











































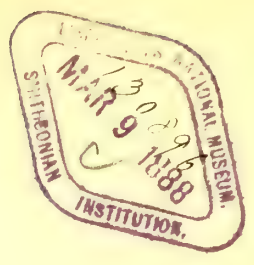








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# MEMOIRS

READ BEFORE THE BOSTON SOCIETY OF NATURAL HISTORY.

I. *Revision of the Polypi of the Eastern Coast of the United States.* By A. E. VERRILL.

Read November 19th, 1862.

THE Polyps of this coast have hitherto been less studied than the representatives of most other classes, and, up to the present time, there has been no attempt made to bring together in a systematic form the species that have been at various times described, both in this country and in Europe. Many of these have, however, long since found their natural positions in the general systematic works of Ellis,<sup>1</sup> Pallas,<sup>2</sup> Lamarck,<sup>3</sup> Lamouroux,<sup>4</sup> Cuvier,<sup>5</sup> Milne-Edwards,<sup>6</sup> and other distinguished naturalists of Europe, and in the magnificent work of Dana,<sup>7</sup> published by our own government. Besides these references, often very brief and imperfect, disconnected notices and descriptions of other species are found scattered through many volumes of the Proceedings and Journals of our scientific societies and associations.

But these materials, owing to their inaccessibility, and, in many cases, to their original imperfection, have not been made available either for scientific study and comparison with the European species, which have been carefully examined during many years, or to incite local naturalists and collectors to more careful studies of the habits and structure of these beautiful and interesting beings, and more thorough search for other forms.

It was for the purpose of supplying in some measure the deficiency in these respects, and to establish a basis for future investigations, rather than to present anything new, that the present work was undertaken; but, on account of the constant accessions of new materials, it has now become necessary to present quite a number of undescribed species, and it is very probable that many more remain to be hereafter discovered. I have also deemed it useful to introduce brief descriptions of the higher groups and their principal subdivisions, even in some cases when they were extralimital, in order to illustrate more clearly the position and zoölogical affinities of the species described. To do this I

<sup>1</sup> John Ellis. *Essay towards a Natural History of Coralines*, 4to, London, 1754; *Natural History of many curious and uncommon Zoöphytes*, 4to, London, 1786. (Edited by Solander.)

<sup>2</sup> Petrus Simon Pallas. *Elenchus Zoophytorum*, 8vo, Leyden, 1766.

<sup>3</sup> Jean-Baptiste Lamarck. *Histoire naturelle des animaux sans vertèbres*, 8vo, Paris, 1815-22; 2d edition, 1836.

<sup>4</sup> J. V. F. Lamouroux. *Histoire générale des Polypiers coralligènes flexibles*, 8vo, Caen, 1816.

<sup>5</sup> Georges Cuvier. *Règne Animal*, t. iv., Paris, 1817; 2d edition, t. iii., 1830.

<sup>6</sup> H. Milne-Edwards. *Histoire naturelle des Coralliaires ou Polypes proprement dits*. 3 vols. 8vo, Paris, 1857.

<sup>7</sup> James D. Dana. *United States Exploring Expedition under Capt. Wilkes. Zoöphytes*, 4to, with folio plates, Philadelphia, 1846; plates, 1849.



have found it necessary to introduce many changes in the generally received systems of classification, — a result due in part to the investigations of the living coral-polyps by Prof. Agassiz, while in Florida, and partly to my own special studies of this class, while arranging and classifying the unrivalled collection in the Museum of Comparative Zoölogy. Although many of the results of the observations of Prof. Agassiz have as yet been made public only through his lectures, I have, in every case, endeavored to give the true authority for those conclusions that are not original with me.

In the preparation of this paper, I have been greatly indebted to Prof. Agassiz, who has not only allowed me the unrestricted use of the extensive collection of the museum, but has also, with characteristic liberality, placed in my hands his magnificent series of drawings, made from life by Mr. J. Burkhardt. These have been of the utmost value, especially in preparing the descriptions of the southern *Actinidæ*, of which I have had no opportunity to examine living specimens. I am also under many obligations to Mr. William Stimpson, who has furnished me with an elegant drawing of *Halcampa producta*, and with valuable notes concerning other species. To Mr. E. S. Morse, my thanks are due for my first opportunity to examine living specimens of *Bunodes stella*, and for several beautiful drawings of that species and of *Edwardsia sipunculoides*, some of which are reproduced in the accompanying plate.

### Order I. ALCYONARIA.

The class of Polyps has undergone many changes, as it has been found necessary, from time to time, to remove groups belonging to other classes, confounded with it so long as their structure was imperfectly understood. The true polyps were for the first time divided into the two natural orders characterized by the number and structure of the tentacles, by Milne-Edwards and Audouin, in 1828, but at that time no special names were applied to the two groups thus established.

The name *Alcyonaria* (Alcyoniens) was given to the first of these divisions by Milne-Edwards,<sup>1</sup> in 1834.

In this order the polyps are more or less cylindrical, made up with eight nearly equal, hollow, elongated spheromeres arranged around the vertical axis and intimately united to each other by their sides, without the interposition of interambulacral spaces. All of them are prolonged at the actinal end into broad tentacles, pinnately lobed along their sides.

The second order, *Zoantharia*, has, on the contrary, spheromeres in multiples of six, often very numerous, united so as to leave interambulacral spaces in which the new ones are developed. The tentacles are simple, and generally cylindrical or conical, rarely branching in a furcate manner.

In the great work of Dana, the *Alcyonaria* have the same limits, but are considered as a sub-order of the order *Actinoidea*, — a group which embraces the whole class of Polyps as now restricted, his order *Hydroidea* having been referred more recently to the class of *Acalephs*.

The *Alcyonaria* have been divided by most modern writers into three natural groups.

I. ALCYONIDÆ; these are tubular and usually much elongated polyps, increasing by lateral or basal gemmation, forming communities by the union of the walls, their bases or appendices, sometimes, also, through the medium of a porous cœenchyma, and therefore communicating by irregular pores and cavities. There is no common, specialized,

<sup>1</sup> *Elémens de Zoologie*, p. 1046. 1834.

central cavity or central axis, and the polyps adhere to foreign bodies directly by their bases or by the cœenenchyma.

II. GORGONIDÆ; in this group the polyps are short, cylindrical; connected laterally by a porous cœenenchyma, at their bases by a common membrane, and by specialized longitudinal canals; and arranged around a firm central axis which is secreted from the common basal membrane. The communities are attached to foreign bodies by the expanded base of the central axis.

III. PENNATULIDÆ; this division includes those that are united into communities which are unattached and capable of voluntary locomotion. The polyps are regularly arranged at the upper part of the structure, which contains special ducts and a central cavity, sometimes subdivided or inclosing a solid axis attached to the walls by muscular fibres. The lower extremity is bulbular and capable of expansion and contraction by means of a well-developed common muscular system.

The nature and rank of these three groups have been variously estimated by naturalists. Milne-Edwards, who is among the highest authorities, in his latest works treats them as families. But since they are characterized by modifications of the most important structures beneath those characteristic of the order, and at the same time include other inferior groups that have the nature of families, I am led to consider them as sub-orders.

#### Sub-order I. ALCYONIDÆ.

The characters of this division have been sufficiently indicated above for our present purpose. It embraces several well-marked families; viz: *Alcyoninæ* Ehr. (restricted), *Xeninae* Ehr., *Cornularinæ* Ehr. (emended), *Tubiporidae* Fleming. Of these, *Alcyoninæ* and *Cornularinæ* are alone represented on our coast, so far as at present known.

#### Family ALCYONINÆ Ehrenberg.

*Alcyonidae (pars)* DANA, Zoöphytes. *Alcyoninae (pars)* MILNE-EDWARDS, Coralliaires.

In this family the polyps are united together by the walls or porous cœenenchyma throughout nearly their whole extent, forming massive lobed or arborescent clusters of fleshy or coriaceous texture, filled with calcareous spicula. The tentacles and upper free portion of the polyps are capable of more or less perfect contraction.

This family has been divided by Milne-Edwards into two groups: 1st, *Alcyoniens nus*, corresponding to *Alcyoninæ* of Dana; 2d, *Alcyoniens armés*, corresponding to *Nephtheæ* Lesson and, in part, to *Spoggodinæ* Dana.

#### ALCYONIUM Linn.

*Alcyonium* LINNÆUS, Syst. Nat., edit. x. vol. i. p. 803, (1758). *Mazina* OKEN, Lehrb. der Nat., t. iii. p. 93, (1815). *Lobularia* SAVIGNY, (Lamk. Hist. An. sans Vert. 1816); EHRENBERG, Corall. des roth. Meer., p. 57, (1834). *Alcyonium* DANA, Zoöph., p. 611, (1846); MILNE-EDWARDS, Coralliaires, t. i. p. 114, (1857).

Corallum fleshy, filled with granular spicula, which do not project from the surface; base enlarged, adherent to foreign bodies; trunk usually destitute of polyps near the base; above,



dividing more or less into lobes or branches; polyps completely retractile into cells, which scarcely rise above the surface of the coenenchyma, and are not armed with prominent spicula; tissue of the trunk and branches membranous, or more or less coriaceous; within, cavernous, with tubes running to each branch.

This genus differs from *Ammothoa*, to which it is closely allied, in not having prominent, verruciform cells; from *Nephthya*, in the same character and in the absence of large navicular spicula around the cells; from *Sarcophytum*, in its lobed or arborescent mode of growth.

***Alcyonium carneum* AGASSIZ.**

*Halcyonium carneum* AGASSIZ, Proc. of the American Association, 1850, p. 209. *Alcyonium digitatum* STIMPSON, Synopsis of the Marine Invert. of Grand Menan, p. 7, 1853, (in Smithsonian Contributions, Vol. VI.)

Base expanded, adhering to rocks or dead shells; from this arises a more or less cylindrical, thick, naked trunk, which, after a short distance, divides into several large branches, some of which in their turn give off smaller ones, thus producing a much branched, arborescent form; branchlets short, somewhat enlarged, and rounded at the ends when contracted.

The cells are small, crowded on the ends of the branchlets, leaving the trunk and principal branches naked; polyps when expanded much exert, nearly half an inch, but capable of entire retraction; walls and tentacles near their bases strengthened by slender spicula, arranged obliquely in eight double rows, so as to form V-shaped lines, with the angle towards the ends of the tentacles. The spicula are imbedded in the tissues, and do not project beyond the surface. The tentacles are long, tapering, narrow lanceolate, with slender and rather distant marginal lobes.

Color somewhat variable, but usually delicate flesh color, sometimes tinged with red, and at other times with yellow. The eggs are bright orange, and often visible through the diaphanous walls.

Range, from Cape Cod to Breton Island, N. S. Generally attached to shells or stones in eight to twenty fathoms; sometimes at low-water mark. (Coll. Mus. Comp. Zoöl.)

In form and mode of branching this species resembles *Gorgonia florida* of Müller,<sup>1</sup> but the branchlets have a different appearance; the true affinities of the latter are somewhat uncertain.

***Alcyonium rubiforme* DANA.**

*Lobularia rubiformis* EHRENBURG, Corall. des roth. Meer. (1834). *Alcyonium rubiforme* DANA, Zoöphytes, (1846).

Low and glomerate, rising from a slightly spreading base; trunk short, dividing into numerous lobes or short branchlets, which are large and rounded at the end, often subglobular, covered by the polyps; surface between the cells even and granulous. Polyps in expansion much exert; tentacles long, lanceolate, with rather long marginal lobes.

Color brick red, not diaphanous.

Range, Newfoundland Banks (Coll. Essex Institute); northern seas of Europe (Ehrenberg); Behring's Straits (Coll. N. Pacific Expl. Exp.).

<sup>1</sup> Zoologia Danica, tab. 137.

## Family CORNULARINÆ Ehrenberg.

*Cornularidæ* DANA, Zoöphytes. *Cornularinæ* and *Telestinæ* MILNE-EDWARDS, Coralliaires. *Xeniadæ (pars)* GRAY, Ann. and Mag. of Nat. Hist., 1859, p. 443.

Corallum tubular, membranous or coriaceous, increasing by buds arising either from creeping stolons or from the sides of erect branches. Tentacles with well-developed lobes in a single marginal row on each side.

In this group I have united the creeping genera, which form the sub-family *Cornularinæ* of Milne-Edwards, with the genus *Telesto*, characterized by its lateral buds and arborescent form. That this is in accordance with their natural affinities is evident from the fact that in two species of *Telesto* I have constantly found small creeping stolons, with rising buds as in *Cornularia*, proceeding from the bases of the larger upright branches, and even in the following species this seems to be the case while young, for the upright stalks forming the clumps are connected together by creeping stolons at the base. The genus *Cœlogorgia* Val. also belongs here, instead of among the *Gorgonidæ*, where it has hitherto been placed.

## Genus TELESTO Lamouroux.

Corallum tubular, arborescent, increasing by lateral buds from upright branches, and sometimes, also, by basal stolons; walls thin, firm, membranous or like parchment, with eight longitudinal sulcations. Polyps wholly retractile, separated at the base from the cavity of the branch by a thin membrane.

This genus differs from *Cornularia* and its allies in its upright growth and arborescent form; from *Cœlogorgia*, to which it is otherwise closely allied, in its thin, parchment-like walls, while in the latter they are thickened, coriaceous, and spiculose.

*Telesto fruticulosa* DANA.

*Telesto fruticulosa* DANA, Zoöphytes, p. 632 (1846); MILNE-EDWARDS, Coralliaires, vol. i. p. 112 (1857).

This is a caespitose, much branched, fastigate species. Several stalks, connected at the base by creeping stolons, arise close together, giving off from their sides numerous simple tubes and other branchlets, which again subdivide into two, three, or more. The large branches as well as the branchlets or polyp cells are tubular, with their walls nearly smooth externally, but incrustated throughout by a dark colored parasitic sponge, which also extends over and around the base, and often forms a tubular prolongation at the ends of the polyp cells. The exterior surface of the branchlets is marked by eight distinct sulcations. A specimen in the Museum of Comparative Zoölogy consists of about twelve crowded, erect stalks, four inches high, the cells averaging about .25 inch in length, .08 in diameter. Another larger specimen forms a closely branched clump seven inches high and five in diameter. This is attached to the dead axis of *Leptogorgia virgulata*, which it incrusts for several inches, rising above the broken end in the form of a panicle. The tubes are orange-yellow when free from the investing sponge.

Charleston, S. C. (L. Agassiz); Stono Inlet (J. W. Page, U. S. A.).



## Sub-order II. GORGONIDÆ.

*Gorgoniadæ* FLEMING, History of British Animals (1828). *Gorgonidæ* DANA, MILNE-EDWARDS, and most other authors. *Sarcophyta (pars)* GRAY, Ann. and Mag. of Nat. Hist., 1859, p. 443.

This division, of which the characters have been briefly indicated above, embraces several families, of which the following are the principal: *Gorgoninæ* Ehrenberg, *Plexauridæ* Gray, *Primnoaceæ* M.-Edw., *Gorgonellaceæ* Val., *Isidæ* Lamx., *Corallinæ* Dana, *Briaraceæ* M.-Edw. The first three and the last of these are represented on our coast.

## Family GORGONINÆ Ehrenberg (restricted).

*Gorgoniées (pars)* LAMOUROUX, Polypiers Flexibles (1816). *Gorgoninæ (pars)* EHRENBURG, DANA, MILNE-EDWARDS and HAIME, etc. *Gorgonaceæ (pars)* MILNE-EDWARDS, Coralliaires.

The species of this family are usually much branched in a pinnate or furcate manner, and have always a tendency to spread in a plane, forming a flattened or fan-shaped, often reticulated, frond; very rarely they are simple. The cells are arranged on the edges of the branches, either in regular longitudinal series or in irregular bands, leaving on each side a naked median space, often marked by a groove, due to the contraction of the tissues while drying, above the longitudinal ducts, two of which are always much larger than the rest and pass along the middle of each branch, one on each side, while the smaller ones correspond in number to the linear rows of polyps, beneath which they pass. The axis is horn-like, generally slender and flexible, often compressed.

## Genus GORGONIA Linn. (restricted).

*Eunicea (pars)* EHRENBURG (1834). *Gorgonia* MILNE-EDWARDS, Coralliaires (1857).

Corallum much branched, frequently in a plane; branchlets slender, cells in two or more rows on the edges of the branches, leaving a narrow median space, prominent, rising in the form of papillæ above the surface of the cœnenchyma, which is usually thin.

This genus is nearly allied to *Leptogorgia*, and differs chiefly in the prominent cells, which are not capable of being contracted so as to become level with the general surface; while in the latter, though the cells are often a little prominent and verruciform, they seem to admit of complete contraction.

**Gorgonia humilis** DANA.

*Gorgonia humilis* DANA, Zoöph. Expl. Exp., p. 663 (1846).

Corallum low, much and irregularly branched and subdivided, sometimes flattened nearly into a plane; smaller branches subpinnate; branchlets slender, short, irregular, usually bent. Cells small, crowded on the edges of the branchlets in two or three rows, moderately and uniformly prominent. Cœnenchyma minutely granular, with well-marked longitudinal grooves. Axis broadly expanded at the base, dark horn-color in the larger branches, yellow and very slender setiform in the branchlets. Color uniform reddish

purple, also pure white. The largest specimens in the Museum of Comparative Zoölogy are four or five inches high, the branchlets about .5 of an inch in length.

Charleston, S. C., attached to stones and shells (L. Agassiz).

### Genus LEPTOGORGIA Milne-Edwards.

*Gorgonia (pars)* LAM., LAMX., EHRENB., DANA, etc. *Plexaura (pars)* VALENCIENNES, Comptes-rendus, xli. p. 12 (1855). *Leptogorgia* MILNE-EDWARDS, Coralliaires (1857).

Corallum branching, often dichotomous; branches slender with a central space on each side destitute of cells, often marked by a median groove, by the contraction of the coenenchyma, which is usually rather thin, above the principal ducts. Cells flat or but little prominent, arranged in several lateral rows on each edge of the branches, often forming two broad bands, separated by a narrow, median, naked space. Axis horn-like, slender, often compressed.

#### *Leptogorgia virgulata* MILNE-EDWARDS.

*Corallina fruticosa elatior*, etc., CATESBY, iii. tab. xiii. p. 13 (1750). *Gorgonia ceratophyta (pars)* PALLAS, Elench. Zooph., p. 185 (1766) (non Linn. ed. x.). *Gorgonia viminalis* ELLIS and SOLANDER, Nat. Hist. Zoöph., p. 82, tab. xii. f. 2, 3 (1786) (non Pallas). *Gorgonia juncea* Bosc, Hist. Nat. des Vers, iii. p. 32, pl. 3, f. 1, 2, 3 (1802) (non Pallas). *Gorgonia virgulata* LAMARCK, Anim. sans Vert., ii. p. 495 (1815); LAMOUREUX, Polyp. Flex., p. 412 (1816). *Gorgonia Olivieri* LAMX., l. c., p. 400 (1816); Bosc, Nouv. Dict., xiii. p. 313, (1817). *Gorgonia virgulata* DANA, Zoöphytes, p. 662 (1846). *Plexaura virgulata* VALENCIENNES, Comptes-rendus, xli. p. 12 (1855). *Plexaura viminea* VAL., l. c., p. 12 (yellow form). *Leptogorgia virgulata* MILNE-EDWARDS, Coralliaires, i. p. 166 (1857). *Leptogorgia viminea* M.-EDW., l. c., p. 165.

Corallum slender, fasciculate; trunk dividing a short distance above the base into two, three, or more principal branches, rising nearly parallel and dividing a short distance above into a few long, slender, virgate branchlets, which originate chiefly from the inner side of the branches and rise at a very acute angle with them; branchlets somewhat compressed or angular, rarely terete, of almost uniform thickness to very near the end, when they taper abruptly to an obtuse point. Cells small, usually oblong, and not at all prominent on the branchlets, but near the base rounded and a little elevated; on the branchlets they are placed in three or more irregular rows along the edges, leaving narrow naked median spaces. Longitudinal grooves not usually apparent except on the larger branches. Coenenchyma smooth and rather thin. Axis slender, round, horn colored in the large branches, brownish yellow and setiform in the small branchlets. Color exceedingly variable, most frequently either bright lemon yellow or clear reddish purple, but often orange, light yellow, gray, and white, in all cases uniform on the same specimen, although the most diversely colored specimens often occur attached to the same shell or stone.

According to the drawings of Prof. Agassiz, the polyps are, when expanded, small, slender, and but little exerted. The tentacles are broad, rounded, with numerous, crowded, rather shallow, even lobes. The tentacles are strengthened at the base with small spicula, placed obliquely.

Occurs abundantly a few feet below low-water mark along the coast of Georgia and S. Carolina, extending from St. Mary's River, Fla., to Beaufort, N. C.

A small parasitic shell (*Volva uniplicata* Sowb.) often occurs on the branches of this species, and is invariably of the same color as the specimen upon which it lives. The same is true of another species which lives on *Leptogorgia rigida* Verr. from Acapulco, Mex., a species quite as variable in color as the present.



An examination of numerous specimens of this species in the Museum of Comparative Zoölogy has shown me, that, while it is perfectly distinct from the European species with which it was formerly confounded, and equally so from *L. purpurea* M.-Edw. of southern Florida, several nominal species have been founded on mere variations in its form and color, their inconstancy being readily seen when a large number of specimens are at hand.

*Leptogorgia tenuis* VERRILL.

Branches unequally and distantly dichotomous, arranged somewhat in a plane; terminal branchlets very long and slender; round and smooth. Cells numerous, small, scattered, oblong, with the borders flat or slightly prominent. Median grooves scarcely apparent even on the larger branches. Cells on the smaller branches arranged somewhat in two opposite bands, but not very distinctly so. Axis towards the base black, in the smaller branches very slender, yellow, and translucent, even at a distance of eight or ten inches from the extremities. Colors, yellowish brown and purple.

Long Island Sound (Smithsonian Institution).

Of this interesting species there are numerous specimens in the collection of the Smithsonian Institution, attached to rocks, and labelled "Bay of New York." It is closely allied to *L. virgulata* of S. Carolina, but after comparing it with several hundred specimens of the latter in the Museum of Comparative Zoölogy, I have become convinced that they are distinct. In the present species the branches are more slender and elongated and less numerous than in *L. virgulata*; the cells are smaller and less frequently prominent; the median grooves are less distinct, and the axis is more attenuated and diaphanous. The color, though probably variable, is different in all the specimens that I have seen, being generally dull yellowish brown or purplish, instead of pure yellow, orange, or bright purple.

Family PLEXAURIDÆ Gray (emended).

*Gorgoninae* (*pars*) EHRENBERG, DANA. *Prinnoaceae* (*pars*) MILNE-EDWARDS. *Plexauridæ* and *Muricidæ* GRAY, Ann. and Mag. of Nat. Hist., Dec. 1859, p. 442.

Corallum branching, dichotomous or arborescent, with a horn-like axis, often calcareous and stony at the base. Cœnenchyma well developed, traversed by a series of equally developed longitudinal ducts, arranged in a regular circle around the axis. Cells arranged equally on all sides of the branches, leaving no naked lateral spaces.

In this family I have united *Muricea* with *Plexaura* and *Emicea*, the only important difference consisting in the spiculose cells of the former; but this seems due rather to the thinness of the external membrane covering them in life than to any peculiarity of the tissue itself, for in *Emicea* the spicula are as well developed and similarly arranged, though covered by a thicker superficial membrane.

Genus MURICEA Lamouroux.

*Gorgonia* (*pars*) LINN., PALLAS, LAMARCK, and others. *Muricea* LAMOUROUX, Exposition Méthodique (1821).

Axis horn-like in the branches, often stony and very solid at the base. Cells prominent,



more or less conical, covered with large calcareous imbricated spicula, which appear externally when dry.

**Muricea elegans** AGASSIZ, MS.

Trunk large, erect, subcylindrical, somewhat compressed transversely, giving off from its sides in a pinnate manner numerous irregular branches, many of which are again irregularly pinnate, others simple or forked; branchlets very numerous, moderately thick, curved, often pendulous, from one to two inches in length. The cells are numerous but not crowded, prominent, compressed-conical, pointed, not appressed, equal in length to about one half the diameter of the branchlets, covered externally with large, imbricated, fusiform spicula, which are granulated over their whole surface. Between the cells there are still larger spicula placed in a longitudinal or oblique position along the branchlets at the surface of the coenenchyma.

Color of dried specimens brownish orange; axis black, yellow at the ends. Height of the largest specimen, 22 inches; diameter of trunk, .75 of an inch; of branchlets, .17. (Coll. Mus. Comp. Zoöl.)

Charleston, S. C., off the bar (L. Agassiz).

This species is readily distinguished from either of the four species found about the Florida Reefs by its mode of growth, all the latter being dichotomous, as well as by the form and arrangement of the cells. In the last character *M. elongata* Lamx. and *M. laxa* Verr. resemble it most, but the first has smaller, more crowded, and appressed cells, while the last has much longer and more pointed ones.

Family PRIMNOACEÆ Milne-Edwards.

*Gorgoninæ* (*pars*) EHRENBURG, DANA, etc. *Primnoaceæ* (*pars*) MILNE-EDWARDS, Coralliaires (1857).

Corallum simple or branched, with an axis containing a large portion of carbonate of lime, especially towards the base, where it is stony, but horn-like in the smaller branches. Cells very prominent, covered with imbricated, scale-like spicula; usually movable at the narrowed base. There appear to be no distinct median grooves; the cells are usually placed equally on all sides of the branches, and often arranged in whorls.

Genus PRIMNOA Lamouroux.

*Gorgonia* (*pars*) of earlier authors. *Primnoa* LAMX., Polyp. Flex. (1816).

Corallum branched, usually arborescent. Branches covered with irregularly scattered cells, which are bell-shaped, narrow and movable at the base, and protected by large superficial scales.

**Primnoa Reseda** VERRILL.

*Gorgonia Reseda* PALLAS, Elench. Zooph., p. 204 (1766). *Gorgonia lepadifera* LINN., ed. xii. vol. i. p. 1289 (1768); ELLIS and SOL., ESPER, LAMARCK, and others. *Primnoa lepadifera* LAMX., Polyp. Flex., p. 442 (1816); BLAINVILLE, EHRENBURG, DANA, MILNE-EDWARDS, VERRILL, Notice of *Primnoa* from St. George's Bank, Proc. Essex Institute (Feb. 1862).

Trunk large, arborescent, branching in a dichotomous manner, often very thick and

stony near the base; branchlets round, tapering to slender flexible points. Cells large, campanulate, irregularly scattered. The cells are capable of moving in different directions, but in preserved specimens are generally turned downward. (Coll. Essex Instit.)

St. George's Bank and Bay of Fundy, in deep waters; northern seas of Europe.

#### Family BRIARACEÆ Milne-Edwards.

Corallum branched or irregularly lobed, with thickened coenenchyma and a spiculate or suberous axis. Cells irregularly scattered on all sides; longitudinal ducts numerous, in one or several irregular rows around the axis.

#### Genus PARAGORGIA Milne-Edwards.

*Alcyonium (pars)* LINN., PALLAS, LAMARCK, etc. *Briareum (pars)* BLAINVILLE (1830) and DANA (1846). *Lobularia (pars)* EHRENBERG (1834). *Paragorgia* MILNE-EDWARDS, Coralliaires, i. p. 190 (1857).

Corallum irregularly branched or lobed with stout branches, large polyps, and a thick spongy axis filled with calcareous spicula, which render the axis quite hard in the larger branches; cells a little prominent, clustered upon the branches into groups.

#### *Paragorgia arborea* MILNE-EDWARDS.

*Alcyonium arboreum* LINN., Syst. Nat., ed. x. (1758). *Lobularia arborea* EHRENBERG, Corall. des roth. Meeres, p. 59 (1834). *Briareum arboreum* DANA, Zoöph., p. 644 (1846). *Paragorgia arborea* MILNE-EDWARDS, Coralliaires, i. p. 190 (1857).

Coarsely and irregularly branched in an arborescent form, often of large size. Branches thick, irregular, covered with large tubercular prominences, on which are clustered the cells; these are large, somewhat prominent, and not very numerous.

Color red or brownish yellow.

Bay of Fundy; Northern Europe.

The only American specimen of this species that I have seen was presented by Dr. Wm. Wood to the Portland Society of Natural History. This was obtained in the Bay of Fundy by a fisherman, but nothing definite could be learned concerning the precise locality or depth in which it occurred. Not being able to obtain the specimen for examination, I have prepared the above description from European specimens in the Museum of Comparative Zoölogy.

#### Genus TITANIDEUM Agassiz, MS.

Corallum irregularly dichotomous or simple; coenenchyma rather thick, suberous, very spiculate, traversed by well-developed longitudinal ducts arranged in a single series around the axis. Cells disposed on all sides of the branches, not prominent. Axis perfectly distinct from the coenenchyma, compact, but soft, cork-like, composed of closely united calcareous spicula.

This genus is closely allied to *Briareum*, but differs in having a much more distinct and compact axis, and longitudinal ducts in a single circle, as well as in its mode of growth.



**Titanideum suberosum** AGASSIZ, MS.

*Spongy Keratophyte* ELLIS, Nat. Hist. Corallines, p. 63, tab. 26, P. Q. R. (1754). *Gorgonia suberosa* ELLIS and SOLANDER, p. 93 (1786), (nec PALLAS nec ESPER). *Briareum suberosum* DANA, Zoöph., p. 643 (1846).

The corallum, consisting of one or several stalks, which rise from a thick, broadly spreading and incrusting base, branches in an irregularly dichotomous manner, the branches curving outward at the base, often to a considerable distance, and then rising nearly parallel, forming a somewhat fastigiata clump. Branches long, rigid, subcylindrical, tapering slightly towards the obtuse ends, often crooked, strongly compressed at the axils, from two to eight inches long, and one quarter of an inch in average diameter. Cells oval, perfectly level with the surface, arranged equally on all sides of the branches, nearly in quincunx, about one twelfth of an inch distant. Cœnenchyma firm and thick, with a smooth surface. Axis in alcoholic specimens very distinct, dark fuscous; when dry the axis is somewhat less distinct than before, yellowish brown, and closely adherent to the cœnenchyma.

Color uniform orange or dark red.

Height of the largest specimen examined, 12 inches; diameter of the trunk, .6. This specimen divides, one and a half inches above the base, into three primary branches, and these afterwards into twelve secondary ones, some of which are again furcately divided. (Coll. Mus. Comp. Zoöl.)

Charleston, S. C.; Stono Inlet; Beaufort, N. C.

This singular and very interesting species, first described and very well figured by Ellis in 1754, seems to have been entirely unknown to later naturalists, until rediscovered by Prof. Agassiz at Charleston in 1852. Subsequently it was dredged by Mr. Stimpson at Beaufort, N. C. The former specimens are dull orange, the latter deep red, but in other respects they agree perfectly. The finest and largest specimens were recently obtained by Dr. J. W. Page, U. S. A., at Stono Inlet, and presented by him to the Museum of Comparative Zoölogy.

## Sub-order III. PENNATULIDÆ.

The characters of this group have been briefly indicated above (page 3). It corresponds nearly with the genus *Pennatula* of Linné and Pallas, *Polypes flottants* Lamarck, *Pennatulaires* Blainville, *Pennatulina* Ehrenberg, *Pennatulidæ* Fleming, Dana, Milne-Edwards, Herklotz, etc.

This division, if we omit *Umbellularia*, which is imperfectly known, contains four well-marked families, viz: I. PENNATULINÆ Dana (restricted), including *Pennatula*, *Pteroides*, *Pteromorpha*, *Sarcoptilus*, *Ptilosarcus*, *Lioptilum*; II. PAVONARINÆ Dana (restricted), embracing *Funiculina*, *Virgularia*, *Lygus*, *Stylatula*, *Syctalium*; III. VERETILLINÆ Gray (emended), containing *Veretillum*, *Cavernularia*, *Sarcobelemnon*, *Lituaria*, *Kophobelemnon*; IV. RENILLINÆ Gray (emended), embracing only *Renilla* and an undescribed genus.

Of these families the last is alone represented on our Atlantic coast, so far as known at present; but on the Pacific coast two genera of *Pennatulinae* have been found, and also two species of *Stylatula*.



## Family RENILLINÆ Gray (emended).

*Pennatulince* (*pars*) EHRENBERG, DANA. *Renilleæ* GRAY, Ann. and Mag. of Nat. Hist., v. p. 20 (1860).

Polyps arranged symmetrically on the upper surface of a more or less flattened cavernous disk or frond, to the lower surface of which there is attached a hollow locomotive organ, in the form of a peduncle, destitute of a solid axis.

## Genus RENILLA Lamarck.

*Alcyonium* (*pars*) LINN., Syst. Nat., ed. x. (1758). *Pennatula* (*pars*) PALLAS (1766); ELLIS and SOL. (1786). *Renilla* LAMARCK, Hist. des Anim. sans Vert. (1816); BLAINVILLE, EHRENBERG, DANA, MILNE-EDWARDS, etc. *Herklotzia* GRAY, Ann. and Mag. of Nat. Hist., 1860, vol. v. p. 24.

Frond more or less reniform, with a notch or sinus in the posterior edge; lower surface somewhat striated with radiating lines; upper surface with scattered cells surrounded by spicula, which usually project a little above the surface. Polyps when expanded much exert, but capable of entire retraction. Among the perfect polyps are scattered numerous rudimentary individuals, which appear like clusters of small white papillæ. The peduncle is attached to the lower surface at or near the sinus; it is hollow, more or less coriaceous, filled, like the surface of the frond, with calcareous spicula, but capable of a great amount of contraction and expansion; a membrane divides it into an anterior and posterior longitudinal chamber. The former communicates with a large cavity occupying the central and posterior portion of the upper surface, and from this by numerous openings with other cavities, filling the whole interior of the frond, and connected with the polyps. The posterior chamber communicates directly with a large cavity at the origin of the peduncle, and then by means of numerous small openings with the other cavities of the disk. The tentacles have rather long lobes, in a single row on each side.

The genus *Herklotzia* of Gray, founded, apparently, on the figure and description of *Renilla Edwardsii* by Herklotz, appears to differ in no respect from *Renilla*, all the characters assigned to it existing in *R. reniformis*, the type of the present genus.

*Renilla reniformis* CUVIER.

*Kidney-shaped Sea-Pen* ELLIS, Phil. Trans. 1763, p. 427, pl. 19, figs. 6-10. *Pennatula reniformis* PALLAS, Elench. Zooph., p. 374 (1766); ELLIS and SOLANDER, Hist. Zoöph., p. 65 (1786). *Alcyonium agaricum* LINN., Syst. Nat., ed. xii. p. 1294 (1768). *Renilla americana* LAMARCK, Hist. des Anim. sans Vert., t. ii. p. 429, and 2d ed. p. 646 (1816); BLAINVILLE, Man. d'Actinologie, p. 518 (1834); EHRENBERG, Corall. des roth. Meeres, p. 65 (1834). *Renilla americana* (*pars*) DANA, Zoöphytes, p. 588 (not the figure, which is *R. Danaë* nob.) (1846). *Renilla reniformis* CUVIER, Règne Animal, 2d ed. iii. p. 319 (1830); GIBBES, Fauna of S. Carolina (App. to Tuomey's Geol. Survey) no description (1846); AGASSIZ, On the Structure of the Halcyonoid Polypi, p. 10 (Extract from the Proceedings of the Am. Association for 1850) (not *R. reniformis* HERKLOTZ, which is *R. Danaë* nob.). *Renilla americana* MILNE-EDWARDS, Coralliaires, t. i. p. 220 (excluding the synonym, *R. violacea* Q. and G., which is a distinct species).

Frond rounded reniform, or heart-shaped, a little longer than broad; sinus extending about one third across the disk, rounded within, the posterior lobes meeting, or overlapping somewhat, behind; peduncle well developed, bulbous at the end and enlarged where it joins the disk to form, in part, the dorsal central cavity of the disk. Lower

surface of the frond nearly smooth, but marked with fine radiating striæ, filled with small spicula, and with a net-work of light-colored lines. Cells few, rather large, surrounded by small and slightly prominent spicula; rudimentary individuals numerous, irregularly scattered among the cells, a little prominent, composed of eight or ten little lobes.

Color of the disk, when living, according to the drawings of Prof. Agassiz, a vivid reddish purple; peduncle the same color, except at the tip and the point of union with the disk, where it is lighter; polyps diaphanous, delicate bluish white, the walls with specks of brown and a circle of brown spots just below the tentacles; tentacles diaphanous with a marginal line of brown on each side, widening towards the base.

The polyps are arranged symmetrically on each side of a narrow naked space, extending from the sinus more than half across the disk, and situated above the large central chamber within; when expanded they are much exsert, but less so than in other species of the genus. The tentacles are narrow lanceolate, with rather distant, long lobes, which are confined principally to the outer half. Mouth oblong, with four small rounded lobes on each side.

This species is capable of distending itself greatly with water, when it becomes very thick and swollen, thinnest at the edges; the peduncle can expand to four or five times its length when contracted. According to Prof. Agassiz, who has carefully studied it while living,<sup>1</sup> it is remarkably phosphorescent, emitting a "golden green light of a most wonderful softness." Its ordinary position when expanded is to have the peduncle buried perpendicularly in the sand and swollen into a bulb at the end. In locomotion the disk itself can be used, either by alternately contracting and expanding the two lateral portions, or by expanding and extending the anterior end and then contracting so as to form a transverse constriction which gradually passes off posteriorly. (Coll. Mus. Comp. Zoöl.)

It is found quite commonly at low-water mark and in pools left by the tide on the coast of Georgia and South Carolina, extending as far northward as Beaufort, N. C.

## Order II. ZOANTHARIA.

The structural features which characterize this order are principally the combination of the spheromeres in multiples of six, and the presence of interambulacral spaces between them, in which the new spheromeres are developed during growth, together with the simple tubular structure of the tentacles, which vary in number from twelve to several hundred.

The lateral walls of the spheromeres, forming radiating partitions, of which the principal ones extend from the outer wall to the digestive sac, have been called *lamellæ* by Dana, and *septa* by some later writers; but since the latter term has been definitely applied by Milne-Edwards and Haime to the solid plates formed, in many genera, within the spheromeres, between the *lamellæ*, it ought to be used in this sense alone.

Owing to the great advance made in our knowledge of the structure of this group within a comparatively recent time, through the careful investigations of Dana, Milne-Edwards and Haime, and others, the number of terms that must necessarily be employed in the description of their parts has been greatly increased, but, in order to avoid con-

<sup>1</sup> Proceedings of the American Association, 1850.



fusion, we have endeavored to use in each case that name which was first definitely applied to any part, although in some cases it has been found necessary to restrict the meaning somewhat, as in the instance above mentioned.

The sub-order ACTINARIA of Dana, if we exclude the *Lucernaridæ*, *Cyathophyllidæ*, and *Favositidæ*, which have been shown by Prof. Agassiz to belong to the class of Acalephs, corresponds to the order as here limited. The order ZOANTHARIA of Milne-Edwards, after removing, in the same way, the *Tabulata* and *Rugosa* to the Acalephs, is also equivalent to the present group.

The name ZOANTHARIA (Zoantha) was first applied to this division, with nearly the same limits as at present, by Blainville in 1830.<sup>1</sup>

Milne-Edwards has divided the order into three principal groups or sub-orders.

I. ACTINARIA, corresponding nearly to the family *Actinidæ* Dana.

II. ANTIPATHARIA, equivalent to *Antipathaceæ* Dana.

III. MADREPORARIA, including *Madreporaceæ*, *Caryophyllaceæ*, and part of *Astreaceæ* of Dana.

The first two of these divisions we adopt almost without change, but it seems necessary to divide the *Madreporaria* into three equivalent groups, which shall rank as sub-orders equal in value to the others, as Prof. Agassiz suggested in his lectures several years ago. These groups will stand as follows, viz: I. FUNGARIA, or FUNGIDÆ, embracing the *Fungidæ* of Milne-Edwards, together with *Merulina* and *Echinopora*; II. ASTREARIA, or ASTREIDÆ, including the *Astreidæ* and *Oculinidæ* of Milne-Edwards, and perhaps also *Caryophyllidæ*; III. MADREPORARIA, equivalent to the *Madreporaricæ perforatæ* of Milne-Edwards, and including *Madreporidæ*, *Gemmiporidæ*, *Eupsammidæ*, and *Poritidæ* as families.

Of these sub-orders, *Actinaria*, *Antipatharia*, and *Astrearia* are represented on this coast.

#### Sub-order I. ACTINARIA.

This group as restricted by Milne-Edwards comprises only a small part of the forms included by Dana under the same name, for in the latter case it corresponds nearly to the entire order *Zoantharia*, as now limited; it seems, however, entirely unnecessary to introduce any other name for the present division.

This sub-order is peculiar in having the muscular system highly developed in nearly all parts of the body, but more particularly in the walls, which are therefore more or less soft and contractile throughout their whole extent and never deposit within their substance solid calcareous corals. The basal or abactinal region is also generally muscular and so specialized as to be used in locomotion. The tentacles vary from twelve to many hundred, in the different genera, but are usually numerous. The species are mostly simple, but a few bud from basal expansions or stolons, and others, which are naturally simple, may do so abnormally, like several *Actininæ*.

A large number of groups are embraced in this division, which have been variously considered as families, sub-families, sections, or genera, by different authors; but with the imperfect knowledge existing at the present time in regard to the details of their anatomy, it is scarcely possible to assign true limits or rank to all these various groups, although some of them seem to be well-marked families. For the present the following seems to me the most natural arrangement of the families: MYNIADINÆ; THALASSIANTHINÆ;

<sup>1</sup> Dictionnaire des Sciences Naturelles, Zoophytes.

ACTINIDÆ, including as sub-families *Phyllactinæ*, *Antheadæ*, *Bunodidæ*, *Sagartiadæ*, and *Actininae* of Gosse; ILYANTHIDÆ; CERANTHIDÆ; and ZOANTHIDÆ.

Representatives of all these except the first two are found on our coast.

#### Family ACTINIDÆ.

Form in expansion more or less cylindrical, rising from a broadly expanded, basal disk, which is usually wider than the column, adherent, muscular, and used in locomotion. The tentacles are simple, numerous, in several rows near the margin.

This group includes several well-marked divisions which appear to have the rank of sub-families, viz: *Actininae*, in which the body is contractile; the walls either smooth or papillose, apparently imperforate; a row of colored vesicles surrounds the margin at the base of the tentacles, corresponding in position to the eye-specks of other radiates:<sup>1</sup> *Bunodidæ*, having large tentacles; the body rather short, moderately contractile; the walls covered with vertical rows of papillæ, corresponding to each spheromere; the upper vesicle of some of the rows usually larger than the others, and homologous with the colored ones of the preceding group: *Phyllactinæ*, in which the uppermost vesicles are developed into lobed, adhesive, or tentacle-like organs: *Sagartiadæ*, having an elongated, very contractile column, the walls perforated with special openings (*cinclides* Gosse) through which are thrown out thread-like, offensive organs (*acontia*); the exterior frequently covered by adhesive suckers, but not often with prominent papillæ: *Antheadæ*, with long cylindrical tentacles not capable of being contracted within the body, owing to the rudimentary condition of the muscular system of the lamellæ; the walls are without appendages of any kind.

All these sub-families except *Actininae* are found within our limits, and comprise the majority of the polyps living on this coast.

#### Sub-family BUNODIDÆ.

*Actinines verruqueuses* MILNE-EDWARDS, Coralliaires (1857). Family *Bunodidæ* Gosse, Ann. and Mag. of Nat. Hist., 3d series, i. p. 417 (1858); *Actinologia Britannica* (1860).

#### Genus BUNODES Gosse.

*Actinia (pars)* LINNÆUS, CUVIER, LAMARCK, DANA. *Cribrina (pars)* EHRENBERG (1834). *Bunodes* Gosse, Trans. Linn. Soc., xxi. p. 274 (1855); Observations on Actiniadæ, Ann. and Mag. of Nat. Hist., 2d series, xvi. p. 294 (1855). *Cereus (pars)* MILNE-EDWARDS, Coralliaires (1857) (*non* Oken).

Column elongated, subcylindrical in expansion, hemispherical in contraction; walls firm, with numerous prominent papillæ arranged in vertical lines corresponding to the chambers within, the uppermost, marginal ones larger than the rest, generally distended, and diaphanous, the others capable of adhering strongly to foreign bodies. Tentacles well developed, large, subcylindrical, not very numerous, perforated at the tips. Lamellæ (in *B. cavernata*) broad throughout their whole length, nearly uniformly thickened with

<sup>1</sup> *Actinia primula* Drayton (Dana, Zoöphytes) pl. 2, f. 12-15, belongs to this division, and appears also to have *acontia*.



longitudinal and oblique muscular fibres; at some distance from their upper ends there are rather large, circular, peripheric pores.

This genus corresponds in part to *Cereus* of Milne-Edwards, but that genus, as established by Oken in 1815, had for its type the *Actinia bellis* of authors, which belongs to the genus *Sagartia* of Gosse. The genus *Cribrina* of Ehrenberg covers very nearly the same ground as *Cereus* of Oken, and has for its principal character the perforation of the walls, which is essentially a character of the *Sagartiadae*, and not of this division.

**Bunodes stella** VERRILL.

*Actinia coriacea?* STIMPSON, Marine Invert. of Grand Menan, p. 7 (1853).

Plate I. figures 1-8.

When in full expansion the column is generally cylindrical, or pillar-shaped with the middle portion smallest, enlarging more rapidly towards the disk than the base; the height is often double the diameter of the column, but sometimes does not exceed it. In contraction it becomes a depressed cone, covered with radiating lines of suckers. The tentacles are large, not very numerous, about equal in length to the diameter of the disk, often somewhat exceeding it; in ordinary expansion they are largest near the base, tapering gradually to the obtuse tips. The largest specimens observed have seventy-two tentacles of which twenty-four belong to the fifth cycle, which is incomplete. Specimens of about an inch in diameter have usually forty-eight tentacles, forming four complete cycles. Those of the first two cycles are somewhat larger than the rest, forming the inner row of twelve, which are generally held in an upright position during expansion, while the rest are curved more or less outward and downward and sometimes curiously curled and bent in all directions. The column is sulcated with vertical lines corresponding to the radiating partitions within, while the ambulacral spaces, corresponding to the chambers below each tentacle, are slightly swollen, and have, at intervals of about one fourth of an inch, rounded suckers or verrucæ, the upper one of each vertical row being more prominent than the rest, and situated at the margin of the disk, just below the base of the tentacle; lower down the verrucæ belonging to the ambulacra of different cycles do not correspond horizontally, so that they appear to be arranged nearly in quincunx. These suckers have the power of adhering firmly to pieces of shells, grains of sand, etc. Specimens when found are generally covered by such foreign substances, which, however, they very soon discard when confined in an aquarium. The disk is flat or somewhat convex at the centre; mouth usually a little prominent, with four conspicuous folds; it often has the form of a cross, the transverse opening longest; at each end there is a small, rounded lobe with a larger one on each side projecting inward and often meeting, thus enclosing a crescent or heart-shaped space at each angle; the sides of the mouth are formed by a broad lobe on each side, which is often again divided into secondary ones.

The color of the column is generally pale, pellucid olive-green, sometimes flesh-color; tentacles, disk, and verrucæ a lighter tint of the same, each tentacle sometimes having a well-defined ring of opaque white near the middle and, at the base on the inside, a conspicuous spot of the same, which is broad below and often cordate, diminishing upwards and blending into the general hue, but these spots are absent on those of the first two cycles; from the mouth six conspicuous flake-white bands radiate to the primary tentacles;

the two that are in a line with the mouth being the broadest; occasionally the other four are indistinct or wanting; sometimes these are fainter, while radii extend to those of the second cycle; inside of the mouth light orange.

The largest specimens that I have observed were about two inches high in full expansion, and one and a fourth across the disk, with the tentacles about the same in length. A specimen, half an inch across the disk, had forty-eight tentacles; another, one quarter inch in diameter, had thirty-six tentacles, and the colors of the adults; one, only one tenth of an inch, had some tentacles of the third cycle developed, with the star on the disk represented by six white spots, two of them largest. The young, when excluded, have usually twelve tentacles, and average about one twelfth of an inch in diameter. (Col. Mus. Comp. Zoöl.)

Cape Elizabeth, Me., in pools near low-water mark, buried to the tentacles in sand; Eastport, Me., and Grand Menan, N. B., in crevices of rocks near low-water mark.

This beautiful species resembles *B. gemmacea* of Europe in many respects, and may well be considered the American representative of that species. A comparison that I have had an opportunity of making at the Museum of Comparative Zoölogy between living specimens of *B. gemmacea*, sent from the Free Public Museum of Liverpool through Captain J. Anderson, and *B. stella*, obtained at Cape Elizabeth, Me., by Mr. E. S. Morse, has enabled me to ascertain the specific characters of the two species.

In *B. gemmacea* the tentacles are more numerous, and smaller in proportion to the size of the body; the verrucæ are more numerous and crowded, and the marginal ones are less prominent; the colors are in vertical bands on the column, and the tentacles are variegated, while in *B. stella*, at least in all the specimens yet observed, the color of the column and tentacles is uniform light greenish, or flesh-color, sometimes with white bands, or basal spots, on the latter. The six white lines radiating from the mouth across the disk seem, also, to be a constant and characteristic feature of *B. stella*, since they could be traced in almost every specimen that I have observed,—even in young ones not more than one fourth of an inch in diameter.

Its favorite situation appears to be in the fissures and crevices of ledges and rocks, overgrown by fuci and other sea-weeds, in the lower portion of the littoral zone. In such places it is often found in great profusion lying in a flaccid, half-expanded state while the tide is out. It thrives well in confinement, and makes a very elegant appearance when expanded. It appears to be most active during the night, but will frequently remain in full expansion during the whole day.

#### **Bunodes cavernata VERRILL.**

*Actinia cavernata* Bosc, Histoire Nat. des Vers (1802); 2d ed. vol. ii. p. 260, pl. 12, f. 2 (1830, apparently the young). *Actinie cavernate* Bosc, Nouveau Dictionnaire d'Histoire Naturelle, i. p. 163, pl. A. 4 (1816, same figure as the preceding). *Actinia cavernata* GIBBES, Fauna of South Carolina, p. xxiii., no description (Appendix to Tuomey's Geol. Survey, 1846). *Actinia cavernosa* McCrady, Proc. Elliott Society of Charleston, S. C., i. p. 275 (1858).

The column is short, cylindrical in expansion, capable of contracting into a hemispherical form, densely covered with prominent, persistent papillæ, arranged near together in vertical series, well developed even at the base, the upper, marginal ones somewhat larger and lighter colored. Tentacles numerous, subequal, the longest less than the radius of the disk, (about one half an inch long in large specimens,) crowded in numerous indistinct rows near the margin, rather thick, tapering from near the base to the acute points. Mouth capable of eversion, rather long, narrow, provided with several lateral folds.

Color of the body dull yellowish, or greenish brown, with numerous small dark brown



spots, arranged somewhat in vertical lines, occasionally forming irregular streaks; tentacles yellowish green, with a dark brown spot at the base, and often with longitudinal lines of brown or dark green, and tipped with white; disk dark, greenish brown, lightest around the mouth.

Height of a good-sized specimen in expansion, 2 inches; breadth, 1.5.

Charleston, S. C. (L. Agassiz).

There are numerous good specimens of this species in the Museum of Comparative Zoölogy, and in the possession of Prof. Agassiz are several colored drawings made from life by Mr. Burkhardt, from which I have taken the description of the tentacles and colors.

Prof. Agassiz has also another drawing representing a cluster attached within the cavities of a stone, apparently the young of this species. These are nearly uniform greenish, with the tentacles tipped with white, thus corresponding very well with the description by Bosc.

#### Genus RHODACTINIA Agassiz.

*Cribrina (pars)* EHRENBERG (1834). *Rhodactinia* AGASSIZ, Comptes-rendus, xxv. p. 677, Nov. 1847 (extract from a letter to Humboldt); Revue Zoologique par la Société Cuvérienne, 1847, p. 394 (another extract from the same letter as the preceding). *Bunodes (pars)* GOSSE, Trans. Linn. Soc. xxi. p. 274 (1855). *Cereus (pars)* MILNE-EDWARDS, Coralliaires (1857). *Tealia* GOSSE, Ann. and Mag. of Nat. Hist., 3d ser. i. p. 417 (Jan. 1858).

Column low, shorter than broad; the walls firm and thick, with a thickened fold near the upper margin in adult specimens; surface covered by distant verrucæ, which are arranged in vertical rows along the ambulacral regions, but so remotely as to appear scattered; these are less prominent and persistent than in the preceding genus, being often so reduced as to be scarcely apparent. Mouth large, often everted; tentacles large, cylindrical, with distinct openings at the ends.

This genus, named and briefly described by Prof. Agassiz in 1847, corresponds perfectly to that recently established by Gosse under the name *Tealia*, the typical species of the former, *R. Davisii*, being the American representative of *R. crassicornis* of Europe, which is the type of *Tealia*.

#### *Rhodactinia Davisii* AGASSIZ.

*Rhodactinia Davisii* AGASSIZ, Comptes-rendus, xxv. p. 677 (Nov. 1847); Revue Zoologique Soc. Cuvérienne, p. 394 (1847, the deep-water form). *Actinia obtruncata* STIMPSON, Marine Invertebrata of Grand Menan, p. 7 (1853, the littoral form). *Actinia carnea* STIMPSON, l. c. p. 7 (young).

#### Plate I. figure 9.

The column is short, cylindrical, broader than high, sometimes four inches broad and about two high in expansion; walls thick, somewhat cartilaginous, with scattered papillæ, which are usually but slightly prominent, and often inconspicuous, the surface then appearing smooth or reticulated; these, though widely scattered, are in vertical lines, corresponding to the sub-tentacular chambers within; in adult specimens there is a thickened fold near the upper edge of the column. Tentacles numerous, in several indistinct rows near the margin of the disk, conical or cylindrical, thick, rather short, obtusely rounded at the ends, or even at times club-shaped. The disk is usually flat, but sometimes convex. The mouth (actinostome) is large, oblong, with a similar fold at each end, in front of which on both sides there is a large rounded fold, giving a somewhat rectangular appearance to

the mouth in some states of expansion. The stomach is often everted so as to completely disguise and replace both the mouth and disk.

The color is often bright cherry red with the tentacles paler and diaphanous, but is quite variable according to the locality. The specimens from deep water are generally as described above, or flesh-color and diaphanous. In shallower water (8 to 15 f.) they are frequently blotched or streaked with bright red on a light red or greenish ground color; the tentacles are pale flesh-color, each with a band of pink near the middle and another near the tip, with often a white band between, and white at the extreme tip; the disk pink with radiating lines of red, which embrace the bases of the tentacles and sometimes fade away before reaching the mouth, which is surrounded by an ill-defined circle of red, the angles of the mouth pale orange. Littoral specimens are most commonly of a clear, bluish green color, irregularly blotched with crimson or reddish brown; tentacles pellucid, or light red, with a diffuse spot of white on the inner side of the base and an undefined white band near the middle; the disk greenish with purple radii. The following are descriptions made from life of some of the other colors frequently met with at Eastport, Me.: 1. Column deep crimson; tentacles light reddish brown, each with a broad band of dark crimson near the end, bordered below by a faint light band, the extreme tip whitish; disk light greenish brown with radiating lines of purple; mouth surrounded by a broad, faint ring of purple (littoral). 2. Column flesh-color with blotches of orange red; disk flesh-color with bright red radii which do not reach the mouth; the latter light orange (littoral). 3. Column flesh-colored, mottled with bright pink with a band of pink just below the tentacles; radii of the disk bright pink, well defined; tentacles, each with a large white spot at the base on the inside and a smaller one on the outside, a broad pink band above the base, a narrow whitish band in the middle, then another broad pink band, and, finally, white at the tip (in 20 f. rocky bottom). 4. Column uniform light pink with an orange tinge, except a band of a somewhat lighter tint below the tentacles, the surface appearing smooth; tentacles pink with lighter tips; disk very pale pink with well-marked spots of opaque white in front of the bases of the tentacles (20 f. shelly bottom). The last form seems perfectly identical with Stimpson's *Actinia carneola*. Some of the smaller specimens agree with his description in every respect, but do not appear to differ in anything except color from the young belonging to the ordinary varieties.

This species discharges young of various sizes, and probably eggs also. Some of the young, about .98 of an inch in diameter, had but six tentacles, which were longer than the width of the disk; others, about .10 of an inch, had twelve tentacles, six of them much longer than the diameter of the disk; another about twice as large had twelve tentacles well developed, and two very small ones appearing regularly in one of the systems and two others appearing in one half of another system; others, about a quarter of an inch in diameter, had twenty-four tentacles about equal in length to the diameter of the disk and some very small ones appearing in some of the systems. Specimens an inch in diameter when expanded have about sixty tentacles, which are nearly half an inch long, the primary ones being placed about midway between the mouth and the margin. (Coll. Mus. Comp. Zoöl.)

Range from Nantucket shoals to Grand Menan, perhaps to Labrador, and in depth from the middle region of the littoral zone to thirty fathoms.

On the shore it seems to prefer ledges covered thickly with fuci, and in such places is often very abundant, completely covering the cavities and fissures. It is often associated with *Bunodes stella*, but does not confine itself so exclusively to fissures as the latter, and is



very seldom, if ever, found coated by foreign substances. In form it is very mutable, both ends being capable of great distension or contraction either separately or at the same time. It will often assume a variety of the most diversified forms within a very few minutes.

This species is very near *R. crassicornis* of Europe, having been considered the same by some naturalists, and like it has a wide range of variation in color and form, but it seems never to have the surface, even in littoral specimens, strongly and persistently papillose, like that of the latter. The tentacles, also, appear to be uniformly blunter at the ends than in the corresponding European forms.

The genera *Bolocera* and *Stomphia* of Gosse seem to me to be founded on forms of *R. crassicornis*, and in the present species corresponding forms occur. A large specimen, which I obtained off Grand Menan in 35 fathoms, agrees with the genus *Bolocera* in all respects, having the same character of surface and furrowed tentacles, which were not withdrawn even after the rough treatment received during its capture; yet I am unable to separate it from *R. Davisii*. Another specimen dredged in 12 fathoms, rocky bottom, at Eastport, Me., had the characters of *Stomphia*.

This individual had the tentacles in two marginal rows, a convex disk with a broad, oblong mouth, having a large fold at each end and fourteen radii on one side and fifteen on the other. The walls were apparently smooth. The color of the column was pale pink mottled with vermilion, with a colorless band just beneath the tentacles; disk light scarlet with a colorless circle near the mouth, the margin of which was bright red; tentacles transparent, bluish white, with a scarlet band near the middle and another close to the end. This specimen, when expanded, was about an inch and a half in diameter and the same in height; in contraction, low and nearly flat.

#### Sub-family PHYLLACTINÆ Milne-Edwards.

The characters of this group have been indicated above, page 15.

#### Genus AULACTINIA Agassiz, MS.

In this genus the base is adherent, but capable of distension; column elongated, moderately contractile, and capable of involving the tentacles and disk with its summit, but not of contracting into a low cone; upper part covered with prominent, adherent verrucæ or suckers arranged in vertical rows, the uppermost one in each row situated just below the tentacles, larger than the others, trilobed, the lobes again subdivided on their lower sides; wall near the margin thickened into a fold. Tentacles numerous, subequal, well developed. Mouth (actinostome) with a fold at each angle, one of which is considerably the largest. Internal lamellæ well developed, much narrowed near the base, thickened above with strong longitudinal muscles, which serve to contract the disk and tentacles. The walls are thin, leathery, or parchment-like, and but slightly muscular; digestive sac short and thick; ovaries attached to the upper part of the lamellæ.

#### *Aulactinia capitata* AGASSIZ, MS.

Column very long, cylindrical, or more commonly clavate, diminishing from the enlarged summit to a constriction near the base, below which it suddenly expands to the edge of the basal disk, which is narrower than the upper part of the column; the base is thin and often

distended. Walls thin, parchment-like, the upper half covered by large, prominent, adhesive verrucæ, concave at their summits, arranged rather closely in vertical rows, becoming obsolete below. The rows are separated by wider naked spaces; margin with a thickened fold, below which there is a circle of large compound verrucæ, which are the uppermost ones in the vertical rows of suckers; these are short, thick, distinctly trilobed on the lower side, each lobe again divided below into short rounded tubercles or crenulations. Tentacles very numerous, short, thick, pointed, arranged in many rows; the twelve inner ones, belonging to the first two cycles, are thicker than the rest, six of them generally curved inwards in expansion, and six erect; the outer ones are more slender, scarcely shorter, and are generally carried spreading outward; mouth with two opposite crescent-shaped folds.

Color brownish gray or greenish brown, with lighter longitudinal lines; disk similar to the column, with darker radiating lines, and a lighter space around the mouth; tentacles yellowish green, with a dark brown median line on the inner side, interrupted by several white spots, which often blend into a white line near the base; verrucæ gray.

Height in expansion often 6 inches; greatest diameter 1.35; length of tentacles about .30. (Coll. Mus. Comp. Zoöl.)

Charleston, S. C., buried to the tentacles in sand (L. Agassiz); Fort Macon, N. C. (Sam'l Cabot); Beaufort, N. C. (A. S. Bickmore).

#### Sub-family SAGARTIDÆ.

Family *Sagartidæ* GOSSE, Actinologia Britannica, p. 9 (1860).

This division has been established by Gosse on the character of having openings like loopholes (*cinclidæ*) piercing the walls, through which peculiar thread-like organs, consisting in great part of lasso-cells, are thrown out for defence when irritated, and possibly, in some cases, for the purpose of obtaining food. These thread-like organs are often, also, thrown out from the mouth and accidental ruptures of the walls in great numbers. When protruded for self-defence, they are slowly withdrawn again, if the exciting cause be removed. This I have observed in *Metridium marginatum*, and Gosse mentions the same fact in respect to other species. The mode in which the threads are expelled and withdrawn seems to be entirely mechanical, depending upon the flow of water through the *cinclidæ*, the force of the current impelling the flexible filaments either outward or inward according to its course.

There are a few additional characters which separate this group from other *Actinidæ*, though mostly of a negative nature, and at the same time it is somewhat doubtful whether *cinclidæ* and *acontia* are not present in other divisions, namely, *Actininicæ*, *Antheidæ*, and, possibly, *Bunodidæ*.

#### Genus METRIDIUM Oken.

*Actinia (pars)* LINNÆUS, PENNANT, ELLIS and SOLANDER, LAMARCK, CUVIER, etc. *Metridium* OKEN, Lehrbuch der Naturgeschichte, iii. p. 349 (1815). *Actinoloba (pars)* BLAINVILLE, Dict. des Sci. Nat. and Manuel d'Actinologie, p. 322 (1830-34). *Cribrina (pars)* EHRENBERG, Corall. des rothen Meeres (1834). *Sagartia (pars)* GOSSE, Manual Mar. Zoöl. *Actinoloba* GOSSE, Actinologia Britannica, p. 11 (1860).

Column very contractile and changeable in form, often much elongated, but capable of



contracting into a broad, flattened cone. Walls smooth, destitute of suckers, pierced with scattered cinclidæ, thickened near the summit into a fold surrounding the column, above this thinner and diaphanous. Disk broad, deeply folded or frilled at the margin. Tentacles very numerous, the inner ones largest, scattered on the disk, the outer ones becoming gradually very small and much crowded, fringe-like at the margin. Acontia very abundant, but not emitted except after considerable irritation. The mouth has a broad and deep groove at one angle and twelve to sixteen folds along each side.

This genus as established by Oken had for its type *Actinia dianthus* of authors, the European representative of *M. marginata*. By Ehrenberg and several other writers the name has been applied to *Actinidæ* of entirely different characters, belonging to the *Phyllactinæ*, thus excluding the typical species. We follow Milne-Edwards in retaining the name for this genus, with *M. dianthus* as its type.

**Metridium marginatum** MILNE-EDWARDS.

*Actinia marginata* LESUEUR, Journal Acad. Nat. Sciences Philad., vol. i. pt. i. p. 172 (1817). GOULD, Report on Invertebrata of Massachusetts, p. 349 (1841). AGASSIZ, Twelve Lectures on Comp. Embryology, p. 38, pl. xx. xxxii. xxxiii. (1849). *Actinia marginata* and *Actinia dianthus*? STIMPSON, Synopsis of Marine Invert. of Grand Menan, p. 7 (1853). *Actinia marginata* LEIDY, Journal Acad. Nat. Sciences Philad., 2d series, vol. iii. p. 140 (1855). *Metridium marginatum* MILNE-EDWARDS, Hist. Nat. des Coralliaires, vol. i. p. 254 (1857). *Actinia dianthus* DAWSON, On Sea-Anemones and Hydroid Polyyps from the Gulf of St. Lawrence, Canadian Naturalist and Geologist, vol. iii. p. 402, figs. 1 and 2 (1858). *Actinia marginata* Mrs. L. AGASSIZ, A First Lesson in Natural History, p. 10, figs. 1 to 6 (1859). *Actinia marginata* AGASSIZ, Contributions to the Natural History of the United States, vol. iii. p. 39, fig. 8 (1860).

The form of this species is very changeable; in contraction it is hemispherical or a broad low cone, sometimes almost disk-like; in expansion most commonly like a thick cylinder or pillar, higher than broad, with an expanded base, the summit surmounted by the broad, elegantly frilled or undulated disk, with the tentacles drooping in a graceful fringe on all sides and concealing the upper part of the column. Sometimes it becomes greatly elongated and attenuated, the disk looking somewhat like a flower supported on its peduncle. This form is most frequently assumed by young specimens. Column smooth, more or less cylindrical, thickened near the top into a slightly elevated band or fold, which is about an inch below the base of the tentacles in large specimens; above this it becomes thinner and diaphanous. Acontia emitted copiously from scattered cinclidæ and from the mouth when strongly irritated. They often extend to the distance of two inches or more. Disk much broader than the column, its margin usually thrown into about twelve deep undulating folds or frills, which are, however, quite changeable in size and number in the same individual. Tentacles arranged on the outer half of the disk, leaving a central area free from them; the inner ones are scattered distantly and somewhat irregularly and are larger than the rest, sometimes half an inch in length; they decrease rapidly in size towards the margin, where they become very crowded and quite small, looking like a delicate fringe along the edge.

Color exceedingly variable, but most commonly with the column some shade of brown; the disk and column about the fold a light shade of the same, or flesh-colored; the tentacles grayish, often with lighter tips; mouth similar in color to the column, but lighter. There are, however, so many styles of coloration that it may be well to mention a few, though to characterize all the variations would be scarcely possible. The following are often met with:—

1. Salmon-colored throughout; tentacles a lighter tint of the same.
2. Yellowish brown, streaked with lighter near the base; tentacles delicate flesh-colored; mouth like the column.

3. Umber brown, with plain, dark slate-colored tentacles.
4. Umber brown; tentacles light slate, having a ring of white near their bases.
5. Umber, with white tentacles.
6. Yellowish umber; tentacles a lighter tint of the same.
7. Column irregularly blotched and mottled with brown on a whitish ground color; tentacles light grayish brown.
8. White or very light flesh-colored throughout.
9. Yellowish red or brick-red, with flesh-colored tentacles.

Very young specimens are slender in expansion, with long slender tentacles, which are not crowded. The disk is not undulated, and there is no apparent fold on the column. Their color is uniform yellowish white or flesh-color. Specimens of about half an inch in diameter show indications of the characteristic fold or thickening of the wall, but have the disk scarcely undulated. Their tentacles are long and slender, considerably crowded, and often marked by a longitudinal dark line. They are frequently lengthened to a very great extent when expanded.

The larger specimens commonly met with are about 4 inches high in ordinary expansion; 3 broad across the disk; 1.50 at the centre of the column; inner tentacles .50 in length; outer .10 to .20. Specimens of much larger size are occasionally found.

Range, from Buzzard's Bay, Long Island Sound, and near New York, to Gaspé, Canada East. (Coll. Mus. Comp. Zool.)

This species is very closely allied to *M. dianthus* of Europe and by some writers has been considered the same. A careful examination of living specimens of the latter in the Museum of Comparative Zoölogy, forwarded from the Free Public Museum of Liverpool, through the kindness of Capt. J. Anderson, and a direct comparison with others of *M. marginata*, has convinced me, that, though very similar in appearance, they are perfectly distinct. In *M. dianthus* the inner tentacles are more scattered over the disk, leaving a more limited central area free from them than in our species, in which they consequently appear more concentrated towards the margin of the disk. The tentacles are also smaller in the former and more delicate than in individuals of the same size of the latter. The margin of the disk in the specimens examined of *M. dianthus* appeared more numerous and deeply frilled than in any specimens that I have seen of *M. marginata*. The margin of the mouth of the latter is nearly always of the same color as the column, but of a lighter tint; while in the former it is said by Gosse to be "generally rufous or orange red, whatever the hue of the body."

This opinion has been much strengthened by the testimony of Dr. Wm. Stimpson, who has had unrivalled opportunities for the study of the marine invertebrata, both on this coast and on that of Great Britain, for I have been assured by him that he has found the difference in the arrangement of the inner tentacles constant among hundreds of specimens of both species, which he has examined. He therefore considers them sufficiently distinct.

The Fringed Actinia is the most abundant species along the whole coast of New England and the Provinces of New Brunswick and Nova Scotia. It ranges in depth from low-water mark to thirty fathoms, and is often, also, found attached to the sides of fissures and in rocky pools between tides, particularly in places sheltered from the sun. Not unfrequently it is seen attached in large numbers to the piles of wharves at or just below low-water mark; but its favorite haunts are rocky situations or bottoms covered by stones of moderate size. In the Bay of Fundy it is particularly abundant and grows to a very large size. At Mount Desert, on the coast of Maine, I have seen, during a very low tide, a rocky bot-



tom completely covered for acres with this species, from low-water mark to a depth of two fathoms or more, and so thickly crowded on every exposed surface of rock that from a stone no more than six inches in diameter I have taken upwards of sixty individuals of various sizes. On the southern coast of Labrador we failed to detect this species during numerous careful searches at low-water mark and while dredging in favorable situations. It is not improbable, however, that it may yet be found there, as well as on the coast of Newfoundland. This species, like *M. dianthus*, often separates from the border of its base small fragments, which in a few days become perfect individuals. This is analogous to basal budding, so often seen in other families of polyps.

#### Genus *CEREUS* Oken.

*Actinia (pars)* ELLIS and other early authors. *Cereus* OKEN, Lehrb. der Nat. (1815, type *Actinia bellis* ELLIS and SOL.). *Actinocerus* BLAINVILLE, Dict. Sci. Nat. (1830); Man. d'Actinologie, (1834). *Cribrina (pars)* EHRENBERG, Corall. roth. Meeres (1834). *Sagartia (pars)* GOSSE, Trans. Linn. Soc., xxi. p. 267 (1855). *Cereus (pars)* and *Adamsia (pars)* MILNE-EDWARDS, Coralliaires (1857). *Sagartia (Scyphyia)* GOSSE, Actinologia Brit., p. 123 (1860).

Column very contractile, pillar-like in expansion, capable of great elongation. Walls extending to the margin, uninterrupted by a fold or thickening, pierced by numerous cinctidæ, the upper part provided with numerous, well-developed suckers. Acontia emitted freely. Tentacles very numerous, the inner ones somewhat scattered on the disk, the outer crowded at the margin. Disk broad, scarcely frilled, though often undulate.

In adopting the genus *Cereus* of Oken I find it necessary to change materially the limits assigned to it by Milne-Edwards, and to take as the type of the group *Actinia bellis* Ellis and Sol., which is the first species named by Oken, and the one which, more than any of the others, possesses the characters mentioned by him, particularly the perforation of the walls. This character does not appear to exist among those species included in section A of the genus as defined by Milne-Edwards, which corresponds to *Bunodes* and *Rhodactinia*. The group as here restricted embraces a part of the genus *Sagartia* of Gosse, but I am disposed to consider those species of the latter genus claimed by him as most typical, worthy of being separated generically under that name. The genus *Cribrina* of Ehrenberg appears to be perfectly synonymous with *Cereus* as defined by Oken, although the first species named under it has not the character of perforated walls assigned by him to the genus.

#### *Cereus sol* AGASSIZ, MS.

*Actinia sol* AGASSIZ, MS. 1849.

The column is very changeable in form, in expansion often like a moderately elongated pillar, enlarging both towards the base and summit. It is capable of contracting into a globular form or into a low, flattened cone; walls provided for a short distance below the tentacles with well-marked suckers, towards the base nearly smooth. Acontia emitted to the distance of two inches from scattered openings, apparently not very numerous. Base adherent to shells, etc., somewhat expanded, circular, the tissue diaphanous, beautifully marked by the internal radiating lamellæ. Tentacles numerous, amounting to several hundreds in large specimens, arranged in many indistinct circles; inner ones largest, placed about midway between the mouth and the border of the disk, about one-half an inch in

diameter, regularly scattered; outer ones much smaller, very crowded; mouth often prominent at the summit of the protruded disk, oblong, provided with seven lobes or folds on each side, with the largest lobe at the posterior end.

Colors of the column arranged in eight broad, longitudinal stripes of cinnamon-brown, alternating with somewhat narrower ones of gray, the whole surface irregularly sprinkled with small dark brown spots, darkest just below the tentacles; mouth bright yellow, surrounded by a ring of purple or crimson, outside of which the disk is bluish gray, often with alternately lighter and darker radiating lines; inner tentacles flesh-colored, with a dark spot at the base, four or five dark brown spots or bands on the upper half, and a longitudinal line of white on each side; outside of these are others similarly colored but with less distinct dark markings, having bright red tips; the next are orange-yellow with red tips but without distinct dark spots; while the outer ones are nearly white, sometimes with yellow bases and a small spot of red at the tips. According to the drawings of Prof. Agassiz a large specimen about 3 inches high and 1.75 in diameter has the tentacles colored as follows: 72 inner banded tentacles, of which 24 are larger and without red tips; 144 orange-colored with red tips; 288 outer ones, which are in great part white, making a total of 504. (Coll. Mus. Comp. Zoöl.)

Near Charleston, S. C., living on shells inhabited by hermit-crabs (L. Agassiz).

This species is more brilliant in its colors than any other known American species, and when fully expanded the blending of the hues of the variegated tentacles around the brightly colored central area produces a very beautiful effect. From the observations of Prof. Agassiz it appears to be a very active species, contracting powerfully on irritation.

A specimen from alcohol on dissection has the lamellæ broad at the upper portion and thickened with strong muscular fibres; towards the base they are narrowed, leaving a large central cavity, but the principal ones suddenly expand again below, so as to meet at the centre of the base. The ovaries are in clusters low down on the lamellæ; the acontia attached to their upper part, not very numerous. The peripheric pores of the lamellæ are well developed, and near their upper edges. The walls are very muscular, both transversely and longitudinally.

A form at first thought to be a distinct species, and originally named *A. guttata* Ag. MS., but afterwards supposed by Prof. Agassiz to be the young of this species, was also observed and drawn at Charleston in 1849. The column is light reddish brown with vertical rows of brownish orange spots, and a lighter band just below the tentacles. The disk is light brown, with a yellow ring around the mouth and a flake-white line crossing it in a line with the longest diameter of the mouth and running up on the bases of two opposite inner tentacles. The inner tentacles are greenish yellow; the outer ones yellow with white lines. Two specimens were observed about half an inch high when expanded, the largest one with about 200 tentacles.

#### Sub-family ANTHEIDÆ.

*Actinincæ (pars)* MILNE-EDWARDS, Coralliaires. Family *Antheidæ* GOSSE, Actinologia Britannica.

This group is distinguished principally by its elongated, non-contractile tentacles, and the absence of suckers, verrucæ, and other appendages upon the walls. The genus *Aip-*



*tasia*, referred here by Gosse, is said to have acontia, but these organs appear to be wanting in the other more typical genera.

### Genus *DYSACTIS* Milne-Edwards

Column often cylindrical, changeable in form, but not capable of involving the tentacles and disk. Tentacles of two kinds: the inner series long and slender; the outer short, conical, and subequal.

#### *Dysactis pallida* AGASSIZ, MS.

*Actinia pallida* AGASSIZ, MS. (1849).

Column sometimes slender and elongated, more frequently short subcylindrical with a narrow base, enlarging above the middle to the margin of the broad disk; walls longitudinally sulcated; disk broad and flat. Mouth elongated, narrow; in alcoholic specimens with prominent margins divided into about twelve small lobes on each side, leaving a fold at each angle. Tentacles well developed; the twelve inner ones often more than an inch long, very slender and flexible; outer ones numerous, very short, conical; between these two sets there are some intermediate in size, about half an inch in length.

Color of the column light brownish yellow, obscurely striated with lighter; disk similar in color, sometimes with a lighter halo around the mouth; longest tentacles a lighter tint of the same, usually with white spots on the inner side, and a larger one at the base; sometimes there are alternate darker spots.

The largest specimens were 1.25 inches in height; .50 in diameter at the middle; .75 across the disk. (Coll. Mus. Comp. Zoöl.)

Charleston, S. C. (L. Agassiz).

One of the drawings belonging to Prof. Agassiz represents an individual with slender filaments, perhaps acontia, protruding from the mouth. I have not been able, however, to demonstrate the existence of these organs from alcoholic specimens.

### Family ILYANTHIDÆ.

*Actinines pivotantes* MILNE-EDWARDS, Coralliaires (1857). *Ilyanthidæ (pars)* GOSSE, Actinologia Britannica (1860).

Column elongated, tapering below to a pointed or rounded base, without a distinct disk. Base continuous with the walls, often capable of inflation and extension so as to serve for locomotion, and also, sometimes, of adhering to foreign bodies. Tentacles usually in limited numbers, well developed. Acontia apparently wanting.

### Genus ILYANTHUS Forbes.

*Isachmæa (pars)* EHRENBERG, Corall. des roth. Meeres (1834). *Ilyanthos* FORBES, British Actiniadæ, Ann. and Mag. of Nat. Hist., vol. v. p. 181 (1840); MILNE-EDWARDS. *Ilyanthus* JOHNSTON, GOSSE.

Column elongated, obconical, tapering below nearly to a point; surface smooth, destitute of suckers and verrucæ. Base very small, scarcely distinct, perforated (in our species) by a central opening. Tentacles marginal, in three or more cycles.

The species of this genus appear to live buried to the tentacles in mud or sand. The terminal pore has not been observed in all of them.

***Ilyanthus chloropsis* AGASSIZ, MS.**

*Actinia chloropsis* AGASSIZ, MS. (1849).

Body when fully expanded elongated and rather slender, tapering to the base, capable of involving the tentacles and contracting into a short obovate form. Base narrow with a rather large terminal pore. Walls thin, smooth, firm in texture. Tentacles short, pointed, numerous, arranged in several rows; mouth long and narrow; disk flat.

Color of column light bluish green, somewhat diaphanous, with lighter longitudinal striations; tentacles light yellowish green with a white spot at base and a white line on each side; disk yellowish green; mouth bright yellow.

Length, in expansion, 3.50 inches; breadth, .75; when contracted in alcohol, length, 1.25; breadth, 1.00.

Charleston, S. C. (L. Agassiz).

This species appears to be very rare. The only specimen known is in the collection of the Museum of Comparative Zoölogy.

***Ilyanthus lævis* VERRILL.**

The form of this species when partly contracted in alcohol is elongated, obconical, tapering below to an obtuse point. Column smooth, marked by faint longitudinal lines corresponding to the internal lamellæ. Tentacles, thirty-six, placed about one tenth of an inch within the margin of the disk, and arranged in two imperfectly defined rows; they are slender, moderately long, acute at the ends. The summit of the column forms, outside of the tentacles, a thin marginal expansion, having its edge crenulated with small rounded teeth. The base does not appear to have a terminal opening. Length of the column, 1 inch; greatest diameter, .25; length of tentacles, .15. Color unknown.

Eastport, Me. (L. Agassiz).

The only specimen that I have seen is preserved in alcohol in the Museum; therefore, the description of this interesting species must remain, for the present, very imperfect. It differs from *I. scoticus* Forbes, specimens of which, collected at Oban, Scotland, by Dr. Stimpson, are also in the Museum of Comparative Zoölogy, in its more slender and elongated form and shorter tentacles, as also in having a broad margin of the disk outside of the tentacles. In the last character it agrees with *I. Mitchellii* Gosse.

Genus **EDWARDSIA** Quatrefages.

*Edwardsia* QUATREFAGES, Mém. sur les Edwardsies, Ann. Sci. nat., ser. 2, xviii. p. 65 (1842).  
*Scolanthus* GOSSE, Ann. and Mag. of Nat. Hist., 2d ser. xii. p. 157 (1853).

Column very slender, elongated, the upper and basal portions thin and membranous, the middle region covered by a thick epidermal secretion, forming a tube into which the membranous portions may be contracted. Base capable of being distended, and when in that state of adhering slightly by its surface to rocks, etc.; at other times tapering to a point. Tentacles slender, marginal, in three or four cycles, the third sometimes incomplete.



**Edwardsia sipunculoides** STIMPSON, MS.

*Actinia sipunculoides* STIMPSON, Marine Inv. of Grand Menan, p. 7, pl. 1, fig. 2 (1853).

## Plate I. figures 12, 13.

Column very slender, elongated, cylindrical, the central portion traversed by eight longitudinal sulcations, between which it is somewhat swollen in the form of broad, rounded, slightly prominent ribs, crossed in contraction by numerous strong transverse wrinkles. The inferior naked portion when expanded is about one half an inch in length, pointed at the extremity, without any distinct basal disk, but capable of being greatly distended, and in this condition of adhering to stones by its membranous surface. This region is marked with eight white lines, which meet at the central point of the base and are continuous with the eight sulcations of the column. These coincide with the corresponding internal partitions, which are seen through the transparent walls. The upper naked portion, in expansion, is one third of an inch or more in length, smooth and cylindrical. The tentacles are about thirty-six in number, arranged somewhat crowdedly in two rows close to the margin. They are long, slender, tapering to a point, the outer ones a little shorter than the inner, which are twice longer than the diameter of the disk; mouth with four small but prominent lobes on each side.

The color of the central, sheathed portion is usually yellowish brown, but varies to black, according to the situation and the color of the mud where found; basal naked area, pellucid yellowish white; upper naked portion, yellowish, surrounded, about midway between the tentacles and sheath, by a ring consisting of eight lunate, arrow-shaped, or square opaque white spots, which are close together and sometimes extend downward at their lower angles, forming a white line along the sides of each invagination; sometimes there is a trace of another ring of smaller white spots lower down; tentacles transparent yellowish white, sprinkled with numerous flake-white dots, sometimes with small white spots at the outer base. Mouth and "stomach" bright red, the former generally prominent; disk yellowish, with faint white radii, and white spots often surrounding the base of the tentacles.

Length of the largest specimens when in full expansion, about 5 inches; in diameter, .15; when contracted, about 1.5 inches in length. (Coll. Mus. Comp. Zoöl.)

Eastport, Me., and Grand Menan, N. B., in gravelly mud under stones at low water.

This interesting species has, as yet, been found in very few places, and, with one exception, very sparingly in its localities. In the vicinity of Eastport, Me., at a point just south of Dog Island, I succeeded in obtaining several hundred specimens in a very short time by turning over the large stones, when they were seen projecting from the mud, chiefly near the edges of the stones, looking much like some species of worms. As many as fifteen or twenty were sometimes found under a single stone. This locality was first discovered by Dr. Stimpson. They here occupy the lower third of the littoral zone. Some force is usually required to pull them from their burrows, but this seems to be owing to the distension of their bases rather than to any adhesive power. When put into sea-water they expand readily and move about with worm-like gyrations. When touched, they suddenly jerk away the upper part of the body before withdrawing the tentacles. They feed readily, like most *Actinidæ*, upon bits of clams and other mollusks.

*Edwardsia sulcata* VERRILL.

The column is long, smooth, with twelve strong sulcations; the intermediate spaces swollen into prominent ribs, which are crossed by slight, transverse wrinkles; upper part in contraction thickest, tapering below. Naked basal portion distended, rounded, with a small, concave, smooth area at the end, the sides marked with twelve lines which do not meet in a point, but disappear on the small terminal convex area, which, however, is scarcely distinct from the sides. Tentacles not observed.

Color light yellowish brown. Length in contraction, 1.25 inches; diameter, .30.

Chelsea Beach, Mass., thrown up after a storm.

Never having seen this species except when contracted in alcohol, I am able to give but a very imperfect description. It differs widely from the other species in the character of the column. From *E. sipunculoides* it may readily be distinguished by its larger size and less slender form, by its much smoother surface and lighter color, and by the twelve sulcations instead of eight.

For a fine specimen of this species, and the first that I had seen, I am indebted to Mr. A. S. Packard, Jr., who found it in the spring of 1862; but Dr. Stimpson informs me that he has also obtained the same species at Chelsea.

Genus *HALCAMP* Gosse.

*Actinia (pars)* PEACH, in Johnston's British Zoöphytes. *Peachia (pars)* GOSSE, Trans. Linn. Soc., xxi. p. 271 (1855). *Halcampa* GOSSE, Ann. and Mag. of Nat. Hist., 3d series, i. p. 418 (1858).

Column very contractile, much elongated and slender in expansion, occupying holes in the earth or among rocks; in contraction irregularly cylindrical, often with constrictions; walls membranous throughout, diaphanous, the upper portion provided with well-developed suckers. Base capable of being enlarged and greatly distended, without a distinct disk, but capable of adhering slightly by its surface to foreign bodies, apparently imperforate. Tentacles short, in two or three cycles, the last usually imperfect in some of the systems, whole number not known to exceed twenty. The internal lamellæ are very thin next the wall, but near the middle have a very strong, longitudinal, muscular thickening, which narrows both above and below. Ovaries very large, extending about half way to the base. The peripheral pores of the lamellæ are large and well defined.

*Halcampa albida* AGASSIZ, MS.

*Corynactis albida* AGASSIZ, Proceedings of the Boston Society of Natural History, vol. vii. p. 24 (1859).

Body very changeable in form, sometimes very long, slender, and attenuated; at other times short cylindrical or clavate; not unfrequently forming two distinct portions separated by a constriction in the middle, the parts above and below being of the same size, or the upper one may be distended while the lower is contracted and slender; in extreme contraction short, oval, rounded at both ends, but the basal end smallest. The base may be expanded into a thin, transparent, bladder-like form, or by contraction become pointed. Surface of the column smooth below, diaphanous, marked faintly by the longitudinal and transverse muscular fibres, and deeply by twenty sulcations corresponding to the internal



lamellæ; upper portion covered by prominent suckers arranged in a vertical row along each ambulacral space, each one situated in the centre of a little square. Tentacles twenty, slender, with rounded knobs at the ends. They are arranged in three cycles forming six systems, but in two of the systems next to one end of the antero-posterior axis, the tentacles of the third system are wanting. Those of the first and second cycles in the perfect systems are nearly equal, and about double the length of those of the third cycle; in the imperfect systems those of the second cycle correspond in length to those of the third in other systems.

Color of the column light brownish yellow; tentacles lighter, the knobs at the tips dark brown.

Average length in expansion, about 3 inches; thickness, .40; length of tentacles, .25. (Coll. Mus. Comp. Zoöl.)

Long Island Sound, shores of Nantucket, Martha's Vineyard, and Cape Cod, buried to the tentacles in sand near low-water mark.

This species is closely allied to the following, and like it is remarkable for its great size compared with the European representatives of the genus. From *H. producta* it differs in having larger and less numerous suckers, which extend lower down on the column, and in the knobbed character of the tentacles. It appears to be quite common in its localities. According to the observations of Dr. Stimpson and Mr. B. T. Morrison, it occupies in expansion the whole length of its burrows, which are sometimes a foot deep, and can contract and withdraw itself to the lower end when disturbed. In some instances the base was found to be adherent to a small pebble at the bottom of the hole.

***Halocampa producta* STIMPSON, MS.**

*Actinia producta* STIMPSON, Some Remarkable Marine Invertebrata inhabiting the shores of South Carolina, Proceedings of the Boston Society of Natural History, v. p. 110 (1856).

Plate I. figures 10, 11.

Column in expansion very long, somewhat claviform above, slender below, in contraction cylindrical, often constricted. Base capable of distension, and of adhering to pebbles or shells beneath the surface of the sand or mud in which it burrows. The surface of the body is marked by twenty longitudinal sulcations, corresponding with the internal lamellæ and continuing to the centre of the base; the upper portion, for about a third of the whole length, is covered by numerous prominent suckers arranged closely in rows along the ambulacral spaces, the upper ones largest, decreasing downward until they become obsolete near the middle. "Tentacles twenty, short, stout, enlarged and rounded at the ends, which are covered with white dots. Five of these tentacles usually stand erect, the remaining ones curving over and alternating by threes with the erect ones. The animal retracts its tentacles very slowly when disturbed."

Color of the column transparent yellowish green. Length in contraction about 3 inches, diameter, .75; in expansion probably 8 or 10 inches, since the base was found attached at that distance below the surface.

Near Fort Johnson, S. C. Found in considerable numbers buried in the mud on the flats near low-water mark. Its position is indicated, after the tide has retired, by little cracks on the surface of the mud, which radiate from a small central hole.

This interesting species, the largest described of the genus, is known to me only through

the description of Dr. Stimpson and the drawings which he has generously placed at my disposal.

### Genus *BICIDIUM* Agassiz.

*Bicidium* AGASSIZ, Proceedings of the Boston Society of Natural History, vii. p. 24 (1859).  
(?) *Philomedusa* MÜLLER, Arch. für Natur. xxvi. p. 57 (1860).

Body elongated, turbinate, or obconic, tapering to the base. Column sulcate, surface without apparent suckers or cinclidæ, uniform along its whole extent. Tentacles twelve, in two cycles, short, thick, marginal. Mouth large, enclosed at one end by a prominent extension of the disk, forming a large conchula, which is partially divided into tentacle-like lobes at the summit; the other end surrounded by small lobes corresponding in number to the tentacles. Base with a terminal pore.

This genus is very closely allied to *Peachia* Gosse, but has a still more remarkable structure surrounding the mouth. It also lacks suckers, and has the tentacular system less developed.

### *Bicidium parasiticum* AGASSIZ.

*Bicidium parasiticum* AGASSIZ, Proceedings of the Boston Society of Natural History, vii. p. 24 (1859).

### Plate I. figures 14, 15.

Form usually turbinate, tapering below to an obtusely rounded base; in contraction sometimes ovate, largest in the middle, broader than long, each end involved. Surface strongly furrowed by twelve sulcations corresponding to the internal lamellæ, between the grooves much swollen and corrugated by transverse wrinkles, no suckers apparent. Tentacles twelve, short, thick, swollen in the middle, obtuse at the tips. Conchula or proboscis greatly developed, surrounding one end and about one half the length of the mouth, and when expanded about as long as the tentacles; its summit is divided into three principal lobes, one opposite the angle of the mouth and one on either side of this, and two subordinate ones, which are about opposite the centre of the mouth. The remaining margin of the mouth is divided into prominent lobes, decreasing in size as they approach the angle opposite the conchula.

Color light purplish brown with a bluish iridescence, similar to that of *Cyanea arctica*.

Length in expansion, 1.25 inches; greatest diameter, .4. (Coll. Mus. Comp. Zoöl.)

Nahant, Mass., to Eastport, Me., parasitic on the large red jelly-fish, *Cyanea arctica*, often imbedded in the tissues of the lower surface of the disk.

### Family CERIANTHIDÆ.

*Cerianthidæ* MILNE-EDWARDS and HAIME, Distribution méthodique (1852); MILNE-EDWARDS, Coralliaires, i. p. 306 (1857). *Ilyanthidæ* (*pars*) GOSSE, Ann. and Mag. of Nat. Hist., 3d ser. i. p. 417 (1855); Actin. Brit. (1857).

Form elongated, tapering to the rounded or pointed base, which is destitute of a disk. Tentacles not retractile, greatly developed, numerous, arranged in two series, one marginal



and the other immediately surrounding the mouth, a tentacle in both sets arising from each spheromere. Internal lamellæ unequal; one pair extending to the base or nearly so, the others shorter, leaving a wide central cavity.

This very peculiar group was first established by Milne-Edwards and Haime in 1852, but with somewhat different limits from those now given. *Ilyanthus* was then included with the typical forms, but has been separated more recently by Milne-Edwards. Gosse has again united the two groups under the name *Ilyanthidæ*. The two families appear, however, to be sufficiently distinct.

For the present I prefer to include the genus *Arachnactis* in this division, although possessing peculiarities which might possibly warrant the establishment of a distinct family for it, as has been suggested by Mr. A. Agassiz.<sup>1</sup> But it seems quite doubtful to me whether its adult condition has been hitherto observed, while the young of *Cerianthus*, according to the observations of Haime, are free, swimming polyps. The structure and arrangement of the internal lamellæ and the two circles of tentacles are also similar. The peculiarity of the development of the tentacles of *Arachnactis*, so well described by Mr. Agassiz, seems also to have an intimate relation to the singular arrangement of the internal lamellæ of *Cerianthus*. It is also probable that the development of the tentacles in the latter follows the same law as in the former.

#### GENUS CERIANTHUS DELLE CHIAJE.

*Moscata* (?) RÉNIER, *Eléments de Zoologie*, partie 3, fasc. i. (1828). *Cerianthus* DELLE CHIAJE, *Descr. anim. inv. della Sicilia citeriore*, iv. p. 124 (1841); MILNE-EDWARDS and HAIME, *Distr. méthodique* (1852); J. HAIME, *Mémoire sur le Cérianthe* (*Ann. des Sci. nat.*, 4<sup>me</sup> ser. i. p. 341, 1854); MILNE-EDWARDS, *Coralliaires* (1857).

Column long, cylindrical, highly muscular and contractile, but not capable of involving the disk; form variable, but usually enlarged towards the disk, tapering slightly below to the pointed or sometimes swollen base; walls firm and strong, smooth externally, naturally enclosed in a loosely investing and unattached tube composed principally of cast-off lasso-cells, or nematocysts, forming a felt-like substance of considerable tenacity. Base with a subterminal opening, serving for the expulsion and introduction of water. Tentacles in both sets long, slender, very numerous, not contractile. Internal lamellæ very unequal, one pair extending to the base, the others shorter and narrower, those opposite the first pair smallest. The species, so far as observed, are hermaphrodite.

#### *Cerianthus americanus* AGASSIZ, MS.

*Cerianthus* Agassiz, *Proceedings of the Boston Society of Natural History*, vii. p. 24 (1859).

Column very long, cylindrical, expanded at the top, tapering gradually below; in expansion, often two feet or more long; in contraction, six or eight inches. Body enclosed in a loosely investing tube, buried in the mud. Tentacles long and numerous, the outer series (125 or more) are from 1.25 to 1.50 inches long, slender, very flexible, usually much curled at the ends; inner series similar, about .75 long, nearly the same as the former in appear-

<sup>1</sup> *Journal of the Boston Society of Natural History*, vol. vii. p. 529 (1863).

ance; often brought together and spirally twisted in a central bundle. Base with a small but distinct opening.

Color of column dark cinnamon-brown, lined longitudinally with a lighter tint of the same; outer tentacles cinnamon-brown, lighter at the bases; inner series darker, marked with white longitudinal lines; disk bright yellow, the central portion brown; at the bases of the tentacles spotted with dark brown.

Length of the largest specimen in expansion, 24 to 28 inches; diameter at disk, 1.50; at centre of body, 1 inch. (Coll. Mus. Comp. Zoöl.)

Charleston, S. C., buried to the tentacles in mud at low water (H. J. Clark, Wm. Stimpson, L. Agassiz); Beaufort, N. Carolina (Wm. Stimpson).

The description of this very interesting species has been drawn chiefly from a beautiful series of drawings in the possession of Prof. Agassiz, made from life by Mr. Burkhardt. It is remarkable for its great size and fine colors.

#### Genus ARACHNACTIS Sars.

*Arachnactis* Sars, Fauna Littoralis Norvegiæ, i. (1846). *Arachnactis* Gosse, Actinologia Britannica, p. 263 (1860).

Column of moderate length, elliptical or subcylindrical, rounded at the base, apparently destitute of a terminal opening; surface smooth, in the British species said to be capable of adhering. Tentacles few in number, not contractile, the marginal ones long and slender; those of the inner circle short and thick, corresponding in number with the others. The development of new tentacles in each circle takes place in pairs at one extremity of the antero-posterior diameter in a bilateral manner. The species swim freely in the sea with the tentacles downward.

#### *Arachnactis brachiolata* A. Agassiz.

*Arachnactis brachiolata* A. Agassiz, Proceedings of the Boston Society of Natural History, ix. p. 159 (1862); Journal of the Boston Society of Natural History, vii. p. 525 (1863).

Body strongly compressed in the plane of the antero-posterior diameter, rounded at the base, and in all the individuals observed somewhat enlarged. The outer tentacles exceed the column in length; the inner are, in the specimens described, very short, conical, generally carried erect.

Color of body pale ochreous, diaphanous; the lamellæ appearing through the walls like darker lines.

Massachusetts Bay, swimming by night near the surface; very abundant about the first of September (A. Agassiz).

This species has as yet been observed only in the young state. It was then about an eighth of an inch in length, and had sixteen tentacles. It still retained some of the yolk mass at the base, and moved chiefly by ciliæ covering the surface, swimming in an oblique position, the largest tentacles hanging downwards.

For a more detailed account of this interesting form I would refer to the original papers by Mr. Agassiz.



## Family ZOANTHIDÆ.

*Zoanthes* BLAINVILLE, Dict. Hist. Nat. (1830). *Zoanthina* EHRENBERG, Corall. des roth. Meer. (1834). *Zoanthidæ* DANA, Zoöphytes (1846). *Zoanthinæ* MILNE-EDWARDS, Coralliaires (1857).

Polyps aggregated, permanently fixed upon rocks, shells, etc. The new polyps arise by budding from basal expansions of the walls in the form either of stolons or broad sheets. Column cylindrical, the summit capable of involution. Tentacles short, conical, placed close to the margin of the disk.

## Genus ZOANTHUS Cuvier.

*Actinia (pars)* ELLIS (1767); ELLIS and SOL. (1786). *Hydra (pars)* GMELIN, LINN., Syst. Nat., ed. xiii. *Zoanthus* CUVIER, Tab. Élém. (1797); Règne Anim. (1817). *Zoantha* LAMARCK, Système des Anim. sans Vert., p. 363 (1801); Hist. Anim. sans Vert. (1815); LAMOUROUX; DANA. *Zoanthus* EHRENBERG, MILNE-EDWARDS.

Base incrusting rocks, shells, or other foreign bodies, sometimes in the form of thin spreading sheets or bands, at other times as narrow creeping stolons. Polyps arising from the spreading base, elongated, subcylindrical, or pillar-like. The surface of the walls is either smooth and covered with mucus, or protected by a layer of sand closely agglutinated to the surface. Disk generally concave, capable of involution, but the polyps contract very little in length.

*Zoanthus parasiticus* STIMPSON, MS.

This species, which is parasitic on shells, has an incrusting base, smooth and uniform on the lower side of the shell, but giving rise to from fifteen to twenty polyps on the upper side, which diverge in all directions. Polyps variable in height and size, those of the upper central portion generally half an inch in height and one eighth in diameter, while those around the margin of the base are not more than half so large, and much crowded. Base spreading over and completely investing dead shells of *Natica*, *Buccinum*, etc., both externally and internally. The substance of the shell in every case has been entirely removed, but the form in all parts is perfectly preserved by the membranes of the polyps, while the cavity is inhabited by a species of hermit crab (*Eupagurus pubescens*). Column pillar-like, smallest in the middle, increasing gradually below, but enlarging rapidly at the summit. Walls thin, covered by a layer of closely adhering, fine sand. When contracted, the summit is slightly concave, and in the medium-sized polyps has seventeen, in the largest twenty-four sulcations, radiating from the centre, which is seldom completely closed. Tentacles forty-eight or more, short, conical.

Off the coast of New Jersey, lat. 40° N., long. 73° W., in 32 fathoms (Capt. Gedney, Coll. Smith. Ins.).

This is the only species of the family yet found on our coast north of Florida. In habits it resembles *Z. Couchii* of England, and, like the latter, will probably be found to assume various forms according to the object upon which it grows. It is a larger species, and the

polyps are much less slender in form, with more numerous tentacles. It is also, apparently, nearly allied to *Z. arcticus* Sars, from Northern Europe.<sup>1</sup>

The above description has been prepared from alcoholic specimens in the Museum of Comparative Zoölogy, received through the Smithsonian Institution. By a singular coincidence, the same manuscript name was independently given to this species in 1861 both by Dr. Stimpson and myself.

#### DOUBTFUL SPECIES.

The following species of *Actinidæ*, which I have never seen, will require further examination before they can be referred to their proper genera.

##### *Actinia rapiformis* LESUEUR.

Journal of the Academy of Natural Sciences, Philadelphia, i. p. 171 (1817).

"Tentacula short, cylindric, equal, disposed in four rows; body fleshy, very contractile, assuming different forms, and frequently those of a turnip and a pear, the former of which it also resembles in its dull opaque white color; when contracted it is of a subglobular form. The young are more transparent than the old, and are sometimes of a darker color.

"This species dwells in the sands of the coasts of the United States, and raises its head above the common surface for the purpose of displaying its tentacula; when contracted in its habitation, it is concealed below the surface. The individual described was an inch and a half in diameter and four or five inches in length. Discovered at Egg Harbor, on the coast of New Jersey. It is necessary to observe that this *Actinia* is frequently disturbed in its habitation by the waves of the ocean, and is found washed on the sands; in this event, a common observer would take it for a rotten pear, or something similar."

##### *Actinia neglecta* LEIDY.

Journal of the Academy of Natural Sciences, Philadelphia, 2d series, iii. p. 141 (1855).

"Body, when closed, obpyriform or shortly cylindrical; when expanded, cylindrical, about an inch in length by one fourth of an inch in breadth, smooth, translucent olive-green. Mouth elliptical, with the lip composed of six greenish-white lobes. Tentacles numerous, up to one half an inch in length, brighter olive-green than the body. A single specimen was found in the mud of a sound in the vicinity of Atlantic City, N. J." This is, probably, an *Ilyanthus*.

##### *Anthea flavidula* McCrady.

Proceedings of the Elliott Society of Charleston, S. C., vol. i. p. 280 (1858). No description.

This is, possibly, the same as *Dysactis pallida* nob., but since it is merely mentioned by name, there is no possibility of ascertaining its true place.

<sup>1</sup> Aftryk af Vidensk. Forhandlinger i Christiania, 1860.



**Actinia (?) nitida** DAWSON.

Canadian Naturalist and Geologist, vol. iii. p. 404, fig. 3-5 (1858).

This name was provisionally applied to an Actinian which I have not seen. It closely resembles specimens of *Rhodactinia Davisii* of the form named *Actinia carneola* by Dr. Stimpson, and may well prove to be only a variation of that polymorphous species.

"Body short, cylindrical, smooth; color red, arranged in stripes; tentacles triserial, short, conical, striated, reddish; disk prominent, dull purple, with two rows of white spots. Oral bands numerous, flesh-color."

The largest specimens were an inch in diameter and had one hundred and fifty tentacles. Gaspé, Canada East, 8 to 10 f. gravelly bottom (J. W. Dawson).

## Sub-order II. ANTIPATHARIA.

In this division the polyps are united, as in the *Gorgonidæ* among the *Aleyonaria*, by a coenenchyma which connects them laterally; and from the common basal membrane there is in like manner secreted a solid axis (*sclerobase*), which serves as a support. The sclerobase is, however, rarely or never striated, and has a smooth or echinulated surface. The polyps, so far as known, have six simple tentacles, similar to those of many *Actinaria*.

## Genus ANTIPATHES Pallas.

Corallum branched; branches but imperfectly coalescent, or not at all so. Axis black, hard, and opaque, with the surface more or less echinulate.

**Antipathes Boscii** LAMX.

*Antipathes Boscii* LAMOUREUX, Polyp. Flex., p. 375, pl. 14, f. 5 (1816); DANA, Zoöphytes, p. 584 (1846); MILNE-EDWARDS, Coralliaires, i. p. 318 (1857).

Corallum finely and densely branched from very near the base, forming an irregular, subflabelliform, matted frond. Branches slender, numerous, divided in an irregularly dichotomous or subpinnate manner, frequently coalescent, especially near the base, the reticulations very irregular. Branchlets slender, setiform, the terminal ones from one fourth of an inch to an inch in length. Surface of the branches and branchlets thickly covered by small acute spines projecting nearly at right angles; between the spines minutely scabrous. Color black, the branchlets translucent, dark amber-colored. Coenenchyma not observed. Height, 10 inches; breadth, 14. (Coll. Mus. Comp. Zool.)

Near Charleston, S. C. (L. Agassiz).

**Antipathes alopecuroides** ELLIS and SOL.

*Antipathes alopecuroides* ELLIS and SOLANDER, p. 102 (1786); DANA, Zoöphytes, p. 584; MILNE-EDWARDS, Coralliaires, i. p. 317

Having had no opportunity of observing this species, I quote the original description of Ellis.

"This branched *Antipathes* has its young branches, which are full of spires and small

prickles, disposed in close panicles. The trunk rises from a broad-spread base, and divides immediately into several large branches of one third of an inch diameter; as these rise up, one side of them appears flat, with a groove or channel along the middle part of it, where there are the remains of many little branches that have grown in rows on each side of it. It then divides into branches, and often into other branches, all of which are in form of close panicles, not unlike the fox-tail grass. These panicles are composed of very rough, thorny, minute branches, which are twice as long on one side of the stem as on the other. The outside of this *Antipathes* is of a grayish color; the inside is black and very brittle. It is near two feet high.

"This was brought from South Carolina, and presented to Corbyn Morris, Esq., F. R. S., and has not before been described."

### Sub-order III. ASTRÆARIA.

In this division the polyps have elongated, more or less cylindrical tentacles, the surfaces of which are generally covered by distinct papillæ or spots, caused by groups of lasso-cells. The walls are highly developed and likewise the septal organs, and solid corals are formed by the secretion of lime in these parts. The corals have mostly solid, imperforate walls; septa in multiples of six, often in great numbers, compact, imperforate, usually extending on the outside of the walls as costæ. Between the septa transverse plates, one above the other, are formed by basal secretions, or the space is filled from below by a continuous deposit of solid matter, as in *Oculina*.

The last character would exclude the *Turbinolidae* of Milne-Edwards, which, in most other respects, agree with the *Eusmilinae*, and ought, perhaps, to be considered as low and simple forms of ASTRÆARIA. There is a gradual and almost complete transition from the *Turbinolidae* through such forms as *Ceratotrochus duodecim-costatus*, in which imperfect transverse dissepiments are often present, to *Parasmilia*, *Celosmilia*, etc., among the *Astræidae*, in which the dissepiments are but slightly developed. There is also a very close connection of the *Turbinolidae* (*Caryophyllinae*) through *Paracyathus*, which sometimes has rudimentary dissepiments, with the *Astrangiaceae* M-Edw., particularly with such genera as *Phyllangia* M-Edw. and H. and *Syndepas* Lyman, which have very imperfect dissepiments and, at the same time, nearly entire septa. The polyps, also, seem to have a very close resemblance, since so accurate an observer as Dana united species of *Flabellum* with his genus *Euphyllia*, principally with regard to this feature.

The character among *Turbinolidae* of always remaining simple has no weight, since there are, also, many simple *Astræidae*, and especially since the observations of Mrs. Thyme, if accurate, prove that *Caryophyllia* undergoes, while young, complete and extensive fissiparity.<sup>1</sup>

We unite *Oculinidae*<sup>2</sup> with the *Astræidae* without hesitation. While young, *Oculina diffusa* and *O. arbuscula* are low, incrusting corals, spreading over the surface of rocks in precisely the same manner as *Astrangia*, and budding in the same way, so that it is even difficult, sometimes, to distinguish the two genera while young. The polyps of these two genera and also of *Cladocora* are very similar in all respects, as is beautifully shown in an excellent series of unpublished plates in the possession of Prof. Agassiz.

<sup>1</sup> On the increase of *Caryophyllia Smithii*, with notes by P. H. Gosse, Ann. and Mag. of Nat. Hist., iii. p. 449 (1859).

<sup>2</sup> This position of *Oculinidae* was suggested by Prof. Agassiz three years ago, and has been constantly confirmed by further examinations.



Leaving *Turbinolidae* out of consideration for the present, the ASTRÆARIA may be arranged as follows:—

A. FISSIPAROUS ASTRÆARIA, embracing three families.

I. *Eusmilinæ* M.-Edw. and H., having the edges of the septa entire, without paliform lobes; polyps with the disk in expansion raised above the coral; tentacles well developed, cylindro-conical.

II. *Lithophyllinæ*, corresponding to a part of *Lithophylliaceæ* M.-Edw. These have the edges of the septa divided into strong teeth or spines, without paliform lobes; disk level with the top of the cells; tentacles surmounting the top of the septa, short, conical, numerous (*Mussa*, *Isophyllia*, etc.).

III. *Mæandrinæ*, including part of *Lithophylliaceæ* M.-Edw., viz.: *Mæandrina*, *Manicina*, *Hydnophora*, *Tridacophyllia*, *Colpophyllia*, etc., together with *Faviaceæ*. In these the septa have their edges finely toothed or crenulate, with a paliform lobe towards the base. The small tentacles are placed at the top of this paliform lobe, and the disk extends across the cells even with the top of the paliform lobes, and does not rise level with the summit of the walls.<sup>1</sup>

B. GEMMIPAROUS ASTRÆARIA, containing four families.

IV. *Stylininæ*, corresponding with *Stylinaceæ* M.-Edw. and Haime. Septa with entire edges; dissepiments well developed; cœnenchyma absent.

V. *Astræinæ*, embracing only a part of the same group as limited by Milne-Edwards and Haime, viz: *Astræaceæ* (*pars*), *Cladocoraceæ*, *Astrangiaceæ*. These have dentate septa, rudimentary cœnenchyma, dissepiments usually well developed.

VI. *Stylophorinæ* M.-Edw. and H., including *Stylophora*, *Madracis*, etc. In these there is a well-developed cœnenchyma, uniting the polyps, which is most compact at the surface. The cells have a tendency to fill up at the surface and remain more open below. Septa mostly entire.

VII. *Oculinidæ*, corresponding to the same group of Milne-Edwards and Haime, with the addition of *Distichopora* and, perhaps, *Errina*. The cells have a tendency to fill up completely from below by deposition of solid matter; dissepiments not very well marked; cœnenchyma well developed, compact.

Of these only the fifth and last are represented within our limits, so far as now known; yet species of all the others, except *Stylininæ*, occur about the Florida Reefs.

Family ASTRÆINÆ Milne-Edwards.

We have restricted this name, as indicated above, to but a small part of the forms included by Milne-Edwards and Haime. This has been done principally from a consideration of the structure of the soft parts. In this respect this group differs widely from most other *Astræidæ*, agreeing more nearly with *Oculina* than with any other division that I have had an opportunity to examine. The upper portion of the polyp has the power of rising out

<sup>1</sup> This peculiar character, which separates *Mæandrinæ* from *Lithophyllinæ*, I have ascertained from numerous examinations and dissections at the Museum of Comparative Zoölogy of alcoholic specimens of *Mæandrina*, *Manicina*, and *Favia*, compared with *Isophyllia dipsacea*, also in

alcohol, and with the figures of the living polyps of *Mussa* and *Symphyllia* in Dana's Zoöphytes. The polyps of *Mæandrina* have also been well figured by LeSueur, Dana, and others.

of and above the cells in all the genera examined, and, on contraction, of sinking back into them. The tentacles are slender and well developed.

This group embraces three divisions of Milne-Edwards, which may be regarded as sub-families, viz: I. *Astræaceæ*, including those genera that form massive corals by the intimate union of the individuals. These bud near or within the disk or from the membrane connecting contiguous polyps; II. *Cladocoraceæ*, comprising those that bud laterally and in which the polyps are united only at the base, forming branching or cæspitose clumps; III. *Astrangiaceæ*, in which the polyps bud from the base, from basal expansions or, more rarely, from the sides, forming, mostly, low incrusting corals. These last two groups ought perhaps to be united, since the separation between even the typical genera, *Cladocora* and *Astrangia*, is not very clear, the former, while young, budding from basal, creeping stolons, and some species of the latter rising when old into incipient branches and increasing thus by lateral, or even marginal, buds.

The last of these subdivisions is the only one found within our limits.

#### Genus *ASTRANGIA* M.-Edw. and Haime.

*Astrangia* M.-EDW. and HAIME, Comptes-rendus, xxvii. p. 496 (1848).

Corallum incrusting, the corallites arising from an expansion of the base of the parent, and sometimes from the walls or margin, forming either clustered groups or aggregated, astrea-like masses, sometimes with rising branches. Walls naked and costate. The cells are circular except where crowded, deep, with numerous subequal septa, which are all dentate, those of the last cycle curved; columella papillose; dissepiments few. The polyps when expanded are subtransparent, and rise to a considerable distance above the cells. The tentacles are long, slender, covered by minute white warts, consisting of lasso-cells, and have a knob at the tip.

#### *Astrangia astræiformis* M.-EDW. and HAIME.

*Astrangia astræiformis* M.-EDW. and HAIME, Ann. des Sci. Nat., 3d ser. xii. p. 181 (1850).

Corallum composed of closely aggregated corallites, united nearly to their summit, spreading over and incrusting the surface of shells, and, by continued growth, forming astrea-like masses of considerable thickness, which often rise into numerous short irregular branches. In these, besides the marginal buds that arise from the basal expansion, many originate from the sides of the parent polyps and some even from the margin of the disk. The cells are widely open, deep, and narrow at the bottom. Columella well developed, papillose, the papillæ confounded with the inner teeth of the septa. Septa much narrowed at the top, in three complete cycles, often with some of a fourth; those of the third cycle are well developed, and curve towards those of the preceding one, uniting with them interiorly; all of them have the sides granulated and the edges sharply dentate. Costæ well marked near the margin. Thickness or height above the base, often two inches; diameter of the cells about .18 inch. (Coll. Mus. Comp. Zoöl.)

Charleston, S. C. (L. Agassiz); Beaufort, N. C. (A. S. Bickmore).

This species often incrusts shells that are inhabited by hermit crabs.



*Astrangia Danæ* AGASSIZ.

*Astrangia Danæ* AGASSIZ, Proc. Amer. Association, ii. p. 68, 1849 (*non* M.-EDW. and HAIME). *Astrangia astreiformis* LEIDY, Journal Acad. Nat. Sci. Philadelphia, 2d series, iii. p. 135, 1855 (*non* M.-EDW. and HAIME).

In its mode of growth and general form this species resembles the preceding, but does not form so thick masses and the corallites are less closely united. Their walls are smoother, with less distinct costæ. The cells are not so deep and have a more open appearance, owing both to the much less developed columella, which is, however, more distinct from the septa and composed of larger papillæ, and to the narrower septa of the fourth cycle, which do not extend half-way to the centre. The polyps are very exsert in expansion, with about twenty-four long slender tentacles. The disk is usually convex or conical. Color of polyps white or light flesh-color, diaphanous. (Coll. Mus. Comp. Zoöl.)

Long Island Sound.

This species incrusts rocks from just below low-water mark to ten fathoms, and is very abundant in some localities. It thrives well in the aquarium, eating oysters and other mollusca with avidity.

Prof. Agassiz has an excellent series of unpublished plates, representing the polyps of this species in various attitudes, with the details of its anatomy.

## Family OCULINIDÆ Milne-Edwards and Haime.

## Genus OCULINA Lamarck.

The corallum while young spreads laterally by basal budding, forming an incrusting base, from which branches arise in a tufted or arborescent manner. Corallites arranged somewhat spirally on the branches, separated by a compact cœnenchyma, the surface of which is nearly smooth midway between the cells, but marked by radiating costæ near them. These are rather deep, with a papillose columella and pali before all the septa except those of the last cycle. Edges of the septa entire or nearly so, moderately exsert.

*Oculina arbuscula* AGASSIZ.

In this species the corallum is arborescently branched from near the base, which is spreading and incrusting. The trunk is short, very thick, and divides soon into several large diverging branches. These are round, usually somewhat bent, gradually tapering, and very rapidly divide dichotomously into two or three spreading branchlets, which are curved and taper rapidly to the blunt tips. Corallites a little prominent, generally with perpendicular walls, arranged spirally around the branches, not crowded; cells rather large, and deep. Septa in four cycles, those of the last generally incomplete. The principal ones are narrow, nearly perpendicular within, their summits somewhat exsert, rounded. Columella slightly developed, pali rudimentary or but slightly prominent. Costæ distinct only near the cells; surface of the cœnenchyma finely granulous, often convex between the cells. Unbleached specimens are light yellowish brown. In a specimen eight inches high the principal branches are .75 of an inch in diameter; the cells about .12.

Charleston, S. C., off the bar, L. Agassiz. (Coll. Mus. Comp. Zoöl.)

*Oculina implicata* AGASSIZ, MS.

This species forms dense clumps of strong, crooked, intricately coalesced branches, which are round and obtuse at the ends when free. Cells rather small, deep, very little prominent, arranged somewhat near together, in spiral lines; septa in three cycles, very narrow, the inner edge perpendicular, scarcely exsert. Columella papillose, little developed. Pali scarcely apparent. Surface of the cœnenchyma between the cells finely granulous, immediately around the cells marked by faint costal radii. The clumps are six or eight inches in diameter and about the same in height; the branches about half an inch in diameter; cells one tenth.

Cape Hatteras and Beaufort, N. C., thrown upon the beach after storms. (Coll. Mus. Comp. Zoöl.)

Among a large number of specimens of this species I have seen none that are perfect, all of them being more or less worn. It is closely allied to the preceding, notwithstanding the great differences in its mode of growth and appearance of the cells, and, when large series of specimens of each can be obtained, may prove to be only a peculiar form of the same species.

## GEOGRAPHICAL DISTRIBUTION.

The eastern coast of North America has been divided into six regions, each characterized by a peculiar assemblage of animals, some of which are confined exclusively to the region in which they belong, while others may extend beyond those limits in either direction, and occur more or less abundantly in two or more of the subdivisions. These regions have been called *provinces* by Dana, and *faunæ* by Lütken and other writers. The limits of most of them are well marked, and have been clearly defined by most naturalists who have recently written upon this subject. The Polyps have not, however, been hitherto sufficiently well known to be made useful to any great extent in these investigations. The facts which I am now able to present accord perfectly with those that have been derived by others from the study of the Crustacea, Mollusca, and Acalephs.

The most northern part of the American coast from Newfoundland to the Arctic Ocean belongs to the great Arctic Realm or Kingdom. This has not yet been examined to an extent sufficient to distinguish many of its subdivisions or *faunæ*, yet it has recently been shown by Mr. A. S. Packard, Jr.,<sup>1</sup> that the southern portion should be distinguished from the more northern. The former he has named very appropriately the Syrtensian Fauna. To the southward of the arctic kingdom we have the sub-frigid region, extending as far south as Cape Cod along the coast, and impinging upon some of the outer banks or shoals still farther south. This division has been called the Nova Scotia Province by Dana,<sup>2</sup> which is changed to Acadian Fauna by Lütken.<sup>3</sup> The cold-temperate region, extending from Cape Cod to Cape Hatteras, has been called the Virginian Province by Dana. This and the preceding are together nearly equivalent to the Pennsylvanian Region of Milne-Edwards. The warm-temperate region, from Cape Hatteras to the northern part of Florida, has been generally called the Carolinian Province or Fauna. The tropical region south of this, including the southern part of Florida, Bermuda, and most of the West India Islands, does not come

<sup>1</sup> Canadian Naturalist and Geologist.

<sup>3</sup> Oversigt over Grönlands Echinodermata, af Chr. Fr. Lüt-

<sup>2</sup> Crustacea of the U. S. Expl. Exp., by J. D. Dana, 1853, vol. iii. p. 1564.

ken, Kjöbenhavn, 1857, p. 91.



within the province of the present paper. It has been called the Floridian Province by Dana, and the West Indian Fauna by others. The following brief conspectus will show the relations of these faunæ more clearly.

*Syrtensian Fauna.* This embraces the southern coast of Labrador, the Straits of Belle-Isle, the Banks of Newfoundland, banks off the mouth of the Bay of Fundy, and St. George's Bank. The three polyps known from this fauna appear to be circumpolar, but are not found in the next.

*Acadian Fauna.* This extends along the coast from the mouth of the St. Lawrence to Cape Cod, embracing partially the island of Anticosti, the Magdalen Islands, Breton Island, and perhaps the southern coast of Newfoundland, and extending to Nantucket Shoals, and, as has been suggested by Dr. Stimpson, to a bank off the coast of New Jersey, from which *Zoanthus parasiticus* has been obtained, associated with many northern species. Of the ten species found in this fauna, but one (*Metridium marginatum*) is known to extend into the Virginian; and one other (*Rhodactinia Davisii*) probably occurs in the Syrtensian.

*Virginian Fauna.* This embraces the whole extent of the coast from Cape Cod to Cape Hatteras. Five species are considered as peculiar to this fauna.

*Carolinian Fauna.* This extends from Cape Hatteras to St. Mary's River, Florida. There are eighteen species found in this region, none of which are known to extend to either of the others, or to the West Indian.

#### SYRTENSIAN FAUNA.

*Alcyonium rubiforme* Dana. Banks of Newfoundland.

*Primnoa Reseda* Verrill. Mouth of the Bay of Fundy in deep water; St. George's Bank, C. H. Fifield.

*Paragorgia arborea* M.-Edw. Mouth of the Bay of Fundy, Dr. Wm. Wood.

? *Rhodactinia Davisii* Agassiz. Specimens of an Actinian too imperfect for accurate determination, but resembling this species, were collected on the coast of Labrador by Mr. A. S. Packard, Jr.

#### ACADIAN FAUNA.

*Alcyonium carneum* Agassiz. Breton Isl., Nova Scotia, 10 f., rocks, Anticosti Expedition;<sup>1</sup> Grand Menan, 15 f., shelly, Dr. Wm. Stimpson; Eastport, Me., low water to 25 f., rocky and shelly bottoms, abundant, A. E. Verrill; Casco Bay, near Portland, Me., E. S. Morse; Massachusetts Bay, L. Agassiz, Wm. Stimpson; Provincetown, Mass., Capt. Atwood.

*Bunodes stella* Verrill. Grand Menan, N. B., and Eastport, Me., in crevices of ledges at low water, abundant, A. E. Verrill; Mt. Desert, Me., at low water, A. E. Verrill; Cape Elizabeth, Me., in rocky pools at low water, partly covered by sand, E. S. Morse.

*Rhodactinia Davisii* Agassiz. Grand Menan, from low water to 30 f., Wm. Stimpson, A. E. Verrill; Eastport, Me., on ledges at low water, and from 2 to 20 f., rocky, abundant, A. E. Verrill; Massachusetts Bay, L. Agassiz; Nantucket Shoals, L. Agassiz.

*Metridium marginatum* M.-Edw. Gaspé, Canada East, J. W. Dawson; Breton Isl., N. S., Anticosti Expedition; Grand Menan, Wm. Stimpson, A. E. Verrill; Eastport, Me., 2 f., rocky, A. E. Verrill; Mount Desert, Me., low water to 3 f., rocky, abundant, A. E. Verrill; Portland, Me., on piles at low water, E. S. Morse; Swampscot, Mass., on rocks and in pools

<sup>1</sup> Conducted by Messrs A. Hyatt, N. S. Shaler, and A. E. Verrill, 1861.

at low water, A. E. Verrill; Nahant, Mass., L. Agassiz. This species also extends to the Virginian Fauna.

*Edwardsia sipunculoides* Stimpson, MS. Grand Menan, at low water, Wm. Stimpson; Eastport, Me., in gravelly mud under stones at low water, abundant at one locality, Wm. Stimpson, A. E. Verrill.

*Edwardsia sulcata* Verrill. Chelsea Beach, Mass., thrown up by a storm, A. S. Packard, Jr.

*Bicidium parasiticum* Agassiz. Eastport, Me., on under surface of *Cyanea arctica*, A. E. Verrill; Nahant, Mass., on *Cyanea arctica*, L. Agassiz, A. Agassiz.

*Ilyanthus laevis* Verrill. Eastport, Me., L. Agassiz.

*Zoanthus americanus* Verrill.<sup>1</sup> Bank off the coast of New Jersey, lat. 40° N., long. 73° W., 30 f., fine sand, Capt. Gedney.

*Arachnactis brachiolata* A. Agassiz. Nahant, Mass., swimming at night near the surface of the water, A. Agassiz.

#### VIRGINIAN FAUNA.

*Leptogorgia tenuis* Verrill. Bay of New York, Smithsonian Institution.

*Metridium marginatum* M.-Edw. Naushon, Mass., A. Agassiz; Point Judith, R. I., J. Leidy; near New York City, Mr. Damon.

*Actinia* (?) *rapiformis* LeSueur. Egg Harbor, N. J., buried in sand, C. A. LeSueur.

*Halcompa albida* Agassiz MS. Nantucket Isl., buried in sand at low water, B. T. Morrison, J. Rice.

*Ilyanthus* (?) *neglectus* (Leidy). Atlantic City, N. J., in mud, J. Leidy.

*Astrangia Danæ* Agassiz. Point Judith, R. I., J. Leidy; off Gay Head, L. Agassiz; Naushon, Mass., A. Agassiz.

#### CAROLINIAN FAUNA.

*Telesto fruticulosa* Dana. Charleston, S. C., L. Agassiz; Stono Inlet, Dr. J. W. Page; Savannah, Georgia, L. Agassiz.

*Gorgonia humilis* Dana. Charleston, S. C., L. Agassiz.

*Leptogorgia virgulata* M.-Edw. Beaufort, N. C., Wm. Stimpson, A. S. Bickmore; Charleston, S. C., L. Agassiz; Stono Inlet, Dr. J. W. Page; coast of Georgia, Dr. J. W. Page; St. Mary's River, Florida, Williams College Expedition.

*Muricea pendula* Verrill.<sup>1</sup> Charleston, S. C., off the bar, L. Agassiz.

*Titanideum suberosum* Agassiz MS. Beaufort, N. C., Wm. Stimpson; Charleston, S. C., L. Agassiz; Stono Inlet, Dr. J. W. Page.

*Renilla reniformis* Cuv. Beaufort, N. C., Wm. Stimpson; Charleston, S. C., at low water, L. Agassiz.

*Bunodes cavernata* Verrill. Charleston, S. C., L. Agassiz.

*Cereus sol* Agassiz MS. Beaufort, N. C., A. S. Bickmore; Charleston, S. C., L. Agassiz.

*Dysactis pallida* Agassiz MS. Beaufort, N. C., A. S. Bickmore; Charleston, S. C., L. Agassiz.

*Aulactinia capitata* Agassiz MS. Beaufort, N. C., A. S. Bickmore; Fort Macon, N. C., Dr. S. Cabot; Charleston, S. C., in sand at low water, L. Agassiz.

*Ilyanthus chloropsis* Agassiz MS. Charleston, S. C., L. Agassiz.

*Halcompa producta* Stimpson MS. Charleston, S. C., Wm. Stimpson.

<sup>1</sup> See Addenda, page 45.



*Cerianthus americanus* Agassiz MS. Beaufort, N. C., Wm. Stimpson; Charleston, S. C., in mud at low water, H. J. Clark, L. Agassiz.

*Antipathes Boscii* Lamx. Edisto Isl., S. C., L. Agassiz.

*Antipathes alopecuroides* Ellis. South Carolina, J. Ellis.

*Astrangia astræiformis* M-Edw. and Haime. Beaufort, N. C., A. S. Bickmore; Charleston, S. C., L. Agassiz; St. Mary's River, Florida, Williams College Expedition.

*Oculina implicata* Agassiz MS. Cape Hatteras, L. Agassiz; Beaufort, N. C., A. S. Bickmore.

*Oculina arbuscula* Agassiz MS. Charleston, S. C., off the bar, L. Agassiz.

#### ANALYTICAL TABLE.

The following table is intended to aid those in the determination of the genera who may not already be familiar to some extent with the classification of polyps. It will apply only to those genera that are included in the present paper.

- A. Tentacles eight, pinnately lobed (1) (*Alcyonaria*).  
 B. Tentacles six, or multiples of six, simple (7) (*Zoantharia*).

#### ALCYONARIA.

	PAGE
1. Polyps forming a free, moving community ( <i>Renilla</i> ) . . . . .	12
1. Polyps forming an attached community (2)	
2. Individuals arranged around a central axis (3) ( <i>Gorgonidæ</i> )	
2. Individuals aggregate, destitute of a common axis (6) ( <i>Alcyonidæ</i> )	

#### Gorgonidæ.

3. Axis firm, spiculose, cork-like ( <i>Titanideum</i> ) . . . . .	10
3. Axis soft, porous, scarcely distinct ( <i>Paragorgia</i> ) . . . . .	10
3. Axis solid and strong (4)	
4. Cells papilliform, covered with imbricated spicula ( <i>Muricea</i> ) . . . . .	8
4. Cells bell-shaped, covered with scale-like spicula ( <i>Primnoa</i> ) . . . . .	9
4. Cells without external spicula (5)	
5. Cells prominent, verruciform ( <i>Gorgonia</i> ) . . . . .	6
5. Cells scarcely prominent ( <i>Leptogorgia</i> ) . . . . .	7

#### Alcyonidæ.

6. Polyps forming a fleshy, lobed community ( <i>Alcyonium</i> ) . . . . .	3
6. Polyps forming a tubulous, branching clump ( <i>Telesto</i> ) . . . . .	5

#### ZOANTHARIA.

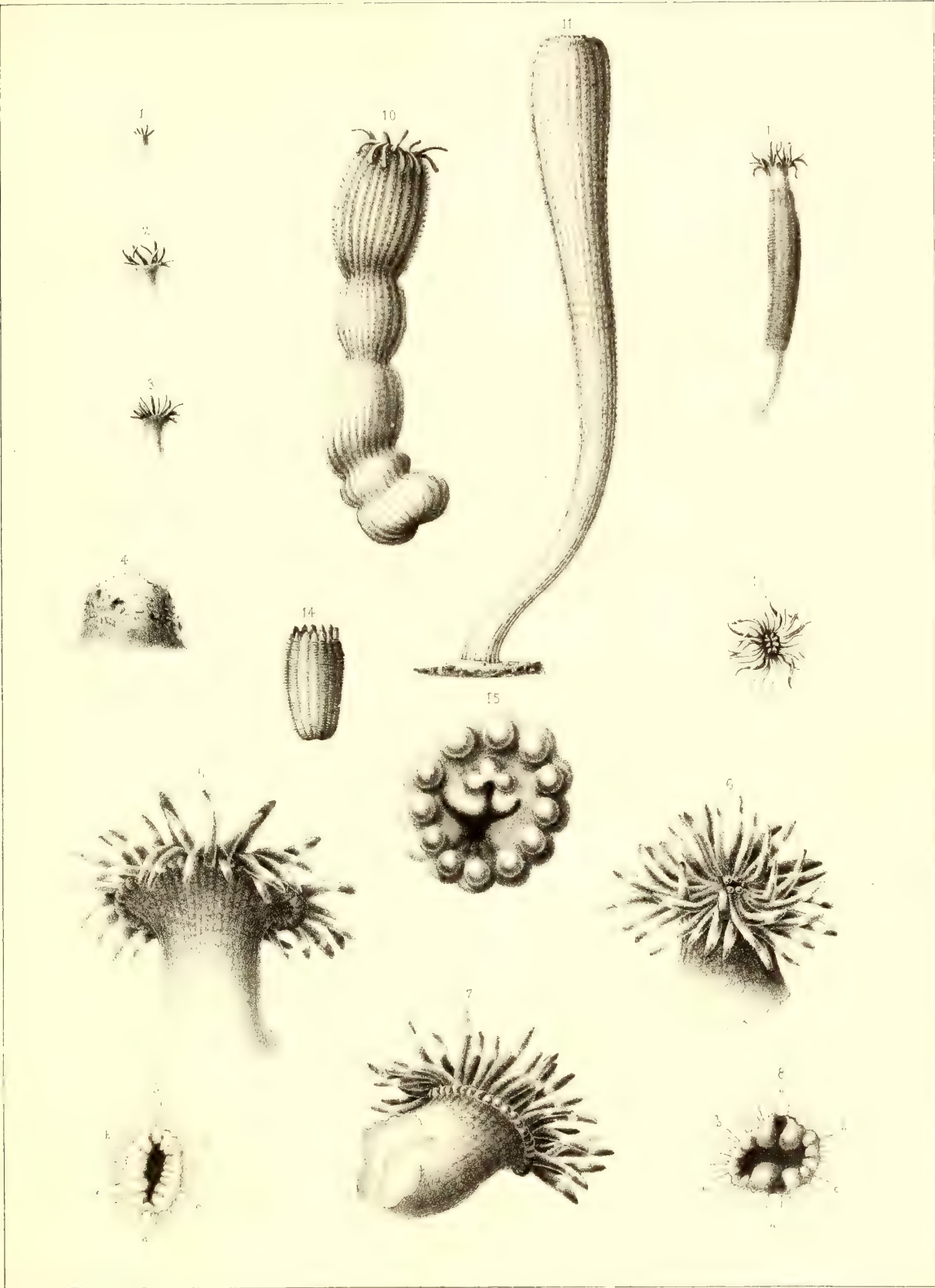
7. Polyps secreting a solid, horn-like axis ( <i>Antipathes</i> ) . . . . .	36
7. Polyps forming solid calcareous corals (8) ( <i>Astræaria</i> )	
7. Polyps fleshy, destitute of solid corals (9) ( <i>Actinaria</i> )	

#### Astræaria.

8. Coral branching, solid within ( <i>Oculina</i> ) . . . . .	40
8. Coral incrusting, cellular within ( <i>Astrangia</i> ) . . . . .	39

#### Actinaria.

9. Polyps compound ( <i>Zoanthus</i> ) . . . . .	34
9. Polyps simple (10)	







10. Basal disk wanting, polyp swimming freely ( <i>Arachnactis</i> ) . . . . .	33
10. Basal disk wanting, polyp sedentary (11)	
10. Basal disk distinct (14)	
11. Tentacles numerous, of two kinds ( <i>Cerianthus</i> ) . . . . .	32
11. Tentacles numerous, marginal only (12)	
11. Tentacles twelve, of one kind (13)	
12. Column of uniform texture ( <i>Ilyanthus</i> ) . . . . .	26
12. Column with a thickened epidermis in the middle ( <i>Edwardsia</i> ) . . . . .	27
13. Mouth with prominent lobes ( <i>Bicidium</i> ) . . . . .	31
13. Mouth simple, column with suckers ( <i>Halcompa</i> ) . . . . .	29
14. Disk frilled, tentacles very numerous, fringe-like at the margin ( <i>Metridium</i> ) . . . . .	21
14. Disk plain, tentacles slender, not contractile ( <i>Dysactis</i> ) . . . . .	26
14. Disk plain, tentacles contractile (15)	
15. Walls covered by crowded verrucæ ( <i>Bunodes</i> ) . . . . .	15
15. Walls with distant verrucæ; tentacles large ( <i>Rhodactinia</i> ) . . . . .	18
15. Walls verrucose above; margin with trilobed verrucæ ( <i>Aulactinia</i> ) . . . . .	20
15. Walls smooth or with inconspicuous suckers (16)	
16. Column smooth, with a thickened fold above, tentacles few ( <i>Metridium</i> , young) . . . . .	21
16. Column with suckers, but no fold, tentacles numerous ( <i>Cereus</i> ) . . . . .	24
16. Column smooth throughout, tentacles few ( <i>Rhodactinia</i> , young) . . . . .	18

## EXPLANATION OF PLATE I.

(Figures 10, 11, from nature, by Wm. Stimpson; 8, 9, 14, 15, by the author; the others by E. S. Morse.)

Figs. 1-8, *Bunodes stella*: 1-3, young when first excluded; 4, adult polyp when contracted; 5-7, different views of the expanded polyp; 8, magnified view of the mouth, *a a* the two primary radii, corresponding with the antero-posterior axis, *b b* and *c c* the other radii of the same cycle.

Fig. 9, *Rhodactinia Davisii*, mouth somewhat enlarged; the letters correspond to the same parts as in fig. 8.

Figs. 10, 11, *Halcompa producta*: 10, polyp when taken from the sand and allowed to expand; 11, form when expanded in its burrow.

Figs. 12, 13, *Edwardsia sipunculoides*: 12, polyp of the natural size drawn from a specimen somewhat contracted in alcohol; 13, disk and tentacles considerably enlarged.

Figs. 14, 15, *Bicidium parasiticum*: 14, polyp natural size; 15, enlarged view of the disk and mouth.

## ADDENDA.

Since this paper went to press, I have been able to examine the "Mémoire sur les Coralliaires des Antilles," by Duchassaing and Michelotti, Turin, 1860, a work not previously accessible to me. These authors have described a species under the name of *Muricea elegans* (p. 19), which is apparently identical with *Muricea laxa* Verrill, recently described in the Bulletin of the Museum of Comparative Zoölogy. For the species called by the same name in the present paper I would, therefore, propose the name *Muricea pendula*. In the same work (p. 50) the name *Zoanthus parasiticus* has been preoccupied. The species herein described under that name I propose to call *Zoanthus americanus*.



II. *On Morphology and Teleology, especially in the Limbs of Mammalia.* By BURT G. WILDER, S. B.

Read June 3d, 1863.

IT is not many years since the very title of this paper would have been enough to insure its remaining unread by most professional men, or, if read, to excite their derision of him who should have so wasted his time as to write, or even think, of such vain abstractions, fit expressions of the useless imaginings of the half-crazy enthusiast Oken, and his only less crazy, because less gifted, disciples. And there are, even now, stern votaries of practical science who would scorn any attempt to raise their eyes above the mere facts of Nature which are as patent to the ignorant vision as to their own, and who refuse to seek an insight into those hidden relations, for the correct understanding of which their superior knowledge might be the surest preparation.

But there are others, and their number is increasing, who, believing in the existence of a general plan underlying all the more external phenomena of Nature, are willing to try to comprehend it in its greater and lesser manifestations; and they, in reading the "Physiophilosophy," may be able to discern, amongst much that is fanciful and absurd, many suggestions of a sound as well as original and striking philosophy. No apology, therefore, is now required for thinking or writing upon subjects which have engaged the attention of the most celebrated students of both animal and vegetable anatomy, and which, I am convinced, will, ere long, be acknowledged to be as essential to the proper understanding of these sciences as the classifications of which they form the only true basis.

To express the various relations which have been observed among the several parts and their functions, of animals and plants, the following terms have gradually come into use: *homology*, *affinity*, *morphology*, *analogy*, *teleology*; to these may be added *physiology*, which, though a term long employed to denote the general study of *function*, has now acquired a certain technical significance, equivalent to the more strictly scientific, and therefore preferable term, *teleology*.

*Analogy* is used to indicate similarity of function, which may be very close, when yet the two parts are widely dissimilar in structure; as, for instance, the organs of aërial locomotion of a bird and a butterfly, which both go by the name of *wings*, though one is built upon the vertebrate, and the other upon the articulate plan of structure. Of course the structure may correspond with the external form and function, and then the analogy is more complete, as between the foot of man and that of a bear.

Now the *general* function or use of a part is its *physiology*; the *special* or principal use of a part is its final cause or end, or *teleology*; and parts which are teleologically similar are said to be *analogous*.

It is evident that the external form and the function must to a great extent correspond, at least much more fully than either may with the internal structure, and here we observe the first distinction between the two groups of terms given above; for this intimate structure and arrangement, in other words, the pure anatomy of anything, is its *morphology*, and parts which are morphologically similar are said to be *homologous*; there is *homology* or *affinity*, or, in still plainer words, more or less *identity of structure* between them; and here again, as was seen in speaking of analogy, parts or organs which are homologous, that is, identical in their









































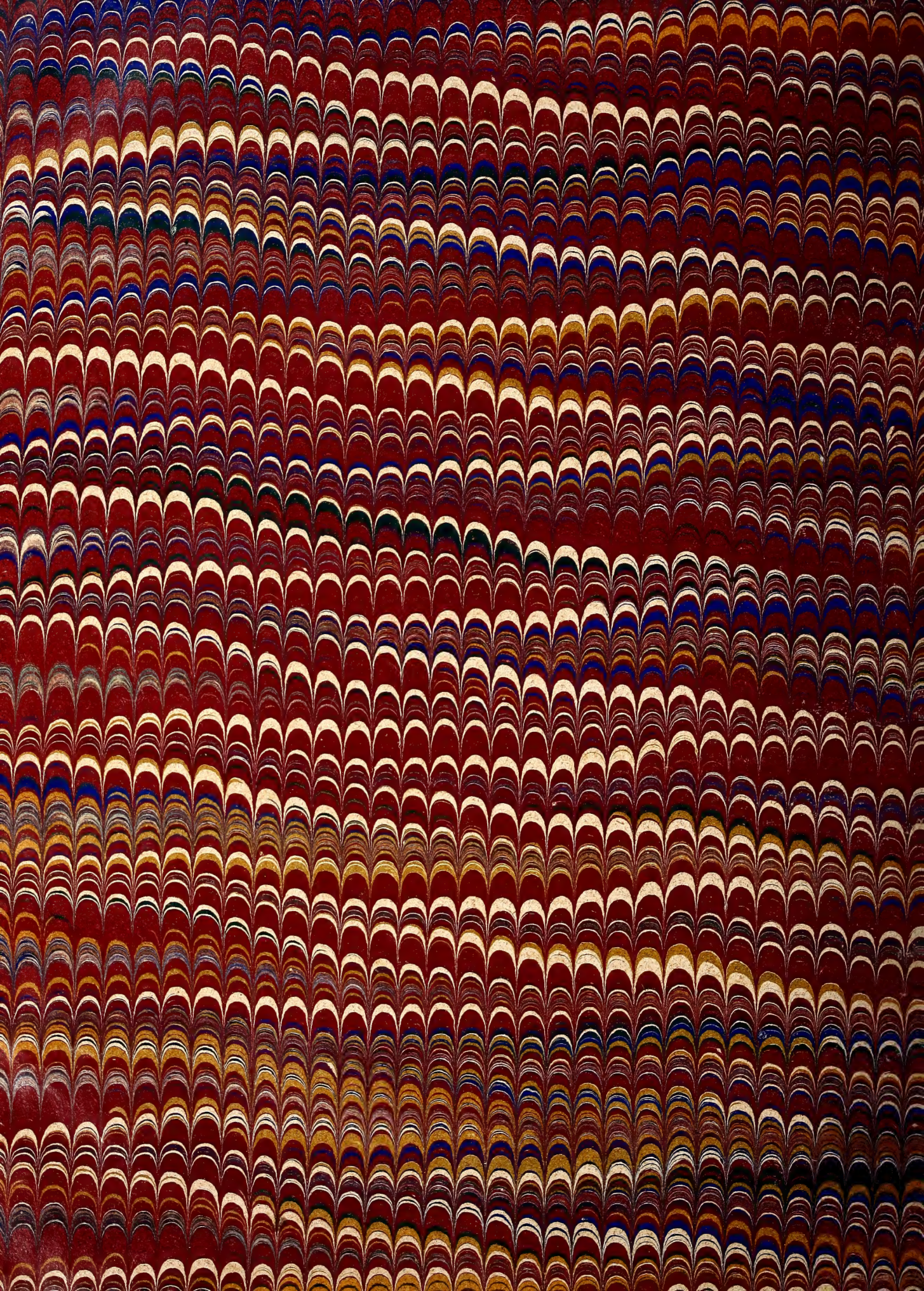


















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