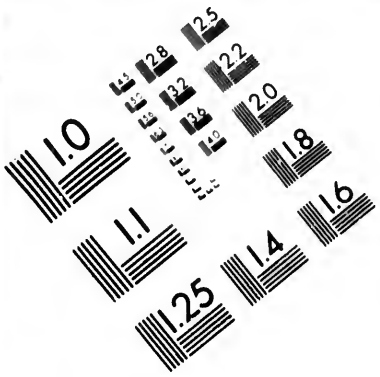

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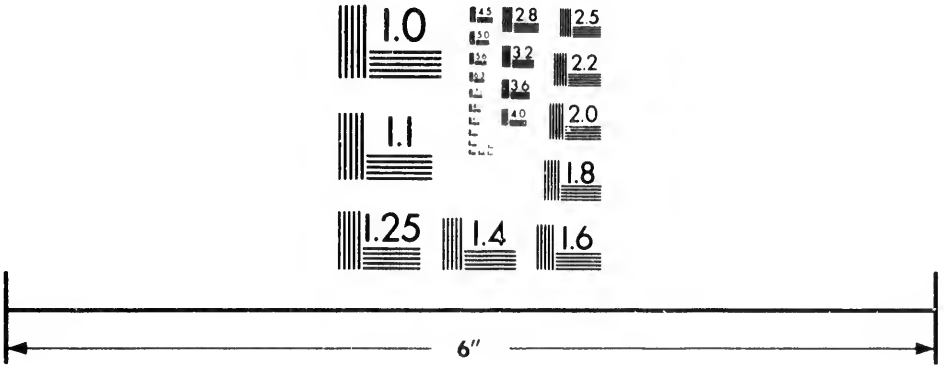

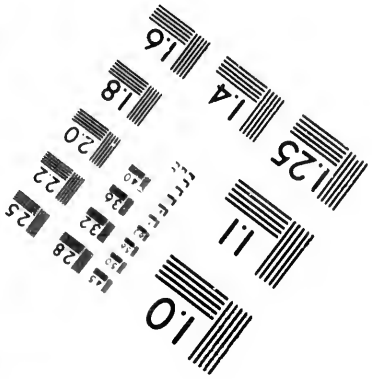

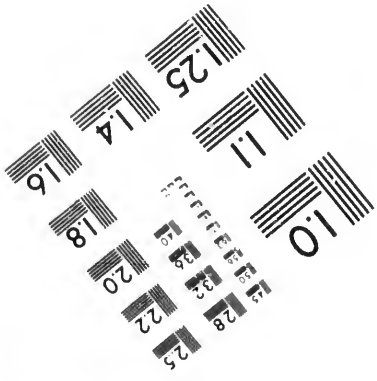

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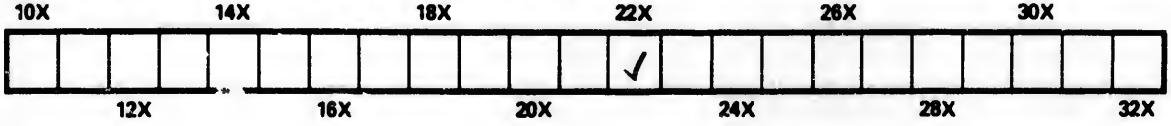

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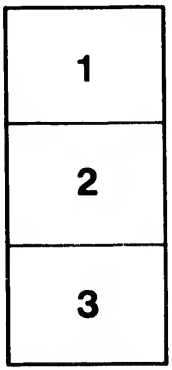

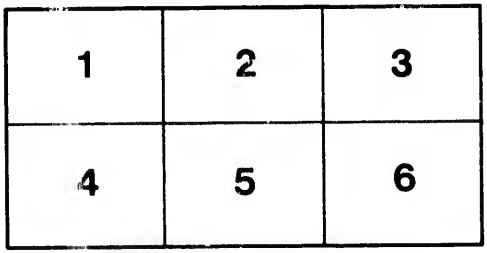

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NOTE TO THE REPRINT.

That portion of Part II which precedes page 503 of this volume of the Transactions, had been printed and the author's separate edition of 150 copies mostly distributed before the fire, by which the regular edition was destroyed, causing considerable delay in issuing the volume. A portion of the author's edition was also distributed, as soon as printed, in sheets, each bearing its date of publication, to all those Zoölogists known to be interested in the subject.

Hence it was thought undesirable to introduce in this reprint even those changes which the progress of science has rendered necessary, except when it could be done in parentheses or foot notes, without essentially changing the paging and original reading. Therefore, in the first five articles, no changes of importance, unless typographical errors, have been made, except in foot notes to which "—Reprint" is appended. In the sixth article, it being still incomplete and less extensively distributed, I have introduced changes more freely, yet without changing the paging, and have in all important cases affixed "—Reprint" to new matter. When a name has been changed the original name follows in parenthesis, in order that no confusion may arise from references to copies of the first edition. The following are the most important changes: p. 386, *Gorgonia* is changed to *Eunicella*, and *Pterogorgia* to *Gorgonia;* p. 387, *Litigorgia* to *Leptogorgia;* p. 392, *L. rutila* is made a distinct species; p. 398, *L. levis* changed to *L. alba;* p. 398, *L. fucosa* to *L. Caryi;* p. 410, *Eugorgia Mexicana* to *E. aurantiaca;* p. 413, *Leptogorgia aurantiaca* E. and H. to *Echinogorgia;* the measurements of the spicula of *Leptogorgia* and *Eugorgia* have been corrected in accordance with the note on p. 415 (1st ed.), and in some cases additional ones given; new localities have been added from the collections of McNiel and Capt. Pedersen; p. 417, *Psammogorgia fucosa* added; p. 450, *Echinogorgia aurantiaca* added; p. 497, *Gemmaria* changed to *Epizoanthus.*

The above changes in nomenclature have also been made in the American Journal of Science, vol. xlviii, p. 419, Nov., 1869, from which they should date.

A. E. VERRILL.

NEW HAVEN, CONN., November 15th, 1869.

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No. 6.—*Review of the Corals and Polyps of the West Coast of America.* By A. E. Verrill.

Presented, April, 1868.

Recent explorations of the west tropical coast of America, principally by Mr. F. H. Bradley for the Museum of Yale College, have contributed so much to the knowledge of the Polypi of that region and have so increased our store of specimens, that a new and much more complete catalogue of the species has become indispensable for a proper understanding of the geographical distribution of the animals of this class. The Smithsonian Institution has contributed the species collected by John Xantus, Esq., at Cape St. Lucas.

In a paper published two years ago,* the writer enumerated nearly all the species then known from Panama and called attention to the remarkable contrast between the polyp-faunæ of the Atlantic and Pacific coasts of Central America, and the bearing of these facts upon the supposed former connection between the two oceans, across the Isthmus of Panama.

The additional forms now presented make these contrasts still greater and more remarkable, and add greater force to the evidence then brought forward to show that no deep or extensive water connection, sufficient to modify the ocean currents, can have taken place since the existence of the species now living upon each coast.

The Panamian fauna proves to be remarkably rich in *Gorgonacea*, no less than 43 species having already been obtained. The genus *Muricea* appears to attain here its greatest development, since 15 species, besides several peculiar varieties, perhaps distinct, are in our collection from Panama Bay, and others from Acapulco and Peru, while from the West Indies there are but four well-ascertained species. The occurrence of two peculiar, gigantic species of *Pavonia*, a genus of corals hitherto known only in the Indo-Pacific faunæ, is noteworthy, and also the presence of a peculiar new form of *Dendrophyllia*.

The classification here followed is that proposed by the writer three years ago† with a few changes that have become necessary by a better knowledge of the anatomy of some groups and the discovery of new forms.

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* Proceedings of the Boston Society of Natural History, vol. x, p. 323, 1865.

† Proceedings of the Essex Institute, vol. iv, p. 145, 1865. See also Memoirs of the Boston Society of Natural History, vol. i, 1864.

Order, ALCYONARIA.

Sub-Order, PENNATULACEA.

Family, RENILLIDÆ.

Renilla.

The polyps arise from the upper surface of a flat, reniform, cavernous disk or frond, having a sinus on one edge, near which there is upon the lower surface a locomotive peduncle, which is muscular and greatly extensible and divided in the interior into two longitudinal chambers, which communicate with two large cavities at its base, and through these with the smaller cavities of the disk, and thus with the bodies of the polyps. The integument of the lower surface, peduncle, and upper surface, is filled with numerous, slender, prismatic spicula, and around the bases of the polyps there are pointed, projecting groups of similar spicula. The polyps originate by budding around the edge of the disk, and are therefore regularly arranged, alternately both in consecutive circles and in radiating lines, which are symmetrical upon the right and left side of a median plane passing through the sinus, and they are smaller and more crowded toward the edge than on the central parts. The polyps are rather large, much exsert in expansion, but wholly retractile.

Besides the ordinary form of polyps, there are in this, as in other genera of Pennatulacea, a second kind, having a different structure and appearance. Or, in other words, the polyps are dimorphous in a manner analogous to that observed in many Hydroids. In Renilla, the second kind of polyps are scattered thickly over the upper surface between the others, and appear in alcoholic specimens like little papillæ, with clusters of whitish spots on their surface, and surrounded with spicula similar to those around the ordinary polyps, but less numerous and smaller. They are also asexual.

The writer first described these peculiar dimorphous forms of the polyps of *Renilla*, in 1864,* as "rudimentary polyps," and afterwards those of *Leioptilum undulatum*, *Ptilosarcus Gurneyi*, *Veretillum Stimpsonii*, etc.†

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* Revision of the Polyps of the Eastern Coast of the United States, Memoirs of the Boston Society of Natural History, vol. i, p. 12.

† Proceedings of the Essex Institute, vol. iv, p. 132–5, 1865.

Dr. Albert Kölliker has recently investigated this interesting subject much more completely, both among *Pennatulacea* and *Alcyonacea*, and has already published a short notice,* preliminary to a more extended memoir upon it. For these reasons it will be passed over in the following pages with only such descriptions of the external appearance of the two forms of polyps as may be useful for the determination of the genera and species.

Renilla amethystina Verrill.

Bulletin of the Museum of Comp. Zoöl., p. 29, Jan. 1864; Proceedings Boston Soc. Nat. History, 1866, p. 326.

Plate V, figure 1.

Frond large, rather thin, broad reniform, broader than long, proportion of breadth to length about as 1·3 : 1; sinus extending more than one third across the length of the frond, about equal to one third of its breadth; the posterior lobes broad and rounded, meeting behind. Peduncle placed at about its own diameter from the end of the sinus; length, in contraction, equal to about a third of the breadth of the frond. Lower surface and peduncle rough with spicula, which are arranged somewhat in radiating lines, upper surface slightly convex, covered with very numerous, rather closely set, small polyps, which are surrounded at base by slightly projecting, rigid calicles, strengthened by numerous spicula, which rise up in angular clusters. Thickly scattered between the ordinary polyps are those of the second or rudimentary kind, which form, in the contracted state, much smaller verrucæ, surrounded by a lower border of spicula, and consisting of clusters of from eight to thirty, small, round papillæ, each with a dark point in the centre.

According to Mr. Bradley's observations upon the living polyps, these are mostly ·25 of an inch long, and about ·12 across the expanded tentacles, the bodies of the polyps being about ·06. "They are transparent, with an opaque stomach, the eight radiating lamellæ showing through the walls; around the small mouth, which is edged with white, are eight radiating white points, corresponding to the intervals between the tentacles; around the base of the tentacles is a brown ring, which runs down in points opposite the spaces between them. Opposite the base of each polyp are two (rarely four or five) bunches of little white rays. The frond is nearly transparent, but highly colored by very numerous purple spicula, evenly distributed on the

* Verhandlungen der physik-medicin Gesellschaft in Würzburg, Dèc., 1867. Also, Annals and Mag. Nat. Hist., March, 1868.

peduncle and lower surface, but on the upper side arranged along the edges of the polypiferous radiating lines, and especially concentrated about the five (rarely six or seven) white points that surround the closed polyps. The polyps are arranged somewhat in quincunx, in lines that radiate from the attachment of the peduncle, and curve outward on the sides to the lobes. The tentacles are narrow and tapering, ·04 to ·06 long, bearing, especially in young specimens, well marked pinnæ at the tip and edges, which in old ones often become reduced to a mere fringe."

In alcohol the usual color is deep rich purple, due to the color of the spicula, with the tip of the peduncle light yellowish; but some specimens are light, reddish purple, and one is pure white, due perhaps to disease or injury, for it has become deformed. The polyps, when expanded, usually show the eight white lobes around the mouth, and the brown band below the tentacles.

The spicula are all slender and irregularly prismatic in form, sometimes bent, a little thickened in the middle, tapering slightly to near the ends, which are somewhat enlarged and bluntly truncated. They vary considerably in size, those of the upper surface around the polyp-cells and in the integument of the lower surface being the largest; many others are about half as long, and others not more than a fourth. The largest spicula of the upper surface are about ·810^{mm} long and ·064^{mm} thick; some the larger ones from the lower surface are ·544^{mm} long by ·056^{mm} thick, and ·608^{mm} long by ·048^{mm}; with these are many small ones about ·350^{mm} by ·048^{mm}. Some of the larger spicula from the white specimen are ·640^{mm} long by ·064^{mm} thick, and the smaller ones ·240^{mm} by ·024^{mm}. The color of the spicula in the darker specimens is deep amethystine purple; in the lighter specimens, light purple or silvery white. The spicula all reflect light in a peculiar manner, which gives them a silvery lustre. They do not appear to have such well marked triangular sections as those of "*R. americana*," figured by Dr. Kölliker,* the angles being less prominent, without reëntrant angles between them. In many cases the section is nearly round, or quadrangular with rounded corners, but toward the ends of the spiculum, usually triangular with rounded angles.

When contracted in alcohol, one of the largest specimens measures 3·75 inches in breadth; 3·30 long, from posterior lobes to front; 2·20 from sinus to front; ·35 in thickness; diameter of polyp-cells ·06. When living, some specimens were more than 6 inches in breadth.

* Icones Histiologicæ, ii, Taf. xix, fig. 16.

Panama, north of the railroad-wharf, on sand at extreme low-water, abundant on one occasion only,—F. H. Bradley; Panama,—J. H. Sternbergh, Capt. J. M. Dow, T. Rowell, Esq.; Pearl Islands, dredged on muddy bottoms, 4 to 6 fathoms,—F. H. Bradley; Acajutla, San Salvador,—F. H. Bradley; Zorritos, Peru, dredged on muddy bottom,—F. H. Bradley.

The single white specimen, referred to above, was found at Panama with the ordinary variety. The frond, apparently owing to injury or disease and subsequent restoration, is divided into three nearly equal lobes by two deep lateral notches and the sinus. The polyps are not retracted and appear a little larger than usual. The spicula are pure white and apparently somewhat smaller than in other specimens. This species has but little resemblance to *R. reniformis* of the southern Atlantic coast of the United States, being much larger, with smaller, more crowded, and far more numerous polyps, while the frond is broader than long, instead of longer than broad. The color is also much deeper and brighter, and the under surface rougher. It resembles *R. patula* Verrill, from Cumana, Venezuela, more than any other species, but can scarcely be confounded even with that, since it differs considerably in form and color and in the size of the polyps, and has a thicker frond.

Family, Pennatulidæ.

Leioptillum undulatum Verrill.

Proceedings of the Essex Institute, iv, 1865, p. 182.

Basal portion smooth, pointed at the end, swelling into a large bulb just below the pinnæ. Posterior part of the body, except along a narrow median band, covered with large verruciform rudimentary polyps, forming rounded papillæ, some of which are a tenth of an inch in diameter. Pinnæ large, very broad and rounded, with narrow bases, the edges thrown into undulations or frills. Polyps rather large, arranged in three alternating rows along the edges of the pinnæ. Axis very slender, about two inches long, extending from about an inch above the basal end to about the middle of the pinnate portion. The naked base, of a specimen 4·25 inches long, is 1·75; the largest pinnæ ·75 long and 1·12 wide. This specimen has twenty-five pinnæ on each side.

Pinnacati Bay, Gulf of California,—Mr. Stone. (Smithsonian Institution).

Ptilosarcus Gurneyi Gray.

Sarcoptilus (*Ptilosarcus*) *Gurneyi* Gray, Ann. and Mag. N. H., vol. v, p. 23, pl. iii, fig. 2, 1860.

Pennatula tenua Gabb, Proc. Cal. Acad. Nat. Sci., ii, p. 166, 1862.

Ptilosarcus Gurneyi Verrill, Proc. Essex Inst., 1865, p. 183.

Puget Sound, Washington Territory,—Dr. C. B. Kennerly.

Family, VIRGULARIDÆ.

Stylatula Verrill, 1864.

Polyps forming clusters upon the upper side of the lateral processes, which are supported beneath by conspicuous, sharp, radiating, spine-like spicula, which are much expanded at the base and divided into a number of irregular teeth. Besides these there are numerous, much smaller, acicular spicula imbricated at the base of the large ones and imbedded in the cœnenchyma. The stem is long and slender, as in *Virgularia*, and the lateral processes become obsolete below. The basal portion is naked, enlarged and bulbous at the base. The axis is almost cylindrical, stony, with a radiated fibrous structure, and passes through nearly the entire length. This genus is, as yet, known only from the west coast of America.

Stylatula gracilis Verrill.

Bulletin Mus. Comp. Zoöl., p. 30, Jan. 1864.

(?) *Virgularia gracilis* Gabb, op. cit., iii, p. 120, March, 1864.

Plate V, figure 2.

Stem very slender, cylindrical; base smooth, swollen and bulbous for a considerable distance relative to the length; above this a row of transverse processes (or wings) commences on each side, which are at first very narrow and slightly prominent, and leave between them, on both the front and back, a longitudinal naked space; the lateral processes gradually become wider and more prominent upward, and the naked bands becoming linear, the one on the back side is soon obliterated by the over-lapping of the lateral wings, while that on the front side finally disappears by the meeting of the processes in front. The lateral transverse processes at first bear very small rudimentary polyps in the form of small papillæ, higher up they become more elevated and supported beneath by sharp, white, radiating spines, 10 or 12 to each wing, while on the upper edge they bear a single row of 15 to 18 moderately large polyps, which in contraction are papillæ about equal in length to the spines. In the middle region the wings are close together, about 30 to an inch, arranged alternately upon

the sides and regularly overlapping behind. Near the upper end they become more oblique and less crowded, about 15 to an inch, but overlap strongly. These wings are everywhere evenly rounded outwardly and more or less crescent-shaped. The axis is white, solid and very calcareous, subcylindrical, with three slight longitudinal grooves, diameter ·03 of an inch in the middle of the largest specimens. The radiating spines of the wings are smooth and sharp at the outer end, longitudinally striated toward the base, which is enlarged to a greater or less extent, flattened, and usually divided by several irregular incisions into unequal lobes. In the largest specimens, several of these spines measure respectively 1·57^{mm} long by ·20^{mm} wide; 1·47^{mm} long by ·25^{mm} wide; 1·36^{mm} long by ·13^{mm} wide. The small spicula among the bases of these and in the cœnenchyma are slender, somewhat prismatic, and acicular; those of average size measure ·59^{mm} long by ·05^{mm} thick, but many are smaller than this. The entire diameter of the largest specimen from Panama Bay, from which the above measurements are taken, in the middle portion is ·10 of an inch; its length is unknown, both ends being broken off.

A nearly perfect specimen from Cape St. Lucas, having much smaller wings and spines, measures 6·8 inches in length; diameter in middle ·07; of bulbous base ·14; length of bulb to commencement of wings (much contracted) 1·30; length, or elevation, of wings ·08. Color, in alcohol, yellowish white.

Pearl Islands, Bay of Panama, dredged in 4 to 6 fathoms,—F. H. Bradley; Cape St. Lucas,—J. Xantus.

Virgularia gracilis Gabb.

Virgularia gracilis Gabb, appears to be near the preceding, but no mention is made of spines below the lateral wings, which are said to be *acute*. It may be a different species or even a different genus. The specific names, *gracilis* and *elongata*, were, by a singular coincidence, independently given to these forms by Mr. Gabb and myself at about the same time. The following is the original description:

"Polypidom long and very slender. Decorticated stem circular or elliptical in section, smooth on the surface. Polypiferous lobes slender, exsert, lunate, acute at the tips and broad at the base; arranged obliquely and alternately on the antero-lateral face of the stem. These lobes occupy the upper half of the polypidom; retaining their full size to the extreme apex, but diminishing below, so that on the middle of the stem they are exceedingly minute; and an inch or two below, are only represented by a slight ridge on the sheath, in which

are two or three cells. The lower fourth of the sheath is dilated to about three times the thickness of the rest of the stem.

Length 19 inches; diameter of the naked stem ·03 in.; smallest diameter of stem, with the sheath, ·04 in.; diameter of expanded base ·13 in.; length of largest lobes ·15 inch.

Locality, Bay of Monterey, 20 fathoms. Collected by Dr. J. G. Cooper, of the State Geological Survey.

This species can be at once distinguished from *V. elongata* G. (Proc. Cal. A. N. S., vol. ii, p. 167) by its more slender form, its proportionally large polypiferous lobes, its cylindrical stem, without any grooves, and the comparatively smaller portion of the stem bearing the lobes."

Stylatula elongata Verrill.

Bulletin Museum Comp. Zoölogy, p. 30, 1864.

Virgularia elongata Gabb, Proc. Cal. Acad. Nat. Sci., ii, p. 167, 1863.

This species is larger and stouter than the preceding. The pinnæ are broader and more overlapping, leaving a naked space between the lateral rows for only a short distance from the base. In the middle twenty of the lateral wings, on each side, occupy an inch. The spines are larger and less numerous.

Near San Francisco, Cal.—A. Agassiz.

Sub-Order, GORGONACEA.

Family, GORGONIDÆ.

Gorgonia.

This genus, which formerly included the entire sub-order, has been repeatedly restricted to narrower limits by successive authors, until in the work of Milne Edwards and Haime* it is limited to those species allied to *G. verrucosa* of the Mediterranean. Yet even they, as it now appears, united with it some species† allied to *Muricea*, etc. Dr. Albert Kölliker, who in a recent work‡ has very thoroughly investigated the microscopic structure of the Alcyonaria, reunites with *Gorgonia* several of the genera established by Milne Edwards, Valenciennes, and others, viz: *Rhipidogorgia*, *Pterogorgia*, *Xiphigorgia*, *Hymenogorgia*, *Phyllogorgia*, *Phycogorgia*, *Leptogorgia*, *Lophogorgia*, and part of *Gorgonella*. As thus enlarged, the genus *Gorgonia* of Kölliker includes all the Gorgonidæ having a horny axis and thin cœnenchyma, with small and simple spicula.

* Histoire naturelle des Coralliaires, 1857, vol. 1, p. 157.

† *Muricea vatricosa* Köll., *Thesea exserta* D. & M., *Echinogorgia arida*, etc.

‡ Icones Histiologicæ, oder Atlas der vergleichenden Gewebelehre, ii, Leipzig, 1866, 4to, with xix plates.

He sub-divides the genus, however, into three groups, as follows:

1. Species having only spindle-shaped spicula.
2. Species having spindles and bracket-shaped spicula (Klammern).
3. Species having spindles, and in a peculiar external layer, singular club-shaped spicula.

The last group contains *G. verrucosa* and closely allied species, and corresponds partly with *Gorgonia* as restricted by Milne Edwards. It appears to be a very natural and well-defined group, approaching, by its smooth external layer composed of club-shaped spicula, the genus *Eunicea*. All the ascertained species belong to the Mediterranean and African coasts.*

The second section is also a natural and clearly defined group, corresponding to a great extent with *Gorgonia* and *Pterogorgia* of Ehrenberg, though a few species of the latter go into the first section (*P. sarmentosa* and *P. petechizans*). It includes the typical species of *Pterogorgia*, *Xiphigorgia*, and *Hymenogorgia* of Edwards and Haime, and two species of *Leptogorgia*, as well as the type of *Rhipidogorgia* Val. (*R. flabellum*). All the species, so far as known to me, are Atlantic, and nearly all are confined to the West Indies and Atlantic coasts of North and South America, not one having yet been found upon the Pacific coast of America.

The first section, however, appears to include several natural groups, two of which appear quite as distinct as the two preceding. Among the species enumerated by Dr. Kölliker are several species referred by Edwards and Haime to *Gorgonia*, *Rhipidogorgia*, *Gorgonella*, *Leptogorgia*, *Pterogorgia*, and the typical species of *Lophogorgia*.

The numerous species of *Gorgoniæ* from the west coast of America, would all fall into the first of Dr. Kölliker's sections, but among them there are two well-defined groups, characterized best by peculiarities of the spicula, each including numerous species.

In the first of these divisions the spicula of the cœnenchyma are mostly small, warty or papillose double-spindles† of two kinds,—a longer and more slender sort, mingled with those that are shorter and thicker. (*Litigorgia* V.).

In the second division there are, in addition to the two forms of double-spindles, a large number of "double-wheels," or short spicula

* *G. papillosa* Esper, formerly supposed to be from the East Indies, was collected at the Cape of Good Hope by the United States Exploring Expedition (Coll. Smithsonian Inst. and Yale Museum).

† Those spicula having a fusiform shape, more or less pointed at the ends, with a narrower and usually smooth space in the middle, are termed "double-spindles" (Doppelspindeln) by Dr. Kölliker. Those without the median constriction are "spindles."

with a slender axis, smooth in the middle, but surrounded toward each end with a circular and usually sharp ridge, like a little wheel. These spicula are often broader than long, and then, when seen endwise, resemble disks or circular beads with an apparent depression or perforation at the centre, owing to the transparency of the axis. In addition to the six species described below, this group includes *G. fusco-purpurea* Kölliker, the spicula of which he has well figured (Taf. xviii, figs. 28–31), and perhaps other described species. (*Eugorgia* V.).

In each of these two groups there are species with virgate, pinnate, bipinnate, and reticulated branches. There are also, in each, species with flat and with prominent cells. It is therefore evident that such external characters as the mode of branching and degree of prominence of the cells, cannot be considered as of generic importance, and that such genera as *Rhipidogorgia* Val. and *Leptogorgia* Edw., founded only on such characters, are unnatural and heterogeneous groups, which should be dropped from our system of classification.

It is probable, however, that more than the two natural groups above described, are included in the first of Dr. Kölliker's sections, represented by species that I have not been able to study satisfactorily, and among those groups that are most likely to prove distinct types, is that embracing *G. palma* and allied species, corresponding partly to the genus *Lophogorgia* Edw. and Haime.

The species of Gorgoninæ which I have been able to study, may be arranged, in accordance with the above considerations, in the following manner:

Gorgonia.—Species having spindles in the cœnenchyma, and an external layer of peculiar, small, club-shaped spicula, producing a smooth surface. Type, *G. verrucosa* L.* (now *Eunicella* V.—Reprint).

Pterogorgia.—Species having in the cœnenchyma small double-spindles and also crescent or bracket-shaped spicula, nearly smooth on the convex side. Type, *P. acerosa* Ehr. (now *Gorgonia.*—Reprint).

Eugorgia.—Species having longer and shorter double-spindles, and numerous double-wheels; surface decidedly granulous, with naked spicula. Type, *E. ampla* V.

* It is not improbable that upon further study this group will be found to belong to the *Plexauridæ*, near *Eunicea*, with which Ehrenberg, indeed, united it. So far as my examinations have gone this appears to me to be more in accordance with its true affinities. If this suggestion prove correct, the group should receive a new generic name, and *Gorgonia* should be restricted, partially in accordance with Ehrenberg's work, to the second group (now *Pterogorgia*) with *G. flabellum* as its type, and including, also, the true *Pterogorgiæ;* and in fact these are also the most common and well-known Linnæan species. (Later studies having confirmed this view, I have since adopted it in Am. Jour. Sci., xlviii, p. Nov., 1869.—Reprint).

Litigorgia.—Species having the two forms of double-spindles and often a few small double-heads; surface somewhat granulous, but less so than in the last. Type, *L. Floræ* V. (now *Leptogorgia.*—Reprint).

Neither of the two groups belonging to the Pacific coast of America can be referred to any of the generic divisions defined by Edwards and Haime, and if classified by their system, each group would have to be dismembered and distributed among *Gorgonia*, *Leptogorgia*, *Pterogorgia*, and *Rhipidogorgia.*

Consequently I have thought it necessary to give distinctive names to the two groups already characterized, which I believe to be natural and well defined, and of generic importance, although others may consider them as subgenera merely. But in the present state of the science there appears to be no way to determine whether a certain natural group be a genus or subgenus, except by the arbitrary decisions or opinions of writers.

Leptogorgia Edw. and Haime, sens. mod. (LITIGORGIA, .st Edition).

Leptogorgia (*pars*), *Gorgonia* (*pars*), *Pterogorgia* (*pars*), *Rhipidogorgia* (*pars*), *Gorgoniella* (*pars*), and *Lophogorgia* Edw. and Haime, Corall., vol. I.—Reprint.

Spicula of the cœnenchyma mostly small double-spindles of two forms, longer and shorter. Branches usually slender, subdividing in various ways; often reticulated, pinnate, or bipinate. Cells usually prominent, sometimes flat, mostly in lateral rows or bands.*

A.—*Flabelliform, branches bipinnate or tripinnate, not reticulated.*

Leptogorgia Floræ Verrill. (LITIGORGIA FLORÆ, 1st Ed.).

Plate V, figure 3; and Plate VI, figure 1.

Corallum very much subdivided, forming elegant, fan-shaped tufts. Several slightly flattened, slender, principal branches usually arise from near the base and spread divergently in a single plane. Each of these gives off, at intervals of about a quarter of an inch, very slender, nearly uniform branchlets, which are alternate, or sometimes opposite, and arranged pinnately. Most of these, especially in large specimens, are again pinnate in the same manner, and some of their

* Having recently received from Dr. Kölliker the spicula prepared from the original specimens of several of the species of *Leptogorgia* of Edwards and Haime, including the type (*L. viminalis*), I have ascertained that of the fourteen species referred by them to *Leptogorgia*, at least five, including the first, belong to the group which I had named *Litigorgia.* Therefore it seems, on some accounts, best to restore the earlier name, although a complete change in the definition and limits of the genus will be necessary. Of their other species, two belong to *Echinogorgia*, two to *Pterogorgia*, one apparently to *Gorgonella*, while three are unknown to me.—Reprint. (See Am. Jour. Sci., vol. 48, p. 325, November, 1869).

pinnæ again subdivide, but less regularly. The branchlets are all of nearly uniform size, slender and short, somewhat flattened and enlarged at the ends, which are tridentate. The cells are very small, but form well marked conical verrucæ, arranged in two alternate rows on most of the branchlets, but sometimes forming only single marginal rows on the terminal ones. The front and back sides of the branches are destitute of cells, and on the principal ones usually show a well-marked longitudinal furrow. Color bright red, sometimes tinged with yellowish. Height of the largest specimens 6 inches; breadth 12; diameter of the main branches at base ·12 of an inch; of the secondary ones ·06; of the terminal ones ·04; length of the terminal branchlets usually about ·35, rarely ·75.

The spicula are bright red with a few yellow ones intermixed. The longer double-spindles are rather slender, with acute ends, and covered with close warts arranged in about six distinct whorls, besides the terminal clusters; stouter ones smaller, with blunt ends; polyp-spicula bright yellow, slender, with few, distant, small warts or papillæ.

The longer double-spindles measure ·132^{mm} by ·048^{mm}, ·132 by ·036, ·120 by ·048, ·120 by ·042, ·108 by ·048, ·108 by ·042, ·108 by ·030; the stouter ones ·095 by ·042, ·084 by ·048, ·084 by ·042, ·078 by ·036, ·060 by ·030; the polyp-spicula ·108 by ·033, ·108 by ·030, ·096 by ·024, ·072 by ·018.

Panama and Pearl Islands,—F. H. Bradley, J. H. Sternbergh.

This species resembles, in its mode of branching, *Eugorgia Mexicana* V. and *E. Daniana* V., but is much more slender and delicate, with a smoother surface and denser cœnenchyma, and is very distinct in its spicula, its color is also very different. The spicula resemble closely those of *L. eximia* V. but are somewhat more slender with the warts not so close. The external characters are very different.

I have named this elegant species in honor of the excellent wife, whose sympathy and encouragement were the chief causes that induced me to devote my life to the study of Nature.

B.—*Flabelliform, the branchlets mostly coalescent and reticulated, the terminal ones free.*

Leptogorgia Agassizii Verrill. (Litigorgia Agassizii, 1st Ed.).

Rhipidogorgia Agassizii (*pars*) Verrill, Bulletin Mus. Comp. Zool., p. 32, Jan., 1864.
Gorgonia Agassizii (*pars*) Verrill, Proc. Boston Soc. Nat. Hist., x, p. 327, 1866.

Plate V, figure 4.

Corallum forming very finely and regularly reticulated fans, usually rounded in outline. Several flattened main branches arise from the large, thickened and very short base and radiate across the fan, subdividing so rapidly and regularly that they cannot often be traced

more than half way across, before becoming lost in the small, even branchlets. These form small, angular meshes, usually about a tenth of an inch across, but often smaller, ordinarily about as high as broad, but sometimes twice as high; at the outer edge the branchlets are free for about an eighth of an inch, with expanded tips, and have a diameter of about ·05 inch. The cells are small but conspicuous, in the form of small oval openings at the summits of small verrucæ. They are thickly scattered over the whole surface of the frond, except upon the large branches and base, where they are few and distant. Color deep red mingled with bright yellow, or red with yellow cells, the relative amount of red and yellow varying. Height of the largest specimen 12 inches; breadth about as much; width of main branches near the base ·32; diameter of branchlets ·04 or ·05 of an inch.

Spicula deep red and bright yellow; those of the polyps pale amber. Most of the spicula are rather short, thick, and blunt, with relatively large, crowded warts, and a very narrow median space. The longer spicula are not so blunt as the others, and have smaller and more numerous warts. The longer ones measure ·120^{mm} by ·048, ·110 by ·048, ·108 by ·042, ·102 by ·054, ·084 by ·036; the stouter ones ·090 by ·084, ·084 by ·048; the double-heads ·048 by ·030, ·036 by ·033; polyp-spicula ·060 to ·084 long by ·012 to ·024. The openings of the cells are from ·21^{mm} to ·35^{mm} in diameter.

Acapulco,—A. Agassiz; Cape St. Lucas,—J. Xantus; La Paz,—J. Pedersen.

Leptogorgia media Verrill. (LITIGORGIA MEDIA, 1st Ed.).

Rhipidogorgia media Verrill, Bulletin M. C. Z., p. 33, Jan., 1864.
Gorgonia media Verrill, Proc. Bost. Soc. N. H., x, p. 327, 1865.

Corallum regularly reticulated throughout, with larger meshes, forming broad fans, often higher than wide, and frequently lobed and more or less subdivided, strengthened by large midribs. Several principal branches, which are large and compressed, arise from near the base and pass divergently through the greater part of the breadth of the frond. The branchlets are round and small, and nearly all coalescent, except the short terminal ones, forming meshes that are mostly nearly square and usually ·20 of an inch in diameter, but often not more than ·12, and sometimes up to ·80 in height, with the width ·20. The branchlets are from ·06 to ·08 of an inch in diameter. The cells form very small verrucæ, with oval opening about ·005 in diameter. The largest specimens are about 15 inches high and 12 broad. Color red or brownish, often tinged with yellow, especially on the midribs.

Spicula very small and blunt, bright red and deep yellow intermin-

gled. Longer double-spindles covered with numerous, close warts, with a narrow but well defined median space, the ends blunt; stouter ones nearly as large and with similar warts. The longer double-spindles measure ·102^{mm} by ·042^{mm}, ·096 by ·042, ·084 by ·042, ·084 by ·036; the stouter ones ·084 by ·048, ·072 by ·042, ·072 by ·036, ·060 by ·036, ·048 by ·024; the polyp-spicula ·060 to ·084 by ·018 to ·024.

Acapulco,—A. Agassiz; Cape St. Lucas,—J. Xantus; La Paz,—Maj. Wm. Rich; San Salvador,—Capt. J. M. Dow; Corinto, Nicaragua,—J. A. McNiel; La Paz,—J. Pedersen.

This species resembles *L. Agassizii* more than any other species.

Leptogorgia eximia Verrill. (LITIGORGIA EXIMIA, 1st Ed.).

Plate V, figure 20. Plate VI, figure 2.

Frond broad and rounded, composed of slender, round branches, which are openly reticulated throughout, except the short terminal branchlets at the edges. There is no distinct midrib, all the branches being nearly uniform in size, except very near the base, which rapidly subdivides into a large number of nearly equal primary branches, not distinct from the secondary. Occasionally secondary fronds start out from the sides of the frond, and one specimen has irregular, crooked, simple branchlets, arising from the sides, with a hollow axis, apparently the habitations of some parasite.

The reticulations are quite irregular in size and form, frequently squarish or rhomboidal, from ·20 to ·25 of an inch across, but more commonly with about the same width and three or four times higher than wide. Many short free branchlets often project into the larger meshes. The terminal branchlets are sometimes free for an inch, but usually much less. The cells are small and usually closely arranged on all sides, forming small, rounded verruceæ, which are slightly prominent. Color bright red or vermilion. The largest specimens are about 10 inches high and broad; diameter of branchlets ·06.

Spicula bright red, with a few light yellow ones; those of the polyps light yellow. The longer double-spindles rapidly taper to the acute ends, and are covered with rather large warts, which are not crowded; stouter ones much smaller, blunt at the ends, with fewer and more crowded warts. Polyp-spicula very slender, with few distant warts. The longer double-spindles measure ·138^{mm} by ·060, ·132 by ·054, ·132 by ·048, ·120 by ·054, ·108 by ·048; the stouter ones ·108 by ·054, ·090 by ·048, ·060 by ·030; double-heads ·060 by ·048, ·038 by ·036; polyp-spicula ·072 to ·120 by ·012 to ·024.

Panama Islands, 6 to 8 fathoms, by divers,—F. H. Bradley.

This beautiful species resembles in its reticulations *L. media* V., but the meshes are usually larger and the coral has a more open and flexible appearance. It also differs, in all the specimens seen, in having no distinct midribs or large branches. The spicula are quite distinct, and resemble those of *L. Floræ* much more closely.

Leptogorgia Adamsii Verrill. (Litigorgia Adamsii, 1st Ed.)

Rhipidogorgia Agassizii (*pars*) Verrill, Bull. Mus. Comp. Zöol., p. 32, 1864; Proc. Bost. Soc. Natural History, x, p. 327, 1866.

Rhipidogorgia ventalina Duch. and Mich., Supplement aux Mem. sur Coralliaries des Antilles, 1864, p. 20, Tab. iv, fig. 3, (*non G. ventalina* Linn., Pallas, Esper, etc., *nec R. ventalina* Edw. and Haime).

Gorgonia (*Litigorgia*) *Adamsi* Verrill, Am. Jour. Sci., xlv, p. 415, May, 1868.

Plate V, figure 5. Plate VI, figure 4.

Corallum forming large, broad, rounded fans, with very small reticulations. Very young specimens, with fronds one to four inches across, usually have a rounded outline, nearly as high as broad, often very regular and almost circular, and in this stage have a few principal branches, radiating from close to the base, scarcely compressed, and traceable about half way across the frond, but often for not more than a fourth of the breadth. The branchlets are all very slender and uniform in size throughout, producing, by their fine, regular reticulations, a very elegant effect. The terminal branchlets are free and usually project about a tenth of an inch. The reticulations are mostly square or polygonal, sometimes rounded, and average ·06 to ·10 of an inch across, and the branchlets are ordinarily about ·03 in diameter, but often less.

Adult specimens have large, slightly compressed principal branches, which arise from near the base, and diverging through the frond, throw off large secondary branches which spread often at nearly right angles. Sometimes these coalesce, forming large, somewhat quadrangular areas, two or three inches across, and filled, like the rest of the frond, with fine reticulations. Occasionally secondary fronds arise from the sides and spread at right angles, other secondary fronds occasionally appear, like nearly circular rosettes, attached only by the centre to the side of the primary frond.

The largest specimens are 20 to 22 inches high, and 20 to 25 broad; the large branches ·3 to ·4 thick; the trunk at base 1 inch to 1·5.

Color light purple, usually with the terminal branchlets light yellow, sometimes yellowish over the whole surface. In life, one specimen was "bright crimson, polyps deep orange,"—F. H. B.

Spicula light purple and yellow, sometimes the same spiculum has

its opposite ends of these two colors. Longer double-spindles with slender and acute ends, the warts rough and not very close, though more so than in *L. eximia* V.; the warts nearest the narrow median space are considerably largest. The stouter ones are much smaller, and also acute. Polyp-spicula light amber, very slender. With the larger spicula are many small, short ones, with only a single wreath of warts at each end.

The longer spicula are ·156^{mm} by ·036, ·156 by ·048, ·120 by ·036, ·132 by ·042; stouter ones ·096 by ·048, ·072 by ·036; the smaller ·048 by ·024.

Panama,—C. B. Adams, J. H. Sternbergh, F. H. Bradley; Pearl Islands, 6 to 8 fathoms by divers, large; and Zorritos, Peru,—F. H. Bradley; Punta Arenas and Corinto, Nic.,—J. A. McNiel.

This is, when well grown and perfect, a very elegant and beautiful species. The reticulations are of about the same size as those of *L. Agassizii*, but the branchlets are more slender and the cells smaller. The character of the midribs is also different, but the best characters for distinguishing them are found in the forms and structure of the spicula, which are very different in the two species. It has some resemblance in form and color to *Pterogorgia flabellum* of the West Indies, but the spicula separate them generically.

I have dedicated this to the memory of the lamented Prof. C. B. Adams, who was, perhaps, the first to bring it to this country. His specimens are in the museum of Amherst College.

Leptogorgia rutila Verrill. (Litigorgia Adamsii, var. rutila, 1st Ed.).

Rhipidogorgia Agassizii (*pars*) Verrill, op. cit., p. 32.

Plate VI, figure 5.

The specimens from Acapulco are bright light red in color (between minium and vermillion) and differ in several other respects. The branches are not so slender and the reticulations are smaller and more regular, the cells also are more crowded, prominent, and distinctly bilobed. In these external characters it resembles *L. Agassizii*, but the cells are not quite so large and the branchlets more slender. The axis is amber-color and translucent in the branches.

The spicula are mostly light red, variable in size and shape, mostly rather slender. Long double-spindles rather slender and acute, with a wide median space; each end has three or four whorls of warts, those next to the median space considerably largest, the others diminishing to the ends. Stouter double-spindles about as thick but shorter, blunt, mostly with but two whorls at each end, the inner ones much the

largest, the outer ones close to the ends; median space rather wide. There are numerous much smaller spicula, with a well marked median space, and a whorl of warts on each end, which are more or less confused with a cluster of terminal warts. Sometimes the terminal warts form a small terminal whorl. Polyp-spicula light red, slender, acute, slightly papillose.

The long double-spindles measure ·156^{mm} by ·048, ·121 by ·048, ·144 by ·042, ·103 by ·030; the stouter ones ·090 by ·042, ·078 by ·042, ·072 by ·036; the small ones ·054 by ·028, ·048 by ·024, ·036 by ·024.

C.—*Flabelliform, loosely and coarsely reticulated; terminal branchlets free. Cells flat or but slightly raised.*

Leptogorgia stenobrochis Verrill. (LITIGORGIA STENOBROCHIS, 1st ed.).

Gorgonia stenobrochis Val.,* Voyage de la Vénus, pl. 12, fig. 1, 1ª.

Rhipidogorgia stenobrachis Val.; Edwards and Haime, Corall., i, p. 176, 1858; Verrill, Bulletin M. C. Z., p. 32; and Proc. Bost. Soc. N. H., x, p. 327. (Misspelled.)

R. Englemanni Horn, Proc. Phil. Acad., 1860, p. 233. (Perhaps distinct).

Gorgonia (Eugorgia) stenobrachis Verrill, Am. Jour. Sci., xlv, p. 414, May, 1868.

Corallum forming large, openly reticulated fans, with stout, subparallel, upright branches, and long, oblong or rectangular meshes.

In young specimens the trunk is divided close to the base into two or more principal branches, which give off irregularly numerous branches of nearly the same size, so that the main branches very soon blend with the others and can be traced only for a short distance. The secondary branches and the branchlets start out nearly at right angles, and then suddenly bend upright and become parallel with the preceding branches. The cross branchlets project nearly at right angles, connecting the branches together at intervals varying from ·5 to 2 inches, so that the meshes have openings of these lengths, and about ·20 to ·25 wide. The terminal branches are of about the same size as the other branches and free for the distance of one or two inches. The branches and branchlets are often nearly round, at other times compressed in the plane of the frond, or even at right angles to it.

The cells are small, very numerous, arranged closely in many rows along each side of the branches and branchlets, but nearly covering the latter. They are mostly flat, but occasionally the borders are slightly raised. Median naked space well marked and often having strong longitudinal furrows. Color dull yellow, often tinged with purple, frequently stained dark umber-brown in drying. In life, "brownish yellow to faint salmon, polyps light yellow,"—F. H. B.

* The locality given (New Zealand) is probably an error. Spicula of the original type agree well with the ordinary forms.—Reprint.

Height of the largest specimens about 2 feet; breadth about the same; diameter of branchlets ·15 of an inch.

The spicula are reddish purple and light yellow intermingled, both colors sometimes occurring on one spiculum. Long double-spindles somewhat slender, acute at the ends, with a rather wide median space; warts distant, forming about three whorls around each end, those next the middle much the largest. Shorter double-spindles thick and blunt, with a wide median space, on each side of which there is a whorl of large thorny warts; beyond these is a small wreath of much smaller warts, close to the ends, and often confused with the terminal cluster of few small warts. In addition to these there are many much smaller double-spindles, with two well separated whorls of small warts on each end, one of which is nearly terminal and much the smallest.

The long double-spindles measure ·121^{mm} by ·036, and ·108 by ·036; the stouter double-spindles ·084 by ·048, ·072 by ·048, ·061 by ·048, and 084 by ·042; the small ones ·036 by ·024.

Zorritos, Peru; Panama; and Pearl Islands, in 6 to 8 fathoms, by divers, large,—F. H. Bradley; Panama,—J. H. Sternbergh, A. Agassiz; Corinto and Punta Arenas,—J. A. McNiel; San Salvador,—Capt. J. M. Dow; Acapulco,—A. Agassiz.

Leptogorgia stenobrochis, var. Englemanni. (Litigorgia, 1st Ed.).

The original specimen, described by Mr. Horn, and others from Acapulco and Panama differ slightly from the ordinary forms from Panama in having smaller and usually less elongated reticulations. The branches are also more compressed and in some specimens thicker, though not constantly so. The cells are very numerous, thickly scattered over the whole surface of the branches, but sometimes leaving a narrow median space. They are oblong and slightly prominent.

The color is reddish brown, yellowish brown, or dull brownish yellow tinged with reddish.

The spicula are light yellow and deep red intermingled, and agree nearly with those of the ordinary variety in form, but are smaller.

D.—*Imperfectly flabelliform, the branches pinnate or imperfectly bipinnate, not reticulated; branchlets rather short. Cells somewhat prominent.*

Leptogorgia ramulus Verrill. (Litigorgia ramulus, 1st Ed.).

Gorgonia ramulus Val., Comptes-rendus, t. xli, p. 12; Edwards et H., Coralliaries, i, p. 160, 1857; Verrill, Bulletin M. C. Z., p. 38; Proceedings Boston Soc. Nat. Hist., x, p. 326, 1866.

Gorgonia humilis Verrill, Mem. Boston Soc. Nat. Hist., i, p. 6, 1864, (*non* Dana).

? *Lophogorgia Panamensis* Duch. and Mich., Supl. Corall. des Antilles, p. 19, Tab. iv, fig. 1, 1864, (the red variety).

Corallum very branching, often in the form of a densely branched shrub or bush, but frequently, especially when young, more or less flabelliform. The base is usually large and spreading, and quite frequently several distinct trunks arise from the same base, forming a thick clump. The trunk is very short and soon divides into several large, divergent branches, which are nearly round, but sometimes a little flattened, often more or less crooked, and give off from their sides, at distances of about a fourth of an inch apart, numerous short, irregular, crooked, and nearly quadrangular branchlets. Many of these become longer and larger than the rest, and again subdivide in the same way. The ultimate branchlets are usually about ·08 of an inch in diameter, and from half an inch to an inch long, but occasionally 2 inches. The terminal branchlets are mostly somewhat acute at the ends. The cells form small rounded verrucæ, which are quite prominent and closely arranged in two series on each side of the branches, giving them a quadrangular appearance. On the larger branches the verrucæ are more scattered and irregularly arranged. The openings are mostly on the upper side of the verrucæ, and laterally compressed. The branches and most of the branchlets have, along the naked median space, a well-marked longitudinal furrow, in which there is usually a slender longitudinal ridge. The axis is light wood-color at the base, blackish in the main branches, slender and light wood-brown in the branchlets. The cœnenchyma is almost always either uniformly greyish white or deep purplish red, but occasionally pink specimens occur. One specimen has the lower branches and base white, the middle part of the trunk and the branches arising from it purplish red, and the upper part of the trunk and terminal branches white, showing conclusively that the white and red specimens are all one species. A large specimen of the red variety is 8 inches high and 16 broad, with the main branches ·15 in diameter; another is 13 inches high and 10 broad, with the main branches ·22 in diameter. Most specimens do not exceed 6 inches in height and about the same in breadth.

Small dwarfed specimens sometimes occur that are 3 or 4 inches high, with the main branches ·08, and the branchlets ·05 of an inch in diameter, but agreeing in other respects with the ordinary forms.

The spicula in the white variety are all white; in the red variety light purple, the polyp-spicula bright yellow. The long double-spindles are but little longer than the others, not very acute at the ends, thickly covered with distinctly separated, large, warty tubercles, axis small. The stouter double-spindles are more blunt and more closely covered with warts, which are still separate. Polyp-spindles

slender, distantly papillose. The longer double-spindles measure ·108mm by ·042mm, ·102 by ·042, ·096 by ·036, ·090 by ·042, ·084 by ·036; the stouter ones ·084 by ·048, ·078 by ·036, ·072 by ·042.

Panama and Pearl Islands.—F. H. Bradley; Panama,—J. H. Sternbergh; Zorritos, Peru,—F. H. Bradley; Acapulco,—A. Agassiz; (?) Cape St. Lucas,—J. Xantus; San Salvador,—Capt. J. M. Dow; Corinto,—J. A. McNiel.

The two very distinct colors assumed by this species are somewhat remarkable and may serve to divide it conveniently into two varieties: 1st, the ordinary white form; 2nd, the red variety. But as shown above these colors may be found on a single specimen, and are not accompanied by any other constant differences. The red variety is possibly the form described as *Lophogorgia Panamensis* by Duchassaing and Michelotti, but does not agree well with their figure.

Their brief and very imperfect diagnosis is as follows: "Ramosa, ramis distinctis sub-compressis, majoribus 4, minoribus 2 millimetris latis, colore rubro. In insula Flamenco, prope Panama."

All the specimens from Zorritos are of the red variety, and agree well with those of Panama, except that they are mostly somewhat smaller and more slender.

The specimens from Acapulco and Cape St. Lucas differ considerably in appearance from those of Panama. The branchlets are shorter and thicker, length ·2 to ·5 of an inch, thickness ·08, often somewhat clavate. Cells nearly uniformly distributed on all sides of the branchlets, smaller and less prominent, distinctly bilobed. Color deep red, some of the spicula bright yellow. This may possibly prove to be a distinct species when a good series can be examined.

The specimens in the Museum of Comparative Zoölogy, formerly described as *Gorgonia humilis*, and supposed to have come from Charleston, S. C., appear to be identical with specimens from Panama. The former locality is probably altogether erroneous.

Leptogorgia pumila Verrill, sp. nov. (LITIGORGIA PUMILA, 1st Ed.).

Plate V, figure 8.

Corallum low, densely branched, imperfectly flabelliform, a few of the branchlets coalescent, forming irregular, coarse reticulations. Several crooked principal branches arise near the base and subdivide in an irregularly pinnate manner, the branchlets being about a fourth of an inch apart and from a fourth to one inch long. These are rather thick, rounded, quadrangular, mostly curved, and spread at a wide angle. The cells form small, rounded verrucæ, which are but little prominent and not crowded, alternating in two rows along each side

of the branches. The largest specimen is 5 inches high and the same in breadth; diameter of the main branches ·15; of the branchlets ·08. Color bright red, the surface sometimes fading to yellowish red.

The spicula are mostly light purplish red, mixed with a few light yellow ones; polyp-spindles light amber-color. The longer double-spindles resemble those of the preceding species, but are relatively larger and more acute. They are closely covered with large warts, with a rather wide median space. The stouter double-spindles are similar, but blunter at the ends; with them are many small, white double-spindles with only one wreath of warts near the ends. The longer double-spindles are ·138^{mm} by ·048, ·132 by ·054, ·120 by ·048, ·120 by ·042, ·114 by ·039; stouter ones ·132 by ·060, ·108 by ·048, ·102 by ·048, ·096 by ·054, ·084 by ·042.

Zorritos, Peru,—F. H. Bradley.

This species is allied to the last, and branches in a similar manner, but has thicker branchlets, with larger and more widely separated verrucæ, which are less prominent and open outward. The branchlets are scarcely quadrangular, the spicula different in form, and the coalescence of the branches, common in this, is very rare in *L. ramulus*.

Leptogorgia diffusa Verrill, sp. nov. (LITIGORGIA DIFFUSA, 1st Ed.).

Plate V, figure 6. Plate VI, figure 3.

Corallum loosely ramose, the branchlets subpinnate, producing an open, shrub-like form. The trunk divides near the base, in the original specimen, into two main branches and these again fork. The branches give off pinnately, at distances of half an inch to an inch apart, slender branchlets, which are flattened and spread at nearly right angles, varying in length from a quarter inch to three inches before subdividing, as some of them do, into secondary pinnæ. The main branches are round, but the branchlets are much compressed and slender. The cells form rather large verrucæ, which are enlarged at base and quite prominent, not crowded, and arranged in two alternating rows on each side of the main branches, but in only one row on each edge of the branchlets, which therefore appear serrate on account of the broad-based cells. There is a very distinct sulcus on the larger branches. The specimen is 5 inches high and 6 broad; diameter of the main branches ·10; width of branchlets ·06. Color bright red.

The spicula are all bright re , resembling those of *L. ramulus*, but larger and relatively stouter. The longer double-spindles are long, covered with large papillæ or warts, those next to the median space largest. Stouter double-spindles decidedly blunt, closely covered by large, rounded, rough warts. Polyp-spicula slender, bright yellow.

The longer spicula are ·144mm by ·042, ·132 by ·054, ·120 by ·054, ·108 by ·048; stouter ones ·114 by ·054, ·084 by ·048, ·072 by ·054; polyp-spicula ·180 by ·036, ·144 by ·030, ·114 by ·024.

Pearl Islands, Bay of Panama,—F. H. Bradley; Gulf of Nicoya, by divers, larger,—J. A. McNiel.

Readily distinguished by its lax branches, and distant, slender, flattened branchlets, serrated by the distant, uniserial verrucæ.

Leptogorgia Californica Verrill, sp. nov. (LITIGORGIA CALIFORNICA, 1st Ed.).

Plate V, figure 10.

Corallum somewhat flabelliform, low, subpinnately branched, the branchlets ascending, not coalescent. The branchlets are nearly round and usually curve outward at first. They are from 1 to 2 inches long, before branching, and from ·08 to ·10 thick. Cells flat, scarcely rising above the general surface, arranged in about three rows along each side of the branchlets. The apertures in contraction often appear stellate. The naked median region is quite narrow. Color reddish purple, often with a narrow yellow streak along the centre of the median space. Height 4 to 6 inches.

The spicula are mostly reddish purple, some are half yellow, others entirely so. The longer double-spindles are slender, scarcely acute, with a wide median space, which is bordered by two whorls of large, rough, distant warts. Close to each end and distant from the preceding, there is a much smaller whorl of small warts, while the ends terminate with two or three similar small warts. Stouter double-spindles thick and blunt, with two wreaths of warts on each end, closely crowded together, those next the narrow median space much the largest. Polyp-spicula slender, light yellow, with few, small, distant papillæ. Compound cross-shaped spicula occasionally occur, which have short blunt rays, with rough, irregular warts. The longer double-spindles measure ·108 by ·048mm, ·090 by ·042, ·084 by ·040, ·084 by ·036; ·096 by ·036; stouter double-spindles ·096 by ·048, ·072 by ·036, ·078 by ·042, ·084 by ·048; the crosses ·072 by ·066, and ·054 by ·048.

Cape St. Lucas,—J. Xantus; Margarita Bay,—A. Garret.

E.—*The terminal branchlets slender and elongated. Cells scarcely prominent.*

Leptogorgia alba Verrill. (LITIGORGIA LEVIS, 1st Ed.).

? *Lophogorgia alba* Duch. and Mich., op. cit., p. 19, Tab. IV, fig. 2, 1864 (*non Gorgonia alba* Lam.).

Gorgonia rigida, var. lævis Verrill, Proc. Bost. Soc. Nat. Hist., x, p. 327, 1866.

Plate V, figure 7.

Corallum flabelliform, with long, slender, virgate, somewhat fasciculated branchlets. The trunk is small, often nearly round, sometimes

compressed, and has a small thin base. It soon gives off from each side, in a somewhat pinnate manner, several main branches, nearly as large as itself. Those nearest the base are usually about a quarter of an inch apart, and spread at a large angle; those higher up are more distant and curving outward at the base afterwards bend upward. The branches subdivide in a similar manner, and some of the branchlets again subdivide. The smaller branches and branchlets are of about the same size and all have a tendency to become parallel by bending upward. The terminal branchlets are from 1 to 5 inches long without subdivisions, but mostly 2 or 3 inches long in ordinary specimens, with a diameter of about ·05, but often smaller. The cells are often perfectly flat, but usually form small, slightly prominent verrucæ, with a small oblong opening. They are not crowded and arranged alternately in two rows on each side of the branchlets, but on the large branches they become more crowded and often form four rows on each side. The axis is slender, light-wood color at the base, dark brown in the branches, yellowish and setiform in the branchlets. Cœnenchyma thin. The largest specimens are about 12 inches high and 15 broad, with the trunk and main branches ·10 and ·12 in diameter. Ordinary specimens are about 4 to 6 inches high and broad. Dwarf specimens occur in which the trunk is only ·05 in diameter, and the branchlets ·03. The specimens in all cases appear to be white; the colored forms, referred to it formerly, prove to be a distinct species (*Eugorgia Bradleyi*). In life, "the stem is very light pink, heads deep pink, polyps transparent,"—F. H. B.

The spicula are white, resembling those of *L. ramulus*, but longer and more acute, with the papillæ less crowded. The longer double-spindles are variable in size, some of them being ·138^{mm} by ·048^{mm}, ·144 by ·036, ·120 by ·048, and ·168 by ·060; the stouter double-spindles ·108 by ·060, and ·102 by ·048; some of the small ones are ·048 by ·024, and many are still smaller.

Panama and Pearl Islands,—F. H. Bradley; Gulf of Nicoya and Corinto,—J. A. McNiel; San Salvador,—Capt. J. M. Dow.

This species resembles in form *Eugorgia Bradleyi*, from which, by its color and very different spicula, it may be readily distinguished. In color it is like the white variety of *L. ramulus*, but differs in its mode of branching, in its long, slender, rounded branchlets, and less prominent cells.

Whether the *Lophogorgia alba* Duch. and Mich. be this species or the white variety of *G. ramulus*, I am unable to determine with certainty, but have referred it to this mainly on account of the size of

the branches. Their brief diagnosis is as follows: "Ramosa, ventalina, alba, calycibus prominulis, sparsis. Hab. prope Panama."

"Height 10 centim., branches all, as well as trunk, 2 mill. broad."

The name, *alba*, was used by Lamarck for a "*Gorgonia*," of which the generic affinities are still unknown,* and, therefore, cannot with propriety be used for this, even if it was intended for the present species. Esper also gave the name, *Gorgonia palma, var. alba*, to a form which proves to be distinct from his *G. palma*.

Leptogorgia flexilis Verrill, sp. nov. (LITIGORGIA FLEXILIS, 1st Ed.).

Plate V, figure 11.

Corallum when young flabelliform, with slender, elongated, erect branches; when large scarcely flabelliform, often bushy or fasciculated, with long, slender, drooping branches. The trunk gives off at distances varying from a quarter inch to an inch, alternately from each side, large primary branches, some of which are often nearly as large as the main stem. These arise mostly at an acute angle and give off secondary branches in the same way, but at greater distances, mostly 1 or 2 inches. These branches again subdivide, giving off in a subpinnate, often secund manner, a few very long, round, slender, nearly parallel branchlets, nearly as large as themselves, and from 10 to 12 inches in length without subdivisions. These diminish very gradually toward the ends and in full grown specimens droop somewhat like the branches of the weeping-willow. Possibly, however, this may not be the case while living.

The trunk and main branches are frequently somewhat compressed, but often round, and are marked by several strong longitudinal grooves. The cells are broad-oval, rather large for the genus, not prominent, usually open, arranged upon the branchlets in four or five irregular longitudinal rows on each side, leaving very narrow, naked median spaces; on the larger branches they form two broad lateral bands, made up of many rows. They are not crowded, the spaces between them being mostly three or four times their own diameters. Color dull reddish brown, uniform throughout. Height of largest specimen about 2 feet; breadth 10 inches; diameter of trunk ·25; of main branches ·15 to ·20; of branchlets at origin ·10 to ·12; near tips ·04 to ·08; of cells ·015.

A Panama specimen, owing doubtless to an unfavorable location,

* Dr. Kölliker has sent spicula from the original type, which indicate that it is a *Plexaura*, therefore I have adopted *alba* for this.—Reprint.

grew in an oblique or creeping position, the branches being nearly all secund and crooked, and the branchlets much shorter and erect.

The spicula include several forms and sizes of double-spindles. The larger double-spindles are slender and acute, with a wide median space; each end with three or four whorls of well separated, nearly simple warts; the whorl next to the median space is largest, the others diminishing regularly to the ends. Stouter double-spindles much shorter and thicker, blunt at the ends, of several sizes; largest ones with a wide median space bordered by whorls of large rough warts; beyond these, and close to the warty end, there is a much smaller whorl, with small crowded warts; the shortest ones have the two whorls on each half and the terminal cluster of warts crowded together into a sort of rounded triangular head; some very small ones have the second whorl well separated from the median and close to the end. Other small spicula, approaching the form of double-heads, have a very narrow median space bordered by close whorls of very small, crowded, rough warts, which are confused with the terminal cluster; in an end view the whorls show four or five close warts. Cross-shaped spicula occasionally occur, which have four nearly equal, club-shaped arms, covered with rough warts. The longer double-spindles measure ·102^{mm} by ·036^{mm}, ·096 by ·042, ·096 by ·036, ·090 by ·042, ·084 by ·036; the stouter ones ·078 by ·042, ·072 by ·036, ·066 by ·042, ·066 by ·039, ·060 by ·036, ·054 by ·031, ·048 by ·030, ·036 by ·030; the crosses ·060 by ·048.

Panama and Pearl Islands, 6 to 8 fathoms, by divers, large,—F. H. Bradley; San Salvador,—Capt. J. M. Dow.

The spicula, though much smaller, resemble most those of *L. rigida* and *L. cuspidata*, from which it differs in the length and slenderness of the branchlets, etc. When young it branches much like *L. alba*.

F.—Imperfectly flabelliform. Branches free, rather stout, rigid when dry. Terminal branchlets elongated. Cells in lateral bands, flat or slightly prominent.

Leptogorgia rigida Verrill. (LITIGORGIA RIGIDA, 1st Ed.).

Plate V, figure 9.

Leptogorgia rigida (*pars*) Verrill, Bulletin M. C. Z., p. 32, 1864.
Gorgonia rigida (*pars*) Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 327, 1866.
Gorgonia (*Eugorgia*) *rigida* Verrill, Amer. Jour. Sci., vol. 45, p. 414, May, 1868.

Corallum scarcely flabelliform, except when young. Trunk dividing very near the base into several stout branches, which are often strongly sulcated and much compressed. These give off, in a more or less

secund manner, at distances of a quarter inch to an inch, somewhat smaller secondary branches, most of which again subdivide. The branches and branchlets mostly arise obliquely, at an acute angle, but occasionally curve outward somewhat at the base. The branchlets are from one to five inches long without subdivision, rather stout, rigid when dry, irregularly compressed, often crooked, and scarcely taper toward the ends, which are often even somewhat enlarged and blunt. The cells are oval, a little prominent, rather large for the genus, and arranged in quincunx, about three or four times their own diameter apart on the branchlets, in four to six longitudinal rows, forming broad, somewhat prominent lateral bands of verrucæ. On the large branches the cells are in many more rows forming broad lateral bands; sometimes, on the same specimen, part of the cells are prominent, while the rest are flat. The median spaces are distinct throughout, with a median groove that often becomes wide and conspicuous on the larger branches.

Color deep bluish purple, or violaceous, occasionally reddish purple, sometimes with streaks of yellow, or with yellowish surface. Height of largest specimen about 15 inches; breadth 10; diameter of main branches ·18 to ·25; of secondary ·12 to ·15; of branchlets ·10 to ·12; breadth of verrucæ ·04; openings of cells ·02.

Spicula of several sizes and forms, with many intermediate, all deep purplish red in the typical variety. Longer double-spindles thick and stout, regularly tapering to the somewhat acute ends; with a narrow median space; each end with three or four crowded whorls of rough irregular warts, those next to the median space much the largest, the others rapidly decreasing to the ends. Other more slender forms occur, with distant warts and a wide median space, and having only two whorls of warts on each half, the ends acute.

The shorter double-spindles are short, thick, blunt, with a wide median space, which is bordered by prominent wreaths of large rough warts, another much smaller whorl of warts is placed just outside of each of these, and close to the ends. Many small, short double-spindles occur, which have only a single wreath of warts on each side of the median space, with a small cluster terminating each end. Occasionally compound cross-shaped spicula occur, which have the four rays about equal, short, blunt, closely covered with rough warts. Longer double spindles measure ·132^{mm} by ·036^{mm}, ·132 by ·048, ·126 by ·048, ·120 by ·042, ·114 by ·048, ·108 by ·042, ·095 by ·036; stouter double-spindles ·120 by ·060, ·095 by ·048, ·090 by ·048, ·078 by ·048, ·072 by ·048, ·060 by ·048, ·054 by ·048; the small ones ·048 by ·030, ·042 by ·024.

Cape St. Lucas,—J. Xantus; Acapulco,—A. Agassiz; San Salvador,—Capt. J. M. Dow; La Paz,—J. Pedersen.

This species and the next approach *Lophogorgia palma* E. and H. in the character of the spicula, more nearly than do any of our other species of *Leptogorgia.*

The existence of numerous small, short, double-spindles, with but two whorls of warts, gives the spicula of these species an appearance quite different from those of the more typical species of *Leptogorgia*, but similar spicula occur in *L. stenobrochis*, and, to a less extent, in several other species.

Leptogorgia cuspidata Verrill. (LITIGORGIA CUSPIDATA, 1st Ed.).

Leptogorgia cuspidata Verrill, Proc. Essex Inst., iv, p. 186, 1865.
Gorgonia (Eugorgia) cuspidata Verrill, Amer. Jour. Sci., vol. 45, p. 414, May, 1868.

Corallum broad, sub-flabelliform, irregularly branching nearly in one plane. The trunk divides near the base into several principal branches, which subdivide in an irregularly dichotomous manner, forming a somewhat fasciculated clump; sometimes the branches are subpinnate. Branchlets moderately elongated, thick, rigid, nearly straight, tapering to the ends. Cells numerous, rather large, rounded, covering the surface of the branchlets, except along a narrow median space on each side. Longitudinal grooves scarcely distinct, except near the base. Color deep purple, the cells surrounded by bright yellow, and the median space sometimes streaked with yellow.

Height about 6 inches; breadth about the same; length of branchlets 1 to 3 inches; diameter ·10 to ·13.

A specimen from Cape St. Lucas, referred with doubt to this, resembles *L. rigida* in its subpinnate mode of branching. The branchlets are from ·75 to 1 inch long, and ·12 in diameter, and less cuspidate than in the typical form. As I have not had an opportunity to examine the spicula of the original specimen, I add a description of those from this doubtful variety, which may, perhaps, belong rather with *L. rigida.* Spicula of various forms and sizes, deep red and bright yellow mingled. Longer double-spindles large, with acute ends, median space rather wide, warts well separated, forming 3 or 4 whorls on each end, the whorl next to the median space much the largest, consisting of large, ragged warts; the others diminish toward the ends, the last warts becoming very small and simple. Stouter double-spindles thick and blunt, with a deeply sunken median space, bordered by whorls of large, crowded, rough, compound warts; outside of these, but close to them, there is a whorl of much smaller warts on each end, and usually another subterminal whorl of very small simple warts. Many

small, short spicula have the form of double-heads, with a well-defined median space, and two closely crowded whorls of small warts on each end. Cross-shaped spicula occasionally occur, having acute points, with well-separated rough warts.

The longer double-spindles measure ·144^{mm} by ·042, ·132 by ·048, ·120 by ·048, ·120 by ·042, ·114 by ·054; the stouter ones ·096 by ·052, ·090 by ·054, ·078 by ·054, ·078 by ·042, ·072 by ·039; the double-heads ·048 by ·033, ·054 by ·036, ·042 by ·024.

The specimens from Zorritos belong to this variety but are dwarfed. Height 3 or 4 inches, branchlets ·25 to ·75 long, ·08 in diameter. Color purple, with the surface streaked and stained with yellow. Spicula much like those of the specimen described above.

Cape St. Lucas,—J. Xantus; Acapulco,—A. Agassiz; Corinto,—J. A. McNiel; Zorritos, Peru,—F. H. Bradley.

This species is closely allied to *L. rigida*, yet the typical specimens from Cape St. Lucas have a very differe... appearance, due mainly to the larger, straight, cuspidate branchlets, and the peculiar color, which is seen, however, to a less extent in some specimens of *L rigida*. Possibly it may ultimately prove to be only a variety of that species, when a larger series of specimens can be examined. Owing to the doubtful affinities of the peculiar specimen from which the spicula above described were taken, no reliable conclusions can, as yet, be based upon the slight differences observed in the spicula.

Leptogorgia Caryi Verrill. (LITIGORGIA FUCOSA, 1st Ed.).

Plexaura fucosa Verrill, Bulletin M. C. Z., p. 45, (*non* Val.).

Corallum dichotomous, subdividing some distance above the base. Terminal branches stout, two to four inches long, as large as the main stem, nearly round. Cells very little raised, scattered on all sides of the branchlets. Color bright orange-red.

Spicula yellowish red. Longer double-spindles rather stout, scarcely acute, with a wide median space; two or three whorls of large, compound, rough warts on each end, those nearest the middle much the largest. Stouter double-spindles short and blunt, with a wide median space, each end with two or three crowded and usually somewhat confused whorls of large rough warts, forming a large terminal cluster. Some approach the form of double-heads, with a narrow median space and a large cluster of closely crowded warts on each end. Other "heads" are shorter, lack the median space, and are entirely covered with crowded warts. Crosses, with four short, roughly warted branches frequently occur.

The longer double-spindles measure ·150mm by ·060mm, ·144 by ·066, ·144 by ·060, ·132 by ·054; stouter double-spindles ·120 by ·060, ·114 by ·054; double-heads ·156 by ·078, ·144 by ·071, ·120 by ·060, ·114 by ·066; heads ·126 by ·060, ·114 by ·060, ·072 by ·048; crosses ·144 by ·120, ·120 by ·078, ·096 by ·084, ·084 by ·072.

California,—Maj. Wm. Rich; near San Francisco,—T. G. Cary, (Coll. Mus. Comp. Zoölogy).

The original description (of *G. fucosa*) is so imperfect as to render the identity of the later specimens with it somewhat uncertain.*

G.—*Densely ramose, low and fruticose; branchlets short, irregular.*

Leptgorgia Peruana Verrill. (LITIGORGIA PERUANA, 1st Ed.).

? *Plexaura reticulata* Ehrenberg, Corall. des rothen Meeres, p. 141, 1834.
Plexaura reticulata Philippi, Wieg. Arch., 1866, p. 119.

Corallum low and shrubby, very densely branched, the branches short, irregular, and crooked, often irregularly coalescent. Several stems often arise from the same large base, close together. They at once divide and subdivide irregularly into numerous crooked branches; these give off very numerous short and crooked branchlets, which are sometimes distinctly pinnate. The branches and branchlets are rather thick and round. The cells are small, not raised, and very numerous, arranged in a broad band on each side of the branches. Axis dark wood-brown, brittle and rigid, often hollow in the branchlets, due perhaps to some parasite. The cœnenchyma is thin and brittle. Color whitish. The largest specimens are about 6 inches high and broad; the branches ·25, and the branchlets ·10 in diameter. The spicula are pure white; the longer double-spindles are slender and acute, with numerous close warts, and a rather wide median space. The stouter double-spindles are much shorter, with a narrow median space and blunt ends, the warts forming a single wreath on each side of the middle and a rounded cluster at each end. The longer spicula are ·120mm by ·048mm, ·120 by ·042, ·108 by ·048; the stouter ones ·084 by ·048, ·078 by ·048, ·072 by ·042, ·084 by ·042.

Callao, Peru,—F. H. Bradley.

I have thought it necessary to give a new name to this species for several reasons:

1st. It is not the *Gorgonia reticulata* Ellis.

2d. It may not be the *Plexaura reticulata* Ehr.

* Dr. Kölliker has sent the spicula prepared from the original specimen of *Plexaura fucosa* Val. It proves to be very different from the present species, and belongs to *Psammogorgia*, (see p. 414).—Reprint.

3d. Although "*reticulata*" might be a somewhat appropriate name for it if considered a *Plexaura*, it becomes very inappropriate when referred to a genus in which there are so many species that are *actually reticulated* throughout, while in this the reticulations are few, irregular, and often entirely absent.

The following species, which I have not seen, are here referred to this genus with doubt.

? Gorgonia sanguinea Lam. (LITIGORGIA (?) SANGUINEA, 1st Ed.).

? Gorgonia sanguinea Lamarck, An. sans verteb., 2d edit., p. 495, (Loc. unknown).
Plexaura sanguinea Val., Comptes-rendus, xli, p. 12.
Leptogorgia sanguinea Edw. and Haime, Corall., vol. i, p. 165.

In the latter work this species is described as follows: Corallum rigid, more branched than *L. virgulata*, and with branches still more slender. Calicles scarcely visible. Color carmine-red. Callao.*

Leptogorgia (?) arbuscula V. (LITIGORGIA (?) ARBUSCULA, 1st Ed.).

Plexaura arbuscula Philippi, Wieg. Arch., 1866, p. 118.
"Pl. 4-6 pollicaris, a basi indo in formam fruticuli divisa, roseo-coccinea; ramis subdichotomis, omnibus libris; ramulis ultimis 1⅓ lin. crassis."

Isl. Santa Maria, Bay of Arauco.

Leptogorgia (?) Chilensis Verrill. (LITIGORGIA (?) ROSEA V., 1st Ed.).

Plexaura rosea Philippi, l. c., p. 118 (*non Leptogorgia rosea* E. & H.).
"Pl. 1½ pedalis, roseo-carnea, subflabellato-dilitata; ramis virgatis, subnodosis liberis; ramulis ultimis elongatis, cylindricis, 1½ lin crassis, sæpe 6 poll. longis."

Algarrobo, somewhat south of Valparaiso, Chili.

Leptogorgia (?) platyclados V. (LITIGORGIA (?) PLATYCLADOS, 1st Ed.).

Plexaura platyclados Philippi, l. c., p. 119.
"Pl. roseo, flabellatim ramoso; ramis latissimis, valde compressis, loriformibus."

Isl. Santa Maria.

It seems very doubtful whether this species be a *Leptogorgia*, but it cannot be a *Plexaura*.

Eugorgia Verrill.

Amer. Jour. Sci., xlv, p. 414, May, 1868.

Cœnenchyma composed chiefly of three forms of small spicula, which are naked at its surface. There are two kinds of warty double-spindles,—longer and usually sharper ones, and stouter and blunter ones. These are intermingled with numerous double-wheels, which are usually shorter; sometimes one of the wheels is smaller than the other, or rudimentary, frequently there are four wheels developed.

* The original *G. sanguinea* is, by its spicula, a true *Gorgonia* (*Pterogorgia*); the Callao species is probably distinct and may be one of the following.—Reprint.

The polyp-spicula are small, slender spindles. The axis is horny. Branches either round or compressed, variously subdivided, much as in *Leptogorgia*, surface finely granulous. Cells mostly in a band along each side of the branches, sometimes prominent, usually flat.

A.—*Flabelliform, branches subparallel, dichotomous, usually stout. Cells flat or very slightly raised.*

Eugorgia ampla Verrill.

Leptogorgia ampla Verrill, Bulletin M. C. Z., p. 32, 1864.

Plate V, figure 12. Plate VI, figure 6.

Corallum large, flabelliform, with numerous elongated, subparallel branches and branchlets. Several main branches, which are large, rounded or slightly compressed, and nearly equal, arise from close to the base, the lateral ones curving out at first and then becoming upright and nearly parallel. The branches give off from each side distant, long, and often slightly flexuous, branches and branchlets, which bend outward and then become parallel like the main branches. The branchlets are rigid, from 2 to 6 inches long without dividing, and but little more slender than the branches from which they arise, usually slightly compressed and tapering but little to the obtuse ends. They arise from 1 to 3 inches apart and are often alternate, but at other times only arise from one side of the branch. The cœnenchyma is quite thick and firm, granulous at the surface. The cells are flat, very numerous, crowdedly arranged in two broad lateral bands, separated by a very narrow, naked median space, which forms a slight groove. The cells are usually so contracted as to appear very small and inconspicuous, but when the surface is removed they are seen to be rather large, oval, and so closely arranged that they are separated only by thin walls. The axis is horn-like, blackish in the main branches, but in the branchlets amber-yellow and translucent. Color, in the typical specimens, bright yellow, in the variety light purple. The largest specimens are 18 inches high and nearly as broad; diameter of the main branches ·30; of the branchlets at base ·12; at tips ·10.

Spicula, in the typical specimens, bright yellow. Long double-spindles very acute, distantly warted, with about three wreaths of warts on each end, those next the middle much the largest; median space wide. Shorter double spindles obtuse and more densely covered with warts. Double-wheels nearly or quite as broad as long, the "wheels" large, rather thin, their edges often acute; median space narrow; axis small. The ends of the axis are also terminated by small, thin, wheel-like disks. The polyp-spicula are of several kinds,

the most common are small but not very slender double-spindles, with few, distant, thorny papillæ.

The longer double-spindles are ·132mm by ·048, ·120 by ·048, ·108 by ·048; the stouter ones ·120 by ·060, ·108 by ·060, ·108 by ·054, ·096 by ·054, ·096 by ·048, ·072 by ·054; the double-wheels ·054 by ·060, ·054 by ·054, ·054 by ·048, ·054 by ·042, ·048 by ·054, ·048 by ·048.

Margarita Bay, Lower California,—A. Garret; La Paz, Gulf of California,—Maj. Wm. Rich.

Var. purpurascens Verrill.

Similar in form to the preceding, with the branches and branchlets, even in large specimens, not more than half as large. Color light purple, spicula similar in form, but usually with the double-wheels smaller and their edges less acute. The colors of the spicula are deep purple, light purple, and white. Height of the largest specimens 2 feet. This form may prove to be distinct, but our specimens are too few to satisfactorily determine. It is near *Eugorgia fusco-purpurea* (? Ehr. sp.) and may be identical with it. The spicula of the latter are well figured by Dr. Kölliker,* and agree very well in form with those of this supposed variety.

Pearl Islands and Zorritos,—F. H. Bradley; Corinto,—J. A. McNiel.

Eugorgia nobilis Verrill, sp. nov.

Plate V, figure 13.

Large, flabelliform, with large, divergent, compressed branches, and numerous short, thick, curved branchlets. Several very large flattened branches arise close to the base from the broad trunk, and spread divergently in the plane of the frond, giving off at short distances (usually about half an inch, often less) numerous sub-parallel, undulate branches, which are strongly compressed at their bases. These give rise to numerous secondary branches and branchlets, which arise at distances of from ·25 to 1 inch apart, and are short, thick, and strongly curved, scarcely tapering, rarely more than an inch long without dividing. The cœnenchyma is thick and persistent. The cells are larger and less crowded than in the preceding species, usually flat, sometimes a little prominent, forming two broad bands, which are separated by a narrow, sterile sulcus on each side, corresponding to a large longitudinal duct. Color brownish yellow, or reddish brown. The largest specimens are 18 inches high and 2 feet broad; diameter of main branches ·35 to ·75; of branchlets ·12 to ·15.

Spicula light purple, yellow, and white. Long double-spindles somewhat acute, thickly covered with warts. Stouter ones more densely

* Icones Histiologicæ, Taf. xviii, figs. 28 to 31.

warty, blunt, quite variable in form and size. Double-wheels small, about as long as broad, with small wheels very close together, and with the axis projecting but slightly at the ends. The long double-spindles are ·120mm by ·048mm, ·120 by ·042, and ·120 by ·036; the stouter double-spindles ·084 by ·054, ·084 by ·048, and ·096 by ·054; the double-wheels ·042 by ·042, and ·048 by ·042.

Pearl Islands, 6 to 8 fathoms by divers,—F. H. Bradley; La Paz,—J. Pedersen (var. *excelsa*);* Corinto,—J. A. McNiel.

This species resembles *E. ampla*, but is more densely ramulous, and has shorter, curved branchlets, instead of long, erect ones. Its spicula are similar, but the double-wheels are smaller and more rounded.

B.—*Flabelliform. Branches bipinnate and tripinnate, not coalescent. Cells prominent.*

Eugorgia Daniana Verrill, sp. nov.

Plate V, figure 14. Plate VI, figure 7.

Corallum densely ramose in one plane, forming broad, rounded, fan-shaped fronds. Near the base the short, thick, compressed trunk divides into several large, divergent, compressed, main branches. These give off, pinnately from each edge, at intervals of a quarter of an inch or less, short, slender branchlets, and occasional longer branches, which are similar to the primary ones. These again subdivide pinnately, in the same manner, part of the pinnæ remaining short and simple, while others elongate into branches, which again subdivide, producing similar simple branchlets, and some branches that subdivide again. The final branchlets are slender and short, varying in length from ·15 to ·30 of an inch, very seldom ·50, with a diameter of about ·06. The verrucæ are small, prominent, higher than broad, conical, crowded on all sides of the branchlets. Surface of the branches and cells distinctly granular with the naked spicula. Color bright yellow, streaked and blotched with dark red both upon the branches and cells. Axis strongly compressed, black in the main branches, setaceous and rigid in the branchlets, where it becomes translucent and brownish.

Height 10 inches; breadth 14; diameter of trunk ·22; of main branches ·15. The spicula are deep red and bright yellow, intermingled. Long double-spindles slender, acute, with a wide median space, and about four whorls of well separated warts on each end, those next to the median space considerably the largest, the others diminishing toward the ends, where they become very small. Some are less slender, but similar in length and structure. Stout double-spindles

* The La Paz specimens (*var. excelsa*) are large and tall, with elongated branches, but the spicula are smaller and more slender. Color brown or yellowish-brown.—Reprint.

short and thick, with two whorls of large warts on each end, the outer ones terminal. Double-wheels large, little longer than broad, with a rather wide median space; inner wheels thin, with sharp edges; outer ones terminal, not half as large, sharp-edged, about as far from the median ones as these are apart. The long double-spindles measure ·120^{mm} by ·042^{mm}, ·114 by ·045, ·117 by ·034, ·096 by ·042; the stouter double-spindles ·090 by ·054, ·072 by ·048, ·078 by ·054, ·096 by ·060; double-wheels ·072 by ·060, median space ·018, diameter of axis ·024, terminal wheels ·036, space between outer and inner wheels ·017. Other double-wheels measure ·066 by ·060, and ·072 by ·054.

Panama and Pearl Islands, 6 or 8 fathoms,—F. H. Bradley; Gulf of Nicoya,—J. A. McNiel.

Eugorgia aurantiaca Verrill. (Eugorgia Mexicana V., 1st Ed.).

Lophogorgia aurantiaca Horn, Proceedings Philadelphia Acad. Nat. Sciences, 1860, p. 233 (*non Leptogorgia aurantiaca* Edw., 1857).

Gorgonia aurantiaca Verrill, Bulletin Museum of Comp. Zoölogy, 1864, p. 33.

Eugorgia Mexicana Verrill, Amer. Journal of Sci., xlv, p. 415, May, 1868.

Plate V, figure 15. Plate VI, figure 8.

Corallum forming large densely branched fans, the branches subdividing in the same manner as in the preceding species, but the main branches are longer and less compressed, and the pinnate branchlets are not so close together (usually ·25 inch). The branchlets are also larger and somewhat longer, the length being from ·25 to 1 inch, the diameter ·10 inch. The cells are crowded on all sides of the branchlets, but form irregular lateral bands on the larger branches. They form rounded prominent verrucæ, that are a little larger but not so prominent as in the preceding species, mostly bilabiate. The main branches have a well marked median groove, surface granular, cœnenchyma thin and friable. Color bright orange, streaked with red; interior of the cœnenchyma red. Axis yellowish brown in the larger branches, light yellow and translucent in the smaller branches and branchlets, where it is very slender and rigid. Height 15 inches; breadth 20; diameter of the trunk ·18; of the main branches ·15.

The spicula are light red and bright yellow. Longer double-spindles slender, acute, with three or four whorls of well-separated warts; stouter double-spindles short and thick, with about two whorls of large, separate warts, the outer whorl nearly or quite terminal, median space wide. Double-wheels small, resembling the stouter double-spindles in size and proportions, with a rather wide median space; inner wheels not large, with rounded edges, sometimes crenulated or a little warty,

especially on one side; terminal wheels much smaller, close to the inner ones, with rounded edges.

The long double-spindles measure ·108^{mm} by ·038^{mm}, ·108 by ·036, ·102 by ·034, ·096 by ·030; the stouter double spindles ·084 by ·042, ·078 by ·039; the double-wheels ·060 by ·042, ·066 by ·042, ·054 by ·042, with the terminal wheels ·021, axis ·021, length of median space ·009.

La Paz, Gulf of California,—J. Pedersen, Maj. Wm. Rich; Mazatlan,—Dr. Horn; Acapulco,—A. Agassiz, Rev. J. Dickinson.

In the mode of branching, the size and structure of the branchlets, and color, this closely resembles the last species, which I have separated chiefly on account of the very different size and form of the spicula, and especially of the double-wheels.*

Eugorgia rubens Verrill, sp. nov.

Corallum slender, bipinnate and tripinnate. The small branches and branchlets arise at distances of a quarter to half an inch apart, and are either alternate or sub-opposite. Branchlets very slender, rather short, the edges dentate by the prominent cells. Axis slender, setiform in the branches, pale amber-color, translucent. Cells prominent, forming small conical verrucæ, arranged in a single row along each edge of the branchlets. Color pale red or rose-color. Diameter of the branchlets ·08 inch; of terminal branchlets ·06; length of branchlets ·35 to ·60; entire specimen 2 or 3 feet across.

The spicula are pale red, and mostly short and stout. The longer double-spindles are rather small, slender, not very acute, with about three distant whorls of crowded warts on each end, the median ones a little larger; median space moderately wide. Stouter double-spindles short and thick, blunt, with two or three close whorls of crowded rough warts. Double-wheels rather large, with thick, round-edged wheels, the outer ones terminal; median space narrow.

The longer double-spindles measure ·120^{mm} by ·048, ·096 by ·042 ·096 by ·036; the stouter double-spindles ·096 by ·048, ·084 by ·036, ·072 by ·048, ·072 by ·036; double-wheels ·066 by ·048, ·066 by ·042, ·060 by ·042, ·060 by ·036.

Paita, Peru,—F. H. Bradley, from Mrs. George Petrie.

C.—*Dichotomous, terminal branchlets slender, elongated. Cells scarcely raised.*

Eugorgia Bradleyi Verrill, sp. nov.

Corallum small, slender, more or less flabelliform. The round, slender trunk arises from a flat, expanded base, and at the height of

* Since Valenciennes' species (see p. 413) proves to belong to a distinct genus, I have restored the earliest name,—Reprint.

one or two inches divides into two equal branches. These subdivide either immediately or at various distances up to 1·5 inches in a similar dichotomous manner. The tertiary branches are again unequally dichotomous. The branchlets are mostly secund, slender, spreading outward from the branches in a wide curve, varying in length from 1 to 4 inches, tapering toward the tips, which are very slender. The cells are small, oblong, flat or very little raised, arranged closely in one or two rows on each side of the branchlets, but in broad bands of four or more, irregular, crowded rows on the larger branchlets. Median groove very distinct. Axis slender, blackish in the trunk and larger branches, brown and translucent in the smaller branches, yellowish and setiform in the branchlets. Color bright purplish red, bright lemon-yellow, or light yellowish brown. Height 7 inches; breadth 5; diameter of trunk ·13; of branches ·10; of branchlets ·03 to ·05.

Spicula light purple, or bright yellow. Longer double-spindles rather slender, very acute, sometimes curved, often with the ends unequal, median space wide, warts numerous, in 4 to 6 whorls, those toward the ends very small, the median ones much larger, occasionally several sharp points terminate one of the ends. Stouter double-spindles much smaller, stout and thick, with about 3 whorls of very prominent, rough warts; the last whorl is sometimes terminal, in other cases the end is formed by a single rough wart; some have the warts so crowded that they resemble double-heads. Double-wheels variable in size, about as long as broad, mostly with a narrow median space, small axis, and thin wheels; terminal wheels small, close to the inner ones. Cross-shaped compound spicula occasionally occur, having slender branches, covered by small but prominent warts.

The longer double-spindles measure ·175^{mm} by ·042^{mm}, ·138 by ·042, ·132 by ·048, ·126 by ·036; the stouter double spindles ·096 by ·054, ·090 by ·048, ·072 by ·054, ·072 by ·048; the double-wheels ·036 by ·036, with median space ·009, diameter of terminal wheels ·018; and ·048 by ·042, with the median space ·012, terminal wheels ·024; others ·048 by ·042, ·043 by ·043; crosses ·084 by ·084, and ·060 by ·060.

Panama and Pearl Islands, rare,—F. H. Bradley; Gulf of Nicoya,—J. A. McNiel.

This species resembles in form, mode of subdividing, and slenderness of trunk and branches, *Leptogorgia alba*, but is very distinct in the character of the spicula. Its color, though variable is probably also sufficient to separate them, since this has not been observed *white*, which is the constant color of *L. alba*, so far as can be judged from an examination of over 200 specimens.

The following species, which I have not seen, is placed here with much doubt. In its external characters it appears to resemble some species of *Eugorgia*, but the form of the spicula, if correctly stated, would indicate affinities with *Psammogorgia* or *Plexaura*. Edwards and Haime describe it as follows:*

Echinogorgia aurantiaca Verrill. (LEPTOGORGIA AURANTIACA, 1st Ed.).

Plexaura aurantiaca Val., Comptes-rendus, xli, p. 12.
Leptogorgia aurantiaca Edw. and Haime, Corall., i, p. 165, 1857.

Corallum rather branching, branches pretty stout, the last elongated. Calicles crowded and very distinct throughout. Spicula in the form of warty clubs ("slérites en massue"). Color ferruginous yellow. Callao ("Calloa").

Phycogorgia Val.; Edw. and Haime, Corall., i, p. 182.

Axis lamellar and dilated in the form of membranous leaflets, similar to a fucus, and covered with a thin sclerenchyma, perforated by poriform calicles. (Edw. and Haime).

Phycogorgia fucata Val.; Edw. and Haime.

Gorgonia fucata Val., Voyage de la Vénus, Zoöl., Pl. 11, fig. 2.

Corallum thin, expanded, divided into ramose fronds, the branches of which are contracted at their base and enlarged toward the summit. Calicles small and close. Color rosy. Mazatlan. (E. and H.)

Family, PLEXAURIDÆ Gray.

Annals and Mag. Nat. Hist., 1859, p. 442.
Eunicidæ Kölliker, Icones Histiologicæ, p. 137, 1865.

Corallum usually dichotomous and more or less arborescent. Axis horn-like, or more or less calcareous, especially at base. Longitudinal ducts equal, arranged regularly all around the axis. Cœnenchyma usually thick. Cells scattered over all parts of the surface, flat, or elevated on prominent verrucæ. Tentacles at base, and sides of the polyps stiffened with large fusiform spicula. Spicula of the cœnenchyma usually large, of various forms, most frequently there are large warty spindles mingled with clubs or crosses.

The three principal genera of this family, *Plexaura*, *Plexaurella*, and *Eunicea*, which are each represented by numerous large and common species in the Caribbean Fauna, appear to be entirely absent from the Pacific coast of America.

The following genus, which is scarcely a typical representative of the family, appears alone to replace the larger forms of the Atlantic.

* Spicula from the original specimen, sent by Dr. Kölliker, show that it is an *Echinogorgia*,—Reprint.

Psammogorgia Verrill.

American Jour. of Sci., vol. xlv, p. 414, May, 1868.

Corallum dichotomous or subpinnate, with round branches. Axis horn-like. Cœnenchyma moderately thick, the surface finely granulated with small rough spicula. Cells scattered, sometimes flat, more frequently raised in the form of rounded verrucæ. Polyps with rather large, elongated, slender, warty spindles at the bases of the tentacles. Spicula of the cœnenchyma mostly short, thick, and very rough, warty spindles and rough, warty clubs of moderate size.

Psammogorgia arbuscula Verrill.

Echinogorgia arbuscula Verrill, Proc. Boston Society Natural Hist., vol. x, p. 329, April, 1866.

Psammogorgia arbuscula Verrill, Amer. Jour. Science, xlv, p. 414, May, 1868.

Plate V, figure 17. Plate VI, figure 9.

Corallum low, irregularly dichotomous, subflabelliform, several stems often arising from one base. Base broad, encrusting, covered with a thin cœnenchyma, which usually bears polyps. From this, one to twelve stems arise, which, when numerous, form rather dense clumps of branches. The young stalks are often 2 to 4 inches long before subdividing, enlarging upward to the obtusely rounded tips. In other cases they subdivide dichotomously very near the base, the main branches being about as large as the trunk. These again subdivide in a similar manner into secondary and tertiary branches and branchlets, which curve outward at base and then become subparallel, but are often crooked and irregular, and sometimes coalesce. The terminal branchlets are round, obtuse, scarcely tapering, often enlarged at the tips, from 1 to 4 inches long, about as large as the main branches. Cœnenchyma moderately thick. Surface of the cœnenchyma roughly granular. Cells large, more or less prominent, at the summit of rather large verrucæ, which are often as high as broad, uniformly scattered over all parts of the branches, arranged somewhat in quincunx, the summits frequently eight-rayed. Color dark red. In life, "stem bright red, polyps bright yellow." Height of largest specimens 4 to 8 inches; breadth 3 to 6; diameter of main branches ·15.

Spicula bright red, mostly rather stout thorny spindles. Longer spindles stout, with acute ends, covered with large thorny warts, which are largest about the middle; stouter spindles blunt at the ends, and more thickly covered with similar rough warts. Other stout, thick spicula, or "heads," about as thick as long, and crowdedly

covered with thorny warts, are abundant, especially in the superficial layer, mixed with the last. Also much smaller and more slender spindles, with few large warts. The club-shaped spicula are not numerous and are variable in form; the larger end is not much expanded, but covered with sharp and thorny warts, which decrease to the somewhat acute, smaller end. The polyp-spicula from the bases of the tentacles are relatively large, very long, slender spindles, with acute ends, often curved, and covered uniformly with small, sharp, conical warts. Some of the smaller ones are but slightly warted.

The longer spindles measure ·264^{mm} by ·096^{mm}, ·240 by ·108, ·240 by ·084, ·204 by 072, ·192 by ·084; the stouter ones ·144 by ·084, ·144 by ·072; the "heads" ·108 by ·102, ·144 by ·126, ·120 by ·096, ·108 by ·084; the "clubs" ·180 by ·084, ·180 by ·078, ·168 by ·078, ·156 by ·072; the polyp-spindles ·264 by ·054, ·240 by ·048, ·240 by ·042, ·227 by ·054, ·204 by ·042, ·204 by ·024.

Panama and Pearl Islands, in pools at extreme low-water mark,—F. H. Bradley; Gulf of Nicoya, by divers.—J. A. McNiel.

This species is very variable in form, and especially in the prominence of the cells, or else there are two or more species here included. The typical form, above described, has the cells large and raised on prominent verrucæ. The two principal variations from this type are as follows:

Var. Dowii Verrill.

Similar in mode of branching to the preceding form but somewhat more flabelliform and regular, branchlets rather smaller. Cells flat, or scarcely raised, when contracted often eight-rayed. Spicula much like those of the typical form. Color deep red.

San Salvador,—Capt. J. M. Dow; Pearl Islands,—F. H. Bradley.

Var. pallida Verrill.

Corallum more or less flabelliform, branching dichotomously, branchlets round, sometimes as large as the main stem, usually smaller. Cells a little raised, forming low verrucæ. In fresh specimens, the cells are often surmounted by a small conical mass of convergent spicula, from the bases of the tentacles. Color dull grayish white, or yellowish. In life, "stem white or light drab; polyps bright yellow,"—F. H. B.

Spicula of the cœnenchyma pale pink or colorless, transparent; polyp-spicula orange red. Longer spindles rather long and slender, acute, covered with distantly scattered, unequal, prominent, rough

warts. Some of the largest are stouter, but acute, and often curved or irregular in outline. Stouter spindles very irregular in form and size, often blunt, very rough and thorny, warts not crowded.* Clubs slender, small end acute, enlarging regularly toward the large end, which is crowded with warts of small size.

The longer spindles measure ·216^{mm} by·090, ·204 by ·084, ·204 by ·0, ·180 by ·060; stouter spindles ·132 by ·084, ·132 by ·060, ·120 by ·2; clubs ·162 by ·048; heads ·102 by ·072; crosses ·192 by ·132; polyp-spindles ·252 by ·042, ·240 by ·042, ·240 by ·036, ·204 by ·042, ·204 by ·030.

Pearl Islands,—F. H. Bradley.

This form resembles, in its branches and cells, *var. Dowii*, but differs in its color and somewhat in the spicula, which are less thickly warted and usually not quite so stout.

Psammogorgia teres Verrill, sp. nov.

Plate V, figure 18. Plate VII, figure 1.

Corallum dichotomous, large, flabelliform, with rather large, round branches, which are often curved. The base is expanded, often giving rise to more than one trunk. The stem forks within half an inch from the base, where it is large and round. The main branches again fork irregularly, and also give off numerous branches and branchlets at distances of half an inch or less, in an irregularly subpinnate and often secund manner. These are all round and thick, and bend outward at the axils with a broad curve, and then turn upward, but most of them are more or less crooked throughout, and not unfrequently coalesce. The terminal branchlets are considerably smaller than the main branches, and usually taper slightly to the blunt ends. Cells large, distant, scattered over the whole surface, flat or very little raised. Cœnenchyma thin, with a finely granulated surface, bright red. Axis dull yellowish, woody in appearance; thick, opaque, and soft in the branchlets. Height 10 inches; breadth 8 inches; diameter of trunk ·40; of main branches ·18 to ·22; of branchlets ·12 to ·15. Spicula bright red, varied in size and form. The greater part are rather large, short, stout spindles, covered with numerous, very prominent, rough warts, arranged on each end in two or three irregular whorls; ends scarcely acute. Others are longer and more slender,

* These principally form the external layer, but are mingled with a few clubs and other forms. In this genus there is no very distinct superficial layer of smaller club-shaped spicula, such as is found in *Eunicea*, *Plexaura*, and *Plexaurella*. Hence I place the genus in this family with some doubt. It is, apparently, allied to *Astrogorgia* and may possibly belong to the Primnoidæ, near *Muricea*.

with acute ends, but equally rough. Some head-like spicula are about as long as broad, sometimes nearly spherical, crowdedly covered with large, thorny warts, those about the middle largest. There are also short, stout spindles, crowdedly covered with warts on the whole surface. Club-shaped spicula occasionally occur, having the larger end but little expanded, covered with large, prominent, thorny warts; these with the two preceding forms chiefly compose the external layer. Cross-spicula, with four or six roughly warted branches, frequently occur. Besides these, there are many small spicula of various forms, but all are covered with rough warts, and most of them are short and stout. Polyp-spindles are long, slender, acute, usually curved, covered with small, sharp warts.

The longer spindles measure ·192^{mm} by ·084^{mm}, ·174 by ·078, ·168 by ·090, ·168 by ·048, ·144 by ·066, ·132 by ·072; stouter spindles ·156 by ·096, ·132 by ·090, ·132 by ·078, ·120 by ·096; warty head-spicula ·168 by ·096, ·144 by ·120, ·144 by ·090, ·108 by ·096; clubs ·132 by ·072, ·120 by ·060; crosses ·144 by ·096, ·120 by ·084; polyp-spindles ·264 by ·054, ·227 by ·048, ·204 by ·036, ·198 by ·048.

Pearl Islands, in 6 to 8 fathoms, rare,—*J. H. Bradley.*

Resembles somewhat *var. Dowii* of the preceding species, but is much larger, with stouter branches and branchlets, and larger and more distant cells. The surface is smoother and the cells are usually not at all raised. The color is also brighter red. The spicula are quite different.

Psammogorgia fucosa Verrill.

Amer. Journal Science, xlviii, p. 427, Nov., 1869.
Gorgonia fucosa Val., Voyage Vénus, Pl. 15 bis.
Plexaura fucosa Val.; Edw. and H., Corall., i, p. 154, (*non* Verrill).

Mazatlan.—Voyage of the Venus. A large species allied to *P. teres*.—Reprint.

Psammogorgia gracilis Verrill, sp. nov.

Plate V, figure 19. Plate VI, figure 10.

Corallum slender, flabelliform, the branchlets subparallel and elongated. The stem, in the only specimen seen, is slender, and at the height of about an inch subdivides into four main branches, one of which then passes onward, like a continuation of the stem, undivided for nearly 1·5 inches, when it gives off branchlets pinnately on each side, at distances of from ·10 to ·40. Two of the other main branches subdivide near their origin into several long, slender, ascending branches and branchlets, some of which fork near their ends. The branchlets are all about equal in size, varying in length from less than

1 inch to 2·5, with a diameter of about ·07; they are round, slender, and scarcely taper. The cells form low, swollen verrucæ, which are closely crowded over the whole surface. Cœnenchyma moderately thick. Axis slender and wood-yellow, opaque even at the ends. Color light red. Height 5 inches; breadth 4; diameter of stem ·10.

Spicula bright red; club-shaped spicula numerous, with the small end very acute. The larger spindles are rather slender, ends very acute, warts prominent, not crowded, forming five or six irregular whorls on each end, which become very small near the points. Shorter spindles very rough, with obtuse ends. Clubs very numerous, about as long as the spindles, but much broader, the large end covered with numerous, large, prominent, rough warts and spines, which diminish toward the small end, which tapers to a sharp point. Polyp-spindles pale yellow, long and slender, covered with small, nearly smooth warts.

The longer spindles measure ·240^{mm} by ·060, ·228 by ·060, ·228 by ·048, ·222 by ·072, ·138 by ·036; stouter spindles ·168 by ·072, ·144 by ·084, ·102 by ·066; clubs ·252 by ·084, ·216 by ·072, ·210 by ·084, ·192 by ·084, ·168 by ·060; polyp-spindles ·150 by ·018, ·144 by ·036, ·132 by ·030, ·114 by ·036.

Pearl Islands, very rare,—F. H. Bradley.

This species is remarkably distinct from the preceding three in its mode of branching, its long and quite slender branchlets, and especially in its very peculiar spicula. It differs widely from all other Gorgonians of the coast, known to me, in the form and abundance of the singular club-shaped spicula.

Family, Primnoidæ.

Primnoacées Val.; Edw. and Haime, Corall., vol. i, p. 138.

Primnoadæ, *Acanthogorgiadæ* and *Muriceidæ* Gray, Ann. and Mag. Nat. Hist., 1859, p. 442.

Primnoaceæ Kölliker, Icones Histiol., p. 135, 1865.

Plexauridæ (*pars*) and *Primnoaceæ* Verrill, Revis. Polyps, E. Coast U. S., p. 8, 1864.

Corallum usually branched, sometimes simple. Axis horn-like or more or less calcareous, especially at base. Cells prominent, covered with large scales or spicula. Cœnenchyma with large scales or spicula, the outer ones conspicuous at the surface. Longitudinal ducts many and equal on all sides, or few and symmetrically arranged.

Muricea Lamouroux (restricted).

Muricea (*pars*) Lam'x, Expos. meth., p. 509, 1821; Blainville, Man. d'Actinologie, p. 509; Ehrenberg, Corallenthiere, p. 134; Dana, Zoöph., p. 673; Edw. and Haime, Corall., vol. i, p. 142, 1857, etc.

Muricea Kölliker, Icones Histiologicæ, ii, p. 135, 1865; Verrill, American Jour. Science, vol. xlv, p. 411, 1868.

Corallum variously branched, usually dichotomous or arborescent. Axis horny, rarely becoming calcareous at the base in large specimens. Cœnenchyma composed of large, one-sided, very warty, and often curved spindles, mingled with many smaller ones of various sizes, the exterior being formed mainly of the large ones, which become imbricated on the surface of the verrucæ and usually project from the surface. The cells are prominent in various degrees, and either tubular or bilabiate with the lower side projecting. Polyps retractile, the tentacles stiffened at base with long, warty spindles.

Dr. Kölliker has very judiciously restricted this genus by the removal of *Paramuricea* and *Echinogorgia*, two well defined and natural genera. As now limited *Muricea* is a well characterized genus, which is widely distributed in the tropical seas, but apparently more fully represented on the American coasts than elsewhere. In the West Indies and on the Atlantic coasts there are at least five species, while on the Pacific side eighteen have already been discovered. The species from the East Indies, China, etc., which I have seen, are smaller and less typical than the American forms.

The species of *Echinogorgia* are mainly from the East Indies. The *Paramuriceæ* are found on the European coasts, in the Mediterranean, and one species, at least, in the West Indies and at Florida (*P. clathrata* (Dana sp.). The genus, *Thesea* Duch. and Mich., is a rare West Indian form. *Bebryce* Phil. is from the Mediterranean. *Anthogorgia* and *Astrogorgia* Verrill, as yet represented only by one species each, are from Hong Kong, while the genus, *Heterogorgia* V., is known only from Panama Bay. *Acanthogorgia* Gray, seems allied to *Muricea*, and especially to *Heterogorgia*. It has several species: *A. coccinea* V.,* from Hong Kong; *A. Atlantica* and *A. Grayi* Johns., from Madeira; *A. hirsuta* Gray, locality doubtful; and *A. aspera* Pourtales,† off Havana, in 270 fathoms. *Blepharogorgia Schrammi* Duch. and Mich., from Guadaloupe, is referred to the same genus by Pourtales, but it appears to agree better with *Paramuricea*. The genus, *Acis* Duch. and Mich., is also allied to *Muricea* and has two West Indian species.

A.—*Verrucæ tubular; cells not bilabiate, lower border not prolonged.*

Muricea acervata Verrill.

Proceedings Boston Soc. Nat History, vol. x, p. 327, Apr., 1866.

Plate VII, figure 5. Plate VIII, figure 1.

Corallum arborescently branched, dichotomous, rather stout and rigid. The trunk divides very near the base into two or three main

* Now *Echinomuricea coccinea* V., Am. Jour. Sci., xlvii, p 285.—Reprint.

† Bulletin Museum of Comparative Zoölogy, No. 6, p. 113, 1864.

branches, which part again at one or two inches from their origin; the secondary branches often subdividing irregularly two or three times, but many remaining simple and two or three inches long. All the branches are thick and rigid, and of nearly the same size with the primary branches, mostly smallest at their origin, enlarging toward the tips, which are bluntly rounded and often slight clavate. All the branches bend outward at base, often nearly at a right angle, and then curve upward with a broad curve and become sub-parallel. Cells eight-rayed at the summit of large, elevated, rounded verrucæ, the rays separated by narrow but very distinct sunken grooves, which extend over the summits and somewhat down the sides of the verrucæ in contraction. Verrucæ unequal, larger and smaller ones intermingled, rather elevated, about as high as broad, somewhat crowded, but uniformly arranged, mostly standing nearly at right angles to the branch, their surface covered with closely imbricated, slightly rough, and rather regular fusiform spicula. Cœnenchyma rather thick, covered with spicula similar to those of the verrucæ. Axis black, compressed somewhat at the axils, rigid and brittle at the ends. Color deep brown. Height of largest specimen about 8 inches; breadth 5; diameter of branches ·30 to ·35; of verrucæ ·07; length of verrucæ ·10.

Spicula yellowish brown and reddish brown. Longer spindles long, moderately stout, usually acute at each end, but sometimes with one end blunt, often somewhat bent, covered closely with small spinules, which on most parts are small, sharp, and conical, but on one side they are usually more closely crowded, and take the form of low, rough, lacerate warts. Stouter spindles usually stout-fusiform and rapidly tapering to each end, covered on one side with small, crowded, rough warts, on the other with conical spinules; these like the others, are frequently bent or irregular, and often one end is truncate or obtuse. Small spicula of these two forms are numerous, some having conical, often lobate spinules, others rough warts, not so crowded as in the larger ones. Other small spicula have the form of rough, warty heads, with lobate warts; others are quite small and irregular spicula with large, subdivided warts; some become club-shaped and rough, others more slender, with scattered spinules.

The longer spindles measure 2·00^{mm} by ·400, 1·90 by ·365, 1·44 by ·243, 1·37 by ·200, 1·29 by ·213, 1·20 by ·150, 1·14 by ·228, 1·06 by ·187; the stouter ones 1·35 by ·325, ·912 by ·248, ·436 by ·243; the small irregular spicula ·187 by ·060; heads ·137 by ·121; clubs ·187 by ·105, ·152 by ·090.

Panama, very rare,—F. H. Bradley.

The large, rounded, unequal, eight-rayed verrucæ are sufficient to distinguish this from all other known species. Two specimens only were obtained.

Muricea tubigera Verrill, sp. nov.

Plate VII, figure 7. Plate VIII, figure 2.

Corallum stout and rigid, dichotomously branched, with greatly elongated, squarrose verrucæ. The trunk divides at about an inch from the base into two main branches, which fork at about an inch from their origin. The secondary branches usually fork again at distances varying from two to five inches, and the tertiary branches are often again divided. The terminal branches are from 1·5 to 2·5 inches long and nearly as large as the main branches (·4 inch), obtusely rounded, and sometimes a little enlarged or clavate at the ends. The branches are but little divergent and form acute angles. The cœnenchyma is only moderately thick, but is crowdedly covered with very long, rather slender verrucæ, which stand nearly at right angles to the surface and give the branches a thick appearance. The verrucæ are enlarged or clavate at their summits, which are rounded and conspicuously eight-rayed in contraction; their sides covered with closely imbricated, long, rather slender and sharp spicula, which project but little from the surface. At the tips of the branches the verrucæ are smaller and densely crowded. Axis horn-like, light wood-brown at base, black and somewhat compressed in the branches. Color light greenish brown when dried.

Height of the largest specimen 8 inches; breadth 4·5; diameter of main branches, including verrucæ, ·50; of branchlets ·40 to ·45; length of verrucæ ·15 to ·20; diameter ·05; their summits ·08.

The spicula are yellowish white, and similar to those of the preceding species, but longer, more slender, sharper at the ends, and usually with less crowded warts and spinules. The spindles of the cells are not larger than those of the cœnenchyma, but often stouter; the latter are mostly very slender and acute, often larger and blunter on one end than the other, or somewhat club-shaped, the spinules being more crowded on the larger end and mostly truncate, while on the small end, which is long, slender and acute, they are sharp, conical, and distantly scattered.

The longer spindles of the cells measure 2·28^{mm} by ·324, 1·36 by ·182, 1·32 by ·152, 1·29 by ·137, ·851 by ·091, ·608 by ·061; the stouter ones 1·36 by ·228, ·988 by ·187, ·699 by ·121; the small irregular ones ·213 by ·071, ·187 by ·106, ·121 by ·061; heads ·076 by ·076; the longer spindles of the cœnenchyma measure 2·37 by ·325, 1·80 by

·175, 1·57 by ·200, 1·57 by ·175, 1·52 by ·197, 1·29 by ·167, 1·14 by ·121, 1·09 by ·136, ·942 by ·106.

Pearl Islands and Panama, very rare,—F. H. Bradley.

This species is very distinct from the preceding by its very long, slender, and smaller verrucæ, its longer and sharper spicula, and its thicker branches. The latter character and the closely crowded cells separate it widely from *M. hispida* and *M. horrida*.

Muricea hispida Verrill.

Proceedings Boston Society of Natural History, vol. x, p. 328, 1866.

Plate VII, figure 4. Plate VIII, figure 3.

Corallum dichotomous, sparingly branched, somewhat flabelliform. The main branches arise close to the base and bend outward and upward with a wide curve, before becoming perpendicular and subparallel. The secondary branches arise from the outward curvature of the primary ones, and quickly become of the same size. The branches are slender, though the long verrucæ give them a rather thick appearance, and gradually enlarge to the tips. The cœnenchyma is thin and but little developed. The cells are rather large and regular, at the summit of very long, rather large, tubular verrucæ, which are narrow at base and enlarged to the summit, or subclavate in form, the sides being covered with long, sharp spicula, which project considerably at the summits. Axis very slender, round and black at base, amber-color and translucent in the branchlets. Color, when dry, umber-brown.

Height of the largest specimen 4 inches; diameter of branches, excluding verrucæ, ·12; length of verrucæ ·16; diameter at summit ·07.

Spicula yellowish white, mostly relatively large, very long, slender, sharp spindles, often curved or crooked, covered on one side with small, very sharp, conical spinules, on the other with small, very closely crowded, rough warts; ends usually very acute. Stouter spindles are numerous, which are frequently irregular in form, often bent, sometimes enlarged, branched, or forked, near one end; one or both ends often obtuse or truncate. The small spicula are mostly regular warty spindles, acute at each end, but often bent in the middle, and are relatively less abundant than in most species.

The longer spindles measure 2·60^{mm} by ·300, 2·30 by ·275, 2·07 by ·250, 2·05 by ·300, 2·00 by ·300, 1·70 by ·175, 1·67 by ·225, 1·65 by ·200, 1·57 by ·225; the stouter spindles 2·00 by ·375, 1·75 by ·375, 1·65 by ·300, 1·39 by ·350; the majority of the small spindles about

·425 by ·100, ·400 by ·125, ·375 by ·100, and ·425 by ·062; the spinules of the larger spindles are about ·025 long.

Panama, very rare,—F. H. Bradley.

The spicula of this species resemble most those of *M. tubigera*, but while the branches are much smaller, the spicula are absolutely much larger. They are also rougher, with larger spinules, and the small spicula are much less abundant and more regular in form. Its thin cœnenchyma, and long, clavate, tubular cells, with slender projecting spicula, will at once separate it from all other species, except, perhaps, *M. horrida* Mob.

Muricea horrida Mobius.

Neue Gorgoniden des Naturhist. Mus. Hamburg, p. 11, Tab. III, fig. 3–8, 1861; Kölliker, Icones Histiolog., p. 135, 1865.

"M. arborescens, ramosissima, ramis teretibus, verrucis polypiferis cylindratis, obtusis. Cœnenchyma spiculis fusiformibus, verrucosis, fulvis suffultum."

This species, as described and figured by Mobius, forms an openly and loosely branched corallum, with slender divergent branches, covered with loosely arranged, tubular, and somewhat clavate verrucæ, which are obtuse or truncate and eight-rayed at summit, the sides and upper margin with a few slightly projecting points of long and large spicula. The cœnenchyma is thin and the verrucæ are about equal in length to the diameter of the branchlets and smaller branches. The long spindles are stout fusiform, with distantly arranged, rough, unequal warts. The two figured would measure 1·45^{mm} by ·30^{mm}, and 1·07 by ·23.

Peru (Hamburg Museum).

Muricea squarrosa Verrill, sp. nov.

Plate VI, figure 13. Plate VIII, figure 4.

Corallum dichotomous, the branches subdividing two or three times, branching nearly in a plane. The trunk usually divides close to the base into two or more main branches, each of which usually forks again within half an inch. Some of the central secondary branches rise nearly perpendicularly and do not subdivide for one or two inches, or even more, but the outer ones often fork two or three times more. at distances of about half an inch. The terminal branches and branchlets are from one to four inches long, round, subparallel in large specimens, tapering but little, usually obtuse at the ends, and nearly as large as the main branches. The branches usually spread at a large

angle at their origin, and bend upward in a broad curve, the outer ones often forming right angles at their origin. The prominent verrucæ are regularly arranged on all sides, and pretty close together, though scarcely crowded, and usually stand nearly at right angles to the branches, but often incline obliquely upward at a wide angle, and never become imbricated. They are moderately large, usually somewhat higher than broad, nearly equal, round, tubular, truncate, the terminal opening looking obliquely upward and outward, the surface covered with many large fusiform spicula, the ends of which project strongly at the summit in the form of small sharp spines, which are often more numerous and larger on the lower margin, causing the cells to approach the characters of those of the second section of the genus. Cœnenchyma moderately thick, filled with large spindles at the surface. Color deep yellowish brown, varying to light brownish yellow and to deep umber brown.

Height of largest specimens 8 inches; breadth 6; diameter of largest branches, including verrucæ ·30 to ·35; of branchlets ·24 to ·28; length of verrucæ ·08 to ·10, often less; diameter ·06 to ·07.

The spicula are light yellowish and brownish, mostly large, stout, warty spindles, many of them irregular, bent or lobed. The longer spindles are large, rather stout, tapering gradually to each end, or frequently with one end irregular, truncate or obtuse, the surface crowdedly covered with small, rounded, rough warts, except upon one side where the warts are usually replaced by small, sharp, conical spinules. The stouter spindles are larger and thick, mostly irregular, bent, lobed, or with one end truncate, but agreeing in the character of the surface with the longer ones. The small spindles are mostly slender, acute at each end, regularly covered with truncate or rounded warts, sometimes with sharp spinules on one side.

The longer spindles measure 1·80^{mm} by ·425^{mm}, 1·80 by ·375, 1·75 by ·375, 1·70 by ·350, 1·70 by ·300, 1·65 by ·225, 1·62 by ·375, 1·57 by ·250, 1·25 by ·250, 1·42 by ·200, 1·12 by ·200, 1·07 by ·175; the stouter ones 1·70 by ·440, 1·57 by ·500, 1·50 by ·500, 1·42 by ·425, 1·37 by ·450, 1·25 by ·400, 1·12 by ·300, ·850 by ·225; the small spindles ·500 by ·100, ·375 by ·075, ·300 by ·062, ·225 by ·062.

Panama and Pearl Islands, in pools at extreme low-water mark, not common,—F. H. Bradley.

This species is easily distinguished by its few, moderately thick branches, evenly covered by the squarrose, tubular verrucæ, which are usually considerably higher than broad. The spicula somewhat resemble those of *M. acervata* and *M. echinata*, but can readily be distinguished from either.

B.—*Verrucæ more or less prominent; cells bilabiate, or opening upward, with the lower lip more or less prolonged.*

1.—*Verrucæ large, elevated, spreading, neither appressed nor imbricated, or but slightly so.*

Muricea crassa Verrill, sp. nov.

Plate VII, figure 10. Plate VIII, figure 5.

Corallum very large, dichotomous, branching nearly in a plane, the branches thick, clavate, covered with large, prominent, coarse verrucæ, which are rough with very large, thick, blunt spicula.

Three or four large main branches usually arise from a thick, swollen base. These fork at distances of two or three inches, many of the secondary branches being three or four times dichotomous; while others are subpinnate, the branchlets usually alternating on opposite sides and from one to two inches apart; others give off branchlets only on the outside. The branches and branchlets are all thick, often crooked, and bend outward at first, in a broad curve, and then upward. Toward the base some of the branches are occasionally coalescent. The terminal branchlets are from one and a half to four inches long, smaller at base than the branches, but enlarging toward the obtusely rounded end, where they are much enlarged and often clavate, frequently having a diameter of half an inch or more. The crowded verrucæ stand at nearly right angles to the surface of the branchlets and are very large, prominent, rough with large, stout, coarse spicula, which are mostly rather blunt at the ends, forming therefore coarse but not sharp spinules at the summit, a cluster of which are a little prolonged, so as to form a short lower lip, which is usually a little incurved in contraction, so as to conceal the cell, which opens upward and inward. The large verrucæ of the branchlets are usually broad at base, somewhat conical, higher than broad, strongly echinate at summit; those of the main branches and trunk are distantly scattered, rounded, low, scarcely as high as broad.

Cœnenchyma moderately thick, coarse, with very large, irregular, blunt spicula, conspicuous at the surface. Axis horn-like, light wood brown at base; round, black, strongly striated in the larger branches, with the axils scarcely compressed; soft, thick, rigid and brittle when dry, and dark brown in the terminal branchlets. Color dark brown, yellowish brown at base.

Height 20 inches; breadth 18; diameter of main branches ·50 to ·90; of terminal branchlets ·30 at base, ·50 or ·60 near the tips; height of verrucæ ·15 to ·20; diameter ·10.

The spicula are reddish brown, mostly very large, thick, coarse, unequal, and irregular, with the ends obtuse or truncate, and the surface rough with minute crowded warts. In the verrucæ the spicula are mostly very stout spindles, oval, oblong, or clavate, in nearly all cases irregular, but generally with one end largest and truncate, obtuse, or divided into two forks or lobes. Their most common size is about half a millimeter in diameter and two long, but there are many much larger ones, and a few quite regular and slender spindles of smaller size. Those of the cœnenchyma are mostly very large, thick, oblong, irregular spicula, obtuse, truncate, or irregular at the ends, mostly bent or distorted and often lobed, most of the larger ones about one-third as broad as long.

The stout spicula of the cells measure 3·20^{mm} by ·875^{mm}, 3·12 by ·300, 2·25 by ·875, 2·12 by ·575, 2·00 by ·575, 2·00 by ·500, 1·75 by ·675. 1·75 by ·375, 1·70 by ·800, 1·45 by ·575, 1·40 by ·875, 1·37 by ·300, 1·25 by ·575, 1·07 by ·325, ·875 by ·450. Those of the cœnenchyma 4·00 by 1·25, 4·00 by 1·20, 3·25 by 1·00, 2·87 by 1·25, 2·75 by 1·25, 2·75 by ·875, 2·25 by ·950, 2·25 by ·800, 1·00 by ·450; the most slender spindles 1·75 by ·225, ·1·00 by ·300; the smaller ones ·650 by ·125, ·525 by ·125, ·450 by ·125 ·275 by 150.

Pearl Islands,—F. H. Bradley.

This species is very different from all others in its great size, very large, coarse, rough verrucæ, and the remarkably large, thick, irregular spicula.

Muricea echinata Val.

Muricea echinata Valenciennes, Comptes-rendus. 1855 (no description); Edw. and Haime, Corall., vol. i, p. 143, 1857; Verrill, Bulletin Museum Comp. Zoöl., p. 36; Proc. Bost. Soc. Nat. Hist., vol. x, p. 328, 1866.

Plate VIII, figure 6.

Corallum irregularly dichotomous or subpinnate, branching nearly in a plane, with clavate branchlets and elongated echinate verrucæ, with the lower lip prolonged and the cells opening upward and inward.

The trunk usually divides, close to the base, into two or three main branches, most of which subdivide several times at distances of one third or half an inch, the central ones usually dichotomous and the outer ones often subpinnate, the branches spreading at first at a wide angle and then curving upward. The terminal branches and branchlets are mostly from one to four inches long, enlarging toward the end, often distinctly clavate, the tips enlarged and obtusely rounded. The verrucæ are mostly slender, clavate, very prominent, especially on the terminal branchlets, not crowded, spreading outward and up-

ward at a wide angle, not imbricated, covered with large, stout spindles, with sharp ends, some of which form the prolonged lower lip and project from the upper part of the verrucæ, in the form of sharp rough spinules. The cells are small and open inward and upward, in contraction nearly concealed by the incurved lower lip, filled with small convergent yellow spicula, from the bases of the tentacles. The cœnenchyma is thin, covered with large spindles. Color deep reddish brown; cells yellow inside. In life "deep red, polyps bright yellow."

Height of largest specimens 6 or 8 inches; breadth about the same; diameter of the main branches, including verrucæ, ·30; of the branchlets at origin ·25; near the ends ·37; length of the longest verrucæ on the terminal branchlets ·15 to ·18; diameter ·05 of an inch.

Dwarf specimens occur only two or three inches high, with the largest branches about ·25 in diameter, and the verrucæ ·10 of an inch long. These grow in shallow water, in rocky pools, etc.

The spicula are reddish and yellowish brown, mostly rather large, rough, acute spindles, of which the larger ones are often bent, irregular, lobed, or with one end truncate. The longer spindles, when perfect, usually have the ends quite acute; some are moderately stout, others quite slender, covered on one side with small but very sharp spinules, on other parts with small, crowded, rough, rounded or truncate warts. When the spindles are bent the spinules are usually on the concave side. The stouter spindles are quite irregular and variable in size and form, but are usually rather thick, often crooked, and with one or both ends blunt or truncate, and very closely covered with warts and spinules. The medium sized spindles are quite regular, slender, and very acute, warted like the larger ones. The smallest are nearly white, regular, some acute and others blunt, covered with prominent very rough warts, which are not crowded.

The longer spindles measure 1·95^{mm} by ·450^{mm}, 1·75 by ·425, 1·75 by ·250, 1·62 by ·275, 1·52 by ·225, 1·50 by ·375, 1·45 by ·350, 1·45 by ·275, 1·45 by ·175; the stouter ones 2·00 by ·750, 1·62 by ·750, 1·60 by ·575, 1·55 by ·450, 1·45 by ·450, 1·35 by ·500, 1·10 by ·475, 1·00 by ·625, ·600 by ·250; the medium sized spindles 1·35 by ·250, 1·27 by ·225, 1·15 by ·150, 1·00 by ·425, ·900 by ·125; the small spicula ·650 by ·125, ·350 by ·100, ·325 by ·100.

Panama, in rocky pools at low-water mark, common,—F. H. Bradley. C. F. Davis, J. H. Sternbergh; Pearl Islands,—F. H. Bradley.

Var. flabellum.

Branches much more numerous and crowded, several principal ones starting nearly together close to the base, and giving off numerous

short, crooked branchlets, mostly on the outer side, which are often at distances of less than a quarter of an inch apart. Terminal branchlets one or two inches long, ·25 in diameter, often tapering. Verrucæ very slender, prominent, the lower lip much prolonged, acute, the surface and summit rough with the sharp ends of the spicula. Cells small, opening upward, often filled with a cluster of bright yellow spicula from the bases of the tentacles. Color deep brown.

Pearl Islands,—F. H. Bradley.

This species somewhat resembles the two following in color and external appearance. From the first it differs greatly in mode of growth, and somewhat in the spicula; from the second (*M. austera*) in its much more slender, longer, and spreading verrucæ, and very decidedly in its spicula.

Muricea fruticosa Verrill, sp. nov.

Plate VII, figure 2.

Corallum large, very branching, cæspitose, fruticose, with rather small, somewhat clavate branchlets, and prominent, spreading, spinose verrucæ.

The trunk is very stout and short, arising from a large irregular base, and usually divides at once into several large, unequal main branches, which rapidly divide and subdivide in an irregular manner, the branches and branchlets usually not more than one quarter or half inch apart. Sometimes several large main branches can be traced for some distance, giving off numerous small branches from all sides, but more frequently the subdivision is so rapid that the main branches are very soon lost among the crowded and crooked branches. The small branches near the ends often divide in an irregularly dichotomous manner, and sometimes coalesce; they are very numerous, nearly equal in size, and usually much curved and crooked, spreading at their origin with a broad curve. The terminal branchlets are short, mostly ·5 to 1·5 inches long, often curved, of moderate size, narrowed at base, enlarging to the obtusely rounded end. Verrucæ close together, but not imbricated, spreading outward and upward, quite prominent, conical, about as high as broad toward the outer ends of the branchlets, where they are more developed than below, and furnished with an acute prolonged lower lip, the surface covered with long, stout spindles, some of which are about as long as the verrucæ. Cells small, situated on the upper side of the verrucæ, near the end, the aperture filled with the yellow polyp-spicula, from the bases of the tentacles. On the surface of the larger branches the verrucæ are low, rounded,

and without a prolonged lower lip; on the trunk and main branches they are distant, small, and but little prominent.

Cœnenchyma thin, its surface composed of very conspicuous, stout spindles, often larger than those of the verrucæ. Color of the branchlets and verrucæ deep reddish brown, branchlets yellowish brown, trunk and main branches yellow, tinged with brown. Axis horn-like, yellowish wood-brown at the base and in the larger branches, darker reddish brown and translucent in the smaller ones, light amber-yellow, translucent, and slender, in the branchlets.

The largest specimen is 15 inches high, greatest breadth, across the upper surface of the clump, 22 inches; least diameter 16; diameter of trunk 1·4; of main branches ·75 to 1 inch; of branchlets at origin ·12 to ·17; near the ends, including verrucæ, ·20 to ·25; length of longest verrucæ ·08 to ·10; diameter ·05 of an inch. Another specimen is 15 inches high, and the same in breadth.

The spicula vary in color from brownish yellow and yellowish white to deep reddish brown. The larger ones are mostly stout, relatively large, blunt, and frequently irregular or crooked spindles. The longer spindles are rather thick in the middle portion, tapering somewhat abruptly to the ends, which are not usually very acute; one side covered with small, very sharp spindles, the other parts with crowded rough warts. The stouter spicula are thick and massive, usually blunt or even truncate at one or both ends, but sometimes tapering to blunt points, often crooked; some of the smaller ones entirely lose their spindle-shape, even becoming triangular; others have the large end forked; while some are quite irregular, compressed, sometimes as broad as long, one side divided into large, sharp, lacerate teeth or spines. The medium sized spindles are more regular, quite stout in the middle, usually tapering to acute points, one side covered with quite large and very sharp spindles, the other with closely crowded rough warts. Other still smaller spicula are quite slender, regular, very warty spindles, light yellow in color. The smallest are very small, snow-white, very warty spindles, some very slender, others relatively short.

The longer spindles measure 2·90^{mm} by ·650^{mm}, 2·50 by ·500, 1·75 by ·350, 1·57 by ·325, 1·55 by ·350, 1·55 by ·300, 1·55 by ·225, 1·50 by ·425, 1·45 by ·350, 1·40 by ·250, 1·27 by ·300, 1·20 by ·250; the stout spicula 2·37 by ·650, 2·25 by ·625, 2·10 by ·675, 2·00 by ·575, 1·75 by ·525, 1·70 by ·525, 1·62 by ·550, 1·62 by ·500, 1·50 by ·475, 1·35 by ·575, 1·07 by ·375, ·725 by ·300; the medium sized spindles 1·07 by ·250, 1·07 by ·225; 1·00 by ·275, 1·00 by ·250, 1·00 by ·200, ·900 by

·200, ·875 by ·200, ·825 by ·200, ·700 by ·150; the smaller spindles ·575 by ·175, ·575 by ·100, ·550 by ·100, ·500 by ·100, ·475 by ·100 ·450 by ·075, ·425 by ·100; the smallest white spindles ·135 by ·075, ·325 by ·062, ·175 by ·075, 1·75 by ·062; some of the small triangular ones ·450 by ·425; the irregular prickly spicula ·400 by ·325. The polyp-spindles measure ·375 by ·100, ·325 by ·075, ·275 by ·075, ·225 by ·100, ·200 by ·075, ·200 by ·062.

Pearl Islands, brought from 6 to 8 fathoms below low-water mark by divers,—F. H. Bradley.

Var. miser.

Corallum dwarfed, forming small, thickly branched, rounded, cæspitose clumps, from two or six inches in diameter and about the same in height, the subdivision taking place rapidly from close to the base. Branches and branchlets small and slender, the latter a little enlarged toward the ends, and from ·5 to 2 inches long. Verrucæ as in the typical form, but smaller, nearly obsolete on the larger branches. Color of branchlets deep brown, of branches and often the bases of branchlets very light yellow. Diameter of branchlets ·10 to ·15; length of longest verrucæ ·04 to ·06 of an inch. The spicula are similar to those of the typical form, but smaller.

Pearl Islands, in rocky pools at extreme low-water mark,—F. H. Bradley; Corinto,—J. A. McNiel.

This species is more nearly allied to *M. echinata* than to any other. Its cæspitose growth and far more numerous and smaller branches will usually separate it readily. The verrucæ are smaller and shorter, and the spicula are different, though quite similar in general appearance. They are mostly stouter and blunter than the corresponding forms in *M. echinata*, while the large, stout spindles of the cœnenchyma are decidedly larger, even in smaller specimens. The medium sized spindles are also decidedly stouter and less acute.

Muricea austera Verrill, sp. nov.

Plate VIII, figure 7.

Corallum large, dichotomous, fruticose, sometimes cæspitose, with rather thick, obtuse branchlets, covered with close, scarcely appressed, sub-conical verrucæ, having an acute lower lip.

In the largest specimen, several trunks arise from a broad base, four or five inches in diameter. These quickly fork, and the branches in their turn rapidly divide, being, in some cases, five or six times dichotomous, producing a rather coarse cæspitose clump, though some of the main branches and their divisions have a tendency to arrange themselves in

a single plane,—a feature that is more characteristic of the smaller specimens. The branches and branchlets usually arise from ·5 to 1·5 inches apart, spreading in a wide curve at first, or even nearly at right angles, and then becoming sub-parallel. The branches occasionally coalesce sparingly. The terminal branchlets are ·5 to 2 inches long, as large as or larger than the smaller branches, and mostly increase in size from their origin to the end, which is well rounded. The verrucæ are prominent, sub-conical, with an acute lower lip, near together, but yet scarcely crowded, and not imbricated, usually forming an angle of about 45° with the surface, closely covered by rough, stout, rather short spindles, tapering to the ends, which scarcely project above the surface, except slightly at the summit of the verrucæ. Cells opening on the upper side of the verrucæ, filled when fresh with a cluster of light yellow polyp-spindles. Cœnenchyma moderately thick, firm, with a hard rough surface, covered with stout, mostly obtuse, rough spicula, some of which are much larger than those of the verrucæ. Axis wood-brown and not calcareous at base; black in the branches and usually a little compressed, especially at the axils; yellowish brown, coarse, and rigid in the branchlets. Color uniform reddish or yellowish brown.

Height of largest specimen, from Panama, 9 inches; breadth 15 by 13; diameter of main branches ·40; of secondary ·30; of branchlets at base ·20 to ·25; at summit, including verrucæ, ·25 to ·35; length of verrucæ ·05 to ·10; diameter about ·05. Another sub-flabelliform specimen from Pearl Islands is 9 inches high and 10 broad, with the branches and verrucæ as in the other. One from Cape St. Lucas is 8 inches high and 6 broad; the branchlets near the ends mostly ·35, rarely ·40, in diameter; the longest verrucæ ·12 of an inch in length.

The largest spicula are all rather short and stout, mostly oblong or oval in outline, with obtuse or truncate ends, only a portion of them being short spindles. The longer spicula are mostly oblong, with obtuse ends, or stout fusiform, tapering somewhat to one or both ends, which are blunt; one side covered with large, conical spinules, the others with rather large, close set, rough warts. The stouter spicula differ but little from the longer ones, except in being shorter and thicker, generally oblong or oval, and truncate at the ends. They are often irregular, or lobed at one or both ends. The small spindles are rather stout, tapering but little, blunt at the ends, and covered with large, prominent, rough warts, about their own diameter apart. Small, irregular, very warty or spiny spicula occur, which are nearly as long as broad; also irregular star-shaped spicula, and nearly round warty

heads. The polyp-spicula are mostly small, rather slender, oblong spindles, with blunt ends, closely covered with small rough warts.

The single specimen from Cape St. Lucas has spicula which average somewhat larger, but agree well in form and appearance with those of the Panama specimens.

The longer spicula measure 1·45^{mm} by ·400^{mm}, 1·22 by ·400, 1·17 by ·375, 1·15 by ·375, 1·15 by ·325, 1·12 by ·375, 1·12 by ·300, 1·07 by ·300, 1·05 by ·350, 1·02 by ·325, ·850 by ·275; the stouter ones 1·47 by ·500, 1·02 by ·400, 1·00 by ·375, ·975 by ·500, ·950 by ·425, ·900 by ·450, ·750 by ·300, ·700 by ·375, ·675 by ·325, ·650 by ·350, ·625 by ·300; the small spindles ·425 by ·100, ·375 by ·100, ·350 by ·125; the small irregular, thorny spicula ·275 by ·175, ·225 by ·150, ·175 by ·100; the stars ·200 by ·200, ·200 by ·150, ·175 by ·175; the heads ·175 by ·150, ·175 by ·100; the polyp-spindles ·500 by ·100, ·450 by ·112, ·450 by ·075, ·425 by ·125, ·400 by ·137, ·400 by ·100, ·375 by ·100, ·350 by ·087, ·325 by ·075, ·300 by ·100, ·250 by ·075, ·225 by ·062. The longer spicula from the Cape St. Lucas example measure 1·67 by ·550, 1·50 by ·500, 1·50 by ·425, 1·50 by ·375, 1·25 by ·300, 1·12 by ·325; the stouter ones 1·60 by ·550, 1·40 by ·575, 1·30 by ·500, 1·27 by ·450, 1·25 by ·500, ·875 by ·450.

Pearl Islands, rare, brought with *M. crassa* and *M. fruticosa* from 6 to 8 fathoms by divers,—F. H. Bradley; Panama, at extreme low-water, on reef, very rare,—F. H. Bradley; Cape St. Lucas,—J. Xantus, from Smithsonian Institution; La Paz,—J. S. Pedersen.

This species resembles in color and general appearance *M. echinata* and *M. fruticosa*, but is quite distinct from both in its short, stout, blunt spicula. From the latter it differs, also, in its much stouter and less numerous branches and larger verrucæ; from the former in its shorter, broader, and more conical verrucæ and firmer texture.

Muricea retusa Verrill, sp. nov.

Plate VIII, figure 8.

Corallum dark purplish, dichotomous, sparingly branched, branches rather thick, with large sub-conical verrucæ, which are not crowded.

The trunk forks near the base and, in the only specimen seen, each main branch subdivides again at the distance of about an inch. One of the secondary branches again forks at two inches from its origin, the others remain simple and about two inches long. The branches spread widely at first and are about equal in size throughout, the terminal branches being a little enlarged toward the end. The verrucæ are rather large, stout, subconical, nearly as broad as high, not crowded,

standing at an angle of about 45° on the upper part of the branches and at a greater angle below, their surface covered with short, thick, rather obtuse spindles, with their sides elevated and very conspicuous at the surface, but the ends not projecting. The lower lip of the verrucæ is rather obtuse and not much prolonged. The cœnenchyma is thick, covered with stout, irregular, blunt spicula, some of them considerably larger than those of the verrucæ. Color deep purplish brown.

Height 3 inches; breadth 2·5; diameter of branches ·30; length of verrucæ ·08 to ·12; breadth ·06 to ·08.

The spicula are mostly deep red or purple, varying toward yellowish, and consist mostly of short, stout, usually irregular, blunt spindles, or oblong spicula, three or four times as long as broad; and very short and thick, irregular, massive spicula, often more than half as broad as long. The longer spicula are partly stout, blunt spindles, often irregular or bent, and closely covered with rough warts, with stout conical spinules on one side; these come mostly from the verrucæ. Others, coming from the cœnenchyma, are oblong or irregularly formed, one end often dilated, frequently truncate. The stouter spicula are very massive and irregular, usually oblong, and truncate at both ends, often w e end dilated, frequently lobed, crowdedly warted, except on the spinulose sides. Others are irregularly triangular and flattened, one edge spinulose, the sides warted. All the stouter irregular spicula appear to come from the cœnenchyma. The smaller spindles from the verrucæ are pretty regular, stout fusiform, or even somewhat oval in outline, the ends not very acute.

The longer spicula measure 1·47^{mm} by ·500^{mm}, 1·40 by ·350, 1·27 by ·450, 1·10 by ·300, 1·05 by ·325, 1·00 by ·300, ·925 by ·250, ·900 by ·225, ·875 by ·325; the stouter ones 1·20 by ·550, 1·02 by ·600, 1·02 by ·500, 1·00 by ·550, 1·00 by ·475, ·950 by ·500, ·925 by ·450, ·750 by ·525, ·700 by ·450, ·625 by ·425; the triangular flattened ones 1·15 by ·575, ·775 by ·400, ·625 by ·375; heads ·275 by ·275; the small oval spindles ·750 by ·300, ·625 by ·225, ·600 by ·225, ·475 by ·225, ·450 by ·250, ·450 by ·175, ·250 by ·150.

Pearl Islands, attached to the base of a large specimen of *M. fruticosa*, from 6 to 8 fathoms,—F. H. Bradley.

This species is closely allied to *M. austera*. Its spicula are still shorter, thicker, and more irregular, approaching, in this respect, those of *M. crassa*, though much smaller. The verrucæ are also larger than those of *M. austera* and less rough. The peculiar rich color will probably prove to be a good specific character, since the color in the species

of this genus appears to be remarkably constant, although quite variable in some genera of Gorgonidæ.

Muricea formosa Verrill, sp. nov.

Plate VIII, figure 15.

Corallum white, dichotomous, the branches moderately stout, divergent, with elongated squarrose verrucæ.

The single specimen in the collection forks at about half an inch from the base; one branch divides again within half an inch; the other forks at two inches, each division again subdividing irregularly. The branchlets diverge at first with a wide angle, often even 90°, and then curve upward; they are short, somewhat conical, obtuse at the end. The verrucæ are elongated, somewhat conical, with the acute lower lip projecting beyond the upper, and spiny with the projecting ends of elongated, sharp spicules. Cells placed on the upper side and near the end of the verrucæ, surmounted by a cluster of white polyp-spindles when the polyps are contracted. Cœnenchyma rather thin, the surface covered with rather short and stout, nearly regular spindles. Axis wood-brown at base, brownish black in the branches. Color pure white throughout.

In life, "the color, both of branches and polyps, is pure white; polyps very inconspicuous, sessile, with eight short, pinnate tentacles," —F. H. B.

Height 4 inches; breadth 3; length of branchlets ·5 to 1·5; diameter, including verrucæ, ·30 to ·35; length of verrucæ ·08 to ·12; diameter ·04 to ·06.

The spicula are clear white, of moderate size, comparatively smooth; the larger are mostly rather elongated spindles from the verrucæ, with one end usually quite sharp; and short, stout, blunt spindles and irregular spicula from the cœnenchyma. The longer spindles from the verrucæ sometimes taper regularly to both ends, which are acute; others have one end short, the other tapering abruptly, truncate, or even forked; the outer surface is covered with very small, crowded warts, the inner surface with very small, low spinules, which gives them a rather smooth appearance when moderately enlarged. The stout spicula, mostly from the cœnenchyma, are in large part short, stout spindles, often regularly elliptical in outline, with the ends regularly tapering and blunt; some are irregular spindles, one end often much the largest and blunt or rounded, the other somewhat acute; others are of various shapes, sometimes sub-triangular, often bent. All are covered with very small warts and spinules, like the longer ones. The

polyp-spindles are mostly small, short spindles, very unequally and roughly warted; others are more slender and very small spindles; others are longer, slender, not very acute spindles, with more distant warts.

The longer spindles measure 1·35^{mm} by ·325^{mm}, 1·25 by ·175, 1·22 by ·250, 1·22 by ·175, 1·17 by ·275, 1·15 by ·175, 1·12 by ·275, 1·07 by ·200, 1·05 by ·250, 1·00 by ·250, ·950 by ·250, ·950 by ·225, ·950 by ·150, ·925 by ·250, ·925 by ·225, ·900 by ·200, ·875 by ·225, ·850 by ·225, ·750 by ·175, ·725 by ·225, ·725 by ·175, ·725 by ·150, ·600 by ·100; the stout spindles 1·45 by ·450, 1·32 by ·375, 1·17 by ·400, 1·15 by ·300, 1·12 by ·275, 1·10 by ·425, 1·05 by ·325, ·975 by ·300, ·925 by ·350, ·900 by ·350, ·850 by ·300, ·850 by ·275, ·800 by ·225, ·775 by ·275, ·775 by ·225, ·750 by ·300, ·750 by ·250, ·700 by ·250, ·675 by ·300, ·650 by ·200, ·425 by ·250; the irregular stout spicula ·950 by ·450, ·925 by ·350, ·800 by ·300, ·775 by ·375, ·725 by ·350, ·700 by ·300, ·650 by ·300, ·600 by ·325, ·525 by ·275, ·425 by ·275, ·400 by ·250, ·350 by ·225; the polyp-spindles ·450 by ·100, ·425 by ·100, ·400 by ·100, ·375 by ·125, ·350 by ·112, ·350 by ·062, ·325 by ·112, ·325 by ·087 ·300 by ·100, ·300 by ·075, ·300 by ·050, ·275 by ·062, ·225 by ·062, ·175 by ·075.

Zorritos, Peru, dredged in 3 fathoms,—F. H. Bradley.

This species resembles *M. albida* in color and size of branches, but has not the appressed verrucæ, with a flattened lower lip, of that species, and the spicula of the verrucæ are much longer, sharper, and more projecting, while all the spicula are much less roughly warted. It somewhat resembles *M. squarrosa* in size and mode of branching and in the divaricate verrucæ, but differs in the elongated lower lip and much stouter spindles of the verrucæ, as well as in color. It also bears some resemblance to the whitish variety of *M. tubigera*, but has smaller branches, shorter verrucæ, with a well-marked lower lip, and much shorter and stouter spicula.

The Zorritos specimen is infested by a small parasitic worm, which forms numerous tubes in the cœnenchyma and surface of the axis. When living "from each tube are protruded a pair of long, slender, flexible tentacles, zoned with black and white, and a long, worm-like process, mammillated on both sides, and showing a dark line (intestine ?) in the centre."

These worms are about a quarter of an inch long and quite slender, with small bundles of setæ along the sides, the posterior extremity tapering. In alcohol the tentacles are relatively large, with large dark brown spots, arranged in pairs along the whole length, producing the "zoned" appearance. Each worm has two holes at the surface

of the cœnenchyma, which are close together and have a slightly raised border. From one of the holes the tentacles are protruded; from the other, the posterior end of the body. The lower part of the tube, bent into a U-shaped form, is more or less deeply excavated in the substance of the axis.

2.— *Verrucæ scarcely prominent. Cells opening outward, with the lower lip little developed.*

Muricea robusta Verrill.

Muricea robusta Verrill, Bulletin Museum of Comp. Zoöl., p. 36, 1864; (*pars*) Proc. Boston Soc. Nat. Hist., vol. x, p. 329, 1866.

Plate VII, figure 3. Plate VIII, figure 9.

Corallum brown, irregularly dichotomous, with few, stout, mostly crooked branches, pretty closely covered by the rather large, unequal cells, which have the border but little elevated.

When young it rises as a simple, clavate, often crooked stem to the height of 2 or 3 inches, attaining a diameter of ·35 to ·40 near the summit, which is bluntly rounded. Larger specimens usually divide within 1·5 inches from the base, the main branches again forking within an inch of their origin, and the resulting branches are irregularly once or twice dichotomous. The branchlets are irregular, crooked, arising from ·5 to 2 inches apart, spreading at their origin in a broad curve, stout and rigid, of nearly uniform size throughout, the ends obtusely rounded. Verrucæ upon the branches and trunk inconspicuous, consisting of a slightly elevated margin around the rather large and conspicuous cells, which are crowded over the whole surface and open outward. Toward the ends of the branchlets the verrucæ become more prominent by reason of the greater development of the lower border of the cells, which forms a concave, semi-circular, or crescent-shaped lower lip, with a somewhat thickened and obtuse edge, the surface scabrous and granulous with small rough spicula. Cœnenchyma thick, and granulous with small spicula. Axis in the branches black and scarcely compressed at the axils, brown and rigid in the branchlets. Color dull yellowish brown.

Height of largest specimen 8·5 inches; breadth 4; diameter of trunk ·40; of branchlets ·35; of largest verrucæ ·06; length of lower lip, when longest, ·04.

Spicula orange-brown and light yellow, quite small for the genus, but very rough, the larger ones consisting in great part of stout, irregular, thorny clubs. The longer spindles are rather slender, irregular, the sides closely covered with very rough unequal warts, one end often

lacerately divided into large, unequal, sharp spinules. The stouter spicula are in part short, stout, very roughly warted spindles; with more numerous and usually large, stout, irregular, very rough clubs. The latter are bluntly pointed at the small end, the sides covered with crowded rough warts, the large end lacerately divided into large, unequal and irregular, sharp spinules. Among the smaller spicula are many short, irregular spindles, roughly warted on one side, and bearing large, elongated, sharp, oblique spinules on the other; also more regular short warty spindles and warty heads; others are quite slender and very roughly warted spindles, often lacerate at one end. The polyp-spicula are deep brown.

The longer spindles measure ·825^{mm} by ·175^{mm}, ·825 by ·162, ·775 by ·175, ·750 by ·250, ·700 by ·150, ·675 by ·125, ·625 by ·175, ·625 by ·125, ·550 by ·175, ·525 by ·125; the stouter spindles ·625 by ·375, ·625 by ·250, ·475 by ·200; the stout clubs ·575 by ·200, ·575 by ·175, ·550 by ·200, ·525 by ·200, ·450 by ·250, ·450 by ·175; the longer spinules of the clubs are about ·100 to ·125 in length; the irregular lacerate spicula ·475 by ·325, ·225 by ·200; the smaller stout spindles ·325 by ·150, ·275 by ·125, ·250 by ·137; the warty heads ·225 by ·175, ·200 by ·150; small slender spindles ·450 by ·125, ·400 by ·112, ·375 by ·100.

Acapulco, Mexico,—A. Agassiz.

This species resembles *M. purpurea* and *M. albida* in its stout branches and mode of subdivision, but differs from both these and all others in its nearly obsolete verrucæ. Its spicula are very different in form and size from those of *M. albida*.

3.—*Verrucæ curved upward at the apex, generally more or less appressed and usually imbricated.*

a.—*Cœnenchyma thick; branches stout, obtuse, dichotomous.*

Muricea albida Verrill.

Muricea robusta (pars) Verrill, Proc. Boston Soc. Nat. History, vol. x, p 329, 1866.
Muricea albida Verrill, American Journal Science, xlv, p. 412, May, 1868.

Plate VII, figure 9. Plate VIII, figure 10.

Corallum white, dichotomous, branching nearly in a plane, with stout, rather long branches, thick cœnenchyma, and large, close, somewhat appressed verrucæ.

When young this species usually grows to the height of two or three inches as a simple, straight, clavate stem, generally quite slender at the base and gradually enlarging to near the summit, where the diameter, including verrucæ, is ·20 to ·35 inch, the end obtusely round-

ed. The first branch usually arises from one side, about 1 or 1·5 inches from the base, and soon becomes about as long and large as the original stem. Each of the two main branches usually forks again at distances of ·5 to 1 inch, their divisions mostly remaining unequal, some of them remaining long simple branchlets, others irregularly two or three times dichotomous, the branches all spreading in one plane. The larger specimens are usually irregularly and sparingly branched, the branches being seldom more than three times dichotomous, the distance between the divisions being two or three inches. Sometimes the secondary branches arise only from the upper side of the outer branches, and are then sub-parallel and erect. In other specimens the branches all rise directly, spreading but little even at base. More commonly the branches spread outward at their origin in a broad curve, or even nearly at right angles, and then bent upward and are usually more or less crooked and slightly enlarged toward the tips, though sometimes of uniform size or even slightly tapering. The verrucæ are rather large and prominent, crowded, usually appressed and loosely imbricated, yet on some of the branches they are often erect, spreading sometimes even at right angles. The upper side is rudimentary, the verrucæ consisting almost entirely of the broad, elongated, more or less flattened and incurved lower lip. The cells are large, occupying nearly the whole of the upper side of the verrucæ, when fresh surmounted by a large cluster of white polyp-spicula from the bases of the tentacles. The surface is somewhat rough with rather small imbricated spicula, many of which project a little at the summit. The cœnenchyma is thick and compact, covered with stout, thick spicula. The axis is a little compressed at the axils; clear black in the larger branches; brown, slender, and rigid in the branchlets. Color uniform yellowish white. In life, "the color, both of branches and polyps, is pure white,"—F. H. B.

Height of the largest specimen 11 inches; breadth 5; diameter of trunk ·37; of branchlets ·30 to ·40; length of verrucæ ·08 to ·10; breadth ·06 to ·08. Another specimen is 6·5 inches high; 4 broad; diameter of trunk ·45; of branchlets at base ·38 to ·40; near tips ·45 to ·48; length of longest verrucæ ·12. A third specimen is 5·5 inches high; 8 inches broad; diameter of branchlets ·30 to 37.

The spicula are white, larger than in the other species of this subsection and more regular. The larger ones are mostly rather blunt oblong spindles, covered with small, very rough, crowded warts on the convex outer side, and with large, prominent, sharp spinules on the inner surface, which is often straight or concave. The longer

spindles are only moderately stout, one end usually larger than the other and more or less obtuse, the other end generally acute, the surface rough with unequal warts and spinules. The stouter spindles are short and thick, frequently irregular and crooked, both ends usually tapering to blunt points, one being often quite obtuse, the surface densely covered with small rough warts. Some stout spicula are club-shaped, with the large end divided into two or three blunt, warty lobes. The medium sized spindles are very strongly warty with large, unequal, rough warts, which are not crowded; most of them are quite slender and acute, others stouter and blunter.

The longer spindles measure 1·42^{mm} by ·325^{mm}, 1·37 by ·350, 1·37 by ·325, 1·37 by ·275, 1·32 by ·300, 1·25 by ·300, 1·20 by ·275, 1·12 by ·275, 1·12 by ·225, 1·04 by ·275, 1·02 by ·225, ·950 by ·225, ·875 by ·175, ·825 by ·200, ·825 by ·175; the stouter spindles 1·50 by ·500, 1·37 by ·350, 1·32 by ·350, 1·17 by ·475, 1·17 by ·425, 1·17 by ·350, 1·12 by ·300, ·925 by ·300, ·875 by ·325, ·800 by ·350, ·700 by ·300, ·700 by ·250, ·575 by ·300, ·500 by ·250; the stout clubs 1·25 by ·500, ·825 by ·325, ·325 by ·250; the smaller spindles ·950 by ·150, ·900 by ·250, ·725 by ·150, ·725 by ·125, ·675 by ·150, ·650 by ·100, ·525 by ·100, ·525 by ·075, ·425 by ·100.

Panama, in rocky pools at low-water mark,—A. Agassiz, J. H. Sternbergh, F. H. Bradley; Pearl Islands, common,—F. H. Bradley.

This species is very distinct from the others of this sub-section, in its white color and the much larger and more regular spicula. Its color and peculiar verrucæ will also readily separate it from all other species which resemble it in size and mode of branching.

Muricea hebes Verrill.

Muricea hebes (pars) Verrill, Bulletin Museum Comp. Zoöl., p. 36, 1864; Proc. Boston Soc. Nat. Hist., vol, x, p. 328, 1866.

Plate VII, figure 8. Plate VIII, figure 11.

Corallum yellowish brown, small, sparingly dichotomous, forming low clumps of few branches, which are short, moderately stout, and clavate.

The base is flat and expanded, often giving rise to several stems, which mostly fork close to the base, each branch dividing again at from ·5 to 1 inch from its origin. Some of these branches again fork, but many remain simple and are 1 to 2·5 inches long. When young the stems are often erect, simple, clavate, and 1 or 2 inches high. The

branchlets are as large as or larger than the branches before division. They are usually curved, sometimes of uniform size throughout, but generally enlarge toward the blunt tips, so as to be decidedly clavate, and vary in length from half an inch to two inches. The verrucæ are often unequal, rather small, crowded, loosely imbricated, mostly somewhat appressed; the upper lip very short or wanting; the lower one prolonged, flattened, and incurved, the lower surface rough and spinulose with the sharp projecting points of the small spicula, which are numerous and imbricated. The cells are situated on the upper and inner surface of the verrucæ and open upward, but are nearly concealed by the incurved lower lip. The cœnenchyma is thick and rather firm, showing but little between the crowded verrucæ of the branchlets. Color dull reddish brown or yellowish brown, varying in shade. In life "stem and polyps deep orange,"—F. H. Bradley.

Height of largest specimen 3 inches; breadth 3·75; diameter of smaller branches and base of branchlets ·23 to ·25; of branchlets near tips ·30 to ·32; length of verrucæ ·06 to ·10; breadth ·05. Another specimen is 2·5 inches high; 3·5 broad; with the brachiets ·25 to ·30 in greatest diameter. Most specimens are considerably smaller, the branchlets often not more than ·20 in diameter, with the verrucæ also considerably smaller.

The spicula are light yellowish brown and yellowish white in color, and relatively small, the larger ones consisting of both longer and stouter warty spindles, and irregular, flattened, rough spicula, often as broad as long, and usually with one edge lacerately divided. The longer spindles are mostly rather stout, often irregular, with a very roughly warted surface, and sharp prominent spinules on one side; the ends usually acute, one often blunter than the other. The stouter spindles are short, thick, often oblong or oval, both ends usually blunt, one often smaller than the other, the surface roughly warted. The irregular flattened spicula of the cœnenchyma are numerous and relatively large, very roughly warted, and with one edge deeply divided into irregular, lacerate teeth or spindles, which are usually sharp. The forms vary exceedingly, some being somewhat oval, quadrangular, triangular, or head-like, but the majority are quite irregular. The small spicula are mostly either quite slender, or short and thick warty spindles.

The longer spindles measure ·875^{mm} by ·275^{mm}, ·775 by ·200, ·775 by ·150, ·750 by ·175, ·750 by ·125, ·725 by ·225, ·725 by ·175, ·700 by ·225, ·675 by ·200, ·650 by ·137, ·625 by ·150, ·600 by ·150, ·600 by ·125, ·575 by ·100, ·550 by ·125, ·450 by ·100; the stouter spindles ·775 by

·350, ·775 by ·300, ·750 by ·350, ·750 by ·325, ·725 by ·300, ·725 by ·275, ·700 by ·275, ·675 by ·325, ·650 by ·300, ·625 by ·325, ·625 by ·300, ·625 by ·225, ·600 by ·325, ·600 by ·250, ·600 by ·225, ·575 by ·325, ·575 by ·275, ·550 by ·275, ·500 by ·200, ·450 by ·225, ·425 by ·300, ·400 by ·225; the irregular flattened spicula ·700 by ·325, ·625 by ·475, ·625 by ·275, ·575 by ·400, ·550 by ·450, ·525 by ·400, ·525 by ·375, ·475 by ·375, ·450 by ·325, ·425 by ·425; the heads ·425 by ·300, ·250 by ·200; the small spindles ·425 by ·150, ·400 by ·100, ·400 by ·087, ·275 by ·150, ·300 by ·125. Some spindles from the verrucæ are included among the preceding measurements of larger spindles, others measure ·825 by ·250, ·800 by ·200, ·775 by ·162, ·625 by ·200, ·625 by ·175.

Panama and Pearl Islands, common in rocky pools near low-water mark,—F. H. Bradley; Acapulco,—A. Agassiz; Corinto,—J. A. McNiel.

This species is liable to be confounded with the young of *M. austera* and *M. albida*, and perhaps other species; from the latter it differs in color and in having smaller verrucæ; from the former in its less projecting, more appressed and smaller verrucæ, and lower growth, as well as lighter color; and from both it differs widely in its much smaller and very differently shaped spicula, which more nearly resemble those of *M. robusta* and *M. purpurea*. From the last it may be at once distinguished by its color and less appressed verrucæ, which are much rougher, owing to the projecting points of the more acute spicula; from the former it differs in its well developed verrucæ, smaller cells opening upward, lower growth, and less robust branches.

Muricea purpurea Verrill.

Muricea hebes (*pars*) Verrill, Bulletin Museum Comp. Zoöl., p. 36, 1864.
Muricea purpurea Verrill, American Jour. Science, vol. xlv, p. 412, May, 1868.

Plate VII, figure 6. Plate VIII, figure 12.

Corallum sparingly dichotomous, with stout, obtuse, rigid, mostly curved branches, usually arranged nearly in one plane, closely covered by small, appressed, granulous verrucæ.

When young it often rises to the height of 2 to 4 inches as an upright, simple, clavate stem, ·25 to ·32 inch in diameter. Other specimens are two or three times dichotomous before they become two inches high. The larger specimens, when well developed, usually consist of several trunks arising near together from a broad, expanded base, forming open clumps of stout, crooked branches, which are sparingly divided, the branchlets upon each main stem generally spreading nearly in one plane. The trunk often forks within half an inch from the base, but

at other times at two or three inches. The main branches are about as large as the trunk and divide again at ·5 to 3 inches from their origin. Some of the secondary branches remain simple, but most of them divide again in an irregularly dichotomous manner, the branches being from ·5 to 2 inches apart. The branches almost always diverge greatly at first, sometimes even almost at right angles, and then bend upward with a broad curve. The branchlets are mostly crooked, or variously curved, divergent, about as large as the branches, sometimes slightly tapering, but usually uniform in size or a little clavate, obtusely rounded at the end, varying in length from ·5 to 2 inches. In two specimens some of the main branches are broad and somewhat flattened, diameter ·65 by ·30. The largest specimens consist of a single stem, which divides at the height of two inches, the first branch remaining simple and about three inches long, the main stem divides again within half an inch, and each of the nearly equal main branches forks at about half an inch from its origin, and their subdivisions are again dichotomous at ·5 to 1·5. Some of the resulting branches remain simple, but most of them are once and a few twice dichotomous, at distances of 1 to 2·5 inches. The branchlets are all curved or crooked, 1 to 2·5 inches long, ·35 in diameter, mostly a little clavate, very ob- e and, like the branches, are situated nearly in one plane. The verrucæ are rather small, short, crowded, usually appressed and somewhat imbricated, the upper lip obsolete, the lower one well developed, oval, obtusely pointed, the tip often incurved. On the trunk and lower part of branches the lower lip is usually less developed, not appressed, often obliquely truncated, the cells opening upward and outward. The surface of the verrucæ is strongly granulous with the very small and short, warty spicula, but not spinulose. Cœnenchyma thick, firm, granulous. Axis yellowish brown at base; brownish black in the branches and compressed at the axils; yellowish brown, coarse, rigid, and brittle in the branchlets. Color uniform reddish purple, the surface when dry covered with a film of dull yellowish.

The largest single specimen is 9 inches high; 7 broad; diameter of trunk ·40; of branchlets ·28 to ·35; length of largest verrucæ ·06 to ·07; breadth at base ·05 to ·06. One of the clumps is 6 inches high; breadth 9 by 5·5. In some dwarf specimens the diameter of the branchlets is only ·20 to ·25. In some specimens the largest verrucæ become ·10 of an inch long, and ·06 or ·07 broad.

The spicula are small and bright reddish purple, sometimes tinged with yellowish. The larger ones are mostly short and stout spindles, stout thorny clubs, and short irregular spicula, lacerately spinulose on

one side. The larger spindles are usually somewhat oblong, blunt at both ends, often irregular, closely covered with larger, very rough warts, except on the inside, which bears rather large, prominent, sharp spinules. The clubs are very stout and rough, often one-sided or irregular, the small end not very acute, covered with crowded rough warts, the larger end much dilated, lacerately divided into many long, sharp, often very slender, unequal spinules. The irregular spicula are very short and thick, often nearly as broad as long, sometimes oval, very rough with large, crowded, prominent, lacerate warts, one side lacerately divided into long, very sharp spinules. Very rough warty heads occasionally occur, similar to the last. The small spindles are mostly rather stout, blunt at the ends, and covered with very prominent, not crowded, somewhat rough warts. The polyp-spindles are mostly slender, acute, yellowish brown spindles, covered with small but prominent warts.

The larger spindles measure ·625^{mm} by ·225^{mm}, ·600 by ·200, ·575 by ·275, ·575 by ·200, ·550 by ·300, ·550 by ·250, ·550 by ·200, ·550 by ·175, ·500 by ·225, ·500 by ·150, ·475 by ·200, ·450 by ·200, ·425 by ·175, ·425 by ·150, ·400 by ·150, ·375 by ·150, ·350 by ·175; the stout clubs ·575 by ·300, ·550 by ·300, ·525 by ·250, ·500 by ·250, ·500 by ·200, ·475 by ·250, ·475 by ·200, ·450 by ·225, ·450 by ·200, ·425 by ·225, ·425 by ·200, ·425 by ·175, ·400 by ·225, ·400 by ·200, ·400 by ·175, ·325 by ·200, ·325 by ·150; the irregular stout spicula ·575 by ·325, ·575 by ·250, ·550 by ·275, ·525 by ·300, ·500 by ·250, ·450 by ·175, ·400 by ·300, ·400 by ·200, ·375 by ·225, ·350 by ·175, ·325 by ·225, ·325 by ·200; the heads ·325 by ·225, ·300 by ·275; the small spindles ·300 by ·112, ·262 by ·100, ·250 by ·125, ·250 by ·100, ·225 by ·112, ·200 by ·100; the polyp-spindles ·262 by ·037, ·250 by ·050, ·225 by ·062, ·225 by ·050, ·175 by ·050.

Pearl Islands and Panama, in rocky pools at low-water mark, common,—F. H. Bradley; Panama,—J. H. Sternbergh, A. Agassiz; Acapulco,—A. Agassiz; Corinto,—J. A. McNiel.

This species differs from most others in color and in the small granulous verrucæ. *M. retusa*, which has a somewhat similar but darker color, has much larger, spreading verrucæ and very different larger spicula. In some respects it is allied to *M. hebes*, which it considerably resembles, except in color, when young. Young specimens of these two species were formerly confounded by me,—a mistake that might readily have been avoided by an examination of the spicula, which are very different. The spicula of this species are remarkable for their relatively small size, roughness, and stout forms, among which the thorny clubs are, perhaps, the most characteristic.

Muricea clavata (*Gonigoria clavata* Gray)* appears to be closely allied to this species, and may prove identical upon actual comparison. The specimen described and figured is evidently young, consisting of a simple clavate stem, as in the young of many other species of *Muricea*. Its locality is unknown and the description is not sufficiently detailed to determine whether it be identical with this or not.

b.—*Cœnenchyma rather thin; branchlets slender.*

Muricea appressa Verrill.

Gorgonia plantaginea Val., Voyage de la Vénus, Zoöph., Pl. 15, 1846,† (*non* Lamarck).
Muricea appressa Verrill, Bulletin Museum Comp. Zoöl., p. 37, Jan., 1864; Proc. Boston Soc. Nat. Hist., vol. x, p. 329, 1866.
Eunicea Tubogensis Duch. and Mich., Supl. Corall. des Antilles, p. 17, Tab. 3, fig. 5 and 6 (after May, 1864), in Mem. Reale Accad. Sci., Torino, xxiii, p. 111, 1866.

Plate VIII, figure 13.

Corallum deep brown, sometimes yellowish white, flabelliform, much subdivided, with small, closely appressed verrucæ.

When young the corallum is quite slender; the small trunk divides within a quarter or half an inch from the base into two or three main branches, each of which usually forks again within about a quarter inch, and the resulting branches subdivide irregularly in a dichotomous or sub-pinnate manner, so that specimens 2·5 inches high often have more than twenty branchlets, all of which are quite slender and nearly equal in diameter. The large specimens are usually very numerously branched, all the branches standing nearly in one plane, the principal branches mostly sub-pinnate, often secund. The branchlets usually arise at ·25 to ·50 of an inch apart, and, after curving outward a little at base, rise nearly parallel with the branch from which they originate; they are usually quite slender, flexible, mostly 1 to 6 inches long, varying considerably in diameter in different specimens. The verrucæ are quite small, crowded, closely imbricated, with the lower lip much elongated and incurved, so as to conceal the cells, usually closely appressed, but not invariably so; their surface is scabrous, covered with small, short, and very rough spicula, the ends but slightly projecting. Cœnenchyma thin, very little exposed, except on the base and main branches, covered with small rough spicula and slender spindles. Axis black at base and in the larger branches, finely striated longitudinally and usually compressed, especially at the axils,

* Proceedings of the Zoölogical Society of London, 1851; Annals and Magazine of Natural History, vol. 3, page 422, 1859.

† The figure represents a coarse, poorly grown specimen. Spicula from the original type agree with those of our typical form,—Reprint.

light brown, slender, setiform, and flexible in the branchlets. Color, except in the light variety, uniform deep brown. In life, "the stem is dull red, polyps brownish yellow,"—F. H. B.

The largest specimens are often 18 inches across; a medium sized one measures in height 8 inches; breadth 10; diameter of trunk ·25; of main branches ·20; of branchlets ·10 to ·12. A stouter branched specimen is 10 inches high; 10 broad; diameter of trunk ·50; of main branches ·25 to ·35; of branchlets ·12 to ·18; length of verrucæ ·06; breadth ·03. In some specimens many of the branchlets do not exceed ·08 in diameter. A specimen from Zorritos is 15 inches high; 8 broad; diameter of branchlets ·12 to ·18; many of the simple terminal branchlets are 6 to 9 inches in length, some tapering very slightly to the end, others of nearly uniform size throughout their length.

The spicula are small, yellowish brown and deep reddish brown. The larger ones are mostly very rough spindles; very thorny, stout clubs; very slender, warty spindles; and stout, irregular, lacerate spicula. The larger spindles are mostly rather stout, somewhat irregular, covered on the outside with very rough, unequal warts, on the inside with large, sharp, lacerate spindles. The clubs are short and stout, often one-sided, the small end acute and warty, the other end much enlarged, lacerately divided into large, prominent, rough spinules. The irregular spicula are of various forms, often flattened, with one edge deeply divided into large, unequal, lacerate spinules. The slender spindles are of various lengths, some being very long and slender, with acute ends, covered on all sides with small, well separated warts.

The larger spindles measure ·925^{mm} by ·125^{mm}, ·900 by ·150, ·750 by ·175, ·700 by ·125, ·575 by ·175, ·575 by ·150, ·550 by ·200, ·525 by ·187, ·525 by ·175, ·525 by ·162, ·500 by ·200, ·500 by ·175, ·500 by ·150, ·475 by ·125, ·450 by ·150, ·450 by ·125, ·425 by ·150, ·425 by ·125, ·400 by ·125, ·350 by ·125, ·275 by ·175; the slender spindles ·800 by ·100, ·725 by ·075, ·700 by ·125, ·700 by ·100, ·625 by ·075, ·575 by ·075, ·525 by ·100, ·525 by ·087, ·525 by ·075, ·500 by ·112, ·500 by ·100, ·475 by ·075, ·425 by ·087, ·425 by ·075, ·350 by ·062; the clubs ·600 by ·225, ·550 by ·200, ·525 by ·225, ·500 by ·275, ·450 by ·200, ·450 by ·175, ·450 by ·150, ·400 by ·150, ·375 by ·175, ·375 by ·150, ·375 by ·125, ·350 by ·137, ·325 by ·175, ·275 by ·125; the irregular spicula ·500 by ·325, ·475 by ·275, ·450 by ·250, ·450 by ·200, ·425 by ·175, ·400 by ·175, ·400 by ·125, ·250 by ·125, ·225 by ·150, ·150 by ·150.

Zorritos, Peru, dredged in 3 to 5 fathoms, F. H. Bradley; Pearl Islands, in pools at extreme low-water mark, F. H. Bradley; Pana-

ma,—J. H. Sternbergh, F. H. Bradley; Corinto, Nicaragua,—J. A. McNiel; La Paz,—J. Pedersen.

Var. flavescens.

Corallum agreeing in the mode of branching and in size and form of branchlets and verrucæ, with the typical specimens, but yellowish or whitish in color. In life, "stem and polyps pure white, polyps ·12 of an inch long, ·03 in diameter, nearly transparent; tentacles eight, very short, appearing as mammillæ on the edge of the disk,"—F. H. B.

The height of a specimen from Zorritos is 8 inches; breadth 11; diameter of branchlets ·10 to ·15. Another one is 12 inches high; 10 broad; diameter of branchlets mostly about ·12; length of branchlets mostly 2 to 5 inches.

The spicula are white and agree very well with those of the typical form, but the larger spindles and clubs, in the specimens examined, average somewhat larger and are, perhaps, a little rougher.

The larger spicula measure ·825^{mm} by ·200^{mm}, ·750 by ·200. ·750 by ·175, ·725 by ·125, ·625 by ·150, ·575 by ·150, ·475 by ·200; the clubs ·650 by ·212, ·625 by ·225, ·575 by ·200, ·500 by ·225, ·500 by ·200.

Zorritos, Peru, dredged in 3 to 5 fathoms; and Pearl Islands, at extreme low-water mark,—F. H. Bradley; Corinto,—J. A. McNiel.

This species can scarcely be confounded with any other, unless with the following, from which it differs in its more numerous, shorter, and less slender branchlets, larger, stouter, and more incurved verrucæ, and especially in the character of the spicula.

The specimen figured by Duchassaing and Michelotti* is evidently the young of this species. The projecting points of the spicula, represented in their magnified figure, should have been a sufficient indication of its generic affinities.

Muricea tenella Verrill, sp. nov.

Plate VI, figure 12. Plate VIII, figure 14.

Corallum whitish, dichotomous, with long and very slender branchlets, and prominent, slender, acute verrucæ, covered with long, slender spindles.

The typical specimens from Panama are small and slender. The trunk divides within half an inch from the base into two or three nearly equal branches, each of which forks again within a quarter inch. The secondary branches afterward subdivide at distances of ·25 to ·80 of

* Although the exact date when their memoir was published is unknown to me, it certainly was subsequent to the publication of this species in the Bulletin of the Mus. Comp. Zoöl., which is sufficiently evident from the foot-note on page 7, dated "*Turin, ce 17 mai*, 1864."

an inch, the branchlets mostly arising from their outer side in a somewhat secund manner. They curve outward a little and then rise subparallel to the branches, and some of them again subdivide. The terminal ones are from ·5 to 2 inches long, very slender and flexible, of nearly uniform size throughout.

A large specimen from Zorritos consists of seven large, compressed, divergent branches, arising together from close to the base. These rapidly divide into many long, slender branches, which form an acute angle with the larger branch, and arise at distinces of ·25 to 1 inch apart, becoming more distant outward. The secondary branches divide in the same manner, and likewise many of the resulting branchlets. In this manner the branches form a broad, rounded, fan-shaped corallum, with long, very slender, flexible, terminal branchlets, some of which are 5 or 6 inches long, but most of them 2 or 3 inches. The verrucæ are very small, but usually quite prominent, with an elongated, slender, sharp, lower lip, which is often but little incurved at tip, and composed of long, slender, acute spindles, which project at the tip.

In the Panama specimens the verrucæ are not crowded and scarcely imbricated or appressed, but in the large specimens from Zorritos they are smaller, crowded, more or less imbricated, with a shorter and less acute lower lip. The cœnenchyma is thin, covered with small, slender, rough spindles. Axis black and somewhat compressed in the larger branches, strongly compressed in the large specimens; brown and setiform in the branchlets. Color, of dry specimens, grayish white; in alcohol dark gray, polyps brown. In life, "stem white, polyps dark brown." In the Zorritos specimen, during life, "the stem is pure white, polyps light brown, body of polyps transparent. The eight tentacles appear as mere thickenings of the edge of the disk, often giving it a somewhat angular form,"—F. H. B.

The largest Panama specimens measure 3·5 high by 3 broad; and 4 inches high by 3·5 broad; diameter of branchlets, including verrucæ, ·10 to ·12; length of verrucæ ·05 to ·06; diameter ·02 or ·03. The largest specimen from Zorritos is 17 inches high; 18 broad; diameter of largest branches at base ·30 to ·40; of branchlets ·07 to ·10.

The spicula are white, the larger ones consisting of remarkably long, slender, and acute warty spindles, which are often bent; of somewhat stouter and shorter, roughly warted and spinulose spindles; with a few very rough, often lobed, irregular spicula, and rather long, thorny clubs. The characteristic, very slender, acute spindles are covered with very small, scattered warts.

The larger spindles measure ·875mm by ·150mm, ·825 by ·150, ·775 by ·150, ·750 by ·150, ·700 by ·150, ·700 by ·125, ·675 by ·125, ·550 by ·137; the slender spindles 1·12 by ·12, 1·12 by ·087, 1·10 by ·100, ·900 by ·087, ·875 by ·100, ·775 by ·100 ·775 by ·062, ·750 by ·100, ·750 by ·075, ·700 by ·075, ·650 by ·087, ·625 by ·075, ·575 by ·075, ·375 by ·050; the clubs ·575 by ·112, ·450 by ·137; the irregular spicula ·400 by ·175, ·375 by ·250, ·325 by ·200, ·300 by ·150.

Zorritos, Peru, dredged in 3 to 5 fathoms,—F. H. Bradley; Panama and Pearl Islands, in rocky pools at extreme low-water mark, very rare,—F. H. Bradley; Corinto,—J. A. McNiel.

This species is remarkably distinct from all others known by reason of its very slender branches; long, slender, and acute verrucæ; and its extremely slender and sharp spindles.

It resembles most the slender specimens of *M. appressa, var. flavescens*, in external characters. The spicula are most like those of *M. aspera*, but are much smaller and more slender.

Muricea aspera Verrill, sp. nov.

Corallum yellowish white, flabelliform, with somewhat slender branches, which are subpinnate.

Only two specimens of this species were obtained, both of which are imperfect at base, and may be only branches from a much larger specimen. Each specimen is once dichotomous and both main branches are subpinnate, giving off branchlets at distances of ·25 to ·50 of an inch, which spread outward at a wide angle, often nearly at right angles. Some of these again divide in the same manner. The terminal branchlets are rather slender and mostly from 1 to 1·5 inches long, narrowed at base and usually enlarged a little toward the end. The verrucæ are prominent, loosely imbricated, usually slightly appressed, but sometimes not at all so, usually with an elongated, acute lower lip, formed of long slender spicula, which project slightly at the end. The upper lip is rudimentary or entirely wanting. On the larger branches the lower lip is often but little developed, and the large cells open outward. The cœnenchyma is thin, covered with long spindles, some of them quite stout. Axis black in the larger branches; yellowish brown, slender, and brittle in the branchlets.

Height of largest specimen 5·5 inches; breadth 4; diameter of branchlets ·10 to ·16; length of longest verrucæ ·10; diameter ·05.

The spicula are white and consist mostly of long, very slender spindles, most of which are very acute; and larger and stouter, but quite

long spindles. The larger spindles are mostly somewhat irregular or crooked, sometimes forked at one end, usually acute at each end, but sometimes blunt or truncate at one or both, densely covered with rough, unequal warts. The slender spindles are very long, slender, acute at both ends, often bent, the surface covered with small, distant warts.

The larger spindles measure 2·00^{mm} by ·325^{mm}, 1·65 by ·350, 1·57 by ·200, 1·52 by ·250, 1·37 by ·200, 1·35 by ·300, 1·32 by ·250, 1·20 by ·200, 1·17 by ·275, 1·17 by ·250, 1·17 by ·200, 1·10 by ·200, 1·05 by ·250, 1·02 by ·225, 1·02 by ·200, ·800 by ·150; the slender spindles 1·37 by ·125, 1·32 by ·125, 1·25 by ·112, 1·25 by ·125, 1·12 by ·150, 1·07 by ·125, 1·05 by ·100, ·100 by ·100, ·925 by ·150, ·900 by ·087, ·875 by ·100, ·875 by ·087, ·825 by ·100.

Panama, at extreme low water, very rare,—F. H. Bradley.

This species bears little resemblance to any other, except the two preceding, from both of which it differs in having much longer and larger spicula. Its branches are much shorter and stouter than those of *M. tenella*, and the verrucæ are very different from those of *M. appressa*.

Remarks on the subdivisions of the Genus, Muricea.

In addition to the 18 species of *Muricea* described in the preceding pages, there are at least 12 other species now known, of which all except four are in the Museum of Yale College.*

All those species which I have examined may be naturally grouped in three divisions, which do not appear, however, to be of more than subgeneric value, even if entitled to that rank. But in view of the manifest tendency among recent authors to multiply generic divisions, I have thought it proper to recognize these groups and give them names.

Group 1, *Eumuricea*. This division corresponds with section A, page 419. It includes those species with tubular verrucæ, without a prolonged lower lip, and usually 8-rayed at summit in contraction. The spindles both of the cœnenchyma and verrucæ are long and usually sharp pointed. The 5 species described above are all that are known to me. Typical species, *M. acervata* V.

* The species not in this collection are *M. vatricosa* (Val.) Köll.; *M. humosa* (Esp.) Köll.; *M. tuberculata* (Esp.) Köll.; *M. sulphurea* Ehr. Also *M. elongata* Lamx. (*non* Dana), which is believed to be an *Acis*, from W. Indies.

Group 2, *Muricea* (typical). This group corresponds to section B, p. 425. It embraces those species in which the verrucæ are bilabiate, or have a prolonged lower lip. The spindles of the cœnenchyma and verrucæ are similar and usually stout, but sometimes slender and pointed.* In addition to the 13 species described above, it includes *M. muricata* V. (*M. spicifera* Lx.); *M. lima* E. and H.; *M. pendula* Verrill; *M. laxa* Verrill; and *M. elegans* Duch. and M., from the Atlantic coast of America; and probably *M. vatricosa* Köll., Archipel. Bizagos, Africa; and *M. sulphurea* Ehr., locality unknown.

Group 3, *Muricella.* This division includes those species which have a rather thin cœnenchyma, filled with long spindles; with low, subconical verrucæ, arising from between the large spicula and usually standing at right angles to the surface, and covered with much smaller and shorter spindles. The species are *M. flexuosa* V., Hong Kong; *M. nitida* V., Ebon I.; probably *M. humosa* Köll., and *M. tuberculata* Köll., from unknown localities; and one or two undescribed species, which I have seen, from the E. Indies.

This group approaches the genus, *Acis* D. and Mich., but the latter differs in having scale-like spicula covering the verrucæ.

Echinogorgia aurantiaca Verrill, (LEPTOGORGIA, 1st Ed., see p. 413).

Callao, Peru,—Edwards and Haime. A species allied to *E. sasappo* of the East Indies.—Reprint.

Heterogorgia Verrill.

American Journal of Science, xlv, p. 413, May, 1868.

Corallum dichotomous, with a horn-like axis. Cœnenchyma rather thin, with a smoothish or finely granulous surface, filled with quite small spicula, which are not conspicuous at the surface, and consist of various forms of roughly warted, short spindles, heads, double-heads, double-stars, crosses, with many irregularly shaped, small, rough spicula. Verrucæ rounded, somewhat prominent, smoothish below, armed at summit with long, sharp, often crooked spindles, which project from the surface around the cell in the form of sharp, divergent spinules. The name alludes to the remarkable diversity in the sizes and forms of the spicula.

* *M. robusta*, *M. purpurea*, and *M. hebes* V. depart considerably from the more typical species of this group, in having smaller, short, stout, very rough and irregular spicula. *Gonigoria clavata* Gray (see page 444) appears to belong to the same group, and in case a subgeneric name be desirable for these species *Gonigoria* may be used.

Heterogorgia verrucosa Verrill, loc. cit., p. 414.

Plate VI, figure 11. Plate VIII, figure 16.

Corallum grayish or yellowish white, low, dichotomous, with clavate branchlets and large, rounded, echinate verrucæ.

Young specimens sometimes grow to the height of two inches before dividing, and are then clavate and obtusely rounded at summit. Other specimens, however, divide dichotomously within half an inch from the base; the main branches again divide at a distance of ·5 to 1·5 inches. In some cases part of the secondary branches are also sparingly dichotomous. The branchlets bend outward at base with a broad curve and are mostly irregularly curved and crooked, like the branches, and usually clavate and obtuse at the end, though sometimes of uniform size. The verrucæ are large, rounded, prominent, not crowded, standing at right angles with the surface of the branches, slightly eight-rayed at the summit and armed with numerous long, very sharp, rough, spindle-shaped spicula, which project from the surface in the form of short, divergent spinules. The sides of the verrucæ and the cœnenchyma are nearly smooth, showing under a strong lens a finely granulous surface composed of small rough spicula. Cells small, sometimes surmounted by a conical cluster of very slender, white polyp-spindles. The cœnenchyma is rather thin and firm, composed of small rough spicula. Axis dull yellowish brown, wood-like in appearance. Color pale yellowish gray when dry, a little darker in alcohol. In life, "stem dull yellowish brown, polyps gamboge-yellow,"—F. H. B.

Height of largest specimens 3 inches; breadth 1·5; diameter of largest branches ·25; of branchlets near tips ·20; length of branchlets 1 to 2; height of verrucæ ·04 to ·06; diameter ·05 to ·07.

The spicula consist chiefly of large, more or less elongated, roughly warted spindles from the verrucæ; much smaller, very rough spindles and heads from the surface of the verrucæ and cœnenchyma; and very slender, small, smoother spindles from the polyps. The largest spindles are elongated; some of them are slender and tapering to one or both ends; others quite stout but equally long; all are covered with large, rough, well separated warts, and one side with short, sharp spinules; they are frequently irregular, often obtuse at one end, and not very acute at either. With these are many shorter and stouter spindles, which show a regular series of forms between the longest spindles and short, thick, oval or oblong spicula, which are not thrice longer than broad, the surface crowdedly covered with rough warts, the inner side with large spinules, the ends often blunt or obtuse, one of

them sometimes forked. The small spicula of the cœnenchyma are of various forms of small, very roughly warted spindles, heads, double-heads, double-stars, crosses, and various irregular and compound forms. The polyp-spindles are slightly and distantly warted, quite slender and acute; most of them are straight and pretty regular; some are much curved and very acute at both ends; others are slender club-shaped, more strongly warted at the larger end.

The longer spindles measure 1·50^{mm} by ·300^{mm}, 1·50 by ·275, 1·35 by ·300, 1·27 by ·275, 1·22 by ·225, 1·15 by ·275, 1·12 by ·250, 1·10 by ·250, 1·10 by ·225, 1·07 by ·250, 1·07 by ·225, 1·05 by ·250, 1·02 by ·225, 1·00 by ·225, ·975 by ·225, ·950 by ·225, ·925 by ·150, ·900 by ·225, ·875 by ·150, ·825 by ·175, ·800 by ·200, ·775 by ·175, ·750 by ·175, ·750 by ·125, ·675 by ·150, ·625 by ·125, ·575 by ·125, ·500 by ·125; the stouter spindles 1·55 by ·375, 1·25 by ·350, 1·22 by ·300, 1·20 by ·375, 1·20 by ·300, 1·15 by ·325, 1·15 by ·300, 1·12 by ·300, 1·05 by ·325, ·900 by ·250, ·850 by ·225, ·850 by ·200, ·825 by ·275, ·775 by ·250, ·725 by ·300, ·725 by ·275, ·700 by ·250, ·700 by ·200, ·450 by ·150; the stout irregular spicula 1·05 by ·325, 1·00 by ·400, ·975 by ·450, ·925 by ·275, ·925 by ·325, ·900 by ·375, ·650 by ·275, ·625 by ·275; the stout spicula with one end forked 1·15 long by ·675 across the forks, 1·00 by ·475, ·925 by ·450, ·675 by ·325; the small spindles from the cœnenchyma ·350 by ·100, ·325 by ·087, ·300 by ·125, ·275 by ·150, ·275 by ·125, ·275 by ·100, ·250 by ·100, ·212 by ·150; double-heads ·162 by ·112, ·162 by ·100, ·150 by ·112; the heads ·300 by ·200, ·212 by ·125, ·200 by ·175, ·150 by ·100, ·125 by ·100, ·125 by ·087, ·125 by ·075; the double-stars ·137 by ·075, ·125 by ·100, ·100 by ·075; the crosses ·300 by ·175, ·225 by ·100, ·200 by ·112, ·175 by ·150, ·175 by ·100, ·162 by ·100, ·150 by ·100; the straight polyp-spindles ·425 by ·075, ·400 by ·075, ·375 by ·075, ·375 by ·062, ·350 by ·075, ·350 by ·050, ·325 by ·075, ·275 by ·062, ·250 by ·037; the curved polyp-spindles ·475 by ·050, ·450 by ·062, ·300 by ·037; the polyp-clubs ·425 by ·083, ·425 by ·075, ·400 by ·075, ·375 by ·075, ·350 by ·062.

Pearl Islands, in rocky pools at extreme low-water, on the reef, very rare,—F. H. Bradley.

Heterogorgia tortuosa Verrill, loc. cit., p. 414.

Corallum pale yellowish, subflabelliform, with more numerous branches and more slender, crooked branchlets, covered with small scattered verrucæ.

In the largest specimens the trunk divides irregularly, close to the base, into several branches, some of which are very irregularly four

or five times dichotomous; the branchlets diverge frequently at right angles and are mostly very crooked, usually tapering somewhat to the obtuse tips, 1 to 3·5 inches long. One small specimen is simple for 1·5 inches from the base and then gives off subpinnately from each side seven crooked branchlets, which are mostly alternate on the opposite sides and from ·3 to ·5 of an inch apart; the lower ones diverge nearly at right angles and some of them branch near the end, or at ·75 to 1·25 of an inch from their bases.

The verrucæ are rather small, low, rounded or subconical, distantly scattered, opening outward, armed at the summit with a few small, slender, projecting spinules, their sides, like the cœnenchyma, having a very finely granulous surface, appearing smooth to the naked eye. Cœnenchyma rather thin, firm, filled with very small rough spicula. Axis dull brownish yellow, wood-like in appearance, its surface strongly furrowed longitudinally, giving it a corrugated or irregularly fibrous appearance.

Color a uniform dull yellowish or buff. Height of largest specimen 5·5 inches; breadth 5; diameter of largest branches ·20; of terminal branchlets ·10 to ·15; height of verrucæ ·03 to ·04; diameter ·04 to ·05.

The spicula are white, much smaller than in the preceding species. The larger ones consist of more or less stout, very roughly warted spindles, which are often irregular and usually acute; and of long, slender, very sharp spindles, with very small, distant warts or spinules. The small spicula of the cœnenchyma are of various forms of crosses, heads, double-heads, clubs, short spindles, etc., all of which are very roughly warted. The larger rough spindles measure ·375^{mm} by ·125^{mm}, ·350 by ·100, ·325 by ·125, ·325 by ·112, ·325 by ·100, ·312 by ·075, ·300 by ·112, ·300 by ·100, ·300 by ·087, ·300 by ·075, ·300 by ·062, ·275 by ·125, ·275 by ·112, ·275 by ·087, ·275 by ·062, ·250 by ·112, ·250 by ·100; the long, sharp, curved spindles ·575 by ·075, ·575 by ·050, ·550 by ·087, ·450 by ·075, ·400 by ·062, ·375 by ·050, ·325 by ·050; the small crosses ·175 by ·125, ·125 by ·087, ·100 by ·075, ·075 by ·062; the heads ·100 by ·075, ·087 by ·075, ·062 by ·062; the double-heads ·125 by ·075, ·100 by ·075, ·087 by ·075, ·087 by ·062, ·062 by ·050; the clubs ·125 by ·087, ·125 by ·075, ·087 by ·062; the small spindles ·125 by ·075, ·112 by ·062, ·100 by ·050, ·100 by ·037.

Pearl Islands, in rocky pools at extreme low-water mark,—F. H. Bradley.

This appears to be quite distinct from the last in its smaller and more numerous branches, smaller and less prominent verrucæ, and

much smaller spicula. Possibly a large series of specimens might show intermediate forms, but none occur in this collection.

Primnoa Lamouroux.

Primnoa Lamx., Polypiers flexibles, p. 440, 1816; Dana, Zoöph., p. 676; Edw. and Haime, Corall., vol. i, p. 139; Kölliker, Icones Histiol., p. 135.

Axis more or less calcareous, especially at the base, which is usually quite stony. Verrucæ usually in whorls, very prominent, covered with scale-like, imbricated spicula. Cœnenchyma also covered by smaller scale-like spicula. Type, *P. reseda* Pallas sp. (*P. lepadifera* Lamx.).

Primnoa compressa Verrill.

Proceedings Essex Inst., vol iv, p. 189, 1865.

This species is, as yet, known only by its axis. It is much branched, flabelliform. The smaller branches arise alternately from each side of the main branches, forming acute angles with them. Branches and branchlets strongly compressed, delicately striated, hard and stony, dark brown near the base, yellowish white and setaceous in the branchlets.

Height 24 inches; diameter of largest branches ·25.

Aleutian Islands,—Capt. Gibson.

Family, Briareidæ Gray.

Briaracées (section) Edw. and Haime, Coralliaires, vol. i, p. 188, 1857.
Briareidæ (family) Gray, Annals and Mag. Nat. Hist., vol. 4, p. 443, 1859.
Briaraceæ (family) Verrill, Memoirs Boston Society Nat. Hist., 1, p. 10, 1863.
Briaridæ (family) Verrill, Proceedings Essex Institute, vol. iv, p 148, 1865.
Briareaceæ (sub-family) Kölliker, Icones Histiol., p. 141, 1865.

Corallum arborescently branched, lobed, or encrusting foreign substances. Axis composed of calcareous spicula, which are not consolidated. Cœnenchyma well developed, filled with small, rough spicula, of various forms. Surface granulous. Cells scattered.

The typical genera of this family are *Briareum*, *Paragorgia*, *Titanideum*, and allied forms. These are usually arborescently branched, or rise in irregular lobes, with a well marked spiculose axis. To these typical genera Dr. Kölliker has added *Sympodium* and *Erythropodium*, which are normally encrusting or parasitic species, with a thinner cœnenchyma and apparently without a distinct axis, and may, perhaps, be best compared with the spreading basal portion of *Briareum*.

The position of the following genus seems doubtful, and though agreeing best, in the structure of its spicula, with this family, it may

belong to the *Alcyonacea*, near *Rhizozenia*, which Dr. Kölliker refers to the *Cornularidæ*.

Callipodium Verrill, gen. nov.

Corallum encrusting stones and shells, with a firm, more or less thickened, finely granulous cœnenchyma, which may spread either in broad expansions or narrow stolons. Polyps rather large, at the summit of round-topped verrucæ, which are more or less elevated above the surface of the cœnenchyma and either distantly scattered or closely crowded together; in the latter case often united laterally nearly to their summits. Polyps wholly contractile, and also capable of involving the summits of the verrucæ, which, in contraction, are usually distinctly eight-rayed.

Spicula short, of moderate size, brightly colored, very abundant in the cœnenchyma and verrucæ, of various forms and sizes, mostly with very roughly warted prominences, the largest about ·30^{mm} long. The most abundant forms have 3, 4, 5, 6, or 8 irregular projections, covered at the ends with rough spinulose warts. Some are short, stout, blunt spindles, about twice as long as broad, with distant, prominent, rough warts. Some approach the forms of double-clubs, double-heads, heads, and crosses. Others are of various irregular forms, with distant rough warts. Type *C. Pacificum* V.

This genus in some characters resembles *Erythopodium* Kölliker, in others *Rhizozenia* Ehr., or at least *R. rosea* Dana (*Evagora* Phil.) as characterized by Dr. Kölliker, which may not belong to the same genus with *R. Thalassantha*, the original type of the genus. The polyps of *Rhizozenia* are said to be non-contractile; the texture of the cœnenchyma is quite different; and the spicula (in *R. rosea*) are much smaller. *Erythropodium* is described as having a membranous base, with scarcely prominent verrucæ, and the spicula are much smaller and differently shaped.

Having had no opportunity to examine typical specimens of either of those genera I have found it difficult to decide to which the present genus is most nearly allied. In the texture of the cœnenchyma, and especially in the structure of the spicula, it appears to be more nearly allied to the *Briareidæ* than to the *Cornularidæ*, and I am therefore inclined to regard it as an encrusting genus of the former family, since even the typical species of the genus *Briareum* is sometimes found growing in broad encrusting sheets on stones, or parasitically covering the dead axis of many species of *Gorgonidæ*.

Callipodium Pacificum Verrill.

Sympodium Pacifica Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 329, 1866.
Erythropodium Pacificum Verrill, Amer. Jour. Sci., vol. xlv, p. 415, May, 1868.

Plate V, figure 22. Plate IX, figure 1.

Corallum red, encrusting, spreading over the surface of stones and shells, either as broad, rather thin sheets, which are usually irregular and often interrupted, or in the form of stolon-like expansions, which may be broad, or quite narrow, and are often reticulated, as in the specimen figured.

Verrucæ irregularly and usually distantly scattered, sometimes a little crowded, on the stolons often arranged in a single series, quite large, usually very prominent and more or less conical, with a rounded, eight-rayed summit; sometimes, when fully contracted, having the form of low rounded warts. Cœnenchyma rather thin, firm, very spiculose, its surface, like that of the verrucæ, strongly granulose with the small rough spicula.

Color, when dry, bright red; in alcohol a deep, clear red. When living, "dull brick-red to purplish red. Polyps, when fully closed, mere pimples on the surface, when expanding they show first a low rounded cone, marked with pointed groups of red spicula, between which now come forth the nearly transparent polyps, which have eight small, acute, pinnate tentacles, swollen at base, surrounding the mouth of the opaque, pinkish white stomach. Height from attachment to summit of tentacles ·20 inch; diameter ·05,"—F. H. B. According to Mr. Bradley's outline sketch of the expanded polyps, the tentacles are very acute, and the pinnæ, which are confined to the outer half, are long and slender.

The largest specimens in the collection almost completely cover portions 3 inches by 1·5 on the surface of the stones; thickness of cœnenchyma, when dry, ·02 to ·03; height of verrucæ above the surface ·04 to ·10, average about ·06; diameter ·05 to ·08, average about ·07. The breadth of the stolons in the reticulated specimens varies from ·05 to ·25, the narrow parts being extremely thin.

The spicula are bright red, very roughly but distantly warted, and very diversified in size and form. The larger ones are partly short, stout, blunt spindles, with few (often not more than twelve) large, distant, rough warts; partly of three, four, five, and six-pronged star-spicula, each branch or prong terminated by one or several rough warts; partly of very roughly warted heads; and of various irregular, very rough forms. The small spicula agree in their forms, to a considerable extent, with the large ones, but in addition to the spindles, heads, and

3 to 6 pronged stars and crosses, there are also double-heads, clubs, double-clubs, and various irregular forms.

The larger spindles measure ·212^{mm} by ·125^{mm}, ·200 by ·100, ·175 by ·125, ·175 by ·112, ·175 by ·100, ·162 by ·125, ·150 by ·112, ·150 by ·100, ·125 by ·087; the three-pronged spicula ·200 by ·150, ·175 by ·162, ·150 by ·150, ·150 by ·125, ·125 by ·125, ·125 by ·100; the four-armed crosses ·212 by ·175, ·175 by ·162, ·137 by ·112, ·125 by ·125; the five-rayed stars ·162 by ·150, ·125 by ·087, ·112 by ·100; the six-pronged spicula ·162 by ·112, ·150 by ·125; the irregular spicula ·175 by ·137, ·162 by ·125, ·150 by ·125, ·125 by ·112. Among the small spicula some of the smaller spindles measure ·100 by ·062, ·075 by ·050; heads ·100 by ·075, ·075 by ·075; double-heads ·062 by ·032, ·050 by ·037; clubs ·125 by ·075, ·075 by ·050; double-clubs ·100 by ·050, ·087 by ·037.

Panama and Pearl Islands, at low-water mark; and Zorritos, Peru, from half-tide downward, on the under side of projecting stones and on shells,—F. H. Bradley; La Paz,—J. Pedersen.

Callipodium aureum Verrill, sp. nov.

Plate V, figure 23.

Corallum yellow, encrusting, consisting of crowded, elongated, tubular corallites, united nearly to their summits, thus forming a corymbose cluster, with an uneven surface.

The verrucæ in the central parts, where most crowded, project but slightly above the surface and are rather large, rounded, and distinctly eight-rayed in contraction. Some of the lateral verrucæ project about ·10 inch. Cœnenchyma thickened, very spiculose, its surface and that of the verrucæ granulous. Color, in alcohol, bright orange-yellow.

Height ·5 of an inch; breadth 1; diameter of verrucæ about ·08.

Spicula bright golden yellow, similar in form to those of the preceding species, but larger, and with longer and more slender branches or rays in the star-shaped forms. The larger spindles are mostly rather stout, blunt, with distant, very prominent, large warts, which are spinulose at summit; they are often irregular or lobed, and some are rather slender. The star-shaped spicula have mostly three or four, sometimes five or six, rays or branches, which are mostly unequal and irregular, but usually considerably elongated and often slender, smooth at base, but covered at the ends with a cluster of rough warts or spinules. Irregular, roughly warted clubs and double clubs, nearly as large as the spindles, also occur sparingly. Irregularly formed spicula of various shapes, but with very prominent warts, are frequent.

The small spicula have all the forms seen among the larger ones, and in addition there are warty heads, double-heads, and other forms. The polyp-spindles are slender and slightly warted.

The larger spindles measure ·275^{mm} by ·075^{mm}, ·250 by ·112, ·225 by ·150, ·225 by ·125, ·225 by ·112, ·225 by ·100, ·225 by ·087, ·225 by ·075, ·212 by ·125, ·212 by ·087, ·212 by ·075, ·200 by ·125, ·200 by ·112, ·200 by ·075, ·187 by ·087, ·187 by ·075, ·175 by ·087, ·162 by ·100, ·162 by ·087, ·150 by ·100; the irregular warty spicula ·275 by ·137, ·225 by ·100, ·200 by ·162, ·200 by ·125, ·187 by ·125, ·175 by ·112; the three-branched spicula ·212 by ·112, ·200 by ·125, ·200 by ·100, ·187 by ·150, ·187 by ·137, ·175 by ·150, ·162 by ·112, ·150 by ·150, ·125 by ·125; the four-branched stars or crosses ·225 by ·187, ·187 by ·125, ·175 by ·162, ·137 by ·137; the six-branched spicula ·175 by ·125; the clubs ·187 by ·087, ·175 by ·100, ·162 by ·100. The small spindles ·125 by ·087, ·100 by ·075, ·100 by ·062; the clubs ·10^ by ·037; the heads ·125 by ·087, ·112 by ·087, ·087 by ·087, ·075 by ·075.

Panama,—F. H. Bradley. There is also a specimen from Panama in the Museum of Comparative Zoölogy.

Suborder, ALCYONACEA Verrill.

Alcyonides (family) Edw. and Haime, Coralliaires, vol. i, p. 102, 1857.
Sarcophyta (suborder) (*pars*) Gray, Ann. and Mag. Nat. Hist., 4, p. 443, 1859.
Alcyonidæ (suborder) Verrill, Mem. Boston Soc. Nat. Hist., i, p. 3, 1863.
Alcyonacea (suborder) Verrill, Proceedings Essex Inst., iv, p. 148, 1865.
Alcyonidæ (family) Köll., Icones Histiolog., p. 131, 1865.

Polyps usually elongated, the body-cavity tapering below. Cœnenchyma, when present, fleshy, usually with slender, rather simple spicula. No distinct axis.

Family, ALCYONIDÆ.

Halcyonina (*pars*) (family) Ehrenberg, Corall. des rothen Meeres, p. 56, 1834.
Alcyoninæ (*pars*) (subfamily) Dana, Zoöphytes, p. 599, 1846.
Alcyoninæ (*pars*) (subfamily) Edw. and Haime, Coralliaires, vol. i, p. 113, 1857; Kölliker, Icones Histiolog., p. 132, 1865.
Alcyoniadæ (*pars*) (family) Gray, Annals and Mag. Nat. Hist., vol. 3, p. 443, 1859.
Alcyoninæ (family) Verrill, Mem. Boston Soc. Nat. Hist., i, p. 3, 1863.
Alcyonidæ (family) Verrill, Proc. Essex Inst., iv, p. 148, 1865.

Corallum fleshy, attached by the abundant cœnenchyma, usually branched. Polyps much elongated, usually highly contractile, spicula mostly long and rather simple.

Alcyonium rubiforme Dana.

Lobularia rubiformis Ehr., Corall. des rothen Meeres, p. 58, 1834.

Alcyonium rubiforme Dana, Zoöphytes, p. 625, 1846; Verrill, Mem. Boston Soc. Nat. Hist., i, p. 4, 1863; Verrill, Proceedings Essex Inst., iv, p. 190, 1865.

Corallum red, with a short trunk, which divides into numerous, large, rounded lobes, or short, obtuse branchlets. The lobes, in contraction, are often subglobular, covered with numerous small polyps. Cœnenchyma, between the retracted polyps, even and granulous. Polyps in expansion much exsert; tentacles long, lanceolate, acute, with rather long lateral lobes. Color, in alcohol, brick red, not diaphanous.

Arctic Ocean, north of Behring's Straits, in 35 fathoms,—Capt. John Rodgers; West Coast of Behring's Straits, in the Laminarian zone,—Dr. Wm. Stimpson (North Pacific Exploring Expedition); Banks of Newfoundland,—Coll. Essex Institute; Northern Seas of Europe,—Ehrenberg.

Specimens apparently identical with this species were recently obtained by me at Eastport, Me., in 10 fathoms.

The northern species of Alcyonidæ require careful revision. This species is evidently closely allied to *A. carneum* Ag., occurring on the coast of New England, from Cape Cod to the Gulf of St. Lawrence.

Alcyonium (?) Bradleyi Verrill, sp. nov.

Corallum, in the only specimen observed, rising as an elongated, subconical, simple stalk, with a rounded summit, and a somewhat spreading base. Whole surface covered with numerous, scattered, small polyps, which are very exsert in expansion.

Height, while living, 1 inch; diameter ·25 to ·33; polyps ·05 to ·25 long, in expansion; diameter ·02 to ·03 of an inch.

"Whole surface and bodies of polyps yellowish white; tips of polyps dark crimson, surmounted by eight yellowish white, semi-ovate, tentacular lobes. Whole group flexible, without a solid axis."

Panama Bay, dredged in 3 to 4 fathoms, on loose shells,—F. H. Bradley.

The specimen from which the description and drawings were made by Mr. Bradley has not been found among his collections. Therefore the generic characters cannot be ascertained at present with certainty.

Order, ACTINARIA Verrill.

Actinaria (*pars*) Dana, including *Actinidæ* (family), *Zoanthidæ* (family), and *Antipathacea* (tribe), Zoöphytes, 1846; Gosse, Actinologia Britannica, p. 6, 1860.

Zoanthaires (*pars*) Edw. and Haime, including *Actinaires* and *Antipathaires* (suborders), Corall., i, p. 224, 1857; Verrill, Mem. Boston Soc Nat. Hist., i, p. 14, 1863.

Actinaria (order) Verrill, Proceedings Essex Inst., iv, p. 147, Feb.—April, 1865; ditto, vol. v, p. 315, 1868.

(?) *Actinoids*, "*Actinaria* Edw." (order) A. and Mrs. E. C. Agassiz, Sea-side Studies in Natural History. p. 7 and 152, after May, 1865. (No characters given or limits assigned perhaps not intended to include *Antipathacea*).

Body fleshy, or coriaceous, composed of from six, or ten, to several hundred spheromeres, which are usually in multiples of six, united only by the outer wall of the body, so as to leave, between adjacent spheromeres, interambulacral spaces in which the new spheromeres originate during growth. Basal or abactinal region well developed, specialized, either free or attached, sometimes capable of secreting a horn-like support (*Antipathes*), or a thin corneus pelicle (*Adamsia*, *Cancrisocia*). No coral or solid calcareous deposits in the wall or radiating lamellæ. Ambulacral chambers open from the summit to the base. Tentacles usually simple, hollow, tubular, or conical, mostly in multiples of six; sometimes only six or ten.

Although the Actinians are evidently numerous, both in species and individuals, upon the tropical portion of the Pacific coast of America, it is remarkable that but one species has hitherto been described from the entire region between Paita, Peru, and San Francisco, Cal. In the collections of Mr. Bradley there are large numbers of *Actiniæ*, but in most cases it would be almost useless to attempt descriptions of these animals from preserved specimens alone. Consequently I have omitted most of the species which are unaccompanied by notes or drawings made from the specimens while living.

Many of the *Actiniæ* from Peru and Chili have been well figured and described by Lesson* and by Drayton,† while those of the northern coast (Sitcha) have been briefly described by Brandt,‡ whose unsatisfactory diagnoses refer almost exclusively to the colors, which

* Histoire naturelle des Zoöphytes recueillis dans le Voyage autour du monde de la Corvette de sa majesté, la Coquille, 1822—1825, Captaine Duperrey. Par R.-P. Lesson, Paris. 1832.

† United States Exploring Expedition, during the years 1838—1842. under the Command of Charles Wilkes, U. S. N. Vol. vii, Zoöphytes. By J. D. Dana. Actinidæ by Mr. Joseph Drayton. Philadelphia, 1846.

‡ Prodromus descriptiones animalium a Mertensio in orbis terrarum circumnavigatione observatorum. J. F. Brandt, 1835.

are notoriously variable in this group, and especially so in some northern genera, like *Urticina* and *Bunodes*.

Suborder, ACTINACEA Verrill.

Actinina (family) Ehrenberg, Corall. des rothen Meeres, 1834.
Actinidæ (family) Dana, Zoöphytes, p. 122, 1846.
Actiniaires (*pars*) (suborder) Edw. and Haime, Corall., i, p. 224, 1857.
Astræacea (*pars*) (tribe) Gosse, Actinologia Britannica, p. 7, 1860.
Actininæ (subfamily) Duch. and Mich., Corall. des Antilles, 37, 1860, from Mem. Reale Accademia delle Scienze, Turin; ditto, (*pars*) (family) Supplément aux Corall., 1864, from Mem. Reale Accad., xxiii, 1366.
Actinaria (*pars*) (suborder) Verrill, Mem. Boston Soc., Nat. Hist., i, p. 14, 1863.
Actinacea (suborder) Verrill, Proc. Essex Inst., iv, p. 148, 1865; ditto, vol. v, p. 317, 1868.

Polyps free and simple, rarely compound, with a well developed and muscular base, which is used both as an organ of locomotion and adhesion. Tentacles varying in number from 10 to several hundred, and quite varied in size and structure; sometimes branched.

The ambulacral spaces usually bear some other organs, such as branchiæ, tubercles, suckers, colored spherules, and special pores.

Family, THALASSIANTHIDÆ Verrill.

Proceedings Essex Inst., iv, p. 148, 1865.

Body more or less cylindrical in expansion, usually broad. The disk bears various ambulacral organs in the form of simple or compound tubercles, or arborescent and variously lobed branchiform organs, in addition to, or replacing, the simple tentacles. Several of these disk-appendages usually arise from each ambulacral chamber, and when true tentacles are present, they may be outside or inside of them, or on both sides. Base a flat locomotive disk.

This family is almost confined to the tropical seas. It includes four well marked subfamilies.

1. *Phyllactinæ* Edw. and Haime. Disk bears both simple tentacles and lobed tubercles, or compound branchiform appendages.

2. *Thalassianthinæ* (*pars*) Edw. and Haime. Disk bears large, compound tentacles or branchiform organs, all of one form, without simple tentacles.

3. *Heterodactylinæ* Verrill. Disk bears large, compound, branchiform organs of two kinds. No simple tentacles. Includes *Heterodactyla* Ehr. and *Sarcophianthus* Less.

4. *Discostominæ* Verrill (*non Discosomæ* D. and M.). The disk bears small, tentacle-like papillæ, or small, sparingly lobed tubercles,

several of which originate from each radiating chamber or ambulacral space, and are therefore arranged in simple radiating lines, or in radiating groups when more than one series arise from the same chamber. These false tentacles increase in size from the centre to the margin of the disk. The disk is usually broad and widely expanded, but generally capable of complete contraction.

This subfamily includes the true genus, *Discosoma* Leuck. (*? Ricordea* D. and M.), excluding many forms wrongly referred to it by various authors;* *Homactis* and *Stephanactis* Verrill;† and apparently *Echinactis* E. and H., *Corynactis* Allman, *Aureliania* Gosse, and *Capnea* Forbes. But most of the descriptions and figures of these genera are insufficient to determine with certainty whether the "tentacles" originate each from a distinct chamber or not. For the three genera last mentioned Gosse has formed the family, *Capneadæ*, but he does not refer to this character, and regards all the disk-tubercles as true tentacles.

Subfamily, Phyllactinæ Edw. and Haime.

Metridium (genus) Ehrenberg, 1834, (*non* Oken); Dana, Zoöph., p. 150, 1846.
Phyllactinæ (subfamily) Edw. and Haime, Corall., i, p. 291, 1857; Verrill (*pars*), Mem. Boston Soc. Nat. Hist., i, p. 15, 1863.

Column usually rather low and broad, its surface generally bearing verrucæ or suckers, sometimes nearly smooth. Disk broad, the tentacles placed considerably within its margin. The branchiform appendages either form a circle just within the margin and outside of the tentacles, *Oulactis;* are mingled with the tentacles, *Rhodactis;* or cover the buccal area within the circle of tentacles, *Actinotryx;* or are placed both within and outside of the circle of tentacles, *Amphiactis* V.‡ These organs differ greatly in number, size, and form in the different genera, as well as in position.

The genus, *Aulactinia*, which I formerly referred to this subfamily, on account of the lobed, sub-marginal, branchiform papillæ, appears to belong rather with the *Bunodinæ*. The same is true of *Oulactis granulifera* (Les. sp.) E. and H., and *Anthopleura Krebsii* D. and M. It was on account of these and other similar forms that the group was formerly made a subfamily of *Actinidæ* by me, but in that family the branchiform appendages are really lateral organs, originating from or below the margin.

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* *Discosomus* was used among Reptiles by Oken in 1816, and *Discosoma* among Arachnida in 1830 by Perty. Ehrenberg has proposed to subtitute the name *Discostoma*, for Luckart's genus.

† Proceedings Essex Institute, vol. vi.

‡ Proc. Essex Institute, vol. vi.

Oulactis Edw. and Haime.

Metridium (*pars*) Dana, Zoöph., p. 150, 1846, (*non* Oken).
Oulactis E. and H., Corall., vol. i, p. 292, 1857; *pars*, Duch. and Mich., Corall. des Antilles, p. 46, 1860.

Column covered with verruciform suckers. Disk broad; simple tentacles placed at some distance from the margin; outside of them a circle of numerous, large, frondescent, branchiform organs.

Oulactis concinnata Edw. and Haime.

Metridium concinnatum Drayton, in Dana, Zoöph., p. 152, Pl. 5, fig. 40 and 41, 1846.
Oulactis concinnata E. and H., Corall., vol. i, p. 292, 1857.

Column low, broad, dilated above and below. Disk very broad, strongly radiate, margin undulated, sides covered with large tuberculiform suckers, to which pebbles and fragments of shells adhere. Tentacles half an inch long, stout, subulate, sub-triangular, the lower side slightly concave. Branchiform organs nearly ·5 of an inch long, 1 to 1·5 lines broad, frondescently laciniate.

Column ochreous olive, with olive-green suckers; three branchiæ of a white color alternate with a brown one; simple tentacles similar to column, but paler, faintly striped with pale purple; disk purple. Another variety has the column green, with ochreous suckers. Diameter at middle, in expansion, 2 inches; at disk 3.

San Lorenzo, near Callao, Peru, buried to its tentacles in sand,—U. S. Exploring Expedition.

Lophactis Verrill, gen. nov.

Column elevated; its walls firm, sub-coriaceous, in contraction rough with deep corrugations and wrinkles, not verrucose, and without apparent suckers in the preserved specimens. Simple tentacles large, placed at a considerable distance from the margin. Branchiæ few in number (12), arranged in a circle between the margin and the tentacles, large and broad, laterally compressed, the upper edge of each bearing a series of finely subdivided papillæ, which consequently form radiating rows of secondary branchiæ. The large branchiform organs are united together on the side nearly to their summits by a thin membrane, which forms a naked area between the branchiæ and tentacles, and they are also united on the outside by adherence to the marginal fold, so that, when contracted, there are deep chambers or cavities between them.

This genus is closely allied to *Phyllactis*, but the latter has more numerous branchiæ, which are quite different in structure, and are

longer and much more exsert, and connected together only on the inside by a membrane that does not reach the summit.

Lophactis ornata Verrill, sp. nov.

This curious species is known only from one specimen, which is well preserved in alcohol, with the disk and tentacles expanded.

The column is higher than broad, though evidently much contracted; the surface has a finely papillose, or deeply and closely wrinkled appearance, and appears to be covered with a dark-colored, thin, inseparable, epidermal layer; its substance is firm and tough, somewhat leathery.

The disk is broad; mouth with numerous marginal folds; buccal disk small, surrounded by a circle of 96 simple tentacles, which are rather long, enlarged somewhat at the end, which is marked with about ten sulcations. They are apparently arranged in four or five circles. The 12 branchiæ are large, with a broad membrane uniting them together on the inside and separating them from the tentacles; their summits are arched, bearing along the crest a narrow, closely convoluted frill, having its edge finely divided into a fringe-like structure; below the crest there is a transversely thickened portion; the lower part is thinner, with strong, longitudinal, muscular folds. These organs, therefore, are probably capable of being considerably extended during life. Height, of specimen in alcohol, 1·5 inches; diameter of disk 1; length of tentacles ·3; of branchiæ from base ·5; along crest ·4.

Pearl Islands,—F. H. Bradley.

Asteractis Verrill, gen. nov.

Column versatile in form; walls firm and sub-coriaceous. Disk broad, capable of involution, bearing, near the mouth, a circle of numerous simple tentacles, and outside of these a corresponding number of radiating rows of small, sessile, somewhat lobed and subdivided tubercles or papillæ, increasing in size to the margin, which is crenulate or dentate with the last tubercles of each series.

This genus is somewhat allied to *Oulactis* but differs in having branchiform organs, consisting of rows of sessile papillæ on the disk, instead of distinct, prominent, frondescent appendages, rising from its surface. The column differs, moreover, in lacking verruciform suckers.

To this genus probably belong *Actinia flosculifera* Les. (*Oulactis flosculifera** Duch. and Mich.) and *Oulactis formosa*† D. and M. from

* Coralliaires des Antilles, p. 46, Pl. vii, figures 7, 11, 1860.

† Loc. cit., p. 47, Pl. vii, fig. 4, 5.

the West Indies. But the figures and descriptions of the branchial appendages are too indefinite to make this certain, while both species are said to have lateral pores, which I have not been able to see in the following species, when contracted, though they may exist.

Asteractis Bradleyi Verrill, sp. nov.

Column whitish, sometimes low and broad, expanding from about the middle to the margin of the broadly expanded disk; at other times vase-shaped, contracted near the base, cylindrical above, the disk partly contracted; at other times cylindrical, the portion of the disk exterior to the tentacles involved, but the tentacles still protruding. Surface in contraction strongly wrinkled transversely, less so longitudinally, near the margin with papilliform interspaces.

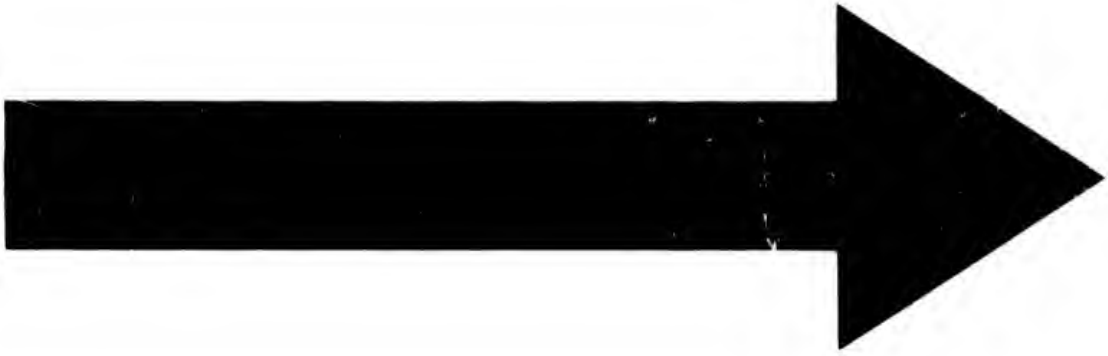
The tentacles are 48 in number, in three rows; the 12 primary ones about ·5 of an inch long; the 12 secondary about ·3; the 24 smallest ones about ·25. All the tentacles are slender and pointed, the larger ones spotted with white. The small branchial papillæ form 48 radiating series, the 12 rows corresponding to the primary tentacles extend from the margin to their bases; the 12 corresponding to the secondary ones extend about half way to their bases; the 24 small ones extend only about quarter way to the bases of the small tentacles. The inner part of each row is formed of very small, scarcely distinct, slightly prominent, crowded papillæ; farther outward they become larger, more prominent, and slightly lobed; the outer ones are considerably larger, crowded, divided into five or six, slightly rounded lobes, the outermost one forming the dentate margin of the disk.

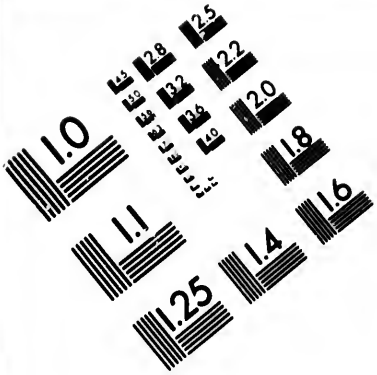
Color of the column, in life, white; largest tentacles delicate pink, bearing four or five, eye-like spots of white, and fading out to white at the tips; secondary tentacles pale pink, with similar, but commonly more numerous, white spots; smallest ones white.

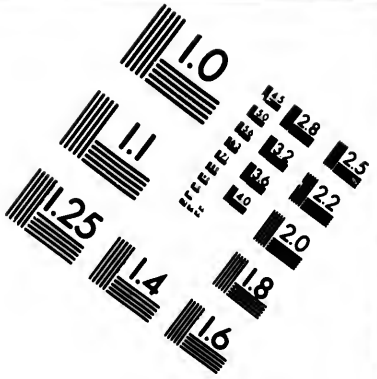
Height, in expansion, ·5 to ·7; diameter of disk ·3 to 1 inch; of column in middle ·3 to ·5; diameter of buccal disk, inside of tentacles, in full expansion, ·5. The same specimen, in alcohol, is about ·5 high; ·5 broad at base; with the partly contracted disk ·35 broad.

Panama Reef, on rocks above half tide,—F. H. Bradley.

This species appears to be rare, as only one specimen is in the collection, which is accompanied by notes and drawings made from it while living. In the drawings there are twelve conspicuous, dark spots, about midway between the tentacles and margin, and corresponding with the primary tentacles. These are not referred to in the







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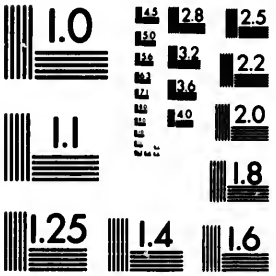

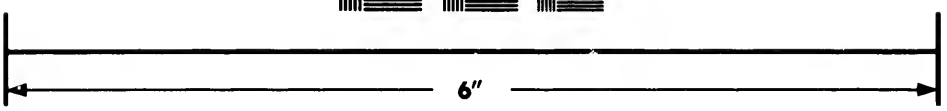

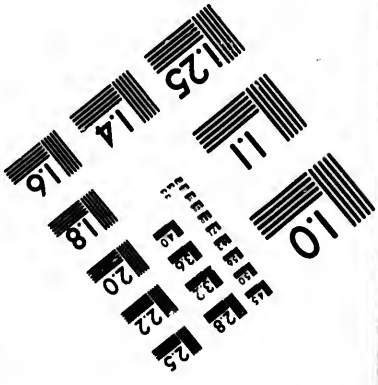

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notes and nothing corresponding to them can be seen upon the specimen. Whether they be mere color spots, disk pores, or tubercles, is uncertain. When fully expanded the column showed longitudinal lines.

According to Mr. Bradley's notes it is a hardy species, feeds well, and bears rough handling.

Family, Actinidæ.

Actinina (*pars*) Ehrenberg, including *Actinia* (genus) and *Cribrina* (genus), Corall. rothen Meeres, p. 31, 1834.

Actinia (genus) Dana, Zoöphytes, p 122, 1846.

Actiniæ (subfamily) Edw. and Haime, excluding "*Actinines pivotantes*," Corall., i, p. 230, 1857.

Actininæ (*pars*) (subfamily) Duch. and Mich., Corall. Antilles, 1860.

Actinidæ (family) Verrill, Mem. Boston Soc. Nat. Hist., i, p. 15, 1863; Proceedings Essex Inst., iv, p. 148, 1865; ditto, vol. v, p. 320, 1868.

Body more or less cylindrical in expansion, with a distinct, flat, muscular, basal disk. Tentacles round, simple, surrounding the buccal disk in few or many cycles, sometimes obsolete. Walls perforate or imperforate. Ambulacral appendages on the sides of the body various.

This extensive family may be divided into several sub-families, which are, however, not always well defined.

1. *Bunodinæ.* Column bears tubercles or verruciform suckers, which are imperforate, or rarely perforate, but do not emit acontia.

2. *Sagartinæ.* Column perforated with special pores, for the emission of acontia. Surface smooth, or with inconspicuous contractile suckers.

3. *Phellinæ.* Column elongated, covered to near the margin with a persistent epidermal layer or tunic. Lateral pores and acontia few, or entirely wanting.

4. *Actininæ.* Column smooth, fleshy, destitute both of verrucæ or suckers and special pores. No acontia. Margin with or without colored spherules. Includes *Actinidæ* and *Antheadæ* Gosse.

Subfamily, Bunodinæ.

Actinines verruqueuses (section) Edw. and Haime, Corall., i, p. 263, 1857.

Bunodidæ (family) Gosse, Ann. and Mag Nat. Hist., 3d ser., i, p. 417, 1858; Actinologia Britannica, p 185, 1860.

Bunodidæ (subfamily) Verrill, Mem. Boston Soc. Nat. Hist., i, p. 15, 1863.

Cercæ (family) Duch. and Mich., Suplem. Corall. Antilles, Mem. Reale Accad., Turin, xxiii, p. 124, 1864–6.

Bunodinæ (subfamily) Verrill, Proc. Essex Inst., vi, 1868.

The column is usually rather low and broad. The verrucæ of the

sides may be simple rounded tubercles or elongated papillæ, without perforations; prominent suckers with a concave surface and thickened border; perforated verrucæ, ejecting water in contracting; or, near the margin of the disk, lobed or sparingly branched papillæ. The margin may be a smooth thickened rim, crenulate or dentate by the uppermost tubercles, or it may bear colored spherules. The disk is usually broad. The tentacles large and not very numerous, usually completely contractile.

Bunodes Gosse.

Cribrina (*pars*) Ehr., Corall. rothen Meeres, p. 40, 1834.
Bunodes Gosse, Trans. Linn. Soc., xxi, p. 274, 1855; Actinologia Britannica, p. 189, 1860; Verrill, Mem. Boston Soc., i, p. 15, 1864.
Cereus (*pars*) Edw. and Haime (*non* Oken), Corall., i, p. 263, 1857.
Anthopleura (*pars*) Duch. and M., Supl. Corall. Antilles, in Mem. Reale Accad., Turin, xxiii, p. 125, 1864–6.

Corallum more or less elevated, texture firm, surface covered with conspicuous verruciform suckers, concave above, or low rounded tubercles, which are arranged in vertical lines along each ambulacral chamber, the uppermost one in each row largest and projecting at the margin, so as to form a somewhat dentate or tuberculate border. The suckers usually, if not always, have the power of adhering firmly to foreign substances. They generally decrease in numbers and size from the margin downward, often becoming obsolete below. Tentacles rather large, not numerous, very contractile, usually separated from the margin by a narrow but distinct naked area or "fosse."

Bunodes cruentata Gosse.

Actinia cruentata Drayton (Couthouy, MS.), U. S. Expl. Exp., Zoöphytes, p. 138, Pl. 3, fig. 23, 1846.
Cereus cruentatus Edw. and H., Corall., i, p. 268, 1857.
Bunodes cruentata Gosse, Actin. Britannica, p. 194, 1860.

Column with small sucker-tubercles arranged in vertical rows, conspicuous near the margin, smaller toward the base. Tentacles about 48 in number, long, subulate. In expansion the mouth has four lobes. Color faint purplish red, with numerous vertical lines of darker red, deepening to crimson near the disk; suckers rose-white, yellowish when expanded; tentacles intense blood-red; disk brownish purple, alternating with radiating pale ochreous lines.

Orange Bay, Terra del Fuego, buried to tentacles in sand,—J. P. Couthouy, U. S. Expl. Exp.

Bunodes papillosa Verrill.

Actinia papillosa Lesson, Voyage Coquille, Zoöphytes, p. 78, Pl. iii, fig. 2, 1832, (*non* Ehrenberg, 1834

Cereus papillosus Edw. and H., Corall., i, p. 267, 1857.

Column low and broad, covered throughout with numerous, crowded, conspicuous verrucæ, closely arranged in vertical rows. Tentacles very numerous, rather short, in three series. Mouth (as figured) with six lobes, in expansion. Color bright green, the verrucæ lighter, each surrounded by a circle of bright red; tentacles bright red, with lighter tips, disk flesh-colored.

Talacahuano, Chili, to Lima, Peru, on submerged rocks; very common near Quiriquine,—Lesson.

Bunodes pluvia Verrill.

Actinia pluvia Drayton, op. cit., p. 144, Pl. 4, fig. 30, 1846.

Cereus pluvia E. and H., Corall. i, p. 267, 1857.

Column broad, 2·5 inches in diameter at middle, expanding above and below to 3·25. Surface closely covered throughout with small, rounded tubercles or papillæ, upper margin not tuberculate. Tentacles numerous, somewhat crowded, in three series, ·5 inch long, stout (over a line thick at base), subulate. Disk strongly marked with radiating lines, mouth prominent. Color very variable; sometimes bright orange throughout, with the tentacles a little darker and the disk paler. Some have dull red tentacles; others pale red, with the mouth very deep red. In others the column is dark brownish green, with the papillæ bright orange, tipped with white beads or dots.

The orange variety, when disturbed, "ejected water from all its tentacles to a distance of 2 or 3 feet."

San Lorenzo I., Peru, on rocks,—J. P. Couthouy, U. S. Expl. Exp.

This species may prove to be identical with the preceding, but this cannot be determined from the original figures and descriptions.

Bunodes ocellata Verrill.

Actinia ocellata Lesson, op. cit., p. 79, Pl. iii, fig. 5, 1832.

Cereus ? ocellatus Edw. and H., Corall., i, p. 268, 1857.

Column covered with small verrucæ, regularly arranged in vertical rows, and scarcely crowded. Tentacles numerous, short, subequal, slender, crowded. Column brownish; the verrucæ bright red; tentacles brownish red with light tips; disk lighter, brownish near the mouth, which is red within.

Paita, Peru, in crevices among rocks, rare,—Lesson.

This species and the two preceding, appear to be true Bunodes, so far as can be judged from the figures and descriptions, but yet on re-examination they may be found to belong to other allied genera.

Urticina Ehrenberg (emended).

Urticina (subdivision of *Actinia*) Ehr., Corall. rothen Meeres, p. 33, 1834.
Rhodactinia Agassiz, Comptes rendus, xxv, p. 677, 1847, (without description); Verrill, Mem. Boston Soc. Nat. Hist., i, p. 18, 1864.
Bunodes (*pars*) Gosse, Trans. Linn. Soc, xxi, p. 274, 1855.
Cereus (*pars*) Edw. and Haime, Corall., i, p. 263, 1857, (*non* Oken).
Tealia Gosse, Ann. and Mag. Nat. Hist., 3d series, i, p. 417, 1858; Actin Brit., p. 205.

Column low and broad, in expansion usually broader than high, margin with a more or less distinct fold or "parapet." Surface covered with irregularly and distantly scattered verruciform suckers, which are often small and inconspicuous, but capable of strong adhesion. Margin of the disk slightly dentate or tuberculate, or not at all so. Tentacles large and stout, retractile. Type *U. crassicornis* Ehr.

Urticina crassicornis Ehr.

Actinia crassicornis Müller, Prod. Zoöl. Danica, p. 231, 1776; Johnston, British Zoöphytes, i, p. 226, Pl. 40; Van Beneden, Faune Litt. de Belgique, Polypes, p. 191.
Actinia spectabilis Fabr., Fauna Grœnl., p. 351, 1788.
? *Actinia coriacea* Cuvier, Tabl. élém., p. 653, 1797; Règne Animal, tom. iv, ed. i, p. 51, 1817; Rapp, Polypen im Allg., p. 51, Taf. i, fig. 3 and 4, 1829; Johnston, Br. Zoöphytes, i, p. 224, Pl. 39, 1847.
? *Actinia Holsatica* Müller, Zoöl. Danica, iv, p. 23, Pl. 139, 1806.
Isacmæa (*Urticina*) *crassicornis* Ehrenberg, Coral. rothen Meeres, p. 33, 1834.
? *Isacmæa* (*Urticina*) *papillosa* Ehr., op. cit., p. 33, (perhaps =*U. digitata*)
? *Cribrina coriacea* Ehr, op. cit, p. 40.
? *Actinia bimaculata* Grube, Actinien, p. 4, fig. 4, 1840.
Rhodactinia Davisii Agassiz, Comptes-rendus, xxxv, p. 677, 1847; Verrill, Mem. Boston Soc. Nat. Hist., i, p. 18, 1864.
Actinia obtruncata and *A. carneola* Stimpson, Invert. of Grand Menan, p. 7, 1853.
Bunodes crassicornis Gosse, Trans. Linn. Soc., xxi, p. 274, 1855.
Actinia? felina Edw. and H., Corall., i, p. 242, 1857.
? *Cereus coriaceus* Edw. and Haime, Corall., i, p. 264, Pl. C 1. fig. 4, 1857.
Tealia crassicornis Gosse, Ann. and Mag. Nat. Hist., ser. 3, i, p. 417, 1858; ... inologia Britannica, p 209, Pl. iv, fig. 1, 1860.
? *Bolocera eques* and *Stomphia Churchiæ* Gosse, Actin. Brit., p. 222 and 351, Pl. viii, fig. 5, ix, fig. 6.
? *Actinia elegantissima* Brandt, Prodromus descr. Anim. a Mertensio, p. 13, 1835; Edw. and H., Corall., i, p. 289.
? *Actinia Laurentii* Brandt, op. cit., p. 13; Edw. and H., Corall., i, p. 289

Column large, low, usually broader than high in full expansion, the surface bearing small, distant suckers, which are capable of becoming

verrucose and attaching foreign substances, or of becoming low, rounded, slightly prominent papulæ, or they may be entirely contracted to the level of the general surface, which then appears nearly smooth, but often longitudinally and transversely striated. Tentacles large and stout, numerous, usually banded. Mouth large, with strongly marked lobes, the stomach often everted.

Color very variable; column usually some shade of red or green, or variously mottled and striped with these colors; often bright red and uniform flesh color. Tentacles usually banded with alternating rings of white and some shade of red or pink; sometimes uniform red or flesh-color. Disk usually lighter than the column, frequently pale reddish, or greenish, or mottled; usually, if not always, with radiating stripes of brighter red or crimson, which extend from near the mouth to and among the bases of the tentacles, two of these stripes going to each tentacle and embracing its base on each side. Small white spots often occur in front of the inner tentacles. The angles of the mouth are usually bright red. Large specimens are often 4 to 6 inches in diameter; tentacles 1 to 1·5 inches long; ·20 to ·25 in diameter at base.

Occurs commonly on all the northern coasts of Europe, from France* northward; Iceland; Greenland; Arctic America, southward to Cape Cod. On the Pacific coast in the Arctic Ocean north of Behring's Straits, in 30 fathoms, and in Behring's Straits,—North Pacific Expl. Exp.; Sitcha,—Brandt; Puget Sound,—Dr. C. B. Kennerly.

The numerous specimens obtained by the North Pacific Exploring Expedition do not appreciably differ from those of the north Atlantic coasts, preserved in the same manner. Nor is there anything in Brandt's descriptions to indicate a specific difference.

A. elegantissima Brandt, is said to have the body pustulous, greenish red or spotted. Tentacles moderate, dilated, and white in the middle, purple at the end. From Sitcha.

A. Laurentii Br., has the body red, blotched irregularly with green and brown. Tentacles vermilion red. Behring's Straits.

Evactis Verrill, gen. nov.

The column bears vertical rows of verruciform suckers or tubercles, and is perforated by numerous openings from which water is ejected when the body suddenly contracts. The inner tentacles are smaller and shorter than the outer ones; mouth with four prominent lobes. Type *Actinia artemisia* Drayton.

* The southern European form (*U. coriacea*) is more verrucose and may be distinct from the true *U. crassicornis* of the north.

This genus is allied to *Anthopleura* Duch. and Mich., but the latter is represented as having equal tentacles, and the uppermost tubercles are subdivided and sub-tentaculiform. It resembles *Bunodes*, but in the latter the walls are imperforate and the inner tentacles are largest.

Evactis artemisia Verrill.

Actinia artemisia Drayton, op. cit., p. 149, Pl. 4, fig. 38, 1846.
Cereus artemisia Edw. and Haime. Corall., i, p. 268, 1857.

Column low, broad, subcylindrical, often dilated in the middle, and covered with regular vertical lines of prominent, rounded tubercles, which are obsolete below, the upper ones larger and forming a row around the margin of the disk. Tentacles in three series, stout, subulate, the inner ones ·5 inch, the outer ones 1 inch in length. Disk radiated; mouth with four prominent lobes.

Column yellowish green; the tubercles dark sap-green, the green line extending to the base, though the tubercles are obsolete below. The colors of the tentacles are various and shaded like those of the prism. Disk greenish, darker toward the tentacles; the mouth flesh-colored. Diameter, in expansion, 2·25 inches

Discovery Harbor, Puget Sound, abundant,—U. S. Expl. Expedition; Puget Sound,—Dr. C. B. Kennerly.

"This species occurs buried to the tentacles in sand, and also attached to pebbles or shells two or three inches below the surface. On contracting, water spurts from various small lateral orifices, as from a watering-pot,"—C. Pickering.

Evactis ? xanthogrammica Verrill.

Actinia xanthogrammica Brandt, Prod. descrip. anim., p. 12, 1835; Edw. and H., op. cit., p. 289.
Bunodes xanthogrammica Gosse, Actin. Brit., p. 194, 1860.

"Body sub-verrucose, yellowish green. Tentacles numerous, elongated, fusiform, flattened below, copper-green, with small, transverse, yellow spots."

Sitcha Island,—Brandt.

This species may prove identical with the preceding, and in that case would have priority. There are no certain indications of its generic affinities, and I have placed it here mainly on account of its general resemblance to *E. artemisia*.

Cladactis Verrill, gen. nov.

Column firm in texture, low, broad, crowdedly covered with elevated, sub-tentaculiform tubercles or papillæ, which have round, in-

dated tips, those on the sides simple or two or three lobed; those at the margin of the disk elongated, pedunculated, the end divided into 2 to 6 rounded lobes. Tentacles numerous, rather long, the inner ones largest. Disk broad, with a naked area or "fosse" between the tentacles and the margin.

Cladactis grandis Verrill, sp. nov.

A large species with the entire surface of the column covered with close vertical rows of crowded, elongated papillæ, which are smaller below, but larger and more complex near and at the margin. The uppermost sub-marginal ones are elevated, with a distinct peduncle, the outer portion divided into about six, rounded, inflated lobes in the larger ones, two to four in the smaller ones. The papillæ become nearly sessile below, but many of them have two or three rounded lobes. The tentacles are moderately large, rather stout, very numerous (528 in a large one), in many rows, forming seven or eight cycles, apparently but little contractile, separated from the margin of the disk by a broad shallow fosse. Buccal disk broad, radiated. The mouth is large, elongated, with strong gonidial folds, and numerous lobes along the sides.

General color greenish-brown or olive; "twelve rows of light colored tubercles, with three or more rows of smaller dark ones between each pair of rows of larger ones; disk dark greenish brown; tentacles of nearly uniform greenish brown." In alcohol the specimens are grayish blue, with dull blue tentacles. Some of the larger specimens, when preserved in alcohol, are about 3 inches in diameter and 2 high; length of inner tentacles 1 inch.

Paita; and Zorritos, Peru; Pearl Islands; and Panama, on stones below half-tide mark,—F. H. Bradley. Rio Brito, near San Juan del Sur, Nicaragua,—B. Silliman.

This species appears to be the most abundant Actinian of the Panamian Fauna in the littoral zone. It occurs under the wharf of the Panama Railroad Co. at Panama. It appears to have limited powers of contraction, since most of the specimens preserved in alcohol have the tentacles more or less extended and the disk exposed. In some cases, however, the disk is so involved as to conceal the tentacles. Mr. Bradley states that it is "very sensitive."

It appears to be allied to some of the species referred to *Cystiactis* by Edw. and Haime, but the latter group appears to include representatives of more than one genus. There is, moreover, nothing in their descriptions to indicate that either of their species have compound tubercles, which is one of the most prominent characters of the

present genus, when mature. In young specimens, however, the marginal tubercles are only 2 or 3-lobed, while those of the sides are simple rounded tubercles, and scarcely crowded.

There are no openings apparant in the sides of the body.* In this respect the genus differs from the typical species of *Anthopleura* (*A. Krebsii*), as well as in the character of the lateral tubercles. *A. granulifera* D. and M. appears to belong to this genus, however, since it is said to be imperforate and tuberculated.

Cystiactis Edw. and Haime, op. cit., p. 276.

"Body entirely covered by subtentaculiform tubercles, or having the aspect of large, very salient pustules."

Cystiactis Eydouxi Edw. and Haime, op. cit., p. 276, 1857.

"Tentacles short, moderately numerous, longitudinally striated by contraction; the external ones smaller than the internal. Body covered with large vesicles of very unequal size, very close, and irregularly arranged. Specimens preserved in alcohol have a uniform brown color."

Coasts of Chili,—Eydoux (Mus. Paris).

The single character upon which the genus, *Cystiactis*, is based is too indefinite, or too imperfectly defined, to be of much importance in identifying genera. Specimens from Brazil, that appear to be identical with *C. Gaudichaudi* E. and H., appear, however, to be generically distinct. The same is true of *Cystiactis Eugenia* D. and M.,† from St. Thomas. But, so far as the description shows, *C. Eydouxi* may not differ from *Cladactis*, since it is not stated whether the marginal tubercles be simple or compound. Should they prove identical, *Cystiactis* may, therefore, be restricted to *C. Gaudichaudi* and similar species.

Anthopleura Duch. and Mich.

Anthopleura D. and M., Corall. des Antilles, p. 40, 1860; ditto (*pars*), Supl. Corall. des Antilles, p. 32, 1864–6.

Column subcylindrical, somewhat elevated, bearing adhesive, verruciform suckers with concave tops, which are arranged in longitudinal rows, and diminish in size and frequency toward the base. Margin surrounded by a circle of elongated papillæ, corresponding to the rows of suckers, and more or less lobed or incised, with small per-

* *C. cavernata* (*Bunodes cavernata* V.) from S. Carolina, has the wall perforated by small, inconspicuous pores, from which water may be ejected.

† Supplément Corall. des Antilles, in Mem. Reale Accad., Turin, xxiii, p. 129, Pl. vi, fig. 1, 1866.

forations on the lower side, from which water may be ejected. Similar perforations occur in the sides below the margin. Tentacles elongated, subequal, rather numerous, separated from the margin by a narrow but distinct fosse. Type, *A. Krebsii* D. and M., 1860.

This genus was originally based upon a single species, with the characters given above. Subsequently two other species were added by the same authors, having quite different structures, and the generic characters were modified accordingly. As defined in the later work the genus does not differ materially from *Bunodes*, and in fact one of the species referred to it, *A. pallida*, appears to be a true *Bunodes*, having imperforate walls and simple tubercles. The other species, *A. granulifera*, has imperforate walls, non-adhesive tubercles, those around the margin being compound. This probably belongs to our genus, *Cladactis*. It seems necessary, therefore, to restrict the genus to its original limits, including only those species with perforated walls, adhesive suckers, and compound sub-marginal papillæ. As thus limited it is allied to *Aulactinia** nobis, and to *Evactis*. The latter differs, however, in having the outer tentacles largest, and the margin surrounded by simple tubercles; the former has more complex submarginal appendages and appears to be imperforate, but when better known may prove to be identical.

Anthopleura Dowii Verrill, sp. nov.

Actinia Dowii Bradley, MS.

Column cylindrical, but little elevated, with vertical rows of rather distant, large, adherent, verruciform suckers, which have concave summits; the upper ones largest, becoming more distant and much smaller below, nearly obsolete near the base. Surface between the suckers smooth in expansion, when contracted covered with elevated, reticulated wrinkles. Corresponding to each row of suckers there is a prominent, inflated, submarginal tubercle; these are mostly divided into 2 to 6, slight, rounded lobes, each one perforated on the lower side by several small pores, through which water may be ejected, but no openings through the walls below could be detected in preserved specimens. Margin of the disk separated from the tentacles by a narrow fosse. Tentacles rather slender, elongated, subulate, arranged in three rows, in the larger specimens 108 or more, in smaller ones often only 48. Disk broad, with radiating striations, mouth small, with numerous folds; stomach often everted.

* Memoirs Boston Soc. Nat. History, i, p. 20, 1864.

Color quite variable; "column often flesh-colored; disk very variable, from uniform olive-brown to variegated with greenish and yellowish, sometimes all greenish white, in other specimens with six bands of pale yellow alternating with dark lines about the mouth, the rest of the disk being greenish brown; tentacles very inconstant in color, varying from dark brown, yellow, orange, and pink, to purple and dark greenish brown, sometimes plain, often with 1 to 5 light yellow, small, irregular spots, the inner surface commonly darker colored."—F. H. B.

The larger specimens, preserved in alcohol, are about 1·5 inches high, and 1 in diameter.

Pearl Islands; and Panama, under the wharf of the Railroad Co., below half-tide mark,—F. H. Bradley; Realejo,—F. H. Bradley; Acajutla, San Salvador, on buoy,—Capt. J. M. Dow.

This species appears to be tolerably common. In alcohol most of the specimens have the tentacles expanded, often with the stomach everted, others have the disk entirely involved. Mr. Bradley states that it bears rough handling well.

The following observations apply to an Acajutla specimen, which has not been found in the collection with its corresponding number, but which probably belongs to the same species with that described above.

"Base broad, 1 inch in diameter; body stout, with lines of small light drab pustules running down from the small tentaculiform lobes on the edge of the disk; disk 1·5 inches broad, dark brown, with whitish stripes radiating from the small yellowish red mouth; tentacles moderately stout, in three rows (16 : 48 : 48), outer two rows ·05 inch from edge of disk, inner ones ·00 farther inward, base light drab, tips dark red, sometimes marked near the tips with small white spots on the inner side,"—F. H. B.

A species somewhat resembling this in general appearance, as preserved in alcohol, but evidently distinct, is in the collection from the Pearl Islands. This has very exsert, adhesive suckers, with concave tops, on the middle of the body, but becoming smaller and sessile above and below. Sub-marginal tubercles small and simple. Tentacles long and slender, in moderate number. In contraction the body is oval, 1·5 inches long; 1 in diameter. It may be a *Bunodes*.

Phymactis Edw. and Haime.

Actinia (*pars*) Drayton, op. cit., p. 125, 1846.
Phymactis Edw. and H., Corall., i, p. 274, 1857.

Column rather low and broad, covered with prominent verrucæ.

Margin surrounded by a circle of bright colored spherules, or eye-tubercles. Tentacles rather large and numerous. Mouth large and prominent with many lateral folds.

Phymactis clematis Edwards and H., op. cit., p. 275.

Actinia clematis Drayton, op. cit., p. 130, Pl. I, fig. 4 and 5, 1846.

Column low, usually much broader than high, base and disk broader; the disk broadest, dilated, and thrown into four or five lobes or folds by the undulations of the margin Pustules or verrucæ of the walls large, numerous, crowded. Marginal tubercles or spherules large, rounded, 1·5 lines broad, yellow or red. Naked portion of disk less than half the whole diameter. Tentacles short and numerous, rather stout, in about five series.

Color quite variable; "in one variety the body with the disk and tentacles, is of a deep rich green color; the centre of the disk a little paler, the marginal tubercles a bright yellow, and the under part of the foot yellow. In another the body is a deep crimson, with the tubercles of the lateral surface deep green, and the marginal tubercles vermilion; the tentacles dark lake, and the central part of the disk a paler lake; under surface of the base a bright orange, approaching vermilion,"—J. Drayton.

Diameter at middle 2·5 inches; diameter of disk 4; height of column about 2; length of tentacles ·5 to ·75.

Valparaiso, Chili,—U. S. Expl. Exp.

In the work of Edwards and Haime the locality is erroneously given as "Côtes du Brésil."

Phymactis florida Edw. and H., op. cit., p. 274.

Actinia florida Drayton, op. cit., p. 131, Pl. 2, fig. 6, 7, 8.

Column low, about as broad as high, somewhat dilated at base and summit; margin of base undulate, of disk somewhat plicate, usually in five folds; surface crowdedly covered with verrucæ. Tentacles "short, about ·5 inch, nearly equal, subulate, stout, crowded, in 5 imperfect series." Disk strongly radiated, the tentacles occupying a breadth of ·5 to ·75 of an inch.

Color variable; "one variety has a royal smalt-color, with the papillæ of the surface a fine ultramarine, the disk a paler blue, and the marginal tubercles pearly white. Another is verdigris-green, with the papillæ of the same color, and the marginal tubercles yellow. Another apparently of the same color, though a little higher (near 3 inches), has the papillæ of the lateral surface of a sap-green color on a reddish

ground, with the tentacles a dull purple, the disk between the tentacles and the mouth light grayish green, the mouth flesh-color, and the under surface of the base scarlet,"—J. Drayton.

Height 2 to 2·5 inches; diameter at middle 2·25; diameter of disk 3. San Lorenzo I., off Callao, Peru,—U. S. Expl. Exp.

This species may, quite possibly, prove to be only a variation of the preceding one, depending on locality, state of expansion, etc. It appears to differ principally in having shorter and more numerous tentacles and a less dilated disk.

Subfamily, SAGARTINÆ Verrill.

Actinines perforées (section) Edw. and Haime, Corall., i, p. 278, 1857.
Sagartiadæ (family) Gosse, 1858; Actinologia Britannica, p. 9, 1860.
Sagartidæ (subfamily) Verrill, Mem. Boston Soc. Nat. History, i, p, 21, 1864.
Sagartinæ (subfamily) V., Proc. Essex Inst., vol. v, p. 322, 1868; ditto, vol. vi, 1869.

Column very changeable in form, usually capable of great extension into long, cylindrical, or pillar-like forms, or of contracting into a low, flattened, conical shape. Surface in full expansion mostly smooth, not verrucose, often with retractile suckers, which are not conspicuous except while in use; in contraction the surface is usually covered with close transverse or reticulate wrinkles. Walls perforated by special openings (*cinclidæ*) through which thread-like, stinging organs (*acontia*) are ejected when the animal is irritated, sometimes in great profusion, in other cases very sparingly and reluctantly. Margin simple or nearly so, usually without special appendages (*Nemactis* is an exception). Tentacles usually numerous, generally slender and elongated, highly contractile.

Species can usually be recognized as members of this subfamily by the smooth, thin walls, usually showing the internal lamellæ, and by their perforations and the existence of acontia. But the latter characters are frequently overlooked, even in living specimens, and are generally difficult to detect in specimens contracted in alcohol, except in a few genera where the borders of the pores are raised (*Adamsia*). Most of the species referred by Edwards and Haime to *Paractis*, and described as lacking perforations and all appendages of the walls, are really *Sagartians* in which the perforations have been formerly overlooked. Therefore I have here referred several similar species of simple Actinians to this group, although the lateral pores and acontia have not actually been observed.

Metridium Oken.

Actinia (pars) Linnæus, Lamark, Cuvier, Dana, etc.
Metridium Oken, Lehrbuch der Naturg., iii, p. 349, 1815, (*non Metridium* Ehrenberg, Dana, Gosse, etc., = *Oulactis*).
Actinoloba (pars) Blainville, Dict. des Sci. Nat., 1830; ditto, Manuel d'Actinologie, p. 322, 1834; Gosse, Actinologia Brit., p. 11, 1860.
Cribrina (pars) Ehrenberg, op. cit., p. 40, 1834.
Metridium Edw. and H., Corall., i, p. 252, 1857; Verrill, Mem. Boston Soc. Nat. Hist., i, p. 21, 1864.

Column very changeable, in full expansion usually tall, pillar-like, expanding toward the disk, or lower and nearly as broad as high; in contraction forming a low cone; surface nearly smooth, with abundant mucus; integument firm, thickened when old, forming at some distance below the margin a thick smooth fold, above which the wall is thinner and translucent. Disk broad, frilled, or thrown into lobes or broad undulated folds, toward the margin. Tentacles very numerous, the inner ones larger, more or less scattered on the disk, the outer ones becoming gradually smaller and more crowded, those at the margin very small and crowded. Walls perforated by scattered openings, not very apparent except when fully expanded. Acontia abundant, but not often emitted except when greatly irritated.

Metridium fimbriatum Verrill.

Proceedings Essex Inst., vol. iv, p. 151, 1865.

Base broadly expanded. Column very changeable, either low and broad, or greatly elongated, the fold or "parapet" nearly an inch below the margin. Tentacles very numerous, encroaching so much upon the disk as to leave only a narrow central area around the mouth, short, very slender, filiform, pointed. Edge of disk thrown into numerous deep frills.

Color of column variable; often translucent pale orange, punctate with dark brown; or light umber-brown; tentacles a lighter tint of the same, white within; mouth deep orange, or light yellowish brown, surrounded by a broad band or halo of purplish.

Harbor of San Francisco, Cal., adhering to the bottom of floating piles, etc., Oct., 1855,—Dr. Wm. Stimpson; Puget Sound,—Dr. C. B. Kennerly.

This species is closely allied to *M. marginatum* of the New England Coast, and *M. dianthus* of Europe. From the former it appears to differ chiefly in having longer and more slender tentacles, with the "parapet" farther from the margin of the disk.

It is possible that the three will eventually be found to belong to

one very variable and widely diffused species, but until direct and careful comparisons of numerous living specimens of each can be made, this question cannot be positively settled.

Metridium reticulatum Edw. and Haime, op. cit., p. 255.

Actinia reticulata Couthouy, in Dana, Zoöph., p. 144, Pl. 4, fig. 31, 1846.
Actinoloba reticulata Gosse, Actin. Brit., p. 24, 1860.

"Exterior smooth and reticulately corrugate, subcylindrical, 1·5 inches high, 2·5 thick, with the disk very much dilated (3·5 broad), and margin somewhat five-lobed, not tuberculate; tentacles very numerous, quite short (3 lines), not turgid and covering the greater part of the disk, the inner a little the largest; mouth somewhat prominent, 6 to 8 lines long."

The column is "covered with a sort of raised network, produced by the corrugations of the external envelope." The disk "is broadly dilated, and the five lobes, or folds, are never effaced so as to leave the disk circular." Tentacles "short, subulate, and disposed in 9 or 10, close, alternate series, the inner ones longest, decreasing to marginal ones, which are mere papillæ."

Column "fulvous orange, sometimes olive-brown, with an indistinct zone of black surrounding the superior margin; tentacles olivaceous; disk between tentacles and mouth bright ochreous, with strong radiating lines, crossed by others of a pale olive-green; mouth velvet purplish-black."

"This Actinia is remarkable for the opacity of all its parts; the colors are all soft and rich, but even in the young they lack that transparency usually met with in these zoöphytes."

Orange Harbor, Terra del Fuego, attached to stones and shells,—J. P. Couthouy, U. S. Expl. Exp.

The specimens of this species preserved in alcohol strongly resemble those of *M. marginatum* and other species of this genus, to which we believe it really belongs, notwithstanding the wrinkled epidermal (or mucous) layer, an appearance which may have been due, in part at least, to imperfect expansion of the column.

The following species, of which the genus is not determinable from the description, may belong here.

(?) **Actinia Mertensii** Brandt, Prod. descr. anim., p. 13, 1835; Edw. and Haime, Corall., i, p. 289.

"Body brown, mingled with black. Tentacles moderate, white. Disk pale brown, with white lines." Coast of Chili,—Mertens.

Cereus Oken.

Cereus Oken, Lehrbuch der Naturg., iii, p. 349, 1815, (type, *C. bellis*).
Actinocereus Blainv., Dict. Sci. Nat., lx, p. 194, 1830.
Oribrina (*pars*) Ehr., Corall., rothen Meeres, p. 40, 1834.
Sagartia (*pars*) Gosse, Trans. Linn. Soc., xxi, p. 274, 1855; (*Scyphyia*) Actinologia Brit., p. 25, (123), 1860.
Cereus (*pars*) Edw. and Haime, Corall., i, p. 263, (269), 1857.
Cereus Verrill, Bulletin Mus. Comp. Zoöl., p. 58, 1864; Mem. Boston Soc. Nat. Hist., p. 24, 1864.

Column very changeable in form, capable of becoming tall, pillar-like, or contracting to a low, depressed cone; no submarginal fold; upper part with small, inconspicuous, contractile suckers; walls nearly smooth, pierced by scattered, inconspicuous pores or cinclidæ. Disk broadly expanded, wider than the column, sometimes undulated at the margin. Tentacles numerous, more or less scattered on the disk, usually rather stout, the inner ones considerably largest; the outer ones quite small. Type, *C. bellis.*

Oken, in constituting this genus, stated that the walls are perforated, and named *C. bellis* as a typical species, therefore it seems not only proper, but necessary, to restrict the name to the group which contains that species. Edwards and Haime have erroneously extended the genus so as to include all the imperforate, verrucose species, belonging to *Urticina* and *Bunodes*, as well as *C. bellis* and allied species.

Cereus Fuegiensis Verrill.

Actinia Fuegiensis Couthouy, op. cit., p. 145, Pl. 4, fig. 32, 1846.
Discosoma ? Fuegiensis Edw. and Haime, Corall., i, 257, Pl. C2, fig. 2, (from Dana, Zoöph.), 1857.
Sagartia Fuegiensis Gosse, Actin. Brit., p. 38, 1860.

"Subcylindrical, 2 inches in diameter, exterior smooth, upper and lower extremities sparingly dilated, margin of base slightly undulate; tentacles throughout remotely scattered, turgid, 3 lines long; mouth small, circular, 5-cleft; form of animal when contracted very much depressed, convex."

The tentacles are scattered over a large part of the disk, about 1 to 1·5 lines apart, nearly in five series, and have "the form of a grain of wheat." The inner ones are considerably largest.

Disk bright orange; column darker orange, with transverse parallel lines or markings of dark brown; tentacles grass-green; mouth pale orange.

Orange Harbor, Terra del Fuego, on rocks,—J. P. Couthouy, U. S. Expl. Exp.

This species is referred to *Cereus* mainly on account of its general resemblance to *C. bellis*, but as neither lateral pores nor acontia have been observed, it may belong properly in some other genus.

The original specimens I have not been able to find in the Smithsonian collections.

Calliactis Verrill, gen. nov.

Adamsia (pars) Edw. and H., Corall., i, p. 278, 1857, (*non* Forbes).

Column very changeable in form, in full expansion elevated, subcylindrical, with a broadly expanded base, in contraction forming a broad, low, flattened cone, or convex disk. Surface nearly smooth in expansion, except near the base, where there are one or more transverse rows of conspicuous lateral pores or cinclidæ, which have thickened, permanently raised borders. Basal margin, below the pores, thin and expanded, usually with additional internal lamellæ intercalated between the larger ones that extend to the disk, all of which are usually visible through the thin but firm walls. Tentacles numerous, slender, subulate, highly contractile. Acontia highly developed, emitted freely from the cinclidæ. Type, *C. decorata* (*Actinia decorata* Drayton).

This genus appears to be abundant in the tropical seas, the species generally living upon univalve shells inhabited by hermit crabs. The colors are usually brilliant and varied. It is allied to *Adamsia*, which has similar basal cinclidæ, but the latter has a low growth, spreading to a great extent laterally, and the tentacles are short and imperfectly retractile, while the base has the power of forming a tough pelicle to extend the aperture of the shell; its base also extends around the aperture in two broad lateral lobes, which unite where they come in contact, giving the body an annular form. To this genus belong several undescribed species from the Pacific Islands, with the following, and perhaps other, described species.

C. decorata (Drayton sp.), Pl. 3, fig. 24. Honden I., in lagoon.
C. tricolor (Lesueur sp.). West Indies.
C. bicolor (Les. sp.). West Indies.
C. Egletes (*Adamsia Egletes* D. and M.), Supl., Pl. vi, fig. 17. St. Thomas, W. I.
C. fusca (Quoy and Gaim., Astrolabe, p. 145, Pl. 11, fig. 8 and 9). Amboinia.
C. ? polypus (Forskal sp.). Red Sea.

Calliactis variegata Verrill, sp. nov.

Base broadly expanded, adhering to shells, the edge thin and spreading. Column broad, moderately elevated in expansion, when contracted forming a low cone, usually rounded at summit. Surface in alcoholic specimens closely wrinkled transversely and minutely corru-

gated on the upper parts, or sometimes cancellated, or covered with reticulated wrinkles with elevated interspaces, smoother near the edge of base, where it is radiated with conspicuous dark lines of unequal length, corresponding to internal chambers, and alternating with narrower light lines, corresponding to the lamellæ; the edge crenulated. Cinclidæ at about ·25 or ·30 inch from the edge of the base, forming a circle of about 24, rather distant, conspicuous, perforated verrucæ, often with another more or less complete circle a short distance below, in which the cinclidæ correspond in position with the upper ones, but appear to be smaller. Acontia pink, long, and fine, protruded freely both from the month and cinclidæ. Tentacles slender, of moderate length, "arranged in four series (24–24–96)."

Column "marked at base with light purplish brown spaces, separated by 97 olive-brown lines, extending ·25 to ·50 inch from edge of base; above these a row of 24 white perforated spots" (cinclidæ); rest of column "mainly olive-brown, striped with six longitudinal bands of dark pink, which are sometimes divided so as to form six pairs of bands. Mouth small, when open pinkish yellow, surrounded by a white space marked with dark radiating lines; followed by a circle of dark brown, marked with 12 narrow white rays; then follows a circle of dark brown, marked with 24, minute, white spots; then a narrow space with 12, nearly equal, alternating dark and white bands, opposite to which the tentacles are mainly of corresponding tint; sometimes all the tentacles have white tips, the rest light brown; sometimes all are surrounded with alternating dark and light bands.

The largest specimens are about 2 inches broad.

Panama Bay, dredged in 2 to 6 fathoms, attached to large shells occupied by hermit-crabs,—F. H. Bradley.

This species is closely allied to *C. decorata* Drayton, sp., with which it agrees, to a considerable extent, in its pattern of coloration.

Sagartia Gosse.

Cribrina (*pars*) Ehr, Corall., rothen Meeres, p. 40, 1834.

Sagartia (*pars*) Gosse, Trans. Linn. Soc, xxi, p. 274, 1855; Actin. Brit., p. 25 and 122, 1860.

Paractis (*pars*) Edw. and Haime, Corall., i, p. 248, 1857.

Column very changeable in form, usually elevated and pillar-like in full expansion. Base and disk only moderately enlarged. Walls smooth or nearly so, often with small retractile suckers on the upper part. Cinclidæ not elevated, inconspicuous when closed, scattered over the surface. Acontia usually abundant. Tentacles rather numer-

ous, near the margin, long and slender; one in the line with the longer diameter of the mouth is often capable of great elongation.

It seems necessary to restrict this genus to the group considered typical by Gosse,* with which the "rather less typical group," to which he gives the subgeneric name, *Thoe*, and some other forms, may also be united.

Sagartia impatiens Gosse.

Actinia impatiens (Couthouy MS.) Drayton, op. cit., p. 135, Pl. 3, fig. 13, 1846.
Paractis impatiens Edw. and H., Corall., i, p. 248, 1857.
Sagartia impatiens Gosse, Actin. Brit., p. 38, 1860.

Column "nearly cylindrical, 1 to 1·5 inches in diameter and height, sometimes very much elongated and writhing. Sides smooth, but somewhat corrugate-striate, and above, color delicately tessellated. Base sparingly dilated. Tentacles subequal, an inch long, stout, subulate, in 2 series. Mouth prominent, with 8 lobes within.

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

Orange Harbor, Terra del Fuego, in tide-pools among the crevices of rocks,—U. S. Expl. Exp.

Sagartia lineolata Verrill.

Actinia lineolata (Couthouy MS.) Drayton, op. cit. p. 137, Pl. 3, fig. 22, 1846.
Paractis lineolata Edw. and H., Corall., i, p. 248, 1857.

Column, as observed in imperfect expansion, forming a low, depressed, rounded cone, in contraction nearly flat; sides smooth, vertically lined with brown. Tentacles 24, in 2 series, 6 to 8 lines long, rather stout. Disk small, radiated with whitish lines. Mouth small, not prominent, circular, retaining its circular form even in contraction; its margin with convex folds corresponding with the tentacles.

Column pale ochre, on which are disposed a number of longitudinal lines of an amber-color, arranged regularly, "a broader one alternating with two narrower, so as to leave between each of the broader lines three ochreous ones of the same width." Near the base the colors are fainter, giving the appearance of an indistinct zone. Tentacles pale flesh-color. Disk purplish brown, with flesh-colored lines extending from the base of the tentacles nearly to the centre. Diameter from ·5 to 1·5 inches, rarely more than ·5.

Forge Cove, near Orange Harbor, Terra del Fuego, on small stones just below low-water mark,—J. P. Couthouy, U. S. Expl. Exp.

* Actinologia Britannica, p. 122.

This species is said to be very active, frequently changing its position, and keeping its tentacles actively in motion. The young were observed in several instances to be ejected from the mouth.

Sagartia crispata Verrill, sp. nov.

Actinia crispata Bradley, MS.

Base broadly expanded. Column, as observed, in expansion subcylindrical and rather low, but little higher than broad. Edge of disk deeply undulated or frilled. Tentacles numerous, very small, in about two rows, close to the edge, the outer row smallest. Acontia numerous and fine, emitted freely. Column light brown above, below marked with dark olive-brown lines and numerous white blotches on a light brown ground-color; inner tentacles dark brown, tipped with yellow, brown, and white; outer row light brown, with white tips. Diameter of base 1 inch; of column ·5; height of column 1 inch.

Panama Bay, dredged in 4 to 6 fathoms, on a large murex (*Phyllonotus*),—F. H. Bradley.

Sagartia carcinophila Verrill, sp. nov.

Base expanded; column elongated, pillar-like, or subcylindrical, in full expansion; capable of contracting to a slightly convex disk. Tentacles in two or three rows at the edge of disk (not seen in full expansion), rather short and blunt.

Column "olive-brown, marked with 24 white longitudinal lines, alternating at the base with a pair of short white lines in each interspace; tentacles same color with the body, but slightly lighter, marked near the tip with two oval spots of dark greenish brown."

Diameter ·5 of an inch; height about 1 inch.

Panama Bay, dredged in 3 or 4 fathoms, adhering to the carapax of a Hepatus-like crab (*Hepatella amica* Smith),—F. H. Bradley.

Sagartia Panamensis Verrill, sp. nov.

Column very extensible, expanding to edge of disk, flesh-colored, translucent, showing the internal lamellæ. Disk rather broad, ·75 of an inch in diameter. Tentacles at the edge of the disk, marked with alternate bands of dark brown and white.

Panama, east reef, on rocks above half-tide,—F. H. Bradley.

Sagartia Bradleyi Verrill, sp. nov.

Column rather short. ·35 of an inch in diameter. Tentacles as long as the diameter of the disk, placed on its edge, in about three rows of nearly equal length; the inner row of 12, a little longer.

Column greenish brown; tentacles greenish brown, the outer ones lighter. In other specimens, supposed to be of the same species, the column is "flesh-color to olive, base of tentacles, especially outer ones, often colored white or pale yellow, occasionally with irregular, small, transverse, white or straw-colored spots on the brown tentacles."

Panama, south reef, near half-tide mark among stones,—F. H. Bradley.

The specimens in alcohol are broader than high; the tentacles obtuse, not retracted; the column with strong longitudinal sulcations.

Sagartia nivea Verrill.

Actinia nivea Lesson, Voyage Coquille, p. 81, Pl. iii, fig. 8, 1832, Plates, 1826, (non *S. nivea* Gosse = *S. Gossei* Verrill).

Actinia ? nivea Edw. and H., Corall., i, p. 247, 1857.

Very changeable in form, often subconical, subcylindrical, or vase-shaped, or the upper portion of the column may be withdrawn into the lower by an infolding of the walls near the summit;* surface very smooth, very soft to the touch, marked with longitudinal sulcations. Mouth small, roundish oblong, with a semicircular fold at each end. Tentacles very numerous, crowded at the margin, rather long, fine and slender. Color bluish white, often more or less mottled with light brownish.

Height 1 to 1·25 inches, in expansion; diameter ·5 to ·75; length of tentacles ·25 to ·40.

Paita, Peru, very common, found by thousands fixed upon the piles of the wharf in front of the city,—Lesson; Callao, Peru, in vast numbers, in the interstices among *Discinæ*, *Balani*, etc., adhering to the bottom of an old vessel,—F. H. Bradley.

Several thousand specimens were obtained by Mr. Bradley, and are in excellent preservation, many of them with the tentacles expanded. These appear to belong to Lesson's species, but this cannot be positively affirmed. Most of these are small, but some, even in partial contraction, are 1½ to 2 inches long; ·5 to ·75 in diameter; the tentacles ·5 of an inch long, when least contracted. The surface is smooth, or finely wrinkled transversely, the integument thin but firm, often showing the internal lamellæ. The tentacles are very numerous, crowded, long and slender. Color of column white; tentacles in alternating clusters of whitish and dull bluish, in the alcoholic specimens.

* I have also observed this habit in *S. modesta* V., from Long Island Sound, and in other species.

As the name, *nivea*, is preoccupied by this species, I propose for the *Sagartia nivea* Gosse, of Great Britain, the name, *Sagartia Gossei*, in honor of its discoverer.

Sagartia Lessonii Verrill.

Actinia bicolor Lesson, op. cit, p. 78, Pl. iii, fig. 3, 1832, Plates, 1826, (*non A. bicolor* Lesueur, 1817).
Actinia (?) bicolor Edw. and H., Corall., i, p. 246, 1857.

Column vase-shaped, higher than broad, contracted above the base and then gradually enlarging to the disk, surface smooth, mouth small, with a slightly thickened border; disk radiated. Tentacles in two series, crowded at the margin, moderately long, slender, nearly equal. Color of column snow-white; of tentacles emerald-green.

Height in expansion about 1·25; diameter of column ·75; across expanded tentacles 1·10; length of tentacles ·35 to ·40 of an inch.

Near Paita, Peru, very common,—Lesson.

This species appears to be closely allied to the preceding and may prove to be identical when reëxamined.

Sagartia (?) Peruviana Verrill.

Actinia Peruviana Lesson, op. cit., p. 75, Pl. ii, fig. 3, 1832, Plates, 1826.
Actinia ? Peruviana Edw. and H., Corall., i, p. 246, 1857.

Column sub-cylindrical, enlarging from the base to the summit; surface smooth, sulcated near the base. Disk flat, dilated, mouth large, oblong, with swollen lips. Tentacles in two series, of moderate length, subequal, round and somewhat swollen at base, attenuated toward the end, which is acute.

Color of column bright light green, the folds between the sulcations near the base brownish; mouth flesh-color; disk clear pale green, with regular, fine, radiating lines of brown; tentacles rosy white.

Height in expansion 1·75; diameter at base 1·10; at summit 1·40; length of tentacles ·60 to ·70 of an inch.

Paita, Peru, in crevices of rocks and buried in sand, common,—Lesson.

Sagartia (?) nymphæa Verrill.

Actinia nymphæa Drayton, op. cit., p. 146, Pl. 4, fig. 33, 1846.
Paractis (?) nymphæa Edw. and H., Corall., i, p. 252, 1857.

Column smooth, dilated above and below, margin of base crenate, sides with corresponding vertical lines. Tentacles stout, in 3 series, slender, mouth a little prominent, and a sixth of an inch long. In contraction the form is a low truncated cone. Column whitish, marked

with vertical, pale ochreous lines, 1·5 lines apart; disk pale purplish; tentacles yellow.

Height ·68 of an inch; breadth of disk and base 1; length of tentacles ·16 to ·20.

Valparaiso, Chili,—U. S. Expl. Expedition.

Sagartia (?) rubus Verrill.

Actinia rubus Drayton, op. cit., p. 147, Pl. 4, fig. 34, 1846.
Paractis rubus Edw. and H., Corall., i, p. 249, 1857.

Column small, smooth, dilated above and below, base crenated, sides with interrupted vertical lines. Tentacles short, in 2 series, mouth a little prominent, about a sixth of an inch long. Color of column ash-brown, vertically marked with slate-colored, dotted lines; tentacles white; disk rich purple; mouth the same, except that the opening is whitish.

Height ·75 of an inch; diameter at base and disk 1; length of tentacles about ·20.

Valparaiso, Chili,—U. S. Expl. Exp.

This species is very near the last, if not identical, which is quite probable. The principal differences are in color and, apparently, in the number and length of the tentacles, which appear to be longer and fewer in this form.

Several other undescribed species of *Sagartia* are known to occur on different parts of the coast. One species from Panama is remarkable for the thinness and transparency of its walls when preserved in alcohol. It grows to a considerable size, some of the preserved specimens being 1·5 inches high and 1 in diameter.

Other species were collected at the Gulf of Georgia and well figured by Mr. A. Agassiz, several years ago.

Nemactis Edw. and Haime, op. cit., p. 282, 1857.

Actinia (*pars*) Dana, Zoöphytes, 1846.

Margin of the disk, outside of the bases of the tentacles, surrounded by a single circle of bright colored, rounded tubercles. Acontia long and slender, protruded from the mouth, and *perhaps* from lateral pores.

The authors of this genus give as one of its characters "pores situated near the border of the disk,"—a character which may possibly exist, but of which there is no proof. In Drayton's figures acontia are represented as protruding from the mouth, which, if carelessly observed, might appear to be figured as coming from the sides, but in the description of *A. primula* we find it stated that "the threads pass-

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

Nemactis primula Edw and Haime loc. cit.

Actinia primula Drayton, op. cit., p. 134, Pl. 2, fig. 12 to 15, 1846.

Small, scarcely an inch high and broad, slightly dilated above and below. Tentacles short, 2 or 3 lines long, slender, arranged in 3 series. Mouth somewhat prominent, ·33 of an inch long. Column with vertical colored lines, which are often interrupted.

One variety has a flesh-colored column, with many dark orange, parallel vertical lines; tentacles white at base, tips orange; disk yellowish brown; mouth pale flesh-color; tubercles and margin of disk green. Another is pink at base, bright green above, with vertical dotted lines of carmine; disk carmine; tentacles bright yellow; marginal tubercles dull green. In another the outer tentacles are white, the rest red; disk and mouth light blue; tubercles white. A fourth variety is white, clouded with pink and green, dotted with crimson; outer tentacles white, the rest brilliant carmine; disk pale lake; marginal tubercles green.

Shores of San Lorenzo I., in tide pools,—U. S. Expl. Expedition.

Nemactis Draytonii Edw. and Haime, op. cit., p. 282.

Actinia primula (*pars*) Drayton, op. cit., p. 135, Pl. 2, fig. 16, 1846.

Form and general appearance as in the preceding, "with prominent green tubercles but no distinct tentacles." Column pale bluish, with vertical brown lines. Disk bluish white, with brown radii; mouth reddish.

San Lorenzo,—U. S. Expl. Expedition.

Nemactis (?) Chilensis Verrill.

Actinia Chilensis Lesson, Voyage Coquille, p. 76, Pl. 2, fig. 5, 1832.
Dysactis Chilensis Edw. and H., op. cit., p. 262, 1857.

Column, as figured, subconical, decreasing in size from the base upward, marked with vertical sulcations. Disk of moderate size, radiated. Mouth rather large, oblong. Tentacles of moderate length, slender, subulate, arranged in one row around the margin, about 50 in number. Fourteen very long, slender, filiform, snow-white organs, apparently acontia, are represented as emerging from the margin outside of the true tentacles. No marginal tubercles are figured.

Color of column light green, with vertical lines of dark green; disk pinkish with darker radii; tentacles orange, tinged with crimson.

Height nearly 1 inch; diameter 1·25; length of tentacles ·35 to ·50; of filiform organs 1·5.

Bay of Talcahuano, Province of Concepcion, Chili, in crevices of rocks where the waves break with force, at the entrance; also upon the shores of Quiriquine Island,—Lesson.

The position of this species is still uncertain. The filiform organs, represented in the figure, were regarded as an outer series of longer tentacles by Edw. and Haime. They have, however, much greater resemblance to acontia in length and slenderness, as well as in color and irregular number. The general appearance is that of a Sagartian, but as no marginal tubercles are described or figured, it may not belong to *Nemactis*, but in the state of expansion represented the tubercles might be concealed from view.

Sub-family, PHELLINÆ Verrill.

Proceedings Essex Inst., v, p. 324, 1868.

Column elongated, covered with a thickened, persistent, epidermal deposit, except that near the margin, and sometimes close to the base, the surface is naked and may be retracted within the thickened portion. Acontia very few and seldom emitted,—perhaps entirely wanting in some species.

Phellia Gosse.

Annals and Mag. Nat. Hist., ser. 3, vol, ii, p. 193, 1859; Actin. Britannica, p. 134, 1860; Verrill, Proc. Essex Inst., v, p. 325, 1868.

Column mostly covered with a persistent epidermal deposit to which particles of mud, sand, and dirt of various kinds often firmly adhere; upper portion, near the margin, naked, smooth. Margin simple, not tuberculate. Tentacles marginal, in moderate numbers, the outer ones usually considerably shortest. Acontia observed only in one or two species, few, sparingly emitted from the mouth, and from pores near the base.

Phellia inornata Verrill, sp. nov.

Base small, not dilated. Column when contracted obpyriform, when expanded obconic, the surface covered with adherent grains of sand. Disk small, wider than base. Tentacles small, arranged in one row at the margin. Color dirty white throughout.

Height ·5 inch; diameter of base ·06; of disk ·12 of an inch.

Panama and Pearl Islands, on loose shells in 4 or 5 fathoms,—F. H. Bradley.

Phellia ? rubens Verrill, sp. nov.

Column small, subcylindrical, "mostly covered with slime." Tentacles numerous, slender, in one row, "raised on a thin expansion,

which forms a wall about ·12 of an inch high around the linear mouth, length equal to two-thirds the diameter of the disk.

Column dull red; tentacles bright scarlet. Height ·50 to ·75; diameter ·25 of an inch.

Zorritos, Peru, attached to a Chama in 4 fathoms,—F. H. Bradley.

The specimens of this species have not been found in the collection and its generic characters are doubtful.

Phellia Panamensis Verrill, sp. nov.

A large species, with the column much elongated, subcylindrical, or enlarging upward, capable of great extension or of contracting into the form of a tall cone by involving the summit; surface entirely covered, except on a narrow band below the margin, with a thick and firm mud-colored epidermis, which is thrown into fine, close, irregular wrinkles, the intervening spaces appearing like small, irregular papillæ. Naked space below the margin smoothish in full expansion, more or less corrugated and with papilliform wrinkles in partial contraction. Tentacles about 96 in number, the 12 inner ones large and stout, much larger than the others, which decrease gradually in size to the outer ones, which are quite small and crowded at the margin. In dissecting a large specimen, it was found that the 12 septa corresponding to the 12 large inner tentacles, are much larger than the others, with the inner edges strongly thickened and muscular, and bear the large convoluted ovaries throughout nearly their whole length, while the intervening small septa are very narrow, not thickened, and bear no sexual organs. Color in life unknown. In alcohol the column is mud-colored, except near the margin, where it is white. Height of the largest specimen, partly contracted in alcohol, 3 inches; diameter 1. Another specimen is 3 inches high and ·5 in diameter.

Panama,—F. H. Bradley.

This large and fine species is known only from alcoholic specimens, most of which have the disk and tentacles expanded.

Phellia arctica Verrill.

Proc. Essex Inst., vol. v, p. 328, 1868.

Arctic Ocean, north of Behring's Straits, in 30 fathoms,—North Pacific Expl. Expedition.

This species grows to a pretty large size, and is remarkable for having, in the only specimen seen, peculiar ova-like bodies imbedded in the surface of the column.

Subfamily, ACTININÆ Verrill.

Actiniadæ (family) Gosse, Annals and Mag. Nat. Hist, vol. i, p. 416, 1858.
Actiniadæ and *Antheadæ* (families) Gosse, Actin. Brit., p. 171 and 148, 1860.
Actininæ and *Antheinæ* (subfamilies) Verrill, Proc. Essex Inst., v, p. 321 and 322, 1868.

Column smooth, or nearly so, sometimes sulcated vertically. Wall imperforate and destitute of verrucæ and suckers. No acontia. Margin with or without colored tubercles. Tentacles usually numerous, long, mostly contractile, sometimes non-retractile.

The existence of numerous forms combining the characters of *Actinia* and *Anthea* (*Anemonia*) appears to require the union of these seemingly very diverse genera into one subfamily.

Owing to the difficulty in ascertaining the existence of acontia and lateral pores in preserved specimens, some species referred to the *Sagartinæ* may belong here, while some of the species referred here may belong to *Sagartia*.

Paractis Edw. and Haime, op. cit., p. 248, (restricted).

Column smooth, imperforate. Tentacles retractile; no marginal tubercles.

This genus was established for numerous species supposed to have these characters, but as most of them were known only by figures and descriptions, many species were wrongly placed in it. Thus of 19 species referred to the genus, some of them doubtfully however, by Edwards and Haime, at least 12 appear to be Sagartians, and most of the others are of doubtful affinities.

Whether a genus having the characters assigned to this really exists, may, therefore, be reasonably doubted. But as species occur which apparently agree with the diagnosis and cannot well be referred elsewhere, it may be best to place them provisionally in this genus, until better known.

Paractis (?) nobilis Verrill, sp. nov.

Column changeable in form, subcylindrical or somewhat elongated and pillar-like in expansion, capable of contracting to the form of a low cone. Surface, in preserved specimens, smoothish in expansion, when partly contracted the lower part of the column is covered with close, deep, transverse wrinkles, becoming more irregular and reticulated above, the upper part with about 48 vertical raised folds or wrinkles, which by contraction are bent in a zigzag manner. Margin with a distinct fold, crenated by the vertical folds. Tentacles of moderate size, about 48 in number.

Height about 1 inch, when partially contracted in alcohol; diameter ·5 to 1 inch.

Panama,—F. H. Bradley.

The following description, which is unaccompanied by numbered specimens, probably refers to this species. "Body large, 1·5 inches in diameter; the column fluted, with 48 vertical sulcations, corresponding to lobes of the base and disk. Base 2 inches in diameter. Disk broad, with wrinkled flutings corresponding with the tentacles; mouth small. Tentacles 48, in two series of 24 each, slender, 1·5 inches long. Color of column red; tentacles olive-brown, with a light streak up the inner side; mouth surrounded by 24 rays of alternating greenish and reddish brown, running to the tentacles. Grows to a large size. Specimens were seen 3 inches across the disk, others were reported as large as 5 inches."

Panama, on northeast reef, at three-quarters tide,—F. H. Bradley.

Epiactis Verrill, gen. nov.

Integument firm. Column subcylindrical, capable of involving the summit and contracting into a hemispherical form, with a distinct submarginal fold or "parapet," separated from the tentacles by a narrow fosse; surface smoothish, in contraction reticulately wrinkled. Near the base it is surrounded by a circular wrinkle or depression, upon which there are borne a variable number of young, of various sizes, appearing as if originating from surface buds, but possibly produced from ova attached in this place to the skin. These young may be removed without rupture of the integument, although they adhere quite firmly and leave a depression in the surface of the skin, but there are no apparent lateral openings in the wall. Tentacles numerous, about 50, in preserved specimens short and thick, arranged in several rows.

Epiactis prolifera Verrill, sp. nov.

Base dilated, crenulate. Column in contraction hemispherical or subconical, broader than high; surface with fine reticulated wrinkles above, near the base transversely wrinkled, the uppermost of these wrinkles more marked and bearing, in all except very small specimens, a circle of young of various sizes, which vary in number from very few up to 30 or 40. When most numerous they are closely crowded, somewhat in two rows. Parapet well marked, its edge rises into slight ridges between vertical wrinkles. Tentacles in alcoholic specimens short, stout, obtusely rounded at the end, about 50 in number in the larger specimens, and apparently arranged in several rows and

somewhat scattered on the disk. Color of column, in alcohol, yellowish brown; the lateral buds or young, white.

Height of the largest specimens, in contraction, ·4 inch; diameter of base ·5; length of tentacles ·1; diameter of lateral buds or young ·01 to ·08 of an inch.

Puget Sound,—Dr. C. B. Kennerly.

The young borne upon the sides give this Actinian a very singular appearance, and are very remarkable, since nothing of the kind has, apparently, been previously observed. Whether they should be regarded as buds, or as ova temporarily attached and developed in this position, I am unable to determine from the preserved specimens, but in either case they appear to remain attached for a considerable time and probably derive nutriment from the parent. The smallest observed have already 6 small tentacles and a slightly prominent mouth; the greater number have 12 tentacles and a small protuberant mouth; the largest ones are nearly all entirely contracted, but appear to have 24 tentacles, and show the internal radiating lamellæ through the walls. In contraction these young are nearly hemispherical. Specimens less than ·25 of an inch in diameter have no young upon the sides.

Anactis picta Ehr., Corall. rothen Meeres, p. 45, 1834.

Actinia picta Lesson, op. cit., p. 80, Pl. 3, fig. 6, 1830.

Column depressed, as broad as high; surface smooth, green, showing close vertical lines of darker green; a well marked fold or "parapet" at some distance from the tentacles, the intervening space, in the figure, appearing like a part of the disk. "Tentacles short, reddish brown; upon the flat buccal disk is a reddish zone, covered with ovals of orpiment-yellow, placed side by side, and touching by their base, or only separated on the sides by a small reddish brown ray."

The figure shows the appearance when not fully expanded. The buccal disk is contracted and apparently concealed by the partially retracted tentacles; outside of the tentacles (?) there is a broad flat area, bordered outwardly by the rounded parapet, and having a light orange ground-color, with 18 radiating bands of light blue, increasing in width outwardly, each one bordered on both sides by a row of small black spots, and with a circle of similar small spots connecting them together at the outer ends, just within the parapet.

Diameter about 1 inch; height a little less.

Paita, Peru, not common,—Lesson.

The true characters and the position of this species are very doubtful. It may belong to the *Sagartinæ*, near *Nemactis Draytonii*, or it may

be allied to *Asteractis*, the figure and description not being accurate enough to determine. The name, *Anactis*, was given under the impression that it has no tentacles, and in fact it is not certain whether the lines in the central part of the figure are intended to represent tentacles or lines on the disk.

Sub-order, ZOANTHACEA Verrill.

Proceedings Essex Inst., vol. iv, p. 147, 1865; ditto, vol. v, p. 316, 1868.

Polyps mostly compound, increasing by budding, permanently attached by the base, which is generally small, and by stolon-like or membranous expansions from which the buds arise, in compound species. Walls but slightly muscular, the summit capable of involution with the tentacles.

In all the species of this suborder, which have been dissected, peculiar flattened organs, having a curved or crescent-shaped form and a transversely striated surface, are found attached to the principal radiating lamellæ, near the base of the stomach. These were first described and figured by Lesueur, who called them "arcuated organs" and supposed them to have the functions of a liver. Dana described them more fully and supposed that they might be branchial organs. The latter view seems most probable, when we consider the character of the outer integument in these animals, which is always thick and firm and often indurated by adhering grains of sand, thus preventing it from acting as an effectual organ of respiration, as it does in most *Actinidæ*. Nor is this want supplied by large tentacles, or by branching tentaculiform organs seen in many *Actinians*. Therefore there appears to be a necessity for some special branchial organs, but careful examinations of living or fresh specimens can alone determine positively whether the "arcuated organs" are of this nature.

This group appears to include three families: *Zoanthidæ*, in which the buds arise from basal stolons or membranes; *Bergidæ*, in which the stolons arise from the sides above the base; and *Orinidæ*, which remain simple and have tubular openings upon the disk, through which thread-like organs (acontia?) are said to be emitted. Perhaps the simple forms referred to *Isaura* or *Hughea* may be admitted as a fourth family when more fully studied, but at present no sufficient characters can be given, since all *Zoanthidæ* must, at first, be simple.

The genus *Sphenopus*, referred to this group by Gray, is a free form and appears to be more closely allied to *Edwardsia*.

Family, Zoanthidæ Dana.

Zoanthina (family) Ehr., Corall., des rothen Meeres. p. 45, 1834.

Zoanthinæ (subfamily) Edw. and H., Corall., i, p. 298, 1857; (*pars*) Duch. and Mich., op. cit., p. 49, 1860.

Zoanthidæ (family) Dana. Zoöph., p. 417, 1846; Gosse, Actin. Brit., p. 295, 1860; Verrill, Mem. Boston Soc. Nat. Hist., i, p. 34; Proc. Essex Inst., v, p. 316, 1868.

Polyps attached by the base, usually compound, the buds arising either from basal stolons or broad expansions. Integument either smooth and naked, or thickened with imbedded and firmly adherent grains of sand.

In the number and arrangement of the internal lamellæ and tentacles, this family, and perhaps, also, the entire suborder, departs from the ordinary rule among *Actinaria* and *Madreporaria*. The tentacles seldom appear to present regular cycles in multiples of six. They are ordinarily arranged in two alternating circles, each having the same number, which is often an odd number, the entire number being, therefore, an even number, and the new tentacles appear to be introduced in pairs at one side and symmetrically to a median plane passing through the odd tentacles and the longer axis of the mouth and stomach.

Mammillifera Lesueur.

Journal Phil. Academy, vol. i, p. 178, 1817; Ehr., op. cit., p. 36; Duch. and Mich., Corall., des Antilles p. 51, 1860.

Palythoa (*pars*) Dana, Zoöph., p. 422, 1846; Edw. and Haime, Corall., i, p. 301, 1857.

Compound, increasing by buds that arise from broad, membranous, basal expansions, which at times may become in some parts narrow and more or less linear, covering broad surfaces of stones, etc. Polyps rather low, subcylindrical, or subcampanulate with a narrow base, in contraction forming rounded verrucæ, or low mammiform prominences. Tissues throughout fleshy and smooth, covered with mucus, but not agglutinating sand.

By the smooth soft tissue of the polyps and basal membranes, this genus is more nearly allied to typical *Zoanthus*, than to *Palythoa* (*Corticifera*), which has its integuments thickened by a layer of sand. From *Zoanthus* it differs mainly in having smaller, shorter, or more sessile polyps, and in the tendency to form continuous basal membranes, instead of linear stolons, but the latter character is not invariable even in the same species. The tentacles are usually shorter and less numerous.

Mammillifera Danæ Verrill.

Zoantha Danai LeConte, Proc. Philad. Acad. Nat. Science, v, p. 320, 1851.
Zoanthus (Mammillifera) Danæ Verrill, Proc. Boston Soc. Nat. Hist, x, p. 329, 1866.

The original description is as follows: "pallide purpurascens, tentaculis brevissimis, crassitie non longioribus, disco viridi, extrorsum purpurascente, ore parvo purpureo-marginato, tentaculis externis basi pallidis. Diam. disci ·25 unc."

"Remarkable for the shortness of the tentacula, which, when fully extended, are scarcely longer than the diameter of their base. The disk is radiately rugose, brilliant green, margined both internally and externally with purple. The root is broad, the animals closely associated, capable of extending 1·25 inches."

The specimens referred to this species form broad patches, covering the surface of rocks, the basal expansion being mostly continuous, but occasionally, in some parts, taking the form of broad irregular stolons, rarely linear for a short distance. The basal membrane and surfaces of the polyps are smooth and soft, without any adhering sand. The polyps in preserved specimens are closely arranged, but usually not so crowded as to be in contact, and vary in height from ·2 to ·5 of an inch; diameter of mature polyps is usually about ·2 of an inch. Column sub-cylindrical, with a rounded top when contracted, or low and mammiliform. Tentacles, in specimens dissected, 46 to 54 in number, in two regular rows, very short, thick, and obtuse, in the largest specimens in two alternating rows of 27 each. Inside of the bases of the inner tentacles, but alternating with them, are 27, small, oblong, tubercles, which are, therefore, opposite the outer tentacles. Disk strongly radiated.

In the interior the lamellæ are arranged bilaterally, 21 broad ones bearing the peculiar "arcuated organs" (branchiæ?) below the stomach; in the spaces between each pair of these there is usually one narrow lamella, but in two adjacent spaces on one side there are three intervening lamellæ, and in two other spaces, placed symmetrically in respect to the median plane, there are two small lamellæ. This arrangemant is, therefore, nearly the same as in *M. auricula*, as figured by Lesueur.* It would appear, therefore, that the lamellæ and tentacles increase by pairs, introduced one on each side of the median plane passing through the longer axis of the mouth and stomach, as observed in *Arachnactis* by Mr. A. Agassiz.†

* Journal Philadelphia Academy, i, Pl. viii, fig. 3.

† Journal Boston Soc. Natural History, vol. vii, p. 525, 1863.

The branchiform organs are dark greenish, broad, short, strongly arched.

Panama,—LeConte; Pearl Islands,—F. H. Bradley.

Mammillifera nitida Verrill.

Polyps close together on a broad basal membrane, rather tall, subcylindrical, with a smooth soft surface; height, of preserved specimens, ·30 to ·40; diameter ·12 to ·15 of an inch. Tentacles, in the specimen dissected, 54, rather long, slender, pointed. Color, in alcohol, dark greenish.

Acajutla, San Salvador,—F. H. Bradley.

The slenderness and length of the tentacles will distinguish this species from the preceding.

Mammillifera conferta Verrill, sp. nov.

Polyps so closely crowded upon the basal membrane that they are usually in contact and pressed into polygonal forms. Column in contraction, low, rounded, mammilliform, about as broad as high. Surface smooth, showing the internal lamellæ through the walls. Tentacles, in the specimens dissected, about 54, very short, like small, rounded papillæ, arranged in two regular series. Color, in alcohol, nearly white. Height, in contraction, ·08 to ·12; diameter ·10 to ·12 of an inch.

San Salvador,—Capt. J. M. Dow; Acapulco,—A. Agassiz.

This species covers the surface of shells, etc., with its crowded polyps, which are usually so close together as to entirely conceal the basal membrane.

Epizoanthus Gray (sens. mod.). (GEMMARIA, 1st Ed.).

Gemmaria Duch. and M., Corall. des Antilles, p. 55, 1860 (*non* McCrady).
Palythoa (*pars*) Edw. and H., Corall., i, p. 301, 1857.
Epizoanthus and *Gemmaria* Gray, Proc. Zoöl. Soc. London, 1867, p. 237.

Polyps arising from a broad, thin, basal membrane, sometimes covering dead shells occupied by hermit-crabs. Column more or less elevated; surface indurated by a layer of firmly adherent grains of sand.

Epizoanthus elongatus Verrill. (GEMMARIA ELONGATA, 1st Ed.).

Basal membrane thin, encrusting rocks. Polyps very unequal in size and height, mostly elongated, not crowded, separated usually by distances less than the diameter of base. Column tall, sub-cylindrical, often constricted somewhat at base, transversely wrinkled, the surface covered throughout by a nearly uniform layer of small grains of sand. Tentacles, in specimens dissected, numerous, about 46, in two rows,

elongated, small, slender, acute, each one having a small tubercle outside of its base.

Color. in alcohol, dark yellowish brown beneath the sandy layer, which is composed of differently colored grains. In a specimen dissected there were 42 internal lamellæ, of which 15 bore convoluted cords on the lower half.

Height of the larger polyps ·30 to ·40; diameter ·10 to ·12 of an inch.

Zorritos, Peru; and Pearl Islands,—F. H. Bradley.

Epizoanthus humilis Verrill, sp. nov. (GEMMARIA HUMILIS, 1st Ed.).

Basal membrane continuous, thin, but firm. Polyps very unequal in size, closely arranged, usually in contact at base, low, in contraction forming rounded verrucæ, which are often broader than high. Surface covered with a thin layer of fine sand, at the top of the contracted polyps showing about 12, distinct, radiating sulcations. Color light yellowish brown, when preserved in alcohol. Height of largest polyps, contracted in alcohol, ·06 to ·08; diameter 08 to ·10 of an inch.

Panama,—F. H. Bradley.

Epizoanthus crassus Verrill, sp. nov. (GEMMARIA CRASSA, 1st Ed.).

Polyps large, elongated, subcylindrical; surface, in contraction, strongly wrinkled transversely, and covered with a thick layer of fine sand; summit with about 20 strong sulcations, which radiate from the centre of the involved summit. Integument thick and firm. Tentacles about 66, acute, moderately long, with a small papilliform tubercle, or secondary tentacle, in front of the base, and a larger, tentaculiform tubercle outside the base of each, the latter bearing sand on its outer surface.

Height of contracted polyps 1·25; diameter ·25 of an inch.

Acajutla, San Salvador,—F. H. Bradley.

The specimen dissected had a very large cavity below the stomach, with 66, narrow, radiating lamellæ, which suddenly become broad near the base, meeting at the centre and nearly filling the cavity. The ovaries were attached to the broad portion, and the parts filled with enlarged eggs rose upward into the cavity, the eggs being arranged in single series.

The marginal processes outside each of the tentacles were larger than the true tentacles, broad, laterally compressed, rounded at tips, the outer edge covered with sand; below their bases the sand grains were aggregated in masses, as if attached to small papillæ. The papillæ in front of the bases of the tentacles were nearly half as long as the tentacles and similar in form.

Sub-order, ANTIPATHACEA.

Antipathina (family) Ehr., op. cit., p. 154, 1834.
Antipathacea (tribe) Dana, Zoöph., p. 574, 1846.
Antipatharia (suborder) Edw. and H., Corall., i, p. 311, 1857.
Antipathacea (suborder) Verrill, Proc. Essex Inst., iv, p. 147, 1865.

Polyps short, arising by budding from a common basal membrane, which secretes an internal horn-like axis, or support, from its internal surface, similar to the axis of *Gorgonidæ*. Tentacles few and simple, 6 to 24 in number.

This suborder appears to include but two families: *Antipathidæ* in which the polyps have 6 tentacles; and *Gerardidæ*, in which they have 24. The living polyps have been observed, however, in but few species, and when better known it may become necessary to establish other families.

Family, ANTIPATHIDÆ Dana, Zoöph., p. 574.

Polyps with 6 tentacles. Axis simple or variously branched; usually black, with the surface more or less spinulose, sometimes smooth, not sulcated.

Antipathes Pallas (restricted).

Elenchus Zoöphytorum, p. 205, 1766; Edw. and H., Corall., i, p. 314, 1857.

Axis much branched and subdivided; the branchlets not coalescent. Surface of the branchlets spinulose.

This genus, which is here adopted as restricted by Edwards and Haime, is not yet satisfactorily circumscribed, since generic characters derived only from the mode of growth and branching are always unsatisfactory in classifying compound Zoöphytes. It is probable that when more of the species shall have been examined in the living state, or when the microscopic structure of the preserved specimens shall have been more fully investigated, it will become necessary to remodel the genera of this family.

Antipathes Panamensis Verrill, sp. nov.

Corallum arborescently and densely branched and finely subdivided; the small branches mostly bipinnate and tripinnate. The trunk is quite stout and subdivides in an irregularly arborescent manner into many secondary branches, which divide in the same way. The resulting small branches arise in large numbers along the sides of the larger branches, at distances of ·08 to ·20 of an inch, many of them remaining small, simple or sparingly divided branchlets, but mostly subdividing in a pinnate, bipinnate, or even tripinnate manner. The final

branchlets are ·08 or ·10 of an inch apart, small, slender, rather short, rarely more than ·15 long without branches, scarcely ·02 in diameter. Their surface is densely covered with small, sharp spinules, which are directed obliquely outward and toward the tips of the branchlets.

Color of the trunk and main branches dull brownish black; branchlets very dark brown.

Height 13 inches; breadth 10; diameter of trunk ·50; of main branches ·15 to ·25 of an inch.

Pearl Islands, brought from 6 to 8 fathoms by pearl divers,—F. H. Bradley.

Order MADREPORARIA Verrill, from Edw. and Haime (restricted).

Madrepora (genus) (*pars*) Linnæus; Pallas; Ellis; Esper, etc.
Polypiers lamelliferes (*pars*) Lamarck, 1816; Lamouroux, 1821.
Zoanthaires pierreux Blainville, 1830.
Actinaria (suborder) (*pars*) Dana, Zoöphytes, 1846; Gosse, Actin. Brit., 1860.
Madreporaria (*pars*) (suborder of *Zoantharia*) Edw. and Haime, Corall., vol. ii, p. 4, 1857, (includes *Milleporidæ* and other Hydroids); Verrill, Mem. Boston Soc. Nat. Hist., vol. i, p. 14, 1864, (excludes Hydroid *Tabulata*).
Actinaria (order) (*pars*) Agassiz, Contributions to Nat. Hist. U. S., vol. i, p. 151, 1857; vol. iii, p. 60, 1860, (includes both *Actinaria* and *Madreporaria*, excluding *Tabulata* and *Rugosa*).
Madreporaria (order) Verrill, Proceedings Essex Inst, vol. iv, p. 145, Feb., 1865; and vol. v, p. 18, May, 1866; A. and Mrs. E. C. Agassiz, Sea-side Studies, after May, 1865.

Polyps simple, or compound by budding and self-division, the basal region imperfectly developed and serving only for attachment; never locomotive. Tentacles and spheromeres usually in multiples of six, the tentacles simple, tubular, generally covered with stinging organs (lasso-cells), which are grouped in clusters on the surface. The lower part of the outer wall and usually the radiating walls of the internal chambers, or the connective tissue in these chambers, secrete carbonate of lime and thus form stony corals, consisting essentially of a more or less circular cell, with radiating internal septa, which correspond in number and position with the tentacles.

Suborder, MADREPORACEA Dana (restricted).

Madreporacea (tribe) (*pars*) Dana, Zoöphytes, p. 428, 1846.
Madreporaria perforata Edw. and Haime, Corall., iii, p. 89, 1857.
Madreporaria (suborder) Verrill, Mem. Bost. Soc., i, p. 14, 1864.
Madreporacea (suborder) Proc. Essex Inst., iv, p. 147, 1865; ditto, v, p. 19, 1866.

Tentacles mostly long, in limited numbers, often but 12, marginal, the disk small, the tentacles therefore concentrated near the mouth,

upper part of the polyps elongated, cylindrical, much exsert above the cells when expanded, but capable of contracting into them; growth chiefly vertical. Coral porous, chiefly mural and septal; sometimes simple, but generally compound by budding, rarely by fissiparity.

Family, MADREPORIDÆ Dana.

Zoöphytes, U. S. Exploring Expedition, p. 431, 1846.

Madreporidæ (*pars*) and *Poritidæ* (*pars*) Edw. and H., Corall., iii, p. 89 and 207, 1860.

Corals always compound, increasing by budding, consisting of small, elongated, tubular corallites, which have very deep, open cells, and are united by an abundant, porous cœnenchyma. The corallites are usually of two sorts in each species: in *Montipora* differing on the opposite sides of foliaceous species; in *Madrepora* the terminal one on each branch differing from the lateral. Within the cells are six or twelve radiating septa, often rudimentary, but usually continuous. Polyps small, tubular, exsert, with twelve tentacles.

This family, as limited by Prof. Dana, appears to be a very natural one, and includes but two genera: *Madrepora* and *Montipora*. These have been widely separated by Edwards and Haime, who refer the former as a subfamily, *Madreporinæ*, to their large family *Madreporidæ*, which includes also *Eupsammidæ* and *Turbinaridæ*, both of which ought to rank as families. *Montipora* they unite with *Psammocora* into a subfamily, *Montiporinæ*, which is referred to *Poritidæ*.

But the *Poritidæ* are destitute of the abundant cœnenchyma and deep cells, characteristic of *Madrepora* and *Montipora*. The resemblance between certain species of these two genera, both in appearance and structure, is very close, the chief difference being that in *Madrepora* there is usually a terminal, or leading polyp at the end of each branch, which is not the case in *Montipora*. In each genus there are branching, foliaceous, encrusting, and massive species. The resemblance in the living polyps, as observed by Dana, is equally close.

The great genus, *Madrepora*, so abundant in species and individuals in the West Indies and on the Atlantic coast of Central America, and especially in the central Pacific, East Indies, Indian Ocean, and Red Sea, appears to be entirely wanting on the west coast of America, and the genus *Montipora*, which is abundant in the Indo-Pacific region, but entirely wanting in the Atlantic, is represented only by one species.

Montipora Blainville (emended).

Montipora and *Porites* (*pars*) Blainv., Dict. des sci. naturelle, t. lx, 1830; Manuel d'actinol., p. 388, 1834.
Montipora Quoy and Gaimard, Voy. Astrolabe, Zoöph., p. 247, 1833.
Manopora Dana, Zoöph., p. 489, 1846.
Alveopora Edw. and Haime, Polyp. foss. des terr. pal., p. 146, 1851, (*non* Blainville).
Montipora Edw. and H., Corall., iii, p. 267, 1860.

Corallum various in form, glomerate-massive, encrusting, foliaceous, lobate, or branching. Corallites small, scattered over the surface, either immersed, or with irregular, somewhat raised, lacerate, or spinulose borders. Cœnenchyma abundant, porous or spongy, usually echinulate at the surface, and often rising into papilliform processes, ridges, or crests between the cells; usually very different on the two surfaces. Cells small, widely separated, deep, without columella or pali. Septa little developed, either six or twelve, often trabicular, the secondary, when present, smaller than the primary ones. Polyps with twelve short tentacles.

Montipora fragosa Verrill, sp. nov.

Corallum sub-ramose or lobate, forming irregular conglomerate masses, which become elevated, and at the summit divide into small unequal, somewhat acute, very papillose branches, or into large, expanded, flat-topped lobes, which are scarcely papillose above. The papillæ on the branches and outer sides of the lobes are very slender and elongated, unequal, roughly spinulose, and directed obliquely upward. The cells are distinctly scattered among the papillæ, small (about ·02 inch), very inconspicuous, with six distinct septa. Toward the summits of the lobes the papillæ are appressed to the surface and become indistinct. On the broad summits of the nearly flat lobes there are no papillæ and the surface is nearly even, having a very open, porous, or spongy structure, with few indistinct, immersed cells. On the smaller lobes and depressed parts of the larger ones the surface rises into small rounded lobules, or large rounded varrucæ, with an openly spinulose, lacerate surface. Color of the unbleached coral brownish yellow, in some parts pinkish. Height 3·4 inches; breadth at top 4; diameter of branches ·25 to ·75; of larger lobes 1·75; length of free branches ·50 to ·80; length of longest papillæ ·10; diameter ·01 to ·02 of an inch.

"California,"—Maj. Wm. Rich. Probably from the Gulf of California.

This curious coral is known only by one specimen, which is, perhaps, in some respects abnormal. It is possible that the broad flat tops of the lobes are produced by the shallowness of the water in which it grew, or by some other disturbing cause. Therefore the structure upon the branching part, which does not rise so high, is probably more characteristic. It was collected by Maj. Rich and received with *Allopora Californica* V. and several *Gorgonidæ*. The latter are from La Paz, Gulf of California, which is very likely the locality of this species.

Family, Poritidæ Dana.

Dana, Zoöphytes, p. 549, 1846.
Poritidæ (*pars*) (*Poritinæ*) Edw. and Haime, Corall., III, p. 173, 1860.

Polyps elongated, crowded, secreting from their lower parts continuous and very porous corals, with shallow cells, from which in expansion the polyps are much exsert, with slender, flexible bodies and 12 to 24 tentacles, rarely more. Corallum massive, glomerate, encrusting, lobate, or branched, consisting of crowded corallites, united completely together by their very porous and often indistinct walls. Cells superficial or shallow, with porous septa, often represented only by series of small spin'es or trabiculæ; transverse septa very rudimentary. Budding generally sub-marginal or interstitial.

Porites Lamarck (restricted).

Porites (*pars*) Lamarck, Hist. des anim. sans vert., t. II, p. 267, 1816; 2nd edit., ii, p. 432.
Madrepora (subgenus *Porites*) (*pars*) Ehrenberg, Corall. roth. Meeres, p. 115, 1834.
Porites Dana, Zoöphytes, p. 550, 1846; Edw. and Haime, Corall., III, p. 173, 1860.
Porites and *Neoporites* Duch. and Mich., Supl. Corall. des Antilles, 1864–6.

Corallum glomerate, lobed or dichotomously branched, very porous, with a rudimentary basal epitheca. Cells shallow, crowded, usually distinctly polygonal; walls thin and imperfect, or very porous; septa generally 12, sometimes 12 to 20, rarely 24, slightly developed, trabicular, or very porous, the edge consisting of small granules or papillæ. A circle of 5, 6 or more small papillæ, or paliform teeth, often scarcely distinct from the septal papillæ, surround a small, central papilliform columella, which is sometimes wanting or scarcely distinct. Polyps small, exsert, with twelve tentacles.

Neoporites, a subdivision of this genus proposed by Duchassaing and Michelotti does not seem to be well founded. The characters assigned appear to be of little importance and are not always constant in the same species, while intermediate species frequently occur.

It was based on the massive mode of growth and rudimentary pali, but in the following massive species the pali are well developed.

Porites Californica Verrill, sp. nov.

Corallum encrusting, glomerate, irregularly lobed, or sub-ramose; the lobes or branches coarse, short, rounded at top, often compressed, or confluent into wide irregular lobes, usually ·50 to ·75 of an inch thick. Cells rather large, mostly separated by very porous walls of moderate thickness, distinctly excavate, but not deep. Septa thin, rough, sparingly spinosely granulated on the sides. Columella rudimentary, spongy, often wanting, surrounded by a circle of five or six, small, prominent pali.

Height 3 to 5 inches; diameter 6 to 8 or more; length of lobes or branches ·5 to 1·5; thickness ·50 to ·75; diameter of polyp-cells ·04 of an inch.

Gulf of California near La Paz, living in 4 or 5 fathoms, from divers, and worn specimens common on the beach,—Capt. J. Pedersen.

Porites porosa Verrill, sp. nov.

Corallum encrusting, irregularly lobed and branched, much as in the preceding; lobes often rounded at top. Polyp-cells rather small and shallow, crowded, separated by thin, fragile, very porous, roughly spinulose and lacerate walls. Septa little developed, thin, narrow, the edge roughly spinulose or lacerate, the sides with small spinule-like granulations. Pali five to seven, slender, prominent, roughly spinulose at top. Columella small, porous, little developed, often wanting. Occasionally a larger cell with 24 septa and 12 pali occurs. Color of the unbleached coral dark yellowish brown.

Height 3 to 4 inches; diameter about the same; thickness of the lobes ·5 to 1 inch; diameter of cells ·03 to ·04 of an inch.

Gulf of California, near La Paz, with the last,—Capt. J. Pedersen.

Resembles the preceding, but is easily distinguished by the unusually porous texture, very thin walls and septa, and crowded cells.

Porites excavata Verrill, sp. nov.

Corallum encrusting, becoming thick, glomerate, massive, and forming irregular hemispheres. Texture rather light and finely porous, but firm. Polyp-cells rather large, polygonal or rounded, well defined, deep and excavate, separated by rather firm, regular, moderately thick, elevated walls, which are thickly covered with coarse, rough granules. Septa very distinct, narrow at summit, wide below, extend-

ing to the columella, varying in number from 10 to 24, commonly 15 to 18, the edge lacerate, the sides roughly granulous. Pali 5 to 12, small but prominent, roughly spinulose or granulous. Columella little developed, trabicular, frequently wanting. Color of unbleached coral dull brownish yellow.

Diameter 8 inches; height 4; diameter of cells ·05 to ·06 of an inch.

Pearl Islands, 4 to 6 fathoms, by divers, two specimens,—F. H. Bradley.

The large, deep, regular cells readily distinguish this species from the others here described. There is no very closely allied Atlantic species. The increased number of septa is a very remarkable character.

Porites Panamensis Verrill.

Proceedings Boston Soc. Nat. Hist., vol. x, p. 329, 1866

Corallum encrusting, usually forming broad, rather thin, somewhat convex, irregular, uneven masses; sometimes completely surrounding small pebbles and thus becoming sub-globular. Polyp-cells small, crowded, a little excavate, rather shallow, but very distinct, separated by rather thin, roughly granulous, porous, but firm, walls. Septa mostly 12, well developed, narrowed and somewhat thickened outwardly, the sides very thickly covered with coarse, rough, lacerate granules, the edge also rough and lacerate. Pali small and rather stout, roughly lacerately granulous. Columella small, inconspicuous, often wanting. Color of unbleached coral dark ash-brown.

Polyps when expanded exsert, with twelve equal, cylindrical, light brown tentacles, not swollen at the tips, which are white,—F. H. B.

Diameter of the larger masses 4 to 6 inches; thickness ·5 to 1·5; diameter of polyp-cells about ·03 of an inch.

Panama and Pearl Islands, in rocky pools and in patches over the bottom just below low-water mark,—F. H. Bradley.

Easily distinguished by the small cells and very rough walls and septa.

Porites nodulosa Verrill, sp. nov.

Corallum much subdivided into small, short, crowded, and frequently coalescent branches, which are rounded and usually not much longer than thick, and form low, crowded clumps. Cells moderately large, shallow, but clearly defined, separated by thin, roughly lacerate and porous walls. Septa usually twelve, roughly lacerate and spinulose, the sides covered with sharp, rough granules.

Pali 5 or 6, short and stout, roughly spinulose. Columella little developed, spongy or trabicular. Diameter of the larger clumps 3 to 4 inches; height about 2; diameter of branches mostly ·25 to ·35; diameter of polyp-cells about ·04 or ·05 of an inch.

La Paz, not uncommon on the beach, but mostly badly worn,—Capt. J. Pedersen.

Family, EUPSAMMIDÆ Edw. and Haime.

Caryophyllidæ (*pars*) Dana, Zoöphytes, p. 364, 1846.
Eupsammidæ (family) Edw. and Haime, Annals des Sci. Nat., ser. 3, x, p. 65, 1848.
Eupsamminæ (subfamily) Edw. and Haime, Corall., iii, p. 90, 1860.
Eupsammidæ (family) Verrill, Proc. Essex Inst., v, p. 28, 1866.

Corallum simple or compound, massive or variously branched. Compound species increase by lateral, basal, and sometimes interstitial budding; but the genera *Lobopsammia* and *Heteropsammia* by fissiparity. Most genera are without distinct cœnenchyma; but in the genera, *Astropsammia* and *Pachypsammia** the cœnenchyma is well developed and spongy. Corallites generally elongated, cylindrical, or somewhat turbinate, and usually with deep cells. Walls porous, especially near the summit, generally covered by vertical rows of granular nodules, so united as to leave irregular openings and pores between them, often producing a vermiculate structure; sometimes forming distinct costæ; sometimes nearly even and solid toward the base.

Septa well developed, lamellar, generally forming four or five cycles, those of the first largest, usually with entire edges; those of the last cycle are often more developed than those of the preceding cycle and curved toward and united to them, or united together in pairs in front of them. In some genera those of the penultimate cycle are also curved toward the preceding, and sometimes even those of the tertiary cycle are curved toward those of the secondary. Owing to these peculiarities of arrangement, the septa never radiate in a regular manner from the center, as in most other families, but usually have an elegant star-like and symmetrical arrangement. Internal transverse plates or dissepiments between the septa are either wanting or distant and imperfect, rarely well developed; in *Astropsammia* all are often at one level in the different interseptal spaces, thus completely shutting off the space below. Columella always present, usually well developed and spongy, or having a cancellate structure.

* *Pachypsammia valida* Verrill, from Hong Kong. Proceedings Essex Institute, vol. v, p. 30, 1866. By error printed "*Pachysammia.*"

Polyps elongated, when expanded exsert, rising above the coral, but capable of retracting into the cells. Tentacles as numerous as the septa, elongated. Colors of living polyps generally bright, often red or orange.

Dendrophyllia Blainville.

Caryophyllia (*pars*) Lamarck, Syst. anim. sans vert., p. 370, 1801; Hist. anim. sans vert., ii, p. 228, 1816; 2d edit., ii, p. 344.
Lithodendron (*pars*) Schweigger, Handb. der naturg.
Dendrophyllia Blainville, Dict. des sci. nat., lx, p. 320, 1830; Man. d'actinologie, 1834; Dana, Zoöphytes, p. 383; Edw. and Haime, Coralliaires, iii, p. 112.
Oculina (*vars*) Ehrenberg, Coral. des rothen Meeres, p. 78, 1834.

Corallum compound, low and corymbose or cæspitose, or high and arborescently branched; budding lateral or sub-basal. Corallites rather large, cylindrical, more or less elongated. Walls subcostate near the cells, covered with rough vermiculate grains in rows, with irregular spaces between, which become more irregular and often curved or variously bent below.

Polyp-cells subcircular, deep; septa scarcely projecting above the margin, rather thin, forming four complete cycles. Columella usually pretty well developed, often convex.

Dendrophyllia circularis Verrill.

Proceedings Boston Soc. Nat. Hist., xii, p. 393, 1869.

Corallum low, rounded above, consisting of a large number of divergent, elongated, cylindrical corallites, varying greatly in size and length, and all united together into a thick base, which, on the sides, is seen to be made up of numerous, short and thick, closely branched trunks, partially united together laterally; the buds arise from all parts of the sides, and from the common basal tissue between the corallites of the upper surface; many of the longer corallites also bud on the sides and near the summit. The largest corallites are ·6 to ·8 of an inch in diameter, and project 1 to 1·4 above the base. Walls thin, very porous, covered externally with fine, subequal, scabrous costæ. Polyp-cells subcircular, very deep and open, often nearly as deep as broad, the septa not projecting above the margin. Septa in four complete cycles, often with narrow rudimentary septa of the fifth cycle. Primary and secondary septa nearly equal, narrow, thin, the lower part perpendicular, the upper part narrowed rapidly to the edge of the cell; those of the third cycle similar but smaller; those of the fourth much narrower, except far within the cell, where they join the columella; those of the fifth very narrow and thin.

None of the septa unite together within, so far as can be seen from the surface, but those of the fourth and fifth cycles are slightly bent. Columella well developed, with a regular convex surface, composed of a fine, spongy tissue. Color of the unbleached coral nearly black.

Height 3 inches; breadth 5·25.

Pearl Islands, Bay of Panama, brought from six to eight fathoms by divers,—F. H. Bradley.

Dendrophyllia tenuilamellosa Verrill.

Cœnopsammia tenuilamellosa Edw. and Haime, Annals des Sci. Nat., vol. x, p. 110, Pl. I, fig. 11 1848; Coralliaires, vol. iii, p. 128, 1860.

Corallum forming low, rounded, convex clumps, consisting of an aggregation of unequal cylindrical corallites, which are all united together at base in a solid mass, and sometimes partially united laterally. Polyp-cells deep, circular or nearly so, with thin margin. Septa thin, in four cycles, with rudiments of the fifth in some of the larger corallites; primaries a little broader than secondaries, but similar in form, narrowed toward the summit, nearly or quite reaching the columella below, the edge nearly entire, the sides smoothish, with lines of small granules. Septa of the third cycle very narrow; those of the fourth very thin and narrow, the edge divided into slender spinules, they curve toward and join those of the third about midway between the wall and columella; those of the fifth cycle, when present, are very small and rudimentary. Columella well developed, a little prominent, occupying about a third of the breadth of the cell, composed of convoluted and cortorted porous plates. Transverse plates between the septa few and distant. Walls thin, porous, with somewhat regular, unequal, rounded costæ, which are roughly granulous and separated by deep irregularly pitted grooves. Tissue of the basal mass very openly porous and irregularly ribbed and pitted. Color of the unbleached coral dark brown, or blackish.

Height of larger specimens 2 to 2·5 inches; diameter 2 to 5; height of larger corallites ·25 to ·50; diameter ·30 to ·40; depth ·25 to ·30.

Panama and Pearl Islands, at and just below low-water mark and in tide-pools,—F. H. Bradley; La Paz,—J. Pedersen; Acapulco,—A. Agassiz.

This is very closely allied to *D. arcularis*, but is a much smaller species. The polyp-cells appear to be never more than half as large. The septa, though about as numerous, are not so well developed.

Astropsammia Verrill.

Proceedings Boston Society of Nat. History, xii, p. 392, 1869.

Corallum massive, consisting of Astræa-like corallites, united quite to their summits by an abundant, very porous cœnenchyma. Walls scarcely distinct from the cœnenchyma, very porous. Septa in four cycles, with some members of a fifth, those of the fourth uniting to those of the third. Columella usually well developed, composed of loose, convoluted and twisted lamellæ and trabiculæ. Cells at times shallow, the interseptal spaces cut off below by thin transverse septa, which often coincide in all the chambers. Budding chiefly marginal and interstitial.

This genus is very remarkable for its abundant cœnenchyma, which is almost exceptional in the family, *Eupsammidæ*.

Astropsammia Pedersenii Verrill, loc. cit.

Corallum massive, convex above, covered with large, unequal, round cells, which scarcely rise above the surface, unequally separated by an abundant, very openly and coarsely porous cœnenchyma, which sometimes equals in thickness the diameter of the cells. Walls indistinct; septa not projecting, rather thin, in the large cells four fully developed cycles, with the rudimentary ones of the fifth in about half the systems. The primary and secondary septa are nearly equal, and with those of the third join the columella; those of the fourth cycle unite to those of the third about half way to the columella. Columella large in the adult corallites, composed mostly of coarsely convoluted lamellæ and spinose projections from the edges of the septa. Transverse septa thin and distant, often closing up the chambers near the surface.

A young specimen about one inch in diameter has sixteen cells, the largest of which are ·3 in diameter and very deep, with a rudimentary columella. One cell appears to have divided by fissiparity.

Diameter of largest specimen 3·5 inches; height 2; diameter of largest cells ·40 to ·50; of smallest ·15 to ·25; distance between cells ·15 to ·30.

La Paz, Gulf of California,—Capt. J. Pedersen.

This species was named in honor of Capt. James Pedersen, whose extensive collections, made in the Gulf of California, have contributed so much to our knowledge of the marine animals of that region, and who has discovered many new and very remarkable species.

Rhizopsammia Verrill, gen. nov.

Corallum compound, low, encrusting, extending by stolon-like expansions of the base, from which buds arise. Corallites cylindrical, or nearly so, connected by thin creeping extensions of the base, which have the same porous texture as the wall. Polyp-cells subcircular or elliptical. Septa thin, crowded, a little projecting, arranged in four or five cycles, those of the last cycle well developed, uniting to those of the preceding cycle, which rise up in the form of prominent paliform lobes, beyond which the central region of the cell is deep. Columella very porous, its surface papillose. Walls very porous, destitute of epitheca, with scarcely distinct costæ, but with series of rough granules.

This genus among Madreporacea corresponds to *Astrangia* among the Oculinacea, in its mode of growth. The paliform lobes are also peculiar.

Rhizopsammia pulchra Verrill, sp. nov.

Corallum composed of clusters of corallites irregularly grouped on the surface of a stone. Corallites united only by the thin basal expansions, mostly placed at distances about equal to their own diameters, low, but variable in height, base as broad as summit, or broader. Walls thin, very porous, subcostate, the ridges nearly equal, with two or three rows of sharp rough granules, the grooves between deep, but narrow, with small, interrupted, deep pits or pores. Polyp-cells subcircular or elliptical, deep at center. Septa well developed, in four complete cycles with some of a fifth, thin, crowded. The primaries and secondaries nearly equal, slightly projecting above the margin, rounded at top, inner edge perpendicular, roughly denticulate, the sides roughly granulous; those of the third cycle thickened outwardly, and united by spongy tissue with the adjacent ones; septa of the fourth cycle thin, bending toward and soon uniting to those of the third, which beyond the point of union rise abruptly in the form of prominent paliform lobes, beyond which the inner edge is nearly perpendicular to the columella, and rudely denticulate, the sides roughly granulous. Columella, moderately developed, papillose at surface. Color of the unbleached coral reddish.

Height of larger corallites ·15 to ·20; diameter ·15 to ·25; depth of cells ·10 to ·13 of an inch.

Pearl Islands, at extreme low-water,—F. H. Bradley.

Upon the same small stone, there were, with this species, specimens of *Ulangia Bradleyi*, *Astrangia dentata*, *A. pulchella*, and a new species of *Paracyathus*.

Balanophyllia Wood.

Descriptive Catalogue of the Zoöphytes from Crag, in Ann. and Mag. Nat. Hist., xiii, p. 11, 1844; Edw. and Haime, Ann. des sci nat., x, p. 83; Corall., iii, p. 99, 1860.

Corallum simple, usually attached by a rather broad base. Walls quite porous, costate, sometimes with an epitheca. Septa thin, in four or five cycles, those of the last cycles well developed, uniting together in pairs in front of the preceding, which are interrupted. Columella well developed, spongy, not prominent.

Some species referred by authors to this genus have a narrow base, others become free at maturity.

Balanophyllia elegans Verrill.

Bulletin of the Museum of Comp. Zoölogy, No. 3, p. 44, Jan., 1864.

Plate 10, figure 3.

Corallum low, subcylindrical, with a broad, expanded base, often somewhat enlarged toward the summit. Wall nearly compact at base, quite porous above, sometimes with an imperfect epitheca reaching above the middle, often naked, strongly costate, the costæ thick, rounded, nearly equal, roughly spinulose granulous, separated by irregular, narrow, interrupted grooves, with many deep pits and pores. Polyp-cell broad elliptical or circular, rather shallow. Septa unequally projecting, those of the two first cycles considerably elevated; four complete cycles, those of the fifth usually developed in half the systems and sometimes in all, in some large specimens a few very small septa belonging to the sixth are visible. Primary septa decidedly broader than secondary, and higher, thickened outwardly, the edge rounded, nearly reaching the columella, at the summit porous, roughly serrulate, and confluent with the adjoining septa of the fourth cycle, the sides granulous; secondaries similar, but narrower and less projecting, the inner edge more deeply divided into slender spinose teeth; those of the third cycle quite narrow, about half as broad as secondaries, not reaching the point of union of those of the later cycles, and therefore leaving an enclosed space of some size in front, the edge deeply divided into rough teeth; those composed of the inner portions of the third and fourth cycles united are broad, reaching the columella, the edge lacerately divided into rough, prominent spinules; they are united to the primaries and secondaries outwardly and curving toward each other unite in front of the tertiaries, about midway between the margin and columella; free outer portion of the septa of the fourth cycle very narrow, little prominent, interrupted by a space before the point of union of the thin curved septa of the fifth cycle. Columella rather small,

oblong, papillose at surface. Color of the living polyp bright orange-red, or flame-red.

Height ·20 to ·40; diameter of larger ones ·30 to ·42; depth of cup ·10 to ·15 of an inch.

Puget Sound,—C. B. Kennerly; Mendocino and Crescent City, Cal.,—A. Agassiz; Monterey,—R. E. C. Stearns; W. H. Dall.

Mr. Stearns found this beautiful species adhering to the under side of large stones at extreme low-water mark at Monterey, and observed *Trivia Californica* living parasitically upon it, the color of the living *Trivia* agreeing very closely with the bright orange-red of the polyp.

Suborder, OCULINACEA Verrill.

Caryophylliaceæ (*pars*) and *Madreporaceæ* (*pars*) Dana, Zoöphytes.
Ocellina (*pars*) and *Milleporina* (*pars*) Ehrenberg, Corall. roth. Meeres.

Corallum simple or compound, encrusting or branched, of firm texture with imperforate, solid walls and septa. Cells generally small, tubular. Polyps when expanded rising above the cell, or long exsert, the mouth protruding, the tentacles 10 to 48, sometimes more, elongated, the tips usually, if not always, swollen or capitate, their surface covered with small wart-like clusters of urticating cells.

In this group the compound species increase by basal and lateral budding, and there is a strong tendency to form hard, compact corals, the coenenchyma being, when present, very compact; the walls are often thickened, or the cells may be partially filled up and obliterated, as in *Oculinidæ*, some *Stylasteridæ*, etc. The transverse plates within the cells are usually few and distant, and may be entirely wanting; in some cases they are coincident in all the interseptal spaces, so as to form continuous transverse plates or septa, as in *Pocilliporidæ*. The septa of the first and second cycles, at least, have the edge entire or nearly so, often all the septa are entire. The exterior of the walls is generally more or less costate, sometimes finely granulous or spinulose, but never strongly spinose.

It is obvious that in Astræacea, as hitherto constituted, there are included two distinct types of corals, characterized especially by the peculiarities of the expanded polyps. In the division here established the polyps, so far as known, are much exsert in expansion and the tentacles are swollen at the tips, but in the typical Astræacea, such as *Astræa* (*Favia*), *Mœandrina*, *Mussa*, the polyps are not exsert and they have more numerous tentacles, which taper to the end; their corals increase by fissiparity or disk-budding, the septa are serrate or echinate, and the interseptal spaces are much subdivided by small oblique plates.

Hence I have taken the *Oculinidæ*, *Stylasteridæ*, and *Stylophoridæ*, kept distinct from the *Astræidæ* by Edwards and Haime, together with certain families of their *Astræidæ*, which possess the same type of polyps, as representatives of a distinct suborder, intermediate in many respects between Astræacea and Madreporacea, the polyps being exsert, as in the latter, the corals compact and imperforate, as in the former. To this suborder it seems necessary to refer the *Pocilliporidæ*, which have corals in many respects similar to those of *Stylophoridæ* and some *Oculinidæ*, although transversely septate or tabulated, as in other widely different groups, and have exsert polyps nearly identical with those of *Stylophora* and similar genera, with 12 or 24 long tentacles, swollen at the tips.

Whether the *Caryophyllidæ* should be referred to this suborder or to Astræacea is somewhat uncertain, since the polyps of but few of the genera have been examined. It is not improbable that the family, as now constituted, includes genera belonging to both suborders, having little in common, except the negative character of lacking transverse septa,—an embryological feature that is evidently of but little importance. The genus *Caryophyllia*, like its allies, *Paracyathus*, etc., appears to have soft parts with the same general structure as *Oculina*, *Astrangia*, *Cladocora*, etc., but *Flabellum* appears to agree better with some Astræacea, like *Euphyllia*, etc. Therefore since the typical genera seem to belong here, we have placed the *Caryophyllidæ* in this suborder, as the lowest family. There are also certain other genera, generally referred to Astræacea, which seem to have greater affinities with the present division, though the soft parts are too imperfectly known to afford positive evidence; such are the genera, *Cyphastræa*, *Galaxea*, *Stylina*, etc.

Prof. Dana's second family of Caryophyllaceæ, the *Caryophyllidæ*, included many of the genera of this group, together with *Dendrophyllia* and other representatives of the Madreporacea, and also *Stylina* and *Galaxea* (*Anthophyllum*); but *Pocillipora*, *Seriatopora*, and *Stylophora* (*Sideropora*) were referred by him to Madreporacea. In his system the porous structure of the coral in Madreporacea was not regarded as of so much importance as by most later writers.

The following are the principal families included in this suborder:

Stylasteridæ. Corallum branched, with very compact, mostly smooth, often colored cœnenchyma. Cells small, much filled up below. Septa equal, 12 to 24 (sometimes only 5 or 6), often united together by their thickened inner edges so as to partially close up the cell. Costæ nearly obsolete.

Oculinidæ. Corallum encrusting or branched, with compact cœnenchyma, smooth, or slightly costate near the cells. Cells of moderate size or large, more or less filled up below. Septa 12 to 48 or more, in several unequal cycles, the edge of the principal ones entire.

Pocilliporidæ. Corallum branched or lobed, with the cœnenchyma compact at surface and mostly spinulose. Cells small, divided by transverse septa below, partially filled up. Septa 12 to 24 (rarely 36), often rudimentary, especially in young cells.

Stylophoridæ. Corallum massive, encrusting, or branched, with the cœnenchyma compact near surface and mostly spinulose. Cells small, not filled up, or but slightly so, with few irregular, transverse interseptal divisions. Septa 10 or 12 to 24.

? Stylinidæ. Corallum massive, astræiform. Cells of moderate size or small. Septa with entire edges.

Astrangidæ. Corallum solitary, or cæspitose, encrusting, or lobed, with little or no cœnenchyma; buds basal, or arising from stolons, or lateral. Cells of moderate size, not filled up below, with few, distant, irregular, transverse divisions. Septa numerous, in several unequal cycles, those of the first and second usually with entire edges. Includes *Astranginæ* and *Cladocorinæ.*

Caryophyllidæ. Corallum solitary, attached or free when adult. Cells often large, increasing upward, open from the base. Septa numerous, in several unequal cycles, their edges entire.

On the west coast of America representative of but four of these families are known: *Stylasteridæ*, *Pocilliporidæ*, *Astrangidæ*, and *Caryophyllidæ.*

The *Oculinidæ* are abundant in the Atlantic, Mediterranean, and Indo-Pacific faunæ. The *Stylophoridæ* are most abundant in the Indo-Pacific, but have a few representatives in the Caribbean fauna. The *Stylinidæ* are mostly fossils of the Cretaceous and Tertiary formations of Europe, but a few species still live in the Atlantic.

Family, Stylasteridæ Pourtales.

Stylasteraceæ (subfamily of *Oculinidæ*) Edw. and Haime, Corall., ii, p. 126, 1857.
Stylasteridæ Pourtales, Bulletin Mus. Comp. Zoöl., No. 7, p. 125, 1868.

The corals included in this family most frequently form delicate, arborescently branched corals, often flabelliform, and sometimes with coalescent branches, in other species the coral is irregularly lobed or encrusting. The cœnenchyma is abundant and very compact, with a smoothish or finely granulous surface, often with peculiar swellings or

vesicles, which sometimes have a radiated structure and may, perhaps, indicate the position of a second form of polyps; in other cases (as in *Allopora*) there are also minute pores or openings with a raised border scattered between the ordinary cells, which appear to represent a second more rudimentary form of polyps. Therefore it is probable that in this family the polyps are dimorphous, as in *Pennatulacea* and some *Alcyonacea*, and in many Hydroids, but the soft parts have not yet been described. The polyp-cells are small, generally filled up below by a solid deposit, sometimes also partially filled up and more or less obliterated by the thickening of the septa and the union of their inner edges, thus separating the interseptal chambers from the central part of the cell, and in some genera, like *Distichipora* and *Errina*, nearly or quite obliterating some of the chambers. The septa are mostly narrow, equal or nearly so, in one to three cycles, in some instances only four to six, most frequently twelve, the third cycle, when present, rudimentary. Columella generally styliform, sometimes wanting.

This family, as now constituted, includes the following genera:—*Axohelia* E. and H.; *Cryptohelia* E. and H.; *Endohelia* E. and H.; *Cyclopora* Verrill; *Stylaster* Gray; *Allopora* Ehr.; *Distichipora* Lamarck; *Errina* Gray.

In the works of Edwards and Haime the genus *Distichipora* was placed, with other still doubtful forms, in the "incerta sedes" at the end of the list of genera. In the final work* it is placed in an appendix and doubt is expressed whether it may not belong to the Alcyonaria, rather than to the Madreporaria, while *Errina* is entirely omitted. The writer first explained the structure of these genera and referred them to their true position near *Stylaster*, in the Bulletin of the Museum of Comparative Zoölogy, No. 3, p. 46, 1864. Mr. Pourtales, who has recently discovered and described several new and very interesting members of this group, fully confirmed this conclusion in later numbers of the Bulletin.† He has also suggested that the group should form a distinct family,—an opinion in which we fully concur.

Many of the species of this family seem to be confined to great depths, where they form a considerable portion of the coral faunæ, and yet there are, also, shallow-water species both in the Atlantic and Pacific. When deeper dredgings shall have been made on the west coast of America, additional genera and species may be expected, but at present two species of the genus *Allopora* are the only known representatives of the family on the whole coast.

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* Coralliaires, vol. iii, p. 450, 1860.

† No. 6, pp. 116, 117, 1867; No. 7, p. 136, 1868.

Allopora Ehrenberg.

Allopora Ehr., Corall. rothen Meeres, p. 147, 1834; (*pars*) Dana, Zoöph., p. 697; Edw. and Haime, Corall., ii, p. 131.

Corallum encrusting, irregularly lobed, or branching. Cœnenchyma abundant, compact, the surface finely granulous, with more or less numerous, scattered ampullæ or vesicles. Cells small, irregularly arranged, scattered. Septa narrow, not exsert, usually five to ten larger, equal, thickened ones, which generally unite by their inner edges below, so as to enclose the intervening small chambers, within which may usually be seen rudimentary septa of the last cycle, in the form of small ascending points or papillæ. Columella conical or rounded, finely spinulose or hirsute.

Allopora Californica Verrill.

Proceedings Essex Institute, vol. iii, p. 37, 1866, (*non* Pourtales).

Plate 10, figure 8.

Corallum encrusting at base, rising into thick, irregularly lobed or palmate branches, three inches or more high, some of which are two inches broad and nearly half an inch thick; some are nearly round and rapidly tapering, of about the same thickness as the others. Many of the branches have an annelid tube, with two apertures side by side, in the center, and appear to be due to the encrusting habit of the coral, which covers the tubes with a thickness of from an eighth to a fourth of an inch, and in this way may rise into false branches. The worm tubes themselves are quite thin, forming a delicate separable lining for the tubes formed by the coral. Some of the branches subdivide into two or three parts near the end, which spread nearly at right angles. Cells very small, about ·02 of an inch, quite irregularly scattered over the whole surface; distance between them equal to two or three times the diameter, or from ·04 to ·07 of an inch. Cœnenchyma compact, with a minutely granulous surface, appearing smooth to the unaided eye, but having a few minute papillæ or minute vesicular ampullæ, some of which are open at top, forming small pores scattered between the cells. In a longitudinal section the cells are seen to be filled up below, and between them there are irregularly scattered, minute, rounded cavities, caused by the superficial papillæ or vesicles. Septa represented commonly by six thick triangular processes which converge toward the center of the cells, leaving only narrow, radiating spaces between them; in other cells the number varies from five to eight. The septa project slightly above the common surface, and do not reach more than half way to the center of

the cell, uniting together by their thickened inner edges, down within the cell, and separating the very small interseptal spaces from the central opening; within each interseptal space there can generally be seen a minute rudimentary septa in the form of an ascending, prominent point. Cells deep in the central portion, nearly filled up below by a round, conical, minutely hirsute, whitish columella. The cells are stellate, with very slightly raised borders, somewhat unequal in size, and many are distorted; two are often seen together and more or less confluent, as if they had been formed by fissiparity or disk budding; others evidently originate by interstitial budding, while some very small rudimentary cells are intermediate between the ordinary form and the ampullæ with central openings, indicating that those are made by rudimentary or dimorphous forms of polyps. Color light miniumred.

Height 7 inches; breadth 5·50; diameter of cells ·02 to ·03, the central cavity about ·01 of an inch.

California,—Maj. Wm. Rich, U. S. A.

Probably from the Gulf of California in deep water.

The basal portion is dead and encrusted with various species of Bryozoa, Serpulæ, etc. It was collected by Major Rich during the Mexican war.

Allopora venusta Verrill, sp. nov.

Allopora Californica Pourtales, Bulletin M. C. Z., p. 136, 1868, (*non* Verrill), no description.

Plate 10, figure 9.

Corallum encrusting and expanded at base, rising up in stout lobes or branches, two inches or more high, some of the branches broad and somewhat palmate or digitate, the terminal branchlets mostly round and about ·12 to ·15 of an inch thick, obtusely rounded at tips. Some of the branches contain worm tubes similar to those in the preceding species, with two openings side by side, and apparently of the same nature with those found in *Muricea formosa* of Zorritos, (p. 435), but other branches are quite solid. Cœnenchyma compact, having a minutely granulous surface, with a few minute, scattered vesicles and pores. Cells small, about ·03 of an inch, regular, circular, with the border sharp and distinctly raised above the general surface; some newly formed cells may be seen scattered among the others, but consisting only of a slight pit in the cœnenchyma, sometimes very superficial, circular, and rounded at bottom, in other cases a little more advanced, showing the outlines of the septa and columella. The cells are irregu-

larly scattered over the whole surface, mostly at distances varying from ·02 to ·10 of an inch. The principal septa vary from 6 to 10, but are mostly 7 or 8, quite narrow at top, but much thickened, broader and united well together below, so as to form a cup-shaped aperture to the cell, around and above the small deep central pit, and entirely separating the very small interseptal spaces, in which the minute, round, projecting points of the small septa may be easily distinguished. Central cavity broader in its upper part than in the preceding species, but with the central pit smaller, nearly filled by the small, round, conical columella. Color light red, the branches often yellowish at tips.

Neah Bay, Washington Territory,—Collection Museum of Comparative Zoölogy.

Although this species resembles the preced[illegible] in color and mode of growth, it is quite distinct in the form and [illegible]ture of the cells. In this they are raised, circular, regular, and [illegible]-shaped, while in the preceding they are stellate, often irregular, not cup-shaped, with larger and fewer septa, the border is scarcely raised, and the columella is larger.

Family, Pocillioridæ Verrill.

Synopsis Polyps and Corals of N. Pacif. Expl. Exp., Part iv, p. 56, in Proceedings (Communications) of Essex Institute, vol. vi, p. 90, 1869.

Favositinæ (*pars*) Dana, Zoöph., p. 514, 1846.

Pocilloporinæ (subfamily of *Favositidæ*) Edw. and Halme, Corall., iii, p. 301, 1860.

Corallum with an encrusting base at first, from which arise clusters of lobes or branches, which grow by interstitially budding at the ends. Cœnenchyma abundant and very compact on the sides of the branches and base, but almost entirely wanting among the crowded terminal cells. Cells small, angular or circular, often filled up below with a solid deposit; the transverse plates generally extend entirely across the cells below. Septa 6 to 24, generally twelve, often rudimentary.

The descriptions and drawings of the polyps of *Pocillipora* by Mr. Bradley, show conclusively that the genus is a true madreporian, as we have already mentioned in other articles.* It seems also to be most closely allied to *Oculina* and *Stylophora*, both in the structure of the polyps and coral. Its affinities with the numerous extinct genera having the same tabulate structure is a subject requiring a great amount of careful investigation. From the *Favositidæ*, as a whole, it differs in having an abundant cœnenchyma. Favosites differs also in having perforate walls, and doubtless ought to be separated, at least

* On the Affinities of the Tabulate Corals, in Proceedings of the American Association for Advancement of Science, 1867, p. 148. See also Proc. Essex Inst., vi, p. 90, 1869.

as a distinct family, which has, perhaps, closer relations with *Madreporacea*. The genus *Seriatopora*, has been united with certain genera of fossil corals to constitute a distinct family, *Seriatoporidæ*, but it would appear to be more in accordance with their true affinities to unite *Seriatopora* and the allied genera with the *Pocilliporidæ*. The living polyps are unknown, however, and might show other relations. The *Thecidæ* E. and H., and especially *Columnaria*, are evidently very closely allied to *Pocillipora* and, ought, perhaps, to be united in the same family.

The association by Edwards and Haime, and others, of the *Milleporidæ* with *Pocilliporidæ* and allied forms, under the name, *Tabulata*, was particularly unfortunate, since they have no relations whatever, and indeed there is no resemblance except in the fact that in certain genera of both groups there are transverse septa,—an artificial character of comparatively little importance, which also occurs in the *Astræidæ* (*Cœlastræa*) and sometimes even in the *Eupsammidæ* (*Astræopsammia*). Prof. Agassiz has shown that *Millepora* belongs to the *Hydroidea*, and holding the opinion that *Pocillipora* and other tabulated corals were allied to *Millepora* he consequently united all the *Tabulata* of Edwards and Haime to the *Hydroidea*, thus removing them from the class of polyps. This view is no longer tenable, since the genus *Pocillipora* has animals identical in structure with the most typical genera of true polyps. Even were the animals of *Pocillipora* unknown, the examination of such species as *P. elongata* Dana, *P. plicata* Dana, *P. stellata* Verrill, and others, in which there are twelve well developed septa, having the same essential characters as those of *Oculinidæ* and *Stylophoridæ*, would be sufficient to convince us that the genus could not possibly belong to the *Hydroidea*, unless that group is to be so modified as to lose the principal characters by which it is separated from the class of polyps. The absence of radiating lamellæ, such as would be required to secrete the radiating septa of *Pocillipora*, *Columnaria*, and some *Favositidæ* is one of the principal class characters by which Acalephs are separated from Polyps, and is a constant feature of acalephs; the presence of such lamellæ is equally constant and characteristic of true polyps.

Pocillipora Lamarck.

Pocillopora (*pars*) Lamarck, Hist. anim. sans vert, ii, p. 273; 2nd ed., ii, p. 144.
Pocillopora Dana, Zoöphytes, p. 523; Edw. and Haime, Corall., iii, p. 301.

The coralla consist of clusters of branches or lobes, varying in the different species from very slender, much divided branchlets to stout,

round, and obtuse, or very broad and convoluted lobes or fronds, which arise from a more or less compact encrusting base. Branches often covered with verrucæ or rudimentary branchlets, composed of a few or many cells. At the ends of the branches the cells are closely crowded, angular, closely united by their walls, without intervening cœnenchyma, but on the sides of the branches they are more or less distantly separated by the compact cœnenchyma, which is sharply granulous or spinulose at the surface. Cells small, often deep, circular where not crowded, often filled below the surface by a solid deposit, but always with transverse septa in the lower parts, which are abundant and regular. Septa narrow, generally 12, of which 6 are larger and alternate with six that are very small or rudimentary; sometimes 24. The septa are often partially or wholly rudimentary or abortive, especially in the crowded cells at the end of the branches, but in many cases two opposite ones are larger than the rest and join the columella, or there may be one larger one. The columella, when present, is small, solid, a little prominent, but is often wanting. The transverse plates have a concentric structure and are often seen incomplete, with an opening through the middle. Occasionally a cell is divided by fissiparity, but the new ones mostly appear in the angles between adjacent cells.

This genus is very abundant throughout the tropical parts of the Pacific and Indian Oceans and the Red Sea. At the Hawaiian Islands several large species of *Pocillipora* constitute an important part of the coral-reefs. In the Atlantic ocean the genus is unknown, but a fossil species occurs in the Miocene of the West Indies.

Pocillipora capitata Verrill.

Pocillipora capitata Verrill, Bulletin Mus. Comp. Zoöl., p. 60, 1864; Proc. Essex Inst., vi, p. 99, 1869.

Coralla composed of clusters of large, irregular, usually stout branches, often an inch or more in diameter, arising from a massive or encrusting base. The branches are covered, except at the ends, with more or less elongated, rising, subacute or bluntly rounded verrucæ. The branchlets are usually spreading, often rounded or clavate at the end, where the verrucæ become obsolete. Surface covered with small, rough, scattered spinules, those around the edge of the cells more prominent. Cells rather small, circular and deep on the side of the branches, and mostly separated by spaces at least as broad as the diameter of the cells, sometimes more crowded; on the ends of the branches and verrucæ, the cells are angular and separated

only by thin walls. Septa twelve, usually very narrow or rudimentary, the lower part generally more developed than the upper; sometimes one is broader and joins the very small columella, which is, however, generally wanting.

The largest specimens seen are more than a foot in diameter; the branches ·5 to 1 inch; verrucæ ·30 of an inch long; ·10 to ·20 in diameter; cells ·03 to ·04 in diameter.

Acapulco,—A. Agassiz; Socorro Islands,—J. Xantus; Pearl Islands,—F. H. Bradley; La Paz,—J. Pedersen.

Pocillipora capitata, var. porosa Verrill.

Pocillipora capitata, var. porosa Verrill, Proc. Essex Inst., vi, p. 99, 1869.

Coralla forming large rounded clumps, 10 to 15 inches in diameter, with more or less elongated, divergent or crowded, angular, and often flattened branches, which are usually ·25 to ·35 of an inch in thickness; ·50 to ·75 in breadth; and 1 to 3 long, often truncate or digitately lobed at the end. Verrucæ variable, mostly ascending, often large and prominent, generally elongated, roundish, tapering to the subacute end, the upper ones often appressed, obsolete on the summits of the branches, where the cells are closely crowded. Cells large and deep, the lateral ones mostly crowded, the intervening spaces generally less than their diameters, often not half as much. Septa 12 or 24, distinct, nearly equal, narrow, slightly exsert and acute at summit. Surface of the cœnenchyma, between the cells, finely spinulose, the spinose grains often crowded, but frequently forming only a single row. The cells are but little closed up in the interior by solid deposits and the texture of the coral is, therefore, quite porous. In one large specimen the branches on one side are of the normal size and form, while on the other they become more slender and much subdivided at the ends into small, obtuse, lobe-like or digitate branchlets. The cells on this part are smaller and more distant.

The larger specimens are about 10 inches high and 12 broad; the larger branches ·50 to 1 inch in width; ·25 to ·35 in thickness; cells ·04 to ·05 of an inch in diameter.

Near La Paz, brought up by divers,—J. Pedersen.

The Museum of Yale College possesses four large and several small specimens of this form.

Pocillipora capitata, var. robusta Verrill, nov.

Coralla forming large, more or less hemispherical, close clumps of stout, angular, mostly flattened, obtuse, dichotomous branches, which usually fork at distances of from 1·5 to 4 inches, in large specimens.

The branches are covered laterally with numerous, rather large, prominent, elongated, mostly acute, ascending verrucæ, which are pretty evenly scattered over the surface and seldom crowded, rarely obtuse or rounded at the end, usually containing a dozen or more polyp-cells. The verrucæ become obsolete at the tips of the branches, which are mostly blunt or truncate and filled with closely crowded, angular polyp-cells. The cells on the sides of the branches and verrucæ are rather small, mostly separated by distances about equal to their diameter. Septa commonly six, very distinct but narrow, often twelve. Columella either a small papilla or rudimentary and scarcely distinct. Cœnenchyma between the cells compact and covered with minute rough granules. In a transverse section the cells are found to be much filled up below, and the coral quite compact; the transverse dissepiments are rather distant, the spaces between usually exceeding the diameter of the cells. Height of the largest specimens 15 to 18 inches; length of undivided branches 2 to 4; breadth ·50 to 1·50; thickness ·35 to ·75; length of average verrucæ ·30 to ·40; their diameter ·20 to ·30; diameter of cells ·02 to ·03 of an inch.

Young specimens attached to shells of *Margaritophora fimbriata* Dunker, have a few short rising branches in the middle, with a broad, thin, encrusting base. The marginal cells are obliquely appressed to the surface of the shell, their outer edges being flattened and extending, with the septa, which are here conspicuous and like elevated costæ, considerably beyond the proper edge of the cells, exactly as in *Astrangia* and the young of *Oculina*. The new cells at the edge are also produced by marginal budding, as in the genera named. A study of these marginal cells confirms the affinities of this family with the Oculinaceæ.

Gulf of California, south of La Paz, 3 to 6 fathoms, brought up by divers,—J. Pedersen.

The Museum of Yale College has received upwards of twenty specimens of this form, most of them of large size and quite constant in character. But some of the smaller specimens are evidently dwarfed by unfavorable conditions of growth and have very irregular branches, sometimes much divided, and the verrucæ nearly obsolete in some parts. The following form, however, seems worthy of a distinct varietal name.

Pocillipora capitata, var. pumila Verrill.

The coralla consist of elongated clumps of short, mostly obtuse and much divided, crowded branches, arising from the upper side of

large, horizontal often forked, branch-like base. These clumps seem to have originated from large detached branches, which have been broken from specimens of the preceding form and, having fallen to the bottom, have served as bases for the numerous rising branchlets, which probably arose from the original verrucæ by excessive enlargement and gradual alteration to the form of branches, the largest of which subdivide and develop verrucæ like those of the parent form. Cells and cœnenchyma as in the preceding variety.

Length of the clumps 6 to 12 inches; breadth 3 to 5; height 2 to 4; length of branches ·50 to 2; their diameter ·25 to ·50.

Gulf of California, with the preceding,—J. Pedersen.

About a dozen specimens of this variety have been received.

In general appearance it is very different from the normal form.

Pocillipora lacera Verrill.

Proc. Essex Institute, vol. vi, p. 100, 1869.

Coralla consisting of more or less irregular or rounded clumps of long, irregular, often crooked, rough, and much subdivided branches. The branchlets are short and lacerately or digitately divided and lobed at the ends. The subdivisions small, variously shaped, often slender, but generally more or less compressed and obtuse at the tips, often having the appearance of elongated verrucæ, while the lateral branchlets pass gradually into the verrucæ, which are few, irregular, and distantly scattered on the larger branches. Lateral cells rather large, round, rather distant, often shallow; septa mostly 12, narrow, usually subequal, sometimes one is larger, often all are rudimentary or wanting. Columella rudimentary or wholly abortive. Cœnenchyma abundant between the cells, firm, the surface finely and evenly spinulose.

The larger specimens are 6 to 8 inches in diameter and height; the large branches ·30 to ·50 in diameter; and 3 to 6 long; the terminal branchlets mostly ·10 to ·30 long; ·10 to ·15 in diameter; the cells ·03 to ·04 of an inch in diameter.

In life, according to Mr. Bradley, the polyps are small, exsert, with twelve equal cylindrical tentacles, which are swollen at the tips; they are about equal in length to the diameter of the body, and they are arranged in a single circle around the margin, but six are held horizontally and six upright in expansion. The color of the polyps is dark brown, greenish brown, or dark green; tentacles dark brown, the tips white.

"In arrangement and form of tentacles this species closely resembles the accompanying *Porites* (*P. Panamensis*), which also has

twelve cylindrical, light brown tentacles, with white tips, but the tips are not perceptibly swollen, and they are *not* held alternately upright and horizontally, as in *Pocillipora*."—F. H. B.

Pearl Islands, Panama, and Acajutla,—F. H. Bradley. "In more sheltered situations near the head of Panama Bay, this coral covers considerable surfaces, but farther out it seems to be confined to sheltered spots, and occurs in scattered clumps."—F. H. B.

This species forms loose open clumps of rather slender and irregular branches, quite unlike those of the preceding species in appearance.

Family, Astrangidæ Verrill.

Cladocoraceæ and *Astrangiaceæ* Edw. and Haime, Corall., ii, pp. 587 and 606.

The coralla in this group consist of encrusting, creeping, or more or less fasciculated clusters of rather small, cylindrical, or somewhat turbinated corallites, which have rather deep, cup-shaped, mostly circular calicles. The buds arise chiefly from the lateral walls, either from near the top, on the sides, at the base, or even on basal stolon-like extensions. In young specimens and at the margins of encrusting species the calicles are often appressed to the surfaces to which they adhere, and buds arise, also, from within the extending outer margins of the calicles.

The septa form from three to five or more, unequal cycles, the primaries and secondaries often with subentire summits, the others denticulate or deeply incised. The columella is variously developed, often papillose. The transverse dissepiments are few and distant. Cœnenchyma wanting or but slightly developed.

The polyps are quite exsert, with slender, tapering tentacles, which are swollen at the tips, and covered with minute scattered verrucæ, composed chiefly of nettling organs.

This family includes two groups distinguished by Edwards and Haime: *Cladocoraceæ*, in which the budding is lateral and the corals consist of more or less cæspitose clumps of tubular corallites; and *Astrangiaceæ*, in which the budding is mostly basal, or from creeping stolons, producing low encrusting corals.

But these two modes of growth pass by almost insensible gradations into each other. Thus there are species of *Cladocora* in which the budding is partially at or near the base, as it is in all the species while young, and there are certain species of *Astrangia* which bud at the same time from basal expansions, from within the margin of the outer calicles, and laterally from the walls near the summit (*A. Danæ* and *A. astræiformis*); while other species bud both from stolons and

laterally, and have more elongated tubular corallites (*A. Haimei*, etc.). It is, therefore, impossible to make any marked distinction between these two groups of genera. It is not improbable that in adopting them as subfamilies, I have given to the mode of growth even more importance than it merits.

Sub-family, ASTRANGINÆ Verrill.

Astreinæ reptantes Edw. and Haime, Ann. des Sciences nat., 3e ser., xii, p. 175, 1849.
Astrangiaceæ Edw. and Haime, Coralliaires, ii, p. 606, 1857.

Coralla encrusting or creeping, formed of low corallites, which multiply chiefly by basal budding.

Astrangia Edw. and Haime.

Astrangia Milne-Edwards and Jules Haime, Comptes-rendus de l'Acad. des Sci, xxvii, p. 496, 1848; Ann. des Sci. nat., xii, p., 180, 1849; Coralliaires, ii, p. 613, 1857; Verrill, Revision of Polyps of Eastern Coast United States, in Memoires Boston Soc. Nat. Hist., i, p. 39, 1864.

Coralla encrusting, consisting of rather small, short, more or less turbinate corallites, which arise by budding, either from basal expansions of the wall of the parents, from the sides, or from within the obliquely extended margins of those in the outermost row, and thus form clusters, spreading over rocks, shells, etc., or in some cases thin aggregate masses, sometimes rising in the middle into irregular lobes or short branches. The calicles are circular, except when crowded or appressed, moderately deep, with a papillose columella. Septa more or less unequal, in three or four cycles, the primaries and secondaries most prominent, all with strongly granulated sides and denticulated edges, the lowest teeth larger and more or less paliform,*

* The following species has the basal teeth of the septa developed into well-marked, prominent pali. As it was figured, by mistake, upon the plate with the Panama species, I add a brief description:

Astrangia palifera Verrill, sp. nov. Plate ix, figure 2.

Corallites low, cylindrical, scattered over the surface to which they adhere, usually at distances twice as great as their diameter, or even more, and connected by narrow and thin, stolon-like expansions of the bases. Calicles circular, shallow. Columella small, with about six to ten prominent papillæ. Septa twenty-four to thirty, not crowded, separated by spaces greater than their thickness, subequal, the primaries a little broader, thicker, and more prominent than the secondaries, which also somewhat exceed the tertiaries; all with finely granulated sides and rather broadly rounded, finely denticulated, and very slightly exsert summits; inner edge perpendicular, separated by a deep notch from the paliform tooth, of which there is usually but one to each septa. The paliform teeth are comparatively large, prominent, obtuse, those of the primaries largest and nearest the center, the others smaller and a little farther from the

in the typical species, and blending gradually with the papillæ of the columella. Transverse dissepiments few and distant. Walls naked and costate toward the summit, often covered toward the base with an imperfect epitheca and various encrustations. The polyps in expansion are sub-pellucid, and rise considerably above the calicles; the tentacles are long, slender, and covered with small white verrucæ, with a knob at the end.

This genus is widely distributed, but appears to be most abundant on the American coasts, where its numerous species range on the Atlantic side from Cape Cod to Patagonia and on the Pacific side from the Gulf of California to Peru, and perhaps farther. Three species, at least, are found in the West Indies; two on the Atlantic coast of the United States; one or more at Rio Janeiro; and one in the Straits of Magellan. One large species is found on the Atlantic coasts of Spain and Portugal; and one on the British coast. From the Indo-Pacific fauna none have been described except *A. palifera*, though others probably exist there. Two or more species are also found in the tertiary strata along the Atlantic coast of the United States.* Two species: *A. Edwardsii* Verrill (*A. Danæ* E. and H.) and *A. Michelini* E. and H., are from unknown localities, but may be identical with some of the species already referred to from the Atlantic coast of South America.

Astrangia Haimei Verrill.

Astrangia Haimei Verrill, Proc. Boston Soc. Natural History, x, p. 330, April, 1866.

Plate IX, figures 6, 6ª.

Coralla encrusting, consisting of prominent cylindrical or turbinate corallites, sometimes rising more than half an inch above the surface of the basal expansion, which connects them together, and becoming slightly turbinate and divergent when highest.

The corallites are distant from each other from ·04 to ·25 of an inch. The basal mural expansion is very thin, compact, and slightly granulated, having a smooth appearance, and usually without apparent striations. Septa from thirty to forty-eight, very narrow and thin, with the inner edges nearly perpendicular, forming a deep cup, narrow at the bottom; they are all, except those of the last cycle, which

center, according to their age, thus forming an irregular circle. Wall compact, glossy, with slight, nearly equal, finely granulated costæ.

Height of coralllites ·06 to ·10 of an inch; diameter ·10 to ·13; distance between them ·15 to ·30.

Ceylon, adhering to dead corals.—Museum of Yale College.

* Both of these fossil species belong to the subgenus, *Cœnangia*,—see page 530.

are more narrow, of nearly the same width, giving an even appearance to the cavity of the cup; they project slightly above the wall, about ·01 of an inch, in the form of narrow points, alternately larger and smaller; the inner edges are thin, evenly and sharply dentate, the sides strongly granulated, but not crowded together, the spaces between them being equal to their thickness, or even wider. The columella is small, consisting of numerous even papillæ, graduating into the teeth at the base of the septa. Walls thin, granulated exteriorly, with low, even costæ on the upper part, which mostly disappear toward the base.

Diameter of cups ·10 to ·18 of an inch; depth ·06 to ·10; height of corallites usually about ·10 to ·25, sometimes ·40 to ·55 of an inch.

Panama and Pearl Islands on the reefs, at low-water in pools; Zorritos, Peru; Acajutla; Realejo; La Union, San Salvador, common,—F. H. Bradley.

The following description, found among Mr. Bradley's notes, is believed to apply to this species, for though no numbered specimen was found corresponding to it, there is no other species in the Zorritos collection to which it would apply: "Tentacles 30 or more, in two unequal rows; those of the outer row deep pink, with whitish tips; those of the inner row greenish, with whitish tips. Those of the outer row are about one-fourth as long as the diameter of the polyp, and twice as long as the inner ones. Disk nearly transparent, greenish, with eight very deep pink lines radiating from the sides of the elongated mouth."

Astrangia pulchella Verrill, op. cit., p. 331.

Coralla encrusting, consisting of patches of small, low, cylindrical corallites, scattered at distances varying from less than their diameter to more than a quarter inch, and connected together by a thin, calcareous, basal expansion, much like that of the preceding species, but smoother and with only minute granulations Calicles shallow, conical, with a narrow center, their whole inner surface crowdedly papillose, the papillæ of the columella being confused with the teeth of the septa, and very small. Septa twenty-four, projecting very slightly above the wall, or not at all, narrow at the top but broad within, all nearly equal, the edges evenly toothed, and the sides very strongly and roughly granulated, so that the granules of adjacent septa often touch, giving them a crowded appearance. Costæ scarcely apparent, even at the summit. Diameter of the cups ·08 to ·10 of an inch; depth ·03; height ·05, sometimes more.

Panama and Pearl Islands, with the last, common,—F. H. Bradley.

Astrangia concinna Verrill, op. cit., p. 331.

Plate IX, figure 5.

The coralla consist of clusters of broad, low, cylindrical corallites, which are distant about their own diameter and connected by stolons or a thin basal expansion. Calicles not so deep as wide, cup-shaped, with a narrow papillose columella, forming the bottom. Septa from thirty-six to fifty, subequal, the primaries often a little broader, and those of the last cycle narrower than the rest. All are rounded at the top, and finely toothed, but at the middle the inner edge becomes more nearly perpendicular and has longer teeth, resembling pali, which blend with the papillæ of the columella, which are fine and numerous. The tops of the septa are thin and project slightly above the wall, the primaries most so. Their sides are not so strongly granulated as in the preceding species, and they appear thinner and less crowded. Exterior granulated, slightly costate near the summit, often encrusted with Bryozoa, etc., to near the top.

Diameter of cups ·18 to ·22; height ·10 to ·15 of an inch.

Panama and Pearl Islands, not common,—F. H. Bradley.

Resembles the last, but has much larger cells and more numerous septa, which are not so strongly granulated.

Astrangia dentata Verrill, op. cit., p. 332.

Coralla forming clusters, encrusting rocks, similar to the last, with cups of about the same size, but deeper and less open. Septa from thirty-six to forty-eight, very unequal according to their cycles, the primaries being comparatively broad and rounded above, while those of the last cycles are very narrow; they are not crowded, being separated by spaces equal to their thickness; they project unequally, the primaries about ·02 of an inch, the others slightly. All the septa are strongly and irregularly toothed, the principal ones especially so; the teeth on the upper part are rough and lacerate, those on the inner part prominent, paliform, merging into those of the columella; the sides are rudely granulous. Columella rather small, concave, forming the narrow bottom of the deep cells, covered by numerous, small, crowded, rough papillæ.

Walls thin, with subequal, low, thick, granulous costæ, which often extend on the surface of the basal expansion, and usually encrusted nearly to the edge of the cups with sponge, etc. Color of the unbleached coral dark brown.

Height of corallites ·20 to ·30; diameter ·15 to ·20; depth about ·05; some of the patches are two or three inches across.

Panama and Pearl Islands, at low-water mark in rocky pools, and in 6 to 8 fathoms on base of *Muricea*,—F. H. Bradley; Acajutla, San Salvador,—F. H. Bradley; Acapulco,—A. Agassiz; La Paz,—J. Pedersen.

This species resembles the preceding more than any other species, but may easily be distinguished by the deeper calicles and more unequal septa, which are more strongly toothed.

Astrangia costata Verrill, op. cit., p. 332.

Coralla consisting of from one to four, turbinate, rather high corallites, surrounded by a very thin mural expansion, usually encrusting dead shells. Cup circular, narrow and deep. Septa twenty-four to thirty, the primaries wide, about one-fourth the diameter of cup, rounded and subentire at the top, perpendicular and toothed within; the others similar, but successively narrower, with sharp teeth throughout. The septa project very unequally, giving a notched appearance to the margin of the cups. Walls very thin, with subequal, elevated costæ, which extend to the base and on the basal expansion. The columella is very small, with few papillæ. The septa within the cell are thin and not crowded, the spaces between them being greater than their thickness, giving them a loose appearance. Diameter of the cups ·08 to ·10 of an inch; height ·10 to ·15.

Panama, on dead shells, in 6 to 8 fathoms,—F. H. Bradley.

This is very distinct from all the others and approaches *Phyllangia*.

Astrangia Pedersenii Verrill, sp. nov.

Coralla composed of clusters of sub-turbinate corallites, connected by thin stolon-like extensions, often arranged in linear series radiating from the center of the cluster, the outer ones oblique. Corallites not crowded, the largest seldom more than a quarter of an inch high. Calicles cup-shaped, narrow and deep at center, with a thin edge and quite open interseptal spaces, which are about twice as broad as the septa. Columella very narrow, papillose. Septa thin, unequal, about 36 in the largest calicles; the primaries are about twice as wide as the tertiaries, thin, a little exsert, the summit rounded and sharply denticulate, the inner edge nearly perpendicular, with small, prominent, paliform teeth toward the base; secondaries similar but a little narrower and less exert; those of the third and fourth cycles very thin and narrow, very slightly exsert, the edge sloping from the narrow summit and sharply denticulate. Walls covered with about 36, low, nearly equal, rather distant, granulous costæ, often encrusted with nullipore, etc.

Some of the clusters are 2 inches across; the corallites ·05 to ·25 apart; ·10 to ·25 high; ·10 to ·15 in diameter; depth of cup ·06 to ·10; primaries about ·03 broad; ·02 exsert.

La Paz, on base of *Eugorgia nobilis*, in 4 to 6 fathoms,—J. Pedersen; Guaymas, on dead shells,—Dr. E. Palmer (Chicago Acad. Sci.).

This species resembles *A. Haimei* more than any of the other species, owing to its deep open calicles, but is readily distinguished by its decidedly costate exterior; by the broader and more exsert primary septa; and especially by the fewer and quite unequal septa and wide interseptal chambers.

Subgenus, **Cœnangia** Verrill.

Corallites united together laterally, forming small, Astræa-like, encrusting masses, sometimes rising into lobes in the middle. Calicles angular and crowded. Septa without distinct paliform teeth at base, those of the last cycles curved towards and usually united to those of the preceding cycles. Columella small or moderate, scarcely papillose, composed of contorted processes originating from the septa. Budding takes place mostly in the angles between the corallites, both around the margin and in the central parts.

Besides the following species this group includes *A. bella* and *A. Marylandica* (Conrad sp.), from the later tertiaries of the eastern coast of the United States. *A. Danæ* Ag. from the Virginian fauna, and *A. astræiformis* E. and H., from the Carolinian fauna, are intermediate between this sub-genus and the typical species, in mode of growth.

Astrangia (Cœnangia) conferta Verrill, sp. nov.

Coralla encrusting, forming Astræa-like crusts with an uneven surface, two or three inches broad and about a third of an inch thick in the middle, consisting of crowded prismatic corallites, intimately united together throughout their whole length. Calicles deep, narrow at bottom, angular, often oblique and expanded on one side, the adjacent ones separated only by a thin, sharp wall; interseptal spaces rather wide, double the thickness of the septa. Columella small, composed of rough, irregular, oblique, transverse, and more or less contorted lamellæ, arising from the inner edges of the septa, the upper surface more or less roughened with small granules, but not papillose. Septa subequal, in three cycles, usually 24 in the largest cells, all of them thin, very narrow at the top, the edge sloping to the columella or somewhat concave, sharply and roughly denticulate throughout, without distinct paliform teeth at base, the sides with few, very scat-

tered, small, rough granules; primaries a little broader and more exsert than the others; tertiaries curved toward and mostly united to the secondaries, about midway between the margin and center. Summit of the walls between the calicles thin, rough with the projecting ends of the septa. The young corallites arise chiefly by budding between the angles of the older cells, both in the central parts and around the margin, where the calicles are oblique and strongly appressed to the surface.

The larger specimens are about three inches across; thickness varying from ·15 to ·30 of an inch; diameter of the largest calicles about ·20; depth ·08 to ·12.

Gulf of California,—J. Pedersen; Guaymas on dead shells of *Strombus gracilior*, etc,—Dr. E. Palmer (Chicago Acad. Science).

This species is more nearly allied to *A. Marylandica* and *A. bella* than to any known living species. The former differs, however, in having but 12 distinct septa and very wide interseptal chambers; the walls are thicker; the septa have smaller lateral granules and more regular teeth; and the columella is less developed. The mode of growth and union of the corallites is the same. *A. bella* has the same number of septa (24), but those of the different cycles are quite unequal. It also has considerable resemblance to *A. Danæ* and *A. astræiformis* of the Atlantic coast of the United States, but these have papillose columellæ and usually 36 septa, which are closer together, not so strongly granulous, and more evenly toothed, while the calicles are more circular and the corallites are generally free laterally, to some extent, and mostly rise above the intervening surface of the cœnenchyma.

The close relations of this species to the fossil and recent species of the temperate coasts on the Atlantic side, together with the occurrence of certain shells that are apparently identical in the two regions, but found neither in the arctic nor in the tropical regions (*Petricola pholadiformis*, etc.), is very suggestive of a former connection, perhaps in early tertiary times, between the two oceans, through the temperate parts of North America.

Phyllangia Edw. and Haime.

Phyllangia Milne-Edwards and J. Haime, Comptes-rendus de l'Acad. des Sci., xxvii, p. 497, 1848; Ann. des Sci. nat., 3e sér., xii, p. 181, 1849; Coralliaires, ii, p. 616, 1857.

Coralla encrusting, consisting of clusters of moderately large, turbinate corallites, which arise by budding from a thin, spreading expansion of the basal part of the wall of the parent corallites. The

calicles are nearly circular unless crowded,—though often appressed while young,—and deep at the center. Columella often rudimentary, when most developed composed of rough, irregular, twisted and contorted processes, arising from the inner portion of the septa and uniting at the center, with a ragged upper surface. Septa very unequal, forming three or four cycles, the fifth sometimes imperfectly developed in some of the systems; the primaries and secondaries much the broadest and most exsert, with the summits broad and entire, or but slightly denticulated; within, toward the base, thin and usually narrowed and then expanded again into a slightly marked paliform lobe, the sides strongly granulated; tertiaries narrow at summit and slightly exsert, the edge strongly denticulated; those of the fourth and fifth cycles narrow and thin, with denticulated edges, those of the fourth often joining the tertiaries Walls and basal expansion naked. Costæ usually well developed. The transverse dissepiments are few and simple.

This genus differs from *Astrangia* chiefly in the deeper calicles, rudimentary and contorted columella, and in the very exsert, subentire primary and secondary septa.

Phyllangia dispersa Verrill.

Phyllangia dispersa Verrill, Bulletin Museum of Comp. Zoölogy, i. p. 47, 1864; Proceedings Boston Soc., vol. x, p. 332, 1866.

Plate IX, figures 3, 3ª.

Corallites cylindrical or turbinate, very unequal, varying in height from ·10 to ·40, and in diameter from ·20 to ·30 of an inch, and either close together or scattered at distances of ·30 to ·50 of an inch, but connected together by a continuous expansion from the enlarged basal portion of the walls. This is generally rather thin, though sometimes forming crusts two or three inches broad, the surface is granulous and the costæ of the walls extend over it in the vicinity of the corallites, gradually fading out as they recede. The walls are compact, finely granulous, covered with low, rounded, unequal costæ, those corresponding to the principal septa often becoming cristiform and denticulate toward the summit. Calicles deep at center, with conspicuous, deep interseptal chambers, giving an open appearance. Septa very unequal; the primaries are broad, much exsert (about ·10 of an inch), somewhat recurved outwardly, the inner edge usually perpendicular or overarching, the end broadly rounded, sometimes arcuate, entire or minutely denticulate, thin at the inner edge, thickened outwardly; the inner edge usually recedes toward the base, which

often rises into a slight, denticulated paliform lobe, before joining the columella processes; the secondaries are similar, in adult corallites, but are considerably narrower and only rise about two thirds as high above the margin of the wall; the tertiaries are strongly denticulate and very thin, narrow in their upper part, and project but slightly above the wall, but the basal portion is broad and usually joins the columella, or unites with the secondaries before reaching it; those of the fourth cycle, and of the fifth when present, are very thin and narrow, scarcely exsert, exteriorly usually united laterally to those of the principal cycles, with the inner edges sometimes united to the tertiaries. All the septa have their sides covered with sharp granulations. Columella often rudimentary, while in other corallites of the same cluster it is pretty well developed, though occupying a small area (usually less than a fourth of the diameter of the calicle), it is composed of coarse, rough, contorted processes, originating from the inner edges of the septa, with irregular openings and a rough uneven surface.

Panama and Pearl Islands, on rocks in pools at low-water mark, and on the base of *Muricea* in 6 fathoms,—F. H. Bradley; Panama,—A. Agasisz; Gulf of Nicoya,—J. A. McNiel.

Ulangia Edw. and Haime.

Oulangia Milne-Edwards and J. Haime, Comptes-rendus de l'Acad. des Sci., xxvii, p. 497, 1848; Annales des Sci. nat., 3e ser., xii, p. 182, 1849.
Ula gia Edw. and H., Coralliaires, vol. ii, p. 617, 1857.

Coralla, so far as observed, simple, consisting of solitary corallites distantly scattered over dead shells, stones, etc., without any apparent connection, or entirely isolated. The corallites are low, broad, subcircular, and unusually large for the family. The calicles are moderately deep, or shallow, with a broad bottom occupied by a well-developed papillose columella. Septa numerous, usually in five complete cycles, unequal, all with sharply granulous sides, with the inner portion divided into numerous small prominent teeth, which blend with the papillæ of the columella. The primary and secondary septa are much broader and more elevated in their outer part, with broadly rounded summits, which are usually subentire, but sometimes incised; the other septa are all strongly denticulate at summit; those of the last cycle very narrow and thin. The wall is covered at base with an imperfect epitheca and usually much encrusted with Bryozoa, Nullipora, etc.; above this it is naked and more or less costate. The transverse dissepiments are few and oblique, close to the base.

This genus is like a gigantic *Astrangia*, except that the corallites are, apparently, always quite separate, and the principal septa are usually more nearly entire at the summit. *Phyllangia* has a smaller columella, which is not papillose, and the septa are fewer, narrow, and very exsert, with nearly entire edges, while the calicles are narrow and deep.

The following and *U. Stokesiana* Edw. and Haime, from the Philippines, are the only species known.

Ulangia Bradleyi Verrill.

Ulangia Bradleyi Verrill, Proceedings Boston Soc. of Natural History, x, p. 333, 1866.

Plate IX, figure 10.

Corallites low, broad, subcircular or elliptical, with the base as broad as the margin, generally quite isolated, sometimes two or more are placed 1·5 to 3 inches apart, which were, possibly, once connected by a thin, or entirely soft, basal expansion, that has since disappeared. Calicle generally quite shallow, sometimes moderately deep and cup-shaped. Columella well developed, but not large, usually occupying less than a quarter of the breadth of the calicle, its surface crowdedly covered with small prominent, spinulose papillæ, which blend insensibly with the similar, rough, papilliform teeth, arising from the inner edges of the septa; the surface of the columella is usually concave. Septa in five complete cycles; those of the fifth are mostly quite narrow, thin, lacerately toothed; all others have the outer part suddenly rising and more or less exsert, according to their cycles, the inner portion thin, gradually sloping inward and sometimes, in large specimens, almost horizontal, most of them extending inward to the columella, but many of those of the fourth cycle joining those of the third before reaching the columella; all have the sides covered with small, sharp, spine-like granules, and the inner portion with the edge divided into prominent, rough, papilliform teeth; the primaries are a little thicker than the rest, and broader throughout, the outer portion rising almost perpendicularly from the inner, broadly rounded or subtruncate at summit, considerably exsert, the edge subentire or minutely denticulate, rarely deeply incised; the secondaries are similar to the primaries, but a little thinner and narrower, with the outer portion somewhat less exsert and the edge more frequently toothed; the tertiaries are considerably narrower than the secondaries, with the outer portion narrow and less distinct from the inner, only slightly exsert, and deeply divided into sharp, or rough, lacerate and blunt teeth; those of the fourth cycle are similar to those of the

third, but a little narrower and less exsert, with the edges still more rough and lacerated. The wall is thin, usually covered nearly and sometimes quite to the summit with an epitheca, which is thickly encrusted below, but usually has a distinct, thin upper edge, above this the wall is usually feebly costate, the costæ and outer edges of septa roughly granulous or denticulate. In a vertical section the septa are roughly granulous, and perforated near the inner margin with irregular, rounded openings; the dissepiments are few and confined to the basal portion, irregular, and quite oblique. In a transverse section near the base the interseptal chambers are divided by two or three of the oblique dissepiments.

One of the largest specimens is ·63 of an inch broad; ·25 high to edge of cup; the primary septa ·06 exsert; the cup ·12 deep; the columella ·10 broad. Another specimen is ·56 broad; ·34 high, to margin; the cup ·26 deep; the primary septa ·05 exsert. An elliptical one is ·50 by ·40 in diameter; ·30 high; the primary septa ·06 exsert; the cup ·15 deep; the columella about ·10 broad. The largest specimen is ·85 broad at base; while the calicle is but ·65 broad and ·20 deep.

Panama, in rocky pools at low-water mark, and Pearl Islands on the bases of *Gorgoniæ* and on *Spondyli* in 6 to 8 fathoms,—F. H. Bradley.

Family, Caryophyllidæ Verrill.

Turbinolidæ (*pars*) Edwards and Haime, Annales des Sci. nat., 3e ser., ix, p. 211, 1848; Coralliaires, ii, p. 7, 1857.

Cyathinæ Edw. and Haime, Annales des Sci. nat., lx, p. 285, 1848.

Caryophyllinæ Edw. and Haime, Coralliaires, ii, p. 9, 1857.

Coralla always simple at maturity.* Calicles cup-shaped, mostly circular or elliptical. Septa rather numerous, in several unequal cycles, with the edges entire or nearly so, except at the inner edge, which is sometimes divided into paliform teeth. One or more cycles of pali in front of the septa. Interseptal chambers open from the bottom. Transverse dissepiments rudimentary or wanting.

The *Turbinolidæ* of Edwards and Haime, united chiefly by the negative character of lacking dissepiments, do not appear to constitute a homogeneous group. Some of the genera, like *Flabellum*, *Rhizotrochus*, *Placotrochus*, etc., seem to be most nearly allied to

* According to Mrs. Thyme (Annals and Mag. Natural History, iii, p. 449, 1859), *Caryophyllia Smithii* undergoes repeatedly, while still young, complete fissiparity, the resulting portions becoming entirely free and circular. This remarkable observation needs confirmation, however.

the simple *Eusmilidæ* (*Trochosmiliaceæ* E. and H.). The soft parts of *Flabellum*, so far as known, agree more closely with those of the *Eusmilidæ* than with those of *Caryophyllia* and *Paracyathus*, while in this respect the latter genera agree very closely with the *Astrangidæ*, to some of which, indeed, they are evidently closely allied. *Syndepas* Lyman, and *Phyllangia* E. and H., so closely resemble some of the *Caryophyllidæ* that, did they not form basal stolons, they might readily be taken for members of that family. The corallites of some of the *Oculinidæ* (*Lophohelia* etc.), also closely resemble some of the *Turbinolidæ*. I have, therefore, thought it best for the present to divide the group into two families, corresponding to the subfamilies of Edwards and Haime, although, when the living polyps shall have been carefully studied in all the recent genera, it may be found that the families are not correctly limited.

The genera of which the relations are most in doubt, are the typical *Turbinolinæ* of Edwards and Haime (*Turbinolia*, *Sphenotrochus*, *Discotrochus*, *Desmophyllum*, etc.). It is possible that these belong with *Caryophyllidæ* to the *Oculinacea*, while the *Flabellinæ* may alone belong to the *Astræacea* near *Eusmilidæ*. This cannot be determined satisfactorily until the living polyps of some of these genera have been thoroughly studied.

Paracyathus Edw. and Haime.

Paracyathus Edwards and Haime, Ann. des Sci. nat., 3 sér., ix, p. 318, 1848; Coralliaires, ii, p. 52, 1857.

Corallum cylindrical or turbinate, attached by a broad, expanded base Wall naked, costulate. Calicle cup-shaped. Septa numerous, in four or five cycles, unequal, the summits rounded and little exsert. Columella concave, composed of prominent, elongated, papilliform processes, connected with the internal edges of the septa. Pali numerous, in several series at unequal distances from the center, those of the primary cycle farthest inward; they arise from the inner edges of the septa of all the cycles except the last, or next to the last,* and are similar to the processes of the columella.

* According to Edwards and Haime they exist before the septa of all the cycles, except the *next to the last*, and those are larger which belong to the younger cycles. But in the three following, and many other species, they exist before all the septa except those of the *last* cycle, and those in front of the primaries are largest. Even in the figure of *P. Stokesii* by Edwards and Haime, pali are wanting only in front of the last cycle of septa.

Paracyathus caltha Verrill.

Paracyathus Caltha Verrill, Proc. Boston Soc. Nat. History, xii, p. 394, 1869.

Plate IX, figures 9, 9ª.

Corallum turbinate, with an expanding base; pedicle about one-half the width of the summit. Costæ corresponding to all the septa, prominent near the margin of the cup and dentate; below represented only by lines of granules. Calicle cup-shaped, elliptical with flattened sides, the ratio of the axes as 100 : 140; the summit of the longer axis is somewhat lower than that of the shorter. Septa in five regular cycles; those of the first and second subequal, rather broad and stout, thickened uniformly, rounded at the summits, projecting about ·02 of an inch, finely granulated on the sides. The other septa are equidistant and diminish regularly in width and height, the last being thin and narrow. Columella formed by numerous stout, styliform processes, rounded at tip, not crowded. The pali are similar in size, but more prominent and flattened, increasing in height as the septa diminish, their inner edges denticulate. They are present before all the septa except those of the fifth cycle.

Height of largest specimen ·50 of an inch; diameter ·45 by ·32; depth of cup ·20 of an inch.

Monterey, California,—J. Xantus, (Museums of Smithsonian Institution and Yale College).

Paracyathus Stearnsii Verrill, op. cit., p. 393.

Corallum with an expanded base, above which it is somewhat constricted, and then expands rapidly to the edge of the broad, shallow cup, which is broad-oval in form, the edge bent into slight lobes or undulations. Exterior of the wall with very numerous, prominent, subequal, scabrous costæ, which extend from the summit to the outer edge of the base; on the basal portion three or five smaller ones often alternate with one more prominent; toward the summit some of them have a tendency to rise into crests; all are covered with several series of small, sharp granulations, similar to those on the sides of the septa. Five complete cycles of septa, with some small ones in some of the systems belonging to the sixth cycle, so that the whole number is about one hundred and twenty. The primary and secondary septa are considerably broader than the others, broadly rounded and somewhat exsert at summit, narrowed toward the base and divided into two or three unequal, broad, stout, paliform teeth, which are rough and lacerately spinulose at summit, and covered on the sides with coarse, rough granulations. The septa of the two succeeding cycles

are successively narrower, thinner, and less exsert, with similar but smaller, rough, paliform teeth. The septa of the fifth cycle are narrow and destitute of pali. Columella small, papillose, the papillæ numerous, slender, prominent, lacerately spinulose at summit.

Height ·60; diameter of narrowest part ·38 by ·50; diameter of cup ·50 by ·72; depth of cup ·25 of an inch.

Monterey, California,—Robert E. C. Stearns. One specimen.

Paracyathus humilis Verrill, sp. nov.

Corallum small, cylindrical, about as wide at base as summit. Wall thin, feebly costate, except near the margin of the cup, where the costæ become thinner, more elevated, and granulous. Calicle rather shallow, with a sunken center. Columella small, composed of rather open, contorted processes, with an irregular, papillose surface. Septa in four cycles; the primaries and secondaries subequal, with the inner edge perpendicular and the summits broadly rounded and considerably exsert; those of the third and fourth cycles much thinner and narrower, and very little exsert; all the septa have their sides strongly and roughly granulated. Pali prominent and rather slender, subequal, a few of them divided into two parts, most of them with irregular sides from which are developed small rough lobes, projecting in various directions. There are no pali in front of the septa of the fourth cycle.

Height of the largest specimen ·20; breadth ·22; depth of calicle ·07; the primary septa are ·06 broad and project ·05; diameter of the columella ·06 of an inch.

Pearl Islands,—F. H. Bradley.

Bathycyathus Edw. and Haime.

Bathycyathus M. Edw. and J. Haime, Ann. des Sci. naturelles, 3e sér., ix, p. 294, 1848; Coralliaires, ii, p. 22, 1857.

Corallum simple, elongated, attached by a broad base. Costæ fine, close, and simple. Calicle elliptical, very deep. Columella slightly developed, composed of irregular processes. Septa well developed, in five cycles (in the known species); those of the last cycle more developed than those of the preceding one, towards which they closely approach exteriorly; primaries and secondaries about equal. Pali narrow and elevated, in a single circle around the columella.

Two species of this genus, besides the following, are known: *B. Indicus* Edw. and H. is from the Island of Juan Fernandez, at the depth of 80 fathoms; *B. Sowerbyi* Edw. and H. is from the upper Cretaceous green-sand, Wiltshire, England.

Bathycyathus Chilensis Edw. and Haime.

Annales des Sci. nat., 3e sér., ix, p. 294, Pl. 9, fig. 5, 1848; Coralliaires, ii, p. 23, 1857.

Corallum with the calicle subelliptical; the ratio of the axes as 100 : 166; the summits of the small axis a little reëntrant and more elevated than those of the large axis, which are rounded. Columella oblong, reduced. Septa very close, very little thickened externally and becoming very thin within, with the faces covered with numerous, very fine grains, disposed in series parallel to the edge. Pali very thin, covered with extremely prominent grains, with the internal edge a little flexuous.—(Edw. and Haime).

Height, ·40mm; larger axis of the calicle, ·25; smaller, ·15; depth of fossette, ·13.

Coast of Chili,—Gay.

Family, TURBINOLIDÆ Edw. and Haime (restricted).

Turbinolinæ Edw. and Haime, Ann. des Sci. nat., ix, p. 235; Coralliaries, ii, p. 95, 1857.

The genera referred to this group are distinguised by the entire absence of pali, and generally by the very open appearance of the chambers between the septa. It includes two groups, or sub-families, already referred to on page 536: the *Turbinolinæ*, in which there is no epitheca and the calicles are generally circular; and *Flabellinæ*, in which the wall is completely covered by a pelicle-like epitheca, and in which the calicles are usually elliptical.

Desmophyllum Ehrenberg.

Desmophyllum Ehrenberg, Corall. des rothen Meores, p. 75, 1834; Edw. and Haime; Ann. des Sci. nat., ix, p. 252, 1848; Coralliaires, ii, p. 76, 1857.

Corallum simple, elevated, attached by an encrusting base. Wall naked, usually smooth below and costate or crested near the summit. Calicle very deep at center, without a columella. Septa broad, much exsert, generally curved outward.

This genus includes several living species from the West Indies; Mediterranean; Atlantic coasts of Europe; Japan; and the following from South America. It also occurs in the Miocene of southern Europe.

Desmophyllum Cumingii Edw. and Haime.

Desmophyllum Cumingii Edw. and Haime, Ann. des Sci. nat., 3e sér., ix. p. 254, Pl. 7, fig. 11, 1848; Coralliaries, ii, p. 77, 1857.

This species differs from *D. cristagalli* in this that it is much less elongated, and fixed by a large and scarcely curved base. Ratio of

the axes as 100 : 157. The septa are proportionally less projecting, and one can distinguish on their sides lines of fine and very scattered grains, parallel to the superior edge; the fosette of the calicle is still more narrow.

Height, 40 millim.; longer axis of the calicle, 26; smaller axis, 19; the primary septa project 5.—(Edw. and Haime).

Pacific coast of South America,—H. Cuming.

This species I have not seen, and therefore reproduce the description given by Edwards and Haime.

As it was collected by Mr. Hugh Cuming, it probably belongs to the Panamian fauna.

Suborder, FUNGACEA Verrill.

Fungidæ (family) Edw. and Haime, Corall., iii. p. 1; + *Merulinaceæ* (tribe) op. cit., ii, p. 627; + *Echinoporinæ* (subfamily) op. cit., p. 621; + *Siderastræa*, and some other genera referred to *Astræidæ*.

Fungacea Verrill. Proceedings Essex Institute, iv, p. 146, 1865; American Journal of Science, vol. xl, p. 128, 1865.

Polyps short and broad, not exsert, either simple, or becoming compound by marginal budding, rarely by fissiparity; in compound species the individual polyps are usually not clearly separated by definite walls, the septa of adjacent cells blending. Tentacles various in number and form, usually short and lobe-like, or bilobed, often rudimentary or wanting. Coralla generally broad and low, in compound species usually foliaceous or encrusting, the growth chiefly centrifugal, the septal system composing the chief part of the coral. Walls imperfectly developed, often rudimentary or wanting, when present usually forming the basal or attached portion. Interseptal chambers generally open from top to bottom, though mostly partially interrupted by transverse bars or trabiculæ, which unite adjacent septa; but sometimes crossed by well formed dissepiments, as in *Pavonia* and *Siderastræa*.

Family, FUNGIDÆ Dana (restricted).

Fungidæ (pars) Dana, Zoöphytes U. S. Expl. Exp., p. 283, 1846.

Fungiæ (subfamily) Edw. and Haime, Ann. des Sci. nat., 3e sér., xv, p. 75, 1851; Coralliaires, iii, p. 4, 1860.

Fungidæ Verrill, Proc. Essex Inst., iv, p. 146, 1865.

Coralla simple or compound, free or attached, low and broad, the compound forms often foliaceous. Walls basal, little developed, often strongly costate, perforated by irregular openings, destitute of

epitheca. Septa dentate, low, widely spreading, in simple species very numerous, in compound ones often but few. Interseptal chambers crossed by transverse trabiculæ. Costæ echinulate, often spinose.

In some compound genera the polyps are of two or more kinds, the lateral or secondary ones often very imperfectly developed, but the central, primary polyp, even in these, has the essential structure of the typical forms.

Fungia Lamarck.

Fungia (pars) Lamarck, Syst. des animaux sans vert., p. 369 1801; Hist. Anim. sans vert., ii, p. 236, 1816; 2nd ed., p. 369, 1836; Ehrenberg, Corall. des rothen Meeres, p. 48, 1834.

Fungia Dana, Zoophytes U. S. Expl. Exp., p. 287, 1846; Edw. and Haime, Ann. des Sci. nat., 3e sér, xv, p. 76, 1851; Coralliaries, iii, p. 5, 1860.

Corallum simple, circular or nearly so, while young turbinate and attached by a narrow base; the outer margin growing outward rapidly and becoming horizontal or revolute, the pedicle breaks off and the coral afterward remains free, resting upon the flat or concave basal surface, formed by the wall, which in life is completely covered by a lime-secreting membrane, by which the scar of adherence is soon obliterated. Wall more or less perforated by irregular openings, especially near the margin, covered with radiating costæ, which are denticulate or even spinose. Septa very numerous, unequal; the principal ones high and thickened near the central fosette, those of the later cycles broadest near the margin, becoming thin and uniting together toward their inner edges, usually with a more or less marked tentacular tooth at the points where they become narrower. Central fosette small. Columella little developed, trabicular.

This genus is represented by many large and fine species, several of them becoming more than a foot in diameter, in the Indo-Pacific fauna. These species abound in the shallow lagoons of the Feejee and Society Islands, Kingsmills, Phillipines, and throughout the tropical parts of the central Pacific and Indian Oceans, extending on the coast of Africa from Zanzibar to the coral reefs of the Red Sea. In the Atlantic Ocean none have hitherto been found, unless a small undescribed species, dredged by Mr. Pourtales, of the U. S. Coast Survey, at a great depth between Florida and Cuba, really belongs to this genus.

The following is remarkable as the only species hitherto discovered on the Pacific coast of America. It appears to be very local in its habitat, having been as yet found only at one small island.

Fungia elegans Verrill.

Fungia elegans Verrill, Amer. Journal of Science, 2d ser, xlix, p. 100, Jan. 1870.

Plate X, figures 1 and 2.

Corallum, when young, regular and round, often becoming slightly oval; when adult, usually more or less angular, the edge plicated, forming six to twelve lobes. The upper surface becomes very convex in mature specimens and the lower surface deeply concave and covered with very numerous, fine, subequal, elevated costæ, which are finely dentate on the outer half, becoming nearly entire and very faint toward the center, which usually shows the scar, where it was attached when young. Septa thick and rather crowded, very unequal, the six primaries very prominent and thick at the inner end; those of succeeding cycles successively shorter and less elevated. Edges of septa unevenly crenulate, or finely dentate. Columella slightly developed, loosely spongy; median fosette small, narrow, elongated; the two septa in the direction of its longer diameter much less elevated and thinner than the rest. Trabiculæ stout, conspicuous, often coalescing into continuous transverse plates.

The smallest unattached specimens are ·90 of an inch broad by ·35 high; ordinary specimens are about 1·90 broad by 1·10 high; some of the largest 2·25 by 1·15; 2·35 by 1·20; 2·40 by 1·25; 2·55 by 1·11.

Near La Paz,—J. Pedersen.

Of this small but very interesting species Capt. Pedersen has sent more than one hundred specimens, all of which came from a single locality.

Family, AGARICIDÆ Verrill.

Fungidæ (pars) Dana, Zoöphytes U. S. Expl. Exp., p. 283, 1846.

Lophoserinæ Edw. and Haime, Comptes-rendus de l'Acad. des Sci., xxix, p. 71, 1849.

Lophoserinæ (pars) Edw. and Haime, Ann. des Sci. nat., 3e ser., xv, p. 101, 1851; Coralliaires, iii, p. 35, 1860.

Lophoseridæ Verrill, Proc. Essex Inst., iv, p. 146, 1865.

Coralla simple or compound. Wall, and basal disk of compound species, compact, imperforate, costate. Costæ generally nearly equal, seldom echinulate or dentate. Septa compact, usually few, low, prolonged outwardly, extending between adjacent cells. In compound species the coral is generally encrusting, or thin and foliaceous, the polyps covering one or both sides of the foliæ, and budding chiefly around the margins, from the prolonged septal systems. The cells are not separated by definite walls. In some genera, however, like *Pavonia* and *Siderastræa*, the coral forms more or less thickened plates, or even globular masses, while the interseptal chambers have transverse dissepiments, as well as trabiculæ.

Since *Lophoseris* is a late synonym of *Pavonia* it is undesirable to use it for the derivation of the family name. *Pavonidæ* is in use in ornithology.

Pavonia Lamarck.

Pavonia (*pars*) Lamarck, Syst. des animaux sans vert., p. 372, 1801; Hist. nat. des anim. sans vert., ii, p. 238, 1816; 2nd edit., ii, p. 376.

Pavonia Ehrenberg, Corall. des rothen Meeres, p. 104, 1834; Dana, Zoophytes U. S. Expl. Exp., p. 319, 1846.

Lophoseris Edw. and Haime, Comptes-rendus de l'Acad. des Sci., xxix, p. 72, 1849; Ann. des Sci. nat., 3e sér., xv, p. 121, 1851; Coralliaires, iii, p. 65, 1860.

Pavonia Verrill, Bulletin Mus. Comp. Zoölogy, i, p. 54, 1864; Proc. Essex Inst., v, p. 45, 1866.

Coralla compound, adherent, encrusting or foliaceous, generally with rising crests, foliæ, or lobes of various kinds; sometimes thick and massive, often thin and delicate. The foliaceous forms usually have both surfaces covered with polyps, but some of the horizontally spreading species are foliaceous near the edge, with polyps only on the upper side, the lower side being naked and finely costulate. Polyp-cells scattered, clearly defined, but not separated by distinct walls, the adjacent ones united by prolongations of the septa.

Columella tubercular, sometimes rudimentary. Septa few, generally more or less thickened. Dissepiments, in the thick species, well developed; in the thinner ones represented only by trabiculæ.

The name, *Pavonia*, was rejected by Edwards and Haime because Hubner used it among insects in 1816, but they overlooked the fact that the genus was first established in the earlier work of Lamarck, published in 1801.

This genus has nearly the same distribution as *Fungia*. It is found throughout the tropical regions of the Pacific and Indian Oceans, from the west coast of America to the east coast of Africa, and from the Hawaiian Islands, Southern Japan, Hong Kong, and the Red Sea on the north, to Australia and Zanzibar on the south. It is represented in this great area by many species. No species has yet been found in the Atlantic Ocean, where it is replaced by *Agaricia*.

Pavonia gigantea Verrill.

Pavonia gigantea Verrill, Proc. Boston Soc. Nat. Hist., xii, p. 394, 1869.

Plate IX, figure 7.

Corallum very large, thick, encrusting, near the edges often somewhat free; upper surface nearly flat or variously undulated and uneven, covered with large, distant, stellate cells, which are either irregularly scattered, or sometimes in somewhat regular rows for a short

distance, and in the latter case contiguous laterally, but the rows are separated by spaces equal to once or twice the diameter of the cells, which are united by very prominent septo-costal lamellæ. In the largest cells there are usually twenty-four septa, in three regular cycles, often twelve, sometimes only eight or ten, and frequently irregular numbers, between twelve and twenty-six, but in all cases they are alternately large and small. The larger septa are very stout, much thickened at the margin, tapering to a sharp edge within, the sides and edge roughly granulous; the costal part is very prominent, thick, but less so than the marginal part, sharp-edged, and almost always continuous with one of the large septa of an adjacent cell. The alternating small septa are not more than half as wide, thin, much less prominent, slightly thickened at the margin, and extend as thin costal lamellæ between the much thicker and more prominent primary ones to adjacent cells, but they are often interrupted and variously branched. Stout trabiculæ are often visible at the surface between the costal lamellæ. Columella represented by a small central tubercle, which is often wanting, and a deeper, large, solid portion, which fills the center of the cell below, and unites with the inner edges of the septa. The endotheca consists of distinct, regular, thin, nearly horizontal, transverse septa, as in many Astræans; these are about ·03 to ·05 of an inch apart in the same interseptal chamber, as seen in a vertical section. The radiating septa are solid and continuous.

The largest specimen is nearly three feet long, two feet broad, and eight inches thick in the middle; diameter of cells mostly ·08 to ·12; distance between them, in the direction of the costal plates, generally ·10 to ·16 of an inch.

Pearl Islands,—F. H. Bradley.

It was brought from seven fathoms by Mr. Clarke, a pearl collector who gave great assistance to Mr. Bradley while making his collections.

Pavonia clivosa Verrill, op. cit., p. 395.

Plate IX, figure 8.

Corallum thick and massive, lobed, or rising into very large rounded eminences or oblong ridges, thickly covered with stellate cells, which are smaller and nearer together than in the preceding species. Cells mostly uniformly scattered, often closely crowded and contiguous on the summits of the prominences, usually separated on other parts at distances about equal to their own diameter. Septa generally from sixteen to twenty-four, alternately larger and smaller; the larger ones rather thin, only little thickened even at the margin, roughly granulous on the sides; their costal prolongations elevated and rather thin.

Smaller septa about half as wide, a little thinner and less elevated, as are also their costal prolongations. Columella a small tubercle, often prominent, sometimes flattened. Internal structure as in the preceding, but the transverse septa are nearer together.

The largest specimens are ten inches to two feet in diameter; and often a foot thick or high; some of the prominences or lobes are from four to six inches in diameter, and nearly as high; diameter of cells mostly ·05 to ·06; distance between them ordinarily ·05 to ·08.

Pearl Islands, at extreme low-water of spring tides,—F. H. Bradley.

Stephanaria Verrill.

Stephanocora Verrill, Proc. Boston Soc. Nat. History, vol. x, p. 330, 1866, (*nou* Ehronberg).

Stephenaria Verrill, Transactions Conn. Acad., i, p. 340, 1867.

Coralla compound, consisting of irregular short, lobe-like branches. Cells moderately large, with two or three cycles of septa, which are denticulate on the edge, well developed, and mostly confluent with those of adjacent cells. Walls indistinct or wanting, the divisions between the cells indicated only by small, granular points, which sometimes interrupt the septa of adjoining cells. Columella papillose. Paliform papillæ before all the principal septa, the inner ones becoming confounded with the columella.

This genus resembles *Synarœa* V. and *Psammocora* Dana, but differs from the first in the well developed septa, and many other characters, and from the last in having papilliform pali and columella.

Stephanaria stellata Verrill.

Stephanocora stellata Verrill, op. cit., p. 330, 1866.

Plate IX, figures 4, 4ª.

Coralla forming rounded clumps of short, irregularly lobed and contorted branches, which are very unequal in size and form; sometimes nearly simple and angular, with a large cell at the top; at other times, even on the same clump, having the summit very much expanded, so as to form flattened, contorted lobes, with acute summits and lateral crests, or even mæandriniform lobes. The branches are usually about an eighth of an inch distant, sometimes more, the sides covered with rather large, starlike, shallow cells, one, or several, larger than the others often terminating the branches, which appear to increase by the upward extension of one of the edges of these cells by submarginal budding. Septa twelve to twenty, often with other rudimentary ones, rather thick and strong, with sharp, spiny granu-

lations or teeth on the sides and edges, and mostly confluent with those of adjacent cells. Color of the unbleached coral ash-gray or yellowish gray.

Height of coral 3 inches; length of living portion of branches ·25 to ·45; the diameter of the larger cells ·10 of an inch.

Panama and Pearl Islands,—F. H. Bradley; La Paz, Gulf of California,—J. Pedersen.

Addenda.

Since the preceding article has been in press several collections have been received from new localities, containing, in some cases, additional varieties and species, some of which are introduced here to make the article more complete, while the others will be enumerated in the geographical lists in the next article. Some of the species of the west coast have also been figured and described during the past year in foreign works. Dr. Albert Kölliker, especially, has very fully described some of the *Pennatulidæ* in his admirable work on that group.

Renilla amethystina Verrill, p. 379.

Renilla reniformis (*pars*) S. Richiardi, Monografia della famiglia dei Pennatularii, in Archivo per la Zoologia, l'Anatomia e la Fisiologia, Ser. ii, vol. i, p. 133. 1869, (*non* Pallas).

Dr. Richiardi has made a serious mistake in referring this very distinct species to the common species of the southern coast of the United States. He also refers *R. Danæ* V. and *R. peltata* V. to *R. reniformis*, both of which are very distinct from it, approaching *R. violacea* more nearly, though apparently quite distinct from that species also. It is probable that he is personally unacquainted with these species.

Leioptilum undulatum Verrill, p. 381

Pennatula undulata Richiardi, op. cit., p. 33.

Leioptilum undulatum Kölliker, Anatomisch-Systematische Beschreibung der Alcyonarien, I, Pennatuliden, (Abhandl. d. Senckenb. Naturf. Gesellschaft, Bd. vii), p. 143, Taf. X, figures 76, 77, 78, 1870.

Prof. Kölliker describes three additional specimens from Mazatlan, all of which were larger than the original specimen. They were respectively 127^{mm} long by 32^{mm} broad; 167 long, the feather 89, stock of 78; and 235^{mm} long, the feather 133, stock 102, breadth of feather 58, stock 22, greatest breadth of the pinnæ 48, height 26. The last specimen had 32 pinnæ on one side and 34 on the other.

Dr. W. Newcomb last year dredged two specimens in the Gulf of Fonseca, one of which he has sent to the Museum of Yale College. He has also loaned me a colored drawing, made from one of these specimens while living, by Mrs. Newcomb.

The specimen referred to is considerably smaller than those previously described, and is evidently quite immature. Its entire length is 66^{mm}, of which the pinnate portion, or feather, is 38, and the peduncle 28. The pinnate portion is rather oblong, very little rounded on the sides and obtusely rounded at the end. The ventral surface (dorsal according to Kölliker) of the stalk is narrow below and concealed by the pinnæ, which meet but do not overlap; the upper part is broader and not concealed, its surface is nearly smooth, light gray with streaks of brown. The dorsal surface (ventral, Kölliker), comprising about half the entire circumference, is thickly covered, except along a linear, median, naked space on the lower half, with rounded verrucæ, formed by the rudimentary polyps, or asexual zoöides; the outer verrucæ are largest, those nearer the middle becoming smaller and more crowded; the verrucæ are purplish brown, owing to numerous minute purplish spicula, the surface between is grayish white. There are 22 pinnæ on each side, with a few other rudimentary ones; the larger ones are broadly rounded, the edge thick and slightly undulated, forming nearly a half circle; they are attached by a narrow base, the polyps of the edge extending in front to the point of attachment, but the dorsal edge is naked, elevated, thin, and concave; the sides are smooth, grayish white, except near the outer border, which, like the edge and the bodies of the polyps, is purplish, owing to the minute purple spicula with which those parts are filled. The polyps are closely arranged on the thickened edge, in about three rows. The peduncle is constricted just below the feather, swollen below the middle, blunt at the end, and yellowish below, blotched with purplish brown on the upper part of the dorsal surface.

Length 2·65 inches; the feather 1·55; the peduncle 1·10; breadth of the feather ·80; of the peduncle ·40; of the stock in middle of feather ·35; breadth of largest pinnæ ·50; their height in center ·30; of posterior edge ·20; width of polyp-bearing edge ·07.

The specimen drawn by Mrs. Newcomb, was, when living, 4·55 inches long; the feather 2·85; the peduncle 1·65; greatest breadth of feather 1·40; of peduncle ·80. The feather is more oval in outline, the middle pinnæ being more extended; the peduncle is strongly constricted above, suddenly expanded below the constriction, and thence tapering to a point. The color of the peduncle, in life, was orange-

yellow at the lower end, light yellow in the middle, upper part spotted with dark gray and brown; front of stalk tinged with purple; back grayish, the verrucæ dark brown; pinnæ, on the back and sides, whitish, the edge with the polyps yellowish brown.

Ptilosarcus Gurneyi Gray, p. 382.

Ptilosarcus Gurneyi Richiardi, op. cit., p. 61, Tav. IX, fig. 58; Kölliker, op. cit., p. 146.

This species has an elongated, club-shaped form, the peduncle constituting from one-third to nearly one-half the entire length. The pinnate portion is thick, rather oblong, slightly tapering both ways from the middle. The pinnæ are numerous, 50 to 54 on each side, crowded, broad, rounded, nearly semicircular, attached by a broad base, the posterior edge extending beyond the base in the form of a rounded lobe; the edge is thickened and covered by small polyps, arranged in about four rows, each polyp surrounded by prominent, spine-like spicula. Dorsal surface (ventral according to Kölliker) of the stalk with two broad bands of small, crowded, granule-like papillæ, formed by the asexual zoöids or "rudimentary polyps." The peduncle is thick, bulbous, very muscular, the surface strongly sulcated in contraction; the interior with four longitudinal canals. Axis long, slender, fusiform, tapering to the long, slender, recurved points.

A large specimen from Puget Sound, in alcohol, is 10 inches long; the feather 5·25; the peduncle 4·75; greatest breadth of feather 2; diameter of peduncle 1·25; breadth of largest pinnæ 1·50; height ·80.

Prof. Kölliker describes a specimen from Vancouver Island, belonging to the Museum of Stockholm, which has quite different proportions: whole length 283^{mm}; feather 130; peduncle 103; breadth of peduncle 20; of feather 45 to 50; of pinnæ 25; height of pinnæ 30^{mm}. This specimen had 54 pinnæ on each side.

Stylatula, page 382.

In addition to *S. gracilis* and *S. elongata*, Richiardi refers to this genus *Virgularia Finmarchica* Sars; *V. multiflora* Kner, from the Adriatic Sea; and *V. elegans* Danielsen, from Christiansand.

Leptogorgia Agassizii Verrill, p. 388.

Some of the specimens from La Paz are of large size (12 to 18 inches high and 18 to 24 broad) and form complex fronds. The more regular ones give off several lateral fronds from near the base of the primary ones; these are at first nearly at right angles to the main

frond and attached to it vertically by one edge, but they soon bend around laterally and become parallel to the primary frond; other fronds often arise from the secondary ones, especially from the part where the bend occurs, and spread in the opposite direction. In some specimens all the secondary fronds, often amounting to a dozen or more, are thus united together, leaving between them large square or oblong spaces, often open both from above and below. In one specimen the fronds are numerous, more or less united together, and spreading outward in all directions, while the upper sides are proliferous and give rise to many small fronds, thus producing a large and pretty regular rosette.

These specimens have slender branchlets and small meshes. The color is bright red or purplish, mingled with yellow.

Leptogorgia pulchra, sp. nov.

Corallum reticulated, flabelliform, either simple and extending in one plane, or composed of several fan-shaped fronds arising from the sides of the primitive one nearly at right angles and then becoming parallel. The trunk usually divides close to the base into several principal branches which subdivide rapidly and soon lose themselves among the reticulated branchlets. The meshes are variable in form and size, but commonly angular with rounded corners, often squarish, frequently higher than broad. The branchlets, in the typical form, are rather thick, squarish, with prominent rounded verrucæ, arranged in about two rows on each side, and rather crowded, but in the slender form fewer and more distant, and often but slightly elevated. The cells, when open, are mostly slightly bilobed.

Color light or deep reddish or purplish and usually tinged with yellow or orange, often yellowish red or brick-color, or various shades of reddish brown.

Height of the larger specimens 8 to 15 inches, generally broader than high; diameter of the branchlets, in the best grown specimens, about ·08, in some cases the branchlets vary in the same specimen from ·05 to ·10, sometimes they are slender throughout and not more than ·05 in diameter.

The spicula are deep red and bright yellow, or orange-yellow, mingled usually in about equal numbers. The longer double-spindles are rather slender, oblong fusiform, rather obtusely pointed, with a pretty broad median space and about three well separated whorls of low crowded warts on each end, and small terminal clusters. The stouter double spindles are similar, but more oblong in form and blunter, with about two crowded whorls and a terminal cluster of

warts on each end. Many small spicula have a wider median space and one whorl, with a terminal cluster close to it, on each end; minute rounded heads are frequent. The polyp-spicula are mostly bright red, but some yellow; they are mostly rather slender with few slight denticulations on one or both sides. The longer double-spindles measure ·102^{mm} by ·036^{mm}, ·096 by ·036, ·090 by ·030, ·084 by ·030; the stouter ones ·090 by ·036, ·084 by ·036, 078 by ·036; the small spicula with single whorl on each end ·054 by ·024, ·048 by ·024, ·040 by ·024.

La Paz,—6 to 8 fathoms, by divers,—J. Pedersen.

Leptogorgia pulchra, var. exilis, nov.

Corallum flabelliform, loosely reticulated, with large, squarish or oblong meshes. Branchlets quite slender, roundish, with smaller, scattered, sometimes prominent, but more commonly scarcely raised, rounded verrucæ, which are mostly arranged alternatingly in about four rows on the branchlets, on the terminal ones often in a single row on each edge.

Color, as in the typical form, variable, but always formed by a mingling of some shade of red with bright yellow or orange spicula, in various proportions. Some of the specimens are 12 to 15 inches high and about as wide; branchlets ·04 to ·07 in diameter; meshes ·20 to ·25 wide; ·25 to ·75 high.

The spicula agree very nearly in size, form, and color with those of the typical form.

La Paz, by pearl divers,—J. Pedersen.

Several specimens of this variety are in the collection. They differ so much from the typical specimens, which are more numerous, that they might readily be mistaken for a distinct species, but one large specimen has the branches, branchlets, and verrucæ of the typical form throughout the greater part of its extent, but toward one edge they gradually diminish in size, while the verrucæ diminish at the same time in size and number, until we have the extreme form of the slender variety, forming a considerable portion of the upper end and one edge of the frond, thus proving the specific identity of the two forms. The spicula, also, even from extreme specimens of each form, show very little variation.

This species in external form has considerable resemblance to *L. media* and *L. Agassizii*. The typical form has about the same sized branchlets and meshes as the former, but has more prominent verrucæ; it is much coarser than *L. Agassizii* and has larger meshes,

but some of the forms might be mistaken for a coarse variety of the latter. The spicula are, however, very different from both those species, which have spicula remarkable for their short stout forms, with bluntly rounded ends and crowded warts.

The slender variety resembles, in the size of the meshes and branchlets, *L. eximia*, but the latter has entirely different spicula, remarkable for the distant and elongated warts.

Leptogorgia tenuis, sp. nov.

Corallum flabelliform, consisting of very slender branches and branchlets, which are loosely reticulated, many of the branchlets besides the terminal ones, remaining free. The meshes are generally about a quarter of an inch wide, and vary in length from a quarter of an inch to nearly an inch. The larger branches are roundish with distant, scattered, relatively large, subconical, prominent verrucæ, which form about four irregular rows. The terminal branchlets are very slender, with the conspicuous, conical verrucæ alternating in a single row on each edge; the tips enlarged and flattened, terminated by two verrucæ. Cœnenchyma thin, firm, finely granulous. Axis blackish.

Color bright light red, uniform throughout. The spicula are light red and yellowish, and are quite regularly fusiform. The longer double-spindles are slender and very acute, with a well defined median space, bordered by large wreaths of short rough warts, beyond which there are three or four whorls of smaller warts, diminishing gradually to the ends, where they blend with the acute terminal ones. The stouter double-spindles are similar in form and structure and only a little less acute, with the warts more crowded. There are a few minute spicula, with a wide median space and a single whorl and terminal cluster of warts on each end. The polyp-spicula are light pink slender, with a few low blunt denticulations on one or both sides.

The longer double-spindles measure ·138^{mm} by ·042^{mm}, ·132 by ·042, ·120 by ·036, ·108 by ·036; the stouter double-spindles are ·138 by ·048, ·126 by ·048, ·120 by .054, ·120 by ·048, ·108 by ·048, ·090 by ·048.

La Paz, on base of *Eugorgia nobilis, var. excelsa*, in from 4 to 6 fathoms,—J. Pedersen. One specimen.

Externally this species most resembles *L. eximia*, though the branchlets are more slender and the verrucæ fewer and larger. The spicula are entirely different, being more regularly fusiform and acute, with much less prominent and more numerous warts. They resemble those of *L. Adamsii* more than those of any other species, but are

larger, and stouter, and less acute. In external appearance it also resembles the slender variety (*exilis*) of the preceding species, but the spicula are much larger, more regularly fusiform, and much more acute, with comparatively few of the short blunt forms.

Leptogorgia labiata, sp. nov.

Leptogorgia ramulus, var. (page 396).

Of this form, hitherto regarded as a northern dwarfed variety of *L. ramulus*, I have more recently seen additional specimens from other localities, all of which present the same characters, both of external appearance and spicula. I am therefore led to regard it as a distinct species.

It is low and densely branched, rigid, the branchlets short, thick, squarish, generally blunt, sometimes clavate, but often obtusely pointed. The verrucæ are conspicuous, elevated, rounded, closely arranged in about four longitudinal rows, divided at the summit or on the upper side into two lateral lobes or lips, which form the borders of the oblong cells.

The color is red or brownish, generally more or less tinged with yellow, especially around the cells.

The largest specimens seen are about five inches high and four broad; the terminal branchlets ·25 to 1 in. long; about ·12 in diameter.

The spicula are somewhat larger than those of *L. ramulus*, and decidely stouter and more rounded at the ends, with more crowded warts, which usually form a rounded terminal cluster. They are rose-red and light yellow.

Acapulco,—A. Agassiz; Cape St. Lucas,—J. Xantus; Corinto, Nic.,—J. A. McNiel; Tehuantepec, Mexico,—Dr. Sumichrast (Chicago Academy).

Leptogorgia exigua, sp. nov.

This form I have formerly regarded as a dwarf variety of *L. cuspidata*, but having recently seen numerous specimens from several widely separated localities, I am led to regard it as a peculiar species, allied to *L. cuspidata* and *L. rigida*.

Although quite variable in color and somewhat so in form, it nevertheless always has characteristic features by which it may be easily recognized. The color is really less variable, when closely examined, than it would seem to be at first sight. It is a mixture of purplish red and yellow in varying proportions, the yellow spicula being generally more or less concentrated around the cells, and often ting-

ing the whole surface, while at other times red or purplish spicula predominate at the surface, giving this hue to the whole coral. It is a low, thickly branched, rather rigid species, the branches arising subpinnately and ascending. The branchlets are roundish, slightly tapering, generally with obtusely pointed or rounded ends. The cells are small, not prominent, often sunken, evenly scattered over the surface, except along a narrow, ill-defined naked space on each side of the branches, which sometimes shows a slight groove.

Color purplish red or brown, with or without a tinge of sulphur yellow; reddish or purplish with a circle of sulphur-yellow around the cells; or yellowish more or less mixed with purplish or reddish at the surface. Axis black.

Height 2 to 5 inches; breadth about the same; length of terminal branchlets ·25 to 1·50; diameter ·10 to ·15.

The spicula are mostly small and blunt, bright rose-red or light purplish, mixed with bright yellow. The longer double-spindles are not numerous, rather oblong, stout, blunt, with about three crowded whorls and a terminal cluster of low, rough warts. The stouter double-spindles are numerous and of various forms, mostly short and thick, obtuse or rounded at the ends, with about two crowded whorls of rough warts on each end; some have a very narrow median space; others a well defined one; many short stout spicula have but one whorl of warts each side of the median, with rounded terminal clusters; minute ones of the same kind are abundant. There are also numerous rough heads and double-heads, of various sizes. The spicula are smaller and blunter, or more rounded, than in *L. rigida* and *L. cuspidata*, and there are none of the stout acute double-spindles, that are abundant in those species.

The longer double-spindles measure ·132^{mm} by ·042, ·102 by ·042, ·096 by ·036, ·084 by ·036; the stouter double-spindles ·102 by ·048, ·096 by ·048, ·084 by ·048, ·078 by ·042, ·072 by ·048; the heads ·072 by ·060, ·072 by ·048, ·060 by ·048, ·042 by ·042; the double-heads ·060 by ·048, ·042 by ·036.

Corinto, Nic., at low water, both yellowish and purplish varieties, common,—J. A. McNiel; Gulf of Nicoya, by pearl divers, small yellowish variety,—J. A. McNiel; Tehuantepec, Mex.,—Dr. Sumichrast (Chicago Acad.); Acapulco,—A. Agassiz; Guaymas,—Dr. E. Palmer (Chicago Acad. Science).

Eugorgia nobilis, var. excelsa Verrill, page 409.

This variety forms fan-shaped fronds and grows to a very large size, some of the specimens exceeding in height those of any other species

of the west coast known to me. The base is large and spreading. The trunk is thick at base, usually very short, dividing at once into a number of main branches. Sometimes several trunks arise from the same expanded base and form large parallel fronds, close together. The main branches give off, subpinnately from each side, at distances of ·5 to 2 inches, irregularly alternating secondary branches, which on the outer branches are more numerous on the upper or inner side of the branches. The secondary branches subdivide in the same manner, as do their branches and branchlets in turn, until many of them are five or six times divided. The branches and branchlets mostly start out at a wide angle and then bend abruptly upward and become sub-parallel. The terminal branchlets are often from two to six inches long without division, and usually rather slender, a little compressed, with a well-marked median groove and a very narrow median naked space. The polyp-cells are very numerous, scarcely raised, and form a broad band on each side.

The color is uniform light yellowish brown or chestnut, varying somewhat in tint in different specimens, sometimes nearly brick-red.

One of the largest specimens is 34 inches high; 28 broad; diameter of the base 6; of the trunk 1·50; of the main branches mostly ·30 to ·40; of the terminal branchlets ·05 to ·12, but mostly about ·10 of an inch.

The spicula are pale yellow and pink. The longer double-spindles are moderately slender and acute, with about three irregular whorls of well-separated, prominent warts. The stouter double-spindles are larger and much stouter, bluntly rounded at the ends, with two or three whorls and a terminal cluster of large, rough warts, which are often crowded, but sometimes well separated. The double-wheels are unusually small, mostly longer than broad, with very small terminal and larger median wheels.

The longer double-spindles measure ·108^{mm} by ·036^{mm}, ·102 by ·042, ·102 by ·036, ·102 by ·030, ·096 by ·024, ·090 by ·033; the stouter double-spindles ·090 by ·042, ·084 by ·048, ·084 by ·045, ·078 by ·045; the double-wheels ·048 by ·042, ·042 by ·042, ·042 by ·036, ·036 by ·030, ·030 by ·030.

La Paz, 6 to 8 fathoms, by divers,—J. Pedersen; La Paz,—Major Wm. Rich; Acapulco,—A. Agassiz.

Eugorgia multifida Verrill, sp. nov.

Corallum flabelliform, the branches very numerously divided in a pinnate manner, forming densely ramulous, but not reticulated fronds, two or more sometimes arising from the same base.

The trunk divides at the base into several large, irregular, divergent

and crooked branches; these often give off similar large and irregular secondary branches, which like the secondary branches are closely pinnate along their whole length the pinnæ or branchlets being separated by intervals of ·10 to ·15 of an inch; most of these are again pinnate and many of them bipinnate and tripinnate, in the same manner, the branches being everywhere closely crowded, and often separated by spaces not exceeding their diameter, and seldom exceeding ·15 or ·20 of an inch. The branchlets are short and variously curved, spreading abruptly at wide angles, the terminal ones varying in length from ·10 to ·50 of an inch; they are more or less angular and covered, except along a narrow, often indistinct, median space, with crowded, prominent, rounded verrucæ. Main branches strongly sulcated on the sides; and partially covered with distant, scattered verrucæ.

Color deep orange-brown; the borders of the cells mostly bright yellow; the main branches streaked with red and yellow, more or less blended, due to the two colors of the spicula.

The largest specimen is 22 inches high; 24 broad; diameter of the main branches ·25 to ·40; of the branchlets ·05 to ·10, mostly about ·07.

The spicula are deep red and bright yellow intermingled with some that are light purplish. They are large for the genus, and consist largely of short, stout double-wheels with much fewer double-spindles.

The longer double-spindles are quite slender, mostly acute, with a wide median space, and there are four whorls of small, separate warts on each end. The stouter double-spindles are similar, but blunter and have more crowded warts. The double-wheels are mostly about as broad as long, with a well developed median space, bordered by broad, often sharp-edged "wheels," beyond which there is a smaller terminal wheel on each end; the edges of the wheels are often rough or warty on one side.

The longer double-spindles measure ·132^{mm} by ·042^{mm}, ·126 by ·030, ·108 by ·036; the stouter double-spindles measure ·132 by ·048, ·120 by ·048, ·108 by ·048, ·108 by ·042, ·102 by ·054, ·102 by ·042; the double-wheels ·066 by ·048, ·060 by ·060, ·060 by ·054, ·054 by ·054.

La Paz, in 6 to 8 fathoms, by divers, rare,—J. Pedersen; Mazatlan,—J. Dickinson; Acapulco,—A. Agassiz.

In mode of growth, this species resembles *E. aurantiaca* and *E. Duniana*, but it is more densely ramulous, with larger and more prominent verrucæ than either of those species, and the double-wheels are stouter and in form quite different from those of both, and much larger than those of the latter. The color is also peculiar in the six specimens examined.

The two following descriptions are reproduced from the American Journal of Science, xlviii, pp. 427 and 428, 1869. The spicula were prepared from the original specimens and sent by Prof. A. Kölliker.

Psammogorgia fucosa Verrill, p. 417.

The spicula from the original example of this species show that it is very distinct from the species that I have hitherto referred to it (*Leptogorgia Caryi*). It appears, judging from the spicula, to be a *Psammogorgia*, allied to *P. teres*, but quite distinct. The figure represents it as 10 inches high and 9 broad, with the branches about ·15 of an inch thick, enlarged at the axils. Several stems arise from one base, as is usual in *P. arbuscula*, the largest trunk being half an inch in diameter. The branches are irregularly dichotomous, the divisions being ·5 to 2 inches apart; the final branchlets are stout, scarcely tapering, obtuse or clavate at the ends, often crooked, ·5 to 1 inch long, ·12 to ·18 of an inch in diameter. Cells small, oblong or oval, flat on the branches, slightly raised on the branchlets. Color dull reddish.

It is remarkable for the great diversity in form and color of the spicula. These are white, yellowish, light red, deep red, and amethystine intermingled. They are mostly stout, blunt, and covered with large rough warts. Among them are various forms of spindles, double-spindles, double-heads, heads, and stout warty clubs, with various irregular forms. The stout double-spindles, which are most numerous, are short and thick, mostly with obtusely rounded ends, sometimes acute, median naked space narrow, bordered by whorls of large, coarse, rough warts, beyond which there are usually one or two whorls of smaller warts and a terminal cluster, but in many cases there are none between the median whorls and the terminal cluster, in other cases the whorls become crowded and thus the forms pass into large, stout "double-heads," in which the ends are rounded and densely covered with rough warts.

Numerous spicula lack the naked median space and are densely covered with large rough warts, some of these are short and rounded, in the form of heads; others are longer, tapering at both ends, and have the form of very stout spindles; others are large at one end, with the other tapering, or club-shaped. The polyp-spicula are long, slender spindles, tapering quite regularly to both ends and covered with small warts. The large double-spindles measure ·156^{mm} by ·072, ·156 by ·066, ·150 by ·072, ·144 by ·084, ·144 by ·060; the smaller ones ·120 by ·060, ·108 by ·060, ·072 by ·048; double-heads ·132 by ·096, ·132 by ·090, ·096 by ·084; the heads ·108 by ·084, ·048 by ·048; the stout

spindles ·156 by ·072, ·144 by ·072, ·120 by ·072; the clubs ·144 by ·084, ·144 by ·072, ·096 by ·048; the polyp-spicula ·156 by ·030, ·156 by ·024, ·144 by ·024, ·102 by ·024.

Mazatlan,—Voyage of the Venus.

Echinogorgia aurantiaca Verrill, pp. 413 and 450.

The spicula of this species show that it is an *Echinogorgia*, pretty nearly allied to *E. sasappo*. The spicula are yellow, mostly large, broad, flattened clubs, or scale-clubs, the smaller end often acute, sometimes blunt, covered with rough warts, the large end usually terminating in one or more broad, flat, irregular, rounded scales, which are often lobed, or even subdivided into sharp, lacerate spinules. With these are many, more or less regular, four-branched crosses, with rather slender, acute, warty branches; and various forms of irregular, often branched, warty spindles and compound spicula.

The clubs and scale-clubs resemble those of *E. sasappo* figured by Dr. Kölliker in his Icones Histiologicæ, Taf. xviii, figs. 9_1 and 9_3. The scale-clubs measure ·290^{mm} by ·216^{mm}, ·288 by ·204, ·288 by ·156, ·264 by ·192, ·260 by ·168, ·240 by ·156, ·216 by ·156, ·192 by ·132, ·192 by ·084, ·180 by ·084; the crosses ·240 by ·192, ·180 by ·156, ·144 by ·120, ·120 by ·096; the irregular spindles ·336 by ·072, ·288 by ·084, ·252 by ·084.

Callao, Peru,—Mus. Paris.

Heterogorgia papillosa Verrill, sp. nov.

Corallum dichotomous, consisting of few, elongated crooked branches, which are two or three times divided. The branches are of nearly uniform size, and bend out in a broad curve at the axils. The terminal branchlets are from one to three inches long without division, and blunt at the end; like the branchlets they are round and crooked, covered on all sides with prominent papilla-like verrucæ, which are mostly eight lobed and open at summit. The lobes of the verrucæ are supported by long slender, sharp, curved spicula, which project but little from the surface. The lower parts of the verrucæ and the surface of the cœnenchyma are smoothish, and consist mostly of quite small, rough spicula. The axis is rigid, grayish, and wood-like in appearance, the surface showing an interwoven fibrous structure; in the branchlets thick, soft, and yellowish.

Color yellowish white, throughout.

The only specimen obtained is 5 inches high; 3 broad; diameter of branches and branchlets ·10 to ·14; height of largest verrucæ ·05.

The spicula are white and smaller than in the other species of the genus. The most conspicuous are roughly warted spindles and double-spindles, varying from long slender acute forms to stout, blunt, and irregular ones. With these are many rough irregular crosses and irregularly branched spicula. The crooked spicula from the verrucæ are long and quite slender, acute, variously curved, often bow-shaped, covered with small distant warts. The polyp-spicula are smaller and straighter, with fewer warts. The larger spindles and double-spindles measure ·336^{mm} by ·096^{mm}, ·336 by ·072, ·288 by ·084, ·264 by ·108, ·264 by ·084, ·264 by ·072, ·252 by ·060, ·240 by ·096, ·240 by ·072, ·240 by ·060, ·228 by ·096, ·228 by ·072, ·222 by ·108, ·222 by ·102, ·216 by ·078, ·192 by ·072; the crosses ·144 by ·108, ·108 by ·084; the long curved spicula ·432 by ·042, ·360 by ·042, ·360 by ·036, ·336 by ·030, ·312 by ·030, ·244 by ·030.

La Paz, on shell with *Eugorgia nobilis, var. excelsa*, in 6 to 8 fathoms, one specimen,—J. Pedersen.

No. 7.—*On the Geographical Distribution of the Polyps of the West Coast of America.*

In the preceding article I have included all the species hitherto described by others from the west coast of America, as well as those examined by myself. It is certain, however, that many additional species remain to be discovered. The tropical region or Panamian province, extending from Cape Blanco, Peru, to Lower California, and including the Gulf of California, is the only portion of the coast from which even tolerably complete collections have been made, and yet in that great region only the littoral and shallow water species have been collected. Doubtless many new and interesting forms will hereafter be discovered in the deeper waters and on the submerged banks off the coast.

Concerning the polyp-fauna of the coast of Lower California, we know almost nothing. From the coast farther northward a few small collections have been brought, and the lists of species from those regions are certainly very imperfect. From the coasts of Peru and Chili a greater number of species, mostly Actinians, have been described, but many of these need reëxamination from living specimens, and many others doubtless remain undescribed. The polyps of the Araucanian and Galapagos provinces are entirely unknown. From the Fuegian region several species of Actinians were described in the

Report on the Zoöphytes of the United States Exploring Expedition, but it is probable that even there several other species will hereafter be found. It will, therefore, be useless to attempt any generalizations upon the extent and limits of the several faunæ occupying these coasts, but it appears desirable to bring together the species already known from each zoölogical province.

So far as can be judged from these imperfect lists, the faunal divisions are the same for the Polyps as for the Echinoderms, and since these were discussed in a previous article in this volume (pp. 336 to 339), it is unnecessary to give their limits or extent at this time.

Arctic Province.

Alcyonaria.

Primnoa compressa Verrill.
Aleutian Islands.

Alcyonium rubiforme Dana.
Behrings Straits and Arctic Ocean.

Actinaria.

Urticina crassicornis Ehr.
Arctic Ocean to Puget Sound.

Phellia arctica Verrill.
Arctic Ocean.

Of the four species known from this fauna two (*Alcyonium rubiforme* and *Urticina crassicornis*) are found also on the north Atlantic coasts of America and Europe. The latter also extends southward to the Oregonian fauna. The others are not known to occur south of the Aleutian Islands.

Sitchian Province.

Actinaria.

Urticina crassicornis Ehr.
Arctic Ocean to Puget Sound.

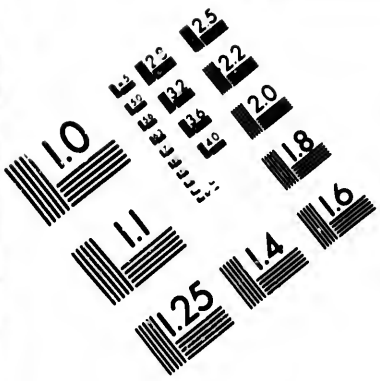
Evactis? xanthogrammica Verrill.
Sitcha.

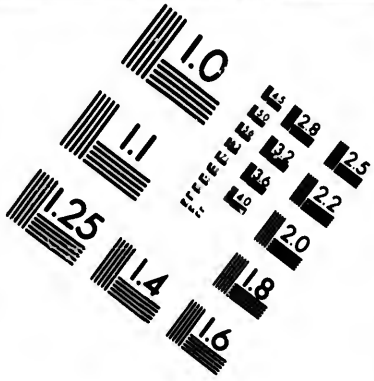
The two species known from Sitcha afford but little evidence in regard to the character of the fauna, for the first is a species of wide distribution on all the northern coasts both of the Atlantic and Pacific, while the second is a doubtful species, which may prove identical with *E. artemisia* of the Oregonian fauna.

Oregonian Province.

Alcyonaria.

Ptilosarcus Gurneyi Gray.
Vancouver I., Puget Sound and Cape Flattery (80 feet) to Monterey.





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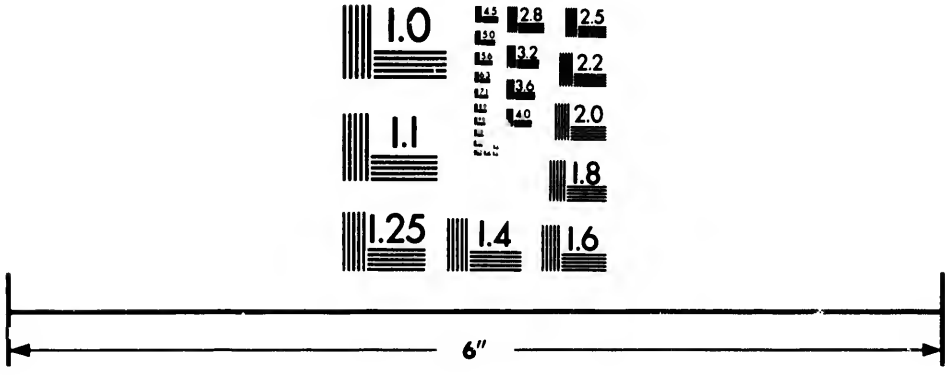

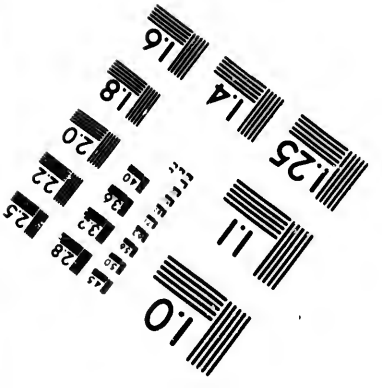

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1.1
1.0

ACTINARIA.

Urticina crassicornis Ehr
Arctic Ocean to Puget Sound.

Sagartia, several sp. ined.
Gulf of Georgia.

Evactis artemisia Verrill.
Puget Sound.

Epiactis prolifera Verrill.
Puget Sound.

Metridium fimbriatum Verrill.
Puget Sound to San Francisco.

MADREPORARIA.

Balanophyllia elegans Verrill.
Puget Sound to Monterey.

Allopora venusta Verrill.
Neah Bay.

Of the seven described species in this list, three are not known to occur elsewhere. Three extend southward into the Californian province, and *U. crassicornis* extends northward to the Arctic Ocean.

CALIFORNIAN PROVINCE.

ALCYONARIA.

Ptilosarcus Gurneyi Gray.
Vancouver Island to Monterey.

(?) *Virgularia gracilis* Gabb.
Monterey.

Stylatula elongata Verrill.
San Francisco to Monterey.

Leptogorgia Caryi Verrill.
(?) Near San Francisco.

ACTINARIA.

Metridium fimbriatum Verrill.
San Francisco to Puget Sound.

Sagartia, sp.

MADREPORARIA.

Paracyathus caltha Verrill.
Monterey.

Balanophyllia elegans Verrill.
Monterey to Puget Sound.

P. Stearnsii Verrill.
Monterey.

Among the eight species described from this fauna there are three that are found also in the Oregonian. The rest have not yet been recorded from beyond the limits of the fauna.

PANAMIAN PROVINCE.

ALCYONARIA.

Renilla amethystina Verrill.
San Salvador to Zorritos.

Leptogorgia Floræ Verrill.
Panama Bay.

Leioptillum undulatum Verrill.
Gulf of California to Gulf of Fonseca.

L. Agassizii Verrill.
Gulf of California to Acapulco.

Stylatula gracilis Verrill.
Cape St. Lucas to Panama.

L. media Verrill.
Gulf of California to Nicaragua.

L. Adamsii Verrill.
Nicaragua to Zorritos, Peru.

L. pulchra V., and *var. exilis* V.
Gulf of California.

L. rutila Verrill.
Acapulco.

L. eximia Verrill.
Bay of Panama.

L. tenuis Verrill.
Gulf of California.

L. stenobrochis Verrill.
San Salvador to Zorritos.

—— *var. Englemanni* Horn.
Mazatlan and Acapulco to Panama

L. ramulus Verrill.
San Salvador to Zorritos.

L. labiata Verrill.
Guaymas and Tehuantepec to Nicaragua.

L. pumila Verrill.
Zorritos.

L. diffusa Verrill.
Gulf of Nicoya and Panama Bay.

L. Californica Verrill.
Margarita Bay and Cape St. Lucas.

L. alba Verrill.
Guaymas to Panama.

L. flexilis Verrill.
San Salvador to Panama Bay.

L. rigida Verrill.
Gulf of California to San Salvador.

L. cuspidata Verrill.
Cape St Lucas to Acapulco.

L. exigua Verrill.
Guaymas to Nicaragua and Zorritos.

Eugorgia ampla Verrill.
Margarita Bay and Gulf of California.

—— *var. purpurascens* Verrill.
Nicaragua to Zorritos.

E. nobilis Verrill.
Nicaragua and Bay of Panama.

—— *var. excelsa* Verrill.
Gulf of California and Acapulco.

E. Bradleyi Verrill.
Gulf of Nicoya to Panama Bay.

E. Daniana Verrill.
Gulf of Nicoya and Bay of Panama.

E. multifida Verrill.
La Paz and Mazatlan to Acapulco.

E. aurantiaca Verrill.
Gulf of California to Acapulco.

Phycogorgia fucata Val.
Mazatlan.

Psammogorgia arbuscula Verrill.
Gulf of Nicoya to Panama Bay.

—— *var. Dowii* Verrill.
San Salvador and Pearl Islands.

—— *var. pallida* Verrill.
Pearl Islands.

P. teres Verrill.
Guaymas (Dr. E. Palmer) to Panama Bay.

P. fucosa Verrill.
Mazatlan.

P. gracilis Verrill.
Pearl Islands.

Muricea acervata Verrill.
Panama.

M. tubigera Verrill.
Bay of Panama.

M. hispida Verrill.
Panama.

M. squarrosa Verrill.
Panama Bay.

M. crassa Verrill.
Panama Bay.

M. echinata Val.
Bay of Panama.

—— *var. flabellum* Verrill.
Panama Bay.

M. fruticosa Verrill.
Bay of Panama.

—— *var. miser* Verrill.
Nicaragua to Bay of Panama.

M. austera Verrill.
Gulf of California to Bay of Panama.

M. retusa Verrill.
Pearl Islands.

M. formosa Verrill.
Zorritos.

M. robusta Verrill.
Acapulco.

M. albida Verrill.
Panama Bay.

M. hebes Verrill.
Acapulco to Bay of Panama.

M. purpurea Verrill.
Acapulco to Bay of Panama.

M. appressa Verrill.
Gulf of California to Panama and Zorritos.

—— *var. flavescens* Verrill.
Nicaragua to Zorritos.

M. tenella Verrill.
Nicaragua to Zorritos.

M. aspera Verrill.
Panama.

Heterogorgia verrucosa Verrill.
Bay of Panama.

H. tortuosa Verrill.
Bay of Panama.

H. papillosa Verrill.
La Paz.

Callipodium Pacificum Verrill.
Gulf of California to Zorritos.

C. aureum Verrill.
Panama.

Alcyonium? Bradleyi Verrill.
Panama.

Actinaria.

Lophactis ornata Verrill.
Panama Bay.

Asteractis Bradleyi Verrill.
Panama.

Cladactis grandis Verrill.
Nicaragua to Zorritos, Peru.

Anthopleura Dowii Verrill.
San Salvador to Panama Bay.

Bunodes (?), sp.
Pearl Islands.

Calliactis variegata Verrill.
Panama Bay.

Sagartia crispata Verrill.
Panama Bay.

S. carcinophila Verrill.
Panama Bay.

S. Panamensis Verrill.
Panama Reefs.

S. Bradleyi Verrill.
Panama Reefs.

Sagartia, sp. ined.
Panama.

Phellia inornata Verrill.
Panama Bay.

P. (?) *rubens* Verrill.
Zorritos.

P. Panamensis Verrill.
Panama.

Paractis (?) *nobilis* Verrill.
Panama.

Mammillifera Danæ Verrill.
Panama Bay.

M. nitida Verrill.
San Salvador.

M. conferta Verrill.
Acapulco and San Salvador.

Epizoanthus elongatus Verrill.
Panama Bay and Zorritos, (?) La Paz.

E. humilis Verrill.
Panama.

E. crassus Verrill.
San Salvador.

Antipathes Panamensis Verrill.
Panama Bay.

Madreporaria.

Montipora fragosa Verrill.
(?) Gulf of California.

Porites Californica Verrill.
Guaymas and La Paz.

P. porosa Verrill.
La Paz.

P. excavata Verrill.
Pearl Islands, Panama Bay.

P. Panamensis Verrill.
Panama Bay.
P. nodulosa Verrill.
La Paz.
Dendrophyllia surcularis Verrill.
Pearl Islands.
D. tenuilamellosa Verrill.
Panama Bay, Acapulco, La Paz.
Astropsammia Pedersenii Verrill.
La Paz.
Rhizopsammia pulchra Verrill.
Pearl Islands.
Allopora Californica Verrill.
(?) Gulf of California.
Pocillipora capitata Verrill.
La Paz and Socorro Islands to Panama Bay.
—— *var. porosa* Verrill.
La Paz.
—— *var. robusta* Verrill.
Near La Paz.
—— *var. pumila* Verrill.
Near La Paz.
P. lacera Verrill.
Acajutla to Panama Bay.
Astrangia Haimei Verrill.
San Salvador to Panama and Zorritos.
A. pulchella Verrill.
Panama Bay.
A. concinna Verrill.
Panama Bay.
A. dentata Verrill.
La Paz to San Salvador and Panama.
A. costata Verrill.
Panama Bay.
A. Pedersenii Verrill.
Guaymas and La Paz.
A. (Cœnangia) conferta Verrill.
Gulf of California.
Phyllangia dispersa Verrill.
Gulf of Nicoya and Panama Bay.
Ulangia Bradleyi Verrill.
Panama Bay.
Paracyathus humilis Verrill.
Pearl Islands.
Desmophyllum Cumingii E. and H.
South America.
Fungia elegans Verrill.
Gulf of California.
Pavonia gigantea Verrill.
Pearl Islands.
P. clivosa Verrill.
Pearl Islands.
Stephanaria stellata Verrill.
La Paz to Bay of Panama.

In this list there are 104 species, none of which have been found beyond the limits of the province. An examination of the list will show, however, that there are sufficient reasons for recognizing the three subdivisions of the fauna, already given in the case of the Echinoderms (p. 337). But the three subdivisions are not equally well known. The Actinians of the Mexican and Equadorian sub-provinces are almost wholly unknown, only one or two species having been examined from each, while from the Panamian division a considerable number are now made known, although there must be many additional ones. The shallow water Gorgonians and corals have been pretty fully collected in both the Mexican and Panamian regions, but from the Equadorian we have only the small collection obtained by Mr. Bradley at Zorritos. In the present state of our knowledge some of the species found in each of the three sub-provinces are peculiar to it, while many extend also to one of the other, and a considerable

portion are found in all three, or throughout the whole extent of this great province. Future explorations will undoubtedly reduce the number of species peculiar to each subdivision, as most of the late collections have done, for there can be no doubt but that part of the apparent differences in the faunæ are due to the incompleteness of the collections. Local peculiarities of the particular places at which the various collections have been made have also undoubtedly increased the apparent differences.

As the list now stands, there are known from the Mexican subdivision 42 species; of these, 20 species are peculiar to the region; 16 are found also in the Panamian subdivision; and 6 are found in both these and the Equadorian regions, ranging to Zorritos.

From the Panamian subdivision there are 80 species known; of these, 51 are peculiar to it (including 16 of Actinaria); 16 are found also in the Mexican district; 7 are common to the Panamian and Equadorian regions; and 6 range through the three sub-provinces.

Of the Equadorian polyp-fauna we know but 17 species; of these 4 are peculiar to it; 7 are found also in the Panamian; and 6 extend through both the Panamian and Mexican regions, even to the Gulf of California.

For convenience of reference some local lists are added, which will at least serve to illustrate the most common and conspicuous species of the several localities.

List of species collected at Guaymas by Dr. E. Palmer.

The following species are in the collection of the Chicago Academy of Sciences:

Leptogorgia Agassizii V.
L. media V.
L. alba V.
L. labiata V.
L. exigua V.
Psammogorgia teres V.
Astrangia Pedersenii V.
A. (Cœnangia) conferta V.
Porites Californica V.

List of species collected near La Paz by Capt. J. Pedersen.

Leptogorgia Agassizii V. Common.
L. media V. Not common.
L. pulchra V. Common.
—— *var. exilis* V. Common.
L. tenuis V. Very rare.
L. rigida V. Abundant.
Eugorgia nobilis, var. excelsa V. Common.
E. multifida V. Rare.
E. aurantiaca V. Common.
Muricea austera V. Not common.
M. appressa V. Common.

Heterogorgia papillosa V. Rare.
Callipodium Pacificum V. Rare.
Epizoanthus elongatus V. Rare.
Porites Californica V. Not common.
P. porosa V. Common.
P. nodulosa V. Common.
Dendrophyllia tenuilamellosa V. Rare.
Astropsammia Pedersenii V. Rare.
Pocillipora capitata V. Common.
—— *var. porosa* V. Not common.
—— *var. robusta* V. Common.
—— *var. pumila* V. Common.
Astrangia dentata V. Rare.
A. Pedersenii V. Not common.
Fungia elegans V. Rare.
Stephanaria stellata V. Rare.

The fauna at Cape St. Lucas appears to be similar to that of La Paz. The collections made there by Mr. J. Xantus include many of the species common at La Paz, especially *Leptogorgia rigida*, *L. Agassizii* and *L. media*, in abundance. He also collected a few additional species, although his collection was much less extensive than that of Capt. Pedersen. At Acapulco considerable collections, chiefly of Gorgonians, have been made by Mr. A. Agassiz, Mr. D. B. Van Brunt, and others. The common species are mostly the same as at La Paz, and there appears to be but little difference in the faunæ of the two localities, except what may be explained by the incompleteness of the collections received. A few species (*Leptogorgia rutila* V., *L. stenobrochis*, *var. Englemanni*, *Muricea robusta*, *M. purpurea*, etc.) common at Acapulco, have not been found at La Paz.

From the coasts of San Salvador and Nicaragua I have seen several collections, made by Capt. Dow, Mr. Bradley, Mr. J. A. McNiel, and others, but none of them can be considered as at all complete, even for the Gorgonians. So far as can be judged from these collections, the faunæ of those coasts are essentially the same as that of Panama Bay.

List of species collected on the coast of Nicaragua by J. A. McNiel.

The following species were collected by Mr. McNiel on the beach at Corinto, and by the aid of divers in the Gulf of Nicoya. Those species found only at one of these places are designated either by (C.) or (N.) according to the locality. The first series from this collection is in the Peabody Academy of Science, Salem, Mass., by which Mr. McNiel was sent out:

Leptogorgia media V. (C.)
L. Adamsii V. Large.
L. stenobrochis V.
L. ramulus V. (C.)
L. labiata V. (C.)
Psammogorgia arbuscula V. (N.)
Muricea fruticosa, var. miser V. (C.)
M. hebes V. (C.)
M. purpurea V. (C.)

L. diffusa V. (N.) Large.
L. alba V. Common.
L. exigua V. Common.
Eugorgia Daniana V. (N.) Large.
E. ampla, var. purpurascens V. (C.)
E. Bradleyi V. (N.) Yellow variety.
E. nobilis V. (N.)
M. appressa V.
—— *var. flavescens* V. (C.)
M. tenella V. (C.)
Cladactis grandis V. (C.)
Astrangia dentata V. (N.)
Phyllangia dispersa V. (N.)

Peruvian Province.

Alcyonaria.

Leptogorgia Peruana Verrill.
Callao.
(?) *Muricea horrida* Mobius.
"Peru." Perhaps this belongs to the Panamian Province.
Eugorgia rubens Verrill.
Paita.
Echinogorgia aurantiaca Verrill.
Callao.

Actinaria.

Oulactis concinnata E. and H.
Callao.
Bunodes papillosa Verrill.
Callao to Talcahuano, Chili.
B. pluvia Verrill.
San Lorenzo Island.
B. ocellata Verrill.
Paita.
Phymactis florida Edw. and H.
San Lorenzo Island.
Sagartia nivea Verrill.
Paita and Callao.
S. Lessonii Verrill.
Paita.
S. (?) Peruviana Verrill.
Paita.
Nemactis primula Edw. and H.
San Lorenzo Island.
N. Draytonii Edw. and H.
San Lorenzo I.
Anactis picta Ehr.
Paita.

Of the fifteen species in this list, only one (*Bunodes papillosa*) is known to extend its range beyond the limits of the fauna.

Chilian Province.

Alcyonaria.

Leptogorgia (?) Chilensis Verrill.
Algarrobo, south of Valparaiso.
L. (?) arbuscula Verrill.
I. Santa Maria.
L. (?) platyclados Verrill.
I. Santa Maria.

Actinaria.

Bunodes papillosa Verrill.
Talcahuano to Callao.
Cystiactis Eydouxi Edw. and H.
Chili.
Phymactis clematis Edw. and H.
Valparaiso.
Actinia (?) Mertensii Brandt.
Chili.

Sagartia ? nymphæa Verrill.
Valparaiso.

Nemactis ? Chilensis Verrill.
Bay of Talcahuano and Quiriquina Island.

S. ? rubus Verrill.
Valparaiso.

MADREPORARIA.

Bathycyathus Chilensis E. and H.
Chili.

Of the eleven species known from this province, none are known elsewhere, except *Bunodes papillosa*, which is also found in the Peruvian fauna.

FUEGIAN PROVINCE.

ACTINARIA.

Bunodes cruentata Gosse.
Orange Bay.

Sagartia impatiens Gosse.
Orange Harbor.

Metridium reticulatum E. and H.
Orange Harbor.

Sagartia lineolata Verrill.
Forge Cove, near Orange Harbor.

Cereus Fuegiensis Verrill.
Orange Harbor.

MADREPORARIA.

Astrangia, sp.
Straits of Magellan.

The six species known from this fauna appear to be peculiar to it.

For want of room, the lists, giving a detailed comparison between the tropical faunæ of the Atlantic and Pacific coasts, and originally intended to accompany this article, have been reserved for the next volume.

EXPLANATION OF PLATES.

Plate V.

All the figures on this plate are from camera-lucida drawings by the author.

Figure 1.—*Renilla amethystina* V.; triquetral spiculum from the disk,—enlarged 100 diameters.

Figure 2.—*Stylatula gracilis* V.; one of the spine-like spicula, which support the pinnæ,—enlarged 50 diameters.

Figure 3.—*Leptogorgia Floræ* V.; *a*, longer double-spindle; *b*, stouter double-spindle,—enlarged 200 diameters.

Figure 4.—*L. Agassizii* V.; *a* and *b*, longer double-spindles; *c*, stouter double-spindle,—enlarged 200 diameters.

Figure 5.—*L. Adamsii* V.; *a* and *b*, longer double-spindles; *c*, stouter double-spindle,—enlarged 200 diameters.

Figure 6.—*L. diffusa* V.; *a*, longer double-spindle; *b*, stouter double-spindle,—enlarged 200 diameters.

Figure 7.—*L. alba* V.; *a* and *b*, longer double-spindles; *c*, stouter double-spindle,—enlarged 200 diameters.

Figure 8.—*L. pumila* V.; *a*, longer double-spindle; *b*, stouter double-spindle,—enlarged 200 diameters.

Figure 9.—*L. rigida* V.; *a*, longer double-spindle; *b* and *c*, stouter double-spindles,—enlarged 200 diameters.

Figure 10.—*L. Californica* V.; *a*, longer double-spindle; *b*, stouter double-spindle,—enlarged 200 diameters.

Figure 11.—*L. flexilis* V.; *a* and *b*, longer double-spindles; *c*, stouter double-spindle,—enlarged 200 diameters.

Figure 12.—*Eugorgia ampla* V.; *a*, longer double-spindle; *b* and *c*, double-wheels,—enlarged 200 diameters.

Figure 13.—*E. nobilis* V.; *a*, longer, and *b*, stouter double-spindles; *c* and *d*, double-wheels,—enlarged 200 diameters.

Figure 14.—*E. Daniana* V.; *a*, longer, and *b*, stouter double-spindles; *c* and *d*, double-wheels,—enlarged 200 diameters.

Figure 15.—*E. aurantiaca* V.; *a*, longer, and *b*, stouter double-spindles; *c* and *d*, double-wheels.—enlarged 200 diameters.

Figure 16.—*Echinogorgia aurantiaca* V.; scale-club,—enlarged 100 diameters.

Figure 17.—*Psammogorgia arbuscula* V.; *a*, spindle from the polyp; *b*, irregular spindle from the cœnenchyma; *c* and *d*, irregular club-shaped spicula,—enlarged 100 diameters.

Figure 18.—*P. teres* V.; *a*, double-spindle; *b*, irregular stout spindle; *c*, irregular head,—enlarged 100 diameters.

Figure 19.—*P. gracilis* V.; *a*, spindle; *b*, club-shaped spiculum,—enlarged 100 diameters.

Figure 20.—*Leptogorgia eximia* V.; longer double-spindle,—enlarged 200 diameters.

Figure 21.—*L. Caryi* V.; *a*, longer double-spindle; *b*, stouter irregular double-spindle,—enlarged 200 diameters.

Figure 22.—*Callipodium Pacificum* V.; *a*, *b*, *c*, branched spicula from the cœnenchyma,—enlarged 100 diameters.

Figure 23.—*C. aureum* V.; *a*, *b*, *c*, branched spicula from the cœnenchyma,—enlarged 100 diameters.

PLATE VI.

All the figures on this plate and the next are copied from photographs made by the author and Mr. S. I. Smith, and represent branches or terminal branchlets of natural size.

Figure 1.—*Leptogorgia Flora* V.
Figure 2.—*L. eximia* V.
Figure 3.—*L. diffusa* V.
Figure 4.—*L. Adamsii* V.
Figure 5.—*L. rutila* V.
Figure 6.—*Eugorgia ampla* V.
Figure 7.—*E. Daniana* V.
Figure 8.—*E. multifida* V.
Figure 9.—*Psammogorgia arbuscula* V.
Figure 10.—*P. gracilis* V.
Figure 11.—*Heterogorgia verrucosa* V.
Figure 12.—*Muricea tenella* V.
Figure 13.—*L. squarrosa* V.

PLATE VII.

Figure 1.—*Psammogorgia teres* V.
Figure 2.—*Muricea fruticosa* V.
Figure 3.—*M. robusta* V.
Figure 4.—*M. hispida* V.
Figure 5.—*M. acervata* V.
Figure 6.—*M. purpurea* V.
Figure 7.—*M. tubigera* V.
Figure 8.—*M. hebes* V.
Figure 9.—*M. albida* V.
Figure 10.—*M. crassa* V.

PLATE VIII.

The figures on this plate are all copied from photographs, enlarged 20 diameters, made by the author from spicula prepared by him from the typical specimens. Only the principal forms of the spicula of each species are represented, and especially the larger spindles from the cells and cœnenchyma.

Figure 1.—*Muricea acervata* V.
Figure 2.—*M. tubigera* V.
Figure 3.—*M. hispida* V.
Figure 4.—*M. squarrosa* V.
Figure 5.—*M. crassa* V.
Figure 6.—*M. echinata* Val.
Figure 7.—*M. austera* V.
Figure 8.—*M. retusa* V.
Figure 9.—*M. robusta* V.
Figure 10.—*M albida* V.
Figure 11.—*M. hebes* V.
Figure 12.—*M. purpurea* V.
Figure 13.—*M. appressa* V.
Figure 14.—*M. tenella* V.
Figure 15.—*M. formosa* V.
Figure 16.—*Heterogorgia verrucosa* V.

PLATE IX.

All the figures are copied from photographs made by Mr. S. I. Smith.

Figure 1.—*Callipodium Pacificum* V., natural size.
Figure 2.—*Astrangia palifera* V., from Ceylon,—enlarged 2 diameters.
Figure 3.—*Phyllangia dispersa* V., natural size, seen from above; 3^a, side view of two corallites, natural size.
Figure 4.—*Stephanaria stellata* V., a small specimen viewed from above, showing the mode of branching; 4^a, some of the cells, enlarged 2 diameters.
Figure 5.—*Astrangia concinna* V., a corallite enlarged 2 diameters.
Figure 6.—*A. Hainei* V., a small cluster of corallites, of natural size; 6^a, a corallite, enlarged 2 diameters.
Figure 7.—*Pavonia gigantea* V., portion of the surface, natural size.
Figure 8.—*P. clivosa* V., portion of the surface, natural size.
Figure 9.—*Paracyathus caltha* V., natural size; 9^a, calicle, enlarged 2 diameters.
Figure 10.—*Ulangia Bradleyi* V., a calicle, enlarged somewhat less than 2 diameters.
Figure 11.—*Pteraster Danæ* V., dorsal surface; 11^a, lower surface,—natural size.

PLATE X.

All the figures, except 8 and 9, are copied from photographs made by the author.

Figure 1.—*Fungia elegans* V., upper surface, natural size.

Figure 2.—Another specimen of the same, lower surface, natural size.

Figure 3.—*Balanophyllia elegans* V., calicle, enlarged 2 diameters.

Figure 4.—*Encopa occidentalis* V., a section through the center, showing the right side; 4^a, left side of the same section,—natural size.

Figure 5.—*E. Californica* V., right side, natural size.

Figure 6.—Another specimen of same, with the spines remaining, left side, natural size.

Figure 7.—*Clypeaster testudinarius* (Gray sp.), left side of a section through the median line; 7^a, right side of the same section,—natural size.

Figure 8.—*Allopora Californica* V., one cell, enlarged 12 diameters.

Figure 9.— *A. venusta* V., one cell, enlarged 12 diameters.

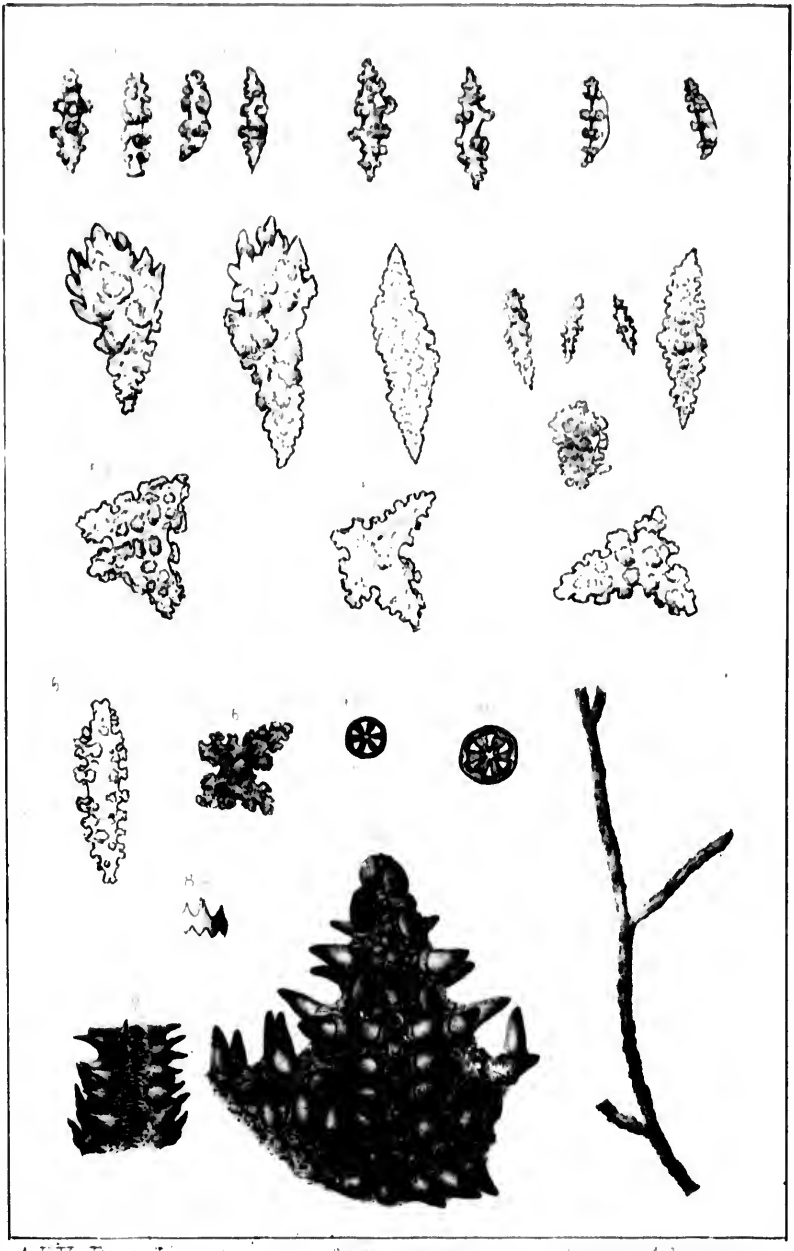
ERRATA.

Page 387, last line, for p. 325, read p. 419.

Page 410, line, 18, omit "Plate VI, figure 8."

Page 413. The spicula of *Phycogorgia fucata*, according to Mr. Wm. S. Kent (Trans. Roy. Mic. Soc., III, p. 91, 1870) agree with those of *Leptogorgia*, to which it should be referred.

Page 554, after *Eugorgia multifida* insert, Plate VI, figure 8.



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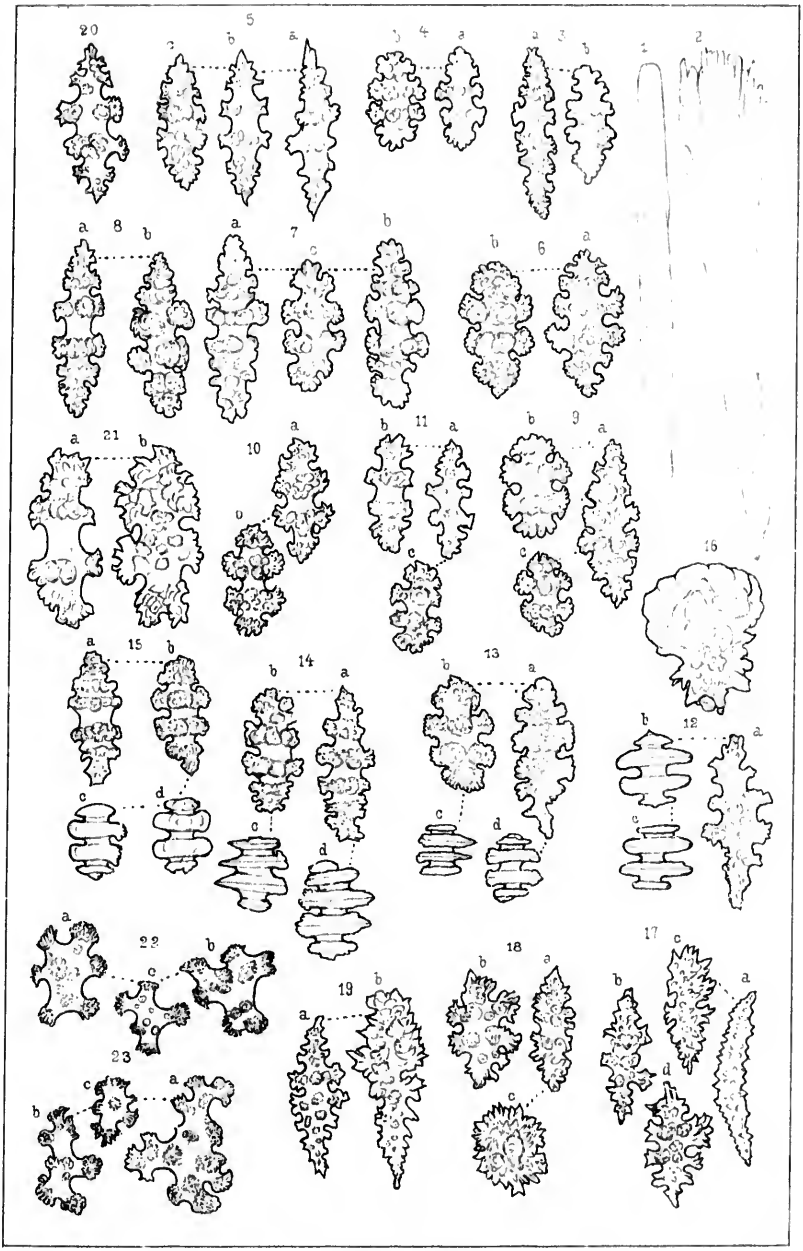
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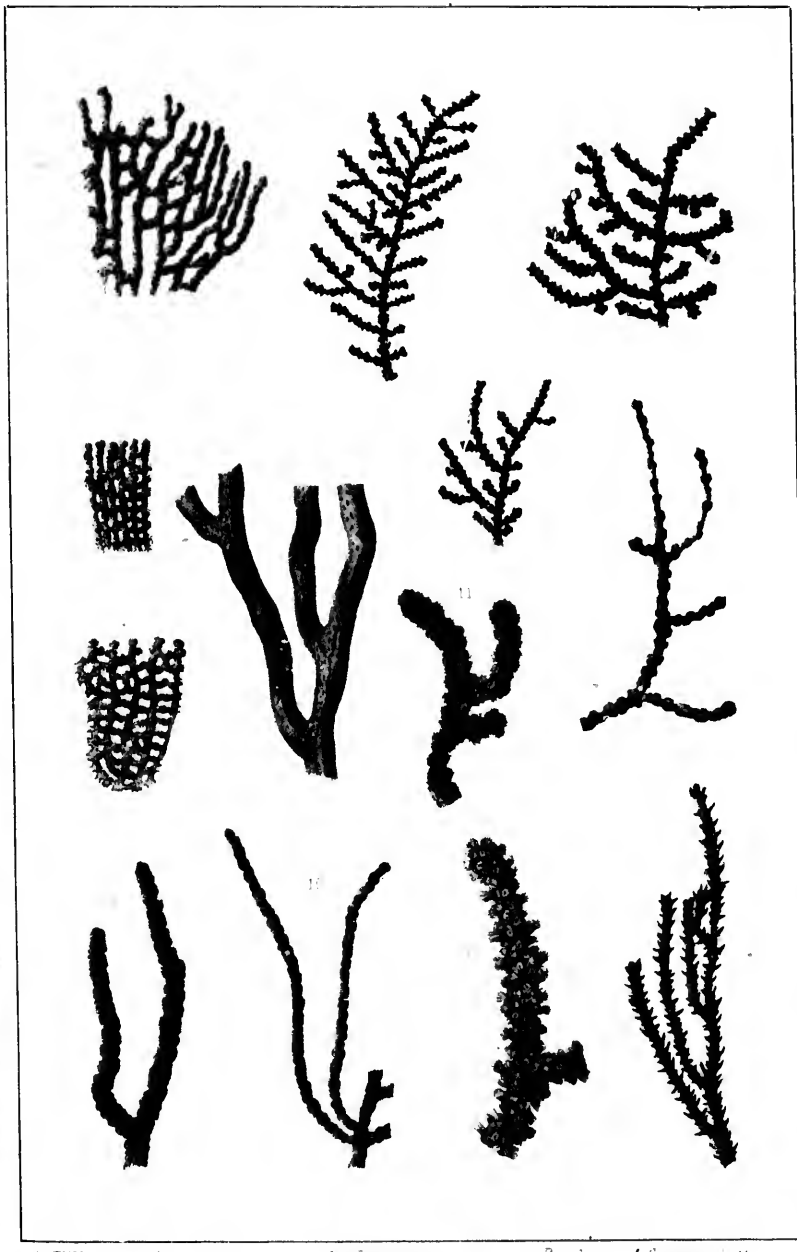

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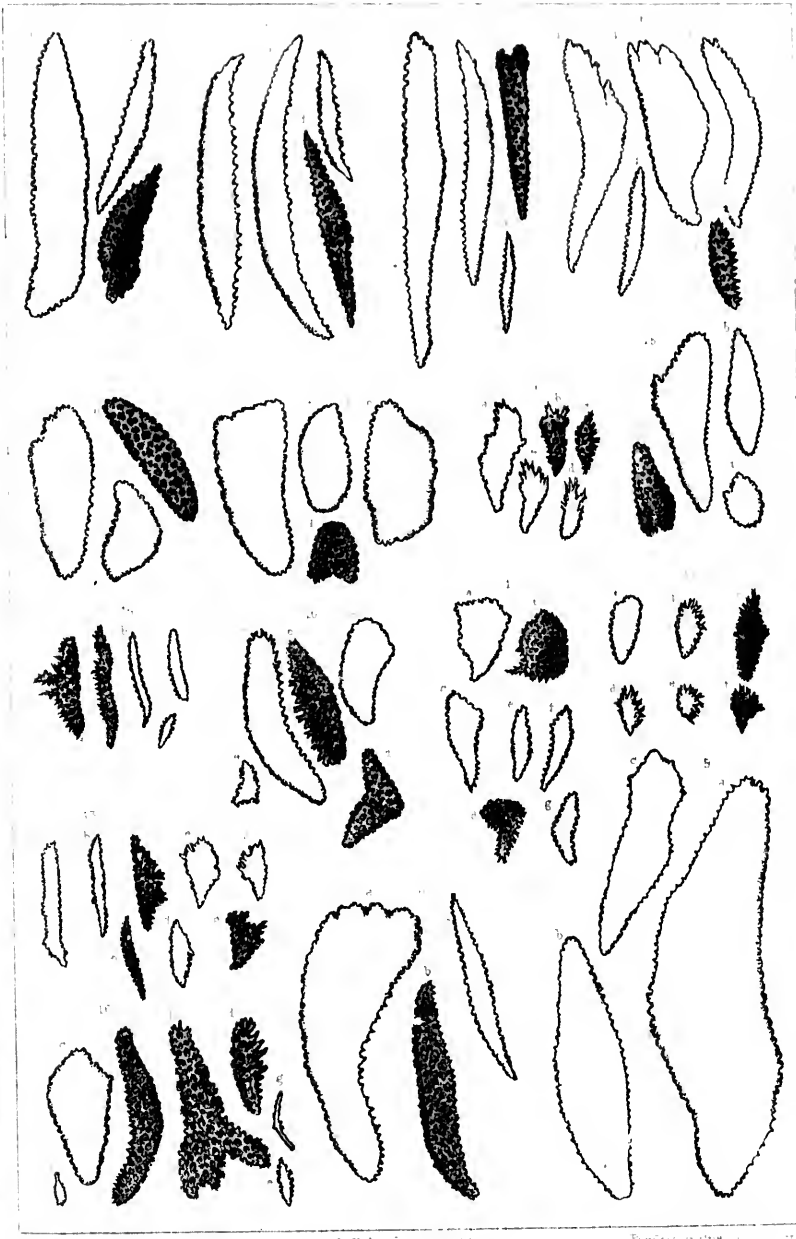
A. E. Verrill, Phot L. Shierholz on Stone Punderson, Crisand & Co Lith



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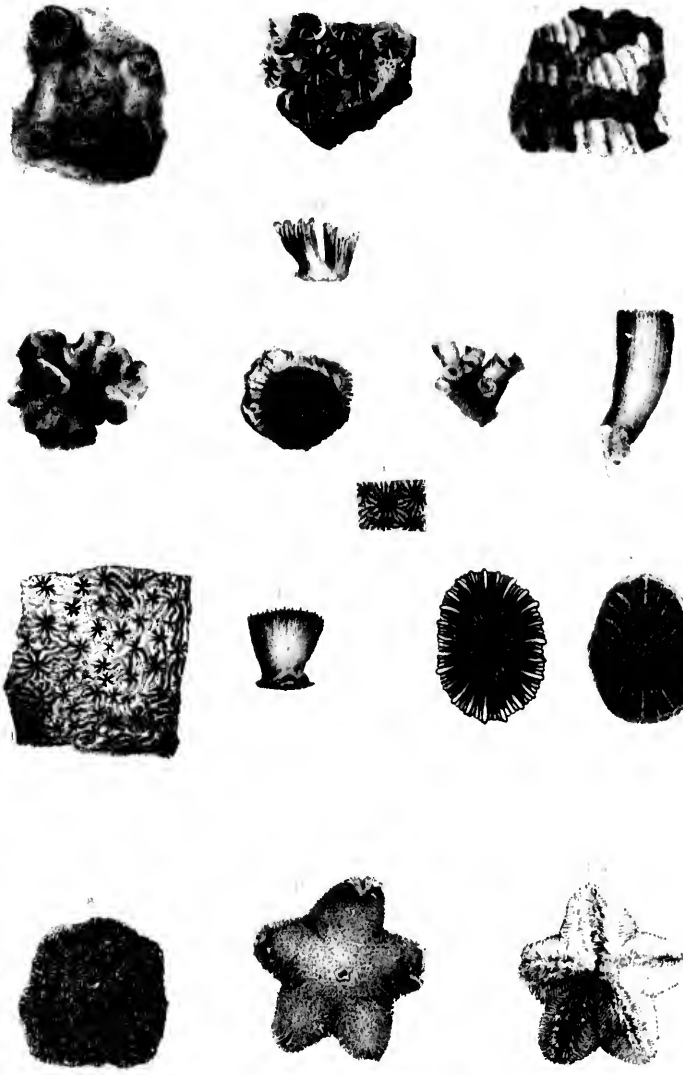

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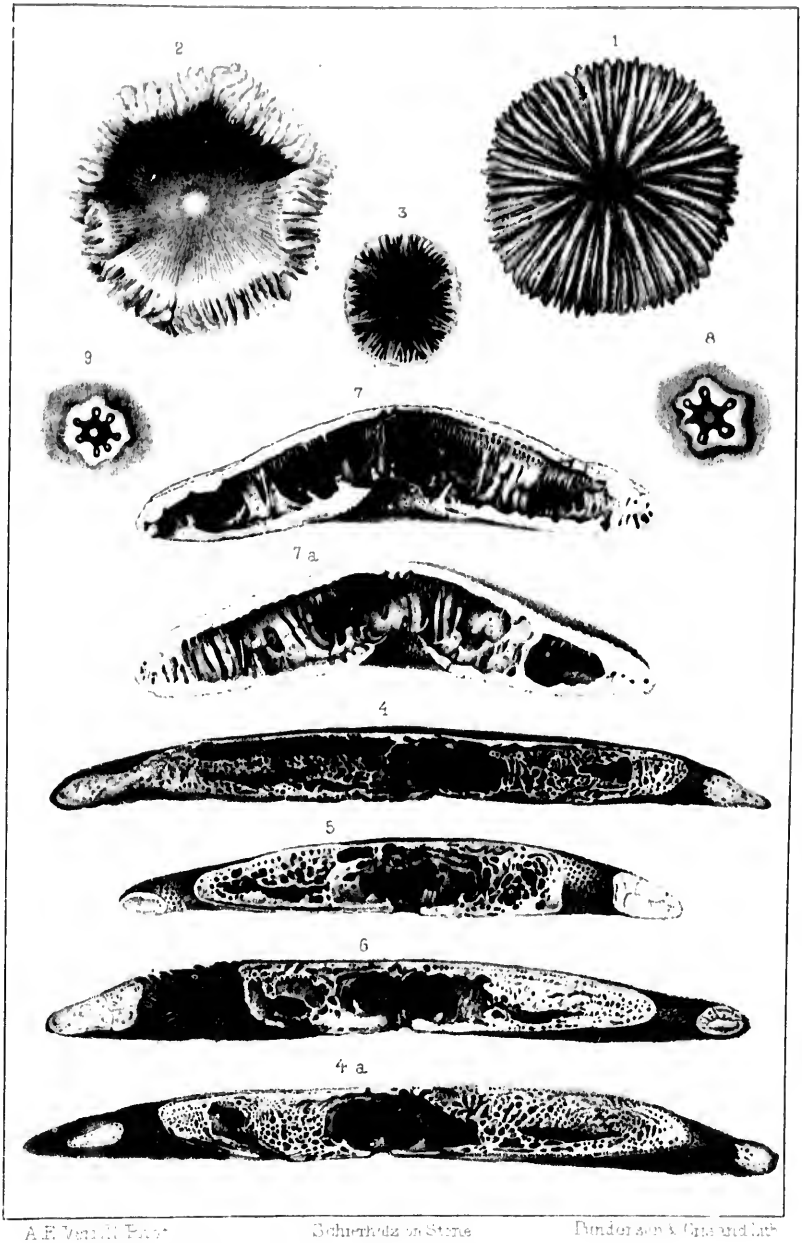
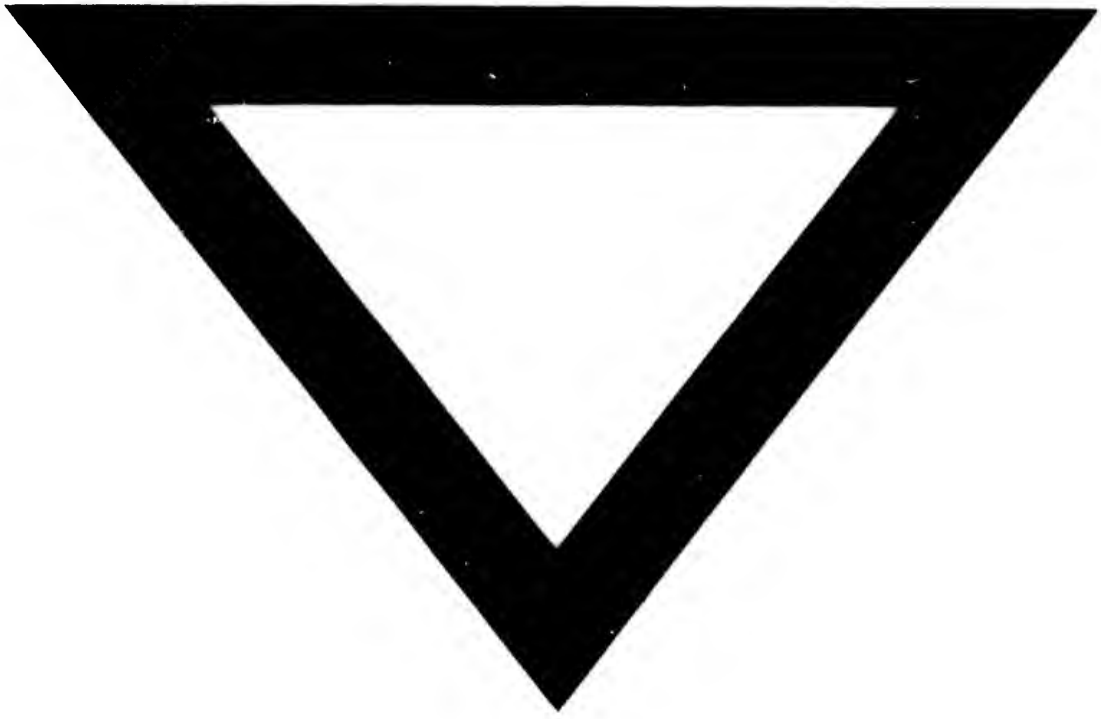
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