

Department of Research and Education
STATE OF MARYLAND
BOARD OF NATURAL RESOURCES

**A Survey of the Bryozoa
of Chesapeake Bay**

RAYMOND C. OSBURN

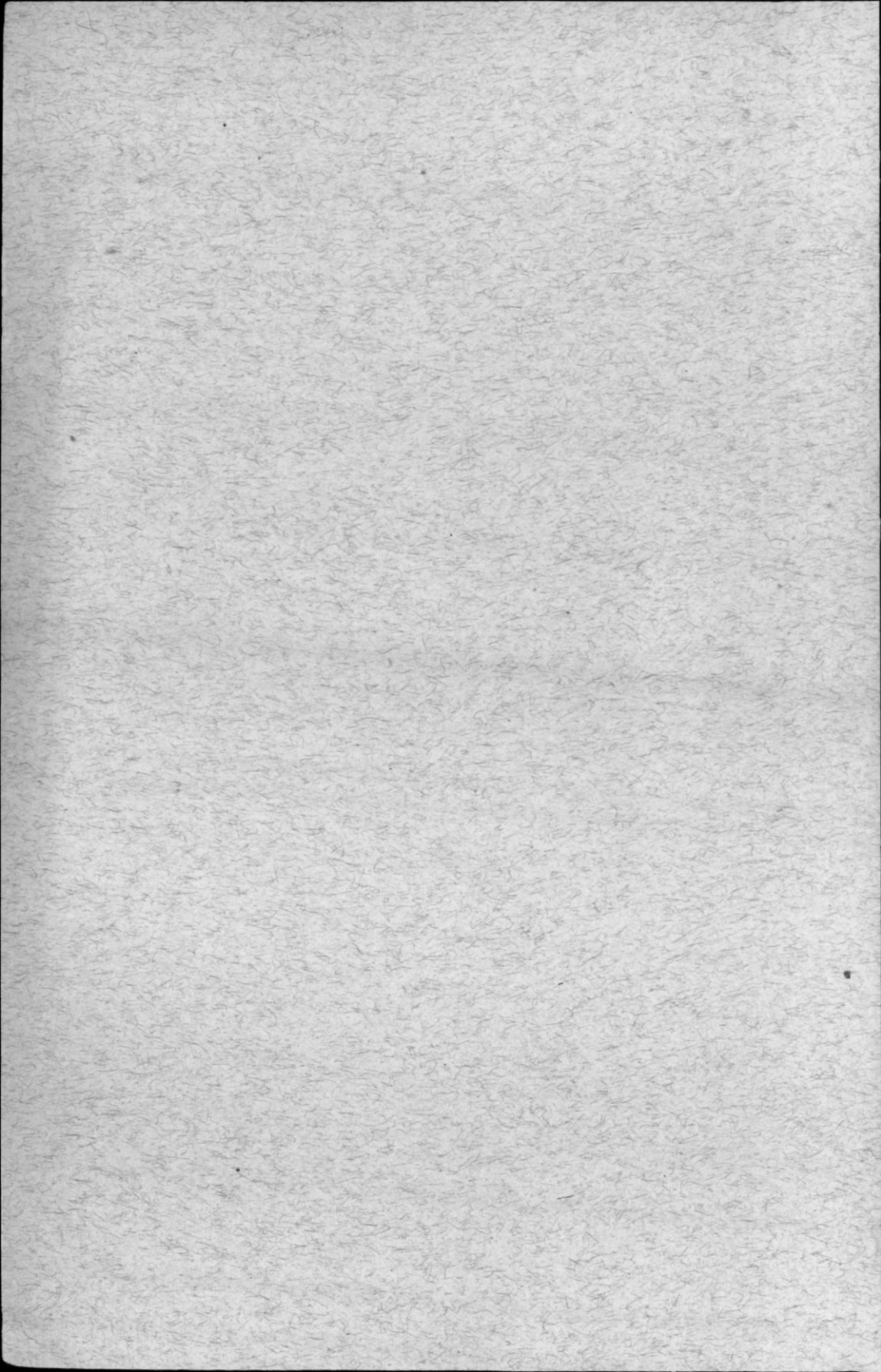


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July, 1944

Publication No. 63

Chesapeake Biological Laboratory
Solomons Island, Maryland



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DEPARTMENT OF RESEARCH AND EDUCATION

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details of the physical features of Chesapeake Bay, the reader is referred to Dr. R. P. Cowles' paper (see Bibliography).

All of the major groups of the marine Bryozoa are represented in the Chesapeake, but the general complex of species is quite different from that of the open coast.

The Endoprocta, always a small group, are well represented by four species in the lower half of the Bay, usually attached to other organisms. The Ctenostomata, with 11 species, are proportionally better represented than the other groups of the Ectoprocta for in some way these chitinous forms are better adapted to brackish-water life. Only one of the Cyclostomata has been taken, the common *Crisia eburnea*, near the mouth of the Bay. Among the Cheilostomata the Anasca are represented by only nine species of the Membranipora-like members of the group, while the Ascophora are almost wanting, only three species occurring in the lower part of the Bay.

A partial report on Chesapeake Bryozoa was published by the author in 1932 (Osburn, 1932a) based on material dredged by Dr. R. P. Cowles in the deeper waters of the Bay, and a digest of this work also appears in Cowles' "Biological Study of the Offshore Waters of Chesapeake Bay" (Cowles, 1930,—Bryozoa on pages 339-340). In the summers of 1943 and 1944 the author made collections in the shallower waters from the head of the Bay to near its mouth with the result that the earlier list has been extended from 18 to 28 species. The distribution, reproduction and rate of growth of certain species important in the fouling of oysters have been given special attention.

Some material was also obtained from Chincoteague Bay on the eastern shore of the Delmarva peninsula. This area, cut off from the ocean by sand bars, is similar in formation to the many "sounds" all along the coast. Since it is very shallow, usually only 3 or 4 feet in depth, and has no confluent rivers, the salinity in the summer months is even higher than that of the ocean water outside, and some interesting contrasts with the Chesapeake biota are evident.

ACKNOWLEDGMENTS

The author cordially acknowledges the many courtesies of Dr. R. V. Truitt, Director of the Department of Research and Education, for facilities and financial support during the course of the work, and the kindly assistance of Mr. G. F. Beaven, Biologist, and others of the staff of the Chesapeake Biological Laboratory, especially for collecting ma-

terial during autumn and winter months. Dr. E. N. Cory, Head of the Department of Entomology, University of Maryland, kindly made available the services of his associate, Mr. Julian J. Chisolm, III, Department Photographer, in the preparation of Plates I to V, for which grateful acknowledgment is made.

A SURVEY OF THE BRYOZOA OF THE CHESAPEAKE BAY

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The Bryozoa are colonial animals which always live attached to some sort of substratum, so they are found growing over other animals, algae, shells, stones, the piles of docks, etc. They may even cover the bottoms of ships to the extent that they impede the progress of vessels. The Bryozoan individual is minute, rarely as much as a millimeter in length, but they often form large colonies which may cover many square inches or produce nodules several inches across, or rise in bushy form to the height of a foot or more. The name Bryozoa, meaning "moss animal" is descriptive of the erect colonies, but does not apply very well to the encrusting forms, which appear more like lichens.

Though the individuals which make up the colony are so small, they are fairly complex, with digestive, muscular, nervous and reproductive organs. The nutritive system consists of a circle of ciliated tentacles, which can be extruded or withdrawn, mouth, pharynx, esophagus, stomach and intestine. Some species even have a well-developed gizzard. The individual consists of a zoecium or body wall, within the cavity of which the zooid (digestive apparatus and appended organs) moves freely.

The wall of the zoecium is well chitinized (in a few cases apparently only gelatinous) and usually more or less heavily calcified. The zoecium may be attached to the substratum by the entire dorsal surface, or it may be partially or fully erect. In the proliferation of the colony the new zoecial buds may appear at the end and sides of those already formed, or they may also occur on the upper, that is, frontal surface, covering the mother zoecia. This process may continue until the colony is many layers in thickness, only the upper layer being alive. In other types proliferation is by means of stolonate processes from which the zoecia bud off singly or in clusters.

In reproduction ciliated larvae are formed which swim about for a short time, sometimes for only a few hours, after which they must become attached if they are to survive. The larva, or "Cyphonautes," is metamorphosed within a few hours into an "ancestrula" or primary individual of the colony, which is usually somewhat smaller and simpler in construction (more primitive) than the later individuals (Fig. 20e).

Occasionally a twin ancestrula is produced as is regularly the case with *Acanthodesia tenuis*, one of the abundant Chesapeake species (Fig. 22d).

The buds of the first generation of daughter zoecia usually appear within a few hours, first at the anterior end and frequently a little later at the posterior end or on the sides or both. The usual encrusting colony is fan-shaped at first, new buds being produced at the free ends and sides of those already laid down, and may later become circular. Since two rows of new zoecia may be produced daily, the growth of the colony is rapid. Thus in *Acanthodesia tenuis* and *Membranipora crustulenta* (both common encrusting forms in the Chesapeake), while the single individual is only about one half millimeter in length the colony is increasing all around the border at the rate of a millimeter a day. It would therefore be possible for a colony to reach two inches across in 25 days. As there are at least eight zoecia to every square millimeter, such a colony would contain thousands of individuals.

The Chesapeake Bay presents a rather peculiar biological situation. This large estuary is about 180 miles long, with an area of some 2800 square miles, and its mouth is only 11 miles across, so it is fairly well enclosed. The bottom is practically all silt and the depth over most of its area is only 30 to 40 feet. However, there is a series of deeper holes, down to more than 150 feet, which apparently are the remnants of the ancient Susquehanna River bed and those of its chief tributaries.

The salinity forms a gradient from the fresh water at the head, where the Susquehanna enters, to the salt water of the ocean at its mouth, and each of the confluent rivers presents a similar gradient from fresh to brackish water. This gradient, however, is not uniform nor constant as it is modified by the gradual influx of the heavier water of higher salinity near the bottom in the deepest parts, while the lighter fresh and brackish water flows on top. The heavy run-off of fresh water from the rivers at time of flood further confuses the picture.*

Naturally the majority of the organisms inhabiting the Bay are those that can withstand varying reduced degrees of salinity. The biota ranges all the way from fresh water forms at the extreme head of the Bay to typical marine species at its mouth. The reduced salinity of the great area of the Bay excludes both the fresh water and the truly marine organisms. The result is a limited number of species which are often represented by excessively large numbers of individuals. For

* The salinities given throughout this paper are those recorded at the time of collection. Considerable seasonal variations occur, especially in the upper half of the Bay. Example: Solomons surface salinities ranged from 5.4 to 18.8 during 1943, a year of unusual extremes.

PHYLUM BRYOZOA EHRENBERG *

1. Individual consisting of a naked head or polypide mounted on a slender pedicel, tentacle crown not retractible but the tentacles rolled inward, anus within the circle of tentacles (Figs. 1-4).

Sub-phylum Entoprocta. 1.

Individual not stalked, the tentacle crown retractible into the zooecial cavity, anus opening outside of the tentacle ring,

Sub-phylum Ectoprocta. 2.

2. Zooecia consisting of slender tubules with heavily calcified walls, the aperture terminal and circular (Fig. 5).

ORDER Cyclostomata

Zooecia with the walls usually calcified, aperture protected by a hinged chitinous flap, like a miniature trapdoor, which is located on the front side of the zooecium (Figs. 17-28).

ORDER Cheilostomata

Zooecia chitinous or gelatinous, erect and tubular or encrusting, the aperture terminal or frontal and puckered when the polypide is retracted (Figs. 6-16).

ORDER Ctenostomata

Entoprocta

The Entoprocta are a small group, the species of which are often very widely distributed. They differ considerably from other Bryozoa, so much so that an attempt has been made to place them in a separate phylum (Cori, 1929, Kamptozoa). Whatever disposition may eventually be made of them, they have always been included with the Bryozoa in such studies as this and only the students of the Bryozoa have paid much attention to them.

They are all stolonate, with the exception of a few which do not produce colonies but live singly, and spread over Bryozoans, hydroids, algae and occasionally pebbles and shells. The zooid is naked, ovoid or rounded, mounted on a pedicel which is somewhat flexible or is provided with a muscular basal enlargement.

* The keys are simplified in the following taxonomic discussion to apply only to the Chesapeake Bay species. Also the references under each species, with a few exceptions, include only the records from the Atlantic coasts of North and South America to indicate the coastwise distribution and the names by which the various species have been recorded in the past.

They are easily distinguished from other organisms, though at first glance the smaller ones might be mistaken for some of the stalked protozoans, or the larger ones for naked hydroids. The nature of the stalk and tentacles and the presence of internal organs are sufficient to separate them at once. They are of no economic importance.

KEY TO THE SPECIES OF ENTOPROCTA.

1. Stalk tapering upward, without a barrel-shaped enlargement at the base, usually with some small spines on the stalk or zooid or both.

Pedicellina cernua.

Stalk not markedly tapering upward, provided with a barrel-shaped muscular enlargement at the base, spineless. 2.

2. Stalk thin-walled and muscular, usually found curved or bent into a loose spiral.

Barentsia laxa.

Stalk more heavily chitinized, straight and rigid. 3.

3. Stalk wall appearing as if punctured by numerous minute pores.

Barentsia discreta.

Wall of stalk without pores, usually secondary muscular enlargements in addition to the basal one.

Barentsia gracilis.

Pedicellina cernua (PALLAS), 1771. Fig. 1.

Leidy, 1855, p. 57 (*P. americana*, n. sp.). Rhode Island.

Verrill, 1873, p. 707 (*P. americana*). Vineyard Sound.

Dublin, 1905, p. 3 (*P. americana*). Long Island Sound.

Cornish, 1907, p. 79. Canso, Nova Scotia.

Osburn, 1912, p. 213. Woods Hole region, Beaufort, N. C. and Tortugas, Fla.

———, 1914, p. 184, Tortugas, Fla.

———, 1933, p. 7, Mount Desert Island, Me.

———, 1940, p. 326, Porto Rico.

Marcus, 1938, p. 5. Rio Janeiro and Santos Bay, Brazil.

Zoarium stolonate and creeping, the stalked individuals rising erect at short distances from each other to a height of 1-2 mm. (one-half to 5 mm. recorded in the literature). The stalks or pedicels are stout, diminished in size rather regularly toward the calyx and flexible and muscular, bending in all directions. The calyx is irregularly ovoid, being more convex on the dorsal (anal) side. The size of the calyx varies greatly, in our specimens the height is usually between 0.20 mm. and 0.30 mm. and the breadth between 0.16 mm. and 0.22 mm.

Both the pedicel and the calyx may bear short, stout and straight or slightly curved spines (form *echinata* Sars), but these vary greatly in

number and distribution and occasionally are entirely absent (form *glabra* Hincks). Specimens from Chincoteague Bay in high salinity are especially well provided with spines.

In the Chesapeake Bay this species appeared sparingly in many places in the lower half of the bay where the salinity was above about 15 parts per 1000, growing over almost anything affording attachment. In the Chincoteague Bay, where the salinity is about that of ocean water, it was found in great profusion, especially on colonies of *Anguinella palmata* at a depth of three to four feet and a salinity of about 32. Here it was accompanied by *Barentsia laxa* in much smaller numbers. It may occasionally occur on shells, but seems to prefer an erect and branching habitat.

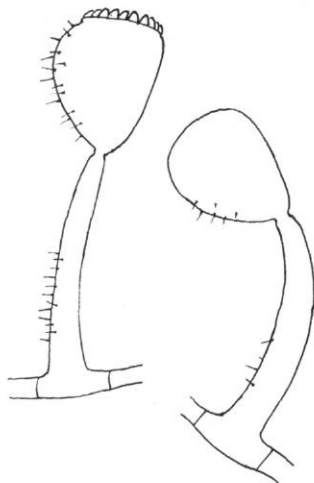


Fig. 1. *Pedicellina cernua* (Pallas). Outline sketch.

This is the best known species of the Endoprocta. It is cosmopolitan in distribution, frequently occurs abundantly, and has been the subject of most of the morphological and embryological research in this group. It is the form usually treated in text-books.

***Barentsia discreta* (BUSK), 1886. Fig 2.**

- Verrill, 1900, p. 594 (*B. timida*, n. sp.). Bermuda.
- Osburn, 1912, p. 214. Woods Hole Region, Mass.
- , 1914, p. 185. Tortugas, Fla., and Beaufort, N. C.
- , 1932a, p. 442. Chesapeake Bay.
- , 1940, p. 327. Porto Rico.

Zoarium stolonate and creeping but the colonies are usually small. The individuals are comparatively large, reaching a height of 3 mm., but our Chesapeake specimens are shorter, about 1.50 mm. The calyx in our material measures about 0.27 mm. in height by 0.20 mm. wide. The muscular base averages about 0.40 mm. in height by 0.14 mm. wide. There are about 18 tentacles. The species may usually be distinguished at once by the very stiff, heavily-chitinized, yellowish stalk, which appears to be perforated from within by numerous funnel-shaped pores.

These so-called "pores" do not penetrate the outer layer of the stalk, though this may be raised into small tubercles, and the "pores" are

really pits in the inner layer. Usually these are quite abundant, but some of the Chesapeake specimens show only a few. This is not entirely a matter of maturity, for some very young stalks show the pits as well as the adults, and within the same colony some stalks have few or no "pores" while others are conspicuously "perforated." Harmer has suggested that these structures may represent rudimentary spines, such as are often present in other species of endoprocts. The measurements of the base, stalk and calyx, as well as other characters appear to place these poreless specimens under *B. discreta*.

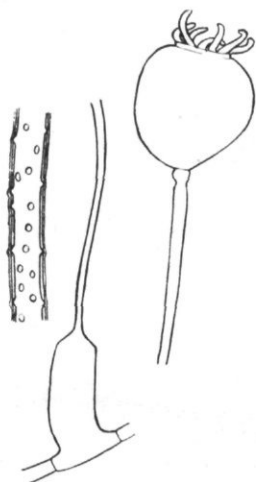


Fig. 2. *Barentsia discreta* (Busk). Outline sketch and enlargement of part of pedicel to show "pores".

This species has an unusually wide distribution, recorded from Tristan da Cunha (the type locality), Cape Horn, Cape of Good Hope, Gulf of Naples, Ceylon, East Indian Region, Japan, British Columbia and Commonwealth Bay, Antarctica. In the Chesapeake it apparently occurs only near the mouth of the Bay where the salinity approaches that of ocean water.

Barentsia laxa KIRKPATRICK, 1890. Fig. 3.

Kirkpatrick, 1890, p. 624. Torres Straits.

Harmer, 1915, p. 32. Malay Archipelago.

Marcus, 1938, p. 10. Santos Bay, Brazil.

The colonies consist of a small number of individuals, usually less than 20, attached to stems, shells, etc. The joints of the stolon are short and the individuals are not widely separated at the base.

The zoecia are the largest of our endoprocts, occasional specimens reaching a total length of 4 mm. The calyx is large, measuring as much as 0.66 mm. in height by 0.52 mm. in width, though the average is about 0.55 mm. by 0.40 mm. The total height of functional individuals varies greatly, as in most species of this genus, the difference being chiefly in the length of the stalk, which is flexible and muscular throughout and with a very thin chitinous coat. The stalk is so flexible that it can twist and loop in various directions. One of our mounted specimens has two complete loops, spiral fashion, in the upper half of the stalk which appears to be more muscular than the lower half. The stalk is marked off from the base internally by a very

definite septum with a communication pore in the center. The muscular base is not unusually large, measuring about 0.20-0.35 mm. high by 0.12-0.20 mm. wide according to the amount of contraction. The base, like the stem, is thin-walled and unusually transparent.

Collected in Chesapeake Bay near the mouth, one small colony, attached to a hydroid stem. Also in Chincoteague Bay, where it was fairly common, attached to oysters and among *Pedicellina cernua* spreading over *Anguinella palmata* on the oysters, at a depth of two

to four feet (salinity 3.2‰). The species has not previously been reported from the North Atlantic, but in the writer's collection there are specimens taken by the U.S. Str. "Fish Hawk", 15 mi. east of Great Point, Nantucket Island, at a depth of nine fathoms. These specimens are somewhat larger than any recorded, the largest having a total height of 6.50 mm., and the calyx of the largest measures 0.78 mm. by 52 mm., but otherwise no differences have been noted.

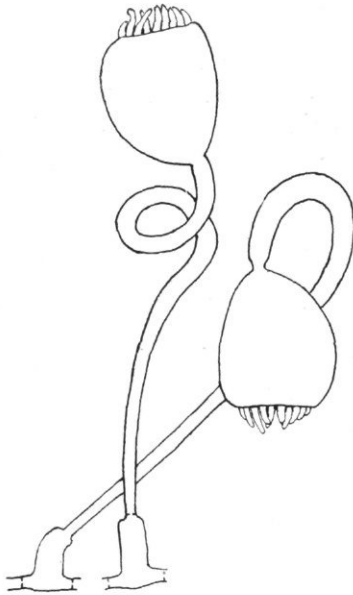


Fig. 3. *Barentsia laxa* Kirkp. Characteristic flexibility of pedicel and muscular base.

The species is known from the Torres Straits (type locality), the East Indies, and has recently (Marcus, 1938) been found in Santos Bay, Brazil. It will probably be found distributed all along the American coast from Cape Cod southward.

It is easily distinguished from all other Bryozoa, by its large size, flexible stalk and the presence of the septum at the base of the stalk above the barrel-shaped muscular pedestal.

***Barentsia gracilis* (SARS), 1835. Fig. 4.**

- Hincks, 1889, p. 432. Gulf of St. Lawrence.
- Cornish, 1907, p. 79. Canso, Nova Scotia.
- Osburn, 1933, p. 7. Mt. Desert Island, Maine.
- Marcus, 1938, p. 8. Santos Bay, Brazil.

One small colony, collected by the U.S. Str. "Fish Hawk" at Sta. 8903, appears to belong to this species, but with some doubt. The shape and size of the calyx (0.23 mm. in height by 0.19 mm. in width)

are within the limits of *B. gracilis*, as are also the total height (1.75 mm.) and the muscular base (0.20 mm. high by 0.10 mm. wide). The stalk is not heavily chitinized, but it entirely lacks the joints with muscular enlargements which ordinarily characterize that of *gracilis*. However, Waters (1904, p. 99) mentions specimens without joints and reaching a height of 1 mm. to 2 mm. The tentacles apparently number 16. It may be a young colony of *B. discreta*, but does not seem to agree with other young specimens of that species in my possession.

Ectoprocta

ORDER Cyclostomata

This order is still well represented in marine waters all over the world, but the species are by no means as numerous as they were in Mesozoic and Tertiary times. Some of the genera still existing go back as far as the Jurassic. Apparently they are limited in their distribution to comparatively pure sea water. Only one species has been taken in the Chesapeake Bay.

Family Crisiidae JOHNSTON, 1847

Crisia eburnea (L.), 1767. Fig. 5.

- Verrill, 1873, p. 707. Vineyard Sound, Mass.
 Whiteaves, 1901, p. 109. Nova Scotia to Labrador.
 Cornish, 1907, p. 78. Nova Scotia.
 Osburn, 1912, p. 215. Vineyard Sound and Buzzards Bay, Mass.
 ———, 1912a, p. 276. Browns Bank.
 ———, 1919, p. 606. Etah, Greenland.
 ———, 1932a, p. 442. Chesapeake Bay.
 ———, 1933, p. 8. Mount Desert Island, Maine.

The zoarium forms dense, bushy, white, jointed tufts, usually attached by a single stem, the base of which does not, as a rule, develop many radicles for attachment; the branches characteristically curved inward. They may be attached to almost any substratum, but are most frequently found on other erect Bryozoa, algae, and hydroids, from very shallow water to the outer edge of the coastal shelf. Height usually $\frac{1}{2}$ to $\frac{3}{4}$ inch.

The internodes are usually short, of five to seven zooecia, but the number varies considerably. The joints are usually yellow, colorless near the growing ends, but may be dark brown near the base in older colonies. The zooecia are in two rows, closely connate to near the tips which are free and bent



Fig. 4. *Barentsia gracilis* (Sars)

forward. The free portion of the zoecial tubule is cylindrical and the aperture round, though occasionally the upper rim is slightly angulated or pointed. The ovicell, which is a highly modified individual, is large and conspicuous and usually replaces the second or third zoecium of an internode; oocystostome conspicuous, slightly elongated transversely with the anterior margin somewhat inflexed, borne on a short but distinct tube which narrows toward the summit.

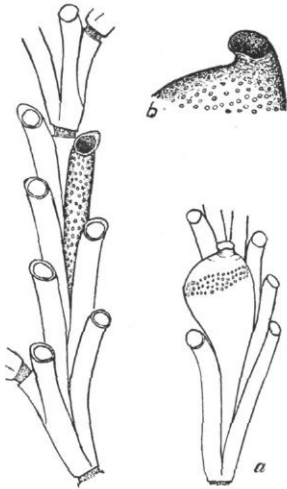


Fig. 5. *Crisia eburnea* (L.). An infertile internode; (a) fertile internode with ovicell; (b) enlargement of oocystostome.

It is a very widely distributed species and on the Atlantic coast of North America has been recorded by almost everyone who has listed Bryozoa, from Greenland to North Carolina. It is not very tolerant of brackish water and in the Chesapeake Bay occurs only in the lower third of the Bay where the salinity exceeds about 18.00 (1.8%). It was not noted in Chincoteague Bay, even though the salinity is high, but it flourishes on the open coast. It is perhaps the best known of all the Cyclostomata in American waters and is the only species of this group thus far taken in the Chesapeake Bay.

ORDER Ctenostomata BUSK

Key to Families

1. Zoarium encrusting, or rising in the form of fleshy, more or less cylindrical expansions.

(Group A, CARNOSA).

Alcyonidiidae.

Zoarium stolonate, often with erect branches, not fleshy. 2.

2. Zooecia arising as expansions of the stolon and directly continuous with it.

(Group B, PALUDICELLEA).

Noellidae.

Zooecia separated from the stolon or stem at the point of attachment by a septum. 3.

3. Zoecia often clustered on the stolons or erect branches, not pedicellate, sometimes attached by a very short internode.

(Group C, VESICULARINA).

Vesiculariidae.

Zoecia with long slender pedicels which are the basal portions of the zoecia.

(Group D, STOLONIFERA).

Triticellidae.

Family Alcyonidiidae JOHNSTON, 1849

The species in this family usually form smooth, fleshy incrustations on pebbles and shells, but occasionally they may rise in somewhat rounded, or finger-like, erect expansions, which may be irregularly branched. All of our species belong to the genus *Alcyonium*, Lamouroux, 1821.

Key to Species.

1. The zoarium takes the form of erect rounded fleshy stalks which are often branched. **verrilli.**

Zoarium encrusting, never erect. 2.

2. The surface becomes so encrusted with earthy matter that the zoecia are scarcely visible. **parasiticum.**

Zoarial surface not encrusted with argillaceous matter, the outlines of the zoecia readily visible. **polyoum.**

***Alcyonium verrilli* OSBURN, 1912. Fig. 6 and Pl. IV.**

Verrill, 1872, p. 289 (*A. ramosum*, n. s. preoc.).

——, 1873, p. 708 (*A. ramosum*). New Jersey to Vineyard Sound.

Osburn, 1912, p. 252. Vineyard Sound, Mass.

——, 1932a, p. 443. Chesapeake Bay.

The zoarium, attached to stones, shells and stems, is more or less cylindrical, sparsely branched and may reach a height of 100-350 mm. The color ranges from yellowish to dull brown. In consistency it is much firmer than *A. gelatinosum*, with which it might be confused, and it is also less transparent. Rounded branches are usually between 5 mm. and 10 mm. in diameter, but flattened portions of the stem may be considerably larger.

The zoecial walls are comparatively thick and the surface more or less level, but at the growing edges of the colony the surface may appear roughened by the slight protrusion of the transversely wrinkled tips of the zoecia.

Recorded only from Vineyard Sound to Chesapeake Bay, and appears to grow larger and most profusely in Long Island Sound. It is

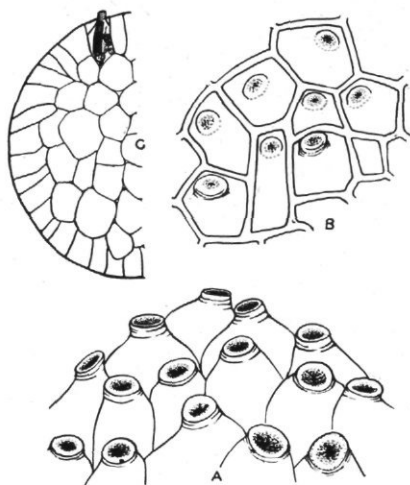


Fig. 6. *Alcyonidium verrilli* Osburn. (a) Young zooecia at tip of branch; (b) thick-walled older zooecia; (c) cross-section of branch.

***Alcyonidium polyoum* (HASSALL), 1841. Fig. 7.**

Verrill, 1880, p. 188 (*A. rubrum*, n. sp.). Long Island Sound to Nova Scotia.

Osburn, 1912, p. 251 (*A. mytili*). Woods Hole Region, Mass.

———, 1932, p. 6. Wakeham Bay, Ungava.

———, 1932a, p. 443. Near mouth of Chesapeake Bay.

———, 1933, p. 61. Mount Desert Island, Maine.

Marcus, 1937, p. 125. Santos Bay, Brazil.

The zoarium forms a firm gelatinous crust over shells and stones and occasionally on the larger algae and on the shells of crabs. The

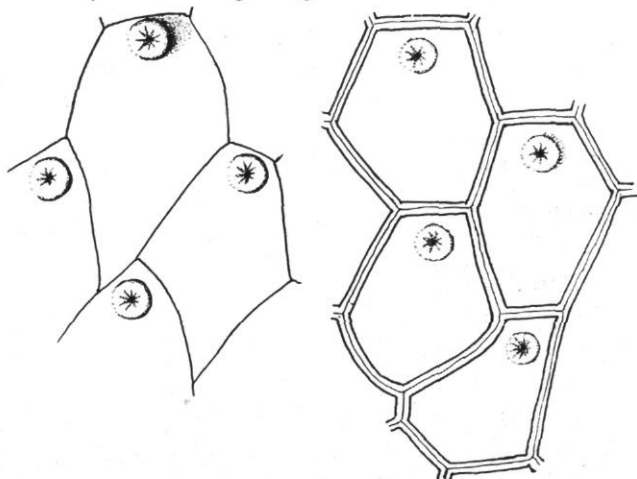


Fig. 7. *Alcyonidium polyoum* (Hassall). Young (left) and old zooecia of the same colony.

abundant in Chesapeake Bay, but does not appear to occur in very shallow water. In Cowles' Survey (see Osburn, 1932a, p. 443) it was dredged at 22 stations from the mouth of the Bay up to above the mouth of the Potomac River. Five colonies have since been dredged in the Patuxent River, near its mouth, and off Travers' Point at the mouth of the Little Choptank River at a depth of 60 feet. The lowest salinity in which it has been found is 13.19 (1.319%). Its abundance in the Chesapeake indicates that it may range farther south.

color ranges from dingy white through yellowish to red, grayish to sometimes dark brown.

Zooecia more or less hexagonal in form, separated by slight grooves, the frontal wall a little inflated and showing a small oral prominence in the contracted state.

Distribution cosmopolitan, but it has not been recorded for the American tropics. In the Chesapeake it has been taken near the mouth of the Bay and rarely up to near the mouth of the Potomac River. It has some ability to withstand lower salinity, but apparently does not thrive well when the salt content is much below 20 (2.0%).

***Alcyonidium parasiticum* (FLEMING), 1828.** Fig. 8.

Verrill, 1873, p. 414. Rhode Island to Arctic Ocean.

Osburn, 1912, p. 251. Crab Ledge and off No Mans Land, Mass.

——, 1932a, p. 444. Mouth of Chesapeake Bay.

——, 1933, p. 61. Mount Desert Island, Maine.

The zoarium forms a thin incrustation usually on stems of hydroids, but occasionally on the firmer algae. At the growing edges the layer is nearly transparent, but it generally becomes so encrusted with

earthy matter as to form a nearly continuous grayish sheet in which the zooecia are discerned with difficulty. The front of the zooecium is smooth, with a row of small marginal papillae.

It is not parasitic in the proper sense, but appears to grow only on the surfaces of other animals, especially on rounded stems.

Common on both sides of the North Atlantic. Not noted south of the Chesapeake Bay, where it appears to be rare. Cowles dredged it near the mouth of the Bay and in 1943 it was taken below the mouth of the Potomac River at a salinity of 15 (1.5%).

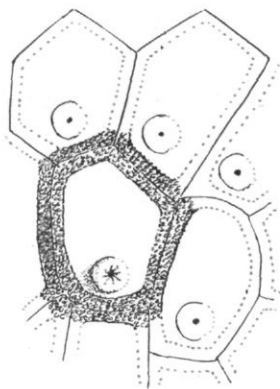


Fig. 8. *Alcyonidium parasiticum* (Fleming). Wide border with minute papillae.

Family Nolellidae HARMER, 1915.

The species of this family are distinguished by the fact that there is no septum or joint between the zooecia and the stolon; the zooecium originates as a segment of the stolon and remains directly connected with it. The genus *Victorella* has usually been placed in a separate family, but the species appear to intergrade with *Nolella* in so many characters that the genus is here assigned to the Nolellidae. The fact

that *Victorella* is only known from brackish water does not seem sufficient to separate it so widely.

Key to Genera.

1. Zooecia very transparent, often giving off secondary lateral zooecia. **Victorella.**

Zooecia covered with earthy matter, not transparent. 2.

2. Zoarium consisting of the creeping stolon, from which erect zooecia take their origin. **Nolella.**

Zoarium erect and branching like a small tree, the zooecia usually brownish with earthy matter. **Auguinedda.**

Nolella gigantea (BUSK), 1856. Fig. 9.

Osburn, 1914, p. 218 (*Cylindroecium*). Tortugas, Florida.

———, 1940, p. 337. Porto Rico to Beaufort, North Carolina.

Marcus, 1938, p. 53. Santos Bay, Brazil.

The slender stolon creeps over shells, algae, hydroids, etc. The erect zooecia stand up like little posts 1 mm. to 2 mm. or even more in height, with a diameter of about 0.13 mm. and with a square tip when not too much contracted. The tubule is about the same diameter throughout its length, narrowing somewhat near the base where it joins the stolon. Its walls are usually encrusted with earthy matter so that the internal structures are rarely visible. The stolon measures only 0.03-0.04 mm. in diameter.

The species is widely distributed in warmer waters, abundant from Beaufort, N. C. to the Caribbean Sea and the Gulf of Mexico and listed for Brazil, as far south as Santos Bay, by Marcus. It has not been noticed in the Chesapeake but was found in the Chincoteague Bay on an oyster shell at a depth of a little over a meter. This is the most northern record for our coast.

Victorella pavida KENT, 1870. Fig. 10 and Plate V.

Hincks, 1880, p. 561. Victoria Dock, London, England.

Kraepelin, 1887. Germany.

Annandale, 1911. India.

Braem, 1914. Germany.

Marcus, 1926, p. 11. Germany and Netherlands.

Osburn, 1932a, p. 445. Chesapeake Bay.

The colony is attached by a creeping, ramifying stolonate base which spreads over almost any sort of substratum on which it can find attachment, such as the wood or bark of piles and stakes, shells, barnacles, the under side of cork floats, live boxes and boats, and even to a lesser degree on the stems of hydroids and algae. It usually forms a dense mat 3-6 mm. in height, but occasionally as much as 15 mm.

The zooecia are greatly variable in height, usually from 2-4 mm., but functional zooecia may be less than 1 mm. and sometimes as much as 6.5 mm. They appear to grow in height after they become functional and the zooid also becomes much longer. The zooecial wall is thin and so transparent that the internal characters are all plainly visible without clearing. The zooecia are very slender, 0.13-0.20 mm. in diameter; quite straight except that secondary zooecia are slightly curved at the base where they bud off; they arise from the stolon in nearly their full width and are only slightly tapered at the upper end where they have the usual squared form. The secondary zooecia, budded off from others, are much smaller at the base, having the same breadth as the stolon, about 0.04-0.05 mm., and soon attain the usual diameter.

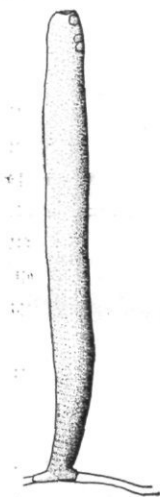


Fig. 9.
Nolella gigantea
(Busk).
With three embryos
about ready to be
liberated.

The stolon is light corn color, with a somewhat thicker wall than the zooecia; it is somewhat enlarged where a zooecium arises and the latter is directly continuous with the short segment of the stolon, but when mature the polypide does not occupy any portion of the stolon enlargement. Two lateral branches of the stolon are usually given off from the enlargement and others may occasionally arise from the zooecia.

Secondary budding of the zooecia is rather constant, the buds may arise at any level, sometimes two or three may be close together or they may be distributed over the whole length of the zooecium. As many as four or five buds are occasionally produced. The secondary zooecia may again bud in the same fashion until as many as five generations of functional zooecia are budded off. Usually only one or two generations of secondary buds are formed. With the stolons interlacing closely the primary zooecia are given off side by side, and the appearance of the colony is often that of the thick nap of a carpet.

The polypide of the younger zooecium fills the cavity fairly well, but as the zooecium elongates the polypide often seems ridiculously small in the large body cavity. There are eight tentacles, none of which are everted (contrary to Hincks' opinion, 1880, p. 561). The gut is simple, without gizzard, though the proventriculus is slightly enlarged. There is a single-strand type of funiculus. The "setae" of the oral membrane measure about 0.25 mm. in length. The internodes of the stolon usually measure between 0.25 mm. and 0.50 mm., but

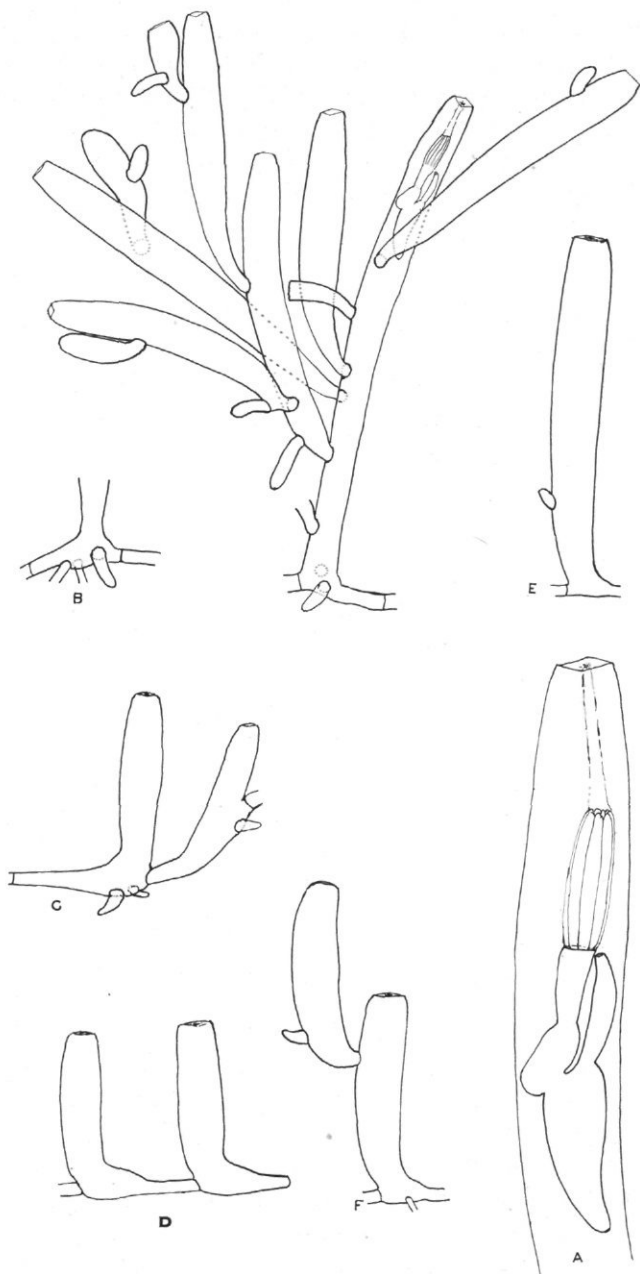


Fig. 10. *Victorella pavida* S. Kent. Part of zoarium showing manner of budding (July); (a) outline sketch of zooid much enlarged; (b) base of another zoecium showing origin of radicles and lateral stolon. Figures c, d, e and f, all from the same colony, show earlier growth stages in May.

may be much longer, and there is a single communication pore in the septum.

This is very definitely a brackish water species. Since it has been reported from England, Netherlands, Germany, Australia and India as well as in the Chesapeake Bay, it may be looked for wherever lower salinity occurs, except perhaps in the polar regions. It will live in water that is almost fresh, but has not been reported from water of higher salinity near that of ocean water. In the Chesapeake Bay it thrives best and grows very profusely about the middle of the Bay where the salinity averages about 10 to 12 (1.0 to 1.2%). In the upper part of the bay it occurs where the salinity is as low as 3 and also lower in the bay where the salinity is about 27, but under such conditions the colonies are not large, the zooecia not as long and budding is not so profuse as in the region of the Chesapeake Biological Laboratory where the salinity is about 14. Where it reaches its greatest abundance it is a nuisance in fouling the bottoms of boats, since within three to four weeks in the summer time a plush-like mat $\frac{1}{4}$ to $\frac{1}{2}$ inch thick may be formed. Oysters and barnacles may be covered to the edges of the shells.

Reproduction and proliferation are both very rapid. Large numbers of the ciliated larvae are produced, especially in June and July, when as many as 50 eggs and larvae have been counted within the body cavity.

Anguinella palmata VAN BENEDEEN, 1844. Fig. 11 and Plate IV.

- Hincks, 1880, p. 540. Charleston, S. C.
- Osburn, 1912, p. 253. Buzzards Bay, Mass.
- , 1914, p.219. Tortugas, Florida.
- , 1932a, p. 444. Chesapeake Bay.
- , 1940, p. 338. Porto Rico.
- Marcus, 1937, p. 133. Santos Bay, Brazil.

Zoarium erect, branching in an irregular palmate form, the tips of the branches consisting of zooecia, which are very irregularly situated on the branch. The surface is usually completely covered with a layer of earthy matter giving it a dark gray or brown color, making the colony look like a brown alga.

The zooecia are cylindrical, about 0.15 mm. in diameter and bluntly rounded at the tip when fully contracted. The primary zoecium, attached to the substratum, may be from 0.60-1.80 mm. in height and may bud at any level, though more commonly near the tip. Colonies are usually less than an inch in height, though occasionally they may attain a height of 2-3 inches. There are 10 rather short tentacles.

It occurs on the European coast in England, Belgium and France, and on the American coast from Massachusetts to Brazil, in shallow and usually somewhat brackish water. In the Chesapeake Bay it is found in the lower half, where the salinity ranges above about 13

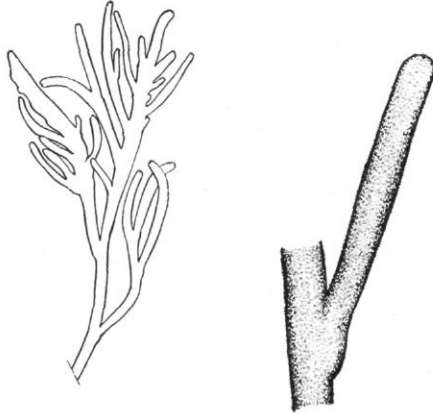


Fig. 11. *Anguinella palmata* var *Beneden*. Outline sketch of branch and enlargement of a zoecium.

(1.3%). In the Chincoteague Bay the species was found attached to oysters and stakes at a salinity around 32, so it evidently is not limited to brackish water if other conditions are satisfactory.

Family Vesiculariidae HINCKS, 1880

The zoecia are jointed at the base, with a septum between the stolon or stem and the zoecium. All are stolonate, but frequently have erect or free branches. A gizzard is present, immediately above the stomach.

KEY TO GENERA.

1. Erect or sprawling branches with long internodes and the zoecia in a spiral cluster. **Amathia.**
- Zoecia never in a spiral cluster. 2.
2. Zoecia arising from the stolon or branch in an irregular manner, not paired. **Bowerbankia.**
- Zoecia arising from very short internodes at the side of the stem, usually in pairs. **Aeverrillia.**

Amathia vidovici (HELLER) 1867. Fig. 12.

Leidy, 1855, p. 11 (*Valkeria pustulosa*). New Jersey.

Verrill, 1873, p. 709 (*Vesicularia dichotoma* n. sp.). New Jersey to Norwalk, Conn.
Osburn, 1912, p. 254 (*Amathia dichotoma*). Woods Hole Region, Mass.
———, 1940, p. 340. Porto Rico.

Zoarium semi-erect, but not stiff, dichotomously branching in a loose spreading form to the height of two or more inches. It grows attached to various objects, but is chiefly found among algae and hydroids.

The internodes are transparent, rather long, usually 1.5-2 mm., and are free of zooecia for more than half of their length (occasionally a small cluster may appear lower down on an internode). The internodes vary in diameter from 0.13-0.20 mm. The joints are sometimes

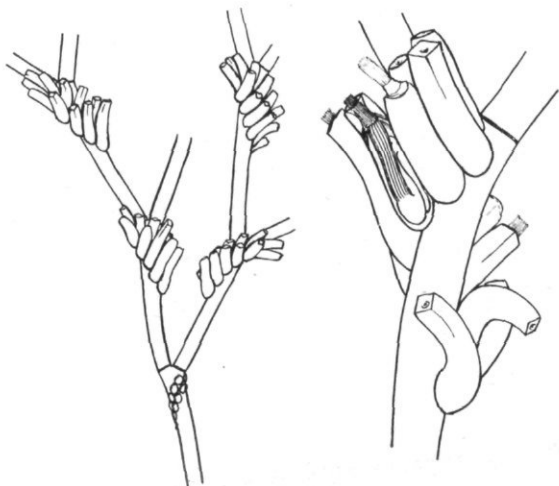


Fig. 12. *Amathia vidovici* (Heller). Portion of zoarium and enlargement of a spiral cluster of zooecia.

dark in older parts of the zoarium, but more frequently they are colorless. The zooecia are of moderate size, about 0.40 mm. long, only slightly connate and little chitinized so that in preserved specimens they seem to be in irregular clumps. There is however a very regular arrangement in a short spiral, with about four to eight zooecia in each series.

In the Chesapeake Bay it occurs plentifully in shallow water near the mouth of the bay and extends into brackish water to above the mouth of the Patuxent River, to salinity 11 (1.1%). On the North American coast it ranges from Cape Cod, Mass., to the Caribbean Sea. Otherwise it is known from the Mediterranean Sea and the Indian Ocean.

Amathia convoluta LAMOUREUX, 1816. Fig. 13.

Osburn, 1932a, p. 444 (*A. alternata*). Chesapeake Bay to Beaufort, N.C.

Marcus, 1937, p. 136. Santos Bay, Brazil.

Osburn, 1940, p. 339. Porto Rico.

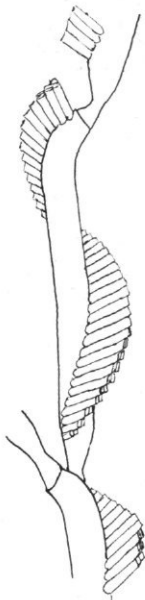


Fig. 13.
Amathia convoluta Lamouroux. Note the very elongate cluster with a complete spiral

Zoarium large, jointed, erect, branching, tree-like, horn-colored, reaching a height of 100-150 mm., with the lower part of the stem strengthened by radicles. The long spiral clusters of paired series of zoecia are very conspicuous, occupying most of an internode and making usually one complete turn around the stem. The spiral usually turns counter-clockwise, but occasional clockwise spirals are found.

The zoecia are moderately chitinized, light brown in color in older colonies, closely connate to their tips, graduated in length from the lower part of the spiral where they are 0.50-0.60 mm. high to about 0.40 mm. at the top of the spiral. Zoecial width 0.10-0.13 mm., diameter of stem internodes varying from 0.25-0.40 mm.

The species is known from Australia, New Zealand and the Malay Archipelago and from Brazil. In North Atlantic waters it occurs from the coast of Maryland to the Caribbean Sea. It has been dredged in a number of places in the lower part of the Chesapeake Bay (salinity 22 to 31) and found on the beach at Ocean City, Maryland.

As to the proper name and synonymy of this species there must be some doubt. Lamouroux (1816, p. 160) described *A. alternata* from the "Mers d'Amerique" and *A. convoluta* from "Mers de l'Australasie." If the two are the same species, the name *A. alternata* will have preference as it precedes *convoluta* in Lamouroux's text.

Bowerbankia gracilis LEIDY, 1855. Fig. 14.

Leidy, 1855, p. 142. Rhode Island.

Verrill, 1873, p. 709 (*Vesicularia gracilis*). New Jersey to Vineyard Sound.

Osburn, 1912, p. 253. Woods Hole Region.

———, 1912a, p. 287 (var. *caudata*). Cape Sable, Nova Scotia.

———, 1914, p. 218. Tortugas, Florida.

———, 1919, p. 607 (*B. caudata*). Etah, Greenland.

———, 1932, p. 6. Wakeham Bay, Ungava.

———, 1933, p. 63. Mount Desert Island, Maine.

———, 1936, p. 541. Murchison Sound, N. Greenland.

———, 1940, p. 341. Porto Rico.

The zoarium creeps over hydroids, algae, among other Bryozoa and occasionally over shells, pebbles, the wood and bark of piles, etc., occasionally spreading free for short distances. The stolon is little chitinized and nearly transparent.

The zoecia are cylindrical, elongate, squared at the tip (except when fully contracted) and narrowed at the base. They are usually attached to the sides of the creeping stolon, sometimes paired, sometimes clustered, and occasionally on the upper side of the stolon. They are transparent, showing the details of the zooids. A distinct gizzard

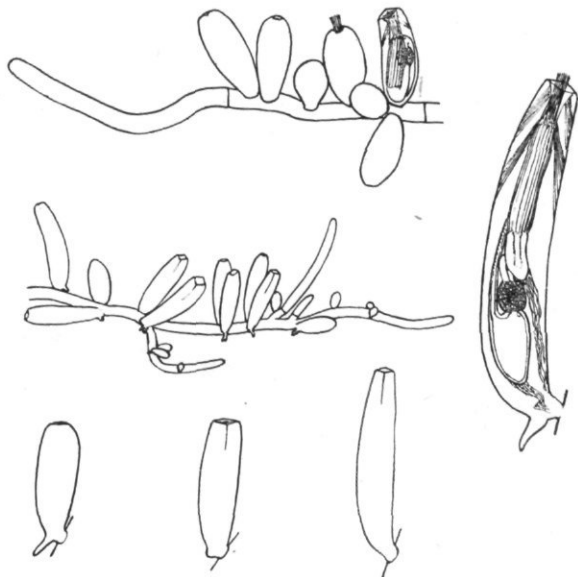


Fig. 14. *Bowerbankia gracilis* Leidy. Mode of growth and variations in the caudate process. The enlarged zoecium shows the form and position of the gizzard.

is present, measuring about 0.10 mm. (0.09-0.12 mm.) according to the amount of contraction and possibly to the age of the zooid. There are 8 tentacles. The functional zoecia (with completely formed zooid) measure about 0.90 mm. in height (0.70-1.60 mm.) by 0.20 in diameter (0.18-0.24 mm.). Some of this variation is probably due to the amount of contraction. The stolon varies in diameter from 0.07-0.11 mm., and the joints where the zoecia are attached vary between 0.053 and 0.075 mm.

The synonymy is in doubt, especially as to whether the *B. caudata* of Hincks is a distinct species, a variety of *gracilis*, or should be united

with it as one species. Marcus (1937, p. 137) lists *caudata* as a distinct species. From Greenland to Porto Rico, at various places along our coast, the writer has examined specimens, some of which have none of the caudate processes at the base near the point of attachment, some which are occasionally caudate, and others in which the caudate process is the rule. Other definite diagnostic characters do not seem to be present.

This species can withstand considerable reduction in salinity and occurs throughout the lower part of Chesapeake Bay to well above the mouth of the Patuxent River, to a salinity of about 10 (1.0%).

***Aeverillia armata* (Verrill), 1873. Fig. 15.**

Verrill, 1873, p. 710 (*Vesicularia armata*, n. sp.). Vineyard Sound, Mass.
 Osburn, 1912, p. 256 (*Hippuraria armata*). Woods Hole Region, Mass.
 ———, 1933, p. 63 (*Buskia armata*). Mount Desert Island, Maine.
 Marcus, 1941, p. 76. Rio de Janeiro, Brazil.

The zoarium is stolonate, creeping over stems with occasional branches rising free, the stems straw-colored and well chitinized, 0.05-0.12 mm. in diameter.

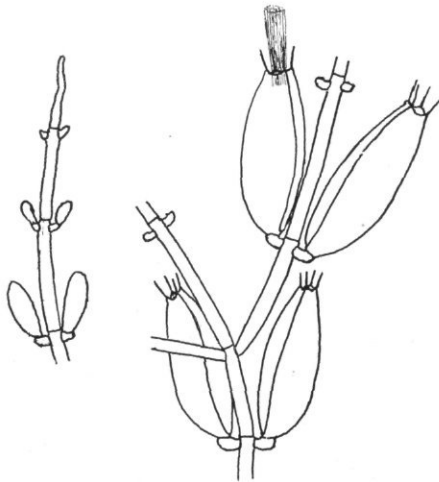


Fig. 15. *Aeverillia armata* (Verrill).

Note especially the mode of attachment of the zoecia and the spines at the tips.

The zoecia are long-ovate, 0.50-0.65 mm. in length by 0.15-0.18 m. in width, with a flattened area on one side which is less heavily chitinized. The tip is squared with a spine on each corner which may be as long as 0.15 mm. The oral "setae" are very long, as much as 0.50 mm. There is a gizzard consisting of four lobes with chitinized teeth. The zoecia are paired at the ends of the internodes and have no clasping processes for attachment.

Marcus (*l.c.*) p. 73, has recently erected a new genus to include *armata* Verrill (the type species), *Buskia setigera* HINCKS and *B. pilosa* HARMER. The separation is based on the fact that in *Aeverillia* the zoecia are not attached directly to the stem but to very short lateral internodes, while in other species of *Buskia* they arise directly from the axis.

A. armata is distributed from Mount Desert Island, Maine, to Rio Janeiro, Brazil, but has not been noted in the tropical area. It can withstand some reduction in salinity and in the Chesapeake Bay it occurs in the lower half up to a salinity of not lower than about 12 (1.2%). It also occurs in the Chincoteague Bay at a salinity of 32 (3.2%).

Family **Triticellidae** G. O. SARS, 1874.

Stolon delicate without free branches, zooecia erect with a long slender base like a pedicel, with a flattened membranous frontal area and without spines at the distal end around the oral aperture.

Triticella elongata (OSBURN), 1912. Fig. 16.

Osburn, 1912, p. 256 (*Hippuraria elongata*, n. sp.). Vineyard Sound to Beaufort, N. C.
———, 1932a, p. 445. Lower part of Chesapeake Bay.

Commensal in the gill chamber of various species of crabs, spreading over the walls and even the gills themselves, sometimes outward on the bases of the legs; also on the outside of the species of crabs inhabiting the tubes of the worm *Chaetopterus*. The adherent stolon is thin-walled, delicate and very slender, measuring only 0.02-0.03 mm. in diameter, enlarging to about twice that amount at the end of an internode.

The zooecia stand erect from the creeping stolon, fusiform with a slender elongate base, very little chitinized and perfectly transparent. The zooecia and lateral branches of the stolon arise close to the end of an internode, not directly from the axis but from a very short internode which is interposed between the zooecium and the stem. They usually are paired in close clusters. The zooecial measurements are: total length 0.90-1.85 mm., length of zooecial body 0.50-0.90 mm., width 0.18-0.25 mm.

Distribution, Vineyard Sound, Mass., to Beaufort, N. C. In Chesapeake Bay it has been found off Solomons Island, at Crisfield, and in the region of the Capes, both in live crabs (*Callinectes sapidus*) and in the sloughed shells about the crab floats of the commercial producers of soft crabs. The species shows a wide range of salt tolerance, but is more abundant at higher salinities.

ORDER **Cheilostomata**

This is the dominant order of the marine Bryozoa, but most of the species cannot withstand much reduction in salinity and hence the group is not well represented in Chesapeake Bay. Of the 12 species

here recorded only five seem to be able to thrive in brackish water conditions. The other seven species occur in the lower part of the Bay where the salinity approaches that of ocean water. There are two sub-orders, depending upon the amount and nature of the calcification of the frontal zoecial wall.

In the *Anasca* the front is membranous, either wide open or partially covered above the membrane by a calcified outer layer. In the protrusion and retraction of the tentacles the membranous front wall simply falls and rises in compensating for the space occupied by the anterior end of the zooid.

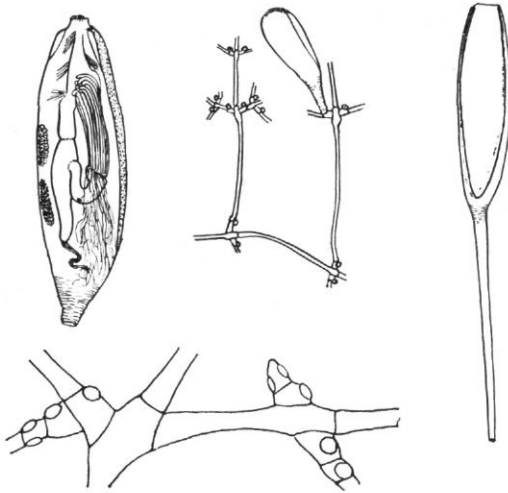


Fig. 16. *Triticella elongata* (Osburn). Adult zoecium with elongate base; mode of branching of the attached stolon, with young zoecium; enlargement of stolon; details of zooid.

In the *Ascophora* on the other hand, the front is completely closed, except for the aperture and a small pore through which water may enter into a special compensation sac beneath the frontal layer. As the tentacles are thrust out the water enters in equal volume and when the tentacles are withdrawn the water is expelled from the sac.

In both suborders there is a special chitinized flap like a little trap-door, the operculum, that opens to allow the tentacles to be thrust out and which closes behind them when they are withdrawn. The peculiar little structures called avicularia because some of them resemble miniature bird heads, are found only in this order. In the majority of cases the avicularia are embedded, with only the movable beak exposed.

Avicularia are highly modified individuals of the colony, the beak being homologous with the operculum of the normal individual. Polymorphism is common in the Cheilostomata and several other types of kenozoecia, or modified individuals which serve as colonial organs occasionally occur.

The Cheilostomes apparently had their origin in the Ordovician Period, but they are not well represented as fossils until the Cretaceous, after which time they occur abundantly.

Sub-order *Anasca* LEVINSEN, 1909.

Key to Families

1. Small stolonate colonies, each individual appearing as a small tubule connected directly with an expansion of the stolon and enlarged somewhat at the upper end, the operculum at the top (Fig. 17).

Aeteidae.
2.

Colony not stolonate.

2. Zoarium erect and bushy (Fig. 25).

Bugulidae.
3.

Zoarium encrusting.

3. Zooecia wide open, the frontal membrane occupying the whole frontal area (Figs. 18-22).

Membraniporidae.

The frontal membrane does not occupy all of the frontal area, proximal to it is a calcified outer layer, the gymnocyst, which is usually perforated by one or more pores; an enlarged spine at the proximal border of the frontal area (Figs. 23-24).

Electrinidae.

Family **Aeteidae** SMITT, 1867. Fig. 17.

Aetea anguina (L.), 1758.

Verrill, 1873, p. 710. Vineyard Sound.

Osburn, 1912, p. 220. Vineyard and Nantucket Sounds and Buzzards Bay, Mass.

———, 1933, p. 18. Mount Desert Island, Maine.

———, 1940, p. 345. Porto Rico.

Marcus, 1937, p. 26. Santos Bay, Brazil.

The stolonate portion of the zoarium creeps over the stems of various organisms, shells and pebbles. The erect portions of the zooecia are often curved and expanded near the end to a shape somewhat like the head of a snake. Ellis in 1755 gave it the name of "snake coralline." The "head" appears to be very finely punctate, the stalk finely annulated and the basal adnate swelling again more or

less punctate. In reality there are no punctations but instead there are minute protuberances which give the appearance of punctures under transmitted light. At one side of the "head" is a flat membranous area and at the upper end of this is the operculum, which also appears to be punctate.

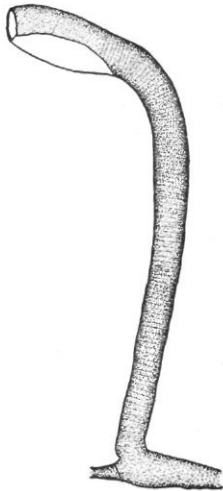


Fig. 17.
Aetea anguina (L.)

While permanent ovicells or oocelia are wanting, the embryos are held for a short time in a membranous sac at the upper end of the "head." These are so fragile, transparent and evanescent that they are rarely seen. Apparently they disappear when the ciliated embryos are liberated.

It is a very widely distributed species, occurring plentifully on our coast from Mount Desert Island, Maine, to the Caribbean Sea, and Marcus (*l.c.*) has reported it from the Bay of Santos, Brazil.

Like most of the Cheilostomata, it is not adapted to low salinities and appears to occur only in the lower part of Chesapeake Bay. It was not found in the Cowles collections (Osburn, 1932a), but a few colonies were taken in the summer of 1943 near the Tue Point Light House at the mouth of the York River (salinity 21.35, depth 13 feet). It was not noted in Chincoteague Bay, but it is common on the outer coast.

Family Membraniporidae Busk, 1854.

Membranipora membranacea (L.), 1766. Fig. 18.

- Packard, 1891, p. 373 (*Flustra*). Labrador.
 Osburn, 1914, p. 193. Tortugas, Florida.
 ———, 1932a, p. 443 (*Nitscheina*). Chesapeake Bay.
 ———, 1940, p. 349. Porto Rico.

Zoarium encrusting in a thin layer, especially spreading over the fronds of the broader algae.

The zoecia are usually very regularly elongate-quadrate, with very thin walls and occasionally with short, erect, bluntly pointed tubercles on the distal corners. Infrequently a very slight evidence of the cryptocyst appears at the proximal corners, so slight as to be practically negligible. The lack of all the usual diagnostic characters is

perhaps the most noticeable feature. Hincks (1880, p. 142) has mentioned tall, cylindrical, chitinous tubules arising from the middle of the frontal wall, but these have not been noticed in American material.

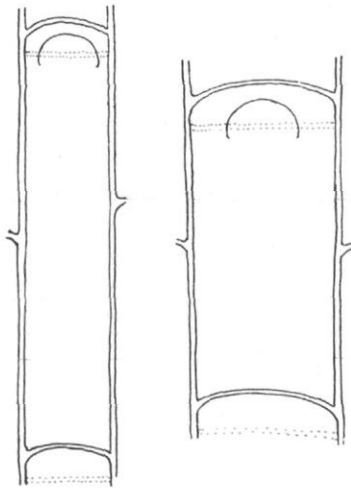


Fig. 18. *Membranipora membranacea* (L.). Right, usual form of zoecium; left, from the same colony in crowded condition; dotted lines indicate position of distal wall on dorsal side.

Patuxent River show a salinity range of about 6.00 to 13.00 (0.6 to 1.3%).

Membranipora tuberculata (Bosc), 1802. Fig. 19.

- Osburn, 1912, p. 231 (*M. tehuelcha*, D'Orb.). Woods Hole Region, Mass.
 ———, 1914, p. 193 (*M. tehuelcha*). Tortugas, Florida.
 ———, 1927, p. 124 (*Nichtina tuberculata*). Curacao.
 ———, 1940, p. 349. Porto Rico.
 Marcus, 1937, p. 33. Santos Bay, Brazil.

The zoarium forms a lace-like crust on the Gulfweed, *Sargassum*, and is about the only bryozoan species ever found in that situation in this region.

The zoecia are moderately large, elongate-quadrangular and nearly all of the front is membranous. At each anterior corner is usually a low heavy tubercle. These tubercles often coalesce across the front of the zoecium.

It is a circumtropical species in its proper habitat, but is drifted everywhere over the wide oceans where currents carry the Gulfweed.

While it is not properly an inhabitant of the Chesapeake Bay, it is often carried into the lower Bay by tide currents and is common among the drift on the outer shores of Maryland.

Membranipora crustulenta (PALLAS), 1766. Fig. 20 and Plates I, II and III.

Verrill, 1873, pp. 406 and 712. New Jersey to Arctic Ocean (*M. lineata* at least in part).

Osburn, 1912, p. 227. Woods Hole Region (*M. lacroixii* in part).

The zoarium forms a thin encrusting layer on anything that will afford attachment, especially on shells and pebbles, but also on such flexible organisms as the alga *Ulva*, the eelgrass *Zostera marina*, the stems of hydroids and the branched red algae. It never rises above the substratum and, though it has been observed to spread over dead colonies of the same species, it never seems to produce thick, multilamellate incrustations.

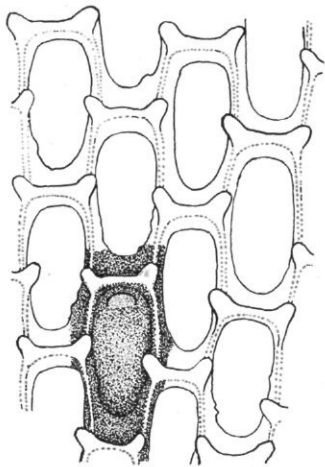


Fig. 19. *Membranipora tuberculata* (Bosc). Note thick side walls and heavy tubercles.

The zoecia are usually rather regularly elongate-elliptical in form, the marginal walls being well separated by a deep groove, which may broaden out into a triangular inter-zoecial space at the ends of the zoecia. The calcified wall is only moderately high, rising somewhat higher at the distal end and is finely granulated on the edge; usually moderately thick but may be very thin especially when growing on a flexible background. The opesium, or membranous frontal area, is typically elliptical, slightly wider at the distal end. Delicate, sharp-pointed spines are often present, curving over the membranous area. The number varies remarkably from none to 12, the ordinary complement being a pair of erect spines near the distal end with three or four curved ones on each lateral wall. There is never a single median spine on the proximal border. The ancestrula, or first individual of a colony, is nearly always without spines, some whole colonies may entirely lack them, others may have only a few, while others are bristling all over with them. Often colonies are spineless for some distance beyond the ancestrula, after which spines appear, sometimes

a scattering few, or the whole colony may suddenly bristle with spines. The zooecia vary considerably in size, ranging from 0.35-0.55 mm. (usually from 0.40-0.45 mm.) in length, by about 0.20-0.25 mm. in width.

As in nearly all Bryozoa, the colony develops by budding from a single individual, the ancestrula, which is metamorphosed from the

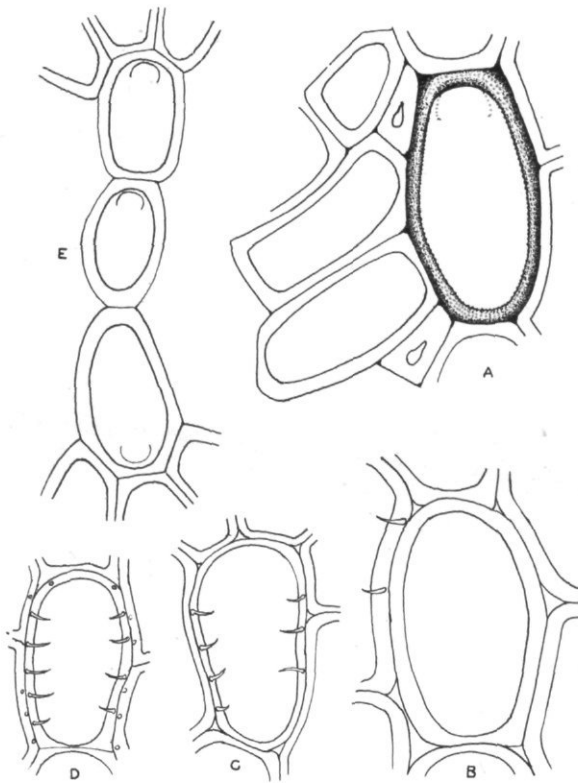


Fig. 20. *Membranipora crustulenta* (Pallas). (a) Details of Calcification, with abortive zooecia at the side; (b, c, and d) variations in spination, all from the same colony; (e) ancestrula and common mode of budding to form biradiate colony.

ciliated larva. From the distal end of the ancestrula a single bud appears and usually a little later a similar one from the proximal end. Each of these buds usually gives off three more daughter buds as shown in figure 20e. However there is much variation in budding; often the first daughter bud gives off only one bud distally and this

may continue for some time so that a single string of zooecia is formed. Sometimes this method of budding may take place at the borders of a radiate colony, continuing the zoarium in an irregularly radiate form. Most frequently both first generation buds are formed, their further budding giving rise to an irregularly biradiate colony. Budding at the margin of the colony continues until limited by the space, often by coming into contact with another colony, when the proliferation ceases. The marginal zooecia, in such cases, are often abnormal (see fig. 20a).

The rate of budding and the proliferation of the colony are remarkable. Experiments carried on at the Chesapeake Biological Laboratory by the writer in the summer of 1943 indicate that, at a water temperature above 70° F. the average rate of budding is two new zooecia per day all around the border of the colony. In spite of the small size of the zooecia, the colony may measure more than 50 mm. across within four weeks after the attachment of the larva. Colonies on oyster shells planted on June 28 and lifted 21 days later measured as much as 40 mm. across. Such a colony would contain at least 10,000 individual zooecia.

The reproductive rate is also very high. Dead oyster shells submerged for 14 days had more than 200 young colonies of this species attached to the surface of a single shell. Within another week the entire surface of the shell would have become covered with a layer of Bryozoa.

M. crustulenta appears to be a serious enemy to the oyster in certain places by covering the shells to such an extent that the oyster larvae find no room for attachment (Plate I). This does not occur everywhere throughout the range of either *crustulenta* or the oyster, but in that part of the Chesapeake Bay where the salinity is less than about 18 (1.8%) it is very evident. This region includes nearly all of the Bay down to about the mouth of the York River. Nothing appears to be able to attach to *M. crustulenta* except the other similarly serious bryozoan pest, *Acanthodesia tenuis*, which does sometimes cover even the *crustulenta* colonies. *M. crustulenta* reproduces ciliated larvae in great abundance throughout the summer till late in September and covers the available "setting" space very rapidly. No apparent harm is done to the growing oysters, even though the outside of the shells may be covered.

This species is excessively abundant in shallow water throughout most of its salinity range—6 to 32 within the Bay. From the region about Baltimore to the mouth of the York River it is the most abun-

0.26) mm., height of chitinous processes 0.013-0.02 mm., diameter about 0.007 mm.

The species is similar to *C. tubigerum* Osburn (1940, p. 352) in most respects, but the pairs of tall tubules at the basal corners of the zooecia are entirely chitinous instead of calcified and are slightly decreased in size and rounded toward the top, the triangles are larger, and the cryptocyst is less in evidence. Also in the present species the membranous frontal area is nearly quadrangular, while in *tubigerum* it is distinctly elliptical and the distal border is much more rounded forward. It may be a brackish water variety of *C. tubigerum*, listed by Osburn from Guanica Harbor, Porto Rico, Captive Island, off the west coast of Florida, and from Port Lavaca, Texas, but on account of the difference cited above, it seems better to keep it separate until more is known of its variability. Solomons, Maryland, encrusting the stems of *Ruppia maritima* (L.), a brackish-water member of the Pondweed family, at a depth of one meter and a salinity of 11.

The species is dedicated to Dr. Reginald V. Truitt, founder of the Chesapeake Biological Laboratory and the director of the Maryland Department of Research and Education.

Robertson (1921, p. 51) has described a somewhat similar form (*Membranipora hugliensis*) from the Bay of Bengal off the mouth of the Hugli River, but the chitinous processes arise farther forward and not in the triangular spaces characteristic of *Conopeum*, and are sometimes single and centrally located. Furthermore the basal calcareous lamina is much broader than in the present form. Hincks (1880, p. 142) has described tubular processes or "tower cells" in *M. membranacea* (L.), but these take their origin from the membranous frontal wall near the middle of the zooecium.

Acanthodesia tenuis (DESOR), 1848. Fig. 22 and Plates I and III.

- Desor, 1848, p. 66 (*Membranipora tenuis*). Muskeget Channel, Mass.
Smitt, 1873, p. 18 (*Bifustra denticulata*). Tortugas, Florida.
Verrill, 1873, p. 712 (*M. tenuis*). Long Island Sound to Cape Cod.
Levinsen, 1894, p. 53 (*M. danica*). Denmark.
Osburn, 1912, p. 231 (*M. tenuis*). Woods Hole Region, Mass.
Canu and Bassler, 1928, p. 62 (*Hemiseptella denticulata*). Florida.
———, 1928, p. 63 (*Hemiseptella hexagonalis*). Off Cape Fear, N. C.
———, 1930, p. 29 (*Hemiseptella africana*). Tunis.
Osburn, 1932a, p. 443 (*Hemiseptella denticulata*). Chesapeake Bay.
Marcus, 1937, p. 42. Santos Bay, Brazil.
Osburn, 1940, p. 353. Porto Rico.

The zoarium encrusts anything that will afford attachment, most frequently on shells and stones, but may be found on submerged wood, algae, eel-grass, hydroids, sponges, ascidians, other Bryozoa, etc. The zoarium is usually unilaminate, but older colonies may form incrusta-

Bassler, 1923; *H. grandicella* (Miocene), Canu and Bassler, 1919; and *Acanthodesia oblongula*, Ulrich and Bassler, 1904. Judging by the figures and descriptions any of these if found among our recent material would at once be classed with *A. tenuis*.

The distribution is general along our Atlantic coast south of Cape Cod, but more abundant in the sounds and bays. Marcus has listed it from Santos Bay, Brazil, and it is also known from Denmark, the Mediterranean Sea and the west coast of Africa in the mouth of the Congo River. In the deeper waters of the Chesapeake, Cowles did not dredge this species north of the Potomac, but in shallow waters it is excessively abundant on oyster beds as far as Poole's Island, above Baltimore, at a salinity of only 6.

Family **Electrinidae** O'ORBIGNY, 1851.

***Electra pilosa* (L.)**, 1766. Fig. 23.

- Leidy, 1855, p. 9 (*Membranipora*). Rhode Island.
 Packard, 1867, p. 272 (*Membranipora*). Labrador.
 Verrill, 1873, p. 712. (*Membranipora*). Long Island Sound to the Arctic Ocean.
 Cornish, 1907, p. 76 (*Membranipora*). Nova Scotia.
 Osburn, 1912, p. 228 (*Membranipora*). Woods Hole Region, Mass.
 ———, 1932, p. 6. Wakeham Bay, Ungava.
 ———, 1932a, p. 442. Mouth of Chesapeake Bay.
 ———, 1933, p. 20. Mount Desert Island, Maine.

Zoarium encrusting, especially on the broader fronds of algae, but occasionally on shells and pebbles. When the rounded stems of algae are encrusted the basal chitinous spine becomes greatly elongated so that the surface of the colony appears to be covered with bristles.

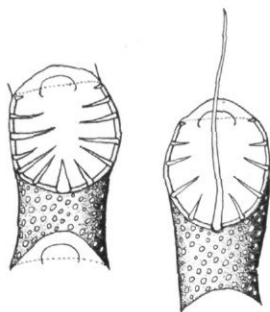


Fig. 23. *Electra pilosa* (L.). Left, usual form on flat surfaces; right, very elongate basal spine on rounded stems.

Zooecia moderately large (0.50-0.60 mm. long by 0.25-0.30 mm. wide) the basal part covered by a porous gymnocyst, the pores being very conspicuous. The rounded or oval membranous area is protected by about nine rather stout chitinous spines which curve over the front. One of these is medially situated at the proximal end of the area and may be greatly elongated. In addition there is an erect spine on either side near the distal end.

The first appearance of a colony growing on a small rounded stem is very different from that on a flat surface because of the elongated

0.26) mm., height of chitinous processes 0.013-0.02 mm., diameter about 0.007 mm.

The species is similar to *C. tubigerum* Osburn (1940, p. 352) in most respects, but the pairs of tall tubules at the basal corners of the zooecia are entirely chitinous instead of calcified and are slightly decreased in size and rounded toward the top, the triangles are larger, and the cryptocyst is less in evidence. Also in the present species the membranous frontal area is nearly quadrangular, while in *tubigerum* it is distinctly elliptical and the distal border is much more rounded forward. It may be a brackish water variety of *C. tubigerum*, listed by Osburn from Guanica Harbor, Porto Rico, Captive Island, off the west coast of Florida, and from Port Lavaca, Texas, but on account of the difference cited above, it seems better to keep it separate until more is known of its variability. Solomons, Maryland, encrusting the stems of *Ruppia maritima* (L.), a brackish-water member of the Pondweed family, at a depth of one meter and a salinity of 11.

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———, 1930, p. 29 (*Hemiseptella africana*). Tunis.
Osburn, 1932a, p. 443 (*Hemiseptella denticulata*). Chesapeake Bay.
Marcus, 1937, p. 42. Santos Bay, Brazil.
Osburn, 1940, p. 353. Porto Rico.

The zoarium encrusts anything that will afford attachment, most frequently on shells and stones, but may be found on submerged wood, algae, eel-grass, hydroids, sponges, ascidians, other Bryozoa, etc. The zoarium is usually unilaminate, but older colonies may form incrusta-

tions several layers in thickness. Also when colonies meet at their edges they may turn upward and form erect bilaminate frills, often to the height of an inch or more. It is usually white in color, but may be pink, pale yellowish or greenish, and older colonies often have a brownish tinge.

The zooecia when growing free on a smooth surface are generally very regularly elongate-quadrangular, about twice as long as wide, but the proportions vary greatly in different colonies and even within the same colony. Under more crowded conditions, or on rough background short, wide, hexagonal zooecia are more common. The walls are rather high, finely beaded on the mural rim, separated by a distinct groove which in older colonies often shows a fine brown line, and the distal wall is usually rounded forward on its upper border. The thickness of the wall also varies greatly, usually well calcified and heavy in greater salinity, but in brackish water and especially when growing on a flexible background the walls may be very thin. The typical *tenuis* has a well-developed cryptocyst, which often fills half of the opesia area with a flat shelf which has an irregular border (Fig. 22c), but this varies greatly in different localities and in brackish water it is often almost absent. Small pointed spicules project inward from the border of the cryptocyst. Rounded tubercles are sometimes present, appearing interopesially at the corners of the zooecia. In Chesapeake material these are seldom observed and are always small. In other material they may be wanting entirely, present on every zoecium or scattering here and there, or they may be small and inconspicuous or so large that they occasionally unite across the front.

Chesapeake specimens measure as a rule about 0.40-0.50 mm. in length (range 0.35-0.60 mm.) by 0.20 mm. to 0.25 mm. wide (range 0.15-0.30 mm.). Shorter individuals tend to be wider and some of the hexagonal zooecia are nearly as wide as long. The individuals of a radial row usually grow regularly wider before the row divides into two rows.

The ancestrula of this species is peculiar in that it is always twinned. The two zooecia of the twin ancestrula usually bud off five daughter zooecia from the distal ends and these produce nine, forming a fan. This proceeds until a complete circle is formed with the ancestrula in the middle. The rate of budding is very rapid, two buds a day being the rule at summer temperatures.

This species is another oyster pest, similar to *Membranipora crustulenta*. It covers the background even more thoroughly, will spread over a rougher substratum and will even cover *crustulenta* occasionally.

proximal spines of the former, but the difference is not even of varietal value since a colony on a flat surface will produce long spines when it comes into contact with the edge of a frond.

The species is widely distributed along the Atlantic coast from the Chesapeake Bay northward and is excessively abundant along the New England coast in shallow water. In the Chesapeake it has been found sparingly from the mouth of the Bay up to the mouth of the Patuxent River. It can therefore endure a salinity as low as 11 (1.1%).

***Electra hastingsae* MARCUS, 1938. Fig. 24.**

Leidy, 1855, p. 9 (*Escharina lineata*). New Jersey.

Verrill, 1873, p. 712 (*Membranipora lineata*). New Jersey to the Arctic Ocean.

Osburn, 1912, p. 227 (*Membranipora monostachys*). Woods Hole Region, Mass. (part, Pl. 22, fig. 29a).

——, 1932a, p. 443 (*Electra monostachys*). Mouth of Chesapeake Bay.

——, 1933, p. 20 (*Electra monostachys*). Mount Desert Island, Maine.

Marcus, 1938, p. 17. Santos Bay, Brazil.

The zoarium usually encrusts shells and pebbles, characteristically forming radiating colonies.

The zoecia are of moderate size and somewhat elongate (about 0.50 mm. by 0.20 mm.), the measurements varying considerably. The

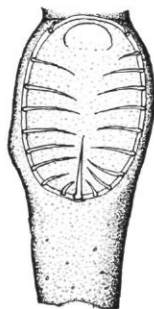


Fig. 24. *Electra hastingsae* Marcus. Note central spine and extension of base to distinguish this species from *Membranipora crustulenta*.

proximal (gymnocyst) portion is slightly narrowed and occupies one fourth to one half of the zoecial length. The opesium (membranous area) is elliptical or oval in form, the mural rim distinctly raised and rounded distally and the individual zoecia are usually very distinctly separated from each other by a groove. The border about the opesium is beset by numerous spines, as follows: a semi-erect spine on either side at the level of the operculum; four to six or more lateral spines on each side which curve over the opesial area, and one stronger spine at the middle of the proximal border curving forward. The proximal spine is rarely wanting; more frequently it may be of the same size as the lateral spines. The lateral spines vary greatly in number, from two to nine on each side. The ancestrula is provided with similar spines.

Encrusting shells near the mouth of the Chesapeake Bay; also at Ocean City, Maryland and in Chincoteague Bay, not abundant. Owing to the confusion of this species with others, the distribution is not at all certain, but it can

be definitely indicated for the western Atlantic coast from Mount Desert Island, Maine, to Santos Bay, Brazil; from Denmark and Great Britain to Portugal and the Mediterranean Sea, and from the Pacific coast of Panama. Dr. Marcus (*l. c.*), in separating this species from those with which it has been confused, presents an excellent discussion of its relationships.

Family Bugulidae GRAY, 1848.

The zoarium is erect, flexible and bushy, the branches consisting of one to several rows of zoecia all facing in the same direction; avicularia all stalked and having the form of a bird's head with a hooked beak; well chitinized but little calcified. Numerous species occur along our coast, but none of them is well adapted to brackish water. In the lower part of the Chesapeake Bay there has been found only the following species.

Bugula turrita (DESOR), 1848. Fig. 25.

Desor, 1848, p. 66 (*Cellularia turrita*). Nantucket, Mass.

Leidy, 1855, p. 142 (*Cellularia fastigiata*). New Jersey.

Perkins, 1869, p. 161 (*Cellularia turrita*). Connecticut.

Verrill, 1873, p. 712; 1878, p. 8; 1879, p. 52; 1880, p. 189. N. C. to Casco Bay, Maine.

Osburn, 1912, p. 224 (*B. gracilis uncinata*), p. 225 (*B. turrita*); 1932a, p. 443 (*B. gracilis uncinata*). Mass. to Chesapeake Bay.

Marcus, 1937, p. 68. Santos Bay, Brazil.

Zoarium one to three inches high, much branched, the branches bearing secondary whorled or spirally arranged branches which curl inward somewhat at their tips, giving each main branch a somewhat pyramidal form. Usually numerous radicles or rootlets arise from the lower zoecia and run down the main stem for additional attachment.

The zoecia are biserial and alternate, narrowed toward the base. The membranous frontal area occupies about two thirds of front side; a short spine is usually present at each upper angle of the front (frequently only the angle is noticeable) and a larger spine is usually present behind the outer spine. The avicularium is small and stout, with a decurved beak, and is attached on the outer margin at about its middle. The globose ovicell arises a little to one side of the axis of the zoecium and is tipped somewhat toward the axis of the branch.

In Chesapeake Bay specimens, as occasionally elsewhere throughout its range the radicles which serve as "hold-fasts" develop into grappling-hooks or anchors with from two to four or more recurved processes or hooks at the end. These appear to be exactly like those figured

by Hincks for his *Bugula gracilis* var. *uncinata* (1880, pl. 12, figs. 6, 7 and pl. 15, figs. 4, 4a) and misled the writer (Osburn, 1912, p. 224 and 1932a, p. 443) into identifying this form of *turrita* with Hincks' variety *uncinata*. Hincks apparently made the same mistake in determining a specimen from Lynn, Mass., as *gracilis* var. *uncinata* (1880, p. 86-89). *B. gracilis* has not been taken in American waters. Whether Hincks' other specimens from England and Madeira belong to *gracilis* may be doubted as he appears to be uncertain in his discussion. Possibly he may have had *turrita*, though this species has not been recorded from the eastern Atlantic. Of course it is possible that more than one species of *Bugula* may develop the uncinata processes in certain habitats.

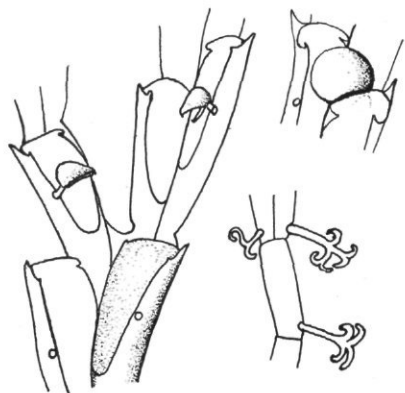


Fig. 25. *Bugula turrita* (Desor). Left, portion of a branch; right, above, note form and position of oecium; below, the uncinata radicles usually present in Chesapeake specimens.

There appears to be no other character to differentiate these specimens with the uncinata processes; the form, spines, avicularia and measurements all agree with the typical *turrita*. All of the uncinata specimens I have seen have been attached to flexible organisms such as eel-grass (*Zostera*), and it is possible that the habitat may have something to do with the modification of the root-like radicles into anchors.

B. turrita occurs commonly from Massachusetts to North Carolina, and Marcus has recorded it from Santos Bay, Brazil. Occasional uncinata specimens have been taken throughout the North Atlantic range. In the Chesapeake Bay it occurs only in the lower part toward the mouth, when the salinity is not below 20.

SUB-ORDER *Ascophora* LEVINSEN, 1909.

In this sub-order the front wall of the zoecium is completely closed over with a calcareous layer except for the aperture and spiracle. The latter is the entrance to the compensation sac which regulates the hydrostatic pressure within the zoecium as the tentacles are protruded or withdrawn. In a few cases the spiracle is a special pore in the frontal wall at a little distance from the aperture. Usually,

however, it is situated immediately proximal to the aperture, so that the operculum in opening to permit the extrusion of the tentacles also opens the entrance to the compensation sac.

The Ascophora have even less tolerance of brackish water than do the Anasca. Only in the lower part of the Bay, where the salinity is higher, three species have been taken, while outside on the open coast as many as 20 to 30 species might be expected.

Family **Hippothoidae** LEVINSEN, 1909.

Zoarium encrusting, the zooecia separated more or less by inter-zooecial areoles, though in older many-layered colonies these are difficult to distinguish. Reproductive individuals, distinguished by oecia or ovicells (rounded calcified capsules on the distal end of the zooecium), are always somewhat smaller than the nutritive zooecia. Some of the species form linear, branching colonies.

Hippothoa hyalina (L.), 1767. Fig. 26.

- Verrill, 1873, p. 713 (*Mollia hyalina*). Long Island Sound to Greenland.
——, 1878, p. 9. Fort Macon, N. C.
Whiteaves, 1901, p. 100 (*Schizoporella*). Gulf of St. Lawrence.
Cornish, 1907, p. 77 (*Schizoporella*). Nova Scotia.
Osburn, 1912, p. 235. Woods Hole Region, Mass.
——, 1912a, p. 280. Nova Scotia to Labrador.
——, 1919, p. 609. Umanak, Greenland.
——, 1932 p. 12. Hudson Bay and Strait.
——, 1932a, p. 443. Mouth of Chesapeake Bay.
——, 1933, p. 33. Mount Desert Island, Maine.
Marcus, 1937, p. 79. Santos Bay, Brazil.

The zoarium encrusts anything that will afford attachment, the fronds and stems of algae, the stems of erect hydroids and bryozoans, shells, stones, etc., glistening white, or in younger stages nearly transparent. The zooecia, in older colonies often pile up on each other in confused masses.

The zooecia are usually elongate, subcylindrical, attenuated proximally, separated by areolated spaces, the surface glossy and usually transversely ribbed. The aperture is rounded with a broad rounded sinus on the proximal border, but this is often obscured by an overhanging umbonate process. The oecia (ovicells) are globose, punctured with rather large pores and are borne on slightly dwarfed individuals (gonozooecia). There are many variations according to age, the piling up and erection of older zooecia and the substratum.

Zooecial measurements, length 0.40-0.50 mm., breadth 0.15-0.20 mm.; aperture length 0.12 mm., breadth 0.11 mm.; breadth of oecium 0.18-0.20 mm. but varies considerably.

A truly cosmopolitan species which is very abundant from New Jersey northward. In the Chesapeake Bay it is not common except near the mouth, but it is occasionally found as far within as the mouth of the Patuxent River, at a salinity of about 11 (1.1%). The colonies found within the Bay were all small and apparently the species is not well adapted to lower salinity.

Family Schizoporellidae BASSLER, 1935.

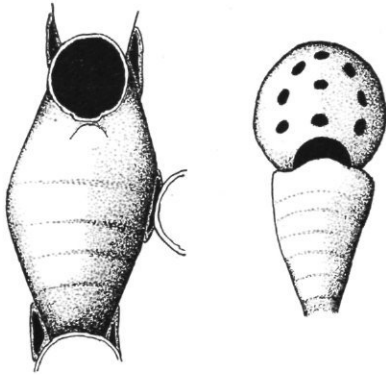


Fig. 26. *Hippothoa hyalina* (L.). Left, young zoecium from margin of colony; right, reduced fertile individual (gonozooecium) with oocidium.

This group is usually distinguished by the presence of a sinus or notch in the proximal border of the aperture, though in some cases it may be merely rounded or even straight. The front wall is usually a tremocyst, that is, perforated by numerous small pores, but some species lack the pores. The family is a very large and varied one with several sub-families. The species are usually encrusting, but occasional species may form erect branches, while others may pile up layer after layer of zoecia to form nodules

of considerable size. Avicularia, sometimes interzoecial in position but more frequently more or less embedded in the calcified frontal wall, are found in most of the species.

1. Aperture with a rounded sinus in the proximal border; frontal pores conspicuous; no oral spines. **Schizoporella unicornis.**

2. Aperture with a straight proximal border; a small median pore (spiracle) a little back of the aperture; a number of slender spines around the border of the aperture, usually lost in older zoecia. **Microporella ciliata.**

Schizoporella unicornis (JOHNSTON), 1847. Fig. 27.

- Desor, 1848, p. 66 (*Lepratia variolosa*). Muskeget Channel, Nantucket.
 Leidy, 1855, p. 10 (*Escharina variabilis*). New Jersey.
 Smitt, 1873, p. 44 (*Hippothoa isabelleana*). Tortugas, Florida.
 Verrill, 1873, p. 713 (*Escharella variabilis*). Massachusetts Bay to S. C.
 ———, 1875, p. 41 (*Hippothoa reversa*, n. sp.). Gay Head, Mass.
 ———, 1878, p. 9 (*Hippothoa variabilis*). Fort Macon, N. C.
 Osburn, 1912, p. 236. Woods Hole Region, Mass.

- , 1914, p. 205. Tortugas Islands, Florida.
 ———, 1927, p. 126 (*Schizopodrella*). Curacao.
 ———, 1932a p. 443 (*Schizopodrella*). Mouth of Chesapeake Bay.
 ———, 1933, p. 38 (*Schizopodrella*). Mouth Desert Island, Maine.
 ———, 1940, p. 419. Porto Rico.
 Canu and Bassler, 1928, p. 97 (*S. isabelleana*). St. Thomas, Virgin Islands.
 Pelluet and Hayes, 1936, p. 157. Halifax Harbor, Nova Scotia.
 Marcus, 1937, p. 83. Santos Bay, Brazil.

Zoarium encrusting, usually on shells and stones. Older colonies become multilaminar (as many as 21 layers have been observed) and the surface may develop nodules, irregular frills or tubular extensions. Young colonies are usually glistening white, later becoming pink, red and even deep purple in tropical seas.

The zoecia of the primary layer are oriented, elongate-hexagonal or more or less quadrangular, but in the secondary layers the zoecia may be turned in any direction and irregular in form. The frontal wall is a thick tremocyst with rather large, numerous pores, and an umbonal process is frequently present in the middle just proximal to the aperture. The aperture is rounded distally, with a rounded sinus in the proximal border; the thickening of the frontal wall does not encroach on the aperture, but leaves a narrow smooth shelf surrounding it on all sides. The oecium (ovicell) is raised, porous and often decorated with marginal costae and sometimes with an umbonate knob on the top. A sessile avicularium is often present on one or both sides of the aperture, the beak usually directed forward, but it may be turned in any direction

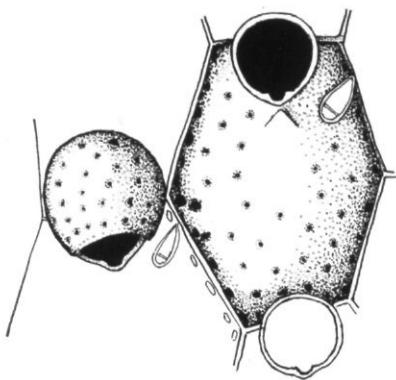


Fig. 27. *Schizoporella unicornis* (Johnston). Details of calcification, oecium and avicularia.

and frequently may be wanting over much of the colony.

Measurements vary greatly, Chesapeake specimens range from 0.35-0.60 mm. in zoecial length by 0.25-0.35 mm. in width; aperture width 0.13-0.14 mm. by 0.13 mm. in length.

The species is cosmopolitan and ranges along the western Atlantic coast from Nova Scotia to Brazil, very abundant from Cape Cod to the Caribbean Sea; common in Chincoteague Bay and at the mouth of the Chesapeake. It does not withstand lower salinity very well, but is found sparingly in the lower part of the Bay where the salinity is not

below 18 (1.8%). A dead specimen was found near the mouth of the Patuxent River (salinity 11) but it may have been carried there on an oyster shell.

Microporella ciliata (PALLAS), 1766. Fig. 28.

- Packard, 1867, p. 270 (*Lepralia ciliata*). Labrador.
 Smitt, 1873, p. 26 (*Porellina ciliata*). Tortugas, Florida.
 Verrill, 1875, p. 53 (*Porellina stellata*, n. sp.). Casco Bay, Maine.
 Whiteaves, 1901, p. 98. Gulf of St. Lawrence.
 Osburn, 1912, p. 233. Woods Hole Region, Mass.
 ———, 1912a, p. 279. Labrador.
 ———, 1914, p. 208. Tortugas, Florida.
 ———, 1932, p. 13. King George Sound and Hudson Strait.
 ———, 1932a, p. 443. Mouth of Chesapeake Bay.
 ———, 1933, p. 44. Mount Desert Island, Maine.
 ———, 1940, p. 432. Porto Rico.
 Canu and Bassler, 1928, p. 110. Gulf of Mexico and Florida Straits.
 Marcus, 1937, p. 110. Santos Bay, Brazil.

Zoarium encrusting on shells and stones and occasionally on fronds of the larger algae and stems of various sorts. Usually glistening white, sometimes pale yellowish.

Zoecia ovate to elongate-hexagonal; front somewhat gibbous, with small pores, smooth and silvery when young but often becoming much

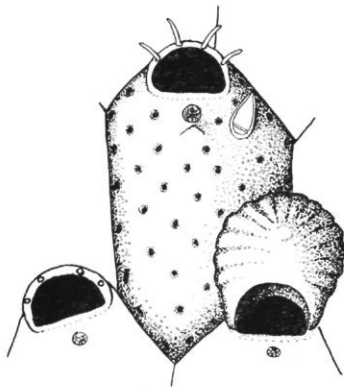


Fig. 28. *Microporella ciliata* (Pallas). Note especially form of aperture and the ascopore just proximal to it.

thickened and rough with age, especially in deeper water. The aperture is semicircular, the border only slightly raised and usually with four spines curving outward on the distal border. Immediately proximal to the aperture on the front is a special small median pore which is usually more or less lunate in form with teeth or spicules projecting into it. This is the spiracle which leads into the compensation sac. An umbonate process is often present just proximal to the median pore and frequently obscures it from view. A pointed avicularium is present usually on one side a little proximal to the aperture with the point forward and outward. The ovicell is prominent, rounded or slightly elongate, with a few pores and often sculptured with radiating ridges and sometimes with an umbonate process on the top.

Zooecial measurements vary greatly, length 0.40 mm. to 0.50 mm. (range 0.30-60 mm.), width 0.25 mm. to 0.30 mm. (occasionally 0.20-0.40 mm.). Short zooecia are usually wide. The length of the avicularian mandible also varies greatly as does the form of the median pore which is usually lunate but may be circular (var. *stellata* Verrill).

A cosmopolitan species, known from Labrador to Brazil, along our shores. Mouth of the Chesapeake Bay and inside to a salinity of about 20 (2.0%), not common; Chincoteague Bay, rare, and Ocean City, Maryland, common.



Plate I. Oyster shell encrusted by Bryozoa, chiefly *Acanthodesia tenuis*. Submerged for one year. The other side of the shell was equally encrusted. Solomons, Md. Natural size.



Plate II. Old over-wintering colony of *Membranipora crustulenta*, with about 10 areas of regeneration spreading over the old colony surface. Solomons, Md. Enlarged 3 diam.

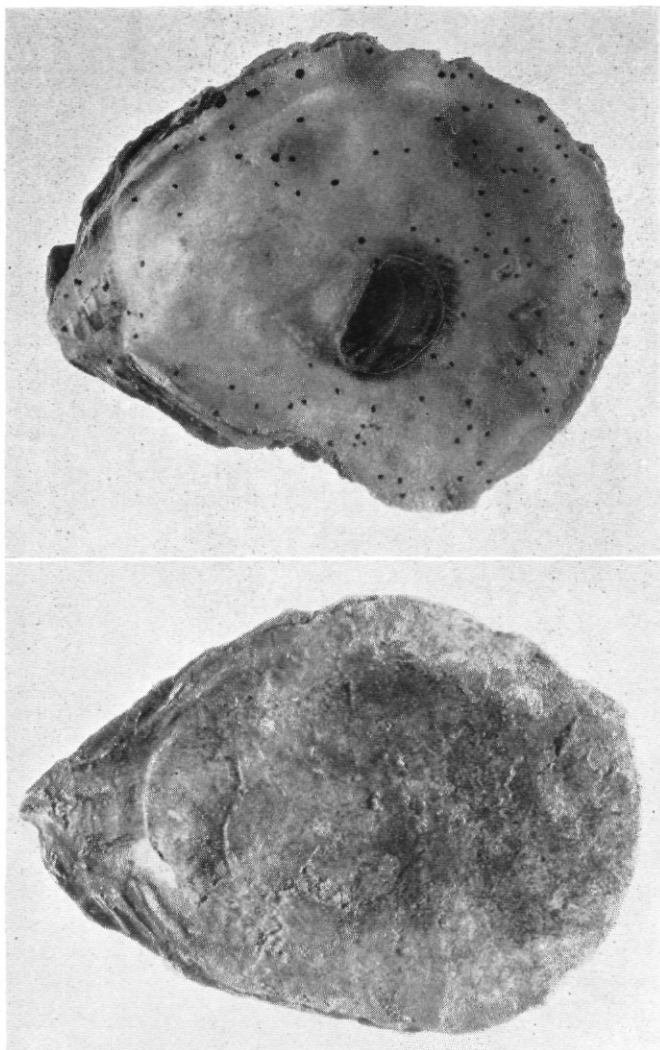


Plate III. Above: oyster shell submerged for 10 days. The ink dots show the number and distribution for young bryozoan colonies. Some of these are already nearly $\frac{1}{2}$ in. across, but most of them are too young and small to be evident in the photograph. Slightly over 100 young colonies are present and the other side of the shell is equally infested. Solomons, Md. Natural size.

Below: shell submerged for one month and completely covered by about 30 colonies of various sizes and ages. The largest colony has 46 rows of zooecia. Solomons, Md. Natural size.

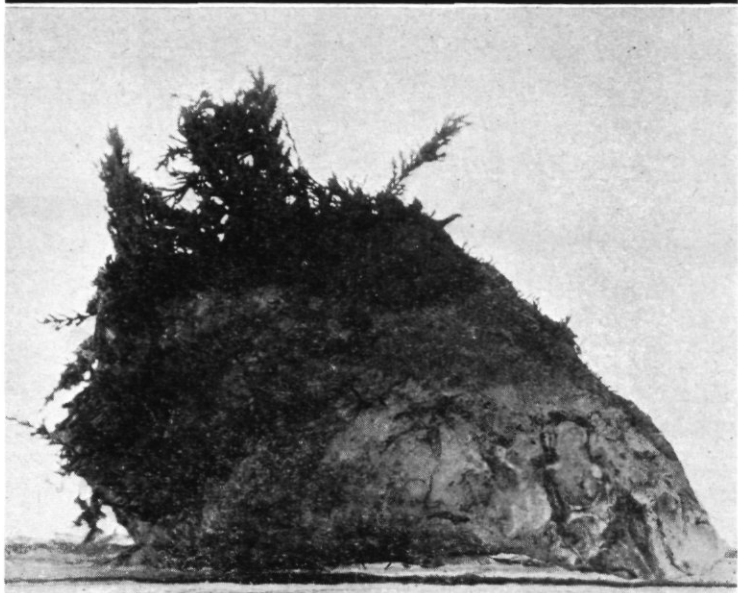
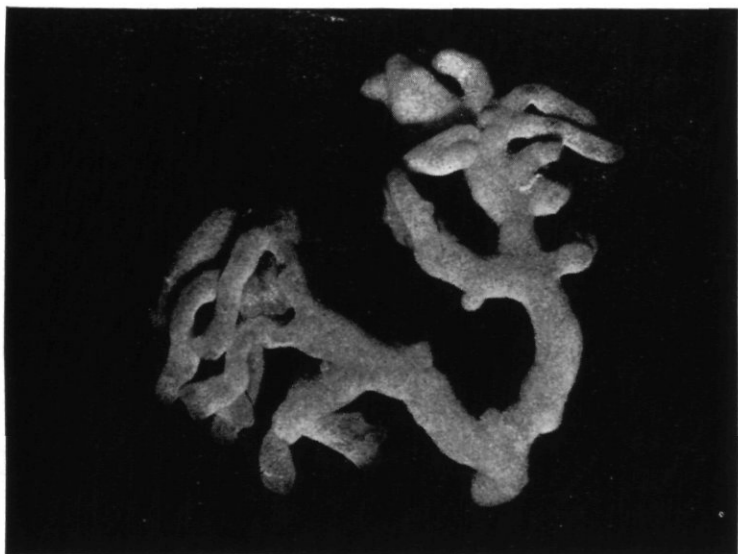


Plate IV. Above: a small portion of a colony of *Alcyonidium verrilli*, showing the irregular, rounded, branching stems. Off mouth of Little Choptank River at 60 feet. Natural size.

Below: oyster shell with the exposed surface fouled by *Anguina palmata*. Great Rock, off Crisfield, Md. Enlarged 2 diam.

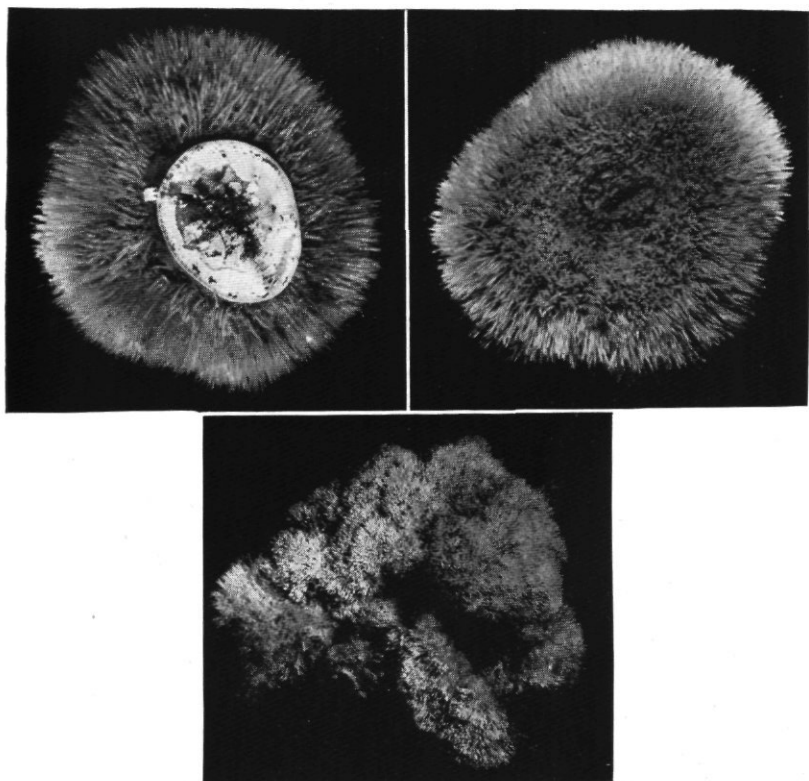
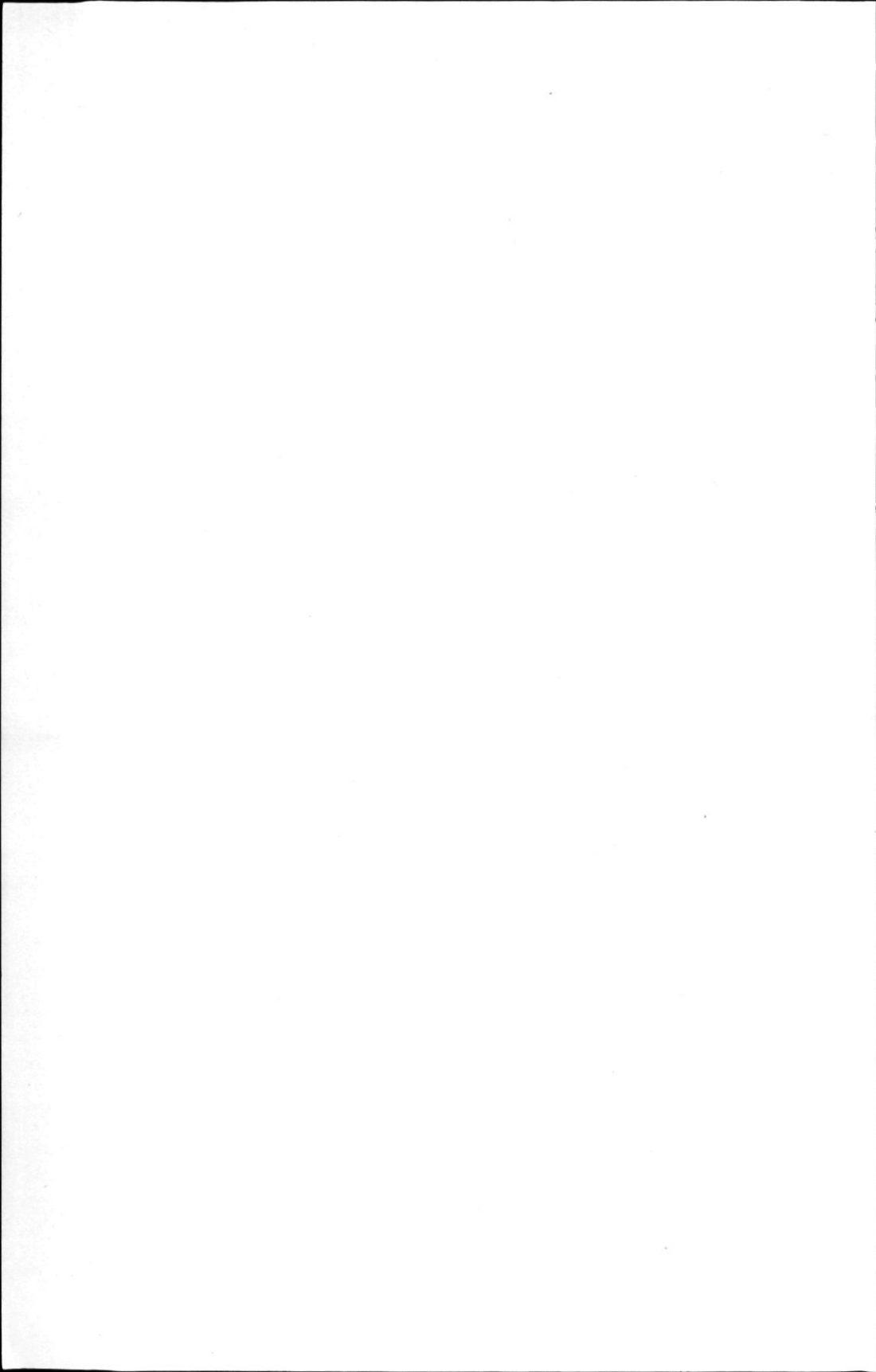


Plate V. *Victorella pavida*. Above: young colony on a barnacle from bottom of a boat, in the water one month, showing both upper (right) and under surfaces. Solomons, Md. Enlarged $1\frac{1}{2}$ diam.

Below: portion of older colony $\frac{1}{2}$ in. thick from pile of wharf at Solomons, Md. Natural size.



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GLOSSARY OF SPECIAL TERMS.

- ANCESTRULA**—Primary individual of a colony.
- APERTURE**—Opening through which the tentacles are extended.
- AVICULARIUM**—A highly modified individual with a snapping beak, sometimes shaped like a bird's head.
- CALYX**—The bulbous head in the Entoprocta, containing the essential organs.
- COMPENSATION SAC**—A thin-walled sac beneath the calcified front wall in the Ascophora for regulating the hydrostatic pressure within the zoecium.
- CRYPTOCYST**—A calcified shelf beneath the frontal membrane in the Anasca. (See fig. 22).
- FRONTAL**—The exposed side in encrusting forms and a similar area in erect species.
- FRONTAL MEMBRANE**—The membrane covering the uncalcified part of the front in the Anasca.
- FUNICULUS**—A string of connective tissue connecting the curve of the stomach with the proximal end of the zoecium.
- GYMNOCYST**—An outer calcified layer covering the base of the zoecium in the Anasca. (See figs. 23, 24).
- INTERNODE**—The portion of a stolon or branch between joints.
- KENOZOECIUM**—Any modified individual of the colony without a zooid: non-nutritive and serving as a colonial organ.
- MURAL RIM**—The exposed edge of the lateral wall of a zoecium.
- NODE**—A joint where a septum occurs, either in a stolon or branch.
- OPESIUM**—The uncalcified area of the front side in Anasca. (See fig. 20).
- OOECIUM**—A special chamber for the development of the eggs.
- OVICELL**—See oecium.
- OOECIOSTOME**—The aperture of the oecium.
- PEDICEL**—The stalk portion in Entoprocta, or the slender base of the erect zoecium in other groups.
- POLYPIDE**—The internal mass of an individual, tentacles, gut, etc., freely movable within the zoecium.
- PROVENTRICULUS**—Portion of the gut just anterior to the stomach.
- RADICLE**—A root-like process, usually for attachment.
- SEPTUM**—A membranous cross-wall between individuals, either in the stolon or elsewhere.
- SPIRACLE**—The opening into the compensation sac in Ascophora.
- STOLON**—Creeping root-like portion of a colony which may bud off other individuals.
- ZOARIUM**—The Bryozoan colony.
- ZOECIUM**—The outer wall of the individual, usually chitinized or calcified.
- ZOOID**—See Polypide.

PUBLICATIONS *

DEPARTMENT OF RESEARCH AND EDUCATION

Chesapeake Biological Laboratory

Herewith are listed the publications, both reprinted and regular, of the Department of Research and Education and its Chesapeake Biological Laboratory. Numbers 1-41 were printed as *Contributions*. Thereafter, they were issued as *Publications*. This series is to be continued in reporting results from the Department's research programme. Future treatises dealing with education and economic problems will be issued in a new series, *Educational Series*, six of which are listed herein.

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