

# THE BRYOZOA OF THE WOODS HOLE REGION

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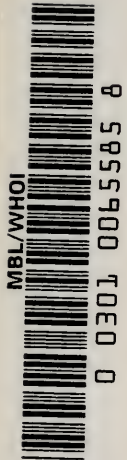
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*Assistant Director, New York Aquarium.*



# THE BRYOZOA OF THE WOODS HOLE REGION.



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## INTRODUCTION.

The report on the Bryozoa (= Polyzoa) of the Woods Hole region, presented in the following pages, has grown out of the work of the survey of this region, which has been conducted by the United States Bureau of Fisheries during the years 1903 to 1909.<sup>a</sup> During the progress of this survey so much bryozoan material was obtained that it has seemed advisable to prepare a special paper dealing with this group. As the Bryozoa of our coast have never received the careful study given to most of the other marine animals, the desirability of making such a study, if even for a limited region, is evident.

The first mention of any American Bryozoa is found in the "Fauna Groenlandica" of Fabricius (1780). D'Orbigny (1839) described and listed certain southern species in his "Voyage dans l'Amerique méridionale." On the northern coast of New England and Canada much more attention has been given this group than elsewhere in America. Here Stimpson made the first attempt since the time of Fabricius, and in his list of the invertebrata of Grand Manan in the Bay of Fundy (1853) he recorded 16 species. Eleven of these he described as new, but subsequent studies have reduced all but four to the synonymy. Dawson's and Packard's papers soon followed, dealing, respectively, with the invertebrate faunas of the Gulf of St. Lawrence and the Labrador coast. A majority of Verrill's papers which make mention of Bryozoa deal with the occurrence of the species north of Cape Cod. Various papers by Hincks treat of the St. Lawrence species, and in 1901 Whiteaves prepared a complete list of those known from eastern Canada.

South of the New England region the Bryozoa have received but scant attention. With the exception of Smitt's excellent treatise on the "Floridan Bryozoa," and a brief preliminary account of the species in the vicinity of the Carnegie Laboratory for Marine

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<sup>a</sup> The general report of this survey, prepared by Dr. F. B. Sumner, Dr. Leon J. Cole, and the present writer, in zoology, and by Dr. Bradley M. Davis, in botany, has been completed and is in course of publication by the Bureau of Fisheries.

Biology at the Tortugas, Fla., by the present writer (1908), only a few scattering species have received mention, and that incidental. The species of the West Indies have been entirely neglected, but Verrill has recorded a few from the Bermudas.

While the Canadian Bryozoa have been fairly well studied through the efforts of Stimpson, Dawson, Packard, Hincks, Whiteaves, and others, and Smitt's monograph deals with the species of the deeper waters of the Floridan region, the extensive tract from New England to Florida has remained entirely untouched, and the New England region has been treated very inadequately.

A number of short papers and references to New England Bryozoa are found in the literature of the subject, but in nearly all cases these are buried in reports dealing with other groups, and hence are not readily accessible and are easily overlooked. The first of these to appear, and the first to be published in America as well, was a short list by Desor (1848) of species observed by him in the region of Nantucket. This paper is chiefly interesting because it contains the original descriptions of two of our most characteristic species, *Bugula turrita* and *Membranipora tenuis*. In 1853 Leidy listed the marine animals known to him from Rhode Island and New Jersey and mentioned a few Bryozoa. Verrill and Smith's "Report upon the invertebrate fauna of Vineyard Sound and vicinity" in 1884 contains a much larger number, about 32 species. Subsequently Verrill has made incidental mention of a few other species of this region, bringing the total number of Bryozoa recorded from southern New England up to about 40. Since 1879, however, the group has remained untouched in this region except for Nickerson's papers on *Loxosoma davenporti*, and the morphological papers of Davenport and Dublin.

In the present intensive study of a very limited region there has appeared a much larger series of forms than the earlier papers would lead one to expect. The list of species previously known has been more than doubled during our dredging work, and 81 species, besides a number of varieties that have been classed as species at some time in the past, are now known to be represented in our fauna. The great majority of our species are widely distributed over the North Atlantic and elsewhere as well. Only a small number (5) are here described as new. In addition to these there are about seven others which are known to occur only within this intermediate region between Florida and Canada. These 12 species are:

- Loxosoma davenporti* Nickerson.
- Loxosoma minuta*, new species.
- Bugula turrita* (Desor).
- Bugula cucullifera*, new name (*B. cucullata* Verrill non Busk).
- Membranipora tenuis* Desor.
- Cellepora americana*, new species.
- Lepralia americana* Verrill.
- Lepralia serrata*, new species.
- Alcyonidium verrilli*, new name (*A. ramosum* Verrill non Lamouroux).
- Amathia dichotoma* (Verrill).
- Hippuraria armata* (Verrill).
- Hippuraria elongata*, new species.



Of characteristic southern species we have almost no representatives. *Barentsia discreta*, which ranges along our coast to the southward and is known from the South Atlantic, is perhaps one. *Anguinella palmata* finds its northern limit for American waters in Buzzards Bay, probably, as it is rare and of small size, while farther south it grows abundantly. Perhaps *Hippuraria elongata* should be added to the list, as it is comparatively scarce at Woods Hole and very common at Beaufort, N. C. It seems probable that others among those now known only from local waters will be found in the future to be more widely distributed.

Our Bryozoa fauna is thus seen to be typically a northern one, since fully one-half of the species are characteristically northern or even arctic in their range. In addition to this about another fourth of the number have such a wide distribution that we may call them cosmopolitan, since they occur in one or more of the great oceans besides the North Atlantic.

The region embraced in the survey above mentioned includes Vineyard Sound between a line drawn from East Chop to Falmouth Heights and one from Gay Head to Sow-and-Pigs Reef, and Buzzards Bay above a line drawn from Sow-and-Pigs Reef to the Hen-and-Chickens Lightship. This region has been thoroughly and systematically dredged during the summers of 1903 to 1909, inclusive, by the United States Bureau of Fisheries vessels Fish Hawk and Phalarope. In all, 458 dredging stations were established, and many of these have been repeatedly redredged. Within this same region shore collections have been made at various points, and the piles of docks in the various harbors have been repeatedly scraped for material. For the purpose of comparison, collections have been made at certain other points within easy reach but situated outside of the region above described. These points are as follows: Crab Ledge, a few miles east of Chatham, on Cape Cod; Great Round Shoal fishing ground, east of Great Point, Nantucket; Nantucket Harbor; and Muskeget Channel. Besides these collections I have been able to examine some material taken by Mr. Vinal Edwards off Sankaty Head, Nantucket, and some collected by the United States Fish Commission 35 years ago on the Nantucket Shoals.

Throughout this whole region the water is comparatively shallow, in no place reaching a depth greater than 25 fathoms, while over the greater part of the area the depth ranges rather uniformly between 6 and 15 fathoms. As might be expected from this, the species which are characteristic of deeper waters are lacking from our fauna. A considerable portion of the bottom of Vineyard Sound is a tide-swept desert of shifting sand, unfavorable for the growth of Bryozoa, but where rock ledges appear, and especially near the shores in the zones of red and brown algæ, they are abundant. The bottom of Buzzards Bay is largely mud covered, the ebb and flow of the tide not producing sufficient current to carry away the silt deposited by the streams which empty into the bay. Naturally such a bottom is unfavorable to the growth of encrusting or sessile animals, and the Bryozoa over a large part of the bay are poorly represented. The piles in the harbors afford usually the best collecting grounds.

Crab Ledge differs noticeably from the Sound and Bay. The depth is in general a little greater (14 to 20 fathoms), but this is not sufficient to have any particular value. The temperature in midsummer is noticeably colder. Records taken on the same day (Aug. 12, 1909) by Dr. Cole and myself showed a mean bottom temperature of 47.2° F. at 17½ fathoms on Crab Ledge, and 69.5° F. at 12 fathoms off West Chop, in the eastern end of Vineyard Sound. The much lower temperature of Crab Ledge, Great Round Shoal, and Nantucket Shoals, due no doubt to their proximity to the deeper water of the open ocean, permits a considerable number of northern species to live on these shoals which are not represented in Vineyard Sound and Buzzards Bay. Crab Ledge in particular is of interest in yielding a number of species supposed to be limited in their distribution to northern waters and which have not hitherto been reported south of Canada.

In comparing the distribution of species in the following pages I have made use of the term "inner waters" to distinguish Buzzards Bay and Vineyard Sound from the other stations which I have designated collectively as the "outer waters."

In the outer waters there are found about 28 species not represented in the inner waters. These are:

- Crisia cribraria.*
- Stomatopora diastoporoides.*
- Tubulipora flabellaris.*
- Tubulipora atlantica.*
- Gemellaria loricata.*
- Scruparia clavata.*
- Caberea ellisii.*
- Menipea ternata.*
- Cellularia peachii.*
- Bugula murrayana.*
- Bugula cucullifera* (*B. cucullata* Verrill non Busk).
- Membranipora arctica.*
- Membranipora cymbæformis.*
- Membranipora unicornis.*
- Cribrilina annulata.*
- Porina tubulosa.*
- Schizoporella sinuosa.*
- Schizoporella auriculata.*
- Cellepora canaliculata.*
- Mucronella ventricosa.*
- Rhamphostomella costata.*
- Porella acutirostris.*
- Porella proboscidea.*
- Porella concinna.*
- Smittia porifera.*
- Alcyonidium parasiticum.*

In the inner waters there are about 12 species not represented in the outer waters, viz:

*Loxosoma davenporti*.  
*Loxosoma minuta*.  
*Barentsia discreta*.  
*Bugula flabellata*.  
*Membranipora lacroixii*.  
*Lepralia pallasiana*.  
*Flustrella hispida*.  
*Alcyonidium verrilli* (A. ramosum Verrill non Lamouroux).  
*Amathia dichotoma*.  
*Anguinella palmata*.  
*Hippuraria armata*.  
*Hippuraria elongata*.

This leaves more than one-half of the number of species common to both the inner and outer waters.

Comparatively few of our species show a preference for any special habitat. *Loxosoma davenporti* lives as a commensal in worm tubes, and *L. minuta* in the same way on *Phascolcon strombi* living in dead gastropod shells. *Hippuraria elongata* is also a commensal living in the branchial chambers of the blue and spider crabs and on the carapace of *Pinnixia* living in the tubes of *Chaopterus pergamentaceus*. The last condition offers a case of double symbiosis. *Flustrella hispida* occurs only in shallow water along shore where it encrusts *Fucus*, etc. *Membranipora tehuelcha* occurs only on the gulfweed (*Sargassum bacciferum*) drifted into our region from the Gulf Stream.

The majority of our species are rather small, yet some of the erect chilostomes form bushy colonies several inches in height. Conspicuous among these are *Bugula turrita* and *Gemellaria loricata*. The semi-erect *Porella proboscidea* grows on the stems of *Boltenia* and Sertularidæ to a length of several inches and rises frill-like to a height of at least  $\frac{3}{4}$  inch. A number of the encrusting species may cover an area of several square inches. One of the most massive of these is *Schizoporella unicornis*. I have one specimen, from the piles of the United States Fisheries dock at Woods Hole, which measures 11 by 5 inches in extent and is over  $\frac{1}{2}$  inch in thickness. *Smittia trispinosa* var. *nitida* also forms nodules, sometimes as large as one's fist, encrusting shells or pebbles. Such a crust consists of many layers of zooecia, the ones underneath being but the dead skeletons of former generations. Of the ctenostomes, *Alcyonidium verrilli* is the only one in our region to attain a considerable size. The largest I have seen were about 6 inches high, the fleshy fronds making a good-sized mass.

While the Bryozoa yield no useful products and thus have no direct value in commerce, they play a part, like most other small marine animals, in furnishing food for fishes. I have seen large nodules of *Schizoporella* and *Smittia* taken from the stomachs of sharks, while among our edible fishes the examination of such species as the "cunner" (*Tautoglabrus adspersus*) and "blackfish" (*Tautoga onitis*) indicates that the various Bryozoa often form no inconsiderable part of the diet.

The list submitted in the following pages is probably fairly complete for the region, though no doubt other species will be added from time to time by close collecting and especially in unusual habitats. Many species are so minute that it is difficult not to

overlook them. As previously stated, our list contains 81 species besides several varieties which often appear as species in other lists. Whiteaves list for eastern Canada contains 115 species (46 of these occur also at Woods Hole); the Plymouth, England, list contains 103 species, while Herdman lists 136 in the Irish Sea. It must be remembered, however, that all these regions are not only considerably larger in extent than ours, but that the depth has a greater range. On the other hand, Levinsen's list in the "Zoologica Danica" includes only 68 species for all Denmark, and Graeffe's list for Trieste but 56. By comparing these lists and taking into consideration the uniform conditions of depth, temperature, and salinity in our region it will be seen that our Bryozoa fauna is a fairly representative one.

In the classification which I have adopted our 81 species are included in 36 genera, and these in 20 families. The Endoprocta are represented by 5 species included in 2 families and 3 genera. The Ectoprocta are well represented in the 3 suborders of the order Gymnolæmata as follows: Cyclostomata, 8 species belonging to 4 genera and 3 families; Chilostomata, 55 species in 21 genera and 10 families; Ctenostomata, 13 species in 8 genera and 5 families.

To bring together in convenient form the widely scattered descriptions of our Bryozoa I have given under each species a rather full diagnosis of the species as it exists in our region. In making out such descriptions I have often drawn largely from the original published sources, where these were satisfactory, and I have amplified or abbreviated or otherwise modified these as the conditions required. In the case of *Vesicularia familiaris* listed by Verrill, but which I have not seen, I have been compelled to copy from other sources without making a comparison.

For the convenience of the student I have also included keys of families, genera, and species. Because of the brevity of such diagnosis the keys must necessarily be more or less unsatisfactory and must be constantly checked up by a perusal of the descriptions and reference to the figures. It must be borne in mind that the form of the colony is generally of little use in determining the species, owing to the great amount of variation in this respect. It must also be noted that a great deal of variation is exhibited in the amount and form of the calcification of the individual zooecia, especially among the encrusting chilostomes, and the same is true of the form and occurrence of avicularia, spines, and other secondary structures. In the soft-bodied endoprocta and ctenostomes the form of the body depends largely on the amount of contraction. I can testify, after a number of years work, that the group is by no means an easy one for the beginner, and I know of no other in which the student is more likely to be misled by superficial resemblances.

Many of our Bryozoa have never been adequately figured, some not at all. Those which occur also in Europe have been illustrated, but, aside from Hincks' "British Marine Polyzoa," now long out of print, the figures are badly scattered and often are not easily accessible to the general student. To cover this deficiency and to bring together the illustrations of our species, I have figured anew all the forms dealt with in the following list. With the exception of six species all the figures are drawn from local specimens, and at least have the merit of representing the forms as they occur in this region. Nearly

all the figures have been drawn by myself, but figures 15, 30, 30a, and 39 are the work of my wife. I must make special acknowledgment for the work of Mr. Howard J. Shannon, who has so faithfully portrayed *Tubulipora atlantica*, *T. flabellaris*, and *T. liliacea*. These figures were drawn under my direction, so I can vouch for their accuracy of detail, but their artistic merit is due entirely to Mr. Shannon's skill and patience.

For the systematic study of the group Hincks' "British Polyzoa" still remains the standard work for North Atlantic species, and is indispensable to the special student. It covers slightly more than half of the species of our region. Hincks' three papers on the "Polyzoa of the St. Lawrence" and Smitt's "Floridan Bryozoa" will also be found most useful in comparison for Atlantic species, and Dr. Alice Robertson's valuable papers (Proceedings California Academy of Science) for Pacific coast species. In the appended bibliography all papers have been listed which contain either the original descriptions or a reference to the occurrence of our species on the Atlantic coast.

The literature on the general structure of the Bryozoa is fortunately more accessible than that dealing with the systematics of the group. Reference may be made to the article by Harmer in the Cambridge Natural History, or for more extended study, to Calvet's "Bryozoaires Ectoproctes marins."

It is scarcely necessary to mention the fact that such changes have been made in the classification and nomenclature of the Bryozoa since the appearance of the earlier papers that many of the species recorded therein are quite unrecognizable except to the special student familiar with the synonymy. I have tried to give a complete synonymy in each case of all the references to the species in American waters. It might also be taken for granted that many errors in identification would be found to occur in these papers. Our knowledge of the Bryozoa is at present none too well organized, but 40 or 50 years ago it was in an extremely chaotic state. For this reason it is not possible to make absolutely certain of the synonymy in all cases, but by obtaining material from the original localities some doubtful cases have been decided with a fair degree of certainty. Prof. Verrill has aided me very materially in this matter by kindly permitting me to examine his collection of mounted slides of specimens determined by himself and by Packard, Stimpson, and Dawson. The Canadian Geological Survey, through the kindness of Mr. Lawrence M. Lambe, has lent me much identified Canadian material for comparison. Dr. S. F. Harmer and Dr. O. Nordgaard have supplied me with many European species. As a result, in the case of nearly all species which occur in other waters, I have been able to make direct comparisons with material from the regions where the species are already well known.

### Class BRYOZOA Ehrenberg (POLYZOA, J. V. Thompson).

Minute animals forming colonies (with rare exceptions), asexual reproduction by budding developed to a high degree. A retractile crown, the lophophore, which bears ciliated tentacles, a U-shaped alimentary canal, a simple nerve ganglion; coelom present, but vascular system wanting.

Subclass ENTOPROCTA—Anal opening situated within the lophophore; coelom greatly reduced; tentacles rolled inward in contraction.

Subclass ECTOPROCTA—Anal opening situated outside the lophophore; coelom well developed; the whole lophophore withdrawn in contraction.

SUBCLASS ENTOPROCTA NITSCHE, 1869.

This group of Bryozoa, although widely distributed in all seas, contains but few species. One genus, *Urnatella* Leidy, is known from fresh water. The genera, which are few, are included in the following order:

Order PEDICELLINÆ Hincks, 1880.

KEY TO FAMILIES.

- 1. Not colonial, not stolonate; buds separating from parent on reaching maturity, individuals attached by a slightly enlarged base or foot; the lophophore obliquely situated. . . . . Loxosomidæ.
- 2. Buds arising from a creeping stolon and remaining attached to form colonies; lophophore placed transversely. . . . . Pedicellinidæ.

Family LOXOSOMIDÆ Hincks, 1880.

Individuals solitary. A contractile peduncle supports the body, from which it is not distinctly marked off. Buds originating on the side of the body, separating from the body on reaching maturity, and securing attachment by means of a pedal gland. The manner of budding and the oblique position of the lophophore indicate this as the most primitive family of Bryozoa.

Genus LOXOSOMA Keferstein, 1863.

KEY TO SPECIES.

- Lophophore with 18 to 30 tentacles, pedal expansion small, length about 2 mm . . . . . *davenporti*.
- Lophophore with about 8 tentacles, foot broad, length less than 1/2 mm . . . . . *minuta*.

*Loxosoma davenporti* Nickerson. [Pl. XVIII, fig. 1.]

Nickerson 1898, p. 220; 1899, p. 368; 1901, p. 351-380.

Entire animal about 2 millimeters long, somewhat vase-shaped. Pedicel cylindrical, about as long as the remainder of the body, into which it merges gradually. Nickerson describes the foot as being destitute of a lateral expansion and foot gland, but in specimens in my possession there is a small glandular expansion. Lophophore with 18 to 30 tentacles, the body somewhat narrowed just below the lophophore. One or more (usually a pair) of flask-shaped glandular organs attached to the ventral side of the body near the lower end of the stomach.

Found in worm tubes at Cotuit Harbor (Nickerson).

*Loxosoma minuta*, new species. [Pl. XVIII, fig. 2, 2a.]

Verrill 1879c, p. 31 (*Loxosoma* on *Phascolosoma*).

Body rather regularly oval, about one and one-half times as long as wide, often somewhat cordate below where it joins the stalk. Tentacles apparently stout and about eight in number, but as only contracted specimens have been studied the details of the lophophore can not be stated definitely. The stalk is one-half to two-thirds as long as the body, transversely wrinkled in the contracted state, the upper end but little expanded below the calyx, the lower end spreading out into an evenly rounded foot which is nearly or quite twice the diameter of the stalk. Buds have not been observed. A very small species, averaging not more than a third of a millimeter, while the largest specimens seen measure under one-half millimeter.

Found on *Phascoleon strombi* (= *Phascolosoma cæmentarium*) in the Woods Hole region, and on *Phascolosoma eremita* at the Isles of Shoals, often in considerable numbers among the tubercles of the skin. As *Phascoleon strombi* lives permanently in small gastropod shells, nearly closing the aperture with mud and sand cemented together, the habitat of the *Loxosoma* is rather unusual. As our sipunculoids were placed in the hands of Dr. J. H. Gerould for identification, I am indebted to him for the material from which the above description is drawn, and I have not seen living specimens. Prof. Verrill informs me that this is the species listed by him as "*Loxosoma* on *Phascolosoma*."

## Family PEDICELLINIDÆ Hincks, 1880.

Zoecium pedunculate on a stalk which has one or two contractile regions and which rises from a creeping stolon; body separated from stalk by a diaphragm, deciduous, a new body regenerating in place of the one cast off; lophophore terminal and transverse.

## KEY TO GENERA.

1. Peduncle not abruptly enlarged at the base near the junction with the stolon . . . . . *Pedicellina*.
2. Peduncle abruptly enlarged at the base . . . . . *Barentsia*.

## Genus PEDICELLINA M. Sars, 1835.

*Pedicellina cernua* (Pallas). [Pl. XVIII, fig. 3, 3a, 3b, 3c, and 3d.]

- Pallas 1771, p. 57 (*Brachionus cernuus*).  
 Leidy 1855, p. 143 (*Pedicellina americana*).  
 Verrill and Smith 1874, p. 707 (*P. americana* Leidy).  
 Verrill 1879c, p. 31 (*P. americana* and *echinata*).  
 Jelly 1889 (? *P. nutans* Dalyell).  
 Ehlers 1889, p. 141 (= ? *P. glabra* Hincks).  
 Jullien 1888, p. 13 (*P. hirsuta*).  
 Cornish 1907, p. 79.

Stolon slender, more or less transparent, branching. Body cup-shaped, usually with a well-marked gibbosity on one side, tentacles 14 to 24. Peduncle stout, tapering gradually at its upper end. Stout spines often present on both stalk and body, or on either, or entirely absent from both. Abundant in certain situations, as on the piles of docks, where it commonly grows intermingled with other creeping forms. It occurs also at some depth in Vineyard Sound, and I have taken it once at Crab Ledge in 18 fathoms.

A comparison with European material shows that our species is undoubtedly the same as *cernua*. Concerning the species in Europe there has been much difference of opinion. Ehlers (l. c.) makes three species out of it, *P. glabra* Hincks entirely without spines, *P. echinata* Sars with spinous peduncle, and *P. hirsuta* Jullien with spinous body, although he recognizes the possibility of their belonging together. Hincks and Joliet had already noticed the variability in the spines, and Hincks mentioned the smooth form merely as a "variety *glabra*." In American specimens is exhibited the whole range of variability in number and arrangement of spines, and there is such an amount of variation among the individuals of a single colony that I am convinced no separation based upon their presence or absence can be of specific value. Leidy's *P. americana*, along with *glabra*, *echinata*, and *hirsuta*, must be considered synonyms of *cernua*.

I have collected the species, exhibiting the variation in spines, at Beaufort, N. C., and at the Tortugas, Fla. Hincks (1889) has recorded *P. nutans* Dalyell from the Gulf of St. Lawrence, but I have failed to find it in the Woods Hole region.

## Genus BARENTSIA Hincks, 1880.

Similar to *Pedicellina* in the form of the body and stolon; the stalk differing from that genus in being suddenly expanded near the base into a muscular organ for swinging the stalk from side to side; stalk above the enlargement more slender than in *Pedicellina*.

## KEY TO SPECIES.

1. Stalk without areolæ or perforations . . . . . *major*.
2. The cuticle of the stalk with rounded areolæ or perforations . . . . . *discreta*.

*Barentsia major* Hincks. [Pl. XVIII, fig. 4.]

- Hincks 1888, p. 226.  
 Jullien and Calvet 1903, p. 27 (*B. elongata*.)

Stolon rather stout, creeping, jointed at intervals. Pedicels of great length, very slender below and expanding somewhat above, delicately ringed, of a very light horn color, rising from a stout cylindrical

base, which is conical above and of a whitish color and with or without annulations. Polypide or body large, white, expanding from the base upward, slightly gibbous on one side, tentacles numerous; the fleshy peduncle connecting the body and stalk is comparatively long and usually somewhat enlarged just below the attachment of the body.

I am convinced from my studies of living and preserved material that too much stress has been placed by systematists upon the condition of the connection between body and stem, and also upon the presence or absence of annulations on the muscular base, as both of these vary in life with the amount of contraction and in preserved material in the same manner, due, perhaps, to different means of killing or fixation. Thus Jullien described his species *elongata* as new, partly on these characters (l. c.). Hincks specifically states that in *major* the base is not annulated, but this does not apply to all specimens. Calvet in a footnote to Jullien's specific description places *elongata* as a variety of *major*.

The species is well distributed throughout the Woods Hole region, though it is not very common. Taken on piles, on the leg of a spider crab, and dredged at 3 to 13 fathoms on shells and stones.

**Barentsia discreta** (Busk). [Pl. xviii, fig. 5, 5a.]

Busk 1886, p. 44 (*Ascopodaria discreta*).

A small, delicate stolon, jointed at intervals where branches or pedicels have their origin. Pedicels becoming slightly larger toward the top, chitinous, irregularly punctured by minute funnel-shaped pores, or areolæ, which on close examination are seen to penetrate the inner but not the outer layer. The muscular cylinder at the base of the pedicel is more or less annulated. Pedicel and stolon horn color varying with age, polypide and cylinder whitish, or the latter light brownish. Polypide small, somewhat gibbous on one side, attached to the pedicel by a flexible, annulate, fleshy portion, which is often more or less bulbous.

The only previous record for this species is the Challenger record "Station 135, off Nightingale I., Tristan da Cunha, 100 to 150 fathoms." It was naturally a surprise to find this species in our region, but it is evidently well distributed, as I have taken it at four places in Vineyard Sound and once in Buzzard's Bay. I have also taken it at Beaufort, N. C., and at the Tortugas, Fla. It is a very inconspicuous form and might easily escape observation, but it seems to be distributed all along our coast.

## SUBCLASS ECTOPROCTA NITSCHÉ, 1869.

### Order GYMNOLÆMATA Allman, 1856.

All of the recent marine ectoproctous Bryozoa are included in this order, which is, consequently, a very large one. The fresh-water ectoprocts comprise the order Phylactolæmata Allman, with but a very limited number of genera and species.

#### KEY TO SUBORDERS.

1. Zoarium well calcified. Zoecia tubular, orifice usually round, without operculum, no appendicular organs (avicularia and vibracula), no external brood pouch, but the ooeecium consisting of a modified zooeecium ..... Cyclostomata.
2. Zoarium usually well calcified. Zooeical orifice closed by a movable lid-like operculum, appendicular organs frequently present, an external brood pouch usually present on fertile zoecia. Chilostomata.
3. Zoarium never calcified. Zooeical orifice with an operculum consisting of a ring of setæ, no appendicular organs or external brood pouch. .... Ctenostomata.

### Suborder CYCLOSTOMATA Busk, 1852.

This suborder is probably much older than the other groups of recent ectoprocts and is abundantly represented among the paleozoic fossils. A noticeable diminution occurs in the tertiary, but a considerable number have persisted to the present time.



## KEY TO FAMILIES.

1. Zoarium erect, articulated, with horny joints, attached by long tubular radical processes... Crisiidæ.  
Zoarium entirely or partially encrusting (sometimes only the small basal portion for attachment), not jointed, solidly attached, without radical fibers..... 2.
2. Zoarium discoid, simple and entirely or partially adnate, zooecia tubular, erect or nearly so, radiating in linear series from a free central area, intermediate space cancellated..... Lichenoporiidæ.  
Zoarium flabellate, lobate or branched, entirely adnate or rising from an encrusting base, zooecia tubular, in contiguous series or in single lines..... Tubuliporiidæ.

## Family CRISIIDÆ d'Orbigny, 1852.

The jointed zoarium, the erect, bushlike habit of growth, the attachment by means of jointed tubular fibers, and the swollen, pear-shaped oocidium, which is merely an expanded cell, easily serve to distinguish this family at a glance from any other. There is only one genus.

## Genus CRISIA Lamouroux (pars), 1812.

## KEY TO SPECIES.

- Zoarium bushy, spreading, tips of branches curled inward, oocidium with a well developed tubular oociestome, the aperture of which is somewhat elongate transversely and inflexed on the front border..... *eburnea*.
- Zoarium more erect, somewhat flabellate, the branches not curved inward; oociestome shorter than in the preceding and conspicuously elongated transversely, twice as long as wide..... *cribraria*.
- Zoarium much as in *eburnea*; oociestome not well developed, very short, the aperture round. *denticulata*.

*Crisia eburnea* (Linné). [Pl. XVIII, fig. 6, 6a, and 6b.]

Linné 1766-1768, p. 1316 (*Sertularia eburnea*).

Verrill and Smith 1874, p. 707.

Verrill 1879c, p. 28.

Cornish 1907, p. 78.

Zoarium forming dense, bushy tufts, usually attached by a single stem, the base of which does not in most cases develop many rootlets; height  $\frac{1}{2}$  to  $\frac{3}{4}$  inch, the branches characteristically curved inward. Internodes short, somewhat flattened, in most cases with an odd number of zooecia, 5 and 7 being the dominant numbers. Joints yellow, colorless near the growing points, sometimes dark brown in old parts of the colony. Zooecia almost entirely connate, the free upper portion bearing the aperture bent forward nearly at a right angle to the stem, a pointed process sometimes on the outer angle of the aperture. Ovicell large, curved inward, usually replacing the second, less often the third zooecium of an internode; oociestome conspicuous, elongated transversely ( $1\frac{1}{2}$  times as long as wide), the front margin somewhat inflexed, borne on a very distinct tube which narrows toward the summit.

An abundant species, growing in all depths from low water to the deepest water of the region. Found on piles, attached to hydroid and other stems, on stones and shells, in fact on anything which will give it a foothold. More abundant in Vineyard Sound and outside waters, but plentiful in many parts of Buzzards Bay.

*Crisia cribraria* Stimpson. [Pl. XVIII, fig. 7, 7a, and 7b.]

Stimpson 1853, p. 18.

Harmer 1891, p. 135 (? = *C. ramosa* Harmer).

Verrill 1879c, p. 28 (*C. eburnea* var. *cribraria*).

Jelly 1889, p. 74 (= *C. denticulata*).

Whiteaves 1901, p. 110 (*C. eburnea* var. *cribraria*).

Stimpson's original description of this species is as follows: "Polydom thickly branched, with the cells so crowded as to form 2 or 3 longitudinal rows, in which they are usually opposite. The back of the

polydom is flat or but slightly convex, presenting an irregularly striate appearance. Color white. Taken in 20 fathoms east of Duck I."

The above description is so entirely inadequate, omitting nearly all points of diagnostic value, that it is practically useless, and the accompanying figure is nearly as noncommittal, so it is not difficult to see why the species has been altogether misunderstood. Material from the Labrador and Nova Scotia coasts, dredged by Mr. Owen Bryant, in 1908, as well as specimens previously dredged by myself at Crab Ledge, correspond to what is of value in Stimpson's description. A study of the ovicells, which are abundant in both the Crab Ledge and Canadian specimens, shows that the species is certainly distinct from *eburnea*, *denticulata* and *ramosa*. The growth habit is also distinct. As we have no other description than that above quoted, and as there has been so much confusion concerning the species, I include the following more complete description.

Zoarium consisting of nearly erect flabellate branches arising from a narrow base,  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in height; the branches show little or no tendency to curve inward and are much stouter and more rigid than is usual in the genus. Occasionally the joint is wanting where it should occur, the region being fully calcified. Internodes long, zooecia even in number, with an average of 18 or 20 zooecia (as many as 26 and as few as 10 have been noted), usually regularly alternate, but sometimes nearly opposite in position; branches broad and flat or slightly rounded on the posterior side; the zooecia overlap to such an extent that the branch is often five times the width of a single zooecium. The zooecia are usually fused in the branch for nearly the whole length, but a very short terminal portion turns abruptly forward and usually slightly inward, so that the apertures seem to lie on the front of the branch, in some cases (usually in the narrower branches) they may project somewhat laterally; a sharp projection often present on the outer border of the aperture. Ooecia large, more elongate than in *C. eburnea*, and more bulging at the upper end, often to such an extent that the aperture is hidden in front view; only one to an internode, occupying the position of the fifth or sixth zooecium of that side of the branch, but sometimes as low as the third or as high as the ninth. Ooeciostome elongate-elliptical transversely, almost slitlike, fully twice as much compressed as in *eburnea*, situated at the top of a stalk which is broadest at its base and which flares out slightly at the top. Radical fibers not very numerous, stout, the joints short. Branches arising alternately, usually two, sometimes three to an internode; the first arises low down, usually between the second and third zooecia, the second between the fourth and fifth zooecia of the opposite side, the third (when present) on the same side as the first, still higher up.

The most distinctive character is the ooeciostome, which distinguishes the species at once from any with which it has been confused. The tube is stout as in *eburnea*, and flares at the top like *ramosa* but not to such an extent; the opening is different from either of these and from *denticulata* as well.

Taken at Crab Ledge (Fish Hawk station 7835) in 18 fathoms, well developed, with numerous ovicells. The species must be considered rare in this region, and has not hitherto been noted south of Canadian waters.

***Crisia denticulata* (Lamarck). [Pl. xviii, fig. 8.]**

Lamarck 1816, p. 137 (*Cellaria denticulata*).

Stimpson 1853, p. 18.

Verrill 1879c, p. 28 (*C. eburnea* var. *denticulata*).

Whiteaves 1901, p. 110.

Zoarium rather large and straggling, averaging about an inch in height; branches showing but little tendency to curve inward, broad and flattened; internodes usually slightly curved from side to side in a sinuous manner. Zooecia usually alternating, the dominant number 11 to an internode, a short terminal portion is curved forward and a pointed projection is often present at the upper outer angle of the orifice. Ovicell large, always high in the internode and usually near the end of a branch; the ooeciostome differs from that of our other species in that it is not borne upon a distinct tube, but is inconspicuous behind the upper end of the ooecium. The radical fibers have black joints at frequent intervals.

It is with considerable doubt that I record this species for the Woods Hole region. I have taken on a number of occasions in the outer waters, specimens which seem from the zoarial characters to

belong to *denticulata*, but as no fully developed ovicells have been seen, I have not been able to arrive at a positive determination. The species has been recorded on the American coast from Florida, the Bay of Fundy and the Gulf of St. Lawrence.

Family TUBULIPORIDÆ Johnston, 1838.

KEY TO GENERA.

Zoarium encrusting or partly free, forming various sorts of expansions, entire, lobate, or branched. Zoecia mostly connate in diverging series. Sometimes a fan-like colony is extended at the edges to appear discoid at first glance.....*Tubulipora*.  
 Zoarium (in our species) entirely encrusting, irregularly lobate, rather thin. Zoecia longitudinally arranged, in great part immersed in the zoarium, the apertures widely separated....*Stomatopora*.

Genus TUBULIPORA Lamarck (pars), 1816.

KEY TO SPECIES.

1. Zoarium rising free from a small base, well branched, dichotomous, branches more or less triangular in cross section; zoecia disposed in alternate series on either side of the median line of the stem, connate and directed outward (*Idmonea*) .....*atlantica*.  
 Not such characters ..... 2.
2. Ooeciostome large, at least as large as the aperture of the cells, turned sidewise so as to open horizontally (*Idmonea serpens*) .....*liliacea*.  
 Ooeciostome small, directed upward, conspicuously flattened sidewise, the aperture not more than half as large as the apertures of the cells. ....*flabellata*.

*Tubulipora atlantica* (Johnston). [Pl. XIX, fig. 9, 9a.]

Johnston 1847, p. 278 (*Idmonea atlantica*, from Forbes' MS.).  
 Verrill 1879c, p. 28 (*T. atlantica* and *Fasciporina flexuosa*).  
 Harmer 1898, p. 88-9 (reasons for combining *Idmonea* with *Tubulipora*).  
 Cornish 1907, p. 78 (*Idmonea atlantica*).

Zoarium erect and spreading, irregularly branched dichotomously, the branches mostly in the same plane, triangular in section, the dorsal side striated and finely punctate. Zoecia 1 to 4 or 5 in each series, connate, the innermost the longest, the apertures directed somewhat outward, leaving a free space in the middle of the front side of the stem. In this space the oecium develops in a very irregular elongate form, swollen and involving the bases of the zoecia. Although the species has been figured by various authors, no one so far as I am aware has figured or mentioned the ooeciostome. In some well-developed specimens from Crab Ledge I find what I take to be this organ, which Harmer has shown to be of so much importance in the determination of the cyclostomatous Bryozoa. It consists of a tube, similar in size and length to the longest zoecium and connected with it, placed on the upper side of the series and curved toward the tip of the branch. The stalk is flared somewhat trumpet-like at its tip when fully developed, and the aperture, which is round, looks toward the tip of the branch. Numerous specimens of this beautiful species were taken at Crab Ledge on August 12, 1909, dredged by the Phalarope in 14 to 18 fathoms, attached to stones and shells. Although it is a widely ranging species it has not heretofore been noticed in this region.

*Tubulipora liliacea* (Pallas). [Pl. XX, fig. 10, 10a.]

Pallas 1766, p. 248 (*Millepora liliacea*).  
 Stimpson 1853 (*Idmonea pruinoso*).  
 Verrill and Smith 1874, p. 708 (*T. flabellaris*).  
 Verrill 1875a, p. 414, and 1879c, p. 28 (*T. serpens*).  
 Harmer 1898, p. 90-4 (synonymy of *Idmonea* and *Tubulipora serpens*, auct.).  
 Cornish 1907, p. 78 (*Idmonea serpens*).

Zoarium entirely or mostly adnate, showing but little tendency to the free, erect growth so common to the species in northern waters, irregularly lobate, in young state rather uniformly flabellate growing on hydroid stems, and in similar situations, the colonies becoming nodular masses of extreme irregularity. Zooecia growing in series, more or less alternate and connate, forming prominent radiating ridges, highest at the inner ends. Ooecia usually plentifully developed on older colonies, ooeciostomes opening sidewise, and so not conspicuous when viewed from above. Viewed from the side they appear as large as the zooecial apertures, and of a rounded form.

Occurs throughout Vineyard Sound, but not very common. Taken also on Sow and Pigs Reef, and in Buzzards Bay near Robinsons Hole. Taken in shallow water on piles at Woods Hole, and dredged in 3 to 15 fathoms; found on eel-grass and algae, and occasionally on hydroid and *Bugula* stems and on shells.

There has been much misunderstanding in regard to this and the following, as well as to other species of the genus. Harmer (l. c.) has carefully gone over all the data in regard to these forms, and has fixed upon the nature of the ooeciostome, a character almost entirely overlooked by the older students of the group, as the best means of determining the species. A study of the form of the zoarium and the arrangement of the zooecia has shown that these characters vary almost endlessly, while the ooeciostome is quite constant.

Verrill confused this and the following species, evidently, since both occur on our coast, and I have found them both in material which he dredged for the United States Fish Commission. His reference to the Vineyard Sound material must be placed under this species (as he later recognized), since it is the only one occurring within the waters of the Sound. Verrill's reference to its habits also indicates that he had this species in Vineyard Sound, though he makes no mention of any other species in the waters of the region.

***Tubulipora flabellaris* (Fabricius).** [Pl. xx, fig. 11.]

Fabricius 1780, p. 430 (*Tubipora flabellaris*).

Dawson, 1859, p. 257.

Verrill 1879c, p. 28.

Cornish 1907, p. 78.

Harmer 1898, p. 99 (synonymy).

Zoarium entirely adnate as far as I have observed in our specimens, in the young state more or less flabellate, in the older stages the form often becomes discoidal by the edges spreading around so as to inclose the base of the colony. Zooecia sometimes free, sometimes connate, in series, and radially arranged. Ooecia usually plentifully developed on the older colonies, the ooeciostome directed upward, the orifice conspicuously narrowed or compressed from side to side, slit-like, not half as large as the zooecial apertures.

Taken at Crab Ledge, off Sankaty Head, and Great Round Shoal, on shells and stones, not common. Finely developed colonies on shells dredged on the Nantucket Shoals by the United States Fish Commission in 1875.

Harmer states that "this seems to be an essentially northern species and I have no evidence of its occurrence in British waters." Hincks's species proves to be *T. phalangca* Couch. The distribution is thus seen to be much farther southward in American than in European waters.

**Genus STOMATOPORA Bronn, 1825.**

***Stomatopora diastoporoides* (Norman).** [Pl. xviii, fig. 12, 12a.]

Norman 1863, p. 310 (*Alecto diastoporoides*).

Zoarium forming a thin irregular crust, usually with a lobed or sinuate outline, milk-white or semi-transparent when fresh, rather coarsely punctate, often transversely striated, reaching a diameter of about  $\frac{3}{4}$  inch. Zooecia embedded for the greater part of their length, the free part suberect and short and the apertures well separated; orifice rounded to subelliptical. No ooecia have been noted for this species.

A few specimens of this species dredged at Crab Ledge on pebbles. It has not hitherto been recorded south of Canadian waters.

Family LICHENOPORIDÆ Hincks, 1880.

Genus LICHENOPORA Defrance, 1823.

*Lichenopora verrucaria* (Fabricius). [Pl. xviii, fig. 13, 13a, 13b.]

- Fabricius 1780, p. 430 (*Madrepora verrucaria*).
- Verrill and Smith 1874, p. 707 (*Diasopora patina*).
- Verrill 1875a, p. 414, and 1879c, p. 28 (*Discoporella verrucaria*).
- Cornish 1907, p. 79.

Zoarium usually a more or less circular disc, sometimes raised into a dome or otherwise modified; usually entirely adherent, but sometimes stipitate, or with the edges projecting; size small, usually about 1/8 inch in diameter. Zoecia comparatively large, raised, in more or less regular radiating lines but not connate; usually with a well-developed rib on the side next to the center of the zoarium and carried upward above the orifice into a pointed process; orifice large and oblique; marginal zoecia not elevated. Ooecium an inflation of the surface; ooeciostome raised, with a rounded or sometimes elliptical trumpet-shaped ooeciostome. The central area, which is free from zoecia, as well as the spaces between the zoecia, is coarsely punctate.

This little species is common at Crab Ledge on the stems of *Bugula*, *Gemellaria* and hydroids, as well as on shells and stones. Taken also off Sankaty Head, Nantucket, Muskeget Channel, Nobska Point in shallow water, Robinsons Hole, and near Gay Head. Recorded for Vineyard Sound off Vineyard Haven by Verrill. The species is a northern and arctic one and probably does not occur much farther south on our coast.

Suborder CHILOSTOMATA Busk, 1852.

KEY TO FAMILIES.

- I. Nonincrusting forms, erect or creeping, usually more or less phytoid and flexible.
  - 1. A creeping stolon, with expansions from which arise the tubular zoecia (the polypide is more or less contained within the expansion); zoecium with a lateral membranous area and a terminal orifice. . . . . Æteidæ.  
 Zoarium phytoid or spreading, never stolonate. . . . . 2.
  - 2. Zoecia uniserial or in two rows back to back, no appendages (avicularia or vibracula). . . . . Eucrateidæ.  
 Zoecia in two or more series, all facing the same way, appendages usually present. . . . . 3.
  - 3. Zoecia closely united, appendages sessile. . . . . Cellulariidæ.  
 Zoecia more loosely united, appendages pedunculate and jointed. . . . . Bicellariidæ.
- II. Incrusting forms, usually forming a well calcified crust on shells, stones, algæ, etc., occasionally erect and foliose or branching, but when so rigid and solidly attached and usually arising from an incrusting base.
  - 1. Front wall of zoecium depressed, membranous or partly bridged over by a calcareous shelf, zoecial borders raised. . . . . Membraniporidæ.  
 Front wall of zoecium entirely calcified (except for a small pore in some cases) up to the operculum. . . . . 2.
  - 2. Zoarium entirely encrusting; zoecial wall more or less traversed with transverse or radiating furrows. . . . . Cribrilinidæ.  
 Zoarium encrusting or more or less erect; front wall of the zoecium often porous, but never regularly grooved transversely or radiately. . . . . 3.
  - 3. A small pore situated in the midline of the front wall below the orifice. . . . . 4.  
 No median open pore, though not infrequently a small rounded avicularium may be so placed. . . . . 5.

4. Zoecial orifice nearly semicircular, not raised into a tube, pore immersed. . . . . Microporellidæ.  
 Zoecial orifice round, raised into a semierect tube, near the base of which the pore is placed, raised on a prominence. . . . . Porinidæ.
5. Lower margin of primary orifice with a definite sinus, or when the sinus is obsolete the cells more or less erected and the aperture guarded by a projection bearing an avicularium on the side, Myrizoidæ.
- Lower margin of primary orifice straight, or occasionally rounded, without a definite sinus, though the overgrowth of a secondary margin may simulate this condition; the lower or lateral margins of the orifice may bear denticles, and avicularia may be present in relation to the orifice; zoecia not erect. . . . . Escharidæ.

#### Family ÆTEIDÆ Smitt, 1867.

This family is easily distinguished by the slender creeping stolon which is expanded here and there into fusiform enlargements from which arise tubular upright extensions. The zoecium consists of the erect tube plus the expansion. The orifice is at the top of the erect part, and a membranous area occupies one side of the terminal portion. There is only one genus.

#### Genus ÆTEA Lamouroux, 1812.

*Ætea anguina* (Linné). [Pl. XXI, fig. 14, 14a.]

Linné 1858, p. 816 (*Sertularia anguina*).

Verrill and Smith 1874, p. 710.

Verrill 1879c, p. 28.

Zoarium delicate, creeping, white, the erect portions of the zoecia arising almost at right angles to the stolonate base. Terminal portion of the tube slightly more expanded, more or less spoon-shaped, finely punctate, one side membranous; stalk about twice as long as the spoon-shaped part, more or less curved or nearly straight, distinctly annulate; dilated basal portion finely punctate. Ooecium subterminal, opposite the membranous area, a round bladder-like transparent sac, through which the cells of the dividing egg may be easily seen.

An abundant species, but inconspicuous on account of its small size and trailing habit of growth. Found on stems of various animals and algæ as well as on shells and stones. Dredged at from 1 to 19 fathoms, and found on piles at low water throughout the region. Old colonies on shells frequently have the erect portions broken off, in which case there is a fairly close resemblance to *Hippothoa divaricata* but the finely punctate character of the expansion, as well as the condition of the aperture, will distinguish it at once.

The ooecia are very rarely present, so that the species was long described as possessing none. Fine colonies taken August 9, 1906 (Fish Hawk station 7567), on *Pennaria* stems, have numerous ovicells, containing embryos from the 4-celled stage to the ciliated larvæ ready for extrusion.

#### Family EUCRATEIDÆ Hincks, 1880.

Zoarium phytoid; zoecia arranged in a single series or in two series back to back; orifice subterminal more or less oblique; no appendages.

#### KEY TO GENERA.

- Zoarium with creeping base and erect branching shoots; zoecia uniserial, branches arising on the front side of a zoecium below the orifice. Fertile cells dwarfed, arising on the front of normal zoecia, ovicells terminal. . . . . *Eucratea*.
- Zoarium erect, phytoid; zoecia regularly biserial, back to back, branches arising from the side of the zoecium near the upper end; ooecia none. . . . . *Gemellaria*.
- Zoarium erect; zoecia uniserial or occasionally biserial, back to back. Branches arising from the back of a zoecium and facing in the opposite direction. Fertile cells small and placed back to back against the ordinary zoecia, ooecium terminal. . . . . *Scruparia*.

Genus **EUCRATEA** Lamouroux, 1812.**Eucratea chelata** (Linné). [Pl. XXI, fig. 15.]Linné 1858, p. 816 (*Sertularia chelata*).

Verrill and Smith 1874, p. 710.

Verrill 1879c, p. 28.

Zoarium branched and straggling, more or less decumbent. Zoecia narrowed below, gradually enlarged upward to the base of the aperture, which slants away to the top of the cell; aperture oval, with a thin, raised, smooth margin; frequently a rudimentary zoecium borne on the front side of the normal cell just below the aperture, and when the oocium is present it is borne terminally on such a dwarfed cell.

Spreading over algæ, hydroids and other Bryozoa. Not common in the Woods Hole region. Verrill (l. c.) records it off Gay Head in 10 fathoms. In hundreds of dredgings I have never noticed it, but it occurs on the piles at Vineyard Haven and at Woods Hole.

Genus **GEMELLARIA** Savigny, 1811.**Gemellaria loricata** (Linné). [Pl. XXI, fig. 16, pl. XXXI, fig. 97.]Linné 1761, p. 542 *Sertularia loricata*.Lamouroux 1816, p. 7 (*Loricaria americana*).Dawson 1865, p. 3 (*Gemellaria willisii*).

Verrill and Smith 1874, p. 747.

Verrill 1879c, p. 29 (*G. loricata* and var. *americana*).Stimpson 1853, 19 (*Gemellaria dumosa*).Whiteaves 1901, p. 91-92 (as *G. loricata* and var. *americana*).

Cornish 1907, p. 75.

Zoarium erect, phytoid, forming bushy colonies often several inches in height. Zoecia joined back to back in a double series of great regularity. Orifice large, slightly oblique, occupying about half of the front of the cell but varying considerably in this respect, a thin raised smooth margin about the orifice. No ovicells nor appendages.

Common in the outer waters of the region. There is considerable difference in appearance between the rather rigid shorter colonies (1 to 3 inches in height) from the shallower waters of Crab Ledge and Nantucket, and the more slender, elongate colonies (6 to 10 inches) from deeper water off No Mans Land. The cells of the latter are more slender and elongate, but otherwise there is no material difference. I take the shorter form to be Lamouroux's *americana* and Stimpson's *dumosa*, but do not consider it worthy of even a varietal name.

Genus **SCRUPARIA** Hincks, 1857.**Scruparia clavata** Hincks. [Pl. XXI, fig. 17, 17a, 17b, 17c.]

Hincks 1857, p. 175.

Whiteaves 1901, p. 92.

Cornish 1907, p. 75.

Zoarium sparingly branched, decumbent, and straggling. Zoecia uniserial, or biserial and placed back to back, elongate, clavate, rounded above and attenuated below, each cell attached to the dorsal surface of the one below it by a cordate expansion of the base. Aperture suborbicular, slightly produced and contracted below, without raised margin. Oocia terminal on small cells back to back with the ordinary ones, globose with a few large punctures.

Apparently a rare species. Dredged at Crab Ledge, 18 fathoms, on *Gemellaria loricata*, and at Great Round Shoal, 8 fathoms, on *Bugula murrayana*. Only very small colonies have been noted and it may be that the species does not reach a very great development in this region. The presence of ovicells indicates sexual maturity, even though the colonies consist of only a few cells.

## Family CELLULARIIDÆ, Johnston (pars), 1849.

## KEY TO GENERA.

1. Zoarium jointed ..... 2.  
 Zoarium not jointed, vibracular cells very large, placed obliquely on the backs of the zooecia, vibracula long ..... *Caberea*.
2. Zooecia few, usually 3 or 5, in each internode, elongated and attenuated below, usually a lateral sessile avicularium and one or two on the front of the zooecium. .... *Menipea*.  
 Zooecia many in each internode. .... 3.
3. Vibracula wanting and usually the avicularia also, but occasionally there is a sessile avicularium, *Cellularia*.  
 Vibracula and avicularia present, the former small and situated low down on the back of the cell, the latter sessile on the outer edge and often on the front of the cell. .... *Scrupocellaria*.

## Genus CABEREA Lamouroux, 1816.

*Caberea ellisii* (Fleming). [Pl. XXI, fig. 18, 18a, pl. XXXI, fig. 93.]

Fleming 1828, p. 251 (*Flustra ellisii*).  
 Verrill and Smith 1874, p. 711.  
 Verrill 1879c, p. 29.  
 Whiteaves 1901, p. 93.  
 Cornish 1907, p. 76.

Zoarium more or less fan-shaped, yellowish brown, branches stout, widening upward. Zooecia in 2 to 4 rows, short, quadrangular, aperture elliptical, occupying nearly the whole of the front, with a broad margin. Lateral zooecia with two stout spines on the outer side and one on the inner, median cells with one spine on each side. Avicularia of two kinds, the lateral ones small with a rounded mandible and placed a little way below the top of the cell, the other sort raised and rounded and placed below the aperture. Vibracular cells very large, covering very nearly the whole of the back of the zooecia on which they are situated; vibracula very long, toothed, especially near the tip. Ooecia flattened, smooth, or finely striate with radiating lines.

Occurs in the outer waters of the region, sometimes abundant. Usually attached to shells and pebbles, but sometimes to other sessile forms. Not taken in Vineyard Sound or Buzzards Bay.

## Genus MENIPEA Lamouroux, 1812.

*Menipea ternata* (Solander). [Pl. XXI, fig. 19, pl. XXXI, fig. 96.]

Solander 1786, p. 30 (*Cellaria ternata*).  
 Desor 1848, p. 66 (*Cellularia densa*).  
 Packard 1867, p. 273.  
 Verrill and Smith 1874, p. 711 (?*Cellularia ternata*).  
 Verrill 1879a, p. 53 (*Cellarina ternata*).  
 Verrill 1879c, p. 28 (*Cellularia ternata* and var. *gracilis*).  
 Whiteaves 1901, p. 92.  
 Cornish 1907, p. 75.

Zoarium dichotomous, straggling, forming delicate, white, bushy tufts. Internodes usually consisting of three cells, but not infrequently five or even seven cells, may be present. Zooecia elongated, much attenuated below, showing much variation in the length of the cell. Two spines are present at the top of the cell, and another, a little separated from these, at the outer margin of the aperture, the shield or scute (a modified spine), more or less developed or occasionally wanting, arches over the aperture. Avicularia of two sorts, a prominent sessile one at the outer upper angle of the cell, and a small one, often wanting, immediately below the aperture. Ooecia somewhat elongated, smooth. Radical fibers simple, arising from the lower parts of the zoarium; long tendril-like structures are com-



mon on the upper branches, arising from the sides of the cells above the lateral avicularia, enlarged toward the end.

Found in the outer waters of the region, sometimes abundant, at 8 to 25 fathoms. Attached to shells, stones, hydroids, other Bryozoa, etc. Off Gay Head, S. W., Crab Ledge, Great Round Shoal, off Sankaty Head, etc.

While Desor's description of his *Cellularia densa* is too inadequate to determine the species under any other conditions, I am satisfied from having dredged the type locality that the above synonymy is correct, and Verrill has already placed it here questionably.

Genus **CELLULARIA** Pallas, 1766.

**Cellularia peachii** Busk. [Pl. XXI, fig. 20 bis.]

- Busk 1851, p. 82.
- Packard 1867, p. 272.
- Verrill 1879a, p. 53, and 1879c, p. 29 (*Bugulopsis peachii*).
- Whiteaves 1901, p. 92.

Zoarium dichotomous, phytoid. Zooecia biserial and alternating, elongate, attenuated below, a short spine on the upper, outer angle (often wanting); at the terminus of each internode the cell situated between the bases of the branches has this spine situated mesially at the top. Aperture oval, or narrowed below, margin slightly thickened, frequently minutely granulated, dorsal surface smooth, with several (3 to 5) perforations. Ooecia subglobose, the surface tessellated.

Apparently rare. A few small specimens attached to shells and to *Bugula murrayana*, taken at Great Round Shoal in 8 fathoms. The species has not heretofore been noted south of Canadian waters.

Genus **SCRUPOCELLARIA** Van Beneden, 1844.

**Scrupocellaria scabra** (Van Beneden). [Pl. XXI, fig. 20, pl. XXXI, fig. 95.]

- Van Beneden 1849, p. 73 (*Cellarina scabra*).
- Verrill 1879a, p. 53 (*Cellarina scabra*).
- Verrill 1879c, p. 29 (*Cellularia scabra*).
- Whiteaves 1901, p. 93.

Zoarium dichotomous, internodes with 5 to 12 cells. Zooecia short, narrowed below, aperture oval, occupying more than half of the front, with a smooth border; one or two stout spines on the outer margin above, and a small one on the inner margin; shield or scute entire, suboval, the surface figured with a lobate or antler-like area, often not well developed. Vibracular cells wedge-shaped, placed transversely across the back of the zoecium (often wanting), with a short vibraculum which is not longer than the zoecium. Radical fibers long and slender, scattered over the whole zoarium. Ooecia somewhat flattened in front, subglobose, a smooth subtriangular space above the aperture, from which fine lines radiate toward the margin.

Rather rare. Crab Ledge and off Sankaty Head, on shells and stones. Woods Hole harbor in drift. The latter specimen must have been carried in from outside waters, for the examination of several hundred dredge hauls in Vineyard Sound and Buzzards Bay did not reveal it.

Family **BICELLARIIDÆ** Hincks, 1880.

KEY TO GENERA.

- Zooecial orifice subterminal, facing partly upward, the margin with several very long, slender spines, one placed just below the orifice.....*Bicellaria*.
- Zooecial orifice occupying a large part, sometimes nearly the whole, of the front of the zoecium, no spine below the orifice.....*Bugula*.

Genus *BICELLARIA* Blainville, 1830.*Bicellaria ciliata* (Linné). [Pl. XXI, fig. 21, 21A, 21B.]Linné 1758, p. 815 (*Sertularia ciliata*).

Verrill 1879c, p. 29.

Whiteaves 1901, p. 93.

Zoarium dichotomous, branches curved inward at tip, forming feathery tufts of a white color. Zoecia alternate, biserial, turbinate, enlarged above and narrowing rather abruptly toward the bottom, where it is cylindrical, while at the top it is somewhat flared outward around the elliptical, oblique aperture. Four to seven very long spines on the upper margin and one centrally located on the lower margin. Avicularium on outer side of cell below the aperture, small, with a serrate beak. Ooecia helmet-shaped, pedunculate, situated at inner side of aperture, the narrow stalk arising from the side of the cell.

This beautiful species is well distributed in the region, but is never very plentiful. Dredged in Vineyard Sound and Buzzards Bay attached to shells, stones, hydroids, etc., and growing less commonly on piles at Woods Hole, Vineyard Haven, and Nantucket. Ovicells plentiful and containing embryos in July and August.

Genus *BUGULA* Oken, 1815.

## KEY TO SPECIES.

1. Zoecia arranged biserially ..... 2.  
Zoecia arranged in more than two series ..... 5.
2. Stalk of colony with ordinary root fibers ..... 3.  
Stalk of colony with hooked or grapnel-like "uncinate" processes in place of root fibers,  
*gracilis*, var. *uncinata*.
3. Avicularia rather short, the beak strongly decurved at tip ..... 4.  
Avicularia elongate and slender the beak gently and evenly curved to its tip ..... *avicularis*.
4. Usually one strong spine at the outer angle of the orifice, ovicell set at an angle with the axis of the zoecium, margin of the beak of the avicularium not serrate ..... *turrita*.  
Usually four spines above, ovicell in line with zoecial axis, beak of avicularium with serrated margin ..... *cucullifera*.
5. With marginal spines bending over the aperture, ooecium large, subglobular, avicularia of two sorts, the lateral ones very large ..... *murrayana*.  
No marginal spines except at the top, ooecium small, hemispherical, avicularia of one sort, small, *flabellata*.

*Bugula gracilis* var. *uncinata* Hincks. [Pl. XXI, fig. 22, 22A.]

Hincks 1880, p. 86-89.

Zoarium one to two inches in height, of a light yellow color, forming a bushy tuft with flabellate branches somewhat spirally disposed. Zoecia biserial, alternate, slightly narrowed below. Aperture rather narrow, about two-thirds as long as the cell, narrowed below and turned inward toward the axis of the branch. A spine on each angle of the margin and a third, somewhat larger, behind the outer marginal spine. Avicularium small, placed on the outer margin about halfway up the aperture. The curious uncinata (tendrill-like or anchor-like) processes developed freely on the basal part of the zoarium, where they replace the radical tubes of other species. Hincks makes no mention of the ovicells and I have not found them in any of my specimens.

Not common but well distributed over the region. Dredged a number of times in Vineyard Sound and Buzzards Bay and found in drift at No Mans Land, also found growing on the Nantucket Cable. Hincks (l. c.) mentions a specimen from Lynn, Mass., which is the only previous record for the species in America.

**Bugula turrita** (Desor). [Pl. XXI, fig. 23, 23a, 23b, pl. XXXI, fig. 102.]Desor 1848, p. 66 (*Cellularia turrita*).

Verrill and Smith 1874, p. 712.

Verrill 1879a, p. 52; 1878, p. 304; 1879 b, p. 189, and 1879c, p. 29.

Perkins 1869, p. 161 (*Cellularia turrita*).? Leidy 1855, p. 142 (*Cellularia fastigiata*).

Desor's description, which is very inadequate, but sufficient under the circumstances for the recognition of the species, is as follows: "Polydom dense, like a bush, stem orange colored, divided into a great number of branches so that each stem looks like a small tower or pyramid. Found in depths ranging from 3 to 15 fathoms. Thrown in great quantity upon the beaches of the islands of Nantucket and Martha's Vineyard."

Zoarium, when fully developed, much branched, several inches in height; the branches bear secondary whorled or spirally arranged branches of a flabellate character, which curl inward somewhat at their tips, giving each main branch a pyramidal form; color ranging from pale yellow to bright orange. Zooecia biserial and alternate, elongate, narrowed toward the base; the aperture occupies about two-thirds of the front and is turned somewhat toward the axis of the branch; a short spine usually present at each angle of the margin, the inner one bent somewhat across the aperture, a larger spine (often very stout) usually present behind the outer marginal spine. Avicularium small and rather stout, with curved beak, situated on the outer margin of the aperture at about its middle. Ooecium rather large, globose, arising at one side of the axis of the zooecium on its upper margin and deflected somewhat toward the axis of the branch. Root fibers strong and plentifully developed. Our largest and most abundant *Bugula*.

Found everywhere throughout the region, dredged at all depths, and growing luxuriantly on piles.

**Bugula cucullifera**, new name. [Pl. XXII, fig. 24, 24a, 24b, 24c.]

Verrill 1879b, p. 188; 1879a, p. 52, and 1879c, p. 29. (*B. cucullata* Verrill.) Verrill's name for this species is preoccupied by *B. cucullata* Busk (1867, p. 241), now regarded as a synonym of *B. serrata* Lamarck.

Verrill's description, somewhat abbreviated, is as follows: Zoarium much branched, branches slender, dichotomously divided, the branchlets diverging but little. Zooecia in two alternating rows, rather large, elongated, narrow, with the long frontal area occupying most of the length. At the distal angles there are usually two rather long slender spines, but often three on the outer angle. The spines are unequal, divergent, more or less curved and directed upward, the one farthest in front is usually longest, curved forward and upward at the base. Avicularia large, elongated, the length greater than the width of the zooecia, situated rather in advance of the middle of the outer margin of the frontal area, the beak reaching beyond the distal end of the zooecium, the head compressed, broad oval; beak long, concave above, strongly incurved or hooked at the tip. Ooecia short, but wide, nearly hemispherical, the front edge turned upward, showing a large opening in a front view, and giving them a hood-like appearance, surface more or less areolated, glistening.

Verrill described this species from Jeffreys Ledge, off Maine, and off Cape Cod, in 51 to 75 fathoms. It occurs sparingly at Crab Ledge in 14 to 20 fathoms.

**Bugula flabellata** (Thompson). [Pl. XXII, fig. 25, 25a, 25b, pl. XXXI, 94.]Thompson 1847 (*Avicularia flabellata*).

Verrill and Smith 1874, p. 711.

Verrill 1879b, p. 189, and 1879c, p. 29 (*Bugula flustroides*).

Zoarium short, rarely exceeding an inch, branching, the branches arranged in a broad fanlike fashion and more or less whorled, the main stem very short so the larger branches all arise near the base. Zooecia arranged in series of three to six, and more or less alternating; elongate, the membranous area occupying the whole of the front; the lateral margin is free from spines, but from two to four rather stout spines appear on the upper margin, the anterior ones stronger and projecting somewhat forward or curved inward. Avicularia situated only on the outer cells of the series, about one-fourth of the way below the upper end of the cell, moderately large, longer than the width of the cell, with

strongly decurved beak. Ovicell situated directly above the cell, the stalk broad, form hemispherical or somewhat hood-like, the opening wide and directed forward and downward. A considerable amount of variation is noticeable in the form of the cell and in the development of the spines. The ovicells in our specimens are more open than Hincks figures them in the English specimens, but the differences are not sufficient to warrant a separation, in my opinion.

Verrill has recorded the species from Vineyard Sound at 6 to 8 fathoms. It has proved rather uncommon in our dredgings, but it grows abundantly on piles throughout the region.

**Bugula murrayana** (Johnston). [Pl. XXII, fig. 26, 26a.]

Johnston 1847, p. 347 (*Flustra murrayana*).

Desor 1848, p. 66 (*Flustra truncata*).

Packard 1863 (*Flustra murrayana*), 1867, p. 273 (*Menipea fruticosa*).

Verrill and Smith 1874, p. 711.

Verrill 1879a, p. 52, and 1879b, p. 189, and 1879c, p. 29 (as *B. murrayana* and *B. murrayana* var. *fruticosa*).

Whiteaves 1901, p. 93.

Zoarium dichotomously divided into broad foliose or ribbon-like strips, truncate at tip, or sometimes (var. *fruticosa* Packard) the divisions are narrow and linear. Zooecia multiserial in four to twelve rows, alternating, oblong, truncate above and narrowed below. Aperture reaching nearly to the bottom; an erect spine at each angle above, and a varying number (1 to 5) of marginal spines curving over the aperture. Avicularia of two kinds, the smaller ones situated on the front of the cells at the bottom, with the mandible turned upward, the larger ones on the lateral cells only, situated on the outer margin of the aperture, and several times as large as the others; in both the beak is strongly hooked. Ooecia large, wider than the top of the zooecia, subglobose, with radiating striæ. Radical fibers long, stout and wrinkled, arising from the marginal cells near the base of the zoarium. Height  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches. The light yellowish or brownish colonies stand up like small frills on the shells and pebbles to which they are attached.

Very common in the outer waters of the region; Crab Ledge, Great Round Shoal, off Sankaty Head, etc., in 8 to 25 fathoms. Noted by Verrill off Gay Head in 10 to 20 fathoms. Not taken in Vineyard Sound or Buzzards Bay.

**Bugula avicularia** (Linné). [Pl. XXI, fig. 27.]

Linné 1758, p. 809 (*Sertularia avicularia*).

Verrill 1879a, p. 52, 1879b, p. 189, and 1879c, p. 29.

This species has been recorded by Verrill from "Long Island Sound to Spitzbergen," but it has not appeared in any of the collections from the Woods Hole region. The species may be recognized by its biserial arrangement of the zooecia, together with the large size of the avicularia, which are elongated and have the long slender beak gently curved to its tip. In our other species of this region the beak is abruptly decurved near its tip.

Family MEMBRANIPORIDÆ Busk, 1854.

This family has a large representation in the waters of this region. All our species are incrusting, and the majority of them have the aperture widely open. I have followed Waters (1898) in merging *Biflustra* with *Membranipora*, so all of our species fall within the limits of one genus.

Genus MEMBRANIPORA Blainville, 1834.

KEY TO SPECIES.

1. Front wall inside of raised margin entirely membranous. . . . . 2.
- Front wall partly (sometimes very slightly) bridged over by a calcareous lamina . . . . . 3.
2. Ooecia and avicularia absent. . . . . 4.
- Ooecia and avicularia present . . . . . 5.
4. Entirely devoid of spines, or with very slender erect spinules . . . . . *lacroixii*.
- Spines well developed. . . . . 6.

6. An area on the front wall below the raised margin perforated with large pores, spines all strong. . . . . *pilosa*.  
Area below raised margin not so perforated, spines weaker, the median spine at lower edge of  
aperture stout, others occasionally absent. . . . . *monostachys*.
5. Spines few, usually 2, one on either side of the aperture at the upper end, ooeecium usually  
with a strong suberect avicularium on its forward end. . . . . *unicornis*.  
Spines more numerous. . . . . 7.
7. Spines usually 13 or more, bent downward over the aperture and flattened in cross section,  
directed strongly forward. . . . . *craticula*.  
Spines less in number, not strongly directed forward. . . . . 8.
8. Spines usually less than 12, nearly erect and pointed, except the most anterior pair, which  
are blunt at the end and directed somewhat forward. . . . . *lineata*.  
Spines 4 to 6, one or two erect, the others broad and flattened and bent downward over the  
aperture, a small avicularium on either side, occasionally on one side only (sometimes  
with a large avicularium transversely placed at the base of the cell, variety *armifera*) . . . . . *arctica*.
3. Ooeccia present. . . . . 9.  
Ooeccia wanting. . . . . 10.
9. Ooeecium with a strongly raised rib inclosing a somewhat triangular area. . . . . *aurita*.  
Ooeccial rib not so strongly developed, inclosing a rectangular area. . . . . *flemingii*.
10. Small avicularia situated on the tops of slender pedicels among the marginal spines, which are  
long, zooecial walls very high. . . . . *cymbaformis*.  
Avicularia wanting; spines, when present, in the form of stout tubercles. . . . . 11.
11. Calcareous lamina well developed, half closing the area, with strong teeth projecting toward  
the center. . . . . *tenuis*.  
Lamina much less developed, lacking the strong teeth of the last species; in this region found  
only on floating *Sargassum* of the Gulf Stream drift. . . . . *tehuetcha*.

**Membranipora lacroixii** (Audouin). [Pl. xxii, fig. 28, 28a, 28b.]

- Audouin, 1826, p. 240 (*Flustra lacroixii*).  
? Packard, 1867, p. 8.  
Dawson, 1859, p. 256.  
Hincks, 1880, p. 131.  
Waters, 1898, p. 679.  
Whiteaves, 1901, p. 97.

Zoarium encrusting, forming a delicate network over stones, etc. Zooecia rather small, the membranous area large and only slightly depressed, i. e., nearly flush with the calcareous margin. The latter is finely granulated on its inner border, and it is slightly raised at the anterior end of the cell in front of the operculum. There are no tubercles, avicularia, or ovicells in this species, and the slender spinules, of which 2 to 12 may be present in the species, are absent from the only specimen I have seen from this region. A colony which was kept for several months living in a standing aquarium at New Haven by Dr. L. J. Cole has the spines well developed. An excellent diagnostic character, mentioned by Waters (l. c.), is found in a pair of rounded uncalcified areas near the anterior end on the underside of the zooecium, with other smaller areas occasionally present, but to discover these it is necessary to remove the zooecia from the substratum.

The species has been so confused in the literature that records of its occurrence are somewhat doubtful. Our species is identical with that which Waters discusses under this name. Packard, Hincks, and Whiteaves have listed it for Canada, and may have been correct in so doing.

A single large colony, several inches in diameter, encrusting a stone, was taken in the estuary of the Weweantic River, at the head of Buzzards Bay, near the low-tide mark, by Dr. E. D. Congdon.

**Membranipora monostachys** Busk. [Pl. xxii, fig. 29, 29a, 29b, pl. xxx, fig. 87.]

- Busk, 1854, p. 61.  
Leidy, 1855, p. 9 (*Escharina lineata*).  
? Verrill and Smith, 1884, p. 712 (*M. lineata*).

Zoarium forming irregular, often radiate or catenulate colonies on shells, stones, and occasionally on algæ. Zoecia rather small, the basal portion solidly calcified or very finely punctate; membranous area oval to elliptical, border slightly raised, smooth, or slightly granular, and usually studded with sharp spines which bend over the area. In the more usual form of the colony there are 8 or 10 pairs of these spines, one pair situated at the anterior end of the cell and directed somewhat forward, and there is a single basal spine somewhat larger than the others; in the other form of the colony to which the species owes its name the margin is unarmed except for the basal spine, which is much stouter but not elongated. Avicularia and ovicells are wanting. In some of the older zoecia there is not infrequently found a secondary calcareous lamina partly closing the membranous area after the manner of *M. catenularia* (Jameson). Abortive zoecia are not uncommon, and these are sometimes completely closed over.

Occurring with some frequency throughout the region, dredged in 2 to 19 fathoms. It is most common in Vineyard Sound and Buzzards Bay on shells and stones, but I have noted it on algæ, egg-cases of skates, and on the carapaces of crabs and *Limulus*; No Mans Land in drift, Muskeget Channel, Great Round Shoals, and Nantucket and Woods Hole harbors on piles. The *Escharina lineata* of Leidy is certainly this species, judging by the figure he gives (pl. x, fig. 22). I am inclined to the belief also that Verrill's reference to *M. lineata* belongs rather to *monostachys*, for the reasons that he places Leidy's reference in his synonymy, and that his remarks concerning the species refer rather to *monostachys*. The latter, moreover, is common in the region dredged by Verrill, while *lineata* seems to be rare south of Cape Cod.

**Membranipora pilosa** (Linné). [Pl. xxii, fig. 30, 30a.]

- Linné 1766-68, p. 1301 (*Flustra pilosa*).  
 Leidy 1855, p. 141.  
 Packard 1867, p. 272.  
 Verrill and Smith 1874, p. 712.  
 Verrill 1879c, p. 29 (*Electra pilosa*).  
 Whiteaves 1901, p. 95 (*Electra pilosa*).  
 Cornish 1907, p. 76.

Zoarium encrusting algæ, stones, and shells, usually in irregular patches. Zoecia large, the basal portion large and coarsely punctate; membranous area usually regularly oval, sometimes elongated, surrounded by a rather high, smooth border, from which project several (usually 7 or 9) stout curved spines. The basal spine varies greatly in size, and seems to be very closely correlated with the character of the substratum. On flat surfaces, as stones, shells, and the broader algæ, this spine is scarcely longer than the others, while on rounded surfaces, as the smaller algæ, hydroid stems, etc., the spine may be considerably longer than the whole zoecium and more or less horny. Intermediate forms are occasionally found which connect the long-spined typical variety with the short-spined var. *dentata* (Solander).

Very common throughout the region, from low tide to 17 fathoms; more common on the broader algæ and taken wherever these occur.

**Membranipora lineata** (Linné). [Pl. xxiii, fig. 31, 31a, 31b, 31c.]

- Linné 1766-68, p. 1301 (*Flustra lineata*).  
 Dawson 1859, p. 256.  
 Packard 1867, p. 272.  
 Verrill 1879c, p. 29.  
 Whiteaves 1901, p. 96.  
 Cornish 1907, p. 76.

Zoarium encrusting shells, stones, and algæ, forming small rounded patches. Zoecia of moderate size, the aperture oval or more elongate, surrounded by a rather narrow raised margin, from which project 4 to 6 pairs of spines. These spines are rather slender and pointed, the anterior one or two pairs are bent forward somewhat, and the others are directed upward and curve somewhat over the aperture. A moderate sized avicularium is occasionally present at the base of the zoecium; it is somewhat raised and the beak is rather prominent. Ooecium large, smooth, and shining, with a raised rib crossing it trans-

versely. Seen from the dorsal side the zoecium shows two pairs of lateral pore chambers and a single large anterior one, with spines projecting into the chambers.

This species appears to be rare in this region, and in the course of several years of dredging and other collecting in this group I have found it only a few times. Gay Head on Devils Bridge reef, 2 to 3½ fathoms; Woods Hole harbor on *Fucus*, Vineyard Haven, and Nantucket Harbor on algæ, attached to piles; Crab Ledge, 15 fathoms on stones and shells.

As stated under that species, Leidy's and Verrill's records of *lineata* refer rather to *monostachys*.

**Membranipora craticula** Alder. [Pl. XXIII, fig. 32, 32a, 32b.]

Alder 1857, p. 144.

Verrill 1879c, p. 29 (as *M. lineata* var. *craticula*).

Whiteaves 1901, p. 96.

Zoarium forming small, usually rounded patches, encrusting shells and stones, rarely on algæ. Zooecia small, arranged usually in radiate series; the membranous area is somewhat elliptical in outline, the raised margin broad and provided with about 14 long spines. The most anterior two pairs are longer and blunter than the others; the first pair is directed well forward, the second pair more erect; and the remaining ones, which are somewhat flattened in cross section, bend forward and downward over the area in a very characteristic manner. On the dorsal side the zoecium strongly resembles *M. lineata*, but there are no spines projecting into the pore chambers. The avicularia are larger than those of *M. lineata* and are raised upon a bulging prominence (dwarf zoecium?). The oocelia are large, rounded, smooth, and shining, with a raised rib much as in *M. lineata*, except that it is more uniformly bent backward at its middle.

Not uncommon in the outer waters of the region, but not noted in Vineyard Sound or Buzzards Bay. Taken at Muskeget Channel, Great Round Shoal, Crab Ledge, No Mans Land, and Nantucket Shoals. The species is a northern one and has not hitherto been recorded south of Canadian waters.

**Membranipora arctica** (d'Orbigny). [Pl. XXIII, fig. 33, 33a, 33b, 34, pl. XXX, fig. 86.]

D'Orbigny 1851, p. 571 (*Reptoflustra*).

Verrill 1879c, p. 29 (as *M. unicornis* var. *sophia*).

Whiteaves 1901, p. 96-7 (*M. sophia* and the var. *armifera* Hincks).

Zoarium forming more or less circular, grayish or brownish patches on shells and stones, rather coarse, often an inch or more in diameter. Zooecia large, the membranous area oval or sometimes nearly round, the margin furnished with 4 to 6 very stout flattened spines, which are often somewhat contracted at the base and which bend down closely over the area. A pair of small avicularia (occasionally only one) on either side of the opercular opening, with an obtusely pointed mandible directed forward and somewhat toward the midline. Ovicell short, broad, and flattened, in the older parts of the colony deeply immersed, crossed by a raised rib.

In the younger stages a relation is shown to *M. lineata* and *M. craticula*, but *arctica* is a much coarser species; in older stages when the spines are heavily calcified there is a superficial resemblance to species of *Membraniporella*.

Not uncommon at Crab Ledge on shells and stones, 14 to 20 fathoms. Not previously recorded south of the St. Lawrence.

A well-marked variety of this species, var. *armifera*, plate XXIII, figure 34 (Hincks, 1880b, p. 82, *Membranipora armifera*), occurs at Crab Ledge with the typical *arctica*, but it is less common. The general character of the colony and of the zooecia is much the same as in the typical *arctica*, but it differs in the more slender character of the spines, in the presence of a small erect spine situated partly within the margin, just behind and in close relation to the avicularia on one or both sides of the aperture. A large elongate avicularium is sometimes present at the base of the zoecium behind the aperture, situated on a raised base which often overlaps the ovicell of the cell behind so as to appear a part of it. More often the raised base alone is present without an avicularium. Hincks figures the avicularium as pointing forward alongside the aperture, but it may be turned in any direction. He also describes the small lateral avicularia as pointing outward and backward, but in our specimens this condition is seen

only in the infertile cells near the center of the colony, while in the zoecia of the same colony bearing ovicells they are directed forward and inward, as in the typical form.

**Membranipora unicornis** (Fleming). [Pl. XXIII, fig. 35.]

Fleming 1828, p. 536 (*Flustra unicornis*).

Verrill 1879c, p. 29.

Whiteaves 1901, p. 96.

Zoarium encrusting shells, forming rounded whitish colonies. Zoecia large, somewhat translucent, the surface shining; aperture large, oval, somewhat contracted at the anterior end; the margin broad, finely crenulate on its inner edge, and bearing usually four spines near the forward end. The anterior pair of spines is small and erect (often wanting); the other pair is larger and usually unequal, one being much longer than the other, and the longer one may stand nearly erect or bend somewhat over the aperture. The ovicell is large, smooth, and bears a transverse rib. An avicularium is usually present at the base of the zoecium, mounted on a raised projection; when the ovicell is present the avicularium appears to arise from the ovicell, and the mandible is directed somewhat forward, but when the ovicell is absent the avicularium is reversed in position, the mandible pointing backward.

Dredged at Great Round Shoal in 8 fathoms, a number of fine colonies. Not hitherto recorded south of Canadian waters.

**Membranipora cymbæformis** Hincks. [Pl. XXIII, fig. 36, 36a.]

Hincks 1877, p. 99, 110, 149; 1888, p. 217 (*M. cymbiformis*).

Verrill 1879c, p. 29 (*M. spinifera*).

Whiteaves 1901, p. 96.

Zoarium encrusting the stalks of hydroids, Bryozoa, etc., usually forming small colonies of a very irregular form. Zoecia large, deep, with unusually high walls; the aperture is large and is often slightly bridged over, especially near the base, by a secondary lamina; the margin, which is rather broad, bears about 6 or 8 long erect spines, and usually one or two long pedicellate avicularia which occupy the same position as spines. Ovicells wanting.

Crab Ledge, 14 to 20 fathoms, and off Sankaty Head, ESE, 13 to 20 fathoms, rather common. The colonies are never large, and the best I have seen for study have been on the back of *Bugula murrayana*.

**Membranipora aurita** Hincks. [Pl. XXIII, fig. 37, 37a, 37b.]

Hincks 1877, p. 213.

Zoarium encrusting, usually on shells, but often on algæ. In the former situation circular colonies are produced and the zoecia are often disposed with extreme regularity, but on the stems of algæ they are generally irregular and the cells sometimes crowded. Zoecia moderately large, considerably narrowed at the anterior third, the walls high, and in the older colonies strongly calcified; entirely membranous in the younger stages, but partly closed by a calcareous lamina when fully calcified (Hincks describes it as entirely membranous); margin broad, finely tuberculate on its inner side, beset with one to four spines which are more or less erect (usually only one or two are found in the adult, and where two are present one is much larger than the other). Ovicell rounded, more or less immersed according to age and calcification, bearing a strong raised rib, which encloses a triangular space on the front of the oecium and which often rises into a strong umbonate process at the top in old colonies. The avicularia vary in a remarkable manner according to whether an ovicell is present on the zoecium just posterior. When no ovicell is present a single avicularium is regularly present with its tip usually pointing backward, but when the oecium is present there are very constantly two avicularia placed with great regularity on either side of the ovicell and pointing forward and outward. Just how the development of an oecium, which belongs to another cell, should thus influence the number and position of the avicularia is by no means clear.

Rather common and well distributed, found in Buzzards Bay and Vineyard Sound, Muskeget Channel, Great Round Shoal, and Crab Ledge, dredged in 3 to 18 fathoms. The species is known from England and Denmark, but has not hitherto been reported from American waters.



**Membranipora flemingii** Busk. [Pl. xxiii, fig. 38.]

Busk 1854, p. 58.

Verrill 1879c, p. 29 (*Mollia flemingii*).

Verrill 1885, p. 530.

Zoarium encrusting shells, stones and occasionally algæ, the outline usually irregular and the cells often crowded and distorted. Zoecia moderately large, usually irregular in outline and in disposition, sometimes so crowded as to be greatly distorted; area expanded below and much constricted at the anterior third, partially bridged over by a calcareous lamina posteriorly and laterally, leaving a somewhat trifoliate membranous area; margin high, granular, with four to six spines, one of which usually attains a much larger size than the others (I have seen no specimens from this region with the flattened scimitar-like spine described by Hincks; the large spine is stout, round and nearly erect). Ovicell rounded, sometimes partially immersed, bearing a raised rib which incloses a somewhat quadrangular space on the front. Avicularia placed one on either side of the ovicell at the base of the zoecium, with the rather elongate mandible turned forward and sometimes a little outward, but in case o oecium is present there is a single avicularium with its mandible reversed to point backward (often obliquely or even transversely placed). The avicularia are thus similar to those of *aurica* in arrangements and in the influence of the oecium, but they are not so regular in position and the mandible is more pointed.

Rather widely distributed but not common, taken in Vineyard Sound, Muskeget Channel, Crab Ledge, and off Sankaty Head, dredged in 7 to 20 fathoms. A common European species, recorded from Eastern Greenland, and Verrill has noted its occurrence off Nova Scotia in 234 fathoms.

**Membranipora tenuis** Desor. [Pl. xxiii, fig. 39, pl. xxx, fig. 87.]

Desor 1848, p. 66.

Verrill and Smith 1874, p. 712.

Desor's description of this species is very inadequate, but there is no other species to which, under the circumstances, he could have referred. I have redredged his type locality and found the species very abundant there. "Cells lobate, more elongated than in *M. pilosa* Pallas, with a plain margin of a pale pink color. Abundant in Muskeget Channel from 3 to 5 fathoms." (Desor, l. c.).

Verrill (l. c.) adds to the above: "Common on pebbles, often covering their whole surface with a delicate, lace-like incrustation, made up of very small, crowded, oval or oblong cells, which have the inner part of the front partly closed over, but with an irregular, mostly three-lobed aperture toward the outer end, which is bordered by small, irregular spinules."

I may state, in addition, that the zoecia are not unusually small for a *Membranipora*, as one might infer from Verrill's description, but are of moderate size. The raised margin is high and finely tubercular on its inner side, and the calcareous lamina is finely punctate; rounded knobs, apparently projecting from the spaces in the angles between the zoecia, are frequently present. Considerable variation is shown in the extent and shape of the calcified lamina, and in the size and shape of the knobs.

*Membranipora danica* Levinsen (1894, p. 53-54, text-fig. 1 and 2) must be very closely related to, if not identical with *tenuis*, but without the examination of specimens I hesitate to place it positively in the synonymy.

Muskeget Channel (Desor); Vineyard Sound (Verrill). Common and widely distributed throughout the region. Most common on the pebbly and shelly bottoms of Vineyard Sound, Muskeget Channel, and Great Round Shoal; rather scarce in Buzzards Bay, except near shore, owing to the predominance of muddy bottom and the lack of proper attachment.

**Membranipora tehuelcha** (d'Orbigny). [Pl. xxiv, fig. 40.]D'Orbigny 1839, p. 17 (*Flustra tehuelcha*).Waters 1898, p. 674-6 (synonymy of *M. tuberculata* Busk with this species).

Zoarium encrusting on "gulfweed" (*Sargassum bacciferum*), appearing as a beautiful white network against the brown stems and floats of the alga. Zoecia of moderate size, usually rather elongate,

and disposed with great regularity when the nature of the substratum will permit. The area is large and elliptical or elongate oval, often somewhat bridged over at the base and on the sides by a calcified lamina, marginal walls high and thin, produced at the anterior angles into a pair of blunt tubercles, which project forward and outward and which are rounded at the top, convex posteriorly, and hollowed out on the anterior (under) side. Ovicells and avicularia absent.

Abundant on the Sargassum drifted into Vineyard Sound from the Gulf Stream, and in the drift on the outer shores of No Mans Land, Marthas Vineyard, and Nantucket Islands. The only bryozoan I have noted on the "gulfweed" and never taken in this region except on this alga. It is distributed world-wide in the tropical and temperate oceans on *Sargassum*.

#### Family CRIBRILINIDÆ Hincks, 1880.

#### Genus CRIBRILINA Gray, 1848.

This genus includes all the members of the family occurring within our region. The arrangement of the pores, and especially the development of the calcareous front wall of the zoecium indicates the origin of this wall by the fusion of spines and shows a relation to *Membranipora* through some connecting stage such as we have in the genus *Membraniporella*. The posterior lip of the orifice, as well as the rib over the aperture of the ovicell, may often show their development from spines even in the adult.

#### KEY TO SPECIES.

Pores disposed in transverse lines or irregularly placed; a small pointed avicularium usually situated on either side of the orifice; oocium large..... *punctata*.  
 Rows of pores more or less radiating, especially on the posterior portion; avicularium wanting; oocia very small and inconspicuous..... *annulata*.

#### *Cribrilina punctata* (Hassall). [Pl. xxiv, fig. 41, 41a, 41b.]

- Hassall 1842, p. 368 (*Lepralia punctata*).  
 Dawson 1859, p. 256 (*Lepralia punctata*).  
 Verrill and Smith 1874, p. 713 (*Escharipora punctata*).  
 Verrill 1875b, p. 41 and 1879c, p. 29 (*Cribrilina puncturata*).  
 Whiteaves 1901, p. 97.  
 Cornish 1907, p. 77.

Zoarium encrusting shells and occasionally pebbles. Zoecia small, subcylindrical, perforated more or less irregularly by a variable number of large irregular openings (sometimes in old colonies these may become almost closed), orifice somewhat semicircular, a small mucro in the middle of the lower lip, which may become very strong with age and which is often bifid and may obscure considerably the shape of the orifice; four marginal spines usually present, the posterior pair the larger, and in fertile cells this pair is often curved inward over the opening of the zoecium, the anterior pair in the fertile cells often fused with the mouth of the ovicell. Oocium subglobose or somewhat elongated, smooth and glossy, perforated by a number of small pores. Avicularia usually two, one on either side of the orifice and pointing obliquely forward and outward.

Taken at various points in Vineyard Sound, but not common. It is found abundantly in the outer waters of the region; Crab Ledge, off Sankaty Head, Great Round Shoal, and Muskeget Channel, dredged in 6 to 20 fathoms. Not noted in Buzzards Bay.

#### *Cribrilina annulata* (Fabricius). [Pl. xxiv, fig. 42, 42a, 42b.]

- Fabricius 1780, p. 436 (*Cellepora annulata*).  
 Stimpson 1853, p. 18 (*Lepralia annulata*).  
 Packard 1857, p. 270 (*Lepralia annulata*).  
 Verrill 1879c, p. 29.  
 Whiteaves 1874, p. 11 (*Escharipora annulata*), 1901, p. 98.  
 Cornish 1907, p. 77.

Zoarium encrusting on stones and shells, forming small rounded colonies of a reddish or brownish color, "*pulcherrima et perfectissima haec omnium visarum*" (Fabricius). Zoecia considerably coarser

than in the last species, and usually much less regular in form, the punctures arranged in rows which are transverse anteriorly but toward the posterior end tend to radiate, a median ridge or carina often present; orifice in the young zoecium nearly semicircular or with a small denticle on the lower lip, but in the later stages the lip becomes greatly thickened, and, especially in the fertile cells, where a secondary lip extends over the ovicell, the original nature of the orifice is entirely obscured; usually four short spines project forward on the anterior lip, the anterior pair being smaller and somewhat divergent. The oecium is small, hemispherical, punctured with a few pores, and overgrown to a varying degree by a secondary lip which is formed by the greatly developed and often fused posterior pair of oral spines. Avicularia wanting. Not infrequently there occur fertile zoecia of smaller size than usual, standing nearly erect between the ordinary zoecia.

Rare and occurring only in the outer waters; Crab Ledge and Nantucket Shoals, 14 to 20 fathoms. These records greatly extend the known southward range of the species, which has not been reported south of the Bay of Fundy (Stimpson).

#### Family PORINIDÆ d'Orbigny (pars), 1851.

##### Genus PORINA d'Orbigny, 1851.

This genus is easily determined by the tubular character of the zoecial orifice, together with the presence of an elevated rounded pore on the front wall below the orifice.

*Porina tubulosa* (Norman). [Pl. xxiv, fig. 43, 43a, 43b, 43c.]

Norman 1868, p. 308 (*Lepralia tubulosa*).

Whiteaves 1901, p. 98.

Zoarium forming small, rounded, white colonies on stones and shells. Body of zoecium recumbent, rather elongate, punctured with small pores which under a high magnification are found to be stellate in appearance; orifice tubular, much extended, more or less erect, thin, often produced irregularly at the margin, a large median pore near the lower part of the tube and surrounded by a projecting ring or tubule. Oecium small, flattened, situated low down behind the erect tube. In the development of the fertile cell the tubular neck is thus seen to be of secondary formation. Avicularia absent.

Not common, and found only in the outer waters of the region; Muskeget Channel, Crab Ledge, and Nantucket Shoals; dredged in 7 to 20 fathoms. Not previously noted south of the St. Lawrence.

#### Family MICROPORELLIDÆ Hincks, 1880.

##### Genus MICROPORELLA Hincks, 1877.

The special median pore, which distinguishes our species in this family, is not always easy to see, since, in some conditions of calcification, it may be more or less hidden in front of an umbonate process. A little experience is necessary also to distinguish it at once from the small avicularia which may have the same position, just below the orifice, in certain other groups. The semicircular form of the zoecial orifice, without any prominence on the posterior, straight, border, is also a good character.

#### KEY TO SPECIES,

Median pore below orifice sublunate, or more or less semicircular, with a toothed projection extending into the opening from the anterior border.....*ciliata*.  
 Median pore circular, with spinules projecting from all sides toward the center.....var. *stellata*.

*Microporella ciliata* (Pallas). [Pl. xxiv, fig. 44, 44a, 44b, 44c, pl. xxx, fig. 90.]

Pallas 1766, p. 38 (*Eschara ciliata*).

Packard 1867, 270 (*Lepralia ciliata*).

Verrill 1879c, p. 29 (*Porellina ciliata*).

Whiteaves 1901, p. 98.

Zoarium encrusting, on stones or shells, occasionally on algæ, forming silvery or white rounded colonies, often an inch or more in diameter, but usually smaller. Zoecia ovate, or when more crowded, rather elongate hexagonal; when young, thin-walled and silvery and punctured with numerous small pores, when older, and especially in deep water, the calcification proceeds much farther and the walls become much thickened, rough, often flat on the surface or occasionally very gibbous, and the punctures are obscured. Orifice semicircular, the border usually but slightly raised, generally with 4 oral spines curved outward; immediately posterior to the orifice is a special median pore which is usually more or less lunate in form, and with teeth or spinules projecting into it; an umbonate process often occurs just behind the pore, partly or entirely obscuring it from above. Ovicell rounded or slightly elongate, frequently punctured, often sculptured with radiating ridges, and occasionally with an umbonate process at the top. Avicularia, usually one (occasionally two), situated on the side a little way behind the orifice, with a more or less sharply pointed mandible directed, usually, forward and outward.

The species is extremely variable. Depending on the amount and the manner of calcification the zoecium may be thick or thin walled, rough or smooth, flat or gibbous, punctured or entire, umbonate or not. The avicularia vary from short triangulate to very elongate. The pore varies with the size and shape of a projection on its anterior lip; usually this projection is evenly rounded and broad so that the pore is lunate in form, but very frequently the pore is nearly round, with a spinous stalked knob projecting from the anterior border into the pore. This latter condition leads up to the variety *stellata*, in which the pore becomes round and the spinous knob is wanting. There are also enormous differences in the size of the zoecia.

Taken with some frequency in the outer waters of the region. Lower end of Buzzards Bay, both ends of Vineyard Sound, Crab Ledge, Great Round Shoal, and Nantucket Shoals. Dredged in 7 to 20 fathoms.

**Microporella ciliata** var. *stellata* (Verrill). [Pl. XXIV, fig. 45.]

Verrill 1875b, p. 53; 1879b, p. 190, and 1879c, p. 29 (*Porollina stellata*).

"A large species forming radiate patches on shells, etc. Zoecia arranged in quincunx, large, broad, moderately convex, white shining, mostly imperforate and smooth, the marginal ones more or less perforate in front. Apertures nearly semicircular, the proximal edge straight or nearly so, often with two spines on the distal border; median pore a short distance from the aperture, large, nearly circular, provided with numerous slender, convergent spinules, which nearly reach the center, giving the pore a stellate appearance. Avicularia near the lateral margin, about opposite the median pore, varying in size and form; in the same colony some are short triangular, while others with a long and acute, erect tip show the transition toward vibracula. The zoecia are about twice as large as those of *ciliata*. Casco Bay, Me., U. S. F. C., 1873." (Verrill.)

As every character on which the above description is based is subject to great variation, I can not consider that *stellata* is entitled to rank as a separate species, particularly as a study of a large number of specimens from the North American coast shows so many intergradations. The nearly circular, stellate character of the pore, caused by the absence of any projection on the anterior side, is the only character of any differential importance, and, as I have shown in discussing *ciliata*, this condition is merely the end of a series.

This form occurs with the normal *ciliata* in the eastern end of Vineyard Sound, Muskeget Channel, Great Round Shoal, Crab Ledge, and Nantucket Shoals.

Family MYRIOZOIDÆ Smitt (pars), 1867.

Authors have been at great variance in their use of this family. Smitt (1867) included certain species now placed in the genus *Smittia* of the family Escharidæ, in which family he included the genus *Cellepora*, but later (1872) he included this genus within the limits of this family. Hincks (1880) separated *Cellepora* widely from the Myriozoidæ, following Johnston and Busk in making it the type genus of the family Celleporidæ. On the other hand Jullien and Calvet (1903) have separated the family

into two, the Myriozoumidæ to include the genus *Myriozoum*, and Schizoporellidæ to include the remainder of the group, and at the same time have merged the species of *Cellepora* with *Schizoporella*. In the present paper I shall include in this family the genera *Hippothoa*, *Schizoporella* and *Cellepora*, which are all that fall within our region. *Cellepora* appears to the writer to present sufficient relationships with *Schizoporella* to fall within the same family, though it seems best to retain it as a separate genus.

## KEY TO GENERA.

1. Adnate, the zooecia more or less distinct and somewhat cylindrical in form, the wall thin and somewhat hyaline, entirely without avicularia. . . . . *Hippothoa*.  
Encrusting or foliaceous, the zooecia contiguous to form a continuous crust, usually with avicularia. . . . . 2.
2. Zooecia recumbent, or, when erected, without an aviculiferous rostrum in relation with the orifice, *Schizoporella*.  
Zooecia erected, except sometimes in the very young colonies; an aviculiferous rostrum below or beside the orifice. . . . . *Cellepora*.

## Genus HIPPOTHOA Lamouroux, 1812.

There is a distinct sinus in the posterior border of the orifice, and appendicular organs are wanting; the zooecial wall is not perforated but is more or less rugose transversely; fertile zooecia somewhat reduced in size. The zooecia are always more or less distinct in young colonies, but in older stages of *H. hyalina* they are much crowded.

## KEY TO SPECIES.

Zooecia prolonged at base into a tubular portion, usually distinct, not erected. . . . . *divaricata*.  
Zooecia not so prolonged at base, usually forming a crust, often erected in older colonies. . . . . *hyalina*.

**Hippothoa divaricata** Lamouroux. [Pl. XXIV, fig. 46, 46a.]

- Lamouroux 1821, p. 82.  
Dawson 1859, p. 256.  
Packard 1867, p. 270 (*Hippothoa borealis*).  
Verrill 1879c, p. 29.  
Whiteaves 1901, p. 100.

Zoarium adnate on stones, shells, and occasionally on algæ. Zooecia elongate pyriform, more or less produced into a peduncle at the posterior end, arranged in a loose branching series; surface smooth or finely striated transversely, often with a median carina; orifice rounded with a sinus in the posterior margin. Ooecia globose, with an umbonate process on top, borne on somewhat dwarfed zooecia. Avicularia wanting.

Rare; taken at either end of Vineyard Sound (Fish Hawk stations 7526 and 7723) and at Crab Ledge in 18 fathoms. Only small colonies of a few cells have been noted. The species is cosmopolitan in its distribution.

**Hippothoa hyalina** (Linné). [Pl. XXIV, fig. 47, 47a, 47b, 47c.]

- Linné 1766-68, p. 1286 (*Cellepora hyalina*).  
Dawson 1859, p. 256 (*Lepralia hyalina?*).  
Verrill and Smith 1874, p. 713 (*Mollia hyalina*).  
Verrill 1879b, p. 193, and 1879c, p. 30.  
Whiteaves 1901, p. 100 (*Schizoporella hyalina*).  
Cornish 1907, p. 77 (*Schizoporella hyalina*).

Zoarium incrusting on stones, shells, algæ, hydroid and Bryozoa stems, etc., in the young colony forming rather regular hyaline patches, especially on flat surfaces, in older colonies very irregular, the cells piled up on each other and often more or less erected, and when on stems forming rough crusts resembling *Cellepora*. Zooecia usually elongate, subcylindrical, and attenuated posteriorly, in young

colonies often separated by areolated spaces; surface hyaline, glossy, and transversely grooved; orifice rounded, with a broad, well-defined sinus in the posterior margin, but this is often obscured from above by an overhanging umbonate process. Ooecia globose, punctured, borne on slightly dwarfed zoecia which stand nearly erect among the other cells. No avicularia. The variations are mostly due to the character of the substratum and to crowding.

An abundant species, occurring from low water to 20 fathoms, and distributed throughout the region. Buzzards Bay, Vineyard Sound, No Mans Land, Nantucket, Crab Ledge, and Great Round Shoal. At the last place it was extraordinarily abundant, encrusting the stems of hydroids. It is a cosmopolitan species.

#### Genus SCHIZOPORELLA Hincks, 1880.

This genus presents a great range of variability, embracing practically all the characters. Perhaps the most constant feature is that which suggested the name, the presence of a distinct notch or sinus in the posterior border of the primary zoecial aperture. In many cases this is obscured in older zoecia by secondary calcification, but the examination of the younger cells of the colony will show the character. The absence of denticles projecting from the lateral or posterior border into the orifice is also useful in separating the genus from certain of the Escharidæ.

#### KEY TO SPECIES.

1. Avicularia usually present, surface punctured, ovicell without special pore at the summit . . . . . 2.  
Avicularia absent, the ovicell with a special pore, primary orifice usually obscured. . . . . *sinuosa*.
2. Avicularia pointed, usually placed on one or both sides of the lower border of the aperture with the mandible pointing forward and outward, occasionally reversed or otherwise placed. *unicornis*.  
Avicularia rounded or spatulate, not pointed. . . . . 3.
3. A small oval avicularium on a raised projection at either side of the orifice (often on only one side), ovicell with a depressed area traversed by radiating furrows. . . . . *biapertura*.  
A small rounded avicularium situated centrally immediately below the sinus (occasionally wanting); depressed area of ovicell with regularly arranged pores instead of furrows. . . . . *auriculata*.

#### *Schizoporella unicornis* (Johnston). [Pl. xxv, fig. 48, 48a, 48b, 48c, 48d, 48e, pl. xxx, fig. 91.]

Johnston 1847, p. 320 (*Lepralia unicornis*).

Desor 1848, p. 66 (*Lepralia variolosa*).

Leidy 1855, p. 142 (*Escharina variabilis*).

Verrill and Smith 1874, p. 713 (*Escharilla variabilis*).

Verrill 1875b, p. 41 (*Hippothoa variabilis*); *ibid.*, p. 41, pl. iii, fig. 1 (*Hippothoa reversa*, n. sp.); 1879b, p. 193, and 1879c, p. 30 (*Escharina isabelliana* D'Orbigny, *E. reversa* Verrill, and *E. ansata* Gray).

Zoarium forming a reddish incrustation, often many layers in thickness, on anything which will afford attachment, most frequently on shells, stones, and worm tubes, though the largest colonies I have seen were on the bark of wooden piles; occasionally the colony rises into free expansions of a very irregular form which are low. The color varies in life from pale orange to a dark brick-red, sometimes colorless and shining in deeper water. Zoecia more or less ovate, hexagonal, or rectangular, often broad and squarish, sometimes rather flat and again very gibbous, the surface sometimes smooth and glossy, but more often rough and tuberculate; punctured with a variable number of small pores which have no apparent order of arrangement, occasionally forming irregular areolæ around the margin; an umbo of variable size immediately below the orifice, not infrequently wanting; the cells may be separated by a deep groove, or a raised wall may be present around the border (form *ansata*); orifice semicircular or subcircular, the posterior border nearly or quite straight, with a rather large rounded sinus, no raised peristome or oral spines. Ovicell subglobose, not immersed, punctured, usually rather smooth near the orifice and more or less grooved in a radiating manner on the sides, often very rough when fully calcified, and not infrequently bearing a rounded umbo at the top. Avicularia one or two, placed laterally just behind the orifice, the mandible, which is usually short triangular, but may be elongated,

points forward and outward in the usual form, though in the form *reversa* it points backward and outward; usually at least one avicularium is present, but not infrequently they may be lacking over a large part of the colony.

The species shows an endless amount of variation in almost all the characters except the orifice, which is fairly constant. The var. *ansata* (Johnston) with the raised border separating the zoecia is commonly found in deeper water, though the ordinary form may occur alongside of it. Verrill's *Hippothoa reversa* was based on the reversed avicularium and is a pure synonym, since this condition may occur in the same colony with normally placed avicularia, and all sorts of intermediate conditions occur.

One of our most abundant and characteristic species, found almost everywhere except on bottoms of pure mud and sand where nothing exists to afford attachment. Not taken in the outermost dredgings at Crab Ledge and off No Mans Land. Taken from low water to 19 fathoms.

**Schizoporella biaperta** (Michelin). [Pl. xxv, fig. 49, 49a, 49b.]

Michelin 1841-42, p. 330 (*Eschara biaperta*).

Verrill 1875b, p. 41 (*Hippothoa biaperta*); 1879b, p. 193, and 1879c, p. 30 (*Escharina biaperta*).

Whiteaves 1901, p. 100.

Zoarium incrusting or rising into free expansions. On stones and shells it forms smooth flat colonies with a more or less regular outline, on algae and hydroid or other stems usually forming shelf-like expansions, often of great beauty; color in life varying from white or translucent to bright pink or red. Zoecia ovate or hexagonal, more or less gibbous, punctured (at least in the younger stages) by small pores; surface smooth and glossy, becoming rough and dull with advancing calcification; separated by a raised border which may be obscured by later calcification; orifice subcircular, the posterior border straight with a rather wide sinus, peristome not raised except in the fertile cells, when it may extend upon the ovicell; no oral spines. Ooecia rounded in outline, often considerably impressed, upper surface flattened, with radiating lines, the flattened area surrounded by a thick border rising from the base. Avicularia one or two with rounded or oval mandible, situated on a rounded prominence at the side of and facing toward the orifice. The mamillate processes bearing large pointed avicularia, which Hincks states are common, seem to be very rare in this region.

A large amount of variation is exhibited, but most of it is traceable to the degree of calcification. The characters of the ooecium and of the oral avicularia afford the best criteria for identification.

An abundant species, well distributed throughout the region, and dredged in 3 to 20 fathoms. Buzzards Bay, Vineyard Sound, Muskeget Channel, Great Round Shoal, Crab Ledge, No Mans Land (drift).

**Schizoporella auriculata** (Hassall). [Pl. xxv, fig. 50, 50a.]

Hassall 1842, p. 411 (*Lepralia auriculata*).

Packard 1867, p. 408 (*Lepralia globifera*).

Verrill 1875a, p. 414 (*Escharella auriculata*); 1879b, p. 192-3 (*Smittia globifera*); and 1879c, p. 30 (*Smittia auriculata* and *globifera*).

Whiteaves 1901, pp. 100 and 106 (as *Schizoporella auriculata* and *Smittia globifera*).

Zoarium encrusting, often quite irregular, on stones and shells, and occasionally on hydroid stems, in which case it may rise free for a short distance, varying from colorless to reddish or yellowish. Zoecia usually quadrangular and disposed in linear series, with a well-developed raised border, more or less punctate, with a well-defined series of large areolæ around the edge of the cell next to the border; in older stages of calcification the surface may become very rough and ribbed, but the marginal areolæ remain distinct; orifice subcircular with a rather broad but well-defined sinus in the posterior margin. Ooecia large, rounded, raised, or occasionally more or less immersed; the upper surface somewhat flattened, punctate, often radiately striate, with a thin border surrounding the flattened area. A small avicularium with a broadly rounded to somewhat pointed mandible is centrally placed just posterior to the orifice, sometimes projecting forward so as to obscure the sinus and the orifice to some extent. Hincks mentions a large avicularium which sometimes replaces the small one, but I have not seen this in our specimens.

This is the *Lepralia globifera* of Packard which Verrill placed at one time under *auriculata*, but later (1879) separated as *Smittia globifera*. The presence of a well-defined sinus seems sufficient to place it in *Schizoporella*, and a comparison with European material of *auriculata*, as well as the study of numerous specimens from this region indicates that *globifera* is not entitled to specific rank.

Variations; border sometimes raised high above the cell, even higher than the avicularian prominence; oocia sometimes raised, again partly embedded; size showing considerable range even in the same colony; avicularium varying slightly in size and in form of mandible, in fully calcified, fertile cells the oral margin may be secondarily raised and a strong rib may extend from the ovicell around to the avicularian prominence.

Crab Ledge in 15 to 20 fathoms; Great Round Shoal in 8 fathoms; Nantucket Shoals in 18 to 25 fathoms; not uncommon.

***Schizoporella sinuosa* (Busk).** [Pl. xxv, fig. 51, 51a.]

Busk 1860, p. 125 (*Lepralia sinuosa*).

Verrill 1879b, p. 193, and 1879c, p. 30 (*Escharina secundaria*).

Whiteaves 1901, p. 100.

Cornish 1907, p. 77.

Zoarium encrusting on stones and shells, forming dark reddish, purplish, or brownish colonies, usually circular in outline. Zooecia ovate or rhomboid, usually sinuate at the border, which is not raised except in very young cells; in the young stage, convex, but later immersed by calcification in an almost even crust; punctured with small pores, surface rather regularly granular; orifice in young cells subcircular, the posterior margin with a well-marked sinus, but with further calcification the primary orifice is overgrown, becoming more or less orbicular with some indication of a sinus at the posterior margin. Oocia large, deeply immersed in the zoarium, somewhat flattened, with a rounded pore at the top. Avicularia wanting. I have not seen the small avicularium which Hincks describes as present in the variety *armata*. The variations seem almost entirely due to calcification. Taken only at Crab Ledge where it occurs with some frequency in 15 to 20 fathoms. Not previously recorded south of Canada.

**Genus CELLEPORA Fabricius (pars), 1780.**

This genus is easily distinguished among others of our region by the erected cells, coupled with the presence of a sinus in the posterior margin of the orifice, and a large aviculiferous rostrum behind the orifice.

KEY TO SPECIES.

Rostrum pointed, with the avicularium borne on one side at the base.....*americana*.  
Rostrum tall and spout-like, with a rounded avicularium at the top.....*canaliculata*.

***Cellepora americana*, new species.** [Pl. xxv, fig. 52, 52a, 52b, pl. xxxi, fig. 99.]

Verrill and Smith 1874, p. 714 (*Cellepora ramulosa*).

Verrill 1879c, p. 30 (*Cellepora avicularis*).

Zoarium encrusting or rising into nodular branches a few millimeters in height, growing on hydroid and Bryozoa stems, algæ, etc., the colonies usually very irregular in form. Zooecia somewhat ovate or pyriform, more or less erect, usually much crowded and irregularly disposed, heaped upon each other and turned in various directions; punctured irregularly around the base, surface smooth and shining; orifice subcircular with a V-shaped sinus in the posterior margin; peristome thin and raised, flaring somewhat outward, in fertile cells present on the sides only, where it projects in labiate processes; a prominent mucronate rostrum just behind and often a little at one side of the orifice, which it overhangs to some extent; an avicularium with an oval mandible is borne at the base laterally and somewhat internally. Oocia rounded in outline, prominent, flattened above, smooth, with a number of punctures.

This species is evidently related to *C. avicularis* Hincks, and shows this relation in the character of the ovicell, the form of the sinus, the punctured surface, and the manner of growth. It presents a number of important differences, however, such as the higher peristome which becomes bilabiate in the



fertile cell, the position of the avicularium which is at the base of the rostrum and is directed laterally and but slightly upward, in the much greater development of the rostrum above the avicularium, in the absence of the small lateral avicularia and the large pointed avicularia described by Hincks for *avicularis*. It may possibly prove to be only a variety of *avicularis*, but after careful comparison with specimens of that species from England, I believe it to be sufficiently different to rank as a separate species.

Abundant in Vineyard Sound, not common but well distributed in Buzzards Bay, dredged in 1 to 19 fathoms; also in drift on the shores of No Mans Land and Nantucket, and near Sandwich on the north shore of Cape Cod.

*Cellepora canaliculata* Busk. [Pl. xxv, fig. 53, 53a, 53b, pl. xxxi, fig. 98.]

Busk 1884, p. 204.

Verrill 1879c, p. 30 (*C. tuberosa*).

Whiteaves 1901, p. 109.

Zoarium encrusting on stems of hydroids and Bryozoa, usually in rounded "pisiform" colonies, but I have one fine specimen taken at Crab Ledge which has an irregular branching structure. Zooecia somewhat ovate in young colonies, punctured around the base, smooth, in older colonies the cells erect, or nearly so, and very irregularly disposed, orifice rounded with a rather broad sinus; back of the orifice rises a stout, elongate, curved rostrum, bending somewhat over the orifice and bearing at its tip a small round avicularium; from the sides of the thin peristome a broad flange rises to the sides of the rostrum, producing a broad spout at the bottom of which the primary aperture is situated. Ovicell rather large, broader than high, flattened above near the orifice, irregularly punctured.

Taken only at Crab Ledge in 15 to 20 fathoms, where it seems to be well developed but not common. The type locality of the species was near Halifax, Nova Scotia, in 51 fathoms (Challenger); and the species has subsequently been taken in the Gulf of St. Lawrence.

#### Family ESCHARIDÆ Smitt (pars), 1867.

This rather heterogeneous family is distinguished among the others of our region rather by the absence of certain characters than by the presence of well-marked structures constant for the group. In the form of the primary zooecial orifice the different genera exhibit a wide range. From the families with a semicircular orifice (Cribrilinidæ and Microporellidæ) the absence of a special pore and the formation of the zooecial wall are sufficiently distinctive, while from the Myriozoidæ the absence of a distinct sinus in the posterior margin of the primary orifice is characteristic, though it may require careful scrutiny of the younger zooecia to determine this, since a sinus may appear secondarily in the peristome. In general, the family is characterized by the great development of secondary characters, and the appendages are extremely varied.

#### KEY TO GENERA.

1. Primary orifice without posterior tooth or shelf, no suboral avicularium, spine or mucro, secondary orifice, when raised, never sinus-like at the posterior margin. . . . . *Lepralia*.  
One or more such characters present . . . . . 2.
2. Posterior margin of orifice more or less developed into an overhanging prominence or mucro which never bears an avicularium. . . . . *Mucronella*.  
Posterior margin of orifice not mucronate, or, if so, the mucro bears an avicularium on the side or at the tip. . . . . 3.
3. A prominent suboral mucro (usually placed a little to one side of the median line) bearing an avicularium on its side, sometimes a similar projection (without an avicularium) on the opposite of the midline; orifice very large; zooecial wall delicate and shining. . . . . *Rhamphostomella*.  
Characters otherwise . . . . . 4.

4. A small avicularium situated at the apex of a prominence immediately below the orifice in the median line and often included within the sinus-like fold of the secondary orifice. . . . . *Porella*.  
 Oral avicularium absent, or, if present, larger and not mounted on a definite rostrum, a prominent tooth or shelf-like projection on the posterior border of the primary orifice (occasionally absent),  
*Smittia*.

Genus **LEPRALIA** Johnston (pars), 1849.

Zoarium in our species encrusting, or rarely rising free for a few millimeters; zooecial orifice without mucro or avicularium, peristome raised or not; lateral margin of the orifice with a small denticle on each side toward the posterior border, no sinus, but sometimes the posterior border rounded between the denticles so as to give at first glance the appearance of a very broad sinus.

KEY TO SPECIES.

1. Orifice large, elongate, distinctly widened near its posterior end, oecia and avicularia wanting,  
*pallasiana*.  
 Orifice smaller, more rounded, or if elongate, not widened posteriorly, oecia and avicularia present,  
 at least occasionally . . . . . 2.  
 2. Oral margin anteriorly with its inner edge finely serrate, lateral denticle large, bifid; avicularia  
 abundant, usually of two sizes; oecium broader than long, with a transverse membranous area  
 above orifice. . . . . *serrata*.  
 Without such characters . . . . . 3.  
 3. Zooecial and oecial pores small and numerous; zooecial orifice rounded, the transverse diameter  
 often slightly the longer; the projecting marginal denticles give the rounded posterior border the  
 appearance of a very broad sinus. . . . . *pertusa*.  
 Zooecial and oecial pores few and large; zooecial orifice more quadrangular, usually somewhat widest  
 posteriorly. . . . . *americana*.

**Lepralia pallasiana** (Moll). [Pl. xxv, fig. 54, pl. xxx, fig. 89.]

Moll 1803, p. 57 (*Eschara pallasiana*).

Leidy 1855, p. 9 (*Escharina pedistoma*).

Verrill and Smith 1874, p. 713 (? *Lepralia pallasiana*).

Verrill 1875a (pl. vii, fig. 5 under *L. americana*, n. sp.).

Cornish 1907, p. 77.

Zoarium encrusting shells, stones, submerged wood, and algæ, the colonies circular when the nature of the substratum will permit, sometimes as much as 2 inches in diameter. Zooecia large, often quadrangular or roughly hexagonal, but varying greatly in this respect; somewhat convex and rising toward the orifice, punctured with rather large pores, in young stages smooth and glossy, when older often rough, with thick ridges between the pores; orifice large, considerably longer than wide, widened rather suddenly near the posterior end, with a small denticle on either side just in front of the expanded portion; peristome thin, smooth, and only slightly raised in our specimens. Ovicells are unknown in this species and avicularia are apparently wanting in specimens from this region. An umbonate process is sometimes present below the orifice.

Well distributed throughout the region from low water to 8 fathoms or deeper, best developed in the shallower waters. Woods Hole, New Bedford, and Nantucket harbors, on piles, West Falmouth harbor in shallow water, Cedar Tree Neck at low tide, Buzzards Bay, Vineyard Sound and Great Round Shoal.

The species has been recorded from Canadian waters at Canso only (Cornish). Leidy figured it as *Escharina pedistoma* from Beesley's Point, N. J. Verrill had it among his material, for one of his figures (fig. 5) of *L. americana* is unquestionably *pallasiana*. I have specimens from Long Island Sound and from the north shore of Cape Cod, near Sandwich.

**Lepralia americana** Verrill. [Pl. xxv, fig. 55, 55a.]

Verrill 1875a, p. 415, name only, with pl. vii, fig. 4 (fig. 5 is *L. pallasiana* instead of *americana*).

Verrill 1875b, p. 42, name only, with distribution; 1879c.

Davenport 1891, p. 47 (*L. pallasiana*).

Zoarium encrusting on shells, stones, etc., forming rather rough whitish to reddish colonies, often several cells in thickness. Zoecia large, but averaging smaller than *L. pallasiana*, roughly quadrangular or hexagonal, slightly convex and rising, often suddenly, to a more or less prominent umbo behind the orifice; surface in young specimens always rather coarsely cancellated with large pores, very roughly ribbed (sometimes radiately) in older stages of calcification; a raised border often separates the cells in young colonies, but this is frequently overgrown later by the thickening of the crust; orifice usually a little quadrangular, slightly longer than broad, but sometimes nearly rounded, a denticle on either side of the orifice near the posterior end, the aperture not widened behind the denticles, peristome thin, slightly raised, often forming a sort of projecting lip on either side of the orifice. Ooecia large, subglobular, occasionally partly immersed, with a few very large, irregular pores on the upper surface. A rounded avicularium is often present below the aperture at the top of the umbo.

This species differs from *pallasiana* in the form of the zoecial aperture, in the possession of ovicells, in the occasional possession of a raised border separating the cells, and in the more radiately ribbed character of the calcification.

Verrill very evidently confused this species with *pallasiana*. He gives no verbal description, but his figure 4 (see above) is sufficient for identification. His figure 5, labeled "the same without ootheca," is *L. pallasiana*, however.

Under the circumstances, it is manifestly impossible to quote Verrill in regard to the range of the species, as in his earlier papers he placed everything in "*L. pallasiana*," and later called them all *americana*. In this region the species is well distributed, being rather common in Vineyard Sound, Muskeget Channel and Great Round Shoal, not common in Buzzards Bay, scarce at Crab Ledge, and found occasionally on piles at Woods Hole and Nantucket. I have also seen specimens from Nantucket Shoals and Long Island Sound. In general, it occurs in deeper water than *pallasiana*, but occasionally they are found together.

**Lepralia pertusa** (Esper). [Pl. xxvi, fig. 56, 56a, 56b, 56c.]

Esper 1791-1797, p. 149 (*Cellepora pertusa*).

Dawson 1859, p. 256.

Verrill 1879b, p. 414 (*Escharella pertusa?*).

Verrill 1870, p. 193 (*Escharina porosa*, n. sp.).

Hincks 1892, p. 154.

Whiteaves 1901, p. 101.

Cornish 1907, p. 77.

Zoarium encrusting stones and shells, and occasionally algæ, forming colonies often of considerable extent, of various shades of red or when young, silvery white. Zoecia ovate or more or less oblong, rhomboid or hexagonal, regularly convex, separated by raised lines, surface smooth and glossy when young, often considerably roughened when fully calcified, punctured with numerous rounded pores, sometimes rising to a rough umbonate process behind the orifice; orifice rounded, a pair of lateral denticles, behind which the oral margin is curved but without a distinct sinus, peristome slightly raised and thickened, smooth. Ooecium large, prominent, subglobular, somewhat flattened above, punctured, smooth, or the upper surface roughened and a smooth border around the base; in specimens from deeper water the whole ovicell is usually roughened when fully calcified and an umbonate process occasionally rises from the top. Avicularia rare, but occasionally a small oval one is seen at one side of the orifice with the mandible turned somewhat obliquely either toward or away from the orifice.

Very material differences exist in the size of the zoecia, but otherwise the variations are almost entirely due to the amount of calcification. I have not observed in our specimens the large avicularia figured by Hincks (1880, pl. XLIII, fig. 4) but a specimen from Cashes Ledge given me by Prof.

Verrill and labeled "*Escharella candida* Stimpson" has these exactly as in Hincks figure. Verrill's *Escharina porosa* is *L. pertusa* with the small avicularia at the side of the orifice, and it may possibly be worthy of a varietal rank, but it seems to intergrade with the ordinary form entirely, and the avicularia are but rarely developed. A comparison with British specimens of *pertusa* shows a close agreement in the essential characters of the species.

Occurs commonly throughout the Woods Hole region, dredged in 3 to 20 fathoms, Vineyard Sound, Buzzards Bay, Great Round Shoal, Crab Ledge. The species is cosmopolitan, and on our coast occurs from Florida to Labrador and Greenland.

*Lepralia serrata*, new species. [Pl. XXVI, fig. 57, 57a, 57b, 57c.]

Zoarium encrusting, usually on stones and shells, occasionally on algæ, at first smooth in subcircular colonies, later piling up into a rough crust of several layers of cells, occasionally rising free into irregular frill-like projections a few millimeters in height. Zooecia roughly ovate or hexagonal, convex, becoming very gibbous with age when distinct, but usually the cells unite as calcification proceeds and become immersed in the common crust; surface rather smooth in the very young cells, vitreous and shining, with a row of perforations around the margin, later the surface becomes very rough and the perforations may or may not persist; orifice longer than broad, ovate, broader anteriorly, with a large bifid denticle on either side posteriorly, dividing the orifice into a larger, anterior portion, the margin of which is finely and evenly serrate, and a smaller posterior portion with a smooth border; the denticle has its points widely divergent, the posterior point being the larger; four or five stout spines project forward from the oral margin in the young cell, but these are deciduous and their bases are covered by the later calcification; a secondary raised wall, often with a strong projecting mucro, rises high about the aperture, giving it an entirely different appearance, but the primary orifice with its denticles and serrated inner margin can be distinguished at the bottom. The ovicell is very striking and characteristic, very prominent, smooth, nearly hemispherical, with a large, somewhat semilunate membranous area on the side next the aperture, with a calcified area between this and the oocelial orifice. Avicularia immersed, or mounted on a mamillate process, ovate to nearly spatulate in outline, occasionally wanting, but usually one to several, very irregularly arranged, usually small but often large; the avicularian aperture, when the mandibles are removed, often finely serrate like the oral margin.

There is an enormous amount of variation in the extent and character of the calcification, in the shape of the secondary orifice, and in the size and arrangement of the avicularia, but the characters of the primary orifice and ovicell are very constant. Colonies growing on algæ in Buzzards Bay (Phalarope station 131) have very elongate oral spines, as long as the whole zooecium. The specific name chosen refers to the serrate inner border of the primary orifice, a character which is unique in this genus, as far as my knowledge goes. The species shows resemblances to *L. edax* Busk and to *L. contracta* Waters, but there are many differences which distinguish it.

Vineyard Sound and the lower part of Buzzards Bay, common, 5 to 15 fathoms, Muskeget Channel in 7 fathoms, Great Round Shoal in 8 fathoms, Crab Ledge in 14 to 20 fathoms. I have also seen specimens in the United States National Museum collection from Nantucket Shoals and from Long Island Sound.

#### Genus MUCRONELLA Hincks, 1880.

##### KEY TO SPECIES.

1. Avicularia present, one on either side of the aperture, which is large; ovicell wanting. . . . . *pavonella*.  
Avicularia wanting, ovicells present. . . . . 2.
2. A pointed mucro behind the orifice, peristome not raised unusually high, zooecia small, but little convex, becoming flat with age. . . . . *peachii*.  
Peristome raised very high, forming a spout-line or tubular erect structure, the mucro very large and broad, zooecia large, very convex, not becoming flat with secondary calcification. . . . . *ventricosa*.

**Mucronella peachii** (Johnston). [Pl. xxvi, fig. 58, 58a.]Johnston 1847, p. 315 (*Lepralia peachii*).Dawson 1859, p. 256 (*Lepralia peachii*).Verrill and Smith 1874, p. 714 (? *Discopora coccinea*).Verrill 1879b, p. 195, and 1879c, p. 31 (*Escharoides coccinea*).

Whiteaves 1901, p. 107.

Zoarium encrusting on stones and shells and occasionally on algae, usually irregular in outline but the cells arranged with considerable regularity. Zooecia rhomboid, not separated by raised lines or deep grooves, rather flat above, surface in young cells smooth with a row of large pores around the margin; raised ribs then appear between the pores, forming radiate grooves with the pores at the bottom, and, finally, with complete calcification, the original surface is completely covered and the pores may be obliterated; primary orifice longer than wide, rounded anteriorly, nearly straight behind, with an emarginate or bifid tooth, the lateral denticles well developed, peristome slightly raised, produced behind into a mucro and with six slender oral spines. Ooecia globose, smooth, imperforate, prominent at first, but later more or less immersed. Avicularia wanting. The variations are almost entirely due to calcification.

Vineyard Sound; Muskeget Channel; Great Round Shoal; Crab Ledge, and off Sankaty Head; dredged in 6 to 20 fathoms. Verrill records the species as very abundant in Vineyard Sound and Quicks Hole, but the results of our survey indicate that it is not common except locally in the inner waters of the Sound.

**Mucronella ventricosa** (Hassall). [Pl. xxvi, fig. 59, 59a.]Hassall 1842, p. 412 (*Lepralia ventricosa*).Verrill 1879c, p. 31 (*Escharoides coccinea* var. *ventricosa*).

Whiteaves 1901, p. 107.

Zoarium encrusting, forming whitish or silvery patches, usually irregular in outline, with the cells radiating in rather regular linear series. Zooecia large, usually regularly disposed, swollen and ventricose, separated by deep grooves, a series of small areolæ about the margin, the surface smooth in very young cells but soon becoming granular with minute rounded tubercles, which are generally arranged in radiating lines; primary aperture rounded in front, straight behind with a large bifid denticle; peristome raised very high and spout-like, thin on the sides, behind rising into a broad and often massive prominence which may or may not bear a rounded umbo at its apex; four stout oral spines are present in the young cell, generally curving over the aperture in the fertile cell, but usually lost as the peristome rises. Ovicell nearly globose, not impressed in our specimens, the surface granular when fully calcified. Avicularia absent.

The species is easily distinguished from *M. peachii* by its much larger size (averaging about twice as large), by its much more convex form, and by the mode of secondary calcification. It never becomes flattened as in *peachii*; the grooves separating the zooecia are very deep, and the peristome is raised into an erect, almost tubular, form. The mucro is much broader than in *M. peachii*.

Taken rather rarely at Crab Ledge, growing on stones and shells, at 14 to 20 fathoms.

**Mucronella pavonella** (Alder). [Pl. xxvi, fig. 60.]Alder 1864, p. 106 (*Eschara pavonella*).

Verrill 1879b, p. 195, and 1879c, p. 30.

Whiteaves 1901, p. 107.

Zoarium encrusting on stones and shells, or forming fan-shaped expansions on hydroid and other stems. Zooecia large and regularly arranged, convex and areolated around the margin, and rising toward the orifice in the young cell, but soon becoming flat with a secondary calcified layer which often closes the areolæ; orifice very large, rounded, with a small posterior tooth, which varies in shape, but which is usually blunt; peristome thin, smooth, unarmed, and but slightly raised. Ooecia wanting. Avicularia oval, somewhat raised, situated one on either side of the orifice and close to it, with the mandible pointing forward.

Crab Ledge, in 14 to 20 fathoms, not common, two colonies on a shell of *Modiolus modiolus* in United States National Museum collections, labeled "Vineyard Sound, 1875, station 4708."

Genus RHAMPHOSTOMELLA Lorenz, 1886.

Among the other genera of this family, *Rhizophostomella* may be easily distinguished by the presence of the large orifice, together with a prominent mucro which bears an avicularium on the side. The zooeccial wall is generally thin and delicate.

KEY TO SPECIES.

1. A single suboral rostrum.....2.  
Two projections behind the orifice, one of which, usually larger, bears the avicularium.....*bilaminata*.
2. Rostrum high, surface of zooeccium strongly ribbed.....*costata*.  
Rostrum not so high, surface not strongly ribbed.....*ovata*.

**Rhizophostomella bilaminata** (Hincks). [Pl. XXVI, fig. 61, 61a.]

Hincks 1877, p. 30 (*Cellepora bilaminata*).  
Verrill and Smith 1873, p. 714 (*Cellepora scabra* pars).  
Verrill 1879b, p. 195, and 1879c, p. 30 (*Mucronella scabra* pars).  
Whiteaves 1901, p. 108.

Zoarium encrusting hydroid stems, etc., often rising into small fan-like or shelf-like expansions. Zooeccia large, the walls thin and glassy, imperforate, convex above, occasionally more or less radiately ribbed, but the ribs do not run up on the rostrum; orifice very large, rounded or irregular in front, straighter behind, with a small denticle centrally placed, the thin peristome rises behind the orifice into a double fold with a deep notch between the lip-like projections, and through this notch the denticle is visible; the median lateral surface of one of these projections bears an avicularium, though the avicularium is occasionally wanting and rarely there is one on each side of the notch. Ooeccium hemispherical, smooth and punctured, very large, usually obscuring half of the aperture of the cell and the base of the cell in front as far as the rostrum; when fully calcified a rib or margin often rises about the base of the oovicell.

Taken at a number of points in Vineyard Sound and Buzzards Bay; common at Crab Ledge and Great Round Shoal. Verrill's references to *Cellepora scabra* include both this species and *R. costata*, as I have determined by a study of his specimens. I believe, however, that Verrill's record "Vineyard Sound and Quicks Hole" refers to *bilaminata* alone, since it is more common in the region than *costata* and is the only one I have observed in the inner waters of the Sound and Bay. The species ranges northward to Greenland.

**Rhizophostomella costata** Lorenz. [Pl. XXVI, fig. 62, 62a, 62b, pl. XXXI, fig. 100.]

Lorenz 1886, p. 12.  
Hincks 1889, p. 426.  
Whiteaves 1901, p. 108.  
?Verrill and Smith 1874, p. 714 (*Cellepora scabra*, pars).  
Verrill 1879b, p. 195, and 1879c, p. 30 (*Mucronella scabra*, pars).

Zoarium encrusting stems of various sorts, forming frill-like or fan-like expansions which rise free to a height of a half inch or more. Zooeccia large, the walls thin, glassy and imperforate, convex above and rising very rapidly to the base of a very high, large rostrum; there is a row of areolæ around the margin and between these there are strong radiating ribs which run up on the rostrum; orifice very large, rounded in front, straighter behind with a small tooth in the middle; peristome very thin and without oral spines in our specimens; the rostrum is enormously developed, the costal ribs run up on it, and it bears on its antero-lateral face a large pointed avicularium with the mandible turned upward; occasionally a large pointed avicularium on the front wall of the cell. Ooeccia very large, usually obscuring half of the orifice and the base of the cell in front to the base of the rostrum; surface smooth, punctured.

The cell shows a great amount of variation from the young to the adult, depending on the amount of calcification, and when the oecia are plentifully developed the general appearance of the colony is much changed. The front of one cell often overlaps the base of the one anterior to it, especially when the cells are crowded. A transverse bar is occasionally developed on the top of the rostrum (var. *cristata* Hincks). The secondary calcified layer covering up the costæ, common in northern specimens, is seldom developed in this region and I have seen the large, pointed avicularia, described by Hincks, only rarely in specimens from this region.

Taken at Crab Ledge, where it is common in 14 to 20 fathoms, and at Great Round Shoal in 8 fathoms, where it is scarce. A specimen in Verrill's collection is labeled "*Discopora scabra*, Nantucket Shoals." The species ranges northward to the Arctic Ocean.

**Rhamphostomella ovata** (Smitt). [Pl. xxvi, fig. 63, 63a.]

Smitt 1867, p. 31 (*Cellepora ovata*).

Verrill 1879b, p. 195, and 1879c (*Mucronella ovata*).

Whiteaves 1901, p. 108.

Zoarium encrusting stones and shells. Zooecia large, slightly convex, with large punctures and a series of marginal areolæ, between which arise strong costæ running only a short distance toward the center; in older cells the punctures and areolæ are more or less closed over; orifice large, ovate (or sub-circular), with the pointed end posterior, the median tooth wanting; peristome slightly raised, and behind the orifice and a little to one side, developed in connection with the peristome, a strong, blunt, smooth rostrum which bears an oval avicularium on its median side. Oecia subglobular, prominent, smooth, imperforate or very finely punctured, sometimes with a single median pore.

Rare in this region, but occurs occasionally at Crab Ledge in 14 to 20 fathoms. I have seen one specimen from Vineyard Sound, a single colony in the United States National Museum collection, taken in 1875 at station 4708, and others in the same collection from Nantucket Shoals. The species is a northern one and has been reported only from Canadian waters.

#### Genus SMITTIA Hincks, 1879.

In this genus the presence of a tooth or shelf-like protection on the posterior margin of the zoecial orifice is usually distinctive, but it is not possible to draw the limits sharply. The tooth may occasionally be wanting, as in *S. porifera*; again the shelf is present in *Porella concinna*, a species which Jullien and Calvet place in the genus *Smittia* on this account, but which has generally been placed in *Porella*. The lateral denticles of the primary orifice are well developed, but they may be equally so in *Lepralia*. The avicularia, oecia, and zoecial walls offer no distinctive characters.

#### KEY TO SPECIES.

1. Orifice rounded posteriorly, with a small, usually pointed, denticle or none; an avicularium immediately behind the orifice.....*porifera*.  
Orifice more straight on the posterior margin, the denticle broader, without an avicularium close behind the orifice..... 2.
2. Large, pointed avicularia in addition to others.....*trispinosa*.  
Large, pointed avicularia wanting.....*trispinosa*, var. *nitida*.

**Smittia porifera** (Smitt). [Pl. xxvi, fig. 64.]

Smitt 1867, pp. 9 and 70 (*Escharella porifera*).

Verrill 1879b, p. 192, and 1879c, p. 30 (*S. landsborovii*).

Hincks 1888, p. 225, and 1892, p. 156.

Whiteaves 1901, p. 105 (*S. landsborovii* var. *porifera*).

Zoarium encrusting stones, shells, and stems of various sorts, flat and smooth or more or less irregular. Zooecia large, ovate or more or less elongate, separated in the young colony by slightly raised borders which are usually obliterated later by calcification of the front; surface at first smooth and

shining, perforated by numerous rounded pores, becoming rougher with age; orifice rounded, with a small posterior tooth which is pointed or bifid or occasionally entirely wanting; immediately behind the orifice is an oval avicularium with the rounded mandible turned upward; peristome thin, more or less raised, when fully developed partly surrounding the avicularium. Ooecia subglobose, prominent, punctured.

The oral avicularium is sometimes wanting, and I have not noted spatulate avicularia on our specimens.

Occasionally taken at Crab Ledge in 14 to 20 fathoms, and at Great Round Shoal in 8 fathoms.

**Smittia trispinosa** (Johnston). [Pl. xxvii, fig. 65, 65a.]

Johnston 1838, p. 280 (*Lepralia trispinosa*).

Dawson 1859, p. 256 (*Lepralia trispinosa*).

Packard 1863 and 1869, p. 67 (*Lepralia trispinosa*).

Verrill 1879b, p. 195, and 1879c, p. 31 (*Mucronella jacotini*).

Whiteaves 1901, p. 106.

Zoarium encrusting on stones, shells, etc., forming whitish to yellowish colonies which are at first thin and smooth, but later rough and much thickened. Zooecia more or less ovate to quadrangular, in young colonies disposed with more or less regularity, but in older colonies extremely irregular, separated by a raised border; surface smooth and shining to more or less granular, with a row of areolæ around the border, these areolæ separated by strong, but short, ribs in older specimens; orifice rounded in front, nearly straight behind, with a squared tooth projecting from the posterior border; peristome usually but little raised in our specimens, though occasionally there is a lamina on either side of the orifice projecting upward; two to four oral spines usually present in young cells. Two kinds of avicularia are present, one with a pointed mandible, the other with the mandible rounded to spatulate; the first of these is large and is usually placed at one side of the orifice with the mandible directed forward and inward, but it may be situated anywhere on the cell with the mandible turned in any direction; the oval avicularia are usually small and situated on the basal part of the cell, but they may take the place of the pointed kind at the side of the orifice; moreover, they vary in length of the mandible, and, while they are usually oval, they are not infrequently elongate or spatulate in form. Ooecia large, globose, a little flattened above, smooth or somewhat roughened, with a few large irregular punctures.

The greatest possible variation exists in the occurrence and disposition of the avicularia; sometimes only the pointed ones are present, again only the oval ones, but both kinds are frequently present and several of them on a single cell, or the oval ones may be more or less spatulate, and not infrequently they are all absent.

Not uncommon at Crab Ledge in 14 to 20 fathoms. Taken also in Buzzards Bay near Penikese Island (Fish Hawk station 7672). The species is widely distributed on both sides of the Atlantic.

**Smittia trispinosa** var. **nitida** (Verrill). [Pl. xxvii, fig. 66, 66a, 66b, 66c, 66d, 66e, pl. xxx, fig. 88.]

Verrill 1875a, p. 415 (*Discopora nitida* n. s. p.) 1879b, p. 195, and 1879c, p. 30 (*Mucronella nitida*).

Encrusting on anything which affords a basis for attachment, most common on stones and shells; at first forming glistening, white colonies of regular appearance, later piling up in masses, and often completely surrounding pebbles and small shells in yellowish nodular masses of considerable size, occasionally rising into low frills on the stems of algae and in similar situations. The general form and character of the zooecium is that of *trispinosa*, but the cells average smaller, and the aperture is correspondingly smaller than in the typical form. The variations in calcification are about as in *trispinosa*. The peristome is usually raised, sometimes evenly, but generally in older stages it is irregular; the most common form is with a labiate process rising on either side of the orifice. Avicularia are abundantly developed, of two sorts, a small oval (occasionally somewhat pointed) type situated usually on one or both sides of the orifice; and a larger, oval or often spatulate, form irregularly located on the front of the cell behind the aperture. (This form of avicularium was not mentioned by Verrill, but is of frequent occurrence.) An umbonal process is sometimes placed irregularly behind the orifice. Ooecia



globose, large, in young state shining and pierced by large irregular punctures, in older stages the pores may become closed and the surface roughly granular.

Although Hincks, Waters, and McGillivray have considered this a separate species, I have no hesitation in ranking it merely as a variety of the extremely variable *trispinosa*. My reasons for so doing are as follows: First, the characters of the zoecial wall, primary orifice, peristome, spines, and oecium are identical in both, and *nitida* runs through all the variations due to calcification that are shown by *trispinosa*. Second, the avicularia intergrade to such an extent that it is impossible to draw a dividing line; *nitida* has usually only the small oval avicularia, but larger spatulate avicularia are not uncommon and are sometimes abundantly developed, and in addition to these specimens are occasionally found, otherwise undistinguishable from *nitida*, which have the large pointed avicularia exactly similar to those of *trispinosa*, while on the other hand specimens of *trispinosa* from Crab Ledge have spatulate avicularia of various lengths showing the transition from the small oval form usually present. In size the zoecia also intergrade completely. I therefore regard *nitida* as a variety of *trispinosa* in which the large, pointed avicularia are wanting, while the oval and spatulate forms are more plentifully developed.

For comparison I have had specimens of *trispinosa* from England, Labrador, Nova Scotia, Beaufort, N. C., and the Tortugas Islands, Fla.

The variety *nitida* replaces the typical *trispinosa* in Vineyard, Nantucket, and Long Island Sounds, Buzzards and Narragansett Bays, and other inshore waters of southern New England. It is extremely abundant from low water to 20 fathoms, and is one of the characteristic Bryozoa of the region. It has been reported also from the British Isles and from Australia, where, without doubt, it constitutes a local form of the cosmopolitan *trispinosa*, as it does here.

#### Genus PORELLA Gray, 1848.

This genus may be recognized by the form of the zoecial aperture, rounded in front and nearly straight behind, with a rounded avicularium mounted on a rostrum immediately behind the primary orifice, which it usually overhangs somewhat. A shelf-like projection is present on the posterior margin of the orifice in *P. concinna* (for which reason Jullien and Calvet have placed the species in the genus *Smittia*), but otherwise the margin is plain behind and is never sinuate. The secondary orifice, formed by the growth of the peristome, is entirely different in character, usually more or less pyriform, with the pointed end posterior and including the aviculiferous rostrum in its sinus-like fold. Many species of this genus are erect and branching in manner of growth, but all of ours are encrusting or rise merely into low frills.

#### KEY TO SPECIES.

1. Primary orifice with a broad shelf-like projection on the posterior margin.....*concinna*.  
Primary orifice without such projection.....2.
2. Rostral avicularium with a somewhat pointed mandible directed upward.....*acutirostris*.  
Avicularium rounded.....3.
3. Primary orifice large and somewhat rounded posteriorly, large spatulate avicularia often present in addition to the rostral one.....*propinqua*.  
Posterior margin straight, rostral avicularia only; zoarium erected into frill-like expansions.....*proboscidea*.

*Porella concinna* (Busk). [Pl. xxvii, fig. 67, 67a, 67b, 68.]

- Busk 1852, p. 67 (*Lepralia concinna*).  
Dawson 1858, p. 256 (*Lepralia belli*).  
Stimpson 1853 (*Lepralia rubens*).  
Packard 1867, 271 (*Lepralia belli*).  
Verrill 1879c, p. 30 (*P. laevis* var. *concinna*).  
Hincks 1889, 428, 1892, p. 156.  
Whiteaves 1901, p. 102.  
Cornish 1907, p. 78.

Zoarium encrusting on stones and shells. Zooecia flat above, with or without punctures when fully calcified, the margin more or less sinuate, a row of marginal pores; in the younger cells the front is more or less convex and rises rather suddenly to the rostrum, a row of large areolæ about the margin with strong ribs between them and running a short way inward, but this condition is usually soon lost by calcification, primary orifice rounded in front, straight behind, with a broad tooth, secondary orifice deep, the peristome rising high and evenly, inclosing the primary orifice and the rostrum, sometimes raised on the side into a pair of blunt projections. Avicularium round. Ovicell globose, prominent in the young stage but often much immersed in old colonies, much roughened by later calcification, usually with a single median pore near the orifice. Some of our specimens seem to fall in the variety *belli* (Dawson), pl. x, fig. 68, though they seldom present the finger-like projections at the side of the orifice to as great an extent as more northern specimens.

Not uncommon at Crab Ledge in 14 to 20 fathoms. Not previously recorded south of Canadian waters.

**Porella acutirostris** Smitt. [Pl. xxvii, fig. 69, 69a.]

Smitt 1867, p. 21.

Hincks 1880, p. 429.

Whiteaves 1901, p. 103.

Zoarium encrusting on stones and shells, usually forming rounded colonies, often of great regularity. Zooecia usually disposed regularly in radiating lines, convex above, smooth or granular, with a row of areolæ about the margin, primary orifice round in front, straight posteriorly; peristome high and thin, connected with but not inclosing the rostrum, running forward upon the ovicell to form a conspicuous border on the front of it. Avicularium with a triangular mandible pointing upward, mounted upon a large rather smooth rostrum which curves forward somewhat over the orifice. Ooecium large, smooth, prominent, globose, the peristome forming a border on its front when fully developed.

The rostrum is very prominent in this species, and the avicularium with its bluntly triangular mandible is the most distinctive character, but the specimen must usually be turned somewhat backward to see this to the best advantage, since the point of the avicularium is directed nearly straight upward.

Very common at Crab Ledge in 14 to 20 fathoms, and at Great Round Shoal in 8 fathoms. Not previously recorded south of the Gulf of St. Lawrence.

**Porella propinqua** (Smitt). [Pl. xxvii, fig. 70, 70a.]

Smitt 1867, p. 22 (*Eschara propinqua*).

Verrill 1875b, p. 41, and 1879c, p. 30 (*Eschara verrucosa*, var. *propinqua*).

Whiteaves 1901, p. 105.

Zoarium encrusting shells, hydroid stems, etc. Zooecia rather large, convex, surface roughened by tubercles and raised lines, a row of areolæ around the margin; a raised border separates the cells; orifice rather large, rounded anteriorly, and slightly rounded behind the lateral denticles but without a distinct sinus; peristome slightly raised in the infertile cells, much raised when ovicells are present, carried up on the sides of the orifice into flap-like projections which extend forward upon the ovicell and backward to partially or entirely inclose the avicularium. Immediately behind the orifice is a stout umbo, curved forward and projecting somewhat over the primary orifice, and bearing on its tip a rather large rounded avicularium. A second avicularium, which is large and spatulate in form, is often present on the front of the cell, usually turned sidewise. Ooecium large, subglobose, prominent or somewhat immersed, punctured, often very regularly, with rather large pores, the pores usually forming an outer ring and a central cluster.

The species undergoes quite a change in appearance from the young cell to the adult condition with ovicells, mostly due to the development of the peristome, and the calcification of the front of the cell.

I am not at all satisfied that this species should be placed in the genus *Porella*, since the character of the primary orifice is much more like that of a *Lepralia*, especially such forms as *L. pertusa* and *L.*

*americana*. The orifice in the young cell is nearly round; the lateral denticles are like those of a *Lepralia* and the margin curves backward in an evenly rounded fashion on the posterior border. Hincks placed the species in *Lepralia*. In Jelly's Catalogue it is placed under *Smittia*, for which I can see no very good reason, and Norman and Whiteaves list it as a *Porella*, on account of the rostrum and avicularium. Not uncommon at Crab Ledge and off Sankaty Head in 14 to 25 fathoms. Recorded by Verrill "off Buzzards Bay, 25 fathoms; Nantucket Shoals, abundant; Bay of Fundy, etc."

***Porella proboscidea* Hincks.** [Pl. XXVII, fig. 71, 71a, 71b, 71c, pl. XXXI, fig. 101.]

Hincks 1888, p. 222.

Verrill 1875a, p. 414 (*Eschara verrucosa*), 1879b, p. 194, and 1879c, p. 30 (*Porella verrucosa* Esper).

Zoarium rising erect from an encrusting base, forming bilaminar folded frills, often of singular beauty, rising to a height of one-half to one inch, growing on stems and occasionally on shells and pebbles, white or light yellowish in color. Zoecia of moderate size, convex, with a row of areolæ about the margin and strong ribs running between these toward the center often to the base of the rostrum; a raised border is present in the young cells but is soon obscured by calcification; in older cells the front wall becomes exceedingly thick, covering the ribs, the raised margins, and even the rostrum, producing a rather smooth, flat, continuous layer; the marginal areolæ are usually distinct even in old cells, however. Primary orifice rounded in front, straight posteriorly: peristome rising evenly, embracing the rostrum and continuous with the ovicell, often rising high above both as calcification proceeds; the secondary orifice thus produced is more or less pyriform with the pointed end posterior. Avicularium small, round, situated at the top of a strong rostrum which curves somewhat forward over the orifice, in a few cases a pointed projection rising from the top of the rostrum just behind the avicularium. Ooecium moderately large, subglobose, smooth and imperforate, prominent in the young state, completely immersed when calcification is complete, continuous with the peristome in its formation.

There is no doubt that this is the species which Verrill recorded as *Eschara verrucosa* (Esper) from Cashes and Jeffreys Ledges, as I have seen specimens so marked in his collection. It is not Esper's species, however, as that is the *Umbonula verrucosa* (Esper), and I have compared both English and Canadian specimens.

Abundant at Crab Ledge, 14 to 20 fathoms, Great Round Shoal, 8 fathoms; off Sankaty Head ESE., 23 fathoms; off No Mans Land (Fish Hawk station 7784), 20 fathoms, Nantucket Shoals. The finest specimens I have seen were on the stems of the ascidian *Boltenia*, where, in one case, a colony several inches in length completely encircled the stem and formed a complicated set of frills.

### Suborder CTENOSTOMATA Busk, 1852

This suborder is characterized, among the marine ectoprocts, by the entire absence of calcification. The walls may be strengthened by impregnation with argillaceous matter, or they may be more or less chitinous, or, not infrequently remain quite soft. Avicularia, vibracula, and ooecia are absent. The zoarium may be stolonate or encrusting, and may rise in the form of phytoid branches or fleshy lobes.

#### KEY TO FAMILIES.

1. Zoecia immersed in a gelatinous crust, not stolonate..... 2.  
Stolonate, zoecia not immersed in a gelatinous layer..... 3.
2. Crust armed with horny spines, zoecial orifice bilabiate, with a movable lip acting as an operculum, Flustrellidæ.  
Crust without spines, no labia present, orifice closed by mere invagination of tentacle sheath Alcyonidiidæ.
3. Zoecium with a flattened area, more membranous than the rest of the wall, occupying nearly all of the ventral side..... Triticellidæ.  
Zoecium without flattened ventral area..... 4.

4. Zoarium (in our species) simply and somewhat palmately branched from a creeping stolon, the branches cylindrical, the ectocyst opaque and impregnated with earthy matter, zooecia connecting broadly with stalk at base..... Cylindroecidae.  
 Zoarium creeping or rising and branching to form phytoid tufts, not impregnated with argillaceous matter, the zooecia not communicating widely with the stalk or stolon..... 5.
5. Expanded tentacles forming a perfect circle, gizzard present..... Vesiculariidae.  
 Expanded tentacles not forming a perfect circle, as two of the number are bent outward, gizzard absent..... Valkeriidae.

#### family FLUSTRELLIDÆ Hincks, 1880.

Zooecia immersed in a gelatinous layer from which rise tall chitinous spines. The orifice is distinctly bilabiate, "resembling exactly a common clasp purse. It is bounded above and below by narrow horny ribs, which correspond with the metal clasps of the purse, and which are connected at the sides much in the same way as the latter, so as to allow of their opening and closing" (Hincks, 1880).

#### Genus FLUSTRELLA Gray, 1848.

*Flustrella hispida* (Fabricius). [Pl. XXVII, fig. 72.]

- Fabricius 1780, p. 438 (*Flustra hispida*).  
 Verrill and Smith 1874, p. 708 (*Alcyonidium hispidum*).  
 Verrill 1879c, p. 28.  
 Whiteaves 1901, p. 114.  
 Cornish 1907, p. 79.

Zoarium forming a brownish incrustation which is hispid with the large spines, each of which arises from a swollen base, and which are arranged around the orifice and along the margin of the cells. Zooecia very large, but their structure is not easily made out except in the young cells where the spines are not yet developed. They are roughly six-sided, the surface smooth and flat, with the bilabiate orifice slightly raised. The beauty of these colonies when the large lophophores are expanded "like a blue mist, hovering as it were, over the masses of *Flustrella* on the weed" (Hincks, 1880), is very striking. They are not less beautiful when expanded for study under the microscope.

Abundantly developed locally on the stems of *Ascophyllum* and *Fucus* at low water, occasionally on stones and other objects, but not taken in the dredge. It is an eminently littoral species.

#### Family ALCYONIDIIDÆ Hincks, 1880.

Zoarium consisting of a gelatinous crust (sometimes more or less filled with earthy matter) or occasionally rising into free cylindrical or expanded growths. Zooecia more or less closely united and more or less immersed in the common crust, orifice not protected by external lips but closed merely by the retraction of the tentacle sheath.

#### Genus ALCYONIDIUM Lamouroux, 1821.

##### KEY TO SPECIES.

1. Zoarium impregnated with earthy matter..... *parasiticum*.  
 Zoarium not containing argillaceous matter..... 2.
2. Zoarium covered with small conical papillæ rising between the orifices of the zooecia, erect or encrusting..... *hirsutum*.  
 Zoarium without such papillæ..... 3.
3. Zoarium encrusting..... *mytili*.  
 Zoarium erect..... 4.

4. Erect branches rather firm, the gelatinous substance comparatively solid, zooecia closely packed, tentacles about 10 in number ..... *verrilli*.  
 Branches softer, the gelatinous matter comparatively soft, zooecia not so closely packed, tentacles 15 to 17 in number ..... *gelatinosum*.

**Alcyonidium parasiticum** (Fleming). [Pl. xxvii, fig. 73.]

Fleming 1828, p. 518 (*Alcyonium parasiticum*).

Verrill and Smith 1874, p. 708.

Verrill 1879c, p. 28.

Zoarium encrusting on stones, shells, and stems of various sorts, impregnated with earthy matter which gives the colony the appearance of a coating of mud. The zooecia, which are rather small, appear in the midst of this layer as depressed areas with minute papillæ around the border. In the younger parts of the colony the zooecia project somewhat and the septa are evident. The tentacles are about 15 in number.

Verrill records this species from Vineyard Sound at a depth of a few fathoms. It was not noted in the inner waters of the region during our survey, but was taken at Crab Ledge in 14 to 20 fathoms, and off No Mans Land in 29 fathoms, in considerable abundance. It has not been reported from Canadian waters, but occurs on the European coasts.

**Alcyonidium mytili** Dalyell. [Pl. xxviii, fig. 74, 74a.]

Dalyell 1847, p. 36.

Verrill 1879b, p. 188 (*Alcyonidium rubrum*, n. sp.); 1879c, p. 28 (as *A. mytili* and *rubrum*).

Zoarium encrusting on stones and shells, occasionally on seaweed, forming rather firm, dingy white, yellowish, reddish, gray or brown colonies, sometimes quite dark, at other times almost colorless, covered with small, low prominences when the zooids are retracted. Zooecia typically hexagonal, but this form is often modified to a pentagon or quadrilateral; septa showing with more or less distinctness on the surface.

Hincks (1880) says of this species that the ova are borne in special zooecia destitute of polypides, within which the ova are arranged so as to form a ring. This is not entirely true of our specimens, for the eggs are most certainly developed in the ordinary type of zoecium. I have counted as many as 14 developing embryos within a single zoecium, though the number varies greatly and not infrequently there are only one or two; when numerous they may be arranged in a circle. I am inclined to think that the polypide may degenerate as the embryos approach maturity, thus giving the appearance of a special zoecium. There is more than a possibility that the *A. polyoum* of Hassall (1841, p. 484, *Sarcoclitum polyoum*) may be the same species, as there seems to be little except the arrangement of the ova to distinguish it from *mytili*. In this case Hassall's name will have precedence.

I believe I am correct in identifying Verrill's *rubrum* with *mytili*. Certainly I have taken the brick-red form, which I have not been able to separate structurally from the pale and grayish-brown specimens, which I have compared with British specimens of *mytili*. Verrill's description is as follows: "An encrusting species, forming broad smooth colonies, covering stones and shells. Zooecia rather large, mostly hexagonal, but often pentagonal, with their boundaries well marked in alcoholic specimens by a distinct line. The retracted zooids in preserved specimens usually form a small papilla in the middle of the zooecia. Color in life, bright brick-red, or sometimes orange red." If further study shall prove that the arrangement of the ova and their method of development in a distinct form of zoecium is characteristic of *mytili*, then *rubrum* must stand as a distinct species, but certainly there is nothing distinctive in the color or the general character of the zooecia.

Widely distributed over the region, from low water to 16 fathoms, sometimes forming extensive crusts on piles, taken also on barnacles, skate egg cases, on the carapace and legs of crabs (especially *Libinia*) and occasionally even in the branchial chamber, as well as on stones and shells. Verrill records *rubrum* from Long Island to Nova Scotia.

**Alcyonidium verrilli**, new name. [Pl. xxviii, fig. 75, 75a, 75b, 75c, pl. xxxi, fig. 92, 92a.]

Verrill 1872, p. 289 (*Alcyonidium ramosum*, n. sp.).

Verrill and Smith 1874, p. 708 (*Alcyonidium ramosum*).

In naming this species Prof. Verrill overlooked the fact that Lamouroux (*Encyclopedie Méthodique*, t. xiv, p. 40) had already applied the name to another species in this genus. As the present species is very evidently not the *ramosum* of Lamouroux, a new name is required, and I have the pleasure of dedicating it to Prof. Addison E. Verrill, who first described it and whose name is so intimately connected with the pioneer work on the Bryozoa of our coast.

"Much branched, when full grown; the branches round, irregularly dichotomous, usually crooked. Surface glabrous, smooth, or nearly so, the cells rather small and crowded, their margins not elevated; zooids with 16 slender tentacles. Color ashy brown, or dull rusty brown. We have often found arborescently branched specimens 12 to 15 inches high, with smooth, cylindrical branches about a third of an inch in diameter."

To the above description by Verrill may be added the following: The branches are not infrequently much flattened, especially at the tips, and the larger branches are often hollow. The texture is firm, and in alcoholic specimens rather brittle. From *A. gelatinosum*, the only species with which it is likely to be confused, it is distinguished by the firmer structure, by greater opacity, by the size of the cells, which are somewhat larger and more crowded, and by the number of tentacles. The statement by Verrill and Smith (l. c.) that the height is ".250 mm. to .350 mm." is a typographical error for 250 to 350 mm.

Verrill records the species from New Jersey to Vineyard Sound. It is not at all common in Vineyard Sound, and occurs, so far as I have observed, only at the extreme western end of the Sound, where only small specimens a few inches in height were taken. The finest examples I have seen were given me by Prof. Verrill from Long Island Sound.

**Alcyonidium gelatinosum** (Linné). [Pl. xxviii, fig. 76.]

Linné 1766-8, p. 1295 (*Alcyonium gelatinosum*).

Verrill and Smith 1874, p. 709.

Verrill, 1879c, p. 28.

There is considerable doubt as to the occurrence of this species in the Woods Hole region. Verrill and Smith recorded it questionably; "a few small specimens, apparently belonging to this species, were dredged in the deeper parts of Vineyard Sound," and later collecting has not revealed its presence.

Zoarium erect, branching or simple, the branches subcylindrical or slightly flattened, yellowish or greenish yellow in color, the softest and most pellucid of the genus. Zoecia small, and rather closely packed, their orifices marked by low papillæ, the tentacles about 15 to 17.

**Alcyonidium hirsutum** (Fleming). [Pl. xxviii, fig. 77.]

Fleming 1828, p. 517 (*Alcyonium hirsutum*).

Verrill and Smith 1874, p. 708.

Verrill, 1879c, p. 28.

Zoarium of rather firm consistency, encrusting, or erect, compressed, expanded, palmate, much and variously divided, of a yellowish brown color; surface thickly covered with tall imperforate papillæ, among which the slightly prominent orifices are placed. Reaches a height of 5 or 6 inches. More commonly grows as a rather thick crust spreading over algæ, etc.

Verrill has recorded this species from Vineyard Sound, but it has not made its appearance in the collections of our survey.

The *Alcyonidium? pellucidum* of Leidy (1855, p. 142) is an *Amouroucium*.

#### Family CYLINDRÆCIDÆ Hincks, 1880.

Stolonate, the zoecia arising singly, and broadly continuous with the stolon (*Cylindræcium*); or somewhat palmately branched, erect portions bear the zoecia, which are cylindrical and broadly continuous with each other (*Anguinella*). Only the latter genus has been observed in this region, but *Cylindræcium* is found abundantly at Beaufort, N. C., and may be looked for at Woods Hole.

Genus *ANGUINELLA* Van Beneden, 1844.*Anguinella palmata* Van Beneden. [Pl. XXVIII, fig. 78, 78a.]

Van Beneden 1844, p. 58.

Zoarium with erect branches bearing the zooecia, which are not at all constricted at the base. The zooecia are cylindrical and bluntly rounded at the apex, irregularly situated on the branch, opaque with impregnated earthy matter, tentacles about 10 in number. Height, according to Hincks (1880), from 3 to 8 inches, but I have seen no specimens on the American coast more than an inch in height, even where it grows abundantly, as at Beaufort, N. C.

The species may be very readily overlooked on account of its peculiar growth habit, which resembles that of a small brown alga, and from the fact that it is rendered obscure by a layer of mud embedded in the ectocyst. I have taken it but once in the Woods Hole region, at Fish Hawk station 7659, in Buzzards Bay, where a few small colonies were dredged.

## Family VESICULARIIDÆ Hincks, 1880.

Stolonate, the zooecia arising singly or in clusters from the stolon, or from erect branches; zooecia well marked off from the stalk or stolon, often deciduous.

## KEY TO GENERA.

1. Zooecia clustered in double rows arranged spirally on the stems which are erect and branching. *Amathia*.  
Zooecia not so arranged. . . . . 2.
2. Zoarium with a creeping stock, from which may arise erect shoots; zooecia irregularly disposed or occasionally clustered. . . . . *Bowerbankia*.  
Zoarium erect, phytoid, rooted by fibers. Zooecia arranged in a single series on one side of the stem. . . . . *Vesicularia*.

Genus *BOWERBANKIA* Farre, 1837.

Our species of this genus are creeping, with occasional branches reaching out in a wandering fashion as though in search of a support. The zooecia are irregularly disposed in our species, though in *B. imbricata*, which has been reported doubtfully from Canadian waters, they are arranged in groups.

## KEY TO SPECIES.

A pointed or divided process near the base of the zoecium on its outer side. . . . . var. *caudata*.  
No projection on the basal portion of the zoecium. . . . . *gracilis*.

*Bowerbankia gracilis* Leidy. [Pl. XXVIII, fig. 80, 80a, 80b, 80c.]

Leidy 1855, p. 142.

Verrill and Smith 1874, p. 709 (*Vesicularia gracilis*).Verrill 1879c, p. 28 (*Vesicularia gracilis*).

"Polydome delicate, creeping, branching, white. Cells cylindrical, erect, about  $\frac{1}{3}$  of a line in length, without appendages at their orifice, the margin of which is retractile with the inhabitant of the cell. Polype provided with 8 ciliated arms. Intestine with a strong gizzard. Pt. Judith." (Leidy.)

In its most distinct form the *gracilis* of Leidy is smaller than *caudata*, the stolon entirely creeping, the zooecia slender and colorless, and attached to the upper surface of the stolon either singly or in clusters, and in such zooecia there is usually no indication of any caudate process. The careful study of any such colony, however, in all large colonies that have come under my observation, has revealed occasional zooecia attached to the side of the stolon, either singly or in pairs after the manner of *caudata*, and in these laterally attached zooecia a caudate process, sometimes as well developed as in *caudata*, is often present. All sorts of intergradations in the size of the process are present, and in size and color also the two forms intergrade. For these reasons, therefore, I unhesitatingly place *caudata* as a variety of *gracilis*. There is, furthermore, no difference in the distribution of these forms in our region, and

they often occur together on piles, stones, and seaweed, etc., from low water to the deepest parts of Vineyard Sound.

**Bowerbankia gracilis**, var. **caudata** (Hincks). [Pl. xxviii, fig. 79, 79a.]

Hincks 1877, p. 215 (*Valkeria caudata*).

Verrill and Smith 1874, p. 710 (*Vesicularia fusca*).

Stem entirely creeping, except for occasional sprawling branches. Zoecia elongate, subcylindrical, biserial and usually opposite in arrangement, at any rate arising from the side of the stolon, truncate and often squared at the top; base narrowed rather suddenly near the point of attachment, and produced on the lower or outer side into a variously shaped process, usually pointed. A strong gizzard is present and there are eight tentacles. The size of the zoecia varies considerably, and in different states of contraction they present quite different shapes. A little study of the specimen will reveal the caudate process. This appendage shows a large amount of variation; it is not infrequently bifid or trifid, it may project straight downward or more outward, and it is quite variable in size and often difficult to find on old cells. The color varies from pale yellowish to brown, and only the very young cells are usually transparent.

Abundant and widely distributed throughout the region, in all sorts of places and at all depths, but I have found it in greater abundance on old piles in New Bedford Harbor than elsewhere. It grows on algæ, hydroid and Bryozoa stems, on shells, stones, ascidians, etc., sometimes so thickly as to cover the substratum with a close nap. Not noted in the outside waters of the region; evidently a shorewise form.

I place Verrill's records of "*Vesicularia fusca* Smitt" under this species with little hesitation, as a specimen from South End, near New Haven, given me by Verrill as *fusca*, proves to be *caudata*. The latter species is often quite brownish in color, and all the material which I have examined has proved to be either this species or *gracilis*. I have specimens of *caudata* from Long Island Sound, from Eastport, Me., and from Labrador, which agrees with Verrill's account of the distribution of *fusca*, and I have taken the species also at Beaufort, N. C., and at the Tortugas Islands, Fla. It should be added that *caudata* was not described at the time of Verrill's records of *fusca*.

#### Genus AMATHIA Lamouroux, 1812.

This genus is easily recognized by the phytoid form of the colony, with the short zoecia arranged in a double series which winds spirally on the stem.

**Amathia dichotoma** (Verrill). [Pl. xxix, fig. 81, 81a.]

Verrill, in Verrill and Smith 1874, p. 709 (*Vesicularia dichotoma*, n. sp.).

Leidy 1855, p. 143 (*Valkeria pustulosa*).

Verrill's description is complete and accurate, so I quote it in full. "Stems clustered, cæspitose usually 1 or 2 inches high, slender, white, and repeatedly forking. The branches stand in different planes so as to produce miniature tree-like or shrub-like forms, many of which generally rise close together, forming crowded tufts upon rocks, oyster-shells or algæ. When the stem or a branch divides there is a joint formed at the base of each of the forks, by the interpolation of a very short segment of a dark, brownish, opaque substance, which contrasts strongly with the white translucent substance of the rest of the stem. Zooids arranged closely in two subspiral rows of 6 to 12 each, just below each fork of the stem and branches, and not occupying half of the length of the internodes, which are naked and smooth below the crowded clusters of the zooids, these are smooth, greenish brown, broad oval or obovate in contraction, subcylindrical or obovate in expansion, entirely sessile, and but little narrowed at the base, and so crowded as to appear imbricated. The tentacles are eight, long and slender, in expansion usually more than half the length of the cell."

Verrill and Smith do not record the species from Vineyard Sound and I have never dredged it. It is common on the piles at Vineyard Haven and Edgartown, and occurs also in similar situations at Woods Hole and Nantucket. Verrill's records are for Great Egg Harbor, N. J., and Long Island Sound.



Genus *VESICULARIA* J. V. Thompson, 1830 (pars).

According to Hincks (1880, p. 512) the genus *Vesicularia* is characterized by an erect phytoid zoarium, with the zooecia disposed regularly in a single series on one side of the stem.

? *Vesicularia familiaris* (Gros). [Pl. XXIX, fig. 82.]

Gros, Bull. Soc. Imp. Moscou, t. XXII, p. 567 (*Plumatella familiaris*).

Smitt 1865, p. 502 (*Vesicularia familiaris*).

Verrill and Smith 1874, p. 710 (*Farrella familiaris* Smitt).

Verrill 1879c, p. 28 (*Farrella familiaris* Gros).

I must confess that I am at a loss to know how to place the species which Verrill has identified with the above. According to his note in regard to it (l. c., p. 487), it is "a singular and delicate species, which occurs both on the underside of rocks and of algæ. The body is small, fusiform, attached by a long and very slender pedicel, flexible. When it surrounds the stems of small algæ, the whitish pedicels project outward in all directions, and thus produce the appearance of a delicate chenille cord." If, as one would suspect from the above description, it is a repent form, it can scarcely be a *Vesicularia*. It has not occurred in our dredgings and I have not seen the species on our coast. Verrill records it from Long Island Sound to Casco Bay.

## •Family VALKERIIDÆ Hincks, 1880.

Zoarium stolonate, entirely repent or with erect branches, zooecia contracted below, deciduous, tentacles not forming a perfect circle when expanded, as two of the number are bent outward, gizzard absent.

Genus *VALKERIA* Fleming (pars), 1823.*Valkeria uva* (Linné). [Pl. XXVIII, fig. 83, 83a.]

Linné 1758, p. 812 (*Sertularia uva* and *S. cuscuta*).

Verrill and Smith 1874, p. 709 (*Vesicularia cuscuta* Thompson).

Verrill 1879c, p. 28 (as *Valkeria cuscuta* and *Vesicularia uva*).

Zoarium repent, sometimes giving off erect shoots, jointed at intervals, branches arising in opposite pairs, zooecia clustered at intervals on the stems. Zoecium small, slender, pointed below, transparent, gizzard absent, two of the eight tentacles characteristically bent outward when expanded.

This species has not appeared in the collections of our survey of the Woods Hole region, but Verrill has recorded it for Vineyard Sound, as well as from Great Egg Harbor, N. J., and Casco Bay, Me.

Verrill's notes (l. c., p. 404-5) indicate the habits of the species as follows: "A delicate, creeping species, which resembles in miniature the dodder-plant (*Cuscuta*), and creeps over other bryozoa and hydroids, very much as the dodder creeps over other plants. It occurs both at low water in pools and in shallow water among rocks."

## Family TRITICELLIDÆ G. O. Sars, 1873.

The important characteristic of this family is the presence of a flattened, membranous area, occupying the greater portion of the ventral side of the zoecium. The presence of a gizzard has not, I believe, been noted in this family, but in one species, the "*Vesicularia armata*" of Verrill, such an organ is present. In general, the species of this family are commensal on Crustacea, but certain species spread over seaweeds and similar surfaces.

Genus *HIPPURARIA* Busk, 1874.

The genus *Hippuraria* is distinguished from *Triticella*, which has not yet been noted in American waters, by the clustered arrangement of the zooecia, which in *Triticella* are scattered singly along the stolon. Our species have the zooecia arranged in pairs at the termination of the internodes.

## KEY TO SPECIES.

Four strong spines at the top of the zoecium.....*armata*  
 Zoecium unarmed.....*elongata*.

**Hippuraria armata** (Verrill). [Pl. XXIX, 84, 84a, 84b.]

Verrill, in Verrill and Smith, 1874, p. 710 (*Vesicularia armata*, Verrill, n. sp.), Verrill 1879c, p. 28 (*Vesicularia armata*).

"Cells stout, oval, broad at base, with a short and narrow pedicel, attached either singly or in pairs along slender, filiform, creeping stems, which often anastomose, the branches being mostly opposite. Distal end of cells prolonged into four conical processes, each of which, when perfect, supports a long, slender spinule, nearly half as long as the cell. Tentacles not seen. Cells yellowish horn-color, with an oval, dark brown internal organ, visible in most of the cells" (Verrill, l. c.).

Verrill very evidently overlooked the flattened membranous area which is characteristic of this family, but it must be recalled that the papers of G. O. Sars, on *Triticella*, and of Busk, on *Hippuraria*, had not at that time made their appearance. The zoecia arise in pairs on either side of the stem at the end of an internode, each cell arising from a protuberance, from which also the branch takes its origin immediately below the zoecium. The branches are not formed at every internode, though zoecia usually are, and occasionally a branch arises on one side only. They are usually in pairs, however, like the zoecia, and the latter are very rarely suppressed on one side. The prominence is present in all cases, and not infrequently bears the evidence of having lost the zoecium. This, I believe, led to Verrill's statement that they may be attached singly. While the stolon is characteristically creeping and adnate it is not unusual to find erect shoots, an inch or more in height, beautifully symmetrical and frond-like in appearance. A small but distinct gizzard is present, not completely surrounding the gut, but forming several rounded lobes, with pointed teeth projecting into the cavity. A gizzard has not heretofore been noted in this family, and its presence may indicate a separate genus, but the general character of this species is so similar to *Hippuraria* that I have included it in this genus.

"Vineyard Sound on floating seaweed, also in 6 to 10 fathoms, rocky, on *Sertularia argentea*" (Verrill). Vineyard Sound and Buzzards Bay, fairly frequent; dredged in 4 to 15 fathoms, on various bottoms; also from the piles of wharves at New Bedford, Woods Hole, Edgartown, Katama Bay, and Nantucket. Best developed on piles, where the erect branches are of frequent occurrence.

**Hippuraria elongata**, new species. [Pl. XXIX, fig. 85, 85a, 85b, 85c.]

Zoarium entirely creeping, the stolon slender, transparent to light brownish in color, jointed, the internodes sometimes elongate, but often very short; branches paired, arising from a lateral projection on either side at the end of the internodes, the same projection giving rise to a zoecium; spreading over the gill-chamber or upon the carapace of various species of crabs. Zoecia rather large, elongate, mounted on slender pedicels, tapering slightly toward both ends, the apex truncate or rounded in contraction, a membranous area on the ventral side extending sometimes nearly the whole length of the cell and again not more than two-thirds of the length; the pedicel varies greatly in length, sometimes shorter than the cell and again more than twice as long, thin walled and transparent, with a flexible portion at the top partly involving the base of the zoecium; the pedicel increases in size toward the top, where it merges into the cell rather gradually at the flexible portion. The zoecia arise in pairs from lateral processes at the ends of the internodes just as in *H. armata*, but the internodes are often so short that the zoecia are brought close together and the substratum covered with a close nap of the cells.

A commensal species, found in the branchial chamber of the blue-crab (*Callinectes sapidus*) and spider-crabs (*Libinia* sp.), and occasionally spreading out to a small extent along the bases of the legs, also on the backs of the small crabs (*Pinnixia* sp.), living in the tubes of *Chatopterus*. Taken a number of times in Buzzards Bay and Vineyard Sound. Also abundant at Beaufort, N. C., in similar situations. The walls of the branchial chamber of the larger crabs are sometimes thickly clothed with the zoecia, and not infrequently the gills are more or less infested with them. *Pinnixia* is sometimes completely covered on the backs and legs with the white nap-like colonies.

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## EXPLANATION OF PLATES.

## PLATE XVIII.

- Fig. 1. *Loxosoma davenporti*.  
 Fig. 2. *Loxosoma minuta*, n. sp., drawn to same scale as fig. 1.  
 2a. The same, much enlarged, in contracted condition.  
 Fig. 3. *Pedicellina cernua*, ordinary form of zooecium.  
 3a. The same, smooth form, the *glabra* of Hincks.  
 3b. The same, with spinous stalk, the *echinata* of Sars.  
 3c. The same, with spinous calyx, the *hirsuta* of Jullien.  
 3d. The same, with spinous stalk and calyx.  
 Fig. 4. *Barentsia major*.  
 Fig. 5. *Barentsia discreta*, partially expanded.  
 5a. The same, detail of stalk.  
 Fig. 6. *Crisia eburnea*, portion of a branch.  
 6a. The same, ooecium.  
 6b. The same, ooeciostome much enlarged.  
 Fig. 7. *Crisia cribraria*, portion of colony, showing the long sinuate internodes.  
 7a. The same, ooecium.  
 7b. The same, ooeciostome much enlarged.  
 Fig. 8. *Crisia denticulata*, portion of branch showing ovicell and ooeciostome, from an English specimen.  
 Fig. 12. *Stomatopora diastoporoides*, colony, size of specimen  $\frac{5}{8}$  inch.  
 12a. The same, detail of portion of colony at edge.  
 Fig. 13. *Lichenopora verrucaria*, colony, size of specimen  $\frac{1}{8}$  inch.  
 13a. The same, two views of a zooecial tube.  
 13b. The same, ooeciostome, at same magnification as 13a.

## PLATE XIX.

- Fig. 9. *Tubulipora atlantica*, specimen from Crab Ledge. Drawn by H. J. Shannon.  
 9a. The same, detail of ovicell and ooeciostome. Drawn by H. J. Shannon.

## PLATE XX.

- Fig. 10. *Tubulipora liliacea*, a colony from Vineyard Sound, characteristic of the species in this region.  
 Drawn by H. J. Shannon.  
 10a. The same, detail of ovicell and ooeciostome. Drawn by H. J. Shannon.  
 Fig. 11. *Tubulipora flabellaris*, detail of ovicell and ooeciostome. Drawn by H. J. Shannon.

## PLATE XXI.

- Fig. 14. *Etca anguina*, a single zooecium showing the basal enlargement.  
 14a. The same, showing membranous ooecium with embryo.  
 Fig. 15. *Eurata chelata*, after Hincks.

- Fig. 16. *Gemellaria loricata*, small portion of colony to show manner of arrangement of the cells.  
 Fig. 17. *Scruparia clavata*, branch of colony to show arrangement of cells.  
 17a. The same, mode of branching.  
 17b. The same, dwarfed fertile cell with ovicell.  
 17c. The same, detail of aperture.  
 Fig. 18. *Caberea ellisii*, portion of a branch, with ovicell, avicularia and vibraculum.  
 18a. The same, vibracula cell from the posterior side.  
 Fig. 19. *Menipea ternata*, portion of colony with radical fiber.  
 Fig. 20. *Scrupocellaria scabra*, portion of branch, showing scute, ovicell, etc.  
 Fig. 20bis. *Cellularia peachii*, a single internode.  
 Fig. 21. *Bicellaria ciliata*, portion of a branch.  
 21a. The same, detail of oecium.  
 21b. The same, detail of avicularium.  
 Fig. 22. *Bugula gracilis* var. *uncinata*, portion of a branch.  
 22a. The same, at base of colony showing uncinata processes.  
 Fig. 23. *Bugula turrita*, portion of colony.  
 23a. The same, details of the ovicell.  
 23b. The same, showing manner of attachment and development of ovicell.  
 Fig. 27. *Bugula avicularia*, from an English specimen.

## PLATE XXII.

- Fig. 24. *Bugula cucullifera*, portion of a branch.  
 24a. The same, side view of ovicell.  
 24b. The same, avicularium.  
 24c. The same, portion of a cell with elongate spines.  
 Fig. 25. *Bugula flabellata*, portion of a branch.  
 25a. The same, details of ovicell.  
 25b. The same, avicularium.  
 Fig. 26. *Bugula murrayana*, portion of colony, showing both kinds of avicularia.  
 26a. The same, details of ovicell.  
 Fig. 28. *Membranipora lacroixii*, portion of colony.  
 28a. The same, drawn from a living cell.  
 28b. The same, back or dorsal side of cell.  
 Fig. 29. *Membranipora monostachys*, portion of a colony, showing an abortive cell and a secondary calcified lamina in some cells.  
 29a. The same, a cell of the commoner many-spined form, enlarged.  
 29b. The same, a cell of the one-spined, "monostachous" form, enlarged.  
 Fig. 30. *Membranipora pilosa*, portion of colony of the typical, long-spined form.  
 30a. The same, the short-spined variety *dentata* of Solander.

## PLATE XXIII.

- Fig. 31. *Membranipora lineata*, arrangement of zooecia.  
 31a. The same, details of avicularia and ovicell, more enlarged.  
 31b. The same, side view of a cell.  
 31c. The same, back of a zooecium showing details of pore chambers.  
 Fig. 32. *Membranipora craticula*, arrangement of zooecia and spines.  
 32a. The same, details of cell, ovicell, and avicularium, much enlarged.  
 32b. The same, back of zooecium, showing details of pore chambers.



- Fig. 33. *Membranipora arctica*, portion of zoarium.  
 33a. The same, more enlarged, details of cell, ovicell, and avicularia.  
 33b. The same, young zoecium at edge of colony, not fully calcified.
- Fig. 34. *Membranipora arctica* var. *armata*, showing large avicularium at base, and small erect spines at base of lateral avicularia.
- Fig. 35. *Membranipora unicornis*, portion of zoarium showing details of various structures.
- Fig. 36. *Membranipora cymbaformis*, portion of colony showing general details.  
 36a. The same, two views of the stalked avicularium, more enlarged.
- Fig. 37. *Membranipora aurita*, showing the usual regular arrangement of the cells.  
 37a. The same, more enlarged to show details of ovicell, and the two basal avicularia pointing forward.  
 37b. The same, showing the avicularium pointing backward in absence of ovicell.
- Fig. 38. *Membranipora flemingii*, enlarged as in 37a, with details of cell and ovicell, and the arrangement of avicularia in presence and absence of the ovicell.
- Fig. 39. *Membranipora tenuis*, showing partially calcified area with spinules projecting inward, and occasional prominences at angles of zoecia.

## PLATE XXIV.

- Fig. 40. *Membranipora tehuelcha*, arrangement of zoecia, with details.
- Fig. 41. *Cribrilina punctata*, portion of colony with general details.  
 41a. The same, with curved spines in front of zoecium, enlarged.  
 41b. The same, aperture of young cell with oral spines in usual condition.
- Fig. 42. *Cribrilina annulata*, portion of colony with details.  
 42a. The same, details of cell with oral spines and keel.  
 42b. The same, dwarfed erect cell bearing ovicell.
- Fig. 43. *Porina tubulosa*, portion of colony.  
 43a. The same, more enlarged, details of aperture, ooecium, and pore.  
 43b. The same, one of the small frontal punctures highly magnified.  
 43c. The same, diagram of side view of cell, ooecium, and pore.
- Fig. 44. *Microporella ciliata*, arrangement of zoecia and general details.  
 44a. The same, a ribbed, umbonate, heavily calcified ovicell, more enlarged.  
 44b. The same, elongate form of avicularium, more enlarged.  
 44c. The same, a series of forms of the pore showing variations leading from *ciliata* to the var. *stellata*, etc., highly magnified.
- Fig. 45. *Microporella ciliata* var. *stellata*, the usual heavily calcified condition of this variety.
- Fig. 46. *Hippothoa divaricata*, portion of colony.  
 46a. The same, ovicell.
- Fig. 47. *Hippothoa hyalina*, portion of colony.  
 47a. The same, at edge of young colony showing spaces between cells.  
 47b. The same, dwarfed fertile cell with ovicell.  
 47c. The same, details of aperture.

## PLATE XXV.

- Fig. 48. *Schizoporella unicornis*, portion of colony, the usual form in the Woods Hole region.  
 48a. The same, an elongate cell from the same colony as figure 48.  
 48b. The same, smooth, convex form with large umbo.  
 48c. The same, with reversed avicularium, the *reversa* of Verrill.  
 48d. The same, ovicell of usual form, and elongate avicularia.  
 48e. The same, ovicell heavily calcified, ribbed, and umbonate, from deeper water, more enlarged.

- Fig. 49. *Schizoporella biaperta*, portion of colony.  
 49a. The same, details of cell and ovicell, more enlarged.  
 49b. The same, the large pointed avicularium occasionally present.
- Fig. 50. *Schizoporella auriculata*, portion of colony.  
 50a. The same, details of fully calcified cell and ovicell, more enlarged.
- Fig. 51. *Schizoporella sinuosa*, portion of colony near growing edge, showing change in shape of aperture.  
 51a. The same, details of cell and ovicell in complete calcification.
- Fig. 52. *Cellepora americana*, n. sp., aperture and ovicell in front view.  
 52a. The same, side view showing avicularium.  
 52b. The same, primary orifice.
- Fig. 53. *Cellepora canaliculata*, cell and ovicell in front view.  
 53a. The same, two views of the rostrum.  
 53b. The same, primary aperture.
- Fig. 54. *Lepralia pallasiiana*, portion of colony with details of one zoecium.
- Fig. 55. *Lepralia americana*, portion of colony with details of infertile cell, more enlarged than figure 54.  
 55a. The same, details of a fertile cell and ovicell.

## PLATE XXVI.

- Fig. 56. *Lepralia pertusa*, portion of colony with cells and ovicell of the usual form.  
 56a. The same, two cells from the same colony, smaller variety.  
 56b. The same, heavily calcified ovicell, umbonate process behind orifice, and lateral avicularia.  
 56c. The same, cells near the edge of the same colony as 56b and at the same magnification, showing variation in size of cells.
- Fig. 57. *Lepralia serrata*, n. sp., young cell with oral spines and primary aperture before beginning of secondary calcification.  
 57a. The same, cell with avicularia, from central part of the same colony as 57, secondary calcification very deep, a large avicularium on a mamillate process.  
 57b. The same, portion of a colony with ovicells and various avicularia.  
 57c. The same, details of aperture and ovicell, more highly magnified.
- Fig. 58. *Mucronella peachii*, portion of colony showing ovicell and details of secondary calcification.  
 58a. The same, young cell at edge of colony showing primary aperture, oral spines, and marginal areolæ.
- Fig. 59. *Mucronella ventricosa*, fully calcified, with ovicells, same magnification as figure 58.  
 59a. The same, aperture of young cell with oral spines and developing peristome, more highly enlarged.
- Fig. 60. *Mucronella pavonella*, portion of colony showing details.
- Fig. 61. *Rhamphostomella bilaminata*, infertile cells.  
 61a. The same, fertile cell with ooecium.
- Fig. 62. *Rhamphostomella costata*, infertile cells.  
 62a. The same, side view of rostrum showing avicularium.  
 62b. The same, fertile cells with ovicells and large pointed avicularium.
- Fig. 63. *Rhamphostomella ovata*, infertile cells.  
 63a. The same, fertile cell with ovicell.
- Fig. 64. *Smittia porifera*, portion of colony.

## PLATE XXVII.

- Fig. 65. *Smittia trispinosa*, two cells of typical form, with oral spines and avicularia.  
 65a. The same, showing connecting links with the var. *nitida* in the variously shaped avicularia, magnified somewhat more than figure 65.

- Fig. 66. *Smittia trispinosa* var. *nitida*, portion of colony of typical *nitida* when fully calcified, drawn to same scale as figure 65.
- 66a. The same, a cell from another part of the same colony as 66; note the difference in the size of the cells.
- 66b. The same, a cell with large pointed avicularium.
- 66c. The same, a cell with small oval and large elongate avicularia.
- 66d. The same, ovicell showing secondary calcification.
- 66e. The same, heavily calcified cell with thickened peristome, large roughened umbo and very thick zoecial wall (avicularium impressed).
- Fig. 67. *Porella concinna*, detail of young cell.
- 67a. The same, portion of colony in ordinary secondary calcification showing ovicell.
- 67b. The same, with central raised area due to secondary calcification.
- Fig. 68. *Porella concinna* var. *belli*, fertile cell with two lateral avicularia, ovicell with irregular umbo, more highly magnified than figure 67a.
- Fig. 69. *Porella acutirostris*, portion of colony showing arrangement of cells.
- 69a. The same, showing details of infertile cell.
- Fig. 70. *Porella propinqua*, portion of colony showing ovicells, oral avicularia and large avicularia—in one case the large avicularium replaces the oral one.
- 70a. The same, ovicell with raised border.
- Fig. 71. *Porella proboscidea*, portion of colony in earlier stages of calcification.
- 71a. The same, young cell showing formation of ovicell and its connection with peristome.
- 71b. The same, primary orifice more highly enlarged, seen partly from in front.
- 71c. The same, older portion of colony, the secondary calcification rising above ovicells and rostra.
- Fig. 72. *Flustrella hispida*, young cells at margin of colony, showing spines and bilabiate orifice.
- Fig. 73. *Alcyonidium parasiticum* portion at edge of colony, showing the broad tuberculate margin and central hyaline area.

## PLATE XXVIII.

- Fig. 74. *Alcyonidium mytili*, portion of colony.
- 74a. The same, a single cell showing retracted polypide and orifice.
- Fig. 75. *Alcyonidium verrilli*, n. nom., young cells at edge of colony.
- 75a. The same, in older part of colony showing thickness of superficial septa.
- 75b. The same, cross-section of a branch.
- 75c. The same, section of a cell showing details of anatomy.
- Fig. 76. *Alcyonidium gelatinosum*, showing the very thin superficial septa, from an English specimen.
- Fig. 77. *Alcyonidium hirsutum*, showing papillæ and orifices, from an English specimen.
- Fig. 78. *Anguinella palmata*, small colony showing manner of branching.
- 78a. The same, a single zoecium.
- Fig. 79. *Bowerbankia gracilis* var. *caudata*, portion of colony.
- 79a. The same, details of anatomy.
- Fig. 80. *Bowerbankia gracilis*, portion of colony at higher magnification than figure 79; the cells are really smaller than those of *caudata*.
- 80a, b, and c. The same, cells from the same colony as figure 80, showing (a) absence of caudate process, (b) very small caudate process, (c) well developed process.
- Fig. 83. *Valkeria uva*, portion of colony, from an English specimen.
- 83a. The same, details of anatomy.

## PLATE XXIX.

- Fig. 81. *Amathia dichotoma*, portion of a branch, showing arrangement of zoecia and mode of branching.  
 81a. The same, a single cluster of zoecia more highly magnified.
- Fig. 82. *Vesicularia familiaris*, a single zoecium, after Smitt.
- Fig. 84. *Hippuraria armata*, portion of an erect branch.  
 84a. The same, a single zoecium in the contracted state much enlarged.  
 84b. The same, details of alimentary system, (L) lophophore, (O) œsophagus, (G) gizzard, (S) stomach, (I) intestine.
- Fig. 85. *Hippuraria elongata*, n. sp., portion of stolon with one zoecium.  
 85a. The same, small portion of stolon more highly magnified to show manner of branching and origin of zoecia.  
 85b. The same, outline of the long-pedicellate form of zoecium.  
 85c. The same, details of anatomy.

## PLATE XXX.

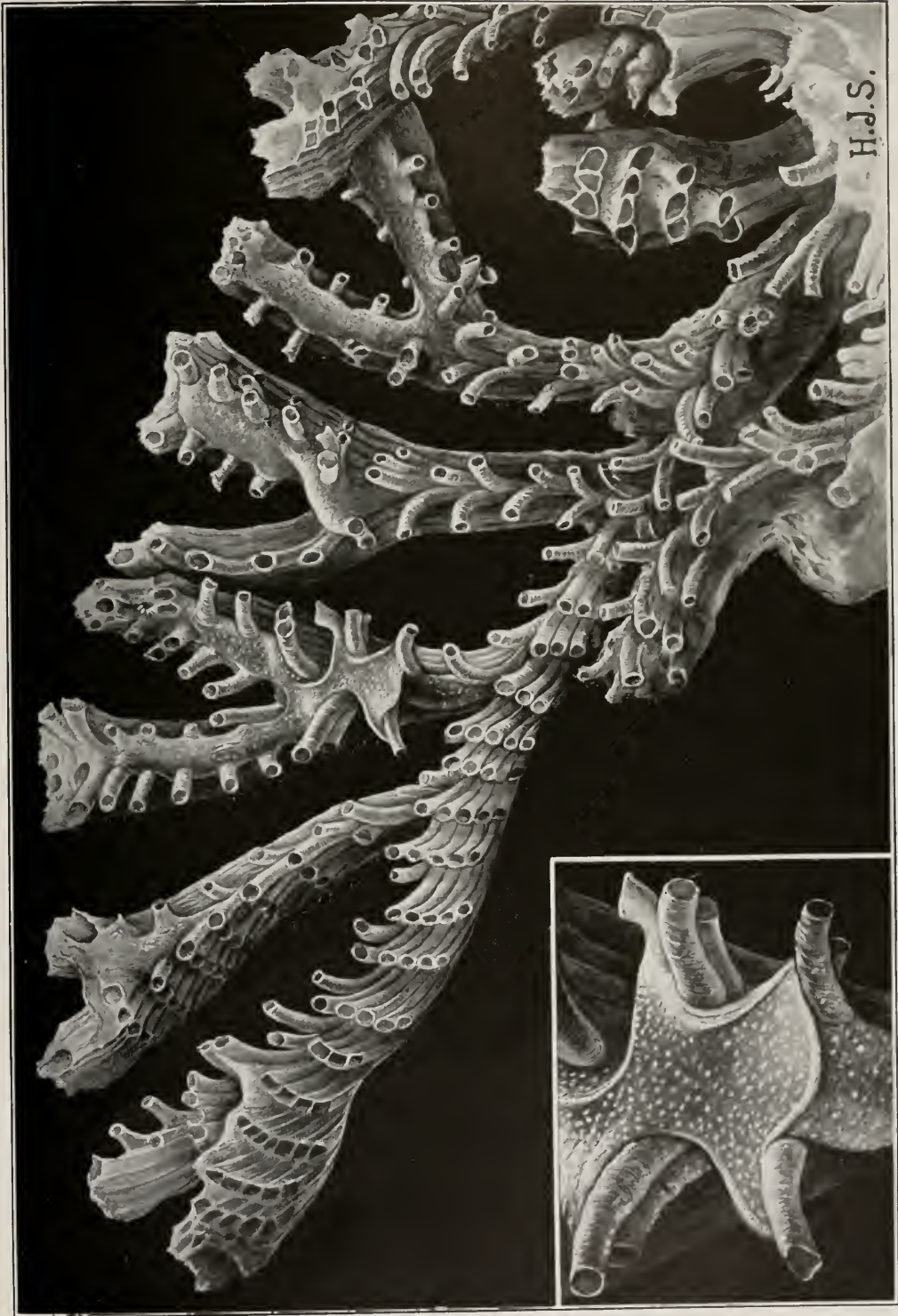
- Fig. 86. *Membranipora arctica* on shell, twice natural size.
- Fig. 87. *Membranipora tenuis*, at the right, and *M. monostachys*, at the left, on pebble, twice natural size.
- Fig. 88. *Smittia trispinosa* var. *nitida*, nodular masses about natural size, encrusting shells.
- Fig. 89. *Lepralia pallasiana*, colony growing on submerged wood, twice natural size.
- Fig. 90. *Microporella ciliata* var. *stellata*, on shell, twice natural size.
- Fig. 91. *Schizoporella unicornis*, on mass of tubes of *Hydroides dianthus*, one-half natural size.

## PLATE XXXI.

- Fig. 92. *Alcyonidium verrilli*, colony with flattened branches, one-half natural size.  
 92a. The same, with rounded branches, one-half natural size.
- Fig. 93. *Caberea ellisii*, natural size.
- Fig. 94. *Bugula flabellata*, natural size.
- Fig. 95. *Scrupocellaria scabra*, natural size.
- Fig. 96. *Menipea ternata*, natural size.
- Fig. 97. *Gemellaria loricata*, reduced about one-half.
- Fig. 98. *Cellepora canaliculata*, natural size.
- Fig. 99. *Cellepora americana*, colonies growing on hydroid stem, natural size.
- Fig. 100. *Rhaphostomella costata*, colony growing on *Boltenia* stem, natural size.
- Fig. 101. *Porella proboscidea*, at the left a colony on a stem of *Boltenia*, at the right the more usual form of the colony on a hydroid stem, both reduced about one-half.
- Fig. 102. *Bugula turrata*, slightly reduced.







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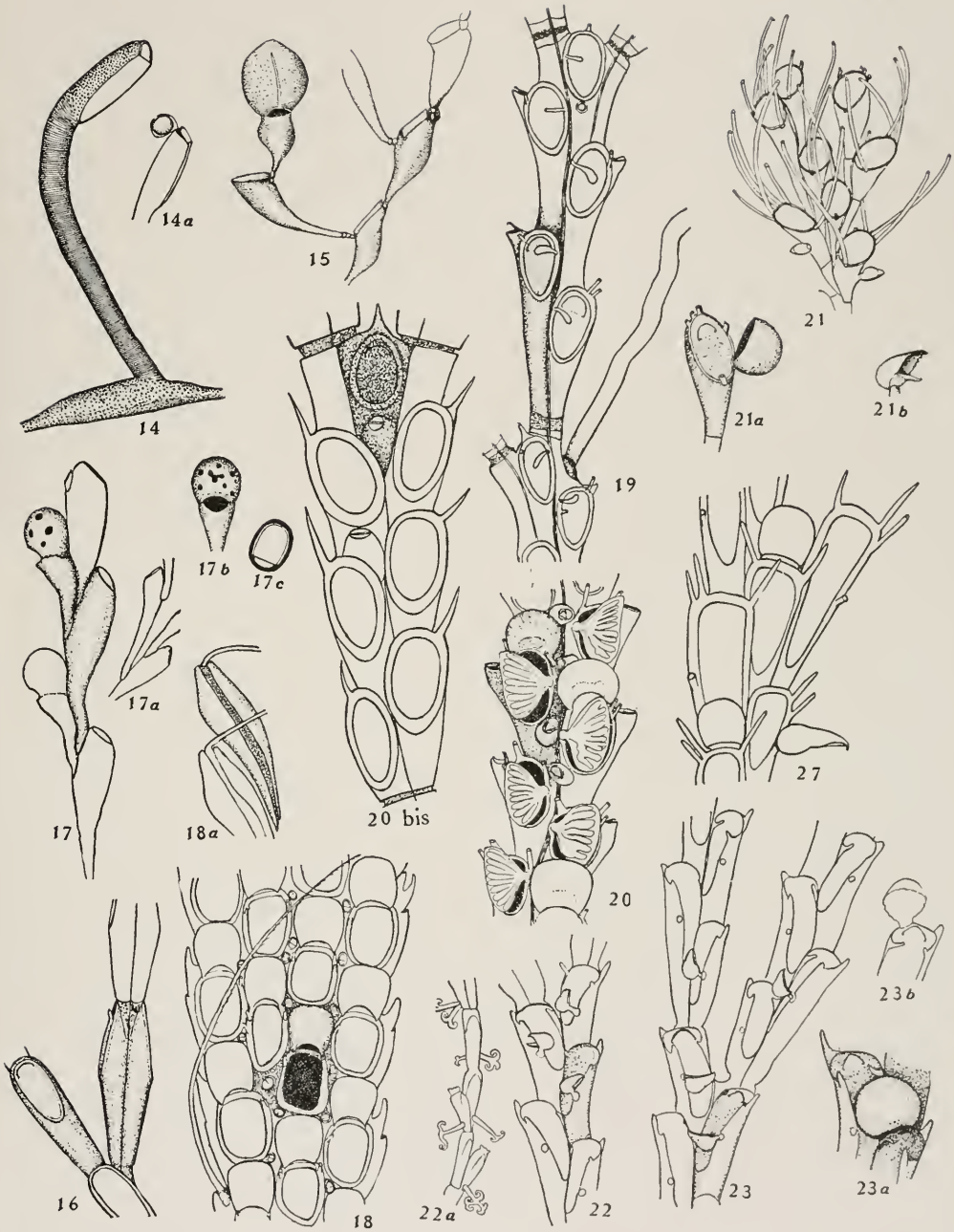


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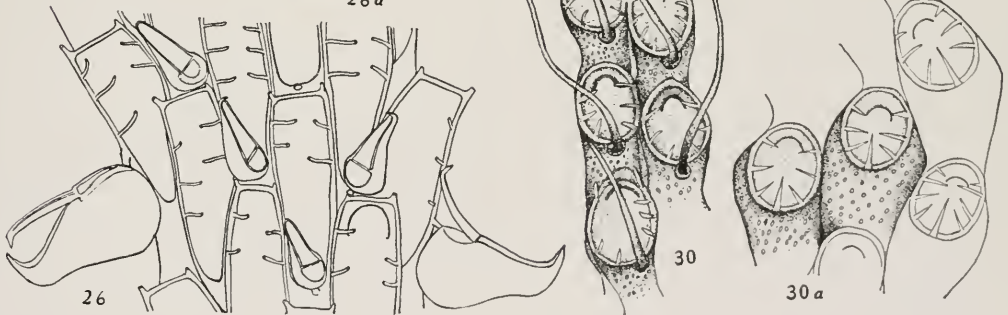
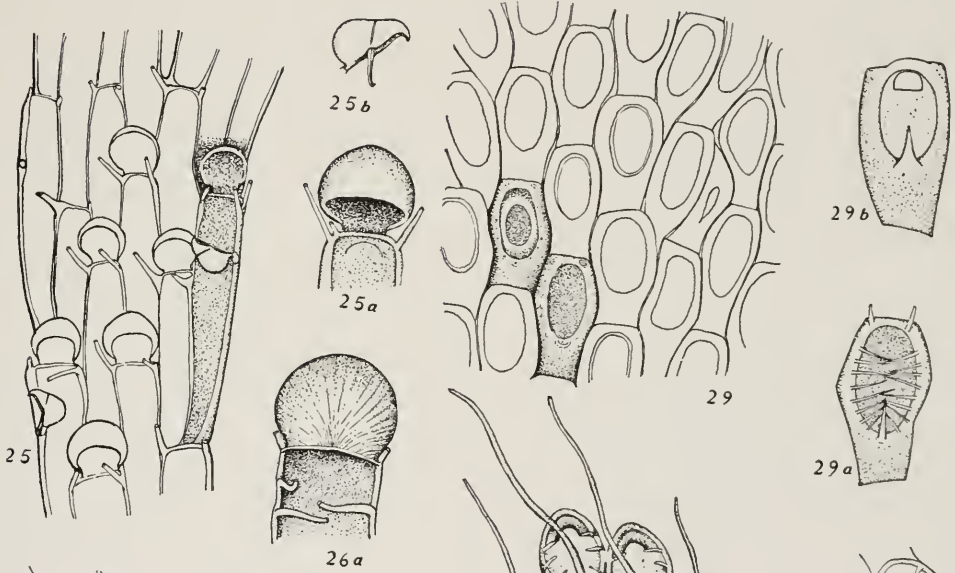
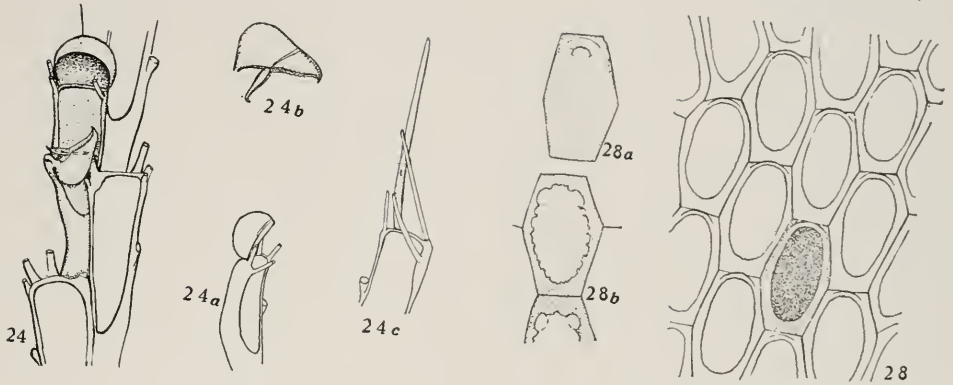


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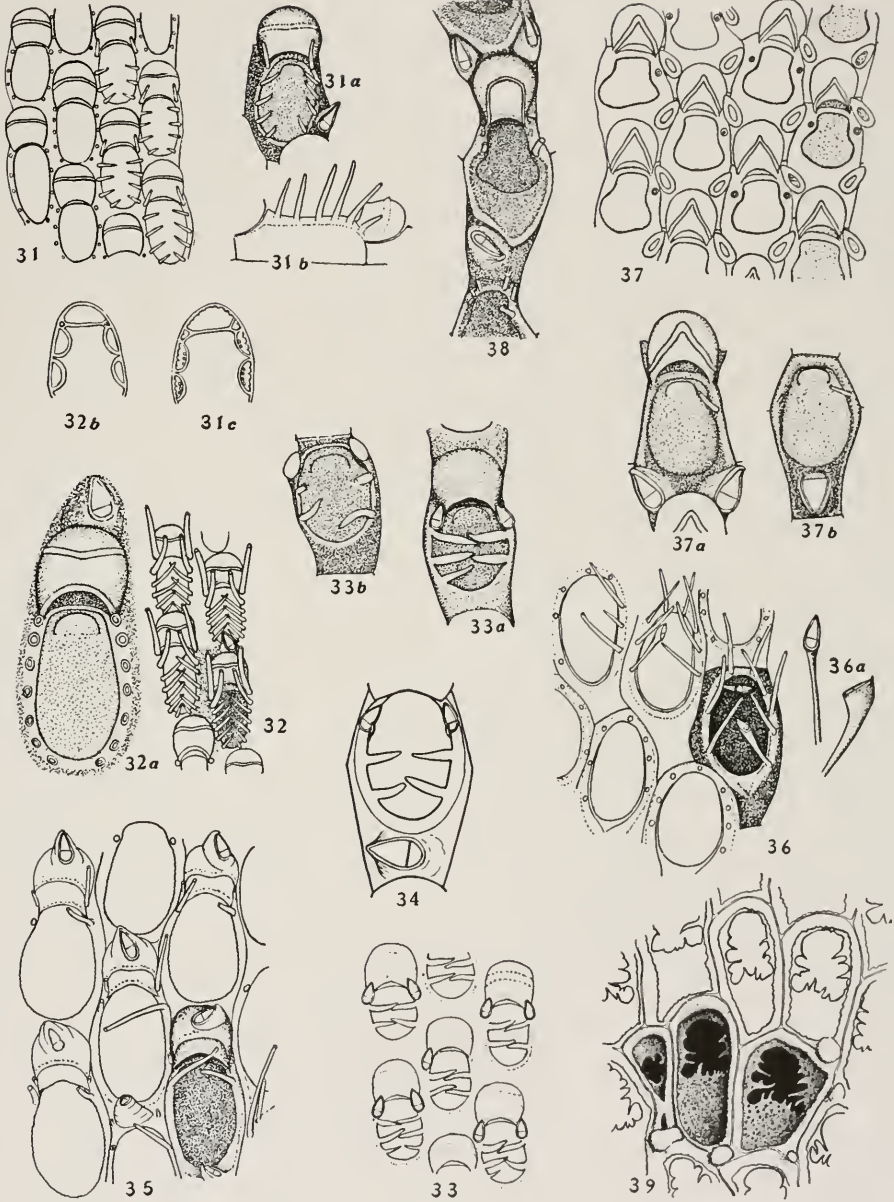






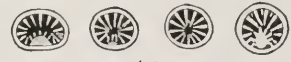
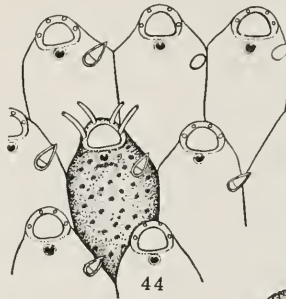
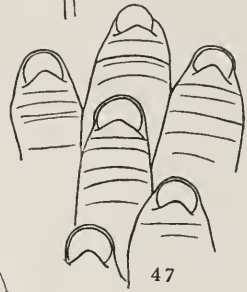
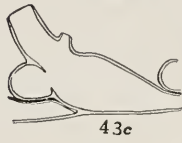
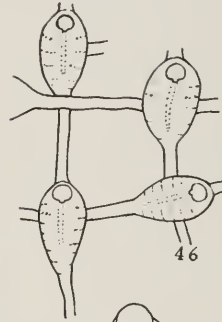
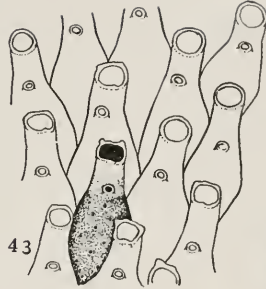
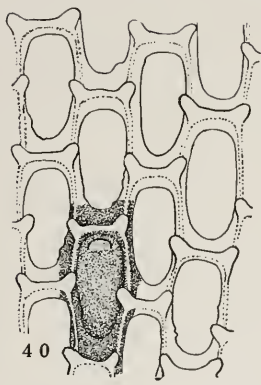




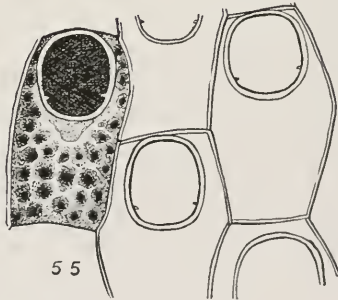
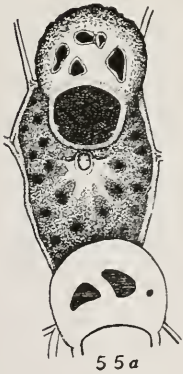
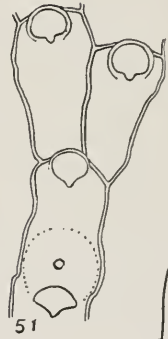
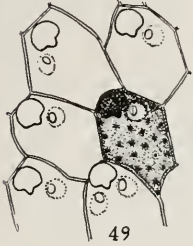
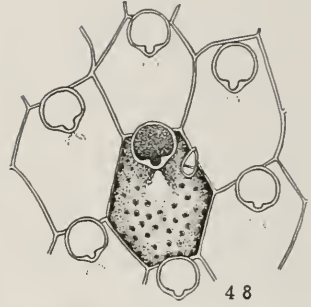
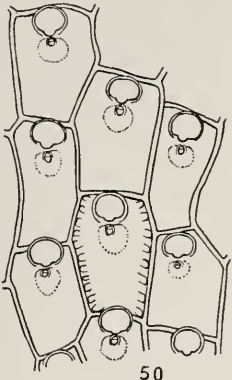








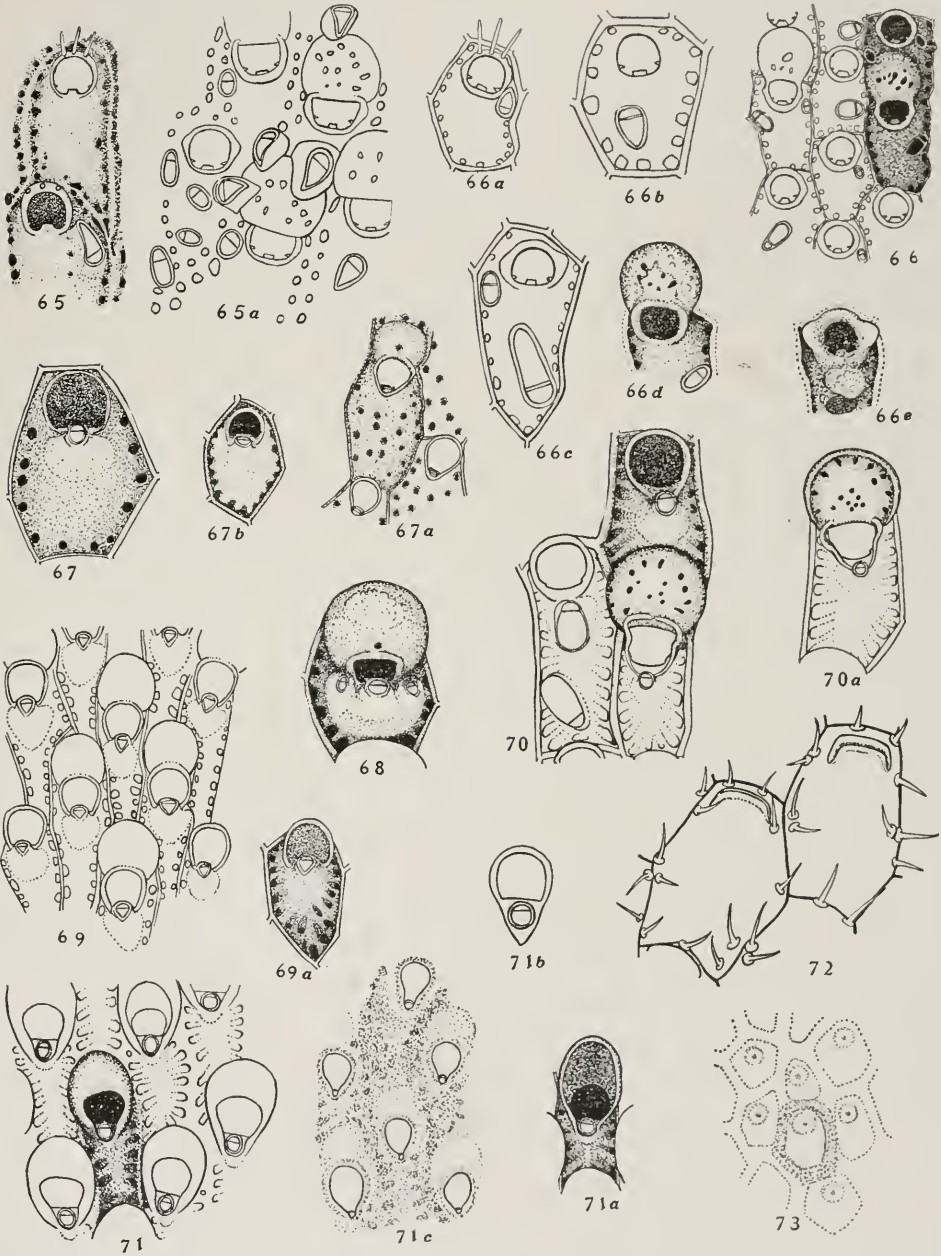






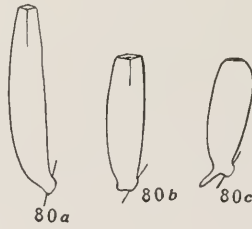
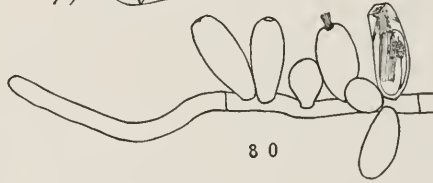
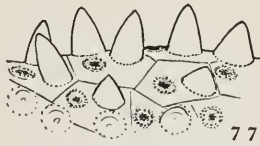
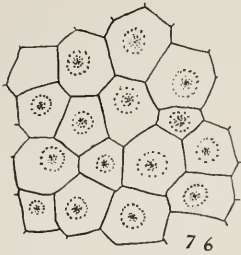
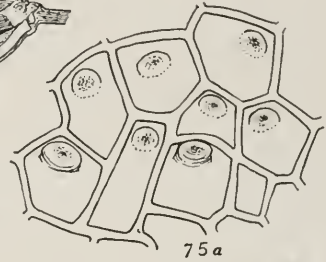
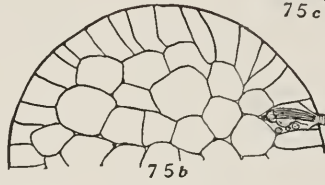
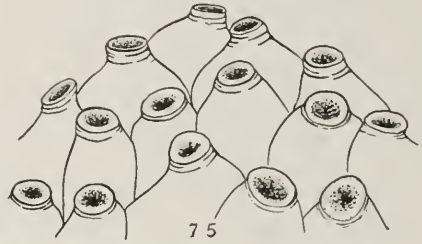
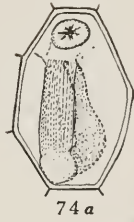
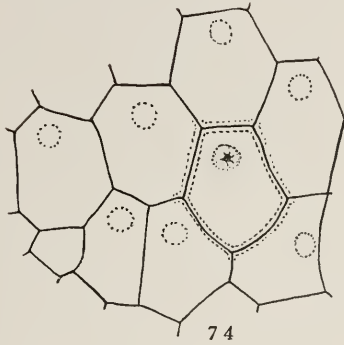








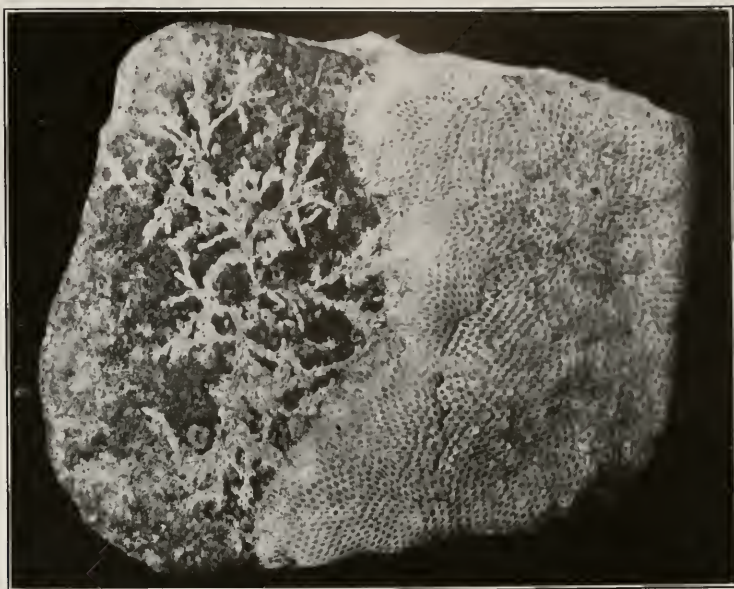








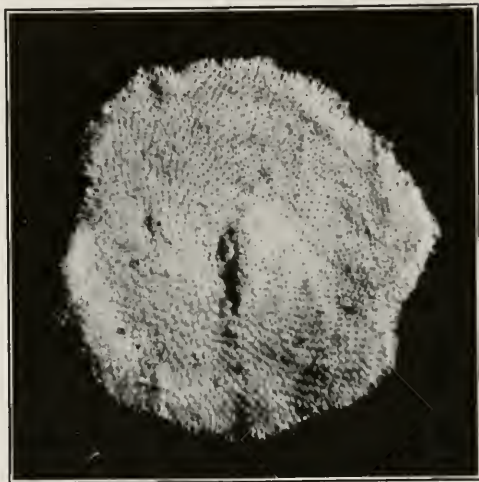




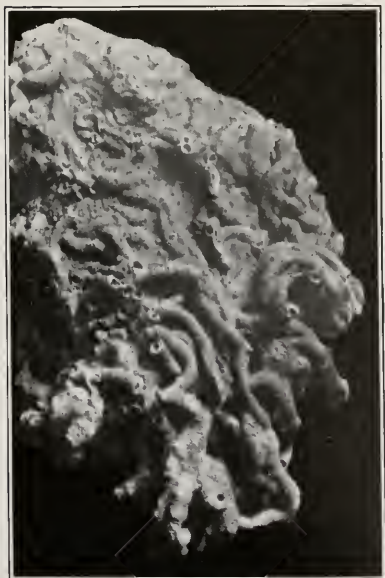
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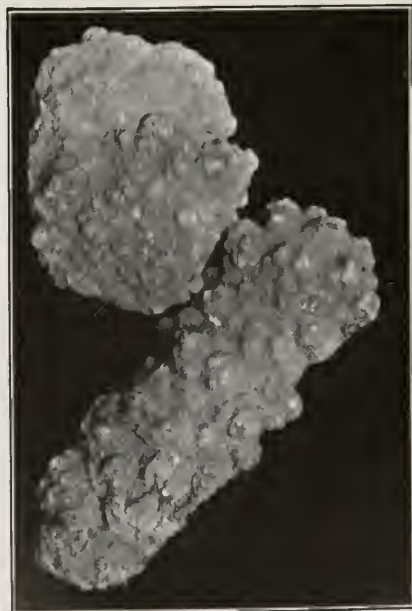
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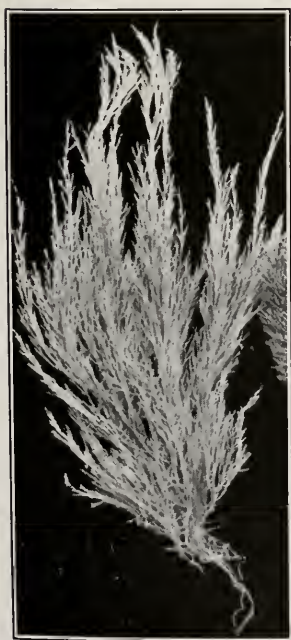
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