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Bryozoa of Porto Rico with a Résumé of the
West Indian Bryozoan Fauna

Raymond C. Osburn



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BRYOZOA OF PORTO RICO
WITH A RÉSUMÉ OF THE WEST INDIAN
BRYOZOAN FAUNA

BY RAYMOND C. OSBURN

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INTRODUCTION

In connection with the cooperative survey of Porto Rico, conducted by The New York Academy of Sciences and the Insular Government, the author spent the summer of 1915 collecting the Bryozoa. The work was all done in the shallower waters about the island down to a depth of about 30 fathoms or near the edge of the coastal shelf.

Dredgings were made at more than 50 stations, some of these being repeated. The piles of docks and the roots of mangroves in shallow water were examined, and material washed up on the beach was looked over carefully. As my whole time was given to collecting and sorting the material in this group, it seems safe to say that the list here presented is fairly representative. Care was taken to cover as many different ecological conditions as possible in the region, various types of bottom, different degrees of exposure, and varying depths.

The coastal shelf of shallow water about Porto Rico is very narrow. The broadest part is on the southern shore, but even here it extends usually only a couple of miles until the bottom plunges abruptly to the depths of the Caribbean Sea.

No previous attempt has been made to list the bryozoan species of this region and only a few have been recorded incidentally. Busk's report (1884) on the group taken by the Challenger Expedition lists only 5 species taken near Porto Rico, Levinsen (1909) mentions a few species from the nearby Virgin Islands, and Osburn (1940) has described a new species of *Cornucopina* taken by the First Johnson-Smithsonian Deep-Sea Expedition.

The region about the Florida Straits and the Tortugas Islands has been fairly well studied. Pourtales (1867) listed 7 species and his material was then turned over to Smitt (1872-73) who determined about 90 species in the Pourtales dredgings about the Straits and the Tortugas. Osburn (1914) reported on his collections in the shallow waters near the Tortugas Islands, recording 83 species and adding 40 species to Smitt's list. Canu and Bassler (1928) covered a larger territory and deeper water—Yucatan Strait, Gulf of Mexico, and the Florida coast to the Bahamas—and added about 80 more species to the list of those previously known from this area.

Of the remainder of the West Indian and Caribbean region very little is known. The largest list is that of Osburn (1927) who reported on 23 species collected in the shallow waters about Curaçao

Island by Dr. C. J. van der Horst. In 1888 Agassiz mentioned 7 species collected by the "Blake"; in 1850 Duchassaing listed 5 from the Antilles; Sonder in his "Coll. Binder" mentioned *Zoo-botryon pellucidum* as an alga under the name *Ascothamnion trinitatis*; Lamouroux, in 1816, described *Amathia alternata* from "Mer des Antilles", and in 1786 Ellis and Solander described *Pasythea (Cellaria) tulipifera* from Jamaica.

My own collections in the shallower waters of Porto Rico include a total of 124 species and varieties, indicating a very rich bryozoan fauna. Seven other species are known to occur in deeper water. Careful collecting in deeper water off the coastal shelf should add very materially to the list.

Included in the keys and distribution records of the present work are the other species known to occur elsewhere in the West Indian region. The whole area from the eastern part of the Gulf of Mexico to the Lesser Antilles is so generally uniform and the currents of the gulf and the Caribbean Sea run in such a manner that there seems to be no good reason why the shallow water species, at least, should not be distributed rather uniformly where local ecological conditions will permit. This distribution will include to a lesser extent the Bahamas, the Bermudas, and the coast northward to the Carolinas where the Gulf Stream runs over or close to the coastal shelf. The fishing banks off Beaufort, North Carolina, where the reef at 13 fathoms lies in the edge of the Gulf Stream, present a very typical tropical bryozoan fauna.

The bryozoan fauna of the West Indies is very similar to that of the warmer waters of the eastern Atlantic and the Mediterranean Sea. Like that of any tropical region it contains some subtropical species and even some that are more characteristic of colder waters. The latter are usually found at some depth, for a considerable number of species appear to have a rather wide range of tolerance for both depth and temperature. As in any such neglected region, some undescribed species occur, along with numerous others not known to occur elsewhere. It would be dangerous, however, to predict that they are limited to the West Indies, for tropical species of Bryozoa have a disturbing habit of turning up almost anywhere in warm seas in true circumtropical fashion. Some of the species of the present list range northward as far as Cape Cod or even farther, and southward to Brazil, and on to Patagonia. The recent work of Marcus (1937, 1938, and 1939) shows that a large number of the present list range at least as far south as Santos Bay, Brazil.

The writer is especially indebted to Dr. R. S. Bassler of the United States National Museum for the privilege of studying numerous types and other material, and to Dr. Anna B. Hastings of the British Museum of Zoology for the comparison of a number of my specimens with the types.

SYSTEMATIC ACCOUNT

BRYOZOA Ehrenberg 1831

The Bryozoa form a very distinct group, distinguished by a number of characters which set them aside very distinctly from all other invertebrates. Whether the group is eventually determined as a phylum, a subphylum, or a class, need not concern us here. Also we need not discuss Cori's recent attempt, 1929, to separate the endoproctous forms as a distinct phylum, the Kamptozoa, since this has not met with much response and bryozoologists will no doubt continue to include all of them in their work.

With a few exceptions among the Endoprocta, they are highly colonial, budding occurring in a number of ways,—terminal, lateral, dorsal, frontal, or stolonate. The zoarium (colony) may be creeping, erect, or encrusting. The individuals consist of an outer wall (zoecium) into which the lophophore and tentacles are usually retractile (endoproctous species simply roll the tentacles inward). The zoecial walls may be gelatinous or chitinous, or in most species more or less heavily calcified. The individual is always small, seldom more than a millimeter, but the colonies frequently measure several centimeters and occasionally much larger, up to one-third of a meter. They are usually white or pale yellowish, but may range through the whole spectrum to occasional species so deeply violet that they appear black; a few are transparent.

The great majority of the species are marine, distributed from the polar seas to the tropics and from the shore line down to great depths.

KEY TO THE CLASSES OF BRYOZOA

1. Tentacles rolled inward, not retractile into the zoecium, anal opening within the tentacle ring ENTOPROCTA, page 326.
2. Tentacles retractile, anal opening outside of the tentacle ring ECTOPROCTA, page 327.

KEY TO THE ORDERS OF ECTOPROCTA

1. Mostly marine, with a circular tentacle ring ..GYMNOLAEMATA, page 327.
2. Fresh-water Ectoprocta with a horse-shoe shaped tentacle ring PHYLLACTOLAEMATA, page 467.

KEY TO THE SUBORDERS OF GYMNOLOEMATA

1. Opening of zoecium circular, not closed by an operculum CYCLOSTOMATA, page 327.
2. Opening closed by a movable opercular valve like a little trap-door CHILOSTOMATA, page 344.
3. Opening closed by puckering a membrane which resembles a fringe of setae CTENOSTOMATA, page 335.

The above keys and all of those which follow throughout this work are meant to refer only to species occurring within the West Indian region. They would have to be much expanded to cover all of the exceptions among species in other parts of the world.

Class ENTOPROCTA Nitsche 1869

This group includes forms with stalked, naked polypides, with tentacles which are bent inward instead of being withdrawn into a zoecium, and in which the anal opening is within the ring of tentacles. In 1929 Cori separated them from the Bryozoa in a distinct phylum, the Kamptozoa, but this has not yet been generally accepted and as they are usually dealt with under the Bryozoa they are included here. The species are few in number and generally widely distributed.

Family PEDICELLINIDAE Hincks 1880

PEDICELLINA Sars 1835

Colony stolonate, the individual stalks not enlarged to form a muscular, barrel-shaped base.

Pedicellina cernua (Pallas) 1771

Common off the mouth of Guanica Harbor at about 6 fathoms. The species is well known and is widely distributed in Atlantic waters and north to polar seas. On the eastern coast of the Americas it has been recorded from Nova Scotia (Cornish 1907) to Santos, Brazil (Marcus 1938). In the West Indian region it has been recorded only by Osburn at the Tortugas Islands (1914: 212).

Occasional specimens have a few spines on the stalk, but for the most part they are bare.

BARENTSIA Hincks 1880

Colony stolonate, stalks enlarged at the base into a muscular, barrel-shaped structure.

Barentsia discreta (Busk) 1886

Taken several times off Guanica Harbor at 5 to 10 fathoms. The species is easily recognized by the peculiar pores in the stalk. Widely distributed over the world. Osburn (1914: 185) recorded it for the Tortugas Islands, but otherwise it has not been noted for the West Indian region. Verrill (1900) recorded it from Bermuda as a new species under the name *B. timida*, and I have also seen the species from there. It ranges from Cape Cod to Santos, Brazil (Marcus 1938) on the Atlantic coast.

Class ECTOPROCTA Nitsche 1869

Nearly all the Bryozoa in all parts of the world belong in this class. The zooids are housed in a zoecial wall, which may be calcareous, chitinous, or gelatinous. The tentacles are attached to a lophophore and may be withdrawn into the zoecium by retractor muscles. The anal opening is situated outside of the tentacle ring.

Order GYMNOLOEMATA

Suborder CYCLOSTOMATA Busk 1852

The individuals are tubular with a circular aperture which is not closed by an opercular valve. All are calcareous and form colonies which may be encrusting or erect. Reproduction is accomplished by certain individuals, gonozooecia or ovicells, which are usually much expanded and provided with a special opening the oocciopore. Polyembryony occurs, a single embryo budding to form a large number of larvae.

KEY TO THE GENERA

1. Erect, or semi-erect branches 2.
- Entirely encrusting 9.
2. Flexible with horny joints 3.
- Rigid without joints 4.
3. Branches slender, of two series of zooecia *Crisia*, page 328.
- Branches flabellate, more than two series of zooecia ... *Crisulipora*, page 332.
4. Stem and branches rounded 5.
- Branches flattened, zooecia all on one (frontal) side 6.
5. Zoecial apertures on all sides of branch *Entalophora*, page 330.
- Apertures on frontal side only, oocia on dorsal side ... *Hornera*, page 334.
6. Zooecia irregularly arranged 7.
- Zooecia arranged in alternating series along stem 8.
7. Oocium on the frontal side among the tubules *Diaperocia*, page 331.
- Oocium on the dorsal side *Tervia*, page 333.

8. Dorsal side of stem with numerous pores [*Crisina*].*
Dorsal side without pores, oocidium a frontal inflation between the tubules
..... *Idmonca*, page 333.
9. Zoarium discoidal, oecium centrally located *Lichenopora*, page 334.
Zoarium lobate or linear 10.
10. Oocidium pyriform, in series with the tubules 11.
Oocidium expanded transversely to the tubules 12.
11. Zoarium of linear encrusting branches *Proboscina*, page 329.
Zoarium of flabellate encrusting branches *Oncousoecia*, page 329.
12. Oocidium spreads around zoecial tubules, small adventitious tubules among
the functional ones *Diplosolen*, page 333.
Oocidium lies between the tubules, disarranging them, no adventitious tubules
..... *Plagioecia*, page 330.

CRISIA Lamouroux 1912

Crisia elongata Milne Edwards 1838

Crisia eburnea form *denticulata* Smitt (1872) 4.
Crisia denticulata Osburn (1914) 185.—Canu & Bassler (1928) 156.
Crisia elongata Canu & Bassler (1928) 157.

This species has been given careful redescription by Harmer (1915: 96-102, pl. 8, figs. 1-8). Our material from Porto Rico seems to agree in every important detail.

The internodes are usually elongate, average about 14 to 16 tubules, but ranging from 6 to 30, slightly sinuated, and the joints of both branches and radicles are jet black, brownish in young parts of the colony. The gonozooid, or ovicell, is situated usually near the middle of an internode, short, suddenly and broadly inflated. The oeciopore, or opening of the ovicell, is a transverse slit and there is no development of a tubular oeciostome. The oecial characters agree closely with the figures given by Harmer (1915).

It is my belief that the determination of *C. elongata* disposes of the questionable occurrence of *C. denticulata* in West Indian waters. Certainly my own material from the Tortugas Islands, doubtfully recorded as *denticulata*, appears to be *elongata*. It will be noted that none of the specimens recorded by Smitt, Osburn, and Canu and Bassler as *denticulata* showed the ovicells, rendering positive identification practically impossible.

C. elongata occurs around the world in warmer waters. It was dredged at several of our Porto Rican stations off Guanica Harbor at 6 to 11 fathoms and is evidently well distributed in the West Indian region.

* Names in brackets not treated in this paper.

Crisia ramosa Harmer 1891

This species with colorless joints and long radicle internodes is easily distinguished by its round oeciopore situated in a flaring or trumpet-shaped oeciostome. The ovicell is pyriform, gently inflated from its base to its widest part near the top, which is rounded. Determined for only one locality, near Caribe Island, off the mouth of Guanica Harbor. It has not been previously recorded for the West Indian region, but Marcus (1937: 17) lists it for Brazil and the writer has specimens from the Bermuda Islands, and from Beaufort, North Carolina.

It seems probable that the "*Crisia* species" with white joints listed by Canu and Bassler (1928: 157) for the Gulf of Mexico is this species.

Family ONCOUSOECIIDAE Canu 1918

Linear or lobate encrusting colonies, the ovicell in line with the tubules, not greatly modified, the oeciopore either terminal or frontal.

ONCOUSOECIA Canu 1918

Oncousoecia arcuata Canu & Bassler 1928

The branches are long, somewhat arcuate; ovicell globular, as wide as the branches, oeciostome terminal. Recorded by Canu and Bassler (1928: 158) for the Florida Strait at 56 fathoms. Not taken at Porto Rico.

PROBOSCINA Audouin 1826

Proboscina robusta Canu & Bassler 1928

Long biserial branches which widen to 3 or 4 series of tubules before bifurcating. Tubes short and transversely striated. No ovicells observed. Canu and Bassler (1928: 157), north of Cuba at 143 fathoms. Not taken at Porto Rico.

Proboscina floridana (Canu & Bassler) 1928

Branches dichotomous, small, palmate; tubules cylindrical, transversely striate. Ovicell orbicular, with a small salient oeciostome at the center. Canu and Bassler (1928: 158, *Peristomoecia*), Florida Strait, 56 fathoms. Not taken at Porto Rico.

Family ENTALOPHORIDAE Reuss 1869

Zoarium consisting of rounded, erect, usually branching stems, with the tubules arranged on all sides.

Apparently there are two species of *Entalophora* among our material from Porto Rico, but their relationships to the species previously listed for the West Indian region appear to be problematical.

ENTALOPHORA Lamouroux 1821

Entalophora delicatula (Busk) 1875

PLATE 1, FIGURE 4

Entalophora deflexa Smitt (1872) 11.
Mecynocelia deflexa Canu & Bassler (1928) 160.
Entalophora delicatula Marcus (1937) 24.

Zoarium erect from a rather broad base which is attached to algae, stems of hydroids, or to other bryozoans; sparingly branched, often a single erect stem not much larger than the attached base. Ovicell located between the tubules near the somewhat enlarged end of the stem, or immediately below a bifurcation. In one case a similar ovicell was present on the encrusting base. The ovicell is not perforated by the tubules lateral to it, but it sometimes partially encloses a few of them. The oocciopore is a semilunate slit at the base of one of the tubules near the upper end of the ovicell.

Porto Rico, a number of specimens taken at Station 2377, between Ratones and Caribe Islands at 6 to 11 fathoms.

Entalophora proboscideoides Smitt 1872

A more slender species than the preceding. Not taken at Porto Rico. Smitt (1872: 11) described it from west of the Tortugas Islands at 68 fathoms.

Family PLAGIOECIIDAE Canu 1918

PLAGIOECIA Canu 1918

Plagioecia dispar Canu & Bassler 1928

Not taken at Porto Rico. Canu and Bassler (1928: 159), Straits of Florida at 56 fathoms. The species is distinct from the well-known *P. sarniensis* (Norman) in its very elongate ovicell which is remote from the margin.

Family DIAPEROECIIDAE Canu 1918

The oocelial cavity is traversed by zoecial tubules, the oocciostome non-terminal and not associated with a zoecial tubule, often turned forward or recurved.

KEY TO THE GENERA

1. Zoarium erect, without joints *Diaperoecia*, page 331.
2. Zoarium erect, with flexible joints *Crisulipora*, page 332.
3. Zoarium encrusting, with flabellate lobes, minute functionless tubules scattered among the normal ones *Diplosolen*, page 333.

DIAPEROECIA Canu 1918

Diaperoecia floridana NEW SPECIES

PLATE 1, FIGURE 3

Idmonea milneana Smitt (non D'Orbigny) (1872) 8. pl. 3, figs. 14-17.
Diaperoecia radicata Canu & Bassler (non Kirkpatrick) (1928) 160. pl. 31, figs. 3-5.

It appears that this species has never been properly named. Smitt (1872) misidentified it with *Idmonea milneana* D'Orbigny 1839. Canu and Bassler (1928) mistook it for *I. radicata* Kirkpatrick 1888, but later corrected the error (1929: 538-540) without renaming the species since their material was not satisfactory for close study.

The writer has some very fine specimens from the fishing bank off Beaufort, North Carolina, at 13 fathoms, some of them as much as 25 millimeters in height, much branched and in some cases the branches anastomosed. There is considerable variation in the width of the branches, ordinarily from 0.70 to 1.00 millimeters, often a little wider near a bifurcation and occasionally narrower branches occur. Five or six tubules, seven or eight near a bifurcation, make up the width of a branch; the free portions of the tubules have some tendency to occur in diagonal rows, and the lateral ones may be connate for a part of their length. The dorsal side of the branch is very definitely wrinkled transversely. The free portions of the tubules are about 0.40 millimeters long, somewhat wrinkled, slightly tapering, the orifice usually quite round.

The oocidium usually encloses several tubules and is irregular in outline, widest at about its middle part, measuring about 2.50 millimeters in length by about 0.90 millimeters in width. It is slightly wrinkled on the narrower basal part only and is quite smooth over most of its surface. The oocciostome is centrally located and recurved toward the base, its width about that of a tubule (0.16 to 0.20 millimeters), the oocciopore elliptical.

Strong unjointed radicle processes are developed from the dorsal side of the zoarium near the base for additional support.

In our Porto Rican collections this species is represented only by two small broken portions from Station 2341, off the mouth of Guanica Harbor, at a depth of 23 fathoms. Smitt recorded it from Florida (*I. milneana*) at 19 to 60 fathoms, and Canu and Bassler list it

(*D. radicata*) from the Gulf of Mexico and the Straits of Florida at 30 to 56 fathoms. The above description and the accompanying figure are taken from the fine specimens collected at Beaufort, North Carolina.

Diaperoecia rugosa NEW SPECIES

PLATE 1, FIGURES 1, 2

Zoarium erect, small, the largest specimen not over 10 millimeters long, basal attachment wanting, but dorsal unjointed radicle processes present; branched dichotomously, the branches varying from 0.30 to 0.40 millimeters in width, one to three (usually two) tubules in a series. The whole surface, frontal and dorsal sides of the branches, the free tubules, the entire oecial surface and the radicle processes, finely and evenly wrinkled transversely.

The free tubules are rather long, 0.30 to 0.60 millimeters, usually decreasing slightly in size toward the end, the aperture round, diameter of peristome 0.14 to 0.16 millimeters.

The oecium is considerably inflated and is traversed by one to several tubules (seven in one case). Each of my four specimens bears a single oecium, in two of them the oecium is near the bifurcation and is forked as in FIGURE 1, in the other two the oecium is situated farther down on the branch and is smaller and simpler as in FIGURE 2. In the simple oecia the oeciostome is centrally located, but in the forked oecia it is situated higher up near the bifurcation. In any case the tubule is turned forward and flared out widely like the bell of a trumpet. The tube at its base measures about 0.16 millimeters, but as much as 0.25 millimeters at the transversely elliptical opening.

The species appears to resemble *Idmonea pulcherrima* Kirkpatrick in several characters, but in that species Harmer (1915: 130) indicates a bulbous enlargement of the base of the oeciostome and does not mention nor figure the surface wrinkles so characteristic of the present species.

Four specimens from Station 2347, between Caya Caribe and Caya Parguera, off Guanica Harbor, Porto Rico, 5½ to 8 fathoms.

CRISULIPORA Robertson 1910

Crisulipora orientalis Canu & Bassler 1928

This erect, jointed species appears to have some of the characteristics of *Crisia* and *Tubulipora*, which the generic name suggests. The ovicell is traversed by the zoecial tubules, very definitely as

in the family Plagioeciidae. The flabellate branches may reach a height of 25 millimeters.

Porto Rico, off the mouth of Guanica Harbor at 8 fathoms, two small colonies. Canu and Bassler (1928: 162) described it from Egmont Key, Florida. It occurs as far north as Beaufort, North Carolina. Marcus (1937: 21) lists the Pacific species, *C. occidentalis* Robertson, for Santos Bay, Brazil.

DIPLOSOLEN Canu 1918

Diplosolen obelium (Johnston) 1938

The species is easily distinguished by the presence of minute zoecial tubules among the normal ones. The zoarium is flat and encrusting and the ovicell is traversed by the zoecial tubes.

Porto Rico, a couple of small colonies without ovicells dredged at 30 fathoms off Guanica Harbor. Canu and Bassler (1928: 161) record it north of Cuba at 143 fathoms. It has an extraordinary range.

Family *TUBULIPORIDAE* Johnston 1838

IDMONEA Lamouroux 1821

Idmonea atlantica var. *flexuosa* (Pourtales) 1867

Pourtales (1867: 111, *Idmonea flexuosa*), described the species from "off Havana in 270 fathoms." Smitt (1872: 6) gives a much more complete description of Pourtales material, but the species has not since been recorded from the West Indian region.

Family *TERVIIDAE* Canu & Bassler 1920

Characterized by the erect branching zoarium and the position of the ovicell on the dorsal side.

TERVIA Jullien 1882

Tervia pourtalesii (Smitt) 1872

Described by Smitt (1872: 9, *Filisparva*), Tortugas Islands at 60 fathoms. Not taken by any more recent collector.

Family *HORNERIDAE* Gregory 1899

Erect, tree-like, with rounded tapering branches, zoecial tubes opening on the frontal side, the ovicell globular on the dorsal side of the zoarium.

HORNERA Lamouroux 1921

Hornera galeata Smitt 1872

Not taken at Porto Rico. Smitt (1872: 10), Florida; Canu and Bassler (1928: 163), north of Cuba, 143 fathoms.

Family LICHENOPORIDAE Smitt 1866

The zoarium is discoidal on a centrally located and usually very short stalk by which it is attached. The zooecia all open on the frontal surface, usually but not always in series, connate or free, and there is usually a basal lamina extending somewhat beyond the tubules. The oecium is usually a single, irregularly shaped, centrally located inflation which may extend a short distance between the rows of tubules. The oeciostome differs in size and form from the tubules and may be near the center or at the edge of the inflation.

LICHENOPORA DeFrance 1823

KEY TO THE SPECIES

1. Zoarium raised, dome-shaped *L. floridana*, page 335.
Zoarium flat or only slightly raised..... 2.
2. Tubules closely connate in very regular uniserial series *L. radiata*, page 334.
Tubules not so arranged..... 3.
3. Tubules not in series, not at all connate *L. buski*, page 334.
Tubules in more or less regular series but not closely connate..... 4.
4. Tubules in rather regular rows, central portion of zoarium reticulate
..... *L. clypeiformis*, page 335.
Tubules less regularly disposed, strongly spinous at tips, center not reticulate
..... *L. hispida*, page 335.

Lichenopora radiata (Audouin) 1826

This well-known and widely distributed species occurred at Station 2377 between Rotones and Caribe Island, off Guanica, Porto Rico, two colonies with oecia at 6 to 11 fathoms. Among other West Indian species it is easily recognized by the regularly radiating rows of tubules which are closely connate in single series. Its occurrence in the West Indies has already been reported by Canu and Bassler (1928: 163) north of Cuba at 67 and 143 fathoms.

Lichenopora buski Harmer 1915

PLATE I, FIGURE 5

This species appears to be the commonest one in Porto Rican waters as it was taken in a number of places at 3 to 27 fathoms.

It was especially abundant at Station 2377 between Rotones and Caribe Islands, where about 50 colonies were taken, attached to algae and hydroid stems at 6 to 11 fathoms. The very irregular arrangement of the tubules which are not at all connate is characteristic. The ovicell is also more irregular than usual in this genus. In one specimen a second ovicell was acentrally placed among the lateral tubules. There is considerable difference in the size of colonies in reproduction, but my largest specimen measures only about 6 millimeters in diameter.

Canu and Bassler (1928: 163) record questionably a specimen of considerably larger size taken at 130 fathoms north of Cuba. This may represent a different species, though the isolation of the tubules and the nature of the central portion of the colony strongly suggest *buski*. Otherwise the species has not been noted for the Atlantic.

Lichenopora hispida (Fleming) 1829

This widely distributed species has been noted in the West Indian region only at Florida, Tortugas, and Biscayne Key, by Osburn (1914: 186). It is generally more northern in distribution though it is known from the Mediterranean Sea and the Madeira Islands.

Lichenopora floridana (Canu & Bassler) 1928

Domopora floridana Canu & Bassler (1928) 164. pl. 30, figs. 5, 6.

This species with the high, dome-shaped character of a *Domopora* is known only from the record of Canu and Bassler from the Gulf of Mexico at 30 fathoms.

Lichenopora clypeiformis (Smitt) 1872 (non D'Orbigny)

Smitt (1872: 12 pl. 4, fig. 31) records under the name *Discoporella clypeiformis* D'Orbigny a single specimen taken in Florida waters at 130 fathoms. Miss Jelly (Cat. Mar. Bry. 134) has removed it from D'Orbigny's species. As the specimen was young and without ovicell, it seems impossible of exact determination, but it appears to be distinct from any known West Indian species.

Suborder CTENOSTOMATA Busk 1853

Gelatinous or chitinous; encrusting, stolonate or erect; aperture closed by constriction of circular muscles; no operculum, no avicularia, no ovicells.

- Group A. CARNOSA Gray 1841. Encrusting. Not represented in Porto Rican collections.
- Group B. PALUDICELLEA Allman 1856. Creeping or stolonate; zoecia tubular, not constricted below, in many cases the zoecium extends into the stolon. No gizzard. Page 336.
- Group C. VESICULARINA Johnston 1847. Erect or recumbent branches arising from a stolon; the zoecia contracted below, usually in clusters. Gizzard present, circular. Page 338.
- Group D. STOLONIFERA Ehlers 1876. A creeping stolon, often with erect branches; zoecia attenuated at the base, a flattened membranous area often present on one side. Gizzard when present consisting of four lobes. Page 342.

Group B PALUDICELLEA

Family VICTORELLIDAE Hincks 1880

VICTORELLA Saville Kent 1870

Victorella sibogae Harmer 1915*

The members of this genus are usually in brackish water, but Harmer described the present one from the East Indies in pure ocean water and Marcus (1937: 129) records it from the Bay of Santos, Brazil. At Porto Rico it was dredged at Station 2367, in 13 fathoms, off the mouth of Guanica Harbor.

The zoarium consists of the elongated bases of the zoecia, from which arise at an angle the erect portions of the zoecia. The older zoecia are well chitinized, yellowish or horn colored. The erect part of the zoecium is circularly wrinkled in constriction. The zoecia are among the largest known among the Bryozoa; Harmer gives the total length as 1.3 to 3.1 millimeters, while Marcus found them as long as 5.0 millimeters, with the diameter ranging from 0.50 to 0.65 millimeters. The Porto Rican specimen comes within the lower range of Harmer's figures, varying from 1.50 to 2.00 millimeters in length, the breadth being about 0.40 millimeters. The number of tentacles is diagnostic, probably more than 20 according to both Harmer and Marcus. There are certainly at least that many in my specimen, but as it had become dried out before examination the exact number is impossible of determination. The size of the zoecia and the method of branching from the sides of the zoecia distinguish the species at once from any other.

* F. Braem has recently erected a new genus, *Sundanelia*, for this species (1939. Zeits. Morph. Ökol. Tiere 36(2): 267-278).

Family NOLELLIDAE Harmer 1915

NOLELLA Gosse 1855

The zoecia are tubular, elongate, with little variation in size from base to tip. The outer coat is somewhat gelatinous so that argillaceous particles adhere to stiffen the tubes and render them opaque. In one species, *gigantea*, the base of the tube is sharply arrested at the stolon, in the other, *dilatata*, the tube is continued downward into an expansion of the stolon.

Nolella gigantea (Busk)

The stolon creeps over shells, algae, and the stems of hydroids and of other bryozoans. The tubular zoecia, whitened in our specimens by the attachment of minute particles of coral mud, stand erect, often closely associated along the stolon, like a row of little white posts in a miniature stockade. In diameter they vary from about 0.13 to 0.20 millimeters; in height from 1.0 to 2.0 millimeters, or even to 3.0 millimeters in zoecia that have been lengthened by regeneration.

This widely distributed species is abundant in the West Indies and northward at least as far as Beaufort, North Carolina. In our Porto Rico collections it occurred at numerous stations, from low tide to 30 fathoms. Previously recorded at the Tortugas Islands by Osburn (1914: 219, *Cylindroecium*). Marcus (1937: 131) found it common as far south as the Bay of Santos, Brazil.

Nolella dilatata (Hincks) 1860

This species is much shorter than the preceding, averaging about 0.50 millimeters in height and is slightly barrel-shaped with a diameter of about 0.20 millimeters at the middle. Unlike *N. gigantea*, the base is expanded into the stolon where a number, 2 to 6, pointed lateral projections appear to act as "hold-fasts." The ectocyst is transversely wrinkled and like that of *gigantea*, becomes covered with mud particles.

Apparently cosmopolitan and found in cold as well as in warm seas. On the eastern American coast it has previously been recorded only by Marcus (1938: 53) at Santos Bay, Brazil. At Porto Rico it was noted at two stations (2335 and 2338) at the mouth of Guanica Harbor, 6 fathoms.

ANGUINELLA Van Beneden 1844

Very much like a branched *Nolella* with the zoecia budding from the sides of other zoecia instead of arising separately from the stolon.

Anguinella palmata Van Beneden 1844

The zoarium forms an irregularly branched colony usually about an inch in height. Hincks (1880: 539) gives the height "from 3 or 4 to 6 or 8 inches," but in the hundreds of colonies I have seen in American waters none have reached a height of more than 2 inches. Busk properly describes its appearance, "resembles a small *Pucus* covered with mud" and one would expect it to appear in the collections of the amateur algologist much oftener than those of the zoologist.

The zoococia average about 0.15 millimeters in diameter; in height varying greatly from 0.50 to 1.50 millimeters, the more elongate ones showing evidence of regeneration. The ectocyst is so thickly covered with mud as to completely obscure the internal structures.

Coasts of western Europe and the east coast of the Americas from Buzzards Bay, Massachusetts (Osburn 1912: 253) to Santos Bay, Brazil (Marcus 1937: 133). Tortugas Islands (Osburn 1914: 219) and Chesapeake Bay (1932: 444). At Porto Rico it occurred sparingly on the piles of docks in Guanica Harbor and on mangrove roots near the mouth of the harbor.

The species appears to thrive best in waters of reduced salinity. In the region about Beaufort, North Carolina, where it is excessively abundant, it reaches its best development in the enclosed harbors and sounds.

Group C VESICULARINA

Family VESICULARIIDAE Johnston 1838

KEY TO THE GENERA

1. Erect or trailing branched horny stems, with the zoococia arranged closely in groups which are spirally disposed about the internodes, two series of zoococia in each group *Amathia*, page 338.
2. Trailing slightly chitinized branching stems, zoococia irregularly disposed or in loose clusters, each zoococium sharply narrowed at base before its point of attachment *Bowerbankia*, page 341.
3. Soft, scarcely chitinized, branching stems, zoococia arranged in rows along both sides of the internodes, both stems and zoococia very transparent *Zoobotryon*, page 341.

AMATHIA Lamouroux 1812

The members of this genus may be recognized by the rather stiffly chitinized stems and the biserial, more or less spiral arrangement of the zoococia. The latter are more or less connate.

Amathia convoluta Lamouroux 1816

A. alternata Osburn (1932) 444.

A large, erect, branching, tree-like, horn-colored species, reaching a height of 100 to 150 millimeters, with the lower part of the stem strengthened by radicles. The spiral clusters of paired series of zoococia are conspicuous, occupying most of the internode, and make usually less than one complete turn about the stem. The spiral usually turns counter-clockwise, but occasionally even in the same colony some of the spirals are clockwise. There appears to be no order to this arrangement and no explanation is suggested.

The zoococia are somewhat chitinized, light brown in color in older specimens, closely connate to their tips, graduated in length from 0.55 or 0.60 millimeters at the lower part of the spiral to about 0.40 at the top. Zoococial width, 0.10 to 0.13 millimeters. Diameter of internodes varying from 0.25 to 0.40 millimeters.

Found in Australian and Malayan waters and along the eastern American coasts from Chesapeake Bay (Osburn 1932: 444) to the Bay of Santos (Marcus 1937: 136). At Porto Rico it was picked up on the beach at San Juan and dredged sparingly near the mouth of Guanica Harbor. I have found it washed ashore in great quantities on the outer beaches at Beaufort, North Carolina.

Amathia distans Busk 1886

Zoarium spreading among stems of various kinds, the internodes slender, 0.06 to 0.12 millimeters in diameter, straw-colored and more rigid than in most species of the genus, free of zoococia for often considerably more than the proximal half.

Zoococia rather short when contracted, 0.30 to 0.40 millimeters, closely connate except at the tip, the clusters forming an elongate spiral that sometimes completely surrounds the internode.

Porto Rico, Station 2377, between Rotones and Caribe Islands at 6 to 11 fathoms, several well developed colonies. Busk described the species from Bahia, Brazil. According to my material *distans* is readily distinguished from *brasiliensis* Busk by the much smaller and more rigid internodes and by the more closely connate arrangement of the zoococia, characters which are carefully pointed out by Busk in his descriptions.

Amathia brasiliensis Busk 1886

A. goodii Verrill (1901) 329.

The zoarium is an irregularly spreading, dichotomous, erect or recumbent colony, reaching a height of 25 to 50 millimeters. The in-

ternodes are rather long, varying considerably in diameter from 0.18 to 0.30 millimeters, transparent but moderately stiff. The spirals sometimes make a complete turn of the stem, but usually are much shorter. Sometimes they occupy most of an internode, but usually occupy one-half to two-thirds of the distance. The zooecia are only slightly connate and quite free from each other toward the distal end. They measure in length about 0.40 millimeters, and in width about 0.13 millimeters.

At Porto Rico it occurred near the mouth of Guanica Harbor and was at first almost unrecognizable even as a bryozoan from the deposit of coral mud. Busk (1886: 83) described the species from off Bahia, Brazil. It occurs at the Tortugas Islands (Osburn 1914: 219, ?*A. goodei* Verrill) and Dr. H. G. Richards has sent me a specimen from the Delaware Bay.

Verrill described *goodei* from Bermuda and I believe it to be the same as *brasiliensis* of which I have a specimen also from Bermuda, but I must confess that I do not understand Verrill's statement in regard to the zooids "in large dense, elongated clusters composed of several close rows." Hastings, 1927, questions the validity of *brasiliensis* Busk as a distinct species and Marcus (1937: 134) frankly places it in the synonymy of *distans*. With this I cannot agree, for while I find much variation in the diameter of the stems, they do not seem to intergrade and the zooecia are much less connate in *brasiliensis*.

Amathia vidovici (Heller) 1867

Vesicularia dichotoma n. sp. Verrill (1873) 404.
Amathia dichotoma Osburn (1912) 254.
Amathia vidovici Waters (1914) 848.

Zoarium semierect but not stiff, dichotomously branching in loose spreading form to the height of one or two inches. The internodes are transparent, rather long, usually one and a half to two millimeters, free of zooecia for more than half their length (occasionally a small cluster may appear lower down on the internode). There is considerable variation in the diameter of the internodes, 0.13 to 0.20 millimeters. The joints may be dark as Verrill indicated in his description of *dichotoma*, especially in old parts of the colony, but frequently there is no indication of this. The zooecia are of moderate size, about 0.40 millimeters 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 4 to 8 zooecia in each series.

A few colonies tangled among algae were taken on piles of the dock at Ensenada. The species occurs on the Atlantic coast from Cape Cod southward to the West Indies, in the Mediterranean and in the Indian Ocean.

BOWERBANKIA Farre 1837

Bowerbankia gracilis Leidy 1855

Zoarium a creeping stolon spreading over algae, hydroids and other bryozoans, occasionally with free branches. The zooecia are irregularly arranged along the stolon, occasionally more or less clustered, sometimes with a bilateral arrangement on two sides of the stolon but frequently in a single row or irregularly placed. In form the zooecia are roughly elongate-elliptical, rounded at the base where the attachment is narrowed to a short stalk and usually somewhat squared at the tip. The wall is transparent so that the intestinal tract and tentacles are visible. The gizzard is rounded, with numerous teeth. A finger-like projection is often present on the outer side of the rounded base, as in the *B. caudata* Hincks.

The measurements appear to be quite variable. Zooecial length, 0.65 to 1.20 millimeters; width, at the middle, 0.16 to 0.20 or more; width of gizzard, 0.09 to 0.12.

Marcus (1938: 56) has separated *gracilis* Leidy and *caudata* Hincks, from Santos, Brazil, partially on the basis of their measurements, but I am unable to make such distinctions in North Atlantic specimens. Material from Greenland and the West Indies and various points between seem to intergrade and to show considerable variation even in the same colony. The caudate appendage, on which Hincks based his species, is apparently variable (Harmer 1915: 70, has noted them also in *B. imbricata* Adams) and not of diagnostic value.

Dredged on various occasions in Guanica Harbor and along the southern coast of Porto Rico, but never as abundant as it appears to be farther north. It is a widely distributed species and on the eastern American coasts occurs from Greenland to as far south at least as the Bay of Santos, Brazil.

ZOOBOTRYON Ehrenberg 1831

Zoobotryon pellucidum Ehrenberg 1831

The zoarium branches irregularly, often trifurcate, and profusely. It is very soft and flaccid, with just enough rigidity to remain spread out in the water from the point of attachment. I have not observed

the stolon to creep on other objects, but the branches are frequently so interlaced with algae and other stems, as well as among each other, that they are difficult to separate. The internodes and zooecia are very transparent, but often obscured by coral mud or tinted greenish or reddish by the attachment of minute algae.

The zooecia are elongate-oval, narrowed at the point of attachment, characteristically arranged in bilateral fashion with one row on either side of the internode, but variations from this are common and occasionally the zooecia are irregularly clustered especially near the ends of the internode. In size the zooecia and internodes vary so much that measurements have little diagnostic value.

In the same colony the author has measured what appear to be fully developed zooecia ranging in length from 0.40 to 0.90 millimeters and in width from 0.18 to 0.30 millimeters. The gizzard when fully contracted measures about 0.08 millimeters, but when expanded is about twice that diameter. The internodes range in diameter from 0.30 to 1.10 millimeters, or even larger.

Apparently the species is circumtropical. On the eastern American coasts it is distributed from Bermuda and Florida throughout the West Indies and the Gulf of Mexico southward to Santos, Brazil. In our Porto Rican collections it was taken on the piles of docks at Ensenada, Parguera, and Ponce.

Group D STOLONIFERA Ehlers 1876

Family VALKERIIDAE Hincks 1877

VALKERIA Fleming 1823

Valkeria atlantica (Busk) 1886

The zoarium creeps over algae, shells, and stems of various kinds, with occasional branches free. The internodes are very slender (about 0.02 millimeters) and of varying length, noticeably enlarged at each end where they are separated by a definite diaphragm. Usually two branches appear at opposite sides of the end of an internode.

The zooecia are usually in pairs at the distal end of an internode, each attached to a very short joint which appears to be a vestigial internode. In form they are elliptical, narrowing rather gradually at the base into a short pedicel, the distal end usually somewhat squared. When contracted the body wall is often wrinkled transversely.

Zooecial length in various degrees of contraction, 0.30 to 0.60 millimeters or more; width, 0.07 to 0.09 millimeters; diameter of stolon, about 0.02 millimeters.

Busk (1886: 37, *Farrella atlantica*) first described the species from Bahia, Brazil. Harmer (1915: 73-76) gives an excellent discussion of material taken in the Siboga Expedition and compared with Busk's type. Taken in Porto Rico at the mouth of Guanica Harbor, 6 fathoms, trailing over a minute calcareous alga. The species is so inconspicuous as to be noted only by accident and it will probably be found to occur around the world in tropical waters.

Family BUSKIIDAE Hincks 1880

BUSKIA Alder 1856

The members of this genus have a creeping stolon from which free branches occasionally are given off. The zooecia have a flattened membranous area on one side, and the gizzard consists of four hemispherical lobes.

Buskia setigera Hincks 1877

The creeping stolon spreads over stems of various sorts.

The zooecia, usually attached in pairs at the distal end of an internode, are long ovate in form, transparent enough to show the four-lobed gizzard and other organs. The flattened membranous area occupies about two-thirds of the length of the ventral side. At the distal end are four small lobes from each of which projects a moderately long spine which is jointed at the base. At the proximal end are a pair of clasping processes and a caudate process. Zooecial length, 0.50 to 0.60 millimeters; width, about 0.18 millimeters; spines 0.20 to 0.30 millimeters.

Porto Rico, not common, occasional specimens on the stems of other bryozoans, hydroids, etc. Reported from Brazil at Santos Bay by Marcus (1937: 142).

This species is similar in most respects to *B. (Vesicularia) armata* Verrill (1873: 710), but lacks the yellowish color of that species. Also it possesses clasping processes near the base of the zooecia and usually a caudate process. The author has examined large numbers of *armata* without finding these structures. If they should be found to intergrade, Verrill's name will have preference.

Buskia nitens Alder 1856

This is a much smaller species than *B. setigera*, measuring only 0.35 to 0.40 millimeters in length. It has no distal spines and the proximal processes or spines for attachment are more numerous, usually three or four. The very slender stolon appears to be always

attached to the stem of a hydroid, other bryozoan, or alga, and the ventral surface of the zoecium is closely appressed to the substratum for about two-thirds of its length proximally.

The colonies are so small that they are found only in looking over other material. It was noted at a couple of stations near the mouth of Guanica Harbor, Porto Rico. Marcus (1938: 59) found it in the Bay of Santos, Brazil. It is apparently distributed around the world in warmer waters.

Suborder CHILOSTOMATA Busk 1852

The zoecia are usually more or less calcified and are provided with an operculum except in a very few cases. A considerable amount of polymorphism occurs in this order, and a number of different names have been applied to the various types,—autozoecia to the ordinary individuals, gonozoecia to modified reproductive ones, and kenozoecia and heterozoecia to those modified for other functions of the colony. Ooecia or ovicells are usually present, consisting of a calcified anterior chamber, as a rule externally placed on the base of the succeeding zoecium (hyperstomial ovicells), but sometimes protruding internally into the base of the succeeding zoecium (endozoecial). The calcified or chitinous lateral and distal walls between the zoecia are furnished with communication pores in various and often characteristic arrangement. Avicularia and vibracula, highly modified and reduced individuals of special function, occasionally resembling bird's heads in form, are found in most of the species and only in this order.

Levinsen (1909) distinguished two suborders, *Anasca* and *Ascophora*, on the basis of the absence or presence of a compensatorium—an internal sac which opens to the exterior for the regulation of water pressure as the polypide is protruded or withdrawn.

Infraorder ANASCA Levinsen 1909

Compensation sac wanting; frontal wall at least in part membranous; or if calcareous depressed and surrounded by a raised margin; or in some cases the membranous ectocyst covered by an arched, porous frontal shield or pericyst.

Levinsen distinguished three divisions,—*Malacostega*, *Coilostega*, and *Pseudostega*. Harmer (1926) separated off the family *Aeteidae* as division *Inovicellata*; reestablished the group *Cellularina* of Smitt as a separate division, and erected a further division, the *Cribri-*

morpha, to include the family *Cribrilinidae* and such species as appear to be somewhat intermediate between the *Anasca* and *Ascophora*.

Canu and Bassler (1927) have erected another suborder, *Hexapogona*, to include a few families in which the ancestrula, or primary individual of the colony, gives rise to 6 daughter zoecia instead of 5 which is the rule. This procedure has been rather severely criticized.

Division I INOVICELLATA Jullien 1888

In this division of the *Anasca* the zoarium is a creeping, stolon-like structure. At intervals along the stolon are swollen, spindle-shaped enlargements, from each of which rises an erect zoecial tube, with an operculum like a little trap door at the upper end. The zoecium evidently consists of both the erect tube and the basal enlargement, since the polypide extends downward into the latter. There are no avicularia, vibracula, nor permanent ovicells, though temporary membranous ovicells are present until the eggs have undergone at least the first few cell divisions. The division includes but one family and genus.

Family AETEIDAE Smitt 1867

AETEA Lamouroux 1812

KEY TO THE SPECIES

1. Zoecial tube coarsely wrinkled or corrugated.....*A. ligulata*, page 347.
Either very finely or not at all annulate..... 2.
2. Erect zoecial tube entirely without annulations.....*A. truncata*, page 346.
With very fine annulations..... 3.
3. Terminal expansion somewhat spoon-shaped and bent at an angle to the erect tube.....*A. anguina*, page 345.
Terminal expansion narrower, in line with the erect tube, basal expansion also finely annulated.....*A. recta*, page 346.

Aetea anguina (Linnaeus) 1758

PLATE 1, FIGURE 8

The stolonate portion of the zoarium is adnate to the stems of hydroids, algae, and other bryozoa, and occasionally to shells and pebbles. The erect stem is often bent or curved snake-like and the expanded terminal portion has somewhat the shape of a snake's head, and Ellis in 1755 named it the "snake coralline." The "head" appears to be finely punctate, the stalk finely annulated, and the basal swelling of the stolonate part is again more or less punctate in appearance. It should be noted that in reality there are no punctations, but instead

minute protuberances which, under transmitted light give the appearance of being punctures. A flat membranous area occupies one side of the "head" and at the upper end of this area is attached the operculum, which is also thickly "punctate." The "ovicells" rarely appear, though they have been observed by several writers and on one occasion I found them rather common at Woods Hole, Massachusetts, with embryos ranging from the 4-cell stage to ciliated larva ready for extrusion (Osburn 1912: 220). Levinsen (1909: 93) considers that these are not homologous with the ovicells of other chilostomes and suggests that it is merely the egg membrane. How it should remain attached, if this is true, is a question, and it may be that there is a thin maternal membrane surrounding the egg. At any rate it seems to disappear after the larva is discharged.

The species is practically cosmopolitan and it has been noted on the eastern coast of North America from Mt. Desert Island, Maine, southward. Duerden (1896. Jour. Inst. Jamaica 270) has noted its presence in Jamaica, but otherwise it has escaped notice in the West Indian region. In our Porto Rican collections it occurred at Stations 2335 and 2367, off Guanica Harbor, in 10 fathoms, and on mangrove roots in Guanica Harbor.

Aetea recta Hincks 1861

PLATE I, FIGURE 7

This species resembles *A. anguina* in its annulated and punctuated areas, but the erect portion is straighter, the "head" longer and narrower and the operculum is set more transversely across the end of the zoecial tube. Furthermore the punctuations of the swollen basal tube are so distributed as to give the effect of annulation. *A. recta* has sometimes been considered only a form of *anguina*, but the writer must agree with Harmer (1926: 195) that this "seems to be improbable."

In his earlier papers (1914: 186. 1927: 124) the author listed this species as *Aetea sica* (Couch) from the Tortugas Islands, Florida, and from Curaçao. It is very widely distributed, but has been noted on the American side of the Atlantic only at the localities given above. In our Porto Rican collections it occurred at Stations 2363 and 2367, off Guanica Harbor, in 5 to 10 fathoms, on coralline algae.

Aetea truncata (Landsborough) 1852

PLATE I, FIGURE 6

This species is easily distinguished from the other members of the genus by its straight erect tubule, the narrow "head" which is

truncated at its tip, and especially by the entire absence of any annulation. The whole surface is finely "punctate."

Like the other members of the genus mentioned it has a wide distribution, and on the American coast has been noted at Canso, Nova Scotia (Cornish 1907: 75) and at the Tortugas Islands, Florida (Osburn 1914: 186). In the Porto Rico collections it occurred at Station 2363, growing on coralline algae at 10 fathoms.

Aetea ligulata Busk 1852

PLATE I, FIGURES 9, 10, 11

Aetea ligulata Busk (1852) 30. pl. 42, fig. 2.—Marcus (1837) 30. pl. 4, fig. 10; (1938) 12.

Aetea fuegensis n. sp. Jullien (1888) 1: 24. pl. 7, fig. 7.

Aetea crosslandi n. sp. Waters (1910) 253. pl. 24, fig. 8.

One outstanding character readily distinguishes this species from others in the genus, the stalk or erect portion below the membranous area is coarsely wrinkled or corrugated in a manner suggesting that seen in hydroid stems. It is quite a different type of "annulation" from that seen in the stalks of *anguina* and *recta*. The expansion of the stolon is also occasionally wrinkled but not so regularly as in the stalk. The whole surface is finely "punctate." The head or terminal portion containing the membranous area is about in line with the stalk and the operculum is semiterminal. In some specimens there is a slight groove or constriction at the junction of the head and stalk, but this does not seem to be a consistent character. The length of the erect stalk varies greatly, but is usually from two to three times the length of the head, extremes one to four times.

Occasionally there is a distinct distal extension of the head beyond the primary operculum, exactly as shown by Jullien (1888. pl. 7, fig. 7) for his *A. fuegensis*. This must be due to a polypide regeneration as a new aperture with an additional operculum is present at the tip of the extension. The old and new opercula are both shown in FIGURES 10 and 11. Jullien did not quite understand the nature of this structure for he states that it is prolonged beyond the operculum which then becomes lateral and not terminal, so he must have failed to observe the secondary terminal operculum. I have also a specimen of *A. recta* from the Tortugas Islands which shows a similar extension.

Described by Busk from Patagonia and Straits of Magellan; Jullien's *A. fuegensis*, Bay of Orange, Terra del Fuego; Waters' *A. crosslandi*, Khor Donogab, Red Sea; Marcus lists *A. ligulata* from

the Bay of Santos, Brazil. At Porto Rico it occurred in two of our dredgings off the mouth of Guanica Harbor (Stations 2362 and 2363), at 18 and 20 fathoms, attached to sponge and calcareous algae. There is also in my collection a specimen from Magdalena Bay, Lower California, at 13 fathoms. Canu and Bassler's (1928: 51, pl. 1, fig. 2) identification of *A. sica* as *recta* from east of Georgia, U. S. A., may be at fault. The wrinkling of the basal expansion shown in the figure certainly suggests *ligulata*. Apparently the species has a very wide range in shallow water.

Division II MALACOSTEGA Levinsen 1909

This group consists chiefly of the large and rather diversified series of forms which were formerly known as Membraniporas, together with some others of primitive structure. The writer must agree with Harmer (1926: 187) and Canu and Bassler (1929: 57) in excluding the family Acteidae to constitute a separate division. The membranipores have given the taxonomist no little difficulty. Harmer (1926: 187) uses Membraniporidae as a superfamily, "which further study is likely to divide into a series of families." Canu and Bassler (1929: 26-27) have resurrected the family Electriniidae of d'Orbigny and have erected the two new families Hincksiniidae and Alderiniidae. Further study will no doubt result in other emendations, but the writer has found this arrangement useful and it will be followed in the present paper.

KEY TO THE FAMILIES

1. Ovicells wanting 2.
- Ovicells present 3.
2. No spines, zooecia rectangular on the dorsal side
 MEMBRANIPORIDAE, page 348.
- No avicularia; spines or tubercles present.....ELECTRINIDAE, page 354.
3. Ovicells hyperstomial.....ALDERINIDAE, page 359.
- Ovicells endozooecial..... 4.
4. Erect with flat flexible branches, little calcification.....[FLUSTRIDAE].
- Encrusting, well calcified, no dietellae.....HINCKSINIDAE, page 356.

Family MEMBRANIPORIDAE Busk 1854

Membraniporae without ovicells or spines; dietellae (pore chambers) also lacking and the dorsal outlines of the zooecia are usually more or less rectangular. The family is sufficiently discussed by Canu and Bassler (1929: 62, Biflustridae).

KEY TO THE GENERA

1. Zoarium encrusting or erect and bilaminar, without joints..... 2.
- Zoarium erect, jointed, zooecia in four series.....*Quadricellaria*, page 354.
2. Zoarium free in the form of a miniature cup or saucer, long vibracula present
 *Cupuladria*, page 354.
- Zoarium attached, not cupuliform..... 3.
3. Zooecia with denticles around the proximal border of the membranous aperture
 *Acanthodesia*, page 352.
- Aperture without denticles or serrations..... 4.
4. Zooecia elongate quadrangular, with tubercles at the distal corners
 *Membranipora*, page 349.
- Zooecia usually with one or two triangular or rounded small openings covered
 with membrane on the basal corners.....*Conopeum*, page 350.

MEMBRANIPORA Blainville 1830

Membranipores of the *membranacea* group. Gymnocyst slightly developed, often with a pair of tubercles. The opesium or aperture occupies nearly all of the frontal surface. Avicularia, dietellae (pore chambers), and ovicells wanting.

Membranipora membranacea (Linnaeus) 1766

Zoarium encrusting, the zooecia usually very regularly quadrate, with thin walls, occasionally with erect tubercles at the distal corners. This species appears to be almost universally distributed but seems not to be common in North American waters. It appeared only once in our Porto Rican collections, at Station 2364 in Guanica Harbor. Osburn (1914: 193) recorded it from the Tortugas Islands.

Membranipora tuberculata (Bosc) 1802

Zoarium encrusting algae, especially the floating *Sargassum*. It is almost the only bryozoan found on the *Sargassum*, which it encrusts in large numbers with a white lacc-like network. The zooecia are moderately large, elongate-quadrangular, the opesium occupying nearly the whole front, the narrow proximal cryptocyst bearing a pair of short heavy tubercles which sometimes coalesce in the midline and which appear to belong to the zoecium proximal to them.

It is a circumtropical species, and in the North Atlantic occurs northward to about the fiftieth parallel. In the West Indian region it has been recorded from the Tortugas Islands, the Strait of Florida, and the island of Curaçao. About Porto Rico it is found wherever the *Sargassum* drifts. Marcus (1937: 33) records it from Santos Bay, Brazil, and gives an excellent discussion and synonymy.

CONOPEUM Norman 1903

The general characters of this genus are well established and mark it as one of the simplest of the membranipores. There are no ovicells, no avicularia, and no dietellae (pore chambers). Spines also are usually wanting on the mural rim, though they may occur occasionally as figured by Barroso (1923: 3-4), and short heavy tubercular processes may appear on the base of the zooecia.

"Interopesia spaces," usually triangular and with special walls are usually present, and though this character has frequently been discussed there still seems to be room for controversy. Levinsen (1909: 144 footnote) refers to "small triangular hollows (kenozoecia) between the zooecia." Canu and Bassler (1920: 86) find that "the hollows of the surface are not interzoecial, as Levinsen has described them, but are only interopesia; they are not deep and are situated between the mural rims; rarely they contain an avicularium." Harmer (1926: 211) also seems to accept the latter view, "Gymnocyct frequently with a pair of triangular depressions, which, like the gymnocyct, may be wanting."

On this basis one of two things is certain; either there is much variation in the development of these structures, or else more than one species is involved. Another interpretation is still possible, however, as there may be two different characters concerned. There can be no doubt that in my specimens from Florida and Porto Rico the "triangular spaces," sometimes abundantly developed, sometimes rare, are developed upon the gymnocyct and are therefore merely interopesia. In the same colony there may be other, usually more rounded or ovate, cavities which do go right down to the dorsal side of the zooecia and which are certainly interzoecial. Probably these are the ones to which Canu and Bassler refer as "rarely containing an avicularium." The author has examined a great many of these and has often thought that he has found an avicularium, but upon careful examination with higher power has never been able to detect a mandible. All such spaces appear to be covered by an imperforate and slightly chitinized membrane. Secondary calcification appears within these interzoecial chambers, partially closing them in older colonies, but the author has never observed them to be completely closed and raised in the form of rounded tuberosities, as may be the case with the triangular interopesia spaces.

Conopeum reticulum (Linnaeus) 1767

PLATE 2, FIGURES 14, 15

? *Membranipora lacroixii* (Audouin) Osburn (1914) 193, Tortugas Islands. See Harmer (1926) 211 for general synonymy of *C. reticulum* = *Membranipora lacroixii* n. sp. (non Audouin).

Zoarium encrusting, yellowish-white in color, on shells, coral-lines, etc. Zooecia separated by a distinct groove, the walls rather high, with a narrow but heavily calcified cryptocyst which descends rapidly into the opesia area and which is thickly tuberculated all around the opesia, broader proximally. The opesia is typically rather regularly oval, the narrower end distal. Triangular spaces with separate walls often appear at the base of the zooecia, situated on the gymnocyct. Typically there are a pair of these, but the number varies and they may be so rare as to be scarcely discoverable on certain colonies. In addition to these there are usually some irregularly rounded spaces which are interzoecial in nature. These are usually scattered, but sometimes appear at the base of nearly every zooecium and occasionally they are paired. They vary much in size and appearance and sometimes resemble avicularian chambers but I have never been able to detect an avicularian mandible. They are different structures from the triangular spaces as they are continued downward to the dorsal side of the colony, while the triangular spaces are above the gymnocyct. Harmer has homologized the triangular spaces with the paired tubercles of *Nitscheina* (*Nichtina*) and this may be the correct interpretation, since they not infrequently develop into heavy rounded or triangular knobs. The interzoecial spaces, on the other hand are certainly kenozoecia.

Barroso (1923. figs. 3, 4) has figured his *Conopeum lacroixii* with occasional mural spines. I have never been able to detect any spines in American material. Neither is the cryptocyst of my specimens porous as he shows it in his figure 4, and the operculum in my material is more evenly rounded. It is possible that he is dealing with another species, ? *C. lacroixii* Audouin.

There has undoubtedly been the greatest confusion about this species. The *Bifustra lacroixii* of Smitt (1872: 18. pl. 4, figs. 85-88) may in part refer to this species since he says in regard to one colony at least, "At the corners of the zooecia sometimes a triangular (through its calcification a little raised) space is left," which seems clearly to indicate *C. reticulum*. His figure 87 may possibly be of this species, but certainly figures 85, 86, and 88 are of a different species. Osburn (1914: 193) questionably recorded *Membranipora*

lacroixii from the Tortugas Islands, Florida. This identification, with the name corrected, is now substantiated. No other authors appear to have recorded the species from the American coast, but Canu and Bassler (1920: 89) list it for Mississippi and South Carolina in the early Tertiary.

In Porto Rican waters the species appears to be well distributed but nowhere very abundant. It occurred, chiefly on dead shells, at a number of stations off Guanica Harbor.

Conopeum tubigerum NEW SPECIES

PLATE 2, FIGURES 12, 13

Characterized by erect flaring tubes developed on the basal gymnocyst at the proximal corners of the zooecia. These arise from triangular areas, similar to those which appear on *C. reticulum*, but become tubular, expand as they rise to the height of 0.05 to 0.10 millimeters, and when fully developed may have a more or less stellate border. The aperture of the tube is closed by a delicate membrane.

Zoarium encrusting, or occasionally erect and bilaminar. Zooecia moderate in size, about 0.40 to 0.50 millimeters long by 0.18 to 0.20 millimeters wide; rather regular in form; moderately calcified, the opesia large and elliptical, the mural rim and the opesial border finely crenulated. In older zooecia the cryptocyst may be developed beyond the gymnocyst.

One colony dredged in Guanica Harbor at 3 fathoms. I have specimens also from Captive Island, Florida, and the erect bilaminar specimens from Port Lavaca, Texas.

ACANTHODESIA Canu & Bassler 1920

Acanthodesia savartii (Audouin) 1826

PLATE 2, FIGURES 16, 17

The zoarium is encrusting on pebbles, shells, and coralline alga; or erect and branching, unjointed and bilaminar. The zooecia are rather large, regularly disposed in lines and the basal part is somewhat bridged over leaving a regularly elliptical membranous area. A small serrated denticle projects forward slightly into the opening from the middle of the base of the area. There are no oecia or avicularia.

Widely distributed in all warmer oceans. Florida, 29 fathoms, (Smitt); Tortugas Islands, 10 fathoms (Osburn); Gulf of Mexico

27 and 30 fathoms (Canu & Bassler). Porto Rico, dredged by the author in 20 meters off Guanica Harbor at Station 2347.

Acanthodesia tenuis (Desor) 1848

PLATE 3, FIGURES 22 TO 30

Membranipora tenuis Desor (1848) 66.—Verrill & Smith (1874) 712.—Osburn (1912) 231.

Bifustra denticulata Smitt (1873) 19.

Membranipora danica Levisen (1894) 53.

Membranipora denticulata Levisen (1900) 144.

Hemiseptella grandicella and *H. tuberosa* Canu & Bassler (1923) 71.

Hemiseptella denticulata Canu & Bassler (1928) 62.

Hemiseptella hexagonalis Canu & Bassler (1928) 63.

Hemiseptella africana Canu & Bassler (1930) 29.

Acanthodesia tenuis Marcus (1937) 42.

Zoarium encrusting, sometimes several layers in thickness. Zooecia irregularly quadrangular to hexagonal, closely adjacent but distinct, separated by a narrow groove in which a brown line sometimes appears; mural rim complete, tuberculated; sometimes large rounded tubercles at the anterior corners; cryptocyst depressed, finely tuberculated, extending forward along the sides of the opesia, its free border nearly up to the operculum beset with spinules projecting laterally into the opesial membrane. These spinules may be straight or curved and occasionally are branched. Smitt (1873: 19) described the cryptocyst "with white pores," though these are absent, and the writer (1912: 231 under *Membranipora tenuis*) mistook the tubercles under transmitted light for punctures. Opesia oval, asymmetrical, large, sometimes occupying most of the front, but usually only about half of it in full calcification.

Canu and Bassler (1928: 62) included this species in *Hemiseptella* "because of the presence of opesial spicules, but we have not seen the trace of opesial muscles on the cryptocyst." The writer has examined hundreds of specimens without finding any evidence of opesial muscles or their attachments, so must agree with Marcus (1937: 42) in placing the species in *Acanthodesia*.

The size is extremely variable, zooecial length in the same colony ranging from 0.40 to 0.66 millimeters, and zooecial width 0.18 to 0.30 millimeters. The form also varies in different parts of a colony, from elongate and quadrangular to short and quadrangular or more or less hexagonal. Occasionally the zoarium may rise in bilaminar folds.

Porto Rico, off the mouth of Guanica Harbor at 20 fathoms. Smitt (1873: 19, *Bifustra denticulata*), Florida, 10 fathoms; Canu and Bassler (1928: 62, *Hemiseptella denticulata*) Punta Rosa, Florida. The species ranges northward to Cape Cod where it is

very abundant, southward to the Bay of Santos, Brazil, and occurs in Denmark, and on the west coast of Africa.

CUPULADRIA Canu & Bassler 1920

This genus was separated out of the old *Cupularia* complex of Lamouroux to include certain species which have neither cryptocyst nor opesiules and which, therefore, do not belong even in the same division with the true cupularias.

Cupuladria canariensis (Busk) 1859

The free, saucer or cup-shaped zoarium, 10 to 20 millimeters in diameter, consists of a single layer of zooecia. The convex side is ventral and each zooecium has a strong curved brownish vibraculum at its distal end. The concave dorsal side is usually free and clean of any attached organisms, but a small species of bryozoan, *Beania cupulariensis* Osburn, often grows attached in the concavity. Canu and Bassler (1929: 73) give an analysis of this and related species with which it has been confused.

Very widely distributed in warmer waters. Florida, 10 to 44 fathoms (Smitt); Tortugas Islands, abundant at 10 fathoms (Osburn); Gulf of Mexico, Strait of Florida, and Atlantic Ocean south of Miami, Florida, 30 to 56 fathoms (Canu and Bassler). In our Porto Rican collections the species was represented by only three colonies, dredged at 20 meters off the mouth of Guanica Harbor.

QUADRICELLARIA D'Orbigny 1851

Zoarium erect and jointed. Zooecia membraniporoid, in four series of which two are narrower, facing four ways, placed back to back. No ovicell.

Quadricella caraibica Canu & Bassler 1928

Not taken at Porto Rico. Described by Canu and Bassler from the Caribbean Sea, east of Jamaica at 52 fathoms.

Family *ELECTRINIDAE* D'Orbigny 1851

Primitive membranipores with an intertentacular organ and in which the larva is a Cyphonautes. No avicularia, no dietellae, no ovicell. Spines or tubercles on the opesial border or at the anterior zooecial angles.

ELECTRA Lamouroux 1816

Proximal portion covered by a gymnocyst, distal to which is the rather large oval or elliptical opesium. The mural rim is beset with

spines (at least two anterior), and a stronger spine, variously developed in the middle just proximal to the opesium. No avicularia, dietellae or ovicells.

Electra bellula (Hincks) 1881

In its characteristic form the zoarium encrusts algae especially, thin and delicate, branching in series of several zooecia. The zooecia are thin-walled, almost transparent in younger stages, never heavily calcified. The mural rim is thin and is surrounded typically by three spines, two of which appear to be always present opposite the operculum. The characteristic large proximal spine, which is bent down over the frontal membrane, is ternately dichotomous, antler-like, with 8 points when fully developed; it varies greatly and may be reduced to a short thick spine without branches, or it may be double as in the nominal variety *bicornis* Hincks. All of these variations may occur in the same colony.

Outside of Guanica Harbor at 3 to 6 fathoms.

Electra bellula NEW VAR. *ramosa*

PLATE 2, FIGURES 20, 21

A variety so different in appearance that it was at first supposed to be another species occurred abundantly on piles at Guayanilla. It grows erect and branching to a height of nearly a centimeter, with joints at the bases of the branches. Two spines are present opposite the operculum; and a large median pointed spine is directed forward over the area, occasionally this spine is bifid. The colony begins as an incrustation, extends among the branches of small algae or hydroids, and then becomes independent of support. It gives off free branches which are jointed at the base. The branches begin with two zooecia placed back to back, one extending somewhat farther than the other, and these are usually followed by four in the next series. When a rounded branch grows into contact with a flat surface it at once takes the form of the substratum and becomes encrusting; it changes character remarkably, the zooecia are shorter and broader and the spines almost disappear, while the cryptocyst becomes extended as in the normal variety. In none of the encrusting phases have I observed branching of the large spine characteristic of the typical *bellula*. Marcus (1937: 37) has given an excellent account and figured it satisfactorily. For convenience in dealing with it, I believe that it should be named and propose the varietal name *ramosa*.

The colonies taken in open water were all smaller, with smaller zoecia and showed no evidence of erect branches. All showed the cervicorn spine and were more delicate than those found on the piles of wharves.

Electra tenella (Hincks) 1880

A pair of short, blunt erect spines on the basal gymnocyst, remote from the opesial border, sometimes with three or four spines on each side of the aperture and bending over it.

Hincks described the species from Florida. Marcus (1937: 38) has recovered it at Santos Bay, Brazil, and gives an excellent discussion. It was not found at Porto Rico.

Family HINCKSINIDAE Canu & Bassler 1927

Membranipores with endozoecial ovicell. Dietellae, spines, avicularia and vibracula may be present.

KEY TO THE GENERA

1. No spines, no avicularia, no dietellae..... *Aplousina*, page 357.
 One or more of these present 2.
 2. Mural rim beaded with spines 2.
 No such spines 3.
 Mural rim beaded with spines 4.
 No such spines 5.
 A pair of pointed avicularia directed toward each other at the distal end of the aperture..... *Antropora*, page 359.

HINCKSINA Norman 1903

Zoecia encrusting, entire area membranous, mural rim surrounded by numerous spines. Ovicell endozoecial, small, short and little raised. Avicularia interzoecial, no dietellae.

Hincksina periporosa Canu & Bassler 1928

PLATE 2, FIGURES 18, 19

Zoarium encrusting. Zoecia oval, distinct, separated by deep furrows, surrounded by a line of interjunctural pores. Gymnocyst small, convex; mural rim very thin and bearing 12 to 18 spicules. Opesium has the form of the zoecium. Ovicell endozoecial, very small, a little convex, transverse. Pyriform zoeciules between the zoecia, sporadic with rounded avicularia.

Porto Rico, dredged at 20 fathoms off Guanica Harbor. Canu and Bassler (1928: 22), Gulf of Mexico, Florida Straits, and north

of Cuba at 30 to 201 fathoms. I have a specimen from Bermuda taken at 2 fathoms.

APLOUSINA Canu & Bassler 1927

Simple appearing membranipores with no spines, avicularia or dietellae (communication pores).

? *Aplousina gigantea* Canu & Bassler 1927

PLATE 3, FIGURE 31

Zoarium encrusting. Zoecia very large, not distinctly separated from each other; mural rim very thin; opercular valve removed from the distal border. Ovicell very small, transverse.

Zoecial length, 0.84 to 0.90 millimeters; width, 0.60 to 0.65 millimeters.

One small specimen near the mouth of Guanica Harbor at 5 fathoms. Canu and Bassler (1928: 20), Gulf of Mexico and Straits of Florida, 30 to 56 fathoms.

The Porto Rican specimen appears to be somewhat intermediate between this species and *A. tuberosa*. It has the thicker granulated mural rim of *tuberosa* and like that species the zoecia are distinct, but tubercles are lacking and the size equals that of *gigantea*. The

Aplousina tuberosa Canu & Bassler 1928

Zoecium encrusting shells, serpulae, and especially *Steganoporella magnilabris*. Zoocia large, distinct, separated by a furrow, elliptical; proximal gymnocyst very small. Mural rim very thin, flat, granular, with smooth termen; opesium very large and of the form of the zoecium. Ovicell very small, transverse, little convex, always accompanied by two lateral tuberosities.

Zoecial length, 0.60 millimeters; width, 0.40 millimeters.

Not found in Porto Rican collections. Canu and Bassler list it from north of Cuba, east of Yucatan, Gulf of Mexico, and Straits of Florida, 24 to 78 fathoms.

CANUA Davis 1934

Membrendoecium Canu & Bassler (1917) wrongly founded on *Amphiblestrum papillatum* Busk.

The ovicell is endozoecial; avicularia small, simple and interzoecial; dietellae present; no spines.

KEY TO THE SPECIES

1. Avicularia oval, with bluntly pointed or rounded mandible....*C. compressum*
- Avicularia long, very narrow, acuminate..... 2.
2. Mural rim thick.....*C. strictirostris*.
- Mural rim thin.....*C. typica*.

Canua (Membrendoecium) compressum (Osburn) 1927

Zoarium encrusting corals and shells, light yellow to brownish in color and often several layers in thickness. Zooecia well calcified, especially in older stages; distinct, separated by a deep groove, though often they are closely compressed against each other. The mural rim is raised and rather smooth, but the descending cryptocyst has progressively larger granulations toward the inner border, which appears finely crenulate. Aperture pyriform or irregularly ovoid, widening rather suddenly just posterior to the operculum. Posterior to the aperture the gymnocyst is somewhat inflated in the midline. The small oval avicularium, with a bluntly triangular or round mandible is interzooecial, though often appearing as if placed upon the proximal portion of the gymnocyst.

Zooecial length, 0.30-0.40 millimeters; width, 0.20-0.30 millimeters.

Described from the island of Curaçao (Osburn 1927: 124). In our Porto Rican collections it occurred at only one station, 2347, between Caya Caribe and Caya Parguera, at 5 to 8 fathoms, where a number of colonies were taken on shells.

Canua (Membrendoecium) strictirostris (Canu & Bassler) 1928

Zoarium encrusting. Zooecia distinct, separated by deep furrows, a little elongated, oval, ornamented frequently by a convex gymnocyst. Opesium oval, mural rim thick, bevelled, enlarged at the base. Ovicell small, endozooecial, convex, transverse. Avicularium in the interzooecial angles, small, long, very narrow, acuminate.

Zooecial length, 0.45 to 0.60 millimeters; width, 0.30 to 0.40 millimeters.

This species differs from *C. compressum* (Osburn) especially in the form of the avicularia, and also in the larger size and the smoother opesial margins. It would seem to be a deeper water species. It has not occurred in our Porto Rican material, but Canu and Bassler described it from north of Cuba at 143 fathoms.

Canua typica (Canu & Bassler) 1928

Dacryonella typica Canu & Bassler (1928) 57.

Not found at Porto Rico. Recorded by Canu and Bassler north of Cuba, 130 to 167 fathoms, and from the Pliocene of Panama.

The species shows such resemblances to *Canua (Membrendoecium)* that I believe it should be placed here.

CAULORAMPHUS Norman 1903

Zoarium encrusting. Zooecia with high lateral walls which are beset with numerous spines among which are two pedicellate avicularia.

Cauloramphus opertus Canu & Bassler 1928

A peculiar species for this genus in that the mural spines are reflected over the membranous area, while four distal spines are elongate and jointed at the base. Not taken at Porto Rico. Canu and Bassler (1928: 35), Gulf of Mexico, 30 fathoms.

ANTROPORA Norman 1903

This genus is characterized especially by the presence of a pair of pointed avicularia immediately distal to the aperture, set transversely with their points nearly touching. Ovicell endozooecial, but fairly well developed.

Antropora granulifera (Hincks) 1880

Zoarium encrusting. Zooecia distinct, mural rim rather thin, cryptocyst broad, especially proximally, descending, coarsely granulated. Opesia triangular with rounded corners. The avicularia are slightly curved to conform to the distal border and the opercular valve opens partially between them.

Rare, one colony taken near Caribe Island at 8 fathoms. I have also a specimen taken at Bermuda in shallow water. The species has not hitherto been noted for the American side of the Atlantic.

Family ALDERINIDAE Canu & Bassler 1927

Membranipores with hyperstomial ovicell.

KEY TO THE GENERA

1. Zooecia in single series, separated by filiform zooeciules *Marssonopora*, page 365.
- Zoarium multiseriate..... 2.
2. No avicularia, no spines..... *Alderina*, page 362.
- Avicularia present..... 3.
3. Cryptocyst very broad, opesial area reduced..... *Amphiblestrum*, page 364.
- Cryptocyst narrower, opesial area much larger..... 4.
4. One to many spines, ovicell usually with rib..... *Callopora*, page 364.
- Spines wanting or vestigial..... 5.

5. Avicularian mandible flagellate or acicular 6.
Avicularian mandible broader..... 7.
6. Avicularium transverse at end of zooecium.....*Cranosina*, page 363.
Avicularia not transverse, in line with zooecia.....*Copidozoum*, page 364.
7. Avicularium independent, its walls heavy.....*Crassimarginatella*, page 363.
Avicularium always associated with a kenozoecium.....*Parellisina*, page 360.

PARELLISINA NEW GENUS

Resembling *Ellisina* Norman 1903, but with vicarious avicularia associated with vestigial zooecia or kenozoecia, which are represented in surface view by membranous areas of varying size and shape without operculum. Spines vestigial.

Genotype.—*Membranipora curvirostris* Hincks 1862.

In addition to the genotype and the new species herein described the following species appear to belong to this group: *Membranipora falcata* MacGillivray 1869 (*M. permunita* Hincks 1881), *M. albida* Hincks 1880, *Callopora tenuissima* Canu & Bassler 1928, and *Callopora subalbida* Canu & Bassler 1929 (*M. curvirostris* var. Waters 1898).

The nature of the structure associated with the avicularium in *curvirostris* and distal to it has been in question for many years. Waters (1898: 684) suggests that "perhaps they must be considered as aborted zooecia." Harmer (1926: 228) thinks that it may be a kenozoecium or a part of the avicularium itself but favors the former view. Canu and Bassler (1928: 32-33) offer the suggestion that it may be "the unoccupied portion of an ordinary zooecium but regenerated by a falciform avicularium." Miss Hastings (1930: 711-713) appears to have cleared up the matter by a careful study in which she finds that the avicularium and distal chamber are distinct structures, separated by a wall, and interprets the chamber as a kenozoecium or aborted zooecium. With this interpretation the author finds himself in full agreement after the examination of both *curvirostris* and the new species, *latirostris*. The latter is especially convincing as the combined avicularium and chamber are occasionally as large as an ordinary zooecium and appear to take the place of it in the series, often without any disarrangement of the zooecia. There is no internal evidence of regeneration. Often the kenozoecium is much smaller than this, though always larger than the avicularian chamber, and both extend dorsally to the general level of the dorsal wall of the zoarium. In the new species the

falcata, *curvirostris*, and *albida* have the mandible curved strongly. In *subalbida* and *tenuissima* they are straight or less curved, and in the new species, *latirostris*, they are short spatulate. There is also much variation in the size of the avicularium as well as of the kenozoecium in the various species. A delicate mural rim may be present on the kenozoecium.

I believe that the presence of the peculiar "distal chamber" or kenozoecium is of more importance than the form of the avicularium and the other characters on which the above species have been relegated to different genera. The presence of the kenozoecium appears in some way to be conditioned by the avicularium, but just what the physiological or morphological influence may be is a puzzle.

Parellisina curvirostris (Hincks) 1862

PLATE 4, FIGURE 32

Zoarium encrusting. Zooecia separated by grooves, gymnocyst small or wanting. Mural rim thin, little raised. A small vestigial spine on either side of the aperture, not always evident, and occasionally others still smaller on the side. A narrow, finely tuberculated cryptocyst descending to the aperture. Dorsal wall little calcified, in keeping with the general nature of the species. Ovicell hyperstomial, rather small but prominent, globose, frontal surface delicately beaded and usually with a small tubercle in the middle, not closed by the operculum. Avicularium interzooecial, large and grooved, followed in series by a kenozoecium covered by a membrane and which varies considerably in size and form. Its opesium is usually more or less triangular and there is occasional evidence of a delicate mural rim.

Taken at Station 2341 off the mouth of Guanica Harbor, Porto Rico, 27 fathoms. Listed by Canu and Bassler (1928: 33) as *Callopora curvirostris* from off Havana, Cuba, 201 fathoms, and north of Cuba, 143 fathoms.

This species has been placed in the genus *Ellisina* by Harmer (1926: 28) and by Hastings (1930: 711).

Parellisina latirostris NEW SPECIES

PLATE 4, FIGURES 33, 34

Zoarium encrusting shells and corallines; yellowish-white in color, somewhat glistening. Zooecia moderately large, rather regularly oval, the opesium occupying nearly all of the front, with a slight development of the gymnocyst occasionally. The mural rim is

beaded internally, sloping downward, but is rather narrow and there is no expansion of the cryptocyst. A minute vestigial spine on either side of the aperture, often wanting. Ovicell of moderate size, hyperstomial, delicately beaded on the upper surface, and not closed by the operculum. The avicularia are vicarious with a short spatulate mandible which is without transverse bar, but has instead two small hinge teeth. The avicularium is followed directly in the series by a kenozoecium which has usually a somewhat reniform, membranous area set transversely to the long axis of the avicularium. This kenozoecium, which may be as wide as a normal zoecium, extends to the dorsal side of the zoarium and is separated from the avicularian chamber by a distinct wall with communication pores. The mural rim of this chamber presents much the same appearance as that of a zoecium but is thinner and does not slope inward. In the distal wall of the kenozoecium there are also communication pores. There is a heavily chitinized sclerite extending forward in the form of a semicircle on the avicularian mandible from the points of its attachment. Otherwise the mandible is not heavily chitinized. The operculum is slightly heavier than the frontal membrane and has a chitinized border.

Zoecial length, 0.45 to 0.55 millimeters; width, 0.30 to 0.45 millimeters. Opesial length, 0.30 to 0.40 millimeters; width, 0.25 to 0.33 millimeters.

Dredged at three stations off the mouth of Guanica Harbor, Porto Rico, at 7 to 27 fathoms.

Parellisina tenuissima (Canu & Bassler) 1928

Zoarium encrusting. Zoecia distinct, much elongated, elliptical or fusiform. Mural rim very thin, smooth. Opesium with the form of the zoecium; ovicell small, globular, finely granular. Avicularium falciform, unguiculated, with two small lateral denticles, and placed in the proximal portion of a zoecium with an aborted poly-pide (kenozoecium).

Known only from Albatross station D. 2387 Gulf of Mexico, 32 fathoms. Canu and Bassler (1928: 34, *Callopora*) state that the species differs from *curvirostris* Hincks in the great delicacy of the mural rim and the larger dimensions of the aborted zoecia.

ALDERINA Norman 1903

Front wall entirely membranous, side walls usually crenulated, no spines; no avicularia, but nodulous processes sometimes present. Ovicell usually bearing a rib or a depressed area. Dietsellae present.

Alderina irregularis (Smith) 1873

Zoarium encrusting. Zoecia of simple construction without avicularia or spines; mural rim granular and enlarged at the base. Opercular valve bordered by a thick sclerite. Ovicell hyperstomial, orifice large, not closed by the operculum.

Smith (1873: 8) records the species from Pourtales dredging, Florida, 60 fathoms; Osburn (1914: 194) listed it from Tortugas Islands 8-22 fathoms; Canu and Bassler (1928: 28) record it from north of Cuba, Gulf of Mexico, and Straits of Florida, 30 to 156 fathoms. It did not appear in our Porto Rican collections.

CRASSIMARGINATELLA Canu 1909

Zoecia with very heavy lateral walls, no spines, avicularia interzoecial, large, oval, or rounded, replacing a zoecium in the series, with a very heavy hinge pivot. Ovicell hyperstomial.

Crassimarginatella crassimarginata (Hincks) 1880

Zoarium encrusting. Zoecia very distinct, lateral wall thick, heavily calcified. Gymnocyst small, smooth. Cryptocyst narrow descending equally on all sides except near the operculum, coarsely granulated. Avicularia large, replacing a zoecium in series, wall granulated like that of the zoecia, mandible large, semicircular, the pivotal bar very heavy. Ovicell rather small but prominent, broader than long, heavily calcified. Abortive zoecia are not uncommon, sometimes small and nearly closed by calcification, sometimes nearly as large as the autozoecia. In the latter case the wall is granulated like that of the ordinary zoecia.

Porto Rico near the mouth of Guanica Harbor at 5 fathoms, one small, but mature colony on a shell. I have the species from Bermuda also, on shell at 20 feet. It has not been previously recorded from the American side of the Atlantic.

CRANOSINA Canu & Bassler 1933

Characterized by the presence of an avicularium with a long vibracular mandible, set transversely across distal to the aperture.

Cranosina coronata (Hincks) 1881

The very long transversely set vibraculum, nearly as long as the zoecium, is a very striking character. The zoecia are distinct, separated by deep grooves, the mural rim thick and granulated;

opesia large, conforming to the shape of the zooecia but narrowed and rounded in the opercular region. No spines. The dietellae are unusually large.

Porto Rico, dredged once at Station 2385 off Pt. Brea, near the mouth of Guanica Harbor at 8 fathoms. It has not been noted before on the American side of the Atlantic.

COPIDOZOOM Harmer 1926

The genus is characterized especially by the interzooecial avicularia, in which the mandible is broad at the base and narrows at once into a long, linear point directed forward between the zooecia.

Copidozoum tenuirostre (Hincks) 1880

This species did not appear in our Porto Rican collections, but has been reported by Canu and Bassler (1928: 31, *Callopora*) from the Gulf of Mexico, Straits of Florida and east of Yucatan, at 24 to 56 fathoms. Marcus also reports it from the Bay of Santos, Brazil at 20 meters.

AMPHIBLESTRUM Gray 1848

The cryptocyst is broad, encroaching on the opesial area which is reduced to an ovate or roughly triangular form; avicularia, spines and hyperstomial ovicell.

Amphiblestrum pustulatum (Canu & Bassler) 1928

Antropora pustulata Canu & Bassler (1928) 24.

The zooecia are distinct with a well-developed gymnocyst. The mural rim bears 4 to 6 spines. A pointed avicularium on either side of the operculum is directed forward and slightly inward.

Not taken at Porto Rico. Reported by Canu and Bassler from north of Cuba at 201 to 230 fathoms.

Dr. R. S. Bassler (*in litt.*) agrees that *pustulatum* should be placed under the genus *Amphiblestrum*.

CALLOPORA Gray 1848

Front wall entirely membranous, marginal wall more or less thickened and bearing spines. Ovicell globose, commonly with a rib across the front. Avicularia and dietellae. None of the several species reported from the West Indian region appear to be typical of the genus.

Callopora pumicosa Canu & Bassler 1928

The zooecia are much separated, with a large gymnocyst and without a mural rim. The space between the zooecia is a calcareous pellicle perforated by numerous polygonal pores.

Not in our Porto Rican collections. Canu and Bassler (1928: 33), Straits of Florida at 56 fathoms.

Callopora caudata Canu & Bassler 1928

The zooecia are uniserial, with branches at right angles, tubular at the base, resembling species of *Pygipora*, but with a hyperstomial ovicell.

Not taken at Porto Rico, but reported from north of Cuba at 143 fathoms by Canu and Bassler (1928: 34).

? **Callopora sigillata** (Pourtales) 1867

The zoarium consists of erect, anastomosing branches. Smitt (1873: 8) gives an excellent account, but the species has not been seen since. Pourtales (1867: 110, *Cellepora*) and Smitt (1873, *Membranipora*), off Havana, Cuba and off Florida at 262 to 270 fathoms.

MARSSONOPORA Lang 1914

Zoarium uniserial, zooecia narrowed proximally into a tube.

Marssonopora uncinifera Canu & Bassler 1928

Zoarium encrusting on shells. Zooecia in linear series, oval, elongated, united with each other by filiform zooeciules with a very small orifice and arranged in the form of stolons. Opesium oval; mural rim thin, with a dozen spines in the form of claws. Ovicell hyperstomial, globular, salient, closed by the operculum.

Known only from Canu and Bassler's records, north of Cuba, at 143 to 201 fathoms.

Family **ARACHNOPUSIIDAE** Jullien 1888

An arched calcified frontal shield (pericyst) above the membranous ectocyst. This is perforated by large pores. It is formed by projections which originate from the lateral margins. Each of the frontal pores has a salient collar.

Levensen (1909: 160) states that the spines are originally hollow but later become partially solid in *Arachnopusia*. In the genus

Exechonella Canu and Bassler, which these authors have placed in the family, there is no indication at any time of hollow spines.

In *Arachnopusia* the opercular valve is membranous. In *Exechonella* there is a true operculum attached to the ectocyst and above this is a thick walled peristome.

It is not certain that these two genera belong together or that this family is properly placed. Perhaps its relations are with the Cribri-morphs as there is a definite pericyst above the ectocyst. This structure is not formed of radial or parallel costae, but it is not certain that the arrangement of the ribs is of sufficient importance to separate them in another division.

ARACHNOPUSIA Jullien 1888

Lateral walls provided with septulae (multiporous rosette plates), ovicell hyperstomial, the ectoocium wholly calcified and covered by the adjoining frontal shields.

Arachnopusia monoceros (Busk) 1854

Zoarium encrusting. Zooecia broad, ovate, primary aperture sub-orbicular, and the proximal sinus with sharp cardelles. Peristome very thick, bearing one or more long club-shaped spines. A strong conical process in the midline proximal to the aperture, the frontal wall with large, irregular perforations below which is the ectocyst. Moderately large avicularia with pointed mandible. Ovicell sub-globose, a little longer than broad.

Recorded by Osburn (1914: 105) from the Tortugas Islands, 5 fathoms. One small specimen washed up on the beach at the Guanica Harbor lighthouse. It is a very widely distributed species.

EXECHONELLA Canu & Bassler 1927

Pores of the pericyst large, orbicular, marginated. A peristome very much thickened, without spines, surrounds an orifice closed by a true operculum. The ectocyst is hidden under the frontal. Lateral and distal walls with a series of uniporous septulae. The salient margins of the frontal pores give a much roughened appearance to the front wall.

Exechonella antillea (Osburn) 1927

Lepralia antillea Osburn (1927) 128.
Exechonella pumicosa Canu & Bassler (1928) 70.

Zoarium encrusting, forming a coarse, greyish layer on shells, corals, etc. Younger zooecia more or less shining, in older stages

becoming multilaminar, the later layers piling up on the primary ones with the zooecia turned in various directions. Zooecia very large, broad, gibbous, deep, coarsely and heavily calcified, well separated even in older stages by deep grooves. The whole of the frontal is coarsely punctured by funnel-shaped openings with raised borders, giving the whole surface a much-roughened appearance. A minute rounded avicularium, somewhat raised and with a heavily calcified border, is sometimes present on the lateral angle of the zooecium, occasionally on both sides but frequently wanting, and may be absent from entire colonies. Aperture very large, rounded, with a pair of small cardelles which are situated a little back of the middle. The poster is large, broad and similar in shape to the anter but is slightly smaller. The aperture averages as wide as long, but there is considerable variation in its form. A rounded, thick-walled peristome surrounds the aperture, often projecting strongly above the level of the zooecium, in some cases raised still higher on the sides in flaring projections and occasionally the whole rim flares outward into a broad, funnel-shaped structure. Usually, however, the peristome merely surrounds the aperture with a heavy border. Ooecia appear to be wanting entirely as I have dissected numerous zooecia without discovering any evidence of them.

Zooecial length, 0.80 to 1.10 millimeters, average 1.00 millimeter; width 0.60 to 0.80 millimeters, average 0.70 millimeters. Aperture length, 0.20 to 0.25 millimeters; width, 0.19 to 0.25 millimeters.

Curaçao Island (Osburn 1927: 128, *Lepralia antillea*), Tortugas Islands, Florida (Osburn 1914: 213, *Phylactella labrosa*). Fowey Light 15 miles south of Miami, Florida, 40 fathoms (Canu & Bassler 1928: 70, *Exechonella pumicosa*). Very abundant in Porto Rican collections encrusting shells, corals, etc., from 5 to 20 fathoms.

My scanty material from Tortugas Islands was incorrectly determined. At the time the species was described (1927) the description of the genus had not reached me and I listed the species under the old genus *Lepralia*. *E. pumicosa* Canu and Bassler is a synonym under this species, as I have examined numerous specimens of their material and find no differences of importance. The species appears to be widely distributed in the West Indian region.

Exechonella antillea NEW VAR. *spinosa*

PLATE 4, FIGURE 35

What appears to be a variety of this species differing by the presence of tall unjointed spines to the number of 10 or 15 on the

frontal. These develop between the pores and are pointed when fully formed. Similar, but shorter, spines appear on the peristome. I have a specimen from Bermuda and Dr. Bassler has kindly loaned me one from Port Antonio, Jamaica. The appearance is so different that I at first presumed them to be of a different species, but the measurements are the same and I find no other differences except in the frontal spines. If worthy of a name, the variety may be called *spinosa*.

Family HIANTOPORIDAE MacGillivray 1895

The frontal is a pericyst forming an incomplete cover above the membranous ectocyst. The zooecia may be separated, with connecting tubes or closely joined to each other. There is a wide range of calcification of the frontal and the formation of a definite pericyst. In some cases the membranous ectocyst is widely exposed while in others the pericyst is complete with the exception of two to four large pores near the middle. The family may not be a natural one as nothing is known of the method of calcification in most cases. Canu and Bassler suggest that *Tremogasterina* "would perhaps be better classed next to *Figularia*."

A pericyst appears several times elsewhere, *Arachnopusia*, *Exechonella* and the cribrimorphs (*Costulæ*) and all of these appear to show some intermediate conditions between the *Anasca* and *Ascophora*, but what little is known of the method of calcification seems to preclude any possibility of allying them very closely. Possibly they may be considered cases of parallel evolution,—sporadic attempts of nature in the direction of a compensatorium which finally arrived by way of the cribrimorphs, if our interpretation of *Figularia* is correct. A complete knowledge of the method of forming the pericyst in the various genera would probably do much to clear up the problem.

It might be better to classify all of these forms with a definite pericyst along with the cribrimorphs, intermediate between the *Anasca* and *Ascophora*, until their relationships can be more definitely determined, but for the present I prefer to leave them in the classification of Bassler (1935) rather than make any further changes in the absence of information.

TREMOGASTERINA Canu 1911

The pericyst closes above the ectocyst to give the appearance of a member of the *Ascophora*, but with two to four large pores,

usually reniform in shape, near the center. This is the only recent representative of the family found thus far, but the genus *Tremogastera*, or *Hiantogastera*, will probably be found to occur. No representatives of the family were found in Porto Rico, but some of them may be looked for.

KEY TO THE SPECIES

1. Avicularia truncate at tip, umbo with transverse process *T. malleolus*.
Avicularia pointed, umbo simple or wanting..... 2.
2. A short pointed umbo present..... *T. mucronata*.
Umbo wanting..... 3.
3. Avicularia very long, lanceolate, oral border with several spines *T. lanceolata*.
Avicularia long, narrowly pointed, no oral spines..... *T. granulata*.

Tremogasterina granulata Canu & Bassler 1928

Known only from the Straits of Florida at 40 fathoms and from the Pliocene of Panama.

Tremogasterina lanceolata Canu & Bassler 1928

Known only from north of Cuba, 130 to 143 fathoms.

Tremogasterina malleolus Canu & Bassler 1928

Reported by Canu and Bassler from the Gulf of Mexico and the Caribbean Sea east of Jamaica at 52 to 60 fathoms.

Tremogasterina mucronata (Smitt) 1873

Known only from Smitt's record (1873: 24, *Escharipora* ?) west of the Tortugas at 36 fathoms.

Division III COILOSTEGA Levinsen 1909

The frontal wall has within the covering membrane a depressed calcareous layer, the cryptocyst, surrounded by raised lateral walls. As a rule the cryptocyst is provided with pores and an aperture, the opesiula, sometimes confluent with the opesium anteriorly on each side, through which passes a muscle to the dorsal side, more or less completely enclosing the anterior part of the polypide with a polypide tube.

KEY TO THE FAMILIES

1. Ovicell hyperstomial..... 2.
- Ovicell endozooecial or wanting..... 3.
2. No avicularia, zooecia disjunct united by short tubes.....
 ASPIDOSTOMATIDAE, page 381.
- Avicularia large, replacing a zooecium in the series.....
 THALAMOPORELLIDAE, page 377.
3. Zoarium cup-shaped, free; a long vibraculum distal to each zooecium.....
 CALPENSIDAE, page 373.
- Zoarium not cupuliform, attached..... 4.
4. Zooecial chamber divided into proximal and distal parts by descending wall
 of the cryptocyst, a distinct polypide tube present.....
 STEGANOPORELLIDAE, page 374.
- Zooecial chamber not so divided, no calcified polypide tube.....
 OPESIULIDAE, page 370.

Family OPESIULIDAE Jullien 1888

There is much variation in this family, but the ovicell is always endozooecial. Avicularia may be small, or absent, or highly developed with long mandibles which are winged at the base (onychocellaria). Similarly the calcification of the cryptocyst varies from a fairly large opesial area to almost closed and with small or large opesiules which may be separated from the opercular area or united with it. Two subfamilies have been erected on the basis of the presence or absence of the onychocellarium.

KEY TO THE GENERA

1. Avicularian mandible winged at base (onychocellarium)..... 2.
- Avicularian mandible not winged..... 4.
2. Opesial area oval, without opesiular notches..... *Rectonychocella*, page 370.
- Opesial area with notches at the proximal corners..... 3.
3. Opesiular notches very distinct, directed laterally..... *Floridina*, page 372.
- Opesium larger, notches shallower and directed more posteriorly.....
 *Velumella*, page 371.
4. Avicularia wanting..... *Floridinella*, page 372.
- Avicularia present, distal to the aperture..... *Micropora*, page 373.

Subfamily ONYCHOCELLINAE Jullien 1881

RECTONYCHOCELLA Canu & Bassler 1917

Canu and Bassler (1917: 25-26) erected three new genera, *Rectonychocella*, *Velumella*, and *Diplopholeos* out of a complex of species allied to *Smittipora* Jullien 1881. Later (1928: 52) they suppressed *Diplopholeos* and merged its species with *Velumella*. Harmer (1926: 259) points out that "the only features which seem to separate them are certain differences in the extent and denticulation of the avicularian opesia, and in the continuity or otherwise of the mural rim with

the horizontal cryptocyst," and he refuses to accept either genus, preferring *Smittipora* of Jullien. Canu and Bassler again (1929: 126) admit that *Rectonychocella* "differs from *Velumella* only in its rarely visible opesiular indentations, these corresponding to the opesiular muscles placed low and to less calcification of the frontal." Probably *Velumella* will also have to be submerged, but as the differences of calcification about the proximal part of the opesium may have some relation to the distribution of opesiular muscles it may be better to let it stand until properly prepared fresh material can be examined to settle the point.

As to the standing of Jullien's genus *Smittipora*, Canu and Bassler (1928: 52) have pointed out that, "The genus *Smittipora* is therefore not established on sufficient characters since it is the manifest result of an error of misinterpretation of Smitt's figure 60." If such is the case, *Rectonychocella* must replace *Smittipora*. My material is too scanty to decide the issue. For the present I accept both genera of Canu and Bassler.

Rectonychocella abyssicola (Smitt) 1873

Zoarium encrusting or with erect cylindrical stems with six series of zooecia. The mural rim may be raised or wanting, in which case the zooecia are separated by a furrow. Cryptocyst convex and finely granulated. Opesium often marginated, either elliptical or with only a concave proximal border. Onychocellaria much smaller than zooecia, the opesium small and without lateral denticles, the mandible winged, symmetrical, its point projecting beyond the oval wing.

Smitt (1873: 6. pl. 1, fig. 61 part), Florida, 68 fathoms; Hincks (1881: 155), off Cojima, Cuba, 628 meters; Canu and Bassler (1928: 53), Florida, 387 fathoms. Not taken at Porto Rico.

VELUMELLA Canu & Bassler 1917

Velumella americana Canu & Bassler 1917

Zoarium encrusting. Zooecia distinct, separated by a furrow in which is a brown line. Mural rim thin distally, enlarged on the sides into facets. Cryptocyst concave longitudinally, smooth, or roughly tuberculate in older zooecia, depressed. Opesium large, a little elongated, straight on the proximal border, with a deep opesiular indentation proximally on either side. Onychocellaria (avicularia) as large as the zooecia, its cryptocyst with sharp spines projecting into the elongate oval opesium, the mandible large, with symmetrical

wings forming an oval structure, beyond which the point of the mandible projects in a long vibraculum.

Smitt (1873: pl. 1, fig. 60, *Vincularia abyssicola*, part) Florida; Osburn (1914: 195, *Smittipora abyssicola*), Tortugas, low water to 15 fathoms, and (1927: 125), Curaçao, shallow water; Canu and Bassler (1928: 54) north of Cuba and Gulf of Mexico, 30 to 143 fathoms. In the Porto Rican collections this species appeared only once, at Station 2377, between Rotones and Caribe Islands, 6 to 11 fathoms. It appears to be well distributed in the West Indian region.

FLORIDINA Jullien 1881

Opesiular indentations symmetrical, very large, limited above by the two very salient opesial processes and placed on each side of a much produced, semitubular polypidial convexity. Operculum attached to the ectocyst above the opesial processes. Onychocellaria straight, mandible bitembranous. (After Canu and Bassler.)

Floridina antiqua (Smitt) 1873

Zoarium encrusting. Zooecia moderate in size, irregularly oval, distinct, mural rim salient, complete. Cryptocyst somewhat granulated, surrounding the opesium, ventricose behind the aperture. Opsiules symmetrical and large. Onychocellarium oval, mandible winged.

Zooecial length, 0.40 to 0.50 millimeters; width, 0.40 millimeters.

Smitt (1873, *Mollia antiqua*) listed the species from Florida, 29 to 44 fathoms; Canu and Bassler (1928), Gulf of Mexico, 30 fathoms, Straits of Florida, 56 fathoms, and Fowey Light, 40 fathoms.

Subfamily MICROPORINAE Hincks 1880

FLORIDINELLA Canu & Bassler 1917

Ovicell endozoecial and separated from the zooecia by a fold. Polypidial convexity not prominent. Opsiular indentations large and rounded. Opsiium constricted by two symmetrical lateral teeth at the level of the opercular articulation. (After Canu and Bassler.)

Floridinella typica Canu & Bassler 1928

Zoarium encrusting. Zooecia distinct, separated by a furrow, irregularly oval, somewhat elongated. Mural rim very thin, smooth, salient, complete. Cryptocyst shallow, flat, granulated. Opsiium large, subtrifoliate, its proximal border concave or convex with very small opsiular indentations, not always present: the two lateral condyles small and deep. Small interzooecial tuberosities.

Zooecial length, 0.50 millimeters; width, 0.40 millimeters.

Recorded by Canu and Bassler (1928: 59), Straits of Florida, 56 fathoms, and Fowey Light, 15 miles south of Miami, Florida, 40 fathoms. Not present in the Porto Rican collections.

Floridinella parvula Canu & Bassler 1928

Zoarium encrusting. Zooecia oval, short. Mural rim thin, salient, much attenuated proximally; opesium oval, elongated, trifoliate; the two lateral condyles salient. Proximal border convex with two irregular opsiular indentations. Sometimes small tubercles between the zooecia.

Zooecial length, 0.25 millimeters; width, 0.20 millimeters.

Recorded by Canu and Bassler (1928: 59), Straits of Florida, 56 fathoms. Not taken at Porto Rico.

MICROPORA Gray 1848

Encrusting. Mural rim ending in a knob-like enlargement on either side of the aperture. Cryptocyst covering the entire frontal except the aperture and the small opsiules. Ooecia endozoecial, but very prominent. A small median avicularium situated just distal to the aperture.

Micropora coriacea (Esper) 1791

Zooecia irregularly oval, distinct, the salient mural rim enlarged opposite the aperture where it ceases. Cryptocyst complete to the level of the opercular hinge, not continued around the aperture which is entirely closed by the operculum. A pair of small opsiules, often scarcely visible and usually close to the mural rim. An avicularium with a triangular mandible pointing upwards situated in the mid-line just in front of the aperture.

Zooecial length, 0.44 to 0.50 millimeters; width, 0.26 to 0.30 millimeters.

Smitt (1873: 13), Florida, 36 to 135 fathoms; Canu and Bassler (1928: 62), Gulf of Mexico, 30 fathoms, and Straits of Florida, 56 fathoms. The writer has also a specimen from Captive Island, in the Gulf of Mexico, west of Florida, but the species did not appear in our Porto Rican collections.

Family CALPENSIIDAE Canu & Bassler 1923

DISCOPORELLA D'Orbigny 1852

Cupularia of authors.

Zoarium free in the form of a more or less expanded cup, the zooecia opening on the outer surface. Opsiium fringed with spinous pro-

cesses of the cryptocyst which are flat and free or joined together. The two distal processes are symmetrically placed and support the opercular valve. Opsiules rounded. No ovicell. Vestibular arch present.

Discoporella doma (D'Orbigny) 1852

The zoarium is cup-shaped, higher than wide. Cryptocyst more or less developed, bordered with flat spinous processes, which may be acuminate, spatulate or fimbriated and which variously modify the shape of the opesium but which never coalesce. An avicularium chamber with a long lash-like, chitinous flagellum, situated distal to every aperture.

Smitt (1873: 15), Florida, 29 fathoms; Canu and Bassler (1928: 64), Straits of Florida, 56 fathoms. Not otherwise noted in the West Indian region.

Discoporella umbellata (Defrance) 1823

Zoarium flatter than in *D. doma*, wider than high, umbrella-shaped. The cryptocyst forms almost a complete cover up to the opercular hinge by the fusion of its spinous processes, leaving usually a number of irregular holes besides the true opsiules. The fusion of the cryptocystal spines easily differentiates this from the preceding species.

Smitt (1873: 14), Florida, 29 fathoms; Osburn (1914: 194, *C. lovei*) Tortugas, 12 to 22 fathoms; Canu and Bassler (1928: 64), various localities in the Gulf of Mexico. The species occurs as far north as North Carolina (Smitt 1873, and Osburn 1914), but it did not appear in our Porto Rican collections.

Family STEGANOPORELLIDAE Hincks 1884

The limits of this family are not yet agreed upon. Three important genera, *Steganoporella* Smitt 1873, *Siphonoporella* Hincks 1880, and *Labioporella* Harmer 1926 (= *Labiopora* Levinsen 1909, pre-occupied) are especially concerned. Harmer (1926: 280) created a new family, Labioporellidae, for the last mentioned genus and expressed the opinion that, "It may perhaps be necessary to establish a new family for the reception of Hincks' genus." Canu and Bassler (1929: 144-149) have reassigned them to the present family "because *Labioporella* and *Siphonoporella* to us are only simplified *Steganoporella*." As very few species are known from Atlantic waters and my own material is scanty I leave them for the present where Canu and Bassler have placed them.

They all agree in having dithalamic zoecia, the body cavity par-

tially subdivided by a descending portion of the cryptocyst; a more or less complete calcified zoecial tube through which the tentacles are protruded; and an anterior opesial area which is not quite occupied by the operculum. In *Steganoporella* there are two kinds of zoecia, one with a larger operculum which apparently represents an early stage in the development of the avicularium, the other zoecia of the ordinary type. In the other genera, large interzoecial avicularia are present, which show clearly their zoecial origin.

KEY TO THE GENERA

1. Cryptocyst surrounding the opesium like a shelf....*Steganoporella*, page 375.
Cryptocyst not surrounding the opesium..... 2
2. Polypide tube continued forward prominently and somewhat expanded, trumpet-shaped; opesium large.....*Siphonoporella*, page 376.
Polypide tube not free at the sides; opesium small....*Labioporella*, page 376.

STEGANOPORELLA Smitt 1873

Zoecia completely covered by a frontal membrane, beneath which is a porous cryptocyst extending forward nearly to the operculum and ending in a median oral shelf, also continued around the sides of the aperture in the form of a projecting shelf. Normal individuals with a large operculum which is supported by an arched sclerite. Avicularian individuals with a much larger operculum with a pointed sclerite. Both types may have chitinous teeth on the chitinous opercular border. The avicularian individuals possess polypides and are therefore but little modified toward avicularia.

Steganoporella magnilabris (Busk) 1854

Zoarium encrusting, or erect and frill-like. Zoecia large, with raised walls. A porous, depressed cryptocyst descending deeply to the level of the polypide tube occupies nearly half of the frontal area. Beyond this is the median oral shelf, with the polypide tube beneath it, and this is separated from the lateral walls by a membranous area on each side in the form of a deep notch. Zoecia of two types. In one the operculum more or less semicircular with an inverted U-shaped main sclerite and with small chitinous teeth on the border; the other with a much larger operculum with an inverted Y-shaped main sclerite, which is usually somewhat broader distally with a straighter distal border armed with heavier teeth. This latter type of zoecium is in reality the avicularian individual, so little modified from the ordinary form that the polypide functions in the usual manner.

2. Mandible short, in the form of a gothic arch
 *T. gothica* var. *floridana*, page 378.
 Mandible elongate, curved sidewise.....*T. jalcifera*, page 380.
 3. Avicularian mandible and sister zooecium symmetrical...*T. mayori*, page 379.
 Avicularian mandible and sister zooecium unsymmetrical
 *T. distorta*, page 380.

Thalamoporella gothica NEW VAR. *floridana*

PLATE 5, FIGURES 42, 43

Zoarium encrusting or erect. Adoral areas present, sometimes with tiny, rounded tubercles. Opesia nearly circular with a rounded sinus without proximal shelf. Opesiules variable in size and form, one usually much smaller (this sometimes wanting). Larger opesiule continued to the dorsal surface where its insertion is closed. Avicularia with pointed mandibles of the form of a gothic arch, the point raised. Avicularian cryptocyst incomplete, leaving a semicircular or semielliptical membranous area behind the mandibles. Ovicells not observed. Spicules in the form of calipers, large or small and intergrading.

Zoocial length, average 0.55 millimeters, range 0.50–0.65 millimeters; width, average 0.23 millimeters; range 0.18–0.27 millimeters. Avicularium, total length, average 0.35 millimeters; mandible length, average 0.15 millimeters.

This form agrees rather closely with Levinsen's figures of *Thalamoporella rozierii* var. *labiata* (1909: 182). In Harmer's review of the genus (1926: 303), he places *labiata* under the synonymy of *Thalamoporella gothica* var. *indica* Hincks. I have a specimen of *labiata* from the China Sea sent me by Levinsen, and my Florida specimen agrees with this and with Harmer's description of the variety *indica* in the form of the avicularium, the nature of the opesiules, the depression of the cryptocyst at the level of the opesiules, and the form of the spicules. It differs, however, in the absence of the calcareous lower lip, in the somewhat smaller size of the avicularia, in the absence of the compass form of spicules and in the smooth inter- and disto-opesiular cryptocyst. It is probably better to keep it separate, at least for the present.

Porto Rico, encrusting a shell at 8 fathoms, off Guanica Harbor. Tortugas Islands, Florida, on a shell on the beach, and in 10 fathoms on sponges (Osburn 1914 under *T. rozierii*). Smitt's record (1873: 16. pl. 4, fig. 102) is probably the same species judging chiefly by the form of the opesia, but his figure and description do not indicate the avicularium and there still must be some doubt in regard to the

record. I have very well developed specimens from Captive Island, Florida.

Thalamoporella mayori NEW SPECIES

PLATE 6, FIGURES 46, 47

Zoarium encrusting on shells and corallines. There is a fairly close resemblance to *T. granulata* Levinsen as restricted by Harmer, but the hinge denticles are less prominent, the border of the sinus usually distinctly granulated or crenulate. The adoral areas are well developed with strong and sharply pointed spines, but these may be entirely lacking, as in the author's figure (1914: 197). The sister zooecia of the avicularia are symmetrical, and the avicularian cryptocyst covers the avicularian chamber up to the hinge line except for two small opesiules. These avicularian opesiules may be separated from the border as in the author's figure of the species, or one or both may be in contact with the border. The avicularian mandible varies somewhat in form, but is nearly symmetrical as shown in my figure. The zoecial opesiules both descend to the dorsal side and are usually closed. The spicules are of two kinds: compasses and calipers of various sizes. The oecia are smooth, glossy, semitransparent, evenly rounded, slightly broader than long, the aperture in the form of a pointed arch.

The zoecial measurements vary considerably, ranging from 0.40 to 0.80 millimeters in length, and from 0.20 to 0.40 millimeters in width. Most of the zooecia, however, will range pretty closely around the average, 0.60 millimeters long, by 0.30 millimeters wide. The avicularian measurements are about as follows: 0.20 millimeters to the hinge line and 0.35 millimeters for the mandible. The widest part of the mandible measures about 0.15 millimeters.

Harmer in his splendid review of this genus (1926: 297) indicates that the *T. granulata* of Osburn "appears not to belong to this species." After further study of the specific characters of this genus I am quite ready to accept Harmer's conclusion.

I dedicate this species to the memory of Dr. Alfred Goldsborough Mayor, a well-known authority on marine zoology, and for many years Director of the Carnegie Institution Laboratory for Marine Zoology at the Tortugas Islands.

Not found in our Porto Rican collections. Osburn (1914: 197. fig. 8, *T. granulata*), Tortugas Islands, Florida, encrusting shells and calcareous algae.

Zooecial length, variable, 0.75–1.45 millimeters, average about 1.00 millimeters; width, variable, 0.53–0.80 millimeters, average about 0.60 millimeters. Smaller operculum, length, average 0.40 millimeters. Larger operculum, length, average 0.60 millimeters.

Porto Rico, Stations 2347, 2363, 2377, 2385, all off shore from Guanica Harbor at 6 to 20 fathoms. This widely distributed warm water species was reported by Smitt (1873: 15, *S. elegans*) from the Florida Straits; by Verrill from Bermuda (1900: 594, *S. elegans*); Osburn from the Tortugas Is. (1914: 196); and Canu and Bassler (1928: 64) north of Cuba, east of Yucatan, Florida Straits, and from the Pliocene of Panama. The species is also known from Pedro Bank, south of Jamaica and from St. Vincent Island. It is therefore one of the most characteristic species of the West Indian region. My specimens are all encrusting except those from Station 2347, which rise in a bilaminate frill.

SIPHONOPORELLA Hincks 1880

KEY TO THE SPECIES

- Zoarium encrusting; zooecia somewhat elliptical, large, zooecial length, 0.70 millimeters; width, 0.50 millimeters.....*S. granulosa*.
 Zoarium erect, cylindrical, bifurcated, rarely lamellar; zooecia more rectangular, a tubercle in each interzooecial angle; size smaller, length, 0.60 millimeters; width, 0.36 millimeters.....*S. dumonti*.

Siphonoporella granulosa Canu & Bassler 1928

Not taken in the Porto Rican collections. Recorded by Canu and Bassler (1928: 69), Gulf of Mexico and Straits of Florida, 30 to 56 fathoms.

Siphonoporella dumonti Canu & Bassler 1928

Not taken at Porto Rico. Canu and Bassler (1928: 68), Gulf of Mexico at 30 fathoms.

There is a possibility that *granulosa* may be only the encrusting phase of *dumonti*, the differences being due to the manner of growth, since they occurred together at one station, Albatross D. 2405.

LABIOPORELLA Harmer 1926

Zooecia with distinctly raised marginal walls. Gymnocyte wanting. A porous cryptocyst, which does not extend forward around the opesium. Polypide tube bilabiate and connected on either side with the lateral wall by a vertical calcareous lamina. (*Labiopora* Levinsen 1909, preoccupied.)

Labioporella sinuosa NEW SPECIES

PLATE 5, FIGURES 40, 41

Zoarium encrusting. Zooecia in regular series, slightly broader near the middle, all of the outlines usually sinuated. Mural rim thin and raised, its border delicately beaded, continued without change around the distal end of the aperture. The perforated cryptocyst is nearly flat, descending slightly to just behind the opesium, where the middle portion is slightly raised to form the ventral lip of the inconspicuous polypide tube. On either side the tube is connected with the lateral walls by a vertical lamina which descends to the dorsal wall. Opesium rather large, broader than long, extending outward to the mural rim, which on the distal border is arched strongly forward where it overlies the base of the distal zooecium. The proximal border is more or less straight, slightly sinuated at its middle where the polypide tube scarcely projects. Avicularia wanting. The specimen was dead and the opercula eroded.

This species was listed by the writer (1914: 196) under the name of *Steganoporella connexa* Harmer, from the Tortugas Islands at 12 fathoms, encrusting a shell. It did not appear in the Porto Rican collections and, as far as I am aware, the genus has not hitherto been noted except in the western Pacific and Indian oceans.

Family THALAMOPORELLIDAE Levinsen 1902

Zooecia with a polypide tube. Cryptocyst developed forward almost to the operculum. Two opesiules separated from the aperture, one or both of these usually in contact with a side wall. Calcareous spicules in the shape of compasses or curves lie free in the zooecial chamber. Avicularia pointed or spatulate, interzooecial. Very large and prominent hyperstomial oecia.

THALAMOPORELLA Hincks 1887

Zooecia with a somewhat depressed, porous cryptocyst which is perforated by two asymmetrical opesiules. Opesia and orifice practically coextensive. The opesiules descend to the basal or the lateral walls. The ovicells have a cavity between the ectooecium and the entoecium divided by a median suture. The avicularium is situated at the base of a new zooecial series.

KEY TO THE SPECIES

1. Avicularium pointed..... 2
 Avicularium rounded at tip..... 3

Thalamoporella distorta NEW SPECIES

PLATE 6, FIGURES 48, 49

Encrusting. Zooecia with perforated cryptocyst which descends very slightly to the region of the opesiules. Between the opesiules and distal to them the surface is finely tuberculated, including the proximal border of the sinuated opesium. The opesiules are large, usually in contact with the lateral wall, more or less symmetrical and both descend to the dorsal wall where the insertions are large, nearly symmetrical and open distally. Spicules in the form of wide open calipers present. Adoral pointed spines, sometimes wanting. The most striking characteristic of the species is found in the sister zoecium of the avicularium in which the oral aperture is turned at right angles to the long axis of the zooecia and directed toward the avicularium. Its aperture also differs, being much shorter than in the normal zooecia, though about the same width. The opesiules are at different levels, the outer one well in advance of the one next to the avicularium and the calcified zoecial tube is curved. The avicularian chamber is covered by the cryptocyst almost to the mandible, with a pair of small opesiules much as in *T. mayori*. The mandible of the avicularium is asymmetrical with a straight border next to the sister zoecium. Ovicells large, rounded, a little broader than long, the aperture in the form of a pointed arch.

Zoecial length, average 0.60 millimeters, range 0.53 to 0.66 millimeters; width, average 0.30 millimeters, range 0.26 to 0.40 millimeters. Covered portion of avicularian chamber, average length 0.27 millimeters; mandible, average length 0.29 millimeters.

Porto Rico, Station 2341, off mouth of Guanica Harbor, 27 fathoms, 3 colonies on dead coralline.

Two other species, *T. granulata* Levinsen and *T. novae-hollandiae* (Haswell), have the sister zoecium of the avicularium more or less asymmetrical, but neither of them is as much distorted as the present species. In *granulata*, as limited by Harmer (1926: 297), the adoral spaces have no tubercles and the cryptocyst of the avicularian chamber leaves a wide open space behind the mandibles. In *novae-hollandiae* the adoral spaces are vestigial and without tubercles, the avicularian cryptocyst incomplete, and the zoarium usually erect and tubular.

Thalamoporella falcifera Hincks 1880

PLATE 5, FIGURES 44, 45

Zoarium encrusting on algae. Zooecia with walls thin and delicate, cryptocyst thin, depressed toward the opesiules, with a few scattering

pores, between and beyond the opesiules finely tuberculate; aperture somewhat longer than broad with a rounded sinus. Operculum with only a short small sclerite on each side near the hinge. Adoral areas well developed, with small pointed adoral spines. Opsiules unequal in size, the larger descending always to the dorsal side and its insertion usually open, the smaller sometimes reaching the dorsal side where its insertion may be open or closed. Avicularia small for this genus, very narrow and curved (in my specimens it is always curved away from the sister zoecium). Avicularian cryptocyst incomplete, reaching only about half way to the base of the mandible and leaving a semi-elliptical membranous area. Ooecia not present.

Zoecial length, average 0.60 millimeters, range 0.53 to 0.66 millimeters; width, average 0.30 millimeters, range 0.24–0.35 millimeters. Avicularian mandible, average length 0.30 millimeters, range 0.26–0.40 millimeters.

Tortugas Islands, 5 fathoms, one colony on algae (Osburn 1914: 197); Campeche Bank, Yucatan (Levinsen 1909: 186); otherwise known from Australian waters. My specimen compares closely with one from the Java Sea sent me by Levinsen. Not taken at Porto Rico.

Family ASPIDOSTOMATIDAE Jullien 1888

Zooecia with a short polypide tube, not continued under the cryptocyst, usually provided with marginal flanges. The two opesiules in the form of narrow incisions connected with the aperture. Ovicell hyperstomial.

MOLLIA Lamouroux 1821

Zooecia separated and united by cylindrical joints. Opsiium trifoliate. Opercular valve not in contact with mural rim. Ooecia hyperstomial and closed by the operculum. Spines, avicularia, and dietellae wanting.

Mollia patellaria Smitt 1873

Zoarium encrusting. Zooecia separated, with a single point of junction to each adjacent zoecium. Opsiium trifoliate. Operculum simple, membraniporidan, supported by cardelles, but not touching the zoecial wall. The opesial space behind the operculum may serve for the passage of opesial muscles, but we have no knowledge of their presence and, as Canu and Bassler remark (1928: 70), this genus might "just as well be classed next to *Amphiblestrum*" in the Alderiniidae. Ooecia prominent, globular and hyperstomial.

Recorded by Smitt (1873: 12), Florida, 36 fathoms; Canu and Bassler (1928: 69), Gulf of Mexico, 30 fathoms. The writer has a specimen from Captive Island, Florida. It did not occur in the Porto Rican collections.

Division IV PSEUDOSTEGA Levinsen 1909

Zoarium usually erect and cylindrical. Zooecia in longitudinal series but usually appearing alternate because of the manner in which the base of each zoecium is overgrown by the sides of the neighboring zooecia. Frontal area completely filled in by an imperforate, depressed cryptocyst. Spines wanting. Avicularia vicarious, without transverse bar. Ovicell immersed in the base of the distal zoecium, with a special opening.

Family CELLARIIDAE Hincks 1880

Cryptocyst covering the whole frontal zoecial wall. Operculum simple, well-chitinized, bilaminar, with a straight or concave proximal margin, a pair of strong supporting denticles (sometimes one broad median denticle). Avicularia vicarious, the submandibular area partly closed by a cryptocyst. Ovicell embedded in the distal zoecium, with a special opening.

CELLARIA Ellis & Solander 1786

Zoarium typically jointed, with cylindrical internodes. Zooecia usually more or less lozenge-shaped. Cryptocyst imperforate, covering practically all of the front to the operculum, which occupies nearly all of the opesium.

Cellaria nodosa Canu & Bassler 1928

Smitt (1873: 4) recorded this species under the name *C. tenuirostris* Busk, but Canu and Bassler (1928: 72) have pointed out essential differences from Busk's species and have renamed the Florida form. Their reasons are as follows: "The ovicelled zooecia are wider than the others. Their presence occasions an enlargement of the segments, which present thus a very characteristic nodosity. The internodes are more slender, the avicularia are lozenge-shaped, and the aperture much smaller."

Smitt listed the species from Carysfort Reef, Caribbean Sea, 52 fathoms, and west of Tortugas Islands, 68 fathoms; Canu and Bass-

ler, Gulf of Mexico, 35 fathoms, and also in the Pliocene deposits of Panama. It did not occur in the Porto Rico dredgings.

Cellaria sinuosa (Hassall) 1842

Zoarium dichotomously branched, internodes long and stout, cylindrical slightly thickened towards the top, the extremities rounded. Zooecia lozenge-shaped or hexagonal, or arched above and tapering off below. Area finely dotted, walls minutely granular. Orifice arched above, placed almost at the top of the area, with a much raised lower lip, which forms a broad and prominent plate in front. Avicularia at the top of a cell, often set obliquely, with a triangular mandible pointing downwards. Ovarian opening at the very top of the area, elongated transversely, with a broad tooth on the lower margin.

Porto Rico, a few dead fragments apparently belonging to this species dredged off Caribe Island at 8 fathoms. Canu and Bassler (1928: 72) have listed it for the North American coast, east of Cape Hatteras, at 102 fathoms.

Division V CELLULARINA Smitt 1867

In Levinsen's revision of the Chilostomata in 1909 the members of the present group were placed in his first division, Malacostega. It has been found advisable to extend the number of divisions and in 1926 Harmer reestablished Smitt's old name for the present group, with a redefinition and the exclusion of certain forms. This change has been accepted generally.

KEY TO THE FAMILIES

1. Zooecia facing in opposite directions, usually in pairs back to back..... 2.
- Zooecia all facing in nearly the same direction..... 3.
2. Sessile avicularia only..... FARCIMINARIIDAE, page 399.
- Pedunculate avicularia also present..... EPISTOMIIDAE, page 402.
3. Zooecia separated, connected by tubular processes..... BEANIIDAE, page 397.
- Zooecia directly attached to each other..... 4.
4. Avicularia sessile, a dorsal vibraeculum usually present, a scutum usually partially covers the aperture..... SCRUPOCELLARIIDAE, page 383.
- Avicularia pedunculate, vibraeculum and scutum absent..... 5.
5. Avicularia very long pedunculate..... BICELLARIELLIDAE, page 396.
- Avicularia all short pedicellate "birds heads"..... BUGULIDAE, page 388.

Family SCRUPOCELLARIIDAE Levinsen 1909

This family is usually considered the basic one in this division. The zoarium is erect or spreading, unilaminar, usually biserial and

attached to the substratum by radicles. A highly specialized spine, usually widened into a shield or branched (the scutum) bends over the membranous area, but is sometimes wanting. Sessile avicularia and vibracula usually present. It is a large and rather diversified family.

KEY TO THE GENERA

Branches attached to each other by cross radicles *Cellularia*, page 387.
Branches not attached to each other *Scrupocellaria*, page 385.

SCRUPOCELLARIA van Beneden 1845

KEY TO THE SPECIES

1. Ovicell with several rounded pores, only one axillary vibraculum 2.
Ovicell imperforate or with one large central fenestra, two axillary vibracula
..... *S. maderensis*, page 387.
2. Zoecia stout, not strongly narrowed below opesia *S. regularis*, page 384.
Zoecia slender, narrowed below opesia 3.
3. Opesia equal to half of frontal length, vibracular groove at right angles to zoecial axis *S. bertholletii*, page 386.
Opesia shorter than half the frontal length 4.
4. Lateral avicularia very small and inconspicuous, vibracular groove at a 45 degree angle with zoecial axis *S. cornigera*, page 386.
Lateral avicularia prominent, vibracular groove nearly in line with zoecial axis *S. pusilla*, page 385.

Scrupocellaria regularis NEW SPECIES

Cellularia cervicornis Smitt (1872) 14 (non *Scrupocellaria cervicornis* Busk, 1852).
Scrupocellaria cervicornis Verrill (1900) 594.—Osburn (1914) 192.

Among the species of the present list this may be distinguished by the short, wide zoecia, the opesia occupying more than half the frontal length. The frontal avicularia are moderate in size, numerous, none of them enlarged. Lateral avicularia quite small, not abundant. Vibracular chamber large, elongate (at least half as long as a zoecium), projecting, its groove straight and about median, the vibraculum about four times as long as a zoecium. Radicle fibers strong, straw colored, occasionally with retrorse hooks. Spines 2 to 6, the two lower ones opposite the operculum often forked. The scutum when fully developed is oval, nearly as broad as the opesia and with a very symmetrical alciiform decoration. The zoecia are large, spherical, or a little longer than broad, covering the front of the distal zoecium to or beyond the proximal lip of the aperture; the perforations rather regular and not tubular.

Zoecial length, 0.33 to 0.40 millimeters; width, 0.165 millimeters. Diameter of radicles, 0.053 millimeters; vibracula reaching a length of 1.5 millimeters, but usually shorter.

Florida Straits, Smitt; Bermuda. Verrill; Tortugas Islands, Osburn. Porto Rico, off Guanica Harbor, Stations 2343, 2347, 2359 and 2385, at 7 to 30 fathoms.

Apparently this is not *S. cervicornis* Busk 1852. Harmer states (1926: 377) that he has examined Busk's type material and he places *cervicornis* under the synonymy of *S. diadema* Busk 1852. The West Indian species which has masqueraded under the name of *cervicornis* for nearly 70 years differs in the following points:

1. The ovicell is longer, has a much narrower aperture and lacks the tubular pores of *diadema*.
2. There are no "giant" avicularia such as occur in both *diadema* and *cervicornis*.
3. The vibracular chamber is larger, nearly in line with the zoecia, its groove is straight and longitudinal, and the vibraculum appears to be longer.

Smitt's figures (1872. pl. 5, figs. 39-42) are excellent. As the species appears not to have been properly named I propose to call it *regularis* in reference to the appearance of the internodes and the even distribution of the appended structures.

Scrupocellaria pusilla (Smitt) 1872

A slender and rather delicate species, spreading among algae and colonies of other bryozoa. The zoecia are curved and considerably narrowed below the opesia. The marginal avicularia prominent with a triangular beak which is decurved at the tip. Frontal avicularia rare and very large, elongate spatulate and straight, with a decurved tip. Zoecia hemispherical, with scattered pores which are slightly raised into short tubes.

Harmer (1926: 382) has placed this species under the synonymy of *S. spatulata* (D'Orbigny), but with this I must disagree for the following reasons. The giant avicularia are always frontal in position, usually on the axial zoecium below a bifurcation, though they are not always there and they may occur on other zoecia. They are directed downward and occupy practically the whole of the frontal gymnocyst. The marginal avicularia, which are often enlarged in *spatulata*, are entirely unmodified in *pusilla*. Smitt's figures (pl. 5, figs. 32 to 34) agree closely with my material, though he does not show the ovicell, and the frontal avicularium, if that is what is shown in his figure 32, is smaller. The arrangement, however, agrees and

his description states that they are rare and limited to the median zoecium at the ramification.

Zoocial length, 0.44 millimeters; width at broadest part, 0.10 to 0.12 millimeters. Diameter of radicle, 0.025 millimeters; longest vibracula, 0.90 millimeters or more, usually about half that length; longest spines, 0.66 millimeters, usually much shorter.

Florida, Smitt (1872: 13, *Cellularia*) in Pourtales' collections; Tortugas Islands, Osburn (1914: 191, under *S. cornigera*, as a recent re-study of my material shows a mixture of the two species). In Porto Rican waters it occurred at Stations 2353, 2354, 2357, 2363 and 2367 off Guanica Harbor, and at Station 2377 off Tallaboa Bay, at 6 to 20 fathoms.

Scrupocellaria cornigera (Pourtales) 1867

Pourtales description of his *Canda cornigera* is very inadequate, but Smitt (1872: 14, *Cellularia*) had some of his material, furnished a full description and accepted the specific name. Osburn (1914: 191) recovered it at the Tortugas at 10 to 15 fathoms. The species did not occur in our Porto Rican collections, nor has it been noted elsewhere except for Marcus' recent (1937: 55) report of it at Rio de Janeiro, Brazil.

Harmer (1926: 383) indicates that *cornigera* "seems to be closely allied to *S. pusilla*." It differs from *pusilla*, however, in that the vibracular chambers are smaller and are broader than long, the marginal avicularia are smaller and the frontal avicularia are altogether different.

Scrupocellaria bertholletii (Audouin) 1826

The zoecia are somewhat elongate and are narrowed rather suddenly proximal to the opesia, which occupy about half of the frontal length. Three or four outer and one or two inner distal spines are present. The scutum, when fully developed, is a four-pointed spine. Two points are more frequent, or only one, and often there is no indication of the scutum. There are two types of frontal avicularia: a small triangular one immediately below the aperture, and a giant one with a longer pointed mandible in the same position. The latter is usually present on the axial zoecium below a bifurcation, but may appear elsewhere. Frontal avicularia are wanting on many zoecia. The small lateral avicularia indicated by various authors as usually present appear to be wanting from West Indian material. The oecia are rounded, but may be somewhat longer than broad, with a number of pores, the openings of which may be raised somewhat above the surface. Radicle fibers strongly armed with retrorse hooks.

Zoocial length, 0.40 to 0.45 millimeters; width, 0.15 to 0.18 millimeters; diameter of radicle, 0.035 millimeters.

Porto Rico, Station 2381, off Guanica Harbor, several colonies at five fathoms. I have the species from the Tortugas Islands, and a colony from Bermuda collected by Dr. H. Prat. Marcus (1938: 24) lists it for Santos Bay, Brazil. It is widely distributed in the eastern Atlantic, Mediterranean, and Red seas, and Hastings has listed it from the Galapagos Islands. It has not previously been recorded from West Indian waters.

Scrupocellaria maderensis Busk 1860

This species may be distinguished in West Indian waters by the presence of two axial vibracula, a broad crescentic cryptocyst in the proximal side of the opesium, and the broad scutum which is truncated next to the operculum. The oecia are somewhat flattened and lack the usual pores.

Reported to the author (*in litt.*) by Dr. Anna B. Hastings, from the Tortugas Islands, in the Colman and Tandy collection.*

CANDA Lamouroux 1816

The most striking character of this genus is the union of the branches by cross radicles which run from one vibracular chamber to another. The ovicell is usually surmounted by an avicularium. A scutum may or may not be present. Otherwise, like *Scrupocellaria*.

KEY TO THE SPECIES

1. No distal spines, no scutum.....*C. caraibica*, page 387.
One or two distal spines..... 2.
2. Scutum well developed.....*C. retiformis*, page 388.
Scutum absent.....*C. simplex*, page 388.

Canda caraibica Levinsen 1909

This species is easily distinguished by the absence of both the scutum and the distal spines. The proximal gymnocyst is short, not more than one third of the frontal length. Vibraculum rather stout, about as long as the width of a branch. Neither oecia nor avicularia have been noted.

Described by Levinsen (1909: 142) from "West Indian material," without exact data. Tortugas Islands, Osburn (1914: 192) at 15 fathoms. Porto Rico at Stations 2334 and 2357, Guanica Harbor, at 3 to 17 fathoms.

* Later Dr. Hastings has written that she has also found *S. frontis* Kirkpatrick 1888, in the Colman and Tandy collections from the Tortugas Islands.

Canda retiformis Pourtales 1867

Zoarium dichotomous, the branches connected every few zoecia by cross radicles which give a ladder-like appearance. Zoecia facing slightly outward. One or two short terminal spines. Opesia occupying about half the length, a broad scutum covering most of the aperture. Avicularia wanting. Vibracular chamber large, the sulcus somewhat curved and placed at an angle of about 45 degrees. Vibracula short, usually not longer than the width of a branch. Ooecia rounded with a small raised lip.

Florida, Pourtales (1867: 110); Gulf of Mexico and Straits of Florida, Smitt (1872: 16, *Caberea*); Gulf of Mexico and Straits of Florida, Canu and Bassler (1928: 43, *Scrupocellaria*), 30 to 270 fathoms. It did not occur in our collections from Porto Rico.

Canda simplex Busk 1884

Zoarium spreading, rather closely reticulate. A small spine at each upper angle. No frontal avicularia except on the summit of the ooecia.

Recorded by Busk from the Gulf of Mexico, 2 to 17 fathoms and off the Chesapeake Bay at 1700 fathoms.

Family BUGULIDAE Gray 1848

The zoarium is erect and branching, flexible, usually without joints, attached by radicles and the zoecia all face in the same direction. The zoecia are little calcified, elongate quadrangular, somewhat narrowed toward the base, with the opesia occupying most of the frontal surface. The ooecia are attached by a short stalk and the avicularia are freely movable on longer or shorter pedicels.

KEY TO THE GENERA

1. Branches consisting of three or more parallel rows of zoecia *Dendrobeania*, page 392.
- Branches of only two rows of zoecia 2.
2. Zoecial branches attached to slender jointed stems which consist of modified zoecia (kenozoecia) *Caulibugula*, page 392.
- Stems not so formed, stalk kenozoecia absent *Bugula*, page 388.

BUGULA Oken 1815

KEY TO THE SPECIES

1. Branches composed of 2 to 4 series of zoecia *B. fabelata*, page 391.
- Branches with never more than 2 series of zoecia 2.
2. Color reddish brown 3.
- Color pale, yellowish or grayish 4.

3. Avicularia absent *B. neritina*, page 389.
- Avicularia present *B. minima*, page 390.
4. Colony simple; avicularia absent; opesia oval, not more than half the zoecial length *B. johnstoniae*, page 392.
- Colony more complex; avicularia present; opesia longer 5.
5. Ooecia very small, hemispherical, inconspicuous *B. microoecia*, page 391.
- Ooecia larger, conspicuous 6.
6. Avicularian beak long, gently decurved *B. avicularia*, page 390.
- Beak short, strongly decurved, ooecia blue-gray *B. dentata*, page 389.

Bugula dentata (Lamouroux) 1816

Zoarium erect and branching, the branches narrow, biserial, the outer distal corners of the zoecia little projecting, radicles contributing to the formation of a short, stout stalk. Zoecia turned somewhat toward each other, the outer angle somewhat inrolled. Opesia about three-fourths as long as the front, narrowed proximally more or less. Three long, stout, jointed spines on the outer distal margin and a smaller one on the inner corner. Avicularia of two kinds, a smaller one of ordinary type with hooked beak which is slightly sinuated, situated below the middle of the zoecium on the outer border, and a much larger one (not present in Porto Rican specimens examined) with an elongate boat-shaped mandible. The ooecia are globular, situated between the inner and the distal outer spines. They are inclined toward the midline of the branch and rotated slightly so that their apertures open somewhat away from each other. In fresh specimens the ovicells are of a distinctly blue-gray color, but this fades in the course of time in alcohol.

The species has a wide distribution in warmer waters, but this is the first time it has been noted in the western Atlantic. Porto Rico, Station 2353 and 2367, off the mouth of Guanica Harbor, at 7½ to 13 fathoms. The material is very scanty, but ooecia are plentiful and all the characters of the species are well defined, except that none of the larger avicularia are present. I have also a small specimen collected by Dr. H. Prat at Bermuda.

Bugula neritina (Linnaeus) 1758

Zoarium erect, bushy, forming reddish brown tufts often three or four inches in height, the basal portion supported by numerous descending radicle fibers. Zoecia plain, not much expanded distally, the membranous area extending nearly or quite to the proximal end, the distal corners produced into sharp angles or points; avicularia and jointed spines wanting. The ooecium is subglobose, attached at the

inner corner of the zooecium by a short pedicel and turned transversely across the top of the zooecium so that its aperture opens toward the outer corner. The reddish brown color of this species and *B. minima* is usually quite distinctive among our American forms.

Tortugas Islands (Osburn 1914: 186) and Curaçao Island (1927: 126); Bermuda Islands (Verrill 1900: 588). Porto Rico at Stations 2339 and 2385 off Guanica; 2334 and 2364 in the Harbor; 2347 off Parguera, and at Guayanilla; especially on piles of docks and on mangrove roots. This well known circumtropical species was very abundant in shallow water, becoming more rare in outside waters down to 6 fathoms. The writer has taken it in abundance as far north as Beaufort, North Carolina, and Marcus (1937: 67) records it as far south as Santos, Brazil.

Bugula minima (Waters) 1909

B. neritina var. *minima* Waters (1909) 136.

It appears that this form should be raised to the dignity of a distinct species for the following reasons: (1) the characteristic differences listed by Waters (size of zooecia and oecia, and the presence of avicularia) are distinctive wherever found throughout its range which appears to be circumtropical; (2) there is a difference in the mode of branching (Harmer's type 4 instead of type 5); (3) the colonies never reach the size of those of *B. neritina* even when growing under the same conditions. The avicularia are somewhat elongate and narrow with a long beak and are attached at the side of the lower end of the aperture.

Porto Rico, Guanica Harbor on piles of docks. Osburn (1914: 187) Tortugas Islands.

Since writing the above, I have received Dr. Anna B. Hastings' critical paper on cellularine Polyzoa (Oct. 1939, Novitates Zool.) in which she comes to the same conclusion. In the light of her paper I have re-examined my material and find my West Indian specimens to be definitely *minima*. Of her new species, *B. crosslandi*, I have a specimen from Bermuda.

Bugula avicularia (Linnaeus) 1758

This species, which is not uncommon along the New England coast, has been listed by Canu and Bassler (1928: 41) for the Gulf of Mexico at 724 fathoms. They have incorrectly cited my reference to the species from the Woods Hole region (Osburn 1912: 226, *Bugula avicularia*) as *Synnotum avicularia*, apparently confusing it

with my reference to *S. aviculare* (Pieper) at the Tortugas Islands (Osburn 1914: 191).

This species did not occur in our Porto Rico collections.

Bugula microoecia Osburn 1914

Bugula microoecia Osburn (1914) 187, figs. 1, 2, 3.

Zoarium delicate, composed of a central stalk with long, narrowly flabellate branches arising in an irregularly dichotomous fashion from the main stem. The stalk, as well as the basal part of its branches, consists of very much elongated and modified zooecia arranged serially. The form is therefore somewhat intermediate between *Bugula* and *Caulibugula*, but the stalk zooecia contain polypides and occasionally have avicularia. Definite joints are present at the bifurcations, but these are not so well developed as in *Caulibugula*. Numerous strong radicle fibers arise from the lower stem zooecia.

Zooecia long, slender, little expanded; frontal aperture extending almost to the base and facing somewhat towards the axis of the branch; avicularium short, stout, with strongly decurved beak, set on a very short stalk near the distal end of the outer border; the distal outer border is continued into a short, stout, pointed spine. Oecia very small, hemispherical, set very low down, very inconspicuous and partially hidden by the spine.

Tortugas Islands (Osburn 1914: 188) at 18 fathoms, several colonies, the largest 2.5 inches tall. Porto Rico, Station 2353, off the mouth of Guanica Harbor, 7½ fathoms.

Bugula mollis Harmer (1926: 445) is much like *B. microoecia* in many respects, but it appears to be a coarser species with more spines and with the joints less completely developed. There appear to be differences in the oecia also.

Bugula flabellata (J. V. Thompson) 1847

Zoarium erect, flabellate, the branches usually beginning with two series of zooecia and ending with three or four. Zooecia elongate, the membranous area extending to the base; lateral margin free of spines, but 2 to 4 elongate spines may occupy the distal margin. Avicularia moderately large, longer than the width of a zooecium. Ovicell directly in line with the zooecial axis, hemispherical and somewhat hood-like.

Porto Rico, taken only once on the piles of a dock at Ponce. Florida (without locality), Smitt (1872: 18); Tortugas Islands, Osburn (1914: 187); Santos Bay, Brazil, Marcus (1938: 27). North-

ward along the Atlantic coast to Maine. Widely distributed, especially in temperate seas.

Bugula (Halophila) johnstoniae (Gray) 1843

The zoarium is of a simple *Bugula* type, erect, branching. Zooecia in two series, aperture oval, about as long as the basal portion, which is much constricted; a very short spine, often wanting, on the outer distal angle; no avicularia; ovicell smooth, hemispherical.

Smitt (1872: 17) listed the species from Florida without locality. Canu and Bassler (1928: 42) report it from the Gulf of Mexico. It did not appear in the Porto Rico collections.

DENDROBEANIA Levinsen 1909

This genus was separated from *Bugula* by Levinsen in 1909 to include species with multiserial branches in which the zooecia are provided with an operculum. Usually lateral spines are present, avicularia not limited to the outer margin, and several minor characters.

Dendrobeatia lamellosa Canu & Bassler 1928

Canu and Bassler described the species from east of Yucatan, the only record thus far. It is evidently related to the well known *D. murrayana* (Johnston) of more northern waters, but differs in the form of the avicularium, the heavier lateral spines and the smooth ovicell.

CAULIBUGULA Verrill 1900

Bugulas with jointed stalks consisting of elongate, cylindrical kenozoecia; branches never more than biserial; proximal zooecia of branches differing more or less from distal ones; ooecia often incomplete.

This is the same as *Stirparia* Goldstein 1880 (preoccupied), and renamed *Stirpariella* by Harmer 1923, who at that time misunderstood Verrill's use of the genus. Later Harmer (1926: 456) corrected the error. The species have usually been allocated to *Bugula* until recent years.

KEY TO THE SPECIES

1. Ooecia completely formed..... 2.
- Ooecia incomplete, wide open hoods..... 3.
2. Ooecia large, prominent, longer than broad..... *C. caraibica*, page 394.
- Ooecia moderate in size, broader than long..... *C. armata*, page 393.
3. Primary zooecium of a branch little modified, spines few, no stem vesicles ...
- *C. levinseni*, page 394.
- Primary zooecium modified, with about 8 spines, numerous membranous vesicles on stem internodes..... *C. zanzibariensis*, page 395.

Caulibugula armata Verrill 1900

Stirparia dendrograpta Waters (1913).

A delicate, beautiful species, with stolon and radicles, and with erect jointed stalks from which there diverge at the upper end fan-like branches composed of zooecia in biserial arrangement. The stalks, which are often branched, are composed of kenozoecia of varying length. The first zooecium of a branch differs in form, bears no avicularium and has six to eight spines about its border. The ordinary zooecia have rather wide open opesia which extend well toward the base; they are curved outward somewhat distally, considerably narrowed proximally; the distal end rounded, angulated, or provided with 1 to 4 jointed spines. There is a peculiar distribution of the avicularia (Osburn 1914: 189), which on the lower zooecia are attached near the proximal end of the opesia, while in the next few succeeding zooecia they are situated more and more distally until the upper zooecia have the avicularia at the outer distal corner.

Porto Rican Survey at numerous stations, at low tide on mangrove roots and piles of wharves, down to 20 fathoms on sponges, corallines, etc., one of the most generally distributed species of the region. Verrill (1900: 588) Bermuda Islands; Osburn (1914: 188) Tortugas Islands; Marcus (1938: 29) Santos Bay, Brazil.

The *Stirparia dendrograpta* of Waters (1913: 470) is apparently the same as *C. armata* Verrill. Waters probably overlooked Verrill's inconspicuous paper and at the time of publication of my Tortugas paper (1914) I had not received Waters' paper on the Bryozoa of Zanzibar. Dr. Marcus, in his excellent review of *Stirpariella* (1925), has offered an analysis of 12 species and indicates differences between *armata* and *dendrograpta* as follows:

- C. dendrograpta*: ooecia on the inner corner; 8 spines on primary zooecia, 3 on other zooecia; internodes of stalk about equal, except the distal one which is shorter.
- C. armata*: ooecia on the outer corner; 6 spines on primary zooecia, 1 or 2 on other zooecia; internodes of stalk alternating longer and shorter.

With the abundance of material at my disposal I am able to determine that the spines of the primary zooecia vary from 5 to 11 usually 6 to 8; those of other zooecia from 0 to 4, usually 2 or 3 on the distal zooecia of a branch. The stalk internodes are subject to a great deal of variation in length, with no alternation or other regular arrangement. The distal internodes are usually short, but others may be. The internodes of two stalks from the same colony measure

in millimeters as follows, from base to tip: 0.92, 1.45, 1.20, 1.06, 1.26, 1.06, 1.20, 1.08, 0.55, 0.46; 1.20, 1.26, 0.66, 1.32, 1.35, 1.58, 0.60, 0.53.

The tentacles and zooecial measurements are about the same and both have the peculiar distribution of the avicularia referred to above. Also there appears to be no difference in the position of the ovicell. Waters states only "The ovicell is lateral and pedunculate," but his figure (1913. pl. 66, fig. 4) shows it attached at the inner corner. In *armata* they are also attached to the inner corner, without any doubt. My earlier statement (Osburn 1914: 189) indicating attachment to the outer corner was either due to faulty observation or more probably to a *lapsus calami*, whatever the explanation, the statement is incorrect. I can find no characteristic differences between *armata* and *dendrograpta*.

Caulibugula armata appears therefore to have a circumtropical distribution, similar to that of many other warm water species.

Caulibugula caraibica (Levinsen) 1909

Zoarium stolonate, rising into long-stalked tufts which may reach a height of 150 millimeters; the flabellate branches usually arranged alternately; the stalks composed of jointed kenozoecia and lateral stalks may arise from the main one. It has a fine purple color and when fully developed is one of the most conspicuous of the Bryozoa.

Zooecia biserial, with the areas turned somewhat inward, the distal end truncated and a single spine occasionally at the middle of the distal end; primary zoecium of a branch differing in form, not truncated and without spines; small avicularia with a curved beak are sparsely distributed; ooecia large, prominent, longer than broad, attached at the middle of the distal end of the zooecia and radiately striated. Radicles arise from the proximal ends of the stems.

Zooecial length, 0.45 millimeters; width, 0.16 millimeters. Avicularia, 0.11 millimeters; ooecia, 0.29 millimeters long by about 0.25 millimeters wide.

Levinsen (1909: 104, *Bugula*), St. Croix Island; Osburn (1914: 188, *Bugula*), Tortugas Islands on piles of docks; Canu and Bassler (1928: 40, *Bugula*), Gulf of Mexico, 24 fathoms. In our Porto Rican collections this species appeared only once, a small specimen on a dock at Ponce.

Caulibugula levinseni NEW SPECIES

PLATE 4, FIGURES 36, 37, 38, 39

Zoarium stolonate with erect stalks composed of jointed kenozoecia, with flabellate, biserial branches. Zooecia moderate in size,

rather narrow, about one-fourth as wide as long; facing nearly forward, opesia extending nearly to the base and narrowed proximally; distal corners usually with only a sharp angulation, but occasionally there is a very elongate spine on the inner angle, jointed at the base and chiefly on the distal zooecia of a branch. Avicularia moderately elongate, the sides of the beak flaring outward slightly, attached at the side of the opesia near the proximal end, not abundant. Ooecia of medium size, abundantly developed as wide open hoods.

Primary zoecium of a branch differing but little from ordinary zooecia, opesia extending nearly to the base, the distal angles usually only a little elongated but occasionally there are very elongate, jointed spines. Rarely two such spines occur on the outer angle.

Zooecial length, 0.33 to 0.40 millimeters; width, 0.08 to 0.10 millimeters. Avicularia, 0.13 millimeters; ovicell about 0.11 millimeters in width. The kenozoecia of the stalk vary in length 0.55 to 1.30 millimeters, and in width from 0.045 to 0.060 millimeters. Radicles arise from near either end of an internode, irregularly waved, 0.03 to 0.035 millimeters in diameter.

Dredged in the middle of Guanica Harbor, Porto Rico, at a depth of 2 to 3 fathoms, one much branched colony about 15 millimeters in height.

Dedicated to the memory of Dr. G. M. R. Levinsen, who described a number of West Indian Bryozoa and whose monumental work on the cheilostomatous Bryozoa (1909) is very important in the study of this group.

? *Caulibugula zanzibariensis* (Waters)

Stalk kenozoecia of what appears to be this species were found in one dredging near the mouth of Guanica Harbor, Porto Rico. The kenozoecia are abundantly provided with pear-shaped vesicles quite similar to those figured for *zanzibariensis* by Harmer (1926. pl. 33, fig. 10). Similar vesicles are known for *C. caliculata* (Levinsen), *C. glabra* (Hincks), and *C. mortenseni* Marcus, all of which are from the East Indian region. *C. zanzibariensis* is known from eastern Africa and the East Indies.

While no fully developed zooecia are present in the Porto Rican material, the nature of the kenozoecia, the vesicles, radicles, and a single basal zoecium of a branch all appear to be closer to *zanzibariensis* than any of the other species. The internodes, radicles and vesicles are all yellowish to light horn-colored. The internodes range in length from 0.65 to 2.70 millimeters, usually either about 1.50 or about 2.50 millimeters; in diameter they range from 0.13 to

0.20 millimeters. The radicles measure about 0.04 millimeters in diameter. The vesicles are sessile or very short stalked, elliptical or pear-shaped, variable in size and form ranging from 0.20 to 0.50 millimeters in height and 0.15 to 0.25 millimeters in diameter.

The stalk kenozoecia appear to be just starting to regenerate new branches, as several very young and only slightly chitinized basal zoecia are present. One of these is sufficiently developed to show the opesia form of *C. zanzibariensis* with eight partially developed spines.

This is the first time a species of *Caulibugula* with stalk vesicles has been observed in Atlantic waters.

Family BICELLARIELLIDAE Levinsen 1909

CORNUCOPINA Levinsen 1909

Cornucopina antillea Osburn 1940

Cornucopina antillea Osburn (1940) *Smithson. Misc. Coll.* 91 (30): 1-3, pls. 1, 2.

Zoarium erect, stalked, profusely branched. The type specimen is about 80 millimeters in height, free from branches for about 25 millimeters above the attachment, and the stalk is conspicuously thickened by the large number of radicle fibers. The central stalk and the stems of all the branches are formed primarily by the union of the tubular proximal ends of the biserial, alternating zoecia.

The nearly transparent zoecia are about 1.00 millimeters long, the basal half rather narrowly tubular, the distal half expanding rather suddenly outward at an angle of 45 degrees. The opesia occupy nearly all of the upper surface of the expansion; the operculum semilunar, thickened a little at the border. The distal margin, dorsally, is beset with a row of 4 or 5 exceedingly elongate, tubular, slightly curved spines, which are jointed at the base. There is no indication of a digitiform process; the spines originate separately from the zoecial wall. The longest spines are more than twice the zoecial length, reaching a maximum of about 2.50 millimeters. A smaller spine occurs at one side of the area near its base and above this on the side there may be another somewhat larger one.

Avicularia are of two kinds. One of these is excessive elongate, averaging about 1.40 millimeters (range 0.95 to 1.90 millimeters), originating on one side near the distal end of the aperture, with a slender tubular stalk and jointed at the base. It expands but little until near the distal end; both beaks are hooked, the mandible more strongly. There is much variation in the size of the mandibulate

portion, the largest being only slightly smaller than a zoecium, the smallest very narrow in comparison, and the size is not coordinated with the length of the pedicel. The second type of avicularium is very small in comparison, only about 0.20 millimeters long, and is short pedicellate. They are not numerous and occur more frequently just above the bifurcation of the branches and at inner side of the opesia. The mandible is noticeably more transverse than in the elongate type.

Ooecia moderately large, about 0.32 millimeters in width, somewhat globular, the rim of the aperture a little flaring and the surface decorated with radiating lines; attached laterally in front of the elongated spines. The radicle fibers arise from the side of the zoecia near the base of the opesia, more frequently from the basal zoecia of the branches, and they follow the stalk down to its point of attachment before spreading out for anchorage.

Dredged by the Johnson-Smithsonian Deep Sea Expedition, a short distance west of Porto Rico, at 400 fathoms, only the type specimen known.

This record is of special importance as hitherto the genus has not been known from the northern hemisphere. (In Harmer's paper, 1926 p. 422, the occurrence of *C. dubitata* Calvet in the "Bay of Biscay" is evidently a typographical error for the Bay of Biscay, Graham's Land, Antarctica.)

Family BEANIIDAE Canu & Bassler 1927

Zoecia little calcified, well separated, connected by stolonate projections. Ooecia wanting. Pedunculate avicularia usually present. The zoecia all face in one direction and the opesia occupy all or nearly all of the frontal surface. Radicles for attachment in many cases.

BEANIA Johnston 1840

KEY TO THE SPECIES

1. Zoarium multiserial.....*B. hirtissima*, page 397.
Zoarium uniserial, branching..... 2.
2. Spines wanting.....*B. intermedia*, page 398.
Spines present..... 3.
3. Five or six weak spines on each side.....*B. cupulariensis*, page 399.
About ten stronger spines on each side.....*B. mirabilis*, page 398.

Beania hirtissima (Heller) 1867

Zoarium forming a unilaminar encrusting, spinous mat, or erect and branching in tubular form and bristling like a porcupine. Zoecia

more closely associated than in the other species, the tubular connecting joints shorter. The opesium occupies all of the frontal surface to the constricted base and is bordered by very numerous slender, more or less erect spines. No avicularia.

The species is widely distributed in warmer waters, but has not hitherto been recorded from North American waters. One small specimen of a few zoecia was dredged off the mouth of Guanica Harbor, Porto Rico, and I have several other specimens from Bermuda, collected in May, 1936, by Dr. S. R. Williams. Dr. Marcus has also recorded it for the Bay of Santos, Brazil (1937: 62).

Beania mirabilis Johnston 1847

Zoecia sharply divided into a body and an elongate tubular portion which is often as long as the body. The terminal, lateral, and radicle buds all arise near each other within a short distance from the proximal end of the body. The rather strong lateral spines curve over the area, except the most distal pair which are directed somewhat forward. In addition there is a pair of short stout distal spines. No avicularia.

Length of body portion about 0.60 millimeters; stalk portion 0.30 to 0.60 millimeters.

Porto Rico, Stations 2347, 2363, and 2381, all off the mouth of Guanica Harbor, at 5 to 20 fathoms. Previously recorded from the West Indian region by Osburn (1914: 189), Tortugas Islands, 18 fathoms. It is distributed around the world in temperate and tropical seas. Marcus (1937: 60) lists it for Santos Bay, Brazil.

Beania intermedia (Hincks) 1881

Stalk not sharply differentiated, zoecium narrowing gradually. Distinct spines are wanting, but there is a pair of distal angulations and another opposite the operculum. An avicularium mounted on a short stalk on one or both sides of the distal end. The terminal bud arises distally on the dorsal side almost beneath the operculum; lateral buds arise about half way along the side of the zoecium; radicle buds originate in the midline of the dorsum a little proximal to the lateral buds. Total length of the zoecium including stalk about 0.90 millimeters.

Porto Rico, Stations 2337, 2339, and 2363, off Guanica Harbor at 6 to 35 fathoms. Tortugas Islands (Osburn 1914: 189). Distributed around the world in warmer waters. Marcus (1937: 61) records it for Santos Bay, Brazil.

Beania cupulariensis Osburn 1914

Zoecial stalk short and rather sharply narrowed from the body, the latter symmetrically elliptical and wider in proportion than in the two preceding species. About five or six weak spines (4 to 7) are curved over the area on each side and two small spines project forward close together at the distal end. An avicularium with a short peduncle at one or both of the distal corners. Terminal bud dorsal and distal, opposite the operculum; lateral (branch) buds about the middle of the side; radicle bud median and usually a little proximal to the lateral ones. Total length of zoecium 0.90 millimeters. It has the peculiar habit of growing inside the concavity of *Cupuladria* (*Cupularia*).

The species was described from the Tortugas Islands, where it was found on the dorsal side of *Cupuladria canariensis* (Osburn 1914: 190, *Cupularia guiniensis*). At Porto Rico one colony was found at Station 2349, off Parguera, at 10 fathoms. Harmer (1926) has recorded it from the Sulu Archipelago and the Aru Islands.

Family FARCIMINARIIDAE Busk 1852

Zoarium erect, jointed, with narrow branches and few bifurcations; the joints round or flattened and unilaminar or bilaminar; radical fibers usually present. Zoecia elongate, little calcified, aperture large. Avicularia adventitious, sessile, sometimes wanting. Ovicell endozoecial, large, reduced, or sometimes wanting.

KEY TO THE GENERA

1. Avicularia paired..... *Nellia*, page 399.
- Avicularia single, median..... 2.
2. Branches square, zoecia in four series..... *Columnella*, page 401.
- Branches flattened, bilaminar, at least 3 series of zoecia on each face
- *Farciminellum*, page 401.

NELLIA Busk 1852

Zoarium erect and jointed, internodes rounded. Zoecia elongate without spines. Ovicells deeply immersed and difficult to observe. A pair of small avicularia on the proximal part of the gymnoecyst.

KEY TO THE SPECIES

1. Internodes with six series of zoecia..... *N. cereus*, page 400.
- Internodes with four series of zoecia..... 2.
2. Avicularia inconspicuous, not raised, not divergent..... *N. oculata*, page 400.
- Avicularia larger, conspicuous, divergent, mandible hooked *N. tenuis*, page 400.

Nellia oculata Busk 1852

The mural rim is somewhat raised, enclosing an elliptical area slightly narrowed at the level of the opercular hinge. The operculum is about as wide as the area behind it. There is a narrow cryptocyst proximally and laterally. A pair of small rounded avicularia situated on the proximal part of the gymnocyst, with a rather wide pivot. Radical fibers arise on the gymnocyst. The zooecia are in regular series.

This widely distributed species has been reported from this region as follows: Florida (Smitt 1873: 3) 17-138 fathoms, Texas and St. Thomas (Levinsen 1909: 120, *N. tenella*), Tortugas Islands (Osburn 1914: 191) 10-18 fathoms, and by Canu and Bassler (1928: 26) from the Gulf of Mexico, 24-30 fathoms, and also from the Pliocene of Panama. In our Porto Rican collections it occurred at Stations 2347, 2382, 2385 in considerable numbers, 5 to 10 fathoms.

Nellia tenuis Harmer 1926

Habit typical, a series of upright stems being given off from creeping rootlets. Internodes short, narrow at the base which is composed of two zooecia. Aperture occupying most of the front, except in the proximal zooecia of the internode, the cryptocyst well developed proximally and narrower laterally. Avicularia opposite the proximal cryptocyst, diverging outwards and closely connected with the margins of the preceding alternate zooecia of the adjacent series; mandibles acute and hooked. Ovicells more developed than in *N. oculata*.

My two specimens, which are small and unbranched, agree with this description in every detail, but ovicells are wanting. The zooecia measure in length about 0.45 millimeters, and in width about 0.18 millimeters, so they also compare favorably in size.

Porto Rico, Station 2367, off mouth of Guanica Harbor, 13 fathoms. Otherwise known only from Harmer's material from the East Indies in the Siboga Expedition and from a specimen from Tizard Bank in the China Sea.

Nellia cereus (Pourtales) 1867

When this species first became a question which cannot be
 Fleming 1828, to which Pourtales assigned it, is a synonym of *Cel-
 lularia* Ellis and Solander 1886. Smitt (1873: 3) reexamined Pour-
 tales' material and thought it should be regarded as a distinct genus
 type but not name of it. The name has since been proposed.

Canu and Bassler (1929: 43) suggest that the *Farcimia* of Pourtales is "probably a synonym of *Nellia*," but the species is certainly different from *N. oculata*.

Smitt figures this species (1873, pl. 1, figs. 55, 56) and compares it (p. 4) with *Nellia oculata*. He especially calls attention to the row of interzooecial pores and the frontal pores in the denuded specimen. The frontal area is not narrow as in *N. oculata* and is largely closed by the cryptocyst. The "pores" mentioned by Pourtales are a pair of small sessile avicularia.

Pourtales recorded the species as "rather abundant in 270 fathoms off Havana."

COLUMNELLA Levinsen 1914

Branches square in transverse section, zooecia long, in four longitudinal rows, spines wanting, an avicularium typically present at the proximal end of the zoecium. Ovicells large and prominent. (After Harmer.)

Columnella brasiliensis (Busk) 1884

Zoarium about two inches high with five or six branches. Zooecia with opesia occupying practically the whole frontal area, slightly narrowed proximally. Oocia prominent, somewhat flattened, surface coarsely rugose. A small sessile avicularium with a semi-circular mandible. Recorded by Canu and Bassler (1928: 26, *Levinsenella*), Caribbean Sea, 683 fathoms. Otherwise known from the coast of Brazil, 9°, 5', S. Lat. (Busk 1884: 50, *Farciminaria*).

FARCIMINELLUM Harmer 1926

Branches pluriserial, bilaminar, flattened, with at least three series of zooecia on each face, those of the basal series being kenozoecial, without orifice or operculum, with the exception of the marginal row on each side. Median and lateral zooecia differentiated as in *Himantozoom*, their proximal ends not conspicuously forked and hardly overlapping their predecessors. Spines and avicularia present or absent, mandibles rounded. Ovicells present, or large eggs in the zooecial cavity. (After Harmer.)

Farciminellum (Farciminaria) atlanticum (Busk) 1884

Zoarium two to three inches high, arising in a single slender stem from a dense tuft of radical fibers, and dividing into several furcate branches. Zooecia multiserial, elongate-oblong, rounded at the top and slightly prominent; contracted downward; the sides of the front beset with numerous, simple incurved equidistant acute spines.

A rather large immersed avicularium of an oval form with a semi-circular mandible pointing upwards at the bottom of the front in the middle. Ooecium immersed, surface smooth. (After Busk.)

Challenger Expedition, Station 23, off Sombrero Island, 450 fathoms; Station 24 off Culebra Island, 390 fathoms.

Family EPISTOMIIDAE Gregory 1903

Zoarium branched, rising from a delicate stolon; zooecia in pairs, back to back, each pair beginning in short tubular processes; sessile and pedunculate avicularia. There is no ovicell, the gonozoecia slightly enlarged.

SYNNOTUM Pieper 1881

Synnotum aegyptiacum (Audouin) 1826

Zooecia small, delicate, scarcely calcified, the area occupying nearly the whole length of the front. A small sessile avicularium at one or both of the distal corners, and occasional stalked avicularia arising distally on the dorsal side of one or both members of a pair. The stalked avicularia are short and bulbous, with a short hooked beak and a very short hooked mandible. Radicle fibers also arise at the distal end of the zooecia.

A widely distributed warm water species. Porto Rico, Station 2349 off Parguera and Stations 2353 and 2367 off Guanica Harbor, 7 to 13 fathoms. Tortugas Islands (Osburn 1914: 191 *S. aviculare*) and Curaçao Island (Osburn 1927: 126). Other specimens in the author's collection are from Beaufort, North Carolina, and Dr. H. Prat has sent me a specimen from Bermuda. It is probably well distributed in the West Indian region, but no other writer seems to have noticed it. Canu and Bassler (1928: 41) are in error in listing Osburn's record of *Bugula avicularia* from Woods Hole as *Synnotum avicularia* (no doubt a *lapsus calami*). Marcus (1937: 58) lists it from Santos Bay, Brazil.

Division VI CRIBRIMORPHA Harmer 1926

This division of the Anasca is somewhat uncertain in our present knowledge of the genera concerned. With the subdivision of the chilostome Bryozoa undertaken by Levinsen (1909) it becomes necessary to assign the various families to their subdivisions. This is very desirable from the standpoint of the taxonomist, but in the evolution of any major group of organisms sharp lines may not al-

ways have been drawn. That appears to be the case with the forms which we assign to the division Cribrimorpha. There are several possibilities in the handling of this group. Levinsen (1909) erected only three divisions of the Anasca, and placed the members of the present group under his division 1, Malacostega. Since then the Anasca have been further subdivided and Harmer (1926: 470) has erected division VI to include the Cribrimorphs of Lang (1916). Marcus (1922: 47) placed them all in the Ascophora, and Canu and Bassler (1929: 27-30) divided the group between the Anasca and Ascophora, but Bassler (1935: 29) places the Cribrimorpha in division I of the Ascophora. Harmer (1926: 470-472) recognizes them as constituting an intermediate group with relations to both the Anasca and Ascophora and further states that "it is thus a matter for legitimate doubt whether they should be placed in the lower or higher of the two groups which they connect." At any rate this arrangement keeps together certain species which have a frontal shield or pericyst developed above the ectocyst, and in the present state of our knowledge of the development of the various members of this puzzling group, it appears to be a logical one, even though it be impossible to draw sharp lines. If Harmer (1926: 472) is correct in his interpretation of the conditions in *Figularia et altera*, we find in the cribrimorphs a series of stages leading up to the frontal and compensation sac which characterize Ascophora. Since the cribrimorphs have not fully developed either the Ascophora type of frontal or compensation sac, I prefer to leave this group where Harmer has placed them as a division of the Anasca, especially since the more primitive genera (*e. g. Membraniporella*) have no more than a series of anastomosed spines above a wide membranous area.

Family CRIBRILINIDAE

KEY TO THE GENERA

1. Avicularia frontal, dependent, at the side of the aperture..... 2.
Avicularia interzoecial, vicarious..... 4.
2. Frontal evidently of depressed spines, partly separated by transverse slits (lacunae) *Membraniporella*, page 404.
Frontal more closed, lacunae smaller in radiating rows..... 3.
3. Frontal with a large opening (spiramen) proximal to the aperture, besides marginal and central pores..... *Gephyrotes*, page 405.
Frontal shield without spiramen, rows of transverse pores between the costae *Cribrilina*, page 404.
4. Costular area occupying most of frontal, ribs thickened, lacunae small
..... *Puellina*, page 405.
Costular area small, limited to the centro-distal area..... *Figularia*, page 407.

MEMBRANIPORELLA Smitt 1873

Frontal formed by more or less coalesced recumbent spines (costules), beneath which is the membranous ectocyst; one distal and two pairs of lateral dietellae; ovicell hyperstomial, closed by the operculum.

Membraniporella agassizii Smitt 1873

The zoarium is erect, branching, unjointed; the zooecia arranged in four series forming a rounded stem and facing four directions. Frontal formed by the union of 8 to 12 pairs of ribs; avicularia short-pointed, one on either side of the aperture.

Recorded by Smitt (1873: 11) off Cojima, Cuba, 450 fathoms, since when the species has not been noted.

Membraniporella petasus Canu & Bassler 1928

Zoarium encrusting. Zooecia distinct, elliptical, elongated, swollen; costules broad and flat, 9 or 10 in number, with linear lacunae on the side and some small irregular ones near the middle. Peristome with 3 or 4 short palmate bifid spines. Ovicell large, globular, smooth.

Recorded by Canu and Bassler (1928: 36) north of Cuba at 201 and 143 fathoms.

CRIBRILINA Gray 1848

Frontal consisting of fused costules, forming a pericyst with the membranous ectocyst beneath. The costules are united at various places along their length, giving the frontal shield the appearance of being more or less regularly perforated in rows; a mucro usually present below the aperture. Dietellae present. Ooecia hyperstomial. Avicularia usually present, opposite the aperture.

Cribrilina lineata Canu & Bassler 1928

Zoarium encrusting. Zooecia isolated, arranged in linear series; large, elliptical, elongated; frontal very convex; costules 16, narrow, separated by very small and linear lacunae, median line raised. Peristome with 2 or 3 short, broad spines and 2 lateral tongues which sometimes unite to form an arch over the aperture.

Canu and Bassler (1928: 38), off Havana, 387 fathoms. Not otherwise known.

Cribrilina (Acanthocella) clypeata (Canu & Bassler) 1928

Zooecia distinct, elliptical, little elongated; frontal convex with the form of a shield; 8 or 9 transverse costules separated by large

lacunae; each costule bears three lumen pores of which the most exterior is very salient and in the form of a hollow spine; peristome thin, salient, with 2 or 3 short hollow spines.

Canu and Bassler (1928: 39), off Havana, Cuba, 78 fathoms, and Gulf of Mexico, 25 fathoms. Not noted in our Porto Rican collections.

Canu and Bassler in 1917 erected the genus *Acanthocella*, mistaking the nature of the operculum. This error they corrected in 1928 (p. 39) where they indicate also that *Acanthocella* should rank only as a subgenus of *Cribrilina* to include those species with tubular lumen pores.

GEPHYROTES Norman 1903

In the formation of the frontal shield (pericyst), a large opening (spiramen) is left in the midline proximal to the aperture, and there is a row of large lateral lacunae in addition to smaller, more central ones. A pair of avicularia opposite the aperture; ovicell small, imperforate; no dietellae.

Gephyrotetes spinosum Canu & Bassler 1928

Zooecia distinct, separated by a furrow, elliptical, a little elongated; costules 16 to 18, narrow, a little distinct, transverse, separated by very small lacunae, and bearing two or three very salient lumen pores which give the frontal a spinous aspect. Peristome thin, with a short hollow spine on each side and distally with 2 broad bifid spines often joined together.

Canu and Bassler (1918: 30), north of Cuba 143 fathoms, and Straits of Florida, 56 fathoms. Not in our collections from Porto Rico.

PUELLINA Jullien 1836

Costular area covering most of the frontal surface; the ribs thickened, the grooves between them provided with small lacunae in radiating rows. Aperture semicircular, oral spines present; avicularia acuminate, interzooecial. Ooecia hyperstomial.

Puellina innominata (Couch) 1844

There appears to be some question whether this is a distinct species or whether it intergrades with *radiata*. The presence of a single sub-oral pore seems hardly sufficient to separate it. However, it averages smaller in size, the costate area appears to occupy somewhat less of the frontal surface, and the costae are fewer in number and

more prominent. The bases of the costae are also enlarged into a series of knobs encircling the frontal.

Not taken at Porto Rico. Smitt (1873: 22, fig. 110); Canu and Bassler (1928: 73), Gulf of Mexico, Straits of Florida and north of Cuba at 30 to 130 fathoms.

Puellina radiata (Moll) 1803

Zoarium encrusting, small white colonies. Zoecia distinct, separated by deep grooves; frontal surface convex, the costate area covering nearly all of the frontal surface; costae usually 14 to 16 in number, between them radiating rows of small lacunae which are often elongated in the direction of the zoecial axis; one or more small pores in a median position near the aperture; an umbonate process sometimes present. The aperture is semicircular, straight on the proximal border, with about 5 oral spines. Ovicell rounded, smooth and glistening, usually with a small carina. Avicularia infrequent, vicarious, long pointed.

There is much variation in size. In three colonies which I measured the normally formed zoecia showed the following length ranges: 0.21 to 0.34 millimeters, 0.21 to 0.47 millimeters, and 0.26 to 0.60 millimeters. The average appears to be around 0.25 to 0.28 millimeters. In form also they vary greatly, usually they are about two-thirds as wide as long, but I have found individuals wider than long. The suboral median pores also vary greatly; there may be one or two, or more, when single they may be semilunate, rounded or elongated, when there are two they may be side by side or one in front of the other, when a larger number is present they are usually irregular in position.

Florida (Smitt 1873: 73), 60 to 176 fathoms; Canu and Bassler (1928: 73) off Havana, Cuba, 78 fathoms, and off Miami, Florida, 40 fathoms. In our Porto Rican collections it occurred at a number of stations, off the mouth of Guanica Harbor, down to 25 fathoms. Marcus (1937: 73) records it from Santos Bay, Brazil.

Some authors place this species in the genus *Colletosia*.

Puellina floridana (Smitt) 1873

Zoarium encrusting. Zoecia well separated by deep grooves, convex, the costate surface occupying practically all of the front; costae about 12, rather slender, with rather large rounded lacunae in radial series between the costae. Aperture roughly semicircular, the proximal border straight or slightly concave and thin. A short,

stout spine, sometimes flattened, on either side of the aperture, and a smaller median one sometimes present. Operculum well chitinized, brownish in color and bordered with a thick sclerite. Ovicells and avicularia have not been observed.

Florida, Smitt (1873: 23, *Cribrilina figularis* var. *floridana*) at 29 to 42 fathoms; Tortugas, Florida, Osburn (1914: 195), 5 to 15 fathoms; Gulf of Mexico, Canu and Bassler (1928: 74), 30 fathoms. Porto Rico, Station 2369, off Guanica Harbor, at 6 fathoms, encrusting shell. The Porto Rican specimens are somewhat larger than those recorded by Canu and Bassler, averaging about 0.50 millimeters.

FIGULARIA Jullien 1885

Frontal shield limited to the centro-distal region, costate, the costae partially separated by rows of lacunae or occasionally by slits. Operculum completely chitinized, closing the aperture. Ovicell large, hyperstomial. Avicularia when present vicarious. No dietellae.

Figularia (?) *ampla* Canu & Bassler 1928

Zoarium encrusting. Zoecia distinct, very large and little elongated; frontal very convex, with six pairs of very broad costules which are separated by series of minute lacunae; a salient median suture line. Ovicell large, smooth, carinated. Zoecial length, 1.5 millimeters; breadth, 1.0 millimeters. Aperture length, 0.26 millimeters; width, 0.30 millimeters.

Off Havana, Cuba, 201 fathoms (Canu & Bassler 1928: 75). Not otherwise recorded.

Infraorder ASCOPHORA Levinsen 1909

This group is characterized especially by the presence of a compensation sac, instead of the membranous ectocyst, beneath the calcified frontal surface. This sac usually opens at the proximal border of the aperture, but may open more proximally by means of a special pore (ascopore). The operculum, usually chitinized to a greater or less extent, is compound in most cases; that is, it is hinged in such a manner that the larger distal part opens upward at the same time the proximal part opens downward. The former movement permits the passage of the tentacles, while the latter opens the compensation sac. When other provision has been made for opening the compensatorium the operculum is simple, having only the larger anterior part. As a rule the members of this group are more fully calcified than those of the Anasca.

Family HIPPOTHOIDEAE Levinsen 1909

The zooecial front is usually transversely wrinkled, showing lines of successive calcification, and the zooecia are without a covering membrane. Rudimentary zooecia often present. Spines usually wanting. Dietellae present. Ooecia (sometimes on dwarfed gonozooecia) covered by kenozooecia, or by avicularia.

The family appears not to be a natural one, and may have to be dismembered.

HIPPOTHOA Lamouroux 1821

Zooecia distinct, often disposed in single series; front transversely wrinkled and without pores; aperture with a well-developed sinus and strong cardelles; avicularia wanting. The reproductive individuals are gonozooecia reduced in size and without polypide, with a conspicuous porous ovicell.

Hippothoa distans MacGillivray 1868

A very delicate species, white and glistening, the zooecia in a single series. The zooecia measure without the caudate portion only about 0.26 to 0.30 millimeters, while the caudate part is variable measuring from 0.13 to 0.26 millimeters. The "two short processes arising from the side of the zooecium" described by Waters (1904: 54), mentioned by the writer as occurring on Tortugas specimens, occur also on the Porto Rican material.

A very widely distributed species. Porto Rico off Guanica Harbor at 27 fathoms, on the stem of a coralline alga. Tortugas Islands, Osburn (1914: 198), low water to 12 fathoms.

Hippothoa divaricata Lamouroux 1821

Not taken at Porto Rico. Recorded by Canu and Bassler (1928: 77), Gulf of Mexico and Bahamas Islands; Marcus (1939: 134) from Brazil.

Hippothoa eburnea (Smitt) 1873

Gemellipora eburnea Smitt (pars) (1873) 35. pl. 9, fig. 178, but not pl. 7, figs. 152-156, which are *Pasythea eburnea* Smitt).

Not taken at Porto Rico. Canu and Bassler (1928: 76) have recorded it from the Gulf of Mexico, north of Cuba and east of Yucatan. In the writer's opinion they would have done better to rename the species, for certainly Smitt never distinguished it as different from his *Pasythea* (*Gemellipora*) *eburnea*, but since they have accepted it as a species of *Hippothoa* the name may be allowed to stand.

TRYPOSTEGA Levinsen 1909

The genus may be recognized by the constant presence of a zooeciule (dwarf zooecium) immediately distal to each zooecium. This possesses a minute aperture closed by a membrane, but without a polypide. In the case of fertile zooecia the zooeciule is enlarged to cover the ooecium.

Trypostega venusta (Norman) 1864

Lepralia inornata Smitt (1873) 61. pl. 11, figs. 215-6.

Gemellipora glabra forma *striatula* Smitt (1873) 37. pl. 11, fig. 207.

Zooecia distinct, rhomboid, inflated, with numerous pores and an umbonate process proximal to the aperture. The aperture is rounded in front of the strong cardelles and behind there is a rather large triangular sinus. The zooecia measure about 0.40 to 0.45 millimeters in length, by 0.26 to 0.30 millimeters in width. The ooecium with its enclosing zooeciule is about 0.25 millimeters long, by 0.20 millimeters broad, narrowed distally and surmounted by an umbonate process.

Porto Rico off Guanica Harbor at 20 fathoms. Smitt, Floridan seas at 26 to 60 fathoms; Osburn (1914: 198) Tortugas Islands; Canu and Bassler (1928: 77) north of Cuba, Straits of Florida and Gulf of Mexico, 30 to 201 fathoms; Marcus (1938: 35), Santos Bay, Brazil.

Family PETRALIIDAE Levinsen 1909

Frontal a tremocyst with moderately large pores. Proximal margin of aperture usually with one to three teeth (lyrulae) above the operculum. Peristome weakly developed. Spines rare. A perforated area (radicular pores) on the dorso-distal region. Avicularia usually one or two just proximal to the aperture. Ooecia hyperstomial, recumbent, with small pores.

The above description requires emendation to include *Coleopora* which Canu and Bassler have placed in this family, and still further change to accommodate *Hippopodina* which appears to be related. All of these genera have in common the large size of the zooecium, the nature of the frontal tremocyst, the large ovicell, the general form of the primary aperture, and the nature of the operculum with a chitinized border and lateral attachment of the muscles.

KEY TO THE GENERA

1. Peristome a high flaring tube.....*Coleopora*, page 410.
Peristome not tubular..... 2.
2. Aperture with two or more teeth on the proximal border *Petraliella*, page 410.
Aperture without proximal teeth.....*Hippopodina*, page 411.

PETRALIELLA Canu & Bassler 1927

A part of the older genus *Petralia* MacGillivray 1868, separated chiefly on account of the fact that the ovicell is not closed by the operculum. The peristomial shield is broad but not elevated.

Petraliella bisinuata (Smitt) 1873

Zoarium encrusting or rising in frills. Zooecia rather large and coarse, not much raised on the frontal surface, which is a tremocyst; a broad shield surrounds the aperture, bearing on one or both sides an avicularium, one often larger than the other; but frequently the avicularia are altogether wanting. The aperture is rounded in front, but bisinuate on the proximal border, a broad square lyrula separating the two narrow sinuses. The operculum is thin and light colored, but chitinized at the border in front of its attachment. The radiceled area on the dorso-distal surface appears as a deep round hole in calcined specimens. Ovicell large, hemispherical, minutely punctured.

There is considerable variation in size. Canu and Bassler give the measurements of the zoecial length as 0.90 to 1.15 millimeters, and the operculum 0.24, or 0.25 by 0.26 millimeters; and the var. *grandis* (1928: 80) from the Pliocene of Panama as 0.30; Smitt (1873: 59) gives the breadth of the aperture as 0.26, while some of the individuals among my Florida material measure as much as 0.30. The form of the proximal border of the aperture also varies, the sinuses sometimes almost wanting, or sometimes the median lyrula is narrow or pointed.

Porto Rico, near Caribe Island, 8 fathoms. Smitt (1873: 59, *Escharella*), Florida, 9 to 19 fathoms; Osburn (1914: 217, *Petralia*), 10 to 18 fathoms; Canu and Bassler (1928: 78) east of Yucatan, at 25 and 21 fathoms, and Gulf of Mexico, at 26 fathoms.

Petraliella marginata Canu & Bassler 1928

A species with a pectinate proximal margin of the aperture. Not taken at Porto Rico. Canu and Bassler (1928: 80), Gulf of Mexico at 26 to 43 fathoms.

COLEOPORA Canu & Bassler 1927

With the characters of the family, but with the peristomial shield raised into a tubular peristome. Ovicell hyperstomial and not closed by the operculum, the latter with a long muscle attachment on either side separated somewhat from the border.

Coleopora americana NEW SPECIES

PLATE 6, FIGURE 50

Zoarium encrusting. Zooecia large, distinct, elongate, the front ventricose, with numerous minute tremopores and with usually one or more (as many as 6) tall tubular processes which when fully developed may flare out, trumpet-shaped, at the tip. The peristomial shield is extended into a high, flaring peristome, which sometimes presents a wavy border. At the bottom of this is the aperture, which is semicircular in front of the cardelles while behind this the poster is narrowed somewhat and nearly straight on the proximal border, with a broad but slightly salient lyrula (sometimes wanting). The dorsal-distal radicular area is large and short elliptical in form. Avicularia and ovicells not present.

Zoecial length, 0.92 to 1.06 millimeters; width, 0.53 to 0.66 millimeters. Aperture length, 0.18; width, 0.18 to 0.21 millimeters.

Porto Rico, Station 2363, off Guanica Harbor, in 20 fathoms.

This species is apparently very close to *C. verrucosa* Canu and Bassler (1929: 267) from Jolo, the Philippine Islands, but has somewhat smaller zoecial measurements and the aperture is notably smaller; the aperture appears to differ somewhat in form also and the presence of the lyrula is not mentioned in the description of *verrucosa*. The tubular processes of the front also appear to be longer (as much as 0.15 millimeters in height). It is possible that it may be found to vary into *C. verrucosa*.

HIPPOPODINA Levinsen 1909

Levinsen (1909: 353) took *Lepralia feegeensis* Busk out of its old catch-all genus and erected the present one for this species. Unfortunately he made a very serious mistake in the nature of the ovicell which he described as endozoecial, while it is merely a deeply embedded hyperstomial ovicell. Dr. Anna B. Hastings examined Busk's type of *feegeensis* and I have studied material from the West Indies, Brazil, and Australia and in all cases the ovicell is hyperstomial. Canu and Bassler in 1927 established the genus *Cosciniopsis* with *C. coelata* Canu and Bassler as the type, to include species with a hyperstomial ovicell and renamed their specimens of *feegeensis* as *fallax* under the supposition that it was only superficially similar to *feegeensis* Busk.

The genus *Hippopodina* will stand, as Levinsen made *feegeensis* Busk the genotype, with the description amended to include the

hyperstomial ovicell. The family Hippopodiniidae Levinsen will have to be dropped, and Bassler (1936: 161) has given the family name Cheiloporinidae to the group of species with an endozoecial oecium.

The genus *Cosciniopsis* will apparently stand also, since its opercular characters seem to differentiate it sufficiently, and these characters appear to place it in the family Galcopsidae. Just where to place *Hippopodina* is more of a problem, but the general characters, the nature of the frontal, the peristomial shield, the character and arrangement of the avicularia, the deeply embedded oecium and especially the operculum with the muscle attachments on the lateral rib, are all reminiscent of the Petraliidae, though it does not possess dorsal radicular pores.

Hippopodina feegeensis (Busk) 1884

PLATE 7, FIGURES 54, 55

- Lepralia feegeensis* Busk (1884) 144. pl. 22, fig. 9.—Macgillivray (1891) 10. pl. 43, figs. 1, 2.—Waters (1913) 514. p. 70, figs. 21, 22.
Lepralia pulcherrima Canu & Bassler (1928b) 25. pl. 6, figs. 1, 2.
 † *Escharella audouinii* Smitt (1873) 56. pl. 11, fig. 211.
Hippopodina feegeensis Levinsen (1909) 353. pl. 24, figs. 3a-f.—Osburn (1927) 130.—Canu & Bassler (1928a) 133. pl. 34, figs. 1, 2.—Hastings (1930) 729; (1932) 413.
Cosciniopsis fallax Canu & Bassler (1929) 276. pl. 28, fig. 7.

Zoarium encrusting. Zoecia very large, well separated, broad and somewhat inflated, the frontal granulated and with small tremopores. Aperture large, elliptical or sometimes as broad as long, peristome low and usually thin, a pair of triangular cardelles of variable size; operculum slightly chitinized, with lateral ribs to which the muscles are attached. Ovicell very large, with small tremopores, deeply embedded. Avicularia long triangular to very elongate, situated at the side of the aperture and turned either forward or backward.

Porto Rico off Guanica Harbor, 8 fathoms. Levinsen (1909: 353), St. Thomas; Osburn (1914: 209, *Lepralia audouinii*), Tortugas.

In his original description Busk (1884: 144) indicated the ovicells as "inapparent," since then Levinsen (1909: 354) has described them as endozoecial and figured them so, probably being misled by their deeply embedded nature; Canu and Bassler (1929: 276) created a new species (*fallax*) in the genus *Cosciniopsis* to include the supposedly different form with hyperstomial ovicells, and another questionably new species *Lepralia pulcherrima* from Brazil (1928b: 25). Hastings (1932: 413) has reexamined Busk's original "Challenger" material and finds large hyperstomial ovicells, throwing *fallax* back

into the synonymy of *feegeensis*. Waters (1913: 514) and Osburn (1927: 130) have also added to the knowledge of the species. The writer has examined the type of *Lepralia pulcherrima* Canu and Bassler and finds it also to be synonymous.

The variations appear to have considerable range. The ovicells from different regions differ much in size; according to Hastings those of the type measure as much as 0.76 millimeters in width and those from Gorgona, Colombia only 0.40 to 0.45 millimeters; in the material I have studied, Tortugas specimens measure about 0.45 millimeters, Curaçao specimens 0.65 millimeters, *L. pulcherrima* from Brazil (type specimen) about 0.70 millimeters, and a specimen from Queensland, Australia, 0.78 millimeters. This is certainly a remarkable range for one species, but it intergrades, and there appear to be no other differences.

As to the avicularia, either there is much variation, or else several different species are involved. In the type they are directed forward and inward distal to the aperture; in other cases they may be directed inward and backward proximal to the aperture, or they may occasionally be directed straight forward or backward at the side of the aperture and I have seen one directed straight across proximal to the aperture; in the type and some others they may be very elongate, in other cases they are much shorter; they may be on both sides, or only on one side and very frequently they are wanting altogether.

The aperture shows considerable variation in size,—length, 0.18 to 0.30 millimeters; and width, 0.17 to 0.25 millimeters,—but as I have measured single colonies in which practically this whole range is exhibited, I take it to be of little importance. The cardelles appear to be similarly variable, often scarcely noticeable and again heavy triangular denticles; they seem to grow with increasing calcification of the zoecium.

Whether Smitt's description of *Escharella audouinii* D'Orbigny refers to this species is a question, but much of it is applicable. He observed no avicularia on his one colony, but frequently these may be wanting over considerable areas or entirely absent from a colony. There is a possibility that it refers to the following species (*H. irregularis* Osburn) on account of its heavier calcification and lack of avicularia. The tremopores, as drawn by Smitt, are fewer and larger than in either *feegeensis* or *irregularis*.

It is possible that there may be more than one species involved

in the material from various parts of the world, but I do not feel warranted in separating them at present. Dr. Anna B. Hastings has kindly given me the distribution of the avicularia as represented in the British Museum material. The long distal form, as in the type, is known from the western Pacific and Indian Oceans and the West Indies; the long proximal form from the West Indies and Brazil (*pulcherrima* Canu and Bassler); and the short distal form from Australia, Africa, Colombia and the West Indies.

As to the statement by Canu and Bassler (1928a: 25-26) that in *pulcherrima* the frontal is a "cryptocyst" there is evidently an error as I have examined the type which has a well developed tremocyst exactly like that of typical *feegeensis*. Their illustration (pl. 6, fig. 1) figures an early stage of calcification. If the form with reversed avicularia should be considered worthy of a varietal name, *pulcherrima* Canu and Bassler is available.

Hippopodina irregularis NEW SPECIES

PLATE 7, FIGURES 51, 52, 53

? *Escharella Audouinii* Smitt (non D'Orbigny) (1873) 56.

Zoarium encrusting corallines, etc., with a coarse single layer; color yellowish or light brownish. Zooecia heavily calcified, very irregular in size and form; large, length, 1.40 millimeters (0.90 to 1.60 millimeters), width, 0.85 millimeters (0.60 to 1.30 millimeters); gibbous, separated by well marked grooves; frontal a tremocyst with numerous small pores covered by a very thick ectocyst; lateral and distal walls with pore chambers. Aperture large, length, about 0.30 millimeters, width, about 0.27 millimeters; very heavy hinge denticles; distal part rounded, proximal part arcuate, large, nearly as broad as the anterior. Operculum well chitinized, darker in color than the frontal; a heavy chitinized rib around the distal portion slightly within the border, the muscle attachments situated on the rib; proximal border more broadly but less heavily chitinized than the anterior rib. Peristome low, not expanded, wanting entirely on the proximal border where the operculum is practically on a level with the frontal. Ovicell very large, width, 0.80 millimeters, length, 0.75 millimeters, heavily calcified, porous like the frontal and similarly covered with a very thick, smooth ectocyst; embedded for half of its depth in the distal zoecium, its exposed portion evenly rounded, encircling the aperture back to the cardelles. Avicularia not observed.

Porto Rico, Stations 2341, 2347 and 2377, off Guanica Harbor, at

5 to 27 fathoms, several colonies. Smitt (1873: 56, *Escharella audouinii*), Tortugas Islands, 37 fathoms. The colonies are not large, seldom more than 6 millimeters across, but the large size of the zooecia renders them fairly conspicuous.

This species is quite similar in general appearance to *Cosciniopsis coelatus* Canu and Bassler. It cannot belong to that genus however, as the operculum is quite different with the muscular attachments on the marginal rib. The characters of the operculum, aperture and ovicell place it close to *H. feegeensis* from which it differs in its deeper zooecia, much greater calcification, the heavy ectocyst, somewhat different shaped ovicell and entire lack of avicularia. It is almost certain that this is the *Escharella audouinii* of Smitt, though his specimen must have had the ectocyst eroded.

Family GALEOPSIDAE Jullien 1903

Characterized by the presence of a large pore (spiramen) extended into a tubule proximal to the aperture, wanting in some cases, but a pair of avicularia is directed across the aperture. Ovicell hyperstomial, opening into the peristome above the aperture.

GEPHYROPHORA Busk 1884

A prominent avicularium on either side of the peristome and pointing directly across the aperture, in some cases meeting and fusing to form a bridge above the aperture.

Gephyrophora rubra NEW SPECIES

PLATE 7, FIGURE 59

Zoarium encrusting, encircling an alga stem; brick red in color; rough in texture. Zooecia moderately large, swollen, with deep grooves between; surface roughly granular. Aperture oval; operculum moderately chitinized, with a heavy chitinized border proximally; attached by a strong pair of cardelles. Peristome low proximally, higher and thin distally; on either side a sharp pointed avicularium is directed straight across the aperture at about its middle: occasionally the points of the mandible nearly touch, but there is no evidence of fusion of the avicularia such as occurs in *G. polymorpha* Busk. Uniporous communication pores 10 or 12, forming a row at the base laterally, and 4 or 5 distally. Zooecia not present.

Porto Rico, Station 2362, off the mouth of Guanica Harbor, at 18 fathoms, the type specimen only. The genus has not hitherto been noted in American waters.

STENOPSIS Canu & Bassler 1927

Aperture rounded quadrangular, without cardelles; peristome elongated into a tube; spiramen broad and salient; frontal a tremocyst; avicularia present.

Stenopsis fenestrata (Smitt) 1873

Not found at Porto Rico. Smitt (1873: 47, *Hippothoa*), Florida, 17 fathoms; Canu and Bassler (1928: 84), Gulf of Mexico, 30 fathoms.

Family **SCLERODOMIDAE** Levinsen 1909

Zoarium erect and branched. Zooecia with a very thick tremocyst with tubules; primary aperture at the bottom of a very long peristomial tube; ascopore present; avicularia usually on or within the peristome; oocia hyperstomial, visible only on young zooecia.

SEMIHASWELLIA Canu & Bassler 1917

Zooecia on only one side of the zoarium, with some avicularia on the dorsal side; both faces of the stem covered by a tremocyst with sulci.

Semihawellia sinuosa Canu & Bassler 1928

Not taken at Porto Rico. Canu and Bassler (1928: 85), Gulf of Mexico at 724 fathoms.

Semihawellia proboscidea (Waters) 1888

Not taken at Porto Rico. Waters (Suppl. Rep. Polyzoa, Challenger Exp. 31 (79): 1, *Porina*), off St. Thomas Island at 729 fathoms.

TESSARADOMA Norman 1868

Zoarium erect, branched, the stems rounded with zooecia on all sides. The frontal is a pleurocyst with a row of marginal areolae.

Tessaradoma gracile (Sars) 1850

Zoarium of rounded stems, branching irregularly dichotomously, the zooecia facing in all directions. The frontal surface is smooth, with a row of pores around the border; peristome salient, with a rounded aperture; primary aperture with a pair of cardelles; the ascopore at the base of the peristome is really a spiramen which opens internally into the peristomie just above the operculum. Avicularia wanting.

Off the west end of Porto Rico, 400 fathoms, Johnson-Smithsonian Deep-Sea Expedition. Smitt (1873: 32, *T. boreale*), Florida, 82 to 450 fathoms; Canu and Bassler (1928: 86), Caribbean Sea, 683 fathoms. Widely distributed northward, even to Arctic seas.

Family **STOMACHETOSSELLIDAE** Canu & Bassler 1917

Frontal wall an exceedingly thick tremocyst; built up around the aperture and notched proximally to form a spiramen which is guarded by small avicularia. Ovicell hyperstomial, deeply embedded. Primary aperture simple, without lyrule and usually without cardelles.

CIGCLISULA Canu & Bassler 1927

Erect or frond-like. Ovicell with a large grill-like area which remains exposed in calcification.

Cigclisula serrulata (Smitt) 1873

Not taken at Porto Rico. Smitt (1873: 27, *Porina*), Florida, 35 to 42 fathoms; Canu and Bassler (1928: 125), south of Miami, Florida at 40 fathoms.

Family **SCHIZOPORELLIDAE** Bassler 1935

This is a large and to external appearances, a loosely connected family, presenting many structural differences, but agreeing in the nature of the larva. Front a tremocyst usually. The ovicell is hyperstomial, sometimes wanting. The operculum is rigid and well chitinized and closes the aperture, the compensatrix and often the ovicell. A vestibular arch usually present, oral spines occur in most cases and dietellae, less frequently uniporous or multiporous septulae. Canu and Bassler (1917: 39) have indicated four subfamilies, distinguished by the following characters:

1. Operculum with two small muscular attachments, more or less removed from the border. Proximal border of aperture with a sinus, rounded or slit-like (rimule), opening into the compensatrix. **SCHIZOPORELLINAE**, page 418.
2. Operculum with a projection on each side for muscular attachment. Aperture with two cardelles for the attachment of the operculum; proximal border without a distinct sinus, but rounded to enclose a considerable space, the "poster" **HIPPOPORININAE**, page 428.
3. Aperture slanting forward (oblique), without cardelles, lyrula or rimule. Ovicell hyperstomial but embedded in the distal zooecium and opening into a cavity above the operculum. **EXOCELLINAE**, page 432.
4. A distinct ascopore (micropore) at some distance from the aperture. Ovicell closed by the operculum. **MICROPORELLINAE**, page 432.

Subfamily SCHIZOPORELLINAE Bassler 1935

KEY TO THE GENERA

1. Frontal a tremocyst (secondary layer porous)..... 4.
Frontal an olocyst (primary layer) or pleurocyst (secondary layer with only lateral pores)..... 2.
2. Frontal a pleurocyst, avicularia not oral..... *Lacernia*, page 426.
Frontal an olocyst, oral avicularia..... 3.
3. Sinus rounded, frontal with radiating veins..... *Buffonellaria*, page 418.
Sinus broad V-shaped, frontal irregularly thickened..... *Stephanosella*, page 423.
4. Sinus narrow or slit-like, ovicell huge..... *Stylopora*, page 423.
Sinus not slit-like, ovicell normal..... 5.
5. Aperture and sinus rounded, muscle attachments of operculum remote from the border..... *Schizoporella*, page 419.
Sinus broadly arcuate, muscle attachments at border..... 6.
6. Aperture elongate oval, no oral avicularia, zoarium erect, cylindrical.....
..... *Gemelliporina*, page 426.
Aperture shorter, oral avicularia irregular..... *Gemelliporida*, page 425.

BUFFONELLARIA Canu & Bassler 1927

Ovicell not closed by the operculum. Frontal an olocyst, with vein-like markings. A small oral avicularium.

Buffonellaria divergens (Smitt) 1873

Zoarium encrusting. Zooccia distinct, separated by grooves, very broad, slightly convex; frontal without pores, showing radial threads characteristic of the genus; aperture rounded in front of the cardelles, broadly sinuate behind; a short pointed avicularium placed on one or both sides of the aperture. Ovicell very fragile, opening widely above the operculum. Zooccal length, 0.65 millimeters; width, 0.45 to 0.55 millimeters.

Smitt (1873: 47, pl. 9, fig. 179, *Hippothoa divergens* forma *typica*) Florida, 135 fathoms; Canu and Bassler (1928: 88), north of Cuba, at 201 to 130 fathoms. Not noted in Porto Rican waters.

Buffonellaria reticulata Canu & Bassler 1928

Zoarium encrusting. Zooccia indistinct; frontal with salient reticulations which divide it into small compartments; aperture at the bottom of an infundibuliform peristomie, the proximal border with a deep rounded sinus; peristome very salient, thin, nodular, with a small avicularium. Ovicell globular, with two orbicular areas symmetrically arranged. Zooccal length, 0.40 to 0.50 millimeters; width, 0.30 millimeters.

Canu and Bassler (1928: 89), Gulf of Mexico, at 30 fathoms.

SCHIZOPORELLA Hincks 1877

Frontal a tremocyst, often with a small suboral umbonate process; aperture semicircular distally, with a slight vestibular arch, slightly rounded proximally with a rounded sinus; muscular attachments at some distance from the border; ovicell hyperstomial and closed by a special membrane; avicularia present, often at the side of the aperture.

Canu and Bassler (1917: 40) erected a new genus "*Schizopodrella*," with *S. unicornis* Johnston as the genotype, to include the species sufficiently described to locate definitely, retaining *Schizoporella* for the species of uncertain generic affinities. Hastings (1932: 415 footnote) shows that *Schizoporella* Hincks 1877 was properly established as a genus, with *S. unicornis* as the genotype and that *Schizopodrella* becomes therefore a synonym.

Schizoporella unicornis (Johnston) 1847

Hippothoa isabelleana Smitt (1873) 44.

Schizopodrella isabelleana, and *S. pungens* n. sp. Canu & Bassler (1928) 95, 97.
S. unicornis and *S. pungens* Marcus (1937) 83-87.

Zoarium encrusting shells, stones, algae, worm tubes, *et altera*, often very irregular, sometimes forming tubular branched colonies, the zooccia often not oriented. Zooccia of the primary layer usually oriented, quadrangular or hexagonal; the frontal a thick tremocyst with rather large pores; an umbonate process often present proximal to the aperture but often wanting entirely. Aperture rounded distally, a rounded sinus on the proximal border; the thickening of the frontal does not encroach on the aperture but leaves a smooth shelf surrounding it on all sides. The ovicell is salient, porous and often decorated with marginal costae and occasionally with an umbonate process on the top in higher calcification. Pointed oral avicularia, usually with one at the side of the aperture with the mandible directed obliquely forward and outward, though they may be turned in any direction even on the same specimen; often they are entirely wanting and they vary greatly in size and height of the avicularian chamber.

Zooccal length, 0.50 to 0.60 millimeters; width, 0.30 to 0.45 millimeters. Aperture length, 0.13 to 0.15 millimeters, width, 0.12 to 0.14 millimeters.

Porto Rico, Guanica Harbor on piles, not common. Osburn (1914: 205) Florida, (1927: 126) Curaçao; Smitt (1873: 44, *Hippothoa isabelleana*) Florida; Canu and Bassler (1928: 98, *S. isabelleana*) St. Thomas, and (p. 95, *S. pungens*) Gulf of Mexico at Cedar Keys,

Florida, and East of Yucatan; Marcus (1937: 83, *S. unicornis*, 86, *S. pungens*), Bay of Santos, Brazil.

This is a very variable species in all secondary details, not only geographically, but locally as well. At different stages of growth and on different substrata the zoarium may be smooth, nodular, thrown up in irregular frills, or rising in tubes of irregular form. The color likewise is of no significance as it ranges from colorless to a deep purple; apparently the color becomes more intense toward the tropics, though I have seen deeply colored specimens as far north as Massachusetts.

The zooecia are fairly well oriented in the primary layer, but in additional layers they may be turned in various directions. The shape is also variable, usually elongate quadrate or hexagonal, but they may be three times as long as broad, or broader than long. Variations in calcification of the frontal and ovicell often give these structures quite different appearances. A pointed umbonate process is often present on the frontal proximal to the aperture but may be entirely wanting on some individuals or on whole colonies. Canu and Bassler distinguish *isabelleana* from *pungens* by the absence of the umbo in the former, but this is evidently not true for the species though it may have been for their specimens. The avicularia differ so much in size, position, orientation and erection, often in the same colony, that they are of little importance in diagnosis. Usually they are located at one side of the aperture and pointed obliquely forward and outward, but they may also be positioned in other directions and they are frequently absent. The avicularian mandible varies in length as much as 100%; the chamber may be small or rarely it may be so large as to cover most of the frontal, resembling *S. floridana* Osburn; the mandible may lie flat at the level of the frontal or it may be pointed upward at varying degrees, in some cases nearly vertical.

Even the primary aperture and operculum vary in size and form to some extent. The average is about 0.13 by 0.13 millimeters, but I have measurements made on the same colony of 0.12 to 0.15 millimeters in length and 0.11 to 0.14 millimeters in width. A specimen of *pungens* given me by Dr. Bassler shows characteristically the longer apertures, but among these are shorter ones, one measuring 0.13 by 0.13 millimeters, which is the average measurement of *unicornis* on Florida specimens.

In *unicornis* there is a series of several basal projections extending forward from the proximal wall, easily seen after the removal

of the frontal, as described by Barroso in 1918. These structures are present in *pungens*, *isabelleana*, and all of the other numerous variations of *unicornis* which I have studied. The species has been described more than a dozen times under as many names.

Marcus (1937: 83-87) discusses *unicornis* and *pungens*, which he separates on the characters given by Canu and Bassler,—the larger size of the avicularia, the greater height of the avicularian chamber and the greater length of the zooecial aperture. These characters, however, are not always associated in the same colony. I have specimens with the shorter aperture in which the avicularia are salient and their chambers of various sizes, and others with longer apertures in which the avicularia and their chambers show a similar range. My conclusion must be that *S. pungens* Canu and Bassler is only a variety in which these characters appear together rather regularly, just as in *isabelleana* the umbo is usually wanting.

Schizoporella unicornis var. *isabelliana* (Smitt) 1873 (non D'Orbigny 1839)

Zoarium multilamellar, encrusting algae and forming branching tubes. Zooecia rhomboidal or irregular, not always oriented; frontal a thick tremocyst with a thick ectocyst, no umbo. Aperture transverse; a rounded spine with a very small indentation on each side of it. Ovicell porous like the frontal, globular, covering about half of the distal zooecium. On the dorsal side, seen by transparency, several rib-like projections run forward from the proximal wall. Zooecial length, 0.50 to 0.60 millimeter; width, 0.30 to 0.35 millimeter. Aperture length, 0.13 to 0.14 millimeter, width, 0.12 to 0.14 millimeter.

Smitt (1873: 44, *Hippothoa*), Florida, 17 to 42 fathoms; Canu and Bassler (1928: 97, *Schizoporella*), St. Thomas, Virgin Islands. Apparently the commonest variety throughout the West Indian region, occurring on piles and shells at Guanica, Porto Rico.

Schizoporella unicornis var. *pungens* (Canu & Bassler) 1928

Zoarium encrusting, unilamellar or multilamellar. Zooecia distinct, separated by a deep furrow, elongate elliptical; frontal convex, a granular tremocyst with large pores; a more or less salient umbo below the aperture. Aperture somewhat elongated, anter large and semicircular, poster small with a broad rounded rimule; peristome thin, salient, with very short spines. Oral avicularium thin, triangular, with a very salient beak, placed obliquely, adjacent to the poster on one side only. Ovicell large, globular, porous, covering a large portion of the distal zooecium. Zooecial length, 0.60 to 0.75 millimeters; width, 0.30 to 0.40

millimeters. Aperture length, 0.14 to 0.15 millimeters; width, 0.12 millimeters (after Canu and Bassler).

Canu and Bassler (1928: 95, *Schizopodrella*), Gulf of Mexico at Cedar Keys, Florida, and east of Yucatan, at 25 fathoms; Marcus (1937: 86), Santos, Brazil. Occasional specimens taken off Guanica Harbor, Porto Rico at 5 to 15 fathoms.

Schizoporella floridana Osburn 1914

Encrusting, forming nodular masses of considerable size. Zooecia of the primary layer oriented and rather regularly disposed, those of later layers turned in any direction. Frontal a tremocyst, with large scattered pores. Oral avicularia usually placed somewhat anterior to the aperture with the beak curved in front of it, but the mandible may be straight and directed forward, sideways or backward and occasionally the avicularium may be situated farther back, even proximal to the aperture. The secondary zooecia often bear a huge avicularium with a long pointed mandible, mounted on a very ventricose, irregularly hemispherical chamber as large as a zooeciun, the mandible turned in any direction. Ovicell rather small, usually broader than long, salient and with very small pores. Zooecial length, about 0.90 millimeter, breadth, variable averaging about 0.45 millimeters. Aperture length, 0.18 to 0.20 millimeters; width 0.15 to 0.18 millimeters.

Osburn (1914: 205, figs. 17, 18), Tortugas Islands, 15 to 18 fathoms; Curaçao Island (1927: 126), and Tarpon Springs and Captive Island, Florida; Canu and Bassler (1928: 93, *Schizopodrella*), east of Yucatan, at 21 fathoms. Not common at Porto Rico, but dredged at a few stations off the mouth of Guanica Harbor, at 6 to 19 fathoms.

Schizoporella canui NEW SPECIES

Schizopodrella incrassata Canu & Bassler (1828) 93.

Canu and Bassler apparently overlooked the fact that Hincks in 1882 had given the name *incrassata* to another species of *Schizoporella*. It therefore becomes necessary to rename the present species. I take pleasure in dedicating it to the memory of Ferdinand Canu, one of the master workers on the Bryozoa.

Zoarium encrusting on algae, often rising into bilaminar fronds, dichotomous and compressed laterally. Young zooecia distinct, elongated, convex; older ones indistinct with a thick tremocyst perforated by very large scattered pores; avicularia irregularly arranged. Ovicell globular, embedded in older stages, finely porous. Two small avicu-

laria symmetrically arranged on each side of the sinus; a large frontal avicularium, orbicular and salient on older zooecia. Young zooecia length, 0.40 millimeters, width 0.30 millimeters. Aperture length, 0.10 millimeters; width, 0.06 to 0.08 millimeters.

Not taken at Porto Rico. Canu and Bassler, Gulf of Mexico and Straits of Florida at 30 to 56 fathoms.

STEPHANOSELLA Canu & Bassler 1917

Schizoporellas with the oeciun radiately grooved and surrounded by a raised border; sinus broadly V-shaped; a small salient avicularium on one or both sides of the aperture.

Stephanosella rugosa NEW SPECIES

PLATE 7, FIGURE 57

Zoarium encrusting, irregularly roughened, shining. Zooecia small, length 0.25 to 0.35 millimeters, in the younger stages resembling *S. biaperta* (Michelin) but the frontal pores smaller and fewer. The aperture is much like that of *biaperta* but is smaller, about 0.10 millimeters long by 0.08 wide, the operculum delicate but thickened at the edge. The oral avicularia are similar in size and position to those of *biaperta*, with a bluntly pointed mandible. The ovicell is also like that of *biaperta*, but is considerably smaller and the raised border may be continued across the front, leaving merely a central area through which the rib-like sculpturing can be observed.

As calcification proceeds a very peculiar raised, more or less circular ridge develops on the frontal surface and covers most of it, leaving a central area through which the small pores may be seen. Occasionally the whole frontal surface may be covered with high irregular ridges, which almost completely obscure the nature of the original frontal wall. Vicarious avicularia wanting.

Porto Rico, Station 2347, off Guanica Harbor, at 5 to 8 fathoms, two small colonies, encrusting a shell and a worm tube. Also two small colonies from Bermuda, at 3 fathoms, collected by Dr. S. R. Williams.

Distinctly smaller than *S. biaperta* and altogether different in the mode of secondary calcification. The growth of this layer appears to be similar to that of *Buffonellaria reticulata* Canu and Bassler, but in that species the frontal is not porous and the ovicell is quite different.

STYLOPOMA Levensen 1909

The hyperstomial ovicell is very large, covering the aperture and oral avicularia. Frontal a tremocyst with small pores. The sinus of the aperture is slit-like, sometimes enlarged proximally or V-shaped.

Stylopoma informata (Lonsdale) 1845

PLATE 7, FIGURE 58

Stylopoma (*Schizoporella*) *spongites* auctt., non Pallas.
Schizopodrella falcifera Canu & Bassler (1928) 95.

Zoarium encrusting or rising in irregular frills. Zooecia rather regularly quadrangular; frontal with numerous small tremopores, little convex, smooth (roughened in older zooecia); a low umbonate process sometimes proximal to the aperture; aperture semicircular, the proximal border straight with a slit-like sinus (often V-shaped, but sometimes enlarged proximally); oral avicularia usually short and narrowly pointed, on one or both sides of the aperture but often wanting. The frontal is often decorated with small avicularia and the ovicell occasionally also; large spiculae of various sizes and shapes may also be present, these may be straight or falciform, pointed or spatulate. Ovicell globular, very salient, huge (often twice as broad as a zooecium) and enclosing both the aperture and oral avicularia. Zooecial length, about 0.50 millimeters; width, about 0.35 millimeters, but with considerable variation. The aperture is often placed in the center of the quadrangular zooecium.

Common in Porto Rico at a number of stations, especially at Station 2369, off Guanica Harbor, where numerous colonies were dredged at 6 fathoms. Smitt (1873: 42, *Hippothoa spongites*) Florida; Verrill (1900: 592, *Hippothoa* or *Schizoporella spongites*) Bermuda; Levinsen (1909: 324, *S. spongites*) St. Thomas and St. John Islands; Osburn (1914: 207, *Schizoporella spongites*) Tortugas Islands, and (1927: 128, *S. spongites*) Curaçao; Canu and Bassler (1928: 91, *S. spongites*) North of Cuba, 143 fathoms and Gulf of Mexico, 30 fathoms, and (p. 95, *Schizopodrella falcifera* n.sp.) east of Yucatan, 24 fathoms.

This species is remarkable for the size of the ovicell and for the range in size, form and distribution of the avicularia. Characteristically there is a small sharp pointed avicularium on one side of the aperture, sometimes on both sides, often wanting. In addition other avicularia, sometimes much smaller, may be present to the number of 5 or 6 on the frontal and even several on the ovicell. Occasionally long acicular, or spatulate, or falcate interzooecial avicularia are present scattered irregularly over the zoarium, measuring as much as 0.50 millimeters in length. *Schizopodrella falcifera* Canu and Bassler (1928: 95) is merely one of these variations of *informata* with falciform avicularia. The type specimen agrees entirely with specimens from Porto Rico in my collection. Canu and Bassler state "Our specimen was in reproduction January 30, 1905," but the type specimen shows no ovicells, so there is an error somewhere.

Gemelliporidra Canu & Bassler 1927

Ovicell hyperstomial, closed by the operculum; frontal and ovicell with tremopores; aperture with two small lateral indentations separating a large suborbicular anter from a very small poster; operculum with linear muscle attachments; oral and interzooecial avicularia.

Gemelliporidra typica Canu & Bassler 1927

PLATE 8, FIGURES 60, 61, 62

Zoarium encrusting, often multilaminar. Zooecia large, distinct, oriented in all directions; frontal convex, a tremocyst with larger lateral pores; aperture suborbicular with a small arcuate poster. Ovicell globular, covered by the tremocyst of the distal zooecium. On either or both sides of the aperture is a triangular avicularium (often wanting). In one case the ovicell was surmounted and partially obscured by two avicularia, one on either side. The avicularia appear to be very inconstant in occurrence and orientation.

Porto Rico, several small colonies off the mouth of Guanica Harbor, 5 to 19 fathoms. Canu and Bassler (1928: 100), north of Cuba 121 to 201 fathoms; also from the Pleistocene of the Canal Zone.

Gemelliporidra aculeata Canu & Bassler 1928

PLATE 8, FIGURE 63

Zoarium encrusting. Zooecia elongated, elliptical or subrectangular; frontal convex, a granular tremocyst with very small pores; aperture orbicular or somewhat transverse, cardelles small; peristome a little salient, granular, formed by the tremocyst. Ovicell globular, salient, closed by the operculum. Interzooecial avicularia with a very long narrow mandible.

Porto Rico, off the mouth of Guanica Harbor, not common. Canu and Bassler (1928: 102), 15 miles south of Miami, Florida, 40 fathoms.

Gemelliporidra magniporosa (Canu & Bassler) 1923

Zoarium encrusting, multilamellar, zooecia of the secondary layers not well oriented. Zooecia irregular in form, generally separated by a salient thread, somewhat convex, the frontal a tremocyst with unusually large pores. Two small triangular oral avicularia, often one of them wanting. Ovicell globular and covered with large tremopores like the frontal.

Not taken in our Porto Rican collections. Canu and Bassler (1928: 103), Gulf of Mexico, north of Cuba and east of Yucatan at 25 to 78 fathoms; also from the Pleistocene of Panama.

GEMELLIPORINA Bassler 1936

Operculum subtriangular, or long oval with a small projection on either side near the proximal end corresponding to the cardelles; muscular attachment close to the border of the operculum; aperture of fertile zooecia wider.

Gemelliporina glabra (Smitt) 1873

Zoarium formed of dichotomous cylindrical branches. Zooecia indistinct except at the ends of the branches; frontal wall very thick and perforated by numerous tubular pores; distal part of the zooecium raised, with several stout short oral spines. Oecium globular, becoming covered by the tremocyst except for a median cicatrix.

Smitt (1873: 37, *Gemellipora*) west of Tortugas Islands; Canu and Bassler (1928: 98, *Gemellipora*) Gulf of Mexico, Straits of Florida, and 15 miles south of Miami at 30 to 56 fathoms. Not noted in the Porto Rican collections. Marcus (1939: 140) reports it from Brazil.

Gemelliporina limbata (Smitt) 1873

Zoarium encrusting, the zooecia in single series. Zooecium tubular at the proximal end, oval and ventricose distally and rising into a tubular portion which bears the primary aperture at its top. Around this a flaring irregularly expanded peristome. Ovicell globular, distally placed on the erect tubule, into which, judging by Smitt's figure (1873, pl. 11, fig. 214) it opens below the aperture.

Smitt (1873: 40, *Gemellipora*), Florida, 471 fathoms; Canu and Bassler (1928: 99) north of Cuba, at 387 and 130 fathoms.

This is a remarkable species, probably not correctly placed in this genus and in need of further study. It did not appear in our Porto Rican collections.

LACERNA Jullien 1888

Ovicell hyperstomial, closed by operculum; aperture rounded with a small rounded sinus (rimule); a slight vestibular arch; frontal a pleurocyst with numerous areolae; frontal avicularia.

Lacerna horstii (Osburn) 1927

Schizopodrella horstii Osburn (1927) 127, figs. 3-5.
Schizoporella horstii Marcus (1937) 87; (1938) 39; (1939) 139.

Zoarium flat and encrusting, often several layers thick, reddish or yellowish in color. Zooecia in radiating lines; frontal an olocyst with a pleurocyst cover, glistening, roughened, with a row of rather large areolar pores between which are short costae; aperture round, with a rounded sinus (rimule) which is of the same form as the aperture; a

slight vestibular arch; peristome raised about the whole border of the aperture and continued forward across the front of the ovicell; a single row of regularly placed septulac. Ovicell evenly rounded, with numerous fine pores; a raised border appears about the base and finally covers the whole ovicell.

Zooecial length, 0.45 to 0.65 millimeters; width about 0.30 millimeters. Aperture including sinus, length 0.16 millimeters; width 0.12 millimeters. Avicularia variable, averaging about 0.20 millimeters.

Porto Rico, off Guanica Harbor, 5 to 8 fathoms. Osburn (1927: 126, *Schizopodrella*) Curaçao Island; Marcus (1937: 87, *Schizoporella*), Santos Bay, Brazil, 20 meters.

This species resembles *Lacerna* (*Smittia*) *signata* Waters 1899, so closely that there seems no doubt of their congeneric relationship. For that reason *horstii* is here placed in *Lacerna*, even though the genotype *L. hosteensis* Jullien 1888, is said by Marcus (1939: 140) to possess pore chambers. Hastings, 1932, and Marcus (1939) present excellent discussions of *signata* Waters and *horstii* Osburn.

LEPRALIA Johnston 1847

This group is now merely reserved for a "catch-all" for species that cannot be definitely allocated to modern genera.

Lepralia uvulifera Osburn 1914

The writer described this species from the Tortugas (1914: 210). It has appeared again in our Porto Rican collections, several colonies at Station 2367, near the bell buoy off Guanica Harbor, at 6 fathoms, encrusting shell. The colonies are all so small as to be practically microscopic, but are mature and in reproduction.

To my previous description I can add the measurements. Zooecial length, about 0.25 millimeters; width about 0.20 millimeters. Ovicell before secondary calcification, 0.13 millimeters long by 0.15 millimeters wide. Aperture, 0.08 millimeters long by 0.10 wide. In younger stages of calcification the frontal is a smooth olocyst; the suboral rostrum is simple and median; the ovicell smooth and globose, raised, not closed by the operculum and with a very characteristic labellum. The denticles are small but distinct and the poster broadly arcuate.

My material is still very scanty and difficult to study on account of the small size of the zooecia and I hesitate to place in any modern genus.

Lepralia palliolata Canu & Bassler 1928

Not taken at Porto Rico. Recorded by Canu and Bassler (1928: 109) from the Straits of Florida at 56 fathoms.

Subfamily HIPPOPORININAE Bassler 1935

Operculum usually thick, with a projection on each side for muscular attachment; two prominent cardelles. Ovicell hyperstomial.

KEY TO THE GENERA

1. Aperture much longer than broad, contracted proximally, frontal an olocyst *Hippoporina*, page 428.
Aperture rounded or but little longer than broad 2.
2. Frontal a tremocyst with numerous pores *Hippodiplosia*, page 430.
Frontal a pleurocyst with marginal pores 3.
3. Oral spines present, avicularia long pointed *Hippomenella*, page 430.
No oral spines, a small median avicularium *Hippadenella*, page 431.

HIPPOPORINA Neviani 1895

Aperture elongated, operculum much contracted laterally, the cardelles prominent, separating a narrow poster from the much larger anter; frontal a thick olocyst.

Hippoporina porcellana (Busk) 1860

Lepralia cleidostoma Smitt (1873) 62.

Zoarium encrusting. Younger zoecia rhombic, distinct, but with later calcification becoming heavy walled and confluent. Frontal an olocyst; pores few, marginal. Pointed avicularia on one or both sides of the aperture or a little proximal to it and directed laterally or somewhat forward. The aperture is claviform, ellipsoid distally but transverse and much smaller proximal to the cardelles. Ooecia globose, imperforate, with radiating striae which are often difficult to observe. The ooecia and apertures vary greatly in size, becoming larger from the ancestrula outward.

Smitt (1873: 62, *Lepralia cleidostoma*), Florida, 30 to 120 fathoms; Osburn (1914: 209, *Lepralia*), Tortugas Islands; Canu and Bassler (1928: 104, *H. cleidostoma*), off Havana, east of Yucatan, Gulf of Mexico and Straits of Florida, 24 to 201 fathoms. At Porto Rico the species occurred off Guanica Harbor at 8 fathoms.

Marcus (1927: 96) has recorded it from Santos Bay, Brazil. He gives a good discussion of the species with reasons for including *cleidostoma* Smitt in the synonymy of *porcellana* Busk, as does also Hastings (1930: 721).

Hippoporina contracta (Waters) 1891

Lepralia contracta Waters (1899) 11.—Norman (1909) 306.

Lepralia serrata Osburn (1912) 242.

Lepralia contracta var. *serrata* Osburn (1914) 211.

Perigastrella contracta Canu & Bassler (1920) 576; (1929) 403.—Marcus (1927) 98.—Hastings (1930) 722.

Zoarium encrusting, sometimes rising into ridges or frills, unilamellate or multilamellate. Zoecia ovate or hexagonal, distinct when young, but later becoming immersed in a common crust. Frontal a granular pleurocyst, thick, vitreous, with marginal areolae; aperture somewhat elongate, rounded in front of the strong bifid cardelles, behind which is a rather broadly rounded sinus; a beaded vestibular arch; peristome thickened irregularly, often mucronate on the proximal border in secondary calcification, interrupted distally where 4 or 6 oral spines are present. Ooecia prominent, not embedded except in extreme calcification, nearly hemispherical, with a large membranous area on the front near the aperture (sometimes extended downward into a broad short labellum). Avicularia ovate to spatulate in form, oral or frontal, immersed or mounted on a mamillate process, the aperture beaded like the oral margin. The species is very variable in secondary calcification, but the primary characters appear to be quite constant, except for the form and position of the avicularia.

Zoecial length, 0.30 to 0.60 millimeters; ovicell about 0.15 millimeters long by 0.18 millimeters wide. The zoecia are smaller near the center of the colony and increase in size outward, and the aperture is similarly larger in the peripheral zoecia.

At Porto Rico the species was taken only once, two small colonies on dead shells between Rotones and Caribe Islands at 6 fathoms. Osburn (1914: 211), Tortugas Islands, 5 to 18 fathoms. Waters and Norman's material came from the Madeira Islands. Hastings listed it from the Galapagos Islands and from Gorgona, Colombia, in the Pacific. Along the Atlantic coast of N. A., it occurs from Woods Hole, Massachusetts, to the Bay of Santos, Brazil. The species is best developed in the southern New England region and all of the colonies I have seen from other regions are smaller and less heavily calcified.

It appears very evident that this species cannot remain in the genus *Perigastrella* where Canu and Bassler (1920: 576) placed it, even if that genus should be removed from the Phylactellidae. Hastings recognized its affinities by placing it next to *Hippoporina* and Marcus suggests its relation to *Hippomenella*. After a careful study of much material I place it for the present in the genus *Hippoporina* for the following reasons: a beaded vestibular arch, oral spines, aperture narrowed proximally, thick pleurocyst, heavy cardelles, absence of lyrula, lateral oral avicularia, ovicell salient and not closed by the operculum, with a semicircular membranous area and a short broad labellum, zoecia increasing in size from the center of the colony outward. *Hippomenella* also appears to be related, but differs in the low, broad and

immersed ovicell which is closed by the operculum. It is possible that a new genus will have to be erected for *Lepralia contracta*, but so many of its primary characters agree with *Hippoporina* that I leave it there for the present.

HIPPODIPLOSIA Canu 1916

This genus was erected by Canu to include certain escharellidan species with a broad poster, the aperture narrowed at the cardelles, a hyperstomial ovicell closed by the operculum, and a frontal tremocyst. The tremocyst is incomplete about the aperture, leaving a small portion of the olocyst exposed. The ovicell rests on the olocyst of the succeeding zoecium.

Hippodiplosia pertusa (Esper) 1794

Zoarium encrusting. Zoecia moderately large, somewhat convex; front a tremocyst with small pores, becoming granular in older specimens; aperture rounded, but a pair of cardelles give the appearance of a very broad shallow sinus. The globular ovicell is perforated, becoming granular with an occasional umbonate process on the top in advanced calcification. An umbonate process also develops occasionally on the front proximal to the aperture.

Zoocial length, 0.60 to 0.70 millimeters; width 0.40 to 0.50 millimeters. Aperture length, about 0.18 millimeters; width, 0.18 to 0.20 millimeters.

Porto Rico at two stations near Caribe Island, 6 to 11 fathoms. Canu and Bassler (1928: 106), east of Yucatan, 25 fathoms; Smitt (1873: 55, *Escharella*), Tortugas Islands; Marcus (1938: 41), Santos Bay, Brazil. A widely distributed species and apparently more common farther north in temperate waters.

HIPPOMENELLA Canu & Bassler 1917

Frontal an olocyst with a more or less developed pleurocyst and areolar pores; aperture semi-elliptical; ovicell hyperstomial, not closed by the operculum; oral spines and avicularia usually present.

KEY TO THE SPECIES

1. Ovicell with a longitudinal groove or fissure *H. fissurata*, page 431.
- Ovicell not grooved longitudinally 2.
2. Avicularia present *H. rubra*, page 430.
- Avicularia wanting *H. mucronata*, page 431.

Hippomenella rubra Canu & Bassler 1928

Not taken at Porto Rico. Gulf of Mexico, Canu and Bassler (1928: 108), 30 fathoms. This species will probably be found identical with

the following, though avicularia are present and the oocial umbo is more proximal.

Hippomenella mucronata (Smitt) 1873

Hippothoa mucronata Smitt (1873) 45.

Not taken at Porto Rico. Smitt records it from Florida at 29 fathoms.

Hippomenella fissurata (Canu & Bassler) 1928

PLATE 8, FIGURE 64

Lepralia fissurata Canu & Bassler (1928) 110, pl. 33, fig. 1.

Zoarium encrusting, white, rather delicate. Zoecia moderate in size (length about 0.40 millimeters, width about 0.25 millimeters), distinctly separated by grooves; frontal moderately rounded, with small pores in addition to areolae, somewhat roughened. Aperture subcircular, with a pair of strongly projecting pointed cardelles, behind which a broadly arcuate sinus or rimule is nearly as wide as the distal portion (length and width about 0.13 millimeter); peristome low and thin with about 4 very small and evanescent spinules on the oral border. A little proximal to the aperture is a small high prominence which bears a small avicularium with a pointed mandible; occasionally two such avicularia are present.

The chief peculiarity of the species is found in the ovicell which is very prominent, subcordate in outline and grooved in the middle of the front. The groove begins at the oocial aperture and extends about two thirds of the way across the ovicell where it ends in a small pore; the pore may become closed and the groove obliterated with complete calcification, and in younger stages the frontal is cleft back to the position of the pore. The oocial aperture is very small, a rounded opening which is invisible from above and can only be seen by tilting the specimen backward.

Porto Rico, Station 2347, between Cape Caribe and Cape Parguera at 5½ fathoms, two small colonies in reproduction.

The author believes himself correct in identifying his material with the *Lepralia fissurata* which Canu and Bassler described from the Pliocene of Panama. Also the genus *Hippomenella* appears to fit it in most respects, the nature of the aperture, the presence of the minute oral spines, and the nature of the ovicell.

HIPPADENELLA Canu & Bassler 1917

Frontal a pleurocyst surrounded with areolar pores; aperture suborbicular, with well marked cardelles; a median avicularian chamber, the mandible with a lucida.

Hippadenella floridana Canu & Bassler 1928

Not found at Porto Rico. Canu and Bassler record it from Cedar Keys, Florida.

Subfamily EXOCHELLINAE Bassler 1935

Aperture oblique, without lyrula, cardelles or rimule. Ovicell hyperstomial and embedded in the distal zoecium. A frontal mucronate process. No peristome.

ESCHAROIDES M.-Edwards 1836

Escharoides costifera (Osburn) 1914

Escharella costifera Osburn (1914) 203.

Zoarium small, encrusting algae. Zoecia very distinct, elliptical; frontal margined by large areolae between which are strong costae which fade out toward the middle, rising strongly toward the aperture, proximal to which is a strong pointed mucronate process; aperture oblique, with 6 or 8 long jointed spines; avicularia commonly one on each side of the aperture. Large peristome and distal zoecium. Frontal globular, areolate and costate like the frontal and with a strong raised rib about its base.

Zoecial length, 0.40 millimeters; width 0.26 millimeters. Aperture length, 0.13 millimeters; width, 0.12 millimeters.

Porto Rico, off the mouth of Guanica Harbor, at 30 fathoms. The species was described from the Tortugas Islands, 2 fathoms, and Marcus (1938: 38) has recently recorded it for Santos Bay, Brazil.

Subfamily MICROPORELLINAE Bassler 1935

A distinct ascopore (micropore) at some distance proximal to the aperture. Ovicell hyperstomial and closed by the operculum.

MICROPORELLA Hincks 1877

Frontal a tremocyst of the usual type; operculum simple, semicircular and closing the oecium. Avicularia present.

Microporella ciliata (Linnaeus) 1758

Zoarium encrusting. Zoecia distinct, separated by deep grooves, elliptical; frontal a tremocyst with small pores, smooth or roughened in older stages; aperture semicircular with a straight proximal border; ascopore situated at a little distance from the aperture, usually semi-

lunar; avicularia (one or two) with triangular or elongate pointed mandible, situated usually at the side of or a little proximal to the ascopore. Ooecium globose, with small pores. Younger zoecia usually show about three spines on the distal border of the aperture and in older ones a thin peristome often rises to considerable height, especially proximal to the aperture and between it and the ascopore (variety *personata* Busk, 1854). A well known and widely distributed species.

Zoecial length, about 0.50 millimeters; width more variable, about 0.30 millimeters. Aperture length, about 0.08 millimeters; width, about 0.12 millimeters.

Smitt (1873: 26, *Porellina*), Florida, 7 to 60 fathoms; Osburn (1914: 208), Tortugas Islands, 5 to 18 fathoms (1927: 129), Curaçao Island; Canu and Bassler (1928: 110), Fowey Light, 40 fathoms, Gulf of Mexico at 30 fathoms, and Straits of Florida, 56 fathoms. Porto Rico, rather common at various stations off Guanica Harbor, 3 to 30 fathoms.

Microporella ampla Canu & Bassler 1928

Not taken at Porto Rico. A much larger species with a round, margined ascopore. Canu and Bassler (1928: 111), 2½ miles northwest of Havana Light, 387 fathoms.

FENESTRULINA Jullien 1888

Frontal with stellate tremopores; no avicularia.

Fenestrulina malusi (Audouin) 1826

PLATE 7, FIGURE 56

A very characteristic species distinguished by the stellate frontal pores and the arcuate ascopore situated at a considerable distance from the aperture.

A single colony off the mouth of Guanica Harbor, Porto Rico, at 8 fathoms. I have a specimen from Bermuda also. Recorded for the Gulf of Mexico at 30 fathoms by Canu and Bassler (1928: 112).

Family SMITTINIDAE Levinsen 1909

Frontal usually not perforated except around the margin. Peristome usually produced and channeled in front. Aperture usually with cardelles and lyrula. Operculum very thin as a rule, with the muscular attachments on a ridge at the border. Oral spines often present. Avicularia usually present, of various types, frequently associated with

the aperture. Ovicell hyperstomial, more or less imbedded in the distal zooecium, usually perforated in front.

KEY TO THE GENERA

1. Front an olocyst (primary layer) 2.
Front a pleurocyst (secondary imperforate layer) 3.
2. Front with ribs (costules) between the areolae; asymmetrical sinus with a
lyrula *Rhamphostomella*, page 439.
Without ribs; oral avicularian chamber covers most of the front; erect, branch-
ing, flabelliform *Cystisella*, page 439.
3. Lyrula and cardelles well developed; areolar pores conspicuous
..... *Smittina*, page 434.
Lyrula and cardelles wanting 4.
4. Peristome very thick and high, with several small avicularia on its margin ...
..... *Palmicellaria*, page 439.
No lateral oral avicularia, but one median 5.
5. Front ribbed *Umbonula*, page 439.
Front without ribs *Bryocryptella*, page 439.

SMITTINA Norman 1903

The frontal surface is a pleurocyst, granular or costate, with a row of marginal areolae; a lyrula of varying width is present on the proximal lip of the aperture at the level of the operculum and a pair of cardelles (hinge teeth) on the sides; peristome variously developed, often high proximally or laterally; operculum little chitinized; avicularia various, often one or two related to the aperture.

The species in this genus are often very difficult to identify because of variations due to secondary calcification and to the number, form and distribution of the avicularia. The primary characters only appear to be dependable.

KEY TO THE SPECIES

1. Zooecia large, 0.60 to 0.80 millimeters long; ovicell large, 0.35 millimeters wide
..... *S. labellum*, page 438.
Zooecia smaller, 0.35 to 0.60 millimeter long 2.
2. Operculum with transverse ribs, zooecia rather flat ... *S. egyptiaca*, page 437.
Operculum without ribs, zooecia more inflated 3.
3. Zoarium tubular, with short conical branches giving the colony a spiny appear-
ance *S. echinata*, page 438.
Zoarium and zooecia very variable but not with above characters
..... *S. trispinosa*, page 434.

Smittina trispinosa (Johnston) 1838

The irregularities of form due to secondary calcification and the variations shown by the avicularia in form and position make it almost impossible to describe this species. Osburn (1914: 208) has indicated

a number of these, and Canu and Bassler (1929: 340-349) have attempted an analysis of the varieties listed under *trispinosa*.

Only the primary characters are of much value, for the secondary features due to calcification are so varied and intergrade to such an extent that they seem to be of little importance. Many varietal names have been applied. The avicularia especially vary and on the same colony one may find larger and smaller pointed, oval and spatulate or ligulate avicularia. The development of the peristome is not far behind in variability. There is not so much variation within the colony, but in colonies which otherwise appear to be very similar, we may find the peristome almost lacking, limited to lappet-like projections at the sides of the aperture, or extending in a high frill around the sides and proximal border and extending forward across the anterior border of the oecium. In the infertile zooecia there is usually a break in the peristome distally, but even this varies and sometimes there is a complete ring about the aperture. The thickness and sculpture of the pleurocyst is similarly variable. One, two, or three spines, and occasionally as many as five are present. Only the size and form of the primary aperture and the size of the ovicell (about 0.18 millimeters broad) show little variation.

The typical *trispinosa* does not seem to be present as all the West Indian specimens from various localities show either ligulate, oval or spatulate avicularia of various sizes and forms, either with or without the characteristic triangular ones.

KEY TO THE VARIETIES

1. Peristome high around proximal border 2.
Peristome low or wanting on proximal border 3.
2. Peristome folded proximally and on the sides, forming a false sinus (pseudorimula), lyrula wide *munita*, page 436.
Peristome not folded but ending in two points with a notch between, lyrula narrow, ovicell umbonate *protecta*, page 437.
3. Secondary aperture somewhat elongate, avicularia spatulate or ligulate (others may be present) *spathulata*, page 435.
Secondary aperture more rounded, avicularia oval (sometimes with pointed ones) *nitida*, page 437.

Smittina trispinosa var. *spathulata* (Smitt) 1873

Escharella jacotini var. *spathulata* Smitt (1873) 60. pl. 10, fig. 200.

My specimens all have larger areolae than are shown in Smitt's figure, but the primary aperture and lyrula, the secondary aperture, with the peristome raised chiefly on the sides, and the combination of forms of avicularia agree. Even in older zooecia the lyrula can usually

be seen since the peristome is not raised very high at the proximal border. In the infertile zooecia the peristome is not continued forward and the spines (usually two, occasionally one or three) may be seen. The fertile zooecia show the same condition at the proximal border of the aperture and on the sides, and the peristome is carried forward, usually on the anterior corners of the ovicell, occasionally around the front border of the ovicell. The pores of the ovicell are moderately large and sometimes slightly marginated, and a raised border in older zooecia sometimes covers a considerable part of the ovicell. The avicularia may be pointed, ligulate, oval or spatulate, of varying dimensions, orientation, numbers and combinations. Occasionally only the ligulate and spatulate forms are present.

Zooecial length, averaging about 0.40 millimeters (ranging from 0.35 to 0.60 millimeters); width about 0.30 millimeters (ranging from 0.26 to 0.40 millimeters). Aperture length, about equal to breadth, averaging about 0.12 millimeters. Lyrula usually not more than one-fourth the width of the aperture.

Smitt (1873: 59-60, pl. 10, fig. 200, but not ? 199), Florida; Osburn (1914: 208), Tortugas, low water to 12 fathoms; (1927: 129, *spathulata* by an error). Curacao: Cass and Bassler (1925: 114). Flower Light, Florida, and east of Yucatan, 24 to 40 fathoms. Porto Rico, common and found at a number of stations off Guanica from low water to 30 fathoms. I also have specimens from Beaufort, North Carolina, at 13 fathoms.

Smittina trispinosa var. *numida* Smitt 1873

Zoarium encrusting shells and almost anything which will afford attachment, unilamellar to multilamellar. The zooecia are of moderate size, 0.40 to 0.50 millimeters, the frontal irregularly roughened, with a row of medium-sized areolar pores. Peristome high, folded into a proximal sinus (pseudorimula) the borders of which may be continued into short spinose processes; in fertile zooecia the peristome is high on the sides and is continued forward upon the border of the ovicell to form a more or less complete rib; in sterile zooecia it descends rapidly to about the middle of the sides, leaving space for 2 to 4 long slender spines. The lyrula is moderately wide, at least a third as wide as the aperture. Ovicell rounded, with rather numerous small pores evenly distributed; the pleurocyst forms a band around the base of the ovicell, leaving a considerable porous area above. The avicularia are long-pointed and usually straight (occasionally falciform), characteristically placed on the frontal touching the peristome and directed backward; in the infertile zooecia they are usually in the midline, but in fertile

zooecia they are turned to one side avoiding the ovicell; occasionally they may be directed forward at the side of the aperture, and short-pointed and oval avicularia may also be present. Some specimens are close to the type species.

Characteristic specimens were dredged at Stations 2347 and 2364, off the mouth of Guanica Harbor, at 4 to 8 fathoms. Marcus (1937: 108) has taken it at Santos Bay, Brazil, 17 meters.

Smittina trispinosa var. *protecta* Thornely

This variety differs from the typical form in the nature of the peristome which is thin and rises high and almost vertically proximally to the aperture; it is not folded but usually ends in two sharp points, one on either side of a rounded notch; on the sides it drops away sharply to the level of the primary aperture, leaving space for the attachment of two slender, elongate spines; in ovicelled zooecia the peristome rises again to form a partial or complete rib on the front of the ovicell. It also differs in the covering of the ovicell, as the pleurocyst of the distal zooecium covers most of the perforated area in mature calcification and usually rises into an erect, thin, transversely laminate process or umbo on the top of the ovicell. The avicularia, usually situated at one or both sides of the aperture are pointed or oval, or occasionally long spatulate with the mandible ending in 3 or 4 points.

Taken at several places off Guanica Harbor, Porto Rico, 5 to 15 fathoms. I have the same form also from the Tortugas and Bermuda Islands. Smitt's figure (pl. 10, fig. 199) resembles this variety in its younger stages. It is known from the Red Sea and Indian Ocean (Waters 1913: 513).

Smittina trispinosa var. *nitida* (Verrill) 1879

Occasional specimens approach more nearly the *nitida* of Verrill in the character of the avicularia, which are usually small oval, though small pointed and spatulate forms are more sparsely represented; the peristome also resembles that of *nitida*, being less developed than in *spathulata* or the typical *trispinosa* and usually present as lappets on the side of the aperture.

Osburn (1914: 208, *S. trispinosa*, part), Tortugas, Florida; Porto Rico, Station 2347, off Guanica Harbor, at 6 to 10 fathoms.

? *Smittina egyptiaca* Waters 1909

The zoarium is peculiar in that "the zooecia are in two longitudinal rows side by side, and then on each side of the two rows there is a

straight, very thick divisional wall" (Waters 1909: 157). Hastings, 1927, has shown that this biserial arrangement does not always appear. In my specimen it is present in a part of the colony. The zooecia are broad and rather flat, distinctly separated, a row of well-marked areolae, surface granular but not greatly thickened. The aperture has a broad lyrula; the peristome scarcely raised and only on the sides, though in ovicelled zooecia it may continue forward to the ovicell but does not form a rib across its front. Avicularia are of various sizes and forms; sometimes a small triangular avicularium at the side of the peristome, but this may be replaced by an oval one or by a very large spatulate form; occasionally others may be present on the frontal. The ovicell is evenly rounded, perforated on the top, the pores slightly margined; the pleurocyst of the distal zooecium nearly covers the ovicell with a smooth layer in older calcification.

A single colony dredged in 6 fathoms at the mouth of Guanica Harbor (Station 2338) appears to belong here, but unfortunately the specimen was dead and the most distinctive character (the transverse chitinous ribs of the operculum) is wanting. Canu and Bassler (1928: 118, *Mucronella*), Gulf of Mexico, 28 fathoms.

Canu and Bassler place this species in the genus *Mucronella* without stating their reasons, except that they mention a little-salient muero. *Mucronella* however is without avicularia and the ovicell is imperforate.

Smittina labellum Canu & Bassler 1928

A very large ovicell, 0.35 millimeters broad, and a tall spout-like peristome distinguish this species.

Not taken at Porto Rico. Canu and Bassler (1928: 116), north of Cuba, 191 fathoms, and Straits of Florida, 56 fathoms.

Smittina echinata Canu & Bassler 1928

The zoarium emits short conical or flabelliform branches in every direction, giving the colony a spiny aspect.

Not taken at Porto Rico. Canu and Bassler (1928: 115), Cedar Keys, Florida.

Smittina (?) *landsborovii* (Smitt) 1873

What this species may prove to be is a question. It has not been recovered by recent workers on West Indian Bryozoa. It can hardly be the *landsborovii* of Johnston as the aperture, lyrule and peristome are different. It differs also from *S. (Porella) bella* Busk 1860, with which Canu and Bassler (1923: 147) have questionably associated it.

Smitt (1873: 60, *Escharella*), Florida, 176 fathoms.

RHAMPHOSTOMELLA Lorenz 1886

Aperture with an asymmetrical sinus and a lyrule; frontal an olocyst, with costules; a large oblique avicularium excentrically placed below the aperture; ovicell hyperstomial and closed by the operculum.

Rhamphostomella magnirostris Canu & Bassler 1928

Not taken at Porto Rico. Canu and Bassler (1928: 120), Cedar Keys, Florida.

UMBONULA Hincks 1880

Aperture suborbicular without cardelles or lyrula; frontal a pleurocyst with areolae and costules; a prominent suboral umbo; ovicell hyperstomial, opening widely above the aperture.

Umbonula undulata Canu & Bassler 1928

Not found at Porto Rico. Canu and Bassler (1928: 119), Cedar Keys, Florida.

CYSTISELLA Canu & Bassler 1917

Resembling *Porella*, from which genus it was separated. The front wall is an olocyst and it bears a very wide avicularian chamber which extends over the whole or most of the front and contains a pair of large glands. There is usually a well marked cicatrix or two pores, above the aperture.

Cystisella americana Canu & Bassler 1928

The species of *Cystisella* hitherto known are northern in distribution, but Canu and Bassler (1928: 113) have found the above species near New Orleans in the Gulf of Mexico, at 32 fathoms. Like other species of the genus, it is erect and branching, flabelliform.

PALMICELLARIA Alder 1864

Aperture orbicular, semicircular or semielliptical, without lyrula or cardelles. Frontal a granular pleurocyst, with areolar pores. Peristome much developed, with the ovicell opening into it and usually with an avicularian muero partially covering the aperture.

Palmicellaria aviculifera Canu & Bassler 1928

Not taken at Porto Rico. Canu and Bassler (1928: 118), Bahama Islands, at 369 fathoms.

BRYOCRYPTELLA Cossman 1906

Zoarium erect with flattened branches, zooecia on one side only; frontal a pleurocyst; aperture subquadrilateral, without lyrula or cardelles; a median oral avicularium; ovicell not closed by the operculum.

Bryocryptella reticulata (Pourtales) 1867*Cellepora reticulata* Pourtales (1867) 110.*Retepora reticulata* Smitt (1873) 69. pl. 13, figs. 242-244.*Bryocryptella reticulata* n. sp. Canu & Bassler (1928) 121. pl. 18, figs. 1-3.

Not found at Porto Rico. Pourtales and Smitt, off Havana, Cuba at 270 fathoms; Canu and Bassler, north of Cuba, 279 fathoms. The latter authors have raised the question whether their *reticulata* may be a different species but I believe them to be the same. The "longitudinal slit" on the ovicell as shown in Smitt's illustration appears to be a ridge rather than a slit, when one compares his drawing of *reticulata* with that of his *marsupiata* on the same plate.

Family TUBUCELLARIIDAE Busk 1884

Zoarium erect, jointed with radicles. Zooecia tubular, thick-walled, porous. Peristome much produced. Multiporous septulae. Ascopore present. Avicularia rare. The oecium is peristomial consisting of an expansion of the tube.

TUBUCELLARIA D'Orbigny 1852

Characters of the family.

Tubucellaria cereoides (Solander) 1786

Zoarium erect and branched, consisting of rounded segments joined by chitinous tubules; radicles are developed for the attachment of the colony. Zooecia elongate, embedded in the general crust, the tubular peristomes rising well above the general level and somewhat fluted on the outer surface; aperture rounded; ascopore round and situated at or near the base of the peristome. The ovicell is an enlargement of the peristome. Avicularia wanting.

A well known species, but apparently not common in American waters. Osburn (1914: 203), Tortugas Islands at 15 fathoms, one colony, first listed it. Canu and Bassler (1928: 113), Fowey Light, Florida, three segments only. In Porto Rican waters it was taken at several stations, off Guanica Harbor, at 6 to 12 fathoms.

Family RETEPORIDAE Smitt 1867

Zoarium various, erect and branched, unjointed, often reticulate, sometimes encrusting. Frontal with only marginal pores. Proximal border of primary aperture usually with a sinus, secondary orifice folded or notched above to form a spiramen, or ascopore. Usually

with oral avicularia and spines. Oocial cover deficient, wide open or with a slit or other opening, or with a slightly calcified or membranous area on its frontal surface, labellum usually present.

KEY TO THE GENERA

1. Zoarium erect and flabellate or fenestrate 2.
Zoarium encrusting *Rhynchozoon*, page 442.
2. Zoarium fenestrate *Reteporellina*, page 441.
Branches not anastomosed (a "catch-all" genus) *Retepora*, page 442.

RETEPORELLINA Harmer 1933

Zoarium reteporelliform, or the branches anastomosed with very long fenestrae. Peristome long and tubular, with a sinus. One pair of frontal pores usually. Frontal avicularium large, usually bifid at tip, below peristome, often wanting. Ovicell ovate, usually with persistent median fissure and simple labellum.

Reteporellina marsupiata (Smitt) 1873

Zoarium erect, branched and somewhat reticulate. Zooecia rhomboid, front convex and provided usually with two pores. In young zooecia these are seen definitely as lateral areolae, but as calcification proceeds they approach each other on the proximal part of the front. I have not observed them to develop any small rounded avicularia. The primary aperture is nearly semicircular and slightly beaded about the anterior border. The peristome is long and tubular, with a small sinus which is continued downward as an internal groove; the margin is irregular and thin. There is a large frontal avicularium, often wanting, below the base of the peristome, usually bifid, though sometimes blunt as figured by Smitt (1873. pl. 13). The avicularian chamber bears two small areolae near its base. On the dorsal side, at the edges are smaller avicularia, usually with a triangular mandible. The oecium is ovate to long ovate, with a median slit (sometimes closed by calcification) and a small median labellum which is truncate and without ridge. The color in life is a delicate pink.

The writer feels certain that this is Smitt's species, although he did not mention nor figure the bifid avicularium nor the labellum. The latter is wanting in younger ovicells so he may have overlooked it. Neither does he mention the lateral avicularia but these are often wanting. The species apparently comes closest to *R. denticulata* (Busk), but differs in the absence of the large infrafenestral avicularium, in the form of the labellum, which is short and broad, and in other minor characters.

Porto Rico, off Caño Gorda Island at 30 fathoms. Smitt (1873: 67, *Retepora*), Florida, 16 to 262 fathoms; Osburn (1914: 200, *Retepora*), Tortugas Islands, 10 to 18 fathoms; Canu and Bassler (1928: 122, *Retepora*), Gulf of Mexico, 27 fathoms and Caribbean Sea at 683 fathoms.

RETEPORA Lamarek 1801

This "genus" is now used as a "catch-all" for those species whose exact generic distinctions cannot be determined.

Retepora prominens Canu & Bassler 1928

Reteporella prominens Canu & Bassler (1928) 124.

Not found at Porto Rico. Canu and Bassler, east of Yucatan, 130 fathoms.

RHYNCHOZOON Hincks 1877

Frontal an olocyst with marginal areolae. Aperture rounded with a well developed sinus which is usually asymmetrical. A beaded vestibular arch. Operculum with the muscular attachments remote from the border. Peristome variously developed, often with processes proximally or laterally. Usually an avicularium at one side of the sinus. Ovicell only partly covered by the secondary layer, leaving the primary layer exposed next to the aperture and often extended into a short wide labellum. Secondary calcification quite variable, occasionally very thick so that the primary aperture lies at the bottom of a long tube and the ovicells are completely covered. Numerous pointed spines may appear on the frontal, especially near the aperture, and various kinds of frontal avicularia are known.

KEY TO THE SPECIES

- | | |
|---|-------------------------------------|
| 1. Zoecia small, 0.25 to 0.40 millimeters long | 2. |
| Zoecia larger, 0.45 to 0.55 millimeters long | 3. |
| 2. Peristome thin, high, without spines | <i>R. tuberculatum</i> , page 442. |
| Peristome with blunt spines; calcification heavy | <i>R. solidum</i> , page 443. |
| 3. Sinus not evident; occasional long spatulate avicularia with truncate mandible | <i>R. phrynoglossum</i> , page 444. |
| Sinus evident; no giant spatulate avicularia, exceedingly variable in secondary calcification | <i>R. verruculatum</i> , page 444. |

Rhynchozoon tuberculatum Osburn 1914

Zoarium encrusting, small and thin. Zoecia small, length about 0.40 millimeters, width about 0.25 to 0.30 millimeters; thin walled and delicate for a member of this genus. Frontal at first smooth but later covered with numerous small tubercles. Marginal pores few and small; peristome thin and high, bearing a minute avicularium placed laterally

on the inner side. When ovicells are present the peristome is continued forward around the aperture and over the oocium. Aperture ovate, about 0.12 by 0.12 millimeters. At one side near the proximal border a strong tooth extends often more than half way across the orifice and curves backward. Opposite this a minute projection sometimes appears. Ovicell prominent, about 0.15 millimeters long by 0.18 millimeters wide, finely tuberculate like the front in complete calcification. A rounded lucida or thin area on either side near the base. Labellum scarcely developed. A very inconspicuous species due to the small zoaria and the thin, semitransparent nature of the zoecia.

Osburn (1914: 200, fig. 9), Tortugas Islands, 18 fathoms; Curaçao (Osburn 1927: 130), shallow water. Porto Rico at Station 2369 off Guanica Harbor at 6 fathoms. Also a colony attached to a specimen of *Trigonopora tenuis* (Busk) taken off the Northeast coast of Porto Rico, "Caroline" Station 68.

Rhynchozoon solidum Osburn 1914

Zoarium encrusting, small, white, heavily calcified. Zoecia very small, 0.25 to 0.30 millimeters long by 0.20 to 0.25 millimeters wide; when young, ventricose with a smooth veined surface, but with age they become very thick walled and more or less immersed in a common crust; areolar pores few. Distally the frontal rises continuous with the peristome into several blunt conical processes around the proximal part of the aperture, usually there is one asymmetrically placed near the middle and another on each side. On younger zoecia there are 4 or 5 stout oral tubercles or short spines. The aperture is evenly rounded, with a beaded vestibular arch, and a rounded sinus in the proximal border. The true sinus is formed by a pair of denticles and shaped like that of many schizoporellas but above this is a second pair of denticles, one usually larger than the other, with the points directed toward each other. The operculum is thin, symmetrical and the muscle attachments remote from the border. The aperture, with the sinus, measures about 0.10 millimeters in length and width. A small avicularium is occasionally present on the suboral prominence but usually this appears to be wanting. Frontal avicularia are frequently present, usually on a slightly raised base and with a triangular or acute mandible. The ovicell becomes very heavily calcified, except for the usual semicircular membranous frontal area, and often bears a pointed or irregular umbonate process on the top. The labellum is short and broad. A very inconspicuous species as none of the colonies observed is more than 5 millimeters across.

Osburn (1914: 201. figs. 10-12), Tortugas Islands at 8 fathoms. Porto Rico, inside and outside of Guanica Harbor and at Caya Caribe, numerous colonies at 4 to 10 fathoms.

Rhynchozoon verruculatum (Smitt) 1873

Cellepora verruculata Smitt (1873) 50.—Osburn (1914) 214.

Zoarium encrusting, bluish white, often irregular on the surface, while the numerous pointed processes give it a very spiny appearance. Zoecia varying much in size, averaging about 0.50 to 0.55 millimeters in length, and 0.30 to 0.35 in breadth; in the young stage ventricose, distinct, a row of marginal areolae from between which short costae run toward the center. Primary aperture symmetrical with a rounded sinus and beaded vestibular arch. Width of aperture 0.13 to 0.15 millimeter. A large bulbous avicularian chamber develops at one side of the sinus, the beak is long, curved inward and the mandible opens above the orifice. The ovicell is large, 0.20 to 0.25 millimeters broad, smooth, with a nearly circular membranous area and a short, wide labellum.

The secondary calcification is so varied that it is impossible to describe it in detail. The oecia become completely immersed. The frontal layer sometimes becomes thicker than the polypide space within. The primary aperture comes to lie at the bottom of a tube. A large frontal avicularium appears with a pointed mandible, and a varying number of spinous processes arise around the secondary aperture which differs entirely from the primary aperture.

Porto Rico, common, taken at a number of stations off Guanica Harbor at 6 to 27 fathoms. Smitt (1873: 50), west of Tortugas Islands, 42 fathoms; Osburn (1914: 214), Tortugas Islands, low water to 15 fathoms. In the author's collection are specimens from Bermuda, from Beaufort, North Carolina, and as far north as No Man's Land Island, Massachusetts. To the southward, Marcus (1939: 153) reports it for San Sebastian Island, north of Santos, Brazil. The species is also known from the Mediterranean.

Rhynchozoon phrynoglossum Marcus 1937

Zoarium encrusting, large and irregular, white. Resembling *R. verruculatum* in the general manner of growth, but differing in several points as follows: (1) the aperture is slightly smaller and is nearly round, lacking the evident sinus of *verruculatum*; (2) the ovicell has a very large conspicuous whitish area, semicircular in form and radially grooved; (3) the triangular frontal avicularia are smaller and

more salient and among these there are occasionally giant avicularia with very elongate, linear-spatulate mandibles truncate at the tip. These characters appear to agree well with *phrynoglossum* which Marcus has recently (1937: 115. pls. 22, 23, figs. 61a, b, c) described from Santos Bay, Brazil.

Porto Rico, near the mouth of Guanica Harbor, encrusting large worm tubes at 6 fathoms.

Family ADEONIDAE Jullien 1903

Frontal a very thick pleurocyst with tubular areolar pores which connect with the septulae; primary aperture at the bottom of a deep peristomial tube; ovicells developed on special gonozoecia which are usually larger than the zoecia.

KEY TO THE GENERA

1. Zoarium encrusting, ascopore present. *Adcona*, page 445.
Zoarium erect or free, ascopore wanting 2.
2. Primary aperture semicircular, without sinus; avicularia frontal, median *Bracbridgia*, page 446.
Primary aperture longer than broad, with a sinus; avicularia lateral, beside the aperture. *Trigonopora*, page 446.

ADEONA Lamouroux 1816

Zoarium encrusting. Frontal wall thick, with ascopore situated somewhere near the middle; avicularia usually situated between the ascopore and the aperture; gonozoecia slightly larger than zoecia, with a wider, more transverse aperture.

Adeona violacea (Johnston) 1847

Zoarium encrusting, usually purplish in color, but ranging from white and pale blue to blue black. Zoecia subhexagonal to subquadrate; the frontal irregularly roughened, somewhat costate about the border; the rounded ascopore indented near the middle of the frontal. Aperture semicircular, straight on the proximal border and somewhat rounded at the corners; avicularium typically median and pointing straight forward toward the middle of the aperture, but variations are found in which the avicularium is directed toward the side and sometimes it may be lateral in position. The gonozoecia are somewhat larger than normal zoecia and have a larger and more transverse aperture. Zoecial length, 0.40 to 0.55 millimeters; width 0.25 to 0.30 millimeters. The width of the aperture appears more variable than

usual and on the same colony may vary from 0.10 to 0.14 millimeters. The aperture of the gonozoecium measures about 0.15 millimeters wide.

Porto Rico at the mouth of Guanica Harbor and near Caya Caribe at 6 to 10 fathoms. Smitt (1873: 30, *Porina violacea* and *P. plagiopora*), Tortugas Islands; Osburn (1914: 199) Tortugas Islands; Canu and Bassler (1928: 126, *A. plagiopora*), Gulf of Mexico, Florida Straits and north of Cuba, 30 to 143 fathoms.

There appears to be no constant difference between *violacea* Johnston and *plagiopora* Busk. In the latter the size is somewhat larger, the aperture larger, the oral avicularium larger and directed toward the side of the aperture, but all of these characters vary and intergrade even in the same colony. In my Tortugas paper (1914: 199) I called attention to this intergradation. Since then Dr. Anna B. Hastings (1930: 728) has placed them in synonymy, and Marcus (1939: 147) has given an extended synonymy including *plagiopora* under *violacea*. The species has a very wide distribution.

BRACEBRIDGIA MacGillivray 1886

Zoarium of flattened dichotomous branches. Ascopore wanting. Avicularia of two kinds, suboral and vicarious, the latter larger. Gonozoecia somewhat larger than ordinary zoecia.

Bracebridgia subsulcata (Smitt) 1873

Zoarium erect, dichotomous, the branches flattened; reaching a height of two or more inches, yellowish pink to orange. Zoecia elongate, subcylindrical; frontal with a row of areolar pores and a depressed area below the aperture bearing anteriorly the median oral avicularium which is usually directed toward the aperture; aperture subcircular, wider than long; large vicarious avicularia at the margin of the branch and smaller ones sometimes interpolated between the zoecia.

Smitt (1873: 28, *Porina*), Florida Straits, 10 to 48 fathoms; Osburn (1914: 199), Tortugas, 10 to 12 fathoms; Canu and Bassler (1928: 127), Gulf of Mexico at 30 fathoms and Fowey Light, 15 miles S. of Miami, Florida, 40 fathoms. The species was taken only once at Porto Rico, broken fragments at Station 2347, near Caya Caribe, at 8 fathoms.

TRIGONOPORA Maplestone 1902

Metrarabdotos Canu (1914).

Frontal a pleurocyst with marginal areolae; primary aperture rounded or elongate, with a rather deep rounded sinus and pointed cardelles; very large ovicells borne on gonozoecia which have large

lunate apertures. The zooarium is erect, branched, unjointed, bilaminar; or free and unilamellar.

Trigonopora tenuis (Busk) 1884

Smittia tenuis Busk (1884) 150. pl. 20, figs. 1, 1a, 1b.

Zoarium erect, branched irregularly, without joints, bilaminar, with 4 to 8 rows of zoecia on each side. Zoecia quite regularly arranged in quincunx; frontal a pleurocyst which becomes very thick but does not obscure the marginal areolar pores; in younger zoecia the frontal rises strongly into a salient peristome, but this soon becomes immersed in the general crust. In younger zoecia there is a pair of very small pointed avicularia surmounting the peristome one on either side of the aperture, but these also become immersed. The primary aperture is visible only at the bottom of the tubular peristome; it is short elliptical in form with a pair of long and slightly recurved cardelles behind which is a nearly round sinus. The secondary aperture has much the same form, constricted proximally to form a spiramen. Occasional large pointed or narrowly spatulate avicularia with a strong, complete pivot are situated distal to the aperture at one side and directed backward close along side the peristome; these measure from 0.30 to 0.50 millimeters in length. Zoecial length, about 0.65 millimeters; width, about 0.30 to 0.35 millimeters. Primary aperture, length 0.20 millimeters (including the sinus); width, 0.14 millimeters. Gonozoecia not observed.

Off the northeast coast of Porto Rico, "Caroline" Station 68, the specimen from Dr. R. S. Bässler. Busk's description of the type from Bahia, Brazil, is very inadequate, but his figures are fairly satisfactory.

Trigonopora unguiculatum (Canu & Bassler) 1928

Metrarabdotos unguiculatum Canu & Bassler (1928) 128.

Not found at Porto Rico. Canu and Bassler, Gulf of Mexico, Straits of Florida and east of Yucatan, 21 to 56 fathoms. The zoecia are much larger and the avicularia with curved mandibles point forward.

Family **CHEILOPORINIDAE** Bassler 1936

Ovicell endozoecial. No peristome. Frontal wall thin, with scattered pores.

KEY TO THE GENERA

1. Zoarium encrusting 2.
- Zoarium erect, jointed, dichotomous *Tetraplaria*, page 448.
2. Frontal without pores except conspicuous areolae *Hippaliosina*, page 448.
- Frontal wall porous 3.

- 5 *Zooecia* moderate in size, frontal with very small pores, not pigmented *Tremosincizoutina*, page 430.
Zooecia large, frontal with large pores, conspicuously dark pigmented
 *Watersipora*, page 449.

TETRAPLARIA Tenison-Woods 1878

Arborella Osburn (1914) 202.

Zoarium articulated, with corneous joints, dichotomous. Zooecia arranged in four series in pairs back to back. Frontal a tremocyst; aperture with a broad shallow sinus. Ooecia endozoecial, somewhat prominent.

Tetraplaria dichotoma (Osburn) 1914

Zoarium erect, forming loosely branching colonies less than an inch in height, dichotomous. Zooecia broad fusiform, wedge-shaped at the base, very distinct, each pair placed back to back and alternating with the next pair. Frontal a tremocyst with small pores; aperture rounded, with an evident rounded sinus; operculum well chitinized, strengthened by an arched rib running forward from the denticles. No spines or avicularia. The fertile zooecia are somewhat shorter and wider than the others, with a larger aperture. Ooecia endozoecial, rather prominent, porous like the frontal and ornamented by the same kind of roughened surface.

Zooecial length, about 0.60 millimeters; width, 0.30 to 0.35 millimeters. Aperture, about 0.14 millimeters in length and breadth. Ooecia length 0.25 millimeters; width 0.35 millimeters. The aperture of fertile zooecia about one-fourth larger in both dimensions.

Porto Rico, off Parguera at 6 fathoms, two small colonies. Osburn (1914: 202, *Arborella* n. g.), Tortugas Islands, at 10 fathoms. There are other specimens in my collection from Beaufort, North Carolina, and the Bahamas Islands.

HIPPALIOSINA Canu 1918

Ovicell endozoecial; aperture elongate, elliptical, constricted at the cardelles, with larger anter and smaller poster. Frontal a granular pleurocyst with areolar pores. Usually an avicularium at each side of the aperture.

Hippaliosina rostrigera (Smitt) 1873

Zoarium encrusting. Zooecia of moderate size, a little elongate, distinct; the frontal nearly flat, with fine tubercles and margined very distinctly and regularly by areolar pores. Avicularia usually one on each side opposite the anterior end of the aperture, with long pointed mandibles directed inward and distally. When only one avicularium

is present it is usually larger, and there is often some variation in the size of the avicularia and the length of the mandibles. Aperture elongate oval or elliptical, the denticles small; operculum well chitinized, with a chitinized rib parallel to the border. Ovicelled zooecia larger, with the aperture broader than long. Ooecium endozoecial and inconspicuous.

Zooecial length, about 0.40 millimeters, ranging from 0.30 to 0.60 millimeters; width, 0.26 to 0.30 millimeters.

Porto Rico, dredged at two stations off the mouth of Guanica Harbor, 6 to 15 fathoms. Smitt (1873: 57, *Escharella*) Florida, 35 to 43 fathoms; Osburn (1914: 211, *Lepralia*) Tortugas Islands, 10 to 15 fathoms; Canu and Bassler (1928: 130) north of Cuba at 143 fathoms, and Gulf of Mexico at 30 fathoms. The writer also has specimens from the Captive Islands, west of Florida.

WATERSIPORA Neviani 1895

Frontal a tremocyst with numerous rather large pores. Ovicell endozoecial. Aperture usually with a broad rounded proximal sinus and strong cardelles; operculum with a chitinized border and a broad axial band, leaving a large clear space on each side beyond the cardelles.

Watersipora cucullata (Busk) 1853

Zoarium encrusting, brownish purple to nearly black in color. Zooecia large, elongate, rather regular in form, distinct. Frontal regularly curved, with numerous large tremopores which are indistinguishable from the areolar pores. Aperture large, peristome scarcely noticeable, evenly rounded in front of the strong cardelles, behind these a broad shallow rounded sinus; operculum brownish with a paler rounded area on either side in advance of the cardelles, sometimes nearly evenly chitinized over the whole surface. The ovicell is said to be endozoecial, cucullate and porous, but I have not observed it on any of my material. The species is conspicuous because of its color and the size of the zooecia. Florida specimens measure as follows:

Zooecial length, about 1.10 millimeters; width, about 0.43 millimeters. Aperture, length 0.23; width, 0.25 millimeters; width between cardelles, 0.13 millimeters.

Osburn (1914: 211, *Lepralia*) common in shallow water at the Tortugas Islands. In Porto Rican waters only a single young colony was obtained on a pile of a wharf in Guanica Harbor.

Dr. Anna B. Hastings (1930: 729) has devoted considerable space and eleven figures to the variations of this species, if indeed all the

recorded forms belong to one species. My material shows little variation among the zooecia and, in the form of the aperture and operculum appears to approach most closely her figure 104, plate 15, of a specimen from Cape Verde Islands.

TREMOSCHIZODINA Duvergier 1921

Aperture with a very broad sinus; frontal a tremocyst. Avicularia lateral, rare or wanting.

Tremoschizodina lata (Smitt) 1873

Not noted at Porto Rico. Smitt (1873: 36, *Gemellipora*), Florida Straits, 68 fathoms; Canu and Bassler (1928: 131), Gulf of Mexico, 30 fathoms and off Havana Light, 387 fathoms.

Family **PHYLACTELLIDAE** Canu & Bassler 1917

The ovicell is recumbent, its orifice very large and closed by a special operculum. "Viewed laterally it appears attached like a sack on the back of a porter" (Canu and Bassler), sometimes it is free, or it may rest on the distal zooecium.

Apparently there are some irregularities in the allocation of certain genera and species to this family. The inclusion of forms which show such fundamental differences as the presence or absence of a lyrule, a beaded or smooth vestibular arch, a pleurocyst or tremocyst frontal, dietellae or septulae and a completely covered ovicell or one with a membranous frontal area, is probably not justified.

Whether the genus *Perigastrella* Canu and Bassler 1917, can be retained in this family may be reserved for future judgment, but certainly the *Lepralia contracta* Waters 1899, belongs neither in *Perigastrella* nor in the family Phylactellidae, where Canu and Bassler have placed it. Apparently the only genus of the Phylactellidae we have to deal with in this report is the following one.

LAGENIPORA Hincks 1877

"Colonies consisting of a number of cells immersed in a common crust. Zooecia recumbent, lageniform; oral extremity free, tubular, with a terminal orbicular orifice" (Hincks). The colonies are usually small and irregular, and the projecting tubules give it a rough aspect.

Lagenipora verrucosa Canu & Bassler 1928

PLATE 8, FIGURE 65

Zoarium encrusting, more or less uniserial. Zooecia in uniserial lines, more or less ramified, elongate, lageniform; frontal smooth to

verrucose, terminated by a long, smooth, cylindrical peristome. Aperture orbicular, at bottom of peristome; the peristome thin, entire or notched at the margin. Ovicell small, globular, opening into peristome above the operculum.

Zooecial length, 0.55 millimeters; width, 0.30 to 0.35 millimeters.

Porto Rico, a single colony at Station 2385, from 6 fathoms. The ovicell has a semicircular perforated area, similar to that of the genus *Costazia*, but the more numerous rounded pores and the absence of oral pedicellate avicularia will easily distinguish it. Canu and Bassler (1928: 137) Straits of Florida at 56 fathoms, and north of Cuba at 33 to 143 fathoms.

Family **CREPIDACANTHIDAE** Levinsen 1909

Zooecia aperture with strong cardelles. Operculum well chitinized. Long oral spines and sometimes marginal spines as well. Avicularia long, pointed, setose or pediform, usually paired on either side of aperture. Septulae usually alternating with intermediate chambers which bear the frontal marginal pores. Oocelia hyperstomial with small pores.

KEY TO THE GENERA

- Aperture with a very narrow, slit-like sinus *Mastigophora*, page 452.
Aperture broad proximally, without sinus *Crepidacantha*, page 451.

CREPIDACANTHA Levinsen 1909

The frontal is surrounded by a row of long setose marginal spines situated between the areolae and corresponding in position to the parietal diatellae (porechambers). Ovicell recumbent, closed by the operculum.

KEY TO THE SPECIES

1. Avicularia situated behind the aperture *C. poissonii*, page 451.
Avicularia farther forward beside the aperture 2.
2. Avicularian mandible shorter than the zooecia *C. setigera*, page 452.
Avicularian mandible longer than the zooecia *C. longiseta*, page 452.

Crepidacantha poissonii (Audouin) 1826

Zoarium encrusting, small, vitreous and glistening. The zooecia, 0.40 to 0.50 millimeters long, are somewhat ventricose and distinct. The marginal areolae are very small and between are situated the marginal setiform spines, on the anterior border the spines are distinctly in advance of the rim of the aperture. A pair of small avicularia with long setiform mandibles symmetrically placed on small

mamillate processes distinctly proximal to the aperture. The aperture is nearly circular in front of the strong cardelles and, behind these, widens abruptly to form a very broad shallow sinus or spiramen which may be even wider than the anterior aperture, the proximal border straight or slightly curved forward; peristome little developed and unarmed; length of aperture, 0.10 to 0.12 millimeters; width 0.08 to 0.09 millimeters. Ovicell rather broad and flattened above, situated in front of the distal zoecial spines which project somewhat from beneath beyond the oecium.

Porto Rico near Caribe Island, a small colony attached to a dead shell at 6 fathoms. I have a specimen also from Bermuda. The species has not previously been noted for the West Indian region, though Canu and Bassler (1928: 136) record it as a fossil from Panama.

Crepidacantha setigera (Smitt) 1873

Not taken at Porto Rico. Smitt recorded it (p. 58, *Escharella*) from the Tortugas Islands at 60 fathoms, and Canu and Bassler (1928: 135) recorded it from Florida Strait at 56 fathoms. The setiform avicularian mandible is shorter than the length of the zoecia.

Crepidacantha longiseta Canu & Bassler 1928

Not taken at Porto Rico. Canu and Bassler (1928: 135) record it from three stations north of Cuba at 67 to 201 fathoms. As *C. setigera* (Smitt) has never been fully described, *longiseta* may prove to be synonymous.

MASTIGOPHORA Hincks 1880

"Zoecia with a semicircular orifice, the inferior margin straight, with a central sinus; furnished with lateral vibracula" (Hincks). Levensen did not include this genus in his family *Crepidacanthidae*, but it evidently belongs here, as Canu and Bassler have indicated, because of its recumbent ovicell, pore chambers, etc.

Mastigophora pesansensis (Smitt) 1873

Zoarium encrusting. Zoecia moderate in size, frontal slightly convex, rising sharply into the peristome which is ornamented with six or eight erect spines. Aperture rounded distally, straight proximally, with a narrow deep sinus. On either side of the aperture and well forward is a peculiar avicularium the mandible of which is shaped like a goose's foot. Eroded specimens are often difficult of identification.

Zoecial length, 0.55 to 0.70 millimeters; width, about 0.50 millimeters.

Smitt (1873: 43, *Hippothoa*), Tortugas Islands, 42 fathoms; Osburn (1914: 207, *Escharina*), Tortugas Islands, 8 fathoms; Osburn (1927: 130), Curaçao Island; Canu and Bassler (1928: 133), north of Cuba at 143 fathoms, Straits of Florida at 56 fathoms, and Fowey Light, Miami, Florida, 40 fathoms. In Porto Rican waters the species was taken several times, at Caya Caribe, Caya Parguera, and southwest of Pt. Brea in 5½ to 8 fathoms. The colonies are always small, less than a centimeter across.

Mastigophora porosa (Smitt) 1873

Differing from *M. pesansensis* (Smitt) especially in the form of the avicularian mandible which is setiform and moderately short. Not taken in Porto Rican waters. Smitt (1873: 41, *Hippothoa*), Florida 40 to 70 fathoms; Canu and Bassler (1928: 134), Gulf of Mexico, Straits of Florida and off Miami, Florida.

Family CELLEPORIDAE Busk 1852

Zoecia usually erected and not oriented, though at the growing edge of a colony they may be horizontal and oriented. Ordinarily the zoecia are heaped upon each other and turned in all directions in the most irregular manner. The oecia are recumbent, on the dorsal surface of the peristome and vary greatly in the different genera. Oral avicularia are present in most of the genera in various positions and often raised. Vicarious avicularia of various shapes and sizes are often present.

Waters (1913: 510) subdivided the family on the basis of the form of the aperture into schizostomatous (with a sinus) and holostomatous (without a sinus) groups, and Canu and Bassler (1920: 596) added a third group with a clithridate (keyhole-shaped) aperture. The family is numerously represented, found in all seas, and is difficult of study since the primary characters are often obscured.

KEY TO THE GENERA

1. Aperture keyhole-shaped, with strong cardelles 2.
- Aperture otherwise, merely sinuate or rounded proximally 3.
2. Frontal with areolar pores only *Hippoporidra*, page 454.
- Frontal a tremocyst with numerous scattered pores ... *Hippotrema*, page 454.
3. Aperture without a sinus, proximal border nearly straight 4.
- Aperture with a more or less developed sinus 5.

4. Ovicell imperforate, an open hood *Holoporella*, page 455.
 Ovicell with a central pore, more completely developed
5. A suboral avicularium usually mounted on a strong rostrum, ovicell without a flat frontal area *Schizopora*, page 460.
 An avicularium on either side of the aperture, ovicell with a flattened frontal area
6. A "catch-all" for insufficiently studied species *Cellepora*, page 461.

HIPPOPORIDRA Canu & Bassler 1927

Frontal with areolar pores and small avicularia. Aperture with strong cardelles separating off a broad poster. Large acuminate interzoocelial avicularia. Ovicell hyperstomial with a frontal area.

KEY TO THE SPECIES

- Suboral umbo usually well developed, aperture about 0.06 millimeters wide *H. edax*.
 Suboral umbo absent or weak, aperture 0.08 to 0.09 millimeters wide *H. calcarea*.

Hippoporidra edax (Busk) 1859

Not taken at Porto Rico. Smitt (1873: 63, *Lepralia*), Elbow Reef, Florida; Canu and Bassler (1928: 139), east of Yucatan at 21 fathoms. It occurs as far north as the coast of New Jersey.

Hippoporidra calcarea (Smitt) 1873

Not taken at Porto Rico. Smitt (1873: 63, *Lepralia edax* forma *calcarea*), Florida, 49 to 79 fathoms; Osburn (1914: 212, *Lepralia*), Tortugas Islands, 12 fathoms; Canu and Bassler (1928: 140), Gulf of Mexico and Straits of Florida.

HIPPOPOTREMA Canu & Bassler 1927

Frontal a tremocyst with numerous scattered pores. Strong cardelles separate off a broad poster. Ovicell hyperstomial, not closed by the operculum.

Hippopotrema janthina (Smitt) 1873

Resembling the species of *Hippoporidra*, but the frontal pores and blue-black color easily distinguish it. Not taken at Porto Rico. Smitt (1873: 63, *Lepralia edax* forma *janthina*), Florida, 13 fathoms; Osburn (1914: 213, *Lepralia janthina*), Tortugas Islands, 6 fathoms; Canu and Bassler (1928: 141), north of Cuba, 130 fathoms.

HOLOPORELLA Waters 1909

Celleporidan species with the proximal lip of the aperture more or less straight and without sinus. Ovicell an open hood. Frontal with a few large areolar pores and occasionally with a few tremopores. Zoocelia usually not well separated. Suboral and frontal avicularia and usually large irregularly placed interzoocelial avicularia.

KEY TO THE SPECIES

1. Ectocyst with dark pigment 2.
 Without dark pigment 3.
2. Zoocelia large, aperture 0.28 millimeters wide; suboral rostrum low
 *H. magnifica*, page 455.
 Aperture 0.14 millimeters wide; suboral rostrum very high, pointed, the tip white *H. albirostris*, page 455.
3. Aperture with a small unsymmetrical notch in the proximal border
 *H. vagans*, page 456.
 Aperture entire on the proximal border 4.
4. Aperture 0.17 millimeters wide; suboral rostrum and avicularium vestigial
 *H. subalba*, page 456.
 Aperture very small, 0.06 to 0.09 millimeters wide; suboral rostrum moderately developed *H. pusilla*, page 457.

Holoporella albirostris (Smitt) 1873

Discopora albirostris forma *typica* Smitt (1873) 70, pl. 12, figs. 234-239.

The zoarium is encrusting, or erect and tubular, with irregular branching. When fully developed the species is easily determined by the white tips of the tall, sharp pointed rostra which stand out in sharp contrast to the dark pigmented frontal. The aperture is moderately small, 0.14 millimeters in width, evenly rounded in front with the proximal border nearly straight (sometimes a little concave). In marginal zoocelia there are sometimes several oral spines. The ovicell is a wide open hood. Younger stages are often difficult to identify as they may entirely lack the dark pigmentation and the suboral rostrum may be shorter. The size and form of the aperture appear to be constant.

Porto Rico at a number of places outside of Guanica Harbor at 5 to 18 fathoms. Smitt (1873: 70), Florida, 25 to 35 fathoms; Osburn (1914: 215), Tortugas Islands; Canu and Bassler (1928: 142), Gulf of Mexico and Straits of Florida. The species has a wide distribution in tropical waters and is known geologically as far back as the Oligocene.

Holoporella magnifica Osburn 1914

Zoarium encrusting, sometimes rising in broad vase-shaped forms as though developed about the base of sponges. The species is easily

determined among our West Indian celled pores by the very large aperture, 0.28 millimeters wide, and the dark brown pigment of the front. The operculum is heavy and nearly black in color and the mandible of the large avicularia is also heavily pigmented. The small oral avicularia often show only a little pigmentation. The frontal wall is thick, the suboral rostrum but little developed, oral spines wanting, and the ovicell is a wide open hood.

Porto Rico, near the mouth of Guanica Harbor at 8 fathoms. Osburn (1914: 216), Tortugas Islands, 10 fathoms, and Biscayne Key, Florida; Canu and Bassler (1928: 144), east of Yucatan and Gulf of Mexico, down to 30 fathoms. I have the species also from Bermuda and from Beaufort, North Carolina.

? *Holoporella vagans* (Busk) 1885

Zoarium encrusting, vitreous, white to flesh colored. Zooecia oriented at the margin, irregularly disposed in the secondary layers; frontal thickly covered with small round bosses which extend upon the suboral avicularium. Aperture with an irregular shaped unsymmetrically placed "sinus" or small notch in the proximal border; width of aperture 0.16 to 0.18 millimeters; peristome low, thick and irregularly calcified; a small preoral umbo bearing a small avicularium with a serrate beak. Interzooecial avicularia large and salient, with a coarsely serrate beak and linear or narrow spatulate mandible. Ooecium a wide open hood.

Porto Rico, off Salinas Cove, Station 2383, at 8 fathoms. Canu and Bassler (1928: 148), off Miami, Florida and Florida Straits, 40 to 56 fathoms. I have the same species also from Bermuda.

I am not at all certain that this is the *vagans* of Busk, though it resembles it in many respects, and it is similar to what Canu and Bassler (1928: 148) have identified as *vagans*. It lacks entirely the dark pigment of typical *vagans*, though one of the colonies is well developed. While the mandible of the vicarious avicularium varies much in size and form there are none of the expanded membranous ones mentioned by Busk, also the peristome seems to be less tubular.

Holoporella subalba Canu & Bassler 1828

Zoarium encrusting or tubular, multilaminar, white. Zooecia of moderate size, distinct, with usually a thin raised line of separation, little erect. The frontal is rather smooth and thinner than is usual in this genus. The aperture is nearly round, more straight on the proximal border. The peristome is thin and somewhat raised and above the

proximal border develops a thickening or umbonate process which sometimes bears a minute avicularium but more often this is entirely lacking. The interzooecial avicularia are usually large and long spatulate. The ovicell is salient, thin walled and is more closed than in most species of the genus. Canu and Bassler (1928: 146) fail to mention the presence of oral spines which are occasionally developed to the number of three or four on young marginal zooecia. The aperture measures about 0.14 to 0.17 millimeters in width.

Porto Rico near Punta Brea, 4 fathoms. Canu and Bassler, east of Yucatan, 25 fathoms. I have also a specimen from Dr. Bassler dredged off Havana, Cuba.

Holoporella pusilla (Smitt) 1873

Discopora albirostris forma *pusilla* Smitt (1873) 70. pl. 12, fig. 233.

Not noted at Porto Rico. Smitt recorded it from Florida at 9 to 60 fathoms; Osburn (1914: 215), Tortugas Islands at low tide.

This is a species with small zooecia and a very small aperture, 0.06 to 0.09 millimeters wide. It is encrusting, white, with oral spines.

Holoporella (?) *tubulosa* Canu & Bassler 1928

Not found at Porto Rico. Canu and Bassler (1928: 147), Gulf of Mexico and off Havana, Cuba, 30 to 167 fathoms. Canu and Bassler have wisely refrained from placing this species positively in *Holoporella*, as it does not seem to belong there. However, as I am unable to place it definitely I leave it tentatively in that genus.

Holoporella is abundantly represented in the tropics and the West Indian region has its full share of the species. Probably several more will be listed in the future.

TREMATOEOECIA NEW GENUS

Zoarium encrusting, in older stages often with many superimposed layers. Zooecia erect, not oriented (except at the edge of rapidly growing colonies), very heavily calcified. Frontal with a few scattered tremopores in addition to the rather large marginal areolae. Aperture semicircular, with a straight or slightly curved proximal border. A low rostrum with a small oral avicularium seated low down near the primary aperture, sometimes wanting even from whole colonies. Peristome thick and slightly raised and usually provided with strong tubercles or spines, which may sometimes bear minute avicularia. Ooecium roughly hemispherical, not widely open as in *Holoporella*, opening into the peristome and not closed by the operculum; heavily

and roughly calcified, with tuberosities, but with an uncalcified area or large pore on its frontal side toward the aperture. Avicularia, in addition to the suboral one, of two kinds, usually one or more small rounded ones and occasional large spatulate ones which may vary in size. The operculum has the lateral sclerites strongly extended downward to form a thick lappet on either side a little distal to the hinge.

Genotype, *Lepralia turruta* Smitt 1873.

It has been recognized that *turruta* does not fit the description of *Holoporella*. Waters (1914: 516) returned it to the "omnium gathrum" of *Lepralia*. Hastings (1930: 732) states that "this species can hardly be considered congeneric with the typical *Holoporellae*," and Canu and Bassler (1930: 75) suggest that it will be necessary to create a special genus for this species. A close study of material from the type locality and other regions of the West Indies, and the discovery of another species related to *turruta* have led the writer to the same opinion.

Trematoecia turruta (Smitt) 1873

PLATE 8, FIGURE 72

Lepralia turruta Smitt (1873) 65.

Holoporella turruta Osburn (1914) 217; (1927) 131.—Canu & Bassler (1928) 145.

Zoarium encrusting, rough, forming nodular masses of a yellowish pink to brick red color, occasionally of considerable size. A specimen from Curaçao Island measured 100 by 120 millimeters across and was about 20 layers in thickness. The zooecia are large, marginal ones measure about 90 millimeters long, roughly and heavily calcified, with usually a few pores in addition to the marginal areolae. Superimposed zooecia are erected and turned in every direction. The aperture is roughly semicircular, 0.16 to 0.20 millimeters in width, with a heavy low rostral process near the middle of the proximal border, on the anterior face of which is a small, oval avicularium (often wanting). The peristome is thick and rather low, though the presence of prominent tubercles may give it the appearance of being raised. The tubercles, ranging in number from 0 to 6, may be low or high, rounded at the tip or bearing minute rounded avicularia. Small rounded avicularia are of frequent occurrence on the frontal surface, and large spatulate avicularia of varying size are not infrequent.

The oecium is nearly spherical, closed to the edge of the peristome into which it opens, but with a rounded membranous area or large pore on the frontal surface at a little distance from the aperture. The ovicell is rounded when first formed, but soon becomes heavily calcified with tubercles of varying size and form which often quite obscure it and may even cover the central pore.

The operculum is slightly chitinized, with a narrow thickened border. On each side just in advance of the point of attachment is a strong, downward-projecting lappet-like process, at the anterior end of which is the muscle attachment.

Porto Rico, dredged at several stations outside of Guanica Harbor, 5 to 18 fathoms. Florida, 26 to 44 fathoms, Smitt; Tortugas, 12 to 15 fathoms, Osburn; Curaçao Island, Osburn; north of Cuba and east of Yucatan, 24 to 143 fathoms, Canu and Bassler.

The species has been listed for several other regions; Southern Brazil (Ridley), East Africa (Waters), Philippine Islands (Canu and Bassler). It seems pretty certain, however, that more than one species has been confused under this name, otherwise discrepancies in statement are difficult to understand. Thus Canu and Bassler (1929: 420) describe the ovicell in Philippine material as being small, smooth and globular, and they make no mention of a frontal pore; Ridley (1881: 55) states that the ovicells bear small scattered punctures, and Hastings (1930: 732) makes no mention of the central pore but comments on the absence of an oral avicularium. Smitt in his original description says in regard to the oecium "*rotunda, interdum bimucronata, media parte frontis supra aperturam poris perforantur*", but the ovicells are usually difficult to see as the thickening of the wall and the development of the processes renders them so much like the zooecia. Ridley's *Cellepora turruta* certainly must be a different species, and possibly those from the Philippines and Galapagos also. The oral avicularia are certainly present on West Indian material though many zooecia of a colony may lack them. The operculum varies somewhat in form, but none of them resemble the figure by Waters (1913: 516, pl. 73, fig. 10) with the muscle attachments removed from the border.

Trematoecia protecta NEW SPECIES

PLATE 8, FIGURES 66, 67, 68, 69, 70, 71

Zoarium encrusting, surface irregular, glistening white, multilamellate. Zooecia moderately large, marginal ones about 0.75 millimeters long, heavily calcified, erected and not oriented except at the growing edge of the colony. Frontal area rough, with a row of marginal areolae and a few additional scattered pores. About the aperture there are usually 4 or 5 (range 0 to 6) tall, conical, erect spines, none of which bear avicularia. In the marginal zooecia these spines may be low or wanting or tall and slender, but in older parts of the colony they are usually tall and stout and tapering rather evenly to a point. Rarely the rostrum is capped by a spine, but usually this is low with a spine

on either side and other spines of similar size and form more anteriorly placed around the aperture on the peristome. One or two spines of a similar nature may be present on the ovicell. Avicularia of two types: an oval suboral one similar to that of *turrita* in form and position and often wanting, and small interzoecial ones with a rounded mandible, which are infrequent.

The primary aperture, width about 0.18 millimeter, is somewhat semicircular, a little broader just behind the attachment of the operculum, and the proximal border is broadly arcuate without a sinus. The operculum is yellowish in color, slightly thickened at the margin and with lateral sclerites, which, like those of *T. turrita* (Smitt), extend dorsally in the form of lappets. The muscle attachments are similar to those of *turrita*.

The ooechia are of moderate size, a little less than the breadth of the zoecia, and soon become heavily encrusted and often surmounted by one or two stout spines; the pleurocyst is incomplete, leaving an irregularly rounded membranous area or large pore on the frontal side toward the orifice. The aperture opens into the peristome and is not closed by the operculum. The ooechium corresponds closely to that of *turrita* and does not have the form of an open hood.

The pointed, instead of blunt, spines; the glistening white, instead of reddish, color; the somewhat smaller size of the zoecia and the slightly different shape of the aperture and operculum serve to differentiate this species from *turrita*.

Porto Rico at two stations (2370 and 2381) due south of the Guanica Harbor bell buoy, at 5 and 10 fathoms.

SCHIZMOPORA MacGillivray 1888

Cellepores with the ovicell perforated by numerous small pores; the frontal smooth; a proximal sinus (rimule); suboral avicularia; no spines.

Schizmopora dichotoma (Hincks) 1864

Not found at Porto Rico. Smitt (1873: 53, *Cellepora avicularis*), Florida at 9 to 111 fathoms; Osburn (1914: 214, *Cellepora dichotoma*), Tortugas Islands, 10 fathoms. The species is well known in the middle North Atlantic.

Schizmopora margaritacea (Pourtales) 1867

Not taken at Porto Rico. Pourtales (1867: 110, *Vincularia margaritacea*), off Sand Key at 100 and off Havana at 270 fathoms. It occurs in very well branched colonies off Beaufort, North Carolina, at 13 fathoms.

COSTAZIA Neviani 1895

Siniopelta Levinsen (1909).

Cellepores with a sinuate orifice. Ovicell with a limited, perforated frontal area; usually with a small avicularium on either side of the aperture mounted on a tall erect process.

Costazia ignota (Norman) 1909

Lagenipora ignota Norman (1909) 309.

Zoarium forming small white nodules on shells, corals, etc. Zoecia erected, the frontal smooth with only a few marginal pores. Peristome rising high proximally and on the sides with usually a small pedicellate avicularium on each side of the aperture. The aperture is subcircular with a moderately developed sinus. The ovicell is globular with a rounded area which is perforated usually by a single row of slit-like pores. The area does not reach the proximal margin, and the peristome is not continued around on the ovicell. Interzoecial avicularia are rare.

Porto Rico, common and taken at a number of stations off Guanica Harbor at 6 to 20 fathoms. Osburn (1914: 214, *Lagenipora*), Tortugas Islands, 10 fathoms. I cannot be absolutely sure that this is Norman's species, since his description is brief, but it approaches it closely.

Costazia costazii (Audouin) 1826

This species resembles the preceding in the presence of the high peristome with a somewhat pediculate rounded avicularium on either side of the aperture, but differs in the following points: (1) the marginal pores are more numerous and regular in distribution; (2) the ooeccial area is semilunar in form, and has two or three rows of more or less rounded pores; (3) the peristome extends across the ovicell next to the aperture like a broad lip when fully formed. The ovicell appears to be exactly like that figured by Hincks (1880, pl. 55, fig. 12, *Cellepora*).

Porto Rico, several colonies dredged at 6 to 11 fathoms off Tallaboa Bay. Not otherwise recorded from American side of the Atlantic.

CELLEPORA Linnæus 1767

This old Linnæan genus is now used as a "catch-all" for those cel-leporine species which have not been sufficiently studied to be properly allocated in the newer genera. There a number of these in the West Indian fauna as follows:

Cellepora coronata Smitt (1873: 51). Possibly a *Schizmopora*. If it is ever recovered and studied it should be renamed, as Chiaje's use of the name pre-occupies it.

Cellepora gigas Smitt (1873: 52). Probably an *Osthimosia*, as Smitt describes it as having a sinus and an imperforate ovicell.

Cellepora tuberosa Smitt (1873: 52). Smitt's figure (pl. 9, fig. 180) resembles a species of *Holoporella*, but his description of the perforated ovicell indicates *Schizmopora*. Smitt used D'Orbigny's specific name, but it is probably not the same species.

Cellepora minutiporosa Canu & Bassler (1928: 150). A species with a sinuate orifice, but the authors do not indicate whether the ovicell is perforate or not.

Family PASYTHEIDAE Davis 1934

A creeping stolon from which arise free, jointed branches, the zooecia arranged in pairs or triads. Zooecial aperture with a broad, shallow sinus. No avicularia or ovicells.

This family contains two genera which have been confused and shifted about for many years. Ellis and Solander, 1786, described *Cellaria tulipifera* from Jamaica. Lamouroux, 1812, removed *tulipifera* from *Cellaria* and erected the genus *Pasythea*; and was followed in turn by Lamarck, 1816, *Liriozoa*; Blainville, 1834, *Tuliparia*; and Hincks, 1881, *Epicaulidium*;—all of whom based their descriptions on *tulipifera*. Evidently *Pasythea* has priority and the other names are pure synonyms.

Smitt (1873: 35 *et seq.*) erected the genus *Gemellipora* for his species *eburnea* and several others which have been removed. Busk (1884) and Canu and Bassler (1928, 1929) confused matters by placing *eburnea* under *Pasythea*. Levinsen (1909) separated *Liriozoa* (syn. *Pasythea*) and *Gemellipora* satisfactorily, but Bassler (1935) lumped them both together again under *Pasythea*. Apparently all this shifting has been done without sufficient knowledge of the species which show very distinct generic characters, as indicated below:

1. Branches consisting of an axis of elongated kenozoecia, from the opposite sides of which, near the upper end, appear zooecia in paired triads. Radicle fibers developed in three ways (1) between and a little below the triads (2) replacing one of the triads, and (3) rarely from the end of a kenozoecium. Branches few and unpaired. *Pasythea*, page 462.
2. Branches consisting entirely of paired zooecia (dyads) placed back to back (kenozoecia wanting); internodes composed of 2 to 10 dyads, daughter zooecia developed at the terminus of the preceding pair, either with or without corneous joints; branches numerous and usually paired; radicle fibers apparently only basal. *Gemellipora*, page 463.

PASYTHEA Lamouroux 1812

Pasythea tulipifera (Ellis & Solander) 1786

PLATE 9, FIGURES 75, 76, 77

Zoarium erect from a stolonate base, irregularly branching, stem composed of elongated kenozoecia separated by flexible joints. Zo-

oecia always joined in triads which usually arise from the stalk kenozoecia near their upper ends in opposite pairs, occasionally the stolon may give rise to a very short kenozoecium which develops a single triad at its tip. In the triads the median zooecium alone is connected with the kenozoecium, the lateral ones being budded off at the sides of the median one. The zooecia do not give rise to other zooecia or to branches or radicles. The zooecial and kenozoecial walls are provided with scattered pores. The kenozoecia vary much in length, 0.40 to 1.10 millimeters, and occasionally are barren of triads. Lateral branches arise from the sides of the kenozoecia between and a little below the origin of the triads.

Radicle fibers may appear on any part of the colony, replacing a branch, a triad, or a kenozoecium at the end of a series. The zooecial aperture is very small, 0.07 to 0.08 millimeters long by 0.06 millimeters wide, slightly sinuate; operculum little chitinized; a short terminal spine frequently developed, especially on the lateral zooecia. No ovicells nor avicularia. The triads measure about 0.40 to 0.45 millimeters in length.

Porto Rico, rather common off the south shore at 5 to 15 fathoms and taken at six stations. Ellis and Solander, 1786 (*Cellaria*) Jamaica; Marcus (1938: 37), Santos Bay, Brazil.

GEMELLIPORA Smitt 1873

Gemellipora eburnea Smitt 1873

PLATE 9, FIGURES 73, 74

Zoarium erect from a stolonate base, pinnately branched, the whole formed of successive pairs of zooecia (dyads) arranged back to back, with horny joints here and there. The internodes vary considerably, 2 to 10 dyads, but a joint is always present at the base of each branch.

Zooecia somewhat tubular, the pairs joined for most of their length, the terminal portion turned sharply outward and slightly twisted so that their apertures face in opposite directions. Branches arise opposite each other between the members of a dyad, a little above the middle of the zooecia. No ovicells and no kenozoecia of any sort except the radicle fibers at the base. Length of dyads about 0.55 millimeters (0.45 to 0.65 millimeters).

Not taken in our collections but found by the Challenger Expedition at near-by Culebra and Sombrero Islands. Smitt described the species from Florida and it has since been reported from the Gulf of Mexico, north of Cuba, off the coast of Brazil, the Gulf of Gascogne, and the Madeira Islands, always in rather deep water, down to 450 fathoms.

Family CATENICELLIDAE Busk 1852

Erect, jointed, branching colonies, often with radicles for attachment. Zooecia all facing the same direction, one, two or three to an internode. Ovicells or gonoecea in different positions according to the genus. Avicularia usually present.

The family is scarcely represented north of the equator, but is abundantly developed in the Australian seas. Hitherto none have been recorded for North American waters of either coast.

VITTATICELLA Maplestone 1900

Characterized by the presence of a vitta (a longitudinal groove with pores) on either side of the front. Occasionally very minute pores on the frontal surface. The ovicell, which is surrounded by a "beaded border," is rather deeply embedded in the base of the next distal zoocium, which in this genus is functional and not reduced to a kenozoocium.

KEY TO THE SPECIES

Avicularia present on either side of the aperture *V. elegans*, page 464.
Avicularia wanting; instead there are conical processes at the distal corners
..... *V. contei*, page 465.

Vittaticella elegans (Busk) 1852

PLATE 9, FIGURES 78, 79

Zoarium erect, flexible, dichotomously branched, zooecia in a single series, one or two to an internode, colonies 12 millimeters or more in height. Zooecia rather slender and tubular, dorsal outline curved; length, 0.50 to 0.60 millimeters, the fertile zoecium and the one distal to it are shorter, the two combined about 0.80 millimeters; width of zooecia and ooecea, about 0.20 millimeters. The front in some cases is slightly papillose. At each distal corner is a small avicularium with a somewhat triangular mandible which has a sharp, recurved point. Rarely one of these is replaced by a giant avicularium with a long spatulate mandible similar to those described by Waters (1913: 484) for specimens from Zanzibar and the Arafura Sea. Rarely, also, the avicularium is wanting, in which case there is a stout conical process.

Ooecea abundantly developed on specimens taken in February, but wanting from those collected in mid-summer; nearly round in outline, flattened on the front surface and deeply embedded in the distal zoocium. The beaded border, characteristic of the genus, is well developed. The distal zoocium, attached without a joint, is functional. Radicles are developed from circular chambers at about the middle of

the dorsal side. Branches arise from a daughter zoocium directly connected to the mother zoocium without a joint and take the place of the avicularium on that side.

Porto Rico at five stations, all in or off the mouth of Guanica Harbor at 5 to 30 fathoms. Dr. R. S. Bassler of the U. S. National Museum has also sent me specimens taken by the Johnson-Smithsonian Expedition in February, 1933, just north of the east end of Porto Rico at 10 fathoms. Widely distributed in warmer waters, but not reported for the American coasts.

Vittaticella contei (Audouin) 1826

PLATE 9, FIGURES 80, 81, 82

Zoarium small and delicate. Zooecia quite transparent, very small, short and rather broad in proportion, length about 0.26 millimeters; width, 0.15 millimeters; the fertile zooecia and the next in series somewhat shorter. The frontal area is somewhat papillose in the earlier zooecia of the colony. The vittae are variable in length but usually not more than half the length of the frontal area. Aperture rounded, the proximal border obscured to the level of the small hinge teeth by a projecting lip of the frontal. Avicularia entirely wanting, replaced by a strong process at each distal corner. The lateral zooecia occupy about the distal half of the border of the mother zooecia. Ooecea rather large, nearly as broad as the "covering" zooecia in which they are embedded; "beaded border" well developed; frontal surface perforated by a number of scattered, rounded pores and with an indefinite longitudinal sulcus; the "covering" zooecia functional and not reduced. Radicle chambers present on the dorsal surface, but no radicles are developed in my material. In one case a branch arises from the basal zoocium in the dorsal position.

Porto Rico, one mature colony with ovicells at 6 fathoms, taken one mile south of Caño Gorda Island; another near the Guanica Harbor bell buoy at the same depth. The larger specimen is only about 2 millimeters in height, consisting of 24 zooecia, with 7 ovicells. In my collection is another specimen from Bermuda at 3 fathoms, collected by Dr. S. R. Williams.

Marcus (1937: 76, *Catenicella*) records the species from Santos, Brazil. The species is widely distributed, Madeira, Mediterranean and Red seas, Java, but has not been noted with any frequency, no doubt because it is so small and inconspicuous.

Family SAVIGNYELLIDAE Levinsen 1909

Catenariidae D'Orbigny (1851).

Zoarium erect, branched, jointed, each segment consisting of a single zoecium. Zoecia elongated, tubular, only slightly calcified, the frontal surface with pores and separated from the dorsal surface by a more or less sharp line. Ovicell recumbent. Avicularia and spines present.

SAVIGNYELLA Levinsen 1909

Catenaria Lamouroux (1824) preoccupied.*Savignyella lafontii* (Audouin) 1826

The trumpet-shaped zoecia forming a chain, with the prominent suboral avicularium and circumoral spines, characterize the species. The colonies are erect or trailing among other bryozoa, algae, etc., and in spite of their small size are conspicuous by their brick red color. The aperture is semicircular, without sinus, its distal border surrounded by strong erect spines. The globular zoecia as well as the zoecial walls are perforated by numerous conspicuous pores. The zoecia vary greatly in length, from 0.75 to as much as 1.50 millimeters, the difference being chiefly in the stalk-like base. Daughter zoecia are produced on the dorsal side near the distal end, and in branching two daughter zoecia appear at the same level, side by side.

Porto Rico, off the mouth of Guanica Harbor at 5 to 30 fathoms. Osburn (1914: 197), Tortugas Islands, down to 10 fathoms. I have the species also from Bermuda, and Marcus (1937: 78) records it for the Bay of Santos, Brazil. It occurs around the world in warmer waters.

Family MAMILLOPORIDAE Canu & Bassler 1927

Zoarium orbicular in outline, cupuliform, the zoecia oriented toward the apex of the colony; fertile zoecia enlarged.

MAMILLOPORA Smitt 1873

Mamillopora cupula Smitt 1873

Not found at Porto Rico. Smitt (1873: 33), Florida, 30 to 68 fathoms; Canu and Bassler (1928: 153), Gulf of Mexico and Straits of Florida, 27 to 56 fathoms.

Order PHYLACTOLAEMATA Allman

No systematic attempt to collect the freshwater Bryozoa was made, but the following species was taken in considerable numbers.

Family FREDERICELLIDAE

Plumatella repens (Linnaeus)

Branched chitinous tubes spreading over the under sides of stones in the stream at Rio Piedras. Some of the branches were erect, but for the most part they were adherent.

LIST OF NEW GENERA, SPECIES, AND VARIETIES

New Genera

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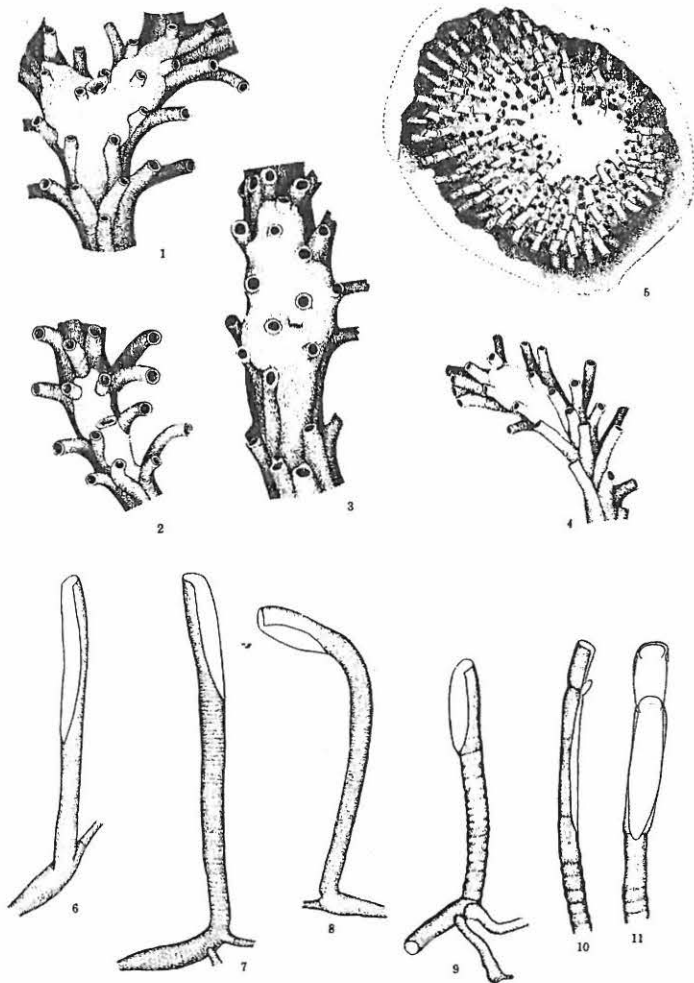
EXPLANATION OF PLATES

The figures were all drawn under camera lucida to the same scale, with a few exceptions which are indicated.

Many of the drawings were made by my former student Dr. Mary D. Rogick, an authority on the freshwater Bryozoa, whose outstanding work as an artist in this field is already well known (see especially the figures under *Parellisina*, *Ezechanella*, *Labioporella*, *Thalamoporella*, *Colcopora*, etc.). The illustrations were completed by Miss Frieda Busch, to whom also I owe a debt of gratitude for her patient and careful work.

PLATE I

- FIGURE 1. *Diaperoccia rugosa* n. sp., with branched ovicell.
 FIGURE 2. *Diaperoccia rugosa* n. sp., with simple ovicell.
 FIGURE 3. *Diaperoccia floridana* n. sp.
 FIGURE 4. *Entalophora delicatula* (Busk). Note oocciostome at base of a zoocial tube.
 FIGURE 5. *Lichenopora buski* Harmer. Note lateral oocciostome.
 FIGURE 6. *Aetea truncata* (Landsborough).
 FIGURE 7. *Aetea recta* Hincks.
 FIGURE 8. *Aetea anguina* (Linnaeus).
 FIGURE 9. *Aetea ligulata* Busk. A young zoocium, note corrugated stalk.
 FIGURE 10. *Aetea ligulata* Busk. Lateral view showing regeneration. The original operculum is still present, with a new one terminally situated.
 FIGURE 11. *Aetea ligulata* Busk. Ventral view showing regenerated portion with the two opercula.



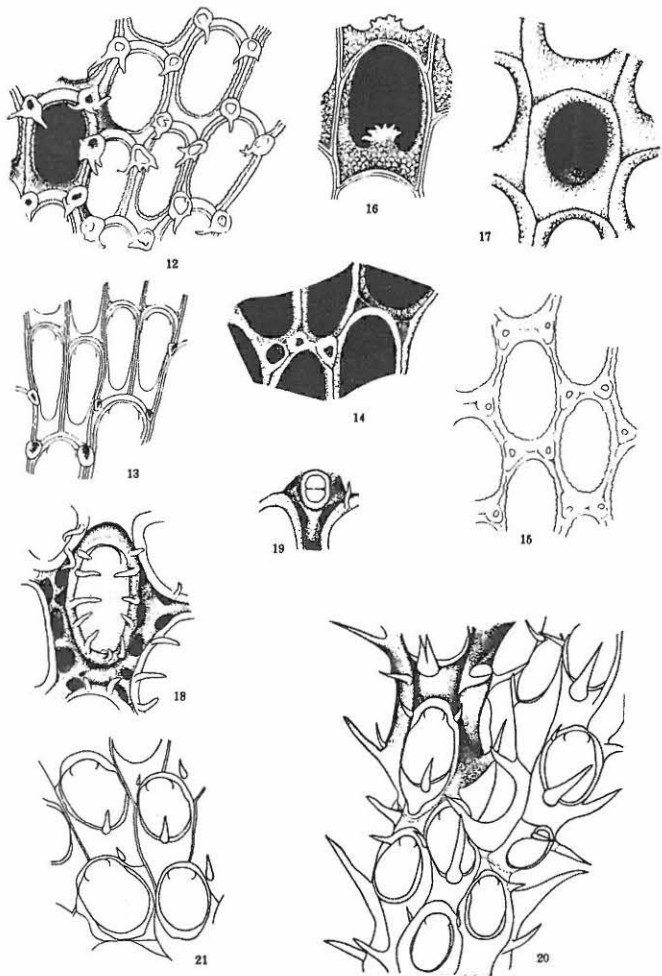


PLATE 2

FIGURE 12. *Conopeum tubigerum* n. sp. Fully developed with trumpet-shaped tubular spines.

FIGURE 13. *Conopeum tubigerum* n. sp. At rapidly growing edge of zoarium, showing development of tubes from the triangular basal corners.

FIGURE 14. *Conopeum reticulum* (Linnaeus). Note interzoecial kenozoecium at left, a pair of nodules and the triangular basal corners from which the nodules develop.

FIGURE 15. *Conopeum reticulum* (Linnaeus). Outline sketch showing characteristic arrangement.

FIGURE 16. *Acanthodesia savartii* (Audouin). Younger stage.

FIGURE 17. *Acanthodesia savartii* (Audouin). Highly calcified.

FIGURE 18. *Hincksina periporosa* Canu & Bassler.

FIGURE 19. *Hincksina periporosa* Canu & Bassler. Interzoecial avicularium.

FIGURE 20. *Electra bellula* (Hincks) n. var. *ramosa*. Branching stage. Note position of joints and nature of spines.

FIGURE 21. *Electra bellula* (Hincks) n. var. *ramosa*. When a branch comes into contact with a flat surface and becomes unilaminar. The spines are much reduced.

PLATE 3

FIGURES 22 to 30. *Acanthodesia tenuis* (Desor). Variation in zoecial form, size, nodulation and development of cryptocyst in a single large colony on an oyster shell from Beaufort, North Carolina. FIGURES 29 and 30 show regeneration. Calcification of the cryptocyst is usually about as in FIGURES 26 and 28, less frequently the cryptocyst is much larger as shown in FIGURES 22, 23 and 27.

FIGURE 31. ? *Aplousina gigantea* Canu & Bassler.

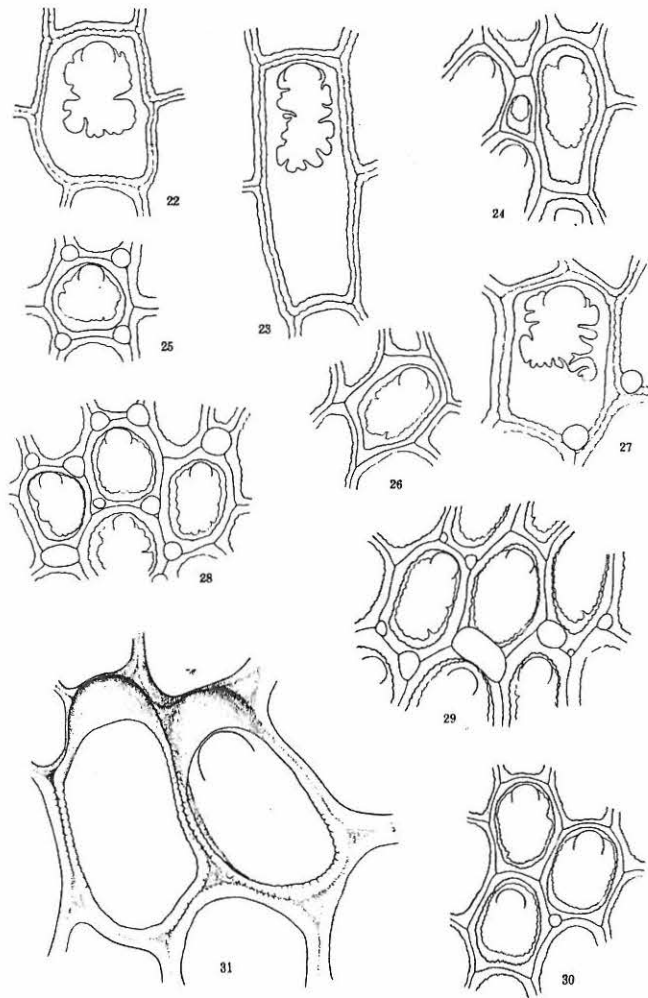
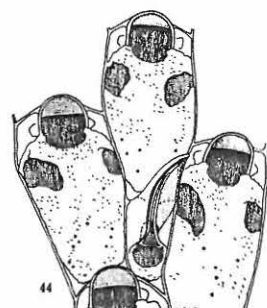
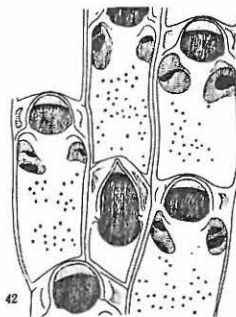
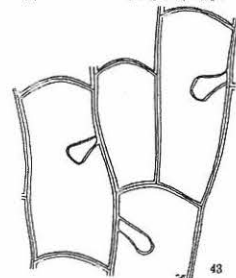
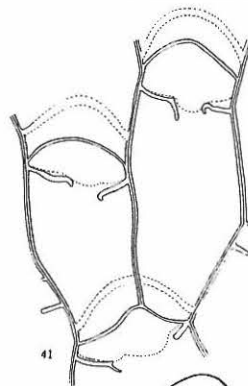
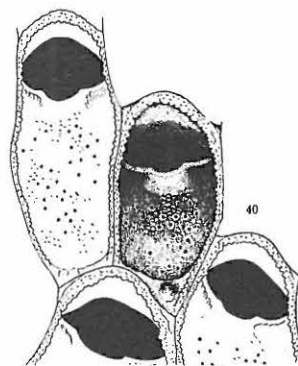
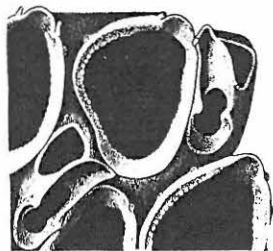


PLATE 5

- FIGURE 40. *Labioporella sinuosa* n. sp.
 FIGURE 41. *Labioporella sinuosa* n. sp. Dorsal view.
 FIGURE 42. *Thalamoporella gothica* n. var. *floridana*.
 FIGURE 43. *Thalamoporella gothica* n. var. *floridana*. Dorsal view.
 FIGURE 44. *Thalamoporella salcifera* Hincks.
 FIGURE 45. *Thalamoporella salcifera* Hincks. Dorsal view.

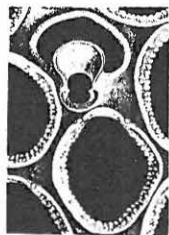




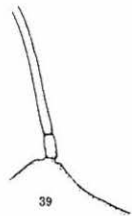
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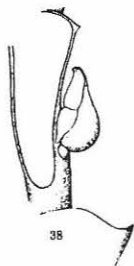
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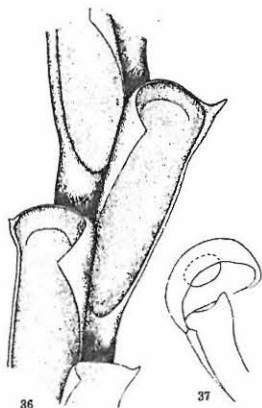
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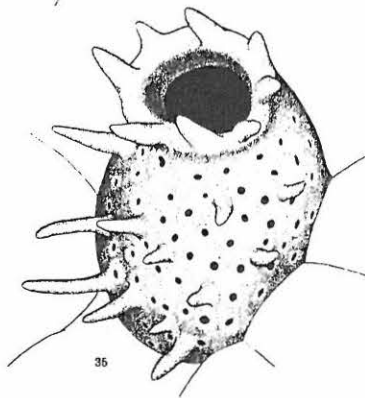
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PLATE 4

FIGURE 32. *Parellisina curvirostris* (Hincks). Showing relation of avicularium chamber to kenozoocium.

FIGURE 33. *Parellisina latirostris* n. sp. From dried specimen with chitinous parts intact.

FIGURE 34. *Parellisina latirostris* n. sp. Calcined specimen showing details of structure. There is some variation in the form and size of the avicularium and kenozoocium, but they are always broad.

FIGURE 35. *Exechanella antillea* (Osburn) n. var. *spinosa*.

FIGURE 36. *Caulibugula levinseni* n. sp. Form of zoecia.

FIGURE 37. *Caulibugula levinseni* n. sp. Outline sketch of ovicell with ovum.

FIGURE 38. *Caulibugula levinseni* n. sp. Form and position of avicularium.

FIGURE 39. *Caulibugula levinseni* n. sp. Elongate jointed spine occasionally present.

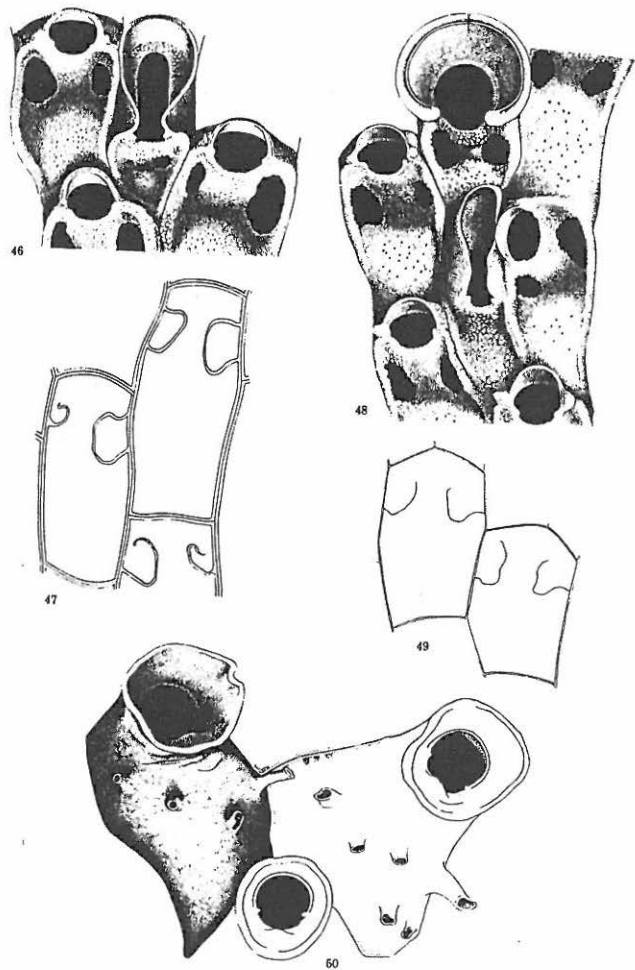
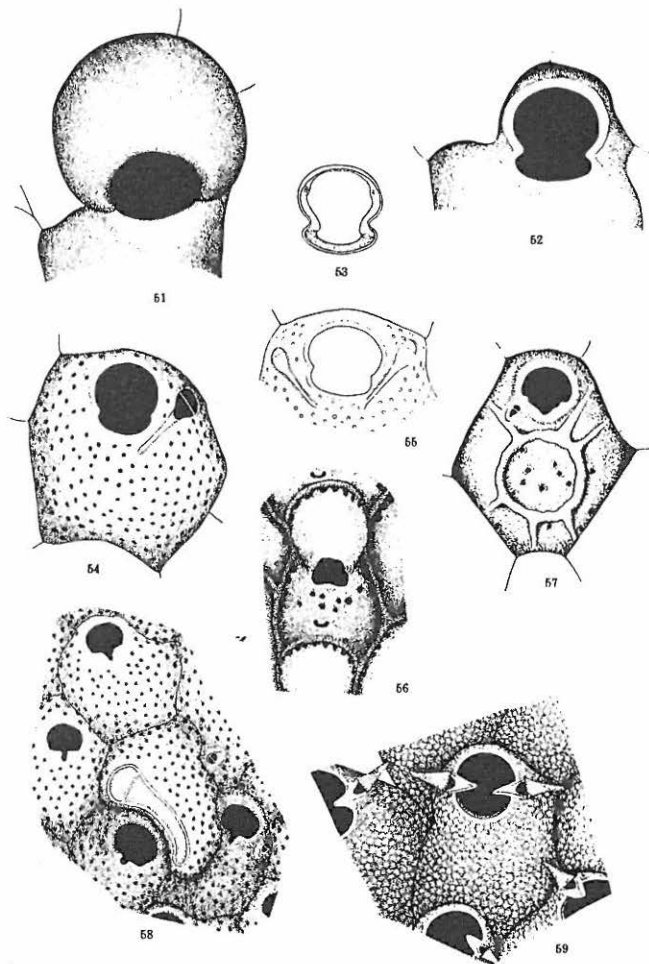


PLATE 6

- FIGURE 46. *Thalamoporella mayori* n. sp. Note especially the avicularian opesicles.
- FIGURE 47. *Thalamoporella mayori* n. sp. Showing dorsal side.
- FIGURE 48. *Thalamoporella distorta* n. sp. The distorted zoecia are always paired with a distorted avicularium.
- FIGURE 49. *Thalamoporella distorta* n. sp. Dorsal view.
- FIGURE 50. *Coleopora americana* n. sp.

PLATE 7

- FIGURE 51. *Hippopodina irregularis* n. sp. Ovicell as covered with a thick pellicle.
- FIGURE 52. *Hippopodina irregularis* n. sp. Details of aperture.
- FIGURE 53. *Hippopodina irregularis* n. sp. Operculum.
- FIGURE 54. *Hippopodina seegeensis* (Busk). A young zoecium with reversed avicularium.
- FIGURE 55. *Hippopodina seegeensis* (Busk). With paired reversed avicularia.
- FIGURE 56. *Fenestulina malusi* (Audouin).
- FIGURE 57. *Stephanosella rugosa* n. sp. A younger zoecium with the beginning of the frontal decoration.
- FIGURE 58. *Stylopoma informata* (Lonsdale). Showing large falcate interzoecial avicularium.
- FIGURE 59. *Gephyrophora rubra* n. sp.



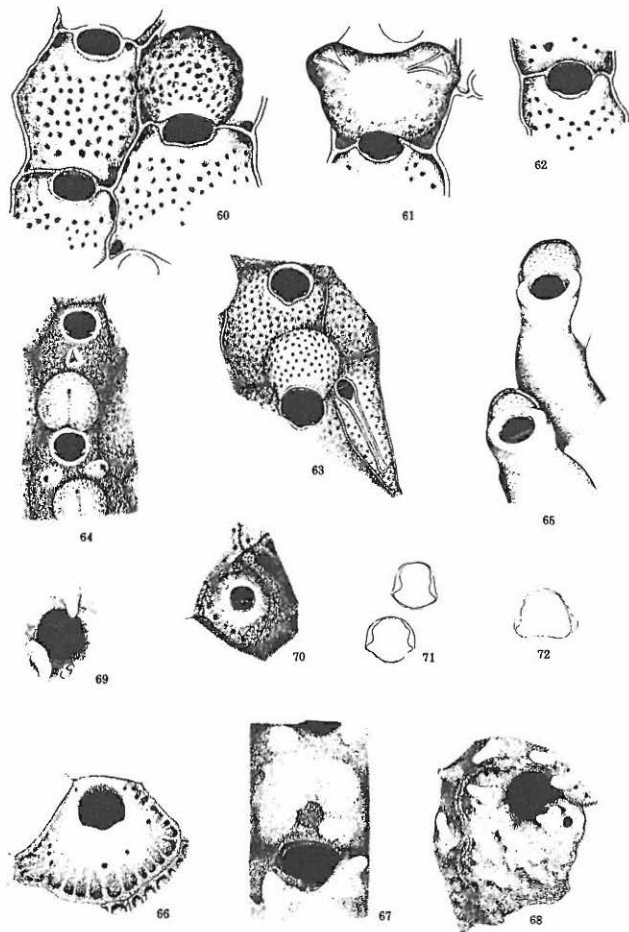
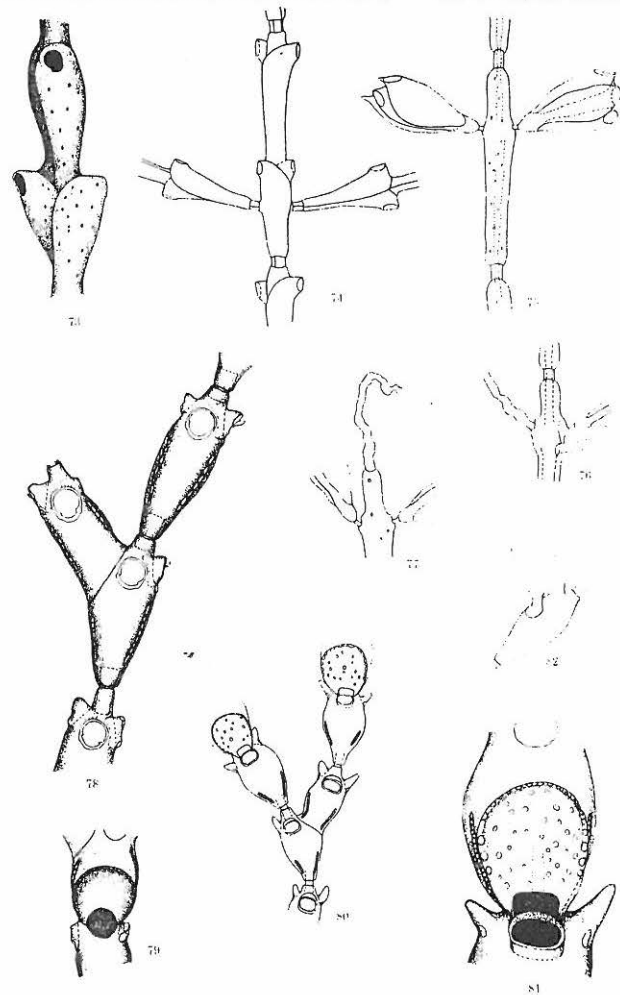


PLATE 8

- FIGURE 60. *Gemelliporida typica* Canu & Bassler. Zoecia with ovicell.
 FIGURE 61. *Gemelliporida typica* Canu & Bassler. An ovicell surmounted by two avicularia, rare.
 FIGURE 62. *Gemelliporida typica* Canu & Bassler. Detail of aperture.
 FIGURE 63. *Gemelliporida aculeata* Canu & Bassler. Ovicell and interzoecial avicularium.
 FIGURE 64. *Hippomenella fissurata* (Canu & Bassler). Showing groove and pore of ovicell. The aperture of the ovicell is obscured.
 FIGURE 65. *Lagenipora verrucosa* Canu & Bassler.
 FIGURE 66. *Trematooecia protecta* n. sp. Young zoecium.
 FIGURE 67. *Trematooecia protecta* n. sp. With oocidium showing central pore and suboral avicularium.
 FIGURE 68. *Trematooecia protecta* n. sp. Advanced calcification.
 FIGURE 69. *Trematooecia protecta* n. sp. Aperture with avicularium and spines.
 FIGURE 70. *Trematooecia protecta* n. sp. Rounded interzoecial avicularium.
 FIGURE 71. *Trematooecia protecta* n. sp. Opercula.
 FIGURE 72. *Trematooecia turrita* (Smitt). Form of operculum.

PLATE 9

- FIGURE 73. *Gemellipora eburnea* Smitt. Form and mode of origin of zooecia.
- FIGURE 74. *Gemellipora eburnea* Smitt. Sketch showing mode of jointing and branching.
- FIGURE 75. *Pasythea tulipifera* (Ellis & Solander). Internodal kenozoocia, jointing and origin of triads.
- FIGURE 76. *Pasythea tulipifera* (Ellis & Solander). Showing ordinary position of radicle and the unusual replacement of a triad by a radicle.
- FIGURE 77. *Pasythea tulipifera* (Ellis & Solander). Showing the occasional termination of a branch in a radicle.
- FIGURE 78. *Vittaticella elegans* (Busk). Zooecia, avicularia, mode of branching and details of aperture.
- FIGURE 79. *Vittaticella elegans* (Busk). Ovicell.
- FIGURE 80. *Vittaticella contei* (Audouin). Zooecia, branching and ovicells.
- FIGURE 81. *Vittaticella contei* (Audouin). Ovicell much enlarged.
- FIGURE 82. *Vittaticella contei* (Audouin). Unusual origin of a branch from dorsal side in place of a radicle.



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