line long, and about one-third of a line broad; axis fuscous.

West Indies.

This species has the habit of the *flexuosa*, but its branches, though of nearly the same diameter, are longer, and the surface is more decidedly verrucose.

*Lithophyton longe racemosum*, &c., Catesby's Carolina, ii., tab. 21.

*Eunicea quincunciatis*, Ehrenberg, op. cit., Gen. lxxxii., sp. 16.

62. GORGONIA DICHOTOMA. (*Esper.*)—Furcato-dichotomous, two feet high, axils arcuate; branches terete, slightly attenuated; branchlets often a foot long, two to three lines thick; oscules linear, numerous; cortex a line thick, axis wood-brown and not flexible.

West Indies.

The axis of the branches is not slender setiform, as in the *antipathes* and *homomalla*, and at apex, even, is not flexible.

*Gorgonia dichotoma*, Esper, ii. 59, tab. 14; the axis of a specimen, wood-like in appearance, incrustated in part by an Alcyonium and a Millepora.

—, Lamarck, ii. 503, No. 37.

63. GORGONIA VERMICULATA. (*Lamarck.*)—Ramosa, one to two feet high, dichotomous; branches erect, long, terete; above nearly two to three lines thick; surface smooth, oscules large and round; axis black, axils not compressed.

West Indies? East Indies? *Lamarck.*

This species is a little larger than the *homomalla*, with the upper branchlets often longer and a little stouter, and having large round oscules. Though the size of the upper branches is scarcely larger than in the *dichotoma*, the axis which they contain is one-half smaller, and is flexible.

*Gorgonia vermiculata*, Lamarck, ii. 497, No. 29.

*Gorgonia friabilis* (?), Lamouroux, Exp. Meth., 35; East Indies.

*Gorgonia porosa* (?), Esper, ii. 49, tab. 10, East Indies?

Esper's figure represents a specimen supposed to be from the East Indies, with the large round oscules of the above, but the upper branchlets four to six inches long, three to four lines thick at base, and one and a half lines at apex.

A specimen in Peale's Museum, has long branches, nearly cylindrical, and above,

full a fourth of an inch thick, with the oscules large. The axis, a foot from the summit, is about a line in diameter. Another from the West Indies, in the collections of the Boston Natural History Society, has the upper branches often a foot long, about two lines thick above, and three at base.

There are probably two species here included, one from the West Indies, and another from the East Indies; the latter is the *Plexaura friabilis* of Lamouroux, and the *Gorgonia porosa* (tab. 10), of Esper.

64. GORGONIA CRASSA. (*Ellis*.)—Springly ramose, dichotomous, branches five to six lines thick, and often five inches long, nearly cylindrical; surface nearly smooth, oscules scattered, large and round, under margin sometimes prominent; axis corneous, pale fuscous.

West Indies. *Ellis*.

*Gorgonia crassa*, Ellis and Solander, 91. Ellis describes his specimen as of a purplish colour, and mentions that the polyps have eight fringed tentacles. He refers to no figure, but it seems quite probable that his figure 3, tab. 18, which is represented with the expanded polyps, and of which he has given no description, was drawn for this species. Very similar specimens from the West Indies have been seen by the author; one of a purplish colour, with the oscules wholly immersed, and another with the under margin slightly prominent. The cortex is about as thick as the diameter of the axis, and the whole from one-third to one-half an inch in diameter.

*Gorgonia multicauda*, Lamk., ii. 503, No. 38.

*Plexaura crassa*, Lamour., Pol. flex., 429; Deslongchamps, Encyc., 628.

The *Plexaura friabilis* of Lamouroux (Pol. flex., 430, and Deslongchamps, Encyc., 628), is stated by him to come from the East Indies, and to have a dull fulvous colour: but he refers to Ellis's tab. 18, fig. 3, as a representation of it. Lamouroux adds, as probable synonyms, Lamarck's *vermiculata*, and Esper's *porosa*, tab. 10.

The *Gorgonia heteropora* of Lamarck, is made identical with the *multicauda* by Milne Edwards (Lamarck, 2d ed., 503, No. 39); the oblong form of the oscules, and the smooth surface, being attributed to the more complete retraction of the polyps. It is characterized as follows by Lamarck: *G. ramosa, dichotoma, crassa; ramis cylindricis, raris; cortice crasso, poris oblongis, variè sitis, pertuso*. A specimen seen by the author in the collections of the Academy of Natural Sciences at Philadelphia, consisted of a few stout finger-like branches, four to five lines thick, and two and a half inches long, with the surface smooth and the oscules three-fourths of a line long, lying in every position.

*Eunicea turgida*, Ehrenb., G. lxxxii., sp. 22.

II.—*Verrucæ prominent (Euniceæ)*.

65. GORGONIA PAPILLOSA. (*Esper*.)—Whitish or yellowish; flabellate, branches flexuous or incurved, upper branchlets mostly two to two and three-fourths lines thick; surface crowdedly verrucose, verrucæ three-fourths of a line long and half a line broad.

West Indies?

*Gorgonia papillosa*, Esper., Fortsetz., tab. 50; also, possibly, *G. papillosa*, ii. 105, tab. 30 (on the plate it is named, by mistake, as Esper says, *G. suberosa*).—Esper compares the surface in the last species to that of the "*Madrepora muricata*," which agrees well with a specimen examined by the author, in which the crowded verrucæ

open upward and are subnariform, and the branchlets terminate in a large polyp; the verrucæ are unequal.

*Eunicea papillosa*, Ehrenberg, op. cit., Gen. lxxxii., sp. 3. "Esperi icon (tab. 50) bona; ramis ultimis cum polypis 2-2½'' crassis, verrucis ¾'' longis, ½'' latis, papillâ terminali superstructis."

*Eunicca microthela*, Lamouroux, Pol. flex., 435; Deslongchamps, Encyc., 380: "E. ramosa, subpinnata, ramis incurvatis; mamillis conicis subeminentibus, cortice friabili cretaceo."

NOTE.—The *Eunicca suberosa* of Ehrenberg is described from a West India specimen and reference made at the same time to Esper's tab. 30. "Semipedalis, isabellina, dichotoma, ramulosa, ramis brevibus, vix hipollicaribus, summis apice  $1\frac{1}{2}$ " crassis, ibique turgidulis, basi curvis, polypis densè sparsis, superficiem verruculosam reddentibus." He adds that the axis is corneoūs, and the cortex is two-thirds of a line thick and purplish within. It is not the *Gorgonia suberosa* of other authors, and appears to be the *Gorgonia calyculata* of Ellis, which is thus described: "G. dichotoma, ramulis crassis, arrectis; papillis truncatis; carne cinerascente, intus purpureâ, oculis majoribus, calyciformibus, confertis, sursum spectantibus; polypis octotentaculatis, cirratis; osse corneo subfusco."

66. GORGONIA CLAVARIA. (*Lamouroux.*) *Edwards.*—Somewhat fuscous; ramose, very stout; branches subterete, clavato-elongate, five to ten lines thick; verrucæ unequal, aperture one line broad.

West Indies.

Lamouroux mentions a specimen of this species seven inches high, having the branches about an inch thick. The verrucæ in Ellis's figure are one and one-fourth lines broad and the same in length.

Ellis and Solander, tab. 18, fig. 2.

—, Blainville, Man., 507.

*Eunicca clavaria*, Lamour., Pol. flex., 437;

—, Ehrenb., G. lxxxii., sp. 20.

Exp. Meth., 36, pl. 18, fig. 2; Encyc., 381.

*Gorgonia clavaria*, Lamk., 2d ed., ii. 505, No. 42 a.

67. GORGONIA PSEUDO-ANTIPATHES. (*Lamarck.*)—Somewhat fuscous; one foot in height; ramose, dichotomous; branches ascending, four to five lines thick, terete, not attenuate; surface of cortex verrucose, verrucæ stout, one line long, and two-thirds broad, opening upward, outer lip prolonged and often a little incurved.

West Indies.

The verrucæ are set on the branches like the calicles of a Madre-pore. The cortex is about a line thick and very dark brown in the dry state. The axis is black. The branches are often nearly in a plane.

*Gorgonia pseudo-antipathes*, Lamk., ii. 504, No. 40.

*Gorgonia succinca?* Esper, Fortsetz., i. 163, tab. 46. Resembles a flabellate specimen seen by the author, except that

*Eunicca pseudo-antipathes*, Lamour., Pol. flex., 437; Encyc., 381.

it is a little more slender, and the verrucæ appear in the figure to open outward instead of upward.

*Eunicca succinca*, Ehrenb., G. lxxxii. sp. 21.

68. GORGONIA MADREPORA. (*Dana.*)—Pale, five inches high;



sparingly ramose; branches four to five lines thick, elongate, with the surface strongly verrucose, verrucæ numerous, subcylindrical, standing nearly erect upon the surface, three-quarters of a line thick, and one to one and a quarter long; cortex very thick; the corneous axis hardly a line broad, black.

West Indies. *Philad. Acad. Nat. Sci.*

The perpendicular verrucæ distinguish this species from the *pseudo-antipathes*; the summit-polyp is much broader than the others.

69. GORGONIA PLANTAGINEA. (*Lamarck*).—Fuscous; ramose, stout, erect; branches terete, echinulate; cortex spongy, verrucæ conical, erect, much crowded.

West Indies? *Lamarck*.

*Gorgonia plantaginea*, Lamk., ii. 505, No. 41. *mollis*, Lamour., Pol. flex., 436; Encyc., 381. "E. teres, dichotoma, ramis flexuoso-recurvatis, implexis; cortice spongioso, fusco; mammillis numerosis, marginibus laceris." Mediterranean.

*Gorgonia succinea?* Esper, Fortsetz., i. 163, tab. 46.

*Gorgonia mollis?* Gmel., Syst. Nat., 3799. Olivier, Zool. Adriat., 233. *Eunicea*

70. GORGONIA LIMA. (*Lamarck*).—Whitish; ramose, dichotomous; branchlets two and a half lines thick; verrucose, verrucæ slender, very densely crowded; axis corneous, black, compressed at the axils.

West Indies. *Tournefort. Lamarck*.

*Lithophytum Americanum*, &c., Tournefort, Mém. de l'Acad. Roy. des Sci., 1700, p. 34, plate 1; also, Inst., 574. *Eunicea limiformis*, Lamour., Pol. flex., 436; Exp. Meth., 36; Encyc., 380; figure 1, plate 18, in Exp. Meth., we have referred to the *M. placomus*.

*Gorgonia muricata*, Esper, ii., tab. 8.

*Gorgonia lima*, Lamk., ii. 505, No. 42.

71. GORGONIA MAMMOSA. (*Lamouroux*). *Edwards*.—Eight inches; ramose, subdichotomous; verrucæ terete, one to three lines long, imbricate.

West Indies.

*Eunicea mammosa*, Lamour., Pol. flex., 438; Exp. Meth., 36, pl. 70, fig. 3; Encyc., 381. *Gorgonia mammosa*, Lamk., 2d ed., ii. 506, No. 42 b.

—, Blainv., Man., 507, pl. 87, fig. 4. *Gorgonia muricata* (?), Esper, tab. 39 A.

D. Unarranged species.

72. GORGONIA PURPUREA.—Violaceous, subdichotomous, branches divaricate, virgate, subverrucose.—Pallas, Zooph., 187; Lamarck, 2d ed., ii. 501, No. 35 m; Lamouroux, Polyp. flex., 416; Encyc., 446.



73. GORGONIA RICHARDIL. (Lamouroux.)—Yellowish, much branched; branches scattered or sublateral, a little flabellate; axis irregular, sometimes compressed, sub-suberose, white; cortex thin, verrucæ conical, half a line high. West Indies.—Lamour., Pol. flex., 407; Encyc., 443; Lamk., 2d ed., ii. 501, No. 35 i.

74. GORGONIA PENNA. (Lamarck.)—Whitish, eight to ten inches high, lax-ramose, complanate; branches furcate, pinnate, pinnules distichous, crowded, filiform, surface remotely verrucose, verrucæ ascending, bifarious. From New Holland.—Peron & Lesueur, Lamk., ii. 508, No. 47, states that it resembles a large whitish plume-like Sertularia. Lamour., Pol. flex., 418; Encyc., 446.

75. GORGONIA MONILIFORMIS. (Lamarck.)—Whitish, simple, filiform, erect; verrucæ prominent, umbilicate at apex, somewhat scattered; cortex very thin. From New Holland.—Lamk., ii. 496, No. 24; Lamour., Pol. flex., 420; Encyc., 447.

76. GORGONIA COCCINEA. (Lamouroux.)—Ramose; branches short, scattered, chladoniiform; cortex scarlet; Australian seas.—Lamour., Pol. flex., 423; Encyc., 447; Lamarck, 2d ed., ii. 502, No. 35 p.

77. GORGONIA RHIZOMORPHA. (Lamouroux.)—Ramose; branches scattered, elongate, like the fibres of a root; cortex brown, axis subcorneous. Near Bayonne.—Lamouroux, Pol. flex., 401; Encyc., 441; Lamk., 2d ed., ii. 500, No. 35 c.

78. GORGONIA ALBA. (Lamarck.)—Ramose; subcompressed; branches subpinnate, erect; branchlets terete; cortex white, oscules scattered.—Lamk., ii. 499, No. 33; Lamouroux, Encyc., 445.

SUBGENUS III.—MURICEA.

*Gorgonia, polypis retractis, verrucosæ, verrucis per spicula aut squamas armatis, fixis.*

Verrucose, in the retracted state of the polyps, the verrucæ armed with spicula or scales, and not movable.

Arrangement of the Species.

I. *Verrucis spiculo-armatis.*

\*79. G. Mur. spicifera.

\*80. G. Mur. elongata.

\*81. G. Mur. placomus.

82. G. Mur. cerea.

II. *Verrucis squamulo-armatis.*

83. G. Mur. verticillaris.

84. G. Mur. myura.

79. G. MURICEA SPICIFERA. (Lamouroux.)—Pale, a foot high; fruticose, with the branches much compressed, and three to four lines

broad, and branchlets subcompressed; surface crowdedly covered with armed subimbricate verrucæ; axis black, throughout very much flattened and two-edged, axils broad.

West Indies.

The axis of the branchlets is one-fourth to half a line wide, and very thin, or two-edged. The verrucæ are a little longer than in the *elongata*.

*Gorgonia muricata*, Ellis and Solander, 82. The specimens are generally less stout above than represented by Lamouroux, and the verrucæ, when dried, often have a different form.

—, Lamarck, ii. 506, No. 43.

*Eunicea muricata*, Lamour., Pol. flex., 439.

*Muricea spicifera*, Lamour., Exp. Meth.,

36, tab. 71, figs. 1, 2; Encyc., 558. —, Ehrenberg, G. lxxxi., sp. 3.

*Gorg. muricata*, var., Esper ii., tab. 39. The verrucæ are a little too large, but the enlarged drawings are not unlike some specimens seen by the author.

The *Gorgonia laxispica* of Lamarck (ii. 507, No. 44), is described as follows: "G. ramosa, ramis spicæformibus, longiusculis, laxè muricatis; papillis cylindricis, arrectis." Milne Edwards adds that it is very near the *muricata*, but with more slender verrucæ, which are less decidedly armed with spicula, and have a more distinct bilabiate opening.

80. G. MURICEA ELONGATA. (*Lamouroux*.)—Sulphur yellow; a foot high; fruticulose, ramulous, but not in a plane; branchlets nearly terete, one and a half lines broad, obtuse, elongate, verrucose; verrucæ much crowded, imbricate, scarcely a line long.

West Indies.

*Muricea elongata*, Lamour., Exp. Meth., 37. —, Blainville, Man., 509.

pl. 71, figs. 3, 4; Encyc., 559.

*Gorgonia virgata*, Lamk., ii. 506.

The *Muricea sulphurea* (?), Ehrenb., G. lxxxi., sp. 4. A young specimen? It is described as follows: "5'' lata, 3'' alta, minor, gracilior (quam *spicifera*), fruticulosa, densè ramulosa, nec flabellata, sulphurea, ramis teretiusculis, papillosis, 1½''' latis, obtusis, papillis paulo brevioribus, nec angustioribus, spiculis sulphureis, appressis." Locality unknown.

81. G. MURICEA PLACOMUS. (*Linn.*) *Ehrenberg*.—Cinereous or fuscous, large, flabellate, much ramose; branches flexuous, sometimes coalescing, one and a half to three lines thick, strongly verrucose, verrucæ three-fourths of a line broad and high, divaricate, and laxly arranged; surface armed, closed at summit by a calyptra made of eight convergent spicula; axis brownish, axils scarcely compressed.

Mediterranean Sea (?). Norwegian Sea.

The flexuous branchings, rough and uneven, from the irregularly crowded spinulous verrucæ standing nearly at right angles with the surface, have a very peculiar aspect. The verrucæ are either coni-

cal, or nearly cylindrical; the extremity is circular, and set about by minute spicules, like those of the sides, which encircle the depressed calyptra, the cover to the terminal opening.

- Ellis and Solandër, tab. 18, fig. 1; without description. This figure is referred by Lamouroux, to the *Gorgonia lima* (p. 672); yet in that species the polyps are not, as here represented, at right angles with the stem. Esper suggests, with much appearance of reason, that it may represent this species.
- Gorgonia placomus*, Linn., ed. xii., 1290.  
 —, Pallas, Zooph., 201.  
 —, Esper, ii., tab. 33, 34, and 34 A.
- , Lamk., ii. 492, No. 14; according to Edwards, Lamarck's description pertains to the *G. verrucosa*, and his *Gorg. granifera* is the above species.  
 —, Lamouroux, Encyc., 443.  
*Muricea placomus*, Ehrenb., G. lxxxi., sp. 1.  
 The *Muricea calyptrata* of Ehrenberg (sp. 2) is a doubtful species, near the *placomus*, but with more slender branches, smaller polyps, and more obtuse verrucæ. He refers to Esper's tab. 34 A.

82. *G. MURICEA CEREÆ*. (*Esper.*) *Ehrenberg.*—Low, slender, fruticulose, subflabellate, covered every where with spreading, reddish spicula; branches nearly terete, rather broader than a line, obtuse; polyps densely and throughout scattered, yellow above, one-third of a line in breadth.

East Indies. *Esper.*

*Gorgonia cerea*, Esper, Fortsetz. i., tab. 47. *Muricea cerea*, Ehrenb., G. lxxxi., sp. 5.

83. *G. MURICEA VERTICILLARIS.*—Ramosæ, flabellate, one and a half feet high; branches pinnate; pinnules setaceous; verrucose, verrucæ ascending, incurved, verticillate, less than a line long.

Mediterranean Sea.

The verrucæ are scattered or opposite on the smaller branchlets, but verticillate below, in whorls, generally of four. They are usually incurved with the extremity pointing nearly towards the branch.

- Ellis's Corallines, tab. 26, fig. s, t, v. —, Lamk., ii. 507, No. 46.  
*Gorgonia verticillaris*, Linn., ed. xii., 1289. —, Lamour., Pol. flex., 417; Encyc., 446.  
 —, Pallas, Zooph., 177. *Primnoa verticillaris*, Ehrenb., G. lxxx.,  
 —, Esper, Fortsetz., i. 156, tab. 42. sp. 2.  
 —, Ellis and Solander, 83.

Ehrenberg describes an allied species as follows, referring with a query, to Esper's tab. 42. "*Primnoa flabellum.*—Sesquipedalis, gracilis, dichotoma, densè ramosa, flabelliformis, virgata, flavicans, polypis laxius imbricatis, verticillis sæpe irregularibus, polypis singulis quadrifarian (!) scutatis, seriebus transversis 10, ultima majore, ut in *lepadifera.*" Esper, in his description, states that the whorls, in his specimen, contained but six polyps.

84. *G. MURICEA MYURÆ*. (*Lamarck.*)—Whitish; simple, filiform,

caudate; surface verrucose, the verrucæ scattered, often bifarious, oblong ascending, subpyriform, incurved, cortex thin.

*Gorgonia myura*, Lamarck, ii. 508, No. 48. *Gorgonia myura*, Lamour., Pol. flex., 420; Encyc., 447.

NOTE.—Ehrenberg also refers to this genus the *Gorgonia retellum*.

GENUS V.—PRIMNOA.—LAMOUROUX.

*Gorgonidæ, axe inarticulato; polypis contractis elongato-verruciformibus et basi flectentibus, latere per squamas imbricatas armatis.*

Gorgonidæ secreting an inarticulate axis; polyps, when contracted, long verruciform, and having motion at base; their sides armed with imbricate scales.

This genus was instituted by Lamouroux on the ground of the imbricately squamous character of the verrucæ. Ehrenberg united to the species so called by Lamouroux, others less regularly imbricate, which are here excluded, by adding as a characteristic the apparently important peculiarity, that the verrucæ admit of motion at base. They are usually reflexed upon the stem; but Esper has figured a specimen in which they were erect.

PRIMNOA LEPADIFERA. (*Linnæus.*) *Lamouroux.*

*P. laxè ramosa, dichotoma, subflabellata; verrucis elongatis (2½–3''), subpyriformibus, per valvulos octo clausis; ramorum axe testaceo, ramulorum corneo.*

Lax ramose, dichotomous, subflabellate; verrucæ long (2½ to 3 lines), subpyriform, closed by 8 scales; axis of the branches testaceous; of the branchlets corneous.

Seas of Northern Europe.

*Gorgonia lepadifera*, Linn., ed. xii., 1289. —, Esper, ii. 71, tab. 18.  
—, Ellis and Sol., 84, tab. 13, figs. 1, 2. —, Lamarck, ii. 507, No. 45.

- , Johnston's Brit. Zooph., 185. —, Deslongchamps, Encyc., 656.  
*Gorgonia reseda*, Pallas, Zooph., 204. —, Fleming, Brit. Anim., 513.  
*Primnoa lepadifera*, Lamour., Pol. flex., —, Blainv., Man., 510, pl. 87, fig. 6.  
 442; Exp. Meth., 37, pl. 13, figs. 1, 2. —, Ehrenberg, G. lxxx., sp. 1.

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 GENUS VI.—BEBRYCE.—PHILIPPI.

*Gorgonidæ axe inarticulato corneo; polypis grandibus, remotis, non retractilibus.*

Gorgonidæ having an inarticulate corneous axis; polyps large and not retractile.

 BEBRYCE MOLLIS. (*Philippi.*)

*B. dendroideum; polypis remotè sparsis; cortice spongioso.*

Arborescent; polyps remotely scattered; cortex spongy.

Mediterranean Sea. *Philippi.*

*Bebryce mollis*, Philippi, Wieg. Arch., viii. 35.

The description appears to ally the species to the *G. exserta* of Ellis, and the *G. trichostemma*; but the latter, and probably the former, has *retractile* polyps.

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 SUBFAMILY III.—ISINÆ.

*Gorgonidæ axem articulatum elaborantes.*

Gorgonidæ forming a jointed axis.

## GENUS I.—MOPSEA.—LAMOUROUX.

*Isinæ articulis corneis et calcareis alternis instructæ, e internodiis corneis ramosæ; cortice tenui.*

Isinæ having the joints alternately calcareous and corneous; ramose, with corneous axils; cortex thin.

The Mopseæ are slender fragile species, with a thin cortex. The calcareous joints are long and smooth, while the corneous, which constitute the axils of the branching zoophyte, are short. The formation of the latter is connected with the periodical development of buds which occasions the branching, corneous basal secretions taking place at that time.

This genus was separated from Isis by Lamouroux; but Ehrenberg first mentioned the important characteristic of the group,—the fact of the species branching from the *corneous* joints, instead of the calcareous, as in the species of Isis.

*Arrangement of the Species.*

- |                          |                        |
|--------------------------|------------------------|
| *1. <i>M. dichotoma.</i> | 3. <i>M. gracilis.</i> |
| 2. <i>M. encrinula.</i>  | 4. <i>M. erythræa.</i> |

1. MOPSEA DICHOTOMA. (*Pallas.*) *Lamouroux.*

*M. 5'' alta; ramosa, dichotoma, ramulis 1''' crassis, articulis lapideis latere compressis, aut subcylindricis; caule 3''' crasso.*

Five inches high; ramose, dichotomous, branchlets 1 line thick; calcareous joints laterally compressed or subcylindrical; main stem 3 lines thick.

## Indian Ocean.

- |   |  |
|---|--|
| <i>Hippuris coralloides carnea Cupensis, geniculis limosis, Pettiveri, Gazoph., 7, Tab. 3, fig. 10.</i> | <i>Isis dichotoma.</i> Schweigger's Handb., 434.                     |
| <i>Isis dichotoma, Pallas, Zooph., No. 143.</i>   | —, Lamk., ii. 475, No. 3.  |
| —, Linn, ed. xii., 1287.  | <i>Mopsea dichotoma,</i> Lamouroux, Pol. flex., 467; Exp. Meth., 38. |
| —, Esper, i. 43, tab. 5; the calcareous joints are about half an inch long.                             | —, Deslongchamps, Encyc., 558.                                       |
|   | —, Ehrenberg, G. lxxviii., sp. 1.                                    |

2. MOPSEA ENCRINULA. (*Lamarck.*) *Ehrenberg.*

*M. subbipinnato-ramosa, ramulis filiformibus, verrucosis, verrucis sparsis ascendentibus, interdum verticillatis.*

Ramose, subbipinnate; branchlets filiform, verrucose; verrucæ scattered, ascending, sometimes verticillate.

Seas of New Holland. *Peron & Lesueur.*

*Isis encrinula*, Lamk., ii. 476, No. 4.

—, Deslongchamps, Encyc., 557.

*Isis dichotoma*, Schweig., Handb., 434.

*Mopsea encrinula*, Ehrenberg, G. lxxvii.,

*Mopsea verticillata*, Lamouroux, Pol. flex., sp. 2.

467, pl. 18, fig. 2; and Exp. Meth., 39.

3. MOPSEA GRACILIS. (*Lamouroux.*) *Ehrenberg.*

*M. basi explanata, laciniata, caulium nodis calcareis paulum crassis, ramorum elongatis, translucidis, lævibus, albis.*

Explanate at base, lacinate; calcareous joints of stem a little stout, those of the branches very long, translucent, smooth, white.

The Antillas. *Lamouroux.*

*Isis gracilis*, Lamour., Polyp. flex., 477,

—, Lamk., 2d ed., ii. 476, No. 6.

pl. 18, fig. 1.

—, Blainville, Man., 503.

—, Deslongchamps, Encyc., 466.

4. MOPSEA ERYTHRÆA. (*H. & Ehrenberg.*)

*M. dichotoma, fruticulosa, verrucosa, coccinea; articulis cortice obductis, geniculo vix angustioribus, ramis in geniculis flexilibus; decorticatâ, articulorum lapideorum axe teretiusculo, longitudinaliter sulcato, geniculis paulum tumidis; tentaculis ramulosis, niveis.*

Dichotomous, fruticulose, verrucose, scarlet; joints concealed by the cortex; scarcely narrower at the geniculations; branches flexible at the geniculations; calcareous joints of the axis somewhat terete,



longitudinally sulcate; geniculations a little tumid; polyps with the tentacles ramulous, white.

Red Sea. *Ehrenberg*.

This description is from Ehrenberg. He mentions that the species is an elegant one when alive, though but two inches in height.

*Mopsea erythraea*, Ehrenberg, G. lxxviii., *Isis erythraea*, Lamarck, 2d ed., ii. 477, sp. 3. No. 7.

APPENDIX.—The *Isis coralloides* of Lamarck may belong to this genus. It is thus described by this author (sp. 5): “*I. ramosa, disticho-ramulosa, rubens; ramulis remotis, breviusculis, cortice papillis, raris, ascendentibus.*” From the “Austral seas.”—*Peron & Lesueur*.

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GENUS II.—ISIS.—LINNÆUS.

*Isinæ articulis corneis et calcareis alternis instructæ, e nodis calcareis ramulosæ; cortice crasso, deciduo.*

Isinæ, consisting of corneous and calcareous joints alternately; branches proceeding from the calcareous joints; cortex thick, deciduous.

The crust of these species is so deciduous that it is rarely seen in collections, although the corals are not uncommon.

This genus, as instituted by Linnæus, contained the genus *Coralium* as well as *Mopsea*.

ISIS HIPPURIS. (*Linneus*.)

*I. parce ramosa, ramis crassis, axe calcareo albo, valde sulcato.*

Sparingly ramose, branches stout; calcareous joints of the axis white, strongly sulcate.

East Indies.

- Accarbarium album*, Rumph., Amb., 6, —, Ellis and Sol., 105, tab. 3. figs. 1-5.  
tab. 84. —, Esper, i., 33, tab. 1 to 3.
- Corallium cinereum*, Battarra, Mus. Richt., —, Lamour., Pol. flex., 475; Exp. Meth.,  
i., 170, tab. 42, fig. 5. 39, pl. 3; Encyc., 466, figs. 1-5.
- Corallium nodosum*, &c., Baster, Op. Sub- —, Lamk., ii. 475, No. 1.  
scev., Lib. i., 46, tab. 6, fig. 1. —, Schweig., Handb., 434.
- Isis hippuris*, Linn., ed. xii., 1287. —, Blainv., Man., 503, pl. 86, fig. 1.
- , Pallas, Zooph., 233. —, Ehrenb., G. lxxix., sp. 1.

ISIS (?) ELONGATA. (*Esper.*)

*I. rubra, laxè ramosa, ramis teretibus, axis articulis lapideis valde elongatis, striatis, internodiis brevissimis.*

Red, lax ramose, branches terete; calcareous joints of the axis much elongate, striate; internodes very short.

This is a very neat and slender species, with long joints, and short internodes. It has the general habit of a Mopsea. According to Risso's figure, the polyps are long exsert and not retractile, forming thus slender elongate verrucæ. The closed polyps are represented as mostly reversed on the stem, nearly as in the Primnoa. The cortex becomes dark brown on drying.

Near Naples, Mediterranean. *Philippi.*

- Frutex marinus*, &c., Seba, Thes., tab. *Isis elongata*, Lamarck, ii. 475, No. 2.  
106, No. 4. The figure represents a —, Blainville, Man., 503.
- specimen with slender graceful branches *Mopsea mediterranea*, Risso Merid. Eu-  
nearly a foot in height. rope, 332. This species is referred here  
by *Isis elongata*, Esper, i., 47, tab. 6. by Philippi.
- , Lamour., Pol. flex., 477; Encyc., 466.

## GENUS MELITÆA.—LAMOUROUX.

*Isinæ articulis calcareis et suberosis alternis instructæ.*

Isinæ, consisting of an alternation of calcareous and suberose joints.

The species of Melitæa are mostly of bright colours, either yellow, orange, scarlet, or crimson, and all these colours are met with in the same species. They are very fragile, the branches breaking easily at the internodes, which have a texture something like cork.

*Arrangement of the Species.*

\*1. *M. ochracea.*

\*3. *M. coccinea.*

2. *M. retifera.*

\*4. *M. tenella.*

1. MELITÆA OCHRACEA.

*M. maxima, ramosissima, plerumque in plano fere arborescens, ramis et ramulis suberectis, non coalitis.*

Large, much branched, generally arboriform nearly in a plane; branches and branchlets suberect, not coalescing.

East Indies.—Feejee Islands, of crimson and orange colours. *Exp. Exp.*

This species grows to a height of three feet or more, and occurs both of crimson, pale yellow, and orange colours, the latter often having minute crimson verrucæ or dots. At base the trunk is sometimes nearly two inches through, while the branchlets are delicate and slender, breaking easily.

Seba, Thes. iii., tab. 104, No. 1.

*Melitæa ochracea*, Lamour., Pol. flex., 462.

*Isis ochracea*, Linn., ed. xii., 1287.

—, Schweig., Handb., 434.

—, Pallas, Zooph., 230.

—, Lamarck, ii. 472, No. 1.

—, Ellis, Phil. Trans., vol. xi., abridg., p. 109; Ellis and Solander, 105.

—, Deslongchamps, Encyc., 512.

—, Esper, i., 38, tab. 4 and 4 A, and

—, Blainv., Man., 504, pl. 86, figs. 3,

Fortsetz., *Isis*, tab. 11; represent well the different varieties.

3 a, 3 b—not good.

—, Ehrenberg, G. lxxvii., sp. 1.

2. MELITÆA RETIFERA.

*M. flabelliformis, in plano ramulosa, ramis suberectis flexuosis, ramulis sæpe subreticulatim coalitis, creberrimè verrucosis.*

Flabelliform, much branched in a plane; branches suberect and flexuous, branchlets often subreticulately coalescing, thickly verrucose.

East Indies. *Peron & Lesueur.*

The colours of this species are various, but mostly some bright shade of red or yellow.

*Isis aurantia*, Esper, Forts., ii., *Isis*, tab. 9.

*Melitæa retifera*, Lamk., ii. 472, No. 2.

—, Lamour., Pol. flex., 463.

—, Blainville, Man., 504.

—, Ehrenb., G. lxxvii., sp. 2.

The *Melitæa textiformis*, of Lamarck (No. 3), is thus described: "M. caule brevi,

nodoso, in flabellum tenuissimum explanato; ramulis numerosis, filiformibus, reticulatim coalescentibus; catenarum annulis elongatis." "Austral Seas. *Peron and Lesueur.*" See Lamouroux, Exp. Meth., pl. 71, figure 5. A variety of the *retifera*?

### 3. MELITÆA COCCINEA.

*M. pumila*, in plano ramulosa, ramis gracilibus (1'''), tortuosis, divaricatis, sæpe reticulatim coalitis, internodiis obsoletis; verrucis subsparsis.

Small, branching in a plane; branches slender (1 line thick), tortuous, divaricate, often reticulately coalescing; internodes obsolete, verrucæ rather remotely scattered.

This species much resembles the *retifera*, but differs, according to Lamarck, in having the verrucæ less prominent and not so crowded. Specimens in the Expedition collections, from New Holland, present yellow, buff, rose-red, and scarlet colours.

Indian Ocean.—New Holland. *Exp. Exp.*

*Isis coccinea*, Ellis and Sol., 107, tab. 12, fig. 5.

—, Esper, i., *Isis*, tab. 3 A, fig. 5, (copy from Ellis), and Forts. ii., *Isis*, tab. 10.

*Melitæa Rissoi*, Lamour., Pol. flex., 463; Exp. Meth., 38, pl. 12, fig. 5.

*Melitæa coccinea*, Lamk., ii. 473.

—, Blainville, Man., 504.

—, Ehrenberg, op. cit., G. lxxvii., sp. 3.

### 4. MELITÆA TENELLA. (*Dana.*)

*M. fruticulosa*, 3'' alta, coccinea; ramulosa, ramis ramulisque gracil-

*limis, passim 1'' minoribus, flexuosis, articulis, 3-8'' longis; cortice verrucoso, verrucis parvulis ( $\frac{1}{8}$ ''), et minimè ascendentibus; polypis lætè flavis; axe calcareo fere levi.*

Fruticulose, 3 inches high; deep scarlet; much branched, branches and branchlets very slender, in no part a line thick, flexuous; joints 3 to 8 lines long; cortex verrucose, verrucæ small ( $\frac{1}{8}$  of a line broad), not at all ascending; polyps bright yellow; calcareous axis nearly smooth.

Sandwich Islands.

This species is much more slender than the preceding, and the branches are not in a plane, and rarely coalescent. The axis is pale red. The stem at base is hardly three-fourths of a line thick, and the axis of the same is less than half a line.

## ORDER II.—HYDROIDEA.

*Zoophyta ventriculo tubuliformi simplicissimo; ovulise lateribus externe nascentibus.*

Zoophytes having a simple tubular visceral cavity; ovules growing externally from the sides.

In Chapter III., the general characteristics of the Hydroidea have been stated, and in the Classification, on pages 116 to 119, the principal divisions in their arrangement are given. The characteristics of the genera are here added, and some few species described, which were obtained by the Expedition.

## FAMILY I.—HYDRIDÆ.

*Hydroidea, gemmis maturis deciduis; ovulis singulis, lateralibus; tentaculis tubulatis.*

Buds deciduous when mature; ovules single, lateral; tentacles tubular.

This family contains the single genus *Hydra*. Of all zoophytes, these were the earliest studied; and the famous works of Trembley and Baker have afforded perhaps more amusement and surprise to their readers than any other details in natural science ever published. Van Beneden has pointed out, as a distinguishing characteristic between them and the Tubularidæ, that the tentacles are tubular, and the cavity communicates directly with the internal cavity of the ani-

mal. These organs are somewhat warty, and, as shown by Corda, the warts, which are arranged spirally around them, are furnished with short bristles, and an exsertile dart, used, as is supposed, for securing their prey.

FAMILY II.—SERTULARIDÆ.

*Hydroidea gemmis persistentibus; polypis sessilibus; ovulis pluribus vesiculo inclusis, lateralibus.*

Buds persistent; polyps sessile; ovules included in a vesicle, lateral.

The species of this family are distinct from the Campanulariæ, in having the calicles without pedicels, and forming, to the naked eye, a denticulate edging to the delicate branchlets. The latter also differ in their modes of developement, in which respect they are near the Tubularidæ.

The following are the characteristics of the genera :

I. *Polyps in one series, branches therefore secund.*

1. ANTENNULARIA. (Lamarck.) *Not plumose. Calicles tubular or campanulate.*

2. PLUMULARIA. (Lamarck.) *Plumose, pinnate, or decompound pinnate.*

II. *Polyps in two series.*

a. *Series uninterrupted.*

3. SERTULARIA. *Calicles urcolate; attached at base, with the summits more or less free.* This genus includes the Dynamene, of Lamouroux, which was instituted for species having the cells opposite, instead of alternate.

4. THUIARIA. (Fleming.) *Calicles attached by one side as well as at base, not free at apex.* This genus is the Biseriaria, of Blainville, a name substituted by that author for Fleming's.

5. THOA. (Lamouroux.) *Calicles very short tubular or campanulate.* The habit of the Thoa, as suggested by Milne Edwards, is much like that of the Campanulariæ, and it may belong to the following family.

b. *Polyps in successive groups, arising from a periodicity in budding.*

6. PASYTHEA. (Lamouroux.)

ANTENNULARIA CYATHIFERA. (*Dana.*)

*A. simplex, recta, semipollicaris; polypis subremotis, caliculis latè eleganterque campanulatis, margine integro, duabus caliculis intermediis obsolescentibus.*

A simple, erect, filiform stem, half an inch high; polyps subremote; calicles elegantly broad-campanulate, with the margin entire; two rudimentary calicles intermediate.

Plate 61, figure 5, zoophyte, unexpanded, enlarged; 5 *a*, same, natural size. Also, figure 9, page 25.

Balabac Passage, East Indies. *Exp. Exp.*

The calicles are neat goblet-shape, with the breadth nearly equal to the length, and the mouth slightly flaring. They are attached to successive joints of the stem, which are oblong, with very oblique articulations. Between them, there are two small appendages, resembling rudimentary calicles. Either side of each calicle there is an oblong slender process having a club-shape head standing out quite free from the polyp. The figure was made from the living zoophyte, though unexpanded.

The genus *Antennularia* is usually characterized as having verticillate branches; but it may be questioned whether this is properly a generic character.

SERTULARIA MIMOSA. (*Dana.*)

*G. plumiformis, 3½" alta, pinnulis fermè 4" remotis et 9" longis, caliculis parcè prominulis; polypis longissimè exsertis, gracilibus, tentaculorum serie valde obliquo, elliptico, tentaculis capillaribus, apice recurvis.*

Neat plumiform, 3½ inches high, pinnules about 4 lines distant, and 9 lines long, calicles short, and sparingly prominent; polyps very long, exsert, and slender, with the circlet of tentacles placed obliquely, elliptical; tentacles capillary, recurved at apex.





Plate 61, fig. 6, zoophyte, natural size, partly in outline; 6 *a*, one of the polyps, expanded, and another contracted, natural size.

The Feejee Islands. *Exp. Exp.*

The oblique circlet of tentacles and very exsertile polyps appear to point to a different genus from the ordinary Sertulariæ. The outer tentacles of the circle were a little longer than those on the inner side, and the apices of the latter were hardly recurved. The breadth of the plume was about one and a half inches; the pinnules were placed alternately, and the rachis was correspondingly a little zigzag. The plate represents the zoophyte as it was figured on the spot, untouched since, as the specimen was afterwards misplaced.

PASYTHEA GRACILIS. (*Dana.*)

*P. sex polyporum acervis seriatis instructa; caliculis extus spectantibus, basi non inflatis.*

Polyps in successive clusters of six; calicles opening outward, not inflated at base.

Fig. 11, page 25, zoophyte, enlarged.

Gulf-weed, Atlantic Ocean. *Exp. Exp.*

This little species is near the *quadridentata* of Lamouroux, but has six, instead of four, polyps to each cluster, and the calicles are not enlarged below. It was obtained and figured by Dr. C. Pickering.

FAMILY III.—CAMPANULARIDÆ.

*Hydroidea gemmis persistentibus, polypis elongato-tubulatis, caliculis pedicellatis; reproductione, Tubularidis affinia.*

Hydroidea with persistent buds; polyps long-tubular, calicles pedicellate; in modes of reproduction near the Tubularidæ.

The structure of the Campanulariæ has been investigated with great skill and minuteness by Van Beneden. He has ascertained their close relation to the Tubularidæ, and their identity with the species of that family in modes of reproduction, and is inclined to associate the two groups in one.

The family includes two genera, as follows:

CAMPANULARIA. (*Lamarck.*)—Polyps budding from an ascending shoot or stolon, erect, or climbing.

LAOMEDEA. (*Lamouroux.*)—Polyps alternately arranged, and zoophyte having its branches usually zigzag.

LOMEDEA GRACILIS. (*Pickering.*)

*L. caulibus 6-8'' altis, et stolone filiformi surrectis, optimè ziczac flexuosis; caulibus juxta axillas penduculisque annulatis; caliculis campanulatis; vesiculis elongato-ovatis, infra suprâque attenuatis, et apice truncatis colloque brevi terminatis.*

Stems 6 to 8 lines high, and rising from a creeping stolon, regularly zigzag in form; the stem for a short distance above the axils, and the pedicels, ringed; calicles campanulate; vesicles oblong-oval, tapering above and below, and truncated at apex, with a short neck.

Plate 61, fig. 7, zoophyte, enlarged; 7 *a*, natural size; 7 *b*, polyp, partly expanded.

Gulf-weed, Atlantic, lat. 34° 39' N., long. 72° 01' W.—*Exp. Exp.*

This species is near the *geniculata*; but the vesicle is not abruptly enlarged immediately below the short neck which surrounds the aperture. "The average length of the pedicels was about  $\frac{1}{16}$  of an inch, and of the cells  $\frac{1}{16}$  of an inch; the outer shell was diaphanous and apparently entirely membranous; tentacles as many as twenty. A distinct, rapid current of globules was perceived in the main axis of one of the stems." *C. Pickering.*

LAOMEDEA SIMPLEX. (*Dana.*)

*L. caule fere rectâ, pedunculis non annulatis, tubulatis, caliculis veris nullis; tentaculis fermè 20, rostro obconico.*

Stem nearly straight, erect, pedicels not ringed, tubular, no true calicles; tentacles about 20, mouth projecting, obconical.

Plate 61, fig. 8, zoophyte, enlarged; 8 *a*, same, natural size; 8 *b*, enlarged view of rostriform mouth; fig. 6, p. 21, a wood-cut of the same.

Feejee Islands. *Exp. Exp.*

The specimen was a minute stem, half an inch high, formed of seven polyps; they were remarkable for having no proper calicles, the extremity of the tubular pedicel answering in place of it. No vesicles were observed.

NOTE.—Figure 9, plate 61, represents a partially expanded Campanularia, from the Gulf-weed, lat. 37° N., long. 43° 30' W., figured by Dr. C. Pickering.

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 FAMILY IV.—TUBULARIDÆ.

*Hydroidea, gemmis persistentibus, gemmulis oviformibus deciduis inter tentaculos nascentibus, cum aliis ovulis veris; polyphis sæpius pedicellatis; tentaculis non tubulatis.*

Hydroidea giving out persistent buds; also producing deciduous oviform gemmules near the base of the tentacles, besides other true ova; polyps mostly pedicellate; tentacles not tubular.

The larger species of Tubulariæ, when unexpanded, often look like tufts of a delicate rush, with threads for leaves, each of which bears

a polyp-flower when expanded; others are much branched; and others are short clumsy polyps. The tentacles are in one or two ranges, or scattered over the summit of the animal, which is usually oblong-conical, or rostriform, with a mouth and a circle of short tentacles at the summit of the beak. Their structure has been developed with unusual fidelity and beauty, by Van Beneden, and some of the results of his investigations are given in the Appendix. The following are the characters of the genera, as laid down by him:

I. *Coralligenous; forming horny coralla.*

1. *PENNARIA* (Goldfuss). *Tentacles of two kinds, the superior scattered and in several rows.*—*Sertularia* of Cavolini, Pol. mar., 134, pl. 5. *Plumularia*, Delle Chiaje, Mem., iv. 145, pl. 63, fig. 3; Blainville, Man., 477. *Pennaria*, Goldfuss; Ehrenberg, op. cit., Gen. xlii.

2. *TUBULARIA* (Pallas). *Tentacles of two kinds, in two series.*—Pallas, Elench. Zooph.; Lamarek, ii. 124; Ehrenberg, op. cit., Gen. xl.

3. *SYNCORYNA* (Ehrenberg). *Tentacles alike, in several series.*—Ehrenberg, op. cit., Gen. xxxix. *Stipula*, Sars. *Hermia*, Johnston, Mag. Zool. and Bot., ii. 326, and Brit. Zooph., 111. *Coryne*, Lamarek, ii. 74, and Blainv., Man., 471.

4. *CORYDENDRIUM* (Van Beneden). *Tentacles alike, scattered.*

5. *EUDENDRIUM* (Ehrenberg). *Tentacles in one series.*—Ehrenberg, op. cit., G. xli.

II. *Not coralligenous.*

6. *CORYNA* (Gærtner). *Tentacles alike, scattered.*—*Hydra*, Müller, Zool. Dan.; *Coryne*, Lamarek, ii. 73; *Coryna*, Blainville, Man., 471; Ehrenb., Gen. xxxviii.

7. *HYDRACTINIA* (Van Beneden). *Tentacles in a single series.*—Van Beneden, Bull. de l'Acad. Roy. de Bruxelles, viii., 1841, 89, pl. 1-5; and Mém. de l'Ac. Roy., xvii. pl. 6; *Dysmorphosa*, Philippi, Zool. Beobacht., Wieg. Arch., 1842, 33, pl. 1, figs. 2, 3; *Cordylophora*, Allman, Brit. Assoc., 1843, and Ann. Nat. Hist., xiii. 328; *Synhydra*, Quatrefages, Ann. des Sci. Nat., Oct. 1843.

*TUBULARIA ORNATA.* (Couthouy.)

*T. filiformis*, 3-4" alta, polypis grandibus, rostro elongatè subcylindrico, tentaculis externis filiformibus, apice supernis brevissimis; ramulis gemmuliferis multiramosis.

Filiform, 3 to 4 inches high; polyps large; beak long, subcylindrical; external tentacles filiform, oral tentacles very short; gemmuliferous branchlets much branched, lax and pendent.

Rio Janeiro. *Exp. Exp.*

This species is figured of the natural size, on page 19, from drawings by J. P. Couthouy. Figure 1 *a* represents an enlarged polyp; and 1 *b*, a cluster of gemmules, enlarged.

CORYNA CAPILLIFERA. (*Pickering.*)

*C. polypi summitate elongato-ovatâ; tentaculis fermè 20, capillaribus sparsis.*

Summit of polyp long-ovate; tentacles about 20, capillary, and scattered.

Plate 61, fig. 10, polyp, enlarged.

Sandwich Islands. *Exp. Exp.*

This species was obtained and figured by my associate, Dr. Pickering. It was a simple polyp, about one and a half lines in height, and the summit over which the tentacles were scattered, was full half the whole length. The tentacles were like slender hairs, and were scattered over the oblong summit; they waved readily with the motion of the water.

S U P P L E M E N T  
TO THE DESCRIPTION OF SPECIES.

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THIS Supplement includes the following genera of doubtful or undetermined character: Allopora, Myrizoum, Pustulopora, Coscinopora, Receptaculites, Tetradium, Theonea, Limaria, Stromatopora, Chaunopora, Distichopora, Orbulites, Marginopora, and Polytrema.

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GENUS ALLOPORA.—EHRENBERG.

*Cumulato-ramosa, polypis uni-gemmatibus. Corallum calcareum, solidum, stellis internis nullis, caliculis prominulis, cellis profundioribus, lineam non superantibus, infundibuliformibus, margine uniseriatim celluloso et crenato.*

Cumulato-ramose, each polyp giving out, in succession, a single bud (branchlets therefore zigzag). Corallum calcareous and solid, not at all penetrated by stellate cells; calicles somewhat prominent, cells quite deep, less than a line broad, funnel-shape, margin crenate, and having a series of cellules between the crenatures.

This genus was established by Ehrenberg for a coral that has the compactness of the *Corallium rubrum*, and appears like that to be an axis of an incrusting zoophyte, although there are distinct cells. A single species belongs to the Expedition collections, and was obtained in the Pacific. The *Oculina flabelliformis* and *O. rosea*, as

Ehrenberg states, have allied characters. The cells are described as radiated with lamellæ. But in the three species of the group seen by the author the interior of the cell is smooth, and the lamellæ are barely distinguishable crenatures of the margin, formed apparently by a row of oblong depressions and pores which alternate with the elevations. These crenatures are much more prominent in a species figured by Esper, and look like lamellæ; moreover, the exterior of the calicle is correspondingly striated. There is no trace of a cell within the interior of the corallum.

The characters here stated, as well as the minute size of the polyps, and their usual arrangement on two opposite sides only of a branch, appear to separate the species from the Oculinæ, with which they have been united. In the *A. bella*, the number of crenatures is twenty-four; and this number of lamellæ or tentacles in so small a polyp (two-thirds of a line in diameter) would be sufficient, of itself, to indicate that the polyps cannot be true Oculinæ; it is, therefore, altogether probable that the crenatures do not correspond each to a lamella. We are unable to infer from the structure of the corallum the true nature of the zoophyte, and leave it to be determined by a discovery of the polyps. They may be related to the Distichoporæ.

The species occur in the tropics, and probably also towards the colder limits of the temperate zone.

*Arrangement of the Species.*

- |                               |                           |
|-------------------------------|---------------------------|
| *1. <i>A. flabelliformis.</i> | *4. <i>A. gemmascens.</i> |
| *2. <i>A. rosea.</i>          | 5. <i>A. oculina.</i>     |
| 3. <i>A. infundibulifera.</i> | 6. <i>A. norwegica.</i>   |

1. ALLOPORA FLABELLIFORMIS. (*Lamarck.*) *Dana.*

*A. 8'' alta, ramosissima, flabellata, secunda, ramulis crebris minimis, brevissimis et flexuosis. Corallum leve, caliculis minutis ( $\frac{1}{8}''$  latis), lamellis vix perspicuis.*

Eight inches high, much branched, flabellate, secund, branchlets crowded, minute, and very short, flexuous. Corallum smooth, calicles minute ( $\frac{1}{8}$  of a line broad), lamellæ scarcely distinct.

East Indies.

The *flabelliformis*, as the name implies, has its branches in a single plane. It is very ramulous, and the outer branchlets are very delicate (plate 60, figure 7). The calicles are a little prominent, or give a zigzag appearance to the branchlets; the cells are about one-sixth of a line in diameter, and the margin is slightly crenulate, as seen under a lens. As Lamarck states, it somewhat resembles a *Millepora*.

*Corallium album, lapideum, densum et compactum, ramis levibus, teretibus, multum divisis*, Seba, Thes., iii., fig. 10, tab. 110. The figure measures seven inches by five in breadth, and resembles closely a specimen in the Boston City Museum.

*Oculina flabelliformis*, Lamarck, ii. 457, No. 8.  
 —, Blainville, Man. d'Act., p. 380.  
*Oculina gemmascens*, Ehrenberg, op. cit., Gen. xviii., sp. 2.

## 2. ALLOPORA ROSEA. (*Pallas.*) *Dana.*

*A. pumila, ramosissima, flabellata, sæpius secunda, ramis attenuatis. Corallum roseum, sæpe verruciferum, caliculis minutis (vix  $\frac{1}{4}$ '''), aliis lateralibus brevissimis, aliis terminalibus, lamellis non exsertis.*

Small, much branched, flabellate, mostly secund; branches attenuate. Corallum rose-coloured, often verruciferous, calicles very minute (scarcely  $\frac{1}{4}$  of a line broad), some lateral and very short, others terminal, lamellæ not exsert.

West Indies.

This small and neat species seldom exceeds two inches in height.

*Madrepora rosea*, Pallas, Zooph., p. 312. *Oculina rosea*, Lamarck, ii. 457, No. 9.  
 —, Ellis and Solander, p. 155. —, Blainville, Man. d'Act., p. 381, pl.  
 —, Esper, Pflanz., Fortsetz., i. 16, tab. 58, fig. 1, 1 a.  
 36. —, Ehrenberg, op. cit., Gen. xviii. sp. 3.

## 3. ALLOPORA INFUNDIBULIFERA. (*Lamarck.*) *Dana.*

*A. ramosissima, subflabellata; ramulis minimis zic-zac flexuosis, sæpe coalitis. Corallum caliculis infundibuliformibus, internè striatis; margine crenulato.*



Corallum very ramose; subflabellate, branchlets very small, flexuous in zigzag, often coalescent; calicles infundibuliform, internally striate; margin crenulate.

East Indies? *Lamarck*.

This description is from Lamarck. He states that the specimens resemble in shape the *flabelliformis*, but the cells are much larger and different in their character. Both the large and small branches are coalescent.

*Oculina infundibulifera*, Lamarck, No. 7. —, Blainville, Man., p. 380.

#### 4. ALLOPORA GEMMASCENS. (*Esper.*) Dana.

*A. ramosa, flabellata, subcompressa, sæpius secunda, ramulis extremis crassioribus, fere lineam latis. Corallum cellis  $\frac{1}{2}$ " latis, prominulis, margine crenulatis; tuberculis minutis asperatum.*

Ramose, flabellate, somewhat compressed and mostly secund; outer branchlets quite stout, nearly a line thick. Corallum having the cells half a line broad, a little prominent; margin crenulate, surface rough with minute tubercles.

East Indies.

This species, as figured by Esper, is very distinct from the preceding in its stouter branchlets and much larger cells.

*β. bella.* A specimen obtained by J. P. Couthouy, in the Paumotu Archipelago, has nearly the characters of the *gemmaescens*, in the size of the branches and calicles; yet as it differs in having the crenulations of the margin obsolete, it is separated as a distinct variety at least, if not a different species. The cells are nearly funnel-shape, about two-thirds of a line broad, and have a flaring aperture, with about twenty-four oblong cellules or pores arranged around the margin. The specimen is but one and a quarter inches high, and is sparingly branched and smooth, with the base nearly two lines wide, and the branches little less than a line at the apex. (Plate 60, fig. 6, natural size; 6 a, enlarged.)

*Madrepora gemmascens*, Esper, Pflanz. Fortsetz., i. 60, tab. 55; "Madrepora ramosa, subcompressa, albida, ramulis poriformibus; stellis tubulosis, erenatis, laminibus obtusis, crassiusculis, superficie tubereulis exasperata."

The *Oculina gemmascens*, of Ehrenberg, (op. cit., G. xviii., sp. 2), is the *flabelliformis*.



## 5. ALLOPORA OCLINA. (Ehrenberg.)

*A. pumila, ramosa, compressa, subflabellata, glabra, ramis dichotomis, 1½-2'' crassis, obtusis. Corallum cellis raris, sparsis, vix prominulis, distinctè 5-9-radiatis, sæpius radiis 7.*

Small, ramose, compressed, subflabellate, smooth; branches dichotomous, 1½ to 2 lines thick, obtuse. Corallum having the cells few, scattered, scarcely prominent, distinctly 5 to 9-rayed, mostly 7-rayed.

Ehrenberg adds to this description the remark that it differs from the *rosea* in its fewer rays, the number in that species being nine to fifteen.

Ehrenberg, op. cit., Fam. xvii.

## 6. ALLOPORA NORWEGICA. (Fabricius.) Dana.

*A. compressa, fere flabellata, ramulis brevibus; subcrassis. Corallum leve, caliculis obsoletis, cellis minutis, orbiculatis aut oblongis, lamellis vix minimè exsertis, subæquis.*

Compressed and almost flabellate, branchlets very short and rather stout. Corallum smooth, calicles obsolete, cells minute, circular, or oblong, lamellæ scarcely at all exsert, nearly equal.

Norwegian seas.

This small species has till lately been made identical with the *Oculina virginea*. Its cells are very much smaller, and not prominent, or scarcely at all so. The number of lamellæ within the cell is stated at eighteen or more. It is referred to this genus with doubt.

Pontoppidan, Norg. Naturl., i. 258, No. 10, tab. 14, fig. G., or English translation, London, 1754, p. 159. "Flat, with several pretty indented shoots, about a finger in length, and half as broad, but appears to have been much larger before it was detached from the body of the plant, which, when entire, must make a very beautiful appearance."

Ström, Söndm., i. 144. Norske Vidensk. Selsk., iv. 56, No. 11, tab. 8, fig. 1-4.

*Madrepora virginea*, Müller, Prod. Zool. Dan., 3041.

*Madrepora norvegica*, O. Fabricius, Oken's Isis, 1845, p. 52.

## GENUS MYRIOZOOM.—DONATI. EHRENBURG.

*Affixæ, ramosæ. Coralla infra nuda, supra cellis punctiformibus instructa; cellis simplicibus, non lamellatis, ex axe radiatis: animalibus multitentaculatis, et operculigeris.*

Attached ramose. Coralla naked below, but above punctured with minute cells, not lamellate within, and radiating from the axis of the stem; polyps multitentaculate, and having an operculum.

The animals of the species here included were first figured by Donati, and afterwards with more accuracy by Cavolini. They are represented as having a funnel-shaped extremity and a circular operculum attached to one side. This peculiar form has much analogy to many *Serpulas*, and the species may belong to that group, although the branches present the compact structure and the aspect of a zoophyte.

## 1. MYRIOZOOM TRUNCATUM.

*M. pumilum; dichotomum; ramis teretibus, apice truncatis.*

Small; dichotomous; branches terete, truncate at apex.

Mediterranean.

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|---|--|
| <i>Madrepore rameux</i> , &c., Marsilli, Phys., 145, tab. 32, figs. 154-156.  | —, Lamk., ii. 308, No. 5.  |
| <i>Miriozoo</i> , Donati, Hist. d. Mer. Adriat., 55, tab. 7.                  | —, Lamour., Exp., 47, pl. 23, fig. 1 to 8.                                     |
| <i>Myriozoom</i> , Phil. Trans., xlvii. 107, tab. 5; vol. x., Abridg., pl. 5. | —, Deslongchamps, Encyc., 546.   |
| <i>Millepora truncata</i> , Linn., ed. xii., 1283.                            | —, Oken's Zool., i. 63.  |
| —, Pallas, Zooph., 249.   | <i>Myriapora truncata</i> , Blainv., Man., 427, pl. 71, fig. 2.                |
| —, Cavolini, Pol. Mar., 59, tab. 3, figs. 9-11.                               | —, Brit. Assoc., 1843, p. 151, "occurs in the Ægean at a depth of 70 fathoms." |
| —, Ellis and Solander, 141, tab. 23, figs. 1-8.                               | <i>Myriozoom truncatum</i> , Ehrenb., G. lxxiv.                                |
| —, Esper, i. 188, tab. Millep., 4.  | <i>Truncularia</i> , Wiegmann (cited from Ehrenberg).                          |
|   | Delle Chiaje, Anim. Nap., iii. 40, pl. 33, figs. 16, 17.                       |

2. MYRIOZOOM GRACILIS. (*Michelin.*) *Dana.*

*M. albidum*; *dichotomè ramosum*, ramis gracilibus, teretibus, suprà irregulariter inflatis, apice rotundato-truncatis.

Whitish; dichotomously ramose, branches slender, terete, above irregularly inflated, round-truncate at apex.

Mediterranean. *Michelin.*

Michelin states that the branches are more slender than in the *truncata* (hardly a line thick in the figure), and have more rounded extremities, with the surface, where the cells are most numerous, inflated.

*Myriapora gracilis*, Michelin; Guerin, Mag. de Zool., 1842, Zooph., pl. 4.

## GENUS PUSTULOPORA.—BLAINVILLE.

*Affixæ.* *Coralla calcarea*, stratis seriatis instructa, cylindrica, aut parçè ramosa; cellis sparsis, prominulis aut pustuliformibus, aperturâ orbiculatâ.

Attached. Coralla calcareous, consisting of a series of layers, cylindrical or sparingly ramose; cells scattered, a little prominent or pustuliform, aperture circular.

This genus, as instituted by Blainville, appears to include species imperfectly allied. The *P. madreporacea* (*Ceripora madreporacea*, of Goldfuss), appears to have some relation to the *Myriozoom*, and not to present the stratified structure above stated.

Blainville, Man., 418. Goldfuss, Petref., tab. 10. Lamarck, 2d ed., ii. 314.

## GENUS COSCINOPORA.—GOLDFUSS.

*Affixæ, cyathiformes aut incrustantes. Coralla calcarea, cellis tubulis fibriformibus composita; cellis in quincuncem dispositis, immersis, infundibuliformibus; interstitiis angustis.*

Attached, cyathiform or incrusting. Coralla calcareous, consisting of fibriform tubes; cells immersed and arranged in quincunx order, funnel-shape; interstices narrow.

This genus, as established by Goldfuss, consisted, as Blainville states, of heterogeneous materials: it was consequently restricted by him to those species having the general characteristics of the *Coscinopora infundibuliformis* of Goldfuss, and placed with the Madrepora tribe. The above description is essentially that drawn up by Blainville.

Goldfuss, Petref., pl. 9, figs. *a, b, c*, and pl. 30, fig. 10. Blainville, Man., 386, pl. 60, fig. 5. Lamarck, 2d ed., ii. 458.

## GENUS RECEPTACULITES.—DEFRANCE.

*Coralla calcarea, cellis quadrangulatis, fere contiguis.*

Coralla calcareous, with quadrangular and nearly contiguous cells.

The genus *Receptaculites*, as characterized by Blainville, includes a clypeiform species (*R. Neptunii*), concave below, and convex above, with a kind of mammilliform summit; cells on the upper surface round, on the under rhomboid or quadrilateral. His characters and figures were taken from DeFrance's specimens and others collected from the old formations in the vicinity of Chimey, France.

The quadrilateral form of the cells appears to be the most prominent characteristic, and in this respect it differs from all recent corals. Blainville, in view of its anomalous form and structure, suggests as a possibility, that it may be a fossil fruit, which, however, seems hardly probable.

Some of Goldfuss's *Coscinoporæ* are represented with quadrangular cells, and belong to this group; as his generic character, cells disposed in quincunx order, would exclude them from his genus.

DeFrance, Dict. des Sci. Nat., xlv., 5, and Blainville, Man., 572, pl. 68.

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GENUS TETRADIUM.—DANA.

*Coralla aggregata, tubulis cellisque quadrangulatis composita, septis parietibusve tenuissimis; cellis lamellis angustis 4 stellatis.*

Coralla massive, consisting of 4-sided tubes, and cells with very thin septa or parietes; cells stellate, with 4 narrow lamellæ.

This genus is near *Receptaculites*, but differs in having very thin parietes, and four distinct rays within the cells, one to each side. The specimen answering to the description, is a fossil of uncertain locality, in the collections of Yale College, New Haven. The cells are about half a line in breadth. The name, from the Greek τετρας, *four*, alludes to the quadrate structure.

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GENUS THEONEA.—LAMOUROUX.

*Pumilæ. Coralla calcarea, lobulato-glomerata, et lacunosa, lobulis parvulis, et apice celliferis, interstitiis tenuissimis levibus, nudis; cellis tubulatis, lamellis nullis.*

Quite small. Coralla calcareous, lobulato-glomerate and lacunose; cells opening at the summits of the prominences, tubular without lamellæ; interstices very thin, naked, and smooth.

The texture of the coralla is delicate tubular, and these tubes open at the summits of the small lobules or prominences. The absence of all traces of lamellæ or transverse septa within the cells, removes the species from the *Actinaria*.

- Theonea*, Lamour., Exp. Meth., 82, pl. 80, —, Blainville, Man., 408, pl. 67, fig. 2.  
 figs. 17, 18. —, Lamarck, 2d ed., ii. 318.  
 —, DeFrance, Dict. des Sci. Nat., liii. 470. *Blumenbachium*, Koninck.

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GENUS LIMARIA.—STEININGER.

*Pumila, ramosa.* *Coralla solida, cellis aperturâ subtriangulatis; caliculis nullis.*

Small, ramose; coralla quite solid, cells with a subtriangular aperture; calicles none.

This genus may pertain to the Bryozoa group; but nothing certain with regard to its relations can be gathered from its very singular structure.

*Limaria*, Steininger, Mem. S. G. F., i.

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GENUS STROMATOPORA.—GOLDFUSS.

*Aggregata.* *Coralla convexa, concentricè leviter rugata, cellis poriformibus minutissimis in sulcos concentricos dispositis.*

Massive. Coralla convex, concentrically faint rugate, cells pore-like, very minute, situated in the concentric depressions.

This genus was instituted by Goldfuss. Blainville, after an examination of the specimen figured by this author, expressed his doubts as to its being a true coral.

Goldfuss, Petref., tab. 8, fig. 5.

Blainville, Man., 413, pl. 70, fig. 1.

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GENUS CHAUNOPORA.—PHILLIPS.

*Aggregata.* *Coralla stratos concentricos aut planiusculos compositis,*

*tubulis parvulis vermiformibus flexuosis, et aliis grandioribus subparallelis non lamelliferis (?) perforata.*

Massive. Coralla consisting of concentric or nearly flat beds, perforated by small vermiform flexuous tubules, and others larger, nearly parallel, and non-lamelliferous (?).

This genus was made by Phillips for the *Coscinopora placenta*, as figured by Lonsdale, which this author describes as consisting of thin beds, perforated by vermiform cavities bounded each by a white circle. The name is from  $\chi\alpha\upsilon\upsilon\omicron\varsigma$ , *loose*, alluding to its texture.

*Coscinopora*, Phillips, Palæoz. foss., 18, pl. *Coscinop. placenta*, Lonsdale, Geol. Trans., New Ser., v., pl. 58, figs. 5 a, b, c, d.  
10, fig. 29.

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GENUS DISTICHOPORA.

*Ramosæ, pumilæ, flabellatæ. Coralla robusta, ramis sæpe paulo compressis sulco cellulifero disticho.*

Ramose, quite small; branched in a plane. Coralla firm; branches often a little compressed, and with a cellular furrow on two opposite sides extending over the extremity.

These delicate species grow to a height of only an inch or two. The furrow along the edges of the branches, contains a medial series of cellules, somewhat irregular, and another cellular line either side, as is shown in figure 3 a, plate 60. Nothing is known with regard to the animals.

The species were separated from the *Milleporæ* by Lamarck.

1. DISTICHOPORA VIOLACEA. (*Lamarck.*)

*D. violacea, apice lutescens; 2-2½" alta; parce ramosa; ramis paulo compressis, dichotomis, 1-1½" latis.*

Violet, with the tips a little yellowish; 2 to 2½ inches high, and ramose; branches somewhat compressed, dichotomous, 1 to 1½ lines broad.





Plate 60, fig. 3; corallum, natural size; 3 *a*, extremity of a branch, magnified.

East Indies and Pacific.—Paumotu Archipelago. *Exp. Exp.*

The specimens of this and the following species were collected by J. P. Couthouy.

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| <i>Millepora violacea</i> , Pallas, Zooph., 258. | —, Schweig., Beob., tab. 6, fig. 61.           |
| —, Gmel. Linn., 3785.                            | <i>Distichopora violacea</i> , Lamk., ii. 305. |
| —, Ellis and Solander, 140, tab. 26,             | —, Schweig., Handb., 413.                      |
| figs. 3, 4.                                      | —, Lamour., Exp., 46, pl. 26, figs. 3, 4.      |
| —, Oken, Zool., i., 62.                          | —, Blainv., Man., 416, pl. 55, fig. 2.         |

## 2. DISTICHOPORA GRACILIS. (*Dana.*)

*D. rubida*; *gracilior*, *ramulosa*; *ramulis triplo angustior* (apice  $\frac{1}{3}$ ''').

Reddish; more slender than the *violacea*, ramulous; branchlets one-third as broad, at summit about a third of a line.

Plate 60, fig. 4, corallum, natural size; fig. 5, a variety? natural size; 5 *a*, 5 *b*, views, enlarged.

Paumotu Archipelago. *Exp. Exp.*

The delicate corallum is about an inch high.

NOTE.—Michelin has instituted the genus LAMINOPORA, for a recent species, which is near the Distichoporæ in structure, though somewhat different in habit. His figure represents a small branch, compressed, and nearly in a plane, with the surface covered with contorted laminate branchlets, one to three lines in breadth; and in the enlarged view the edges of these plates have two series of pores. Michelin describes the specimen as having pores on the lateral surface, but adds that they become filled and obliterated by age, so that they are only distinguishable along the margin. The specimen was three inches high, and the branches one and a half to nearly three lines wide. It approaches, a little, in habit, the Apsendesia of Lamouroux. No locality is given.

*Laminopora contorta*, Michelin, Guer. Mag. de Zool., 1842, pl. 3.

## GENUS ORBULITES.—LAMARCK.

*Liberæ*; orbiculatè disciformes, suprâ infrâque planiusculæ, superficie utrâque leviter porulosâ.

Free; disk-shape, circular, nearly flat above and below; both surfaces minutely porulose.

This genus was established by Lamarck, and originally named Orbitolites. It contains, beside some fossils, a single recent Mediterranean species (*O. marginalis*), which is about a line in diameter. Blainville doubts its being a zoophyte, and suggests that it may be an internal piece from some animal. He adds that it has no proper cells, and enlarges by growth at the margin.

Lamarck, ii. 302. Blainville, Man. d'Actinologie, 411.

GENUS MARGINOPORA.—QUOY & GAYMARD.

*Liberæ; orbiculatè disciformes. Coralla suprâ infrâque planiuscula et concentricè striatula; margine subtiliter punctata; internè cellulosa.*

Free; very thin disk-shape, circular. Coralla nearly plane above and below, and concentrically faint striate; margin minutely punctate; internal texture concentrically cellular.

These small disks are found unattached, and are of common occurrence about the reefs of the Pacific. The punctations of the margin (pl. 60, fig. 9 a) do not appear to be punctures, except in worn specimens, and the remark of Blainville with regard to the nature of the Orbitolites, applies here with equal force. The pores of the interior, which appear as shown in figure 9 b, pl. 60, on polishing down the surface, are not enclosed cellules, as in species of Bryozoa. We distinguish, under a magnifier, concentric calcareous lines, about a tenth of a line apart, which are connected by minute points or columns, in several ranges, above one another; and the cellules are merely the intervals thus left. A cross section in the line of a radius, shows nearly the same structure as a horizontal section. It is, therefore, altogether probable that each disk belongs to a single animal, and is an internal formation, increasing, as in the Orbitolites, by the margin.

This genus was established by Quoy and Gaymard, and named in allusion to the character of the margin. They report to it a single

species, the *Marginopora vertebralis*, which is a simple, delicate disk, about three-fourths of an inch in diameter, and about two-thirds of a line thick. (Plate 60, fig. 8.)

A singular variety (*plicata*) is represented in figure 9 *a, b*, of the same plate, which may possibly be only a more advanced state of Quoy and Gaymard's species, though very distinct in appearance. Instead of a simple flat disk, it is in part double, and the two portions are in folds, and coalesce at intervals. Many specimens of both these varieties are contained in the Expedition collections.

*M. vertebralis*, Quoy and Gaymard, Voy. —, Blainv., Man. d'Actinologie, 412, pl. de l'Astrolabe. 69, fig. 6.

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GENUS POLYTREMA.—Risso.

*Pumilæ; incrustantes aut subramosæ, interdum lacerato-divisæ. Coralla subporosa, superficie punctatâ, cellis poriformibus minutis, sparsis, irregularibus, sæpius margine laceratis, sive immersis, sive ad pustulos elevatis.*

Small; incrusting or subramose, sometimes lacerato-subdivided. Coralla somewhat porous; surface punctate, and with scattered, minute, poriform cells, irregular, and having usually a lacerate margin, either immersed or at the summits of rounded or spiniform elevations.

The colour of these incrusting species is usually some shade of deep red. They seldom exceed an inch in breadth, and one-third this in height, and have either a smooth, minutely pustulate, or a lacerate surface, and the prominences are often ragged at tips. The cells have no regular shape, and no lamellæ within, and are placed without order over the surface; and in the smoother varieties are often confined to near the growing margin.

There is little reason to believe these species to be true zoophytes. They should probably be removed to the vegetable kingdom, near Nullipores, or the sponges.

The genus *Polytrema* was instituted by Risso for the *Millepora* miniacea, of preceding authors.

## POLYTREMA MINIACEA.

*P. miniacea minima, subtiliter ramoso-divisa.*

Bright red; minute, and minutely ramoso-subdivided.

Mediterranean Sea.

This species is found attached to shells forming minute tufts, one to three lines broad, and about the same in height.

- |   |  |
|---|--|
| <i>Millepora miniacea</i> , Pallas, Zooph., 251.  | —, Deslongchamps, Encyc., 546.                   |
| —, Esper, i. 225.                                 | <i>Polytrema corallina</i> , Risso, Merid. Eur., |
| —, Oken's Zool., i. 62.                           | v., 340.   |
| <i>Millepora rubra</i> , Ellis and Solander, 137. | <i>Polytrema miniacea</i> , Blainv., Man., 410.  |
| —, Lamk., ii. 309, No. 8.                         |  |

The following are probably distinct species, though usually referred to the *miniacea*.

*β. crustula*.—Surface either smooth or somewhat gibbous or pustulous; colour very deep red; often six to eight lines broad, surface punctate, the punctations dull, and other parts shining. From the West Indies. (Esper, i., Mill., tab. 17; and Blainv., Man., pl. 69, fig. 4.) Fig. 2, plate 61, natural size; 2 *a*, surface, enlarged.

*β. echinulata*. Surface minutely pustulous, or covered with delicate echinuliform points, nearly a line high, and having one or more cells about the summits. Plate 61, figs. 1, 1 *a*, 1 *b*, natural size; 1 *c*, 1 *d*, some of the prominences, enlarged; 1 *e*, a transverse section, enlarged. From the Pacific. *Exp. Exp.*

POLYTREMA BRUNNESCENS. (*Dana.*)

*P. pallidè brunnescens, crassè incrustans, cavernosa, superficie gibbosâ, et laceratâ, et valde irregulari.*

Pale brownish; thick incrusting, cavernous, surface gibbous, lacerate, and very irregular.

Plate 61, fig. 3, natural size.

Society Islands. *Exp. Exp.*

The very ragged surface rises, in some parts, into slender points,

rough at summit. The specimen is an inch in breadth, and half an inch thick, with some of the slender points a line to a line and a half long.

POLYTREMA MESENERINA. (*Dana.*)

*P. kermesina, mesenterina laminis plicatè aggregatis suberectis composita, margine minutè pannoso aut crispo, cellis sparsis poriformibus irregularibus instructo.*

Deep carmine, mesenteriform, consisting of suberect plicately aggregated laminæ; the margin minutely ragged or crispate, and furnished with a few scattered pores of irregular shape.

Plate 61, figure 4, natural size; 4 *a*, portion enlarged, showing the character of the margin.

Tutuila, Navigator Islands. *Exp. Exp.*

The clump is an inch broad, and half an inch high, and the plates are about two-thirds of a line thick, with the margin a little thickened and crisped. The pores are without regularity, and but few in number, appearing like punctures resulting from fracture. This species differs so decidedly from the other *Polytremæ*, that it may well form a new genus. Like the above species, it has probably a nearer relation to the sponges than to zoophytes. It has the habit of an *Apsendesia*.

## A P P E N D I X.

### ADDENDA AND ANNOTATIONS.

#### *Reproduction in the Hydroidea.*—p. 22.

THE observations of Van Beneden, on the Tubularidæ, but lately published, have brought out many new facts with regard to the structure and modes of reproduction characterizing this division of the Hydroidea.\* His investigations have led him to distinguish the following modes of reproduction :

1. By persistent buds, by which, as in the Sertulariæ, and in zoophytes generally, compound groups are formed.

2. By caducous ovule-like buds or gemmules. These are produced about the bases of the tentacles, and have been considered true ova (pp. 22, 23), to which they are closely analogous. Van Beneden describes them as presenting within, when complete, a distinct cellule, which he considers as corresponding to the germinant vesicle of the true egg. This cellule enlarges, and shortly a membrane forms across, which is in contact below with the circulating fluids of the axis; from this membrane the new polyp proceeds. He traces out the changes in progress from this state to the development of the medusa-like young, a *Beroë* in form,—a floating pellucid disk, fringed around with delicate tentacles, and furnished with eight eyes.

3. By a single ovule, thus approaching in character the Actinoidea.

Besides the above modes, he mentions also two others.

4. Compound ova, resulting in each instance from a production of numerous ovules from the yolk of what at first appears to be a simple ovum, each ovule having its own germinal vesicle, and producing separate young.

5. Ovules formed within the caducous gemmules. This mode corresponds nearly to known instances of ova in larvæ or undeveloped young. These develop and take the form of a *Planaria*, and are the *Planules* of Sir J. G. Dalyell. (Fourth Rep. Brit. Assoc., 1834, p. 602.) From the *Planule*, a kind of larve, the perfect animal afterwards proceeds.

\* Van Beneden's very elaborate Memoir is just published in the Transactions of the Royal Society of Brussels. A short abstract of it is given in a late number of *L'Institut*, and also in the *Annals and Magazine of Natural History*, vol. xv., p. 346; and these are the only sources of information with regard to it which the author has had.

The condition of a forming bud, that is, the nutrition present and forces at work, seem to render it liable to this abnormal development in animals of the lower grades, in which the formation of an ovule is little more than the reproduction of any other cellule in the body. The ovigerous portion of any animal must be that best fitted in these respects for the developments required; and in these inferior organizations, the powers of reproduction are more generally distributed, as less concentration is needed.

Van Beneden has observed, that in the *Corynæ* and *Hydractinæ* the stomachs of the several polyps in a compound zoophyte are isolated, instead of communicating with one another along an axial tubular cavity; and that consequently there is no circulation in these animals like that of other *Hydroidea*. This fact decides the unimportance of the character upon which the *Alcyonaria* have been hitherto so widely separated from the *Actinaria*. See note to page 45.

*Reproduction in the Alcyonaria.*—p. 43.

Milne Edwards, by his dissections of the *Veretillum cynomorium*, illustrated by excellent figures in the late edition of Cuvier's *Règne Animal* (Paris, 1837, pl. 91, fig. 1), shows that both spermatic cords and ovarian clusters sometimes occur attached to the same lamellæ. The figures represent the upper part of the lamellæ as spermatic and the lower part ovarian. It is interesting to observe the close analogy here exhibited to a *gynandrous* plant. Two of the lamellæ, however, as in the *Tubipora* described in the text, were without spermatic cords.

*Structure of Coralla.*—p. 51.

Under a microscope of moderate power, animal fibres may be readily detected in a thin slice of coral, ramifying irregularly throughout it. But beyond this, even with an instrument magnifying three hundred diameters, I have been unable to discover any regular structure that can be traced with certainty to the pre-existence of separate animal cellules. In the lamellæ of the *Euphyllia gracilis* and *Astræa dipsacea*, polished down and examined with the power above specified, only a minutely clouded appearance was made out, too indefinite in character to be represented. By rubbing a crayon over a piece of paper a little rough, as good a figure of it would be had, as a more laboured sketch could give. There were parallel bands of light and shade corresponding in direction with the margin of the plate, and with all its dentations, which indicated what other observations had shown, that these plates gradually enlarge by the extension of the edge; and this was the only evidence made out of regularity of structure. Examined with a polarising attachment to the microscope, the thin slices permitted the polarised light to pass, but no colours were exhibited, except in points which were extremely minute when magnified one hundred and fifty diameters, the power used in making the observation. This fact indicated that the coral plates were composed of minute granules, confusedly aggregated, as if each had been the result of independent formation, or the secretion of a separate animal cellule. There was no reason whatever to infer that the particles of the plate had been secreted and accumulated by superposition under crys-

tallogenic forces; on the contrary, the structure was completely amorphous, and such as could have resulted only from a mere aggregation of extremely minute granules, themselves crystalline. Although there seemed to be nothing of the tessellated structure, which has been detected in the shells of many molluscs, yet the observations may point to a similarity of formation; and it is possible that with more skilful manipulation and higher lenses, something more satisfactory might be ascertained. It should be observed, however, that the beautiful results obtained by Mr. Carpenter, in his investigations into the structure of shells, were generally distinct when a power of only fifty diameters was used.

The structure of the spicula in the *Alcyonia* appears to be somewhat different. These spicula are commonly five or six times as long as their greatest breadth, and are more or less pointed at each extremity. The surface is usually rough with minute prominences, so that a profile, seen in any direction, gives nearly the appearance in the figures on page 54, though often still more irregular. In the *Spoggodia florida* of Lesson, their length is equal to full twenty diameters, and the spicula are mostly a little curved. They lie in every position in the thin integuments which constitute these zoophytes (figure 4 *c*, plate 59), and are exert about the small clusters of polyps. But in the *Alcyonia* they are generally much shorter, and often lie nearly parallel, through much of their texture; and near the bases of the tentacles, there are two oblique divergent series, corresponding apparently with the lines of tissue.

One of the spicula of the *Spoggodia* is figured, enlarged, on plate 59, fig. 4 *d*. Although unusual in length, the knobby character of its surface is the prevailing one in the *Alcyonaria*. When polished down very thin, the appearance in figure 4 *e*, is presented. Faint lines varying in distinctness are seen to run parallel with the edge, through all its uneven outline; that is, there is evidence of a concentric structure, evincing that the spicula are formed by successive superpositions over the irregular surface. About the central portions of the figure there are a few oblong dark spots, each of which pertained to one of the surface knobs that had been polished off. The concentric layers in these transected knobs, have their edges towards the observer, and consequently they are not as transparent as the flat parts between. It is also seen that these prominences, traced inward, become a little oblique at the centre, from which they appear to radiate, showing that the spicula, as they were formed, increased most rapidly towards one extremity. In polarised light the spicula exhibit brilliant colours; and the same magnifying power which gave scarcely visible points of colour with the lamellæ of the *Astræa*, here afforded sheets half an inch or more in breadth, of rich green and flame tints. The spicula appeared therefore to be the result of a simple crystalline superposition of the calcareous material from the depositing secretions. With a power magnifying three hundred diameters, no trace of animal cellules was distinguished, and no regular texture apart from the evidences of a concentric structure above stated.

The hardness of these coral secretions, which is much above that of common carbonate of lime, as stated by Mr. Silliman on a following page, is not fully explained by the peculiar chemical composition detected by this chemist. We suggest, as one cause, that the calcareous portion may have, in its intimate texture, the structure of Arragonite, or prismatic carbonate of lime, instead of that of common rhombohedral calc spar. The Arragonite structure has been shown to be due to crystallization at a higher temperature than that which is required for calc spar, the two minerals being identical in composition: in consequence of this higher temperature, a different crystalline form is assumed; and,



moreover, the material has a higher degree of hardness, that of Aragonite being designated by  $3\frac{1}{2}$  to 4, while common calc spar or rhombohedral carbonate of lime is 3. These remarks, it will be perceived, bear upon the internal calcareous secretions of other animals. In connexion, it should be observed, however, that distinct rhombohedrons of *calc spar* have been detected by Carpenter in the shells of some molluscs.

With regard to the structure of the horny axis of the Gorgoniæ, we have nothing to add to what is stated in the text. In structure, growth, and vitality, they appear to correspond to the horny secretions of other animals.

Much yet remains to be done in investigating the microscopic structure of corals, and we may express the hope that one who has been so successful in his examinations of molluscs, may extend his researches to this department of science.

*Composition of Coralla.*—p. 56.

It has been stated that the chemical analyses of corals were undertaken for this work by Mr. B. Silliman, jr. The following pages contain the results of his researches, which will be found to be highly important, both in a physiological and geological point of view.

“No extended researches on the chemical constitution of corals have been made, it is believed, since Mr. Hatchett’s, already quoted in this work. This chemist did not operate *quantitatively* on any of the species examined by him; and his investigation tended to show that the calcareous corals, as well as the coverings of most of the molluscs, experimented upon, consisted merely of carbonate of lime. Such was the opinion with which these chemical examinations were commenced. But while it has been found that carbonate of lime is the principal ingredient, other elements have been detected, showing that coral is far from being the simple calcareous material supposed.

“The following is a list of the species examined, which are here numbered for the convenience of reference:

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| 1. <i>Porites favosa</i> , Sandwich Islands. | 16. <i>Madrepora</i> , Feejees.                |
| 2. <i>Porites nigrescens</i> , Feejees.      | 17. <i>Madrepora</i> , Feejees.                |
| 3. <i>Porites limosa</i> , Feejees.          | 18. <i>Mad. cyclopea</i> , Wakes Island.       |
| 4. <i>Porites cylindrica</i> , Feejees.      | 19. <i>Pocillopora damicornis</i> , Sooloo.    |
| 5. <i>Porites fragosa</i> , Feejees.         | 20. <i>P. elongata</i> , Ceylon.               |
| 6. <i>Porites</i> ,* Paumotu.                | 21. <i>P. grandis</i> , Feejees.               |
| 7. <i>Porites</i> ,* Wakes Island.           | 22. <i>P. ligulata</i> , Sandwich Islands.     |
| 8. <i>Porites</i> ,* Wakes Island.           | 23. <i>P. cespitosa</i> , Sandwich Islands.    |
| 9. <i>Madrepora palmata</i> , West Indies.   | 24. <i>Millepora tortuosa</i> , Feejees.       |
| 10. <i>Mad. spicifera</i> , Ceylon.          | 25. <i>Heliopora cærulea</i> , East Indies.    |
| 11. <i>Mad. prolifera</i> , Bermuda.         | 26. <i>Gemmipora brassica</i> , Feejees.       |
| 12. <i>Mad. plantaginea</i> , Ceylon.        | 27. <i>Dendrophyllia nigrescens</i> , Feejees. |
| 13. <i>Mad. cytherea</i> , Tahiti.           | 28. <i>Meandrina phrygia</i> , Ceylon.         |
| 14. <i>Madrepora</i> , Feejees.              | 29. <i>Astræa orion</i> , Ceylon.              |
| 15. <i>Madrepora</i> , Feejees.              | 30. <i>Astræa</i> (pl. 13, fig. 15).           |

\* Worn specimens, not identified.

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| 31. Astræa, Wakes Island. | 34. Astræa, Feejees. |
| 32. Astræa, Wakes Island. | 35. Astræa, Feejees. |
| 33. Astræa, Feejees.      | 36. Shell of Chama.  |

“Nine of the above species, of which there was the largest quantity on hand, were selected for a minute determination of each ingredient, while of the others, only the proportion of carbonate of lime and animal matter to the other ingredients, was determined. The following are the nine selected :

- I. Porites favosa (No. 1), Sandwich Islands.
- II. Madrepora palmatum (No. 9), West Indies.
- III. Madrepora spicifera (No. 10), Ceylon.
- IV. Madrepora prolifera (No. 11), Bermudas.
- V. Madrepora plantaginea (No. 12), Ceylon.
- VI. Pocillopora ligulata (No. 22), Sandwich Islands.
- VII. Meandrina phrygia (No. 28), Ceylon.
- VIII. Astræa orion (No. 29), Ceylon.
- IX. Astræa (No. 30, p. 721, pl. 13, fig. 15).

“A few remarks are added upon some of their physical characters, before giving the mode and results of analysis.

“*Hardness.*—All the various corals examined were superior in hardness to calcareous spar or common marble, and not inferior to Arragonite; while some were as hard as Apatite or crystallized phosphate of lime; or according to the scale used by mineralogists, the usual hardness will be expressed by 4, though in a few instances as high as 5. Using an iron mortar in the earlier trials, the iron pestle was roughened and cut under the resistance of the angular masses of coral, to a degree quite remarkable considering the nature of the substance operated on. So much iron was communicated to the powder from this source, that recourse was had to a mortar of porcelain, and even this was not proof against wear, the porcelain pestle being pitted by the repeated blows. The more porous species, of course, were crushed with less difficulty; and this was especially the case with the species of Porites.

“*Specific Gravity.*—The specimens were reduced to fine powder before trying the specific gravity, as the porous character of the coral would otherwise interfere with obtaining correct results. Considerable variation will be observed in the following table. The numbers correspond to the catalogue on the preceding page.

Specimens.	Sp. Grav.	Specimens.	Sp. Grav.	Specimens.	Sp. Grav.
No. 1	2.817	No. 20	2.217	No. 31	2.688
3	2.732	22	2.564	33	2.500
4	2.564	23	2.353	34	2.500
9	2.421	25	2.578	Meand. rustica	2.571
10	2.105	26	2.584	Shell of {	2.857
12	2.427	27	2.740	Chama. }	

“The average from the sixteen species of corals is 2.523.

“*Colour.*—In general the colour of the specimens examined was white, or nearly so; but some of them, as *Dendrophyllia nigrescens*, and the blue *Heliopora* (*H. cerulea*) were highly coloured. The colouring matter, in all cases, proved to be organic, and was generally due to some trace of the animal tissues. The highly-coloured ones, when powdered, burned white, giving out, at a red heat, the odour of animal matter. The *Heliopora* dissolved in chlorohydric acid, without having its colour altered, and gave a light indigo-blue solution. A drop of nitric acid, however, discharged this colour, and ammonia threw it down as a brown precipitate. Heat immediately destroys it. It is, therefore, evident that the colouring matter is entirely organic, and is in no way connected with the mineral constitution of the coral. However, some corals have a slight ferruginous tint, from the presence of a little peroxyd of iron, which will be seen to be an almost constant constituent, although in exceedingly small quantity.

“*Behaviour with reagents.*—All corals are rapidly dissolved in dilute chlorohydric, nitric, or acetic acids, with brisk effervescence and escape of carbonic acid. The solution is frequently coloured by organic matter, which sometimes renders it turbid. When the powdered coral is treated with pure water, more or less of common salt and other soluble saline matters, derived from the evaporation of sea water, are washed out, and this precaution was found necessary to insure accurate results.

“The solution of a coral in nitric acid is very soon blackened by a solution of *nitrate of silver*, from the presence of organic matter. Ammonia, added to a solution in nitric or chlorohydric acid, with the least possible excess of acid, will generally produce an immediate precipitate of granular ammonio-phosphate of magnesia, thus indicating the presence of both magnesia and phosphoric acid.

“Chloride of barium produces, with a chlorohydric solution, a granular, white precipitate, which is nearly all redissolved in an excess of chlorohydric acid. (A small portion of sulphate of barytes is generally formed in using this test, owing to the almost constant presence of a small quantity of sulphate of lime in the corals.)

“A portion, dissolved in nitric acid, and carefully neutralized, when treated with nitrate of silver, will, on standing, deposit a considerable yellowish precipitate of phosphate of silver, which is redissolved in ammonia and nitric acid.

“Acetate of lead, added to a chlorohydric solution, produces a copious precipitate of chloride of lead, which is not wholly redissolved by an excess of acetic acid, but is taken up by nitric acid. These facts are a sufficient proof of the presence of phosphoric acid.

“Lime-water, added to a solution of coral, either neutral or slightly acid, will produce an immediate gelatinous precipitate of all the bases and acids which the coral can contain, except, of course, the lime and solvent acid. Great care is needed in this operation to prevent the formation of a carbonate of lime: the solution should have been recently boiled, and the test applied while it is yet hot, the air being excluded; and the precipitate should be immediately collected on a filter and washed. If the precipitate by lime-water be fused in a platinum capsule, with carbonate of soda, or carbonate of potassa in excess, the phosphoric acid is all transferred to an equivalent portion of alkaline base, while the lime or magnesia, or the base with which it was before united, will remain as a carbonate. The usual tests, which have already been enumerated, will show the presence of the phosphoric acid.

“The *lime-water* test offers far the best means of separating from the lime (which exists as a carbonate), all the other constituents of a coral, as these various substances are in

very small quantity compared with the entire mass of the coral. Some easy means of completely separating them all, is an indispensable preliminary step in their examination and estimation.

“I am indebted to my friend Dr. J. L. Smith, of Charleston, South Carolina, for suggesting to me the use of this test in the analysis of the corals.

“As the several elements whose presence our researches have determined in corals, have been enumerated in the body of the work (p. 57), it is not necessary to repeat them here; but we may state, in a summary manner, an outline of the general course of analysis pursued in determining the constitution of the *lime-water precipitate*, which, it will be allowed, contains several elements, whose association has always been considered as offering some of the most difficult problems in the whole range of inorganic analysis. The following plan of analysis has been contrived in part, from the late researches of Von Rammelsberg, on the estimation of phosphoric acid, and partly from the labours of Rose and Berzelius, adapting the method to the requirements of the particular problem before us.

“A. The lime-water precipitate, after ignition, is weighed and then digested in fine powder in cold chlorohydric acid; it slowly dissolves, leaving a white flocculent powder. This collected and washed, will be found to be *silica*. It is harsh and gritty between the teeth, is not taken up by long digestion in strong acids, dissolves in a solution of caustic potassa, and before the blow-pipe forms a hard colourless glass with carbonate of soda, dissolving in this reagent with effervescence.

“B. The solution in chlorohydric acid is supersaturated with caustic ammonia, and boiled; a gelatinous precipitate separates, which is usually coloured by iron, and by its characters indicates the presence of alumina. This precipitate contains the phosphoric and other acids and the bases therewith combined. It is collected and the filtrate therefrom (C) is examined for *lime and magnesia*, both of which are usually present.

“D. The precipitate by ammonia (B) is next made into a thick paste with strong sulphuric acid, in a small vessel of platina. A plate of glass, coated with wax and written on, is placed over the crucible; and heat being applied, *hydrofluoric acid* escapes, and attacking the glass, leaves a permanent record of its presence. I have never failed to obtain evidence of the presence of fluorine in any coral which has been subjected to the test. Generally, exposure for one minute will etch the glass most decidedly; and one experiment will suffice to mark distinctly several pieces of glass. By this plan of analysis the quantity of fluorine cannot be estimated, and it must be judged of either by the loss or by the deficiency of acids to satisfy all the bases formed. The constant association of phosphoric acid and fluorine, renders it advisable, in compounds in nature, where one of these elements is found, to search for the other.

“E. After the sulphuric acid has been digested on (D), long enough to convert all the bases present into sulphates, a portion of bisulphate of potash or caustic potash is added, and a little water, to dissolve it; to this, a very large quantity of alcohol of a specific gravity about .860, is added, and the whole is allowed to stand for some hours; during which the double sulphates of potassa, alumina, and iron, crystallize out, while any lime previously combined is separated as sulphate, and in the solution we must look for the phosphoric acid and magnesia, together with a little persalt of iron, held up by the alcohol.

“F. The mixture (E) being filtered and the precipitate washed quite clean with alcohol, the filtrate is evaporated until all the alcohol is expelled, and then supersaturated with ammonia; a little trace of alumina and iron separates, which may be added to that to be obtained from the other portion (H). We may now either add an excess of pure chloride

of calcium to the filtrate (F), or a portion of perchloride of iron. The object in either case, is to separate the phosphoric acid in combination with a base, from whose weight its quantity may be directly estimated, which is an indispensable step, since the fluorine, according to this plan of analysis, can be estimated only by the amount required to saturate the excess of bases. In case the chloride of calcium is employed, we have all the phosphoric acid in the form of phosphate of lime, mixed with a large quantity of sulphate of lime, derived from the sulphuric acid and sulphate of potassa previously employed. This mixture of phosphate and sulphate of lime is collected, washed, and redissolved in chlorohydric acid. The sulphate of lime is separated by alcohol, and the phosphoric acid remains in solution, which, after the excess of alcohol has been expelled, may be thrown down by ammonia, ignited and weighed, or preferably, may be estimated by a magnesian salt. If we employ the method by perchloride of iron, we form in the acid solution containing the phosphoric acid, a basic perphosphate of iron, on supersaturating the solution with ammonia. This compound is mixed with a bulky mass of peroxide of iron, which being thrown on a filter and thoroughly washed; is subsequently decomposed completely by hydrosulphuret of ammonia, into sulphuret of iron and phosphate of ammonia. Care must be taken to use a sufficient quantity of perchloride of iron, otherwise a white precipitate of neutral perphosphate of iron is formed, which is soluble in an excess of ammonia. In either case (the employment of the chloride of calcium, or the perchloride of iron), the phosphoric acid eliminated may be finally best estimated by a magnesian salt and ammonia, as the ammonio-phosphate of magnesia, from whose known constitution the phosphoric acid is easily calculated. We have employed both of these methods; but on many accounts prefer that by the perchloride of iron.

“G. The alcoholic filtrate from (H), containing magnesia and lime, is treated by the well-known methods of analysis for the estimation of those substances. The lime in all cases in these researches, was converted into sulphate and precipitated by alcohol. The magnesia was estimated as phosphate.

“H. The crystalline precipitate from (F), which was collected on the filter, contained the alumina and iron, previously in combination with phosphoric acid or fluorine. This precipitate is boiled in a capsule with a strong solution of carbonate of soda, to decompose the sulphate of lime; it is then filtered, the insoluble residue washed thoroughly and treated with chlorohydric acid, the precipitate by ammonia from (F) being added, and the whole treated with excess of ammonia. Alumina and iron fall, which may be afterward separated in the usual way; but this was generally not deemed requisite, the quantity of iron being very small in most cases.

“I. The filtrate from (H) is treated for lime by oxalate of ammonia, and the oxalate converted into sulphate and weighed: this dose of lime had been previously united to phosphoric acid or fluorine.

“J. Magnesia is next separated from the filtrate of (I), by ammonia and phosphate of soda.

“K. The alkaline liquor from (H) contains another portion of magnesia, which is separated in like manner as the ammonio-phosphate. Much labour is saved if we take care to reserve the several portions, from which magnesia has been thrown down, and unite them in one filtration and weighing, instead of treating them as so many separate portions.

“The minute determination of all the constituents of the lime-water precipitate, was attempted only on those specimens of which we had a large quantity at command; for a solution of half a pound or more of the coral in nitric or chlorohydric acid was necessary to

afford sufficient precipitate for analysis. The carbonate of lime, by far the most abundant constituent, was separately determined on one gramme, as sulphate of lime, and from this the carbonate was calculated. The ratio of phosphates and fluorides of the several bases to the entire mass, was also determined from a distinct portion of coral, two grammes by weight; and from the data thus furnished, we have the means of safely estimating the organic matter by the loss.

*Organic Matter.*—This constituent of the corals deserves particular notice. Some remarks have already been made on it, when speaking of the colouring matter of corals. This organic matter is so intimately united, throughout the whole structure of the corals, amounting to 4–8 per cent., that it cannot be separated by any method resorted to, except by repeated deflagrations with the nitrate of ammonia. When reduced to the finest impalpable powder, it may be digested in repeated doses of boiling water, until no trace of organic matter is longer found in the water, and yet a careful analysis, by falling short of the amount required to complete the 100 parts, will invariably show its presence. The oxalate of lime obtained in their analysis, if ignited (as in the usual manner directed for the estimation of lime), will always have a dark carbonaceous hue, derived from the organic matter of the coral.

“During the solution of considerable quantities of several corals, whose analyses are given beyond (particularly in No. IV., but more or less in all), a large quantity of fatty (?) matter separated, of a yellow colour and disagreeable penetrating odour, though not fetid. It was easily seen floating on the surface of the solution, in transparent jelly-like masses of a yellowish colour. It was insoluble in alcohol, but readily so in cold ether, and the evaporation of its ethereal solution yielded a yellow solid, resembling wax. It fuses below 200° F. A pungent irritating odour arose from the evaporation of the ethereal solution near its close, which acted powerfully on the eyes and nostrils. This volatile principle may be analogous to that known, to proceed from the decomposition of fat (acrolein?). It deserves more attention than I have been able to give it, particularly as it may perhaps be the source of the disagreeable odour of some limestones of coral origin.

*Analyses.*—The following tables exhibit a comprehensive view of the results of the several analyses. The relative proportions of organic matter, carbonate of lime, and the complex precipitate of phosphates and fluorides thrown down by lime-water, are first given; and afterwards the definite composition of this precipitate in the nine species more minutely investigated.

	Porites.	Porites.	Porites.	Porites.	Porites.
	No. 1 (I.)	No. 3.	No. 4.	No. 5.	No. 6.
Carbonate of lime,	95.84	94.412	94.807	93.875	89.864
Phosphates and fluorides,	2.05	0.900	0.950	1.561	0.700
Organic matter,	2.11	4.688	4.243	4.564	9.431
	Porites.	Porites.	Madrepora.	Madrepora.	Madrepora.
	No. 7.	No. 8.	No. 9 (II.)	No. 10 (III.)	No. 11 (IV.)
Carbonate of lime,	94.438	95.000	94.807	92.815	95.086
Phosphates and fluorides,	2.100	1.650	0.745	0.600	0.300
Organic matter,	3.462	3.350	4.448	6.585	4.614

	Madrepora. No. 12 (V.)	Madrepora. No. 14.	Madrepora. No. 15.	Madrepora. No. 16.	Madrepora. No. 17.
Carbonate of lime,	94.881	93.297	94.143	94.239	93.59
Phosphates and fluorides,	0.710	2.450	0.900	0.500	0.500
Organic matter,	4.409	4.253	4.957	5.261	5.91
	Pocillopora. No. 19.	Pocillopora. No. 20.	Pocillopora. No. 21.	Pocillopora. No. 22 (VI.)	Pocillopora. No. 23.
Carbonate of lime,	94.659	93.60	95.001	93.848	94.583
Phosphates and fluorides,	0.550	1.90	1.450	0.550	1.050
Organic matter,	4.791	4.50	3.549	5.602	4.397
	Millepora. No. 24.	Heliopora. No. 25.	Gemmipora. No. 26.	Meandrina. No. 28 (VII.)	Astræa. No. 29 (VIII.)
Carbonate of lime,	94.226	95.545	92.751	93.559	96.471
Phosphates and fluorides,	1.200	1.000	1.500	0.910	0.802
Organic matter,	4.574	3.455	5.749	5.536	2.727
	Astræa. No. 30 (IX.)	Astræa. No. 31.	Astræa. No. 33.	Astræa. No. 34.	Astræa. No. 35.
Carbonate of lime,	96.551	94.810	91.782	93.923	91.112
Phosphates and fluorides,	0.262	0.900	2.100	0.500	.550
Organic matter,	3.187	4.290	6.118	5.577	8.338

“A portion of the massive shell of a large Chama, treated in a similar manner, afforded for 100 parts the following result:

Carbonate of lime, . . . . .	97.007
Precipitate by lime-water, . . . . .	2.600
Organic matter, . . . . .	0.398

“The amount of organic matter is here very small; while the precipitate by lime-water is large. The examination of other shells with reference to this point, would have been highly interesting, and had it fallen within the scope of these researches, the subject would have been farther investigated.

“The per-centage of phosphates and fluorides in the above analyses, after excluding the organic matter, is as follows:

Specimens.	Phosphates and Fluorides.	Specimens.	Phosphates and Fluorides.	Specimens.	Phosphates and Fluorides.
No. 1 (I.)	2.095	12 (V.)	0.743	No. 24	1.258
3	0.945	14	2.562	25	1.036
4	0.992	15	0.947	26	1.593
5	1.637	16	0.528	28 (VII.)	0.964
6	0.774	17	0.537	29 (VIII.)	0.825
7	2.177	19	0.578	30 (IX.)	0.270
8	1.710	20	1.990	31	1.040
9 (II.)	0.780	21	1.504	33	2.114
10 (III.)	0.642	22 (VI.)	0.553	34	0.529
11 (V.)	0.314	23	1.099	35	0.600

“It now remains to give the constitution of the precipitate of fluorides and phosphates. The results annexed are calculated for a hundred parts of the precipitate.

	I.	II.	III.	IV.	V.
Silica,	22.00	12.5	13.50	10.32	23.74
Lime,	13.03	7.5	10.40	15.57	35.01
Magnesia,	7.66	4.2	1.63	38.49	1.35
Fluoride of calcium,	7.83	26.34	34.85	7.50	8.88
Fluoride of magnesium,	12.48	26.62	19.06	2.62	20.44
Phosphate of magnesia,	2.70	8.00	5.87	0.25	3.46
Alumina (and iron),	16.00	14.84	14.69	25.25	7.12
Oxide of iron,	18.30				
		VI.	VII.	VIII.	IX.
Silica,		5.35	11.0	30.01	8.70
Lime,		7.17	25.9	17.45	16.74
Magnesia,		0.49	0.8	24.57	45.19
Fluoride of calcium,		4.05	15.0	0.85	0.71
Fluoride of magnesium,	Phosphate } of lime. }	4.25	Fluoride } of mag. }	23.2	4.31
Phosphate of magnesia,		16.30	4.7	0.32	0.34
Alumina (and iron),		35.00	19.4	22.49	25.97
Oxide of iron,		27.39			

“The foregoing results show that, contrary to the expectation when the research was commenced, fluorine is present in much larger proportion than phosphoric acid. The silica exists in the coral in its soluble modification, and probably is united to the lime. The free magnesia existed as carbonate, and was thrown down as caustic magnesia by the lime-water. Some small portion of lime was probably thrown down as carbonate, in spite of every precaution to the contrary. Only in two or three instances, however, was there any effervescence on the addition of chlorohydric acid to redissolve it.

“It need hardly be said, that the existence of all the matters noted in these analyses in sea water, is a just inference; but this subject, as well as the important geological inferences, which may be drawn from the results now presented, will be fully discussed on another occasion.

“My warmest acknowledgments are due to my friends and pupils, Messrs. D. Olmsted, Jr., and T. S. Hunt, who have zealously aided me in the laborious parts of these investigations.

“B. SILLIMAN, JR.

“Yale College Laboratory, Dec. 16th, 1845.”

*Radiated Structure of the Lower Animals.*—p. 107.

In the remark that a radiated structure characterizes the simplest forms of animal life, we do not intend to imply, that it is apparent in all these forms. As stated, in connexion, the vegetable kingdom affords us examples of the great variety of structures, which may result from simple cellule development. The cellules may grow in simple lines or spreading plates, and endless shapes may proceed from them under all their possible mo-



difications. When several lines proceed together in growth, their mutual influence appears to result in a radiated structure. But whether this be so or not, this structure is the highest to which cellule development alone can attain. The unsymmetrical forms which are exhibited in certain flowers, may all come under the general laws stated on page 99, and be owing to a more rapid reproduction on one side than the opposite.

*Euphyllia aspera*.—p. 164. *Mussa fastigiata*.—p. 175.

The *Euphyllia aspera*, which appears to be in part the *Caryophyllia fastigiata* of Lamarek, might with some propriety have been retained under his specific name. But the term is bad, as the species grow in hemispherical forms, a necessary result of their furcato-ramose mode of increase. There can be no fastigate zoophytes among the Euphyllia.

The term *Mussa fastigiata*, in page 175, is equally objectionable. This species has been confounded with the *E. aspera*, although, taking Ellis's figure as at all correct, it is strikingly different in its larger calicles, and the appearance of the exterior costæ, and of the slightly erose lamellæ. It is probably a fragment from a hemispherical clump.

*Euphyllia costata*. (D.)—A specimen, placed in the hands of the author by Mr. J. S. Phillips, of Philadelphia, has the strongly-ribbed exterior, non-spinulose and nearly smooth, of the *Mussa fastigiata*, with the size of the *E. aspera*. The costæ are very stout, and hardly acute, and become quite obsolete, leaving the surface even below, an inch or less from the summit. In a transverse section, the star is closely multiradiate, and the septum enclosing it is very solid, and has the unusual thickness of a line to a line and a half. The locality is not known. It is a species intermediate between the *Mussæ* and Euphyllia. The lamellæ are entire, as in the latter genus, but scarcely meet at centre, a narrow interval, the bottom of the cell, intervening. They are unequal, the largest somewhat exsert, and cultriform.

*Astræa: Appendix*.—p. 252.

*A. Orbicella orion*. (Dana.)—A polypis parvulis ( $1\frac{1}{4}$ '' latis), lamellis 24. Corallum percellulosum: transversè secto, stellis orbiculatis, subtiliter annulatis, 1'' latis, medio valde porosis, tenuiter 12-radialibus, aliis radiis intermediis obsoletis: septis percellulosis, cellulis 1-2-seriatis; verticaliter secto, texturâ subtilissimè cellulosâ, stellæ medio irregulariter minutè porulosâ.

Polyps very small ( $1\frac{1}{4}$  lines broad), lamellæ 24. Corallum light and cellular: in a transverse section, stars circular, delicately annulate, a line broad, with a very porous centre, delicately 12-rayed, with other obsolescent rays intermediate; septa very cellular, cellules in one to two series; in a vertical section, texture very finely cellular, and irregularly minute porous along the centre of the star.

This new species, from Ceylon, of which I have only seen a worn specimen, is figured on plate 14: fig. 14, is a transverse section, natural size; 14 a, same, enlarged; 14 b, a vertical section, natural size. The species resembles the *annularis*, but is more delicate in texture, and unlike that species, has the centre of the star very delicately porous. In a vertical section, three to four of the cellules in a longitudinal series (where coarsest) oc-

copy a line in length. The *pleiades* is a lighter coral, with the stars larger, and the cellules in a vertical section one-half coarser.

Plate 13, fig. 15, represents a worn coral of uncertain locality, near the *porcata* in its stars (in a transverse section). Fig. 14 represents a transverse section, and 14 *a*, a vertical section. It is probably from the West Indies. A single cell remains on the specimen, nearly perfect, and from that the interstices appear to be slightly concave with a medial sulcus (nearly as in the *porcata*); the lamellæ are thin and evenly regular over the interstices, and very minutely denticulate; the cells rather shallow; the septa nearly solid, two-thirds to three-fourths of a line wide; the stars three lines in diameter, many-rayed, with the cellules sparingly decompound.

*Genus Fungia.*—p. 287.

The following species has been described by Michelin.

*Fungia distorta.*—*F. suborbicularis*, lobata, subtus irregulariter concava, striata, scabra; striis tenuissimis, dichotomis, sæpe divaricatis, rugosis, stella convexa, contorta, lamellis inæqualibus dentatis, latere granulosis; oririmâ subdivisâ.

Michelin adds that the species is remarkable for its irregular form, it being divided into five or six lobes, one of which lies partially beneath the others; this character was alike in four specimens examined. The figure represents a specimen one and a half inches in diameter, with the lamellæ minutely denticulate. The locality is not given in Guerin, from which work it is here cited.

*Fungia distorta*, Michelin, Revue Zool., par la Soc. Cuv., 1842, p. 316; Guerin, Mag. de Zool., 1843, pl. 5.

*Pavonia frondifera.*—p. 328.

The references for this species, omitted in the text, are as follows:

*Pavonia frondifera*, Lamarck, ii. 379. —, Deslongchamps, Encyc., 605.  
—, Blainville, Man., 365.

*Genus Turbinalopsis.*—p. 349.

Ehrenberg proposes to substitute the name Trochopsis for Turbinalopsis, of which he says "Hybridum nomen e scientiâ removendum est."

*Genus Turbinalia.*—p. 374.

The remark that the Turbinaliæ are free Dendrophylliæ should be modified, inasmuch as we find the Caryophyllia structure also represented among them. The Caryophylliæ and Dendrophylliæ are so closely related, that although we have attempted to point out distinguishing characters, none can be certainly relied on excepting the mode of budding and growth.

*Genus Phylloides.*—p. 374.

Philippi's figure of the *Phylloides*, though representing a perfect individual according to his description, is a *half* of some cuneiform species, perhaps allied to the *Turbinaliæ*, as stated in the text, but possibly nearer the *Euphyllia*. The description and figure leave it doubtful.

Lonsdale has given the name *Endopachys* to certain free *Turbinaliæ*, characterized by having thick porous sides and base to the corallum, and no trace of a pedicel in the adult state; to it belong the cuneiform species which the *Phylloides*, properly characterized, may include. In the lamellæ and texture, they are near the *Dendrophyllia*. Lonsdale refers to it both turbinate and cuneiform species, and rests his genus principally upon the idea, that the thickening of the corallum takes place from within through foramina—a very doubtful fact. On an examination of specimens of Lonsdale's species, I find no evidence of so anomalous a mode of secretion. The name alludes to this supposed fact, and is from *ενδον*, *within*, and *παχος*, *thick*.—LONSDALE, *Proceed. Geol. Soc., London*, iv., 1845, part iii.

*Genus Astroitis.*—p. 405.

Many of the fossil corals referred to the genus *Astræa*, appear to be more properly allied to the group *Astroitis*. They have the *narrow* interstices of the *Astræa*, which bud in the disks (the *Fissicellæ*), but bud *interstitially*, like the *Astroites*; and we may infer from analogy that they have the polyps prominent when expanded, as in this genus, a character which would place them with the *Caryophyllacea* (see p. 203). Some species appear to have the imperfectly united cells of the Mediterranean *Astroitis*, and to this division of the group probably belongs the *Columnaria sex-radiata* of Lonsdale. (*Proceed. Geol. Soc., London*, iv., 1845, part. iii.) In others, the cells are solidly coalescent; and these may be distinguished by the generic name *Pleiadia*.

*Madrepora: Appendix.*—p. 489.

*Heteropora imbricata*. (Ehrenberg, op. cit., G. lxi., sp. 15): "Quadri-pollicaris, lator, cespitosa, ramis gracilibus, densè stellulatis, stellulis [caliculis] inferioribus parum prominulis, superioribus semitubulosis, densè imbricatis, in laminas planas striatas apice dilatatas passim glabras abeuntibus, stellis terminalibus parvis ostiis apice apertis." No locality is given.

The genus *Madrepora* of Ehrenberg, which includes species not budding from a parent-polyp, is divided into the two subgenera *Phyllopora* and *Porites*. *Phyllopora* includes two species, *spherostoma* and *leptostoma*, the first of which appears to be an *Echinopora*, and perhaps also the other. If not *Echinopora* (as having twelve tentacles, in connexion with an inferior mode of budding, would prove), they may be representatives of that genus among the *Madreporacea*, in the same manner as the *Heliolites* represent the smaller *Orbicellæ*. They are described as follows:

*P. spherostoma.* (H. & E.)—"Octo-pollicaris, glomerata, subglobosa, stellis prominulis hemisphericis, inæqualibus, irregularibus, sulco distentis, adutorum aperturâ 1''' lata, capitulo 2½''' lato, totâ superficie apiculis spinuloso-hispidis aspera, stellis profundis, lamellis senis latioribus alternis." Red Sea.

*P. leptostoma.* (H. & E.)—"Quinque-pollicaris, effusa, hemispherica, stellis margine obsoletè et irregulariter prominulis, fere immersis, minoribus, aperturâ 1''' lata, nec sulco discretis, interstitiis complanatis, superficiei papillis obtusioribus, hispidis, nec spinulosis." Red Sea.

*Genus Heteropora.*—p. 539.

A species of this genus from the Tertiary of Petersburg, N. C., is described by Lonsdale, as having no transverse septa in the cells within the corallum, which character would remove the group from the neighbourhood of the *Heliopora*.

Lonsdale, *Proceed. Geol. Soc., London, iv., 1845, part iii.*

*Porites: Appendix.*—p. 568.

*Porites cervina.* (Lamarck.)—"P. pumila, gracilis, dichotomo-ramulosa; stellis distinctis; margine prominulo, ciliato." This species is referred to the genus *Seriatopora*, by Blainville. (Lamk., ii. 438, No. 11; Deslongch., *Encyc.*, 653.—*Seriatopora cervina*, Blainv., *Man.*, 397.)

*Porites angulata.* (Lamarck.)—"P. ramis contortis, lobatis, compressis, angulatis; stellis in fossulis immersis; margine denticulis scabro." (Lamk., ii. 438, No. 9; Deslongch., *Encyc.*, 653.—*Heliopora angulosa*, Blainv., *Man.*, 392.)

## GLOSSARY.

It has been found necessary to apply more definite significations to some terms than they have hitherto received in this department of zoological science, or to use them in a modified sense; and a short glossary is here added for the convenience of reference.

### 1. *General Terms.*

*Zoophyte.* An individual in this order of animals, whether a solitary polyp, or a compound group.

*Segregate.* The polyps of a group, disunited except at base.

*Aggregate.* The polyps united throughout laterally, as well as at base.

*Acrogenous*. Growing upward indefinitely (§ 61), increase taking place at summit.

*Prolate*. The summits of the polyps widening by growth and budding.

*Stolon*. A shoot or margin growing outward indefinitely, and gradually giving out buds from above.

*Dichastic*. (From διχαζω, to subdivide spontaneously). The apparent subdividing of a polyp arising from disk-budding.

*Coralligenous*. Forming coral secretions.

*Corallum*. The solid secretions of zoophytes, whether calcareous, horny, suberose, or siliceous (§§ 9, 46).

*Polypary, Polypifer, Polypidom*. See Corallum.

## 2. General Forms of Zoophytes.

*Glomerate*. Massive; proceeding from acrogenous growth, and budding in every direction.

*Explanate*. Oblique or horizontal foliaceous; proceeding from budding in a plane, without acrogenous growth.

*Lamellate*. Erect foliaceous; the opposite surfaces of the erect plates similar.

*Arborescent*. Forming ramose tree-like zoophytes.

*Fruticulose*. Arborescent stems, clustered on a common base, and not forming an even-top clump.

*Cespitose*. Stems clustered on a common base and forming an even-top clump.

*Flabellate*. Branching in a plane.

*Reticulate*. Flabellate, with the branches and branchlets coalescing.

*Fronde*. Applied to a reticulate or flabellate zoophyte, or a folium of a foliate species. In the reticulate or horizontally growing Madreporæ, the term applies to the whole, including the reticulate plate or base with the branchlets that cover it.

*Caliculato-ramose*. Each calicle forming a separate branch to the corallum; arising from segregate budding.

*Patrio-ramose*. Branches lengthening through the indefinite growth and lateral budding of a terminal polyp.

*Cumulato-ramose*. Branches lengthening by buds at apex, the new polyps being successively the terminal.

*Furcato-ramose*. Branching by a spontaneous subdivision of the summit.

## 3. Structure of Corallum.

*Cell* (cella). A surface depression, corresponding more or less perfectly to the visceral cavity of a polyp.

*Calicle* (caliculus, a little cup). A cup-like elevation containing a cell; the result of coral secretions within the sides of prominent polyps. (For their various forms among the Madreporæ, see page 432).

*Cellule, Porule*. The pores in the internal texture of a corallum.

*Lamella*. One of the radiating plates within a cell.

*Star* (stella). The stars of radiating lamellæ, seen in a transverse section of the cells of some coralla; also on the surface in some Fungidæ.

*Septum*. The wall enclosing a cell, or that intervening between two cells in massive species; also the cross-partitions in the cells through the interior of some coralla (Favositidæ, Cyathophyllidæ).



*Ridge* (Collis). An elevation between two cells, including, along with the septum, the lamellæ which cover it.

*Trench* (Fossa). A meandering cell in the Meandrine corals.

*Gyrus*. A trench together with the sides enclosing it; or, in massive species, the space between the middle of two ridges.

*Oririme*. A small pore in the surface of the coralla of the Fungidæ, situated beneath the mouth of a polyp, and forming the centre from which the lamellæ radiate.

*Dissepiments*. Restricted to the septa which unite two lamellæ of a cell to one another by their lateral surfaces.

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## I N D E X.

The names of the Genera, adopted in this work, are here printed in SMALL CAPITALS, in order to distinguish the names of received species from the synonyms; the latter form a separate paragraph from the former. To guide in the pronunciation, the accented syllable is indicated wherever it might appear doubtful.

- ACERVULARIA, 359, 360  
 Acrop'ora cespitosa, 380  
 Actinantha florida, 606  
 Actinaria, general characters of, 45, 46  
     geographical distribution, 102  
 ACTINARIA, 121  
 ACTINECTA, 124  
 ACTINERIA, 125  
 Actinia, structure of, 30  
     analogies with a flower, 88  
 ACTINIA, 124, 125; achates, 142; artemisia, 149; clavigera, 135; clematis, 130; cruentata, 138; curta, 148; decorata, 139; diadema, 133; flagillifera, 126; florida, 131; fuegiensis, 145; gemma, 147; graminea, 132; impatiens, 135; lineolata, 137; mollis, 141; monilifera, 136; nymphæa, 146; papaver, 143; paumotensis, 141; pluvia, 143; pretiosa, 137; primula, 134; pustulata, 128; reticulata, 144; rhodora, 148; rubus, 147; tabella, 132; veratra, 129  
 Actinia sociata, 421  
 ACTIN'IDÆ, 122  
 ACTINODENDRUM, 124  
 Actinoidea, general structure of, 30  
     general subdivisions of, 45  
 Adamsia, 126  
 AGARICIA, 333; agaricites, 342; cristata, 343; cucullata, 339; fragilis, 341; gibbosa, 341; levicollis, 338; planulata, 338; purpurea, 340; rugosa, 336; speciosa, 337; undata, 336  
 Agaricia ampliata, 273, 324; aspera, 282; boletiformis, 328; crispa, 323; elephantotus, 324; explanata, 322; explanulata, 322; lima, 505; papillosa, 506  
 Alcyonaria, structure of, 45, 50, 700  
     secretion of corallum, 53  
 ALCYONARIA, 586  
 Alcyonella Savignii, 513  
 Alcyonidia elegans, 624  
 ALCYONIUM, 611; aurantiacum, 618; brachycladum, 617; confertum, 621; cydonium, 614; digitatum, 613; elegans, 624; flabellum, 619; flavum, 620; flexile, 619; latum, 623; glaucum, 623; murale, 622; palmatum, 615; pauciflorum, 616; polydactylum, 617; pulmo, 624; rigidum, 622; stellatum, 615; spherophora, 616; trichanthinum, 620; viride, 618  
 Alcyonium agaricum, 589; amicorum, 608, 621; arboreum, 625, 644; asbestinum, 643; botryoides, 626; bulbosum, 624; coriaceum, 625; exos, 614, 615; floridum, 626; imbricatum, 608; incrustans, 624; lobatum, 614; mammillosum, 424; massa, 615; ocellatum, 426; ramosum, 608; rubiforme, 625; rubrum, 610, 614; spongiosum, 616; terminale, 607; tuberculosum, 427, 616  
 ALLOP'ORA, 693; flabelliformis, 694; gemmascens, 696; infundibulifera, 695; norwegica, 697; oculina, 697; rosea, 695

- Alveolites, 536  
 ALVEOP'ORA, 511; dedalea, 512; fenestrata, 514; retepora, 512; rubra, 513; spongiosa, 513  
 Alveop'ora viridis, 514, 516  
 ALVEOPORINÆ, 510  
 AMMOTHEA, 607; thyrsoides, 607; virescens, 608  
 Ammothea amicorum, 608; imbricata, 608; ramosa, 608; virescens, 617  
 AMPLEXUS, 357  
 ANTENNULARIA, 686; cyathifera, 687  
 ANTHEA, 124  
 ANTHELIA, 602; Desjardiana, 603; glauca, 602; purpurascens, 603; strumosa, 602  
 Anthelia rubra, 610, 614  
 Anthoph'ora cucullata, 516  
 ANTHOPHYLLUM, 398; astreatum, 400; cespitosum, 401; clavus, 403; cuspidatum, 402; fasciculatum, 399; hystrix, 401; musicale, 399  
 Anthophyllum anthophyllites, 383; calyculare, 406; cespitosum, 380; cyathus, 371; Esperii, 401; fasciculare, 402; saxum, 383; spherula, 403  
 Anthozoa, 15  
 ANTIPATHACEA, 574  
 ANTIP'ATHES, 575; alopecuroides, 584; anguina, 576; arborea, 584; Boscii, 584; corticata, 583; cupressus, 581; ericoides, 580; eupteridca, 577; flabellum, 579; feniculum, 582; lacerrata, 583; larix, 577; mimosella, 580; myriophylla, 578; pectinata, 578; pennacea, 582; pinnatifida, 581; pyramidata, 583; reticulata, 579; scoparia, 582; spiralis, 576; subpinnata, 579  
 Antip'athes clathrata, 580; compressa, 585; dichotoma, 585; glaberrima, 585; ligulata, 580; radians, 580; ulex, 581  
 ANTIPATH'IDÆ, 574  
 APSENDESIA, 573  
 ARACHNOPHYLLUM, 360  
 ASTRÆA, 206  
 — (ORRICELLÆ) annularis, 214; argus, 207; crispata, 216; coronata, 211; curta, 209; excelsa, 212; glaucopsis, 208; hyades, 212; microphthalma, 217; ocellina, 218; orion, 720; patula, 209; pleiades, 213; radiata, 206; rotulosa, 210; stelligera, 216; stellulata, 215  
 — (SIDERINA) galaxea, 218  
 — (FISSICELLÆ) abdita, 247; ananas, 222; cerium, 245; deformis, 235; denticulata, 234; dipsacea, 225; echinata, 229; eximia, 242; favistella, 241; favulus, 245; filicosa, 232; flexuosa, 227; fragilis, 230; fuscoviridis, 228; intersepta, 246; magnifica, 231; melicerum, 244; pallida, 224; pandanus, 222; parvistella, 244; pectinata, 235; pentagona, 241; petrosa, 238; porcata, 226; pulchra, 240; purpurea, 239; puteolina, 223; reticularis, 237; rigida, 237; robusta, 248; sinuosa, 243; speciosa, 220; tenella, 231; tesserifera, 248; uva, 221; varia, 236; versipora, 233; virens, 228  
 — (APPENDIX) complanata, 249; cyclostra, 251; favosa, 252; halicora, 250; heliopora, 250; Hemprichii, 250  
 Astræa ananas, 221, 222; astroites, 220; calycularis, 406, 569; detrita, 239; diffluens, 332; halicora, 232; meandrina, 347; myriophthalma, 415; palifera, 409; planulata, 570; pulvinaria, 415; punctifera, 416; siderca, 332; viridis, 406  
 ASTRÆACEA, 121  
 ASTRÆ'IDÆ, 154  
 ASTRÆOP'ORA, 414; fungiformis, 416; pulvinaria, 415; punctifera, 416; stellulata, 416  
 Astræopora myriophthalma, 415  
 ASTROITIS, 405, 722; calicularis, 406; viridis, 406  
 AULOPORA, 630; tenuis, 631  
 BENRYCE, 677; mollis, 677  
 Blumenbachium, 702  
 Bonnet de Neptune, 312

- Branching, by furcation, 71  
 —, by lateral shoots, 71  
 BRIA'REUM, 642; arboreum, 644; gorgo-  
 nideum, 645; suberosum, 645  
 Bryozoa, 15, 108  
 Budding, 14, 24, 57, 709  
 —, in Astræa, 75  
 —, in Aulopora, 66  
 —, in Caryophyllia, 69  
 —, in Cyathophyllidæ, 80  
 —, in Dendrophyllia, 69  
 —, in Echinopora, 75  
 —, in Fungidæ, 77  
 —, in Gemmipora, 67  
 —, in Madrepora, 69  
 —, in Meandrina, 77  
 —, in Oculina, 67  
 —, in Zoontha, 66  
 —, connexion with modes of growth,  
 66
- Calamites, 637  
 Calamophyllia, 368  
 Calamop'ora, 536  
 CALOPHYLLUM, 356  
 CAMPANULARIA, 689  
 CAMPANULAR'IDÆ, 688  
 CANINIA, 358  
 CAP'NEA, 124  
 CARYOPHYLLACEA, 350  
 CARYOPHYLLIA, 378; anthophyllum, 383;  
 arbuscula, 381; cespitosa, 379; con-  
 ferta, 380; cornigera, 382; flexuosa,  
 381  
 —, dilatata, 384; solitaria, 383; pocil-  
 lum, 384  
 Caryophyllia angulosa, 164, 168, 177; as-  
 treata, 400; aurantiaca, 388; calycu-  
 laris, 406; carduus, 176; cespitosa,  
 380; compressa, 161, 162; corym-  
 bosa, 178; cristata, 180; cyathus,  
 371, 372; dianthus, 375; fasciculata,  
 400; fastigiata, 164, 165, 175, 720;  
 glabrescens, 163; lacera, 176; musi-  
 calis, 399; ramea, 386; sinuosa, 180;  
 Smithii, 372  
 CARYOPHYLLIDÆ, 364  
 CATENIP'ORA, 538
- CAULASTRÆA, 197; distorta, 199; furcata,  
 198; undulata, 199  
 Caunop'ora, 702  
 Cavolinia mammillosa, 425; rosca, 424  
 CERIOP'ORA, 571  
 Ceriop'ora, 536  
 CHAUNOP'ORA, 702  
 Chætetes, 536  
 Chrysa'ora, 571  
 Cirrhip'ates Sieboldi, 577; spiralis, 576  
 Clado'cora anthophyllum, 383; calicularis,  
 406; candelabrum, 382; cespitosa,  
 380; flexuosa, 381; levigata, 380  
 Classification of Zoophytes, 105  
 Clavularia, 629; violacea, 603, 629; viri-  
 dis, 603, 629  
 CLISIOPHYLLUM, 361  
 Coalescence of branches, 65  
 COLUMNARIA, 362  
 CONSTELLARIA, 537  
 CORALLIUM, 640; nobile, 640; secundum,  
 641  
 Corallium rubrum, 640  
 Corallum, secretion of, 15, 50  
 —, definition of, 15  
 —, constitution of, 56, 712  
 —, specific gravity of, 713  
 —, structure of, 50, 710  
 Cordyloph'ora, 691  
 CORNULARIA, 627; rugosa, 628  
 Cornularia cornucopiæ, 628; floridea, 606;  
 subviridis, 606; thalassianthoidea, 601  
 CORNULAR'IDÆ, 627  
 Corticif'era aggregata, 427; flava, 426;  
 glareola, 426  
 CORYDENDRIUM, 691  
 COR'YNA, 691; capillifera, 692  
 COSCINOP'ORA, 700  
 Cribrina, 126  
 CTENOPHYLLIA, 169; pachyphylla, 172;  
 pectinata, 170; profunda, 172; quad-  
 rata, 171  
 CULICIA, 376; stellata, 377; tenella, 377;  
 truncata, 378  
 Curalium, 15  
 CYATHI'NA, 369; cyathus, 370; flexuosa,  
 371; pezita, 371; Smithii, 371; tur-  
 binata, 372

- Cyathoph'ora, 357  
 CYATHOPHYLLIDÆ, 352  
 CYATHOPHYLLUM, 355  
 CYCLOLITES, 305  
 Cyclolithas, 306  
 Cydo'nium Mulleri, 614  
 Cystiophyllum, 360  
  
 Death of Zoophytes, 63  
 Dendrogyra caudex, 266; cylindrus, 265  
 DENDROPHYLLIA, 384; aurantiaca, 388;  
     coccinea, 388; diaphana, 389; mi-  
     crantha, 386; nigrescens, 387; ra-  
     mea, 386; rubeola, 389; scabrosa, 390  
 Dendrophyllia cornigera, 383  
 Dentip'ora anastomozans, 395; virginea, 395  
 DESMOPHYLLUM, 375; dianthus, 375; stel-  
     laria, 376  
 Dimorphæa, 15  
 Diploctenium, 158  
 Dipsastræa deformis, 236; denticulata, 235;  
     dipsacea, 225; versipora, 234  
 Discoso'ma, 126  
 DISTICHOP'ORA, 703; gracilis, 704; vio-  
     lacea, 703  
 Dymorphosa, 691  
  
 Echinastræa gemmacea, 282; ringens, 280;  
     rosularia, 279  
 ECHINOP'ORA, 277; aspera, 281; horrida,  
     282; reflexa, 280; ringens, 279; ro-  
     sularia, 279; undulata, 278  
 ECMESUS, 369  
 Ectacmæa, 126  
 EDWARDSIA, 124  
 Entacmæa, 126  
 Epicla'dia, 125  
 EPICYS'TIS, 124  
 ERRI'NA, 570; aspera, 571  
 EUENDRIUM, 691  
 Eunice'a antipathes, 661; apiculata, 661;  
     arbuscula, 659; Bertolonii, 663; cla-  
     varia, 671; furcata, 668; granulata,  
     660; limiformis, 672; mammosa, 672;  
     microthela, 671; mollis, 672; muri-  
     cata, 674; nivea, 661; papillosa, 670;  
     pseudo-antipathes, 671; quincuncialis,  
     669; ramulosa, 665; reticulum, 660;  
     suberosa, 671; succinea, 671; tama-  
     rix, 659; tuberculata, 664; turgida,  
     670; umbratica, 660; verrucosa, 661  
 Euno'mia, 538  
 EUPHYLLIA, 157; anthophyllum, 160;  
     aperta, 165; aspera, 164, 720; cos-  
     tata, 720; cultrifera, 169; glabre-  
     scens, 163; gracilis, 163; Hemprichii,  
     169; incandrina, 167; pavonina, 159;  
     rubra, 161; rugosa, 166; sinuosa,  
     168; spheniscus, 160; spinulosa, 162;  
     turgida, 166  
 Europ'ala, 125  
 Evag'ora rosca, 601.  
 Explanaria annulata, 214; aspera, 282;  
     cinerascens, 412; crater, 410; cris-  
     tata, 500; gemmacea, 282; Hempri-  
     chii, 282; infundibulum, 411; radiata,  
     207; ringens, 280  
  
 Favia ananas, 222; complanata, 249;  
     denticulata, 235; microphthalma, 218;  
     porcata, 222; rotulosa, 211; uva,  
     221; versipora, 234  
 FAVISTELLA, 538  
 FAVOSITES, 535  
 FAVOSITIDÆ, 509  
 Flabellum, 158; pavoninum, 160  
 Flustroid polyps, 15  
 FUNGIA, 287; actiniformis, 299; agarici-  
     formis, 292; asperata, 303; conferti-  
     folia, 297; crassa, 304; crassitentac-  
     ulata, 299; cyclolites, 289; dentata,  
     293; dentigera, 301; discus, 291;  
     distorta, 721; echinata, 294; Ehen-  
     bergii, 303; glans, 290; horrida,  
     298; integra, 296; paumotensis, 300;  
     pectinata, 302; repanda, 295; Rüp-  
     pellii, 304; scutaria, 301; tenuis, 902  
 Fungia echinata, 304; limacina, 307; li-  
     max, 307; patellaris, 293; pileus, 312  
 FUNGIDÆ, 283  
 Funiculi'na, 593; stellifera, 590; tetragona,  
     593  
  
 Galaxea anthophyllites, 383; cespitosa,  
     380; cuspidata, 402; cyathus, 371;  
     fascicularis, 400; musicalis, 399

- Gemmip'ora, growth of, 67  
**GEMMIP'ORA**, 408; brassica, 413; cinerascens, 411; crater, 411; frondens, 412; palifera, 409; patula, 410; peltata, 410  
 Gemmip'ora mesenterina, 412  
**GEMMIPOR'IDÆ**, 407  
**GONIOF'ORA**, 568; columna, 569; pedunculata, 569; Savignii, 570  
 Gorgonia, axis of, 55, 712  
**GORGON'IA**, 644; alba, 673; anguiculus, 668; antipathes, 666; apiculata, 661; Bertolonii, 663; cancellata, 658; clathrus, 656; clavaria, 671; coccinea, 673; crassa, 670; dichotoma, 669; elongata, 664; exserta, 666; flabellum, 655; flammea, 662; flavida, 664; flexuosa, 660; furcata, 664; graminea, 663; granulata, 660; homomalla, 667; humilis, 663; juncea, 664; lima, 672; madrepora, 671; mammosa, 672; miniacea, 662; moniliformis, 673; nivea, 661; olivacea, 668; papillosa, 670; penna, 673; plantaginea, 672; pseudo-antipathes, 671; purpurea, 672; quincuncialis, 668; ramulosa, 665; retellum, 659; reticulum, 656; rhizomorpha, 673; Richardii, 673; sanguinea, 663; sasappo, 663; spicifera, 665; stricta, 659; suffruticosa, 665; tamarix, 659; trichostemma, 665; tuberculata, 659; umbella, 656; umbraculum, 657; ventilabrum, 657; venusta, 658; vermiculata, 669; verriculata, 657; verrucosa, 661; virgulata, 662  
 Gorgonia abietina, 650; acerosa, 649, 651; americana, 650; anceps, 648; briareus, 643; calyculata, 671; ceratophyta, 652, 653, 662; cerea, 675; citrina, 648; coralloides, 610; dilatata, 647; florida, 611; friabilis, 669; furfuracea, 659; heteropora, 670; humosa, 661; laxa, 651; laxispica, 674; lepadifera, 676; leucostoma, 653; mollis, 672; multicauda, 670; muricata, 672, 674; myura, 676; nobilis, 640; nodulifera, 666; ochrostoma, 652; palma, 661; patula, 650; pectinata, 652; petechizans, 650; pinnata, 649, 651; placomus, 675; porosa, 669; pseudo-antipathes, 658; pustulosa, 654; quercus-folium, 647; reseda, 677; reticulata, 657; rosea, 651; sanguinolenta, 651, 653; sarmentosa, 653; setacea, 653; setosa, 651; stricta, 663; suberosa, 643, 652, 671; succinea, 671, 672; sulcifera, 652; umbratica, 660; ventalina, 657; verticillaris, 675; viminalis, 661, 662; violacea, 651; virgata, 674  
**GORGON'IDÆ**, 637  
 Haliglossa echinata, 304; foliosa, 309; interrupta, 308; limacina, 308; stellaris, 309  
**HALOMITRA**, 311; pileus, 311  
 Halysi'tes, 538  
 Harmodites, 637  
**HELIOLI'TES**, 541  
 Heliophyllum, 356  
**HELIOF'ORA**, 539; cærulea, 540  
 Heliopora angulosa, 723; furcata, 555  
 Hermia, 691  
**HERPETOL'ITHUS**, 306; crassus, 310; foliosus, 308; interruptus, 308; limacinus, 307; stellaris, 309; strictus, 309  
 Herpetolithus echinata, 304; Ehrenbergii, 303; Ruppellii, 304  
 Heterodac'tyla, 125  
**HEREROP'ORA**, 539; 572, 723  
 Heteropora abrotanoides, 478; appressa, 453; cervicornis, 476; corymbosa, 446; decurrens, 459, 488; echidnaea, 458; flabellum, 439; Forskalii, 489; Hemprichii, 473; imbricata, 722; laxa, 488; microclados, 444; palmata, 437; prolifera, 480; regalis, 488; seriata, 488; squarrosa, 488; tubulosa, 488; tylostoma, 489  
**HYALONE'MA**, 641; Sieboldi, 642  
 Hydno-ph'ora Pallasii, 268; Esperii, 268  
**HYDRA**, 12, 24, 685  
 Hydra sociata, 421  
**HYDRACTINIA**, 691



- HYDRIDÆ, 685  
 Hydroidea, structure of, 14  
 —, reproduction in, 22, 709  
 HYDROIDÆA, 685  
 Hughea Hemprichii, 418; Savignyi, 419
- ILYANTHUS, 124  
 Isacmæa, 126  
 ISAURA, 418; aster, 419; Hemprichii, 418;  
 Savignii, 419; speciosa, 419  
 -ISIS, 680; elongata, 681; hippuris, 680  
 Isis aurantia, 683; coralloides, 680; dichotoma, 679; encrinula, 679; enerinus, 598; erythracea, 680; gracilis, 679; nobilis, 640; ochracea, 682
- LAOMEDE'A, 689; gracilis, 689; simplex, 690  
 LICHENOP'ORA, 574  
 Lichenopora glomerata, 537  
 LIMA'RIA, 702  
 Lithodendrum angulosum, 177; cristatum, 180; proliferum, 393; rameum, 386; virgineum, 395  
 Lobophyllia angulosa, 166, 167, 177; aurantiaca, 388; carduus, 176; corymbosa, 178; fastigiata, 175; glabrescens, 163; sinuosa, 180  
 Lobularia arborea, 644; asbestina, 643; aurantiaca, 618; brachyclados, 618; coriacea, 625; conoidea, 614; digitata, 614; grandiflora, 614; palmata, 615; pauciflora, 617; polydaetyla, 617; spherophora, 616; rubiformis, 625
- LUCERNARIA, 125  
 MADREP'ORA, 431; abrotanoides, 477; acervata, 460; aculeus, 450; alces, 437; appressa, 457; arbuseula, 474; aspera, 463; austera, 478; brachiata, 474; carduus, 464; cerealis, 460; cervicornis, 479; conigera, 440; convexa, 449; corymbosa, 456; cribripora, 470; cuneata, 487; cuspidata, 485; cyclopea, 439; cytherea, 441; decurrens, 488; deformis, 484; digitifera, 454; divaricata, 477; echidnæa, 458; echinata, 464; efflorescens, 441; effusa, 455; exigua, 469; flabellum, 438; florida, 466; formosa, 473; Forskalii, 489; globiceps, 454; gracilis, 482; gravida, 470; hebes, 468; horrida, 472; humilis, 483; hyacinthus, 444; hystrix, 476; implicata, 466; labrosa, 486; laxa, 487; millepora, 446; nasuta, 453; nobilis, 481; palmata, 436; paxilligera, 452; plantaginea, 459; pocillifera, 484; prolifera, 480; ramiculosa, 463; regalis, 488; retusa, 462; prostrata, 447; robusta, 475; rosaria, 465; secunda, 481; securis, 486; seriata, 488; spicifera, 442; squarrosa, 488; subulata, 448; sureulosa, 445; tenuis, 451; tortuosa, 467; tubicinaria, 451; tubulosa, 488; tylostoma, 489; valida, 461; virgata, 471  
 Madrepora abdita, 247; acropora, 211; agaricites, 343; ampliata, 272; ananas, 222; angulosa, 177, 180; annularis, 214; anthophyllum, 371; anthophyllites, 383; arborea, 386; areolata, 192; aspera, 281; astroites, 219; axillaris, 394; boletiformis, 328; cærulea, 541; calycularis, 406; capitata, 165, 175; carduus, 176; caryophyllites, 400; cavernosa, 203, 234; cellulosa, 242; cespitosa, 401; chalcidicum, 403; cinerascens, 412; contigua, 560; corymbosa, 178; crater, 411; cristata, 180, 328; cucullata, 340; cyathus, 371; damicornis, 525, 527, 528; dedalea, 255, 513; denticulata, 234; denudata, 424; detrita, 239; digitata, 516; divergens, 403; echinata, 295; elephantotus, 324; exesa, 268; fascicularis, 380, 400; fastigiata, 164, 165, 168, 175; favosa, 225, 247, 252; favus, 235; filograna, 260, 263; flexuosa, 380, 381; foliosa, 498, 505; fungites, 292; galaxea, 219; gemmascens, 696; hirtella, 392; intersepta, 247; labyrinthica, 257, 264; lacera, 176; lactuca, 196; lamellosa, 281; lima,

- 307; meandrites, 171; 193, 257; musicalis, 390; natans, 194; norvatica, 697; oculata, 395; patella, 293; patiniformis, 497; peltata, 410; pentagona, 241; phrygia, 260, 261; pileus, 307, 322; pistillata, 517; pleiades, 214; porcata, 226; porites, 554, 558, 559; prolifera, 393; punctata, 568; radiata, 207, 221; ramca, 386; retepora, 512; rosacea, 498; rosea, 458, 695; rotulosa, 211; seriata, 520; siderea, 332; solida, 562; stellulata, 215; trilinguis, 309; undata, 336; uva, 221; virginea, 397, 697
- MADREPORACEA**, 428
- MADREPORIDÆ**, 431
- Mæandra**, see *Meandrina*
- Mammillifera auricula**, 424; denudata, 424; fuliginosa, 425; mammosa, 425; nymphæa, 424; ocellata, 426
- MANIC'NA**, 188; amarantum, 189; areolata, 191; dilatata, 194; fissa, 190; hispida, 193; meandrites, 193; prærupta, 193
- Manicina interrupta**, 194; lactuca, 196; manica, 192; pachyphylla, 172; pectinata, 171
- MANOP'ORA**, 489; caliculata, 492; capitata, 504; circumvallata, 496; compressa, 494; crista-galli, 494; digitata, 508; effusa, 500; erosa, 504; expansa, 498; foliosa, 497; foveolata, 507; gemmulata, 491; grandifolia, 499; hispida, 496; incrassata, 503; lichen, 492; lima, 505; nodosa, 501; nudiceps, 505; palmata, 493; papillosa, 506; planiuscula, 507; scabricula, 502; spumosa, 495; stilosa, 500; tortuosa, 509; tuberculosa, 506; venosa, 501; verrucosa, 506
- MARGINOP'ORA**, 705; vertebralis, 706
- Massarium massa**, 615
- MEANDRI'NA**, 252; caudex, 266; cerebriformis, 263; cylindrus, 265; dedalea, 254; filograna, 262; gracilis, 261; interrupta, 258; labyrinthica, 256; mammosa, 265; phrygia, 260; rustica, 258; spongiosa, 255; strigosa, 257; tennis, 262; truncata, 264; valida, 259
- Meandrina areolata**, 192; crispa, 184; gyrosa, 185, 186; lamellina, 266; pectinata, 171; sinuosa, 188; spatiosa, 266
- Megalactis**, 125
- MELITÆA**, 681; coccinea, 683; ochracea, 682; retifera, 682; tenella, 683
- Melitæa Rissoi**, 683; textiformis, 683
- MERULI'NA**, 271; ampliata, 272; crispa, 274; folium, 274; laxa, 276; regalis, 273; rigida, 276; scabricula, 275; speciosa, 273
- Mesacmæa**, 126
- METRID'IUM**, 125, 150; concinnatum, 152; muscosum, 153; prætextum, 150
- MICHELINIA**, 362
- Microsolena**, 637
- MILLEP'ORA**, 542; alpicornis, 543; complanata, 547; incrassata, 547; plicata, 546; platyphylla, 548; pumila, 545; ramosa, 544; squarrosa, 547; tortuosa, 545
- Millepora aspera**, 494, 571; cærulea, 541; clavaria, 544; compressa, 494; lineata, 520; miniacea, 707; porulosa, 549; rubra, 707; truncata, 698
- Minyas**, 124
- Mitra polonica**, 312
- Monomyces**, 349; anthophyllum, 160, 350; eburneus, 350, 373; patella, 293, 350
- MONTICULARIA**, 266; lobata, 268; microcona, 267; polygonata, 269
- Monticularia exesa**, 268; folium, 275
- Montip'ora**, 490; lima, 505; papillosa, 506; verrucosa, 503, 506
- Montivaltia**, 306
- MOPSEA**, 678; dichotoma, 678; encrinula, 679; erythræa, 679; gracilis, 679
- Mopsea mediterranea**, 681; verticillata, 679
- Moschata**, 124
- MURICE'A**, 673; cerea, 675; elongata, 674; myura, 675; placomus, 674; spicifera, 673; verticillaris, 675
- Muricea calyptrata**, 675; furfuracea, 659; muricata, 674; sulphurea, 674

- MUSSA, 173; angulosa, 176; cactus, 178; carduus, 175; cerebriformis, 182; corymbosa, 177; costata, 179; crispa, 183; cytherca, 180; dipsacea, 184; fastigiata, 175, 720; fragilis, 185; gyrosa, 186; multilobata, 181; nobilis, 187; recta, 186; regalis, 182; sinuosa, 179
- Mussa dianthus, 375
- Myce'dium ampliatus, 273; elephantotus, 324; cucullatus, 340
- Myriap'ora truncata, 698; gracilis, 698
- MYRIOZO'UM, 698; truncatum, 698; gracile, 699
- Neptæa florida, 611, 626; innominata, 611
- ΝΕΡΠΙΤΗΥΑ, 610; Savignii, 610
- Nephtya florida, 611; Rathkiana, 611
- Oculi'na, budding of, 67.
- OCULI'NA, 390; axillaris, 394; diffusa, 397; hirtella, 392; horrescens, 392; oculata, 395; pallens, 395; prolifera, 393; varicosa, 394, virginea, 396
- Oculina coccinea, 389; echidnæa, 458; flabelliformis, 695; gemmascens, 696; infundibulifera, 696; micranthus, 387; ramea, 386; rosea, 695; virginea, 395, 397
- ORBELI'TES, 704
- Organic development, 85
- Palmip'ora alcornis, 544; complanata, 547; squarrosa, 547
- PALYTHOA, 422; argus, 427; auricula, 424; cæsia, 427; denudata, 423; flavo-viridis, 426; fuliginosa, 425; glareola, 426; nymphæa, 424; mammillosa, 425; ocellata, 426
- Palythoa Bertholetii, 422; Perii, 425; Savignii, 419; stellata, 425
- PASYTH'EA, 686; gracilis, 688
- PAVONARIA, 597; quadrangularis, 597
- Pavonaria antennina, 598
- PAVO'NIA, 319; boletiformis, 327; cactus, 324; clavus, 332; crassa, 331; crispa, 322; decussata, 329; divaricata, 327; elephantotus, 323; explanata, 322; formosa, 325; frondifera, 328, 721; lata, 330; latistella, 332; papyracea, 323; prætorta, 325; siderea, 331; venusta, 326
- Pavonia agaricites, 343; cristata, 343; lactuca, 196; obtusangula, 346; plicata, 560
- Pectinia lactuca, 196
- PELAGIA, 573
- PENNARIA, 691
- PENNAT'ULA, 594; argentea, 596; grisea, 595; phosphorea, 594; rubra, 595
- Pennatula antennina, 598; cynomorium, 590; elongata, 596; enerinus, 598; grandis, 596; granulosa, 595; juncea, 592; mirabilis, 592; phalloides, 590; quadrangularis, 598; reniformis, 589; rubra, 595; setacea, 595; spinosa, 596; stellifera, 590
- PENNATU'LIDÆ, 587
- PHYLLASTRÆA, 269; tubifex, 270
- Phyllop'ora leptostoma, 723; spherostoma, 723
- Phyllodes, 374, 722
- Planules, 709
- Plexaura antipathes, 667; crassa, 670; flexuosa, 668; friabilis, 669, 670; homomalla, 668; miniacea, 662; olivacea, 668; reticulata, 657; suberosa, 643; viminalis, 662
- PLUMULARIA, 686
- Pocillop'ora, 523; acuta, 524; brevicornis, 520; bulbosa, 527; cespitosa, 525; clavaria, 530; damicornis, 527; elegans, 532; elongata, 531; favosa, 528; grandis, 533; informis, 535; ligulata, 531; meandrina, 533; plicata, 534; squarrosa, 530; verrucosa, 529
- Pocillopora Andreosoyi, 516; apiculata, 528; cærulea, 541; fenestrata, 514; Hemprichii, 529; verrucosa, 533
- Polypary, 15, 52
- POLYPHYLLIA, 312; fungia, 316; galeriformis, 317; leptophylla, 314; pelvis, 315; pileiformis, 317; sigmoides, 314; talpa, 313
- Polypidom, 15, 52
- Polypifer, 15

- POLYTRÉ'MA, 706; brunnescens, 707; mesenterina, 708; miniacea, 707  
 Polytrema corallina, 707  
 PORI'TES, 550; arenacea, 567; astræoides, 561; clavaria, 554; compressa, 553; conglomerata, 561; contigua, 560; cribripora, 564; cylindrica, 559; divaricata, 556; erosa, 565; favosa, 564; flexuosa, 554; fragosa, 563; furcata, 555; informis, 565; levis, 559; lichen, 566; limosa, 563; lobata, 562; monticulosa, 566; mordax, 552; nigrescens, 557; palmata, 558; recta, 556; reticulosa, 567  
 Porites angulata, 723; armata, 568; cervina, 723; circumvallata, 496; complanata, 503; conglomerata, 562; crista-galli, 494; dedalea, 513; digitata, 516; elongata, 517; flabelliformis, 555; foliosa, 497; Peronii, 512; pistillata, 517; punctata, 568; reticulata, 512; rosacea, 498; scabra, 516; spongiosa, 496; spumosa, 496, 497; stilosa, 501; stromatopora, 568; subdigitata, 517; tuberculosa, 507; verrucosa, 506  
 PORIT'IDÆ, 549  
 PRIMNOA, 676; lepadifera, 676  
 Primnoa flabellum, 675; verticillaris, 675  
 PSAMMO'CORA, 344; columna, 347; exesa, 348; fossata, 347; obtusangula, 345; plicata, 346  
 PTEROGOR'GIA, 647; acerosa, 649; anceps, 648; citrina, 648; fasciolaris, 648; fusco-purpurea, 652; laxa, 651; leucostoma, 653; ochrostoma, 652; patula, 650; pectinata, 652; petechizans, 650; pinnata, 649; pustulosa, 654; quercifolia, 647; rosea, 651; sarmentosa, 653; setacea, 653; setosa, 650; sulcifera, 652; thomasien-sis, 649; turgida, 651; violacea, 651  
 Pterogorgia sancti-thomæ, 649; stricta, 650  
 Podasteria, 186  
 PUSTULOP'ORA, 699  
 RECEPTACULITES, 700  
 RENILLA, 588; americana, 588; violacea, 589  
 RHIZOXE'NIA, 600; primula, 601; rosea, 601; thalassantha, 600  
 SARCIN'ULA, 363  
 Sarcin'ula, 404; astreata, 400; musicalis, 399; perforata, 405  
 Sarcorhinanthus, 125  
 Scirpea'ria, 593; mirabilis, 592  
 SERIATOP'ORA, 518; calicndrum, 522; hystrix, 521; lineata, 520; octoptera, 521; subulata, 519  
 Seriatopora cervina, 723; ocellata, 520; valida, 523  
 SERTULARIA, 686; mimosa, 687  
 Sertularia dumosa, 628  
 SERTULAR'IDÆ, 686  
 Siderastræa galaxea, 219; siderata, 332  
 SIDEROP'ORA, 515; digitata, 515; elongata, 516; mordax, 518; palmata, 517; subdigitata, 517  
 Siderop'ora pistillata, 517  
 SPINOP'ORA, 572  
 SPOGGO'DIA, 625; celosia, 626  
 STENOP'ORA, 536  
 Stephano'cora Hemprichii, 282  
 STEPHANOPHYLLIA, 373  
 Stipula, 691  
 STROMATOP'ORA, 702  
 Strombo'des, 359, 362; Hemprichii, 169  
 STYLI'NA, 403; echinulata, 404  
 Styloph'ora, 517  
 SYMPO'DIUM, 608; cæruleum, 609; fuliginosum, 609; roseum, 609  
 Sympodium coralloides, 610; massa, 610; ochraceum, 610; rubrum, 610, 614  
 SYNCORYNA, 691  
 Synhydra, 691  
 Synoicum pelagicum, 632  
 SYRINGOP'ORA, 637  
 TELESTO, 631; aurantiaca, 632; fruticulosa, 632; lutea, 632; pelagica, 632  
 TEREBELLARIA, 572  
 Tethya mammillosa, 425  
 TETRADIUM, 701

- Thalassianthus, 125  
 Thamnasteria, 321, 345  
 THEONEA, 701  
 THOA, 686  
 THUIA'RIA, 686  
 TILESIA, 572  
 TRIDACOPHYLLIA, 194; lactuca, 195;  
     manicina, 196; pæonia, 196  
 Tridacophyllia aspera, 282  
 Trochopsis, 721  
 Truncularia, 698  
 Tubastræa annularis, 214; cavernosa, 208;  
     pleiades, 214; radiata, 207  
 TUBIP'ORA, 633; Chamissonis, 635; fim-  
     briata, 634; Hemprichii, 636; musica,  
     633; purpurea, 634; rubeola, 636;  
     syringa, 635  
 Tubip'ora, structure of, 42  
 TUBIPOR'IDÆ, 629  
 Tubiporites, 637  
 TUBULARIA, 691; ornata, 691  
 Tubularia cornucopiæ, 628; tubifera, 628  
 TUBULAR'IDÆ, 690  
 Tubularidæ, reproduction in, 709  
 TURBINALIA, 374, 721  
 TURBINALOPSIS, 349, 721  
 Turbinaria cinerascens, 412; cupula, 410;  
     microstoma, 412; peltata, 411  
 Turbinolia, 374; amicorum, 163; compressa,  
     161; cuneata, 161; rubra, 161, 162  
 UMBELLULARIA, 598; greenlandica, 598  
 Umbellularia encrinus, 598; stellifera, 590  
 Undaria undata, 336  
 VERETIL'LUM, 589; clavatum, 591; cyno-  
     morium, 590; luteum, 590; phal-  
     loides, 590  
 Veretillum stellifera, 590  
 VIRGULARIA, 591; juncea, 592; mirabilis,  
     591  
 Virgularia australis, 593; juncea, 593;  
     laxipinna, 592  
 XENIA, 604; cærulea, 605; elongata, 606;  
     florida, 606; fuscescens, 605; um-  
     bellata, 604  
 Xenia Desjardiana, 603; purpurea, 607,  
     626  
 ZOANTHA, 420; Bertholetii, 422; dubia,  
     422; Ellisii, 420; sociata, 421; So-  
     landri, 421  
 Zoantha thalassanthos, 601  
 Zoanthidæ, structure of, 40  
 ZOANTH'IDÆ, 417  
 Zoophytes, classification of, 16, 45, 105  
     —, definition of, 11  
     —, forms of, 59  
     —, geographical distribution of, 101  
 ZOO'P'ILUS, 318; echinatus, 319

THE END.



N.T.

UNITED STATES  
EXPLORING EXPEDITION.

DURING THE YEARS

1838, 1839, 1840, 1841, 1842.

UNDER THE COMMAND OF

CHARLES WILKES, U. S. N.

[v.7]

ATLAS.

ZOOPOHYTES.

BY

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PHILADELPHIA:  
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## ZOOPLYTES.

### PLATE 1.

Fig. 1. *ACTINIA FLAGELLIFERA*, natural size; 1 *a*, the same with part of the tentacles removed, showing the disk; 1 *b*, 1 *c*, 1 *d*, extremities of the inner, middle, and outer tentacles, magnified about three diameters; 1 *e*, tentacles of another variety.—p. 126.

Fig. 2. *ACTINIA PUSTULATA*, natural size; 2 *a*, disk and mouth; 2 *b*, animal contracted.—p. 128.

Fig. 3. *ACTINIA VERATRA*, natural size.—p. 129.

Fig. 4. *ACTINIA CLEMATIS*, natural size. Fig. 5, another variety.

### PLATE 2.

Figs. 6, 7, 8. *ACTINIA FLORIDA*, different varieties, natural size.—p. 131.

Fig. 9. *ACTINIA TABELLA*, natural size, expanded; 9 *a*, same contracted.—p. 133.

Fig. 10. *ACTINIA GRAMINEA*, natural size; 10 *a*, disk and tentacles; 10 *b*, animal contracted.—p. 132.

Fig. 11. *ACTINIA DIADEMA*, natural size; 11 *a*, disk and tentacles; 11 *b*, animal contracted.—p. 133.

Figs. 12, 13, 14, 15. *ACTINIA PRIMULA*, different varieties, natural size; 12, 15, 16, with many of the white seminal cords exsert.—p. 134.

Fig. 16. *ACTINIA PRIMULA*?—p. 135.

Fig. 17. *ACTINIA CLAVIGERA*, natural size, with some of the visceral lamellæ partly protruding from the mouth.—p. 135.

### PLATE 3.

Fig. 18. *ACTINIA IMPATIENS*, natural size; 18 *a*, disk; 18 *b*, 18 *c*, 18 *d*, 18 *e*, 18 *f*, forms assumed by this *Actinia*.—p. 135.

Fig. 19. *ACTINIA MONILIFERA*, natural size.—p. 136.

Fig. 20. *ACTINIA PRETIOSA*, enlarged; 20 *a*, natural size.—p. 137.

Fig. 21. Young *Actinia*, found swimming free in the ocean at the Feejees.

Fig. 22. *ACTINIA LINEOLATA*, natural size; 22 *a*, disk and tentacles.—p. 137.

Fig. 23. *ACTINIA CRUENTATA*, natural size; 23 *a*, disk and tentacles.—p. 138.

Fig. 24. *ACTINIA DECORATA*, three individuals in different conditions affixed to a *Cypræa*.—p. 139.

Fig. 25. *ACTINIA PAUMOTENSIS*, half natural size lineally.—p. 141.

Fig. 26. *ACTINIA MOLLIS*, natural size; 26 *a*, tentacles; 26 *b*, form of mouth; fig. 27, one of the positions assumed by the animal.—p. 141.

Fig. 28. *ACTINIA ACHATES*, natural size; 28 *a*, disk and tentacles. This species was named in allusion to one of the artists of the Expedition, Mr. Agate, since deceased, by whom the drawing was made.—p. 142.

### PLATE 4.

Fig. 29. *ACTINIA PAPAVER*, natural size.—p. 143.

Fig. 30. *ACTINIA PLUVIA*, natural size.—p. 143.

Fig. 31. *ACTINIA RETICULATA*, natural size; 31 *a*, same contracted.—p. 144.

Fig. 32. *ACTINIA FUEGIENSIS*, natural size; 32 *a*, disk and tentacles; 32 *b*, animal contracted.—p. 145.

Fig. 33. *ACTINIA NYMPHLEA*, natural size; 33 *a*, same contracted.—p. 146.

Fig. 34. *ACTINIA RUBUS*, natural size; 34 *a*, same contracted.—p. 147.

Fig. 35. *ACTINIA GEMMA*, natural size; 35 *a*, same contracted.—p. 147.

Fig. 36. *ACTINIA CURTA*, natural size; 36 *a*, disk and tentacles.—p. 148.

Fig. 37. *ACTINIA RHODORA*, natural size; 37 *a*, disk and tentacles.—p. 148.

Fig. 38. *ACTINIA ARTEMISIA*, natural size; 38 *a*, disk and tentacles.—p. 149.

### PLATE 5.

Fig. 39. *METRIDIUM PRÆTEXTUM*, natural size; 39 *a*, under view of exterior tentacular appendages; 39 *b*, disk.—p. 150.

Fig. 40. *METRIDIUM CONCINNATUM*, natural size; 40 *a*, one of the tentacles; 40 *b*, transverse section of tentacle; fig. 41, animal as it appears half buried in the sand.—p. 152.

Fig. 42. *METRIDIUM MUSCOSUM*, natural size; fig. 43, same as it appears buried in the sand.—p. 153.

## PLATE 6.

Fig. 1 *a*. EUPHYLLIA SPHENISCUS, animal unexpanded, natural size; 1 *b*, animal expanded; 1 *c*, one of the tentacles; 1 *d*, profile section of corallum; 1 *e*, a small specimen with side processes.—p. 160.

Fig. 2. EUPHYLLIA SPINULOSA, corallum, natural size; 2 *a*, profile of vertical section of corallum.—p. 162.

Fig. 3. EUPHYLLIA RUGOSA, expanded, (some polyps partly so,) natural size; 3 *a*, tentacle enlarged; 3 *b*, a calicle of the corallum; 3 *c*, part of a transverse section of a branch; 3 *d*, one of the lamellæ, as seen in a vertical section; 3 *e*, corallum of a young individual, growing on the side of one of the calicles.—p. 166.

Fig. 4. EUPHYLLIA MEANDRINA, corallum, natural size; 4 *a*, transverse section.—p. 167.

Figs. 5, 6. EUPHYLLIA PAVONINA, corallum of different varieties, natural size.—p. 159.

## PLATE 7.

Fig. 1. MUSSA CACTUS, zoophyte, natural size; 1 *a*, tentacle enlarged; 1 *b*, vertical section of calicle, showing profile of lamellæ; 1 *c*, part of a transverse section of a branch.—p. 178.

Fig. 2. MUSSA COSTATA, branch, natural size; 2 *a*, 2 *b*, sections of cells, showing profile of lamellæ, natural size.—p. 179.

Figs. 3 *a*, 3 *b*, 3 *c*. MUSSA CYTHEREA, section of cells, showing profile of lamellæ, natural size.—p. 180.

Fig. 4. MUSSA ANGULOSA, section of cell, showing profile of lamellæ.—p. 176.

Figs. 4 *a*, 4 *b*. MUSSA ANGULOSA, section of cell, showing profile of lamellæ, natural size.

Figs. 5 *a*, 5 *b*. MUSSA ———? from Tahiti, profile of cells, showing outline of lamellæ, of natural size, perhaps a variety of the *M. cactus*.

## PLATE 8.

Figs. 1 *a*, 1 *b*, 1 *c*. MUSSA SINUOSA, transverse sections of different calicles, showing outline of cells and lamellæ, natural size.—p. 179.

Fig. 2. MUSSA MULTILOBATA, animal not expanded, the tentacles being concealed; 2 *a*, 2 *b*, profile of cell and lamellæ; natural size.—p. 181.

Fig. 3. MUSSA CEREBRIFORMIS, transverse section of corallum, showing the cellules within; 3 *a*, 3 *b*, section showing profile view of cell and lamellæ; natural size.—p. 182.

Fig. 4. MUSSA ANGULOSA, section, showing profile of cell and lamellæ; natural size.—p. 176.

Fig. 5. MUSSA REGALIS, section, showing profile of cell and lamellæ; natural size.—p. 182.

Fig. 6. MUSSA CRISPA, section, showing profile of cell and lamellæ; natural size.—p. 183.

Fig. 7. MUSSA FRAGILIS, section, showing profile of cell and lamellæ; natural size.—p. 185.

Fig. 8. MUSSA CARDUUS, section, showing profile of cell and lamellæ; natural size.—p. 175.

Fig. 9. MUSSA DIPSACEA, section, showing profile of cell and lamellæ; natural size.—p. 184.

Fig. 10.—MUSSA NOBILIS, worn fragment of corallum; natural size.—p. 187.

Fig. 11. MUSSA RECTA, worn fragment; 11 *a*, surface as seen in a vertical section of corallum; natural size.—p. 186.

## PLATE 9.

Fig. 1. MANICINA AMARANTUM, part of a corallum; natural size.—p. 189.

Fig. 2. MANICINA AMARANTUM, var. STRICTA, section of trench and outline of lamellæ.—p. 190.

Fig. 3. MANICINA AREOLATA, section of trench and outline of lamellæ and ridges.—p. 191.

Fig. 4. CAULASTREA FURCATA, part of zoophyte, natural size; 4 *a*, calicle, natural size; 4 *b*, transverse section, natural size; 4 *c*, lamellæ of calicle, enlarged.—p. 198.

Fig. 5. CAULASTREA DISTORTA, part of corallum, natural size.—p. 199.

Fig. 6. CAULASTREA UNDULATA, 6 *a*, 6 *b*, transverse section of calicle, in longer and shorter diameter, showing outline of lamellæ, natural size.—p. 199.

Fig. 7. EUPHYLLIA ASPERA, part of corallum, natural size; 7 *a*, vertical section of calicle, showing outline of lamellæ.—p. 164.

Fig. 8. EUPHYLLIA CULTRIFERA; 8 *a*, 8 *b*, section of calicle or trench; showing outline of lamellæ.—p. 169.

Fig. 9. EUPHYLLIA TURGIDA; 9 *a*, 9 *b*, section of calicle, showing outline of lamellæ.—p. 166.

Fig. 10. TRIDACOPHYLLIA LACTUCA, part of a crest-form septum of corallum; 10 *a*, section of the same, showing outline of lamellæ.—p. 195.

Fig. 11. TRIDACOPHYLLIA PEONIA, zoophyte, natural size; 11 *a*, section of crests of corallum, showing outline of lamellæ.—p. 196.

## PLATE 10.

Fig. 1 *a*. ORBICELLA ARGUS, transverse section of corallum, natural size; 1 *b*, vertical section, natural size.—p. 207.

Fig. 2 *a*. ORBICELLA GLAUCOPIS, vertical section; 2 *b*, transverse section; natural size.—p. 208.

Fig. 3. ORBICELLA CURTA, calicles of natural size; 3 *a*, profile of section of calicle, enlarged; 3 *b*, transverse section, enlarged; 3 *c*, vertical section, natural size.—p. 209.

Fig. 4 *a*. ORBICELLA CORONATA, calicles, natural size; 4 *b*, calicle, enlarged; 4 *c*, profile of vertical section of cell; 4 *d*, vertical section of corallum, natural size; 4 *e*, transverse section, enlarged; 4 *f*, the same, natural size.—p. 211.

Fig. 5 *a*. ORBICELLA PLEIADES, transverse section of corallum, natural size; 5 *b*, same, enlarged; 5 *c*, vertical section, natural size.—p. 213.

Fig. 6. ORBICELLA ANNULARIS, transverse section of corallum, natural size.—p. 214.

Fig. 7 *a*. ORBICELLA STELLULATA, transverse section, natural size; 7 *b*, vertical section, natural size.—p. 215.

Fig. 9. ORBICELLA STELLIGERA, surface of corallum, natural size; 9 *a*, section of cell, showing outline of opposite lamellæ; 9 *b*, lamella, enlarged; 9 *c*, vertical section, natural size; 9 *d*, transverse section, natural size; 9 *e*, same, enlarged.—p. 216.

Fig. 10. ORBICELLA OCELLINA, calicle, enlarged.—p. 218.

Fig. 11. ORBICELLA MICROPHALMA, surface of corallum, natural size; 11 *a*, animal, enlarged; 11 *b*, calicle, enlarged; 11 *c*, vertical section of corallum, enlarged; 11 *c'* same, natural size; 11 *d*, transverse section, natural size; 11 *e*, same, enlarged.—p. 217.

Fig. 12. SIDERINA GALAXEA, surface of corallum, natural size; 12 *a*, same, another variety; 12 *b*, transverse section of the variety fig. 12, natural size; 12 *c*, same, enlarged; 12 *d*, transverse section of the variety 12 *a*.—p. 218.

Fig. 13. ASTREA PALLIDA, natural size, with part of the polyps expanded; 13 *a*, tentacles of the two series enlarged; 13 *b*, calicles, natural size; 13 *c*, profile of vertical section of calicle, showing out-



line of lamellæ; 13 *c'*, same, natural size; 13 *d*, transverse section of corallum, natural size; 13 *e*, vertical section of same.—p. 224.

Fig. 14. *ORBICELLA PATULA*, natural size, polyps not expanded; 14 *a*, profile of section of cells, showing outline of lamellæ; 14 *b*, enlarged view of the same; 14 *c*, 14 *d*, vertical sections, natural size; 14 *e*, transverse section, natural size.—p. 209.

Fig. 15. *ORBICELLA HYADES*, transverse view of corallum, natural size.—p. 212.

Fig. 16. *ORBICELLA EXCELSA*, transverse view of corallum, natural size.—p. 212.

## PLATE 11.

Fig. 1. *ASTRÆA SPECIOSA*, part of corallum, natural size; 1 *a*, profile of cell and ridge, outline of lamellæ; 1 *b*, lamella enlarged; 1 *c*, transverse section of corallum, natural size; 1 *d*, vertical section, natural size.—p. 220.

Fig. 2. *ASTRÆA PANDANUS*, zoophyte, unexpanded, natural size; 2 *a*, a few cells of corallum, in outline, natural size; 2 *b*, profile of cell, ridge and lamellæ, enlarged; 2 *c*, vertical section of corallum, natural size; 2 *d*, transverse section, *ibid.*—p. 222.

Fig. 3. *ASTRÆA PUTEOLINA*, a few cells of corallum, natural size; 3 *a*, profile of cells and ridges, and outline of lamellæ, natural size; 3 *b*, vertical section of corallum, natural size.—p. 223.

Fig. 4 *a*. *ASTRÆA DIPSACEA*, profile of cell and ridge, and outline of lamellæ; 4 *b*, same, through longer diameter of cell; 4 *c*, vertical section of corallum, natural size; 4 *d*, transverse section, natural size.—p. 225.

Fig. 5. *ASTRÆA PORCATA*, zoophyte unexpanded, natural size; 5 *a*, profile of cell and ridges, and outline of lamellæ; 5 *b*, same, enlarged; 5 *c*, vertical section of corallum, natural size; 5 *d*, transverse section, *ibid.*—p. 226.

Fig. 6. *ASTRÆA FLEXUOSA*, part of zoophyte, with polyps partly expanded; 6 *a*, 6 *b*, tentacles enlarged; 6 *c*, view of mouth aperture, enlarged; 6 *d*, profile of cell and ridges and outline of lamellæ, natural size; 6 *e*, vertical section of corallum, natural size.—p. 227.

Fig. 7. *ASTRÆA FUSCO-VIRIDIS*, part of zoophyte, animal unexpanded; 7 *a*, another variety, enlarged; 7 *b*, vertical section of corallum, natural size; 7 *c*, profile of cell and ridge, and outline of lamellæ, enlarged.—p. 228.

Fig. 8. *ASTRÆA VIRENS*, zoophyte, unexpanded; 8 *a*, portion of corallum, in outline, natural size; 8 *b*, profile of cell and outline of lamellæ, enlarged; 8 *c*, vertical section of corallum, natural size; 8 *d*, transverse section, *ibid.*—p. 228.

## PLATE 12.

Fig. 1. *ASTRÆA ECHINATA*, zoophyte, natural size; 1 *a*, vertical section of corallum; 1 *b*, transverse section.—p. 229.

Fig. 2 *a*. *ASTRÆA FRAGILIS*, vertical section of cell and ridges, showing outline of lamellæ, natural size; 2 *b*, same enlarged; 2 *c*, vertical section, natural size; 2 *d*, transverse section.—p. 230.

Fig. 3 *a*. *ASTRÆA MAGNIFICA*, cells of corallum, natural size; 3 *b*, transverse section; 3 *c*, vertical section.—p. 231.

Fig. 4. *ASTRÆA FILICOSA*, cells of a worn corallum, natural size; 4 *a*, transverse section, natural size; 4 *b*, vertical section.—p. 232.

Fig. 5 *a*. *ASTRÆA VERSIPORA*, vertical section of cell and intervening ridges, showing outline of lamella; 5 *b*, transverse section of corallum, natural size.—p. 233.

Fig. 6 *a*. *ASTRÆA DENTICULATA*, vertical section of a cell and intervening ridges, showing outline of lamellæ, natural size; 6 *b*, transverse section; 6 *c*, vertical section.—p. 234.

Fig. 7, 7 *a*, 7 *b*, 7 *c*, 7 *d*. *ASTRÆA DEFORMIS* var.?—p. 236.

Fig. 8 *a*. *ASTRÆA RIGIDA*, vertical section of cells and ridges, showing profile of lamellæ, natural size; 8 *b*, half of a cell with a vertical section of corallum beneath; 8 *c*, size and form of cells; 8 *d*, transverse section of corallum.—p. 237.

Fig. 9 *a*. *ASTRÆA RETICULARIS*, vertical section of cells and intervening ridges or septa, natural size; 9 *b*, size and form of cells; 9 *c*, transverse section of corallum, natural size.—p. 237.

Fig. 10. *ASTRÆA PURPUREA*, zoophyte, natural size, expanded; 10 *a*, cells of corallum, natural size; 10 *b*, vertical section, showing profile of lamellæ and ridges, enlarged; 10 *b'*, same, natural size; 10 *c*, vertical section of corallum, enlarged; 10 *d*, same, natural size; 10 *e*, transverse section, enlarged four diameters.—p. 239.

Fig. 11. *ASTRÆA PULCHRA*, zoophyte, natural size; 11 *a*, polyp enlarged; 11 *b*, vertical section, showing profile of lamellæ and ridges, enlarged; 11 *c*, same, natural size; 11 *d*, vertical section, enlarged; 11 *e*, same, natural size; 11 *f*, transverse section.—p. 240.

Fig. 12 *a*. *ASTRÆA PETROSA*, transverse section of corallum, natural size; 12 *b*, vertical section, natural size.—p. 238.

Fig. 13 *a*, 13 *b*. *ASTRÆA VARIA*, transverse sections of cells, showing profile of cells and lamellæ.—p. 236.

## PLATE 13.

Fig. 1. *ASTRÆA TENELLA*, part of surface of a worn corallum, enlarged one-sixth; 1 *b*, vertical section of corallum, natural size.—p. 231.

Fig. 2. *ASTRÆA FAVISTELLA*, part of surface of corallum, natural size, showing cells; 2 *a*, 2 *b*, profile of vertical sections of cells, natural size; 2 *c*, transverse section of corallum, enlarged; 2 *d*, vertical section of corallum.—p. 241.

Fig. 3 *a*. *ASTRÆA FAVISTELLA?* transverse section of corallum, natural size; 3 *b*, vertical section of same.—p. 242.

Fig. 4 *a*. *ASTRÆA EXIMIA*, profile of vertical section of cells, natural size; 4 *b*, size and form of cells; 4 *c*, transverse section of corallum, natural size; 4 *d*, vertical section, ditto.—p. 242.

Fig. 5. *ASTRÆA SINUOSA*, cells of corallum, natural size; 5 *a*, profile of vertical section of cells, natural size; 5 *b*, transverse section of corallum, natural size; 5 *c*, vertical section, ditto.—p. 243.

Fig. 6. *ASTRÆA PARVISTELLA*, cells of corallum, natural size; 6 *a*, transverse section of corallum, enlarged; 6 *b*, same, natural size; 6 *c*, vertical section of corallum, natural size.—p. 244.

Fig. 7. *ASTRÆA FAVULUS*, cells of corallum, natural size; 7 *a*, profile of vertical section of cells, natural size; 7 *b*, transverse section of corallum, natural size; 7 *c*, vertical section, ditto.—p. 245.

Fig. 8. *ASTRÆA CERIUM*, transverse and vertical sections, natural size.—p. 245.

Fig. 9 *a*, 9 *b*, 9 *c*. *ASTRÆA TESSERIFERA*, profiles of vertical sections of cells, natural size; 9 *d*, transverse section of corallum, natural size.—p. 248.

Fig. 10. *ASTRÆA ROBUSTA*, cells of corallum, natural size; 10 *a*, profile of vertical sections of three successive cells; 10 *b*, similar profile, enlarged; 10 *c*, transverse section of corallum, natural size; 10 *d*, vertical section, ditto.—p. 248.

Fig. 11 *a*, 11 *b*. *ASTRÆA HELIOPORA?* transverse and vertical sections of corallum, natural size.—p. 250.

Fig. 12. *ASTRÆA INTERSEPTA*, surface of corallum, natural size; 12 *a*, cells enlarged; 12 *b*, vertical section of cells, showing profile of lamellæ, natural size; 12 *c*, profile of lamellæ, enlarged; 12 *d*, transverse section of corallum, enlarged; 12 *e*, vertical section, natural size.—p. 246.

Fig. 13 *a*. *MONTICULARIA MICROCONA*, part of surface of corallum, enlarged; 13 *b*, part of surface of zoophyte, enlarged; 13 *c*, transverse section of corallum, enlarged; 13 *d*, vertical section, ditto; 13 *e*,

polyps mutilated, and spermatie cords and lamellæ visible, enlarged; 13 *f*, visceral lamellæ exsert from mouth.—p. 267.

Fig. 14. *ORBICELLA ORION*, worn surface of corallum, natural size; 14 *a*, same, enlarged; 14 *b*, vertical section, natural size.—p. 720.

Figs. 15, 15 *a*. *ASTREA PORCATA?* transverse and vertical sections, natural size.—p. 721.

## PLATE 14.

Fig. 1. *MEANDRINA LABYRINTHICA*, outline of fossa and lamellæ of corallum, natural size.—p. 256.

Fig. 2. *MEANDRINA CEREBRIFORMIS*, outline, *ibid.*—p. 263.

Fig. 3. *MEANDRINA TRUNCATA*, outline, taken from worn corallum, showing form of fossa, and intervening solid septa, natural size; 3 *a*, general direction and width of fossæ.—p. 264.

Fig. 4 *a*. *MEANDRINA STRIGOSA*, transverse section of corallum, natural size; 4 *b*, vertical section, *ibid.*—p. 257.

Fig. 5 *a*. *MEANDRINA RUSTICA*, transverse section of corallum, natural size; 5 *b*, vertical section, *ibid.*—p. 258.

Fig. 6. *MEANDRINA GRACILIS*, surface of corallum, natural size; 6 *a*, outline of fossæ, and profile of lamellæ, natural size; 6 *b*, transverse section of corallum, natural size.—p. 261.

Fig. 7. *MEANDRINA TENUIS*, part of expanded zoophyte, enlarged; 7 *a*, one of the tentacles, enlarged; 7 *b*, profile of lamellæ and fossa, from a vertical section, natural size; 7 *c*, lamellæ of same, enlarged; 7 *d*, transverse section of corallum, natural size.—p. 262.

Fig. 8. *MEANDRINA PHRYGIA*, surface of corallum, natural size; 8 *a*, profile of lamellæ and fossa, from a vertical section, natural size; 8 *b*, vertical section of corallum, natural size.—p. 260.

Fig. 9. *MEANDRINA FILOGRANA*, profile of lamellæ and fossa.—p. 262.

Fig. 10. *MEANDRINA MAMMOSA*, profile of lamellæ and fossæ; 10 *a*, general character of trenches and ridges.—p. 265.

Fig. 11 *a*. *MEANDRINA VALIDA*, worn surface of corallum, natural size; 11 *b*, profile of septa and fossæ, of same.—p. 259.

Fig. 12 *a*, 12 *b*. *MEANDRINA DEDALEA*, profile views of lamellæ and fossæ, natural size; 12 *c*, vertical section of corallum, natural size.—p. 254.

Fig. 13. *CTENOPHYLLIA PECTINATA*, profile of lamellæ and fossæ, natural size.—p. 170.

Fig. 14. *CTENOPHYLLIA QUADRATA*, *ibid.*; 14 *a*, view, showing breadth of fossa and the character of the lamellæ.—p. 171.

Fig. 15. *CTENOPHYLLIA PACHYPHYLLA*, *ibid.*—p. 172.

Fig. 16. *CTENOPHYLLIA PROFUNDA*, *ibid.*—p. 172.

Fig. 17 *a*. *MEANDRINA SPONGIOSA*, *ibid.*; 17 *b*, view of surface, showing breadth of fossa.—p. 255.

Fig. 18. *MEANDRINA INTERRUPTA*, transverse section of corallum.—p. 258.

## PLATE 15.

Fig. 1. *MERULINA REGALIS*, outline view of part of a few folia of a zoophyte, natural size; 1 *a*, view of living zoophyte; 1 *b*, enlarged view, showing the tentacles and a mouth; 1 *c*, enlarged view of ridges and cells of corallum; 1 *d*, 1 *e*, enlarged profile views of lamellæ.—p. 273.

Fig. 2. *MERULINA AMPLIATA*, enlarged view of ridges and cells of corallum; 2 *a*, enlarged profile of lamellæ, and section of ridge.—p. 272.

## PLATE 16.

Fig. 1. *MERULINA SPECIOSA*, corallum, natural size.—p. 273.

Fig. 2. *MERULINA SCABRICULA*, corallum, natural size, (part of

a clump); 2' a branch, showing surface and cells; 2 *a*, animals, enlarged; 2 *b*, section of corallum.—p. 275.

Fig. 3. *MERULINA LAXA*, branch of corallum, natural size.—p. 276.

Fig. 4. *PHYLLASTREA TUBIFEX*, natural size; 4 *a*, polyp, enlarged; 4 *b*, surface of corallum, and cells.—p. 270.

## PLATE 17.

Fig. 1. *MERULINA RIGIDA*, corallum in outline, natural size; 1 *bis*, branch of the same; 1 *a*, one of the prominences of the surface, enlarged; 1 *b*, animals, enlarged; 1 *c*, part of a transverse section of the corallum.—p. 276.

Fig. 2. *ECHINOPORA REFLEXA*, corallum, natural size; 2 *a*, animals of a portion, enlarged; 2 *b*, transverse section of corallum, enlarged.—p. 280.

Fig. 3. *ECHINOPORA UNDELATA*, corallum, natural size; 3 *a*, cell, natural size.—p. 278.

Fig. 4. *ECHINOPORA HORRIDA*, corallum, natural size; 4 *a*, polyps, enlarged; 4 *b*, transverse section of corallum, enlarged; 4 *c*, cell, enlarged.—p. 282.

## PLATE 18.

Fig. 1. *FUNGIA TENUIS*, profile view of corallum, natural size.—p. 290.

Fig. 2. *FUNGIA GLANS*, *ibid.*—p. 290.

Fig. 3. *FUNGIA DISCUS*, profile view of corallum, natural size, showing outline of lamellæ, and under surface; 3 *a*, one of the intermediate lamellæ, with the tentacular tooth.—p. 291.

Fig. 4. *FUNGIA DENTIGERA*, profile view of corallum, natural size, showing outline of lamella, (with the tentacular tooth,) and under surface.—p. 301.

Fig. 5. *FUNGIA AGARICIFORMIS*, profile view, *ibid.*—p. 292.

Fig. 6. *FUNGIA AGARICIFORMIS*, var. *TENUIFOLIA*, *ibid.*—p. 292.

Fig. 7. *FUNGIA DENTATA*, *ibid.*—p. 293.

Fig. 8. Same as 9 *b*, another specimen.—p. 295.

Fig. 9. *FUNGIA ECHINATA*, zoophyte, expanded; 9 *a*, tentacle, enlarged, with summit of ridge; 9 *b*, profile view of lamella of corallum, and under surface.—p. 294.

## PLATE 19.

Fig. 1. *FUNGIA REPANDA*, a double individual, expanded, natural size; 1 *a*, profile of section of corallum, showing outline of lamellæ, and the spines below, natural size. Fig. 2. Outline of a specimen from the Feejees. Fig. 3. A large specimen from the Feejees.—p. 295.

Fig. 4. *FUNGIA INTEGRATA*, sectional view of corallum, showing outline of lamellæ, natural size.—p. 296.

Fig. 5. *FUNGIA CONFERTIFOLIA*, sectional view, *ibid.*—p. 297.

Fig. 6. *FUNGIA CONFERTIFOLIA* (?), part of animal, expanded, natural size.—p. 298.

Fig. 7. *FUNGIA HORRIDA*, sectional view, showing outline of lamellæ, natural size.—p. 298.

Fig. 8. *FUNGIA PAUMOTENSIS*, animal expanded, natural size; 8 *a*, sectional view of corallum, showing outline of lamellæ, natural size. Fig. 9. Young? of this species.—p. 300.

Fig. 10. *FUNGIA SCUTARIA*, sectional view of corallum, showing outline of lamellæ, natural size; 10 *a*, form, seen in vertical view.—p. 301.

Fig. 11. *FUNGIA EHRENBERGII*, sectional view, *ib.*, natural size.—p. 303.

Fig. 12. FUNGIA GIGANTEA, sectional view, *ib.*, natural size.—p. 303.

Fig. 13. FUNGIA CRASSA, sectional view, *ib.*, natural size.—p. 304.

Fig. 14. FUNGIA ASPERATA, view of margin of part of a lamella, showing the character of the dentation.—p. 303.

## PLATE 20.

Fig. 1. FUNGIA DENTATA, var., profile of vertical section, natural size.—p. 293.

Fig. 2. HERPETOLITHUS LIMACINUS, profile of vertical section, from the middle or oririme to one side, natural size; 2 *a*, shape of zoophyte; 2 *b*, 2 *c*, 2 *d*, lamellæ.—p. 307.

Fig. 3. HERPETOLITHUS FOLIOSUS, profile of vertical section, natural size; 3 *a*, form of outline of zoophyte, as seen from above.—p. 308.

Fig. 5. HERPETOLITHUS CRASSUS, zoophyte expanded, natural size; 5 *a*, profile of vertical section of corallum, natural size; 5 *b*, profile of a marginal lamella; 5 *c*, outline of a lamella, and of another smaller (one of the intermediate).—p. 310.

Fig. 6. POLYPHYLLIA LEPTOPHYLLA, 6 *a*, form of corallum; 6 *b*, 6 *c*, outline of lamellæ.—p. 314.

## PLATE 21.

Fig. 1. HERPETOLITHUS STRICTUS, profile of transverse section of corallum, natural size.—p. 309.

Fig. 2. HALOMITRA PILEUS, profile of transverse section of corallum, natural size; 2 *a*, outline of lamella, natural size; 2 *b*, same, of another variety.—p. 311.

Fig. 3. POLYPHYLLIA GALERIFORMIS, zoophyte expanded, natural size; 3 *a*, lamellæ of corallum, natural size; 3 *b*, same, enlarged.—p. 317.

Fig. 4. POLYPHYLLIA PILEIFORMIS, lamellæ of corallum, natural size.—p. 317.

Fig. 5 *a*. POLYPHYLLIA TALPA, lamellæ, as they radiate from one side of an oririme, natural size; 5 *b*, 5 *c*, outline of lamellæ; 5 *d*, outline of one of the lamellæ forming the margin of the corallum, natural size.—p. 313.

Fig. 6. ZOOPILUS ECHINATUS, corallum, natural size; 6 *a*, outline of part of a section.—p. 319.

Fig. 7. AGARICIA SPECIOSA, corallum, natural size.—p. 337.

Fig. 8. AGARICIA UNDATA, part of corallum, natural size.—p. 336.

## PLATE 22.

Fig. 1. AGARICIA RUGOSA, part of corallum, natural size; 1 *a*, living surface of zoophyte, showing polyps enlarged; 1 *b*, longitudinal cross-section, enlarged; 1 *c*, transverse, ditto.—p. 336.

Fig. 2. AGARICIA LEVICOLLIS, part of corallum, natural size.—p. 338.

Fig. 3. PAVONIA PAPYRACEA, corallum, natural size.—p. 323.

Fig. 4. PAVONIA DECUSSATA, corallum, natural size; 4 *a*, polyps or part of living zoophyte, enlarged; 4 *b*, section of cell, and corallum, enlarged.—p. 329.

Fig. 5. PAVONIA PRETORTA, part of corallum, natural size; 5 *a*, a single plate.—p. 325.

Fig. 6. PAVONIA DIVARICATA, part of corallum, natural size.—p. 327.

Fig. 7. PAVONIA BOLETIFORMIS, part of a leaf of corallum, natural size.—p. 327.

Fig. 8. Young of Tridacophyllia?—p. 350.

## PLATE 23.

Fig. 1. PAVONIA LATA, natural size, in outline, excepting a small part, (1 *a*).—p. 330.

Fig. 2. PAVONIA CRASSA, natural size, in outline; 2 *a*, surface, natural size.—p. 331.

## PLATE 24.

Fig. 1. PAVONIA CRASSA, var. OBTUSA, corallum, natural size, in outline; 1 *a*, a portion, showing the surface.—p. 331.

Fig. 2. PAVONIA FORMOSA, part of corallum, natural size.—p. 325.

Fig. 3. PAVONIA FRONDIFERA, var. BREVICRISTATA, corallum, natural size; 3 *a*, portion of same.—p. 329.

Fig. 4. PAVONIA CLAVUS, corallum, natural size; 4 *a*, surface of part of zoophyte, enlarged, showing animals; 4 *b*, surface of corallum, enlarged, showing stars; 4 *c*, part of a transverse section, enlarged; 4 *d*, part of a vertical section, enlarged.—p. 332.

## PLATE 25.

Fig. 1. PSAMMOCORA COLUMNA, corallum, natural size; 1 *a*, cell; 1 *b*, sectional view.—p. 347.

Fig. 2. PSAMMOCORA PPLICATA, corallum, natural size; 2 *a*, animals, enlarged; 2 *b*, view of surface, enlarged.—p. 346.

## PLATE 26.

Fig. 1. PSAMMOCORA EXESA, corallum, natural size; 1 *a*, part of surface of expanded zoophyte (2 polyps, and a portion of another), enlarged; 1 *b*, cell of corallum, enlarged; 1 *c*, vertical section of corallum, enlarged.—p. 348.

Fig. 2. PSAMMOCORA FOSSATA, outline view of corallum, showing form of specimen; 2 *a*, surface of the same, natural size.—p. 347.

Fig. 3. HELIOPHYLLUM, vertical section through middle of corallum.—p. 356.

Figs. 4, 4 *a*. CYATHOPHYLLUM, subgenus HELIOPHYLLUM.—p. 356.

Fig. 5. ARACHNOPHYLLUM, view of cell, natural size; 5 *a*, part of same, enlarged.—p. 360.

Fig. 6. CLISIOPHYLLUM, vertical section through middle of a turbinate species, natural size; fig. 7, from a massive species, natural size; 7 *a*, central part of fig. 7, enlarged.—p. 361.

Fig. 8. CYATHOPHYLLUM DIANTHUS, section through middle.—p. 355.

Fig. 9. COLUMNARIA, part of transverse section, natural size; 9 *a*, exterior vertical surface, natural size; 9 *b*, vertical section through middle.—p. 362.

Fig. 10. Another species of Columnaria.—p. 362.

Fig. 11. SARCINULA, vertical section through middle.—p. 363.

## PLATE 27.

Fig. 1. DENDROPHYLLIA NIGRESCENS, branch of zoophyte, natural size; 1 *a*, animal, enlarged; 1 *b*, tentacle; 1 *c*, part of branch near extremity, showing the surface and a calicle, natural size; 1 *d*, ver-

tical section of a calicle; 1 *e*, transverse section, near base of zoophyte, natural size; 1 *f*, same, near apex.—p. 387.

Fig. 2. *DENDROPHYLLIA SCABROSA*, corallum, natural size.—p. 390.

Fig. 3. *DENDROPHYLLIA DIAPHANA*, corallum, natural size.—p. 389.

Fig. 4. *DENDROPHYLLIA COCCINEA*, corallum, natural size.—p. 388.

Fig. 5. *CARYOPHYLLIA FLEXUOSA*, part of corallum, natural size.—p. 381.

Fig. 6. *CARYOPHYLLIA CONFERTA*, part of corallum, natural size.—p. 380.

Fig. 7. *CARYOPHYLLIA ARBUSCULA*, corallum, natural size.—p. 381.

Fig. 8. *CARYOPHYLLIA POCILLUM*, corallum, natural size.—p. 384.

Fig. 9, 9 *a*. *CARYOPHYLLIA DILATATA*, corallum, natural size.—p. 381.

Fig. 10. *GEMMIPORA FRONDENS*, corallum, excepting a single lobe, in outline, natural size; 10 *a*, animal, partly expanded; 10 *b*, section of corallum, enlarged; 10 *c*, surface of corallum, magnified.—p. 412.

Fig. 11. *GEMMIPORA CINERASCENS*, surface of corallum, magnified.—p. 411.

N. B. In the text, the above figures are referred by mistake to plate 30.

#### PLATE 28.

Fig. 1. *OCULINA HORRESCENS*, corallum, natural size; 1 *a*, transverse section of branch, magnified; 1 *b*, calicle enlarged.—p. 392.

Fig. 2. *ANTHOPHYLLUM HYSTRIX*, corallum, natural size; 2 *a*, polyp, enlarged; 2 *b*, tentacle, enlarged; 2 *c*, calicle, natural size; 2 *d*, transverse section of calicle; 2 *e*, texture of spongy part, magnified.—p. 401.

Fig. 3. *ANTHOPHYLLUM CLAVUS*, corallum, natural size; 3 *a*, calicle, enlarged; 3 *a'*, same, natural size; 3 *b*, section of part of stem.—p. 403.

Fig. 4. *ANTHOPHYLLUM CESPITOSUM*, calicle, natural size.—p. 401.

Fig. 5. *CULICIA STELLATA*, calicles, natural size; 5 *a*, expanded polyp, enlarged; 5 *b*, tentacle, enlarged; 5 *c*, calicle, enlarged; 5 *d*, lamellæ of calicle, enlarged.—p. 377.

Fig. 6. *CULICIA TENELLA*, calicle, enlarged; 6 *a*, natural size; 6 *b*, lamellæ of cell, enlarged.—p. 377.

Fig. 7. *CULICIA TRUNCATA*, calicle, enlarged; 7 *a*, same, natural size.—p. 378.

#### PLATE 29.

Fig. 1. *GEMMIPORA BRASSICA*, corallum, showing the cells, natural size; 1 *b*, horizontal section of corallum, enlarged, viewed from above; 1 *c*, calicle, enlarged.—p. 413.

Fig. 2. *GEMMIPORA PALIFERA*, corallum, natural size; 2 *a*, transverse section, enlarged; 2 *b*, polyp, enlarged.—p. 409.

Fig. 3. *ASTREOPORA PULVINARIA*, corallum, natural size; 3 *a*, animal, enlarged, partly expanded; 3 *b*, cell, enlarged; 3 *c*, animal, less expanded; 3 *d*, vertical section of corallum, enlarged.—p. 415.

#### PLATE 30.

Fig. 1. *ISAURA SPECIOSA*, natural size; 1 *a*, animal, enlarged.—p. 419.

Fig. 2. *ISAURA ASTER*, natural size; 2 *a*, animal enlarged.—p. 419.

Figs. 3, 3 *a*, 3 *b*, 3 *c*, 3 *d*, 3 *e*, 3 *f*, 3 *g*, 3 *h*. *PALYTHOA CÆSIA*.—pp. 40, 427.

Figs. 4, 4 *a*, 4 *b*. *GEMMIPORA PELTATA*.—p. 410. (Reference omitted in the text.)

N. B. Several figures, referred in the text by mistake to Plate 30, will be found on Plate 27.

#### PLATE 31.

Fig. 1. *MADREPORA CRIBRIPORA*, zoophyte expanded, natural size; 1 *a*, polyp, enlarged; 1 *b*, extremity of branch of corallum; 1 *c*, surface of corallum magnified about 10 diameters; 1 *d*, part of a transverse section of corallum, enlarged.—p. 470.

Fig. 2 *a*. Calicle of *MADREPORA FORMOSA*, enlarged, lateral view; 2 *b*, end view, showing cell and rays.—pp. 432, 473.

Figs. 3 *a*, 3 *b*. Calicles of *MADREPORA ROBUSTA*, enlarged, lateral view; 3 *c*, end view, showing cell and rays.—pp. 432, 475.

Figs. 4 *a*, 4 *b*. Calicles of *MADREPORA HUMILIS*, enlarged, lateral view; 4 *c*, end view.—pp. 432, 483.

Fig. 5. Calicle of *MADREPORA HYSTRIX*, lateral view, enlarged; 5 *a*, end view.—pp. 432, 476.

Figs. 6 *a*, 6 *b*, 6 *c*. Calicle of *MADREPORA SPICIFERA*, enlarged, different views.—pp. 432, 442.

Fig. 7 *a*. A dimidiate calicle, 432.

Fig. 8 *a*. Calicle of *MADREPORA APPRESSA*, lateral view, enlarged; 8 *b*, end view.—pp. 432, 457.

Fig. 9 *a*. Calicle of *MADREPORA ECHIDNÆA*, lateral view, enlarged; 9 *b*, end view.—pp. 432, 458.

Fig. 10 *a*. Calicle of *MADREPORA LABROSA*, lateral view, enlarged; 10 *b*, end view.—p. 486.

Fig. 11 *a*. *MADREPORA PALMATA*, end view of calicle, enlarged; 11 *b*, 11 *c*, 11 *d*, 11 *f*, different calicles, natural size.—p. 436.

Fig. 12 *a*. *MADREPORA ALCES*, end view of calicle, enlarged; 12 *b*, 12 *c*, 12 *d*, 12 *e*, 12 *f*, different calicles, natural size.—p. 437.

Fig. 13 *a*. *MADREPORA FLABELLUM*, end view of calicle, enlarged; 13 *b*, 13 *c*, 13 *d*, 13 *e*, different calicles, natural size.—p. 438.

#### PLATE 32.

Fig. 1. *MADREPORA CONIGERA*, part of corallum, in outline; 1 *a*, one of the conical prominences.—p. 440.

Fig. 2. *MADREPORA HYACINTHUS*, fragment of corallum, natural size, showing branchlets of upper and under surface.—p. 444.

Figs. 3 *a*, 3 *b*. *MADREPORA CYTHEREA*, fragments of corallum, natural size, showing branchlets and parts of the main branches; 3 *a*, somewhat weathered.—p. 441.

Fig. 4. *MADREPORA SUACULOSA*, corallum, natural size; 4 *a*, branchlets, natural size.—p. 445.

Fig. 5. *MADREPORA SUACULOSA* (?).—p. 445.

Fig. 6. *MADREPORA ACULEUS*, part of corallum, natural size; 6 *a*, branchlet, natural size.—p. 450.

Fig. 7. *MADREPORA TUBICINARIA*, corallum, natural size; 7 *a*, extremity of branch, natural size.—p. 451.

#### PLATE 33.

Fig. 1. *MADREPORA PROSTRATA*, part of corallum, natural size; 1 *a*, polyp enlarged; 1 *b*, same, partly contracted; 1 *c*, branchlet of corallum; 1 *d*, surface enlarged; 1 *e*, cell enlarged in profile; 1 *f*, transverse section of branch of corallum, enlarged.—p. 447.

Fig. 2. MADREPORA MILLEPORA, part of corallum, natural size; 2 *a*, branchlet, natural size.—p. 446.

Fig. 3. MADREPORA SUBULATA, part of corallum, natural size; 3 *a*, branchlet, natural size.—p. 448.

Fig. 4. MADREPORA SPICIFERA, corallum, natural size, from Feejees; 4 *a*, branch from the same; 4 *b*, same species, Singapore.—p. 442.

Fig. 5. MADREPORA SPICIFERA, var. from Singapore, natural size.—p. 443.

Fig. 6. MADREPORA EFFLORESCENS, part of corallum, natural size.—p. 441.

## PLATE 34.

Fig. 1. MADREPORA PAXILLIGERA, part of zoophyte, natural size; 1 *a*, part of one of the branchlets.—p. 452.

Fig. 2. MADREPORA NASUTA, natural size; 2 *a*, branchlet, natural size; 2 *b*, view of calicles.—p. 453.

Fig. 3. MADREPORA GLOBICEPS, a branchlet, natural size.—p. 454.

Fig. 4. MADREPORA ACERVATA, branchlet, natural size.—p. 460.

Fig. 5. MADREPORA APPRESSA, branchlets, natural size; 5 *a*, calicle, natural size.—p. 457, where the reference is incorrect, to figure 3.

## PLATE 35.

Fig. 1. MADREPORA VALIDA, corallum, natural size.—p. 461.

Fig. 2. MADREPORA CEREALIS, corallum, natural size; 2 *a*, branchlet, natural size.—p. 460.

Fig. 3. MADREPORA ECHIDNEA, branch of corallum, natural size; 3 *a*, calicle, natural size; 3 *a'* same, enlarged.—p. 458.

Fig. 4. MADREPORA RAMICULOSA, part of a branch of corallum; 4 *a*, extremity of a branchlet, natural size.—p. 463.

Fig. 5. MADREPORA HEBES, corallum, natural size.—p. 468.

Fig. 6. MADREPORA —?—

## PLATE 36.

Fig. 1. MADREPORA ECHINATA, corallum, natural size; 1 *a*, branchlet, ditto.—p. 464.

Fig. 2. MADREPORA CARDUUS, corallum, natural size.—p. 464.

Fig. 3. MADREPORA ROSARIA, corallum, natural size.—p. 465.

## PLATE 37.

Fig. 1. MADREPORA FLORIDA, corallum, in outline, natural size.—p. 466.

Fig. 2. MADREPORA IMPLICATA, corallum, natural size; 2 *a*, part of transverse section of branch, enlarged.—p. 467.

Fig. 3. MADREPORA TORTUOSA, corallum, natural size.—p. 467.

## PLATE 38.

Fig. 1. MADREPORA ASPERA, in part with polyps expanded, natural size; 1 *a*, polyp, enlarged; 1 *b*, part of transverse section of a branch of the corallum, enlarged.—p. 468.

Fig. 2. MADREPORA EXIGUA, corallum, natural size; 2 *a*, extremity of branch; 2 *b*, profile of calicles.—p. 469.

Fig. 3. MADREPORA BRACHIATA, corallum, natural size; 3 *a*, extremity of a branch; 3 *b*, profile of calicle.—p. 474.

Fig. 4. MADREPORA FORMOSA, corallum, natural size; 4 *a*, extremity of branch.—p. 473.

## PLATE 39.

Fig. 1. MADREPORA VIRGATA, corallum, natural size; 1 *a*, extremity of branch.—p. 471.

Fig. 2. MADREPORA HORRIDA, corallum, natural size; 2 *a*, extremity of branch.—p. 472.

Fig. 3. MADREPORA ROBUSTA, branch of corallum, natural size; 3 *a*, extremity of branch.—p. 475.

## PLATE 40.

Fig. 1. MADREPORA HYSTRIX, corallum, natural size.—p. 476.

Fig. 2. MADREPORA ARBUSCULA, extremity of a branch of corallum, natural size.—p. 474.

Fig. 3. MADREPORA NOBILIS, branch of corallum, natural size; 3 *a*, extremity of branch.—p. 481.

Fig. 4. MADREPORA SECUNDA, corallum, natural size; 4 *a*, extremity of branch; 4 *b*, profile of calicles.—p. 481.

## PLATE 41.

Fig. 1. MADREPORA ABROTANOIDES, corallum, natural size; 1 *a*, extremity of a branch, natural size.—p. 477.

Fig. 2. MADREPORA DIVARICATA, corallum, natural size; 2 *a*, extremity of branch.—p. 477.

Fig. 3. MADREPORA GRACILIS, corallum, natural size; 3 *a*, extremity of branch; 3 *b*, calicle.—p. 482.

Fig. 4. MADREPORA HUMILIS, corallum, natural size; 4 *a*, calicles.—p. 483.

## PLATE 42.

Fig. 1. MADREPORA CUSPIDATA, corallum, natural size; 1 *a*, extremity of a branch.—p. 485.

## PLATE 43.

Fig. 1. MADREPORA DEFORMIS, corallum, natural size; 1 *a*, part of branch.—p. 484.

Fig. 2. MADREPORA SECURIS, corallum, natural size; 2 *a*, part, enlarged.—p. 486.

Fig. 3. MADREPORA LABROSA, corallum, natural size; 3 *a*, part, enlarged.—p. 486.

## PLATE 44.

Fig. 1. MANOPORA CALICULATA, corallum, natural size.—p. 492.

Fig. 2. MANOPORA PALMATA, corallum, natural size; 2 *a*, a variety of the same; 2 *b*, polyp, enlarged; 2 *c*, surface of corallum, enlarged; 2 *d*, same, natural size; 2 *e*, transverse section, enlarged.

three diameters; 2*f*, part of a transverse section, enlarged twelve diameters.—p. 493.

Fig. 3. *MANOPORA PALMATA*, variety.—p. 494.

Fig. 4. *MANOPORA SPUMOSA*, corallum, natural size; 4*a*, a portion of the same.—p. 495.

Fig. 5. *MANOPORA HISPIDA*, corallum, natural size.—p. 496.

#### PLATE 45.

Fig. 1. *MANOPORA GRANDIFOLIA*, corallum, natural size; 1*a*, polyp, enlarged; 1*a'*, natural size of polyp; 1*b*, surface of corallum, natural size; 1*c*, surface, enlarged; 1*d*, transverse section, enlarged.—p. 449.

Fig. 2. *MANOPORA EXPANSA*, corallum, half natural size; 2*a*, polyp enlarged; 2*a'*, same, natural size; 2*b*, surface of corallum, natural size; 2*c*, surface, magnified; 2*d*, section, magnified.—p. 448.

#### PLATE 46.

Fig. 1. *MANOPORA CRISTA-GALLI*, corallum, natural size; 1*a*, part of a branch, natural size.—p. 494.

Fig. 2. *MANOPORA NODOSA*, zoophyte, natural size; 2*a*, part of a zoophyte with expanded polyps, enlarged; 2*b*, part of surface of corallum, enlarged; 2*c*, transverse section of corallum, enlarged.—p. 501.

Fig. 3. *MANOPORA SCABRICULA*, zoophyte, natural size; 3*a*, part of surface, with polyps enlarged; 3*b*, part of surface of corallum, enlarged; 3*c*, vertical section of corallum, enlarged.—p. 502.

Fig. 4. *MANOPORA EFFUSA*, corallum, part in outline, natural size; 4*a*, surface of corallum, natural size.—p. 500.

Fig. 5. *MANOPORA EROSA*, corallum, natural size; 5*a*, vertical section, enlarged.—p. 504.

#### PLATE 47.

Fig. 1. *MANOPORA INCRASSATA*, corallum, natural size.—p. 503.

Fig. 2. *MANOPORA TUBERCULOSA* (?), corallum, natural size; 2*a*, polyp, enlarged, beginning to expand.—p. 506.

Fig. 3. *MANOPORA PLANIUSCULA*, corallum, natural size; 3*a*, vertical section, enlarged.—p. 507.

Fig. 4. *MANOPORA CAPITATA*, corallum, natural size.—p. 504.

#### PLATE 48.

Fig. 1. *MANOPORA DIGITATA*, zoophyte, in part expanded; 1*a*, polyp, enlarged; 1*b*, part of branch of corallum, natural size; 1*c*, cell, enlarged; 1*d*, section of branch of corallum.—p. 508.

Fig. 2. *MANOPORA TORTUOSA*, corallum, natural size.—p. 509.

Fig. 3. *ALVEOPORA SPONGIOSA*, corallum, the drawing showing general shape only, size reduced two diameters; 3*a*, part of corallum, natural size; 3*b*, cells, enlarged; 3*c*, section of cell; 3*d*, vertical section of corallum, enlarged.—p. 513.

Fig. 4. *ALVEOPORA DEDALEA*, corallum, natural size.—p. 512.

#### PLATE 49.

Fig. 1. *SIDEROPORA MORDAX*, zoophyte expanded, natural size; 1*a*, polyp, enlarged; 1*b*, surface of corallum at the extremity of

a branch, showing the stellate cells, enlarged; 1*c*, section, enlarged.—p. 518.

Fig. 2. *SIDEROPORA PALMATA*, var. *COALESCENS*, corallum, natural size.—p. 516.

Fig. 3. *SERIATOPORA HYSTRIX*, branches from the central part of a hemispherical clump, natural size; 3*a*, supposed to be the same, from the outer part of a clump; 3*b*, part of a section of a branch, enlarged.—p. 521.

Fig. 4. *SERIATOPORA CALIENDRUM*, a few branches of the corallum, natural size.—p. 522.

Fig. 5. *POCILLOPORA CESPITOSA*, part of a clump, natural size, in outline; 5*a*, extremity of a branch, showing the surface, natural size.—p. 525.

Fig. 6. *POCILLOPORA BULBOSA*, part of a clump, in outline, natural size; 6*a*, extremity of a branch, showing the surface, natural size.—p. 527.

Fig. 7. *POCILLOPORA DAMICORNIS*, part of a clump, in outline, natural size; 7*a*, extremity of a branch, natural size, showing the surface.—p. 527.

Fig. 8. *POCILLOPORA BREVICORNIS*, part of a clump, in outline.—p. 526.

#### PLATE 50.

Fig. 1. *POCILLOPORA FAVOSA*, corallum, natural size.—p. 528.

Fig. 2. *POCILLOPORA LIGULATA*, branch of corallum, natural size; 2*a*, surface and cells, enlarged. (This species may be the same with *P. Plicata*, fig. 7.)—p. 531.

Fig. 3. *POCILLOPORA VERRUCOSA*, branch of corallum, in outline, natural size; 3*a*, verrucæ, natural size.—p. 529.

Fig. 4. *POCILLOPORA ELONGATA*, branch, natural size, in outline; 4*b*, cells, enlarged.—p. 531.

Fig. 5. *POCILLOPORA SQUARROSA*, branch of corallum, in outline; 5*a*, extremity of a branch, showing surface, natural size.—p. 530.

Fig. 6. *POCILLOPORA MEANDRINA*, branch of corallum, natural size; 6*a*, the verrucæ, natural size; 6*b*, transverse section of branch, natural size.—p. 533.

Fig. 7. *POCILLOPORA Plicata*, a plate or branch, natural size; 7*a*, surface enlarged, view of cells oblique; 7*b*, same view, vertical; 7*c*, vertical section of corallum, enlarged; 7*d*, transverse section, enlarged.—p. 534.

#### PLATE 51.

Fig. 1. *POCILLOPORA ELEGANS*, part of a clump, natural size; 1*a*, verrucæ of rami, natural size.—p. 532.

Fig. 2. *POCILLOPORA GRANDIS*, corallum, natural size; 2*a*, part of a branch, showing surface; 2*b*, verrucæ, natural size; 2*c*, surface, enlarged.—p. 533.

Fig. 3. *POCILLOPORA INFORMIS*, corallum, natural size; 3*a*, surface, magnified, showing cells.—p. 535.

#### PLATE 52.

Fig. 1. *HELIOPORA MEANDRINA*, corallum, natural size; 1*a*, surface, enlarged; 1*b*, internal structure shown, much magnified.—p. 540.

Fig. 2. *HELIOPORA CÆRULEA*, var. *TUBEROSA*, corallum, natural size.—p. 540.

Fig. 3, 3 *a*. MILLEPORA TORTUOSA, different varieties of form; 3 *b*, extremity of branch.—p. 545.

Fig. 4. MILLEPORA PUMILA, corallum, natural size.—p. 545.

Fig. 5. MILLEPORA PLATYPHYLLA; 5 *a*, surface, with cells, enlarged; 5 *a'*, same, natural size; 5 *b*, general appearance of transverse section, natural size; 5 *c*, same, enlarged.—p. 548.

Figs. 6 *a*, 6 *b*. CONSTELLARIA CONSTELLATA, transverse and vertical section, very much magnified. (The diameter of the cells in the specimens is about a tenth of a line.)—p. 537.

## PLATE 53.

Fig. 1. MILLEPORA INCRASSATA, part of corallum, natural size.—p. 547.

Fig. 2. MILLEPORA PLATYPHYLLA, var. TRUNCATA, part of corallum, natural size; 2 *a*, position and size of cells.—p. 548.

Fig. 3. PORITES MORDAX, corallum, natural size; 3 *a*, cell enlarged.—p. 552.

Fig. 4. P. MORDAX, var. ELONGATA, corallum, natural size.—p. 553.

Fig. 5. PORITES COMPRESSA, corallum, natural size; 5 *a*, cell enlarged.—p. 553.

Fig. 6. PORITES FLEXUOSA, part of branch, natural size.—p. 554.

Figs. 7, 8, 9, 10, 11, 12. Sections of cells in species of Porites.—p. 550.

## PLATE 54.

Fig. 1. PORITES NIGRESCENS, corallum, natural size (part of a clump); 1 *a*, portion of the surface, magnified; 1 *b*, part of a transverse section of a branch, enlarged.—p. 557.

Fig. 2. PORITES NIGRESCENS, var. MUCRONATA, corallum, natural size.—p. 558.

Fig. 3. PORITES PALMATA, corallum, natural size; 3 *a*, a portion of surface, showing two cells enlarged.—p. 558.

Fig. 4. PORITES CYLINDRICA, corallum of part of a clump, natural size.—p. 559.

Fig. 5. PORITES LEVIS, outline view of a branch of a corallum, natural size; 5 *a*, 5 *b*, polyps in different positions; 5 *c*, surface, enlarged; 5 *d*, part of a transverse section, enlarged.—p. 559.

Fig. 6. PORITES CONTIGUA, part of a clump, natural size; 6 *a*, surface of corallum, enlarged.—p. 560.

## PLATE 55.

Fig. 1. PORITES LOBATA, corallum, natural size; 1 *a*, 1 *b*, cells, enlarged.—p. 562.

Fig. 2. PORITES LIMOSA, part of corallum, natural size; 2 *a*, cells, enlarged.—p. 563.

Fig. 3. PORITES CONGLOMERATA, corallum, natural size; 3 *a*, cell, enlarged.—p. 561.

Fig. 4. PORITES FAVOSA, corallum, natural size; 4 *a*, cells, enlarged.—p. 564.

Fig. 5. PORITES CRIBRIPORA, corallum, natural size; 5 *a*, cell, enlarged.—p. 564.

Fig. 6. PORITES INFORMIS, corallum, natural size; 6 *a*, expanded polyps and surface of zoophyte, enlarged; 6 *b*, cells and surface of corallum, enlarged; 6 *c*, part of a transverse section of corallum, enlarged.—p. 565.

Fig. 7. PORITES MONTICULOSA, corallum, natural size; 7 *a*, ex-

panded polyps, enlarged; 7 *b*, cells, enlarged; 7 *c*, part of a transverse section, enlarged.—p. 566.

Fig. 8. PORITES EROSA, corallum, natural size; 8 *a*, cell, enlarged.—p. 565.

Fig. 9. PORITES FRAGOSA, surface of corallum, natural size; 9 *a*, cells, enlarged.—p. 563.

## PLATE 56.

Fig. 1. ANTIPATHES ANGUINA, extremity of zoophyte, with polyps expanded, natural size; 1 *a*, axis of the same; 1 *b*, 1 *c*, polyps, enlarged; 1 *d*, portion of axis, enlarged.—p. 576.

Fig. 2. ANTIPATHES ARBOREA, part of a branch, with polyps expanded; 2 *a*, polyp, enlarged; 2 *b*, part of trunk, natural size.—p. 584.

Fig. 3. PORITES RETICULOSA, corallum, very slightly magnified (incorrectly referred to as fig. 1).—p. 567.

Fig. 4. PORITES LICHEN, corallum, natural size.—p. 566. (Incorrectly referred to as fig. 2.)

Fig. 5. GONIOPORA COLUMNNA, with polyps expanded, natural size; 5 *a*, polyp, enlarged; 5 *b*, part of corallum, showing the cells, natural size.—p. 569.

## PLATE 57.

Fig. 1. RENILLA AMERICANA, natural size, with the polyps expanded; 1 *a*, polyp, enlarged; 1 *a'*, tentacle.—p. 588.

Fig. 2. RHIZOXENIA PRIMULA, polyps, natural size, on a piece of coral rock; 2 *a*, polyp, enlarged.—p. 601.

Fig. 3. XENIA CERULEA (?), natural size; 3 *a*, polyp, enlarged; 3 *b*, part of tentacle, more enlarged.—p. 605.

Fig. 4. XENIA FLORIDA, natural size; 4 *a*, upper view of tentacle, enlarged; 4 *b*, under view.—p. 606.

Fig. 5. XENIA ELONGATA, natural size; 5 *a*, under view of tentacle, enlarged; 5 *b*, upper view, ib.—p. 606.

Fig. 6. ALCYONIUM FLEXILE, unexpanded.—p. 619.

Fig. 7. ALCYONIUM CONFERTUM, unexpanded, one branch with the polyps partly retracted; 7 *a*, some of the spicula; 7 *b*, polyp, partly expanded.—p. 621.

Fig. 8. ALCYONIUM BRACHYCLADUM (?).—p. 617.

## PLATE 58.

Fig. 1. ALCYONIUM TRICANTHENUM, natural size; the polyps of part expanded, but owing to the long, flexible, capillary tentacles, the animals are not separately distinct.—p. 620.

Fig. 2. ALCYONIUM RIGIDUM, unexpanded, natural size.—p. 622.

Fig. 3. ALCYONIUM MURALE, unexpanded, natural size.—p. 622.

Figs. 4 and 5. ALCYONIUM GLAUCUM, natural size.—p. 623.

Fig. 6 *a*. ALCYONIUM LATUM, surface, magnified, of unexpanded zoophyte; 6 *b*, expanded polyp, enlarged; 6 *b'*, natural size of polyp.—p. 623.

Fig. 7. ALCYONIUM LATUM?

## PLATE 59.

Fig. 1. TUBIFORA SYRINGA, part of a zoophyte, expanded; 1 *a*, polyp, enlarged; 1 *a'*, tentacle, more enlarged; 1 *b*, section, show-

ing the interior structure; 1 *c*, part of a visceral lamella with clusters of ovules attached.—p. 635.

Fig. 2. *TUBIPORA FIMBRIATA*, polyp, enlarged; 2 *a*, extremity of tentacle, more enlarged (natural size, nearly same as in fig. 1).—p. 634.

Fig. 3. *GORGONIA TRICHOSTEMMA*, natural size; 3 *a*, polyp, enlarged; 3 *b*, papilla of tentacle, enlarged.—p. 665.

Fig. 4. *SPOGGODIA CELOSIA*, part of a zoophyte, natural size; 4 *a*, polyp, enlarged, with an adjoining calcareous spiculum; 4 *b*, section of branch, natural size; 4 *c*, magnified view of surface, showing the calcareous spicula in position; 4 *d*, part of a spiculum, much magnified; 4 *e*, a thin longitudinal section of the same, through the middle, obtained by polishing it down, showing the interior appearance, under a high magnifying power, the dark spots corresponding each to a surface protuberance.—pp. 626, 711.

Fig. 5. *AULOPORA TENUIS*, corallum, natural size, adhering to dead coral.—p. 631.

Fig. 6. *ALCYONIUM GLAUCUM*, unexpanded, natural size.—p. 623.

Fig. 7. *GORGONIA SUFFRUTICOSA*, unexpanded, natural size; 7 *a*, polyp, enlarged; 7 *a'*, same, natural size.—p. 665.

#### PLATE 60.

Fig. 1. *CORALLIUM SECUNDUM*, natural size; 1 *a*, part of surface of dried specimen, magnified.—p. 641.

Fig. 2. *GORGONIA FLEXUOSA*? natural size; 2 *a*, expanded polyp, enlarged.—p. 660.

Fig. 3. *DISTICHOPORA VIOLACEA*, corallum, natural size; 3 *a*, end view of extremity of a branch, enlarged.—p. 703.

Fig. 4. *DISTICHOPORA GRACILIS*, corallum, natural size.—p. 704.

Fig. 5. *DISTICHOPORA GRACILIS*? natural size; 5 *a*, same, enlarged; 5 *b*, view of margin, enlarged.—p. 704.

Fig. 6. *ALLOPORA BELLA*, corallum, natural size; 6 *a*, surface, enlarged; showing cells.—p. 696.

Fig. 7. *ALLOPORA FLABELLIFORMIS*, extremity of a branchlet, natural size.—p. 694.

Fig. 8. *MARGINOPORA VERTEBRALIS*, natural size.—p. 705.

Fig. 9. *MARGINOPORA VERTEBRALIS*? var. *PPLICATA*, natural size; 9 *a*, margin, enlarged; 9 *b*, view of horizontal section, enlarged.—p. 706.

#### PLATE 61.

Figs. 1 *a*, 1 *b*. *POLYTREMA ECHINULATA*, different varieties, natural size; 1 *c*, 1 *d*, the small prominences, magnified; 1 *e*, section of corallum, magnified.—p. 707.

Fig. 2. *POLYTREMA CRUSTULA*, natural size; 2 *a*, part of same magnified.—p. 707.

Fig. 3. *POLYTREMA BRUNNESCENS*, natural size.—p. 707.

Fig. 4. *POLYTREMA MESENERINA*, natural size; 4 *a*, portion magnified, showing the character of the margin.—p. 708.

Fig. 5. *ANTENNULARIA CYATHIFERA*, much enlarged; 5 *a*, natural size.—p. 687.

Fig. 6. *SERTULARIA MIMOSA*, frond in mere outline, showing only its general form, excepting one branchlet with partially expanded polyps; 6 *a*, one of the polyps fully expanded, enlarged.—p. 687.

Fig. 7. *LAOMEDEA GRACILIS*, enlarged; 7 *a*, natural size; 7 *b*, a polyp, enlarged, partly contracted, and seen for the most part through the transparent calicle.—p. 689.

Fig. 8. *LAOMEDEA SIMPLEX*, enlarged; 8 *a*, natural size; 8 *b*, rostriform mouth.—p. 690.

Fig. 9. *CAMPANULARIA* —?—p. 690.

Fig. 10. *CORYNA CAPILLIFERA*, enlarged.—p. 692.

Fig. 11 *a*. *LIAGORA RUBRICEPS*, natural size; 11 *b*, portion enlarged; 11 *c*, sporidia, more enlarged; 11 *d*, part of a transverse section of stem, showing the cells within cut across and partly disarranged; *e*, *e'* longitudinal cellules, enlarged 150 diameters; 11 *f*, cellules detached, with a lateral branch of cellules passing to the sporules at apex; 11 *g*, one of the sporules magnified 400 diameters.—p. 92.





1. 1. a. b. c. h. e. Actinia flagellifera.  
 2. 2. a. b. A. pustulata.  
 3. Actinia veratra.  
 4. 5. A. elomalis.

describ. by J. Swinhoe

J. Drayton, Edm.



6. 7. 8.	Actinia	florida.	
9. 9. a.	A.	tabella.	
10. 10. a. b.	A.	graminea.	
11. 11. a. b. A.	A.	diadema.	
12. 13. 14. 15.	Actinia	primula.	
16.	A.	primula?	
17.	A.	clavigera.	

Drawn by J. Dmyten.

J. Dmyten, Editt.

U.S. Exploring Expedition



18. 18. a. b. c. d. e. f. Actinia impatiens.  
 19. A. mouilifera.  
 20. 20. a. A. pretiosa.  
 21. A. (young).  
 22. 22. a. A. lineolata.

23. 23. a. Actinia ermentata.  
 24. A. decorata.  
 25. A. paumotensis.  
 26. 26. a. b. 27. A. mollis.  
 28. 28. a. A. achates.

Drawn by J. DeKay.

J. DeKay, Edist.

PLATE 3.

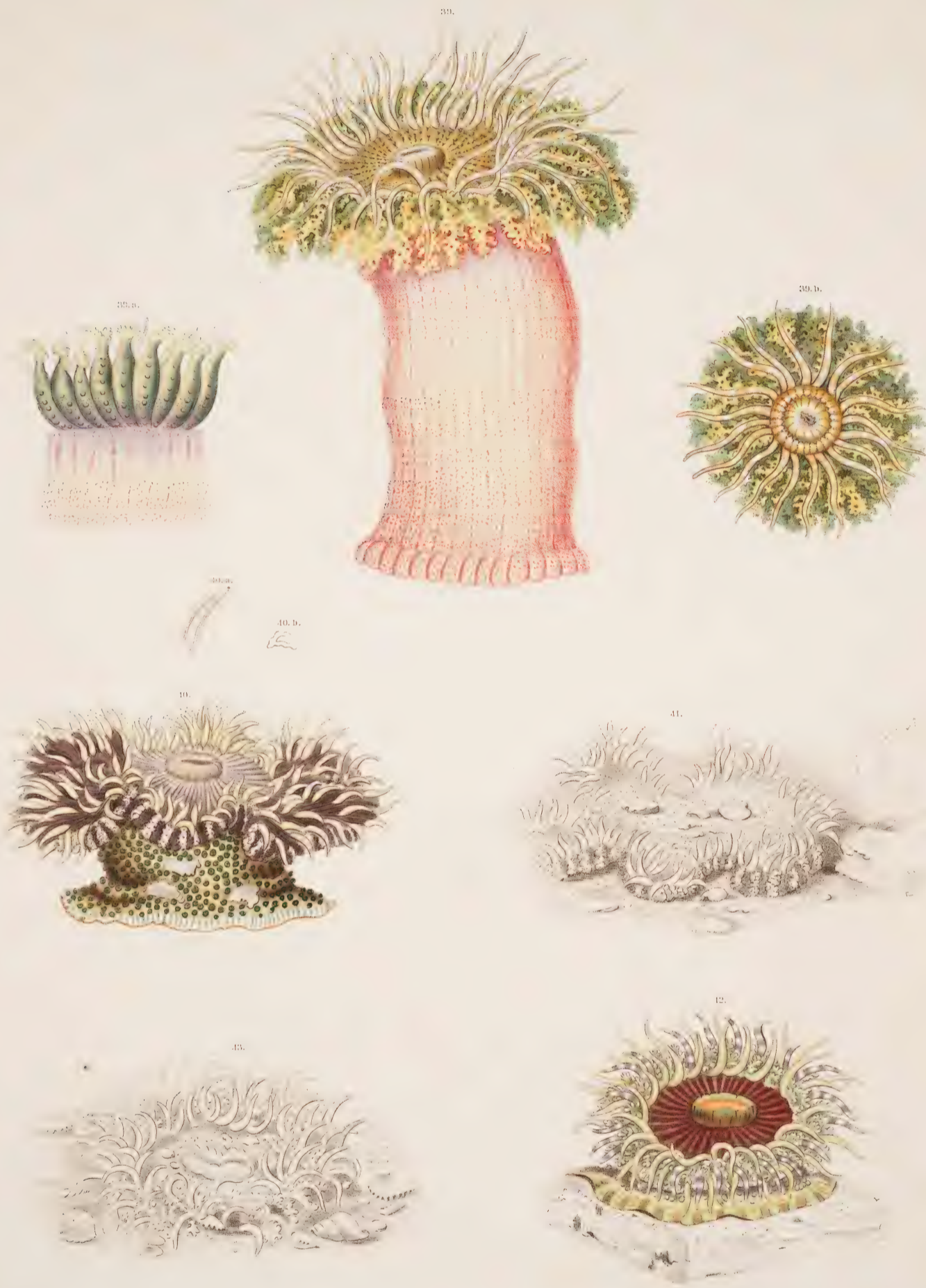


29. Actinia, papaver.  
 30. 30 a. A. pluvia.  
 31. 31 a. A. reticulata.  
 32. 32 a, b. A. fucgensis.  
 33. 33 a. A. nymphaea.

34. 34 a. Actinia, rubus.  
 35. 35 a. A. gemma.  
 36. 36 a. A. cuta.  
 37. 37 a. A. rhodora.  
 38. 38 a. A. artemisia.

Drawn by J. Dreyfus

J. Dreyfus, Edm.



39. 39. a. b. Metridium prætextum.  
 40. 40. a. b. 41. M. concinnatum.  
 42. 43. M. mucosum.

Drawn by J. Johnston.

J. Dreyer, Ed.

E. S. Palmer, Jr.



1. a. b. c. d. e. Euphyllia spheniscus.  
 2. 2. a. E. spinulosa.  
 3. 3. a. b. c. d. e. Euphyllia rugosa.  
 4. 4. a. b. E. meandrina.  
 5. 6. 6. a. Euphyllia pavonina.

Drawn by J. H. Van Dyke.

J. Doughton, Editt.



1.a



3.a

1.b



1.b

3.b

3.b

1.c

1.c

3.c



1. 1 a, b, c. *Mussa cactus*.  
 2. 2 a, b. *M. costata*.

3. a, b, c. *Mussa cytherea*.  
 4. *M. angulosa*.

5. *Mussa*. \_\_\_\_\_



1. a. b. c. <i>Mussa sinuosa.</i>	5. <i>Mussa regalis.</i>	8. <i>Mussa carduus.</i>
2. 2. a. b. <i>M. multilobata.</i>	6. <i>M. crista.</i>	9. <i>M. dipsacea.</i>
3. 3. a. b. <i>M. cerebriformis.</i>	7. <i>M. fragilis.</i>	10. <i>M. nobilis.</i>
4. <i>M. angulosa.</i>		11. 11. a. <i>M. recta.</i>

J. D. Dana, del.

J. Dreyfus, Ed. del.

W. A. Wood, sculp.





1. b.



1. c.



1. d.



2. a.

2. b.

2. c.



3. a.



3. b.

3. c.



4.

- |                |                   |  |          |                   |                  |          |                       |                    |
|----------------|-------------------|--|----------|-------------------|------------------|----------|-----------------------|--------------------|
| 1.             | <i>Manicina</i>   | <i>amarantum.</i>                      | 5.       | <i>Caulastrea</i> | <i>distorta.</i> | 8. a. b. | <i>Euphyllia</i>      | <i>cultrifera.</i> |
| 2.             | <i>M.</i>         | <i>amar<sup>um</sup> var. stricta.</i> | 6.       | a. b. c. C.       | <i>undulata.</i> | 9.       | <i>E.</i>             | <i>turgida.</i>    |
| 3.             | <i>M.</i>         | <i>areolata.</i>                       | 7. 7. a. | <i>Euphyllia</i>  | <i>aspera.</i>   | 10.      | <i>Tridacophyllia</i> | <i>lactuca.</i>    |
| 1. 1. a. b. c. | <i>Caulastrea</i> | <i>furcata.</i>                        |          |                   |                  | 11.      | <i>T.</i>             | <i>paonia.</i>     |



1. a. b.	Orbicella	argus.	6.	Orbicella	annularis.	12. 12. a. b. c. d.	Siderina	galaxea.
2. a. b.	0.	glaucopis.	7. a. b.	0. —	stellulata.	15. 15. a. b. c. d. e.	Astraea	pallida.
5. a. b. c.	0.	curta.	9. 9. a. b. c. d. e.	0.	stelligera.	11. 11. a. b. c. d. e.	Orbicella	putida.
1. a. b. c. d. e. f. g.	0.	coronata.	10.	0.	ocellina.	15.	0. —	hyades.
5. a. b. c.	0.	pleiades.	11. 11. a. b. c. d. e.	0.	microphthalma.	16.	0.	excelsa.

A. D. Dana Del.

J. Doughton, Esq. Del.

W. H. Tappan Sc.



1. 1. a. b. c. d. *Astraea speciosa.*  
 2. 2. a. b. c. d. *A. pandanus.*  
 5. 5. a. b. *A. puteolina.*  
 1. a. b. c. d. *A. dipsacea.*

5. 5. a. b. c. d. *Astraea porcata.*  
 6. 6. a. b. c. d. e. *A. flexuosa.*  
 7. 7. a. b. c. *A. fusco viridis.*  
 8. 8. a. b. c. d. *A. virens.*

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1. a. b. *Astrea echinata*.  
 2. a. b. c. d. *fragilis*.  
 3. a. b. c. *magnifica*.  
 1. 1 a. b. *filicosa*.  
 5. a. b. *versipora*.  
 6. a. b. c. *denticulata*.

7. 7 a. b. c. d. *Astrea deformis*:  
 8. a. b. c. d. *rigida*.  
 9. a. b. c. *reticularis*.  
 10. a. b. c. d. e. *purpurea*.  
 11. a. b. c. d. e. f. *pulchra*.  
 12. a. b. *petrosa*.

13. a. b. *Astrea vincta*.  
*A. Polygona* *ESCH.*

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H. Kitchin Sc.



1.	Astraea	tenella.	6. 6. a. b. c.	Astraea	parvistella.	11. 11. a. b.	Astraea	robusta.
2. 2. a. b. c. d.	A.	favistella.?	7. 7. a. b. c.	A.	favulus.	12. 12. a. b. c. d. e.		intersepta.
5.	A.	favistella.	8.	A.	cerium.	15. 15. a. b. c. d. e. f.	Monticularia	microcona.
4. 4. a. b. c. d.	A.	eximia.	9. 9. a. b. c. d.	A.	tesserifera.	11. 11. a. b.	Orbicella	orion.
5. 5. a. b. c.	A.	sinuosa.	10. 10. a. b. c. d.	A.	robusta.	15. 15. a.	Astraea	porcata.

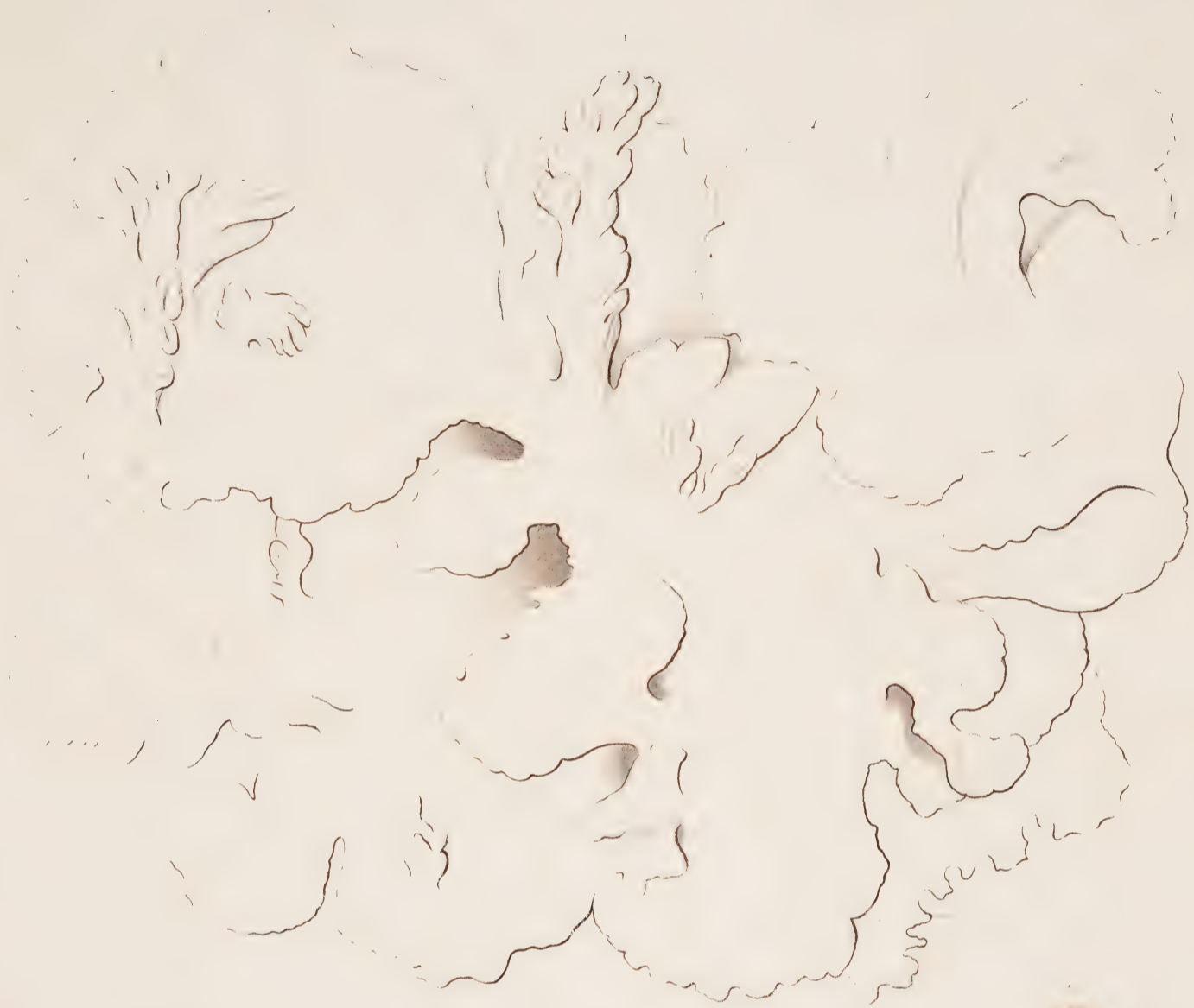
J. D. Dana Del.

J. D. Dana Edit.

J. E. Penhonne Sc.



- |    |           |                |           |                |              |            |          |              |            |              |             |
|----|-----------|----------------|-----------|----------------|--------------|------------|----------|--------------|------------|--------------|-------------|
| 1. | Meandrina | labyrinthica.  | 7.        | 7. a. b. c. d. | Meandrina    | tentis.    | E3.      | Ctenophyllia | pectinata. |              |             |
| 2. | M.        | cerebriformis. | 8.        | 8. a. b.       | M.           | phygia.    | 14.      | 14. a.       | C.         | quadrata.    |             |
| 3. | 3. a.     | M.             | truncata. | 9.             | M.           | filigrana. | 15.      | C.           | C.         | pachyphylla. |             |
| 4. | 4. a. b.  | M.             | strigosa. | 10.            | 10. a.       | M.         | mammosa. | 16.          | C.         | profunda.    |             |
| 5. | 5. a. b.  | M.             | rustica.  | 11.            | 11. a. b.    | M.         | valida.  | 17.          | 17. a. b.  | Meandrina    | spongiosa.  |
| 6. | 6. a. b.  | M.             | gracilis. | 12.            | 12. a. b. c. | M.         | dedalea. | 18.          | M.         | M.           | interrupta. |



1. 1. a. b. c. d. e. *Merulina regalis*.

2. 2. a. *Merulina ampliata*.



1. Merulina speciosa.  
2. 2'. 2. a. b. M. scabricula.

3. Merulina laxa.  
4. 4. a. b. Phyllostrea tubifex.

Drawn by J. D. Dana.

J. Doughton, Editt.

P. J. Oliver.





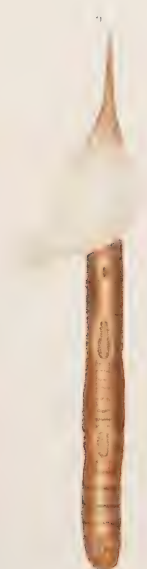
1. 1 bis, 1 a, b c. *Merulina rigida.*  
 2. 2 a, b. *Echinopora reflexa.*

5. 5 a. *Echinopora undulata.*  
 1. 4 a, b, c. *E. horrida.*

J. D. Dana Del.

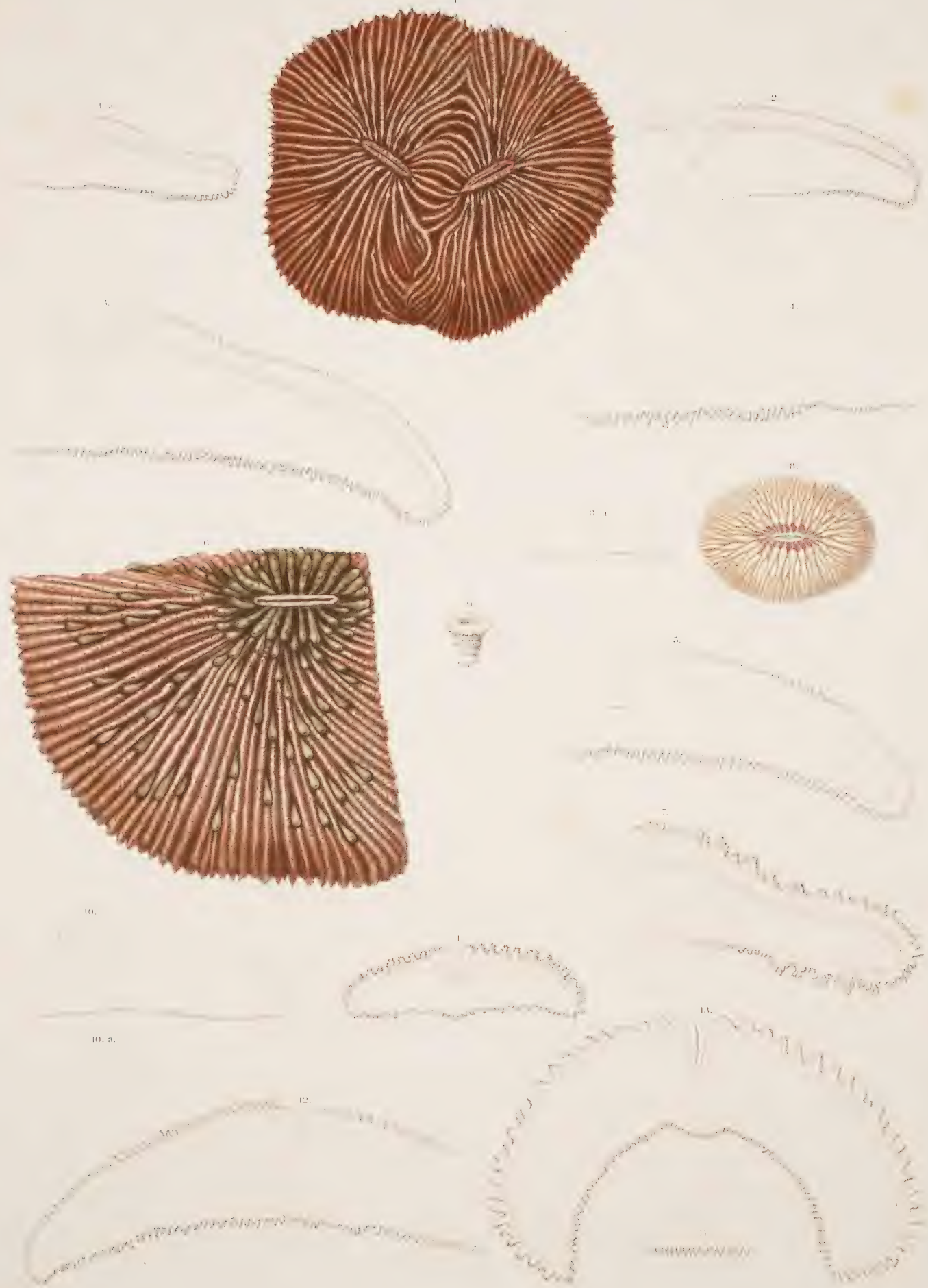
J. D. Dana Edif.

J. W. Githam Sc.



- 1. *Fungia tenuis.*
- 2. *F. glaus.*
- 3. a. *F. discus.*
- 4. *F. dentigera.*

- 5. *Fungia agariciformis.*
- 6. *F. var. tenuifolia.*
- 7. *F. dentata.*
- 8, 9, 9 a, b. *F. echinata.*



1. 1. a. 2. 3. *Fungia repanda.*  
 4. *F. integra.*  
 5. *F. confertifolia.*  
 6. *F. confertifolia.*

7. *Fungia horrida.*  
 8. 8. a. *F. paumotensis.*  
 9. *F. paumotensis: young.*  
 10. 10. a. *F. scutaria.*

11. *Fungia Ehrenbergii.*  
 12. *F. gigantea.*  
 13. *F. crassa.*  
 14. *F. asperata.*



1. *Fungia dentata*.  
 2. 2. a. b. c. d. *Herpetolithus limacinus*.  
 3. 3. a. *Herpetolithus foliosus*.  
 4. 4. a. b. c. *Polyphyllia leptophylla*.  
 5. 5. a. b. c. *H. crassus*.



1. Herpetolithus strictus.  
 2. 2. a. b. Halomitra pileus.  
 5. 5. a. b. Polyphyllia galeriformis.  
 4. P. pileiformis.

5. a. b. c. d. Polyphyllia talpa.  
 6. Zoopilus echinatus.  
 7. Agaricia speciosa.  
 8. Agaricia undata.

A. D. Dana. Del.

A. Doughty. Calc.

W. H. Tappan. Sc.



1. 1 a, b, c. *Agaricia rugosa*.  
 2. A. *levicollis*.  
 3. *Pavonia papyracea*.  
 4. P. *decussata*.

5. 5 a. *Pavonia pretorta*.  
 6. P. *divaricata*.  
 7. P. *boletiformis*.  
 8. young of *Tridacophyllia*!



1. *Pavonia lata*.

*Drawn by J. D. Dana.*



2. 2. a. *Pavonia crassa*.

*J. Dreyton. Edif.*

*Shapton & Smith. Sc.*



1. *Favonia crassa* var. *obtusa*.  
 2. *F. formosa*.

3. 3. a. *Favonia frondifera* var. *brevicristata*.  
 4. 4. a. b. c. d. *F. clavus*.

J. J. Van Dyke del.

J. J. Van Dyke del.

J. Dwight, sculp.





1. 1 a, b, c. *Psammocora* columna.  
2. 2 a, b, c. " *plicata*.



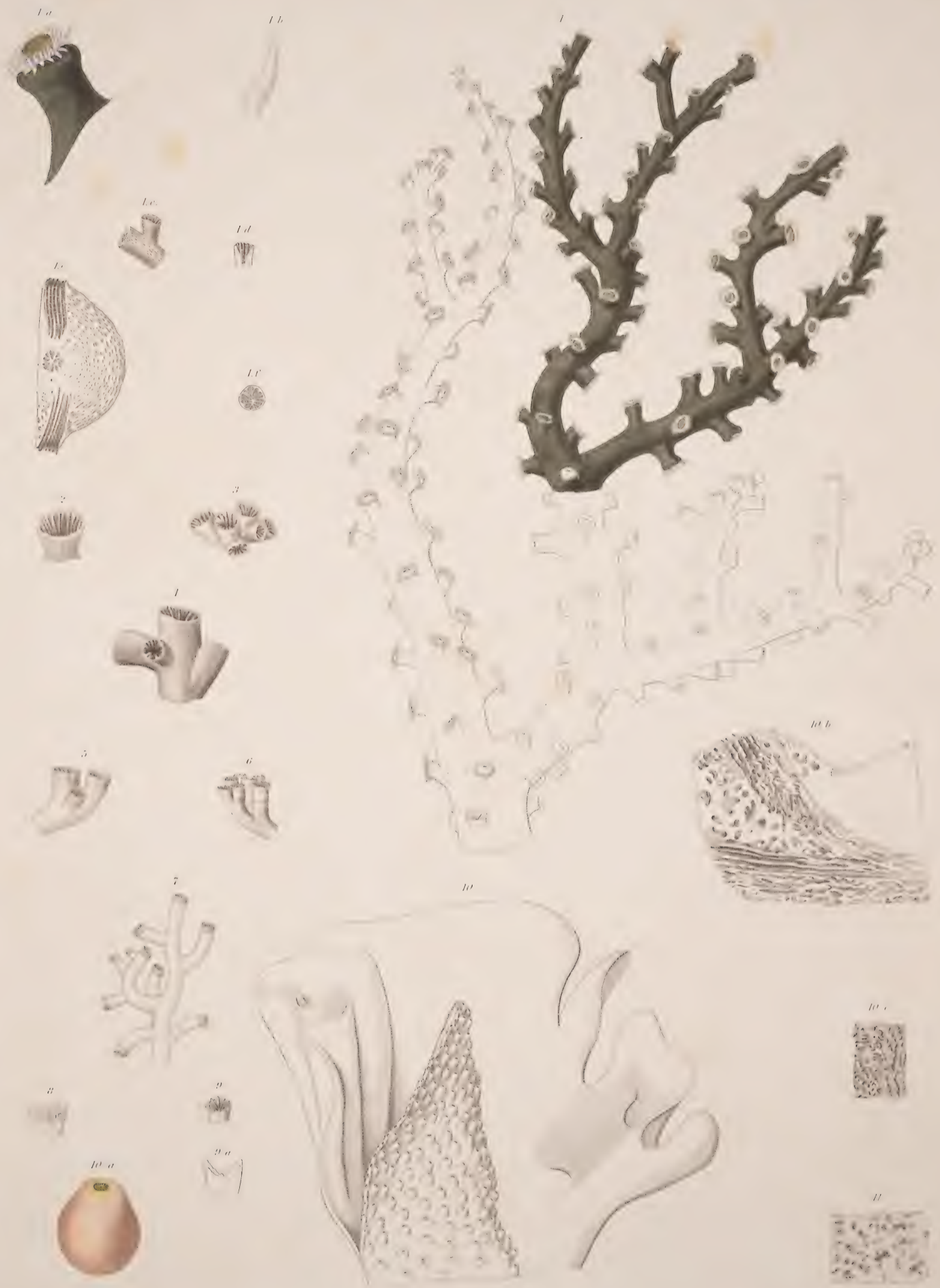
1. 1. a. b. c. Psammocora exesa.  
 2. 2. a. P. ——— fossata.  
 5. 4. 4. a. Subgenus Heliophyllum.  
 5. 5. a. Genus Arachnophyllum.

6. 7. 7. a. Genus Clisiophyllum.  
 8. Cyathophyllum diantlus.  
 9. 9. a. 10. Genus Columnaria.  
 11. G. — Sarcinula.

J. D. Dana Del.

J. D. Dana Del.

E. Halpin Sc.



1. 1a. b. c. d. e. f.	Dendrophyllia	nigrescens.	5. Caryophyllia	flexuosa.	8.	C.	poecillum.
2.	D.	scabrosa.	6. C.	conferta.	9. 9. a.	C.	dilatata.
3.	D.	diaphana.	7. C.	arbuscula.	10. 10. a. b. c.	Genimipora	frondens.
4.	D.	coccinea.			11.	G.	cinerascens.

J. D. Dana Del.

J. D. Dana Ed.

D. C. Hinman Sc.



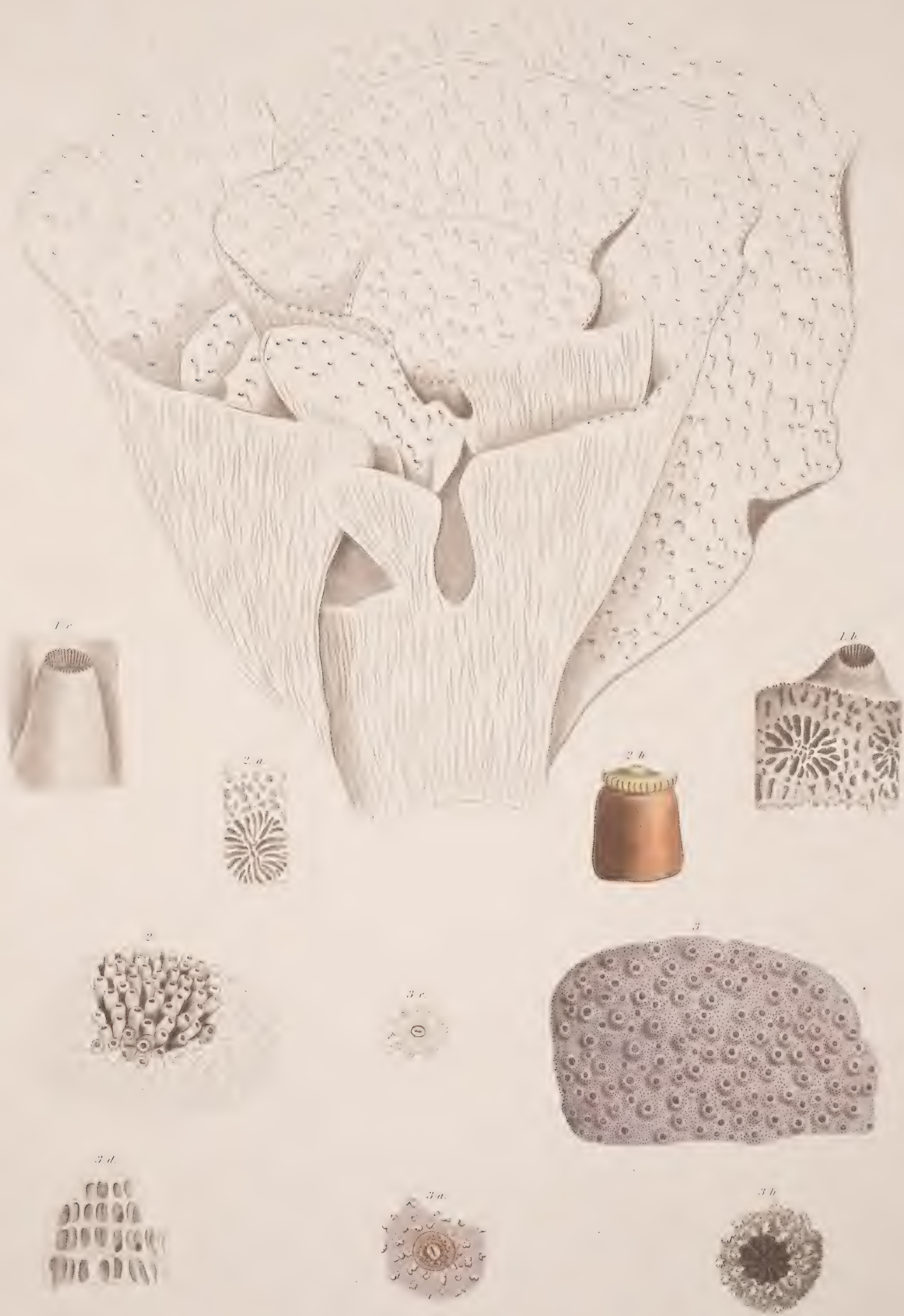
1. 1 a. b. - *Oculina horescens*.  
 2. 2 a. b. c. d. e. *Anthophyllum hystrix*.  
 3. 3 a. a. b. A. clavus.

4. *Anthophyllum cespitosum*.  
 5. 5 a. b. c. d. *Culicia stellata*.  
 6. 6 a. b. C. *tenella*.

7. 7 a. *Culicia truncata*.

J. P. Combs.

J. Doughton. Edt.

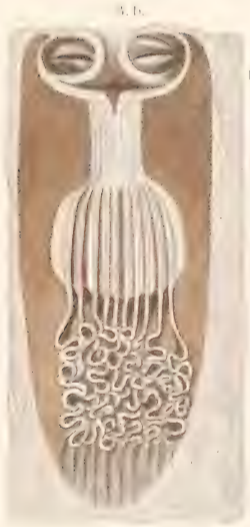


1 1. a. b. c. Gemmipora brassica.  
 2 2. a. b. G. palifera.  
 5 5. a. b. c. d. Astraeopora pulvinaria.

J. B. Dana Del.

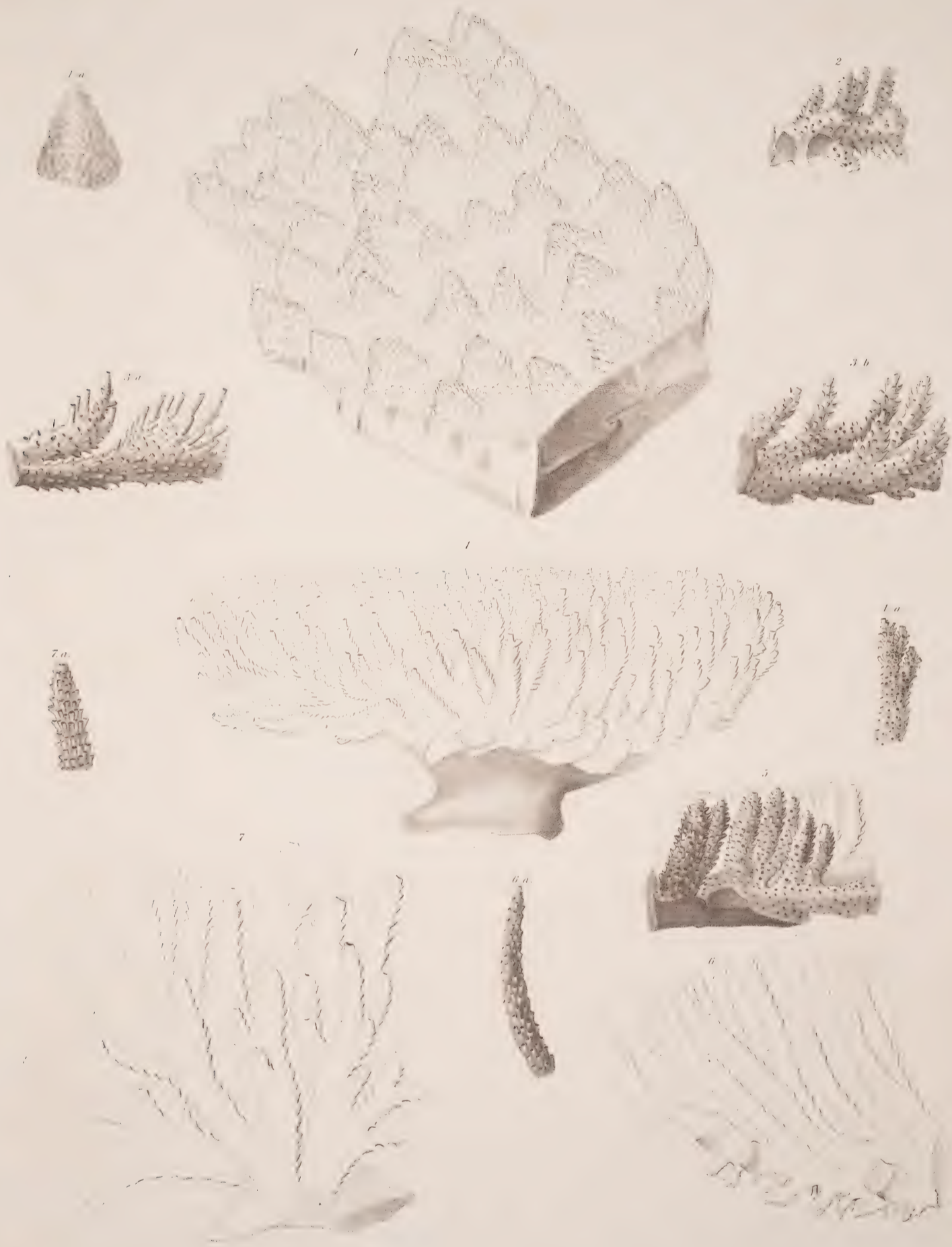
J. Dreyton, Editt

W. A. Wilmer Sc.



1. 1. a. *Isaura speciosa*.  
2. 2. a. 1. *Aster*.

3. 3. a. b. c. d. e. f. g. h. *Palythoa coccinea*.  
4. 4. a. b. *Gemmipora peltata*.



1. 1. a. Madrepora conigera.  
 2. M. hyacinthus.  
 5. a. 5. b. M. cytherea.

7. 7. a. Madrepora tubicinaria.

4. 4. a. Madrepora surculosa.  
 5. M. — surculosa.  
 6. 6. a. M. aculeus.

J. D. Dana Del.

J. Dymally, Editt

J. H. A. G. W. Gieseler Sc.



1. La. b. c. d. e. f. Madrepora prostrata.  
 2. 2a. M. millepora.  
 5. M. subulata.

1. 1. a. b. Madrepora spicifera.  
 5. M. spicifera var.  
 6. M. efflorescens.

A. D. Dana, Del.

J. Douglas, Editt.

W. H. Dall, Sc.







1. Madrepora valida.  
 2. 2 a M. cerealis.  
 3. 3 a 3 a' M. ochidnea.

4. 4 a. Madrepora ramiculosa.  
 5. M. -- hebes.

J. D. Dana Del.

J. Drayton, Editt

J. F. P. Protheroe Sc



1. *Madrepora echinata.*
2. *M. carduus.*
3. *M. rosaria.*

*J. Dreyer. Ediz.*

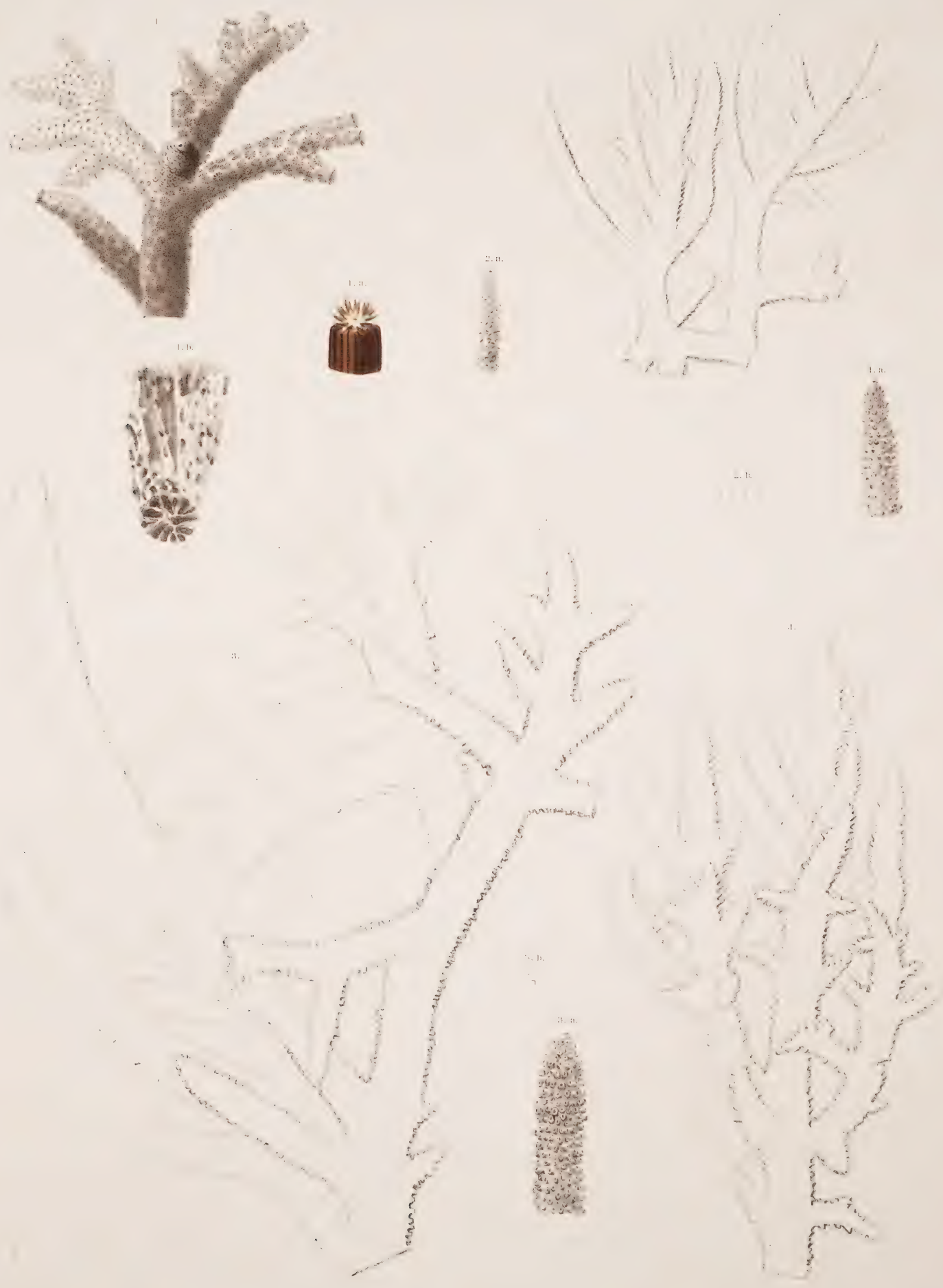


- 1. Madrepora florida.
- 2. 2 a. M. implicata.
- 3. M. tortuosa.

*J. D. Dana Del.*

*J. Doughton. Ed.*

*F. Holpin Sc.*



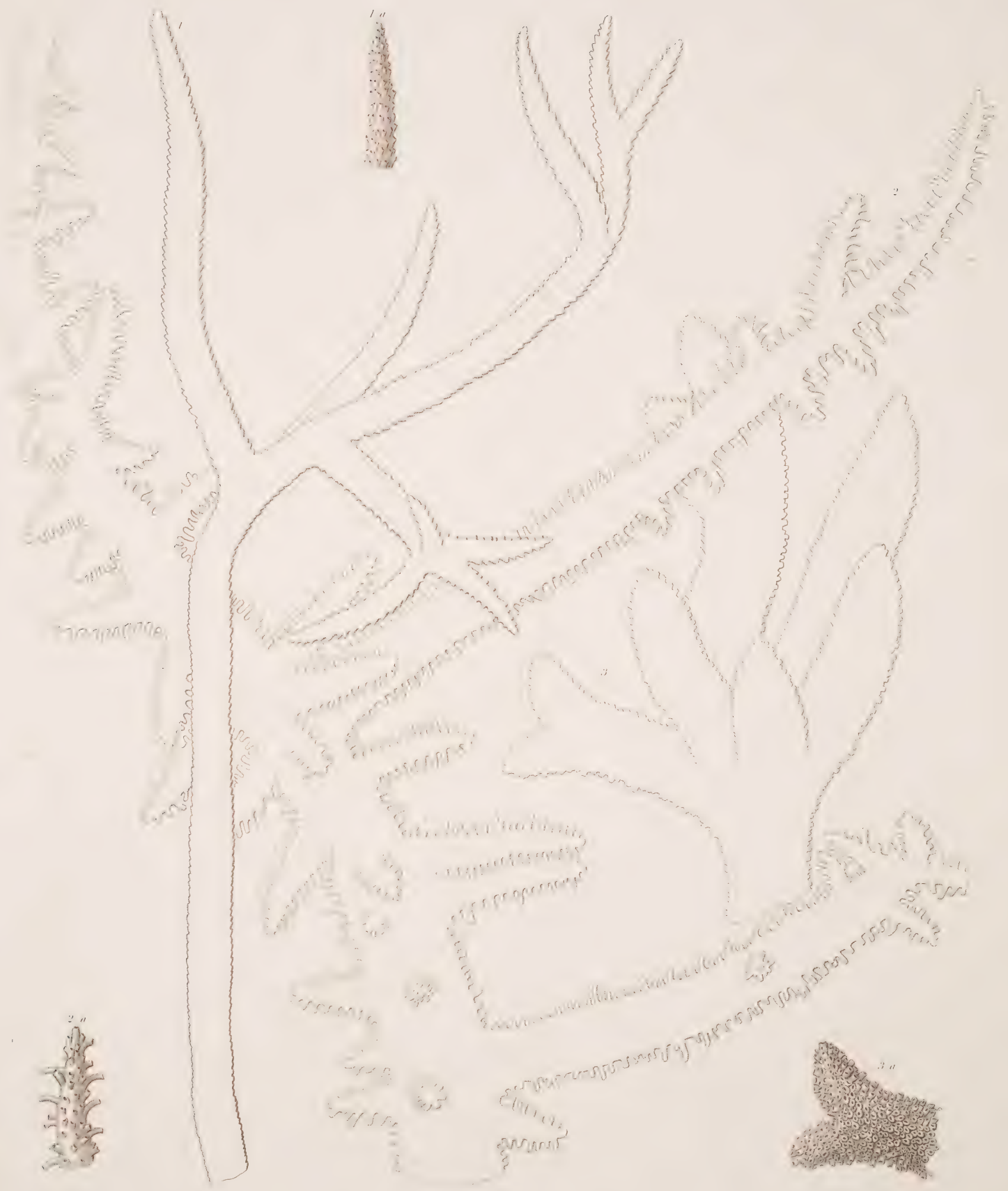
1. 1. a. b. *Madrepora aspera*.  
 2. 2. a. b. *M. exigua*.

3. 3. a. b. *Madrepora brachiata*.  
 4. 4. a. b. *M. formosa*.

Engrs by J.B. Dana.

J. Doughty, Collt.

Edin. J.

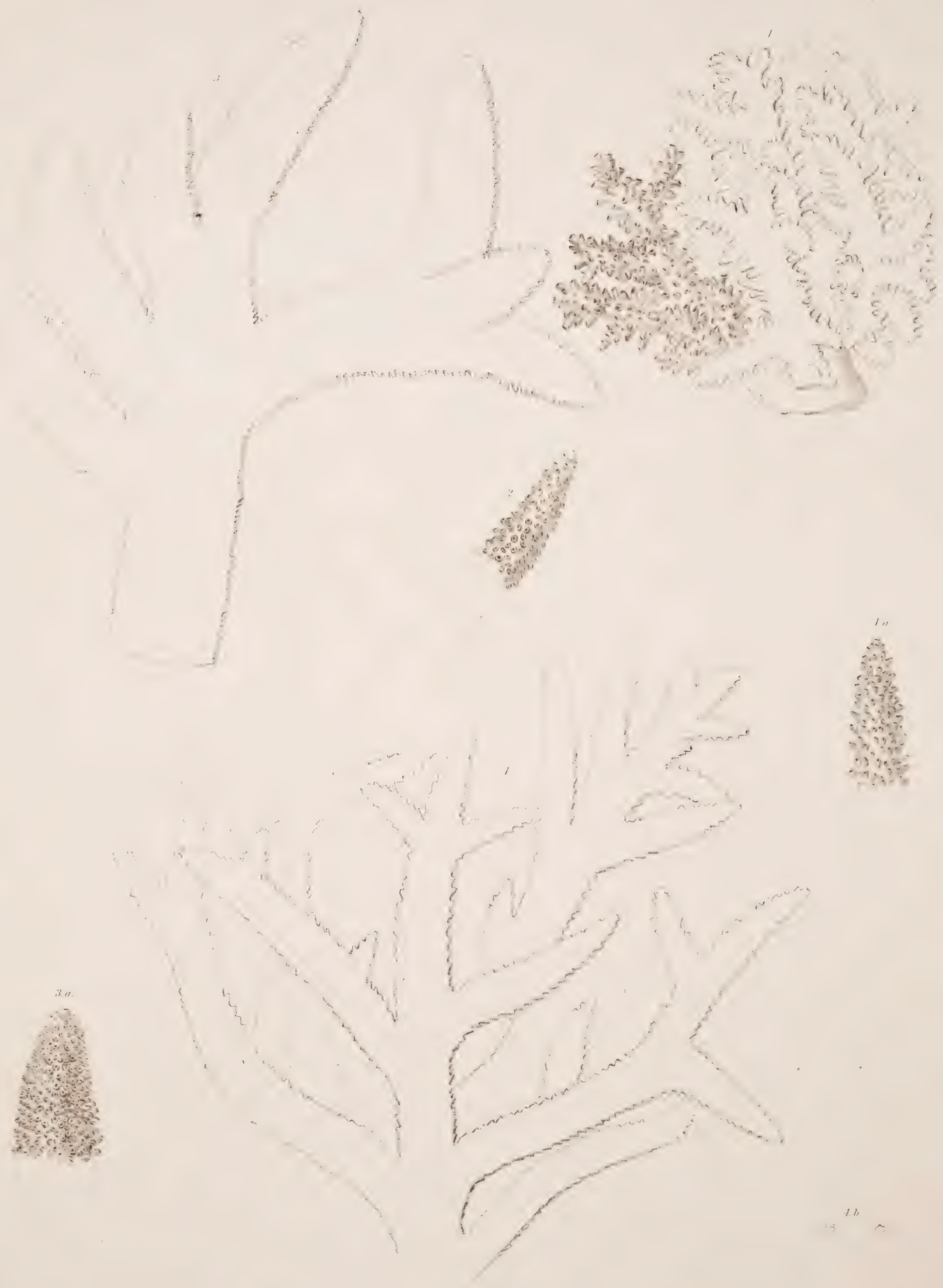


- 1. 1. a. Madrepora virgata.
- 2. 2. a. M. horrida.
- 5. 5. a. M. robusta.

J. D. Dana, del.

H. C. Hummer, Sc.

J. Douglas, Edid.



1. Madrepora. hystrix.  
 2. M. arbuscula.

5. Madrepora nobilis.  
 4. 4 a. b. M. secunda.

J. P. Dana Del.

F. Halpin Sc.

J. Doughton. Edt.



1. 1. a. Madrepora abrotanoides.  
 2. 2. a. M. divaricata.

3. 3. a. b. Madrepora gracilis.  
 4. 4. a. M. humilis.

Drawn by J. B. Smit.

J. Dreyton, Editt.

N.Y. Dent. No.





1. f a. b. Madrepora cuspidata.

*J. D. Dana Del.*

*D. C. Hoeman Sc.*

*J. Duffon Edit.*



1. 1 a. Madrepora deformis.  
2. 2 a. M. securis.  
3. 3 a. M. labrosa.

J. D. Dana Del.

J. Doughton Engr.

J. F. Poulton Sc.





1. 1. a. b. c. d. *Manopora grandifolia*.  
2. 2. a. b. c. d. *Manopora expansa*.



1. 1 a. Manopora crista-galli.  
 2. 2 a, b, c. M. nodosa.

5. 5, a. M. crosa.

3. 3 a, b, c. Manopora scabricula.  
 4. 4 a. M. effusa.



1. Manopora incrassata.  
 2. 2 a, b M. tuberculosa.

3. 3 a. Manopora planiuscula.  
 4. M. capitata.

Drawn by J.L. Dana.

J. Dreyer, Edite.



1. 1. a. Manopora digitata.  
 2. M. tortuosa.

5. 5. a. b. c. d. Alveopora spongiosa.  
 4. A. dedalea.

J. D. Dana Del.

J. D. Dana Lith.

J. E. P. Prudhomme Sc.



1. 1a. b. c. Sideropora mordax.  
 2. S. digitata? var. coalescens.  
 3. 3a. b. Seriatopora hystrix.  
 4. S. calicudrum.

5. 5. a. Pocillopora cespitosa.  
 6. 6. a. P. bulbosa.  
 7. 7. a. P. damicornis.  
 8. P. brevicornis.

J. D. Dana, Del.

J. D. Dana, Ed.

D. C. Hoeman, Sc.





1. Pocillopora favosa.  
 2. 2. a. P. ligulata.  
 3. 3. a. P. verrucosa.

4. 4. b. Pocillopora elongata.  
 5. 5. a. P. squarrosa.  
 6. 6. a. b. P. meandrina.

7. 7. a. b. c. d. Pocillopora plicata.

Drawn for J. D. Dana

J. Dighton, Engr.



1. 1 a. Pocillopora elegans.  
2. 2 a, b, c, P. grandis.  
3. 3 a. P. informis.



1. Millepora incrassata.  
 2. 2 a. M. platyphylla.  
 5. 5. a. Porites mordax.  
 1. P. mordax var. elongata.

5. 5 a. Porites compressa.  
 6. P. flexuosa  
 7. 8. 9. 10. 11. 12. sections  
 of Cells in species of Porites.

A. D. Dana Del.

J. Dwight Sculp

et. Litho. N.



1. 1 a, b. *Porites nigrescens*.  
2. *P. nigrescens* var. *micronata*.  
3. *P. palmata*.

4. *Porites cylindrica*.  
5. 5 a, b, c, d. *P. levis*.  
6. *P. contigua*.



1. 1. a. b. Porites lobata.  
 2. 2. a. P. limosa.  
 5. 5. a. P. conglomerata.

4. 4. a. Porites favosa.  
 5. 5. a. P. criripora.  
 6. 6. a. b. c. P. informis.

7. 7. a. b. c. Porites menticulosa  
 8. 8. a. P. erosa.  
 9. 9. a. P. fragosa.

J. D. Dana Del.

J. Dighton. Editt

D. C. Humann Sc.



1. 1. a. b. c. d. Antipathes anguina.

2. 2. a. b. A. arborea.

5. 5. a. b. Goniopora columna.

3. Poites reticulosa.

4. P. lichen.

Drawn by J.R. Bennett.

J. Doughton del.



1. 1 a. 1 b. *Renilla americana*.  
 2. 2 a. *Rhizoxenia primata*.  
 3. 3 a. 3 b. *Xenia caerulea*.  
 4. 4 a. 4 b. *Xenia florida*.

5. 5 a. 5 b. *Xenia elongata*.  
 6. *Alcyonium flexile*.  
 7. 7 a. 7 b. *Alc. confertum*.  
 8. *Alc. brachycladum*.



1. Aleyonium triacanthinum.  
 2. A. rigidum.  
 3. A. murale.

4. 5. Aleyonium glaucum.  
 6. a. b. A. latum.  
 7. A. latum.

J. DeLong & J. Drayton, Del.

J. Drayton, Editt.





1. 1 a. a. b. c. Tubipora syringa.  
 2. 2 a. T. fimbriata.  
 3. 3 a. b. Gorgonia trichostemma.

7. 7 a. Gorgonia suffruticosa.

1. 1 a. b. c. d. e. Spongia celosia.  
 5. Antopora tenuis.  
 6. Acyonium glaucum.



- 1. 1. a. Corallium secundum.
- 2. 2. a. Gorgonia flexuosa.
- 5. 5. a. Distichopora violacea.
- 4. D. — gracilis.
- 5. 5. a. b. D. — gracilis?

- 6. 6. a. Allopora bella.
- 7. A. flabelliformis.
- 8. Marginopora vertebralis.
- 9. 9. a. b. M. — vertebralis?

A. H. Dana Del.

A. Dreyler, Lith.

G. Parker Sc.



1. 1.a. 1.b. 1.c. 1.d. 1.e. *Polytremia echinulata.*  
 2. 2.a. *Polyt. crustula.*  
 3. *Polyt. brunnescens.*  
 4. 4.a. *Polyt. mesenterina.*  
 5. 5.a. *Antennularia cyathifera.*  
 6. 6.a. *Sertularia mimosa.*

7. 7.a. 7.b. *Laomedea gracilis.*  
 8. 8.a. 8.b. *L. simplex.*  
 9. *Campanularia.*  
 10. *Coryna capillifera.*  
 11. a. b. c. d. e. f. g. *Liagora rubriceps.*