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*With very best regards.*

*Raymond C. Osburn*

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BRYOZOA OF THE PACIFIC COAST  
OF AMERICA  
PART 2, CHEILOSTOMATA-ASCOPHORA  
(PLATES 30-64)

BY

RAYMOND C. OSBURN, Ph.D., D.Sc.



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MARY D. ROGICK





REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF  
VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND  
GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, IN 1938,  
IN 1939, IN 1940, AND IN 1941, AND VELERO IV IN 1949-1952 OFF THE COAST OF  
MEXICO AND SOUTHERN CALIFORNIA.

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# BRYOZOA OF THE PACIFIC COAST OF AMERICA

## PART II, CHEILOSTOMATA-ASCOPHORA

By RAYMOND C. OSBURN, PH.D., D.Sc.

PLATES 30-64

A report based chiefly on the Bryozoa collected by the Allan Hancock Expeditions, 1933-1942, in the *Velero III*. (See pages 1-2 of Part I.)

### ASCOPHORA

Levinsen (1909:213) defined the "Suborder Ascophora" chiefly on the presence of a compensation sac or ascus, which suggested the name.

It may appear somewhat illogical to apply the term "suborder" while there is still difference of opinion as to where the Anasca leave off and the Ascophora begin. However, with the exception of the Cribrimorpha and a few other scattering genera there is no doubt as to their position for the differences are very distinct. This does not appear a proper place to enter into an extended discussion of the origin and evolution of the Ascophora and, since the subdivision is a very convenient one, I shall continue to use it in the hope that future research will clarify our knowledge of the relationships.

#### Suborder ASCOPHORA Levinsen, 1909

The frontal area is completely calcified, with the exception of the aperture, and beneath this is the compensatorium or compensation sac which is a hydrostatic arrangement permitting the influx and outflow of water when the polypide is extruded or withdrawn. As a rule this sac opens into the proximal part of the aperture, but in some cases there is a separate opening, the ascopore, situated proximally to the aperture. The operculum is usually compound, hinged on the sides, the larger distal portion opening upward to permit the extrusion of the tentacles while the small proximal part is deflected downward to open the compensation sac. When an ascopore is present the operculum is simple, lacking the proximal part.

As a rule the species are more heavily calcified than in the *Anasca*. The frontal is primarily an olocyst, which is probably merely the completed extension of the anascan gymnocyst. In most cases an additional calcified layer is laid down on top of the olocyst, either a pleurocyst which grows inward toward the center of the front from the marginal pores or areolae, or a tremocyst which develops evenly over the olocyst from the numerous scattered tremopores which perforate the frontal wall. Oral spines are frequently present; also avicularia which may be either interzoecial (vicarious) or frontal (dependent). The zoaria are usually encrusting, but not infrequently rise into folds, nodules, or stems. The latter may be branched and are sometimes provided with chitinous joints. The ovicells in most cases are hyperstomial, opening above the primary distal rim of the aperture, or they may be endozoecial and formed by the distal extension of the zoecial cavity and opening below the level of the operculum; in a few genera ovicells appear to be entirely absent, the larvae developing within the zoecial cavity.

The Ascophora are a dominant group of the recent Bryozoa, occurring everywhere in the seas and are of some importance as nuisance organisms in the encrusting of ship's bottoms, buoys, etc., or covering the "cultch" of oyster beds to the exclusion of oyster larvae. While the individual zooecia rarely are more than a millimeter in length the colonies often reach considerable size. Budding may be terminal, lateral or frontal and in the latter case new layers may grow over the older ones to form very thick encrustations. The writer has counted more than 30 layers in species of *Smittina*.

They are distributed from the polar seas to the equator and from shore to great depths. A few species are estuarine in water of low salinity but none of them have been able to become adapted to pure fresh water. They are abundant as fossils from the Cretaceous onward since the thick calcareous walls are readily preserved in bottom deposits. Many of the earlier genera no longer exist, but more than 100 of those known as fossils are still living and about the same number are known only as Recent genera. As research continues these figures will undoubtedly be greatly altered. The present work includes several genera now living but hitherto known only as fossils and a few in which the reverse is true. Evidently the bryozoan fauna of the Pleistocene differed very little in its general aspects from that of the present. The Ascophora do not appear to be a decadent group.

It appears impossible with our present lack of knowledge, to arrange the families of the Ascophora in any logical evolutionary order. Certain families appear to be simpler than others, that is, they seem to have

undergone less modification from anascan ancestors, but we still have no certain information concerning the origin of the Ascophora. In several of the anascan families, especially the cribrimorphs, a more or less complete cover, the pericyst, has been developed. The ancestors of the Ascophora may have evolved from one of these, but which one is still in doubt, and there is some evidence that there may have been parallel evolution from more than one anascan type of progenitor.

The arrangement of the families in the present work follows that of Bassler in the *Fossilium Catalogus* merely for the sake of convenience. When our knowledge of relationships is more complete this arrangement may suffer many changes. This is true also of the genera within a family as certain of the "families" are admittedly merely "catch-alls" which include genera of uncertain relationship. Truly there is much to be learned before the taxonomy of the Ascophora arrives at a settled basis.

Owing to the heavy calcification the Ascophora are especially difficult to work with. Ordinarily the polypides have been neglected, but by careful decalcification of the skeleton, and staining, many of the details of the soft parts may be observed. The chitinous appendages, opercula and avicularian mandibles, are often of great value in the determination of species and of generic and family relationships. It is possible, by very careful dissection to remove these individually, but it is much easier and usually just as satisfactory to crush a small portion of a zoarium on a glass slide, add a drop of absolute alcohol and mount in clarite or some similar medium.

For the study of the skeletal details it is frequently necessary to remove the chitinous ectocyst. Treatment with "Javelle water" (eau de Javelle) will remove all the chitinous and soft parts and leave beautiful preparations, but it is much quicker and usually just as satisfactory to burn away the organic matter by the use of the mineralogist's blow-pipe. The technique is very simple—place a small part of a colony on a spatula and with the blow-pipe direct the flame from an alcohol lamp on the specimen. A little experience will indicate when to stop the incineration. Details of the surface, the arrangement of pores, the presence and nature of cardelles and lyrulae within the aperture, the nature of the avicularian rostrum and pivot or hinge denticles, etc., are usually clearly presented by this method. The communication pores, in the side walls, septulae and diatellae, and the nature of the frontal, olocyst, pleurocyst or tremocyst, also are more readily observed. A word of caution is necessary, for overheating may destroy a specimen. Unique specimens naturally should never be incinerated unless small fragments can be removed for the purpose.

## GLOSSARY

Many of the terms used in the classification of the families, genera and species will be found on pages 5-7 of Part I (Anasca), but there are numerous others which apply only to the Ascophora.

*Anter.* The portion of the primary aperture distal to the cardelles.

*Areolar pores.* One or more rows of pores around the margin of the zooecial front.

*Ascopore.* A special median frontal pore opening into the compensation sac (*q.v.*) proximal to the aperture.

*Ascus.* See compensation sac.

*Compensation sac.* A chamber beneath the frontal wall for the adjustment of internal pressure by permitting the entrance and exit of water as the tentacles are protruded or withdrawn.

*Cardelles.* Lateral hinge denticles to which the operculum is attached.

*Condyles.* The same as cardelles.

*Costae, costal ridges.* Rib-like ridges which arise between the areolar pores and run inward on the frontal.

*Epitheca.* The ectocyst or outer chitinous membrane.

*Frontal.* The entire ventral area surrounding the aperture, but more frequently applied to that part of it proximal to the aperture.

*Labium.* A descending lip-like fold of the upper margin of the orifice of the ovicell.

*Lyrula.* A median denticle or shelf on the proximal border of the primary aperture.

*Marginated.* Bordered, as in the secondary fold around the base of an ovicell.

*Multilaminar.* Referring to a mode of zoarial growth in which new layers of zooecia grow over and cover the older ones.

*Muscle attachments.* The insertions of the occlusar muscles of the operculum, sometimes at the border, sometimes at a distance from it, frequently on the opercular sclerites.

*Olocyst.* The primary calcified covering layer, usually thin but sometimes heavily calcified. (See pleurocyst and tremocyst.)

*Oral avicularia.* Those definitely associated with the aperture, either suboral or lateral-oral.

*Oral spines.* Spines, usually jointed at the base, which develop on the primary peristome.

*Peristome.* The primary peristome is the original fold of the olocyst around the aperture; the secondary peristome develops from the frontal wall and often covers the primary peristome and partially obscures the aperture.

*Pleurocyst.* A secondary calcified covering layer which originates at the border of the zooecium and grows toward the center.

*Poster.* That portion of the primary aperture proximal to the cardelles. (See sinus.)

*Primary aperture.* The original aperture, closed by the operculum which usually fits it very exactly.

*Sclerite.* A chitinous thickening of the operculum, either at the margin or otherwise located; the occlusar muscles are usually attached to it.

*Secondary aperture.* The aperture above the level of the operculum, formed by the surrounding frontal wall; it is variable in height and form, complete or incomplete, and is frequently notched on the proximal border to form a secondary sinus or spiramen.

*Shield.* A broad, elevated area occasionally surrounding the aperture.

*Sinus.* An extension, usually rounded or v-shaped, of the poster into the proximal border of the primary aperture.

*Tremocyst.* A secondary calcified layer of the frontal above the olocyst; usually thickly perforated all over and developed evenly from the frontal pores instead of growing inward from the border.

*Tremopore.* Pores which are scattered more or less evenly over the whole frontal; apparently they all contribute to the formation of the tremocyst; they are continuations of similarly placed pores in the underlying olocyst.

*Vestibular arch.* A narrow rim surrounding the aperture inside of the primary peristome.

*Umbo.* An elevated process or knob-like structure on the frontal usually just proximal to the aperture; occasionally paired, sometimes on the top of the ovicell.

*Zooeciule.* A diminutive zooecium sometimes occurring in series with normal ones, usually closed, sometimes bearing an avicularium.

Family **Hippothoidae** Levinsen, 1909

"The zooecia become calcified from behind in successive zones forward, leaving at the surface more or less salient lines of growth, and are furnished with a variable number of dietellae." (Canu and Bassler, 1920:325). In *Hippothoa*, *Chorizopora* and *Hincksipora* the frontal is imperforate; the first two of these and *Trypostega* have hyperstomial ovicells, they are endozooecial in *Hincksipora*, and none have been found in *Harmeria*; in *Hippothoa*, *Chorizopora* and *Trypostega* there is a distinctly sinuate aperture but there is no indication of a sinus in the others; in *Trypostega* and *Chorizopora* there are interzooecial avicularia in line with the zooecial axis, but none at all in the other genera. As pointed out by Canu and Bassler, the family is not a natural one and appears to be a group of primitive Ascophora associated by their simplicity rather than by more positive factors.

## KEY TO GENERA OF HIPPOTHOIDAE

1. Zooecial front imperforate (except areolar pores) . . . . . 2  
    Frontal more or less perforated . . . . . 4
2. Avicularia distal to and in line with the zooecia . . . *Chorizopora*  
    Avicularia wanting . . . . . 3
3. Ovicell hyperstomial, porous; frontal thin . . . . *Hippothoa*  
    Ovicell endozooecial, frontal excessively thick . . . *Hincksipora*
4. The whole frontal finely perforated; small avicularia on zooeciules  
    in line with the zooecia . . . . . *Trypostega*  
    Pores limited to a definite disto-central area, avicularia and ovicells  
    wanting . . . . . *Harmeria*

Genus **HIPPOTHOA** Lamouroux, 1821

The zooecia are usually uniserial, but may be multiserial and loosely attached to each other with small fenestrae between. There are no frontal pores but the ovicells are porous. The fertile zooecia (gonoecia) are usually different in size from the infertile ones and may be different in form. The aperture has a shallow sinus. The growth ridges on the front are transverse and usually very conspicuous. No spines, no avicularia. Genotype, *H. divaricata* Lamouroux, 1821.



KEY TO SPECIES OF *Hippothoa*

1. Zoarium multiserial, often covering large areas . . . . . *hyalina*  
    Zoarium uniserial, with lateral branches . . . . . 2
2. Zoecia with very long basal tubular prolongations . . . . . *flagellum*  
    Basal prolongations usually not longer than the zoecial body . . . . . 3
3. Zoecia large, with a broad calcareous expansion along the . . . . .  
    sides . . . . . *expansa*  
    Zoecia much smaller, the lateral expansion narrow or . . . . .  
    wanting . . . . . *divaricata*

***Hippothoa hyalina* (Linnaeus), 1758**

Plate 30, figs. 1-5

*Cellepora hyalina*, Linnaeus, 1758:1286.*Schizoporella hyalina*, Hincks, 1884: 17.*Schizoporella hyalina*, Robertson, 1908:289.*Schizoporella hyalina*, O'Donoghue, 1923:35.*Hippothoa hyalina*, Canu and Bassler, 1923: 92.*Hippothoa hyalina*, O'Donoghue, 1925:101; 1926:54.*Hippothoa hyalina*, Hastings, 1930:720.

Zoarium encrusting on anything that will afford attachment, often covering large areas on shells and broader algae; at first a smooth, glistening, more or less hyaline layer, it may become multilaminar and piled up into irregular masses with a rough surface, or losing its hyalinity may be chalky white.

The zoecia in the younger stage are more or less terete, with narrow, elongate fenestrae partially separating them, transversely ribbed or lined, smooth and glistening, imperforate. The aperture is rounded or short-ovate, with a broad, shallow sinus, the peristome thin and slightly elevated. A low, pointed umbo is often present just proximal to the aperture.

The ooecia are large and conspicuous, usually borne on somewhat dwarfed gonoecia which stand up more or less erect among the zoecia.

There is so much variability in this species that it often presents a difficult problem to the beginner, but marginal zoecia will usually show the essential characters. A number of varieties have been given names.

It is a truly cosmopolitan species, occurring around the world and from the Arctic, where it is often excessively abundant, to the tropics. It has been reported by everyone who has studied Pacific coast Bryozoa, from Alaska to southern California, and Hastings recorded it from the Galapagos Islands.

In the Hancock collections it has been noted at 69 stations all the way south to Peru and the Galapagos Islands.

**Hippothoa divaricata** Lamouroux, 1821

Plate 30, fig. 6

*Hippothoa divaricata* Lamouroux, 1821 :22.*Hippothoa divaricata*, Hincks, 1880 :289.*Hippothoa divaricata*, Robertson, 1908 :296.*Hippothoa divaricata*, O'Donoghue, 1923 :38 ; 1926 :53.

The zoarium is uniserial, branched, encrusting pebbles and shells. The zooecia have a short basal, tubular portion, usually considerably less than the length of the expanded portion, and in the variety *conferta* Hincks the basal portion is almost wanting. The zooecial body is elongate-ovate, inflated, the front usually with a low carina, and there is never more than a slight expansion of the dorsal side for attachment. The aperture is rounded with a distinct sinus in the proximal border.

The ovicell is smooth and globular with a small rounded umbo on the top, borne on a slightly reduced zooecium.

Widely distributed around the world. Hincks and the O'Donoghues listed it from a number of localities in British Columbia and Robertson collected it at several localities on the California coast. Hincks, 1880 :289, lists it from Mazatlan, Mexico.

In the Hancock collections it was found to range southward from southern California to Mexico, the Gulf of California, Costa Rica, Panama, and the Galapagos Islands. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Alaska Research Laboratory.

**Hippothoa flagellum** Manzoni, 1870

Plate 30, figs. 7-8

*Hippothoa flagellum* Manzoni, 1870 :6.*Hippothoa flagellum* Hincks, 1880 :293.

This is a more delicate species than others of the genus, with a basal tubular portion often several times as long as the expanded zooecial body. The latter is elongate ovate, without dorsal expansion ; the aperture ovate instead of rounded and with a sinus in the proximal border. The oecia are borne on short, reduced individuals which are usually on short tubular stalks at the sides of normal zooecia.

Distributed around the world in warmer and temperate seas.

In the Hancock collections this species was found to be well distributed along the Pacific coast from Mexico (Guadalupe Island and the Gulf of California) to Panama, Colombia, Peru and the Galapagos Islands, from shallow water down to 100 fms.

**Hippothoa expansa** Dawson, 1859

Plate 30, fig. 9

*Hippothoa expansa* Dawson, 1859:255.*Hippothoa divaricata* var. *expansa*, Verrill, 1885:232.*Hippothoa expansa*, Hincks, 1880:291.

This species resembles *H. divaricata*, but is much larger, has a calcareous lamina expanding from the dorsal sides of the zoecial body and tubular portion, and the ovicell is broader than long.

Apparently this species has not been recorded previously for the Pacific coast of America. It is well distributed in the northern North Atlantic and Arctic Oceans.

Hancock Station 1283-41, Santa Rosa Island, off the coast of southern California, 28 fms; Palos Verdes, California, on kelp hold-fast (R. C. Osburn). Common at Point Barrow, Alaska, G. E. MacGinitie collector, Alaska Research Laboratory.

Genus **CHORIZOPORA** Hincks, 1880

"Zooecia more or less distant, connected by a tubular network; the orifice semicircular, with the inferior margin entire" (Hincks, 1880:222). Genotype *Flustra Brogniarti* Audouin, 1826.

The genus is similar in appearance to *Hippothoa hyalina*, but is readily distinguished by the semicircular aperture and by the presence of a small avicularium distal to each zoecium and to the oecium when it is present.

**Chorizopora brogniarti** (Audouin), 1826*Lepralia Brogniarti*, Busk, 1854:65.*Chorizopora Brogniarti*, Hincks, 1880:224.*Chorizopora brogniarti*, Canu and Bassler, 1930:14.

Zoarium encrusting in a thin layer, resembling younger stages of *Hippothoa hyalina* in its cross-ribbed, disassociated, terete zooecia. The frontal is imperforate, the only decoration being a low, pointed umbonate process which overhangs the aperture; the latter is semicircular, broader than long and straight on its proximal border. At the distal end of each zoecium is a small avicularium with a triangular mandible directed forward. The ovicell is rounded, conspicuous, with a longitudinal carina, and its distal end is surmounted by an avicularium similar to those associated with the infertile zooecia.

It is a widely distributed species and is known as a fossil as far back as the Miocene. The only record for the Pacific coast of America is that of Canu and Bassler "Galapagos Islands, D.2813." It has not appeared in the Hancock collections.

Genus **TRYPOSTEGA** Levinsen, 1909

"The zooecia with scattered pores and a compound operculum. The oecia covered by dwarf zooecia with scattered pores. No avicularia" (Levinsen 1909:280). Genotype, *Lepralia venusta* Norman, 1864.

A zooeciule is usually present at the distal end of each normal zooecium in the form of a small quadrangular chamber, but they are often wanting, sometimes over considerable areas; also the zooeciule forms a covering layer over the oecium. The nature of the zooeciule or dwarf zooecium has been in doubt and Levinsen definitely states "no avicularia." The rounded apertures of the zooeciules in *T. venusta* are very minute, only about 0.03 to 0.04 mm in diameter and appear to have no mandibles, but in *T. claviculata* (Hincks) there are small spatulate mandibles. The zooeciules may therefore be interpreted as avicularian kenozoecia and in the type species, *venusta*, the avicularium is vestigial.

**Trypostega venusta** (Norman), 1864

Plate 30, fig. 10

*Lepralia venusta* Norman, 1864:84.

*Trypostega venusta*, Canu and Bassler, 1930:14.

*Trypostega venusta*, Hastings, 1930:720.

*Trypostega venusta*, Marcus, 1938:35 (synonymy).

Zoarium encrusting, sometimes multilaminar, white, smooth and glistening. The zooecia are somewhat rhomboid, a little inflated; with numerous pores, sometimes with a small rounded umbo proximal to the aperture; 0.40 to 0.45 mm long by 0.26 to 0.30 mm wide. The aperture is pyriform, rounded distally to the strong, triangular cardelles and behind these is a broad, somewhat triangular sinus; aperture length 0.10 mm, width 0.08. The zooeciules are usually situated at the distal ends of the zooecia, but sometimes between them. Occasionally the zooeciules may be nearly as large as the normal zooecia, but without any increase in the size of the minute aperture.

The oecia are deeply immersed, scarcely raised above the level of the crust, covered by the enclosing zooeciule, about 0.25 mm broad by 0.20 mm long, porous and surmounted by a low umbonate process.

The species is widely distributed in tropical and temperate seas, but appears not to have been noted on the Pacific coast of America except for the record of Hastings at Panama and that of Canu and Bassler at Galapagos.

In the Hancock collections it has been noted at 23 stations ranging southward from Santa Catalina Island, southern California, to Ecuador and the Galapagos Islands, including stations from west Mexico, Socorro and Clarion Islands, the Gulf of California, Cocos Islands, Panama and Colombia. Low water to 100 fms.

**Trypostega claviculata** (Hincks), 1884

Plate 30, fig. 11

*Lepralia claviculata*, Hincks, 1884:23.

*Trypostega claviculata*, Levinsen, 1909:281.

Zoarium similar to that of *T. venusta*. The zooecia are also similar, but are somewhat larger, ranging from 0.40 to 0.65 mm in length. The aperture is different in size and form, measuring about 0.13 mm in either dimension, the same strong triangular cardelles present, but the sinus is wider and shallower. The zoeciules are larger and more frequently wanting, and the aperture which Hincks figures as a clavicular opening, is closed by a spatulate avicularium.

The ovicell, with its zoeciule cover, is unusually large, about 0.40 mm long and varying in width from 0.30 to 0.45 mm; somewhat trilobate in form, with the middle lobe large and carinate.

Hincks described the species from Houston Stewart Channel and Cumshewa, British Columbia. Levinsen studied Hincks' material, but otherwise I have found no reference to it.

Hancock Stations 1242, off Point Loma; 1281-41, Santa Rosa Island; off Santa Catalina Island, and off San Pedro, all from southern California, shallow water to 40 fms.

Genus **HARMERIA** Norman, 1903

"Zooecia ovate, thin, glassy, hyaline, with a scutiform or ovate area on the front, distinctly circumscribed by a raised line, within which the surface is punctate. Oral aperture semielliptic; lip straight in the younger stage, but afterwards overhung by a suboral collar-like process with more or less developed rostrum. No visible oecia. No avicularia" (Norman 1903:107). Genotype, *Lepralia scutulata* Busk, 1855:255.

*Harmeria scutulata* (Busk), 1855

*Lepralia scutulata* Busk, 1855:255.

*Harmeria scutulata*, Levinsen, 1916:447.

Zoarium encrusting, usually on larger algae, the colonies always small. Zooecia closely set, but distinct with deep separating grooves; ventricose, the front smooth proximally, except for fine growth lines, and with a shield-shaped or oval area proximal to the aperture which is definitely punctate. There are two sizes of the zooecia.

The ancestrula is membraniporoid with a complete membranous area; the first daughter zooecia are large, similar in size to the ancestrula, and these are followed suddenly by much smaller zooecia which bear a short, umbonate median process and a broad collar around the side of the aperture.

Recorded from various localities north of Europe, in Greenland waters as far north as Etah, Hudson Strait, and as far west as Dolphin and Union Strait (Osburn 1923:9d) and Victoria Island, North-West Territory, Canada (Hutchins 1940:33). The following additional record suggests that it is circumpolar.

Punuk Island, Bering Sea. From a shell in the Los Angeles Museum, collector unknown, one colony.

Genus **HINCKSIPORA** new genus

Zoarium encrusting. The frontal is a heavy pleurocyst with a single row of areolar pores and covered by a thick ectocyst. The ovicell is endozooecial, opening below the closed position of the operculum and extending into the proximal end of the succeeding zooecium. The operculum is simple, heavily chitinized, attached without cardelles and straight across its proximal border where it is broadly attached to the compensation sac, oclular muscles attached a little inside from the border. The primary aperture is straight or nearly so on the proximal border and without a sinus; the suboral spinule, often wanting, is not a lyrula; the primary peristome is wanting and the oral rim is formed by the thick frontal wall. No spines, no cardelles, no avicularia; multiporous septulae present in the lateral and distal walls. Genotype, *Mucronella spinulifera* Hincks, 1889.

The species which forms the genotype has been passed around from one genus to another, *Lepralia*, *Discopora*, *Porellina*, *Mucronella* and *Monoporella*, but for obvious reasons it cannot be assigned to any of these as they are now understood. The nature of the ovicell excludes it from all of them. The operculum is simple and so firmly attached to

the floor of the compensation sac that it is separated only with difficulty, while the latter structure appears to be chitinized and spreads over the whole width of the zoecial cavity, resembling the ectocyst of the *Anasca*. Because of its simplicity this genus is tentatively assigned to the family Hippothoidae, "a group of primitive Ascophora associated by their simplicity rather than by more positive factors."

The genus is named in honor of Thomas Hincks, the great English bryozoologist who was the first to recognize *spinulifera* as a distinct species.

### **Hincksipora spinulifera** (Hincks), 1889

Plate 33, figs. 1-4

*Mucronella spinulifera* Hincks, 1889:431.

*Monoporella spinulifera*, Hincks, 1892:152 (but not var. *praeclara*).

*Porellina ciliata* forma *dura* Smitt, 1867:6.

*Discopora cruenta*, Smitt, 1871:1127.

*Lepralia cruenta*, Waters, 1900:73.

*Monoporella spinulifera*, Norman, 1903:115.

*Mucronella spinulifera*, Osburn, 1912a:282.

Zoarium encrusting on shells in a single layer; reddish-brown, in old colonies nearly black, the color all in the thick ectocyst. Zooecia large, 0.65 to 1.00 mm long by 0.50 to 0.65 mm wide; separated by deep grooves, the front arched, very thick, white and shining on the removal of the ectocyst, with a row of conspicuous areolar pores. The aperture is slightly broader than long (about 0.25 by 0.20 mm), rounded distally and nearly straight on the proximal border; usually there is a minute median spinule on the proximal border, but this is situated above the level of the lyrula of *Mucronella* and not homologous with it; occasionally there are two or three spinules and often they are wanting. The secondary peristome is a broad fold of the frontal which extends around the lateral and distal sides of the aperture. Proximal to the aperture there is occasionally a broad, low umbonate swelling, which sometimes shows a rounded membranous area placed vertically on its distal face; this may be a vestigial avicularium, but in my material I have not been able to find positive evidence of a mandible. No oral spines, no dietellae.

The oecium is endozoecial, about 0.30 mm wide by 0.24 mm long, the wall similar to the frontal, thick and granular; the peristome is thicker on the sides and extends more or less around on the front of the ovicell.

Spitzbergen to Greenland and south to the Gulf of St. Lawrence. Point Barrow, Alaska, common down to 22 fms, G. E. MacGinitie, collector, Arctic Research Laboratory.

Frankly I am entirely at a loss to know where to place this remarkable form. By its manner of growth, from the border inward producing a secondary cover layer, the frontal appears to be a pleurocyst with large areolar pores; the ovicell is endozoecial, opening beneath the closed position of the operculum and extending into the proximal end of the succeeding zooecium; the operculum is heavily chitinized, simple, attached without cardelles and straight across its proximal border where it is broadly attached to the compensation sac and to which it adheres closely. It does not conform to the aperture, there is a broad lunate thickening near the distal end and one on each side but these do not appear to be definite sclerites; muscles attached a little in from the border. The proximal spinule of the aperture does not appear to be a useful character, as it is very frequently wanting, but it is usually present on some of the zooecia of every colony and rarely there are two or even three spinules close together.

The membrane to which the operculum is attached is somewhat chitinized and covers the full width of the zooecial cavity like an anascan ectocyst. If this is its true nature the frontal wall must be a pericyst of a totally different nature from that of the Cribrimorpha. If it is true that the anascan ectocyst has evolved into the floor of the compensation sac, as has been suggested by several authors, there appear to have been "attempts" by different methods in this direction by a number of disassociated genera in addition to the Cribrimorpha, viz. *Hiantopora*, *Tremogasterina*, *Exechonella*, *Anexechona*, *Arachnopusia*, and the present genus, *Hincksipora* among the recent Cheilostomata. With our present knowledge it seems futile to speculate on which, if any, of our present genera are remnants of the stem group, or groups, which gave rise to the Ascophora. It is even possible that there have been two lines of evolution since some of the Ascophora have a simple operculum, notably *Umbonula* and *Rhamphostomella*, and others a compound one.



Family **Cyclicoporidae** Hincks, 1884

"Zoecia having the front wall wholly calcified and destitute of raised margins or depressed areas, with a more or less orbicular orifice" Hincks 1884:279.

Genus **CYCLICOPORA** Hincks, 1884

"Zoecia with a perfectly simple orifice more or less orbicular. Zoarium (in the only known species) incrusting," Hincks, 1884:279. Genotype, monotypic, *Cyclicopora praelonga* Hincks, 1884:279 (= *Lepralia longipora* MacGillivray, 1882).

Canu and Bassler (1920:424) have added the following characters: Ovicell hyperstomial and always closed by the operculum. The frontal is a tremocyst with pores in quincunx. There are no cardelles. The border of the aperture is straight or somewhat concave. No spines.

Such a complete simplicity exists in the genotype—absence of avicularia, spines and cardelles and all decoration of the zoecium—that it leads one to doubt whether some of the fossil species assigned to this genus belong here.

**Cyclicopora longipora** (MacGillivray), 1883

Plate 32, fig. 4

*Lepralia longipora* MacGillivray, 1883:135.

*Cyclicopora praelonga* Hincks, 1884:279.

Zoarium encrusting or with erect, cylindrical or somewhat compressed hollow branches which bifurcate once or twice to an inch or more in height, the branches are usually between 1 and 3 mm wide; without joints. Zoecia moderately large, 0.75 to 0.90 mm long (0.60 to 1.20) by 0.40 (0.35 to 0.50) mm wide, distinct, straight sided and arranged in parallel linear series. The front is evenly arcuate transversely, slightly elevated proximal to the aperture which has a low, thin peristome; numerous small pores perforate the rather thin frontal, which is covered by a delicate glistening membrane. The aperture is rounded, slightly straighter on the proximal border and measures 0.20 to 0.24 mm in length by 0.18 to 0.22 mm in width. The operculum is thin and delicate, with a heavier border and is attached without cardelles a little proximal to its middle.

The oecia are hyperstomial, very prominent, hemispherical or slightly elongate, resting on the olocyst of the succeeding zoecium, 0.35 to 0.40 mm wide by 0.35 to 0.45 mm long, perforated like the frontal, the orifice wide and high.

There are no spines, no avicularia nor any other type of decoration; multiporous septulae are present in the thin lateral and distal walls.

Hincks described the species as *C. praelonga* from Port Philip Heads, Australia, in 1884, overlooking the fact that MacGillivray had already described it as *Lepralia longipora*. There are slight differences in their descriptions and figures, but Hincks has accepted the synonymy.

The species also bears considerable resemblance to "*Monoporella*" *waikupurensis* Waters (1887:50) from the "newer Pleistocene" of New Zealand, which Canu and Bassler (1929:158) have reported as a recent species from the Sea of Japan and which has never been properly allocated. It cannot possibly be assigned to *Monoporella* which is an anascan genus; its characters suggest *Cyclicopora* as the proper genus.

Hancock Stations: 275, Raza Island, Gulf of California, 28°44'00" N, 113°00'00"W, 40 fms; 1250-41, 1251-41 and 2160, south of San Benito Islands, west of Lower California, 44 to 81 fms: and 450, Galapagos Islands, 0°55'00"S, 90°30'00"W, 60 fms. Also a fine series received from the Kenyon-Williams expedition to the San Benito Islands.

### Family **Catenicellidae** Busk, 1852

Erect, jointed, branching colonies, often with radicles for attachment. Zooecia all facing the same way, one, two or three to an internode. Ovicells or gonozooecia in different positions according to the genus. Avicularia usually present.

The family, which is abundant in the Australian seas, is scarcely represented north of the equator and hitherto no species has been recorded from the western coasts of the Americas.

### Genus **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 zooecium, which in this genus is functional and not reduced to a kenozooecium. Genotype, *Caloporella insignis* MacGillivray, 1895:18.

### **Vittaticella elegans** (Busk), 1852

Plate 31, figs. 1-2

*Catenicella elegans* Busk, 1852:361: 1884:12.

*Vittaticella elegans*, Okada, 1921:27.

*Vittaticella elegans*, Osburn, 1940:464.

Zoarium delicate, erect, jointed, dichotomously branched, zooecia in a single series, one or two to an internode; rather slender and tubular, dorsal outline curved; length 0.50 to 0.60 mm; the fertile zooecium and the one distal to it are shorter, the combined length about 0.80 mm. The frontal is transversely rounded, somewhat papillose, with a long vitta on each side which extends nearly the full length of the front and bears 8 to 10 small pores. At each distal corner is a small avicularium with a triangular mandible which has a sharp, recurved point; rarely a giant avicularium with a spatulate mandible replaces the usual form, but these have not been observed on our scanty material. Rarely also the avicularium is wanting, in which case there is a stout conical process. Radicles are developed at about the middle of the dorsal side. Branches arise from a daughter zooecium directly connected with the mother zooecium without a joint, replacing the avicularium on that side.

Our specimen is not in reproduction, but the ovicell of Caribbean specimens is nearly round in outline, flattened on the front and deeply embedded in the distal zooecium. The distal zooecium, attached without a joint, is functional.

Distributed around the world in warmer waters; as far north as Bermuda in the Atlantic (Osburn), and reported for Japan (Okada).

Cabeza Ballena, near Cape San Lucas at the southern tip of Lower California, shore, collected by Dr. E. Y. Dawson (Sta. 53), one colony.

### Family *Savignyellidae* Levinsen, 1909

"The narrow, elongated, rather slightly calcified zooecia have a frontal surface, provided with scattered pores, which is separated from the basal surface by a more or less sharp boundary line. The distal wall has a number of uniporous or multiporous rosette-plates in its periphery. Spines may appear around the aperture, proximally to which there may be a freely projecting avicularium. We may find free oocidia, two-layered from the proximal part, the ectooecium of which has a membranous frontal side. The colonies are richly branched, jointed, and each internode consists of a single zooecium" (Levinsen, 1909:273).

Levinsen erected this family for the single genus *Savignyella*, but it needs little modification to include the genus *Euteleia* Marcus, 1938, which differs chiefly in the absence of avicularia and spines (oral tubercles are present), and by the lack of an ovicell. The general zooecial characters, the manner of growth and budding ally *Euteleia* to *Savignyella*.

Genus **SAVIGNYELLA** Levinsen, 1909

"The aperture surrounded by spines, with a concave poster and with no sinus; an avicularium proximally to the aperture; distal wall with uniporous rosette-plates; oocia present" (Levinsen, 1909:274). Genotype, *Eucratea lafontii* Audouin, 1826.

Zoarium uniserial, jointed, each internode of a single zooecium.

**Savignyella lafonti** (Audouin), 1826

Plate 31, fig. 3

*Eucratea lafontii* Audouin, 1826:242.

*Catenaria lafontii*, Hastings, 1930:732.

*Savignyella lafonti*, Osburn, 1940:466.

Zoarium brick-red in color, erect or spreading, uniserial, with chitinous joints, each internode consisting of a single zooecium; budding from the distal end of the dorsal side. The zooecia are elongate, trumpet-shaped, the proximal end a narrow tube; varying greatly in length from 0.75 to 1.50 mm, the difference chiefly due to the stalk-like basal portion. The aperture is more or less semicircular, without a sinus; the peristome raised, provided with about 6 strong spines and with a suboral avicularium with a triangular mandible. The zooecial body is perforated by rather large pores, but these do not appear on the narrowed stalk.

The ovicells are globular, conspicuous and perforated like the frontal.

Distributed around the world in warmer waters: common in the Gulf of Mexico and from Bermuda to Brazil. On the Pacific coast recorded only by Hastings, Coiba and Taboga Islands, Panama, and Gorgona, Colombia.

Hancock Stations: dredged at only two stations, 66-33, Tagus Cove, Albermarle Island, Galapagos, and 411-35, Gorgona, Colombia. Taken occasionally along the coast of southern California, San Pedro Harbor, Newport Harbor and La Jolla (R. C. Osburn, coll.).

Genus **EUTELEIA** Marcus, 1938

The zoarium climbs over the stems of other bryozoans, hydroids, etc., with occasional short, free branches; uniserial, the zooecia single and with chitinous joints at the base; aperture terminal or nearly so; the front perforated. No avicularia, no oocia. Genotype, *Euteleia evelinae* Marcus, 1938:33.

**Euteleia evelinae** Marcus, 1938

Plate 31, fig. 4

*Euteleia evelinae* Marcus, 1938:33.

The zoarium is uniserial, branching irregularly on the stems of erect bryozoans and hydroids (Marcus indicated algae and stones), often in parallel series with free branches which may extend for a short distance.

The zooecia average about 0.40 mm in length, fusiform, much narrowed at the base where there is a chitinous joint. The front is evenly arched, smooth with numerous pores over the whole front to the edge of the aperture; there is a short conical umbo in the median line and one on each side opposite the operculum; the peristome is low and thin. The primary aperture is short-clavate, terminal and very oblique, rounded distally, the condyles strong and the proximal border arcuate.

Each zoecium arises from the dorsal side of the preceding one at the distal end; in branching two zooecia arise side by side. When zooecia lie side by side their walls may partially fuse, and occasionally even when they are at a little distance a short tube from the side of one may fuse with the wall of its neighbor. No avicularia; no ovicells. Described by Marcus from Bahia de Santos, Brazil, 20 meters.

Hancock Stations: 445-35, Panama City, Panama, shore; 847-38, SW of Zorritos Light, Peru, shore; 1385-41, at 16½ mi. SSE of East Point, Santa Rosa Island, California, 76 fms. The species has a wide range on the Pacific coast and a considerable depth range. It is an inconspicuous species because of its small size and its habit of closely adhering to small stems, and it may be much more common than the number of stations would indicate.

Family **Petraliidae** Levinsen, 1909

The ovicell is hyperstomial with very small pores. The aperture is surrounded by a shield placed next to the tremocyst. On the dorsal surface there is near the distal end of each zoecium a perforated area with small radicular pores (after Canu and Bassler, 1929:250).

The above description of the family is based on *Petralia* and *Petraliella*. The introduction of several other genera into the family necessitates some modification of the description. *Coleopora*, *Hippopodina* and *Cycloperiella* have no dorsal attachment processes and in *Robertsonidra* they are in the form of scattered tubules; the circumoral shield is variable in width or wanting; the frontal of *Robertsonidra* is a pleurocyst.

## KEY TO THE GENERA OF PETRALIIDAE

1. Zooecia very large, more than 1 mm long; peristome high and flaring; a large dorsal pore present . . . . . *Coleopora*  
 Only moderately large, peristome low . . . . . 2
2. Dorsal surface with several scattered attachment tubules . . . . . *Robertsonidra*  
 No dorsal attachment tubules . . . . . 3
3. Aperture nearly round, ovicell surrounding the aperture . . . . . *Cycloperiella*  
 Ovicell not enclosing the aperture . . . . . 4
4. Aperture with the proximal border transverse . . . . . *Petralia*  
 Aperture with a large arcuate poster . . . . . *Hippopodina*

Genus **PETRALIA** MacGillivray, 1879

Ovicell hyperstomial, closed by the operculum, deeply immersed. Poster wider than the anter. The shield is a regular smooth pad around the aperture; it bears sometimes two small lateral avicularia. (After Canu and Bassler, 1929:253.) Genotype, *Petralia undata* MacGillivray, 1869.

***Petralia japonica*** (Busk), 1884

Plate 31, fig. 5

*Lepralia japonica* Busk, 1884:143.*Petralia japonica*, Canu and Bassler, 1929:254.

Without the oecium it is not possible always to distinguish the genus *Petralia* from *Petraliella* Canu and Bassler. The present small fragments resemble exactly Canu and Bassler's figure 1, Plate 23 (1929), except for the lack of ovicells. The aperture is broadest proximally, the proximal border is slightly arcuate, the circumoral shield is low and broad and bears on either side of the aperture a small avicularium with a short triangular or somewhat semicircular mandible, the rostrum elevated. The frontal is coarsely perforate and somewhat roughened by heavy calcification.

The species is widely distributed in the western Pacific and Indian Oceans, but has not been noted along the American coasts.

Hancock Stations 468-35, Port Parker, Costa Rica, 5 fms, and 303, Port Culebra, Costa Rica, 17 fms.

Genus **COLEOPORA** Canu and Bassler, 1927

"The zooecia are exceptionally large; the frontal is a tremocyst with small pores. The ovicell is hyperstomial and never closed by the operculum. The apertura is buried at the bottom of a long tubular peristomie with structure different from that of the frontal. The operculum bears two long lateral attachments" (Canu and Bassler, 1929:267). Genotype, *Coleopora verrucosa* Canu and Bassler, 1927:6.

**Coleopora gigantea** (Canu and Bassler), 1923

Plate 32, figs. 9-10

*Cylicopora*(?) *gigantea* Canu and Bassler, 1923:139.

Zoarium encrusting on rough or nodular surfaces, light yellowish in color. The specific name, *gigantea*, was well chosen for this is one of the very largest of all ascophoran species. The measurements vary greatly, usually the length is somewhere between 1.00 and 1.50 mm but occasional zooecia as short as 0.90 and as long as 2.00 mm have been noted. The width is usually between 0.80 and 1.00 mm. The highly convex front also adds to the bulk of the zooecium. The individuals are unusually distinct. The frontal is a somewhat reticulated, thick tremocyst with small pores and this is continued forward along the sides of the aperture. The primary peristome is low and thin, but the secondary peristome is a high, vertical, smooth-walled tube which often flares slightly at the border, of equal height on all sides. The aperture is noticeably elongate, 0.35 to 0.40 mm long by 0.24 to 0.30 mm wide, rounded distally, nearly straight on the sides and broadly arcuate on the proximal border. The operculum is well chitinized, with a strong bordering sclerite distally; inward from the lateral border a heavy sclerite runs forward from the point of attachment to the prominent muscle scars and then more lightly to near the tip of the operculum; the latter sclerite is enlarged at the point of attachment, but cardelles are diminutive or usually wanting. No spines, no avicularia.

The ovicell is correspondingly large, about 0.60 mm wide by 0.50 mm long, very prominent, globular, somewhat roughened, a semilunate band of different texture on each side, these often broadly coalesced above the orifice; not closed by the operculum.

Canu and Bassler described the species from the Pleistocene of Santa Monica, California. Our recent specimens appear to agree with the description in every detail except that the apertura is slightly more elongate.

Canu and Bassler placed the species questionably under *Cyclicopora* Hincks, but in that genus the ovicell is closed by the operculum and the axis of rotation of the operculum is at its middle; in *gigantea* the point of attachment of the operculum is near the proximal end. While the operculum is more elongate than in other species of *Coleopora* the nature of the bordering and internal sclerites appear to ally it more nearly to that genus, and the presence of a dorsal pore indicates the family Petraliidae.

Hancock Stations: 1296-41, 1300-41 and 1662-48, Santa Cruz Island, 1283-41 and 1284-41, Santa Rosa Island, 1268-41 and 1271-41, Anacapa Island, 1130-41 off Laguna Beach, southern California; Santa Cruz Bay, California, 36°57'00"N Lat.; 1190, Cortez Bank, 32°20'00"N Lat.; Tepoca Bay, Sonora, Mexico, Gulf of California; San Benito Islands, 28°12'05"N Lat., off the west coast of Lower California. The known range is rather limited, from 36°57'N to 28°12'05"S, and bathymetrically from 7 to 131 fms.

#### Genus HIPPOPODINA Levinsen, 1909

"The horizontal part of the distal wall is continued into an expansion which forms a partial partition between the oecium and the zooecium; uniporous rosette plates; no peristome" (Levinsen, 1909:353). Genotype, *Lepralia feegeensis* Busk, 1884:144.

Unfortunately Levinsen misunderstood the nature of the ovicell which, though deeply embedded, is clearly hyperstomial (see Osburn, 1940:411 for details). The genus must stand as Levinsen indicated the genotype. A peristome is present, sometimes rather conspicuous.

#### *Hippopodina feegeensis* (Busk), 1884

Plate 31, figs. 6-8

*Lepralia feegeensis* Busk, 1884:144.

*Hippopodina feegeensis*, Levinsen, 1909:353.

*Cosciniopsis fallax* Canu and Bassler, 1929:276.

*Hippopodina feegeensis*, Hastings, 1930:729.

*Hippopodina feegeensis*, Osburn, 1940:412.

Zoarium encrusting, rather thin. Zooecia moderately large, 0.65 to 0.90 mm long by 0.45 to 0.65 mm wide; distinct and somewhat inflated; the frontal finely granulated, with numerous tremopores. The aperture is moderately large, about 0.20 in either dimension, rounded distally, straighter on the sides and on the proximal border, the poster nearly as wide as the anter; the triangular cardelles varying in size. The oper-



culum is chitinized, with elongate lateral sclerites for muscle attachment a little way within from the border. Peristome low and thin. The avicularia, beside the aperture, are long triangular to very elongate and are directed either forward or backward.

The ovicell is hyperstomial, deeply embedded and somewhat depressed, with small tremopores.

Levensen's unfortunate error in describing the ovicell as endozoecial misled Canu and Bassler, 1929:276, into redescribing the species and placing it under another genus, *Cosciniopsis fallax*.

Widely distributed in warmer waters; western Pacific and Indian Oceans and the Atlantic from Florida to Brazil. Hastings listed it from Gorgona, Colombia.

It did not appear in the Hancock dredgings, but Mr. G. P. Kanakoff of the Los Angeles Museum has presented me with a fine specimen collected by him in the Pleistocene of Newport Harbor, southern California.

### **Hippopodina californica** new species

Plate 31, fig. 9; Plate 32, figs. 1-3

*Phylactella collaris*, Robertson, 1908:307.

This species is definitely the *Phylactella collaris* of Robertson, but just as certainly is not the *P. collaris* of Norman and surely does not belong in the Phylactellidae.

Zoarium encrusting on shells and pebbles. Zooecia moderately large, 0.65 to 0.80 mm long by 0.35 to 0.45 mm wide, urceolate in form and very distinct. The frontal is a tremocyst, highly arched, with numerous infundibular pores and covered by a glistening membrane. The distal end of the zooecium is elevated and projects somewhat over the succeeding individual. The aperture is rounded, more than a semicircle beyond the prominent cardelles and the proximal border concave in a smaller arc. The operculum fills the aperture, is well chitinized and has a prominent sclerite all the way around slightly within the border. The primary peristome is low and thin, the secondary wall thick and high; in the absence of an ovicell it usually forms a complete tube, but it may be wanting on the distal border, the sides often flaring outward and on the proximal border it may be raised into an umbonate process, directed backward or over the aperture. No avicularia, no spines, no dietellae.

The ovicells are large, 0.40 to 0.45 mm wide, very prominent when young, somewhat flattened on the front, recumbent and, when calcification is complete, considerably embedded.

It is a large coarse species in comparison with *P. collaris* Norman (a specimen from Norman's collection sent me for comparison by Dr. Anna B. Hastings of the British Museum) and resembles it only in its general appearance. It evidently belongs in the genus *Hippopodina* and it shows a close resemblance to *H. feegeensis* (Busk) and *H. vestita* (Hincks), except in the absence of avicularia which are also often wanting in *H. feegeensis*.

Robertson recorded it as *P. collaris* from one locality, "45 fathoms on the west coast of the island of Santa Catalina, off the coast of southern California."

Type, AHF no. 56.

Type locality, Hancock Station 1232-41, five miles off San Pedro breakwater, 33°38'30"N, 118°12'20"W, at 18 fms. Other stations, 1017, 1201 and 1371-41, Santa Catalina Island; 1023, 1283-41, 1284-41 and 1295-41, Santa Rosa Island; 1241, San Miguel Island; 1242, Anacapa Island; 1303-41, Santa Cruz Island, all off southern California; 1190, Cortez Bank, off San Diego Bay, California; 270 and 271, Angel de la Guardia Island, and 283, San Pedro Nolasco Island, off Guaymas, Sonora, Gulf of California. The known distribution is from the northern Channel Islands, off southern California, to San Pedro Nolasco Island in the Gulf of California, N. Lat. 28°; bathymetric range 15 to 131 fms.

### Genus **ROBERTSONIDRA** new genus

The frontal is a pleurocyst (little more than an olocyst but with a thin secondary layer), with a row of areolar pores, the surface with numerous small papillary tubercles, covered by a thick ectocyst; a small pointed umbo centrally placed proximal to the aperture. The primary aperture is semicircular, the proximal border broadly arcuate or nearly straight, no cardelles, no lyrula; operculum well chitinized, a narrow sclerite separated from the border, muscle attachments on the sclerite. Peristome thin, wanting on the proximal border, elevated on the lateral and distal sides, no spines. Dorsal side with several tubular attachment processes. Vertical walls with numerous irregularly distributed septulae. Ovicell hyperstomial, large and prominent, with minute pores and a small central umbo; closed by the operculum.

Named for Dr. Alice Robertson in recognition of her important work on the Bryozoa of California. Genotype, *Schizoporella oligopus* Robertson, 1908.

Because of the simple nature of the aperture and operculum the genus appears to belong with the more primitive Ascophora and the dorsal radicular processes suggest the family Petraliidae.

**Robertsonidra oligopus** (Robertson), 1908

Plate 34, figs. 9-11; Plate 35, fig. 1

*Schizoporella oligopus* Robertson, 1908:292.

Not *Schizoporella oligopus* Waters, 1918:18.

Zoarium encrusting, white to brick red, loosely attached in a single layer by short tubular dorsal processes. The zooecia show a remarkable degree of variation in dimensions, form of aperture and avicularia, often within the same colony. The zooecia usually range between 0.50 and 0.75 mm long by 0.35 to 0.50 mm wide, very distinct at all ages. The front is ventricose and consists of a thin pleurocyst with a single row of areolar pores (rarely a few additional ones) and is thickly decorated with small papillate tubercles; the areolar pores and tubercles are usually not visible until the thick ectocyst is removed. There is a small rounded umbo, centrally placed proximal to the aperture, often wanting. The primary aperture varies in form and size; semicircular and evenly rounded distally and on the sides, the proximal border broadly arcuate, or with a broad and very shallow sinus, or often nearly straight, all within the same colony; in the infertile zooecia the aperture measures 0.14 to 0.16 mm long by 0.16 to 0.20 mm wide, while that of the ovicelled zooecia measures 0.20 to 0.22 mm in width. The operculum is well chitinized, colored like the frontal ectocyst, with a narrow sclerite slightly within the border, the muscle attachments on the sclerite; the proximal border is thinner and without a sclerite. The peristome is low or wanting proximally, somewhat elevated distally, thin and smooth, and the operculum is fully exposed to view. No spines, no cardelles and no lyrula. There are numerous uniporous septulae scattered irregularly over the lateral and distal walls.

Moderately large avicularia occur sporadically, sometimes abundantly but often wanting from considerable areas; situated on one side near the aperture (rarely on both sides), with a large chamber which is considerably elevated and provided with areolar pores and tubercles similar to those on the front. The mandibles are of two kinds, the usual ones triangular with a strongly decurved tip; the others, replacing the usual form, are elongate (as much as 0.40 mm), and rarely intermediate conditions occur. The mandibles are heavily chitinized, with a rounded lucida and are directed more or less sideways; there is complete hinge-bar.

The ovicell is unusually large, very conspicuous, extending upon the distal zoecium to the umbo which it sometimes involves; the surface is tuberculated like the frontal and is perforated by numerous small pores which are visible only on removal of the ectocyst; proximally it covers the distal end of the aperture and is closed by the operculum; usually a low rounded umbo on the top. It is noticeably longer than broad, 0.50 to 0.60 mm long by 0.40 to 0.45 mm wide.

Robertson described the species from "the vicinity of San Pedro," southern California, under the genus *Schizoporella*, but the imperforate frontal, the nature of the operculum, the absence of a true sinus and the closure of the ovicell prevent its assignment to that genus as it is now understood.

Waters' "*?Schizoporella oligopus*" from the Cape Verde Islands is closely related but apparently should be renamed as the umbo is asymmetrically situated in the presence of an avicularium, the aperture of the ovicelled zoecia is wider and the ovicell covers much more of the aperture.

Hancock Stations: 1190-40, 1295-41 and 1662-48, Santa Cruz Island, southern California; 1274-41, off Point Hueneme, southern California; 1340-41 and 1896-49, Tanner Bank, near the United States—Mexican boundary; 687-37, Conception Bay, Gulf of California, and 450, Galapagos Islands, 0°55'00"S, 90°30'00"W. Also collected by Dr. Carl L. Hubbs at Guadalupe Island, west of Lower California. The known depth range is from 20 to 60 fms.

### Genus **CYCLOPERIELLA** Canu and Bassler, 1920

"The ovicell is hyperstomial, globular, not embedded in the distal zoecium, and entirely covers the apertura. The apertura is formed of a semilunar anter and of a very concave poster. The frontal is formed of a very thin olocyst supporting a tremocyst with large widened pores" (Canu and Bassler 1920-431). Genotype, *C. rubra* Canu and Bassler, 1923:137, from the Miocene and Pliocene of the southeastern United States.

It should be added that the peristome is in reality an oral shield similar to that of *Petralia* and surrounding the true peristome which may sometimes be seen within the shield. The operculum is well chitinized with strong lateral sclerites removed from the border. Cardelles small or wanting. No spines.

*Cycloperiella rosacea* Osburn, 1947

Plate 32, figs. 5-8

*Cycloperiella rosacea* Osburn, 1947:31.

Zoarium encrusting, rose red to reddish purple. Zooecia moderately large, 0.55 to 0.75 mm long by 0.40 to 0.50 mm wide, a little inflated and distinct; frontal a thick tremocyst with large infundibulate pores. The thin peristome is surrounded and obscured by an oral shield developed from the frontal. The apertura is suborbicular, straighter on the proximal border, 0.16 to 0.18 mm long by 0.15 mm wide. The operculum is well chitinized, with a strong sclerite on each side, running from the attachment forward inside of the border. Rarely a small avicularium with a triangular mandible situated at the side of the aperture and directed forward or toward the peristome. A low umbonate process sometimes is present proximal to the aperture.

The oecium is large, 0.30 to 0.35 mm wide, globular and prominent, the surface a rough tremocyst like the frontal, partially covering the aperture. The peristome of the fertile zooecia is much more elevated than in the infertile zooecia and extends around the sides of the aperture to fuse with the ovicell; often rising into lappets which sometimes bend toward each other across the aperture.

There is much variation in the size of the zooecia and especially in the number and distribution of the avicularia; often whole colonies show no avicularia, but rarely nearly every zoecium will have one or more near the aperture or more proximally on the front.

The species was described from the Caribbean Sea, several localities along the north coast of South America. I can find no differences between Atlantic and Pacific specimens. The only other species known is the genotype, *C. rubra* Canu and Bassler 1923:127, from the Miocene and Pliocene, Virginia to South Carolina and Jamaica.

Hancock Stations: 129-34, Socorro Island, 137-34, Clarion Island, west of Mexico; 155-34, Albemarle Island and 458, Indefatigable Island, Galapagos; 322, Bahia Honda, Panama; 457-35, Secas Islands, Panama. Also at Albatross Sta., 2824 and 2825, off Espiritu Santo Island, Gulf of California. Depth range 14 to 60 fms.

Family **Umbonulidae** Canu, 1904

The frontal is a pleurocyst with strong costules and large areolar pores; the aperture large, suborbicular or subquadrangular, without cardelles or with very small ones. The operculum is simple. The genotype of *Umbonula* bears a large suboral avicularian umbo and is without spines. The peristome is low or wanting. The ovicell is large and hyperstomial or wanting.

Hastings (1949a:526) shows that the genus *Hippopleurifera* Canu and Bassler is related to *Umbonula* and states: "The two genera may be referred to one family, Umbonulidae Canu, to be placed near the Petraliidae."

Genus **UMBONULA** Hincks, 1880

Zooecia with the primary orifice suborbicular or subquadrangular, lower margin slightly curved inwards, peristome not elevated, no secondary orifice; a prominent umbo immediately below the mouth, supporting an avicularium (Hincks). Genotype, *Cellepora verrucosa* Esper, 1790.

No lyrula, no cardelles, frontal a pleurocyst with large areolae and strong costules; ovicell hyperstomial, opening widely above the aperture.

Dr. Anna B. Hastings, of the British Museum, has recently re-studied the specimens in the Museum which were assigned to the species of this genus by the older authors. The genotype, *verrucosa* Esper, cannot be positively identified with any accepted species, but it is undoubtedly an *Umbonula*, and "*Umbonula ovicellata* Hastings may be taken as showing the characters of *Cellepora verrucosa* Esper, genotype of *Umbonula* Hincks" (Hastings, 1949:211). The genus, which in the past has been associated with the Smittinidae, is shown by Hastings to have closer relationships with the Petraliidae.

**Umbonula patens** (Smitt), 1867

Plate 36, figs. 2-3

*Eschara patens* Smitt, 1867:22 and 143.

*Discozora patens*, Nordgaard, 1918:80.

*Umbonula patens*, Hastings, 1944:277.

Zoarium forming a rough incrustation on shells and stones. Zooecia large, averaging 0.75 mm long by 0.45 mm wide but varying greatly; distinct in younger stages, with a raised line in the separating groove; the frontal ventricose, smooth in the central area, with a row of large

areolar pores between which are short conspicuous costae which extend to the base of the avicularian chamber. The disto-central area is occupied by a large, rounded avicularian chamber which rises in the form of a central umbo; the rounded avicularium is conspicuous, set at an angle of about 45 degrees to the plane of the aperture. In older, ovicelled specimens there are occasional frontal avicularia similar to the usual suboral ones. The peristome is low and thin; in one very young specimen there are 2 or 3 small distal oral spines. The aperture is rounded, usually a little broader than long and straighter on the proximal border, varying considerably in size and form, averaging about 0.30 mm wide by 0.26 mm long.

The ovicell is large, about 0.45 mm wide by 0.40 mm long, high and rounded, rough except at the center of the front.

There are very few references to *U. patens*; Smitt described it from Spitsbergen and Nordgaard knew it only from that area. Otherwise there appear to be no records under that name, but it is more than probable that the two references to *U. verrucosa* from Greenland refer rather to *patens*. The differences are not great, but Nordgaard has pointed out that in *patens* the costules on the front are shorter and smaller and the mandible of the avicularium is slanted backward from the aperture and exposed to view. Hastings adds that it differs "in the form of avicularian chamber, which is larger and more oval in outline, extending further towards the proximal end of the zooecium." Also the wing-like processes of the frontal at the sides of the aperture are wanting.

Point Barrow, Alaska, Arctic Research Laboratory, Prof. G. E. MacGinitie, collector, several colonies, 7 to 15 fms.

### *Umbonula arctica* (Sars), 1851

Plate 36, fig. 6

*Lepralia arctica* Sars, 1851:149.

*Eschara pavonella* Alder, 1864:106.

*Discopora pavonella*, Smitt, 1867:28.

*Mucronella pavonella*, Hincks, 1880:376.

*Mucronella pavonella*, Robertson, 1908:308.

*Mucronella pavonella*, O'Donoghue, 1923:46; 1926:71.

*Discopora arctica*, Nordgaard, 1918:79.

*Umbonula arctica*, Hastings, 1944:282.

Zoarium encrusting, sometimes rising into bilaminar folds. The zooecia are moderately large, very variable, averaging about 0.60 mm

long by 0.35 mm wide; the frontal area nearly flat, with a row of large areolar pores separated by short costae, without other decoration. The aperture is very large and quite variable in size, usually about 0.30 mm wide by 0.25 mm long, rounded, but somewhat straighter on the proximal border; peristome low and thin (often scarcely visible) except on the proximal border where it projects forward as a short, broad mucro, very variable in size and form. No oral spines, no cardelles. On either side of the aperture is an oval avicularium, very slightly elevated and with the short-spatulate mandible directed forward. No ovicell.

Widely distributed in the Arctic Ocean, southward along the Atlantic coast to Cape Cod, Massachusetts, and on the Pacific coast to Puget Sound.

Not taken in the Hancock dredgings, but represented in the collections by specimens from San Juan Island, Friday Harbor, Puget Sound; U. S. Alaska Crab Investigation, Alaska, Sta. 20-40 and 24-40; Punuk Island, Bering Sea (no further data): and Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

### *Umbonula alvareziana* (d'Orbigny), 1847

Plate 36, figs. 4-5

*Escharina alvareziana* d'Orbigny, 1847:44.

*Lepralia alata* Busk, 1854: 71.

*Mucronella alvareziana*, Jullien, 1881:5.

*Smittia alvareziana*, Waters, 1905:239.

Zoarium encrusting a shell, white and unilaminar. Zoecia small for this genus, 0.40 to 0.55 mm long by 0.30 to 0.40 mm wide, ovate or elongate-hexagonal, distinct. The frontal is a thick pleurocyst, considerably arched, with a row of large areolar pores between which are prominent ribs running toward the center of the front; a broad rounded umbonate process near the aperture. The primary aperture is nearly round, somewhat straighter on the proximal border, length 0.11, width 0.12 mm. The operculum is moderately thin, faintly yellowish, with a slender sclerite on each side which originates at the point of attachment and curves inward to the muscular attachment which is well separated from the thin border. No lyrula, no cardelles; 4 minute spine bases are present on some of the marginal zoecia. The primary peristome is scarcely evident but the thick frontal submerges the operculum below a wall which extends proximally to the umbo. A small avicularium with an acute mandible is often present, usually on the side at the widest part of the zoecium, with the rostrum directed laterally.



The primary oecium is globular, smooth, 0.15 mm wide, but very soon becomes covered by the pleurocyst of the succeeding zoecium, is ribbed with coarse costae like the frontal and bears a small rounded umbo on the top.

D'Orbigny described the species from Arica, Chile; Busk and Waters recorded it from Cape Horn, and Jullien from Valparaiso, Chile. Waters' *Mucronella* ? *alvareziana* (1887:57) from the Tertiary of New Zealand is certainly another species. As the synonymy indicates it has been shifted about considerably. Busk (1854:72) evidently appreciated its relationship to *Umbonula*: "Its nearest congener is *Lepralia verrucosa*." The nature of the aperture and operculum and the strongly costate frontal with very large areolae definitely ally this species to *Umbonula*, of which *verrucosa* Esper is the genotype.

Hancock Station 394-35, Lobos de Afuera Islands, Peru, 6°56'04"S, 80°43'00"W, at 12 fms.

### Genus **HIPPOPLEURIFERA** Canu and Bassler, 1927

"The ovicell is hyperstomial and is not closed by the operculum. The frontal bears at least a double row of areolar pores separated by radial costules. The cardelles are small. There are spines on the peristome and zoecial avicularia in which the beak is always oriented toward the top of the zooecia" (Canu and Bassler, 1927:7). Genotype, *Eschara sedgwicki* Milne-Edwards, 1838.

Canu and Bassler (1929:326) compared it with *Umbonula*, and Hastings (1949a: 521-528) has since made a critical study of the genus and arrived at the conclusion that it should be associated in the same family, Umbonulidae.

The essential difference between the genera lies in the complete absence of cardelles in *Umbonula*; there are well-developed oral spines in *Hippopleurifera* while none have hitherto been observed in *Umbonula*. However, this latter distinction has disappeared on the discovery by the writer of minute spines on young marginal zooecia of *Umbonula patens* (Smitt).

### **Hippopleurifera mucronata** (Smitt), 1873

Plate 35, figs. 7-8; Plate 36, fig. 1

*Hippothoa mucronata* Smitt, 1873:45.

*Hippomenella rubra* Canu and Bassler, 1928:108.

*Hippomenella mucronata*, Osburn, 1947:33.

The zoarium encrusts shells and corallines, conspicuous because of its brilliant coloration, orange to very dark red. The zooecia are moderately large, 0.60 to 0.80 mm long by 0.45 to 0.60 mm wide, irregularly ovoid and distinct with deep separating grooves. The frontal is a thick pleurocyst with about two rows of large areolar pores between which are often strong costal ridges; in final calcification the pores may be carried up toward the central area, a roughly pointed umbo may be developed and the costal ridges may extend upon it; there is a thick shining red ectocyst and the color also pervades the skeletal structure. The aperture is elongate, 0.18 to 0.20 mm long by 0.13 to 0.15 mm wide, rounded distally, the sides somewhat parallel; cardelles vary in size, in older zooecia often prominent; the poster does not always conform to the shape of the operculum and varies from broadly arcuate to deeply sinuate. The operculum is rather strongly chitinized, red in color like the frontal ectocyst, with a strong sclerite which extends half the distance inside of the border beyond the points of attachment; proximal to the cardelles the operculum is small and short, like a semi-circular lobe, thinner and without sclerites and even in dried specimens usually remains attached to the compensation sac. The peristome is low and is usually wanting on the proximal border, with 6 to 8 strong spines. There are conspicuous dietellae.

Frontal avicularia are often present on some of the zooecia, but may be wanting from the whole colony; the mandible red and elongate, as long as 0.25 mm but usually shorter, the beak somewhat elevated and directed proximally or laterally.

The ovicell is large, 0.25 mm in either dimension, prominent and slightly embedded, hyperstomial and not closed by the operculum, surrounded at the base by a row of large pores between which costal ridges radiate toward the top, which bears a low, pointed umbo.

Canu and Bassler (1928:108) described *Hippomenella rubra* doubtfully on the basis of avicularia, which were not noted by Smitt in his *mucronata*, but there is the same variation among colonies from the Eastern Pacific. Brown (1949:513-520) has recently studied the type material of *Hippomenella* (*Lepralia mucronelliformis* Waters, 1899), has discovered the ovicell and has rejected *mucronata* (*rubra*) as a member of that genus. I am placing the species in the genus *Hippopleurifera*, with which most of its characters agree, though the operculum is more complete proximally and the cardelles are sometimes moderately large.

Described from the Gulf of Mexico at 29 fms by Smitt, and recorded from the Gulf at 30 fms by Canu and Bassler; also from Aruba Island, Gulf of Venezuela, 23 fms by Osburn.

Hancock Stations: recovered at 16 stations from Espiritu Santo Island, Gulf of California, to a little south of the equator, and from shore to 133 fms, but not abundant anywhere; 2186, Cabeza Ballena and 299, San Jose del Cabo, at the tip of Lower California; 223 and 136-34 and 137-34, Clarion Island; 132-34, Socorro Island; 431-35 Octavia Rocks, Colombia; the following from the Galapagos Islands, 85-33, North Seymour Island; 147-34, 155-34 and 461, Albemarle Island; and 454 and 473, Hood Island.

### Family **Gigantoporidae** Bassler, 1935

Galeopsidae Jullien, 1903.

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

The two genera of the present work may be distinguished as follows:

1. Zoarium encrusting; boreal and arctic . . . . *Cylindroporella*
2. Zoarium erect, zooecia all facing the same side, avicularia on the dorsal side, tropical . . . . . *Semihawswellia*

### Genus **CYLINDROPORELLA** Hincks 1877

Zoarium encrusting. Zooecia more or less terete, the proximal end usually much narrowed, the distal end elevated into a high tubular peristome which bears a small tubular ascopore near its base. Frontal with numerous small pores. Ooecium hyperstomial. No avicularia, no spines. Genotype, *Lepralia tubulosa* Norman, 1868.

#### ***Cylindroporella tubulosa*** (Norman) 1868

Plate 35, fig. 2

*Lepralia tubulosa* Norman, 1868:308.

*Porina tubulosa*, Hincks, 1880:230.

*Porina tubulosa*, Osburn, 1912:233.

*Cylindroporella tubulosa*, Osburn, 1933:34.

Zoaria encrusting, usually small, on shells. The zooecia are somewhat terete, the proximal end often narrowed to a point, very distinct, the front ventricose and perforated with numerous small pores.

The distal end rises into a long thin tubular peristome which bears a small tubular ascopore near the base on the proximal side. No avicularia and no spines.

The hyperstomial ovicell is situated low down on the distal side of the peristome.

North Atlantic and Arctic Oceans from Spitsbergen west to Dolphin and Union Straits, Northwest Territory, Canada; on the Atlantic coast it ranges as far south as Cape Cod. I have found no record of its occurrence in the Pacific Ocean.

Cordova, Alaska, Albatross, June 28, 1914; Penuk Island, Bering Sea, 15 fathoms; Port Etches, British Columbia, from specimens in the Los Angeles Museum, with no other data. Common at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector. It is evidently a circumpolar species.

#### Genus SEMIHASWELLIA Canu and Bassler, 1917

Zooecia on only one side of the erect zoarium; the dorsal side bears only avicularia. Frontal and dorsal sides of the same nature, formed of a tremocyst with sulci. A spiramen or "ascopore" below the base of the peristome. (After Canu and Bassler, 1917:58.) Genotype, *Porina proboscidea* Waters, 1889.

#### *Semihaswellia sulcosa* Canu and Bassler, 1930

Plate 35, fig. 3

Zoarium erect, branching dichotomously, without joints. Zooecia gigantic, indistinct; deep longitudinal sulci, with large vacuoles at the bottom; peristome long, cylindrical, oblique, thick, sharp edged, its aperture orbicular. Ascopore tubular, salient, directed proximally. Small orbicular avicularia (?) on the front, and small dorsal avicularia. The zooecia measure 2.75 mm long by 1.00 mm wide and the peristome 0.45 mm high. (After Canu and Bassler 1930:15.)

Described from the "Albatross" dredgings, "Galapagos Islands, D. 3048."

Hancock Station 481, Cartago Bay, Albemarle Island, Galapagos, 12 fms, several small branches.

Family **Stomachetosellidae** Canu and Bassler, 1917

Frontal wall a very thick tremocyst or pleurocyst, built up around the aperture and notched to form a spiramen which is sometimes guarded by small avicularia. Primary aperture simple, without lyrula and usually without cardelles. Ovicell hyperstomial, deeply embedded.

The original description of the family has had to be modified to include other genera than *Stomachetosella* which have been assigned to this family.

The genera here treated may be distinguished by the following key:

- 1. Frontal a tremocyst with wide-mouthed pores . . . . . 2  
    Frontal a pleurocyst with areolar pores only . . . . . 3
- 2. Proximal border of the aperture with a sinus . . . *Stomachetosella*  
    Proximal border of the aperture without a sinus . . . *Pachyegis*
- 3. Zoarium with cylindrical branched stems, zooecia on all  
    sides . . . . . *Diatosula*  
    Zoarium encrusting or erect with flattened bilaminate lobes or  
    frills . . . . . 4
- 4. Zoarium erect from a small base, branching in lobes or pal-  
    mate . . . . . *Ragionula*  
    Encrusting base usually wide, the erect portion, often wanting,  
    forming broad bilaminate frills . . . . . *Posterula*

Genus **STOMACHETOSELLA** Canu and Bassler, 1917

“The ovicell entirely surrounds the aperture. The frontal is a tremocyst with wide-mouthed tubules. No avicularia. The peristomice of the ovicelled zooecia possesses a straighter rimule-spiramen.” (Canu and Bassler, 1917:45.) Genotype, *Stomachetosella crassicollis* Canu and Bassler, 1917:45.

The ovicell is hyperstomial but is deeply submerged in the base of the succeeding zooecium. The ovicell does not “entirely surround the apertura,” instead a thick rim of the frontal wall surrounds the aperture on the sides and connects or fuses with the edges of the ovicell.

KEY TO SPECIES OF STOMACHETOSELLA

- 1. Ovicell wanting . . . . . *cruenta*  
    Ovicells present . . . . . 2
- 2. Ovicell imperforate . . . . . 3  
    Ovicell with one or more pores . . . . . 4

3. Aperture transverse, sinus narrow; frontal pores large . . . *limbata*  
 Aperture round, sinus broad and shallow; frontal pores small;  
 ovicell thick walled and umbonate . . . . . *distincta*
4. Aperture subcircular with a narrow sinus; ovicell with a single  
 large pore . . . . . *sinuosa*  
 Aperture transversely elliptical, its proximal border nearly straight;  
 ovicell with a few small pores . . . . . *abyssicola*

***Stomachetosella sinuosa* (Busk), 1860**

Plate 34, fig. 3

*Lepralia sinuosa* Busk 1860:125.

*Schizoporella sinuosa*, Hincks, 1884:17.

*Stomachetosella sinuosa*, O'Donoghue, 1926:62.

*Stomachetosella sinuosa*, Osburn, 1933:36.

*Schizoporella perforata*, Canu and Bassler, 1929:318.

The zoarium is encrusting, usually forming round colonies on shells, the color ranging from a delicate rose, in young specimens, to deep purple in old colonies. The zoecia are moderately large, 0.50 to 0.70 mm long by about 0.40 mm wide; the front is a little inflated, with large tremopores, and very heavily calcified. The primary aperture is subcircular with a proximal sinus; the secondary aperture is more or less orbicular with a proximal notch which varies considerably in size and form; in the young stage there is a low smooth peristome but this soon becomes covered by the encroachment of the thick frontal layer. The ovicell is hyperstomial, deeply immersed, somewhat flattened, with a large, rounded pore on the top. No avicularia, no spines, no dietellae.

In the ovicelled zoecia the border of the aperture is elevated slightly into a thick rim which is connected with the sides of the oecium.

It is a common northern species, extending on the Atlantic coast as far south as Cape Cod. Reported by Hincks from Queen Charlotte Islands and by O'Donoghue from Puget Sound and numerous localities along the British Columbia coast.

Punuk Island, Alaska, Bering Sea; common at Point Barrow, Arctic Research Laboratory, G. E. MacGinitie, collector; and taken at Middle Bank, Puget Sound by Dr. J. L. Mohr.

***Stomachetosella cruenta* (Norman), 1864**

Plate 34, fig. 1

*Lepralia cruenta* Norman, 1864:88.

*Schizoporella cruenta*, Hincks, 1884:40.

*Schizoporella cruenta*, O'Donoghue, 1926:55.

Zoarium encrusting, usually white or yellowish, but old colonies may be deep red. The zooecia are moderately large and vary greatly in size, 0.55 to 0.80 mm long by 0.35 to 0.45 mm wide, arranged in quincunx, distinct in younger stages with the frontal slightly inflated; with secondary calcification, which proceeds very rapidly, the tremopores become much enlarged at the surface which is also modified by irregular nodules and granules. The primary aperture, which usually can be observed only on the marginal row, is subcircular with a u-shaped proximal sinus; a low, smooth peristome is present until it is overgrown by the encroaching thick frontal wall; secondary aperture short-pyriform, the proximal notch more or less irregular in form. The aperture is somewhat removed from the distal zooecial end and, in older stages, is surrounded by a thick, granular, raised wall except at the proximal sinus.

Ovicells have not been observed in this species and there are no avicularia nor spines.

This is a high northern species, known from Nova Zembla to Greenland. Hincks records it from the Queen Charlotte Islands and O'Donoghue from several localities from the San Juan Islands, Puget Sound, and British Columbia.

Off Cape Lisburne, Alaska (Arctic Ocean), 30 fathoms, and Punuk Island, Bering Sea, 15 fathoms, from material in the Los Angeles Museum. Also from Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

### *Stomachetosella limbata* (Lorenz), 1886

Plate 34, fig. 2

*Schizoporella limbata* Lorenz, 1886:6.

*Escharella linearis* forma *secundaria* Smitt, 1867:14 (in part).

Zoarium encrusting on shells, the color pale yellow to bright brownish. The zooecia measure 0.50 to 0.65 mm in length by 0.30 to 0.40 mm in breadth; arranged in quincunx, distinct with large pores and slightly inflated. The primary aperture is semicircular, nearly straight on the proximal border which bears a narrow, rounded sinus; these characters observable only on the youngest zooecia. As in other species of this genus, the secondary aperture is formed by the thick frontal wall; it differs somewhat in shape from the primary aperture, the proximal border usually being more arcuate and the sinus is often irregular in form; the raised rim about the aperture is less developed than in the other species.

The ovicell averages 0.25 mm in width, immersed, imperforate, finely granular, with a collar above the aperture.

Lorenz described the species from Jan Mayen Island, NE of Iceland, 160-180 meters. I have not been able to find any other reference to it, except for that of Smitt, whose fig. 75 (Pl. 25) is from a Greenland specimen.

In the Hancock collections is a specimen from Gabriola Pass, British Columbia, presented by Dr. W. A. Clemens.

### ***Stomachetosella distincta* new species**

Plate 34, figs. 7-8

Zoarium encrusting on stones and shells, covered with a shining ectocyst. The zooecia are moderately large, 0.65 to 0.85 mm long by 0.45 to 0.65 mm wide, very distinct with unusually deep grooves, more or less hexagonal and arranged in quincunx. The frontal highly arched, a thick, finely granulated tremocyst, the pores well separated and tubular; a rounded umbo situated at some distance from the aperture. The primary aperture varies slightly, usually a little broader than long but often circular; the anter a regular three-fourths of a circle, the poster usually with a broad, shallow sinus, but sometimes evenly arcuate; without cardelles or lyrula; length 0.14 to 0.16 mm, width, 0.16 to 0.18 mm. The operculum has the form of the aperture, slightly chitinized, with a narrow bordering sclerite and a short sclerite removed from the border on each side for muscle attachment. The peristome is low and the thick frontal wall descends to it gradually without obscuring it. The aperture is located so near the distal end that its distal border appears to be formed by the succeeding zooecium. Avicularia wanting.

The ovicell is large and rounded, 0.40 to 0.45 mm in width, granulated like the frontal and with a rounded umbo on the top, hyperstomial, not closed by the operculum, except in the transmission of eggs.

The separating grooves are unusually deep and the distinctness is exaggerated in older parts of the colony by the presence of a brown line at the bottom of the groove. With a tremocystal front wall and a simple aperture which bears no cardelles or lyrula, and the absence of avicularia and spines, this species appears to agree most nearly with the genus *Stomachetosella*.

Type, U.S. Nat. Mus., 11027.

Type locality, off Point Barrow, Alaska, 217 feet, G. E. MacGinitie, collector, Arctic Research Laboratory.



*Stomachetosella abyssicola* new species

Plate 34, figs. 4-6

Zoarium encrusting on rock, unilaminar. Zooecia large, 0.85 to 1.05 mm long by 0.65 to 0.80 mm wide; very distinct, with raised separating lines, considerably ventricose. The frontal is a coarse, granulated tremocyst with large, scattered pores, the marginal ones larger and separated by short costae. The primary aperture is transversely elliptical, broadly arcuate on the proximal border, about 0.20 mm wide by 0.14 mm long, without cardelles or lyrula, sloping downward distally. The operculum is well chitinized, with a narrow bordering sclerite. The peristome is raised high on each side into a thick lappet and in the infertile zooecia is continued as a thinner raised rim around the distal border, the secondary aperture being somewhat ovoid and narrowed proximally. There are no spines and no avicularia. Multiporous septulae are present.

The ovicell is large, prominent, semilunate, partially surrounding the aperture, 0.40 mm wide, cucullate with a large orifice which is not closed by the operculum; its texture like that of the frontal, granulated, with a few small pores; resting on the base of the distal zooecium but scarcely embedded.

The character of the frontal, the form and nature of the primary aperture, the operculum, and the peristome which unites with the corners of the ovicell to form a high wall around the aperture with a narrowed proximal "rimule spiramen," appear to ally this species with *Stomachetosella*. The ovicell is less deeply embedded than in other species of that genus, but perhaps this may be the result of the thinner wall of this abyssal species.

Type, U.S. Nat. Mus., 11028.

Type locality, Albatross Station D.5685, at 645 fms, off Abrejos Point, west coast of Lower California, 25°42'45"N, 113°38'30"W.

Genus **POSTERULA** Jullien, 1903

Front bordered by a line of areolar pores; primary aperture oval, without sinus or cardelles; secondary orifice elongate-pyriform, with a deep, irregular sinus within which are one to several small avicularia. Ooecium small, hemispherical, becoming completely embedded. Genotype, *Escharoides sarsii* Smitt, 1867:158.

**Posterula sarsi** (Smitt), 1867

Plate 35, fig. 6

*Escharoides sarsii* Smitt, 1867:24.*Posterula sarsi*, Jullien, 1903:98.*Escharoides sarsi*, Robertson, 1908:301.

Zoarium with encrusting base, rising in coarse, bilaminate branches or frills to a height of 100 mm or more; often only the encrusting base is present and this may spread over wide areas of shells and stones. Zooecia large with very variable measurements, 0.60 to more than 1.00 mm long by 0.45 to 0.60 mm wide; smooth and somewhat swollen in younger stages; a marginal row of ovate pores with short costae between; the frontal wall soon becomes very thick and roughened.

The primary aperture is oval, but varying considerably in form, without sinus or cardelles. The secondary aperture is irregularly pyriform with a deep, irregular sinus, with one or more pointed, oval or rounded avicularia submerged within the sinus; the avicularia may present the following variations; one in the middle or at one side, one on each side, one in or near the middle and one on each side, or as many as four have been noted, all situated below the level of the frontal crust. No spines.

Robertson first recorded from the Pacific area this well-known Arctic species, "A large colony growing over a clamshell obtained at Juneau," Alaska.

A large frilled specimen was taken at Hallo Bay, Alaska, by the U. S. Alaska Crab Investigation, 40-28 fms. Also common at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Genus **RAGIONULA** Canu and Bassler, 1927

Formerly assigned to *Eschara*, *Escharopsis*, *Discopora* and *Escharoides*, until Canu and Bassler very properly erected a new genus for it.

"The ovicell is hyperstomial, opening into the peristomie, not closed by the operculum. The frontal is (in appearance) a very thick, granular pleurocyst. The aperture is semicircular. The peristomie bears a pseudorimule bordered by a small eccentric peristomial avicularium. The operculum and the mandible are of the type of *Porella*." (Canu and Bassler, 1930:294.) Genotype, *Eschara rosacea* Busk, 1856:33.

A slight correction should be made to the above description, as the oral avicularium is asymmetrical in origin, arising from one areolar pore, while in *Porella* the avicularium is median and is connected with areolar pores on both sides.

**Ragionula rosacea** (Busk), 1856

Plate 36, fig. 7

*Eschara rosacea* Busk, 1856:33.

*Escharoides rosacea*, Hincks, 1880:336.

*Discopora rosacea*, Nordgaard, 1918:77.

Zoarium erect from a small base, with a few flattened bilaminate branches or lobes, more or less contorted; white to light rose colored. The zooecia are small, 0.40 to 0.50 mm long by 0.25 to 0.35 mm wide; ovate or irregular in form; ventricose when young but soon becoming indistinct as the granulated pleurocyst quickly becomes excessively thick. There are a few areolar pores, but those of adjoining zooecia are fused into single pores by the secondary calcification so that there appears to be only one row which marks the lateral limits of the zooecia. The primary aperture, showing only on the very youngest zooecia, is short-elliptical, the proximal border nearly straight; the operculum has the form of the aperture and bears an elongate sclerite on each side a little within the border; the secondary aperture bears a deep sinus which is usually distorted by the oral avicularium at one side of the notch. The oral avicularium is small, with a semicircular mandible; small rounded avicularia, often slightly elevated, are occasionally present on the frontal.

The ovicell is hemispherical, smooth, and soon becomes completely immersed in the thick crust.

It is an arctic species, known from the Kara Sea to Greenland and down the Atlantic coasts to Scotland and Labrador.

Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector, common and well-developed, one colony measures 18 mm high by 22 mm wide with 10 lobes. Its occurrence at Point Barrow indicates that it is circumpolar in distribution.

Genus **DIATOSULA** Canu and Bassler 1927

"The ovicell is hyperstomial and opens in the peristomie; it bears a triangular area bordered with pores. The frontal is very thick and smooth. The aperture is formed of a large anter separated from the small poster by two cardelles. The peristomie bears a pseudo-rimule

limited laterally by two peristomial avicularia more or less salient and more or less visible. On the frontal a large spatulated avicularium sometimes appears" (Canu and Bassler, 1929:293). Genotype, *Myrionozoum marionense* Busk, 1884:171.

It should be noted that the above description of the genus was drawn, as far as the ovicell, spatulate avicularium and aperture are concerned, from *M. marionense* Calvet, 1903:130, which is probably a different species from *marionense* Busk.

### **Diatosula californica** new species

Plate 35, figs. 4-5

The zooecium is erect, rigid, rising to a height of 40 mm, branching irregularly at nearly right angles, the branches of nearly uniform width of about 1.30 mm, white or pale yellow in color. The zooecia are of moderate size, 0.45 to 0.55 mm long by 0.30 to 0.40 mm wide; young individuals distinct; the front is a smooth pleurocyst, considerably inflated, with a row of areolar pores between which are short costae; a few other pores perforate the frontal, apparently without any special arrangement. The distal end of the zooecium is somewhat elevated. The primary aperture is a little elongate, about 0.16 mm long by 0.12 mm wide; rounded at the distal end, straight and slightly converging on the sides to the cardelles; proximal to these is a shallow, wide poster with a small, narrow, somewhat v-shaped sinus. The operculum is bright yellow, with a strong sclerite inside of the border.

The peristome soon rises above the aperture, often bearing on each side a minute rounded avicularium with a semicircular mandible, and the form of the secondary aperture becomes more or less oval with a proximal notch. The heavy secondary calcification soon obscures all of the structural details, except near the growing tips. Large spatulate interzooecial avicularia occur infrequently; these are about the size of the primary aperture, oriented proximally.

The ovicells are large, 0.26 mm wide by 0.20 mm long, hyperstomial but deeply embedded and eventually may be completely enveloped in the thick crust. The frontal area of the ovicell is broadly semicircular, surrounded by a row of pores and the surface radiately striated. The secondary aperture of the ovicelled zooecia is strikingly different in form, transversely oval and without a sinus in the proximal border.

This species differs from *D. (Myrionozoum) marionense* Busk (from the southern Indian Ocean) in the details of the front, the shorter peristome and in the nearly sessile oral avicularia; Busk did not mention

the ovicell nor the spatulate avicularia. From *D. (M.) marionense* Calvet it differs in the shape of the frontal area of the ovicell, the rounded instead of triangular oral avicularia and in the much narrower apertural sinus.

Type, AHF no. 59.

Type locality, 1435-41 off Santa Cruz Island, California, 33° 56' 00"N, 119° 50' 55"W at 48 fms. Also at Sta. 1130-40, off Abalone Point, Laguna Beach, at 25 fms; 1413-41, off Cardwell Point, San Miguel Island, 27 to 48 fms; 1294-41, off Gull Island, (Santa Cruz Island), 41 fms; 1938-50, off Anacapa Island, 37 fms; and 1391-41, Santa Rosa Island, 40 fms, all off southern California.

### Genus **PACHYEGIS** new genus

Zoarium encrusting. Zooecia large with an excessively thick frontal covered by a thick ectocyst and perforated by large pores. The ovicell is hyperstomial but deeply embedded and covered with a thick crust like the frontal, which also forms a broad fold above the orifice. Primary aperture semielliptical with a straight, proximal border and without a sinus. Primary peristome low and thin, surrounded by and usually obscured by a thick fold of the frontal on the lateral and distal sides. Often with a rounded suboral umbo and between this and the aperture there is a minute rounded suboral avicularium, frequently wanting. No oral spines; no cardelles. Multiporous septulae in the lateral and distal walls. Genotype, *Porella princeps* Norman, 1903:114.

### **Pachyegis princeps** (Norman), 1903

Plate 33, figs. 5-8

*Porella princeps* Norman, 1903:114.

?*Discopora megastoma*, Smitt, 1871:1128.

*Monoporella spinulifera* var. *praeclara* Hincks, 1892:152.

*Porella princeps*, Levinsen 1916:465.

*Porella princeps*, Nordgaard, 1918:72.

Zoarium forming a coarse reddish-brown crust, occasionally multi-laminar, over considerable areas on stones and shells; the largest colony observed measures about 60 mm in length and width. The zooecia are very large, often more than a millimeter long by 0.60 to 0.70 mm wide and deep in proportion; very irregularly ovate, highly arched and separated by deep grooves. Abnormal zooecia are common, sometimes merely reduced in size and occasionally without an aperture. When the thick

reddish-brown ectocyst is removed the front is white, finely granulated and perforated by funnel-shaped pores; it is excessively thick. Proximal to the aperture but not obscuring it is a low, rounded umbo which, in younger stages, often bears a membranous area on its distal side, but this area is nearly always closed off in complete calcification. Norman noted the presence of a small, rounded avicularium low down near the aperture, but this is usually rare and often wanting from whole colonies. Levinsen found none in his Greenland material.

The primary aperture is slightly more than a semicircle, the proximal border nearly straight. The operculum has the form of the aperture, slightly broadest at the straight proximal end, a pair of heavily chitinized sclerites at the proximal corners for attachment, a moderately broad bordering sclerite and on each side a somewhat fan-shaped one inside from the border extending forward about two-thirds of the length of the operculum with the muscle attachments at its tip. No cardelles; no spines. The primary peristome is low and thin and is surrounded on the lateral and distal sides and deeply immersed by a broad, heavy fold of the frontal which may fuse with and obscure the primary peristome.

The primary ovicell is hyperstomial, prominent, thin-walled with a few pores, but very soon becomes covered with a thick layer like that of the front, in addition to which the heavy lateral-oral ridges grow around above the orifice and may unite to form a broad, low collar; in complete calcification the ovicells are almost entirely submerged.

Smitt may have been the first to record this species (from Spitsbergen) if my interpretation of his figures (1871, plate 21, figs. 25, 26) is correct; certainly they cannot refer to *Lepralia megastoma* Busk, 1857:55, which has an imperforate and costate frontal. Hincks had it from the Gulf of St. Lawrence but considered it only a variety *praeclara* of his *Mucronella spinulifera*; it is much like *spinulifera* in general appearance but totally different in fundamental characters since the latter species has a simple operculum, an endozoecial ovicell and an imperforate frontal. Norman described it as *Porella princeps*, from west Greenland, but in spite of the occasional suboral avicularium it cannot be a *Porella* because of the porous frontal; moreover I have not been able to discover any lateral connections of the avicularian chamber with the areolar pores and presume that it is developed from the frontal pore at the bottom of the chamber. Levinsen also recorded the species from Greenland.

Point Barrow, Alaska, 18 to 80 fms, numerous colonies on stones and shells, G. E. MacGinitie, collector, Alaska Research Laboratory.

***Pachyegis brunnea* (Hincks), 1889**

Plate 33, figs. 9-11

*Monoporella brunnea* Hincks, 1889:16.

Zoarium encrusting, yellowish-brown. The zoecia are smaller than in the other species, 0.60 to 0.80 mm long by 0.30 to 0.45 mm wide. On the removal of the thick ectocyst the frontal is shining white, slightly granulated, with large, funnel-shaped pores, strongly arched and separated by deep grooves. Proximal to the aperture but not obscuring it is a low, rounded or pointed umbo, which usually has a membranous area on its distal side. A minute rounded suboral avicularium is occasionally present in the midline at the base of the umbonate process. The primary aperture is somewhat more than a semicircle, the proximal border straight; the peristome thin, surrounded laterally and distally by a low fold of the frontal which usually does not fuse with it. The operculum, like the other species of the genus, has on either side a strong, straight sclerite extending forward, not reaching the distal end and removed from the border. No spines, no dietellae.

The ovicell has not been observed.

Described by Hincks from the Queen Charlotte Islands. Also in the writer's possession is a specimen labeled "Virago Sound, Queen Charlotte Is., 8 to 15 fms, G. M. Dawson, 1878"; this is no doubt a part of the material from which Hincks drew his description.

Canoe Bay, southern Alaska, one colony collected by the U. S. Alaska Crab Investigation, Sta. 26-40, at 100 fms. Also at Point Barrow, Alaska, 16 to 80 fms.

**The *Schizoporellidae*, *sens lat.***

The "family," as constituted by Jullien in 1903, included numerous genera with a sinus in the proximal border of the aperture, which have now been assigned to other families, e.g. *Hippothoa*, *Posterula*, *Mastigophora*, etc. Canu and Bassler in 1923, after the removal of several genera, separated the remaining ones under the family "Escharellidae" into four groups, the Schizoporellae, Microporellae, Hippoporae and Peristomellae. Still later Bassler, 1935, accepted the family Schizoporellidae (as restricted by Levinsen, 1909) and gave the groups subfamily status, Schizoporellinae, Hippoporinae, Exochellinae (Peristomellae) and Microporellinae.

By agreement with Dr. Bassler I am now elevating these subfamilies to family status on the following characters:

Schizoporellidae Jullien, 1903. The frontal is a tremocyst.

Hippoporinidae new family. The frontal is an olocyst or pleurocyst.

Exochellidae new family. The aperture is sharply slanted downward and there are no cardelles; frontal a pleurocyst.

Microporellidae Hincks, 1880. There is an ascopore separated from the aperture, frontal a tremocyst.

Family **Schizoporellidae** Jullien, 1903 (in part)

This family as limited by Bassler, 1935, still contains numerous genera. They are characterized especially by the tremocystal front which is usually thickly and evenly perforated over the whole area, and by the nature of the aperture and operculum. The proximal border of the primary aperture usually bears a distinct and moderately deep sinus, though in some genera (e.g. *Hippodiplosia* and *Gemelliporida*), it is broadly arcuate. The operculum, which is well chitinized, has the form of the aperture; a narrow bordering sclerite and in some cases an additional sclerite inside from the border; the muscle attachments may be removed from the border or on the margin. A vestibular arch is usually present. The ovicell is hyperstomial and either open or closed by the operculum. Avicularia are usually present, associated with the aperture or scattered over the front. Spines are occasionally present. Cardelles are small or wanting.

KEY TO THE GENERA OF SCHIZOPORELLIDAE

1. Sinus a narrow linear notch . . . . . 2  
    Sinus broader and more rounded or arcuate . . . . . 3
2. Ovicell gigantic, completely covering the aperture . . . *Stylopoma*<sup>334</sup>  
    Ovicell normal, not covering the aperture . . . . *Arthropoma*<sup>333</sup>
3. Ovicell not closed by the operculum . . . . . 4  
    Ovicell closed by the operculum . . . . . 5
4. Avicularia in the midline proximal to the aperture . . *Schizomavella*<sup>330</sup>  
    Avicularia not in the midline . . . . . *Schizoporella*<sup>317</sup>
5. Aperture with a v-shaped sinus . . . . . *Schizolavella*<sup>335</sup>  
    The sinus, or poster, is wider, not v-shaped . . . . . 6
6. The poster is concave, moderately deep and much  
    narrower than the anter . . . . . *Gemelliporida*<sup>337</sup>  
    The poster is wide, a broadly arcuate border . . . . . 7



- 7. Avicularia wanting (but see also some species of *Hippodiplosia*) . . . . . *Dakaria*<sup>325</sup>  
 Avicularia usually present . . . . . 8
- 8. Tremocyst incomplete, leaving a narrow semicircular area proximal to the aperture; pores of ovicell usually irregular; avicularia present or wanting . . . . . *Hippodiplosia*<sup>338</sup>  
 Without a semicircular suboral area, pores of ovicell regularly distributed, avicularia present . . . . . *Emballotheca*

Genus **SCHIZOPORELLA** Hincks, 1887

*Schizopodrella* Canu and Bassler, 1917.

The frontal is a tremocyst; aperture semicircular distally, with a slight vestibular arch, the proximal border with a rounded sinus; operculum well chitinized, the muscle attachments at some distance from the border. Ovicell hyperstomial, not closed by the operculum. Avicularia present, often at the side of the aperture.

Genotype, *Lepralia unicornis* Johnston, 1847.

KEY TO SPECIES OF *Schizoporella*

- 1. Avicularia present . . . . . 2  
 Avicularia wanting . . . . . 4
- 2. Frontal pores large and numerous, avicularia long-pointed, a small suboral umbo . . . . . *unicornis*  
 Pores smaller and more scattered, avicularia rounded or short pointed, ovicell marginated . . . . . 3
- 3. Sinus broadly rounded . . . . . *dissimilis*  
 Sinus narrower, more or less v-shaped . . . . . *cornuta*
- 4. Sinus somewhat v-shaped, frontal pores stellate . . . . . *trichotoma*  
 Sinus broader, semicircular . . . . . *linearis inarmata*

**Schizoporella unicornis** (Johnston), 1847

Plate 37, figs. 1-2

*Lepralia unicornis* Johnston, 1847:320.

*Schizoporella unicornis*, Hincks, 1880:283.

*Schizoporella unicornis*, Osburn, 1940:419.

Zoarium encrusting shells, stones and almost anything that will afford attachment, often very irregular, frequently multilaminar, sometimes forming tubular branched colonies. Zooecia of the primary layer usually oriented, quadrangular or hexagonal; the frontal a thick tremocyst with

rather large pores; an umbo often present behind the aperture but frequently wanting. Aperture rounded distally, a rounded sinus on the proximal border; the thickening of the frontal does not encroach on the peristome which is low and smooth. Pointed avicularia are present, usually one at the side of the aperture with the triangular mandible directed more or less forward, but they may be turned in any direction and often they are wanting over large areas of a colony; they vary greatly in size and height of the avicularian chamber. Zoecial length, 0.50 to 0.60 mm, width 0.30 to 0.45 mm; aperture 0.13 to 0.15 mm long by 0.12 to 0.14 mm wide.

Ovicell salient, porous, often decorated with marginal costae and with an umbonate process on the top in higher calcification.

Widely distributed in the North Atlantic, Indian and western Pacific Oceans, on the eastern American coast abundant as far south as Brazil. It has not been recorded from the Pacific coast of the Americas by any of the earlier students of the Bryozoa, but is a rather common species in the bays where oysters from the Atlantic coast have been planted, and it seems probable that it may have been introduced in recent years.

Hancock Stations: 1130-40 off Laguna Beach, 29 fms; 1222-41 and 1449-42, Newport Harbor on piles; Corona del Mar on piles; Elkhorn Slough, Monterey Bay, shallow water; Dillon Beach on piles (R. J. Menzies), all on the coast of California in shallow water. Also one small colony from James Island, Galapagos, 22 fms.

### *Schizoporella trichotoma* (Waters), 1918

Plate 37, fig. 3

*Schizoporella trichotoma* Waters, 1918:19.

*Schizopodrella trichotoma*, Hastings, 1930:720.

Zoarium encrusting, usually in a single layer. The zoecia are of moderate size, exceedingly variable in their dimensions, usually ranging between 0.40 and 0.65 mm long by 0.25 to 0.40 mm wide, occasionally broader than long; distinct, considerably inflated; the front a smooth tremocyst with numerous pores which have a stellate appearance. The primary aperture is rounded distally, nearly straight on the sides to the large cardelles and with a u-shaped or somewhat v-shaped proximal sinus. A thin, slightly raised peristome surrounds the aperture distal to the cardelles and bears about 4 minute and evanescent spines. The operculum is well chitinized, with a pair of sclerites which are diagonal in position and nearly meet at some distance from the distal border. Avicularia have not been found.

The ovicell is large, about 0.35 mm in each dimension, hyperstomial, not closed by the operculum, porous and heavily calcified with radiating ridges.

Hastings lists it from the Galapagos Islands; previously it was known only from the Atlantic, Cape Verde Islands and John Adams Bank.

Hancock Stations: from 14 stations about the Galapagos Islands, Wenman, Charles, Chatham, Indefatigable and Albemarle Islands; also at two stations in the Gulf of California, Angel de la Guardia Island, and Raza Island. Shore to more than 100 fms.

*Schizoporella linearis* var. *inarmata* (Hincks), 1884

Plate 37, figs. 4-5

*Schizoporella linearis* form *inarmata* Hincks, 1884:41.

*S. linearis* subsp. *inarmata*, Robertson, 1908:291.

*S. linearis* var. *armata*, O'Donoghue, 1923:36.

*Schizopodrella linearis* var. *armata*, O'Donoghue, 1925:102; 1926:58.

Zoarium encrusting in a thin layer, glistening. Zooecia more or less quadrangular and usually very regularly disposed; 0.40 to 0.50 mm long by 0.30 to 0.40 mm wide; slightly inflated and distinct except in advanced calcification. The frontal is a tremocyst with numerous small pores, between which there are minute rounded prominences which give the surface a granulated appearance; a small umbo may be present proximal to the aperture. The peristome is low, thin and smooth, but the frontal wall often forms a low tuberculate wall around it. The aperture, 0.13 by 0.13 mm, is nearly round with a well-marked sinus shaped between a U and V; the cardelles are strong. The operculum is thin with a narrow sclerite a little within the border. Small dietellae are present. No avicularia and no spines.

The ovicell is comparatively large, about 0.30 mm wide, hyperstomial but somewhat depressed and not closed by the operculum; its surface is similar to that of the frontal. The fertile zoecium has a slightly wider aperture.

Hincks named this form from the Queen Charlotte Islands, without further data and without description except "totally destitute of avicularia. In other respects they agree with the typical form and must be regarded as unarmed variety." Robertson recorded it from Santa Catalina Island, California, without comment. O'Donoghue listed it from numerous localities in British Columbia and questioned its status as a variety. It may be added that there are no spines, while these are found in *linearis*. Compared with a specimen from Scotland, I find no differences except the lack of avicularia and spines.

Hancock Stations: 136-34 and 137-34, Clarion Island, W. of Mexico, 32 to 57 fms; 275, Raza Island, Gulf of California; 468-35, Port Parker, Costa Rica; 1064, Santa Barbara Island and 1191-40, Santa Cruz Island, southern California. Depth range 5 to 57 fms.

**Schizoporella cornuta** (Gabb and Horn), 1862

Plate 37, figs. 9-11

*Reptescharella cornuta* Gabb and Horn, 1862:147.

*Schizoporella biaperta*, Hincks, 1883:447.

*Schizoporella biaperta*, Robertson, 1908:287 (part).

? *Schizoporella biaperta*, O'Donoghue, 1923:35.

? *Stephanosella biaperta*, O'Donoghue, 1926:58.

*Stephanosella biaperta*, Canu and Bassler, 1923:99 (part).

*Schizopodrella biaperta*, Canu and Bassler, 1930:16.

This species has been confused with *Stephanosella biaperta* Michelin, probably because of the striking similarity of the ovicells and the presence of lateral-oral avicularia; it has a porous frontal (tremocyst) while that of *biaperta* is an olocyst with only areolar pores, and it is a smaller species in all its measurements with less embedded ovicells. The original description is excellent as far as it goes, even to the communication pores:

"Colony encrusting, cellules agglomerated, only in one layer; quadrangular in form; sides nearly parallel, sometimes slightly curved. Mouth terminal, round to transversely elliptical, often bordered by a very small lip (peristome); proximal lip deeply notched. Special pores (avicularia) abreast of, or in advance of the mouth, placed at the end of somewhat conical tubes arising from the distal angles of the cellule, and looking almost directly forwards. Surface broadly convex and coarsely punctate (a tremocyst). The connecting pores (septulae), between the cellules are large and few in number. We noticed but one lateral one, invariably placed near the proximal end of the cellule and almost at the bottom of the side wall. No abortive cellules, nor ovarian vesicles (ovicells) were observed."

The zooecia are usually between 0.45 and 0.55 mm long by 0.30 to 0.40 mm wide; the aperture measures about 0.13 mm in either dimension, with a v-shaped sinus, and the ovicell 0.18 to 0.20 mm in breadth.

The ovicell is prominent, globular and only partially embedded even in advanced calcification, not closed by the operculum; imperforate, its frontal surface radiately grooved, the secondary cover incomplete and exposing a rounded area on the top, appearing to have a peripheral row

of pores but these are merely the bottoms of the grooves at the edge of the secondary cover. It is almost exactly like that of *Stephanosella biaperta*, but is smaller and less embedded.

The "special pores" of the fossil in original description are the lateral-oral avicularia, the mandibles of which vary from round to triangular. The frontal avicularia, sometimes wanting but often abundant, are moderately large, the chamber elevated and often covering most of the frontal proximal to the aperture, the mandible triangular and acuminate.

This species has been confused with *Stephanosella biaperta* on the Pacific coast to such an extent that the synonymy is much in doubt, except where authors have indicated the nature of the frontal. It is possible that the tremocystal species of the Atlantic and Mediterranean which has been confused with *S. biaperta*, may also be *cornuta*, but there are slight differences in the aperture and in the position of the lateral-oral avicularia.

The species was described from "Santa Barbara, California. Miocene," but a terminal footnote to the work makes the correction that the stratum should be "Post-Pliocene." It is now known to be Pleistocene. The records of Hincks and of O'Donoghue of *S. biaperta* for British Columbia are probably of this species, and certainly the record by Robertson from southern California belongs here. Also those with a perforated frontal listed by Canu and Bassler from the Pleistocene of California and from the Galapagos Islands are evidently *S. cornuta*, and Canu and Bassler (1923:100) suggested separating them as var. *cornuta*.

It is an abundant species all along the coast and neighboring islands from southern Alaska to the Galapagos Islands and from near shore to a depth of over 100 fms; recorded at 124 Hancock dredging stations.

### *Schizoporella dissimilis* new species

Plate 37, figs. 12-13

Zoarium encrusting, multilaminar (one colony shows 7 layers), the surfaces of older zoaria somewhat rough. Zooecia of moderate size, 0.40 to 0.50 mm long by 0.25 to 0.35 mm wide, roughly hexagonal and arranged in quincunx, distinct with deep grooves and moderately inflated in the younger stages. The frontal is a tremocyst with numerous funnel-shaped pores, smooth when young, covered by a thick shining ectocyst which in older zooecia obscures both pores and granulation. The aperture is transversely ellipsoid, 0.13 mm wide by 0.10 to 0.12 mm long, with a broad and moderately deep sinus, the cardelles small. Peristome thin and low, later obscured by the encroachment of the thick frontal; the secondary peristome is low and thick, often wanting, no spines. The

operculum has the form of the aperture, moderately chitinized, with a narrow thickened border, and the muscle attachments well removed from the margin. Small lateral-oral avicularia are present distal to or at both sides of the sinus, a little elevated and with a rounded or triangular mandible; similar small avicularia with a short-pointed mandible occur more proximally on the front.

The ovicell closely resembles that of *S. cornuta* and *Stephanosella biaperta*, imperforate, rounded and prominent when young but later much embedded, with a radiately grooved surface which is partially covered by a secondary wall from the distal zoecium, leaving a rounded area on the top; not closed by the operculum; width 0.20 mm.

The species has a close resemblance to *S. cornuta* (Gabb and Horn), especially in the characters of the ovicell, but the sinus is much wider (not v-shaped), and the ovicells more embedded, the most important difference being in the form of the aperture and operculum.

Type, AHF no. 60.

Type locality, Hancock Station 147-34, Tagus Cove, Albemarle Island, Galapagos,  $0^{\circ}16'38''S$ ,  $91^{\circ}22'44''W$ , at 30 fms. Also taken at Stations 155-34 and 156-34, off Tagus Cove, Albemarle Island at 50 to 60 fms; 190-34, off Albemarle Island; 352-35, Chatham Island; 810-38, Barrington Island, all from the Galapagos Islands; and 674-37, Pulpito Point, Lower California, Gulf of California,  $26^{\circ}30'00''N$ ,  $111^{\circ}27'10''W$ , the most northerly record. Depth range 14 to 60 fms.

### Genus **EMBALLOTHECA** Levinsen, 1909

Frontal a tremocyst with numerous pores; aperture usually with a broad shallow sinus, cardelles present; operculum moderately chitinized, the muscle attachments near the border. Avicularia frontal, usually somewhere near the aperture. No spines. Ovicell hyperstomial and closed by the operculum, perforated like the frontal; the aperture of the fertile zoecium is noticeably broader.

The genus is much like *Dakaria*, but is useful to receive the schizoporellids which have the ovicell closed by the operculum and possess avicularia, which are wanting in *Dakaria*. Genotype, *Lepralia quadrata* MacGillivray, 1880.

**Emballotheca latifrons** new species

Plate 39, figs. 10-11

Zoarium encrusting, sometimes multilaminar, white. Zooecia moderately large, 0.65 to 0.80 mm long by 0.45 to 0.60 mm wide, distinct, broadly arched, the frontal a tremocyst with large infundibular pores. The primary aperture is transverse, moderately large, 0.18 to 0.22 mm wide by 0.13 to 0.16 mm long, the anter a semi-circle and the poster broadly sinuate; the aperture of the fertile zoecium is noticeably larger. The operculum is well chitinized with a thickened border to which the muscles are attached. The primary peristome is low, thin and smooth and is always visible since it is not covered by the secondary peristome; the latter is low, thick and granulated. A small avicularium, so small that it may often be overlooked, is usually present at one or both sides of the aperture, typically they are opposite the proximal border of the aperture, the mandible pointed and oriented laterally or backward; occasionally they are more proximally situated and they are often wanting.

The ovicell is large, about 0.40 to 0.45 mm in width and length, somewhat depressed, hyperstomial and closed by the operculum, with large pores similar to those of the frontal.

Type, AHF no. 61.

Type locality, Hancock Station 1882-49, Cortez Bank near the United States-Mexican boundary, 32°33'52"N, 119°15'17"W, at 42 fms. Also at Stations 874-38, Anacapa Island; 1181-40, Santa Catalina Island; 1276-41, off Point Dume; off San Pedro and off Rocky Point; all from southern California. Also at Station 1252-41, south of San Benito Islands off the west coast of Lower California. The known depth range is 42 to 71 fms.

**Emballotheca obscura** new species

Plate 40, figs. 9-10

Zoarium encrusting. Zooecia moderately large, 0.65 to 0.90 mm long by 0.40 to 0.60 mm wide, quadrate to irregularly hexagonal in form, distinct; the frontal a tremocyst with numerous small pores, evenly arched, slightly granulated but with no other decoration, moderately thick and covered with a thin shining ectocyst. The aperture is broader than long, about 0.20 mm wide by 0.16 mm long, the anter semicircular, the cardelles moderately developed and behind these the poster extends for the full width in a broad shallow arc. The operculum is well chitinized with a marginal sclerite which is broader for some distance beyond the cardelles, the muscular attachments near the border. The peristome

is low and smooth, without spines; the secondary peristome rises somewhat above it in a broad ring which completely encircles the aperture and is decorated with small low tubercles. The avicularium is very minute, situated close beside the aperture, usually just proximal to one of the cardelles, its rostrum fused with the peristome, the chamber small, the mandible pointed and directed more or less laterally; the avicularium is frequently wanting and is always so small that it may readily escape observation.

The ovicell is large, about 0.40 mm in length and breadth, somewhat depressed, covered with a tremocyst like the frontal and closed by the operculum; the aperture of the fertile zoecium is broader, about 0.24 mm.

The minute asymmetrical avicularium which appears to be riding on the rim of the peristome is the distinguishing character.

Type, AHF no. 62.

Type locality, Hancock Station 1316-41, off Santa Catalina Island, southern California, 33°20'55"N, 118°30'25"W, at 45 fms. Also Albartross Station 2945, near Santa Cruz Island, southern California, 34°N, 119°29'30"W, at 30 fms.

### *Emballotheca altimuralis* new species

Plate 37, figs. 6-7

Zoarium multilaminar, encrusting, white to brownish in color. The zoecia are small, 0.40 to 0.45 mm long by 0.30 to 0.40 mm wide in the primary layer; in the secondary layers they are irregularly hexagonal, often as wide as long. In the primary layer the zoecia are distinct with well marked grooves and separating lines or fillets; in the secondary layers the latter become very thick and high, forming enclosing walls on all sides of the zoecia. The frontal is a tremocyst with numerous large pores, slightly inflated and granulated between the pores. The primary aperture is small, 0.12 mm in either dimension, round, with a broadly rounded sinus and small cardelles set far back. The primary peristome is thin and low; the secondary peristome formed by the fusion of the tremocyst is comparatively thick and tuberculate.

The most characteristic feature, aside from the high separating walls, is the occasional presence of a long slender curved avicularium which is situated at one side of the aperture, directed proximally and curved around the aperture behind the sinus; the mandible is triangular at the base and acicular toward the tip, yellow in color, and measures as much as 0.20 mm; the hinge bar is complete.



The ovicell is rounded, prominent, slightly flattened on the front, closed by the operculum, perforated and roughened like the frontal, and measures 0.26 to 0.30 mm in width.

The high, thick separating walls and the tuberculate rim of the secondary peristome are present on all but the young zoecia. The peculiar, curved, reversed avicularia are usually rare, but sometimes are more numerous.

Type, AHF no. 63.

Type locality, Station 406-35 off Monkey Point, Gorgona Island, Colombia, 2°57'00"N, 78°10'00"W, at 22 fathoms. Also taken at Sta. 23-33, La Plata Island, Ecuador, along shore, and at 275-34, west of Navidad Head, Tenacatita Bay, Mexico, 19°12'50"N, 104°49'48"W, several colonies at 25 to 30 fms.

Genus **DAKARIA** Jullien, 1903

Schizoporellae without avicularia and with a rounded sinus (rimule). Jullien's description is brief and not too comprehensive. Translated it reads as follows: "Frontal smooth, perforated by numerous small pores (origelles), especially in the proximal region. Orifice of the young with the two lips juxtaposed at their extremities, the extremities of the anter enclosing between them those of the poster" (Jullien 1903:90). In other words the distal border of the aperture is a wider circle than that of the proximal border. Genotype, *D. chevreuxi* Jullien, 1903:90.

The genus is certainly close to *Schizoporella*, but it should be added that the operculum has a broader bordering sclerite, with the muscle attachments near the margin and that the operculum closes the ovicell.

KEY TO SPECIES OF *Dakaria*

- 1. Ovicell with a distinct frontal area . . . . . 2
- Ovicell without a restricted frontal area . . . . . 4
- 2. Area of ovicell elongate triangular . . . . . *pristina*
- Area of ovicell more or less rounded . . . . . 3
- 3. Area central, separated from the orifice . . . . . *dawsoni*
- Area not parted from the orifice . . . . . *ordinata*
- 4. Numerous oral spines . . . . . *biserialis*
- No oral spines . . . . . 5
- 5. Ovicell evenly perforated, not more than 0.40 mm wide,
- peristome beaded . . . . . *sertata*
- Ovicell 0.50 mm or more in width, peristome low and without
- beaded rim . . . . . *apertura*

**Dakaria apertura** new species

Plate 39, figs. 7-9

Zoarium encrusting rocks and shells. The zooecia are large, 0.65 to 0.90 mm long by 0.45 to 0.60 mm wide, arranged in series when free-growing, distinct with well-marked grooves; the frontal somewhat ventricose, a thick tremocyst with large infundibular pores, granular in older stages and often with a broad umbonate swelling on the distal half; covered with a thick ectocyst. The primary aperture is nearly round, width 0.20 to 0.23 mm, length, 0.18 to 0.22 mm; the anter a little more than a semicircle back to the prominent cardelles between which the poster extends in an arc similar to and only slightly narrower than that of the anter. The operculum has the form of the aperture, rather heavily chitinized and, except in young zooecia, whitish in color with a light brown border; there is a complete bordering sclerite, with the muscle attachments near the margin. The peristome is low and thin, the secondary border not elevated but often rough, especially on the proximal border where it joins the low umbonate swelling.

The ovicell is large, 0.50 to 0.60 mm wide, not deeply embedded, the front somewhat depressed and perforated with irregularly shaped pores of different sizes; in full calcification a heavy and very rough border extends up the sides of the ovicell but leaves a broad rounded perforated area.

The large size, longer aperture with larger poster, the nature of the ovicell and the presence of the broad umbonate process distinguish the species.

Type, AHF no. 64.

Type locality, Tomales Bay at Dillon Beach, California, about 38°15'00"N at 6 fms, R. J. Menzies, collector, several colonies.

**Dakaria dawsoni** (Hincks), 1883

Plate 39, figs. 1-2

*Schizoporella dawsoni* Hincks, 1883:449.

*Schizoporella torquata* Hincks, 1884:41 (not *Escharina torquata* d'Orbigny).

*Schizoporella dawsoni*, O'Donoghue, 1926:56.

Zoarium encrusting, multilaminar, white to yellowish or reddish-brown. Zooecia moderately large, 0.55 to 0.75 mm long by 0.35 to 0.50 mm wide, quite variable in size and arrangement in the secondary layers; considerably inflated and distinct in younger zooecia, with a raised separating line in older specimens. The frontal is a tremocyst with numer-

ous infundibular pores, the areolar pores slightly enlarged; finely granular but no other surface decoration. The primary aperture is distinctly broader than long, 0.18 to 0.20 mm wide by 0.14 to 0.16 mm long, evenly semicircular beyond the strong cardelles, the proximal border broadly arcuate or slightly sinuate. The operculum has the form of the aperture, with a brownish bordering sclerite and the muscle attachments at the edge. The primary peristome is thin and somewhat raised; the secondary peristome, formed by the frontal, is low, the proximal border often tuberculate. No spines, no avicularia.

The ovicell is large, 0.40 to 0.45 mm wide, rounded, hyperstomial but deeply embedded, closed by the operculum. Hincks' description is good: "closely united to the cell above, somewhat depressed in front, glossy, covered with rather large punctures; a prominent thickened border around the opening." This is exactly true for earlier stages of calcification, but in later stages the secondary layer covers all of the front except a rounded area on the top.

Hincks described the species from Dolomite Narrows, British Columbia, and O'Donoghue recovered it from San Juan Island, Puget Sound, Washington.

In the Hancock Collections are specimens from Middle Bank and Hein Bank, Puget Sound, collected by Dr. John L. Mohr, and one also from Cordova, Alaska, dredged by the "Albatross," June 28, 1914.

### **Dakaria ordinata** (O'Donoghue), 1923

Plate 57, figs. 10-11

*Schizoporella ordinata* O'Donoghue, 1923:38.

*Dakaria ordinata*, O'Donoghue, 1926:61.

The zoarium encrusts stones, shells, etc.; also there is one branching erect cylindrical colony which possibly may have encrusted an alga; white and shining. The zooecia are variable in size and form, especially those on the superficial layers; on free-growing areas they measure 0.50 to 0.70 mm long by 0.35 to 0.45 mm wide; slightly ventricose, with a separating line. The frontal is a tremocyst with moderately large pores, smooth, without decoration except for a low, slightly tubercular rim proximal to the aperture. The primary aperture is broader than long, 0.15 to 0.18 mm wide by 0.13 to 0.15 mm long, semicircular back to the cardelles, broadly arched or slightly sinuate on the proximal border; there is a narrow smooth proximal shelf between the aperture and the beaded secondary rim of the peristome. The primary peristome is thin and low, not obscured by the low secondary peristome, and without spines.

The ovicell is rounded, prominent, slightly flattened, with numerous pores; the secondary layer of calcification leaves a rounded perforated area above the orifice; width about 0.40 mm.

O'Donoghue named the species for the orderly arrangement of the zooecia, which is quite evident in the primary layer on smooth surfaces, but in superficial layers the zooecia are oriented very irregularly; Gabriola Pass, British Columbia and San Juan Island, Puget Sound.

Hancock Stations: 1123-40, San Nicolas Island; 1232-41, off San Pedro breakwater; 1283-41, Santa Rosa Island; 1295-41, Santa Cruz Island, all off southern California; 1896-49 middle of Tanner Bank, United States-Mexican boundary (the most southern record). Also off Del Monte, California, Dr. R. L. Bolin, collector. Depth range 20 to 35 fms.

### **Dakaria pristina** (Hincks), 1883

Plate 39, figs. 3-4

*Schizoporella pristina* Hincks, 1883:448.

*Dakaria pristina*, O'Donoghue, 1926:60.

Zoarium encrusting on stones and shells. Zooecia moderately large, 0.60 to 0.80 mm long by 0.40 to 0.50 mm wide, often quite regularly elongate-quadrilateral in form; the frontal ventricose and the zooecia separated by rather deep grooves within which are raised lines. The frontal tremopores are large and become more or less infundibuliform. The primary aperture is nearly round, sometimes a little longer than wide and again it is slightly shorter than the width, averaging about 0.20 mm in each dimension; in any case the operculum has the form of the aperture and is provided with a comparatively broad, complete bordering sclerite, the muscle attachments being at the margin. The cardelles are large and prominent, the anter a semicircle and the poster nearly as large, its proximal border usually seeming to be a continuation of the same circle as that of the anter. The appearance of the aperture is exactly represented by Hincks, 1883, pl. 17, fig. 6. The peristome is low, slightly higher on the proximal border and roughened with low tubercles. No spines, no avicularia.

The ovicell is large, rounded, about 0.40 mm wide, bordered by a thick, rough collar which leaves a large roughly triangular frontal area with large irregular pores; closed by the operculum.

Recorded by Hincks from Dolomite Narrows, and by O'Donoghue from Gabriola Pass and off Round Island, British Columbia.

Hancock Collections, Tomales Bay, Dillon Beach, California, several specimens on stones, R. J. Menzies, collector.

**Dakaria sertata** Canu and Bassler, 1930

Plate 57, figs. 12-13

*Dakaria sertata* Canu and Bassler, 1930:17.*Dakaria sertata*, Marcus, 1937:95.

Zoarium encrusting on corallines, shells, etc.; sometimes multilaminar in which case the zooecia are poorly oriented. The zooecia are of moderate size, 0.45 to 0.65 mm long by 0.30 to 0.45 mm wide, more or less elliptical or quadrangular when free-growing but assuming all sorts of proportions when crowded or in superficial layers; the front ventricose, separated by deep grooves; the frontal a tremocyst with numerous small pores; in full calcification the pores become infundibuliform and the front is slightly granulated. The primary aperture, 0.16 mm wide by 0.14 to 0.16 mm long, is nearly round except that the broad sinus, extending between the cardelles, is often slightly angulated. The operculum has the form of the aperture, with a comparatively broad bordering sclerite and the muscle attachments near the margin. The peristome is slightly elevated and thin; the frontal forms a secondary peristome which is broader and is decorated with small rounded tubercles, especially on the proximal border though often the tubercles form a complete "necklace" about the aperture. No spines, no avicularia.

The ovicell is deeply embedded but conspicuous, rounded, large (0.40 to 0.45 mm broad); its front a tremocyst with numerous pores which are somewhat smaller than those on the frontal; closed by the operculum.

Recorded from the Galapagos Islands by Canu and Bassler and later by Marcus from Santos Bay, Brazil.

Hancock Stations: 30-33, Hood Island, 190-34 and 450, Albemarle Island, 453, Gardner Island, Galapagos; 136-34, Clarion Island, west of Mexico; 557-36, Isla Partida, 275, Raza Island, and 276, San Esteban Island, Gulf of California; 1191, Cortez Bank, near the United States-Mexican boundary; 232, San Miguel Island, 874-38, Anacapa Island, 1294-41, Santa Cruz Island, and 1143-40, off Portuguese Point, southern California. The known distribution is from little south of the equator to slightly north of 34°N Lat., and from shore down to 60 fms.

**Dakaria biserialis** (Hincks), 1885

Plate 39, figs. 5-6

*Schizoporella biserialis* Hincks, 1885:250; 1889:9.

Zoarium encrusting on a coralline, white and shining. Zooecia more or less hexagonal, distinct with deep grooves, 0.55 to 0.75 mm long by 0.40 to 0.55 mm wide; the frontal a tremocyst, considerably inflated,

with numerous pores; no evidence of an umbo. The primary aperture, 0.18 mm wide by 0.15 mm long, is evenly rounded to the cardelles, proximal to which is a rounded sinus about half as broad as the distal part. The operculum has a lunate chitinized border, thinning out toward the points of attachment. A low thin peristome extends around the border distal to the cardelles and bears 8 to 12 short, erect, closely set spines. Distal to the peristome is another row of similar but recumbent spines of about the same number; occasionally this outside row extends along the side of the front a short distance proximal to the aperture.

The ovicell is large, 0.40 mm wide, heavily calcified, perforated and prominent; closed by the operculum; the aperture of the fertile zoecium slightly broader, 0.20 mm.

The genus *Dakaria* as a rule is without oral spines while this has a double row, but the absence of the avicularia, and the closure of the ovicell by the operculum, together with the broad sinus and the lack of a definite peristome on the proximal border which appears to be enclosed between the proximal ends of the distal border, all agree with *Dakaria*.

Hincks described the species from New Zealand and I have not found any more recent record. He states that "there are 14 to 16 spines but there may be as many as 40 or 50"; the largest number I have observed is 26, but evidently with so much variation the exact number is of no consequence.

Hancock Station 779-38, off Nuez Island, Cocos Islands, Costa Rica, 5°34'00"N, 86°59'20"W, one colony at 30 to 50 fms. Also Station 438, Chatham Island, Galapagos, one colony.

#### Genus **SCHIZOMAVELLA** Canu and Bassler, 1917

"The operculum closes the ovicell. The muscular attachment is usually in the immediate vicinity of the border of the operculum. The rimule is wide and arched. The frontal is a tremocyst. A median avicularium occurs on the front wall. There are small oral glands. 23 tentacles" (Canu and Bassler). Genotype, *Lepralia auriculata* Hassall, 1842.

**Schizomavella auriculata** (Hassall), 1842

Plate 38, fig. 5

*Lepralia auriculata* Hassall, 1842:411.*Schizoporella auriculata*, Hincks, 1880:260.*Schizoporella auriculata*, Robertson, 1908:286.*Schizoporella auriculata*, O'Donoghue, 1923:34; 1926:58.

Zoarium encrusting, especially on shells. Zooecia rather small, averaging about 0.45 mm long by 0.35 mm wide but varying greatly, more or less quadrate or rhomboid; the frontal a tremocyst with small pores, moderately convex, distinct with a separating line, smooth or granulated. The primary aperture is round back to the level of the cardelles, with a rather shallow sinus, the length and width about equal and varying from 0.10 to 0.12 mm in either dimension. Peristome low and smooth. A small avicularium, usually mounted on a small umbo, is situated in the midline proximal to the sinus, the mandible varying from semi-circular to short spatulate.

The ovicell is comparatively large, about 0.25 mm broad, hyperstomial, perforated, the front slightly flat.

The species is unusually variable and scarcely any two colonies are exactly alike.

Recorded by Robertson from the Coronado Islands just south of the United States-Mexican boundary, and by O'Donoghue from several localities in British Columbia. It is a common North Atlantic species.

Hancock Stations: Dredged at numerous stations from the coast of Oregon south to San Benito Islands and Dewey Channel on the west coast of Lower California and Isla Partida in the Gulf of California; common about the islands off southern California, but not noted south of 29° N Lat.

**Schizomavella auriculata ochracea** (Hincks), 1880

Plate 38, fig. 6

*Schizoporella auriculata* var. *ochracea* Hincks, 1880:262; 1884:16.*Schizoporella auriculata* subsp. *ochracea*, Robertson, 1908:286.*Schizomavella auriculata* var. *ochracea*, O'Donoghue, 1926:59.

This variety is characterized by the avicularium which is submersed and lies flat in the frontal instead of elevated; it is also usually farther removed from the aperture; its mandible may be rounded or subspatulate. Other characters are similar to the typical form.

Recorded by Hincks from the Queen Charlotte Islands, by Robertson from San Pedro, southern California, and by O'Donoghue from Gabriola Pass and Houston Channel, British Columbia.

Hancock Stations: 1259-41, Dewey Channel, west coast of Lower California; 1415-41, San Miguel Island, southern California, and 1474-42, Charleston, Oregon; shore to 49 fms.

### *Schizomavella auriculata acuta* new variety

Plate 38, figs. 7-9

This rather characteristic variety differs but little from the typical *auriculata* except in the nature of the avicularia. These are usually mounted on a low umbo with the sharp-pointed mandible directed backward, they are less elevated than in the typical form, occasionally enlarged; on the same colony there are more rarely very elongate slender avicularia, pointed at both ends, with the mandible occupying only about half of the avicularian area. These elongate avicularia are little elevated and horizontal with the frontal; they resemble the giant avicularia of the variety *ochracea* Hincks, except for their form and position of attachment of the mandible. The frontal is usually thickly granulated with small round tubercles between the pores. The zoarium is encrusting and varies from white to reddish brown in color.

At first I believed this to be a different species, but the intergradations and the similarity of the operculum and ovicell seem to rank it as merely another variety of *auriculata*.

Type, AHF no. 65.

Type locality, Hancock Station 1662-48, Santa Cruz Island, southern California, 33°55'50"N, 119°31'05"W, at 23 fms. Also taken at Stations 1232-41, off the San Pedro Breakwater, 18 fms, and off Santa Catalina Island, 55 fms, southern California.

### *Schizomavella porifera* (Smitt), 1867

Plate 38, fig. 10

*Escharella porifera* forma *typica* Smitt, 1867:9.

*Lepralia porifera*, Hincks, 1877:102.

*Lepralia porifera*, Waters, 1900:75.

*Schizoporella porifera*, Nordgaard, 1906:29.

Zoarium encrusting, white. Zooecia moderately large, 0.65 to 0.80 mm long by 0.40 to 0.50 mm wide, distinct, considerably inflated; the frontal a tremocyst with large pores which become infundibular with



age. The aperture is nearly round, with a broad, shallow sinus. The operculum is well chitinized, yellowish, with muscle attachments removed from the border. The peristome is slightly raised, thin, and sometimes connects with the suboral avicularian chamber. The avicularium varies in size and location, usually close to the border but often a little removed from it, and the mandible semicircular to very short spatulate.

The ovicell is large, 0.40 mm wide, the front considerably depressed, perforated by rather large pores.

As shown by Nordgaard (1918:28) Smitt confused no less than five species in his *Escharella porifera*, the "form typica" being the present one. The species, as limited, has been placed under several other genera, *Lepralia*, *Smittina*, *Schizoporella*, but the characters, except for the large size, appear to conform to the genus *Schizomavella*; the nature of the aperture and operculum, the depressed frontal area of the ovicell and the character of median suboral avicularium.

It is a high northern species, known from Nova Zembla to Greenland, but the confusion with other species makes it impossible to cite references except where authors have noted the form of the aperture without a lyrula.

Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector, 14 fms.

### Genus **ARTHROPOMA** Levinsen, 1909

The frontal is a smooth tremocyst with numerous small pores; aperture semicircular, straight on the proximal border, with a narrow slit-like sinus; peristome inconspicuous. The operculum bears a tongue-shaped appendage which fills the sinus. Genotype, *Flustra cecilia* Audouin, 1826.

#### **Arthropoma cecili** (Audouin), 1826

Plate 38, figs. 1-3

*Schizoporella cecilia*, Hincks, 1884:17.

*Schizoporella cecilia*, Robertson, 1908:288.

*Schizoporella cecilia*, O'Donoghue, 1923:35.

*Arthropoma cecilia*, O'Donoghue, 1926:58.

Zoarium encrusting, forming thin, smooth, white layers. Zoecia moderately large, 0.65 to 0.75 mm long by 0.50 to 0.65 mm wide, hexagonal, distinct with well-marked grooves; the frontal is a smooth tremo-

cyst with numerous small pores, considerably inflated and with or without the small umbo which is present in typical specimens. The aperture is semicircular, about 0.18 mm wide, the proximal border straight with a narrow, deep, slit-like sinus. The peristome is unusually thin and low. No spines, no avicularia.

The ovicell is very prominent, longer than wide, smooth, imperforate.

Hincks and O'Donoghue have reported the species for several localities in British Columbia, and Robertson recorded it from San Pedro, California.

Hancock Station 328, Chatham Bay, Cocos Island, Costa Rica at 14 fms. It is a very widely distributed species, but appears to be rare in the Eastern Pacific area. There are also specimens collected by Miss A. E. Blagg off Lighthouse Point at the entrance to Monterey Bay, California.

### ***Arthropoma circinata* (MacGillivray), 1868**

Plate 38, fig. 4

*Lepralia circinata* MacGillivray, 1868:9.

*Schizoporella circinata*, Busk, 1884:166.

*Schizoporella circinata*, Hincks, 1885:253.

Zoarium encrusting, unilaminar. Zooecia of moderate size, 0.40 to 0.50 mm long by 0.25 to 0.35 mm wide, irregularly hexagonal, very distinct with deep separating grooves; the frontal high and evenly arched, smooth or somewhat reticulate in older zooecia, with conspicuous pores and a small, smooth central area. Proximal to the aperture is a thin, arcuate, umbonate process with a concavity on its distal side forming a shallow pouch, but there is no other appendage or decoration. The primary aperture is semicircular, about 0.12 mm wide, the proximal border straight with a slit-like sinus. The operculum is thin, conforming to the aperture and sinus, with a narrow bordering sclerite and the muscle attachments removed from the border. The peristome is low and thin, with 6 short, stout spines which are often little more than tubercles. No avicularia.

The ovicell is prominent, smooth and imperforate, 0.20 to 0.25 mm wide and usually a little longer than wide, not closed by the operculum.

The species is similar in appearance to *A. cecili*, but it is much smaller, and the smooth central area of the front is larger, the umbonate process is thin and arcuate, and there are vestigial oral spines.

Known from Australia, New Zealand and Tristan da Cunha.

Hancock Stations: 276, San Esteban Island, Gulf of California, 32 fms; 275, Raza Island, Gulf of California, 40 fms, and 431-35, off Octavia Rocks, Colombia, 45 fms. Also at Albatross Station 2939, off Santa Catalina Island, southern California. The species is widely distributed along the coast, from 33°36'00"N to 6°47'20"N, the depth range down to 45 fms, but it appears to be rare as only one or two colonies were taken at each station.

Genus **SCHIZOLAVELLA** Canu and Bassler, 1920

The genus is closely allied to *Schizoporella*, but the oocial aperture is closed by the operculum and there is a pair of lateral frontal avicularia with long vibraculoid mandibles. Genotype, *Eschara vulgaris* Moll, 1803.

**Schizolavella vulgaris** (Moll), 1803

Plate 38, fig. 13

*Schizoporella vulgaris*, Hincks 1880:244.

*Schizolavella vulgaris*, Canu and Bassler, 1923:108.

Zoarium encrusting. Zooecia about 0.50 mm long by 0.35 mm wide, occasionally as wide as long, distinct with deep separating grooves; the frontal tremocyst with small pores, inflated and evenly granulated. The aperture is rounded distally, straighter on the sides, the proximal border straight with a rather narrow v-shaped sinus, 0.12 mm in either dimension. The peristome is thin and low, slightly raised on the sides, somewhat thicker on the distal border where 3 or 4 small evanescent spines are often present. The avicularia are usually paired, one on either side near the lateral borders and at some distance from the aperture; the base of the avicularium is small and rounded with a complete hinge bar, the mandible elongate, slender and appearing "vibraculoid."

Ovicells rounded, prominent, 0.25 mm broad, perforated like the frontal, occasionally with a small umbo on the top, and closed by the operculum.

The species has been known living only in the eastern Atlantic from the British Isles to the Cape Verde Islands and in the Mediterranean. Canu and Bassler (1923:108) have recorded it from the Pleistocene of Santa Barbara, California. It is of some interest to find it still living in the Gulf of California.

Hancock Stations: 539-36, Angeles Bay, Lower California, and 650-37, San Francisco Island, Gulf of California. One to 47 fms. Rare.

Genus **STYLOPOMA** Levinsen, 1909

Levinsen separated this group from *Schizoporella* and figured but did not describe the genus (1909, Plate 18, fig. 4). Canu and Bassler (1920:359) have established it with *Cellepora informata* Lonsdale as the genotype.

The most striking character of the genus is the enormous ovicell which completely covers the zooecial aperture; the frontal is a tremocyst with small pores and the aperture is semicircular with a narrow, v-shaped sinus.

**Stylopoma informata** (Lonsdale), 1845

Plate 38, figs. 11-12

*Cellepora informata* Lonsdale, 1845:505.

*Schizoporella spongites*, Osburn, 1914:207.

*Stylopoma spongites*, Canu and Bassler, 1928:91.

*Stylopoma spongites*, Hastings, 1930:721.

*Stylopoma informata*, Osburn, 1940:424.

The species has usually been known as *spongites* but the consensus of opinion now is that the *Eschara spongites* Pallas, 1766:45, is something else, probably a *Schizoporella*.

The zoarium is encrusting, multilaminar and often rises into low irregular frills. The zooecia are of moderate size, about 0.50 mm long by 0.35 mm wide, usually rather regularly quadrangular; frontal a tremocyst with numerous small pores, little convex, smooth (roughened in older stages); a low umbonate process proximal to the aperture. The aperture is semicircular, straight on the proximal border, with a narrow v-shaped or sometimes slit-like sinus; the peristome low.

Avicularia vary in size and form; small triangular ones are often present at one or both sides of the aperture and this form is sometimes found in abundance on the front and even on the surface of the ovicell; larger avicularia, straight or falciform, pointed or spatulate are more rarely found on the front.

The ovicell is huge, about 0.55 mm wide and long, often as broad as two zooecia, globular, very salient, and encloses both the aperture and the oral avicularia.

This species is very abundant in the West Indian region, Bermuda Islands to Santos Bay, Brazil. It is apparently rather rare on the Pacific coast of the Americas, where it has been recorded only by Hastings from the Galapagos Islands.

Hancock Stations: 167-34, Charles Island; and 182-34 and 462, James Island, all from the Galapagos. Shallow water to 30 fms.

Genus **GEMELLIPORIDRA** Canu and Bassler, 1927

"The ovicell is hyperstomial and always closed by the operculum. The frontal and ovicell are covered by tremopores. The aperture bears two small lateral indentations separating a very large suborbicular anter from a very small concave poster. The operculum bears two lateral marks corresponding to oral indentations and two linear muscular attachments. There are two oral avicularia irregularly arranged on each side of the aperture. The complete colonies are multilaminar and the zooecia are then poorly oriented." Genotype, *Gemelliporida typica* Canu and Bassler, 1927:7.

**Gemelliporida lata** new species

Plate 55, fig. 14

Zoarium encrusting, multilaminar, the zooecia turned in every direction in the superficial layers. Zooecia of moderate size, usually between 0.55 and 0.65 mm long by 0.40 to 0.50 mm long, but occasionally broader than long, distinct. Frontal a tremocyst with numerous small pores which enlarge at the surface; little inflated and heavily calcified. The primary aperture is suborbicular back to the small cardelles, behind which is a shallow, slightly sinuate anter. The frontal covers the primary peristome and forms a thick wall which is only slightly elevated; there are small pointed oral avicularia on one or both sides of the aperture, irregularly arranged; in addition there is rarely a giant avicularium which takes the place of a zoecium, with a long mandible which is broadly triangular at the base, narrow thence to the tip, and attached by a strong pivot bar.

Ooecium large, 0.40 mm wide, hemispherical and covered with tremopores like those of the genotype, *G. typica*; the frontal pores are smaller and much more numerous.

Type AHF No. 66.

Type locality, Station 299, San Jose del Cabo at the tip of the Lower California peninsula, 22°55'30"N, 109°47'15"W, one colony, dead, at 82 fms.

**Gemelliporida colombiensis** new species

Plate 40, figs. 11-12

Zoarium encrusting small shell fragments, the surface rough, pale yellow. Zoecia small, 0.35 to 0.45 mm long by 0.25 to 0.30 mm wide, distinct only when young. The frontal is a tremocyst with small pores, thick, and so rough that the pores are difficult to see except when calcined. The aperture is longer than wide, 0.10 mm long by 0.08 mm wide, slightly pyriform, the small cardelles set well back and the poster forms a broad arc between them. The operculum is moderately chitinized, light yellow, a narrow sclerite extends around from one cardelle to the other slightly within the margin. The peristome is low, thin, smooth and without spines; the secondary peristome, formed by the thickening of the frontal wall, does not occlude the aperture. A comparatively large avicularium is situated on one side proximal to the aperture, the rostrum tilted upward at an angle of about 45°, the mandible semi-elliptical and directed laterally, frequently wanting.

The ovicell is comparatively large, 0.18 to 0.20 mm wide, globular and very prominent, not closed by the operculum, perforated like the frontal but the surface less coarsely granulated; a small umbonate process sometimes present directed backward over the aperture. The ovicells are present in such numbers that the surface is obscured over much of the zoarium.

The nature of the aperture and operculum, the ovicell and the frontal avicularium appear to ally this species with *Gemelliporida*, but it is much smaller and neater in appearance than others of this genus.

Type, AHF no. 67.

Type locality, Colombia, a single colony in the Hancock Collections without further data. Also Hancock Stations 277, Tiburon Island, Gulf of California and 539-36, Angeles Bay, east coast of Lower California, at 1 to 16 fms.

Genus **HIPPODIPLOSIA** Canu, 1916

Frontal a tremocyst with numerous large pores which become infundibulate, the tremocyst does not reach the proximal border of the aperture and leaves a small, smooth area. The aperture is rounded with a broadly arcuate or somewhat sinuated proximal border. The ovicell is perforated, somewhat depressed on the front and marginated. Avicularia sometimes present. Genotype, *Hippodiplosia verrucosa* Canu, 1916.

KEY TO SPECIES OF *Hippodiplosia*

1. Avicularia present . . . . . 2  
    Avicularia wanting . . . . . 3
2. Avicularia usually median and suboral . . . *reticulato-punctata*  
    Avicularia lateral, usually beside the aperture . . . . *americana*
3. Ovicell radiately ribbed, imperforate . . . . . *insculpta*  
    Ovicell not ribbed, irregularly perforated . . . . . *pertusa*

**Hippodiplosia americana** (Verrill), 1875

Plate 40, fig. 4

*Lepralia americana* Verrill, 1875: 415.*Lepralia americana*, Osburn, 1912: 241.*Hippodiplosia americana*, Hastings, 1930: 725.*Hippodiplosia americana*, Marcus, 1937: 101.

Zoarium encrusting on shells, sometimes multilaminar. Zooecia moderate in size, 0.50 to 0.65 mm long by 0.35 to 0.40 mm wide, quadrilateral to more or less hexagonal and arranged in quincunx, distinct and ventricose in younger stages. The frontal is a thick tremocyst with large pores; sometimes rising into a small suboral umbo, and variously roughened in full calcification. The aperture is nearly round (slightly quadrangular), 0.14 to 0.16 mm wide by 0.12 to 0.14 mm long; the poster broadly arcuate between the small cardelles. The peristome is low and thin, without spines, the frontal does not unite with it, especially on the proximal border (a characteristic of the genus). A moderate sized avicularium, with a pointed mandible and complete hinge-bar, is situated near the side of the aperture, directed more or less distally.

The ovicell is large, about 0.35 mm in either dimension, hyperstomial, prominent, slightly flattened on the upper surface, with numerous pores which are irregular in size, shape and distribution.

The species is common on the Atlantic coast from Mt. Desert Island, Maine, to North Carolina, especially abundant about southern New England. Marcus recorded it from Santos Bay, Brazil, and Hastings from Balboa, Canal Zone (the only Pacific record).

Hancock Stations: 254, Agua Verde Bay in the Gulf of California; 253-34, Port Culebra, Costa Rica; 147-34, Tagus Cove, Albermarle Island, and 440, James Island, Galapagos. Depth range 10 to 30 fms.

**Hippodiplosia pertusa** (Esper), 1796

Plate 40, figs. 5-8

*Cellepora pertusa* Esper, 1796:149.*Lepralia pertusa*, Hincks, 1880:305.*Hippodiplosia pertusa*, Hastings, 1930:724.*Hippodiplosia pertusa*, Osburn, 1933:41.

Zoarium encrusting, often covering considerable areas on shells, etc. Zooecia moderately large, 0.60 to 0.75 mm long by 0.35 to 0.45 mm wide, distinct with deep grooves, the front considerably inflated, a tremocyst with numerous large pores. The aperture is moderately large, 0.16 to 0.18 mm in each dimension, nearly round, the proximal border a wide arc behind the strong denticles. The peristome is low and thin, not covered by the tremocyst. Proximal to the aperture an umbo is often present and in our California specimens it is exceptionally high and strong, ending in a point. No spines, no avicularia.

The ovicell is large, prominent, irregularly perforated, closed by the operculum.

It is a very widely distributed species and has been recorded in the Eastern Pacific by Hincks from Mazatlan, Mexico, and by Hastings from Gorgona, Colombia, and from the Galapagos Islands.

Hancock Stations: 1232-41, San Pedro, shore; 1283-41, Santa Rosa Island, 23 fms; and 1295-41 and 1666-49, Santa Cruz Island, 17 fms, southern California.

**Hippodiplosia reticulato-punctata** (Hincks), 1877

Plate 40, fig. 3

*Lepralia reticulato-punctata* Hincks, 1877:103.*Escharella porifera* form *edentata* Smitt, 1867:9.*Schizoporella reticulato-punctata*, Nordgaard, 1918:66.*Hippodiplosia reticulato-punctata*, Osburn, 1933:41.

Zoarium encrusting. Zooecia moderately large, 0.60 to 0.70 mm long by 0.45 to 0.60 mm wide, broad and little inflated, more or less distinct. The frontal is a tremocyst with very large pores which increase in size outward so that the surface of old zooecia looks like a network. The tremocyst does not involve the proximal border of the aperture but leaves a small v-shaped area which is usually occupied by a suboral avicularium. The peristome is thin, a little elevated on the sides but wanting on the proximal border, no oral spines. The aperture is broader than long, 0.20 to 0.24 mm wide by 0.18 to 0.20 mm long, regularly rounded back to the cardelles, behind which it is broadly arcuate. A



rather large suboral avicularium occupies the triangular area proximal to the aperture, the mandible semicircular to short subspatulate and hinged to a complete bar, sometimes inclined forward toward the aperture but usually nearly level with the frontal surface, often wanting. The avicularian chamber is symmetrically developed in the median line but does not connect with marginal pores.

The ovicell is hyperstomial but considerably embedded in the distal zoecium and closed by the operculum, perforated in a rather regular pattern, 0.20 to 0.24 mm wide.

It is an arctic and high northern species, known from Nova Zembla to Greenland and down the Atlantic coast of North America to Maine. In the Canadian Arctic Expedition it was found at Icy Cape and Point Barrow, Alaska (Osburn, 1923:10, *Smittina reticulato-punctata*). It is possible that the *Smittia Landsborovii* var. *porifera* of O'Donoghue (1923:42) from British Columbia, also belongs here.

Bering Sea (Dall Collection, United States National Museum). Common at Point Barrow, Alaska, G. E. MacGinitie, collector.

### **Hippodiplosia insculpta** (Hincks), 1882

Plate 40, figs. 1-2

*Schizoporella insculpta* Hincks, 1882:252.

*Schizoporella insculpta*, Robertson, 1900:326; 1908:290.

*Schizoporella insculpta*, O'Donoghue, 1923:36; 1925:102; 1926:57.

Zoarium encrusting on almost anything that will afford attachment, stones, shells, hydroids, bryozoans, algae, etc., often rising in short bilaminate frills or fan-like expansions; light yellow, but bright orange when in reproduction. Zooecia elongate-quadrangular to more or less hexagonal; length 0.50 to 0.75 mm, width 0.30 to 0.40 mm; distinct and a little inflated. Front a tremocyst, slightly granular, with numerous large pores; there is a pointed umbo, with its base about as wide as the aperture and a crescentic cavity on its distal side is sometimes partially closed to form a rounded pore, but no evidence of an avicularium has been found. The peristome is low and very thin, not covered by the tremocyst. The aperture is round back to the strong cardelles; proximal to these is a broad, shallow poster with a slightly arcuate border; in the infertile zooecia the aperture measures 0.18 to 0.20 mm in each dimension, in the fertile zooecia the aperture is larger but of the same form. The operculum is thin, without any marked sclerites and the muscle attachments are well removed from the border; in the fertile zooecia it is larger and closes the ovicell.

The ovicell is large, 0.40 mm wide and long, globular and prominent, often radiately striated. The primary oecium is smooth or slightly granular and imperforate; the tremocyst of the succeeding zooecium rises over the distal end and slightly on the sides, often giving the ovicell an elongated shape. No avicularia, dietellae or spines.

Described by Hincks from Virago Sound and Cumshewa Harbor, British Columbia; listed by Robertson from Sitka, Alaska, to the Coronados Islands, California, and by O'Donoghue from numerous localities in British Columbia. It is an abundant species in shallow water and often found in tide pools.

Toward the southern part of its range it is much smaller and neater in appearance; length 0.45 to 0.55 mm, width 0.30 to 0.35 mm; aperture about 0.13 mm long by 0.14 mm wide, and the ovicell 0.25 mm in width. The appearance of these and other characters is the same as in the larger form, however, and there appears to be a rather regular gradation of size from Alaska to southern California. South of this point only the small form was found.

Hancock Stations: Dredged at 24 stations from the coast of Oregon to Cocos Island off the coast of Costa Rica, and at numerous shore stations. Albatross Station 2824, in the lower part of the Gulf of California. In the collection are also specimens from Nootka, Alaska, and Five Fingers, British Columbia. It is most abundant in shallow water but was dredged as far down as 128 fms.

Family **Hippoporinidae** new family

In this group the frontal consists of a thick olocyst or pleurocyst, usually imperforate except for the marginal areolar pores; the ovicell is hyperstomial; the aperture in the typical genus *Hippoporina* is considerably elongated proximal to the cardelles but this is not true of all the genera; the operculum also varies in the proportions of the proximal part, it is well chitinized and provided with a sclerite or thickening at the margin or at some distance within the border and to this sclerite the muscles of the operculum are attached. The cardelles are usually strong and the operculum constricted on the sides. Avicularia are usually present and in some species there are oral spines. In some of the genera there are additional pores, which at least leave the central area free proximal to the aperture.

## KEY TO THE GENERA OF HIPPOPORINIDAE

1. Ovicell perforated with numerous pores . . . . . 2  
   Ovicell imperforate . . . . . 6
2. Ovicell closed by the operculum . . . . . 3  
   Ovicell not closed by the operculum . . . . . 4
3. Frontal smooth and porcellanous . . . . . *Hippomenella*  
   Frontal granular or reticular . . . . . *Hippomonavella*
4. Poster deep and rounded . . . . . *Gemelliporella*  
   Poster more or less transverse . . . . . 5
5. Poster with a v-shaped sinus; suboral avicularium . . . . *Lacerna*  
   Poster straight, without sinus; suboral avicularium . . *Hippothyris*
6. Avicularium small, median, suboral; poster transverse . *Aimulosia*  
   No median suboral avicularium . . . . . 7
7. Poster broadly transverse and without a sinus . . . . . 8  
   Poster deep, rounded, or with a median sinus . . . . . 9
8. Zoecia erect and cumulate . . . . . *Hippoporidra*  
   Zoecia procumbent; avicularium suboral,  
     asymmetrical . . . . . *Hippoporella*
9. Poster with a rounded or v-shaped sinus . . . . . *Stephanosella*  
   Poster deep and rounded, no sinus; few areolar pores . . 10
10. Zoarium broadly encrusting; frontal porcellanous . *Hippoporina*  
   Zoarium uniserial or erect and branching . . . . *Gemelliporina*

Genus **HIPPOPORINA** Neviani, 1895

The aperture is unusually elongate, due to the form and size of the area proximal to the large cardelles; the operculum has the form of the aperture, constricted by the cardelles, is well chitinized and bears a bordering sclerite to which the opercular muscles are attached; a vestibular arch is present; the frontal is a thick olocyst which bears a few areolar pores; avicularia are usually present and oral spines may occur. The ovicell is hyperstomial and is closed by a special membrane.

KEY TO THE SPECIES OF *Hippoporina*

1. Zoecia large, more than 1 row of areolar pores, poster a broad deep arc . . . . . *ampla*  
     Zoecia of moderate size, few areolar pores in 1 row . . . . . 2
2. Poster a broad deep arc, conical tubercles at the sides of the aperture . . . . . *tuberculata*  
     Poster deep and narrow . . . . . 3
3. Poster rounded, frontal surface smooth or slightly granular . . . . . *porcellana*  
     Poster semicircular, front roughened, cardelles usually bifid . . . . . *contracta*

**Hippoporina porcellana** (Busk), 1860

Plate 41, figs. 1-3

*Lepralia porcellana* Busk, 1860:284.*Lepralia cleidostoma* Smitt, 1873:62.*Lepralia cleidostoma*, Waters, 1899:10.*Lepralia porcellana*, Norman, 1909:305.*Hippoporina cleidostoma*, Canu and Bassler, 1928:104.*Hippoporina porcellana*, Hastings, 1930:721.*Hippoporina cleidostoma*, Canu and Bassler, 1930:18.*Hippoporina porcellana*, Marcus, 1937:96.*Hippoporina porcellana*, Osburn, 1940:428.

The zoarium is encrusting, usually on shells, white and glistening. The younger zoecia are distinct, rhombic in form and a little inflated, but with age the thick crust becomes nearly flat and obliterates the outlines. The frontal is a thick olocyst with only a few areolar pores, smooth but with complete calcification, it is decorated with low, rounded granules. The primary aperture is round to the long cardelles, which are directed

slightly backward, and proximal to these is a deep and broad sinus or poster, the whole aperture having a "key-hole" form. There is a well developed vestibular arch which is sometimes faintly beaded. The peristome is low, in older zoecia submerged below the level of the surrounding frontal crust. The operculum has the form of the aperture, with a complete sclerite extending around from one cardelle to the other at a distance from the border. Pointed avicularia are present, usually on one or both sides opposite the aperture, but often wanting. Dietellae.

The ovicell is hyperstomial, imperforate, not closed by the operculum; prominent when young, with longitudinal striae; later with a semi-circular area above the orifice, but the whole ovicell becomes embedded in the thick frontal wall of the distal zoecium and completely buried within it when calcification is complete.

There is much variation in the size of the zoecia, those near the center of the zoarium being much smaller than the outer ones. Typically the avicularia are located near one or both sides of the aperture and directed forward and laterally, but they may have any position on the frontal and be turned in any direction, all on the same colony. Descriptions and illustrations of this species do not indicate any areolar pores, but calcined specimens always show a few. In complete calcification there is often a small rounded umbonate swelling near the aperture. The synonymy of *cleidostomata* Smitt with *porcellana* Busk has been disputed, but Norman (1909:305) examined Busk's type in the British Museum and states that "it proves to be a somewhat overgrown specimen of Smitt's *L. cleidostomata*." After observing the wide variation in the supposed diagnostic characters of numerous Atlantic and Pacific specimens I am unable to separate them.

It is a warm water species, recorded from the Mediterranean Sea and the Madeira Islands; on the Atlantic coast from Florida to Santos Bay, Brazil; and on the Pacific coast from the Galapagos Islands and Peru northward to southern California.

Hancock Stations. An abundant species, occurring at 66 stations. The most southerly record is for Callao, Peru, and the northerly for Santa Cruz Island off southern California; coastwise it was taken also in Ecuador, Panama, Costa Rica and Mexico at various places, and off shore at the Galapagos, Socorro and Clarion Islands.

**Hippoporina tuberculata** new species

Plate 43, fig. 10

Zoarium encrusting on a shell. Zooecia small, 0.40 to 0.45 mm long by 0.25 to 0.35 mm wide, moderately distinct, ovate and arranged in quincunx; the frontal is a granulated pleurocyst, little inflated, with a few small inconspicuous areolar pores. The aperture is elongate, about 0.12 mm long by 0.09 mm wide, the anter somewhat pyriform, the cardelles very strong, pointed and directed backward, the poster broadly arcuate and varying in width; the operculum has the form of the aperture, well chitinized with a narrow sclerite paralleling the border. The peristome is low, thin, smooth, without spines and is not covered by the surrounding frontal wall. Small frontal avicularia are rare. The most unusual feature for this genus is the presence of low conical tubercles, one of these usually occupies the position of a median suboral umbo, one to three on each side of the aperture and one or more on the frontal. Dietellae are present.

Ovicells are wanting on our small specimen.

It is similar in most respects to *H. porcellana*, but the measurements are all smaller, the poster wider and shallower, and the conical tubercles give the frontal a very different appearance.

Type, AHF no. 68.

Type locality, Hancock Station 438, Chatham Island, Galapagos, 0°46'10"S, 89°30'10"W, at 35 to 40 fms. One small colony.

**Hippoporina contracta** (Waters), 1899

Plate 41, figs. 4-5

*Lepralia contracta* Waters, 1899:11.

*Lepralia serrata* Osburn, 1912:242.

*Lepralia contracta*, Norman, 1909:306.

*Lepralia contracta serrata*, Osburn, 1914:211.

*Perigastrella contracta*, Canu and Bassler, 1920:576; 1929:403.

*Perigastrella contracta*, Hastings, 1930:722.

*Perigastrella contracta*, Marcus, 1937:98.

*Hippoporina contracta*, Osburn, 1940:428; 1947:33.

Zoarium encrusting, often multilamellate, sometimes rising into ridges or frills. The zooecia are ovate or hexagonal, distinct when young but later immersed in a common crust. The front is a granular olocyst (? pleurocyst), thick, vitreous, with irregular tuberosities and marginal areolae. The aperture is somewhat elongate, rounded distal to the strong cardelles which are often more or less bifid; proximal to the cardelles

is a moderately broad and deep sinus or poster, semicircular in form. The vestibular arch is well developed and beaded. The primary peristome is low and smooth, but the frontal forms a secondary peristome which is irregularly thickened and often mucronate or umbonate on the proximal border in full calcification; 4 to 6 oral spines are usually present. Avicularia are numerous and various, ovate to spatulate or pointed in form, oral or frontal, immersed or mounted on mamillate processes, the aperture beaded like the oral margin. Dietellae are present.

The oecia at first are prominent, embedded only in full calcification; with a large semicircular and lightly striated area above the orifice which is not covered by the secondary calcification; the wall eventually becomes very thick and irregular.

In secondary calcification this species varies greatly, but the primary characters are quite constant, except for the form and position of the avicularia. The zooecia near the middle of the colony are much smaller than the later ones, graduated from about 0.30 to 0.60 mm in length, and the ovicell also varies from 0.15 to 0.18 mm in width.

The reasons for transferring this species to the genus *Hippoporina* have been given by Osburn (1940:429), the nature of the frontal, the form of the aperture, the structure of the operculum, the arrangement of the avicularia, and the nature of the ovicell.

The species was described from Madeira. It is an abundant form on the Atlantic coast from Cape Cod, Massachusetts to the Bay of Santos, Brazil. Recorded also on the Pacific coast from Gorgona, Colombia, and from the Galapagos Islands by Hastings.

Hancock Stations: Taken at 62 stations from Ecuador to the Gulf of California, abundant about the Galapagos Islands and Clarion Island.

### *Hippoporina ampla* new species

Plate 41, figs. 6-8

The zoarium is encrusting on shells and corallines, white and glistening. The zooecia are large, 0.90 mm long (0.70 to 1.10) by 0.80 mm wide (0.65 to 0.95), very distinct with deep grooves even in complete calcification, somewhat hexagonal in form. The frontal is a granular pleurocyst with 2 or 3 rows of pores and a large central imperforate area; in advanced calcification some of the granules on the proximal area become elevated into short, erect, pointed processes. The aperture is more or less removed from the distal border, pyriform, with sharp cardelles directed backward, and proximal to these is a moderately broad poster; 0.18 to 0.20 mm long by about 0.16 mm wide, the poster 0.10

to 0.13 mm wide; vestibular arch present; peristome low with about 8 oral spines; only in very advanced calcification does the frontal wall fuse with the peristome. The operculum has the form of the aperture, yellow and well chitinized, with a broad curved sclerite extending forward. The avicularia are comparatively minute, one on either side and distant from the aperture, pointed and directed laterally, and another pair of similar size and form about halfway back on the frontal, well separated and directed proximally.

The ovicell is correspondingly large, about 0.45 mm wide and long, hemispherical, hyperstomial and not closed by the operculum, the texture of the very thick wall similar to that of the zooecial front.

This species is a veritable giant among the others of the genus. As a rule in this genus there is only one row of areolar pores, but the nature of the aperture, operculum and ovicell appear to ally this species with *Hippoporina*.

Type, AHF no. 69.

Type locality, Hancock Station 438, Chatham Island, Galapagos, no additional data. Also at Stations 442, James Bay, James Island; 471, one-half mile north of Black Beach, Charles Island; 452, Post Office Bay, Charles Island; and 171-34, off Stephens Bay, Chatham Island, all from the Galapagos at 18 to 65 fms.

### Genus **HIPPOPORELLA** Canu, 1917

*Hippoponella* Canu and Bassler, 1920:379, is a pure synonym.

The frontal is a thick, vitreous, granulated pleurocyst with a row of areolar pores. The aperture is broad proximally, slightly arcuate on the proximal border and approximately as wide as the anter; the cardelles strong and set well back; the vestibular arch usually delicately beaded. Peristome low and thin with 2 to 4 small spines. Dietellae present. Ovicell hyperstomial, not closed by the operculum, hemispherical, imperforate, often becoming completely immersed. Genotype, *Lepralia hippopus* Smitt, 1867.

This genus, which resembles *Hippoporina* in many respects, is easily differentiated by the form of the aperture.

### **Hippoporella gorgonensis** Hastings, 1930

Plate 45, figs. 10-12

*Hippoporella gorgonensis* Hastings, 1930:723.

The zoarium encrusts shells, etc., multilaminar and rough with mamillate or knob-like processes. Zooecia moderate in size, the young marginal ones 0.40 to 0.50 mm long by 0.25 to 0.40 mm wide, inflated



and the distal end somewhat elevated, arranged in quincunx; in the secondary layers the zooecia are partially erected and turned in every direction. The frontal is a pleurocyst with a row of areolar pores (often difficult to see and occasionally there are a few additional pores), smooth or granulated in the young but becoming exceedingly irregular with ridges and high tubercles. Normally there is a pointed umbonate process proximal to the aperture and one on each side (sometimes spine-like) and often there are others on the frontal. The aperture is lepralioid, rounded in front of the strong cardelles, broadest proximal to the cardelles and broadly arcuate, about 0.12 by 0.12 mm. The vestibular arch is often delicately beaded. The primary peristome is low and thin, with 2 to 4 small spines; with secondary calcification the spines disappear and the peristome is covered by the encroaching frontal wall. As indicated by Hastings, there are two kinds of opercula, one with sinuous sclerites and the other with thick bordering sclerite which is produced downward; muscle attachments are at the distal ends of the sclerites. The avicularia vary exceedingly; often there is a small rounded one asymmetrically situated at the base of the umbo and included in the secondary aperture, the lateral processes may be replaced by small round or pointed avicularia, and frontal avicularia, round or pointed, large or small, may occur on the frontal.

The ovicell is hyperstomial, not closed by the operculum, broader than long (0.18 to 0.20 mm wide), prominent, smooth and imperforate when young but soon covered and embedded by the rough ectocyst and surrounding frontal walls.

The species was described by Hastings from Gorgona, Colombia, and recorded also from Taboga, Jicaron and Coiba Islands, off Panama, and from the Galapagos Islands.

Hancock Stations: recorded from more than 30 stations, all the way from southern California to the Galapagos Islands; Santa Cruz, Santa Rosa and Santa Catalina Islands and off the San Pedro breakwater, southern California; Angel de la Guardia Island, Gulf of California; west coast of Mexico; Socorro Island; Costa Rica; Panama; Colombia; Ecuador; and Wenman, James, Albemarle and Hood Islands, Galapagos. The known geographic range is from about 34°N to a little south of the equator, and the depth range from shore to 82 fms.

**Hippoporella hippopus** (Smitt), 1867

Plate 45, figs. 8-9

*Lepralia hippopus* Smitt, 1867:20.*Lepralia hippopus*, Hincks, 1880:309.*Lepraliella hippopus*, Levinsen, 1916:466.*Hippoponella hippopus*, Osburn, 1933:44.

The zoarium is encrusting on stones and shells, vitreous or white and glistening. The aperture is round anteriorly, nearly straight on the sides, the proximal border only slightly arcuate; 0.15 mm long by 0.12 mm wide; the strong cardelles are set far back and the shallow poster is about as broad as the anter. The vestibular arch smooth or delicately beaded. The operculum fills the aperture, well chitinized and yellow in color, indented on the sides at the position of the cardelles, and with a slightly sinuous sclerite separated from the border. The peristome is low and thin, with 2 to 4 small spines which soon disappear. The avicularia are round or ovate and vary in size, usually small, often one is found situated at one side of the median line and proximal to the aperture; others may apparently occur at any other position on the front.

The ovicell is hyperstomial, not closed by the operculum, hemispherical, imperforate and smooth; it soon becomes more or less completely immersed.

This species has a slightly longer aperture and a smoother frontal than our other species; while the frontal becomes more coarsely granulated and irregular it never seems to develop the heavy tuberosities which are found on *nitescens* and *gorgonensis*. It has been recorded in Arctic waters from Spitsbergen to Greenland and the American Archipelago, and in the North Atlantic south to Great Britain and to Maine on the New England coast.

Point Barrow, Alaska, Arctic Research Laboratory, 6 fms, common, G. E. MacGinitie, collector.

**Hippoporella nitescens** (Hincks), 1884

Plate 45, figs. 4-5

*Lepralia nitescens* Hincks, 1883:450.*Lepralia nitescens*, O'Donoghue, 1923:40.*Hippoporella nitescens*, Hastings, 1930:724.

The zoarium encrusts pebbles, shells, etc. The zoecia are of moderate size, 0.45 to 0.65 mm long by 0.40 to 0.50 mm wide, irregularly ovate, quincuncial, considerably inflated, distinct in younger stages. The frontal is a very thick vitreous or porcellanous pleurocyst, with a marginal row

of areolar pores and occasionally a few additional ones; when young the frontal may be slightly costate around the sides, but this is lost with increasing calcification, and frequently there is a low, rounded umbonate swelling on either side of the aperture. There is a thin shining ectocyst. The aperture is longer than broad, varying but averaging about 0.15 mm long by 0.13 mm wide, the sides nearly straight, the cardelles set far back, the poster very broad and shallow, the proximal margin nearly straight. The operculum fills the aperture, well chitinized and a sinuous sclerite runs forward from the cardelle on either side. The vestibular arch is delicately beaded. The peristome is low and thin, sometimes with 2 to 4 small spines which are lost very early, and the thick frontal submerges both aperture and peristome at the bottom of a deep tube. Proximal to the aperture and a little to one side is a small avicularium (often wanting) with a semicircular mandible which is directed laterally; the chamber of the avicularium appears like an asymmetrical umbo and, with the thickening of the frontal it is often submerged to open into the secondary aperture. Similar small avicularia frequently appear elsewhere on the front. Dietellae are present.

The ovicell has not hitherto been noticed. It is high, globular, imperforate and smooth but soon becomes covered by the pleurocyst of the adjoining zooecia; 0.26 mm wide.

The species was described by Hincks from Houston Stewart Channel and Cumshewa, later listed by O'Donoghue from Northumberland Channel, British Columbia.

Not taken in the Hancock dredgings, but collected at Middle Bank, Puget Sound, by Dr. John L. Mohr, several colonies.

### *Hippoporella rimata* new species

Plate 45, figs. 6-7

Zoarium encrusting, white and shining. Zooecia small, 0.30 to 0.45 mm long by 0.25 to 0.30 mm wide, irregularly hexagonal; frontal thick, porcellanous, shining and with numerous comparatively large granules which are conspicuous even in the young. The aperture measures about 0.09 mm wide by 0.08 mm long, the anter rounded back to the prominent cardelles, behind which a very shallow poster extends the full width of the aperture with its proximal border straight or very slightly arched; the vestibular arch is delicately beaded. The operculum is well chitinized, yellowish, with the sinuate sclerites separated from the border. The peristome rises but little above the thick front, its rim provided with 4 or 5 short spines; notched on the proximal border to produce a

shallow secondary sinus. A suboral or labial avicularium is situated transversely above the aperture, a little to one side, the long-triangular mandible directed laterally; no other avicularia have been observed. Multilaminar colonies are nodular and the zooecia oriented in every direction.

The ovicell is hyperstomial, prominent when young but becoming more or less embedded, imperforate; a striking feature is the large rima or fissure which extends nearly to the distal end of the ovicell and apparently never becomes closed.

The small size and especially the widely cleft ovicell distinguish the species from any of its congeners.

Type, AHF no. 70.

Type locality, Hancock Station 155-34, Albemarle Island, Galapagos,  $0^{\circ}16'45''S$ ,  $91^{\circ}22'52''W$ , 50 to 60 fms. Also at Station 170-34, Stephens Bay, Chatham Island, Galapagos, 32 fms; 210-34, Santa Elena Bay, Ecuador, near shore; and collected by Capt. Fred E. Lewis at Acapulco, Mexico, 15 fms.

### Genus AIMULOSIA Jullien, 1888

The frontal is a thick porcellanous pleurocyst with small areolar pores. The aperture is somewhat bell-shaped, widest at the proximal end; the poster extends the full width back of the cardelles, its border gently arcuate. The ovicell is hyperstomial, imperforate, not closed by the operculum, the orifice large, not much embedded. Avicularia, typically median and suboral, but sometimes wanting in this position; lateral-oral and frontal avicularia also often present. Oral spines and dietellae present. Genotype, *Aimulosia australis* Jullien, 1888:59.

#### *Aimulosia uvulifera* (Osburn), 1914

Plate 45, figs. 16-17

*Lepralia uvulifera*, Osburn, 1914:210; 1940:427.

*Aimulosia uvulifera*, Osborn, 1947:35.

Zoarium encrusting, forming small white areas on shell fragments and corallines. The zooecia are small, about 0.25 to 30 mm long by 0.20 mm wide, distinct only when young; the frontal a thick porcellanous pleurocyst, highly arched and bearing a few areolar pores which are difficult to observe except in calcined specimens. The frontal rises into a high broad umbo which overhangs the aperture and often is trifid at the tip; frequently there is a much smaller pointed erect process on either side of the aperture, proximal to the oral spines. The aperture

is slightly longer than wide, about 0.10 by 0.08 mm, rounded distally, nearly straight on the sides and broadly arcuate on the proximal border (often nearly straight), the small cardelles set far back. The operculum has the form of the aperture, well chitinized, with a narrow sinuate sclerite running forward from the hinge inside from the border. The primary peristome is low and smooth and bears 6 slender spines which soon disappear; the frontal wall usually obscures the peristome. A minute pointed oral avicularium is sometimes present beneath the overhanging umbo; small frontal avicularia with a triangular mandible are scattered over the frontal area proximal to the aperture.

The ovicell is hyperstomial, not closed by the operculum, prominent, broader than long and heavily calcified like the frontal; the orifice is comparatively wide and its upper edge is directed downward into a broad rounded labiate projection.

Described from the Tortugas Islands, Florida, and later reported by Osburn from Porto Rico and the southern Caribbean Sea.

Hancock Stations: 299, San Jose del Cabo, at the tip of the Lower California peninsula; 129-34, Braithwaite Bay, Socorro Island, west of Mexico; 116-33, Cocos Bay, 253-34, Port Culebra, and 328, Chatham Bay, Cocos Island, Costa Rica; 210-34, Santa Elena Bay, Ecuador; 173-34, South Seymour Island, Galapagos.

### *Aimulosia palliolata* (Canu and Bassler), 1928

Plate 42, figs. 9-11

*Lepralia palliolata* Canu and Bassler, 1928:109.

Zoaria small, white, encrusting shell fragments. The zoecia are distinct with deep separating grooves, ovate to elongate-hexagonal, 0.40 to 0.50 mm long by 0.25 to 0.35 mm wide. The frontal is a thick pleurocyst with one row of areolar pores, the surface smooth or with low irregularities: enclosing sides of the aperture and the suboral avicularium at a little distance is a high fold which is probably homologous with the umbonal process of other species of the genus. The aperture is widest proximal to the cardelles, 0.10 mm long by 0.08 mm wide, the poster shallow and its border slightly concave. The operculum is well chitinized, a narrow sclerite extends straight across it between the cardelles and a very narrow sclerite close to the border bears the muscle attachments. The primary peristome is low and thin and bears 4 to 6 comparatively strong oral spines; the secondary peristome, formed by the frontal pleurocyst, rises into a high flaring wall which surrounds

the aperture and avicularium without obscuring them (rarely only a median umbo is present). The suboral avicularium is small with a triangular or semicircular mandible directed upward.

The ovicell, 0.20 mm wide, is hyperstomial, not closed by the operculum, covered by a thick layer from the distal zoecium which often leaves exposed a small area of the endozoecium.

I believe there can be no error in transferring this species to the genus *Aimulosia*. If the circumoral wall is merely an extension of the sides of the suboral umbo, all of the difficulties in interpretation disappear.

Hitherto known only from the original record by Canu and Bassler, from the Straits of Florida.

Hancock Station 143-34, off Wenman Island, Galapagos, 1°23'10"N, 91°48'45"W, at 100 fms, several colonies (compared with specimens from Florida Straits); and 270, east coast of Angel de la Guardia Island, Gulf of California, 29°31'00"N, 113°27'00"W, at 10 fms. It is probable that the species extends all along the coast from the Gulf of California to the Galapagos Islands, since the colonies are very inconspicuous.

#### Genus **HIPPOPORIDRA** Canu and Bassler, 1927

*Hippotrema* Canu and Bassler, 1927:9.

"The ovicell is hyperstomial and bears a frontal area. The zoecia are accumulated; the frontal is surrounded by areolar pores and often bears small avicularia. The aperture is formed of an anter and a poster separated by two cardelles. The large interzoecial avicularia are acuminate," Canu and Bassler, 1927:8. Genotype, *Cellepora edax* Busk, 1859.

The frontal is a thick costulate pleurocyst with one or more rows of areolar pores. In the genotype, *H. edax*, there is usually a single row, but in *H. calcarea*, *H. janthina* and *H. spiculifera* there are some additional pores. The appearance of the last two species misled Canu and Bassler into erecting another genus, *Hippotrema*, on the supposition that the frontal is a tremocyst. The study of younger zoecia, however, reveals the fact that in all of the above species the formation of the frontal is identical, the pleurocyst arising from the margin and developing centrally; when additional pores are present the openings of these are carried upward on the front and give the appearance of a tremocyst. In all other characters *Hippotrema* is similar to *Hippoporidra* and should be suppressed.

**Hippoporidra janthina** (Smitt), 1873

Plate 45, figs. 13-15

*Lepralia janthina* Smitt, 1873:63.*Lepralia janthina*, Osburn, 1914:213.*Hippotrema janthina*, Canu and Bassler, 1928:141.*Hippotrema janthina*, Osburn, 1940:454; 1947:43.

The zoarium usually encrusts gastropod shells, rising into rough prominences and subcylindrical branches, the ectocyst varying in color from white in the young to the deep violet color which is suggested in the name of the species. The zooecia are small, 0.30 to 0.40 mm long in the procumbent marginal ones. The frontal is a thick pleurocyst with large areolar pores and usually with a second row of pores; the pleurocyst arises as a series of costal ridges between the areolar pores and spreads upward to the aperture, carrying the openings of the pores upward at the same time, which often gives the frontal the appearance of a tremocyst; the ridges unite proximal to the aperture to form an irregular umbonate process. The aperture is a little elongate, about 0.11 by 0.09 mm, the anter rounded back to the strong cardelles between which the poster extends in a broad arch; the row of areolar pores extends around the distal end of the aperture. The primary peristome is low, thin and smooth, without spines; in advanced calcification the frontal may cover the primary peristome with a rough, slightly raised wall on which pointed tubercles are occasionally present. The operculum has the form of the aperture, indented on each side at the level of the cardelles, well chitinized and yellowish in color. Small pointed avicularia, much elevated, are usually present on the front, and rarely there are larger interzooecial avicularia with a longer mandible.

The ovicells are prominent at first, not closed by the operculum, with a rounded frontal area which may become covered by secondary calcification.

The species is common in the Gulf of Mexico, where it was described by Smitt and where it has been recorded by Osburn and by Canu and Bassler. It has not hitherto been noted on the Pacific coast.

Hancock Stations: 1071-40, San Felipe Bay; 1078-40, Tepoca Bay; 283, San Pedro Nolasco Island; and one colony (without other data) from Conception Bay, all from the Gulf of California between 26° and 31° N. Lat., at 2 to 60 fms; also 2196, at Cabeza Ballena, near the extreme tip of the peninsula of Lower California, 30 fms.

**Hippoporidra spiculifera** (Canu and Bassler), 1930

Plate 55, figs. 8-10

*Hippotrema spiculifera* Canu and Bassler, 1930:43.

Zoarium encrusting and nodulous or erect with stout short branches. The zooecia are cumulate, not oriented except at the margins of encrusting colonies, more or less erected, little distinct, small, 0.25 to 0.40 mm long by 0.25 to 0.35 mm wide. The frontal area is ovate to hexagonal, thick and porcellanous, rising slightly to the aperture which, in the secondary layers often is nearly central; one or two rows of areolar pores. The aperture is slightly elongate, 0.12 mm long by 0.10 mm wide, straight on the sides, the small cardelles set far back and the poster broadly arched the full width of the aperture. The operculum has the form of the aperture, notched on the sides at the cardelles, well chitinized and yellow in color, with a narrow sclerite paralleling the margin.

The full development this species presents an extravagant display of oral spines and spiny frontal processes. The peristome bears six tall slender spines, sometimes nearly as long as the zooecium. In the position of a central umbo is a tall pointed spinous process which is finely granulated to its tip, around the sides of the aperture and sometimes elsewhere on the frontal are other similar sharp-pointed tall processes, and even on the top of the ovicell there may be one or two; occasionally these processes are bifurcated near the tip.

Small sharp-pointed avicularia are frontal in position and turned in every direction.

The ovicell is hyperstomial, prominent and smooth when young with a rounded area above the orifice, but later the whole wall becomes very thick and often bears a tall spine on the top.

The species was described from Albatross Station 2813, Galapagos Islands at 40 fms.

Hancock Stations, 137-34, Clarion Island, 18°19'05"N, 114°45'25"W, at 57 fms; and 1078-40, and Tepoca Bay, Sonora Mexico, 30°14'57"N, 112°52'27"W, at 12 fms. Also in the Galtsoff collection from the Gulf of Panama, on pearl oyster shells. Also Barra Navidad, Jalisco, Mexico, low tide, Dr. Yale Dawson, collector.



**Hippoporidra granulosa** Canu and Bassler, 1929

Plate 42, figs. 12-14

Zoarium encrusting shells. Zoecia of the primary layer recumbent and oriented, those of the secondary layers more or less erect and irregular, the surface roughened. The frontal is imperforate except for a row of areolar pores, with rarely a few others; these pores are not carried up around the base of the peristome in secondary calcification. The frontal is coarsely granular even in the young stage and becomes excessively thick, as thick as the cavity beneath it, the areolar pores outlining the margin. The peristome is somewhat elevated in young zoecia and bears six small spines which soon disappear, and the thickening of the frontal soon obscures all evidence of the primary peristome. The secondary aperture is oval and somewhat expanded. The primary aperture is elongate, 0.14 by 0.10 mm, with strong cardelles, proximal to which the semicircular sinus measures about 0.07 mm across. The operculum is deeply incised on the sides at the point of attachment and bears a strongly sinuated sclerite on each side well removed from the margin. There are small frontal avicularia which appear to have no special relation to the aperture.

The ovicells are small, opening well above the primary aperture and apparently have a small rounded frontal area, but in our specimen they are so deeply embedded in the thick crust that details cannot be determined.

The species was described by Canu and Bassler from the Galapagos Islands, Albatross Sta. D.2813.

Hancock Stations: 1049-40, Angel de la Guardia Island, Gulf of California, 29°32'47"N, 113°34'35"W, 54 fms, one colony, and 438, Chatham Island, Galapagos, 32 fms, one colony.

Genus **GEMELLIPORINA** Bassler, 1936

"Proposed for species with keyhole-like aperture, hyperstomial ovicell and tremocystal frontal, with *Gemellipora glabra* Smitt, 1873, a common species in the Gulf of Mexico, as the type" (Bassler, 1936:161).

The frontal is not a tremocyst, however, as young zoecia at the growing edge definitely show the development of a pleurocyst with one or two rows of areolar pores. On the very thick front of older zoecia these pores are more or less dispersed, giving an appearance somewhat like a tremocyst. The genotype has an erect zoarium with dichotomous

cylindrical branches; zooecia indistinct except at the growing edge; frontal wall very thick with tubular pores; distal part of zooecium raised, with stout oral spines; ovicell globular but soon covered by the distal pleurocyst except for a median cicatrix.

**Gemelliporina monilia** new species

Plate 41, fig. 13

Zoarium uniserial, encrusting on the rough surface of a small pebble, sparsely branched dichotomously. Zooecia small, 0.35 to 0.40 mm long by 0.25 mm wide, the base sometimes expanded to 0.30 mm; the proximal end only slightly narrowed. The frontal is a pleurocyst with small areolar pores; ventricose and the sides sloping downward to the dorsal side which is more or less expanded for attachment. Proximal to the aperture is a high arcuate umbonate process of varying size, sometimes not wider than the aperture, sometimes forming a high border around the sides of the aperture at a little distance from the peristome. The aperture is elongate, key-hole shaped, almost exactly like that of *G. glabra* (Smitt) the genotype; 0.13 mm long by 0.08 mm wide, the anter ellipsoid and the poster much smaller, resembling a deep sinus. The resemblance to *glabra* is further enhanced by the presence of six oral spines. The peristome is low and thin and is not encroached on by the thickening of the frontal. The operculum has the form of the aperture, moderately chitinized, with a narrow sclerite extending forward from the point of attachment somewhat within the border. The spines are peculiar in that there is a regular gradation in size, the proximal one on each side being tall and strong, the next one only about half as large and the third quite diminutive.

The primary oecium is globular, hyperstomial, smooth, imperforate and not closed by the operculum; secondarily a thick fold of the frontal of the distal zooecium partly covers it.

The specimen is very small, with only 12 zooecia, three of which are ovicelled. The ancestrula is similar to the later zooecia except that it is much smaller; it gives off a string of zooecia from each end, one of which shows the base of a branch.

Type, AHF no. 71.

Type locality, Hancock Station 270, Angel de la Guardia Island, Gulf of California, 29°29'00"N, 113°27'00"W, 14 fms.

Genus **GEMELLIPORELLA** Canu and Bassler, 1920

The ovicell is perforated, hyperstomial, and not closed by the operculum. The form of the aperture is like a keyhole. The frontal is a granular pleurocyst, with areolar pores. Avicularia are present near the aperture. Genotype, *Gemelliporella vorax* Canu and Bassler, 1923:111.

This genus is much like *Hippoporina* in the form of the aperture and the nature of the frontal, but it has a finely perforated ovicell.

**Gemelliporella globulifera** new species

Plate 41, figs. 9-12

The zoarium is encrusting, usually on shells, white or pale yellow. Zoecia moderately small, 0.30 to 0.40, rarely as much as 0.50 mm long, by 0.25 to 0.35 mm wide (occasionally wider when the avicularium is large); inflated and distinct when young. The frontal is a thick, evenly granulated olocyst (? pleurocyst), with a very few areolar pores. The aperture is elongate, 0.13 to 0.16 mm long by 0.10 to 0.12 mm wide, the anter somewhat pyriform, the cardelles sharp and directed backward, the poster semicircular and one-half to two-thirds as wide as the anter; the peristome low and thin, not covered by the bordering frontal. The operculum has the form of the aperture, yellowish and well chitinized, with a thickened marginal sclerite. The avicularia are situated at the side of the aperture, frequently paired, the mandible semicircular to short-spatulate, rarely long-spatulate, varying much in size, the larger ones distorting the form of the zoecium, the chamber little elevated.

The ovicell is unusually prominent, globular, 0.18 to 0.22 mm in width, perforated by numerous small pores; not closed by the operculum.

The species appears to be much like *Hippoporina fallax* Canu and Bassler (1930:320) from the Philippines, which may possibly belong to this genus, but the poster of the aperture is larger, the operculum lacks the inner sclerite, the ovicell is coarsely granulated instead of smooth, and the avicularia different.

Type, AHF no. 72.

Type locality, Hancock Station 1303-41, one-half mile N of Platt Point, Santa Cruz Island, southern California, 34°03'50"N, 119°45'25"W, 36 fms, several colonies. Also taken at Station 1251-41, the San Benito Islands, Lower California, 28°12'35"N, 115°34'35"W, at 79 fms; off the San Pedro Breakwater at 20 fms, and Cortez Bank on the Mexican Border at 32 fms. Also from the Pleistocene of Newport Harbor, California, G. P. Kanakoff, collector.

**Gemelliporella aviculifera** new species

Plate 55, fig. 13

The zoarium is encrusting on small shell fragments and stems, the colonies all small. Zooecia small, 0.35 to 0.40 mm long by 0.30 to 0.35 mm wide, often somewhat accumulated, distinct when young. The frontal is a granulated pleurocyst with a few areolar pores which are difficult to observe except when calcined. The aperture is elongate, about 0.11 mm long by 0.09 mm wide, the poster noticeably wider than in *G. globulifera*, and the condyles less prominent. The operculum has the form of the aperture, slightly notched at the position of the cardelles, well chitinized with a bordering sclerite and yellow in color, the muscle attachments at the border. The peristome is low, thin and smooth, usually not obscured by the encroachment of the frontal.

The most striking feature of the species is the large avicularium the base of which occupies a considerable portion of the frontal. It is situated near the aperture, at one side and proximal; it is much elevated and more or less pedunculate, broader at the top which is extended into a horizontal beak; the mandible long and narrow and strongly decurved, as much as 0.15 to 0.20 mm in length, hinged to a cross-bar. The avicularia are present on every zooecium and give a very rough appearance to the zoarial surface.

The ovicell is globular, very prominent, not closed by the operculum, perforated by numerous small pores, 0.20 mm wide. The ovicells are usually very abundant, and in living specimens the frontal is almost entirely obscured by the large ovicells and avicularia but on dead colonies usually only the bases of these remain.

Type, AHF no. 73.

Type locality, Hancock Station 1245, 1½ mi. southwest of Gull Island, off Santa Cruz Island, southern California, 33°56'00"N, 119°50'55"W, at 48 fms. Also 1294, Santa Cruz Island, and 232, 1050 and 1413-41 off San Miguel Island, southern California; 1250-41, San Benito Islands, Lower California, 28°18'15"N Lat., the most southern record. Depth range 10 to 44 fms.

**Gemelliporella inflata** new species

Plate 43, fig. 11

Zoarium encrusting, white. The zooecia are very distinct with a highly arched frontal and deep separating grooves, 0.55 to 0.70 mm long by 0.40 to 0.50 mm wide, ovate to elongate hexagonal in form and arranged in quincunx. The frontal is a rather thin pleurocyst, minutely

granular, with one row of small areolar pores. The aperture is elongate, 0.16 mm long by 0.12 or 0.13 mm wide, pyriform, the anter rounded back to the strong cardelles which are directed somewhat proximally, the poster is semicircular or slightly v-shaped and about two-thirds as wide as the anter. The peristome is thin, slightly elevated on the sides but entirely wanting proximal to the cardelles. Close behind the aperture and at one side is a conspicuous avicularium with a slightly elevated chamber and a long narrow rostrum directed proximally, the mandible (wanting in our specimen) attached by small hinge denticles.

The ancestrula is small in comparison, 0.30 mm long by 0.16 mm wide, but is similar in most other respects to the later zoecia, even to the presence of an avicularium; the aperture differs in the poster which is comparatively broader and shallower.

Ovicells wanting and the chitinous structures missing from our dead specimen.

Some doubt remains as to the generic position, in the absence of the ovicell and operculum, and it may prove to be a *Hippoporina*. The larger size, thinner frontal wall and especially the nature of the avicularium sufficiently distinguish it as a species from any of our species of either *Gemelliporella* or *Hippoporina*.

Type, AHF no. 74.

Type locality, Hancock Station 1050, off San Miguel Island, southern California, at 34 fms, one colony about 1 cm in width.

### Genus **LACERNA** Jullien, 1888

The frontal is a pleurocyst with numerous areolar pores. The aperture is rounded, the proximal border with a deep narrow sinus; a narrow vestibular arch is present. Avicularia near the aperture, suboral or lateral. Peristome complete, with stout oral spines. Ovicell hyperstomial, hemispherical, not closed by the operculum except in the passage of eggs; perforated, the pores varying in size. Genotype, *Lacerna hosteensis* Jullien, 1888:48.

In young zoecia the frontal is a veined olocyst which later is covered by a pleurocyst which may be either smooth or granular. The sinus is always a distinct median notch which varies from square to round and partially enclosed in different species.

**Lacerna fistulata** (O'Donoghue), 1923

Plate 36, figs. 8-11

*Schizoporella fistulata* O'Donoghue, 1923:37.

The zoarium is encrusting, thin, white and glistening. The zooecia vary much in size and form, 0.40 to 0.65 mm long by 0.30 to 0.50 mm wide, often wider than long, irregularly quadrilateral or hexagonal, little inflated, distinct. The frontal is a veined olocyst in the young zooecium but this becomes covered by a comparatively thin pleurocyst which, in complete calcification, is slightly granular. There is a single row of areolar pores, with the addition of 1 or 2 more opposite the peristome. The aperture appears small in comparison with the zooecia, 0.10 mm wide by 0.08 long (not including the sinus); the proximal border nearly straight with a moderately deep and narrow rounded sinus; the vestibular arch is narrow. The operculum is moderately chitinized, with a narrow border and a narrow sclerite which parallels the border at a little distance. The peristome is thin, little elevated, bears about 6 oral spines and is united proximally with the avicularian chamber. The latter is small and narrow, shaped like a truncated cone, much elevated and curved forward above the sinus; the small avicularian mandible is triangular, situated on the distal side of the cone and directed upward; the chamber is bilaterally connected by a minute tube with the inner pores opposite the sinus and does not reach the marginal pores; rarely the chamber is slightly asymmetrical, in which case it is connected with only one of the pores.

The ovicell is hyperstomial, very prominent, the distal end elevated, a little flattened on the frontal surface, perforated with pores of various sizes which are slightly collared; with advancing calcification the pleurocyst of the distal zooecium rises about the sides of the ovicell, covering nearly all of the perforated area and forming a small pointed umbo toward the distal end. The ovicell is longer than broad, 0.25 mm long by 0.22 mm wide, and often extends forward to the avicularian chamber of the distal zooecium.

Described by O'Donoghue from Departure Bay, British Columbia, 15 fms. Our material agrees closely with the description, except that oral avicularian mandible is usually more or less pointed.

Hancock Station 1191, Cortez Bank, 32°25'50"N, 119°07'30"W, at 32 fms. Also dredged at stations 1294-41, off Santa Cruz Island; 1289-41, off Santa Rosa Island, 47 fms; 1064, off Santa Barbara Island, and 1232-41, off the San Pedro Breakwater, southern California, 15 fms. Also found on a sunken buoy off Rocky Point, southern California, at 45 fms (Earl Fox, collector).

Genus **HIPPOTHYRIS**, new genus

The frontal is a pleurocyst with several rows of pores and a comparatively small imperforate central area; aperture with the anter semi-circular and the poster wide and shallow, the proximal border nearly straight, cardelles moderate in size; peristome thin and somewhat elevated, without spines, enclosing on the proximal border a small median avicularium. Ovicell globular, recumbent and not embedded, perforated, not closed by the operculum. Genotype, *Hippothyris emplastra* new species.

**Hippothyris emplastra** new species

Plate 40, figs. 13-14

The zoarium forms a thin encrustation on siliceous sponges. The zooecia are large, 0.80 to 1.20 mm long by 0.65 to 0.90 mm wide, ovate, hexagonal or quadrate in form, very distinct. The frontal is a granulated pleurocyst with several rows of pores and a comparatively small imperforate central area which is delicately reticulate resembling a small breast-plate; the imperforate area is about as wide as the perforated area on each side. The aperture is subquadrangular, the sides parallel, the poster about as wide as the anter and very shallow with the proximal border nearly straight; condyles moderate; broader than long, 0.18 to 0.20 mm wide by 0.14 to 0.16 mm long. The peristome is thin, a little elevated and on the proximal border encloses a small median avicularium with its short-triangular mandible directed vertically. The avicularian chamber is very small and umbonate in form. Spines wanting. Multiporous septulae present.

The ovicell is hyperstomial, globular and prominent, recumbent on the distal zoecium but not embedded, perforated and the rather large pores slightly collared; width about 0.35 mm but appearing small in comparison with the large zooecia.

Type, U. S. Nat. Mus., 11029; paratype AHF no. 75.

Type locality, Albatross Station D.5682, Magdalena Bay, on the west coast of Lower California, at 491 fms. Two colonies encrusting a siliceous sponge.

Genus **HIPPOMENELLA** Canu and Bassler, 1917

"Hippoporininae with a finely perforate hyperstomial ovicell. Orifice with a shallow but wide poster separated from the anter by prominent condyles. Frontal avicularia generally paired forming prominent

chambers on either side of the median line near the orifice, the mandibles directed outward. Other subsidiary avicularia may be present. Frontal wall usually with a central smooth imperforate area, often greatly reduced, surrounded by concentric rows of irregular tube-like pores" (Brown, 1949:517). Genotype *Lepralia mucronelliformis* Waters, 1899.

The description of the genus, as originally drawn by Canu and Bassler, is incorrect in a number of points and was evidently compiled from a number of species, some of which must belong elsewhere. Brown has carefully restudied type material of *mucronelliformis* and found the ovicell, which was overlooked by Waters; it is merely recumbent and not embedded, perforated and is definitely closed by the operculum, perfectly plain without the lunar crescents described by Canu and Bassler.

### *Hippomenella flava* new species

Plate 43, figs. 7-9

Zoarium encrusting, small, yellowish. Zooecia rather regular in arrangement, little inflated, separated by distinct grooves; moderate in size, 0.55 (0.45 to 0.70) mm long by about 0.40 mm wide, but sometimes broader than long. The frontal is a smooth pleurocyst when young and later bears low smooth ridges and bosses but there is no trace of an umbo; a row of moderately large areolar pores (often with 2 rows or even 3 toward the distal end); the inner pores carried upward on the imperforate central area in advanced calcification. The aperture is longer than wide (0.15 by 0.12 mm), rounded distally, nearly straight on the sides, with strong cardelles proximal to which is a wide shallow poster; the poster has a wide shallow sinus (?) of varying form, often wanting. The operculum does not conform to the proximal "sinus" but is nearly transverse on its proximal border; well chitinized, yellow, with a broad sclerite well within from the border. The peristome is thin, smooth, wanting on the proximal border, and bears about 6 slender spines. The avicularia are long-pointed, located at one or both sides of the proximal end of the aperture, or sometimes more proximally, directed outward and backward; the mandible very slender, varying in length from 0.20 to 0.50 mm, with a complete pivot bar.

The ovicell is globose, closed by the operculum, smooth and shining, margined around the base, perforated by numerous small pores; 0.30 mm wide, and the first oral spine on each side is not covered by the ovicell.



Type, AHF no. 76.

Type locality, Hancock Station 1340-41, Tanner Bank, off San Diego, California, 32°41'00"N, 119°06'30"W, at 38 fms. Also at Station 1896-49, Tanner Bank, 22 fms; and 1196, Cortez Bank, 32°35'00"N, 119°11'45"W, at 110 fms.

### Genus **HIPPOMONAVELLA** Bassler, 1934

"The ovicell is hyperstomial. The frontal is a pleurocyst surrounded by a row of areolar pores. The aperture bears two cardelles more or less median. In front of the aperture there is an oral avicularium placed on the median axis of the zooecium. Genotype, *Lepralia praeclara* MacGillivray, 1895." Bassler, 1934:407.

It should be added that the ovicell is closed by the operculum, and that more often than not the avicularium is off center and frequently at the side of the aperture with all intermediate positions represented. The operculum is well chitinized, yellowish in color.

Apparently the genus has not been recognized except as a fossil, but two living species, *Schizoporella longirostrata* Hincks, 1883, and *Hippomonella parvicapitata* Canu and Bassler, 1930, are modern representatives.

### **Hippomonavella longirostrata** (Hincks), 1883

Plate 43, figs. 1-3

*Schizoporella longirostrata* Hincks, 1883:477.

*Schizoporella longirostrata*, Robertson, 1908:291.

*Schizoporella longirostrata*, O'Donoghue, 1923:36.

*Schizomavella longirostrata*, Canu and Bassler, 1923:109.

*Schizomavella longirostrata*, O'Donoghue, 1925:102; 1926:59.

Zoarium encrusting on shells and stems, the thick ectocyst gray or light brown. Zooecia moderate in size, 0.45 to 0.65 mm long by 0.30 to 0.40 mm wide, distinct, slightly inflated, rather regularly arranged in radiating lines. The frontal is a granular pleurocyst with a row of areolar pores and usually with 2 or 3 additional rows; sometimes most of the frontal is perforated, but the central area is always imperforate. The primary aperture (about 0.15 mm in either dimension) is rounded distally, straight on the sides, and the poster extends the full width behind the strong cardelles with a broad shallow sinus; as pointed out in Hincks' original description, there is considerable variation in the form of the poster. The operculum is well chitinized, light brown in

color, with a narrow sinuous sclerite slightly within from the border. The peristome is thin and low, raised only on the sides into low lappets. There are 5 to 7 slender oral spines which are soon lost.

The avicularia are elongate, sharp pointed and quite variable in size and arrangement (length 0.13 to 0.30 mm); typically they are located just proximal to and at one side of the aperture and are directed toward the proximal end of the zoecium; sometimes they are nearly median, again they may be situated at the side of the aperture and directed outward, and rarely they are paired, one on each side of the aperture. All of these variations may be found in the same colony.

The ovicell is prominent, hemispherical or slightly elongate, 0.24 to 0.28 mm wide, perforated and closed by the operculum.

The granular pleurocystal frontal, the nature of the avicularia and their occasional position similar to that in the genotype, the closure of the ovicell and the characters of the aperture and operculum all appear to ally this species to *Hippomonavella*.

Described by Hincks from Virago Sound and Cumshewa Harbor, British Columbia; listed by Robertson from southern California; by O'Donoghue from numerous localities in Puget Sound and British Columbia, and by Canu and Bassler from the Pleistocene of Santa Barbara, California.

Hancock Stations: 18 stations about the islands off southern California; 3 stations off Cedros Island, Lower California, and 2 stations (1045-40 and 1050-40) off Tiburon Island and Angel de la Guardia Island, in the upper part of the Gulf of California. The geographical range appears to be from British Columbia to about 28° N Lat., and the bathymetric range from shallow water to 100 fms.

### *Hippomonavella parvicapitata* (Canu and Bassler), 1930

Plate 43, figs. 4-6

*Hippomenella parvicapitata* Canu and Bassler, 1930:19.

Zoaria encrusting, sometimes multilaminar. The zoecia are of moderate size, 0.55 to 0.70 mm long by 0.40 to 0.50 mm wide, somewhat ventricose and separated by deep grooves, elliptical or long hexagonal. The frontal is a granular pleurocyst, sometimes with a low umbo, surrounded by one or two rows (more rarely 3) of areolar pores. The primary aperture is semielliptical, 0.14 mm wide by 0.16 mm long, often narrowed slightly toward the proximal end, the proximal border broadly arcuate between the small cardelles. The peristome is thin and slightly elevated all around the aperture, with about six small oral

spines which soon disappear. The operculum is well chitinized, yellow, with a broad, lateral sclerite which divides beyond the muscle attachments, one band continuing distally around the margin while a much narrower branch continues at some distance within from the border. The avicularia are long-pointed, often paired and located usually at the sides of the aperture about opposite the cardelles and directed more or less laterally and backward; not infrequently they are single and more proximally located, occasionally median or nearly so and directed backward; the mandible may be as much as 0.30 mm long but usually is much shorter; attached by an incomplete pivot.

The ovicell is hyperstomial, closed by the operculum, hemispherical and prominent, with numerous small pores, somewhat margined around the base.

Described by Canu and Bassler from the Galapagos Islands.

Hancock Stations: 143-34, Wenman Island, Galapagos, 100-150 fms; 239-34, Port Utria, Colombia, shore collection; 431-35, Octavia Rocks, Colombia, 45 fms; and 275, Raza Island, Gulf of California, 28°48'00"N, 113°00'00"W, at 40 fms.

### Genus STEPHANOSELLA Canu and Bassler, 1917

*Buffonellaria* Canu and Bassler, 1927.

"The ovicell is hyperstomial and embedded in the distal zoecia. It opens above the apertura by an especial orifice. The frontal is a smooth olocyst. No spines. The ovicelled zoecia have a large apertura and their avicularium is frontal." (Canu and Bassler, 1917:40). Genotype, *Eschara biaperta* Michelin.

Later (1930:16-17) Canu and Bassler withdrew the genus and referred *biaperta* to *Schizopodrella* because of the "tremocystal" frontal. "Our genus *Stephanosella* has no further reason for existence and should be suppressed." Still later Bassler (1935:207) returned to the use of *Stephanosella*.

The confusion arose when Smitt (1873:46) and Hincks (1880:255) combined with *biaperta* Michelin another species which has a similar ovicell but a tremocystal frontal. Busk (1859:47, ? *Lepralia biaperta*) correctly interpreted the species and Smitt in his earlier work (1867:14) also figured his *Escharella linearis forma biaperta* correctly with areolar pores only. Also Nordgaard (1906:15-16) had the true *biaperta*.

The original description of *Stephanosella*, as given above, needs only a few comments. The frontal is smooth in the young but becomes irregularly roughened with age; the ovicell at first is prominent but becomes covered by the excessively thick frontal wall except for a small sculptured area on the top; the aperture of the ovicelled zooecia differs very little in size from the others.

The genus *Buffonellaria* Canu and Bassler, 1927, presents no fundamental differences and is a pure synonym; the genotype, *Hippothoa divergens* Smitt, is merely a thinner-walled and smoother *Stephanosella*. Dr. Bassler (*in litt.*) agrees to this synonymy.

### *Stephanosella biaperta* (Michelin), 1845

Plate 42, figs. 1-2

*Eschara biaperta* Michelin, 1845:330.

*Lepralia biaperta*, Busk, 1859:47.

*Escharella linearis* forma *biaperta*, Smitt, 1867:14.

*Schizoporella biaperta*, Nordgaard, 1906:15.

Not *Hippothoa biaperta*, Smitt, 1873:46.

*Schizoporella biaperta*, Hincks, 1880:255 (in part).

Not *Schizoporella biaperta*, Osburn, 1912:237.

Not *Stephanelloso* (*sic*) *biaperta*, Canu and Bassler, 1925:30.

*Schizoporella biaperta*, Robertson, 1908:287 (in part).

Not *Stephanosella biaperta*, Canu and Bassler, 1923:99.

Zoarium encrusting, sometimes multilaminar and forming rough colonies. Zooecia moderate in size, 0.55 to 0.70 mm long by 0.35 to 0.50 mm wide, ovate to roughly hexagonal in form, slightly inflated and distinct when young. The frontal is an olocyst, smooth and veined in the young but becoming very thick and somewhat roughened; a row of 4 or 5 areolar pores on each side, difficult to see except when calcined. Aperture a little broader than long, about 0.12 mm long by 0.15 wide, the proximal border with a shallow rounded sinus. The operculum has the form of the aperture, well chitinized, yellowish in color, the border with a narrow sclerite, a small lucida at the points of attachment and the muscle attachments well within from the border (in typical schizoporellid fashion). The peristome is low and thin, without spines. The avicularia are of two kinds, (1) lateral-oral, usually paired on a small elevated chamber at the sides of the aperture, the mandible either rounded or pointed; (2) a larger frontal avicularium, considerably elevated with a pointed mandible, the chamber connected with one of the areolar pores.

The ovicell is rounded and prominent at first but soon becomes deeply embedded in the thick crust of the distal zoecium, imperforate and radiately grooved. The secondary layer is incomplete, leaving a rounded area on the top which appears to have a peripheral row of pores, but the "pores" are merely the bottoms of the grooves at the edge of the covering layer. Width of ovicell about 0.26 mm.

This species has evidently been confused with another of a different genus (see *Schizoporella cornuta*) which has the same type of ovicell and oral avicularia but in which the frontal is a tremocyst with numerous frontal pores.

Described by Michelin and later recorded by Busk as a fossil. Known as a recent species from Spitsbergen to Greenland and south to the British Isles. Reported by Robertson from Alaska and by Hincks and by O'Donoghue from various localities in British Columbia, but these records are doubtful. That of Robertson from Alaska may be correct, but Hincks states that "The surface of the younger cells is thickly covered with minute punctures," which is not a character of *Stephanosella*.

Not taken in the Hancock dredging but collected by MacGinitie at Point Barrow, Alaska, (Arctic Research Laboratory). It appears to be a circumpolar and northern species.

### ***Stephanosella vitrea* new species**

Plate 42, figs. 6-8

Zoarium small, encrusting, especially on stems, worm tubes, etc., vitreous or porcellanous, the surface often rough. Zoecia small, 0.30 to 0.45 mm long by 0.25 to 0.35 mm wide, distinct only when very young. The frontal is a smooth vitreous olocyst which later becomes very thick and irregular, except for a small area around the aperture; a few small areolar pores and occasionally a few additional ones irregularly situated; with the thickening of the olocyst the pores are sometimes carried up on the front. The aperture, always clearly visible even in highly calcified specimens, varies slightly in dimensions but averages about 0.10 mm wide by 0.11 mm long, nearly round back to the cardelles, proximal to which is a v-shaped sinus; the sinus also varies somewhat, occasionally almost slit-like. The peristome is low, smooth, without spines, and is not involved in the secondary thickening of the front. The operculum has the form of the aperture, moderately chitinized with a narrow, thickened border, the muscle attachments distant from the margin. There is a pair of small oral avicularia with a pointed (some-

times rounded) mandible opposite the sinus or a little proximal to it; these usually lie at the bottom of the circumoral depression, but may be more or less fused with the thick frontal. A larger avicularium occupies much of the frontal surface, its chamber elevated, the mandible variously directed and with a strong hinge bar.

The ovicell is about 0.18 mm wide, globular, not closed by the operculum, imperforate, very prominent at first but later immersed more or less in the thick frontal of the distal zoecium which leaves in view only a radiately grooved rounded area on the top.

This species resembles a miniature *S. biaperta*, but is much smaller in all measurements, the sinus narrower and more definitely v-shaped and the anter less transverse.

Type, AHF no. 77.

Type locality, Hancock Station 1388-41, off East Point of Santa Rosa Island, southern California, 33°54'30"N, 119°54'28"W, at 54 fms. Also at stations 1387-41, off Santa Rosa Island, 52 fms; 1067, N.E. of Santa Barbara Island, 83 fms, southern California; 1241 and 2160, S. of San Benito Islands, W. of Lower California, 44 fms; 2131, N. of Isla Partida, Gulf of California, 75 fms, and 438, Chatham Island, Galapagos. Other specimens in collection are from Banderas Bay, W. Mexico (about 21°30'N), and from Middle Bank, Puget Sound, Washington (about 48°30'N), Dr. J. L. Mohr, collector. The Pleistocene of Santa Barbara, California, also yielded a number of specimens, collected by Mr. J. D. Soule.

### *Stephanosella bolini* new species

Plate 42, figs. 3-5

Zoarium encrusting the rough surfaces of pebbles, white and porcellanous. Zooecia large, 0.70 to 0.90 mm long to 0.50 to 0.65 mm wide, very irregular in size, form and orientation; distinct in younger stages, little inflated. The frontal is a very thick olocyst with large areolar pores and a varying number of smaller ones irregularly distributed over the proximal part of the front; the appearance is sometimes very much like a tremocyst but there is no secondary frontal layer and the pores are always absent from an area proximal to the aperture. The surface is more or less irregular in older zoecia but there are no umbonate processes.

The aperture is rounded back to the cardelles, and proximal to these has a shallow, broad, u-shaped sinus; about 0.17 mm in either dimension; the peristome is low and smooth, without spines and is usually obscured

by the secondary peristome which forms a low, broad, smooth wall. The operculum is yellowish in color, with a complete narrow bordering sclerite and the muscle attachments situated well within from the border.

Usually there are two pairs of lateral-oral avicularia; one pair very small, situated about opposite the middle of the aperture, a little elevated, close to the aperture and involved in the secondary peristome; a larger pair situated about opposite the sinus, farther removed from the aperture and embedded in the frontal wall; the mandibles of the smaller ones are directed backward, those of the larger ones laterally. Occasionally there are one or more additional avicularia, similar to the larger oral ones, situated along the zooecial margin.

The ovicell is very prominent, hyperstomial, not closed by the operculum, the surface radiately grooved, and collared around the base, its width about 0.30 mm.

The species is dedicated to Dr. Rolf L. Bolin of the Hopkins Marine Station, Pacific Grove, California, who has contributed much fine material for the present monograph.

Type, AHF no. 78.

Type locality, off Point Sur, California,  $36^{\circ}20'45''\text{N}$ ,  $121^{\circ}06'15''\text{W}$ , at 208 fms, Bolin and Budd, collectors, several colonies. Also at Hancock Station 1387-41, east of Santa Rosa Island, southern California,  $33^{\circ}54'05''\text{N}$ ,  $119^{\circ}54'10''\text{W}$ , at 52 fms.

Family **Exochellidae** new family

The frontal is a pleurocyst with radiating costae and a series of areolar pores; the aperture slants downward and forward and has no proximal sinus (rimule) and no cardelles; the well-chitinized operculum bears a bordering sclerite for attachment of the opercular muscles; avicularia are usually well developed, frequently paired opposite the aperture, and oral spines are well developed and sometimes jointed.

Genus **ESCHAROIDES** Milne-Edwards, 1836

*Peristomella* Levinsen, 1902.

The aperture is oblique, without lyrula, cardelles or rimule. Ovicell hyperstomial, embedded, opening above the primary aperture. The frontal is a pleurocyst, with areolar pores. A small mucro usually projects into the secondary aperture from the proximal lip of the peristome. Avicularia are usually paired at the sides of the peristome, directed more or less laterally. Oral spines present. Genotype, *Cellepora coccinea* Abildgaard, 1805.

**Escharoides praestans** (Hincks), 1882

Plate 43, fig. 12

*Mucronella praestans* Hincks, 1882:168.

A large attractive species, the zoarium unilaminar and encrusting on shells, corallines, etc., white and glistening when young. Zooecia robust, large, 0.90 (0.70 to 1.00) mm by 0.50 (0.45 to 0.60) mm, much elevated distally. The front is a pleurocyst with large, deep areolar pores in one or two rows, the pores often separated by strong ribs. The peristome is much elevated on the proximal border, less so on the sides and very little distally, moderately thin. A denticle ("umbo"), triangular, quadrate or short spatulate, situated high up on or just within the proximal tip of the peristome (similar in appearance to a lyrula but not homologous). The secondary aperture is large, about 0.20 by 0.20 mm, directed forward, rounded-pyriform in outline; on the distal border there are 4 large conspicuous spines jointed at the base. The primary aperture which, except in the very young, can be seen only after dissection is rounded proximally, without cardelles, the distal border is nearly transverse often with a peculiar rounded lip projecting slightly inward and backward. The avicularia are paired or single at the sides of the aperture, varying in size and form from small and sharp-pointed to very



long and spatulate; the small ones are usually beside the aperture and directed forward, the large ones situated more proximally are directed laterally.

The ovicell is hyperstomial, much immersed, costate like the frontal, with a central umbonate process.

Recorded from New Zealand and Australia.

Hancock Stations: 143-34, Wenman Island, shore; 155-34 and 455, Albemarle Island, 50 to 70 fms; 788-38, Daphne Major Island, 55 fms, all from the Galapagos. Also 271, Angel de la Guardia Island, Gulf of California, 29°31'00"N, 113°28'30"W, at 10 fms. These are the first records of this species from the American coasts and indicate a wide distribution.

### Genus **TRYPEMATELLA** Canu and Bassler, 1920

The ovicell is hyperstomial and closed by the operculum only for the passage of the eggs. The aperture is semilunar with proximal border a little concave. The frontal is a thick pleurocyst with large areolar pores. Two large lateral avicularia are placed below the aperture; also a small rounded avicularium on either side of the aperture. Genotype, *Trypematella papulifera*, Canu and Bassler, 1923:135.

#### **Trypematella umbonula** new species

Plate 43, figs. 13-14

Zoarium encrusting on a shell, multilaminar, white, rough in appearance. Zooecia of moderate size, 0.40 to 0.50 mm long by 0.30 to 0.40 mm wide; the frontal a thick pleurocyst with large areolar pores, occasional additional smaller pores, short costal ridges and irregularities of surface, and a prominent suboral umbo. The primary aperture is wider than long, 0.12 by 0.10 mm, the proximal border broadly arcuate or with a broad shallow sinus and without cardelles; peristome low and thin, with 4 delicate spines which are seen only on marginal zooecia. The avicularia are distributed as follows: a small rounded one on each side of the aperture, another of similar size and form on the distal side of the suboral umbo, and more rarely a larger pointed one on the side of the zooecial front.

The ovicell is moderately large, 0.20 to 0.25 mm wide and broader than long, prominent when young but becoming considerably embedded, somewhat flattened above the orifice, an ovate fenestra near the proximal

corner on each side and one or more smaller pores between these; in advanced calcification the base of the ovicell is bordered by a costate band and there is a small, centrally situated umbo on the top.

The genotype, *T. papulifera* Canu and Bassler, was described from the Pleistocene of Rustic Canyon, Santa Monica, California. The present species, which may be its modern representative, agrees in all important details except for the presence of the suboral umbo and avicularium; the paired frontal avicularia of *papulifera* are represented rarely by a single one of the same form and position. As the genus has been known only as a fossil from the one locality mentioned above, it is especially interesting to find a recent representative in the same general region.

Type, AHF no. 79.

Type locality, west end of Santa Catalina Island, southern California; a single zoarium without further data, from the Los Angeles Museum.

Family **Microporellidae** Hincks, 1880

The most important character is a small median pore, the ascopore, at a little distance proximal to the aperture. It is the outlet of the ascus or compensation sac, and varies in form and position in the different species, and it may also show considerable variation with different degrees of calcification. The aperture is nearly straight on the proximal border, and the operculum is simple, having no extension proximal to the cardelles. Spines are present on the peristome and avicularia are present in the genus *Microporella*. The frontal is a tremocyst. Dietellae present. The ovicell is hyperstomial and closed by the operculum.

Genus **MICROPORELLA** Hincks 1877

The aperture is semicircular, straight on the proximal border. The ascopore is semilunar or round and is situated rather close to the aperture so that there are no tremopores between. Pointed avicularia are present in various positions. Genotype, *Eschara ciliata* Pallas, 1766.

The question of what is a "good species" rises again and again in this genus, as most of the differential characters are subject to variation. The avicularia differ in position, alongside or slightly distal to the ascopore, or on the front proximal to it; in the latter case they are usually more lateral in position. There is some variation, however, in some of the species, as in *ciliata* where occasionally an avicularium may be found beside the ascopore. The number is of some importance, whether single or paired, but again those with a single avicularium may occasionally have two and those which ordinarily are paired may have only one. The form of the mandible also varies within the species, and species with long-triangular mandibles may have them more or less setose, even within the same colony. The form of the aperture varies in the different species from semicircular to considerably more than a semicircle, and the same colony may show some variation; also the proximal border may or may not bear small hinge teeth. The umbos in some are heavily developed, in others they are smaller and in still others they may be evident only occasionally. The ovicell offers little of importance, though in some forms it is developed around the aperture farther than in others, in some it bears a collar around the orifice, and in some cases the size is useful. The size and number of the spines have been made use of, but here the variation, especially in size, is very great.

Still these forms are different and can be separated usually without much difficulty if the colonies are fully developed. Several of these species occur in the Pleistocene, where they present just the same characters shown by the recent specimens, e.g. *californica*, *umbonata*, and *vibraculifera*, while *ciliata* is known as far back as the Miocene. It appears evident that they are different and have been for a long time, even though they do not show as sharp distinctions as are often found in other genera. Fortunately most of them present more than one distinguishing character and I have been able to present the following key which at least enables one to separate the forms named in the following pages. I have listed most of them as species, as otherwise it would seem necessary to regard all of them as varieties of *ciliata*.

#### KEY TO THE SPECIES OF *Microporella*

1. Avicularia single, occasionally paired, proximal to ascopore . . . 2  
    Avicularia paired, occasionally single, beside the ascopore . . . 6
2. Avicularium large with exceedingly long flagellum . . . *vibraculifera*  
    Avicularium smaller, mandible usually ending in a setose point . . . 3
3. Three umbos, 1 central, the others beside the aperture . . . *umbonata*  
    One umbo or none . . . . . 4
4. Aperture and ascopore surrounded by a high peristome which is  
    bridged across its middle in fertile zooecia . . . . . *pontifica*  
    The peristome not elevated . . . . . 5
5. Avicularium small, located in the lateral zooecial angle, the  
    mandible setose, directed somewhat laterally . . . . . *gibbosula*  
    Avicularium larger, usually located on one side a little proximal  
    to the ascopore, mandible long triangular to setose (the variety  
    *stellata* with a stellate ascopore) . . . . . *ciliata*
6. Avicularia far forward beside aperture, mandibles setose, very  
    long and directed forward parallel . . . . . *tractabilis*  
    Avicularia beside ascopore, mandible setose or lanceolate, not  
    unusually long, directed diagonally forward . . . . . 7
7. Ascopore surrounded proximally by an arcuate umbo of vary-  
    ing size . . . . . *marsupiata*  
    Umbo, if present, pointed . . . . . 8
8. Mandible long-triangular, with a more or less setose point . . . 9  
    Mandible setiform or long hastate . . . . . 10

9. Ascopore large with cribrate aperture (sieve plate) . . . *cribrosa*  
 Ascopore with the usual lunate aperture . . . . . *californica*
10. Avicularia small, a small setose mandible . . . . . *setiformis*  
 Avicularia with narrow hastate mandible ending in a setose  
 point . . . . . *coronata*

**Microporella ciliata** (Pallas), 1766

Plate 44, fig. 1

*Eschara ciliata* var. B Pallas, 1766:38.

*Cellepora ciliata*, Linnaeus, 1759:1286.

*Microporella ciliata*, Hincks, 1880:206; 1884:14.

*Microporella ciliata*, O'Donoghue, 1823:31; 1925:103; 1926:64.

*Microporella ciliata*, Canu and Bassler, 1923:119.

*Microporella ciliata*, Hastings, 1930:727.

Zoarium encrusting on various substrata, especially shells and stones. The zooecia are somewhat ovate to elongate hexagonal; (length 0.45 to 0.50, width 0.30); the front with numerous small tremopores, slightly inflated, smooth and usually without decoration, though a small median umbonate process is sometimes present. The aperture is nearly semi-circular, evenly rounded in front and on the sides and straight on the proximal border; 0.08 or 0.09 mm long by 0.11 to 0.13 mm wide; the peristome low and smooth with 5 to 7 oral spines. The ascopore, in the midline a little proximal to the aperture, is lunate (a small calcified shelf projects backward from the distal border of the pore partially closing the pore).

The ovicell is globose and prominent, smooth or umbonated on the top and ribbed around the base; a slight collar around the aperture; about 0.25 mm in width.

Usually there is a single avicularium situated a little to one side of the midline and proximal to the ascopore, the mandible long triangular to more or less setose directed forward and outward. Occasionally there are two avicularia symmetrically placed, and the location may vary from the lateral zooecial angle to opposite the ascopore.

A cosmopolitan species, listed on the American Pacific coast by Hincks and O'Donoghue from British Columbia waters and by Hastings from Panama, Colombia and the Galapagos Islands.

In the Hancock collections it appeared at nearly 100 stations from the coast of Oregon to the Galapagos Islands, from near shore to depth of 90 fathoms.

**Microporella ciliata stellata** (Verrill), 1875

*Porellina stellata* Verrill, 1875:53.

*Microporella ciliata* var. *stellata*, Osburn, 1912:234.

*Microporella ciliata* var. *stellata*, O'Donoghue, 1923:30.

Similar in all respects to *M. ciliata* except that the ascopore is not provided with a calcified shelf but with minute spicules all around the border which give the pore a stellate appearance. Occasionally a small shelf is present, similar to that of *ciliata* but smaller.

Described by Verrill from Casco Bay, Maine, and found commonly by Osburn in the Woods Hole region of Massachusetts. O'Donoghue records it from British Columbia.

Hancock collections: specimens with the stellate pore and with intermediate conditions from Mussel Point, Dillon Beach and Monterey Bay, California.

**Microporella umbonata** (Hincks), 1884

Plate 44, fig. 4

*Microporella ciliata* form *umbonata* Hincks, 1884:15.

*Microporella ciliata* var. *umbonata*, O'Donoghue, 1923:31.

*Microporella umbonata*, Canu and Bassler, 1923:123.

The general characters of this form are much like those of *ciliata*, but in its complete calcification it presents a very striking appearance with high pointed umbos on the front and the ovicell and on each side of the aperture. The zoecia are slightly larger than those of *ciliata*, very heavily calcified, the gibbous frontal comparatively smooth except for the median umbo, the tremopores large and numerous. The aperture is more elongate than in *ciliata*, forming more than a semicircle, the proximal border straight, cardelles not evident. The peristome is low and thin, with 4 to 6 small oral spines which are evanescent. The ascopore is of moderate size, semilunar, close to the border of the aperture and usually obscured by the median umbo. There is a single avicularium, often wanting, situated as in *ciliata* at one side proximal to the ascopore and oriented diagonally.

The ovicell is large, 0.28 to 0.33 mm wide, heavily calcified, perforated like the frontal, with a large blunt or pointed umbo on the top.

The lateral umbos are usually tipped forward as in Hincks' figure 1 (plate 17), but occasionally stand erect beside the aperture.

Described by Hincks from Dolomite Narrows, British Columbia; listed by O'Donoghue without data, and recorded by Canu and Bassler

from the Pleistocene of Santa Barbara, Santa Monica and San Pedro, California.

Hancock Stations: 1232-41, San Pedro, and 1300-41, Santa Cruz Island, California. Also from Dillon Beach, California (Menziés, collector). Shallow water to 56 fms.

**Microporella vibraculifera** (Hincks), 1884

Plate 44, fig. 7

*Microporella ciliata* form *vibraculifera* Hincks, 1884:15.

*Microporella ciliata* var. *vibraculifera*, O'Donoghue, 1923:31; 1926:64.

*Microporella vibraculifera*, Canu and Bassler, 1923:124.

There is much general resemblance of this species to *ciliata*, but it is larger in all dimensions, coarser in appearance, and the avicularium is strikingly different.

The zoarium is encrusting on shells, stones and coarser algae. The zooecia are irregularly elongate hexagonal, 0.50 to 0.60 mm long by 0.34 to 0.40 mm wide, a little inflated, the frontal with large tremopores when the smooth shining ectocyst is removed. The aperture is semicircular with the proximal corners a little rounded, the proximal border straight and with no evidence of cardelles, 0.09 mm long by 0.13 mm wide. The peristome is thin, a little elevated and provided with 5 to 7 stout spines. The ascopore, as in *ciliata*, is reduced to a lunate slit by the development of the shelf on the proximal border; the rim of the pore is very slightly elevated. The avicularium, comparatively, is of giant proportions, its chamber usually extending laterally over more than half the width of the front and elevated on its proximal side so that it appears to be tipped forward; there is a very heavy pivot; the setose mandibles, which may be 1.00 mm or more in length, are grooved on the under surface for their entire length, with a pair of minute hooks near the base, and are directed more or less sideways. There is no difficulty in identifying the species when the mandibles are present and even when these are denuded the size and position of the avicularian base, with its unusually strong hinge bar, easily distinguish it.

The ovicell is large, 0.35 to 0.40 mm wide, smooth or slightly umbonate, ribbed around the base and usually with a thick, raised collar around its aperture.

Described by Hincks from British Columbia, "Queen Charlotte Islands," and listed by O'Donoghue without special data. Canu and Bassler record it from the Pleistocene of San Pedro, Santa Monica and Santa Barbara, southern California.

Hancock Stations: 1232-41, San Pedro; 1171-40, 1371-41 and 1118, off Santa Catalina Island; 1051, San Miguel Island, and 1153, Santa Rosa Island, all from southern California. Stations 488-36, San Quentin Bay; 1250-41, San Benito Island, and 1261-41, Dewey Channel, all from Lower California, west coast. 5 to 160 fms. Also at Middle Bank, Puget Sound, Washington, Dr. J. L. Mohr, collector. These records extend the range from British Columbia to about the parallel 28°N Lat.

### *Microporella cribrosa* new species

Plate 44, fig. 3

*Microporella californica* Robertson, 1908:281 (non Busk).

There is much general zoarial resemblance to *californica* Busk, but differences occur in several characters. The most evident of these is the presence of a perforated cover, "sieve plate" (Robertson), over the ascopore, instead of the usual lunate opening. The zoarium usually encrusts algae, but sometimes is found on shells and pebbles. The zooecia resemble those of *californica* but average smaller, about 52  $\mu$ m long by 0.35  $\mu$ m wide. The tremopores are large and there is often a small umbonate process proximal to the ascopore: the process rarely becomes high and flabellate. The aperture is more transverse than usual in this genus, nearly twice as wide as long, 0.07 to 0.08 long by 0.13 to 0.15  $\mu$ m wide, straight on the proximal border, the small cardelles usually evident. The ascopore is larger than in any other of our species, transversely short-elliptical, often a little inflected on the distal border where a small projection may extend a short distance into the aperture; the remainder of the aperture of the ascopore is filled in with a calcified, porous membrane, the numerous pores perfectly round (Robertson's figure represents this feature well).

The avicularia are similar in form and position to those of *californica* but smaller. The spines, usually 6 (5 to 7), are long, sometimes longer than a zooecium, and strong, jointed at the base and occasionally dark about the basal joint.

The ovicells are larger than those of *californica* (though the zooecia are smaller), averaging 0.35  $\mu$ m in width (0.33 to 0.38  $\mu$ m), the base of young undeveloped ones measuring 0.28  $\mu$ m in width. As in most species of the genus they are ribbed about the base, but the base is rather sharply constricted. A low smooth umbo is present on the top and the sides extend backward to the proximal spines.



The characters mentioned appear only slight for the separation of a new species but the cribrate covering of the ascopore is very definite and I have not been able to find any evidence of intergradation with the usual form of ascopore in other species. Spinules are present in several other species, both on the distal projection and around the inner border, but they never appear to fuse to form rounded pores over the whole area as they do in *cribrosa*. The smaller zooecia with larger and less embedded ovicells also separate it from *californica*. It should be noted that in dead specimens with the ectocyst removed, the cribroid plate is usually lost and the ascopore resembles that of *californica* except that it is much larger.

Type, AHF no. 80.

Type locality, Corona del Mar, Newport Harbor, southern California, growing on algae attached to the piles of docks. Occurring commonly along shore from Mussel Point, northern California (A. E. Blagg, collector) southward to Tomales Bay, Monterey Bay, Santa Barbara, San Pedro Harbor, Newport Harbor to San Diego Bay, California. Dredged by the Albatross, Sta. D 2945 near Anacapa Island, southern California at 30 fms, and by Dr. C. L. Hubbs at Guadalupe Island off Lower California at 40 fms.

### *Microporella californica* (Busk), 1856

Plate 44, fig. 2

*Lepralia californica* Busk, 1856:310.

*Microporella ciliata* form *californica*, Hincks, 1883:444.

?*Microporella californica*, Robertson, 1908:281, (part).

*Microporella californica*, O'Donoghue, 1923:32; 1926:65.

*Microporella californica*, Canu and Bassler, 1923:123.

"Cells broadly oval, surface minutely punctured; a lunate pore in front, a little below the mouth; an avicularium on either side above. Mouth rounded above, lower lip straight, four superior spines. Ovicell small, sub-immersed. Hab. California, Dr. Gould."

The above is Busk's brief description. His figure (plate 11, figs. 6 and 7) represents the species very well, except that his artist appears to have added a row of tremopores distal to the ascopore. The lunate opening of the ascopore, as shown by Busk, is correct.

The related form described by Robertson as *californica* is quite similar in most respects, but has the ascopore closed by a "sieve plate" with small round pores instead of having the usual lunate slit (see *M. cribrosa*, new species). Otherwise Robertson's description applies equally well to both forms.

The zoarium encrusts shells, pebbles and frequently algae. The zooecia are moderately large, 0.60 to 0.70 mm long by 0.40 to 0.50 mm wide (Busk's figure 7 is within this range), the frontal somewhat inflated and more coarsely punctured than in *ciliata*; a small umbo often present proximal to the ascopore. The aperture is large for the genus, 0.12 mm long by 0.16 mm broad, rounded distally, the sides considerably incurved to meet the straight proximal border; rarely there are very minute cardelles. The ascopore is slightly elliptical transversely with the usual projection from the distal border; this projection and the inner edge of the border minutely dentate.

The avicularia are usually paired, one on either side of the ascopore, the mandible long-triangular and sharp pointed, directed forward and slightly outward. The spines are usually 5 (5 to 7), frequently long and heavy, frequently black at the basal joint and occasionally dark throughout.

The ovicell is small, compared to the zooecia, and more immersed than usual, width 0.26 to 0.30 mm (the base of young zooecia 0.20 to 0.24 mm), the radiating ribs extending well toward the top which is either smooth or with a low umbo; perforated like the frontal; on the sides extending proximally to the first spines.

Hancock Stations: dredged at more than 20 stations from the coast of Oregon southward to the Galapagos Islands (Albemarle and James); abundant along shore and about the islands off southern California; Clarion Island west of Mexico; San Esteban Island, Gulf of California; common in shallow water at shore stations and down to 74 fms. The records of Hincks and O'Donoghue from British Columbia are somewhat in doubt, owing to the possible confusion of this species with *cribrosa* new species, but as I have seen a specimen from Vancouver Island (Ricketts collection) they may be correct.

### ***Microporella marsupiata* (Busk), 1860**

Plate 44, fig. 6

*Lepralia marsupiata* Busk, 1860:284.

*Microporella marsupiata*, Norman, 1909:297.

Distinguished by an arcuate or semicircular umbonate process proximal to and partially enclosing the ascopore. The zoarium encrusts shells, corallines, etc. The zooecia are moderate in size, 0.40 to 0.55 mm long by 0.30 to 0.40 mm wide, the frontal smooth to coarsely granular with numerous small tremopores. The aperture shows considerable variation in form, sometimes as high as broad (0.08 by 0.08 mm), or again

considerably wider (0.07 by 0.10 mm), straight on the proximal border. The bordering sclerite of the operculum is usually dark brown. The peristome is slightly salient with 5 to 7 strong spines which are sometimes black at the basal joint; the proximal spine on either side is occasionally forked at the tip, as in Busk's figure (plate 31, fig. 4). The ascopore has a semilunar slit and is finely dentate all around its inner border, with the usual projecting shelf; it is partially surrounded proximally by a semicircular umbonate process ("a pouch-like rostrum," Busk) of varying height and width. The avicularia are single (Busk) or paired at the side of the ascopore (rarely more proximal), with setose mandibles which are directed forward and slightly outward. Busk states that the mandible ("vibraculum") is black, but in our specimens they are only occasionally tinged with brown.

The ovicell is large, 0.30 mm wide, globular and prominent, its surface like the frontal, ribbed around the base and in full calcification the lip of the aperture is produced into a strong rib; the sides of the ovicell stop abruptly at the proximal spines.

Busk described this species from Madeira and Norman refigured it from the same locality (plate 38, fig. 7). It differs from *ciliata* in the position of the avicularia and the nature of the oecium as well as by the presence of the peculiar umbonate process.

Hancock Stations: 155-34, Albemarle Island; 182-34 and 462, James Island; 810-38, Barrington Island and 435, Chatham Island, Galapagos; 136-34, Clarion Island, W. of Mexico; 234, Baja Point, Lower California. 17 to 73 fms.

### *Microporella pontifica* new species

Plate 44, fig. 5

Distinguished by the peristome of the fertile zooecia which encloses the ascopore and extends forward upon the ovicell and which is bridged across near the middle to produce two secondary apertures; also by the avicularium which is lateral, proximal to the ascopore and with an aciculate or narrowly lanceolate mandible which is grooved on its under surface.

Encrusting on shells and corallines. The zooecia are of moderate size, 0.50 to 0.60 mm long by 0.40 to 0.45 mm wide; the frontal finely granular, less inflated and the separating grooves more shallow than is usual in the genus. The aperture is semicircular, 0.08 mm long by 0.10 mm wide, straight on the proximal border and without cardelles; the peristome of infertile zooecia elevated distally and with 4 to 6 short

spines. The ascopore is of the usual lunate type with a slightly elevated collar. The avicularium is moderate in size, located usually in the lateral zoecial angle and directed laterally; the mandible, with a complete pivot, has a short triangular base, narrows considerably for a short distance, broadens again into a narrow lanceolate form and ends in an acicular point, the under surface grooved nearly to the tip and a pair of small hooks turned downward at its widest part. Length 0.25 to 0.30 mm.

Ovicelled zoecia differ strikingly in appearance due to the extension of the peristome which continues distally across the front of the oecium and proximally surrounds the ascopore, while on each side is a lappet which bends across to unite with the opposite one and forms a complete bridge on a level with the top of the ovicell; the secondary aperture is thus divided, somewhat unequally into two, the distal one for the tentacles, the proximal one for the ascopore. The ovicell is globular, prominent, its surface like the frontal and without umbo or ribs, its average width 0.26 mm.

Type, AHF no. 81.

Type locality Hancock Station 137-34 Sulphur Bay, Clarion Island, W of Mexico, 18°9'05"N, 114°45'25"W, 57 fms. Also Stations 147-34 and 155-34, Albemarle Island, Galapagos; 650-37, E. of San Francisco Island, Gulf of California, and 298, Agua Verde Bay, Lower California, in the Gulf of California; 20 to 60 fms.

### ***Microporella tractabilis* Canu and Bassler, 1930**

Plate 45, fig. 2

*Microporella tractabilis* Canu and Bassler, 1930:22.

The zoecia are of average size, 0.55 to 0.60 mm by 0.40 to 0.50 mm, finely granulated, with small tremopores and there is no indication of an umbonate process. The aperture is somewhat more than a semi-circle, 0.07 mm long by 0.10 to 0.12 mm wide, straight on the proximal border, the cardelles more prominent than usual. The peristome is thin, slightly raised and bears 4 to 6 small spines. The ascopore is large, nearly straight on its distal border which has a projecting shelf that leaves a lunate opening; the pore is situated farther from the aperture than is usual in the genus, its border only slightly raised. The avicularia peculiar in arrangement, paired, one on either side, distal to the ascopore and directed straight forward parallel to each other; the mandibles are long and setose. Canu and Bassler state (p. 22) "the mandibles are

always long enough to touch the pivot of the avicularia of the adjacent superior zooecia so that all of the avicularia of the same colony are in direct tactile communication." I have found colonies in which the setae are so long, but this is not always the case even on the same colony.

The ovicell is globular, very prominent, granulated and perforated like the frontal and there is only slight evidence of ribs around the base.

The paired, parallel avicularia situated far forward easily distinguish this species.

Described from the Galapagos Islands, Albatross D.2813 and D.2815.

Hancock Stations: 431-35, off Octavia Rocks, Colombia, and 307, Secas Islands, Panama. 40 to 80 fms.

### *Microporella setiformis* O'Donoghue, 1923

Plate 44, fig. 8

*Microporella setiformis* O'Donoghue, 1923:32; 1926:65.

Encrusting on stones, shells, worm tubes, etc., white and shining. The zooecia are moderate in size, 0.50 to 0.65 mm long by 0.40 to 0.45 mm wide, considerably inflated, elongate hexagonal; the frontal with numerous pores and covered by shining ectocyst. The aperture is more than semicircular, 0.09 by 0.12 mm, the proximal border quite straight and with no indication of cardelles. The peristome is thin, smooth, slightly elevated and there are 5 evanescent oral spines. The ascopore is unusually small, round, slightly elevated and lacks the projecting shelf which is common to most members of the genus. The avicularia are paired, opposite the ascopore near the zoecial margin, the chamber small and rounded, the rostrum short, the mandible setose and usually less than half as long as a zoecium, directed diagonally.

The ovicell, which O'Donoghue did not observe, is very prominent, globular, 0.25 to 0.30 mm in width; appearing smooth under the epitheca but when this is removed it is porous like the front and with delicate radiating ribs which are enlarged at the base; on the sides the ovicell extends backward around the aperture to the proximal border. Rarely there is an umbonate process on the frontal.

Described by O'Donoghue and recorded by him from 11 localities in British Columbia, from the San Juan Islands northward.

Hancock Stations: 1284-41, 1388-41 and 1152, Santa Rosa Island; 1064, Santa Barbara Island; 1234, off San Pedro, California. Also at Hein Bank, Puget Sound, Washington, Dr. J. L. Mohr, collector. Low water to 54 fms.

**Microporella gibbosula** Canu and Bassler, 1930

Plate 44, fig. 9

*Microporella gibbosula* Canu and Bassler, 1930:20.

Zoarium encrusting shells, worm tubes, etc. The zooecia are moderate in size, 0.50 to 0.55 mm long by about 0.45 mm wide, the front swollen and smooth or with fine granules. The aperture is nearly as long as broad, 0.08 mm by 0.09 with the proximal border straight; the peristome low and smooth with 5 small oral spines. The ascopore is round and unusually small, often with a small raised collar. There is one small avicularium (rarely 2) situated usually in the lateral zooecial angle close to the margin, oriented laterally, or slightly oblique, the mandible setiform or somewhat lanceolate.

The ovicell is globular, conspicuous, smooth and perforated and only slightly ribbed about the base, width about 0.26 mm. The form of the aperture, the small rounded ascopore and the position of the small avicularium appear to be constant and are the most diagnostic characters.

Described from the Galapagos Islands, Albatross Sta. D.2813.

Hancock Stations: 8 stations among the Galapagos Islands; 431-35, Octavia Bay, Colombia; 114-33, Bahia Honda, and 437-35, Secas Islands, Panama; 309, Port Culebra, Costa Rica; and 298, Agua Verde Bay, Lower California. 5 to 80 fms.

**Microporella coronata** (Audouin), 1826

Plate 45, fig. 1

*Flustra coronata* Audouin, 1826:239.*Microporella coronata*, Waters, 1909:42.*Microporella coronata*, Canu and Bassler, 1925:37.*Microporella ciliata* var. *coronata*, Hastings, 1927:340; 1930:727.

Encrusting on shells, etc. Zooecia of moderate size, usually between 0.45 and 0.55 mm long by 0.40 to 0.50 mm wide, but varying greatly; distinct, the frontal somewhat ventricose with numerous small pores. The aperture is semicircular, a little narrowed proximally, the proximal border straight, width 0.13 mm, length 0.10 mm; peristome low and thin, with about 6 oral spines the basal joints of which are dark. The avicularia are paired, about opposite the ascopore and directed forward and slightly outward; the mandible has a hastate shape, the small lateral projections usually bent downward like hooks and inconspicuous, the distal portion slender with a setose point and a curved tip; the rostrum is short, grooved and truncate at the tip, extending only to the lateral projections of the mandible. The ascopore is lunate in form.

The ovicell is large, about 0.26 mm wide, rounded, perforated like the frontal, striated lightly and radially in the young stage; a visor-like projection usually extends above the orifice.

In the absence of ovicells this species may be confused with *M. pontifex*, new species, as both have hastate avicularian mandibles, but in the latter the avicularia are single and quite proximal to the ascopore. When an ovicell is present the peristome at the sides of the aperture is not raised, while in *pontifex* the lateral peristomial lappets are high and meet above the aperture.

It is distributed around the world in warmer waters, and Hastings has recorded it from Coiba, Panama, and Gorgona, Colombia. Hastings also places *M. californica* (Busk) under the synonymy of *coronata*, but this is incorrect as the mandible is never hastate and the rostrum is pointed; also it is a larger and coarser species than *coronata*.

Hancock Station 650-37, E of San Francisco Island, Gulf of California, 47 fms, several colonies.

### Genus FENESTRULINA Jullien, 1888

This genus differs from *Microporella* by the stellate character of the tremopores, by the more proximal position of the ascopore so that there are one or two rows of tremopores between it and the aperture, and by the absence of avicularia. Genotype, *Cellepora malusii* Audouin, 1826.

#### *Fenestrulina malusi* (Audouin), 1926

Plate 45, fig. 3

*Microporella malusii*, Hincks, 1884:16.

*Microporella malusi*, Robertson, 1908:282.

*Microporella malusii*, O'Donoghue, 1923:32.

*Fenestrulina malusii*, O'Donoghue, 1926:63.

*Fenestrulina malusi*, Canu and Bassler, 1923:115.

*Fenestrulina malusi*, Osburn, 1940:433.

The zoarium forms white, flat encrustations on shells and stones. The zoecia are moderately large, irregularly hexagonal, sometimes as broad as long, very distinct with deep separating grooves and the front considerably inflated, the surface smooth; the stellate tremopores numerous. There is much variation in size of the zoecia, which average about 0.60 mm long by 0.50 mm wide. The aperture is semicircular, with

a straight proximal border, the peristome low and smooth with 4 or 5 small spines (often entirely wanting). The ascopore is semicircular, like that in most species of *Microporella*, but is situated farther proximally so that there some tremopores between it and the aperture.

The ovicell is large and prominent, perforated and with a row of conspicuous areolae around the base.

It apparently occurs around the world in tropical and temperate waters. Hincks and O'Donoghue recorded it from British Columbia; Robertson from La Jolla and Catalina Island, southern California; and Canu and Bassler from the Pleistocene of southern California.

The Hancock collections extend the range southward to the Galapagos where it was dredged at Charles, Wenman and Albemarle Islands. At intermediate points it was found at Clarion Island, west of Mexico and at several stations within the Gulf of Mexico. It is common about the Channel Islands off the coast of southern California and northward to Oregon. Depth 3 to more than 100 fms.

#### *Fenestrulina malusi* var. *umbonata* O'Donoghue, 1926

This variety is characterized especially by the presence of a conspicuous umbonate process immediately proximal to the ascopore. The measurements are somewhat larger than in the typical form, averaging 0.70 mm long by 0.60 mm wide in our specimens, and the aperture is correspondingly larger. Otherwise there appears to be no essential difference, and there is some intergradation.

O'Donoghue described the variety from the San Juan Islands, Puget Sound and from Bentinck Island, and Hincks had already noted its occurrence, without naming it, in the Queen Charlotte Islands.

Hancock Station 1325-41, off Santa Catalina Island, southern California, 59 fms. Also from Cadboro Bay, Victoria, British Columbia, G. E. MacGinitie, collector.



Family **Eurystomellidae** Levinsen, 1909

Zooecia thick walled, without a covering membrane; without pores or with several large fenestrae; aperture very broad, widest at the broadly concave proximal border. Ooecium enclosed in a kenozoecium, the front with a large membranous area. No avicularia, no spines. (After Levinsen).

Genus **EURYSTOMELLA** Levinsen, 1909

Characters of the family, without frontal pores. Genotype, *Lepralia foraminifera* Hincks, 1883.

**Eurystomella bilabiata** (Hincks), 1884

Plate 58, fig. 5

*Lepralia bilabiata*, Hincks, 1884:49.

*Lepralia bilabiata*, Robertson, 1908:298.

*Eurystomella bilabiata*, Canu and Bassler, 1923:142.

*Eurystomella bilabiata*, O'Donoghue, 1926:65.

Zoarium encrusting in a single layer, forming rather coarse layers on stones, shells, etc., reddish or brownish in color. The zooecia are moderately large and very deep, varying much in size, average 0.65 mm long by 0.50 mm wide; broad and rounded distally, narrowed and truncate at the proximal end. The front is a heavy, smooth olocyst entirely without pores, often rising into a broad low umbo. The aperture is shaped like a hat with a very narrow brim, rounded distally and suddenly wider near the proximal border which is nearly straight; 0.20 mm long by 0.30 mm wide. The operculum has the form of the aperture, is brown with a darker sclerite which extends all around the border. The ovicell is comparatively quite small, rounded, with a membranous area on the top. No avicularia, no spines.

Described by Hincks from Houston-Stewart Channel and recorded by O'Donoghue for Brotchie Ledge, Victoria, and Bentinck Island, all in British Columbia. Robertson listed it from Puget Sound, Washington, and Mendocino City and Pacific Grove, California. Canu and Bassler recorded it from the Pleistocene of San Pedro, California.

Hancock Stations: 1176-40, Santa Barbara Island and 1130-40, off Laguna Beach, southern California; 275-34, Navidad Head, Tenacatita Bay, Mexico, 19°12'50"N (the most southern record). I have a specimen from Nootka Island, Alaska, which is the most northern record. It is a rather common species at low tide on rocky shores from California northward, not frequently dredged, but has been taken at 35 fms.

Family **Smittinidae** Levinsen, 1909

This is a large and varied family, but on the whole is fairly distinct. The frontal is an olocyst with few to many areolar pores, or a pleurocyst which develops above the olocyst from the margin inward to the center of the front, or a tremocyst with numerous evenly distributed pores. (Additional pores are often present in the pleurocyst, especially near the proximal end, but these seldom approach the region of the aperture and usually leave an imperforate area proximal to it. The nature of the growth of this layer may be observed on young marginal zooecia.) The primary aperture is somewhat semicircular (sometimes nearly round, occasionally a little asymmetrical) and usually there are cardelles and a lyrula. The secondary sinus is often well developed proximally. Oral spines are of common occurrence but may be entirely wanting. The operculum is thin and delicate and there is usually no evidence of a vestibular arch. Multiporous rosette plates are the usual means of communication in the lateral and distal walls, but pore chambers (dietellae) may be present.

Avicularia are very regularly present, though in individual zooecia they may be wanting, and they are of two categories: (1) median, suboral avicularia in which the avicularian chamber extends across the front to communicate with an areolar pore on each side immediately proximal to the aperture, and (2) frontal avicularia of various forms and sizes. Only the suboral, or only the frontal avicularia may be present, but both kinds are frequently found on the same zoecium. Giant interzoecial avicularia also are occasionally found.

The ovicells are hyperstomial, usually prominent at first but often becoming deeply embedded in the later stages of calcification. The surrounding zooecia often contribute to the formation of the secondary ooecial layer. The ovicell may be imperforate, it may be perforated by numerous small or larger pores, by a few larger pores centrally placed, or in a few species there is a single central pore (occasionally doubled).

**SMITTINA**, *sens lat.*

The genera *Porella* Gray and *Smittina* Norman have been much confused. Formerly nearly all of the species with a median suboral avicularium were allocated to *Porella* but later many of these were transferred to *Smittina*, especially those with a well developed lyrula. The lyrula is rather variable, however, and there has seemed to be no sharp line of division on this basis. There are other criteria to be

considered, viz., the nature of the calcification of the frontal, the presence or absence of frontal pores and oocelial pores, and the mode of origin of the avicularia.

1. The genotype of *Porella* is *Millepora compressa* Sowerby. Unfortunately when describing this genus Gray misidentified *compressa* with *Millepora cervicornis* Pallas, which has somewhat the same growth form but has a porous frontal (tremocyst). As late as 1920 Canu and Bassler accepted *cervicornis* as the genotype of *Porella*, but Bassler later (1935) corrected the error. The genotype of *Porella* therefore has a bilaterally symmetrical avicularian chamber, an imperforate frontal (except the areolar pores), an imperforate ovicell and a very low, broad lyrula which is so short as to be indistinguishable except when viewed from the interior of the frontal, and no cardelles. The other species which may be allied to *compressa* have the characters mentioned, but the frontal is usually much smoother and is easily mistaken for an olocyst. Careful study of incinerated specimens shows the secondary layer or pleurocyst. In most of the species the frontal becomes very thick, so that the median avicularian chamber and the ovicell are often completely buried beneath the secondary crust and the areolar pores are often occluded. Frontal avicularia also are sometimes present.

2. The genotype of *Smittina* is *Lepralia landsborovii* Johnston which agrees with *Porella* in the presence of a median bilaterally symmetrical suboral avicularium, but in which the frontal is a tremocyst with numerous pores, the ovicell is usually similarly perforated and the lyrula and cardelles well developed. Usually the pores of the ovicell are well distributed, but in a few cases, *bella* Busk and *retifrons*, new species, they are limited to 1 or 2 central pores and these may even be occluded in final calcification. The tremocyst often becomes thick and the frontal pores more or less infundibuliform.

3. A third group, *Smittoidea* new genus, differs in having the frontal a pleurocyst, with a median symmetrically developed suboral avicularium, perforated ovicell and well developed lyrulae.

4. Still a fourth group, *Parasmittina* new genus, is easily distinguished by the pleurocystal front and the nature of the avicularia which are variously distributed over the front but never median and suboral; they take their origin from areolar pores on one side only. The lyrulae and cardelles are well developed, though they are sometimes so hidden by the overhanging peristome that dissection is required to reveal their presence. The ovicell is variously perforated, sometimes by small pores or by larger pores which often vary in size and form, or more rarely by one to three central pores.

## KEY TO THE GENERA OF SMITTINIDAE

1. Frontal an olocyst or pleurocyst, sometimes with numerous pores  
but the central area at least imperforate . . . . . 2  
Frontal a tremocyst with numerous pores over the whole area . . . . . 8
2. With suboral avicularia . . . . . 3  
No suboral avicularia . . . . . 6
3. Avicularia symmetrically developed in the midline . . . . . 4  
Avicularia asymmetrical, close behind the aperture *Rhamphostomella*
4. Avicularian chamber very long, developed from a pore at the  
proximal end of the zooecium . . . . . *Cystisella*  
Avicularian chamber short, developed from an areolar pore on each  
side of the aperture . . . . . 5
5. Lyrula and cardelles small or wanting, ovicell imperforate *Porella*  
Lyrula and cardelles well developed, ovicell with pores *Smittoidea*
6. Avicularia variously situated on the front, never median and sub-  
oral . . . . . *Parasmittina*  
Avicularia wanting entirely . . . . . 7
7. No lyrula, no umbo . . . . . *Hemicyclopora*  
Lyrula well developed, umbo (mucro) usually present *Mucronella*
8. No lyrula, proximal border of aperture broadly arcuate, ovicell  
closed by operculum . . . . . *Codonellina*  
Lyrula well developed, ovicell not closed by the operculum *Smittina*

## Genus PORELLA Gray, 1848

The frontal is a thick pleurocyst with areolar pores, otherwise imperforate (except rarely a few additional pores near the margins); a suboral median avicularium which is bilateral in origin with narrow tubules extending around the proximal side of the peristome to the areolar pores; lyrula small, short, often also narrow, wanting in some species; cardelles small and low, often wanting. Ovicell hyperstomial, imperforate, often becoming completely embedded with later calcification. Genotype, *Millepora compressa* Sowerby, 1805.

Most of the species have a smooth frontal, the areolar pores are often occluded in older stages, and the suboral avicularia vary in position and form, more or less embraced within the "sinus" fold of the peristome or completely proximal to it, the mandible semicircular or pointed in the different species.

KEY TO THE SPECIES OF *Porella*

1. Zooecia large, the frontal more or less costate, no cardelles, no spines . . . . . *compressa*  
 Zooecia of moderate size, slightly or not at all costate . . . . . 2
2. No oral spines, avicularian mandible pointed . . . . . *acutirostris*  
 Small oral spines (2 to 4), mandible not sharp-pointed . . . . . 3
3. Avicularian chamber large and prominent, with 2 to 6 pores . . . . . *porifera*  
 Avicularian chamber smaller and less prominent, pores usually wanting . . . . . 4
4. Peristome flaring, especially at the proximal end, no lyrula, 4 small evanescent spines . . . . . *patens*  
 The secondary aperture is pyriform, the avicularium projecting over the aperture . . . . . 5
5. Zooecia distinct only when young, ovicell becoming completely embedded . . . . . *concinna*  
 Zooecia remaining distinct, ovicell marginated around the base, lightly striated . . . . . *columbiana*

***Porella compressa* (Sowerby), 1805**

Plate 46, figs. 1-3

*Millepora compressa* Sowerby, 1805:83.

*Eschara cervicornis*, Busk, 1854:92.

*Porella compressa*, Hincks, 1880:330.

The zoarium is erect, bilaminar and branching or flabellate and contorted, arising from an encrusting base to a height of 50 mm. The zooecia are large, averaging about 0.70 mm long, but varying from 0.60 to 1.00 mm, and the width ranges usually between 0.40 and 0.50 mm. The frontal, which is only slightly swollen, is a granular pleurocyst with a row of numerous and well-marked areolar pores and occasionally some additional scattered similar pores near the proximal end; between the areolar pores narrow costal ridges run toward the center; a slightly raised line usually separates the zooecia. The primary aperture is large, about 0.20 mm wide by 0.16 mm long, rounded distally and on the sides, straight on the proximal border where there is a very low lyrula which is nearly as wide as the aperture and which usually cannot be observed except from the inner view of the frontal; cardelles appear to be entirely wanting. The secondary aperture is more or less pyriform, the high, thin peristome rising slightly above the thick frontal wall and enclosing

the suboral avicularium. The avicularium chamber extends laterally to the areolar pores on both sides but is completely embedded in and obscured by the thick front which rises even above the avicularium so that the rounded mandible often may be seen only by tilting the specimen. There are no spines and no additional avicularia.

The ovicell, about 0.24 mm wide, is at first smooth and shining, imperforate, but soon becomes entirely immersed.

This species, the genotype of the genus *Porella*, differs considerably in appearance from most of the other species which are here assigned to *Porella* because of the rougher frontal surface, but the imperforate frontal and ovicell, the low, small (vestigial or incipient) lyrula and cardelles (often wanting), with a suboral avicularium, appear sufficient to characterize the group.

The species is northern Atlantic in distribution, extending into the Arctic where it is apparently circumpolar. Earlier records are often questionable as it was confused with *Smittina (Millepora) cervicornis* (Pallas), which has a perforated frontal and which is more southern in distribution. In the Pacific it has not been reported, but at Point Barrow, Alaska, Prof. G. E. MacGinitie has dredged large foliate specimens (Arctic Research Laboratory).

### ***Porella acutirostris* Smitt, 1867**

Plate 46, fig. 4

*Porella acutirostris* Smitt, 1867:21 and 132.

*Porella major* Hincks, 1884:51.

*Porella acutirostris*, Waters, 1900:83.

*Porella acutirostris*, Osburn, 1912:248; 1923:11D.

*Porella acutirostris*, O'Donoghue, 1923:41.

Zoarium encrusting on stones and shells, usually in the form of white rounded colonies. The zooecia are elongate-ovate and usually regularly disposed in radiating series, the frontal evenly convex and smooth or slightly granulated, with a row of small areolar pores which often become occluded in later calcification. (Zooecial length 0.45 to 0.60 mm, width 0.30 to 0.45 mm.) The primary aperture is rounded distally, straight on the proximal border with a small, short (often scarcely noticeable) lyrula, or none, and the cardelles are minute and inconspicuous or wanting. The peristome is high and thin, connected with the sides of the avicularian rostrum but not enclosing it; when an ovicell is present the peristome is connected with it. The avicularian chamber

is semilunate, broad, extending across the full width of the front to the lateral pores; the rostrum considerably elevated, in the midline and directed toward the aperture which it overhangs slightly; the mandible short-triangular and directed upward and backward at an angle of about 45 degrees.

The ovicell is comparatively large, about 26  $\mu$ m wide, smooth, rounded, prominent and conspicuous; the peristome is sometimes extended across above the orifice in complete calcification.

This is a common northern and arctic species, on the Atlantic coast as far south as Cape Cod and along the Pacific coast from Point Barrow, Alaska, to southern California. O'Donoghue listed it from Round Island and Northumberland Channel, British Columbia.

Hancock Stations: 1224, Newport Harbor channel, and 1067, Santa Barbara Island, southern California, the most southerly localities. Also Tomales Bay, California (R. J. Menzies, collector); Middle Bank, Puget Sound, Washington (J. L. Mohr, collector); Stations 20-40 and 100-40, Alaska Crab Investigation; and Point Barrow, Alaska, Arctic Research Laboratory (G. E. MacGinitie, collector). Shallow water down to 60 fms.

### *Porella porifera* (Hincks), 1884

Plate 46, figs. 9-11

*Porella marsupium* form *porifera* Hincks, 1884:24.

*Porella marsupium* var. *porifera*, O'Donoghue, 1923:40.

*Smittina porifera*, Canu and Bassler, 1923:147.

*Cystisella aviculifera* Canu and Bassler, 1923:152.

*Smittina marsupium* var. *porifera*, O'Donoghue, 1926:69.

The zoarium forms small white encrustations on shells and pebbles. The zooecia vary remarkably in size from the center of the colony outward, from 0.40 to 0.65 mm in length often in the same colony when free-growing on a plane surface; width 0.30 to 0.40 mm; rhomboid to long ovate. The frontal is considerably inflated in young zooecia but may become nearly flat in advanced calcification; the few areolar pores are sometimes occluded with the thickening of the crust. The primary aperture is a little more than a semicircle, and varies in size with the zooecia, from 0.12 to 0.14 mm in width. The peristome is high and thin, united with the avicularian chamber proximally, lower distally where it bears 4 small evanescent spines; with complete calcification the frontal on the sides may rise to the top of the peristome and fuse with it. The chamber of the suboral avicularium is considerably inflated and extends

laterally on both sides to the marginal areolae, and is perforated by a varying number of pores, usually 2 to 6 (the areolar pores of the kenozoecium); the rostrum is elevated, directed slightly over the aperture and bears a small avicularium with a semicircular or slightly triangular mandible. Additional small avicularia are usually present on most of the zooecia. Hincks figured them in several positions (Plate 4, fig. 4), most frequently 1 or 2 near the proximal end of the frontal, but often there are several; occasionally they are wanting on most of the zooecia.

The ovicell is prominent, round and smooth, 0.16 to 0.18 mm in width, the peristome forming a thin lip above the orifice; in very advanced calcification the ovicells may become completely immersed.

Hincks described it from the Queen Charlotte Island and O'Donoghue listed it from a number of British Columbia localities. Canu and Bassler recorded it from the Pleistocene of Santa Monica, California. The latter authors also described the form with numerous avicularia as *Cystisella aviculifera* from the same locality, placing it in that genus because of the absence of lateral areolar pores. However, younger zooecia always show the areolar pores quite distinctly when calcined, small and widely separated with no evidence of costal ridges. It is very probable that the pores of the type material had become occluded with age or fossilization. At any rate it could not remain in the genus *Cystisella* in which the avicularian chamber rises in connection with the proximal areolar pores and extends the full length of the frontal.

Hancock Stations: dredged at numerous stations from the Oregon coast south to Cedros and the San Benito Islands off Lower California, the most southern record at Station 309, Port Culebra, Costa Rica; most abundant about the islands off southern California; 6 to 100 fms.

### **Porella concinna** (Busk), 1854

Plate 46, figs. 5-6

*Lepralia concinna* Busk, 1854:67.

*Porella concinna*, Hincks, 1884:24.

*Porella concinna*, Robertson, 1908:300.

*Porella concinna*, O'Donoghue, 1923:40.

Zoarium encrusting on shells and stones. The zooecia are of moderate size, averaging about 0.50 mm long by 0.35 mm wide, distinct when young but tending to become immersed in a heavy crust. The frontal is a pleurocyst, shining but somewhat rough in the young stage and becoming rougher and very thick with increasing calcification. The areolar pores are few in number and in older specimens may become completely



occluded. The primary aperture measures about 0.15 mm in width, rounded distally but somewhat straighter on the proximal border where it bears a broad but very short lyrula, often wanting. The peristome is moderately high but does not rise much above the level of the thick frontal wall; on the proximal side it is connected with the avicularian chamber. The avicularium is round or nearly so and often projects slightly over the aperture; its chamber is large and prominent, rising like a large blunt umbo. It is roughened like the front and bears a few areolar pores which are not conspicuous. The ovicell is rough like the frontal wall and often bears an umbonate process.

The species is widely distributed in northern waters. Hincks and O'Donoghue recorded it from a number of localities in British Columbian waters and Robertson from San Pedro, southern California.

Not taken in Hancock dredgings. San Juan Island, Puget Sound, (J. L. Mohr, collector); Canoe Bay, Alaska, Sta. 26-40 and 160-41, and Alitak Bay, 100-40, (U. S. Alaska Crab Investigation); Penuk Island, Bering Sea; Point Barrow, Alaska (G. E. MacGinitie, collector).

### *Porella patens* new species

Plate 46, figs. 12-13

Zoarium encrusting on shells and stones, unilaminar, white and shining. Zooecia moderate in size, 0.50 to 0.60 mm long by 0.30 to 0.35 mm wide, usually arranged very regularly in parallel rows when on a smooth surface; very distinct. The frontal is smooth, considerably inflated; several areolar pores on each side, small and often difficult to see except in prepared specimens, often occluded in secondary calcification. The primary aperture is rounded distally and on the sides, the proximal border slightly arcuate and without even a vestige of a lyrula; a small pair of cardelles. The peristome is high, somewhat flaring on the sides which are often raised into short lappets, low on the distal border where there are 4 minute evanescent spines. The secondary aperture subquadrangular in form, much larger than the primary aperture, widest proximally, exposing the whole of the aperture. The suboral avicularian chamber is small but extends laterally on both sides to the areolar pores; often with two pores (the areolar pores of the heterozooecium); the rostrum high, shaped like a truncated cone and bearing on its tip a small rounded avicularium.

The ovicell is high, globular, smooth, the peristome forming a thin lip above the orifice, about 0.20 mm wide and long.

The species differs in the complete absence of a lyrula and in the spreading form of the secondary aperture which is widest at the proximal end.

Type, AHF no. 82.

Type locality, Station 1190, Cortez Bank, just south of the United States-Mexican boundary, 32°24'00"N, 119°02'30"W, 131 fms. Other stations: 1187-40 and 1224, Santa Catalina Island; 1190-40, Anacapa Passage; 1294-41 and 1299, Santa Cruz Island, all from southern California; 2160, San Benito Islands west of Lower California; 270, Angel de la Guardia Island, Gulf of California; 328, Cocos Island off Costa Rica; and Wenman Island, Galapagos. Bathymetric distribution 14 to 150 fms.

### *Porella columbiana* O'Donoghue, 1923

Plate 46, figs. 7-8

*Porella columbiana* O'Donoghue, 1923:41.

*Smittina columbiana*, O'Donoghue, 1926:69.

Zoarium encrusting in a thin, glistening layer. The zooecia are moderate in size, 0.45 to 0.55 mm long by 0.25 to 0.35 mm wide, rather regularly arranged; the frontal ventricose, thin and more or less hyaline in younger stages, somewhat thicker and white when fully calcified; the areolar pores are large and conspicuous at all stages, with short costae which extend toward the center. The primary aperture is slightly wider than long, rounded distally and nearly straight on the proximal border which bears a very low inconspicuous lyrula; the cardelles are minute and often wanting. The peristome is high, especially on the sides, encloses the suboral avicularium proximally and bears 2 or 4 small spines on the low distal border; it fuses with the ovicell of fertile zooecia at the sides but does not develop across the front. The avicularian chamber is considerably inflated in young zooecia, bears about 3 small areolar pores and becomes more or less immersed with age; the rounded rostrum rises above the chamber and projects slightly over the aperture, bearing a semicircular or slightly triangular mandible. No frontal avicularia.

The ovicell is at first rounded, hyaline and shining, about 0.18 mm broad; with increased calcification a broad collar develops around the base, and a thin-walled area is usually present on the top.

Described and listed by O'Donoghue from a number of localities in British Columbia.

Hancock Collections: Redondo Beach and Santa Monica, southern California, a number of colonies on kelp hold-fasts, washed up on the beach (R. C. Osburn, coll.); Friday Harbor, Puget Sound, Washington, collected by Dr. J. L. Mohr. Also dredged at Stations 147-34, Albemarle Island, and 406, 1°03'30"S, 90°17'30"W, Galapagos Islands. The little species is widely distributed along the coast and from shallow water to a depth of 60 fms.

### Genus **SMITTINA** Norman, 1903

*Smittia* Hincks, 1879 (preoc. by Holmgren, 1874).

The frontal is a tremocyst with numerous pores; a suboral median avicularium similar in origin to that of *Porella*; lyrula well developed, and varying in length and breadth; ovicell hyperstomial, usually with numerous perforations similar to the frontal pores. Genotype, *Lepralia landsborovii* Johnston, 1847.

The suboral avicularium is usually included in the peristomial fold of the "sinus," but may be quite proximal to it; the front wall is usually thick and the pores are sometimes much enlarged and infundibulate; frontal avicularia are sometimes present in addition to the constant suboral type; the peristome often overhangs the primary aperture and obscures its characters; the ovicell pores are usually numerous and well distributed, but in a few cases they are limited to 1 or 2 central pores and even these may be occluded in final calcification.

#### KEY TO THE SPECIES OF *Smittina*

1. Ovicells with 1 to 3 central pores, sometimes occluded . . . . . 2  
    Ovicells with numerous distributed pores . . . . . 3
2. Frontal coarsely reticulate; raised separating lines . . . . . *retifrons*  
    Frontal with enlarged pores but not reticulate, no separating lines,  
    1 ooecial pore often closed . . . . . *bella*
3. Zooecia small, not over 0.45 mm in length, numerous very small  
    ooecial pores; avicularian rostrum denticulate . . . . . *smittiella*  
    Zooecia larger, 0.60 mm or more in length . . . . . 4
4. Umbo very high, pointed, obscuring the small avicularium at its  
    base; ovicell costate, much embedded . . . . . *altirostris*  
    Umbo not unusually high, often wanting . . . . . 5
5. Peristome incomplete proximally; avicularium usually wanting;  
    frontal coarsely tuberculate . . . . . *cordata*

- Peristome complete proximally; avicularium usually present;  
 frontal not tuberculate . . . . . 6
6. Peristome high, tubular; avicularian rostrum usually much elevated, in the absence of an avicularium the peristome is circular . . . . . *maccullochae*  
 Peristome not high and tubular . . . . . 7
7. Avicularium not enclosed by peristome, its chamber elongate, mandible elliptical . . . . . *spathulifera*  
 Avicularium enclosed in the peristomial sinus fold . . . . . 8
8. Avicularian rostrum low, chamber small and short; frontal little ventricose . . . . . *landsborovi*  
 Avicularian rostrum higher, projecting over lyrula; ovicell with a transverse groove . . . . . *arctica*

**Smittina landsborovi** (Johnston), 1847

Plate 47, figs. 1-2

*Lepralia landsborovi* Johnston, 1847:310.

*Lepralia landsborovii*, Busk, 1854:66.

*Escharella landsborovii*, Smitt, 1867:92.

*Smittia landsborovii*, Hincks, 1880:341.

*Smittia landsborovii*, Robertson, 1908:305.

*Smittia landsborovii*, O'Donoghue, 1923:42.

*Smittina landsborovii*, O'Donoghue, 1926:66.

Just what the typical form of *landsborovii* may be appears to be in doubt. Johnston's description is brief and his figure (Plate 54, fig. 9) is inadequate, and we can only be certain that the frontal is smooth and thickly perforated, that the secondary aperture is pyriform and that there is an elongate, slender, pointed lyrula. Busk added the suboral avicularium and figures it (Plate 86, fig. 1) as small rounded and enclosed in the proximal fold of the peristome and the lyrula is broad. Smitt certainly confused two other species with it and only his figure 63 (Plate 24) shows the characters indicated by Johnston and Busk. Alder (1864:105) gives a more complete description and his figure (Plate 4, figs. 1-3) is evidently of the same species as those of Johnston and Busk. Hincks confused another species with *landsborovii*, as his figures (Plate 48, figs. 7, 8) with imperforate frontal certainly do not belong to this species. How many other errors have been made in recording *landsborovii* from all parts of the world it is impossible to judge. The form corresponding to the figures of Johnston, Busk and Alder is here described.

Zoarium encrusting (Alder describes it as rising in convoluted frills from an encrusting base) thin and flat. Zoecia large (0.65 to 0.95 mm long, 0.45 to 0.70 mm wide), regularly disposed in series or quincunx, little inflated, the frontal with numerous pores, the marginal ones not enlarged. The primary aperture is rounded, about 0.20 mm wide, with small cardelles and a broad lyrula (in young colonies the lyrula is often narrow, which may explain the pointed lyrulae of Johnston's figure). The peristome is high and thin, enclosing or at least fusing with the rostrum of the suboral avicularium and the secondary aperture is more or less pyriform (subtriangular on ovicelled zoecia). The suboral avicularium is small, little elevated but projecting forward over the lyrula, the chamber small, the mandible semicircular or slightly longer than broad. The large spatulate frontal avicularia described on British specimens have not been found on Pacific colonies.

The ovicell is comparatively small, 0.26 to 0.30 mm broad, prominent at first but later considerably immersed, porous like the frontal.

Cosmopolitan (if the records are all correct). San Pedro, California, Robertson; numerous localities in British Columbia, O'Donoghue.

Hancock Stations: too numerous to list, ranging from the coast of Oregon to the Galapagos Islands. Also from Canoe Bay and Leonard Harbor, Alaska, Alaska Crab Investigation.

### *Smittina spathulifera* (Hincks), 1884

Plate 47, fig. 3

*Smittia spathulifera* Hincks, 1884:52.

The zoarium is encrusting and flat. The zoecia are similar to those of *S. landsborovii*, as large or even larger, sometimes more than 1.00 mm long, little inflated, regularly arranged in quincunx, with a delicate, slightly raised bordering line. The frontal is a tremocyst with numerous, moderately large pores. The primary aperture is also similar, except that the lyrula is even broader, but the secondary aperture is quite different as the peristome does not enclose the avicularium and the lyrula is fully exposed within the short "sinus." The avicularium is at a little distance from the proximal border of the aperture and is not enclosed in the peristome folds, much larger than in *landsborovii*; the mandible is horizontal and short spatulate or long oval; the chamber varies much in size but is always low and flat and appears to be embedded in the frontal wall, sometimes occupying as much as the median third for nearly half of the frontal length. The frontal pores are naturally occluded in the area occupied by the chamber, but in rare cases when the avicularium

is absent the pores extend forward to the aperture. No spines. Ovicell wanting in our specimens, but Hincks describes it as large, immersed, the surface roughened and punctured around the edge.

Houston Stewart Channel, British Columbia (Hincks).

Hancock Stations: 650-37, San Francisco Island, Gulf of California,  $24^{\circ}47'35''N$ ,  $110^{\circ}32'20''W$ , at 47 fms; and 1258-41, Natividad Island, off Lower California,  $27^{\circ}44'17''N$ ,  $115^{\circ}14'20''W$ , at 66 fms. Also a specimen from off San Pedro, southern California, "deep water."

### ***Smittina arctica* (Norman), 1894**

Plate 47, figs. 13-14

*Smittia arctica* Norman, 1894:128.

*Escharella porifera* var. *majuscula* Smitt, 1867:9, Plate 24, figs. 36-38.

*Smittina arctica*, Norman, 1903:121.

*Smittina arctica*, Nordgaard, 1906:29.

Zoarium encrusting. The zooecia are usually quite regular in arrangement, elongate-ovate; the front considerably inflated, a tremocyst evenly perforated with small pores. The primary aperture is about as wide as long, rounded with the proximal border transverse; the lyrula is of moderate width (Norman, 1903:121, describes it as slender, but it is often as wide as it is long); the cardelles small, often scarcely noticeable. The peristome is thin and raised on the sides, embracing the suboral avicularium on the proximal border, more or less fused with the ovicell in fertile zooecia. The avicularian chamber is comparatively small and low, the rostrum projecting slightly over the aperture and bearing a semicircular to subtriangular mandible.

The ovicell is quite prominent in the young stage, more or less embedded later, with a few minute pores or punctures and usually with a transverse groove across the top formed by the union of the secondary covering layers.

This is an arctic species and is probably circumpolar in distribution.

Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

### ***Smittina retifrons* new species**

Plate 47, figs. 6-8

Zoarium encrusting shells and the stems of hydroids, uni- or multi-laminar, white or light yellowish, with a shining ectocyst. The zooecia are elongate-hexagonal, regularly arranged in quincunx, averaging in length about 0.65 mm by 0.50 mm in width, distinct in younger stages

with a raised separating line. The frontal is slightly elevated, with numerous large and evenly distributed pores. The pores expand upward to form large infundibuliform pits separated at their rims by narrow walls which produce a coarsely reticulated surface over the whole front. The primary aperture is like that of *S. landsborovii* (about 0.20 mm wide by 0.18 mm long), with distinct cardelles, but the lyrula is much smaller, seldom as much as one-fourth of the width of the aperture. The secondary aperture is also of the same pattern but is more elevated, especially at the proximal border where it completely surrounds the more elevated avicularium. The avicularium chamber is small (appearing to be entirely median but dissection shows a narrow tube on each side extending to a lateral pore); the rostrum elevated, narrow and longitudinally ribbed nearly to its tip; the mandible is semicircular.

The ovicell is comparatively small (about 0.25 mm wide), rounded and prominent, smooth or slightly roughened, with a single large rounded pore on the top (more rarely there are two or even three smaller pores).

Type, U. S. Nat. Mus., 11030; paratype AHF no. 83.

Type locality, Leonard Harbor, Alaska, 20 fms, Alaska Crab Investigation station 60-40, several colonies. Also at Canoe Bay, Alaska, shore, station 12-40.

### *Smittina bella* (Busk), 1860

Plate 47, figs. 4-5

*Lepralia bella* Busk, 1860:144.

*Smittina bella*, Osburn, 1923:10D; 1933:49.

The zoarium forms flat, smooth and rather regular incrustations on stones and shells. The zooecia are of moderate size, about 0.55 to 0.70 mm long by 0.35 to 0.50 mm wide, arranged quite regularly. The frontal is a tremocyst with moderately large pores, slightly inflated in the young marginal zooecia but becoming quite flat with age so that the zooecial borders are indefinite. The primary aperture (marginal zooecia) is nearly round, straight on the proximal border where there is a short, narrow, truncate lyrula; the cardelles small and low. The primary peristome is low and thin and soon becomes completely obscured by the thick frontal wall which forms the secondary aperture; this is more or less pyriform, at the level of the general crust, and encloses the small median suboral avicularium with a semicircular mandible. In very young marginal zooecia the avicularian chamber is lunate and extends across the front from one areolar pore to another on the opposite side, but the chamber soon becomes

covered by the frontal crust; in older zooecia all that is seen of the avicularium is the mandible enclosed in the proximal border of the secondary aperture.

The ovicell is rounded, about 0.26 mm in width and very soon becomes completely immersed beneath the secondary crust of the two lateral and the distal zooecia which usually leave a large irregular pore at the point of junction.

This is an arctic and northern species, on the Atlantic coast occurring as far south as Mount Desert Island, Maine. Osburn recorded it from Point Barrow and Icy Cape, Alaska (Canadian Arctic Exped.).

Point Barrow, Alaska, G. E. MacGinitie (Arctic Research Laboratory).

### *Smittina smittiella* Osburn, 1947

Plate 47, figs. 11-12

*Smittina smittiella* Osburn, 1947:37.

? *Escharella landsborovi* var. *minuscula*, Smitt, 1873:60.

*Smittina* species, Marcus, 1938:44.

The zoarium is encrusting, small, the largest colonies I have observed are not more than 5 mm across. Apparently they mature very rapidly as zooecia of the second row from the ancestrula are often provided with ovicells.

The zooecia are rather small (average about 0.45 mm long), regularly arranged, distinct, the frontal somewhat inflated and with numerous pores. The primary aperture is rounded, with small cardelles and a broad lyrula with laterally projecting corners. The median avicularium is small, its mandible short oval (a little broader at the tip), elevated and projecting above the lyrula, and the tip of the rostrum is finely serrate or denticulate across its upper border. The avicularian chamber is short but extends laterally on both sides to marginal areolar pores. The peristome is elevated into lappets on the sides, lower but continued around the aperture distally on the infertile zooecia, low proximally and leaving a rather deep secondary sinus on either side of the avicularian rostrum.

The ovicell is comparatively large, about 0.24 mm wide, prominent, with pores similar to the frontal.

Osburn listed the species from the southern shore of the Caribbean Sea and Pensacola, Florida: Smitt's specimen was from Pourtales' Florida collections, and Marcus recorded his "*Smittina* species" (which he assures me, *in litt.*, is *smittiella*) from the Bay of Santos, Brazil. It is therefore a special pleasure to record this little species from the Eastern Pacific.



Hancock Stations: 316-35, Indefatigable Island, 0°33'35"S, 90°10'40"W, 20 fms; 136-34, Albemarle Island, 80 fms; 143-34 off Wenman Island, 100 fms, and 147-34, Albemarle Island, 30 fms, Galapagos; 205-34, La Libertad, Ecuador, 8 to 12 fms.

***Smittina altirostris* new species**

Plate 47, figs. 9-10

Encrusting on a shell. Zooecia characterized by the high, erect, conical process on the median line proximal to the aperture; size moderate, 0.40 to 0.50 mm long by 0.25 to 0.35 mm wide; distinct and separated by deep grooves. The front is a tremocyst with relatively few large pores over the whole surface, considerably ventricose even in complete calcification. The primary aperture is broader than long, about 0.16 mm broad by 0.14 mm long; the lyrula very broad, straight across the tip and the angles extended laterally into points. The suboral avicularium is small, rounded with a semicircular mandible and is difficult to observe beneath the high process. The secondary aperture is pyriform with a rather broad sinus through which the lyrula may be seen, even in older stages. The peristome is moderately thick-walled and extends to the base of the process, enclosing the avicularium. Two or three small distal spines may be present on the younger zooecia, but are very evanescent. The median frontal process is sharp-pointed, granular and white at the tip; rarely there are two of these, one on either side of the midline, and also not infrequently there is a similar but smaller process distal to the aperture on the base of the succeeding zooecium. Frontal avicularia are rare, but a small one with a triangular mandible is occasionally present at the side of the peristome.

Ovicell small, 0.20 mm wide, with radiate costal ridges and much embedded.

Type, AHF no. 84.

Type locality, Nunivak Island, Alaska, one colony, 8 to 10 fms (no further data).

***Smittina maccullochae* new species**

Plate 48, figs. 5-6

*Porella collifera*, Canu and Bassler, 1923:148.

Zoarium encrusting, usually unilaminar, with a rough surface. The zooecia are large and quite variable, ranging from 0.65 to more than 1.00 mm in length by 0.40 to 0.60 mm in width; the most noticeable features being the coarse tremocystal front and the erect tubular peristome

which bears a small suboral avicularium on its proximal lip. The front is evenly arched, except in extreme calcification and there is sometimes a salient thread in the separating grooves; the pores are large, evenly distributed, there is no apparent distinction between the marginal and frontal pores, and there is no umbo or other type of surface irregularity. The primary aperture is rounded, nearly straight on the proximal border with a conspicuous lyrula which is about one-third as wide as the aperture and excavated at the tip. The peristome is an erect tube, continuous around the aperture, usually bearing a small suboral avicularium which is carried up on the edge of the proximal rim, and it is continued on the ovicell above the orifice. The avicularium is small, oval and usually at the level of the peristome but occasionally it is less elevated than the peristome which is then notched proximally; the avicularia are sometimes wanting on some of the zoecia but I have never found them entirely absent on any colony.

The primary ovicell is comparatively small and prominent, but with complete calcification it measures 0.40 to 0.45 mm in width by 0.30 to 0.35 mm in length, thick walled with large pores like the frontal and with the peristome extending across above the orifice.

By some unhappy accident this species was listed by Canu and Bassler from the Pleistocene of Santa Barbara, California, as Robertson's *Smittia collifera*, which is quite another species. Dr. Bassler has kindly checked the identification of his material for me. Aside from Canu and Bassler's reference the species has apparently not been previously observed. It is a fairly common species along shore and about the islands off southern California, not noted north of Santa Barbara, California, nor south of the San Benito Islands, Mexico (Lat. 28°17'15"N).

This species is dedicated to Dr. Irene McCulloch of the Hancock Foundation, whose interest and help have contributed in many ways to the completion of this monograph.

Type, AHF no. 85.

Type locality, Hancock Station 1295-41, Santa Cruz Island, California, 34°00'30"N, 119°31'30"W, at 19 fms. Other localities: Sta. 894-38 and 1279-41, San Miguel Island; 1143-41, Portuguese Point; 1217-41, Point Fermin; 1280-41 and 1283-41, Santa Rosa Island; 1300-41, Santa Cruz Island; 1407-41, Santa Catalina Island, and San Pedro and Newport Harbor, all from southern California. Station 1250-41, San Benito Islands, off Lower California. Also from the Lower Pleistocene, Timms Point, California, collected by G. P. Kanakoff.

**Smittina cordata**, new species

Plate 48, figs. 1-4

Zoarium encrusting, usually unilaminar, the surface often irregular. The zooecia are large, 0.65 to 0.85 mm long by 0.40 to 0.55 mm wide, distinct in younger stages, with a raised line in the separating groove; the frontal is a little inflated, a coarse tremocyst with large pores, the areolar pores usually larger, the frontal granulated in the young but in complete calcification often with irregular umbonate thickenings which occasionally cover nearly all of the frontal area. The primary aperture is subcordate (slightly narrowed distally, but sometimes more nearly round) length 0.22 to 0.25 mm, width 0.20 to 0.22 mm, with distinct cardelles and a small but distinct lyrula which is quadrate, or double pointed. The peristome is thin, somewhat elevated on the sides, less raised on the distal border and usually wanting entirely on the proximal border above the lyrula, which is always fully exposed. Only rarely there is a small oval suboral avicularium which is not enclosed by the peristome; frequently whole colonies are without avicularia and when present they are never numerous and never much elevated, but the chamber extends across the front in a narrow lunate cavity proximal to the aperture.

The ovicell is large, 0.35 to 0.40 mm wide by about 0.30 mm long, thick walled and porous like the frontal.

The most striking feature of this species is the almost complete absence of the suboral avicularia, always rare and often they are wanting over whole colonies. This character, with the usually low peristome gives the aperture a wide open appearance revealing the whole of the lyrula and the proximal border. Occasionally the peristome rises rather high on the sides and more rarely may be complete proximal to the aperture.

Type, AHF no. 86.

Type locality, Catalina Island, southern California, 30 fms. Also at stations 1284-41 and 1410-41, Santa Rosa Island; 1271-41, Anacapa Island; 1232-41 off San Pedro Breakwater; Redondo Beach, and on a shell from an Indian kitchen midden at Dana Point, southern California; 1889-49, Cortez Bank and 871-39, Coronado Islands near the United States-Mexican boundary; Dewey Channel off Point San Eugenio, Lower California; and Raza Island, Gulf of Mexico, 28°48'N, 113°W, the most southern locality. Near shore to 40 fms.

Genus **SMITTOIDEA** new genus

The frontal is a granular pleurocyst, surrounded by a row of conspicuous areolar pores which are separated by short costal ridges. There is a median suboral avicularium, enclosed within the peristomial sinus fold or proximal to it. Lyrula and cardelles well developed. The ovicell is hyperstomial and perforated by numerous, evenly distributed pores. Genotype, *Smittoidea prolifica* Osburn, new species.

KEY TO SPECIES OF *Smittoidea*

1. Avicularium with a long-pointed mandible which is directed backward and located proximal to the peristome . . . . . *reticulata*  
 Avicularium enclosed by the sinus fold of the peristome . . . . . 2
2. Avicularium with a semicircular mandible directed more or less vertically . . . . . *prolifca*  
 Avicularium with a pointed mandible which is directed laterally, more or less enclosed by the sinus fold of the peristome *transversa*

***Smittoidea prolifica*** new species

Plate 48, figs. 7-8

*Smittia reticulata*, Robertson, 1908:306.

Zoarium small, white, encrusting on stones, shells and stems. The zooecia are of moderate size, 0.40 to 0.50 mm long by 0.25 to 0.30 mm wide, ovate or irregularly hexagonal, somewhat swollen and very distinct. The frontal is a pleurocyst, smooth when young but becoming granular with age; a single row of rather large areolar pores and between these are distinct short ribs which run part of the way toward the center. The primary aperture is nearly circular, rounded distally and on the sides and straighter on the proximal border, about 0.13 mm wide by 0.12 mm long; the lyrula large, its tip transverse and the angles usually extended laterally; the cardelles strong, pointed. The peristome rises sharply on the sides, descending to the distal border where there are 2 to 4 evanescent spines; proximally the peristome forms a somewhat quadrate sinus which encloses the suboral avicularium. The avicularian chamber is low and small and connected on each side with an areolar pore by a narrow tubule, the rostrum is somewhat elevated and bears a small rounded avicularium and often partially obscures the lyrula. Frontal avicularia are wanting.

The ovicell is comparatively large, 0.24 to 0.28 mm wide, very prominent, with numerous pores each of which is slightly tubular; the peristome joins the proximal corners of the ovicell but is not continued across the front. The species is unusually prolific, nearly every zooecium, except the first 2 or 3 rows, bearing an ovicell.

This species differs from *S. reticulata*, with which Dr. Robertson placed it, in a number of ways, especially in the nature of the avicularium, the characters of the ovicell and the appearance of the frontal. Miss Robertson described and listed it from La Jolla, California, and the Coronado Islands, just south of the Mexican border. The *S. reticulata* of Okada and Mawatari (1936:64) appears to be the same as they refer to the avicularium as "oval or elliptical, somewhat elevated, placed just below the rimule on the median longitudinal axis of the zooecium." Since the species appears not to have been properly recognized it is named, as a new species, for its remarkable reproductive capacity.

Type, AHF no. 87.

Type locality, Hancock Station 1449-42, Newport Harbor, southern California, on a float, 34°35'47"N, 117°52'55"W. Also taken at Hancock Stations: 1178-40, Santa Catalina Island; 1217-40, Point Fermin; 1232-41, off San Pedro Breakwater; 1283-41, Santa Rosa Island; 1295-41 and 1662-48, Santa Cruz Island; all from southern California. Also Albatross Station 2945, southern California, and San Ignacio Lagoon, Lower California, Dr. C. L. Hubbs, collector. It is a common species on piles and floats and along shore and down to 45 fms, but has not been noted north of Point Conception, California, nor south of the San Ignacio Lagoon, Lower California.

### *Smittoidea reticulata* (MacGillivray), 1842

Plate 48, figs. 9-10

*Lepralia reticulata* J. MacGillivray, 1842:467.

*Smittia reticulata*, Hincks, 1880:346.

*Smittina reticulata*, Nordgaard, 1918:60.

*Smittina reticulata*, Canu and Bassler, 1929:337; 1930:27.

Not *Smittia reticulata*, Robertson, 1908:306 (see *Smittoidea prolifica*).

The zoarium encrusts shells, corallines, etc., small, white or pale yellow. The zooecia are moderate in size, 0.40 to 0.55 mm long by about 0.30 mm wide; ventricose and distinct when young but becoming nearly flat with age; the frontal a coarsely granulated pleurocyst with conspicuous areolar pores which have high ribs between them. The primary aperture measures 0.12 mm in width by 0.10 mm long, rounded with

a more transverse proximal border which bears a moderately large lyrula with laterally extended points; the cardelles are strong and bluntly pointed. The peristome is elevated, thin, bearing 2 to 4 small evanescent spines on the distal border, the proximal border higher and extended proximally into a deep rounded sinus which is broad enough to expose at least a part of the lyrula.

The avicularium is usually median (often slightly to one side of the midline), slightly raised, the narrow and long-pointed mandible directed proximally; it is rather unique in that it is placed entirely proximal to and separated from the fold of the peristomial sinus. In spite of this separation and frontal position the species appears to belong with those which have the median suboral avicularium, as the avicularian chamber is continued as a narrow tubule around the base of the peristome on both sides.

The ovicell is comparatively large, about 0.26 mm wide, the front finely granulated, with numerous small pores, and the base surrounded by a thick collar; becoming more or less immersed with age.

As Marcus (1938:46) has already pointed out, the *S. reticulata* of Robertson, from California, and that of Okada and Mawatari, from Japan, with a rounded avicularium enclosed in the peristomial sinus, cannot be *reticulata* but another species. (See *S. prolifica*.)

The species has a very wide distribution, if the records can be trusted, from Australia, where it was described, to northern Norway and around the world. It has hitherto been noted in the Eastern Pacific only at the Galapagos Islands (Canu and Bassler, 1930:27), and apparently it is not common in this region as only a few colonies were noted at the various localities.

Hancock Stations: 155-34, Albemarle Island; 170-34, Chatham Island; 411, Duncan Island; 430, Wenman Island, and 439, James Island, Galapagos; and 580-36, San Marcos Island; 249, Isla Partida, and 275, Raza Island, Gulf of California. 20 to 150 fms. Also the writer has a specimen from Halape, Hawaii, collected by Dr. R. W. Hiatt.

### *Smittoidea transversa* (Busk), 1884

Plate 48, fig. 11

*Smittia transversa* Busk, 1884:152.

Zoarium encrusting, multilaminar. Zooecia of moderate size, 0.40 to 0.55 mm long by 0.30 to 0.40 mm wide, alternating in series and somewhat hexagonal in form. The front is a slightly ventricose, granulated pleurocyst; the areolar pores conspicuous, with a few additional frontal pores. The primary aperture is nearly round, 0.13 mm wide; the lyrula

moderate (one-third the width of the aperture). The secondary aperture is irregularly pyriform, the peristome with a low lappet on each side and proximally it embraces the transverse avicularium in an unsymmetrical notch; it is wanting distally where 2 small evanescent spines are rarely present. The suboral avicularium is median in character though sometimes slightly at one side of the midline; the elongate curved rostrum often makes it appear assymmetrical when the chamber is median; the mandible is ogival or triangular in form, the tip strongly decurved; the avicularian chamber is not prominent.

The ovicell is rounded or slightly elongate, 0.20 to 0.24 mm wide; a broad collar surrounds the base leaving a central rounded area on the top which is perforated by numerous small pores.

The type of suboral avicularium is unusual. Busk described the species from Australia (Challenger Sta. 163a) and it does not appear to have been noticed since.

Hancock Station 1344-41, south of San Nicholas Island, southern California, 32°53'00"N, 119°23'45"W, one colony at 75 fms.

#### Genus **PARASMITTINA**, new genus

Avicularia variously distributed on the frontal, but never median, suboral and bilaterally symmetrically developed around the proximal border of the aperture; they take their origin from areolar pores on one side. The frontal is a pleurocyst with a row of areolar pores and occasionally there are some additional pores, usually at the proximal end; the lyrula and cardelles usually well developed, though the overhanging peristome in some cases may require dissection to expose them. The ovicell is variously perforated, by numerous small pores, by several larger ones which may vary in size and form, or more rarely by 1 to 3 central pores. Genotype, *Lepralia jeffreysi* Norman, 1876:208.

The essential differences between this group and *Smittina* (*sens str.*) are in the nature of the frontal and the avicularia. The frontal is a pleurocyst, and even in the occasional zoecia which have additional pores inside from the areolar row the pleurocystal layer is seen to develop from the border toward the center; young marginal zoecia show this manner of growth, especially after incineration. The avicularia are various in size, form and distribution, but the chamber is never bilateral; they may be oval, spatulate, short-triangular or long-pointed and range from minute to gigantic, and they may sometimes be interzoecial; not infrequently there may be several forms and sizes on a single zoecium; they often vary greatly on the same zoarium.

KEY TO SPECIES OF *Parasmittina*

1. Ovicell with 2 or 3 large central pores . . . . . *jeffreysi*  
Pores of ovicell more numerous . . . . . 2
2. Peristome high, forming a complete tube . . . . . *tubulata*  
Peristome not forming a high tube . . . . . 3
3. Small, less than 0.45 mm long; lyrula very broad . . . . . *fraseri*  
Larger, 0.50 to 0.60 mm . . . . . 4
4. Giant pointed avicularia directed proximally, small ligulate avicularia at side of aperture . . . . . *crosslandi*  
Giant pointed avicularia directed distally . . . . . 5
5. Giant avicularia long-pointed or subspatulate, not elevated, directed more or less laterally distal to the aperture . . . . . *californica*  
Giant avicularia with the tip elevated, below or at one side of the aperture, directed distally . . . . . 6
6. One to several high frontal tuberosities; giant avicularia with broad triangular mandible, the point much elevated . . . . . *collifera*  
No such frontal tuberosities . . . . . 7
7. Frontal very thick and covered with small round granules, a rounded embedded avicularium at the proximal end . . . . . *alaskensis*  
Frontal only moderately thick, avicularia different . . . . . 8
8. Primary aperture longer than wide, peristome developed only on the sides, avicularia spatulate or oval . . . . . *spathulata*  
Primary aperture not longer than wide, peristome usually developed on the proximal border, avicularia pointed . . . . . *trispinosa*

***Parasmittina trispinosa* (Johnston), 1838**

Plate 49, figs. 7-8

*Discopora trispinosa* Johnston, 1838:222.*Lepralia trispinosa*, Johnston, 1847:324.*Escharella Jacotini*, Smitt, 1867:11.*Smittia trispinosa*, Hincks, 1880:353.*Smittia trispinosa*, Hincks, 1884:25 ("Several varieties occur.")*Smittia trispinosa*, Robertson, 1908:302.*Smittia trispinosa*, O'Donoghue, 1923:43.*Smittina trispinosa*, O'Donoghue, 1926:67.*Smittina trispinosa*, Canu and Bassler, 1930:27.*Smittina trispinosa*, Hastings, 1930:726.

If all the varieties which have been described under this species really belong here, it is probably the most variable species known. It has been given cosmopolitan distribution, which may be quite correct, but it is



also possible that more careful analysis would show further distinctions in various parts of the world. Most of the varieties have been based on the form, size and distribution of the avicularia and the height and form of the peristome and no one can deny the variability of these structures in *P. trispinosa*, but the size and form of the primary aperture, the characters of the operculum, lyrula, cardelles, oecium, etc., have usually been neglected. In all of the numerous specimens similar to *trispinosa* on the Pacific coast, from Alaska to the Galapagos, which have come under my observation, none are exactly like those from western Europe. The nearest approach to identity is among the northern specimens, from Alaska to British Columbia. Farther south the peristome is usually lower and less spout-like and the aperture somewhat larger. The avicularia near the peristome also are usually much larger than in the northern specimens.

The zoarium is encrusting, often becoming multilaminar and nodular or even erected in low folds. The zooecia are moderate in size, 0.45 to 0.60 mm long by about 0.30 mm wide, but varying greatly in both size and form; the primary layer growing on a flat surface is quite regular with the zooecia in parallel series, but in the secondary layers they may be turned in all directions; distinct only in younger growth stages which often are slightly ventricose and have raised separating lines. The frontal is a pleurocyst, granular or irregularly roughened, with a row of areolar pores (occasionally a few additional pores). The primary aperture in marginal zooecia averages 0.11 mm in width by 0.10 mm in length, rounded except on the proximal border where there is a moderately developed lyrula; the condyles small. The peristome is thin, high on the proximal border where it is often somewhat notched, sloping downward on the sides and wanting on the distal border where there are 3 (2 to 4) spines; the overhang of the peristome usually obscures the lyrula and condyles. The avicularia are variable; the most characteristic type is moderately large, located a little proximal and to one side of the peristome, the long-triangular rostrum elevated and directed more or less distally beside the peristome, there is much variation in the size; frequently there are other avicularia, varying in size and form distributed irregularly over the frontal.

Ovicell prominent, the frontal surface usually a little flattened, with moderately large pores that vary in size and form; width 0.26 mm; in full calcification the front often becomes rough and the ovicell much embedded.

The above description applies to more northern and English specimens; farther south on the Pacific coast there are minor differences, such as: the aperture is slightly larger; the giant avicularia are usually larger

and more erected, and there seems to be a tendency toward a larger number of frontal pores in addition to the areolar pores.

In its various forms the species is cosmopolitan. In the Eastern Pacific area it has been noted by Hincks, Robertson, O'Donoghue, Canu and Bassler and Hastings, all the way from British Columbia south to the Galapagos Islands.

Hancock Stations: dredged and collected along shore at more than 60 stations from Oregon to the Galapagos Islands. In the collections also are specimens from Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector; from southern Alaska; and from Puget Sound, Dr. J. L. Mohr, collector.

### *Parasmittina jeffreysi* (Norman), 1876

Plate 49, figs. 5-6

*Lepralia Jeffreysi* Norman, 1876:208.

*Smittina Jeffreysi*, Norman, 1903:120.

*Smittina Jeffreysii*, Levinsen, 1916:458.

Zoarium broadly encrusting, or rising into tubular or folded expansions which are sometimes branched. The zooecia near the growing edge are moderately large, averaging about 0.65 mm long by 0.40 mm wide, regularly arranged in quincunx, elongate-ovoid with the proximal end usually narrowed between the adjoining zooecia. The frontal is only slightly elevated, a granulated pleurocyst with a row of conspicuous areolar pores. The primary aperture measures about 0.16 mm in either direction, broadest at the proximal end which is nearly straight; cardelles of moderate size; the lyrula broad at the base and narrowed toward the tip which is truncate. The peristome is low, slightly higher on the sides, usually exposing the whole of the aperture; the distal border with 2 to 4 evanescent spines. There are two kinds of avicularia; a large triangular one on the front proximal to and at one side of the aperture, the rostrum elevated and the pointed mandible directed forward beside the peristome, frequently wanting, and smaller elliptical avicularia scattered over the front, sometimes numerous, not elevated and variously oriented.

The ovicell is prominent, rounded, large (0.35 to 0.40 mm wide), the surface granulated like the frontal and bearing 3 (2 to 4) conspicuous pores, each with a slight collar.

This is a common arctic species known from Spitzbergen to Greenland and south to Labrador.

Very common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory. Evidently it is circumpolar in distribution.

**Parasmittina spathulata** (Smitt), 1873

Plate 49, figs. 12-14

*Escharella Jacotini* var. *spathulata* Smitt, 1873:60.*Smittina trispinosa* var. *spathulata*, Osburn, 1914:208; 1927:29,  
(*spathulosa*, by error); 1940:435.*Smittina trispinosa spathulata*, Canu and Bassler, 1928:114.

Zoarium encrusting, usually in a flat smooth layer, white and shining. Zooecia moderately large, 0.55 to 0.75 mm long by 0.40 to 0.50 mm wide, indistinct but sometimes there is a low separating line; the front nearly flat, a pleurocyst with small shining granules; areolar pores of moderate size. The primary aperture is slightly longer than wide, 0.14 mm long by 0.12 mm wide; the rather narrow lyrula always visible, the cardelles larger than usual in the genus. The peristome is limited to a distinct lappet on each side. The avicularia are usually spatulate or oval, but may be ligulate or more rarely pointed, variously located, and usually directed proximally; sometimes there is a large spatulate avicularium at one side of the aperture directed proximally.

The ovicell is round, about 0.26 mm wide, moderately prominent, with a few rather large pores; the peristome connects with it and may be continued across the border of the orifice; in older stages the pleurocyst of the succeeding zooecium may form a basal collar and may even cover a considerable portion of the ovicell.

It is an abundant form in the Gulf of Mexico and the Caribbean Sea and apparently has not been reported elsewhere. The *S. reticulata* var. *spathulata* of MacGillivray, 1882:135, is evidently a different species. I believe the characters are sufficiently different to warrant its elevation to specific rank, especially on the basis of the elongate primary aperture and the nature of the secondary aperture.

Hancock Stations: 55-33, Charles Island; 143-34, Wenman Island; 155-34, Albemarle Island, and 201-34, Hood Island, all from the Galapagos Islands. 25 to 100 fms.

**Parasmittina californica** (Robertson), 1908

Plate 51, figs. 8-11

*Mucronella californica* Robertson, 1908:308.

Zoarium encrusting, rather coarse. Zooecia moderately large, averaging about 0.60 mm long by 0.40 mm wide, irregularly quadrangular, distinct with rather deep grooves. The front wall is heavily calcified; it has somewhat the appearance of a tremocyst with a small number of large infundibuliform pores similar in size to the areolar pores, but the

secondary layer is laid down by growth from the areolar pores toward the center in the fashion of a pleurocyst. The peristome is thin and usually low, but sometimes rises to a considerable height on the sides and may surround the proximal border of the aperture. The primary aperture is nearly round, only slightly wider than long (0.15 mm wide); the lyrula moderately developed, not more than one-third the width of the aperture, transverse at the tip and the corners not extended.

Small, pointed, oval or short-spatulate avicularia are variously distributed on the front and usually directed laterally; at the side of the peristome there is frequently a giant avicularium with a long sub-spatulate mandible (the sides gradually narrowing toward the tip) directed forward and often somewhat curved around the peristome, the mandible as long as 0.40 mm but usually shorter. The oral spines number one to three, small and very evanescent.

The ovicell is large, about 0.35 mm in width, roughened and heavily calcified like the frontal, with a few large pores and with the peristome extended across the front.

This is evidently the species which Dr. Robertson described as a *Mucronella*, but the supposed mucro is undoubtedly a lyrula and the peristome extends behind it; the presence of avicularia similar to those common in *Parasmittina* and the nature of the ovicell also relate it to the latter genus. Robertson recorded it from "several localities on the coast of southern California," and "dredged off the island of Santa Catalina."

As in many other species there is a distinct bathymetric change to the southward; all of the southern California localities are less than 50 fms, those in Mexican waters are around 50 to 60, and the one Galapagos station was 100 to 150 fms.

Hancock Stations: 1281-41, Santa Rosa Island; 1327-41, San Clemente Island; off Santa Catalina Island, off La Jolla and several other localities without specific data, southern California. Stations 1008-39 and 1250-41, San Benito Islands, and 1264-41, Cedros Island, off Lower California; 557-36, Isla Partida, Gulf of California, and 143-34, Wenman Island, Galapagos.

### ***Parasmittina collifera* (Robertson), 1908**

Plate 49, figs. 9-11

*Smittia collifera* Robertson, 1908:304.

*Smittia collifera*, O'Donoghue, 1923:43.

*Smittina collifera*, O'Donoghue, 1926:68.

(Not "*Porella collifera* Robertson," Canu and Bassler, 1923:148.)

Zoarium encrusting, the secondary layers often rough and nodulous. Zooecia of moderate size, averaging about 0.50 mm long (range 0.40 to 0.65 mm), the width between 0.30 and 0.40 mm. In the primary layer the zooecia are regularly disposed in quincunx, the form ovate or elongate-hexagonal; the frontal is a coarsely granulated pleurocyst, with moderately large areolar pores and usually a few additional pores (especially near the proximal end). The extra frontal pores often give the appearance of a tremocyst, but this is nullified by their occasional complete absence, and in young zooecia the pleurocyst may be observed to develop from the zooecial borders above the olocyst. The frontal prominences or colli (hills) which characterize the species are often but little developed on the primary layer, usually 1 to 3 small but rather high, erect knobs, but in later growth the tubercles may be broad and heavy and sometimes nearly cover the front.

The primary aperture is nearly round, slightly longer than broad (0.16 mm long by 0.15 mm wide), with strong cardelles and a moderate lyrula which is considerably wider at its base and truncate at the tip. The peristome is thin and little elevated, sometimes forming a secondary sinus on the proximal border but always leaving the lyrula and aperture well exposed; 2 long spines are present on the distal border in young zooecia. The avicularia are of three kinds: (1) small to large, semi-erect, with a triangular mandible directed distally, located proximal to and usually at one side of the peristome; (2) small ovate avicularia variously situated on the front or replacing the triangular ones beside the aperture; (3) rarely an elongate-spatulate avicularium replacing an oval one on the frontal.

The ovicell is large, 0.25 to 0.30 mm in width, rounded and conspicuous, with several (6 to 8) large pores which vary in size, form and disposition; with complete calcification the ooecial cover often becomes very rough, with protuberances similar to those on the frontal.

This species is evidently a member of the *S. trispinosa* group, but it is differentiated by its larger size, especially of the primary aperture, and by the conspicuous erect frontal nodules or protuberances. Described from the Coronado Islands, Mexico, a little south of the harbor of San Diego, California, which appears to be about its southern limit. O'Donoghue listed it from numerous localities in British Columbia.

Hancock Stations: dredged at numerous localities from Oregon south to the islands off the coast of southern California; common also at various shore stations.

**Parasmittina crosslandi** (Hastings), 1930

Plate 48, fig. 12

*Smittina crosslandi* Hastings, 1930:726.*Smittina trispinosa*, Canu and Bassler, 1930:27 (in part).

Zoarium variable in form, the primary layer often broadly encrusting, the secondary, multilamellar growth nodular and frequently rising to form rounded, crooked stems, which branch irregularly; scarcely any two colonies entirely alike in form.

Zooecia of the primary layer rather regularly arranged in quincunx, elongate-hexagonal or somewhat quadrate, distinct with a raised separating line, average length 0.45 mm (0.40 to 0.65), width about 0.30 (0.25 to 0.40) mm. In the secondary layers the zooecia vary greatly in form and arrangement. The frontal is a granular pleurocyst with a row of rather large areolar pores around the margin. The primary aperture is rounded, more transverse on the proximal border, with well developed cardelles and moderate lyrula which is long and truncate at the tip; width 0.10 or 0.11 mm. The secondary aperture is "spout-shaped," the peristome high on the sides, descending toward the distal border and with a deep narrow "sinus" on the proximal border, the lateral wall sometimes slightly folded in older zooecia. In marginal zooecia 3 to 5 oral spines are often present. The avicularia are various, small or large long-pointed ones near the aperture and directed proximally, small ligulate ones beside the aperture, and small to large oval ones on the frontal, all directed proximally; there is much irregularity in their occurrence, but the small ligulate ones are the most characteristic.

The oecia are rounded, prominent, with numerous small pores, the base surrounded by a moderately thick collar, and the peristome is continued in a thin ridge above the orifice.

The species was described from Taboga Island, Panama, and also listed from Gorgona, Colombia, and the Galapagos Islands. The *S. trispinosa* of Canu and Bassler, from the Galapagos, at least in part, belongs under *crosslandi*.

Hancock Stations: 24 stations about the Galapagos Islands, with numerous others shorewise northward from Colombia to the Gulf of California. The most northerly record is Station 277, Tiburon Island, 28°43'45"N, 112°15'30"W. It is the commonest species of the genus within this range, from near shore to more than 100 fms.

**Parasmittina alaskensis** new species

Plate 48, fig. 13

Zoarium encrusting on a shell, pale yellow, glistening. Zooecia moderate in size, 0.55 to 0.70 mm long by 0.35 to 0.40 mm wide, irregularly ovate, distinct with deep grooves in the young, indistinct with complete calcification. The frontal is a very thick pleurocyst, heavily granulated, a low pointed umbonate process near the aperture; a single row of conspicuous areolar pores with short ribs between them which do not extend upon the front. The primary aperture is nearly round, 0.13 mm wide by 0.12 mm long, straight on the proximal border with a moderate lyrula. The peristome is somewhat elevated all around the aperture, except for a short space on the distal border where there are 2 strong but evanescent spines; cardelles wanting. The secondary aperture is ovate in form, usually exposing the lyrula. The avicularia are of two kinds; a round or short-ovate one at or near the proximal end, usually immediately distal to the aperture of the preceding zoecium, with a heavy cross-bar and becoming deeply sunk in the crust in older zoecia; the other type is pointed, with a triangular mandible and elevated rostrum, located a little proximal to the aperture, on one or both sides, the mandible directed toward the aperture.

The most striking characters are the heavily and evenly granulated front, the simple ovate secondary aperture and the round, sunken avicularium which is usually in the midline at the extreme proximal end.

The one colony has no ovicells.

Type, U. S. Nat. Mus., 11035.

Type locality, Point Barrow, Alaska, 25 fms, Arctic Research Laboratory, G. E. MacGinitie, collector.

**Parasmittina fraseri** new species

Plate 49, fig. 15

Zoarium encrusting, small, white and glistening, a very attractive little species. The zooecia are rather small, 0.35 to 0.45 mm long by about 0.26 mm wide; alternating in series; younger individuals somewhat ventricose and separated by deep grooves, later more nearly flat. Frontal pleurocyst irregularly reticulate over the surface, the areolar pores moderately large with short costae between. Primary aperture small, 0.10 mm wide, rounded, with a very broad lyrula (almost as broad as the aperture) which has a straight border, and with minute cardelles. The lyrula is so hidden by the peristome that it is difficult

to see. The peristome is thin, a little elevated all around the aperture, more so on the proximal border where two longer points enclose a rounded secondary sinus. Three to five oral spines are present in young stages but soon disappear.

Small rounded or elliptical avicularia occur in various positions on the front and occasionally on one or both sides of the peristome opposite the notch, the mandible directed upward on the side of the peristome. On one colony there is a single long-pointed frontal avicularium, the mandible directed laterally.

The ovicell is small, about 0.18 mm wide including the secondary border, low and bordered by the pleurocyst of the succeeding zoecium, leaving a rounded frontal area which is finely and regularly porous; the peristome is connected with the sides of the ovicell and in complete calcification forms a low collar around the orifice.

Dedicated to the late Dr. C. McLean Fraser of the University of British Columbia.

Type, AHF no. 89.

Type locality, Station 136-34, Sulphur Bay, Clarion Island, west of Mexico, 18°20'05"N, 114°44'40"W, 32 fathoms. Taken also at Station 23-33, off La Plata Island, Ecuador, 10 fathoms; 155-34, Tagus Cove, Albemarle Island, Galapagos, 50 to 60 fathoms, and 224, Benito Islands, off Lower California. As the colonies are very small and inconspicuous, it may be much more common than the above records indicate.

### ***Parasmittina tubulata* new species**

Plate 49, figs. 1-4

Zoarium encrusting, loosely attached, the surface very rough because of the erect tubular peristomes. Zooecia irregularly ovate or quadrate, distinct, large but varying much in size (length 0.70 to 1.00 mm, width 0.40 to 0.60 mm). The front is slightly ventricose, smooth or with small granules; the thin pleurocyst is perforated by a series of small areolar pores and often by a few additional ones. The primary aperture is rounded, 0.16 to 1.18 mm wide, with a moderately long and narrow lyrula (one-fourth as wide as the aperture). Spines wanting. The peristome is extraordinarily high (as much as 0.50 mm), completely surrounding the aperture and with a conspicuous U-shaped or slit-like secondary sinus in the proximal tip; in younger stages the border is smooth, but in complete calcification the rim of the peristome expands slightly and its distal border bears 3 or 4 stout pointed processes; in



the fertile zooecia the peristome develops across the front of the ovicell and continues to form an erect tube similar to that of the infertile zooecia. The aperture and lyrula can only be observed on very young zooecia or after dissection.

Several types of avicularia are present: 1, small short-spatulate ones on the front, variously situated and oriented; 2, giant broad-spatulate, also on the front, usually directed backward; 3, small pointed or sub-spatulate ones on one or both sides of the peristome; 4, a large pointed one often extending upward on the side of the peristome, the rostrum elevated and pointing at nearly a right angle from the peristomial wall.

The ovicell is large, 0.40 mm wide, resting on the succeeding zooecium, globular, its base surrounded by a low, smooth collar, the front evenly perforated with small pores; the peristome continues around the border of the orifice without a break to complete the high tube.

In certain respects this species appears to be close to *S. labellum* Canu and Bassler (1928:116) from the Gulf of Mexico, but the great height of the peristomes, the lack of oral spines, the much larger primary aperture and the nature of the peristomial avicularia are sufficient to differentiate it. It has even more resemblance to *S. projecta* Okada and Mawatari (1936:66) from Japan, but the peristomial rim is complete, without oral spines, the peristomial avicularia do not have a serrated rostrum, the areolar pores are inconspicuous, and the ovicell appears to be much larger.

Type, AHF no. 90.

Type locality, Hancock Station 1978-50, south end of Ranger Bank, west of Lower California, 28°26'45"N, 115°31'30"W, 71 fms. Also Station 1271-41, west of Point Dume, southern California, 34°00'20"N, 119°01'30"W, 48 fms. Also off Rocky Point, California, 45 fms, Earl Fox, collector.

### ? *Smittia californiensis* Robertson, 1908:303

What this species may be has puzzled me greatly as I am completely unable to interpret Dr. Robertson's description in terms of any Smittinid species, and unfortunately her types seem to have been lost. She refers to it as common along the California coast from between tide marks to 50 fathoms. Such expressions as: "a thick, coarse, spiny crust of a dark gray color"; "primary orifice orbicular, closed by a dark-colored operculum"; and "interspersed between the zooecia are large spatulate avicularia," certainly do not apply to any local species of the Smittinidae. However, they do apply to *Holoporella brunnea* Hincks, which she

does not mention but which is one of the commonest species in the area cited. On the other hand her figure 71 on plate 22 definitely shows a lyrula and peristome of the smittinid type.

The genus *Holoporella* Waters was not established until 1909, a year after Robertson's paper was published. How so careful an observer could confuse a celleporoid species with the Smittinidae is difficult to understand, but it seems that is what happened as the description is mostly that of *H. brunnea* and the figure also, with the exception of the lyrula and peristome. The name should be dropped from the literature.

#### Genus **CODONELLINA** Canu and Bassler, 1934

*Codonella* Canu and Bassler, 1930:29, preoccupied and changed, 1934:407, to *Codonellina*.

The ovicell is hyperstomial, closed by the operculum, porous and marginated. The frontal is a tremocyst. A median avicularium is placed before the aperture. The peristome is salient and complete. The aperture is suborbicular with a very concave poster; the peristomice bears two false cardelles, limiting a broad rounded sinus (Canu and Bassler). Genotype, *Lepralia galeata* Busk, 1852.

The general appearance is that of a member of the Schizoporellidae, but the delicate nature of the operculum, without sclerites, and the suboral avicularium which communicates with an areolar pore on each side, appear to ally it to the Smittinidae.

#### **Codonellina anatina** (Canu and Bassler), 1927

Plate 46, figs. 14-15

*Codonella anatina* Canu and Bassler, 1927:26.

*Codonella granulata* Canu and Bassler, 1930:29.

*Codonella granulata*?, Hastings, 1930:725.

Zoarium encrusting in a thin, white, shining layer. Zooecia moderately large, unusually variable, ranging all the way from 0.45 to 0.90 mm long by 0.26 to 0.45 mm wide, distinct with deep grooves; the frontal is evenly arched, a tremocyst with numerous small pores, smooth but becoming finely granulated in advanced calcification; the aperture rounded or slightly quadrangular, about 0.16 mm in either dimension, a pair of small but distinct cardelles limit a broad shallow poster. The peristome is smooth and somewhat elevated all around the aperture. A small pointed avicularium, directed proximally, is usually present in the midline proximal to the aperture, but it is sometimes asymmetri-

cally located, and it may be replaced by a larger spatulate avicularium, or sometimes wanting. There is much variation in the size and form of the mandible, the tip of the triangular form is sometimes rounded (subspatulate) and the spatulate mandible varies in size and is occasionally so narrow as to be almost filiform; the spatulate avicularia may sometimes be half as long as a zoecium.

The ovicell is hyperstomial, rounded, 0.26 to 0.30 mm wide and long, with numerous pores and a raised border about the base; the peristome fuses with the ovicell at the sides of the aperture but is not continued across the front.

From the data at hand it seems that *C. granulata*, described from the Galapagos Islands, is synonymous with *C. anatina* from Hawaii. Canu and Bassler found only the small triangular avicularia on their Galapagos material and among our specimens there are several colonies in this condition. Hastings found spatulate avicularia in her Galapagos specimens and they are present, but not constant, in our material from the Galapagos and the Gulf of Mexico. The measurements are quite variable, transcending in both directions those given for *anatina*. The giant avicularia of Hawaiian specimens appear to be larger than any from the Galapagos and if this should prove to be a constant feature *granulata* may be worthy of varietal status.

Hancock Stations: dredged at 14 stations among the Galapagos Islands, Albemarle, James, Charles, Hood, Chatham, Albany, Onslow and Wenman Islands; and three stations in the Gulf of California at Angel de la Guardia, Isla Partida and Raza Islands, near 29°N Lat. The known bathymetric range is from 14 to more than 100 fms.

### *Codonellina anatina ligulata* new variety

This form is rather more distinct than *granulata* in lacking entirely the small median suboral avicularium. The spatulate avicularia, occasionally present, are narrower than those described for *anatina*, but are of the same general character, about 0.26 mm long, variously located on the front and without any definite orientation, turned sometimes forward, sometimes backward or diagonally. The zoecia are smaller than the usual measurements of the species, length 0.40 to 0.55 mm, the aperture about 0.13 mm in either direction and the ovicell 0.26 mm wide. The other characters agree with typical *anatina*.

Type, AHF no. 91.

Type locality, Hancock Station 210-34, Santa Elena Bay, Ecuador, 2°11'25"S, 80°58'W, at 5 to 7 fms, three colonies.

**Codonellina cribriformis** (O'Donoghue), 1923

Plate 46, fig. 16

*Porella cribriformis* O'Donoghue, 1923:42; 1926:72.*Codonella cribriformis*, Canu and Bassler, 1930:29.

O'Donoghue's description is good, but incomplete; his figure 30, plate 4, is excellent. Zoarium encrusting. Zooecia moderate in size, 0.50 to 0.65 mm long by 0.30 to 0.40 mm wide, long ovate to hexagonal, somewhat ventricose and very distinct, sometimes with a raised separating line. The frontal is a moderately thick tremocyst with large, regularly spaced pores, shining, hyaline in younger stages, smooth to slightly granular. The aperture is nearly circular, 0.13 by 0.13 mm, with small cardelles between which the broad shallow poster extends, slightly arcuated. The operculum is a little chitinized, with a narrow brownish bordering sclerite; muscle attachments near the border. The peristome is thin, moderately elevated all around the aperture, without spines and fusing with the avicularian chamber proximally. The median suboral avicularium is elevated, the mandible usually semicircular but sometimes considerably enlarged and short-spatulate; the avicularian chamber is connected with lateral pores on both sides around the base of the peristome by small tubes to lateral pores, as it is in *Porella*.

The ovicell is hemispherical, partially embedded, a little flattened on the upper surface, with numerous pores which vary in size and form; slightly collared about the base; 0.26 mm wide.

Described by O'Donoghue from Departure Bay and listed by him from several other localities in British Columbia and from the San Juan Islands in Puget Sound, 15 to 35 fms.

Specimens in the Hancock collections are from Cadboro Bay, British Columbia.

**Genus RHAMPHOSTOMELLA** Lorenz, 1886

Aperture with an asymmetrical poster and a lyrula; frontal an olocyst with costules; a large oblique avicularium excentrically placed below the aperture; ovicell hyperstomial, prominent and closed by the operculum. Genotype, *R. costata* Lorenz, 1886:12.

The lyrula is variable in size and wanting in some species; the primary aperture is not always asymmetrical; oral spines are present in at least one species, and frontal avicularia are sometimes present. Most of the species are arctic or at least northern in distribution.

Among the species here dealt with there are two rather distinct subdivisions, based especially on the form of the primary aperture. In the first group, those like the genotype, *R. costata* Lorenz, there are no cardelles and the proximal border is broadly arcuate (only modified by the median lyrula, when this is present). In general these species are also much more heavily calcified, the costules run up on the front and frontal avicularia are often present. This group includes, besides the genotype, *R. scabra* (Fabricius), *R. fortissima* Bidentkap, *R. hincksi* Nordgaard, *R. ovata* (Smitt) and *R. gigantea* Osburn new species.

The second group shows a very distinctive bisinuate outline of the proximal border of the primary aperture, with a deep rounded "sinus" on either side between the lyrula and the cardelles, which are usually quite distinct. The frontal is usually plain, the wall is thinner, the costules do not run up on the frontal, and frontal avicularia are wanting. In this group are *R. bilaminata* (Hincks), *R. spinigera* Lorenz, *R. curvirostrata* O'Donoghue, and *R. townsendi* Osburn new species.

Probably *R. ovata* (Smitt), which has a perforated frontal and an imperforate ovicell should be placed by itself, but *R. gigantea* also has some additional frontal pores and there is much variation throughout the group.

KEY TO SPECIES OF *Rhamphostomella*

- 1. Frontal pores present, ovicell imperforate . . . . . 2
  - Frontal with areolar pores only, ovicell with pores . . . . . 3
- 2. Zoecia of moderate size, frontal little granulated . . . . . *ovata*
  - Zoecia very large (over 1 mm long), frontal excessively thick and rough . . . . . *gigantea*
- 3. Lyrula and cardelles both wanting . . . . . *hincksi*
  - Lyrula or cardelles or both present . . . . . 4
- 4. Lyrula and cardelles both present, proximal border of primary aperture bisinuate . . . . . 5
  - Lyrula present, cardelles wanting . . . . . 9
- 5. Oral spines present . . . . . *spinigera*
  - No oral spines . . . . . 6
- 6. Avicularian process high and flabellate, with a similar peristomial lappet opposite . . . . . *bilaminata*
  - No flabellate process opposite the avicularium . . . . . 7
- 7. Avicularian rostrum and mandible curved laterally across the aperture . . . . . *curvirostrata*
  - Rostrum and mandible shorter and not curved over the aperture 8

8. Avicularium large and prominent . . . . . *townsendi*  
 Avicularium very small, conforming to the margin of the peri-  
 stome . . . . . *cellata*
9. Numerous giant frontal avicularia . . . . . *fortissima*  
 Frontal avicularia, when present, smaller; a high pointed umbo  
 with costal ridges . . . . . *costata*

**Rhamphostomella costata** Lorenz, 1886

Plate 50, fig. 7

*Rhamphostomella costata* Lorenz, 1886:12.

*Rhamphostomella costata*, Nordgaard, 1906:30.

*Rhamphostomella costata*, Osburn, 1912:244; 1919:610.

*Rhamphostomella costata*, O'Donoghue, 1923:44; 1926:72.

Encrusting, usually on stems and rising into flabellate bilaminar expansions or contorted folds. The zooecia are large, 0.60 to 0.90 mm long by 0.40 to 0.50 mm wide; distinct, the frontal arched and rising into a high pointed umbonate process on the top of the avicularian chamber which covers practically all of the width of the front; there is a row of large areolar pores, between which strong costal bars run up even to the tip of the umbonate process. This process is higher than in the other species of the genus, a little asymmetrical in position, and its tip is often developed into a transverse bar (variety *cristata* Hincks). The primary aperture is round distally, the proximal border somewhat straighter and a little asymmetrical, without cardelles, but with a small lyrula which is often wanting. The secondary aperture is usually a little angulated proximally, due to the overhanging base of the umbonate process. A moderately large avicularium, with a subspatulate mandible is located at the side of the base of the process and directed vertically. Frontal avicularia with a triangular mandible are found on most of the zoaria, located near the proximal end of the zooecia.

The ovicell is large, about 0.40 mm wide, prominent, perforated with large pores, more or less submerged by advanced calcification.

A common arctic and northern species, extending down the Atlantic coast to Cape Cod, Massachusetts, and on the Pacific coast to Puget Sound. Recorded by O'Donoghue from a number of British Columbia localities.

Point Barrow, Alaska, down to 23 fms, G. E. MacGinitie, collector (Arctic Research Laboratory). Also from Friday Harbor, San Juan Island, Puget Sound, Dr. J. L. Mohr, collector.

**Rhamphostomella fortissima** Bidenkap, 1900

Plate 50, figs. 1-2

*Rhamphostomella fortissima* Bidenkap, 1900:524.*Discopora scabra* var. *fortissima*, Nordgaard, 1918:78.

This species bears a close resemblance to *R. costata* in the younger stages and the measurements are close, though in our specimens the primary aperture is somewhat larger (about 0.26 mm in either dimension). Possibly Nordgaard is correct in giving it merely varietal status, but in our specimens the costae do not extend beyond the base of the umbo, the secondary calcification is much heavier, and raised frontal avicularia of huge proportions are abundantly distributed over the surface.

Recorded by Bidenkap and Nordgaard from Spitsbergen and several of the northern fjords of Norway.

Point Barrow, Alaska, 23 fms, Arctic Research Laboratory, Prof. G. E. MacGinitie, collector, several colonies.

**Rhamphostomella bilaminata** (Hincks), 1877

Plate 52, fig. 10

*Cellepora bilaminata* Hincks, 1877:111.*Rhamphostomella bilaminata*, Lorenz, 1886:13.*Discopora bilaminata*, Levinsen, 1916:461.*Rhamphostomella bilaminata*, Osburn, 1923:10D.*Rhamphostomella porosa*, O'Donoghue, 1923:45.

Zoarium encrusting on various surfaces, frequently on hydroid stems where they rise into bilaminate folds. Zooecia of moderate size, 0.65 to 0.75 mm long by 0.40 to 0.45 mm wide; the front nearly flat, smooth or with short costae which do not run to the base of the umbonate process, areolar pores large but indistinct because of the crowding together of the zooecia. The primary aperture is rounded, about 0.20 mm in either dimension, the proximal border bisinuate with a small cardelle at each side and a bifurcate lyrula in the midline, deeply immersed within the peristome. On the proximal border there is a moderate-sized avicularian chamber, asymmetrically located, the rostrum high and lobed; a spatulate mandible; opposite this is a high peristomial lappet of similar form, the two producing a large slit-like sinus in the secondary aperture.

The ovicells at first are hemispherical and prominent, about 0.40 mm wide, with large pores, but with advancing calcification they become almost completely immersed.

It is a common arctic and northern species, occurring on the Atlantic coast as far south as Cape Cod, Massachusetts; abundant in the waters about Greenland, and recorded as far west as Icy Cape, Alaska (Osburn, Canadian Arctic Exped.). It has not been reported south of Alaska, except for O'Donoghue's record of *R. porosa* at Cape Ebenshaw, British Columbia. O'Donoghue recognized the similarity to *bilaminata*, but the distinguishing characters which he indicates for *porosa* (viz., "the far larger size of the rostrum and peristome") are within the range of variation of *bilaminata*.

U. S. Alaska Crab Investigation, Leonard Harbor, Alaska, station 60-40, at 25 fms; also at Point Barrow, Alaska, Arctic Research Laboratory, down to 23 fms. G. E. MacGinitie, collector.

### *Rhamphostomella hincksi* Nordgaard, 1906

Plate 50, fig. 3

*Rhamphostomella hincksi* Nordgaard, 1906:31.

*Cellepora plicata*, Hincks, 1877:106.

Zoarium encrusting on various surfaces. Zoecia moderately large, 0.70 to 0.85 mm long by 0.45 to 0.55 mm wide: frontal somewhat inflated, smooth, with a row of conspicuous areolar pores between which costal ribs run up for a short distance on the front (occasionally to the base of the rostrum) as noted by Hincks and Nordgaard. The primary aperture is nearly round, about 0.26 mm in either dimension, a little narrower and slightly asymmetrical proximally, and without either cardelles or lyrula (as noted by Nordgaard). Proximal to the aperture and asymmetrically placed is a moderate-sized bulbous avicularian chamber, the rostrum high and extending somewhat over the aperture; the distal wall of the rostrum is nearly straight and set at an angle to the midline and a peristomial lappet is directed in the same manner on the opposite side so that the secondary aperture is angulated proximally (a condition which no doubt led Hincks to place this species under *R. plicata*). The mandible is short-spatulate or a little narrowed terminally.

The ovicell is large, 0.35 to 0.40 mm wide and 0.30 to 0.35 mm long, prominent, smooth or roughened around the sides, with several frontal pores and the area above the orifice a little flattened.

The complete absence of lyrula and cardelles seems to ally this species with *R. scabra* (Fabricius) rather than *R. plicata* (Smitt).



Recorded by Nordgaard from several places in the Greenland area, and from Iceland by Hincks.

Point Barrow, Alaska, 25 fms, Arctic Research Laboratory, G. E. MacGinitie, collector. Also a specimen from Tuan Island, Pavlof Bay, Alaska.

### **Rhamphostomella spinigera** Lorenz, 1886

Plate 51, fig. 1

*Rhamphostomella spinigera* Lorenz, 1886:12.

*Rhamphostomella spinigera*, Nordgaard, 1906:32.

*Discopora plicata* var. *spinigera*, Levinsen, 1916:460.

*Rhamphostomella spinigera*, Osburn, 1936:542.

Zoarium encrusting. Zooecia moderate in size, 0.60 to 0.70 mm long by about 0.40 mm wide, distinct with deep separating grooves; the front somewhat inflated, smooth with delicate reticulations, with a row of areolar pores between which short costae reach only to the edge of the frontal wall. The primary aperture is rounded, 0.22 mm wide by 0.20 long, the proximal border bisinuate, with a cardelle at each end and a median lyrula which is usually expanded at the tip. The peristome is thin, elevated into a lappet opposite the avicularian umbo, and with about 4 oral spines which are rather evanescent. The avicularian chamber is moderate in size and rarely extends past the midline of the front, the rostrum narrow and high and bearing on its lateral surface an elongate avicularium with a spatulate mandible. Opposite the rostrum is a small lappet of the peristome and the form of the secondary aperture is more or less angulated proximally and rounded distally.

The ovicell is hemispherical and conspicuous, often slightly longer than wide (0.30 mm wide by 0.30 to 0.35 mm long), with small pores. One pair of oral spines is often involved in the proximal corners of the oecium.

Described from Jan Mayen, and listed by Nordgaard, Levinsen and Osburn from Greenland.

Canoe Bay, Alaska, U. S. Alaska Crab Investigation, Sta. C. 160-41, 28 fms; and Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector, 18 fms.

**Rhamphostomella curvirostrata** O'Donoghue, 1923

Plate 50, fig. 4

*Rhamphostomella curvirostrata* O'Donoghue, 1923:44.

Zoarium encrusting in a thin layer. The zooecia are moderately large, 0.75 to 0.85 mm long by 0.40 to 0.55 mm wide, the front evenly arched, undecorated except for fine granulation, with a row of large areolar pores; the costae separating the pores do not extend upon the front. There is often a raised line in the groove separating the zooecia. The primary aperture is nearly round, the proximal border bisinuate with a small cardelle at each side and a lyrula of varying width (notched at the tip) in the middle; 0.24 mm wide by 0.22 mm long. The peristome is thin, high and tubular, continued around the aperture except for a notch at the middle of the distal border; at one side of the proximal border is an elevated avicularian chamber, with a long, laterally curved rostrum which extends more or less across the proximal part of the aperture and which may fuse with a prominent lappet on the opposite side to enclose the proximal part of the secondary aperture. The mandible is elongate-triangular, curved laterally and hooked at the tip. Occasionally the avicularium is wanting and two lateral lappets extend toward each other across the aperture.

The ovicell is hemispherical and prominent, about 0.40 mm wide by 0.35 mm long, smooth, with numerous pores.

The most striking characters of this species are the high peristome and the curved and elevated avicularium which partially or entirely subdivides the secondary aperture.

Described by O'Donoghue from Bull Passage, Northumberland Channel, British Columbia, 15 to 25 fms.

Hancock Station 1662-48, Santa Cruz Island, southern California, numerous colonies at 23 fms. Also on a sunken buoy recovered from 45 fms off Rocky Point, California, Earl Fox, collector; and San Juan Island, Friday Harbor, Puget Sound, Dr. J. L. Mohr, collector.

**Rhamphostomella townsendi** new species

Plate 51, figs. 2-3

Zoarium encrusting on sponge. The zooecia are large, 0.85 to 1.15 mm long by 0.50 to 0.60 mm in width; the frontal rather evenly inflated and beautifully reticulate with honeycomb impressions, with conspicuous areolar pores between which the short costae extend only slightly; a prominent line in the deep separating grooves. The primary aperture is nearly symmetrical, rounded, with a pair of pointed cardelles

and a small bicuspidate lyrula; the peristome is high and thin and unites slightly with the proximal corners of the ovicell. The secondary aperture is asymmetrically ovate. Proximal to the aperture and asymmetrically placed is a comparatively small avicularium with the long-triangular mandible directed more or less laterally; the avicularian chamber only slightly elevated.

The ovicell is prominent, hemispherical, smooth with large pores and with a low collar around the base; 0.40 mm wide by 0.25 to 0.30 mm long.

This is a striking species, due to its smooth appearance, as the only decoration of the front is the delicate reticulation.

Type, U. S. Nat. Mus., 11032.

Type locality, Albatross Station 5695 (cruise of 1911), Lower California, 534 fms.

It is named in memory of my former friend, Dr. Charles Haskins Townsend, Naturalist on the "Albatross" from 1886 to 1896 and temporarily on the cruise in 1911 when this species was dredged.

### *Rhamphostomella cellata* (O'Donoghue), 1923

Plate 52, fig. 9

*Smittia cellata* O'Donoghue, 1923:43.

*Smittina cellata*, O'Donoghue, 1926:68.

*Smittia torquata* O'Donoghue, 1923:43.

*Smittina torquata*, O'Donoghue, 1926:68.

Zoarium encrusting, smooth and glistening. The zooecia are moderately large, 0.65 to 0.90 mm long by 0.45 to 0.55 mm wide, ovate, slightly inflated; the frontal thin and smooth, later becoming granulated, a row of areolar pores separated by short costules; a crescentic area proximal to the aperture is delicately outlined. The aperture is nearly round, about 0.18 to 0.20 mm in either direction; the cardelles distinct and pointed and there is a slender bifid lyrula with laterally directed points. The peristome is thin and more or less elevated, connected with the avicularian chamber on one side and forming a low lappet on the opposite side. The avicularian chamber is small and low, asymmetrical and connected with one areolar pore, the mandible is long-triangular and directed laterally; when completely developed the mandible appears as if lodged just within the rim of the peristome and curved to conform to it.

The ovicell, according to O'Donoghue's description and figure is characteristic of the genus, "globose, hemispherical and projecting, and its surface perforated by a series of large irregular pores."

There can be no question as to the position of this species in the genus *Rhamphostomella*. Similarly I have no doubt that *Smittia torquata* O'Donoghue is merely the young stage of his *S. cellata* as the basic characters are the same and the only differences are due to advanced calcification and the presence of the ovicell.

Described from British Columbia and recorded from numerous localities there and about the San Juan Islands in Puget Sound.

Dr. J. L. Mohr collected the species for the Hancock collections at Middle Bank, Puget Sound.

### *Rhamphostomella ovata* (Smitt), 1867

Plate 50, fig. 6

*Cellepora ovata* Smitt, 1867:31.

*Rhamphostomella ovata*, Nordgaard, 1906:32.

*Rhamphostomella ovata*, Osburn, 1912:248; 1919:610.

*Discopora ovata*, Nordgaard, 1918:78.

Zoarium encrusting on stones and shells, occasionally on stems. The zooecia are smaller than those of our other species, averaging about 0.70 mm long by 0.45 mm wide, elongate oval, regularly arranged in quin-cunx; the front is evenly arched, with a number of large pores in addition to the areolar pores, the costae if present short and not prominent. The avicularian chamber is comparatively small, usually reaching only to the midline; the umbonate process small and low, consisting chiefly of the avicularian rostrum which bears on its lateral face a small elliptical avicularium with a round-tipped mandible. The primary aperture is rounded, 0.28 to 0.30 mm long and wide, the proximal border often a little asymmetrical. There are no cardelles and in our specimens no lyrulae; rarely vestigial oral spines on very young zooecia. (Nordgaard, 1906:34, lists this species among those which have a "median denticle," but I have never found it in all the Atlantic and arctic specimens I have seen.) The secondary aperture is more or less asymmetrically ovate, the slightly overhanging base of the avicularium producing a straighter edge at that side.

The ovicell hemispherical, prominent, smooth and imperforate when young, but becomes rough when covered by secondary calcification.

This species is unique in the genus in view of its perforated frontal and imperforate ovicell but, as all other characters agree and no other genus appears to fit it, I leave it where it has usually been assigned. It is fairly common in the arctic and northern seas, extending southward on the Atlantic coast to Cape Cod, Massachusetts. It seems not to have been noted on the Pacific coast.

Alaska Crab Investigation, entrance to Olga Bay, 40 fms and Leonard Harbor, 25 fms, Alaska; Pুনuk Island, Bering Sea, 15 fms; and Point Barrow, Alaska, 23 fms, Arctic Research Laboratory, G. E. MacGinitie, collector.

### *Rhamphostomella gigantea* new species

Plate 50, fig. 5

Zoarium encrusting and forming coarse, erect, bilaminate expansions and frills to a height of 25 to 40 mm, yellowish to deep orange in color. The zooecia are among the largest I have ever observed, averaging 1.20 mm long (ranging from 1.00 to 1.80 mm), the width ranging from 0.65 to 0.80 mm; the depth is correspondingly great, the cavity varying from 0.60 to 0.75 mm and the total thickness about 1.00 mm in full calcification. The frontal is highly arched and excessively thick, with a row of large areolar pores and a varying number of frontal pores; very strongly costate, the costae often uniting to form a coarsely reticulate surface over the whole front; the ribs sometimes extend to the tip of the avicularian umbo. The avicularium arises at one side but its base is so broad that it often covers nearly the whole width of the frontal; the avicularium is located on the disto-lateral side of a low-conical umbonate process, the mandible slightly more than a semicircle in form, about 0.13 mm long and wide. The primary aperture is only slightly asymmetrical on its proximal border, rounded distally and somewhat straighter on the sides, the length and breadth nearly equal, 0.40 to 0.45 mm. The peristome is moderately low on the sides. No oral spines, no cardelles and no lyrula. Small oval avicularia, similar in size and form to the suboral ones, often occupy the middle of the frontal, mounted on a slightly elevated chamber.

The ovicells are proportionate in size to the zooecia, averaging about 0.65 mm wide by 0.50 mm long, smooth and imperforate, prominent when young but with complete calcification almost entirely immersed.

Type, U. S. Nat. Mus., 11033; paratype, AHF no. 93.

Type locality, Point Barrow, Alaska, Arctic Research Laboratory, 140 feet, Prof. G. E. MacGinitie, collector. Another colony at a depth of 80 feet from the same locality.

Genus **CYSTISELLA** Canu and Bassler, 1917

Zoarium erect, branching, flabelliform, bilaminate. The frontal is an olocyst with few areolar pores; a large elongate avicularium chamber covers most of the front, with two large pores in its proximal end a little distal to the preceding aperture, and its mandible is semicircular and perpendicular to the apertural plane. No lyrula, no oral spines, cardelles present. Ovicell hemispherical, smooth and imperforate. Genotype, *Eschara saccata* Busk, 1856.

A short, broad lyrula is present in some species. The avicularian chamber is unique in that it extends the full length of the front of the zoecium, originating from proximal instead of lateral pores.

**Cystisella saccata** (Busk), 1856

Plate 51, figs. 4-5

*Eschara saccata* Busk, 1856:33.*Cystisella saccata*, Osburn, 1923:10D.

A common high northern species, growing in erect bilaminate folds to a height of 50 mm. The zoecia are moderately large, averaging about 0.75 mm long, quincuncial in arrangement, the frontal thick, smooth and shining, with one or two pores at the proximal end (visible only after removal of the ectocyst). Most of the front is covered by a large and elongate avicularian chamber which extends from the proximal pores to overhang the aperture; the distal end is vertical to the plane of the aperture and is occupied by a large semicircular mandible. The primary aperture is so deeply hidden below the avicularium and the high peristome that it can be seen only on young zoecia; it is a little more than a semicircle, with a straight proximal border and without lyrula or cardelles; 0.18 to 0.20 mm wide.

The ovicells in the young stage are globular, prominent, smooth except for faint radiating striae but in older parts of the colony they become embedded and covered by the thick crust; width and length 0.30 to 0.35 mm.

This species was confused for many years with *C. elegantula* (d'Orbigny) until Waters, 1900:81, pointed out the differences. It is widely distributed in the arctic region and Osburn (1923, Canadian Arctic Exped.) recorded it as far west as Icy Cape, Alaska.

Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

*Cystisella bicornis* new species

Plate 51, figs. 6-7

Zoarium erect from a small encrusting base, flabellate, reaching a height, in our specimens, of 10 mm, bilaminar. Zoecia moderate in size (0.55 to 0.65 mm long), arranged in quincunx, the frontal smooth with the usual two pores at the proximal end. As in other species of the genus, the frontal is largely covered by the elongate avicularian chamber, but the distal end is more erected than in *C. saccata* and the position of the avicularium is less vertical: the mandible is usually slightly triangular or ogival, but is sometimes nearly semicircular, yellow and heavily chitinized and with the tip decurved. On either side of the mandible between it and the corner of the aperture is a short, stout conical process which often projects well above the level of the avicularian rostrum; there is much variation in these spinous processes, near the base of the colony they are absent, in younger colonies they are smaller and shorter, in older zoaria they are regularly present except near the base. The primary aperture (seen only at the zoarial edge) is somewhat more than a semicircle, the sides and the proximal border straight; no cardelles and no lyrula; width and length 0.15 to 0.16 mm.

The ovicell is like that of *saccata* but smaller, 0.26 mm, round, prominent, smooth and delicately striated when young, but becoming completely embedded with age.

The species differs from *C. saccata* in its more erected avicularia, the form of the mandible, the presence of the spinous processes, and in the smaller measurements of the aperture, ovicell and zoecia.

Type, U. S. Nat. Mus., 11031; paratype, AHF no. 94.

Type locality: Point Barrow, Alaska, Arctic Research Laboratory, 7 to 25 fms, Prof. G. E. MacGinitie, collector, 7 colonies. Also from Orca, Prince William Sound, Alaska, without further data, 3 colonies, and the Dall collection from Alaska, 1 colony.

Genus *MUCRONELLA* Hincks, 1880

Hincks' description indicates merely "Zoecia with a subcircular or semicircular orifice; the peristome elevated in front into a more or less prominent mucro," but later he states "the lower margin of the orifice is almost universally dentate" (that is, with a lyrula). However, the first three species discussed by him are characteristic, and the first mentioned, *Lepralia peachii* Johnston (= *L. immersa* Johnston), is the genotype.

The frontal is a pleurocyst, with one row (occasionally 2 or 3) of areolar pores. Spines are present on the oral border. No avicularia. The lyrulae are like those of *Smittina*, varying in length, breadth, excavation of the tip and in the lateral points. Dietellae are present and sometimes characteristic of species.

KEY TO SPECIES OF *Mucronella*

1. Peristome high, tubular, oral spines 8 to 10 . . . . . *major*  
Peristome not tubular but forming an umbonate  
process; spines 2 to 6 . . . . . 2
2. Dietellae long, only two on a side; ovicell with a  
raised lip above the orifice . . . . . *connectens*  
Dietellae small and numerous; ovicell without a lip . . . . . 3
3. Front highly arched transversely; zooecia more elevated  
distally; ovicell high and depressed toward the tip . . . *labiata*  
Front moderately arched: distal end of zooecium not  
unusually elevated; ovicell broadly rounded . . . *ventricosa*

***Mucronella ventricosa* (Hassall), 1842**

Plate 52, fig. 3

*Mucronella ventricosa*, Hincks, 1880:363.

*Mucronella ventricosa*, Osburn, 1912:243.

*Mucronella ventricosa*, O'Donoghue, 1923:46; 1926:70.

Zoarium encrusting, usually on shells and stones. Zooecia moderately large, averaging about 0.75 mm long by 0.45 mm wide, more or less ovate but varying widely in proportions; very distinct even in full calcification, with deep grooves. The front is ventricose, delicately pebbled with minute tubercles which are usually arranged in radiating lines; numerous small areolar pores usually in one row but occasionally two. The primary aperture, 0.16 mm wide by 0.13 mm long, is straight on the proximal border, with a moderately broad lyrula. The peristome is thin and little raised on the sides and bears 6 to 8 long erect spines; proximal to the aperture it is raised into a thick fold which usually is continued into a pointed umbonate process overhanging the aperture more or less.

Ovicell subglobose and prominent, slightly immersed in full calcification, 0.35 mm wide by 0.30 mm long, imperforate, the secondary cover finely pebbled like the frontal.



An abundant northern and arctic species, extending down the Atlantic coast to Cape Cod, Massachusetts, and on the Pacific coast to Oregon. O'Donoghue recorded it from a number of localities in British Columbia.

Hancock collections. Not taken in the Hancock dredgings, but there are specimens from the "Albatross" Sta. D.2886, off the Oregon coast; Puget Sound, Dr. J. L. Mohr, collector, and Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

***Mucronella connectens* (Ridley), 1881**

Plate 52, figs. 6-7

*Mucronella ventricosa* var. *connectens*, Ridley, 1881:451.

*Escharella indivisa* Levinsen, 1916:450.

*Mucronella indivisa*, Osburn, 1932:14.

*Mucronella connectens*, Osburn, 1936:542.

This species has much the appearance of *M. ventricosa*, with which Ridley associated it. On closer study it shows a number of differences which are sufficient to distinguish it clearly. The size of the zooecia is larger, length 0.75 to 0.95 mm, the lyrula is a broad shelf, extending nearly the full width of the proximal border of the aperture, the peristome proximally is high and thin, extended into a low point and descending on the sides to the base of the spines (2 to 4 in number); the aperture is somewhat larger, 0.18 to 0.20 mm wide by 0.14 long; and the ovicell has a different form, narrow proximally, widest at its middle and with a distinct raised lip above the orifice. The most distinctive feature is the very elongate pore chambers (dietellae) limited to usually two on each side, whereas in *ventricosa* they are small and numerous.

Ridley described the species from Spitsbergen and figured it carefully, showing the long dietellae. Levinsen redescribed it as *indivisa* from Greenland, apparently overlooking Ridley's description. Osburn had it (*M. indivisa*) from Hudson Strait and Port Burwell, Ungava, and again from Greenland (*M. connectens*).

Point Barrow, Alaska, not uncommon on stones at 18 to 26 fms, Arctic Research Laboratory, G. E. MacGinitie, collector.

***Mucronella labiata* (Boeck MS), Levinsen, 1886**

Plate 52, figs. 1-2

*Lepralia labiata* Boeck, MS.

*Discopora coccinea* form *labiata*, Smitt, 1867:27.

*Mucronella labiata*, Levinsen, 1886:19.

*Escharella labiata*, Levinsen, 1916:451.

*Escharella labiata*, Nordgaard, 1918:55.

Zoarium encrusting on stones and shells. The zooecia are large, 0.75 to 0.90 mm long by 0.40 to 0.50 mm wide, highly arched and elevated distally, very distinct; the frontal densely and minutely granulated, with 1 to 3 rows of small lateral pores. The primary aperture is semicircular, 0.18 to 0.20 mm wide, the proximal border straight with a broad, short lyrula. The peristome is high proximally, extending almost vertically into a rounded or pointed process, descending sharply on the sides to the oral spines; in the presence of an ovicell it fuses around the spines with the oocial cover. The spines are strong and erect or somewhat bent over the aperture, 1 pair.

The ovicell is large, 0.30 to 0.35 mm wide by about 0.30 mm long, more or less hemispherical and the distal end is often sloped downward toward the base of the succeeding zooecium.

It has been recorded from numerous localities from the Kara Sea to Greenland, but has not hitherto been known from the Pacific area of the Arctic Ocean. It is undoubtedly another circumpolar species.

Point Barrow, Alaska, 18 fms, G. E. MacGinitie, collector, Arctic Research Laboratory.

### ***Mucronella major* (Hincks) 1884**

Plate 52, figs. 4-5

*Mucronella spinosissima* form *major* Hincks, 1884:53.

*Phylactella major*, Canu and Bassler, 1923:170.

?*Mucronella microstoma*, O'Donoghue, 1923:46.

?*Mucronella simplicissima* var. *perforata* O'Donoghue, 1923:46.

Zoarium encrusting on stones, shells and stems, forming white irregular colonies. The zooecia are moderately large, 0.60 to 0.75 mm long by 0.40 to 0.50 mm wide, varying greatly in proportions, sometimes nearly as broad as long and again elongate and lageniform, apparently in response to the substratum; very distinct and separated by deep grooves. The ventricose front is a smooth pleurocyst with 2 or 3 rows of small marginal pores; as the pleurocyst develops inward from the margin the pores are carried along as microscopic tubules as far as to the middle of the front and even up along the sides of the peristome and over the top of the ovicell. When the process of calcification is complete the front and the ovicell have the appearance of a tremocyst. Hincks described these as "slender tubes immersed in the cell wall"; they are very clear in the younger zooecia but may be completely ob-

scured with age. The primary aperture is about 0.11 to 0.13 mm wide by 0.10 mm long, rounded, the proximal border straighter with a moderately broad lyrula which has a lateral point at each corner. The primary peristome is low and bears a series of 8 or 10 long, slender vertical spines; the secondary peristome begins as an umbonate process proximal to the aperture and develops into a tube of varying height (occasionally as much as 0.40 mm), formed by the pleurocyst which usually fuses with the spines and often carries a series of the areolar tubules with it up on the sides. The tips of the spines may often be seen projecting above the partially developed peristome. The fully developed peristome also usually bears a small proximal denticle projecting inward from the tip of the tube. No avicularia. The dietellae are small and numerous.

The ovicell is semiglobular, smooth, imperforate, recumbent, resting on the succeeding zooecium, the pleurocyst of which grows up over it, carrying the small tubules with it; in complete calcification it appears, like the frontal, to be covered by a tremocyst.

Hincks described it from British Columbia, "probably the commonest species amongst Dr. Dawson's dredgings." Canu and Bassler listed it from the Pleistocene of Santa Monica, California, under the genus *Phylactella*; in complete calcification there is much resemblance to that genus, but the supposed frontal pores are merely the ends of the areolar tubules distributed through the pleurocyst. Our abundant material represents all stages of the development. O'Donoghue did not recognize it, but I am of the opinion that his record of *M. microstoma* belongs here, and that his *M. simplicissima* var. *perforata*, "with scattered perforations" is the complete stage of development of the same species.

Hancock Stations: taken at 10 stations about the islands off southern California; at Point San Eugenio and San Juanico Bay, Lower California; at Clarion Island, west of Mexico; and at three stations, Charles, Albemarle and James Islands, Galapagos. This temperature range is very wide, but there are numerous other species with a similar range. The known bathymetric range is from shallow water down to 135 fms.

### Genus HEMICYCLOPORA Norman, 1894

"Zooecia with pores confined to the sides and sometimes anterior portion of the front wall. Mouth-opening well arched above, lower margin straight (no denticle within the lip). Reproduction by ooecia, which are imperforated. No avicularia." Norman. Genotype, *Lepralia polita* Norman.

As Norman remarks, "This genus comes very near to *Mucronella*, but differs in the absence of the denticle ("lyrula")." In addition, the frontal slopes downward and thins out at the proximal border of the aperture and there is no suggestion of the mucro which is characteristic of *Mucronella*. Otherwise the two genera appear to agree in all details.

**Hemicyclopora polita** (Norman), 1864

Plate 52, fig. 8

*Lepralia polita* Norman, 1864:87.

*Discopora emucronata* Smitt, 1871:1129.

*Lepralia polita*, Hincks, 1880:315.

*Hemicyclopora polita* Norman, 1894:124.

Encrusting stones in a smooth reddish or yellowish-brown layer. The zooecia are large, ranging from 0.75 to 1.00 mm long by 0.50 to 0.75 mm wide, very distinct with deep separating grooves; the frontal considerably inflated, smooth (only in extreme calcification the surface is minutely granulated), with 1 or 2 rows of areolar pores. The primary aperture is large, 0.18 mm wide by 0.15 mm long, the sides straight for a short distance and the proximal border usually quite straight; there is no lyrula or at most a very slight irregularity near the middle of the border. The peristome is slightly raised on the lateral and distal borders, provided with 6 (rarely 8) strong erect spines; on the proximal border the peristome is entirely wanting and there is no evidence of an umbonate process or mucro. No avicularia. The dietellae vary from small to moderately elongate.

The ovicell is large, 0.40 to 0.45 mm wide by 0.35 to 0.40 mm long, hemispherical and prominent, smooth and shining like the frontal: the proximal pair of spines are fused in the proximal corners of the ovicell.

The species was described by Norman from the Shetland Islands at 70-100 fms, and later recorded by him from the Hebrides and Greenland, and from the Trondhjem Fjord, Norway. Smitt evidently overlooked Norman's description and redescribed it from Spitsbergen as *Discopora emucronata*.

Point Barrow, Alaska, 18 to 26 fms, Arctic Research Laboratory, Prof. G. E. MacGinitie, collector, abundant.

Family **Adeonidae** Jullien, 1903

The frontal is a thick pleurocyst; the areolae are unique in that they do not open directly through the frontal wall but proceed downward in the lateral wall to communicate with the septulae. In some genera there is an ascopore which may be near the center of the front wall, but in other genera the compensatrix opens in the sinus of the aperture. The fertile zooecia are gonozooecia which are usually larger and provided with a larger aperture. Both frontal and interzooecial avicularia may be present.

Genus **ADEONA** Lamouroux, 1812

Zoarium encrusting. Frontal wall a thick pleurocyst, with an ascopore in the center; tubular areolar pores; primary aperture at the bottom of a peristomial tube. Ovicells endozooecial on gonozooecia which are usually larger than ordinary zooecia and without a peristome. Genotype, *Adeona grisea* Lamouroux, 1816.

**Adeona violacea** (Johnston), 1847

Plate 58, figs. 6-7

*Lepralia violacea* Johnston, 1849:325.

*Porina violacea*, Smitt, 1873:30.

*Microporella violacea*, Hincks, 1880:216.

*Adeona violacea*, Osburn, 1914:199; 1940:445.

*Adeona plagiopora*, Canu and Bassler, 1928:126.

*Adeona violacea*, Hastings, 1930:728.

Zoarium encrusting, often forming rounded nodules, ranging in color from lavender to intense purplish-black. The zooecia are moderate in size, 0.40 to 0.55 mm long, 0.25 to 0.30 mm wide, the frontal somewhat ventricose, the pleurocyst thick and roughened with a row of conspicuous areolar pores. At or near the center is an ascopore which, with the thickening of the front, lies at the bottom of a rounded indentation. An avicularium with a pointed mandible is situated between the ascopore and the aperture and directed distally in the midline (directed more or less laterally in the variety *plagiopora*). The primary aperture is small, transversely short-elliptical, averaging about 0.12 mm wide by 0.09 mm long; there is a short-tubular peristome. No spines.

The gonozooecia are slightly larger than the infertile zooecia and the aperture measures about 0.15 mm wide.

It is a conspicuous species because of its color, distributed around the world in warmer waters; on the Pacific coast noted only by Hastings at Gorgona, Colombia, and Mazatlan, Mexico.

Hancock Stations: a common species dredged at 24 stations; from San Benito Islands off the west coast of Lower California and Angel de la Guardia Island in the Gulf of California, to the Galapagos Islands; including Clarion and Socorro Islands west of Mexico; the coast of Mexico; Cocos Island off Costa Rica; Secas Islands and Taboga Island, Panama; Octavia Rocks, Colombia; and the Galapagos Islands. The range is therefore from about 28'N southward to the equator, and from the shoreline down to 125 fms.

***Adeona tubulifera* Canu and Bassler, 1930**

Plate 58, fig. 8

*Adeona tubulifera* Canu and Bassler, 1930:34.

This species differs from *A. violacea* (Johnston) in the larger size (average 0.65 mm long by 0.45 mm wide), in the presence of a tall, thick-walled peristome, and the location of the avicularium on the proximal wall of the peristome instead of on the frontal. Our specimens encrust coralline nodules and are coarser in appearance than *violacea*, and I have never observed any pigmentation. The ascopore and the aperture are similar to those of *violacea*, but the avicularium is much more slender and is pointed upward on the peristome above its base.

The gonozooecium has no peristome, is noticeably enlarged, and its aperture measures 0.18 mm in width.

Known only from the Galapagos Islands, "Albatross" stations D.2813 and D.2815.

Hancock Stations, 143-34, Wenman Island; 147-43 and 155-34, Albemarle Island; 170-34, and 438, Chatham Island; 810-38, Barrington Island; 409, James Island; 469, Charles Island; and 473, Hood Island, all from the Galapagos. Also at 210-34, Santa Elena Bay, Ecuador. The known range is very limited and near the equator, and bathymetrically from 10 to more than 100 fms.

Genus **TRIGONOPORA** Maplestone, 1902

*Metrarabdotos* Canu, 1914.

"The ovicell is endozooecial. The aperture is semilunar, with a rimule and lyrula. The frontal is surrounded with lateral areolae and formed of an olocyst surmounted by a pleurocyst" (Canu and Bassler, 1920:533). Genotype, *Trigonopora vermicularis* Maplestone, 1902:23.

The ovicell is very large, broader than a zooecium, and the fertile zooecium has a long transverse aperture that contrasts sharply with the apertures of the ordinary zooecia. Triangular avicularia are often present at the side of the aperture.

### *Trigonopora pacifica* new species

Plate 58, fig. 9

Zoarium encrusting, covering large areas on shells; dark reddish brown or purple, due to the pigmentation of the thick ectocyst which covers the whole surface except the aperture and the avicularia. The dorsal wall is thin and smooth.

Zooecia moderately large, length 0.65 (0.50 to 0.75) mm, width 0.35 to 0.45 mm; quadrangular or somewhat ovate; little ventricose; the whole surface to the edge of the peristome covered with a thick smooth ectocyst, beneath which is the roughly granular pleurocyst perforated at the edges by a row of large areolar pores, which are separated by short costae. The peristome is somewhat elevated, thin, rounded or short-ovate, with a deep, narrow proximal sinus, but without the "lyrula." The primary aperture is nearly circular, about 0.15 mm in diameter, without a sinus but the peristomial sinus (rimule spiramen) rises immediately above it.

The avicularia, which are not abundant, are located at one or both sides of the peristome, directed forward and inward and the tip of the mandible curved outward slightly; the mandible is shorter and less curved than in the Atlantic species (*T. unguiculata* Canu and Bassler 1928:128).

The ovicell is remarkable for its size and structure, being noticeably larger and wider than the zooecia, endozooecial and deeply embedded but very conspicuous because of the size (0.75 mm wide by 0.60 mm long); covered by the pigmented ectocyst, beneath which the ectooecial wall is extremely rough and perforated by numerous small pores. The oocial aperture is a transverse slit 0.40 to 0.50 mm wide by about 0.13 mm long. The fertile zooecia are much modified, (gonozooecia), usually much shorter than normal zooecia and distally widening to the breadth of the oocium; the peristome is a raised lip the full width of the oocium, upon which it extends for a short distance.

This species bears a close resemblance to *T. unguiculata* (Canu and Bassler) from the Gulf of Mexico, but the measurements are much smaller, the avicularia are shorter and located farther toward the distal end and the oocial cover is perforated by numerous small pores.

Type, AHF no. 95.

Type locality, Hancock Station 457-35, Secas Islands, Panama, 7°57'50"N, 82°01'15"W, 12 fms, several colonies on shells.

### Family **Reteporidae** Smitt, 1867

"Zooecia ovato-cylindrica secunda in stirpem reticulatam componuntur." This definition of the family by Smitt (1867:34) is very incomplete, since not all fenestrate bryozoans can be included in this family and many which we now allocate here are not fenestrate. Levinsen (1909:290) gives an extended definition from which we may sort out the following essential characters: zooecia heavily calcified, with few pores; spines present or wanting; a well-developed vestibular arch which is usually beaded; dependent avicularia of varying size and form (usually a suboral one not in the midline); ovicell at first prominent but becoming immersed, often with a median fissure, above the orifice a labellum or prolongation (almost wanting in *Rhynchozoon* and *Lepraliella* in which there is a triangular or semicircular area above the orifice consisting of the endozooecial layer only). In the erect forms the zooecia are all on the frontal side and the dorsal side is covered by a layer of kenozoecia, which may or may not have pores and avicularia. Erect species are usually fenestrate, sometimes forming a close network, (retepores), but a few are merely branching or have only occasional fusions.

#### KEY TO GENERA OF RETEPORIDAE

1. Zoarium erect, branching or fenestrate . . . . . 2  
    Zoarium encrusting . . . . . 4
2. Zoarium not fenestrate, or branches only occasionally joined;  
    ovicell with a median fissure . . . . . *Reteporellina*  
    Zoarium intricately fenestrate, forming a network;  
    ovicell not fissured . . . . . 3
3. Front of ovicell complete, with a pointed labellum;  
    peristomes high obscuring aperture . . . . . *Phidolopora*  
    Front of ovicell incomplete above the aperture;  
    peristomes high only on the sides . . . . . *Schizoretepora*
4. Ovicell with a small median fissure; aperture with a  
    narrow, slit-like sinus . . . . . *Schizotheca*  
    Ovicell with a subtriangular or semicircular area above the orifice 5



5. Aperture rounded, its proximal border more or less sinuate,  
 vestibular arch beaded . . . . . *Rhynchozoon*  
 Proximal border of aperture straight or broadly arcuate,  
 vestibular arch slightly or not at all beaded . . . *Lepraliella*

### Genus RETEPORELLINA Harmer, 1933

“Zoarium ramose, Reteporelliform, not fenestrate; or, if with anastomoses, having many of the fenestrae long and slit-like. Frontal pores seldom more than one pair, often inconspicuous or absent. Peristomes frequently cylindrical or tubular, with marginal teeth or marginal denticles; sinuate or with a closed labial pore. Frontal avicularia various, a strong bicuspid avicularium being characteristic but not always present. Ovicells typically elongate and pyriform, wider distally, often with a narrow, persistent, median fissure or groove, the small labellum distinct but not carinate; lateral sinus wanting; lateral flanges extending proximally considerably beyond the labellum flanges” (Harmer 1926: 580). Genotype, *Retepora denticulata* Busk, 1884.

The genus differs from *Reteporella* Busk, 1884 (the other non-fenestrate genus), in which the ovicell is much shorter, with only a vestigial labellum and no lateral flanges.

### *Reteporellina bilabiata* new species

Plate 53, figs. 11-14

Zoarium erect to a height of 20 mm, and branches in contact may occasionally fuse, irregularly fan-shaped, branching dichotomous; width of branch 1.00 mm or more. Zooecia in about 6 (4 to 8) alternating series, elongate and tubular (averaging about 0.50 mm long by 0.26 mm wide), peristomes prominent and tubular in young zooecia, labial pore soon enclosed and occluded. With further calcification a somewhat triangular lip rises on each side of the secondary aperture, usually with 3 denticles on each lip; the secondary aperture thus remains incomplete on the proximal and distal borders; the secondary sinus (spiramen) is deep and very irregular in form. The primary aperture is nearly straight on the proximal border, about 0.11 mm wide by 0.09 mm long. The frontal pores are more numerous than is usual in this genus, 2 at the proximal end and 2 (1 to 3) on each side.

Labial avicularia are entirely wanting. The frontal avicularia are of two kinds: 1, a large form, usually in the midline with a pointed rostrum more or less elevated and directed proximally (varying con-

siderably in size and elevation and sometimes directed partially outward); 2, this form is sometimes replaced by a short-spatulate avicularium which is little or not at all elevated and is usually much reduced in size, and similar small avicularia sometimes occur laterally and are variously oriented. Both kinds are present on the dorsal side, but the small spatulate ones are much more numerous. The kenozoecia of the dorsal side also usually have 1 or more pores, especially the lateral ones.

The ovicell is characteristic of the genus, pyriform with a median elongate fissure which remains open, a narrow U-shaped labellum without a keel and narrow lateral flanges which extend beyond the labellum.

This species resembles *R. denticulata* (Busk) in many of its characters but is distinguished from it by the absence of labial avicularia, the absence of bicuspid avicularia, the absence of the toothed fenestral avicularium, the larger number of frontal pores and the nature of the adult peristome.

Type, AHF no. 96.

Type locality, Hancock Station 275, Raza Island, Gulf of California, 28°48'00"N, 113°00'00"W, two complete colonies and several fragments, 40 fms. Also at 2180, two miles east of Magdalena Bay, Lower California, 18 fms, several complete colonies and fragments; and two fragments from U. S. National Museum No. 1474.

### *Reteporellina denticulata* var. *gracilis* new var.

Plate 53, figs. 8-10

*Retepora denticulata* Busk 1884:109.

*Reteporellina denticulata*, Harmer, 1934:581 (bibliography).

Zoarium erect, ramose, irregularly dichotomous, no fusion of branches in our specimens; branches slender, width 0.65 to 0.80 mm. Zooecia usually in 3 alternating series, about 0.50 mm long by 0.30 mm wide, the younger zooecia separated by distinct ridges, the frontal surface flat and granular, the peristomes tubular and sharply elevated; the frontal pores very regularly 2 (occasionally 1 or 3). The peristome is infundibuliform, the labial pore enclosed and the sides of the peristome rise a little higher than the proximal and distal borders and are provided with small denticles, usually 2 on the inner border and 3 or 4 on the outer, but there is much variation.

Large bifurcate labial avicularia are rare and are almost exactly like those in Harmer's figure (1934: text fig. 33). The frontal avicularia are usually small, oval or short-spatulate and variously oriented, only rarely is there a larger, more elevated one. On the dorsal side the avi-

cularia are rare, similar to the oval frontal ones but usually larger. Pores are also often wanting on the dorsal kenozoecia, but occasionally as many as 2 are present. The large infrafenestral avicularium figured by Harmer (text fig. 33) is rare; the mandible has the same form as in the figure, with 3 or 4 points. Occasionally there are small frontal zoeciules bearing oval avicularia.

The ovicell is pyriform, smooth and glossy, with an elongate median fissure which remains open; the labellum is well developed, elongate v-shaped with a rounded point, the lateral flanges narrow and extending beyond the tip of the labellum.

This variety differs from *denticulata* Busk in the consistently narrower branches (very regularly 3 series of zooecia, never more than 4), in the absence of any fused branches or connecting trabeculae and in the comparatively rare avicularia. Otherwise it conforms to the description of *denticulata*. While Harmer (1934:582) indicates that the width of the branches ranges from 2 to 9 zooecial series, the consistently narrow branches of our 24 specimens, distributed from the Galapagos Islands to Costa Rica, makes it seem advisable to apply a varietal name to this form from the Eastern Pacific region. *R. denticulata* has been recorded from the Sandwich Islands (the type locality), from Japan and other localities in the western Pacific and across the Indian Ocean to East Africa.

Type, AHF no. 97.

Type locality, Hancock Station 455, Albemarle Island, Galapagos, 0°55'00"S, 90°30'00"W, 70 fms. Other Hancock Stations, 143-34, Wenman Island; 173-34, South Seymour Island; 324-35, Albemarle Island; 788-38, Daphne Major Island; 466, James Island, Galapagos; and 324, Salinas Bay and 328, Cocos Island, Costa Rica, 5 to 150 fms.

### Genus PHIDOLOPORA Gabb and Horn, 1862

The description of the genus by Gabb and Horn (1862:138) is so brief as to be worthless, but as it is based on their new species, *P. labiata*, the description and figure of which are clear, it must be accepted.

Canu and Bassler (1923:154) give the following description: "The frontal of the ovicell is not fissured. The aperture is semilunar, with a concave proximal border. The peristomice bears a rimule spiramen. The frontal is an olocyst. No labial avicularium." Genotype, *Phidolopora labiata* Gabb and Horn, 1862.

Gabb and Horn also set up a new family "Phidoloporidae," the description of which is worthless and misleading, but they were dealing with fossil material at a period when the Reteporidae were little known. Their new species *P. labiata*, is abundantly represented along the Pacific coast in the Pleistocene of California, and its modern representative (*Retepora pacifica* Robertson) is so similar to it that it appears to deserve no more than varietal status.

### **Phidolopora pacifica** (Robertson), 1908

Plate 53, figs. 1-2

*Retepora pacifica* Robertson, 1908:310.

*Retepora pacifica*, O'Donoghue, 1923:47.

*Phidolophora pacifica*, Canu and Bassler, 1923:154.

*Phidolophora pacifica*, O'Donoghue, 1926:72.

? *Retepora wallichiana* Hincks, 1884:29.

Zoarium erect, often forming convoluted masses of considerable size, in which the branches are supported against each other by small columnar processes (trabeculae); fenestrated to produce an intricate network; the zooecia of a branch all face in the same direction. A very beautiful specimen from off Newport Beach, California, presented by Dr. R. L. Bolin, measures 110 mm long by 100 mm wide and 65 mm high.

The zooecia vary greatly in size, usually between 0.45 and 0.55 mm in length, by 0.26 to 0.30 mm in width, the front nearly flat and delicately granulated. The primary aperture measures about 0.09 mm in either direction, the proximal border slightly arcuate with a shallow median sinus, and 1 or 2 long oral spines may be present on either side. The peristome soon obscures all of the primary oral features; it rises high, with a conspicuous secondary sinus (spiramen) on the proximal border, the lateral edges irregular, rarely a labial pore is formed by enclosing the proximal end of the sinus.

Labial avicularia are entirely wanting; a large frontal avicularium, partially erected, is present on many of the zooecia, the mandible long-triangular and both rostrum and mandible hooked. A similar avicularium is often present on the dorsal side, especially near the lower ends of the fenestrae.

The fenestrae are elliptical and pointed at both ends, ranging from about 1.20 to 1.60 mm long and 0.50 to 0.65 mm wide. The trabeculae joining adjacent fronds are round, smooth and devoid of zooecia.

The ovicell is prominent in the young stage, smooth, subglobular, about 0.20 mm wide and without a fissure; there is a small U-shaped

labellum and narrow lateral flanges which extend beyond the tip of the labellum. As calcification proceeds the ovicell becomes deeply immersed.

It seems quite possible that *P. pacifica* may be found to intergrade with the Pleistocene *P. labiata*. Canu and Bassler, who record both of them from the same localities, Pleistocene of San Pedro and Santa Monica, indicate the differences only as the larger size of the peristome of *pacifica* and the absence of a labellum in *labiata*. Our Pleistocene specimens from Santa Barbara (the type locality of *labiata*) occasionally show a definite trace of a labellum, while others have it well developed. Perhaps *pacifica* should have been recorded merely as a variety of the Pleistocene *labiata*.

Recorded by Robertson from Puget Sound to the coast of California, and by O'Donoghue from a number of British Columbia localities.

In the Hancock dredgings it occurred at 78 stations, ranging from the coast of Oregon to Peru (Independencia Bay) and the Galapagos Islands (Wenman, Albemarle and James): also in the Gulf of California from Agua Verde Bay, near the mouth, north to Angel de la Guardia Island. It appears to be most abundant on the coast of the United States from Oregon to southern California. The bathymetric range is from shallow water to more than 100 fms, and it is frequently found washed up on shore.

### *Phidolopora pacifica* var. *catalinensis* (Robertson), 1908

*Retepora pacifica catalinensis* Robertson, 1908:311.

This variety from Catalina Island, southern California, according to Miss Robertson's description, appears to differ from *pacifica* only in "the greater height of the peristome and in the loop formed by the peristome in front." This loop closes off the proximal part of the secondary sinus (spiramen) to form a pore. In ordinary specimens of *pacifica* this occasionally happens. In our material I have found no colonies worthy of a varietal name.

### Genus **SCHIZORETEPORA** Gregory, 1893

*Schizellozoon* Canu and Bassler, 1917.

*Schizoretepora* Harmer 1933:619.

Gregory's description is so brief as to be practically useless, but he indicated *Retepora tessellata* Hincks, 1878, as the type which as Harmer indicates (1933:619) "makes it necessary to admit the genus as valid."

Canu and Bassler (1917:55) described *Schizellozoon* with *Retepora*

*imperati* Busk 1884 as the genotype. Harmer (1933:621) makes this a synonym of *Schizoretepora* and Bassler (1935:194) accepts this correction.

The generic characters as indicated by Canu and Bassler under *Schizellozoon* are as follows: "The ovicell is widely open and provided with a semicircular slit. It has neither labial avicularium, nor reteporidan pore. The operculum has a broad thickened border; the proximal edge is not straight. The poster of the aperture bears a wide, little deep sinus."

### *Schizoretepora tessellata* Hincks, 1878

*Retepora tessellata*, O'Donoghue, 1923:47.

*Schizellozoon tessellatum*, O'Donoghue, 1926:73.

O'Donoghue recorded this species from five localities in British Columbia but gave no description or figure. It has not appeared in the Hancock collections. A brief digest of Hincks' description follows: Fenestrae elongate, narrow, not so wide as the interspaces; orifice arched above, lower margin straight, with a small central sinus; a spine immediately above each lateral prolongation of the front wall; a narrow elongate frontal avicularium directed laterally or proximally; ovicell immersed, subglobose, smooth, hollowed out in front; the most marked peculiarity is the tessellated dorsal surface, covered with great numbers of pointed avicularia similar to those on the front.

The species has no labial avicularium, no labial pore and no fissure or labellum on the ovicell.

### Genus **SCHIZOTHECA** Hincks, 1877

"Zoarium encrusting; zooecia with a suborbicular (primary) aperture, the lower margin slightly sinuated; secondary aperture raised, tubular, notched or dentate in front; oecium terminal, with a fissure in the front surface; avicularia borne on distinct areas and distributed among the cells, sometimes wanting. Type *Lepralia fissa*, Busk" (Hincks 1877:528).

The original description of the genus by Hincks will have to be amended to include certain other species, as *S. fissurella* Hincks, 1882, has the oocial fissure closed proximally and a small labellum, giving an appearance like that of *Reteporellina*, and in *S. umbonata* new species, described below, there is a labial (suboral) avicularium asymmetrically placed close to the primary aperture. I find no mention of a beaded vestibular arch but in *S. umbonata* new species the arch is minutely beaded.

**Schizotheca fissurella** (Hincks), 1882

Plate 55, fig. 5

*Schizoporella fissurella* Hincks, 1882:253.*Schizotheca fissurella*, Hincks, 1884:21.

Hincks described this species from "Dolomite Narrows; Cumshewa, etc.; not uncommon on shells and stone." British Columbia. It has not been recorded since and a brief digest of Hincks' description follows: Zoarium encrusting. Zooecia small, ovate, the oral region raised, sub-erect. Orifice (primary aperture) arched above, straight below, with a narrow slit-like sinus; peristome thickened and elevated, notched in the center and bimucronate; on each side a sharp spinous process, often wanting. Ooecium rounded and smooth, with a small longitudinal fissure above the opening, and a central tooth (labellum) just within the oral arch. Spines?

Our one specimen agrees well with the above description, but Hincks did not mention the avicularia which in our specimen are moderately large, with pointed mandible, located on the front proximal to the peristome and oriented more or less proximally. Also he did not note the beaded vestibular arch, which is a common feature of the family. In spite of these additions our specimen fits the description so well that I have little hesitation in placing it under *fissurella*.

Hancock Station 2160, one mile south of San Benito Island, west of southern California, 28°17'15"N, 115°35'40"W, 44 fms.

**Schizotheca umbonata** new species

Plate 55, fig. 4

Zoarium encrusting, the surface very rough with stout, high umbos. The zooecia are moderate in size, 0.40 to 0.50 mm long by 0.30 to 0.40 mm wide, but very deep; the frontal in young marginal zooecia is highly arched and smooth, but almost immediately becomes very heavy with the development of a large, high pointed umbo. The base of the umbo is semilunate, partially encircles the proximal end of the aperture, extends nearly the full width of the zoecium, and covers one-third to one-half of the frontal surface; it usually rises into a single tall medium process, but may present two or rarely three points. The primary aperture is so deeply immersed that its character is visible only on marginal zooecia; it is somewhat more than a semicircle, straight on the proximal border, with a small, deep rounded sinus; the vestibular arch is beaded. Small avicularia with pointed mandible are irregularly distributed. Dietellae are present.

The ovicell is about 0.20 mm wide, broader than long, smooth when young, with an elongate frontal fissure and a small, pointed labellum; later the ectoecium becomes very thick-walled except in the region of the fissure.

Type, AHF no. 98.

Type locality, Hancock Station 66-33, Tagus Cove, Albemarle Island, Galapagos, 0°16'17"S, 91°22'41"W, 10 to 20 fms. One colony.

### Genus **LEPRALIELLA** Levinsen, 1916

"The zooecia are provided with a distinct, not beaded or faintly so, vestibular arch, and with two well-developed hinge-teeth. Avicularia of different size and position. The oecia, the proximal portion of which is not pedicel-shaped or shaft-like, have no pores and are not provided with an inwards directed tongue" (Levinsen 1916:466). Genotype, *Cellepora ramulosa contigua* Smitt, 1867.

### **Lepraliella contigua** (Smitt), 1867

Plate 53, figs. 3-4

*Cellepora ramulosa contigua* Smitt, 1867:31.

*Lepraliella contigua*, Levinsen, 1916:467.

The zoarium is encrusting, porcellanous and shining. The zooecia are of moderate size, 0.40 to 0.50 mm long by 0.30 to 0.35 mm wide, distinct and ventricose when young, soon becoming very heavily calcified; the front is roughly granular or nodulous, with 2 or 3 pores at a little distance from the margin (as in other members of the Reteporidae). The primary aperture is semicircular, the proximal border straight or slightly arcuate, about 0.15 mm wide by 0.10 mm long, the vestibular arch smooth or rarely very faintly beaded; the primary peristome thin and low (higher on the proximal border); the 3 or 4 long oral spines arise distal to the primary peristome. The thickening of the frontal wall obscures all of the primary oral characters and the secondary aperture varies in form. There is a moderately large suboral avicularium at one side of the midline, its base often forming an irregular prominent umbonate process, its mandible long-triangular, hooked at the tip, and directed more or less laterally in front of the aperture.

The ovicell is rounded and smooth and conspicuous when young, but soon becomes much embedded; the proximal part of the front is incomplete leaving a large and more or less elongate triangular orifice (? frontal fissure).



It is an arctic or high northern species, known from northern Norway westward to Prince George Sound (Canadian Arctic) and south along the North American coast to Cape Sable, Nova Scotia (Osburn, 1912a:221).

Point Barrow, Alaska, 22 fms (Prof. G. E. MacGinitie, Arctic Research Laboratory), several colonies. Considering its distribution in the Atlantic south to Nova Scotia, the species may be expected to occur much farther south along the Alaskan coast. Its presence at Point Barrow also suggests that it is circumpolar in distribution.

### ***Lepraliella bispina* (O'Donoghue), 1923**

Plate 53, figs. 5-7

*Porella bispina* O'Donoghue, 1923:41; 1926:72.

The zoarium forms a whitish, shining crust on shells and pebbles. The zooecia (young) are of moderate size, 0.40 to 0.50 mm long by 0.30 to 0.40 mm wide, distinct and inflated, the frontal smooth with 2 to 4 pores a little removed from the margin; the primary aperture measures about 0.13 mm in either direction, the proximal border slightly arcuate, the vestibular arch very slightly or not at all beaded; the 2 (rarely 4) oral spines arise distal to the peristome in contact with it; the primary peristome is low and thin. Secondary heavy calcification soon covers nearly all of the primary characters, producing first a nearly level surface, then a granular or nodular one, submerging the aperture on all sides, often with small tubercles. The oral avicularia, often wanting, are small with a rounded mandible, situated usually at the proximal "corner" of the aperture, occasionally at or near the midline, and sometimes one on each side; these may be submerged in the frontal crust so that they open into the secondary aperture. A secondary sinus or spiramen consisting of a shallow v-shaped notch is usually a little unsymmetrical. Small frontal avicularia similar to the oral ones are irregularly scattered, sometimes numerous, often wanting over considerable areas.

The ovicell, 0.20 mm wide, is broader than long, subglobular and prominent when first formed but very soon becomes almost completely submerged in the thick crust; the endooecium bears the usual wide "fissure" next to the orifice, but on secondary calcification this area becomes the subtriangular or semicircular, lightly calcified area similar to that of *Rhynchozoon*.

This species is removed from *Porella*, where O'Donoghue described it, because of the nature of the avicularian chamber, the vestibular arch and the ovicell. The form of the primary aperture places it under *Lepraliella* rather than *Rhynchozoon*, but these genera have much in common.

Recorded by O'Donoghue from a number of British Columbia localities and from the San Juan Islands, Puget Sound.

Hancock collections: Accession 1190, Middle Bank, Puget Sound, numerous colonies, Dr. John L. Mohr, collector.

### Genus RHYNCHOZOOM Hincks, 1895

*Rhynchopora* Hincks, 1877 (Preoc. and renamed by Hincks).

"Zooecia with the primary orifice transversely elliptical, lower margin slightly sinuated; secondary orifice suborbicular, with a mucro on the lower margin and an uncinat process immediately above it, within the mouth" (Hincks 1880:385). Genotype *Lepralia bispinosa* Johnston, 1847.

To the above characters, which are quite insufficient for the characterization of the genus, there should be added: 1, a suboral avicularium at one side of the midline and directed laterally; 2, a well developed and usually strongly beaded vestibular arch; 3, the presence of pore chambers (diatellae), and 4, the nature of the ovicell, which lacks the frontal fissure common to most members of the Reteporidae and has instead a flat subtriangular or semicircular, lightly calcified plate above the oocial orifice. This plate, which is the exposed endozooecial wall, sometimes bears a short wide labellum.

The species are often difficult to determine, as secondary calcification, which is very heavy, obscures the primary characters and these can be found only on the young zooecia at the edge of the colony. It is one of the genera that "try men's souls." Hincks remarks concerning *R. bispinosum* that "This form is a difficulty in the way of the systematist," and Canu and Bassler (1927:32) use somewhat stronger language, "La plupart des . . . espèces . . . sont abominablement compliquées par leurs ornements frontaux et leurs organes adventifs."

### KEY TO SPECIES OF *Rhynchozoon*

1. Zooecia small and plain, a small avicularium on the rim of the thin peristome, no frontal avicularia, a small lucida on each side of the ovicell . . . . . *tuberculatum*
- Zooecia without these characters . . . . . 2

2. A tall pointed or cylindrical process proximal to the aperture . . . 3  
 No tall processes present . . . . . 4
3. An uncinatè process in the aperture at the base of the oral avicularium, oral sinus indistinct . . . . . *bispinosum*  
 Uncinatè process wanting, oral sinus distinct, suboral erect processes usually very numerous . . . . . *spicatum*
4. Zoecia large, 0.65 to 0.80 mm long, oral avicularian process broad and long, projecting far over the aperture . . . *grandicella*  
 Zoecia smaller, avicularian process not unusually large . . . 5
5. Aperture with a distinct schizoporellidan sinus, the frontal costate to the base of the avicularium . . . . . *tumulosum*  
 Sinus broader and shallower, the frontal weakly costate around the border . . . . . *rostratum*

**Rhynchozoon bispinosum (Johnston), 1849**

Plate 55, figs. 6-7 and Plate 54, fig. 9

*Lepralia bispinosa* Johnston, 1849:326.

*Rhynchopora bispinosa*, Hincks, 1880:385.

*Rhynchozoon bispinosum*, Hincks, 1895.

*Rhynchopora bispinosa*, O'Donoghue, 1923:47.

*Rhynchozoon bispinosa*, O'Donoghue, 1926:73.

Zoarium encrusting shells. Marginal zoecia quite regularly arranged in quincunx, moderate in size (length 0.45 to 0.60 mm, width 0.30 to 0.40 mm), the frontal much inflated, smooth with never more than a trace of costal ridges, 6 or 7 areolar pores on each side. The primary aperture is subcircular, a little broader than long (0.14 by 0.12 mm) with a broad and very shallow sinus; the vestibular arch slightly beaded. The suboral avicularian chamber is a bulbous, moderate swelling at one side of the midline and projecting forward over one side of the aperture; the mandible small (usually about 0.10 mm long) and directed laterally; only a trace of an uncinatè process at the base of the chamber. In secondary calcification the front becomes very thick and corrugated but not regularly costate; the secondary aperture somewhat ovate with a rounded notch or sinus between the base of the avicularium and a slight prominence opposite it. The primary aperture is obscured by the overhanging walls of the frontal and the avicularian chamber. Frontal avicularia rare, similar in size but with a more acute mandible, usually on a somewhat elevated chamber. Spines 2, widely separated, found only on marginal zoecia and soon lost.

The ovicell (0.25 mm wide, 0.20 to 0.25 mm long) is very thick-walled, the surface smooth and glossy except in extreme calcification, the frontal endooecial area nearly semicircular with a broad, short labellum.

There is some doubt as to the identity of this form with *R. bispinosum* (Johnston). It has the smooth, non-costate frontal and the pair of widely separated oral spines of that species. Hincks (1880: plate 40) shows a large uncinat process on figure 1, but not on figs. 2, 3 and 4; this process is never large on our specimens. He also describes a large avicularium (suboral), but his figures show it to be small in comparison with some other species of the genus and both the chamber and mandible appear similar in size to those in our specimens. The operculum is similar to that figured by Hastings (1930, plate 14, fig. 91). O'Donoghue gives no description of his British Columbia specimens from Northumberland Channel, and otherwise the species is not known except from the British Isles and western Europe.

In the Hancock Collections there are two specimens labelled "Tuan Island, Pavlof Bay, Alaska, July 25, 1937," with no other data.

### **Rhynchozoon rostratum** (Busk), 1856

Plate 54, figs. 1-3

*Lepralia rostrata* Busk, 1856:178.

*Cellepora verruculata* Smitt, 1873:50.

*Cellepora verruculata*, Osburn, 1914:214.

*Rhynchozoon verruculatum*, Canu and Bassler, 1923:157; 1928a:31.

*Rhynchozoon rostratum*, Hastings, 1930:728.

*Rhynchozoon verruculatum*, Marcus, 1939:153.

*Rhynchozoon verruculatum*, Osburn, 1940:444.

(References to *R. verruculatum* from the Mediterranean Sea and Indian Ocean are omitted as it is possible that they do not belong in this species.)

Encrusting on shells and corallines, often irregular on the surface and the numerous pointed processes give it a very spiny appearance. The marginal zooecia, which are the only ones that can be safely measured, are of moderate size (0.45 to 0.55 mm long by 0.30 to 0.40 mm wide), distinct with deep grooves; the front ventricose, with 5 to 7 marginal pores between which are low costal ridges. The primary aperture is slightly transverse (average 0.13 mm wide by 0.11 mm long), rounded with the proximal border broadly sinuated; the vestibular arch definitely beaded; the primary peristome thin, without oral spines. A

large, bulbous avicularian chamber at one side of the median line occupies more than half of the frontal width, the rostrum elevated above the aperture and directed laterally, both the rostrum and mandible strongly hooked.

Secondary calcification soon completely alters the appearance. The front becomes very thick, with short, heavy costal ridges, corrugations and tuberosities. Frontal avicularia similar to the suboral, or with an acuminate mandible, variously oriented, are often abundantly developed. The secondary peristome, formed by the thickening of the front wall, usually develops a small uncinat process at the base of the avicularium, opposite to this there is usually an erect pointed tubercle and between these is a deep secondary sinus or spiramen; 2 or 3 additional pointed, erect tubercles are often disposed around the oral border. The suboral avicularium often becomes submerged within the peristome. There is so much variation in the secondary calcification that scarcely any two zooecia are exactly alike.

The ovicell is about 0.20 mm wide, a little broader than long, the ectooecial wall very thick, soon becoming deeply immersed: the exposed "area" of the endooecial wall is semicircular, large, its dull white color usually making it conspicuous, and with a very short, very wide labellum only occasionally visible.

Busk described the species from Mazatlan, Mexico, after which it lay unrecognized in the literature for more than 70 years until Dr. Hastings found it in the Crossland collections of the S. Y. "St. George" from Panama and the Galapagos. In the meantime Smitt described *Cellepora verruculata* from the Gulf of Mexico, and this name has been applied to the western Atlantic form which occurs from southern New England to Brazil.

There can be little doubt as to the identity of the Atlantic and Pacific specimens; their measurements are practically identical; both have the semicircular frontal area on the ovicell; they have the same form of operculum with very minor variations in both; the secondary calcification is similar, and both have two similar types of frontal avicularia, one with a slightly longer and more acuminate mandible than the other. The "curved outline below the lucida" which Hastings mentions as a "chief peculiarity" is present in Atlantic specimens from Puerto Rico and Bermuda as well as in those from the Pacific; there is some variation in the width of the area but the ends are always broadly rounded and quite different from the figures given by Hastings (plate 14, figs. 87, 88) for the Mediterranean *R. verruculata* Waters. The operculum of the

Mediterranean form as figured by Hastings (fig. 86) and by Barroso (1919, text figs. 11 and 11a) is more pointed at the proximal border and the attachments are less separated.

Described by Busk from Mazatlan, Mexico, and recorded by Hastings from Taboga Island, Panama; Gorgona, Colombia, and the Galapagos Islands. In the Atlantic recorded as *verruculatum* from Massachusetts to Brazil.

Hancock Stations: taken at 34 stations ranging from the Galapagos Islands to southern California; Port Utria, Colombia; Taboga and Secas Islands, Panama; Playa Blanca, Costa Rica; Tenacatita Bay, Mexico; Socorro Island, west of Mexico; Angel de la Guardia and Isabel Islands and Agua Verde Bay, Gulf of California; San Benito Islands, west of Lower California; and common along the shores and about the islands off southern California, as far north as Point Conception. Shore to 100 fms.

### *Rhynchozoon tumulosum* (Hincks), 1882

Plate 54, figs. 4-5 and 12

*Schizoporella tumulosa* Hincks, 1882:252; 1884:19.

*Schizoporella tumulosa*, Robertson, 1908:293.

*Schizoporella tumulosa*, O'Donoghue, 1923:37; 1926:56.

Zoarium encrusting shells and stones, older colonies sometimes multilaminar and roughened. Zooecia (marginal) varying greatly in size, 0.45 to 0.65 mm long by 0.25 to 0.40 mm wide, ovate and arranged regularly in quincunx; distinct, the front inflated with 7 to 9 areolar pores on each side, and with costate ridges. The primary aperture is slightly broader than long (0.13 to 0.15 mm wide by 0.11 to 0.13 mm long) with a shallow sinus proximally; vestibular arch definitely beaded. The primary peristome is at first low and thin, but soon becomes elevated except on the distal border. A large globose suboral avicularian chamber is located at one side of the midline, its rostrum overhanging the aperture and directed laterally; the long-triangular avicularium and the rostrum both sharply hooked at the tip. Only two or three marginal rows show these characters, after which secondary calcification completely changes the appearance. The frontal becomes very thick, costate, corrugated or tuberculate; frontal avicularia make their appearance, some of them short-triangular, others somewhat longer and more acuminate; an umbo, low or high, thick or pointed, usually rises above the base of the suboral avicularium; the side of the peristome rises with a notch (spiramen) between it and the

avicularian chamber; occasionally additional low pointed tubercles appear on the lateral border of the peristome. Spines are entirely lacking.

The ovicell at first is subglobose, about 0.20 mm wide, the length less than the width, but it very soon becomes buried within the thick frontal crust. The area above the orifice is nearly semicircular, with often a short labellum extending nearly across above the orifice.

The avicularian mandibles are of 3 kinds, the long-triangular suboral, the long-triangular and acuminate frontal and the short-triangular (almost equilateral) frontal; the area below the lucida with sharp outer corners. The operculum is shaped much like that of *R. rostratum*, but the points of attachment are much closer together.

Described from Cumshewa, British Columbia, and later recorded by O'Donoghue from numerous British Columbia localities. Robertson lists it from San Diego to San Pedro, California, but as *R. rostratum* is also common in this region she may have had both species.

Hancock Stations: Dredged at 45 stations from the coast of Oregon southward to San Benito Islands, Lower California. Abundant in Puget Sound and all along the coast southward to the Channel Islands off southern California, shore to more than 100 fms.

### **Rhynchozoon grandicella** Canu and Bassler, 1923

Plate 54, figs. 7-8 and 11

*Rhynchozoon grandicella* Canu and Bassler, 1923:156.

Zoarium encrusting on shells, pebbles, etc. Zoecia large (young zoecia at the edge 0.65 to 0.85 mm long by 0.40 to 0.55 mm wide, much smaller near the center of the colony); distinct and considerably inflated, irregularly ovate, with numerous small marginal pores between which low costal ridges radiate toward the center. The primary aperture is broader than long (0.16 mm wide by 0.13 long) with a shallow rounded sinus on the proximal border, the vestibular arch coarsely beaded; the operculum thin, without marked sclerites and with a lightly pebbled surface. Two minute oral spines are occasionally present. A large suboral avicularium is always present at one side of the midline and overhanging the aperture; the mandible, directed laterally, is elongate-triangular, strongly hooked, its borders dark brown and its length varying from 0.13 to 0.20 mm. At the inner corner of the avicularian base is a strong uncinat process, opposite this process there is usually a small pointed projection and between these is the rounded spiramen. Frontal avicularia are frequently present, similar to the suboral ones but smaller and mounted on a large chamber.

Secondary calcification masks the primary characters to produce a very different picture; the front becomes irregularly roughened and nodular and the short costal ridges heavier, the peristome projects forward above the aperture and almost completely covers it, and the ovicell becomes deeply submerged.

The ovicell is at first nearly globular, 0.26 mm wide, with a large semicircular frontal area which shows delicate radiating lines and a trace of a broad and very short labellum.

Hancock Stations: 1234 and 1067, San Miguel Island, 55 fms; 1232-41, off San Pedro Breakwater, 18 fms; 1271-41 and 1938-50, Anacapa Island, and 1896-49, Tanner Bank, off San Diego, 23 to 35 fms, southern California; 1250-41, San Benito Islands, 66 fms, and 1258-41, Natividad Island, 63 fms, off Point San Eugenio, Lower California. The known range is from about 34° to 28° N Lat. and the bathymetric range from 18 to 66 fms. The species was described by Canu and Bassler from the Pleistocene of Santa Monica, southern California.

### **Rhynchozoon spicatum** new species

Plate 55, figs. 1-3 and Plate 54, fig. 10

Zoarium encrusting on various objects, often multilaminar. Zooecia closely set in quincunx, marginal ones distinct with deep separating grooves, length 0.40 to 0.50 mm, width 0.30 to 0.35 mm. The front of the younger zooecia is ventricose, smooth on the top, with a row of small marginal pores between which low costate ridges extend for a short distance. Distally the front is strongly elevated and ends in a high pointed or rounded umbonate process proximal to the aperture, the small suboral avicularium hidden at its base. The umbonate process may be as much as 0.50 mm high and pointed, but usually has the form of a short, stout column with a rounded tip; as they appear on nearly all of the zooecia, they give the surface a "hobnailed" appearance. The primary aperture is nearly round, 0.12 mm in diameter, with a broad shallow sinus, and the vestibular arch is strongly beaded. The suboral avicularium is small, the pointed mandible only 0.06 to 0.08 mm long, directed laterally and can be observed only by turning the specimen so as to look into the aperture. The frontal avicularia are larger, elevated on a broad base, the mandible elongate triangular (0.10 to 0.12 mm long), and abundant on the older areas of the zoarium. There are two long, slender oral spines.



The primary ovicell is prominent, hemispherical, smooth with numerous radiating striae and the usual broad, semicircular frontal area above the orifice, width 0.18, length 0.15 mm; with increasing calcification the ovicell becomes entirely embedded.

In the presence of the tall suboral process and a pair of long oral spines this form is similar to *R. bispinosum*. It differs in its somewhat smaller size, the smaller size and different proportions of the operculum, the form of the secondary aperture, the absence of the uncinat process at the base of the oral avicularium, the much smaller oral avicularium, and in the shape of the semicircular area of the ovicell which in *bispinosum* is subtriangular.

Type, AHF no. 99.

Type locality, Hancock Station 1242, Anacapa Island, southern California, 34°02'30"N, 119°21'10"W, at 77 fms. Other localities: Station 1023, Santa Rosa Island, 16 fms; 1130-40, off Laguna Beach, 27 fms; 1181-40 Santa Catalina Island, 58 fms, southern California; and San Benito Islands, 44 fms, off lower California, 28°17'15"N, 115°35'45"W. There are also two colonies from La Jolla, California, taken on a kelp holdfast, presented by Dr. H. R. Hill.

### **Rhynchozoon tuberculatum** Osburn, 1914

Plate 54, fig. 6

*Rhynchozoon tuberculatum* Osburn, 1914:200; 1940:442; 1947:39.

The zoarium is small and comparatively thin. Zoecia small, length 0.40 to 0.50 mm, width 0.25 to 0.30 mm, delicate for a member of this genus; the frontal at first smooth but later covered thickly with small, shining tubercles; marginal pores few and small. Peristome high and thin-walled, the secondary aperture ovate; a minute avicularium placed laterally on the inner side, often wanting. Primary aperture ovate, about 0.12 by 0.12 mm; at one side immediately above the proximal border an uncinat process (sometimes merely a slender pointed spine) projects often more than half way across the orifice and curves backward; opposite this process a small tooth is sometimes present.

The ovicell is at first prominent, 0.15 mm long by 0.18 mm wide, finely tuberculate like the front in complete calcification; the frontal "triangular area" is small, thin and hyaline: labellum wanting or very small; a small rounded lucida on each side near the base; in the presence of the ovicell the peristome is continued forward over the top of the ovicell, above the triangular area.

This is a comparatively delicate species, less heavily calcified than most members of the genus and all of the many colonies observed are small (usually less than 5 mm in diameter), but the aperture and its appended organs, the nature of the frontal and the characters of the ovicell ally it with *Rhynchozoon*.

Described from the Tortugas Islands, Florida, and later recorded from Curaçao Island, Porto Rico, and Caledonia Bay, Panama. Canu and Bassler have described a similar species *R. levigatum* (1923:157) from the Pleistocene of Panama, which appears to differ only by its larger size and smoother frontal surface.

Hancock Stations: 129-34, Braithwaite Bay, Socorro Island, west of Mexico; 219, Clarion Island, west of Mexico; and San Benito Islands, west coast of Lower California, 13 to 18 fms. The Pacific coast specimens agree in all details with those from the Gulf of Mexico and the Caribbean Sea.

Family **Cheiloporinidae** Bassler, 1936

Hippopodinidae Levinsen, 1909:353, in part.

Ovicell endozoecial, sometimes distinctly visible, in other cases not evident on the surface. Avicularia present or wanting. Spines wanting. The frontal is a tremocyst, except in *Hippaliosina*, where it is a pleurocyst. The aperture varies greatly in form and cardelles are present or wanting.

The absence of a hyperstomial ovicell is the only character in which all the genera assigned to the family agree and the association often appears inconsistent. While the family, as constituted, is admittedly a provisional one, it seems better to follow this arrangement rather than to erect new families in the present state of our information.

The family name Hippopodinidae was unfortunately chosen by Levinsen under the mistaken idea that the ovicells of *Hippopodina feegeensis* (Busk) are endozoecial, and this genus has been removed from the family.

## KEY TO THE GENERA OF CHEILOPORINIDAE

1. Zoarium erect and branching, with chitinous joints . . . *Tetraplaria*  
 Zoarium encrusting . . . . . 2
2. Frontal a pleurocyst with areolar pores only . . . *Hippaliosina*  
 Frontal a tremocyst with numerous pores . . . . . 3
3. Ovicells endozoecial . . . . . 4  
 Ovicells apparently entirely wanting . . . . . 5
4. Aperture large, without cardelles; avicularia present . *Cheilopora*  
 Aperture constricted on the sides, with strong  
 cardelles; no avicularia . . . . . *Hippopodinella*
5. Aperture small, semicircular; a pair of lateral-oral  
 avicularia directed forward . . . . . *Enantiosula*  
 Aperture large, rounded or elongate . . . . . 6
6. Aperture elongate, widest at the proximal end . . . *Cryptosula*  
 Aperture nearly round, with a rounded sinus . . . . . 7
7. Zoarium heavily dark pigmented; operculum with a broad dark  
 border and broad axial band, or uniformly dark . *Watersipora*  
 No pigment; zoecia remarkably deep; operculum thick, without  
 sclerites, muscle attachments remote from the border . *Veleroa*

Genus **CHEILOPORA** Levinsen, 1909

Ovicell endozoecial. Frontal perforated, thin, inflated; the peristome somewhat tubular; aperture large, without cardelles; avicularia sometimes present at the side of the aperture. Genotype, *Discopora sincera* Smitt, 1868:28.

**Cheilopora praelonga** (Hincks), 1883

Plate 56, fig. 8

*Mucronella praelonga*, Hincks, 1884:27.

*Mucronella praelonga*, O'Donoghue, 1923:46.

*Cheilopora praelonga*, O'Donoghue, 1926:73.

Zoarium encrusting or erect and bilaminar. Zoecia large, elongate and somewhat tubular in form; averaging about 0.90 mm but ranging all the way from 0.65 to 1.10 mm long by 0.40 to 0.50 mm wide; the front a tremocyst with numerous large pores. The primary aperture is round, without cardelles, about 0.26 mm long and wide. The operculum has the form of the aperture, thin and with a narrow bordering sclerite. The peristome is high, tubular, thin-walled, the secondary aperture similar to the primary except for the presence of a small, sharp triangular denticle high up in the middle of the proximal border. The proximal border of the peristome is often elevated above the denticle into a broad process which terminates in one or more points, and the distal lip may also be extended into a long process; in our material these processes are not developed to the extent figured by Hincks, plate 4, fig. 2. No avicularia, no spines and no external evidence of the ovicells.

Hincks described the species from Houston Stewart Channel and O'Donoghue recovered it from numerous localities in British Columbia.

It was not taken during the Hancock Expedition, but from material sent me for identification I have the following records:

Masste Inlet, British Columbia, E. F. Ricketts, collector; Friday Harbor, Puget Sound, Dr. Alice Robertson, collector (Miss Robertson did not mention the species, but in some of her Friday Harbor material I have found a small specimen); Seattle, Tacoma and Indian Island, Washington, in material sent me for identification by the W. F. Clapp Biological Laboratories. Intertidal to 20 fms.

**Cheilopora praelucida** (Hincks), 1884

*Mucronella praelucida* Hincks, 1884:26.

*Mucronella praelucida*, Osburn, 1912a:283.

*Cheilopora praelucida*, Osburn, 1923:11d; 1936:539.

*Cheilopora praelucida*, O'Donoghue, 1926:73.

?*Discopora sincera*, Smitt, 1867:28.

Encrusting or growing free, unilaminar or bilaminar. The zoecia have much the aspect of *C. praelonga*, but the frontal is not so ventricose and there are raised separating lines. The primary aperture is rounded, or slightly quadrangular with rounded corners, and without cardelles. The proximal tooth near the summit of the peristome is wanting in *praelucida*, and the umbonate proximal lip is not so prominent; there is a forward extension of the distal lip but this also is smaller. There are avicularia at one or both sides of the aperture, often wanting and still more often degenerate to the extent that the avicularian aperture is merely covered with a membrane. Hincks described it "avicularia none," but his illustration (plate 4, fig. 1) shows one. In Labrador specimens (Osburn 1912:283) the avicularian mandible is sometimes well developed (see Osburn, plate 34, figs. 3 and 3c). Some zoecia and some whole colonies are devoid of avicularia, some zoecia have degenerate avicularia and others have them fully developed.

The ooecium was not found by Hincks and O'Donoghue. I have seen it only once, in a Labrador specimen (Osburn, 1912, plate 34, fig 3a). It is hemispherical, deeply set in the base of the succeeding zooecium, endozooecial, the exposed surface irregularly perforated.

In my opinion *praelucida* is merely a variety of *sincera* Smitt, though the avicularium is more pointed and the ovicell, if one may judge from Smitt's imperfect figure, is larger and more rounded. Without the opportunity to make a direct comparison it seems better to keep them separate for the present.

Hincks described the species from Houston Stewart Channel, British Columbia, and later discussed it in material from the Gulf of St. Lawrence. O'Donoghue reported it from Brotchie Ledge, Victoria, British Columbia. Osburn has listed it from Labrador, Hudson Strait and Bay, and Dolphin and Union Strait in the Arctic Ocean. *C. sincera* has been reported from Spitzbergen, Finmark, Greenland and as far west as Dolphin and Union Strait.

Genus **TETRAPLARIA** Tenison-Woods, 1878

Zoarium with an encrusting base, from which rise erect, articulated branches with corneous joints, branching dichotomously. Genotype, *T. australis* Tenison-Woods, 1878:61.

The zoarium of this genus has a small encrusting base, hitherto unknown. In the species discussed below, the one base consists of about 20 zooecia, only 6 of which are functional in nutrition, the others being closed. This base measures about 3 mm long by 2 mm wide; from it there arise 5 erect branches, each from a small interzooecial kenozoecium, the joint being similar in size and form to those between the internodes. Each internode begins with 2 zooecia arranged back to back, which arise from a kenozoecium between the terminal zooecia of the internode.

**Tetraplaria veleroae** new species

Plate 57, figs. 1-3

Zoarium with a small encrusting base and erect, jointed branches. The functional zooecia of the base measure 0.40 to 0.50 mm long by 0.26 mm wide. The closed heterozooecia are very variable in form and size. The ancestrula is similar to the later zooecia, but is considerably smaller.

The zooecia of the erect branches are arranged in alternating pairs, back to back, 2 to 4 pairs in a series, in the internodes; about 0.70 mm long by 0.55 mm wide, elliptical with a narrowed proximal end, distinct with shallow grooves and narrow raised lines. The frontal is a granular tremocyst with numerous small pores, moderately inflated and elevated toward the distal end. The aperture is nearly round, 0.16 mm in each dimension, with a broad shallow sinus between the small cardelles. The aperture of the fertile zooecia is much broader, 0.20 mm.

The endozooecial ovicell is exposed at the surface, broad and short, 0.40 mm wide by 0.18 mm long, rough and perforated like the front but with a thin collar around the aperture, which is closed by the operculum.

This species resembles *T. (Arborella) dichotoma* (Osburn, 1914: 202) from the West Indies, but has a much shorter ovicell and a broader sinus. It is similar also to *T. gryllus* Canu and Bassler 1929:395 from the Philippines, but the zooecia are only about half as long and the sinus is much wider.

This is the first record of the genus from the Eastern Pacific and the first account of the mode of attachment.

Type, AHF no. 100.

Type locality, Station 450, 0°55'00"S, 90°30'00"W, Galapagos Islands, 60 fms. Also at Stations 432 and 461, Tagus Cove, Albemarle Island, Galapagos, 80 to 100 fms.

### Genus **HIPPOPODINELLA** Barroso, 1924

Ovicell endozoecial. Operculum much contracted on the sides; aperture elongate, the anter much larger than the poster which is short and wide; the cardelles strong. The frontal is a tremocyst. Dietellae are present. No avicularia. Genotype, *Lepralia adpressa* Busk, 1854.

#### **Hippopodinella adpressa** (Busk), 1854

Plate 57, fig. 6

*Lepralia adpressa* Busk, 1854:82; 1856:178.

*Hippopodinella adpressa*, Barroso, 1924:6.

*Hippopodinella adpressa*, Hastings, 1930:729.

Zoarium encrusting, sometimes multilaminar. Zooecia moderate in size, averaging about 0.55 mm long by 0.40 mm wide; distinct but the grooves not deep; slightly inflated. The frontal is a tremocyst, the pores similar to the areolar pores, slightly roughened or with radiating ribs. The aperture is elongate, about 0.14 mm long by 0.10 mm wide; the cardelles project strongly and the proximal part of the aperture is wider than the distal part, transverse, with a slightly arcuate proximal border. A very slightly raised peristome surrounds the whole aperture. Rarely a minute avicularium is present near the aperture. No spines. The general appearance is that of a very small *Cryptosula pallasiana*.

Described by Busk from Chiloe, Chile, and later recorded by him from Mazatlan, Mexico. Hastings lists it from the Galapagos Islands and Coiba, Panama.

Hancock Stations: Noted at 29 stations from Angel de la Guardia Island in the Gulf of California, W. Mexico, Costa Rica, Panama, Ecuador, and south to the Galapagos where it is a common species.

**Hippopodinella turrita** new species

Plate 56, fig.13

Zoarium encrusting, white. Zooecia of moderate size, 0.40 to 0.55 mm long by 0.30 to 0.35 mm wide; considerably inflated and very distinct; frontal rough, a tremocyst with numerous pores, the areolar pores larger with strong, short ribs between them. The primary aperture is widely removed from the distal zoecial border; similar in form to that of *H. adpressa* but smaller (0.12 mm long by 0.08 mm wide), the poster a little wider than the anter and nearly straight on its proximal border; condyles strong. The primary peristome is low and thin; a heavy secondary peristome, formed by the frontal and roughly corrugated, surrounds this on all sides without obscuring the aperture. With complete calcification this secondary peristome or shield often bears several strong, erect, conical processes; typically one either side opposite the cardelles and two somewhat smaller ones distal to the aperture, but the distal ones may vary from 1 to 3; rarely a similar process may occur elsewhere on the front, and any or all of the processes are frequently wanting. The turrets sometimes bear small rounded avicularia at their tips, but more frequently they are merely pointed. Ovicell endozoecial and not evident on the surface.

Two characters apparently distinguish this species from others of the genus; 1, the distance between the aperture and the distal zoecial wall; 2, the broad, heavy, tuberculate distal rim of the secondary peristome.

Type, AHF no. 101.

Type locality: Hancock Station 452, Charles Island, Galapagos, (Post Office Bay), 65 fms, one colony on a gastropod shell. Also taken at Station 438, Chatham Island, Galapagos, one colony.

**Genus ENANTIOSULA** Canu and Bassler, 1930

"Without ovicell. The zooecia are surrounded by a common row of parietal dietellae. The frontal is a tremocyst. The peristomice (apparent aperture) is semielliptic. The operculum has the form of a bell with concave proximal border. There are two oral avicularia with beak converging on the axis of the distal half of the aperture." (Canu and Bassler, 1930:23). Genotype, *Enantiosula manica* Canu and Bassler.

This genus was questionably referred by Canu and Bassler to the "Escharellidae," but in the absence of ovicells, cardelles, sinus and proximal peristome it seems better to relegate it to the family Cheiloporinidae along with *Tremoschizodina*.



**Enantiosula manica** Canu and Bassler, 1930.

Plate 57, fig. 7

*Enantiosula manica* Canu and Bassler, 1930:23.

The zoarium is at first encrusting, but often rises into tapering, finger-like projections to a height of 40 mm or more and 10 mm across the base; highly multilaminar. The zooecia average about 0.65 mm long by 0.40 mm wide, little distinct; the frontal a coarse tremocyst with large infundibular pores, somewhat costate in full calcification, but without an umbo. The primary aperture is semicircular, the proximal border straight or slightly arcuate; no cardelles, no spines. The operculum has the form of the primary aperture and is moderately chitinized, with a narrow bordering sclerite. On either side of the aperture is an avicularium with a long-pointed mandible directed distally and toward the midline, often curved laterally to a slight degree. In addition there is a very minute rounded avicularium, appearing like a large pore, situated in the midline immediately distal to the aperture. I am unable to agree with Canu and Bassler that the avicularia are interzooecial; their development at the margin of the zoarium shows them to be developed from areolar pores as a part of the zooecium to which they belong, before the succeeding zooecium is formed. This applies also to the minute median avicularium, which is developed from a terminal areolar pore. Dietellae are present in the lateral and terminal walls.

There are no ovicells.

The species was described from the Galapagos Islands, Albatross Station D.2815.

Hancock Stations: dredged at 24 stations, Albemarle, Chatham, Duncan, Gardner, James, Onslow and South Seymour Islands, Galapagos; Secas Islands, Panama; Cocos Island, Costa Rica; Clarion Island, west of Mexico; Carmen and Tiburon Islands, Gulf of California; Magdalena Bay and San Benito Islands, Lower California; and off Laguna Beach, southern California. The last station, 1130-40, is at the latitude of 33°32'15"N, and the species is distributed from here southward to slightly south of the equator among the Galapagos Islands. The known depth range is from 3 to 60 fms.

**Enantiosula plana** new species

Plate 57, figs. 8-9

Zoarium encrusting, white. Zooecia of moderate size, ranging from 0.45 to 0.60 mm long by 0.30 to 0.40 mm wide, indistinct. The frontal area is nearly flat, outlined by the areolar pores, a dense tremocyst with

scattered pores and nearly smooth. The primary aperture is nearly semi-circular, about 0.10 mm long by 0.12 mm wide, the proximal border straight or slightly arcuate, no cardelles. The operculum is moderately chitinized, has the form of the aperture and a narrow bordering sclerite. The primary peristome is low and thin; the frontal forms a low secondary peristome around the sides and distal border but this is entirely wanting on the proximal border; no spines. There are three avicularia on every zoecium, one on each side opposite the proximal border of the aperture and the third in the median line immediately distal to the aperture; the three form an equilateral triangle and all of them arise from areolar pores as shown by their development; the lateral avicularia are pointed but shorter than in *E. manica* and the median one is larger than in that species.

No ovicell.

The species is similar to *E. manica* in most respects but is smaller, smoother, the tremopores are smaller and more scattered, the lateral avicularia are smaller and the median one larger, its base about as large as that of the lateral ones. The single specimen of *E. plana* is entirely encrusting in a single layer.

Type, AHF no. 102.

Type locality, Hancock Station 1257-41, 3 miles NW of Natividad Island, Lower California, 27°44'17"N, 115°15'58"W, at 30 fms.

### Genus **CRYPTOSULA** Canu and Bassler, 1925

There is no external evidence of an ovicell, the larva develops in the distal end of the zoecial chamber. The frontal is a pleurocyst with large pores. The aperture is a little elongate, the poster wider than the anter; the operculum bears a long sclerite on each side slightly within from the border and the muscle attachments are near the border. Genotype, *Eschara pallasiana* Moll, 1803.

Avicularia are sometimes present and a suboral umbonate process often occurs; in extreme calcification the frontal pores become widely infundibuliform. There are no oral spines.

### **Cryptosula pallasiana** (Moll), 1803

Plate 57, figs. 4-5

*Eschara pallasiana* Moll, 1803:57.

*Cryptosula pallasiana*, Canu and Bassler, 1925:33.

*Lepralia pallasiana*, Osburn, 1912:240; 1933:43.

*Lepralia pallasiana*, O'Donoghue, 1925:19.

The zoarium is encrusting on anything that will afford attachment, producing colonies of considerable size and sometimes rising in frills. The zooecia are moderately large, 0.65 (0.50-0.80) mm long by 0.35-0.45 mm wide, but extremes often exceed these measurements. The frontal is a tremocyst with large infundibuliform pores. The aperture is unusually large, 0.20 to 0.24 mm long by 0.18 to 0.20 mm wide, the sides nearly parallel, the poster wider than the anter, shallow, with the proximal border broadly arcuate; the cardelles small. The operculum fills the aperture, well chitinized, with a narrow sclerite scarcely separated from the lateral border. The peristome is thin, slightly elevated and not fused with the surrounding frontal. No spines; no external evidence of an ovicell. Avicularia are usually wanting but occasionally there is a small median, suboral one mounted on a small umbonate process; I have found these only rarely on Atlantic specimens and at only two Pacific stations but at one of the latter the avicularia are well distributed over the colony. Otherwise there seems to be no difference in the zooecia.

As this species was confused for many years with *G. complanata* (Norman) and *Hippodiplosia otto-mulleriana* (Moll), the distribution references are very uncertain, but at least it is known from the Mediterranean Sea and the coasts of Morocco, Portugal and France, and in the western Atlantic from Nova Scotia to North Carolina. It is especially abundant on the shores of New England. On the Pacific coast earlier writers did not mention it, and the only record is that of O'Donoghue (1925:19) from Homer, Alaska. It is a fairly common species along the coast of southern California, especially in the littoral zone.

Hancock Stations: 1274-41, Hueneme, 29 fms; 1271-41, Anacapa Island, 23 fms; 1208-40, Playa del Rey and 1644-48, White Point, near San Pedro, along shore; 1221-41 and 1222-41, Newport Bay, shore; and the writer has taken it along shore at Monterey Bay, Corona del Mar and La Jolla, all in southern California. Farther south it has been found at Station 1508-45, Sebastian Viscaïno Bay, Lower California, and at Salina Cruz, Oaxaca, Mexico, in shallow water (E. Yale Dawson, collector).

Genus **WATERSIPORA** Neviani, 1895—*Watersipora* 1895: 1021

*Pachycleithonia* Canu and Bassler, 1930:25.

Frontal a tremocyst with numerous rather large pores. Ovicell endozooecial, not evident on the surface. Aperture rounded, usually with a broad rounded sinus and very strong cardelles. No spines, no avicularia. Operculum with a chitinized border and a broad dark axial band which

leaves a large clear space on each side beyond the cardelles (the extent of this axial band quite variable). A thick ectocyst which varies from brownish to nearly black in color. Genotype, *Lepralia cucullata* Busk, 1854:81.

*Watersipora cucullata* (Busk), 1854

Plate 56, figs. 1-5

*Lepralia cucullata* Busk, 1854:81.

*Lepralia atrofusca* Busk, 1856:178.

*Schizoporella atrofusca* and var. *labiosa* Hincks, 1886:269.

*Lepralia?* *cucullata*, Waters, 1909:150 (excellent bibliography).

*Pachycleithonia nigra* Canu and Bassler, 1930:25.

*Watersipora cucullata*, Hastings, 1930:729.

*Watersipora cucullata*, Marcus, 1937:118.

*Watersipora cucullata*, Osburn, 1940:449; 1947:40.

Zoarium encrusting, occasionally rising into low frills, conspicuous because of its color, brownish-purple to black. Zooecia large but varying greatly in size, average length about 1.00 mm, width about 0.40 mm, rather regular in form and quite distinct. The front is regularly rounded from side to side, a smooth tremocyst with numerous large pores; chalky white beneath the thick, pigmented ectocyst. The primary aperture is large and varies in its proportions; typically the poster is more or less semicircular, but it may be broadly arcuate; the condyles are usually strong and conspicuous; just above each condyle there is usually a small cup-shaped indentation of the border of the aperture. The operculum has the form of the aperture, heavily pigmented like the front, sometimes with a rounded clearer area on either side in advance of the condyles, usually with a black sclerite extending straight forward from the point of attachment on either side; an unusual feature of the operculum is the presence of a small shining tubercle on each side proximal to the condyles. The peristome is typically simple and slightly elevated, but it may rise into erect lappets or folds on its proximal border (var. *labiosa*), or extend forward in a flat shelf above the poster (var. *nigra*). No spines, no avicularia. As Hastings (1930:730) indicates, there is much variation even on the same zoarium, and about the only invariable character I have been able to note is the presence of the minute shining tubercles on the operculum behind the condyles.

There is no evidence of an ovicell externally, and Waters (1909:151) has shown that the larva develops in a sac at the distal end of the zoecial chamber.

The numerous variations have been discussed by Waters (1909:151), Hastings (1930:730) and Marcus (1937:119) but without the separation of any distinct species. The type (Hastings, pl. 15, fig. 98) has a comparatively narrow, rounded poster, and eastern and western Atlantic specimens agree on this point; some colonies from Colombia, Galapagos and the Gulf of California have a rounded poster, while in others it is shallow and nearly as wide as the anter. Two rather distinct varieties are based on the nature of the aperture and the peristome.

Variety *labiosa* (*Lepralia atrofusca* var. *labiosa* Hincks, 1886:269), from the Arabian Sea, occurs also in the Caribbean Sea and at Santos Bay, Brazil. The zooecia are somewhat smaller. The proximal border of the peristome rises into erect and contorted lappets.

Variety *nigra* (*Pachycleithonia nigra* Canu and Bassler, 1930:25), from the Galapagos Islands, and later recovered by the Hancock Expeditions at a number of localities as far north as in the Gulf of California, is characterized by the broad shallow poster and the forward projection of the frontal nearly to the condyles. But for the variation in the breadth and form of the poster this might well be considered a distinct species. All of the other characters, however, agree with the typical form.

The species, in its various forms, has been reported from the Mediterranean Sea, Red Sea, Arabian Sea, Indian Ocean, China Sea, Gulf of Mexico, Caribbean Sea, South Africa, Brazil, and in the Eastern Pacific from Mexico, Colombia and the Galapagos Islands.

Hancock Stations: at 36 stations from the Galapagos Islands and Colombia on the south to Angel de la Guardia Island in the Gulf of Mexico. The variety *nigra* occurred at numerous stations about the Galapagos Islands and north to Mazatlan, Mexico, along with the more typical variety.

### Genus **VELEROA** new genus

No oocia; no avicularia; aperture rounded with a large rounded sinus; operculum thick, without sclerites and with muscle attachments remote from the border; frontal a tremocyst with numerous pores; the zoecial cavity very deep; lateral and distal walls with very numerous uniporous septulae which are evenly scattered over the whole surface. Genotype, *Veleroa veleronis* Osburn, new species.

The aperture and the frontal surface are much like *Watersipora*, but the operculum lacks entirely the broad bordering sclerite and other characters of that genus, and the muscle attachments are far removed from the margin on a slightly more chitinized area. The great depth

of the zooecial cavity is an unusual character, usually deeper than long, but the zooecia do not appear to be erected as they are in the Celleporidae, as the frontal area is quite horizontal. The distribution of the numerous communication pores over the whole surface of the lateral and distal walls appears to be a unique character.

The absence of ovicells and the nature of the aperture and frontal appear to relate this genus most nearly to *Watersipora* in the family Cheiloporinidae.

The genus is named in honor of the "*Velero III*," Captain Allan Hancock's yacht, in which ten years of dredging expeditions were carried on, from Oregon to Peru and the Galapagos Islands.

***Veleroa veleronis* new species**

Plate 56, figs. 6-7 and Plate 55, fig. 11

*Schizoporella areolata*, Robertson, 1908:285.

Zoarium encrusting. Zooecia large, 0.60 to 0.85 mm long by 0.55 to 0.65 mm wide and very deep, the cavity often deeper than long; distinct, without separating raised lines, the surface slightly inflated; frontal a tremocyst with numerous large pores and covered with a thick yellowish ectocyst. The primary aperture is evenly rounded to the level of the large cardelles, proximal to which is a broad rounded sinus about half the width of the aperture, which measures about 0.25 mm in either direction. The operculum is heavily chitinized, "leathery," without any definite sclerites though the proximal tip of the "tongue" bears a thicker band and there is also an indefinite thickened area near the center where the muscle attachments are located far within the border (similar to their position in *Schizoporella* and *Gephyrophora*). The primary peristome is thin and low and appears to extend back only to the cardelles; the secondary peristome is slightly raised, only a little thickened, and finely granulated. No spines, no avicularia and no ovicells. The communication pores are very numerous and are scattered thickly over the entire surface of the lateral and distal walls.

This species was first obtained at Santa Catalina Island by Dr. Alice Robertson who identified it with the *Lepralia areolata* Busk, 1854, from the Straits of Magellan. The surface appearance of Busk's species is slightly similar, but in *areolata* the sinus is deeper and narrower, there are conspicuous separating lines, and the zooecia appear to be much smaller. It is possible that *Lepralia areolata* should be included in the present genus, but the description is very incomplete and the species apparently has never been recovered.

Type, AHF no. 103.

Type locality, Hancock Station 1257-41, three miles NW of Natividad Island, Lower California, 27°55'53"N, 115°15'58"W, 31 fms. Also dredged at Station 1051, off San Miguel Island, 12 to 19 fms; 1662-48, Santa Cruz Island, 23 fms; Palos Verdes (Accession 1212) 3 to 5 fms on an abalone shell; and a part of Robertson's *Schizoporella areolata* (non Busk) from Santa Catalina Island, all from southern California.

### Genus HIPPALIOSINA Canu, 1918

Ovicell endozoecial. The aperture is elongate, elliptical, divided into two parts by triangular cardelles; the poster smaller than the anter. Frontal a granular pleurocyst with areolar pores which are sometimes in more than one row. Usually a small avicularium at each side of the aperture. Genotype, *Escharella rostrigera* Smitt, 1873.

#### *Hippaliosina rostrigera* (Smitt), 1873

Plate 56, fig. 9

*Escharella rostrigera* Smitt, 1873:57.

*Lepralia rostrigera*, Osburn, 1914:211.

*Hippaliosina rostrigera*, Canu and Bassler, 1928:130.

*Hippaliosina rostrigera*, Hastings, 1930:729.

*Hippaliosina rostrigera*, Osburn, 1940:448.

Zoarium encrusting. Zooecia of moderate size but very variable, ranging from 0.30 to 0.60 mm in length by 0.25 to 0.35 mm in width; the frontal a granular pleurocyst with a row (sometimes two rows) of areolar pores, nearly flat. The aperture is variable in form, longer than broad, the anter more than a semicircle and separated from the poster by strong, pointed cardelles; the poster usually narrower than the anter and with an arcuate proximal border. The peristome is thin and slightly raised only around the distal border. No spines. There is usually a small avicularium on either side of the aperture, the mandible short or long and directed forward and inward around the border.

The endozoecial ovicell is scarcely noticeable on the surface but the fertile zooecia are easily distinguished by their short, wide apertures.

Described from the Gulf of Mexico and known only from the West Indian region until Hastings recorded it from Gorgona, Colombia.

Hancock Stations: 154-34, Albemarle Island, Galapagos; 332, Bahia Honda, Panama; and 270, east of Angel de la Guardia Island, Gulf of California. Shore to 27 fms.

**Hippaliosina inarmata** new species

Plate 56, fig. 10

Zoarium encrusting on shells and corallines. Zoecia of moderate size; 0.45 to 0.55 mm long by 0.35 to 0.40 mm wide, distinct with a raised separating line; front little inflated, a granular pleurocyst with a row of large areolae which are separated by short ribs, without umbo or other irregularities. The aperture measures about 0.13 mm in either dimension, rounded distally, the poster broader than the anter; the proximal border nearly straight; cardelles wanting. The operculum has the form of the aperture, the distal border thickened and a narrow sclerite on either side close to the lateral edge, as in *H. rostrigera*. The peristome is thin, slightly raised all around the aperture and with a low lappet on each side, the primary aperture not obscured. There are no avicularia, no spines, no dietellae.

The ovicell is endozooecial, but its porous frontal surface is partially exposed, scarcely raised above the level of the aperture.

The species is readily distinguished from *H. rostrigera* by the shorter aperture which is widest proximally, by the complete peristome and by the entire absence of avicularia.

Type, AHF no. 104.

Type locality: Hancock Station 136-34, Clarion Island west of Mexico, 18°20'05"N, 114°44'40"W, 32 fms. Also at Station 136-34 in the same region, 57 fms; 239-34, Port Utria, Colombia, shore; and Albatross Station 2886, off the Oregon coast, 43°59'00"N, 124°56'30"W, at 50 fms.

**Hippaliosina costifera** new species

Plate 56, figs. 11-12

Zoaria encrusting on the smooth surface of pebbles, sometimes multi-laminar, white. Zoecia moderate in size, 0.55 to 0.75 mm long by 0.35 to 0.50 mm wide; distinct, the younger ones separated by deep grooves. The frontal is thick pleurocyst with a marginal row of large areolar pores, between which strong costal ridges extend radially toward an irregularly broad, prominent umbo. Frequently the marginal areolae extend around the distal end in front of the aperture and in older zoecia the rows of pores mark the outlines. The primary aperture is slightly elongate, 0.14 mm long by 0.12 mm wide, semielliptical, the condyles small and set far back, the proximal border nearly straight and extending



the full width between the cardelles. The operculum has the form of the aperture, moderately chitinized, with a slender bordering sclerite which is thickened for some distance beyond the cardelles, and the muscle attachments close to the border. The primary peristome is thin and inconspicuous; the frontal forms a thick wall about the aperture, but usually leaves a semilunar area proximal to the aperture. No spines and no avicularia.

No ovicells are present on the 30 colonies examined.

The general appearance of the species is somewhat like *Escharina costata* d'Orbigny (1847:44) from Valparaiso, Chile, but in that species the aperture is altogether different, and there are oral spines.

Type, AHF no. 105.

Type locality, Hancock Station 369-35: off Fronton Island, near Callao, Peru,  $12^{\circ}07'25''\text{S}$ ,  $77^{\circ}11'30''\text{W}$ , at 5 fms; more than 30 colonies encrusting three pebbles.

Family **Crepidacanthidae** Levinsen, 1909

The oecium is hyperstomial and recumbent. Pore chambers and septulae sometimes alternate. Zoocial aperture with strong cardelles; operculum well chitinized. Avicularia long, setose or pediform, usually paired at the sides of the aperture; long oral spines usually present and sometimes marginal spines also.

Genus **CREPIDACANTHA** Levinsen, 1909

The frontal is surrounded by a row of long setose marginal spines situated between the areolae. Aperture with a very broad poster and without a sinus. Ovicell recumbent, closed by the operculum. Genotype, *C. poissoni crinispina* Levinsen, 1909:266.

**Crepidacantha poissoni** (Audouin), 1826

Plate 58, fig. 2

*Flustra poissoni* Audouin, 1826:10.

*Lepralia poissoni*, Waters, 1899:16.

*Crepidacantha poissoni*, Canu and Bassler, 1929:33.

Zoarium encrusting, forming small white colonies, usually on shells. Zooecia moderate in size, averaging about 0.55 mm long by 0.40 mm wide, but subject to much variation; the frontal is smooth, inflated, the separating grooves deep; a row of small areolar pores. The primary aperture is rounded beyond the strong triangular cardelles, and proximally to these is a wide, shallow poster with a straight proximal border; 0.10 mm long by 0.08 mm wide. The peristome is little developed and is unarmed, but a slight umbo usually projects forward just enough to give the proximal border an incurved outline. A pair of setiform avicularia, one on either side a little proximal to the aperture, is characteristic of this species. From 6 to 10 very slender marginal spines occur low down around the distal end below the level of the aperture.

The ovicell is slightly flattened above, situated on the distal side of the peristome, hyperstomial and closed by the operculum.

It is a circumtropical species, but has been noted on the Pacific coast of the Americas only by Canu and Bassler from the Galapagos Islands (also from Hawaii).

Hancock Stations: Noted at 25 different stations from Santa Barbara Island, Station 1064, off southern California to the Galapagos Islands. Angel de la Guardia and San Esteban Islands in the Gulf of California;

Clarion and Clipperton Islands west of Mexico; Secas Island, Panama; La Libertad, Ecuador, and abundant about the Galapagos Islands. Shore to 73 fms.

**Crepidacantha setigera** (Smitt), 1873

Plate 58, fig. 1

*Escharella setigera* Smitt, 1873:58.

*Crepidacantha setigera*, Canu and Bassler, 1928:135.

? *Crepidacantha longiseta* Canu and Bassler, 1928:135.

Encrusting on shells and corallines, the general aspect is that of *C. poissoni*, except for the form of the aperture and the position of the avicularia. The proximal border of the aperture is not straight as it is in *poissoni*, but broadly arcuate and it is much narrower than in *poissoni*. The setose avicularia are situated at the sides of the aperture instead of proximal to it. The number of the marginal spinules is larger, 10 to 16. The ovicell is similar except that in final calcification it sometimes has a low umbo on its top.

In the opinion of the writer, *C. longiseta* Canu and Bassler is only a variant of *setigera*. Canu and Bassler state that it differs "in its smaller dimensions and its long setiform mandible," but I cannot find constant differences in either character.

Smitt described *setigera* from Florida (Tortugas Islands) and Canu and Bassler list it from the Florida Straits; *C. longiseta* was recorded from north of Cuba.

Hancock Stations: 143-34, Wenman Island, 155-34 and 157-34, Albemarle Island, Galapagos; 328, Cocos Island, off the coast of Costa Rica. Seven colonies, ranging in depth from 18 to more than 100 fms.

Genus **MASTIGOPHORA** Hincks, 1880

"Zooecia with a semicircular orifice, the inferior margin straight, with a central sinus; furnished with lateral vibracula" (Hincks). To this may be added the presence of a recumbent ovicell and pore chambers. Genotype, *Lepralia hyndmanni* Johnston, 1847.

**Mastigophora pesanseris** (Smitt), 1873

Plate 58, fig. 3

*Hippothoa pes anseris* Smitt, 1873:43.

*Mastigophora pes-anseris*, Hastings, 1930:722.

Zoarium encrusting. Zooecia of moderate size, averaging about 0.65 mm long by 0.40 wide; distinct with deep grooves, the front

considerably inflated and rising sharply toward the peristome, with numerous minute pores, the areolar pores usually obscured by later calcification. The primary aperture is small, about 0.09 mm long by 0.12 mm wide, semicircular with a straight proximal border; the sinus is narrow, deep and constricted and the proximal corners are definitely notched. The peristome is somewhat elevated, thickened, completely surrounds the aperture and bears about 6 oral spines.

The striking feature of this species is the presence on either side of the aperture of a peculiar avicularium, the mandible of which is shaped like the foot of a goose; there is a strong cross bar for the attachment of the mandible.

The ovicell is very short, small and prominent.

Described by Smitt from Florida, it is found around the world in warmer waters. The only record for the Pacific coast of the Americas is that of Hastings from Gorgona, Colombia.

Hancock Stations: 270, Angel de la Guardia Island, Gulf of California; 307, Secas Island, Panama; 411-35, Gorgona Island, Colombia; and 143-34, Wenman Island, 788-38, Dahpne Major Island, 155-34, 432, and 461, Albemarle Island, Galapagos. 14 to more than 100 fms.

### *Mastigophora porosa* (Smitt), 1873

Plate 58, fig. 4

*Hippothoa porosa* Smitt, 1873:41.

*Mastigophora porosa*, Canu and Bassler, 1928:134; 1928b:38.

Zoarium encrusting in a single layer, flat and white, with very conspicuous brown vibracula. Zoecia large, but very variable in measurement, 0.60 to 0.80 mm long by 0.45 to 0.80 mm wide; the frontal a tremocyst with minute pores and so flat that the zoecia are distinct only in the youngest stages; there are a few very large areolar pores, which usually become closed by secondary calcification. The primary aperture is wider than long, 0.14 mm wide by 0.11 mm long, rounded with a straight proximal border in which there is a v-shaped sinus; the notches at the proximal corners, referred to by Smitt, are usually quite distinct. The operculum is thin, with a triangular proximal tongue, and of the same form as the aperture.

The most striking feature is the large, elongate vibraculum, usually more than 1.00 mm in length, one on every zoecium at the side of or a little proximal to the aperture.

"The ovicell is very short and of the same structure as the frontal" (Canu and Bassler). Our specimens are not in reproduction.

Smitt described the species from west of the Tortugas Islands, Florida, and Canu and Bassler listed it from the West Indian region and Brazil. The Pacific coast specimens appear to present no essential differences.

Hancock Station 423-35, off Port Utria, Colombia, 12 fms, encrusting corallines, five small colonies.

### Family **Phylactellidae** Canu and Bassler, 1917

"The ovicell is very large and closed by a special membrane. The special ovicell which Waters called recumbent is placed on the distal part of the zooecium itself between the apertura and the distal zooecium. Evidently it is also more or less supported on the distal zooecium, but frequently it is completely separated from it." (Canu and Bassler, 1920: 573).

### Genus **PHYLACTELLA** Hincks, 1879, (in part).

"Zooecia with the primary orifice more or less semicircular, the lower margin usually dentate; peristome much elevated, not produced or channelled in front No avicularia." (Hincks, 1879:161).

To this description Canu and Bassler (1920:573) added the following characters: frontal a tremocyst with small pores; the thick band of the operculum is a little distance from the edge; no spines; a lyrule or cardelles present; the aperture more or less circular; peristome more or less funnel-shaped.

The genus, more recently, has very properly suffered much from amputation, and of the three species selected by Hincks, *Alysidota labrosa* Busk has a porous frontal and a lyrula and has been returned to *Alysidota* Busk (preoccupied and renamed *Alysidotella* by Strand) as the genotype of that genus. Also the third species, *Lepralia eximia* Hincks, has a porous frontal and a lyrula and has been removed. This leaves only *Lepralia collaris* Norman, which has been selected as the genotype. The fossil species described by Canu and Bassler (1920:573) all have the porous frontal and appear to belong more properly to *Alysidotella*.

The genus *Phylactella* may be redescribed as follows:

Zooecia with the primary aperture more or less rounded; cardelles small; frontal a pleurocyst with small, well-spaced areolar pores; the secondary peristome (developed from the frontal) high and flaring proximally and on the sides, but entirely wanting on the distal border. Ovicell

prominent, recumbent on the distal zoecium but not immersed, perforated. Genotype, *Lepralia collaris* Norman, 1867:204.

The above description is drawn from a specimen from Norman's collection and from the type locality, loaned me by Dr. Anna B. Hastings of the British Museum.

### *Phylactella aperta* new species

Plate 59, figs. 1-2

Zoarium encrusting on a shell. Zoecia ovate, very distinct, slightly ventricose and more elevated distally; length 0.65 mm (0.55 to 0.70), width 0.40 mm (0.35 to 0.50); frontal a reticulated olocyst covered by a thin pleurocyst, imperforate except for small well-spaced areolar pores and sometimes a few additional ones. The primary aperture is slightly quadrangular, longer than broad (0.13 by 0.11 mm), the proximal border a little arcuate, cardelles minute. The operculum is moderately chitinized and bears a narrow sclerite a short way within the border. The secondary peristome (an extension of the frontal) forms a high funnel-shaped wall proximally and laterally, extended into large flaring lappets on the sides, but wanting entirely on the distal border. No spines. A small pointed slightly elevated avicularium is present on most of the zoecia proximal to the peristome and at or near the midline; it is asymmetrical in origin and arises from an areolar pore on one side only; the mandible is directed proximally, pointed and with a complete hinge bar.

The ovicell is hemispherical, prominent, resting on the distal zoecium but not embedded; perforated by small pores which are slightly elevated; a small flattened imperforate area above the orifice.

The genotype of *Phylactella* has no avicularia and I am not aware that they have been found in any other species of the genus. However, all of the other features of *aperta* agree so closely with *P. collaris* that they must be congeneric. Through the kindness of Dr. Anna B. Hastings of the British Museum I have been able to study a specimen of *collaris* from the Norman collection and from the type locality, Antrim, Ireland.

Type, AHF no. 106.

Type locality, Hancock Station 450, Cartago Bay, Albemarle Island, Galapagos, 0°55'00"S, 90°30'00"W, at 60 fms, one colony in reproduction.

*Phylactella alulata* new species

Plate 59, figs. 3-5

Zoarium encrusting on stones. The zooecia are moderately large, broad and distinct, 0.65 to 0.70 mm long by 0.45 to 0.50 mm wide, hexagonal, thin at the borders and rising regularly toward the aperture. The frontal consists of a thin olocyst which from the internal view appears to be made up of a series of minute plates; this is covered by a thin pleurocyst which is finely reticulated which gives the appearance of being thickly perforated, but the "pores" do not penetrate to the interior; the areolar pores are very small. The peristome is striking in appearance, with a high, pointed, flaring lappet on each side and a median pointed umbonate process which bears a small median avicularium on its distal aspect; wanting on the distal border. The primary aperture is rounded distally, the sides somewhat parallel and the proximal border broadly arcuate; a little longer than broad, 0.13 mm wide by 0.15 mm long; cardelles minute. The operculum is thin, with a narrow bordering sclerite. The suboral avicularium has a triangular mandible and a complete hinge bar; the chamber appears to be connected with an areolar pore on each side.

The ovicell is large, 0.40 mm long by 0.32 mm wide, prominent and recumbent on the distal zooecium but not embedded; the front bears numerous scattered pores of varying form and size; not closed by the operculum.

It is a striking species from very deep water. Unfortunately it is represented by only a few zooecia encrusting rocks and I have not been able to study it thoroughly without destroying the specimen. The presence of a median suboral avicularium does not conform to the type of the genus, but in all other characters, nature of the frontal, form of the aperture, small cardelles, peristome high proximally and wanting distally, ovicell recumbent and perforated, the agreement appears to be perfect.

Type, U. S. Nat. Mus., 11034.

Type locality, Albatross Station 5688, 27°38'45"N, 115°17'40"W, southwest of Point San Eugenio, Lower California, at 525 fms. One small specimen which was salvaged by the writer from other invertebrate material which came to the American Museum of Natural History from the 1911 cruise of the Albatross; it has been in my possession ever since, awaiting a proper time for publication.

Genus **LAGENIPORA** Hincks, 1877

Hincks' description is meager and inadequate: "Colonies consisting of a number of cells immersed in a common calcareous crust. Zooecia decumbent, contiguous, lageniform; oral extremity free, tubular, with a terminal orbicular orifice." Genotype, *Lagenipora socialis* Hincks, 1877:214.

There has been much misunderstanding in regard to this genus, possibly from the failure to consider the nature of the various characters which differentiate it from *Costazia*, with which it has been most frequently confused. The writer has had the privilege of studying seven species which present the same general characters: *L. socialis* Hincks (the genotype), *L. spinulosa* Hincks, *L. punctulata* (Gabb and Horn = *L. erecta* O'Donoghue), *L. marginata* Canu and Bassler, *L. lacunosa* Bassler, *L. verrucosa* Canu and Bassler, and *L. hippocrepis* (Busk). In all of these the following assemblage of characters is presented: zooecia lageniform (flask-shaped), the zooecial body entirely decumbent; a tubular peristome of variable height erect or semierect; the frontal a tremocyst with numerous conspicuous pores evenly distributed over the surface; a pair of small lateral-oval avicularia at the rim of the peristome or extending above it; absence of frontal avicularia; a hemispherical oecium on the distal side of the peristome, high above the base or lower down but always opening into the peristome well above the primary aperture, its upper surface with a finely perforated area.

In *Lekythopora* MacGillivray, which has somewhat the same manner of growth, the ovicell is borne upon the proximal side of the peristome and the frontal pores are few. In *Costazia* Neviani (*Siniopelta* Levinsen) the zooecia are erected, the frontal provided with enlarged areolar pores and the aperture is more or less sinuate, also frontal avicularia (sometimes interzooecial) are present and the perforated area of the ovicell presents a different picture.

KEY TO SPECIES OF *Lagenipora*

1. Zoarium erect and branching from an encrusting base . . . . 2  
    Zoarium encrusting at all stages . . . . . 3
2. Zoarium rough, zooecia large (av. 0.70 mm long), coarsely  
    punctate, peristome high and costate . . . . . *punctulata*  
    Zoarium smoother, zooecia smaller (av. 0.55 mm long), pores  
    smaller, peristome lower and smooth . . . . . *mexicana*



3. Zoarium with linear branches of usually 1 to 3 series of  
 zooecia . . . . . *marginata*  
 Zoarium irregular but not branching in linear form . . . . . 4
4. Ovicell at base of peristome . . . . . 5  
 Ovicell higher up on distal side of peristome . . . . . 6
5. Peristome short, thick-walled, smooth; zooecia large and  
 coarse . . . . . *lacunosa*  
 Peristome high and thin, delicately costulate . . . . . *hippocrepis*
6. Peristome very high, thin, costate, flared, with spinous processes all  
 around the border . . . . . *spinulosa*  
 Peristome moderately high, smooth to coarsely costate, flared  
 especially on the proximal lip . . . . . *socialis*
7. Also a still smaller species, zooecia not more than 0.40 mm long,  
 with v-shaped sinus; avicularia pedicellate and with a cervicorn  
 branch which sometimes unites with the opposite one to form a  
 bridge distal to the aperture . . . . . *admiranda*

***Lagenipora punctulata* (Gabb and Horn), 1862**

Plate 60, figs. 1-2

*Entalophora punctulata* Gabb and Horn, 1862:171.

*Lagenipora spinulosa* Hincks 1884:40 (in part).

*Lagenipora spinulosa*, Robertson, 1908:283 (in part).

*Tubucellaria punctulata*, Canu and Bassler, 1923:170.

*Lagenipora erecta* O'Donoghue, 1923:33; 1926:74.

Zoarium erect and branching from a small encrusting base, varying greatly in size and form, attached usually to stems of hydroids, bryozoans, etc., coarse and stiff to a height of 20 mm or more. There is much variation in the diameter of the branches, as few as 4 zooecia to as many as 12 surrounding the axis. The zooecia are lageniform, more or less embedded in the rounded stem, with a tubular peristome projecting at a marked angle; moderately large (0.60 to 0.80 mm long by 0.40 to 0.50 mm wide), the frontal considerably inflated and coarsely punctured. The peristomial tubes vary in length, occasionally as long as the zooecial body but usually much shorter, definitely ribbed with the costae extending from the base to the tip; in younger zooecia the proximal lip is often flared or extended forward, and often with low crenulations. There is a small avicularium on either side, sometimes projecting above the level of the peristome but usually on a level with its rim. In older specimens the tremocyst may extend upon the peristome nearly to its tip. The primary aperture is slightly ovate, length 0.16 mm, width 0.13 mm.

The ovicell is located at or near the base of the peristome, and on complete calcification may be partially embedded; it measures about 0.24 mm wide and has the characteristic finely perforated, semicircular frontal area.

There is a remarkable difference in appearance between the young zooecia with their long peristomes and the heavily calcified old ones in which the tremocyst covers the peristomes nearly to the tips, and old colonies encrusting stones are often scarcely recognizable except at the growing edges.

Hincks and Robertson both confused this species with *L. spinulosa*, though there is much difference in the size of the zooecia and the nature of the peristomes. Canu and Bassler located the species properly under Gabb and Horn's *E. punctulata*, but misplaced it in the genus *Tubucellaria* which has an ascopore and flexible joints. Dr. Bassler has kindly reexamined his fossil material and agrees (*in litt.*) that it belongs in the genus *Lagenipora*. O'Donoghue separated it from *spinulosa* and considered it to be a new species, *erecta*.

Gabb and Horn described the species from the "Miocene" (later corrected to "Post-Pliocene") of Santa Barbara, California, and Canu and Bassler found it in the Pleistocene of Santa Barbara and Santa Monica. It is quite abundant in the Pleistocene of southern California at various places from Santa Barbara to Newport Harbor, and I have seen numerous fossil specimens which have been dredged near shore and which had been washed out of the shore-wise cliffs.

The records of Hincks, O'Donoghue and Robertson indicate distribution from British Columbia to Monterey Bay, California.

Hancock Stations: occurring at 125 dredging stations, from northern California to the tip of Lower California, the Gulf of California (16 stations), and the Galapagos Islands (13 stations). It appears to be most abundant in the southern California region at depths ranging from near shore to about 100 fms.

### ***Lagenipora mexicana* new species**

Plate 59, figs. 7-8

Zoarium with a small encrusting base which surrounds stems; erect and irregularly branching, the branches round, not all in one plane; basal portions of the stems 1.00 to 2.00 mm in diameter, the younger tips 0.60 mm. The zooecia are moderate in size, 0.50 to 0.60 mm long by 0.35 to 0.40 mm wide; lageniform, completely decumbent, in younger stages quite distinct, the front inflated with evenly distributed large

tremopores, in older stages of calcification the zoarial surface becomes nearly level. The peristome is raised in young zooecia, but rather low for this genus, the walls smooth and thick; in old zooecia the thickened frontal wall more or less obscures the peristome. There is the usual pair of avicularia on the rim of the peristome, set a little in advance of the middle of the aperture. The primary aperture is slightly elongate, 0.12 mm long by 0.10 mm wide. There are no avicularia except the oral ones and no spines or other external characters.

The ovicell, 0.20 mm wide, is situated at the base of the peristome and opens into it well above the primary aperture, but with advancing calcification becomes more or less embedded; it bears the usual finely punctate semicircular area on the upper surface.

The species has some resemblance to *L. punctulata*, especially in its erect zoarial form and rounded branches, but it is much smaller, smoother, the peristome does not rise above the ovicell and the zooecia become more embedded with age.

Type, AHF no. 108.

Type locality, Banderas Bay, west Mexico, 20 to 40 fms, 9 colonies and fragments, collector, George Willett. Also Hancock Station 270, Angel de la Guardia Island, Gulf of California, 14 fms; and off Puerto Escondido, Lower California, 34 fms. Also at Guadalupe Island, west of Lower California, 40 fms, C. L. Hubbs, collector.

### **Lagenipora spinulosa** Hincks, 1883

Plate 59, fig. 6

*Lagenipora spinulosa* Hincks, 1883:31; 1884:40 (in part).

*Lagenipora spinulosa*, Robertson, 1908:283 (in part).

*Lagenipora spinulosa*, O'Donoghue, 1923:33; 1926:74.

*Lagenipora spinulosa*, Canu and Bassler, 1923:171.

*Lagenipora spinulosa*, Hastings, 1930:730.

The zoaria form small irregular incrustations on shells, worm tubes, the stems of hydroids and bryozoans, etc. The zooecia are lageniform, about 0.50 mm long by 0.30 mm wide, usually oriented very irregularly, the frontal inflated and coarsely punctate. The peristomes are high, often as long as the zooecial body, the proximal side smooth and hyaline, the sides striate to the tip which is somewhat expanded; the proximal lip is usually simply flared outward but may bear one or two low points; the distal border is provided with several long spinous processes, some or all of which may be lacking. A small avicularium on either side rises

usually well above the border of the peristome. The primary aperture at the bottom of the tube is nearly round, 0.13 by 0.13 mm.

The ovicell is borne well above the base of the peristome on the distal side, the finely perforated area broadly lunate.

Described by Hincks from the Queen Charlotte Islands and recorded by O'Donoghue from numerous British Columbia localities. Robertson recorded it from Catalina Island, and Canu and Bassler from the Pleistocene of San Pedro, California. Hastings recorded it from the Galapagos Islands.

Hancock Station, 270, Angel de la Guardia Island, and Albatross Sta. 3005, Gulf of California; otherwise only off southern California at 16 stations; shore to 60 fms. There is also a specimen from Humpback Bay, Alaska (U. S. "Stranger," 1937, W. Williams).

### *Lagenipora socialis* Hincks, 1877

Plate 60, figs. 3-4

*Lagenipora socialis* Hincks, 1877:215.

*Lagenipora socialis*, O'Donoghue, 1923:33; 1926:74.

Zoarium forming small irregular patches, often on stems. The zooecia are disposed irregularly, lageniform, inflated and coarsely punctured, 0.40 to 0.55 mm long by 0.35 mm wide. The peristomial tubes are nearly erect, much shorter than in *spinulosa* and wider, costate; the aperture flared, especially the high proximal lip which is somewhat pointed; the distal border is slightly lower and may be smooth or bear a few short processes. On either side is an avicularium with a pointed mandible, a little larger than is usual in the genus.

The ovicell is borne high above the base on the distal side, conspicuous, its perforated area varying from semicircular to a more or less transverse band.

The zooecia are more erect than in the other species, the primary aperture is ovate, 0.14 mm long by 0.12 mm wide, and in the fertile zooecia the proximal border of the ovicell is often extended to some degree over the peristomial aperture.

Described by Hincks from England. O'Donoghue recorded it from numerous British Columbia localities, but it has not otherwise been noticed on this coast.

Hancock Stations: 1219-40, San Nicholas Island, and 1284-41, Santa Rosa Island, southern California, 16 to 22 fms; and 126-33, Santa Maria Bay, Lower California, 3 to 25 fms. The writer also has specimens from Departure Bay and Queen Charlotte Sound, British Columbia.

**Lagenipora hippocrepis** (Busk), 1856

Plate 60, figs. 5-6

*Lepralia hippocrepis* Busk, 1856:177.*Costazia hippocrepis*, Hastings, 1930:731.

Zoarium encrusting on shells and stems. The zooecia are moderate in size, 0.55 to 0.65 mm long by 0.30 to 0.40 mm wide, slightly inflated (Busk says "Cells immersed," but the separating grooves are always quite distinct), with large tremopores. The primary aperture is ovoid and slightly sinuate on the proximal border, 0.14 mm long by 0.12 mm wide. The peristome is inclined forward, less erect than most other species of the genus, low to moderately high on the proximal border, lower distal to the avicularia, smooth or with slight striation, the rim smooth without any evidence of spines or other processes. The avicularia are at the level of the peristomial rim or they may be considerably elevated above it, their short-triangular mandibles directed laterally.

The ovicells are situated at the base of the peristomes, but they open into the peristome well above the primary aperture; hemispherical in form; "A thin unpunctured hood invests the anterior part, and there is sometimes a semicircular plain area above the lip, outlined with a ridge" (Hastings). The perforated area is similar to that of other species of the genus.

Busk described the species from Mazatlan, Mexico. Dr. Hastings recovered it again from the Galapagos after more than 70 years and compared her specimens with Busk's type. In my opinion the species does not belong in the genus *Costazia* and the tremocystal frontal with numerous evenly distributed pores, the lack of special areolar pores, and the nature of the ovicell which opens into the peristome well above the primary aperture are all characters of *Lagenipora*.

Hancock Stations: 430, Wenman Island, Galapagos, 150 fms; 1050, San Miguel Island, southern California, 34 fms; a specimen from the Gulf of Panama (Bradley coll.), and another from Redondo Beach, California, along shore.

**Lagenipora marginata** Canu and Bassler, 1930

Plate 59, fig. 9

*Lagenipora marginata* Canu and Bassler, 1930:36.

Zoarium encrusting shells, coralline and dead *Discoporella umbellata*, with narrow linear branches of one to three series of zooecia. The zooecia are lageniform, about 0.60 mm long by 0.35 mm wide, inflated, with numerous small tremopores. The peristome is moderately high, occa-

sionally half as long as the zooecial body, semierect, smooth and without costae or striae, usually little or not at all flared, but the tall peristomes may be conspicuously flared. The primary aperture is ovate, about 0.12 mm long by 0.10 mm wide. The usual pair of minute avicularia is present, scarcely elevated above the rim, often absent. The "small orbicular avicularia" on the frontal, mentioned by Canu and Bassler, are not present in our material.

The ovicell is small, 0.16 mm wide, located well above the base of the peristome, the perforated area covering practically the whole upper surface.

Described from the Galapagos Islands, Albatross Sta. D.2813.

Hancock Stations: 332, Bahia Honda, Panama; 328, Cocos Island, off Costa Rica; 276 and 278 at San Esteban and Tiburon Islands in the Gulf of California; and 10 stations among the Galapagos Islands (Albemarle, Chatham, Hood and Barrington Islands). Shallow water to 80 fms.

### **Lagenipora lacunosa** Bassler, 1934

Plate 59, fig. 10

*Lagenipora verrucosa*, Canu and Bassler, 1930:35.

*Lagenipora lacunosa* Bassler, 1934:35 to replace *L. verrucosa* Canu and Bassler 1930 (not Canu and Bassler, 1928).

Encrusting shells, pebbles, corallines and encrusting bryozoans. The zooecia are moderately large, 0.70 to 0.85 mm long by about 0.50 mm wide, lageniform but with a much shorter "neck" than most of the "flasks" in this genus. The front is inflated, roughened and coarsely punctate. The primary aperture is ovate, 0.16 mm long by 0.14 mm wide. The peristome is short, thick-walled, and without costules, little or not at all flared, its rim smooth or with low, irregular prominences in older stages. In later stages of calcification the frontal tremocyst may cover most of the short peristome. The small paired oral avicularia are situated farther forward than is usual in the genus, distal to the middle of the aperture.

The ovicell, a little more than a hemisphere, is located low down at the base of the peristome, resting on the base of the succeeding zooecium and with advancing calcification may become partially embedded; the perforated area varies with age from semicircular to lunate.

This species has much resemblance to *L. verrucosa* Canu and Bassler (1928:137, non *verrucosa* 1930:35), but is larger, with shorter peri-

stomes and does not have the branching serial zoarial mode of growth of that species.

Described from the Galapagos Islands, Albatross Sta. D.2815.

Hancock Stations: 7 stations at the Galapagos Islands (Albemarle, James, Wenman, Hood and Marlborough Islands); 372-35, Independencia Bay, Peru; 12-33, La Libertad, Ecuador; Socorro Island, west of Mexico; Agua Verde Bay at the tip of Lower California; San Esteban Island and Guaymas, Gulf of California; and San Miguel Island, southern California. Shorewise to a depth of 100 fms.

### **Lagenipora admiranda** new species

Plate 52, figs. 13-15

Zoarium encrusting small worm tubes and stems, with erect terete branches 0.55 to 0.80 mm in diameter; the colonies all small, the longest branch not more than 1 cm. Zooecia small, 0.30 to 0.40 mm long by about 0.25 mm wide, long-ovate, distinct and inflated when young but more or less immersed with complete calcification. The frontal is a tremocyst with comparatively large pores, smooth and shining but later granulated between the pores. The aperture is rounded, with a rather deep v-shaped sinus, length 0.10 mm (including sinus), width 0.08 mm. The peristome is usually less elevated than in other species of the genus but occasionally a broad proximal lip extends forward to partially cover the aperture. There are 4 distal spines. The lateral-oral avicularia are pedicellate, extending high above the rim of the peristome and project somewhat forward; from the inner side, just below the mandible there is often a remarkable cervicorn spinous process, one branch of which may fuse with the one on the opposite side to form a complete bridge high above the distal end of the aperture.

The ovicell is recumbent on the base of the succeeding zooecium, with the usual lunate, finely perforated frontal area and the peristome sometimes rises above it to form a thin lip across the front above the orifice; width 0.18 mm, length 0.13 mm.

The small size and the remarkable development of the avicularian spinules are distinctive.

Type, AHF no. 109.

Type locality, Hancock Station 72, Guadalupe Island, west of Mexico (30°N, 120°W) at 17 fms, 8 colonies and fragments.

### Family *Celleporidae* Busk, 1852

The zoecia are usually erect and irregularly disposed though at the growing edge they may be horizontal and oriented. Ordinarily the zoecia are heaped upon each other in irregular layers and turned in all directions in the most irregular manner. The oecia are recumbent on the distal surface of the peristome, and they vary greatly in details in the different genera. Oral avicularia are present in most of the genera in various positions and often elevated. Frontal and 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 a large one, numerously represented, found in all seas, and is difficult of study since the primary characters are usually obscured.

#### KEY TO THE GENERA OF CELLEPORIDAE

1. Aperture with a straight or broadly arcuate proximal border, without a sinus but an irregular notch may sometimes be present . . . . . 2  
 Aperture with a more or less definite median sinus in the proximal border . . . . . 3
2. Ovicell an open hood, imperforate . . . . . *Holoporella*  
 Ovicell cover complete, except for a central pore which may be closed in final calcification . . . . . *Trematoecia*
3. Peristome high, with a small avicularium on each side; ovicell with a perforated area above the orifice . . . . . *Costazia*  
 A single avicularium on a rostral projection proximal to the aperture; ovicell perforated but without a special frontal area . . . . . *Schizmopora*

#### Genus *SCHIZMOPORA* MacGillivray, 1888

Cellepores in which the proximal lip of the aperture bears an arcuate sinus and the ovicell is complete and perforated with evenly distributed pores. The small oral avicularia are situated on the disto-mesial side of an asymmetrical umbonate process which is sometimes much elevated; the frontal avicularia are usually large and spatulate, often sparsely dis-



tributed. The muscle attachments of the operculum are usually in the form of small dots, somewhat removed from the border. Oral spines present or wanting. Genotype, *Cellepora coronopus* S. Wood, 1850.

The zoaria are usually encrusting and nodular, but occasionally erect and branching, and without pigment.

### **Schizmopora anatina** (Canu and Bassler), 1930

Plate 62, figs. 5-6

*Osthimosia anatina* Canu and Bassler, 1930:42.

The zoarium rises free from an encrusting base, usually on small stems, to a height of 30 mm or more; the branches more or less cylindrical, the basal one as much as 6 mm in diameter, secondary ones about 3 to 6 mm, the lateral branches sometimes anastomosing at their tips. The zooecia are moderately large, 0.60 to 0.75 mm long by 0.30 to 0.40 mm wide in the procumbent marginal ones at the tips of the branches. The zooecia of the secondary layers are very irregularly disposed and erect or semi-erect. The frontal is considerably swollen, smooth or slightly rugose and imperforate except for the usual complement of areolar pores. In the marginal zooecia a tall, pointed avicularian umbo projects over the aperture, its base often wider than the aperture, but in the secondary layers the umbo is much reduced in size and often wanting. The peristome is low, thin and without spines. The primary aperture is nearly round, with a broad, shallow (sometimes slightly v-shaped) sinus, length 0.14 to 0.16 mm, width 0.14 mm. The suboral avicularia are small with a semicircular, bluntly triangular or slightly spatulate mandible, situated a little to one side of the median line and usually directed sideways; in the marginal zooecia they are somewhat triangular and mounted at one side of the high umbo, but in the secondary layers they are often only slightly raised and are sometimes wanting. The large interzooecial avicularia are very irregular in distribution and vary much in size (0.25 to 0.50 mm long, average about 0.40); the mandible shaped like a duck-bill, widest near the tip, with a pair of sclerites which unite beyond the middle and a round lucida at a distance from the base; attached by condyles or complete pivot.

The ovicell is globular, prominent, with rather large round pores arranged in quincunx over the whole frontal surface, about 0.26 mm in width.

Canu and Bassler described this species from the Galapagos Islands under the genus *Osthimosia* Jullien, neglecting the nature of the perforated ovicell in favor of that of the frontal, but the ovicell is similar

in all details to that of other recent species of *Schizmopora* while that of *Osthimosia* is imperforate. As far as the frontal calcification is concerned, in the abundant material at my disposal I can find no essential difference, in younger stages the frontal is as smooth as in any of the *Schizmopora* species, though the olocyst does become more heavily calcified and somewhat roughened with age. For these reasons I place the species in the genus *Schizmopora*.

Hancock Stations: 20 stations about the Galapagos Islands as follows: 155-34, 317-35, 450 and 483 at Albemarle Island; 170-34, 432, 451 and 467 at Charles Island; 173, South Seymour Island; 182-34 and 446 at James Island; 201-34, 473 and 488 at Hood Island; 310-35 and 311-35 at Bindloe Island; 810-38 and 484 at Barrington Island; 400 at Gardner Island; 411 and 416 at Duncan Island. The species appears to be very abundant about the Galapagos archipelago with the bathymetric range from 5 to 160 fms. The only stations at which it appeared outside of the Galapagos area were at Station 264-34, White Friars Islands, off Tenacatita Bay, Mexico,  $17^{\circ}30'50''N$ ,  $101^{\circ}29'56''W$ , at 25 fms; 450-35, Secas Islands, Panama; and 1250-41, San Benito Islands, west of Lower California,  $28^{\circ}17'15''N$ , the northernmost latitude.

***Schizmopora margaritacea* (Pourtales), 1867**

Plate 62, figs. 7-9

*Vincularia margaritacea* Pourtales, 1867:110.

*Cellepora margaritacea*, Smitt, 1873:53.

*Schizmopora margaritacea*, Osburn, 1940:460.

One small dead portion of a colony of what is presumably this species conforms in all the characters that are present. Unfortunately the specimen shows no large avicularia. The zoarium is erect and branched from a narrow encrusting base, the branches terete and narrow, diameter about 0.80 mm, with zooecia evenly distributed on all sides; the broken portion, 10 mm in length, shows the bases of four branches. The zooecia are elongate-oval, distinct and somewhat inflated near the tip of the branch, more basally the outlines are indistinct, 0.60 to 0.65 mm long by 0.35 to 0.40 mm wide. The aperture is nearly circular with a broad, shallow sinus, width about 0.12 mm. Proximal to the aperture and asymmetrical is a small avicularium on the distal side of a small low umbonate process, both of which become more or less enclosed in the secondary aperture in advanced calcification. Smitt mentions 4 minute oral spines, but I have found evidence of only two.

The ovicell is prominent, globose and evenly perforated, about 0.22 mm wide, and becomes partially submerged in older stages.

Pourtales and Smitt recorded the species from off Sand Key, Florida, 100 fms, and off Havana, Cuba, at 270 fms. Osburn listed it off Beaufort, North Carolina, at 13 fms.

Hancock Station 446, James Bay, James Island, Galapagos, at 54 fms. It is an unusual record but the identification appears to be satisfactory.

Genus HOLOPORELLA Waters, 1909

Cellepores in which the proximal lip of the aperture is more or less straight and the ovicell an imperforate, wide-open hood. The operculum usually has a sclerite near the border on the sides. Suboral avicularia are usually present, located on the disto-mesial side of an asymmetrical umbonate process, small, occasionally wanting; frontal avicularia are usually much larger and spatulate in form, often wanting over much of the zoarium. Oral spines usually present. The form of the aperture and the cap-shaped, imperforate ovicell readily separate this genus from others of the family. Genotype, *Cellepora descostilsii* Audouin, 1826.

The proximal lip of the aperture asymmetrically often bears a small rounded notch which bears no relation to the operculum, and in at least one species there are minute denticles on the proximal border. Some of the species may be highly pigmented. Usually the zoaria are encrusting and nodular, but they may rise into frills or strong rounded branches.

KEY TO SPECIES OF *Holoporella*

- 1. Proximal border of aperture unmodified, straight or slightly arcuate . . . . . 2
- Proximal border of aperture modified by denticles or notches . . . . . 4
- 2. Zoarium dark pigmented; suboral rostrum high and pointed, the white tips conspicuous . . . . . *albirostris*
- Unpigmented; rostrum comparatively low . . . . . 3
- 3. Zoarium erect, branching, tree-like; interzooeccial avicularia unusually long, sides nearly parallel, spines small . . . . . *hancocki*
- Zoarium encrusting; interzooeccial avicularia long-ovate; spines usually flattened, oar-shaped; peristomes of lower layers continued upward as tubular processes . . . . . *peristomata*

4. Proximal lip of aperture with 2 to 4 small forward-projecting denticles . . . . . *tridenticulata*  
 Proximal border of aperture incomplete, with a small slightly asymmetrical notch which varies somewhat . . . . . 5
5. Heavily brown or gray pigmented; interzoecial avicularia large, long-elliptical, the mandible with a dark brown spade-shaped columella; 2 spines . . . . . *brunnea*  
 Unpigmented; interzoecial avicularia small, with broad bordering sclerites and narrow median columella; 4 spines . *quadrispinosa*

### *Holoporella brunnea* (Hincks), 1884

Plate 62, figs. 10-12

*Cellepora brunnea* Hincks, 1884:30.

?*Smittia californiensis* Robertson, 1908:303 (in part).

*Cellepora brunnea*, O'Donoghue, 1926:75.

*Holoporella brunnea*, Hastings, 1930:731.

?*Holoporella vagans*, Canu and Bassler, 1928:148.

?*Holoporella vagans*, Osburn, 1940:456; 1947:44.

The zoarium encrusts anything that affords attachment, algae, stems, worm tubes, shells, rocks, etc., usually forming rough nodules or massive bases with more or less erect frills and cylindrical offshoots; encrusting colonies sometimes as much as 50 mm across and 10 mm thick, erect, rough colonies as much as 60 mm high with rough branches 6 to 12 mm in diameter. Hincks described the color as "rather dark brown" and this seems to be the case with more northern specimens; off the coast of southern California they are more grayish in color, but occasional colonies are entirely white.

The zooecia are moderately large, the procumbent ones at the growing edge 0.60 to 0.75 mm long by about 0.40 mm wide; in the secondary layers the zooecia are all more or less erected and turned in every direction. The frontal is inflated, rising on all sides to the primary aperture, with a row of areolar pores and often with a few additional ones; the surface is smooth or granular, or occasionally ribbed. The avicularian umbo proximal to the aperture varies greatly; on the secondary layers it is usually small, but on the marginal zooecia it rises in a cylindrical form occasionally as high as 0.20 to 0.30 mm; the avicularium is borne on the distal side, the nearly semicircular mandible varying in size and the beak delicately dentate. The primary aperture averages 0.16 mm long, 0.14 mm wide, the proximal border nearly straight with a

conspicuous notch (not a sinus) at its middle (usually a little asymmetrical). The peristome, which is thin and little raised, bears a pair of strong spines, jointed at the base, widely separated, with occasionally one to three smaller ones between them; the longest spines noted measured 0.50 mm; they are seldom found on zoecia of the secondary layers. The interzoecial avicularia are subspatulate, the sides straight or slightly converging distally, the mandible with a peculiar dark brown thickened area shaped like a spade with a short handle; the beak when fully formed turns sharply upward at the tip; the largest avicularia measured 0.50 mm or more in length by 0.14 mm wide, the width does not appear to vary with the shorter mandibles.

The ovicell is hooded, widely open, smooth or finely granular and imperforate.

Hincks described the species from British Columbia, locality not stated, and O'Donoghue reports it from Banks Island, British Columbia. Robertson failed to identify it and redescribed it as *Smittia californiensis*, abundant on the California coast; her description is very confusing, containing mostly the features of *H. brunnea*, but her illustration (plate 22, fig. 71) is definitely that of some species of *Parasmittina*). Dr. Hastings recorded it from Taboga Island, Panama; Gorgona, Colombia, and the Galapagos Islands. The species listed questionably as *vagans* by Osburn from the Atlantic is definitely *brunnea*, as I have recently found a specimen with spines and an avicularian mandible having exactly the brown area of this species. It is presumed that the form listed by Canu and Bassler is also *brunnea*; at any rate it can hardly be *vagans*.

Hancock Stations: recovered at more than 130 stations from Oregon southward along the coast to Ecuador; taken at 21 stations at the Galapagos Islands; Socorro and Clarion Islands; from low tide to more than 100 fathoms, apparently most abundant in shallow water.

### *Holoporella albirostris* (Smitt), 1873

Plate 61, figs. 3-6

*Discopora albirostris* Smitt, 1873:70.

*Holoporella albirostris*, Osburn, 1914:215; 1940:455; 1947:43.

*Holoporella albirostris*, Canu and Bassler, 1928:142.

Zoarium encrusting or erect and tubular or cylindrical. Fresh specimens when adult are usually dark colored, with sharp-pointed rostral tips white in strong contrast; younger colonies are usually white or nearly so. The zoecia are characterized by a high pointed suboral umbo,

resembling a conical spine; the suboral avicularium is situated near the base of the umbo, with the spine towering high above it; the spines of lower layers often project between the zooecia of the layers above. The frontal is ventricose, smooth or granular, with a single row of rather small areolar pores. The aperture is a little more than a semi-circle, the proximal border broadly arcuate, the operculum thin and colorless with narrow linear sclerites close to the border. The inter-zooecial avicularia are of two kinds, long (0.40 mm or more) with a spatulate mandible, and shorter (about 0.25 mm) with a narrower mandible.

Ovicell a wide open hood.

Older colonies with the dark pigmentation of the ectocyst and with the white tips of the spines are easy of identification, but younger specimens usually lack the color and there is considerable variation in the size of the spinous processes.

Smitt described the species from Florida and it is a common species in the Gulf of Mexico and the Caribbean Sea (Osburn and Canu and Bassler). It has been recorded from the Indian Ocean and from Australia; in the Miocene of Jamaica and Australia, and the Pliocene of Florida and New Zealand.

Hancock Station 788-38, Daphne Major Island, Galapagos.

### **Holoporella tridenticulata** (Busk), 1884

Plate 61, fig. 7

*Cellepora tridenticulata* Busk, 1884:198.

*Holoporella tridenticulata*, Canu and Bassler, 1929:39.

Encrusting on algae and corallines and there are two colonies on a small pebble; small, rough surfaced and multilaminar. The zooecia are erect or nearly so, except at the margin of young colonies where they measure 0.60 to 0.70 mm long by 0.40 to 0.50 mm wide. The frontal in marginal individuals is inflated, smooth and imperforate except for a few small areolar pores; rising on all sides to the level of the primary aperture which is horizontal. The peristome is but little elevated above the operculum and proximal to the aperture there is a small, low avicularian umbo, the mandible semicircular and directed upward on the distal side. The primary aperture rounded distally, nearly transverse on the proximal border where there are three denticles (the middle one larger and sometimes divided into two); the operculum delicate with a brown bordering sclerite. The peristome bears 2 to 4 erect spines,

jointed at the base. Interzoocial avicularia were not observed by Canu and Bassler in Galapagos specimens, but I have found several at the edges of older colonies, exactly similar to that figured by Busk (plate 29, fig. 3).

The ovicell is incomplete, hood-shaped, smooth and measures 0.26 mm in width; it has not previously been observed.

Among the zooecia of the secondary layers there are high cylindrical tubes with a round aperture which appear to have been a mystery to other observers. Busk remarks that "The nature of these appendages appears very obscure," and Canu and Bassler add "The sporadic salient tubes also have an unknown zoarial function." A little dissection would have solved the mystery since, on dissecting carefully to the bottom of the tube, a primary aperture with its denticles is discovered. The tubes are the extended peristomes of underlying zooecia, some as far down as the second lower layer. Apparently the covered zooids have found a method of continuing their existence by extending their peristomes above the superficial layer. The phenomenon is to be observed, even more strikingly in the new species, *H. peristomata* new species, and in *H. pilaefera* Canu and Bassler (1930:422).

The species has been found in several places in Australian waters, listed for the Miocene of Australia and New Zealand, and recorded for the Galapagos Islands by Canu and Bassler.

Hancock Stations: 143-34, Wenman Island; 155-34, 432 and 450, Albemarle Island; 438, Chatham Island, and 444, James Island, all at the Galapagos, where it appears to be well distributed. The depth range was from 20 to more than 100 fms.

### **Holoporella hancocki** new species

Plate 61, figs. 1-2

Zoarium erect and irregularly branching dichotomously and more or less in one plane, attached by a small base; the branches round, varying in diameter from 4 mm near the base to 1 mm near the tips of the outer branches; considerable areas of the older stems are devoid of autozoocia; the broken tips of the larger colony indicate a height of more than 25 mm. The zooecia are moderately large, those at the growing tips about 0.70 mm long by 0.45 mm wide, oriented and procumbent; in older parts of the colony they are turned in all directions; distinct in the younger stages. The frontal is well arched, smooth or delicately granulated, with a few small areolar pores; usually there are no suboral

avicularia and the front rises rather sharply to form a high, smooth rim above the proximal border of the primary aperture. When a suboral avicularium is present the chamber is always small and low, the rostrum and mandible subspatulate and varying in length from 0.10 to 0.20 mm. Similar small avicularia often appear elsewhere on the front. The inter-zooecial avicularia are elongate subspatulate, little raised or with the elongate rostrum free and more or less elevated; the mandibles vary in length from 0.25 to more than 0.80 mm, the rounded tip decurved; attached to strong cardelles or a complete pivot. The primary aperture is semicircular with the proximal border broadly arcuate, varying in size in different parts of the colony from 0.18 to 0.24 mm wide to 0.15 to 0.18 mm long; the peristome is thin and very little raised except on the proximal border; a pair of widely separated oral spines, jointed at the base and reaching a length of 0.40 mm, present only on younger zooecia near the edges of the colony. The operculum is thin and pale yellowish with a narrow bordering sclerite.

The ovicell characteristic of the genus, elevated, smoothly rounded, hood-shaped and widely open, 0.30 mm in width.

The species is dedicated to Captain Allan Hancock whose numerous collecting expeditions have added so materially to our knowledge of the fauna of the Eastern Pacific area.

Type, AHF no. 110.

Type locality, Hancock Station 346-35, between Seymour and Daphne Islands, 0°24'25"S, 90°21'50"W, Galapagos Islands, one colony at 55 fms. Also at Station 788-38, S.E. of Daphne Major Island, Galapagos, 0°27'00"S, 90°21'50"W, one colony at 55 fms.

### **Holoporella peristomata** new species

Plate 61, figs. 8-11

Encrusting; zoarium roughly hemispherical in form, with many superimposed layers of zooecia; the surface much roughened by the extended peristomes of buried layers which project above the living zooecia sometimes to a height of 0.50 mm. The zooecia are large, so nearly erect that the length cannot be estimated but the width of marginal zooecia is 0.40 to 0.45 mm. The front is a heavy olocyst, smooth in younger stages, granular when older, with a row of areolar pores which are distinguishable only in young zooecia. The front rises on all sides to the level of the aperture which is horizontal; the primary peristome is only slightly elevated, thin and bears two widely separated,



strong spines which are usually flattened and oar-shaped (occasionally cylindrical) and jointed at the base. Proximal to the aperture is the usual avicularian umbo, typically small and low, but on marginal zooecia may be much larger; the avicularium situated usually at one side of the rostrum with the short spatulate mandible (0.08 mm long by 0.06 mm wide) directed upward, the beak dentate. The interzooecial avicularia are rare, not elevated, long-oval in form and ranging in length from 0.15 to 0.40 mm long, the mandible without a complete pivot. The primary aperture is slightly more than a semicircle and the proximal border a broad arc with a shallow notch at its middle, width about 0.18, the length 0.15 mm. The operculum is light brown, thin, with a strong dark brown sclerite on each side, running diagonally forward from the point of attachment.

The ovicell is characteristic of the genus, a wide-open hood, imperforate, granulated like the frontal, prominent and measures 0.25 to 0.30 mm in width.

The species appears to have much in common with *H. pilaefera* Canu and Bassler (1930:422) from the Philippines, and if I am not mistaken in my interpretation of their figure (plate 60, figs. 4 and 5) the "enormous cylindrical beak, in the form of a pillar" is of the same nature as the similar appearing one in the present species, as its distribution appears to be interzooecial. Their figures show the tube to be closed at the tip and this is true also of a few of the tubes in *peristomata*. The nature of the tube seems definite enough as the dissection of some of the shorter ones near the margin revealed an operculum at the bottom. The exposed tubes are thick-walled and their apertures perfectly circular, their buried bases descend to different levels indicating that they are from lower layers. The tubes are merely the projected peristomes of zooecia of the lower layers.

The present species differs from *pilaefera* in the form of the interzooecial avicularia, the presence of distal oral spines and in the nature of the ovicell which is much less complete and much smoother in texture.

Type, AHF no. 111.

Type locality, Hancock Station 346-35, between South Seymour and Daphne Islands, Galapagos, 0°24'25"S, 90°21'50"W, 55 fms, one colony. Also 4 young colonies from Sta. 182-34, off James Bay, James Island, Galapagos, 30 fms; and 324-35, Tagus Cove, Albemarle Island, Galapagos, 45 fms.

**Holoporella quadrispinosa** Canu and Bassler, 1930

Plate 55, fig. 12

*Holoporella quadrispinosa* Canu and Bassler, 1930:37.

Zoarium encrusting. Marginal zooecia distinct, separated by deep furrows, elongated, elliptical; the frontal convex, granulated, sometimes with areolar pores and a small elongated avicularium with pivot. The peristome salient, thin, with 4 spines; the aperture semielliptic. There is a small suboral avicularium with a triangular mandible directed upward on the side of a small pointed rostrum. The cumulate zooecia are irregular, granulated, with small elliptical avicularia. The interzooecial avicularia are narrow, little elongated, with a pivot. The ovicell is globose, widely open, the surface much granulated. (After Canu and Bassler.)

Described from the Galapagos Islands, Albatross stations 2813 and 2815.

One colony in the Hancock collections appears to agree perfectly with the above description, except that the ovicell is wanting.

Hancock Station 299, San Jose del Cabo at the southern tip of Lower California, 22°56'16"N, 109°47'15"W, at 82 fms.

**Genus TREMATOOECIA** Osburn, 1940

Zoarium encrusting, in older stages often with superimposed layers. Zooecia erect, appearing to stand on end, large and extremely thick-walled. Peristome thick and slightly raised, usually with strong tubercles or spinous processes which sometimes bear minute avicularia. Aperture semicircular or bell-shaped, the proximal border slightly arcuate; strong, pointed cardelles. A suboral avicularium is sometimes present. The ooecium is roughly hemispherical, not widely open as in *Holoporella*, opening into the peristome and not closed by the operculum; heavily and roughly calcified, but with an uncalcified area or large pore on its frontal surface. Frontal avicularia are present, small and rounded or larger and spatulate. The operculum has the lateral sclerites extended downward to form a thick lappet on each side a little distal to the hinge. Genotype, *Lepralia turrita* Smitt, 1873.

The writer has had the privilege of studying four species in addition to the genotype; *Discopora pertusa* Smitt, *Holoporella porosa* and *H. hexagonalis* Canu and Bassler and *T. protecta* Osburn. These agree in essential characters; perfectly erect zooecia with heavy calcification,

areolar pores and scattered frontal pores, the form of the primary aperture and the nature of the operculum, the complete ovicell, and frontal and oral avicularia. The oral spinous processes are wanting in *porosa* Canu and Bassler and little developed in *pertusa* Smitt. Suboral avicularia are often wanting in all of the species and rare in *porosa* and *hexagonalis*.

### **Trematooecia porosa** (Canu and Bassler), 1930

Plate 60, figs. 8-9

*Holoporella porosa* Canu and Bassler, 1930:39.

The zoaria form small rounded or cap-like encrustations on coralline nodules, etc. The zooecia are perfectly erect, even at the growing edge, the exposed ends roughly hexagonal, averaging about 0.40 to 0.45 mm in diameter; somewhat swollen, a row of areolar pores and one or two rows of smaller ones which are carried upward toward the aperture in secondary calcification. The primary peristome is low and thin and soon becomes obscured by the encroachment of the heavy frontal wall. The aperture is large, 0.20 mm long by 0.18 mm wide, rounded in front, the proximal border somewhat arcuate, the widest part immediately proximal to the heavy cardelles; it is situated near the middle of the frontal area and one or two rows of pores surround it distally. Rarely a minute suboral avicularium is present, either median or at one side of the midline. Minute rounded avicularia are also occasionally present on the front.

The ovicell is large, about 0.45 mm wide, hemispherical, the aperture not wide open, the primary cover perforated with small pores, which become obscured as the secondary layer advances over it. There are no oral spines or prominences.

Canu and Bassler described the species from the Galapagos Islands, Albatross D.2815, a single specimen.

Hancock Stations: 276, San Esteban Island, Gulf of California, 28°38'30"N, 112°36'00"W, 32 fms; and at 440, 441 and 442, 20 to 24 fms, and 452, Charles Island, 65 fms, Galapagos.

### **Trematooecia hexagonalis** (Canu and Bassler), 1930

Plate 60, fig. 7

*Holoporella hexagonalis* Canu and Bassler, 1930:38.

Encrusting shells, corallines, worm tubes, etc., sometimes multi-laminar. The zooecia are erect. The measurements, the porosity of the frontal, the nature of the aperture (except that the cardelles are smaller

and the proximal border a little more arcuate), and the row of pores around the distal side of the aperture are all much like those of *T. porosa*. There is, however, a striking difference in appearance of the species due to the presence of 4 (2 to 6) strong, pointed, erect spinous processes around the aperture; these sometimes bear minute avicularia at their tips (as in *T. turrita* Smitt) but usually they are either strong tubercles or end in sharp points. The frontal is often somewhat roughened and the pores obscured. Rarely a minute suboral avicularium is present and very small rounded ones occasionally occur on the frontal.

The ovicell is smaller than that of *porosa*, about 0.35 mm wide, the primary layer with small pores, but this soon becomes covered with the rough secondary layer, leaving temporarily a small central porous area, but this eventually also becomes closed and a pointed umbo may develop on the top.

There is considerable resemblance to *T. turrita* but *hexagonalis* is much smaller, more vitreous in appearance, the frontal is more porous and there are no larger spatulate avicularia.

Described by Canu and Bassler from the Galapagos Islands, Albatross D.2815.

Hancock Stations: 438, Chatham Island; 450 and 155-34, Albatross Island; 452, Charles Island; and 810-38, Barrington Island, Galapagos. Also at 267, Angel de la Guardia Island, Gulf of California, and 491-36, Rosario Bay, west coast of Lower California. In the collections there are also specimens collected at Banderas Bay, Mexico (George Willett); off Acapulco, Mexico (F. E. Lewis); and West Mexico (H. R. Hill), through the courtesy of the Los Angeles Museum.

The known geographic range is from the Galapagos Islands to about 30°N Lat., and the bathymetric range from 5 to 75 fms.

#### Genus *COSTAZIA* Neviani, 1895

Genotype, *Cellepora costazii* Audouin, 1826. Until rather recently the species of this genus were allocated to the old Linnaean genus *Cellepora*. Neviani's description was apparently overlooked until Canu and Bassler reestablished it in 1920. Waters in 1889 to 1913 confused it with *Lagenipora* Hincks, and Levinsen in 1909 erected a new genus, *Siniopelta*, with *C. costazi* as the type. The group of species is now well enough understood to indicate its distinct separation from any of the other celleporid genera; also the nature of the front and of the ovicell distinguish it at once from *Lagenipora*, which evidently does not belong with the Celleporidae.

The zooecia are usually erected, sometimes more or less procumbent especially at the growing edges; the frontal imperforate in the central area, with one or more rows of areolar pores which usually are carried upward by later calcification to the base or sometimes nearly to the top of the peristome; the primary aperture bears a distinct sinus, usually somewhat v-shaped; there is a pair of small lateral oral avicularia which usually rise above the level of the peristome. The ovicell is prominent, opening into the peristomial cavity above the level of the primary aperture and not closed by the operculum; it always bears a semicircular frontal area which is bordered with radiately arranged pores separated by small ribs, though a few more central pores may also occasionally be present; in advanced stages of calcification this area sometimes becomes covered.

The species of *Lagenipora* often resemble those of *Costazia* but the frontal is a tremocyst with the pores distributed over the whole surface and the semicircular area of the ovicell has smaller and more numerous pores without radial arrangement.

KEY TO THE SPECIES OF *Costazia*

1. Zoarium encrusting, or if erect the branches are stout . . . . . 2  
     Zoarium erect with slender, cylindrical branches; the sinus of the  
     aperture semicircular . . . . . *procumbens*
2. Zoarium rough, encrusting and nodular, or erect with terete stout  
     branches; zooecia coarse . . . . . 3  
     Zoarium smaller and neater in appearance, usually pisiform on  
     small stems . . . . . 4
3. Usually encrusting, the coarsest of our species; aperture with a  
     deep v-shaped sinus . . . . . *ventricosa*  
     Erect from a small base, with rounded irregular branches; the  
     sinus small and shallow . . . . . *surcularis*
4. A distal median oral avicularium in addition to the lateral ones;  
     sinus deep . . . . . *robertsoniae*  
     Only the lateral oral avicularia present . . . . . 5
5. Sinus deep; frontal area of ovicell lunate . . . . . *costazi*  
     Sinus small and shallow; frontal area of ovicell rounded; arctic  
     species . . . . . *nordenskjoldi*

**Costazia costazi** (Audouin), 1826

Plate 62, figs. 3-4

*Cellepora costazii* Audouin, 1826:7.*Cellepora costazii*, O'Donoghue, 1923:48 (? part).*Costazzia costazii*, O'Donoghue, 1926:75 (? part).Not *Cellepora costazi*, Robertson, 1908:313 (see *C. robertsoniae*)

Zoarium pisiform or terete on small stems, less frequently incrusting flat surfaces. Zooecia moderate in size, young marginal ones 0.55 to 0.65 mm long by 0.35 to 0.40 mm wide, without orientation except at the margin (and only partially so there); distinct with the terminal tubular portions well separated. The frontal is irregularly roughened, usually with several pores in addition to the areolar pores and these are usually carried up on the front in later calcification. The primary aperture at the bottom of the peristome is noticeably longer than broad (about 0.17 mm long by 0.13 wide), rounded with a rather deep v-shaped sinus. The peristome is moderately high, with a pedicellate avicularium on each side rising above the peristome and with the small ovate avicularia turned more or less toward each other across the aperture. Spatulate avicularia, varying in size are sometimes present among the zooecia, but are often wanting from whole colonies.

The ovicell is wider than long (0.28 by 0.20 mm average), attached moderately high on the peristome, smooth and glossy; the characteristic semicircular frontal area with a row of radiately arranged pores extends in full width across the front above the orifice.

The records of Robertson and O'Donoghue are in doubt as both of them have confused *costazi* with *robertsoniae* Canu and Bassler. Robertson indicates the presence of a third avicularian process on some of her specimens, and the "var. *erecta*" of O'Donoghue is certainly *robertsoniae* with erect stems and the oecia "sunk to the level of the general surface."

Robertson's records are from "south shores mainly," California, and those of O'Donoghue from numerous localities in British Columbia.

Hancock Stations: dredged only twice, at Station 1205-40, San Nicolas Island, and off San Pedro Breakwater, California, numerous colonies, down to 20 fms. There are also specimens from San Francisco Bay. It is apparently much less abundant than the related *robertsoniae*.

***Costazia robertsoniae* Canu and Bassler, 1923**

Plate 62, figs. 1-2

*Costazia robertsoniae* Canu and Bassler, 1923:181.*Cellepora costazi*, Robertson, 1908:313, in part.*Cellepora costazii*, O'Donoghue, 1923:48, in part.

The zoarium encrusts small stems, sometimes forming only irregular nodules but often giving off erect branches, irregularly forked, to a height of 30 mm or more; the branches are from 2 to 4 mm or more in diameter; occasionally encrusting on flat surfaces. The zooecia are more or less decumbent at the growing edges, but erect or nearly so in the secondary layers; moderately large, about 0.40 mm in width and the marginal ones about 0.65 mm in length. The frontal is roughened as in *costazia*, with a few pores in addition to the areolar ones, in advancing calcification carried upward on the frontal, and those near the distal end carried upward around the peristome. The primary aperture is a little elongate, about 0.18 by 0.14 mm, rounded distally, slightly narrower proximally and with a distinctly v-shaped sinus. The peristome is moderately high, with the usual pair of lateral-oral small pedicellate avicularia and a third similar median avicularium (rarely two) on the distal border in the absence of an ovicell; the latter type is often wanting but I have never found it entirely absent from any colony. Broadly spatulate or oval interzoecial avicularia are sometimes present, with a complete pivot.

The ovicell is attached lower on the peristome than in *costazii* and is much more readily embedded by later calcification, 0.26 to 0.30 mm wide and broader than long, the ectooecium smooth and shining, the semicircular frontal area with triangular radiating pores, which may eventually be occluded by the overgrowth of the ectooecium. The peristome sometimes forms a narrow cross-bar immediately above the orifice, but the area always retains its lunate form.

The species was described from the Pleistocene of Santa Monica, California. The original description is wanting in some respects, especially in the failure to note the median distal avicularium. A specimen from the type locality, presented to me by Dr. R. S. Bassler shows this character, and abundant fossil and recent material in the Hancock collections and those of the Los Angeles County Museum prove the identity of the Pleistocene and recent specimens.

It is the most common species of the genus in the waters of California, dredged at 9 stations among the Channel Islands and shorewise

from Dillon Beach (a little north of San Francisco) to La Jolla, California. The most southerly record is from Tanner Bank on the northern border of Mexico. While the records of O'Donoghue from British Columbia are in question, it appears certain that he had this species in his *C. costazii* var. *erecta* and in my personal collection there is a specimen labeled "Queen Charlotte Sound, B. C."

Hancock Stations: 876-32, 898-38, 1130-40, 1190-40, 1232-41, 1269-41, 1280-41, 1410-41, all about the Channel Islands, and 1339-41 at Tanner Bank near the Mexican border. Numerous specimens, shore to 55 fms.

### *Costazia nordenskjoldi* (Kluge), 1929

Plate 63, figs. 6-7

*Cellepora nordenskjoldi* Kluge, 1929; 1946:203.

Zoarium more or less pisiform, surrounding stems of hydroids and bryozoans. The zooecia are all erected, their distal ends well separated and standing up prominently on the surface of the zoarium; the measurements made at the growing edges are approximate, length 0.65 mm, width 0.40 mm, the erected distal ends 0.30 to 0.35 mm in width. There is no orientation of the zooecia, except partially at the growing edge. The frontal is highly arched, smooth and shining, with a row of areolar pores, the distal ones carried upward around the peristome. The primary aperture, deep within the peristomial tube, is a little longer than broad with a distinct sinus, about 0.18 mm long by 0.15 mm wide. The lateral oral avicularia are pedicellate, usually rising prominently above the edge of the peristome, the mandible semicircular. Frontal and interzoecial avicularia appear to be wanting.

The ovicell is subglobular, attached high up on the distal side of the peristome, smooth and shining, about 0.30 mm wide by 0.26 mm long; in earlier calcification the usual semicircular row of pores is present, but the covering layer encroaches on this area on all sides leaving, with complete calcification, a small rounded area near the center of the oecial front and the row of pores may be occluded.

The species is similar to *costazi* in many respects but differs in the smooth frontal, the higher peristome, the more elevated position of the ovicell and the secondary calcification of the ovicell.

Recorded by Kluge for the arctic seas north of Europe.

Point Barrow, Alaska, 18 to 25 fms, Prof. G. E. MacGinitie, Arctic Research Laboratory.



***Costazia procumbens* new species**

Plate 63, figs. 8-10

The zoarium encrusts small stems and rises into narrow, erect, cylindrical branches 1 to 2 mm in diameter, tapering at the tips, branching rarely and irregularly, rough in appearance. The zooecia are more or less procumbent, entirely so at the growing tips, those of the secondary layers half erected or more; the size moderately large, the procumbent ones 0.65 to 0.85 mm long by 0.40 to 0.50 mm wide. The frontal, which is more exposed than usual in the genus, is moderately ventricose, smooth in young individuals, with a row of marginal pores and an irregular second row of scattered pores (the central area always imperforate); with increasing calcification the pores are carried upward, some of them to the base of the peristome, and the frontal surface becomes radiately ribbed to a slight degree. The peristome is high and nearly erect, complete in the infertile zooecia and fusing with the sides of the ovicell in the fertile ones; on the sides are the usual lateral oral avicularia, raised slightly above the level of the rim, the small rounded mandibles tilted toward each other; the oral avicularia are located slightly more proximally than usual and the secondary aperture is roughly pyriform, the proximal part between the avicularia narrowed to form a secondary sinus. The primary aperture is round with the addition of a semi-circular sinus, length 0.18 and width 0.15 mm. Frontal avicularia are infrequent, regularly oval, length 0.30 and width 0.20 mm, the rostrum thin-walled and only slightly raised.

The ovicell is very prominent, rounded, large (0.35 to 0.40 mm broad), the frontal area with a marginal row of pores separated by radiating ribs. The details of the ovicell, as well as those of the front are difficult to determine until the glossy covering membrane is removed.

The sinus of the primary aperture is broader and more semicircular and the zooecia more procumbent than usual in the genus; but the nature of the front, of the paired oral avicularia, the characters of the ovicell and the interzoecial avicularia are definitely those of *Costazia*.

Type, AHF no. 112.

Type locality, Hancock Station 1659-48, S. of Avalon Bay, Santa Catalina Island, southern California, 46 fathoms, 33°19'53"N, 118°17'51"W. Also at stations 1449-42, Newport Harbor, on a float, and 1012-39, off Pyramid Cove, San Clemente Island, southern California, 55 fms; and 1251-41, south of San Benito Islands, 66 fms, and 1078, S. of San Benito Islands, 92 fms, 28°12'05"N, 117°52'55"W, Lower California.

**Costazia surcularis** (Packard), 1863

Plate 63, figs. 1-3

*Celleporaria surcularis* Packard, 1863:410.*Cellepora incrassata* Smitt, 1867:33 (non *incrassata* Lamarck).*Cellepora cervicornis*, Busk, 1856:32.*Cellepora incrassata*, Hincks, 1884:29.*Cellepora surcularis*, Osburn, 1912a:281.*Cellepora incrassata*, Robertson, 1900:327; 1908:312.*Cellepora surcularis*, Nordgaard, 1918:86.*Cellepora incrassata*, O'Donoghue, 1923:47.*Schizmopora surcularis*, Osburn, 1923:12D.*Costazia incrassata*, O'Donoghue, 1926:74.

The zoarium is erect from a small base, branching irregularly to a height of 50 mm; the basal stem as much as 3 or 4 mm in diameter, the branches varying in size, rounded at the tips. The zooecia are somewhat oriented at the growing tips, but otherwise more or less erected, moderately large and coarse, about 0.45 mm across the erect ones; heavily calcified, the frontal with a conspicuous row of areolar pores and occasionally with a few additional pores, all of which are carried upward by the thickening of the front wall. The peristome is usually low, thick-walled, with the usual small avicularia, one on each side, sometimes rising above the border of the peristome. There are rather infrequent vicarious avicularia, short spatulate in form and averaging about 0.40 mm long by 0.18 mm wide at the widest part; these are little or not at all erected. The primary aperture is short-oval, slightly narrower proximally, with a small v-shaped sinus, and measures about 0.18 mm long by 0.14 mm wide.

The ovicell is hemispherical, 0.30 mm wide, at first prominent but later more or less embedded, with the usual semicircular perforated area, the pores radiating; as calcification proceeds the secondary layer may almost or quite obscure the perforated area.

This species is evidently not the *Cellepora incrassata* of Lamarck, with which it has been confused, nor the *Millepora cervicornis* of Pallas. While Packard's description is incomplete, it is clear enough under the circumstances, for the species is common on the Labrador coast and there is no other in that area with which it could be confused. Moreover, in naming this species Packard realized that he was dealing with the common northern form, as he wrote, "European authors have confounded this arctic species with *Cellepora cervicornis* of the Mediterranean Sea." It may be confused with *C. ventricosa*, but the latter species is much

coarser, with a more elongate aperture and larger zooecia and ovicells.

In the Arctic Ocean this species has been recorded from Spitsbergen westward; it is common in Greenland waters and south on the Atlantic coast to Nova Scotia. The writer (1921:452) has listed it from the Pribilof Islands in the Bering Sea. Hincks recorded it from British Columbia; Robertson had it from the Pribilof Islands to northern California, and O'Donoghue added numerous British Columbia records. It did not appear in the Hancock dredgings, but there are specimens in the collection from Cleveland Passage, Alitak Bay and Big Koniuji Island, Alaska, the last two collected by the U. S. Alaska Crab Investigation. Common at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

*Costazia ventricosa* (Lorenz), 1886

Plate 63, figs. 4-5

*Cellepora ventricosa* Lorenz, 1886:14.

*Cellepora ventricosa*, Waters, 1900:96.

*Costazia ventricosa*, Osburn, 1932:16.

Zoarium encrusting on pebbles, shells and occasionally on algae, more or less nodular on stems but covering considerable areas on stones, occasionally erect and branching; the large projecting zooecia giving a rough appearance. The zooecia are erect, except at the growing edges on stones where they are somewhat procumbent; large (0.55 to 0.70 mm long in the procumbent zooecia, usually about 0.55 mm across the erect ones), prominent and very distinct. The frontal is very thick, with two or three rows of large infundibuliform pores which are carried up around the peristome in final calcification, often rising above the level of the operculum; the frontal wall fuses with the peristome to form a thick, rough border which does not rise much above the level of the operculum. The lateral oral avicularia, with semicircular mandible, rise above the level of the peristome and are inflected toward the aperture; they are often wanting. Interzooecial avicularia are apparently wanting, as Lorenz and Waters did not observe them in the European Arctic and I have not found them in specimens from Arctic America and the Pacific coast.

It is the largest and roughest of the *Costazia* species and, as Waters states (1900:96) "can be distinguished by the naked eye."

The ovicells are large, hemispherical, about 0.40 mm wide by 0.26 mm long. Lorenz states that they are easily overlooked on account of their small size and they often have a single median pore, while Waters says that the ovicell is imperforate. In earlier stages the ovicells are

prominent and are provided with the usual frontal area with radiating pores but they become inconspicuous on complete calcification of adjacent zooecia, and the smooth ectooecial cover may completely obscure the frontal area or leave a central pore above it.

Lorenz described the species from Jan Mayen, Waters from Franz-Josef Land, Kluge from Greenland and Osburn from Greenland and Ungava (Port Burwell at entrance to Hudson Strait).

It did not appear in the Hancock dredgings, but there are numerous specimens in the collections from Big Koniuji Island, and Alitak Bay, Alaska (U. S. Alaska Crab Investigation); from Nunivak Island and Pavlov Bay, Alaska; and from Dillon Beach, California, a little north of San Francisco, R. J. Menzies, coll. Several large colonies with rounded branches 6 mm in diameter and 25 mm high were brought up in a fisherman's net at Cordell Point, California. Also taken at Friday Harbor, Puget Sound, Washington, by Dr. J. L. Mohr. Abundant at Point Barrow, Alaska, G. E. MacGinitie, collector.

Family **Myriozoidae** Smitt, 1867

"The frontal is thick and bears a tremocyst with tubules. Uniporous septulae or dietellae are present. The avicularia are adventitious and bear a pivot. The ovicell is hyperstomial not adjacent to the zooecium and lodged in a niche-like depression of the distal zooecium." (Canu and Bassler, 1923:185.)

There are two genera, *Myriozoum* which has tall, branched zoaria, and *Myriozoella* which is encrusting.

Genus **MYRIOZOOM** Donati, 1750

The zoarium is erect from a small encrusting base, cylindrical and irregularly branched without articulations. The ovicells are usually completely embedded except on younger zooecia. Genotype, *Millepora truncata* Pallas, 1766.

KEY TO SPECIES OF *Myriozoum*

1. Avicularium large, nearly as large as the aperture and immediately above it, often wanting . . . . . *coarctatum*  
Avicularium very small . . . . . 2
2. Aperture longer than broad; avicularia single, situated slightly at one side of the midline . . . . . *subgracile*  
Aperture round; avicularia paired, or single, situated opposite the distal border of the aperture; zoarium more slender . . . . . *tenue*

**Myriozoum coarctatum** (M. Sars), 1850

Plate 64, figs. 5-6

*Cellepora coarctata* M. Sars, 1850:148.*Leieschara coarctata*, M. Sars, 1862:155.*Myriozoum coarctatum*, Waters, 1900:68.*Myriozoum coarctatum*, Hincks, 1884:21.*Myriozoum coarctatum*, Robertson, 1908:295.? *Myriozoum coarctatum*, O'Donoghue, 1923:38; 1926:76.

Zoarium irregularly branching to a height of 75 to 100 mm, cylindrical. Zooecia moderate, about 0.65 mm long, indistinct as there are no lines of separation; the frontal a very thick tremocyst with large pores and no other frontal characters. The aperture is usually a little longer than wide, rounded distally, straighter on the sides, the proximal border transverse with a narrow U-shaped sinus. The primary peristome

is low and thin but the thickening of the frontal wall gradually submerges the operculum. The avicularium is single, in the midline immediately above the aperture, about as large as the aperture, rounded or ovate, the mandible semicircular or slightly subtriangular. Occasionally, on Washington and Oregon specimens, there is also a small rounded avicularium placed transversely in the median line below the proximal border of the aperture.

The ovicell is hyperstomial but is submerged and completely covered by the thick crust of the distal zoecium, visible only in the youngest stages.

The record of O'Donoghue is in doubt as his description of the avicularia indicates that they are minute and at one side of the midline. Hincks and O'Donoghue have listed the species from a number of localities in British Columbia; Robertson recorded it from Juneau, Orca and Yakutat, Alaska.

Albatross Stations: 2886, off the coast of Oregon, the southernmost record, and 3455, off the coast of Washington at 152 fms; also from Puget Sound, Washington, specimens collected by Dr. W. A. Clemens and by Dr. J. L. Mohr.

### **Myrionozoum subgracile** d'Orbigny, 1852

Plate 64, figs. 3-4

*Myrionozoum subgracile* d'Orbigny, 1852:662.

*Myrionozoum subgracile*, Waters, 1900:69.

*Myrionozoum subgracile*, Robertson, 1908:296.

*Myrionozoum subgracile*, O'Donoghue, 1923:39:75.

Zoarial form and general appearance similar to that of *M. coarctatum*. The zoecia are also similar, entirely without separating grooves, and the frontal is a thick tremocyst with large tubular pores. The primary aperture is more elongate than in the other species, the sides straight and converging slightly toward the proximal end which is straight with a deep, narrow u-shaped sinus. The primary peristome is higher than in *M. coarctatum*, but later covered by the thick frontal wall. The avicularium is single, minute, situated on or near the median line a little distal to the aperture, often wanting, occasionally paired.

The ovicell, like that of *coarctatum*, is hyperstomial but is so early embedded in the wall of the distal zoecium that about all that can be seen is a rounded swelling, and even this may soon be obliterated.

The species is close to *M. coarctatum*, but the form of the aperture and the minute size of the avicularium easily differentiate it.

Robertson recorded the species from Puget Sound and O'Donoghue listed it for several places in British Columbia.

U. S. Alaska Crab Investigations, Sta. 60-40, Leonard Harbor, Alaska, and Sta. 61-40, Cold Bay, Alaska, 15 to 25 fms. Also taken by Prof. G. E. MacGinitie at Point Barrow, Alaska, Arctic Research Laboratory, 13 to 22 fms.

### *Myriozoum tenue* O'Donoghue, 1923

Plate 64, figs. 7-9

*Myriozoum tenue* O'Donoghue, 1923:39.

Zoarium similar to the other species of the genus but more slender. Zooecia also similar, indistinct, the frontal with large pores, but narrower than in the other species. The primary aperture is distinctly shorter, but with the same straight proximal border and deep sinus. The avicularia are minute, round, typically paired but well separated and located near the aperture just above its distal border; not infrequently there is only one present but in the same position.

The ovicell, as in other species, is hyperstomial, deeply embedded, first appearing as a low rounded swelling and later becoming completely covered by the front of the distal zooecia. Their presence may be noted, as O'Donoghue states, by their occurrence "in bands about two zooecia deep around the stem and so form an annular enlargement."

The slender form, the shorter aperture and the presence of the minute paired avicularia are the distinguishing characters.

Described by O'Donoghue from Departure Bay, Buccaneer Bay and Swiftsure Shoal, British Columbia, 15 to 25 fms.

Albatross Station 2886, off the coast of Oregon, several fragments.

### Genus *MYRIOZOELLA* Levinsen, 1909

Levinsen, in his synopsis of the genera of Myriozoidae, 1909:297, states merely "Avicularia without transverse bar; pore chambers," and indicates the genotype, *Myriozoum crustaceum* Smitt (*Lepralia plana* Dawson, 1859).

The zoarium is encrusting, the zooecia indistinct without separating grooves, the frontal a tremocyst with large pores, the aperture with a transverse proximal border and a deep narrow sinus; avicularia paired beside the aperture; ovicell hyperstomial, subimmersed, perforated like the frontal.

**Myrionzoella plana** (Dawson), 1859

Plate 64, figs. 1-2

*Lepralia plana* Dawson, 1859:256.*Myrionzoum crustaceum* Smitt, 1867:18.*Myrionzoum planum*, Hincks, 1892:157.*Leieschara plana*, Norman, 1903:110.*Myrionzoum crustaceum*, Robertson, 1908:295.*Myrionzoum crustaceum*, Osburn, 1919:609; 1923:9D.*Myrionzoella crustacea*, Osburn, 1932:16.

Zoarium encrusting, often multilaminar, on various objects, the colonies often an inch or more in breadth on shells and stones. The zoecia are flat and indistinct, except in the youngest stages when they are slightly inflated and the outlines of separation are visible. The frontal is a coarse tremocyst with large infundibular pores which leave a reticulated surface. The aperture is somewhat more than a semicircle, varying slightly in length and breadth, the proximal aperture straight with a narrow deep sinus. On either side of the aperture is a rounded avicularium of moderate size, without hinge bar; immersed or slightly elevated; rarely wanting on one or both sides.

The ovicell is hyperstomial, deeply immersed in the base of the distal zoecium but usually evident as a distinct rounded swelling, perforated like the frontal.

Smitt, in describing *Myrionzoum crustaceum*, probably overlooked Dawson's description of *Lepralia plana*. Since that time the species has been recorded under both names. Objections have been made to the use of Dawson's name on the basis of inadequate description. However, Hincks (1892:157) remarks: "Dawson's diagnosis may not be as full and minute as we should now desire, but it indicates the general character of the species, and his description has as good a claim to be retained as those of a large proportion of the older writers." Norman (1903:110) also writes: "Dawson's description of *Lepralia plana* was very inadequate; but I have seen specimens named by him, and there can be no doubt as to the species which he intended." Furthermore there is no other species in the area dredged by Dawson which could possibly be confused with it.

The species is a common circumpolar form, extending its range down the east coast of Canada to the Gulf of St. Lawrence, and on the west coast to southern Alaska. Robertson recorded it from Yakutat, Orca,



Kadiak and Juneau, Alaska. Osburn (1921:451) reported it from the stomach of a king eider duck at St. Georges Island, Bering Sea.

Abundant at Point Barrow, Alaska, down to 25 fms, Arctic Research Laboratory, G. E. MacGinitie, collector.

### Family **Mamilloporidae** Canu and Bassler, 1927

"Hexapogona with orbicular zoarium without pit. The cells are juxtaposed. The proximal border of the apertura is oriented toward the apex. The ovicell has a special interzoecial cavity and is closed by the operculum." (Canu and Bassler, 1930:474.)

Canu and Bassler placed this family in a new suborder Hexapogona which apparently cannot be maintained, at least on the basis of the short description, "The ancestrula engenders six zooecia." The family Mamilloporidae, however, is quite satisfactory, including several related genera, of which only *Mamillopora* occurs in our collections.

### Genus **MAMILLOPORA** Smitt, 1873

The zoarium is free, cupuliform, but varying from short-conical to nearly flat, the outline rounded. The zooecia are erect, showing only the aperture and broad peristome on the frontal surface. The frontal avicularia are interzoecial, as their chambers are continued to the dorsal side parallel to the zoecial chambers; avicularia occur also on the dorsal side of the zoarium. The ovicell is hyperstomial and closed by the operculum, deeply embedded; as it develops before the succeeding zooecium is completely formed the distal zooecium is distorted to conform to the ovicell at the frontal surface. Genotype, *Mamillopora cupula* Smitt, 1873.

### **Mamillopora cupula** Smitt, 1873

Plate 64, figs. 10-11

*Mamillopora cupula* Smitt, 1873:33.

*Mamillopora cupula*, Canu and Bassler, 1928:153; 1930:45.

*Mamillopora cupula*, Hastings, 1930:733.

*Mamillopora cupula*, Osburn, 1947:46.

Zoarium free, cupuliform or saucer-shaped, the outline round. The zoaria are quite erect, their cavities parallel, the frontal surface limited to the aperture and the broad peristome which is usually provided with a series of low tubercles. The aperture is somewhat variable in size and form, averaging about 0.13 mm wide by 0.17 mm long, rounded back

to the large cardelles, proximal to which is a large deep poster (somewhat narrower than the anter) with an arcuate border. The operculum is well chitinized with a bordering sclerite. The frontal avicularia appear to be dependent, but their development at the growing border shows them to be interzoecial as their chambers descend to the dorsal side parallel to the zoecial cavities; avicularia are also scattered over the dorsal surface.

The ovicell is hyperstomial, deeply embedded so that only its frontal surface is visible, and it is closed by the operculum; it is developed before the distal zoecium and the latter is modified to accommodate it, as its cavity extends beneath the ovicell and later becomes erect.

The species is fairly common in the Gulf of Mexico and Caribbean Sea. On the Pacific coast it has been recorded by Hastings from Gorgona, Colombia, and by Canu and Bassler from the Galapagos Islands.

Hancock Stations: dredged at 42 stations, abundant about the Galapagos Islands and in the Gulf of California south of the 29th parallel (Angel de la Guardia Island). Also taken at Clarion Island, west of Mexico; Cocos Island and Port Culebra, Costa Rica; Secas Islands, Panama, and at Dewey Channel on the west coast of Lower California. The known distribution in the Pacific is from about 29°N Lat. southward through the Galapagos Islands to a little south of the equator; the depth range is 10 to 55 fms.

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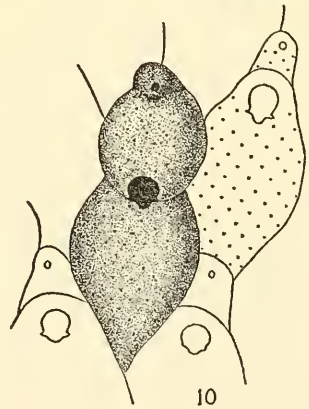
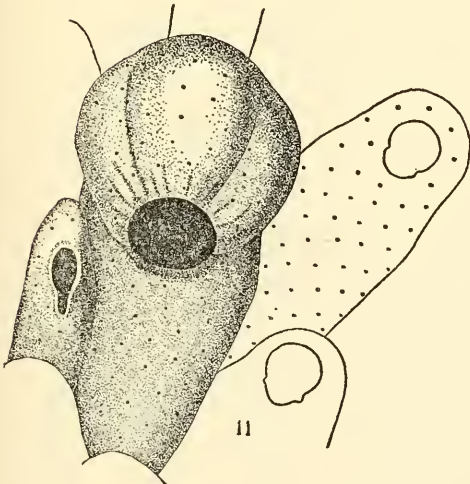
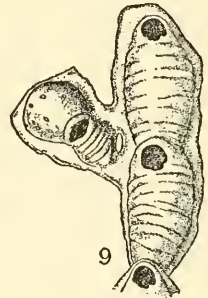
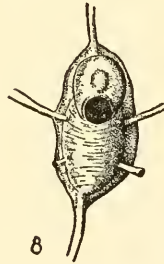
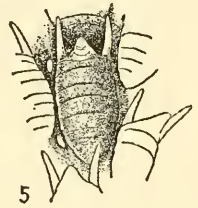
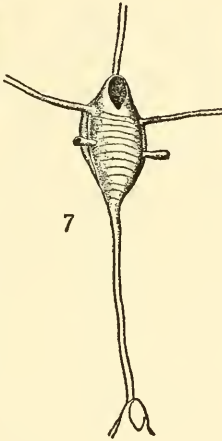
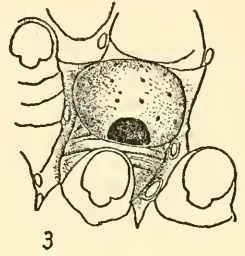
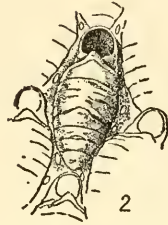
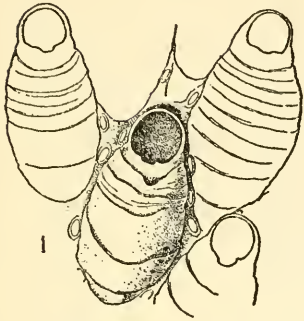
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PLATES

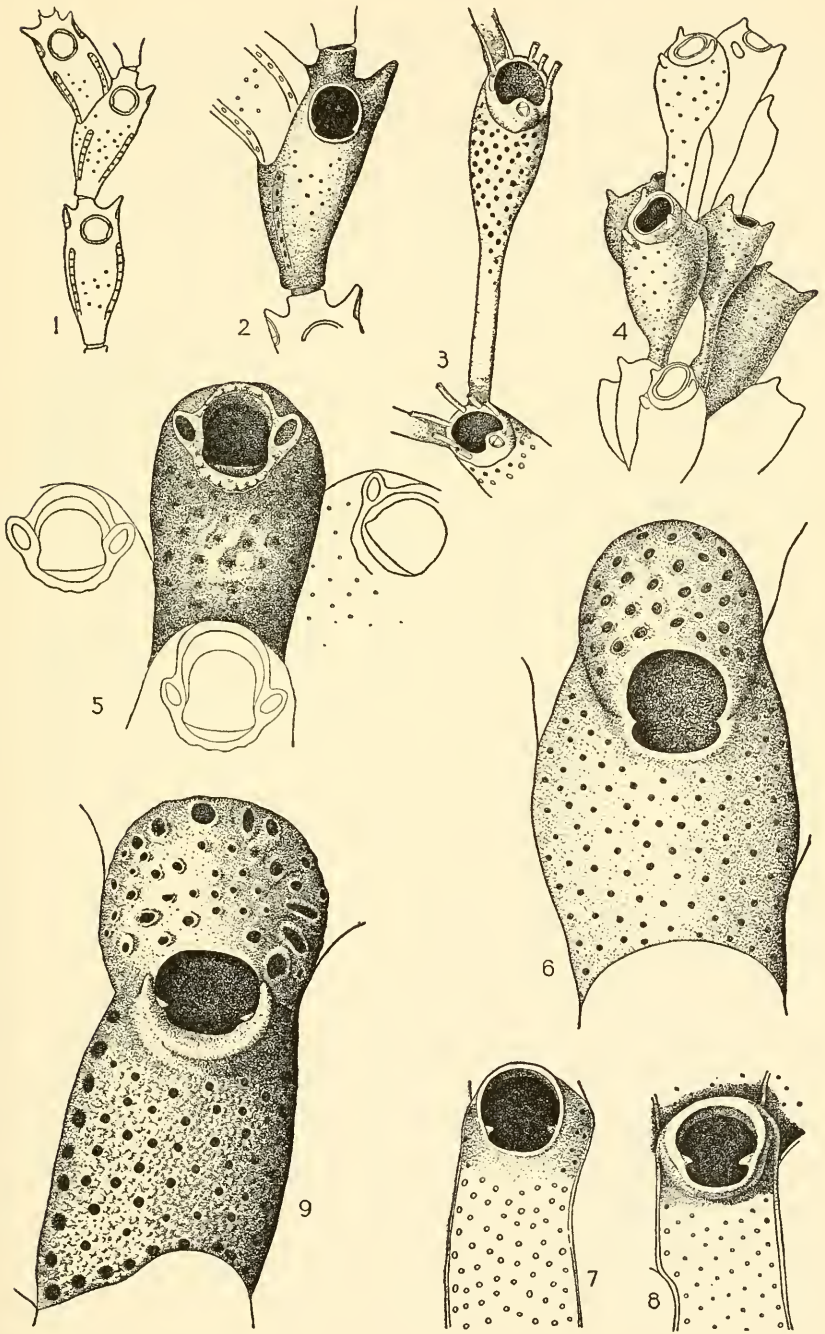
## PLATE 30

- Fig. 1. *Hippothoa hyalina* (Linnaeus), zooecia of typical form with interzooecial fenestrae.
- Fig. 2. The same, with suboral umbo.
- Fig. 3. The same, modified zooecium with ovicell.
- Fig. 4. The same, with lateral-oral processes.
- Fig. 5. The same, lateral processes and central umbo.
- Fig. 6. *Hippothoa divaricata* Lamouroux, zooecia and ovicell.
- Fig. 7. *Hippothoa flagellum* Manzoni, elongate base and mode of branching.
- Fig. 8. The same, ovicell.
- Fig. 9. *Hippothoa expansa* Dawson, zooecia, reduced zooecium with ovicell, and expanded base.
- Fig. 10. *Trypostega venusta* (Norman), zooecia, ovicell and zooeciules.
- Fig. 11. *Trypostega claviculata* (Hincks), zooecia, ovicell and zooeciule with clavate avicularium.



## PLATE 31

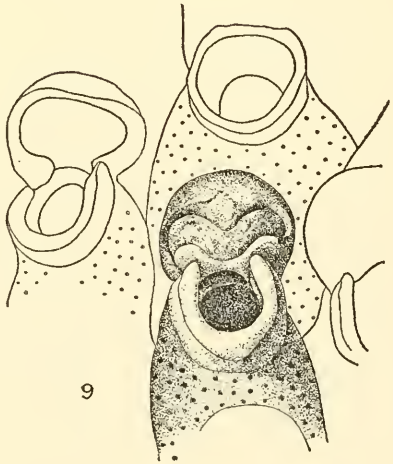
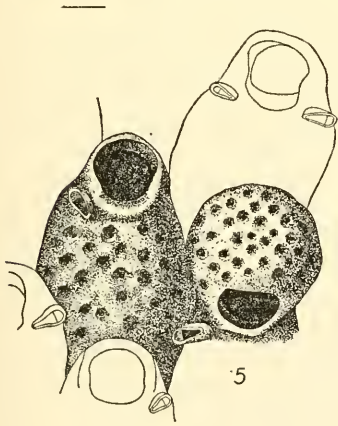
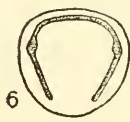
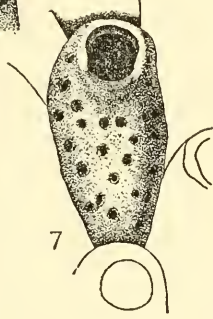
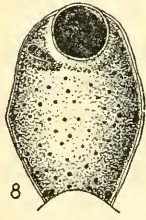
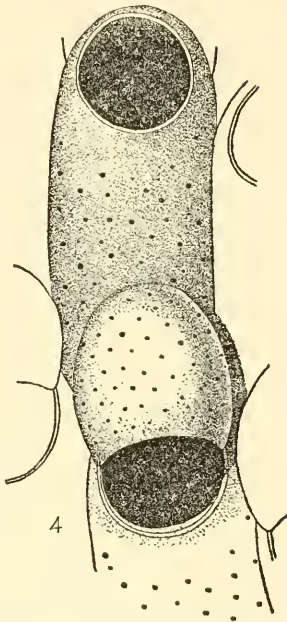
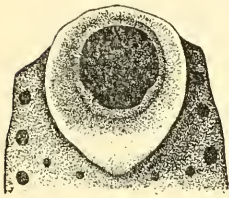
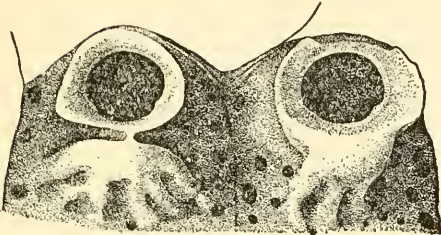
- Fig. 1. *Vittaticella elegans* (Busk), zooecia with branch.  
Fig. 2. The same, enlarged to show details of aperture.  
Fig. 3. *Savignyella lafonti* (Audouin), zooecium and branching.  
Fig. 4. *Euteleia evelinae* Marcus, zooecia and manner of growth.  
Fig. 5. *Petralia japonica* (Busk), zooecium with details of aperture and avicularia.  
Fig. 6. *Hippopodina feegeensis* (Busk), zooecium with ovicell.  
Fig. 7. The same, young zooecium showing aperture.  
Fig. 8. The same, older infertile zooecium with raised peristome and heavier cardelles.  
Fig. 9. *Hippopodina californica* new species, zooecium with ovicell and details of aperture.



## PLATE 32

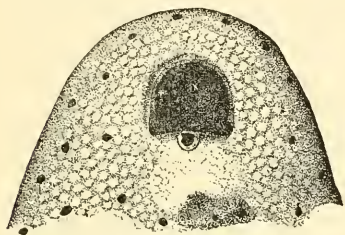
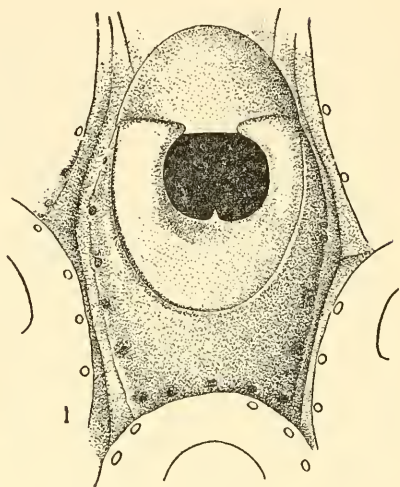
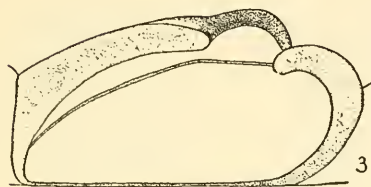
- Fig. 1. *Hippopodina californica* new species, details of calcification.  
Fig. 2. The same, form of aperture and flaring peristome.  
Fig. 3. The same, operculum with curved sclerites.  
Fig. 4. *Cyclicopora longipora* (MacGillivray), zooecia and ovicell.  
Fig. 5. *Cycloperiella rosacea* Osburn, zooecia, ovicell and avicularia.  
Fig. 6. The same, operculum.  
Fig. 7. The same, zooecium without avicularia.  
Fig. 8. The same, young stage of zooecium and avicularium.  
Fig. 9. *Coleopora gigantea* (Canu and Bassler), zooecia with high peristome and peculiar decoration of ovicell, reduced  $\frac{1}{2}$ .  
Fig. 10. The same, operculum.



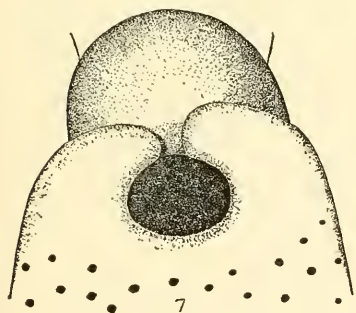


## PLATE 33

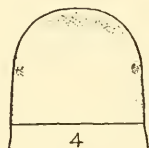
- Fig. 1. *Hincksipora spinulifera* (Hincks), fertile zooecium with ovicell, broad peristome and median spinule.
- Fig. 2. The same, younger infertile zooecium.
- Fig. 3. The same, diagram of longitudinal section.
- Fig. 4. The same, outline of operculum with muscle attachments.
- Fig. 5. *Pachyegis princeps* (Norman) zooecium with umbo, reduced one-half.
- Fig. 6. The same, showing form of aperture and avicularium at base of umbo.
- Fig. 7. The same, ovicell.
- Fig. 8. The same, operculum with broad sclerites.
- Fig. 9. *Pachyegis brunnea* (Hincks), infertile zooecium showing aperture, avicularium and umbo.
- Fig. 10. The same, younger zooecium showing avicularian chamber.
- Fig. 11. The same, ovicell.



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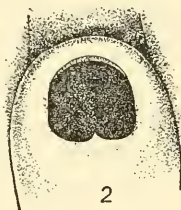
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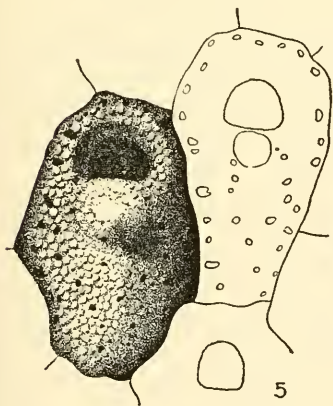
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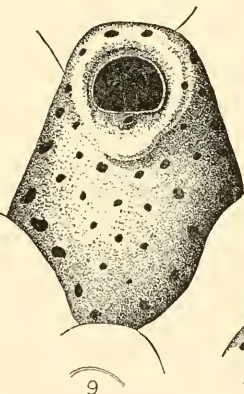
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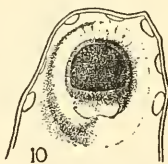
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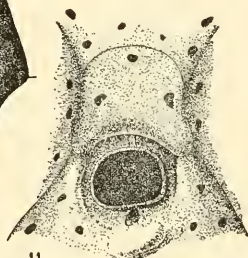
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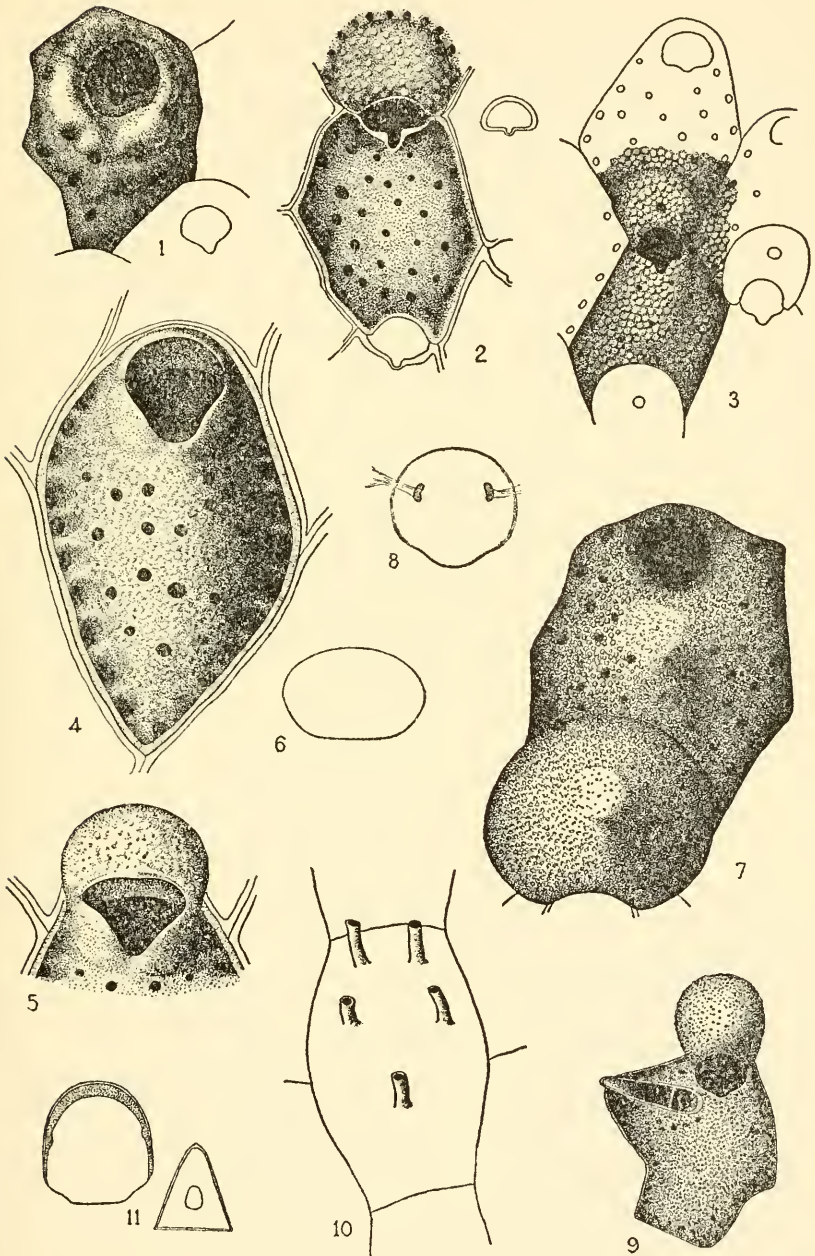
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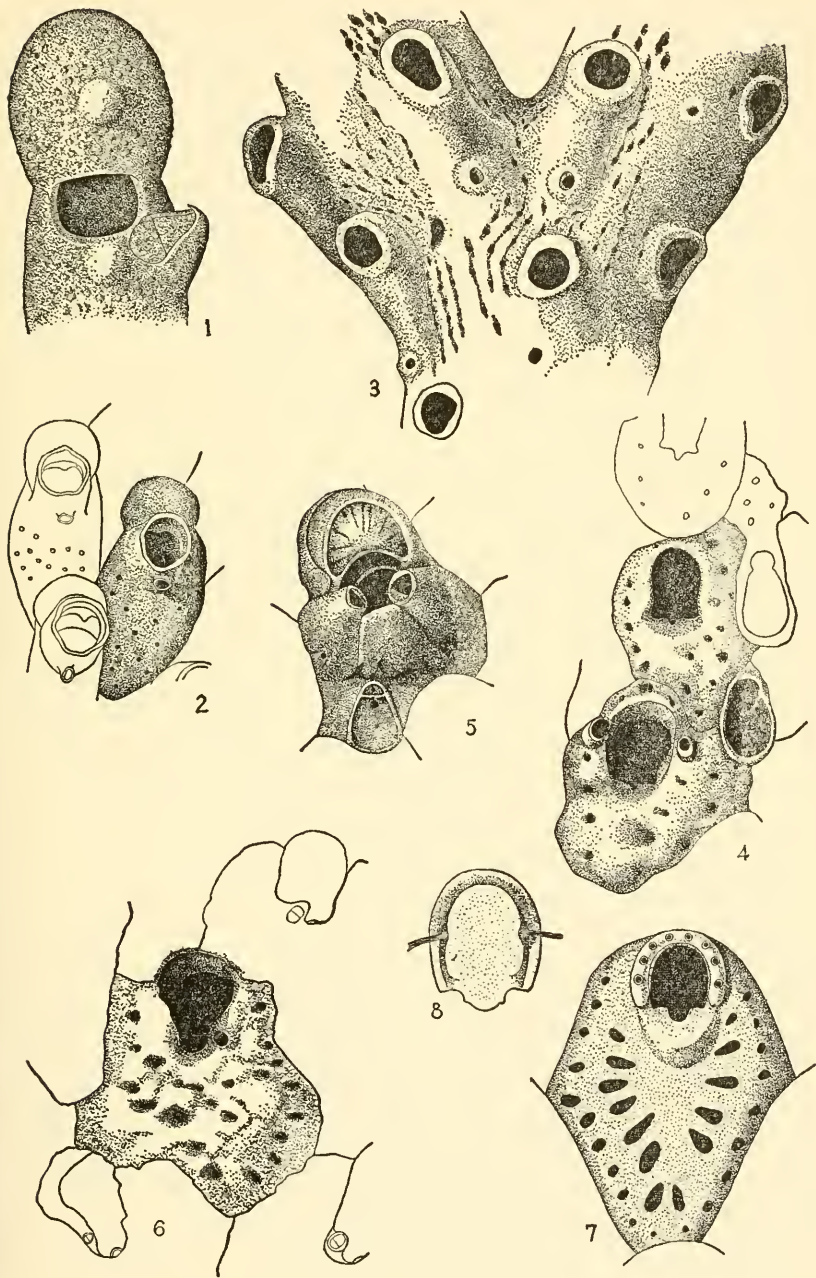
## PLATE 34

- Fig. 1. *Stomachetosella cruenta* (Norman), zoecium with rough tuberosities, outline of operculum.
- Fig. 2. *Stomachetosella limbata* (Lorenz), zoecium with ovicell, outline of operculum.
- Fig. 3. *Stomachetosella sinuosa* (Busk), zooecia with ovicell and form of aperture.
- Fig. 4. *Stomachetosella abyssicola* new species, infertile zoecium.
- Fig. 5. The same, ovicell.
- Fig. 6. The same, operculum.
- Fig. 7. *Stomachetosella distincta* new species, zoecium and ovicell with umbos.
- Fig. 8. The same, operculum with muscle attachments.
- Fig. 9. *Robertsonidra oligopus* (Robertson), zoecium with ovicell and lateral avicularium, reduced  $\frac{1}{2}$ .
- Fig. 10. The same, dorsal side showing tubular attachment processes.
- Fig. 11. The same, operculum and mandible with central lucida.



## PLATE 35

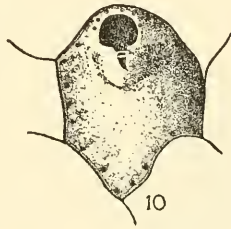
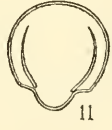
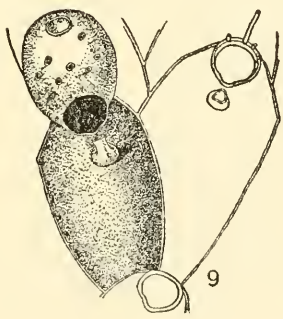
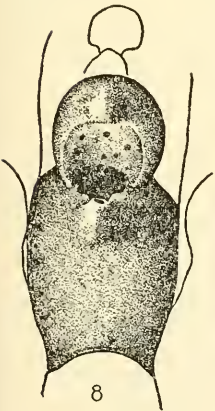
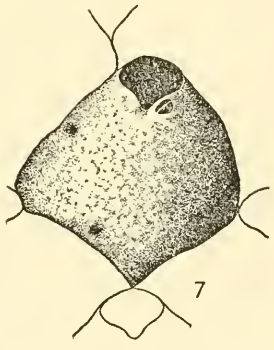
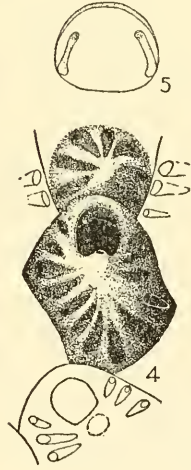
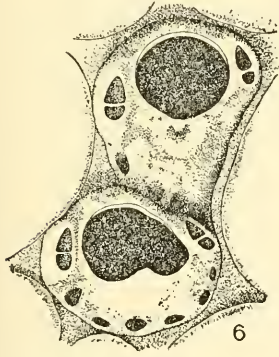
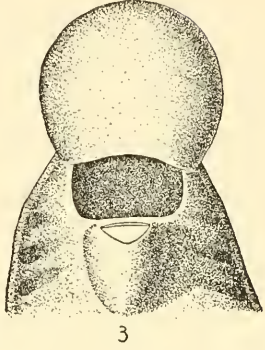
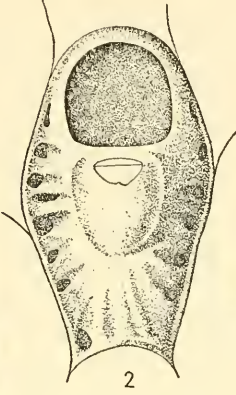
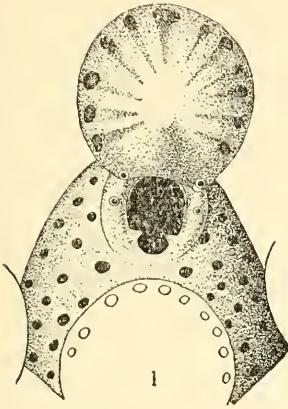
- Fig. 1. *Robertsonidra oligopus* (Robertson), ovicell.
- Fig. 2. *Cylindroporella tubulosa* (Norman), zooecia, ovicell and high peristome with ascopore.
- Fig. 3. *Semihawellia sulcosa* Canu and Bassler, portion of branched zoarium.
- Fig. 4. *Diatosula californica* new species, zooecia, aperture, oral and interzooecial avicularia.
- Fig. 5. The same in advanced calcification, showing ovicell and oral and frontal avicularia.
- Fig. 6. *Posterula sarsi* (Smitt), zooecium with two oral avicularia (one deeply submerged).
- Fig. 7. *Hippopleurifera mucronata* (Smitt), infertile zooecium showing form of aperture and oral spines.
- Fig. 8. The same, operculum showing attachment of muscles.



## PLATE 36

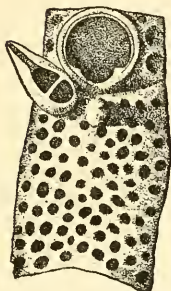
- Fig. 1. *Hippopleurifera mucronata* (Smitt), ovicell and aperture.  
Fig. 2. *Umbonula patens* (Smitt), infertile zooecium.  
Fig. 3. The same, ovicell.  
Fig. 4. *Umbonula alvareziana* (d'Orbigny), zooecium, aperture and avicularia.  
Fig. 5. The same, operculum.  
Fig. 6. *Umbonula arctica* (Sars), zooecium with paired oral avicularia.  
Fig. 7. *Ragonula rosacea* (Busk), zooecium, aperture, avicularium.  
Fig. 8. *Lacerna fistulata* (O'Donoghue), zooecium with ovicell in complete calcification.  
Fig. 9. The same, at a younger stage, with ovicell and fistula-like avicularian umbo.  
Fig. 10. The same, young zooecium with low umbo and avicularium.  
Fig. 11. The same, operculum, enlarged.



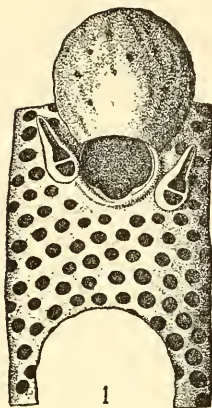


## PLATE 37

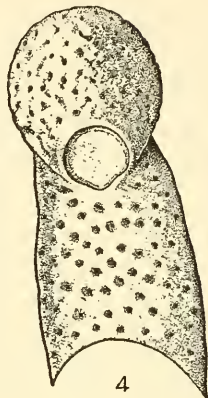
- Fig. 1. *Schizoporella unicornis* (Johnston), infertile zoecium with form of aperture, avicularium and umbo.
- Fig. 2. The same, ovicell and paired avicularia.
- Fig. 3. *Schizoporella trichotoma* (Waters), zooecia with stellate pores and ovicell.
- Fig. 4. *Schizoporella linearis* var. *inarmata* (Hincks), zoecium with ovicell.
- Fig. 5. The same, showing aperture and regularly roughened frontal.
- Fig. 6. *Emballothecha altimuralis* new species, zoecium and ovicell.
- Fig. 7. The same, details of aperture and high separating wall.
- Fig. 8. *Schizoporella dissimilis* new species, marginal zoecium with characteristic distal oral avicularia.
- Fig. 9. *Schizoporella cornuta* (Gabb and Horn), showing ovicell and frontal avicularium.
- Fig. 10. The same, operculum, enlarged twice.
- Fig. 11. The same, young zoecium of the secondary layer.
- Fig. 12. *Schizoporella dissimilis* new species, with pointed lateral oral avicularia.
- Fig. 13. The same, with ovicell and avicularia in more proximal position.



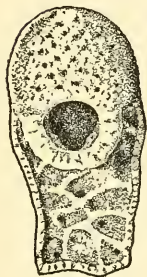
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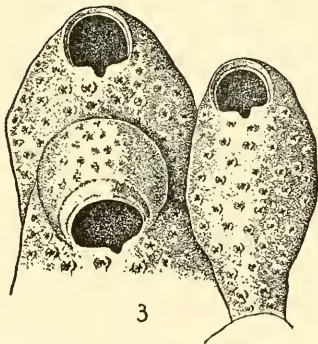
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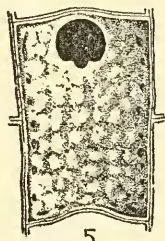
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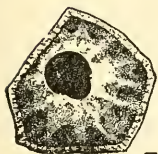
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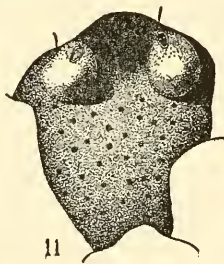
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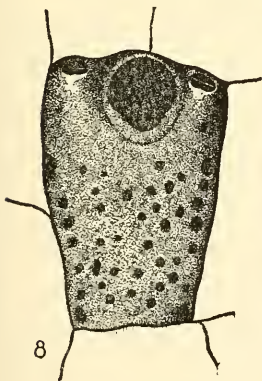
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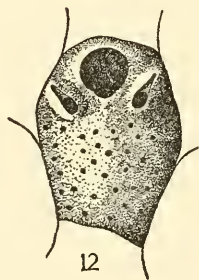
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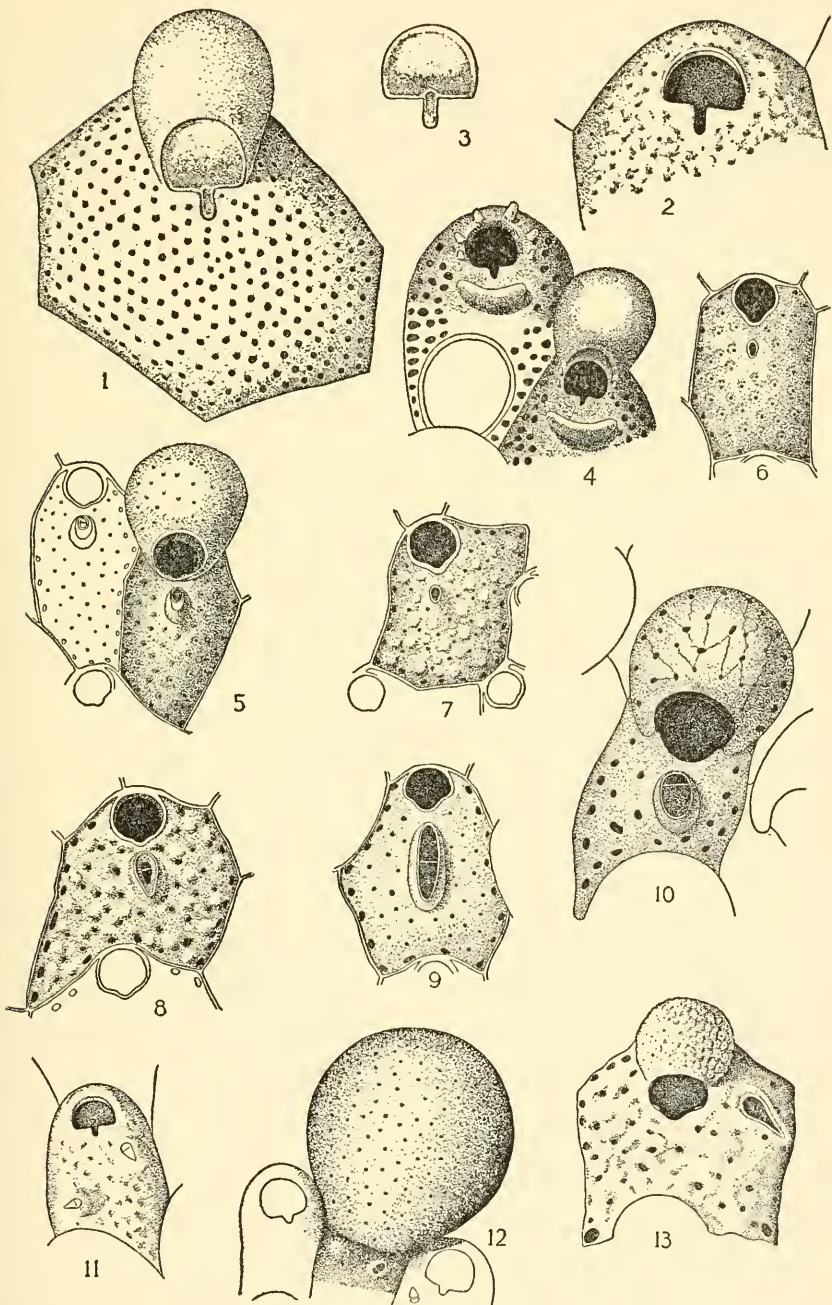
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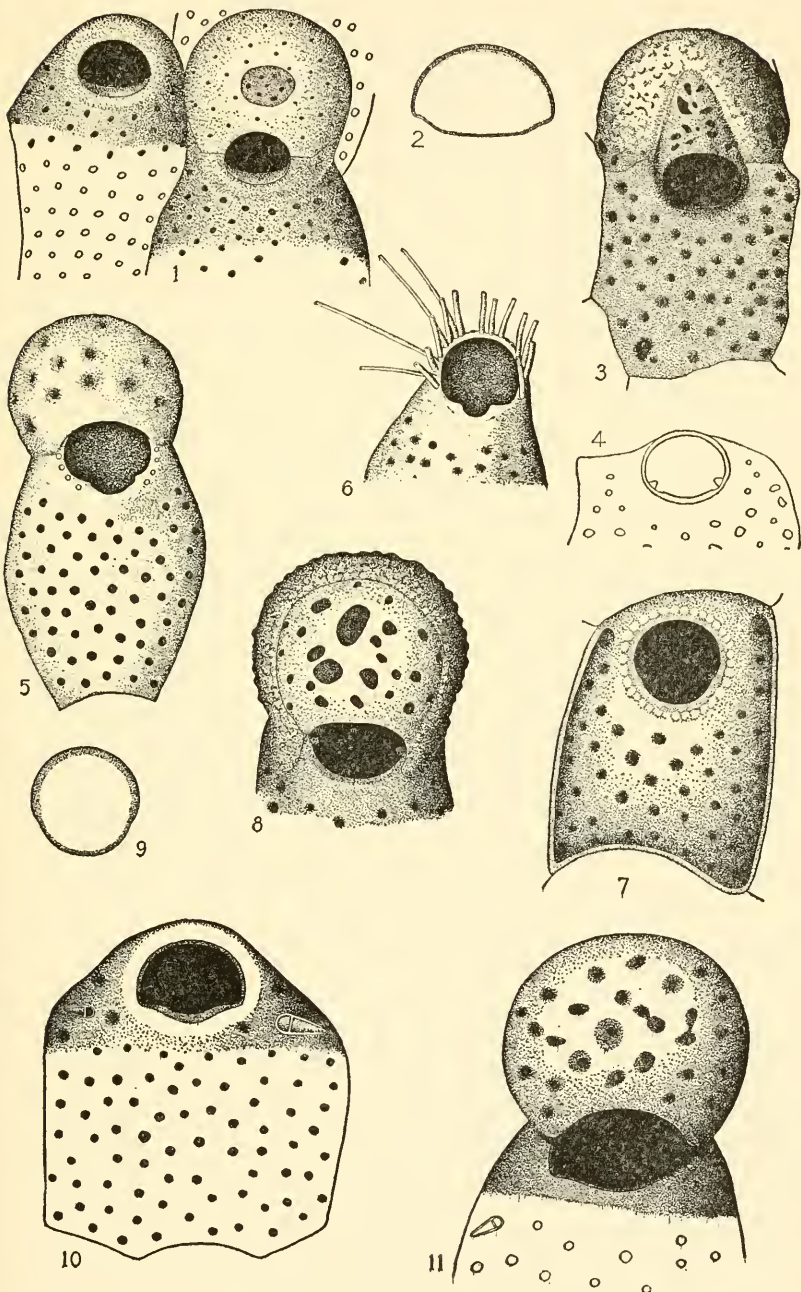
## PLATE 38

- Fig. 1. *Arthropoma cecili* (Audouin), zooecium and ovicell.  
Fig. 2. The same, details of aperture.  
Fig. 3. The same, operculum.  
Fig. 4. *Arthropoma circinata* (MacGillivray), zooecium and ovicell.  
Fig. 5. *Schizomavella auriculata* (Hassall), zooecium, ovicell and small elevated oval avicularium.  
Fig. 6. *Schizomavella auriculata ochracea* (Hincks), zooecium with oval avicularium not elevated.  
Fig. 7. *Schizomavella auriculata acuta* new variety, with small pointed avicularium and frontal granules.  
Fig. 8. The same, with large pointed avicularium.  
Fig. 9. The same, with long narrow avicularium, young and without granulation. (Figs. 7, 8 and 9 all from the same colony.)  
Fig. 10. *Schizomavella porifera* (Smitt), zooecium, ovicell and large median avicularium.  
Fig. 11. *Stylopoma informata* (Lonsdale), infertile zooecium.  
Fig. 12. The same, showing enormous ovicell in comparison with zooecia.  
Fig. 13. *Schizolavella vulgaris* (Moll), zooecium with ovicell and lateral avicularium.



## PLATE 39

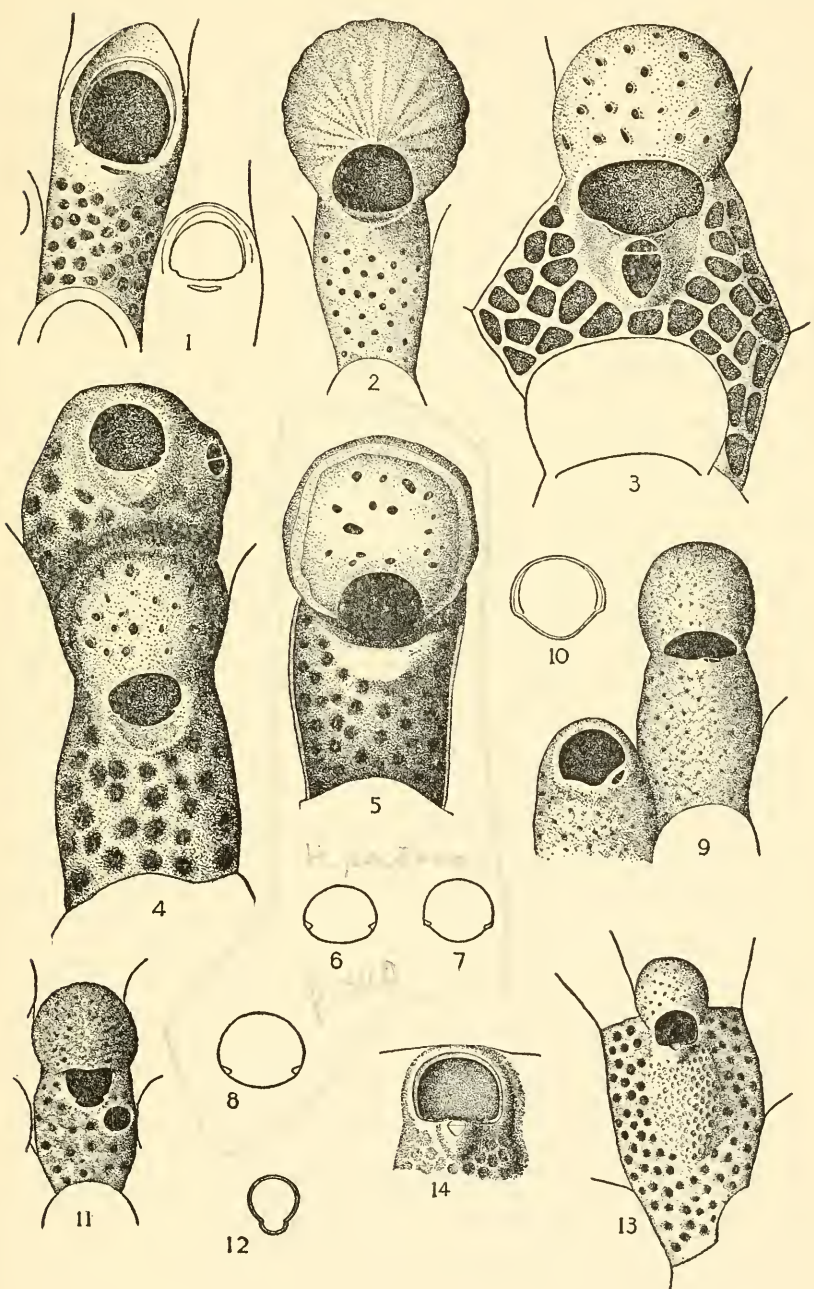
- Fig. 1. *Dakaria dawsoni* (Hincks), ovicell with rounded frontal area.
- Fig. 2. The same, form of operculum, enlarged twice.
- Fig. 3. *Dakaria pristina* (Hincks), ovicell with irregular pores and triangular frontal area.
- Fig. 4. The same, form of aperture.
- Fig. 5. *Dakaria biserialis* (Hincks), zoecium with ovicell.
- Fig. 6. The same, details of aperture with two rows of oral spines.
- Fig. 7. *Dakaria apertura* new species, infertile zoecium with rounded aperture.
- Fig. 8. The same, ovicell with broader aperture and large area with irregular pores.
- Fig. 9. The same, operculum of infertile zoecium.
- Fig. 10. *Emballothecha latifrons* new species, showing form of aperture and small lateral-oral avicularia.
- Fig. 11. The same, ovicell and avicularium distant from aperture.



## PLATE 40

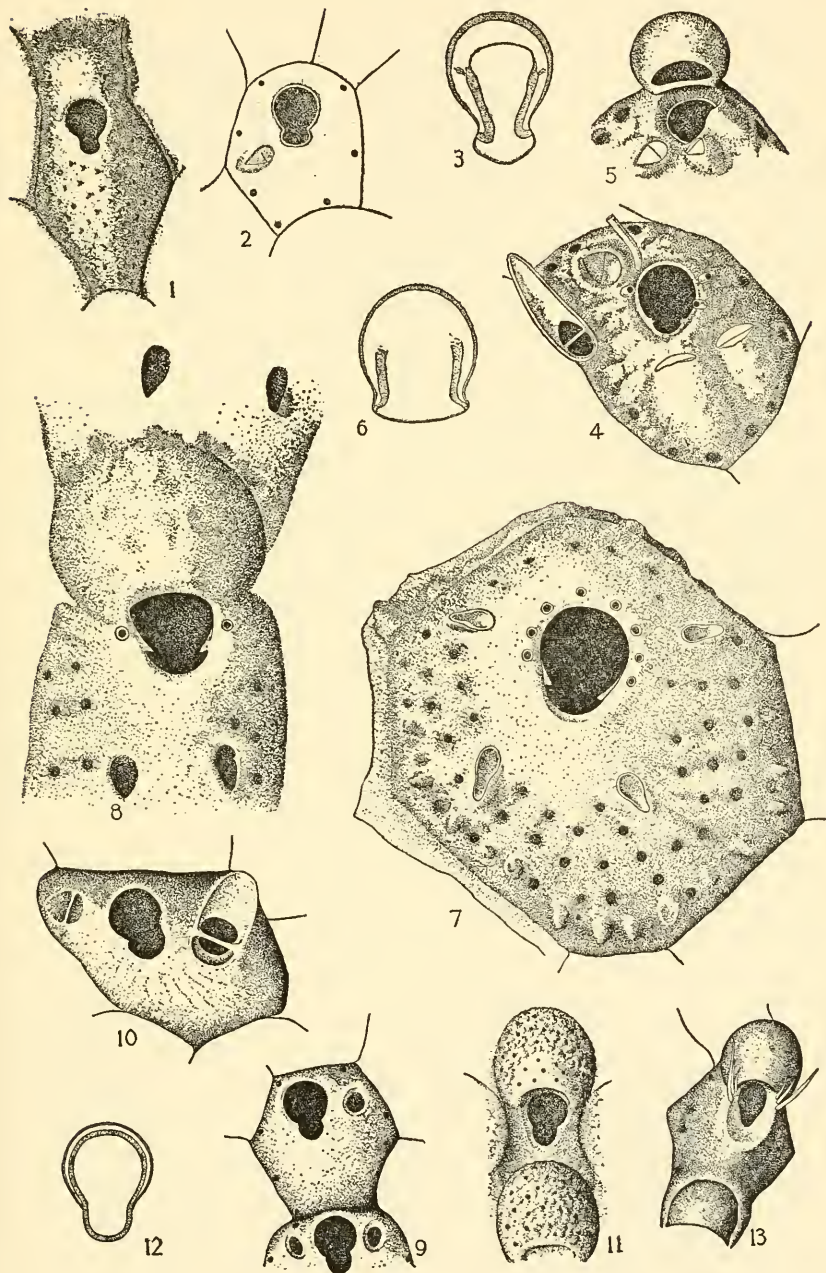
- Fig. 1. *Hippodiplosia insculpta* (Hincks), young fertile zooecium showing aperture compared with that of the infertile zooecium.
- Fig. 2. The same, ovicell.
- Fig. 3. *Hippodiplosia reticulato-punctata* (Hincks), reticulate zooecium, suboral avicularium and ovicell.
- Fig. 4. *Hippodiplosia americana* (Verrill), zooecia with ovicell and lateral avicularium.
- Fig. 5. *Hippodiplosia pertusa* (Esper), zooecium with ovicell.
- Figs. 6 and 7. The same, two forms of operculum of infertile zooecia.
- Fig. 8. The same, operculum of fertile zooecium.
- Fig. 9. *Emballothecca obscura* new species, zooecia with ovicell, aperture and suboral avicularium.
- Fig. 10. The same, operculum.
- Fig. 11. *Gemelliporida colombiensis* new species, zooecium with ovicell and lateral avicularium.
- Fig. 12. The same, operculum.
- Fig. 13. *Hippothyris emplastra* new species, zooecium with ovicell, suboral avicularium and the plastron-like frontal.
- Fig. 14. The same, details of aperture.





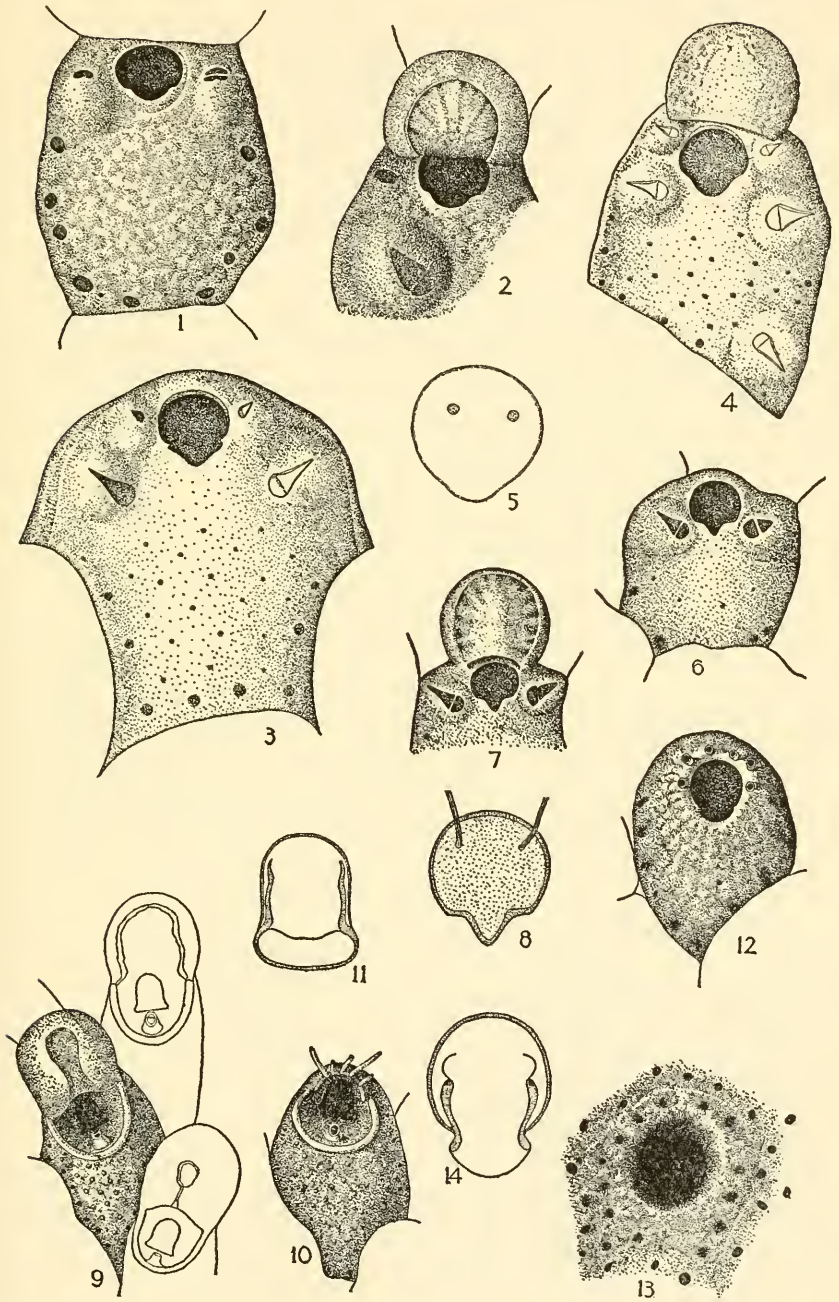
## PLATE 41

- Fig. 1. *Hippoporina porcellana* (Busk), highly calcified zoecium with minute tubercles and ovicell.
- Fig. 2. The same, diagram of aperture, avicularium and pores.
- Fig. 3. The same, operculum much enlarged.
- Fig. 4. *Hippoporina contracta* (Waters), zoecium, aperture, spines and different types of avicularia.
- Fig. 5. The same, ovicell.
- Fig. 6. *Hippoporina ampla* new species, operculum.
- Fig. 7. The same, zoecium showing aperture, spines, disposition of avicularia and marginal tubercles.
- Fig. 8. The same, ovicell.
- Fig. 9. *Gemelliporella globulifera* new species, showing aperture and position of avicularia.
- Fig. 10. The same, distorted zoecium with two types of avicularia.
- Fig. 11. The same, ovicells.
- Fig. 12. The same, operculum.
- Fig. 13. *Gemelliporina monilia* new species, zoecium, ovicell, aperture and graded spines.



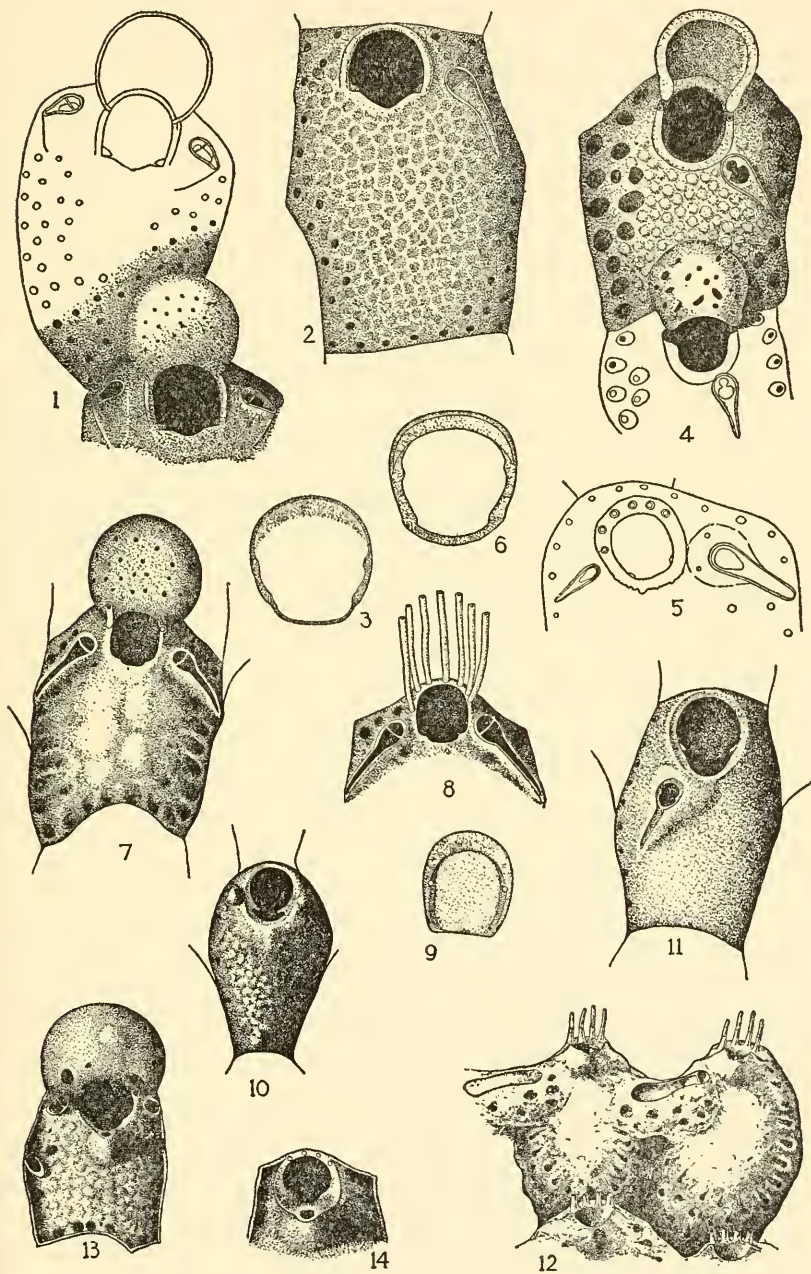
## PLATE 42

- Fig. 1. *Stephanosella biaperta* (Michelin), infertile zoecium with aperture, lateral-oral avicularia and areolar pores.
- Fig. 2. The same, ovicell and frontal avicularium.
- Fig. 3. *Stephanosella bolini* new species, zoecium, aperture, oral and frontal avicularia.
- Fig. 4. The same, ovicell and avicularia.
- Fig. 5. The same, operculum.
- Fig. 6. *Stephanosella vitrea* new species, infertile zoecium, aperture and avicularia.
- Fig. 7. The same, ovicell.
- Fig. 8. The same, operculum.
- Fig. 9. *Aimulosia palliolata* (Canu and Bassler), different degrees of calcification of the ovicell.
- Fig. 10. The same, marginal zoecium with details of aperture, spines, avicularium and encircling umbo.
- Fig. 11. The same, operculum much enlarged.
- Fig. 12. *Hippoporidra granulosa* Canu and Bassler, marginal zoecium showing spines, aperture and frontal granulation.
- Fig. 13. The same, very advanced calcification.
- Fig. 14. The same, operculum much enlarged.



## PLATE 43

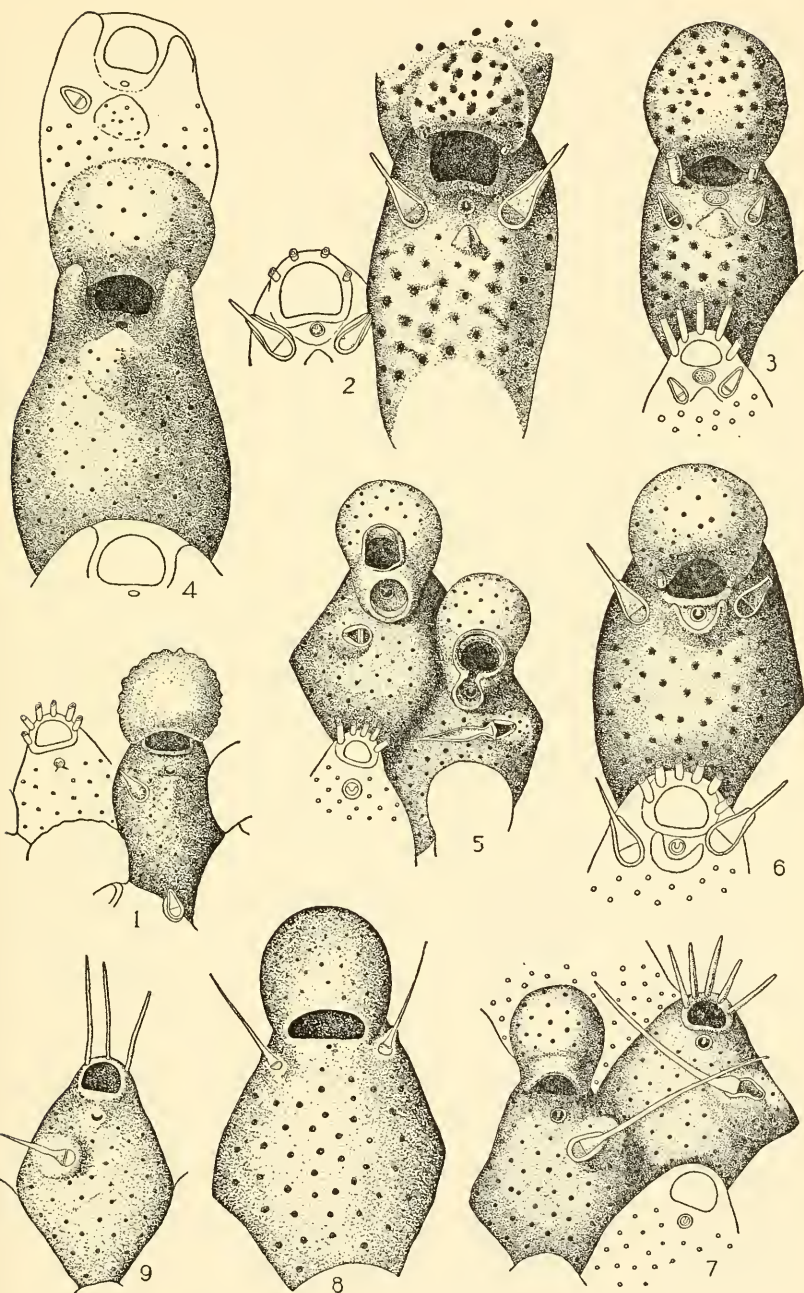
- Fig. 1. *Hippomonaxella longirostrata* (Hincks), zooecia, paired avicularia and ovicell.
- Fig. 2. The same, details of frontal, aperture and avicularium.
- Fig. 3. The same, operculum.
- Fig. 4. *Hippomonaxella parvicapitata* (Canu and Bassler), zooecia in full calcification and ovicell.
- Fig. 5. The same, aperture, spines and avicularia.
- Fig. 6. The same, operculum.
- Fig. 7. *Hippomenella flava* new species, zooecium and ovicell in full calcification.
- Fig. 8. The same, aperture and spines, the small cardelles are obscured by the edge of the frontal.
- Fig. 9. The same, operculum.
- Fig. 10. *Hippoporina tuberculata* new species, showing aperture and characteristic position of tubercles.
- Fig. 11. *Gemelliporella inflata* new species, zooecium, aperture and avicularium.
- Fig. 12. *Escharoides praestans* (Hincks), zooecia in full development with spatulate avicularia and suboral denticle.
- Fig. 13. *Trypematella umbonula* new species, zooecium with ovicell and avicularia.
- Fig. 14. The same, details of aperture.



## PLATE 44

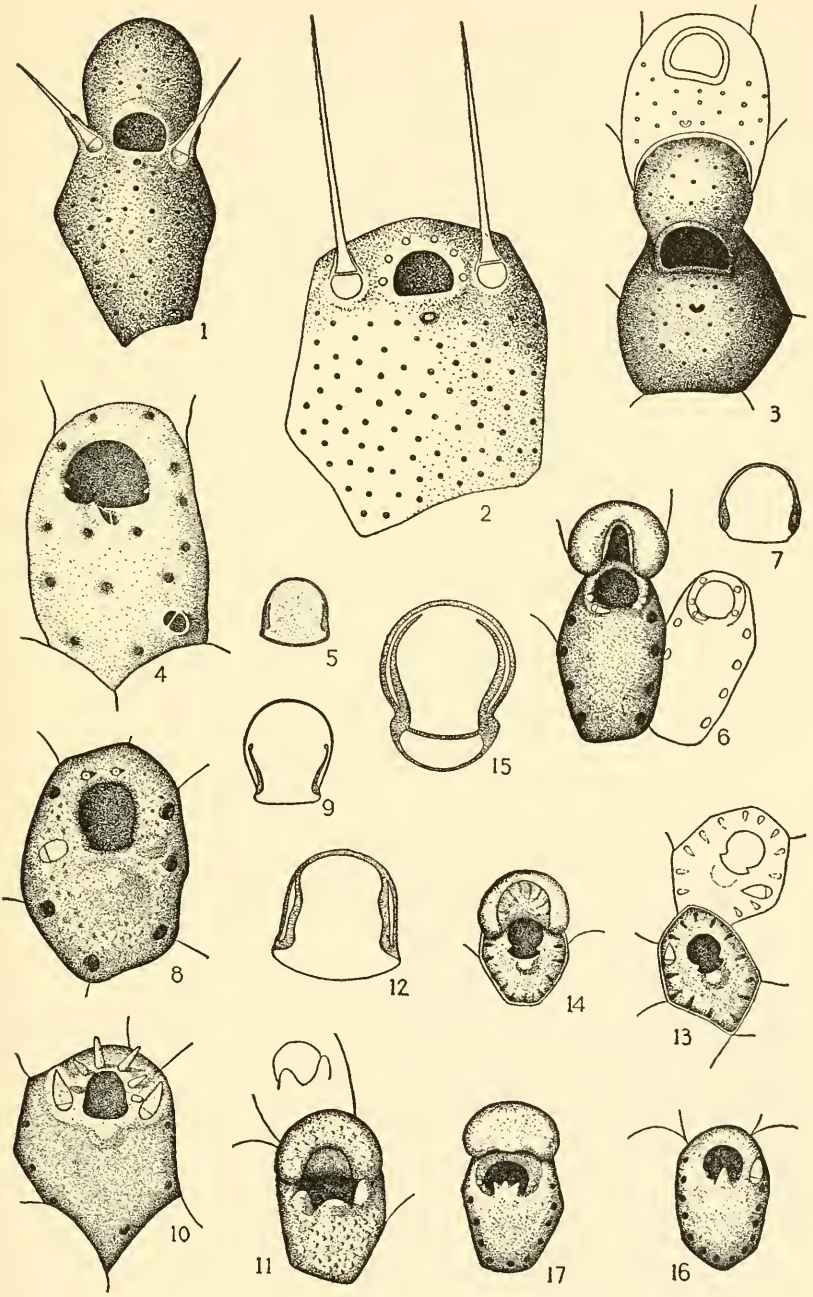
- Fig. 1. *Microporella ciliata* (Pallas), details of zooecia.  
Fig. 2. *Microporella californica* (Busk), details of zooecia.  
Fig. 3. *Microporella cribrosa* new species, note especially the large cribrate ascopore.  
Fig. 4. *Microporella umbonata* (Hincks), showing both median and lateral umbones.  
Fig. 5. *Microporella pontifica* new species, showing the formation of the peristomial bridge, and the form of the mandible.  
Fig. 6. *Microporella marsupiata* (Busk), the lunate umbo forms a shallow sac behind the ascopore.  
Fig. 7. *Microporella vibraculifera* (Hincks), showing the very elongate vibraculoid mandibles and the form of the ovicell.  
Fig. 8. *Microporella setiformis* O'Donoghue, minute round ascopore, small setiform avicularia and form of ovicell.  
Fig. 9. *Microporella gibbosula* Canu and Bassler, showing lunate ascopore, position of avicularium and form of mandible.





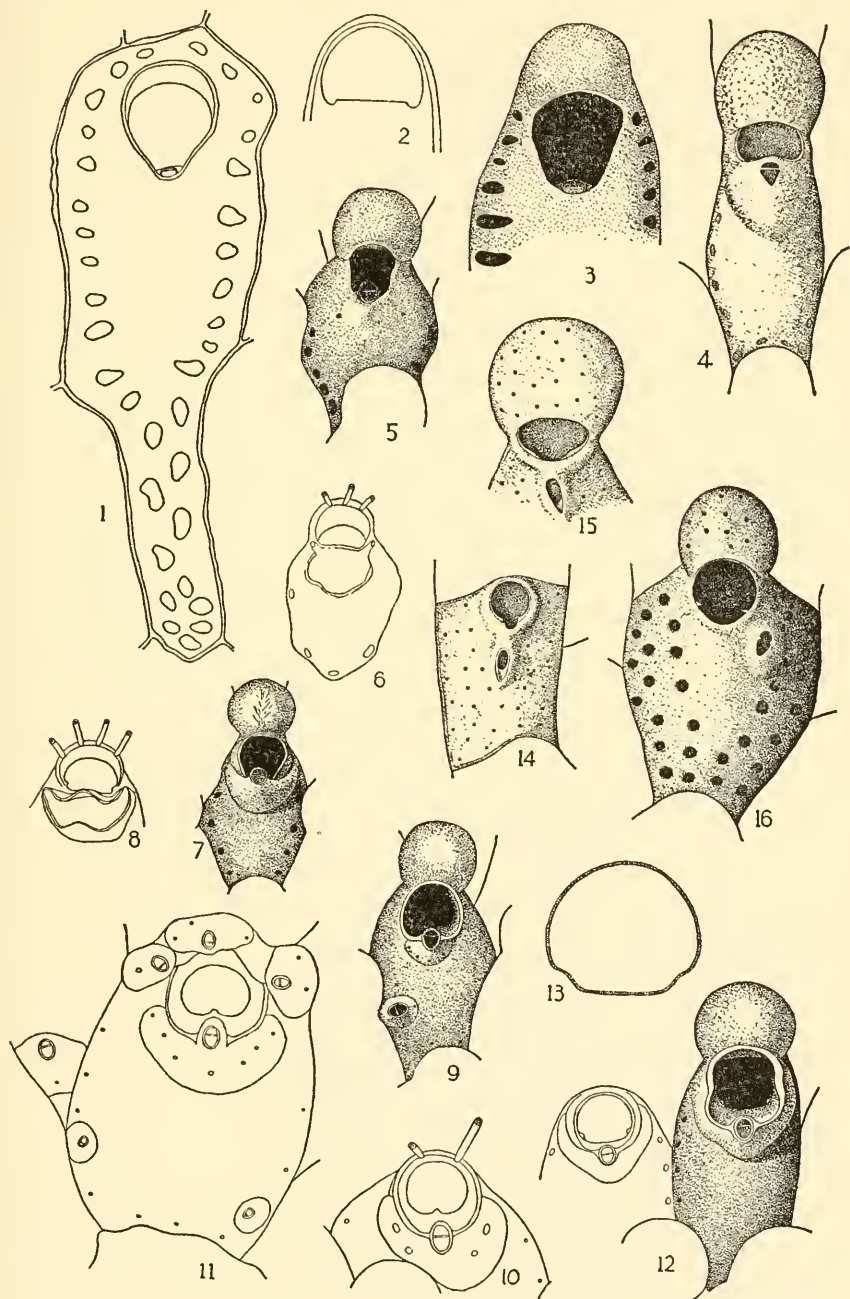
## PLATE 45

- Fig. 1. *Microporella coronata* (Audouin), zoecium, ovicell and especially the form of the avicularia.
- Fig. 2. *Microporella tractabilis* Canu and Bassler, note the extremely elongate and parallel mandibles.
- Fig. 3. *Fenestrulina mausi* (Audouin), zoecium, and ovicell; note presence of pores between ascopore and aperture.
- Fig. 4. *Hippoporella nitescens* (Hincks), zoecium, form of aperture and two types of avicularia.
- Fig. 5. The same, operculum.
- Fig. 6. *Hippoporella rimata* new species, zoecia, form of aperture with small avicularium and tubercles; ovicell with elongate membranous area.
- Fig. 7. The same, operculum.
- Fig. 8. *Hippoporella hippopus* (Smitt), zoecium with frontal tubercles, avicularium, spines and aperture.
- Fig. 9. The same, operculum.
- Fig. 10. *Hippoporella gorgonensis* Hastings, marginal zoecium showing spines and paired avicularia.
- Fig. 11. The same, zoecium and ovicell in full calcification.
- Fig. 12. The same, operculum, much enlarged.
- Fig. 13. *Hippoporida janthina* (Smitt), young marginal zoecia.
- Fig. 14. The same, zoecium of secondary layer with ovicell.
- Fig. 15. The same, operculum, greatly enlarged.
- Fig. 16. *Aimulosia uvulifera* (Osburn), young zoecium, showing aperture, avicularium and simple umbonate process.
- Fig. 17. The same, complete calcification, with ovicell.



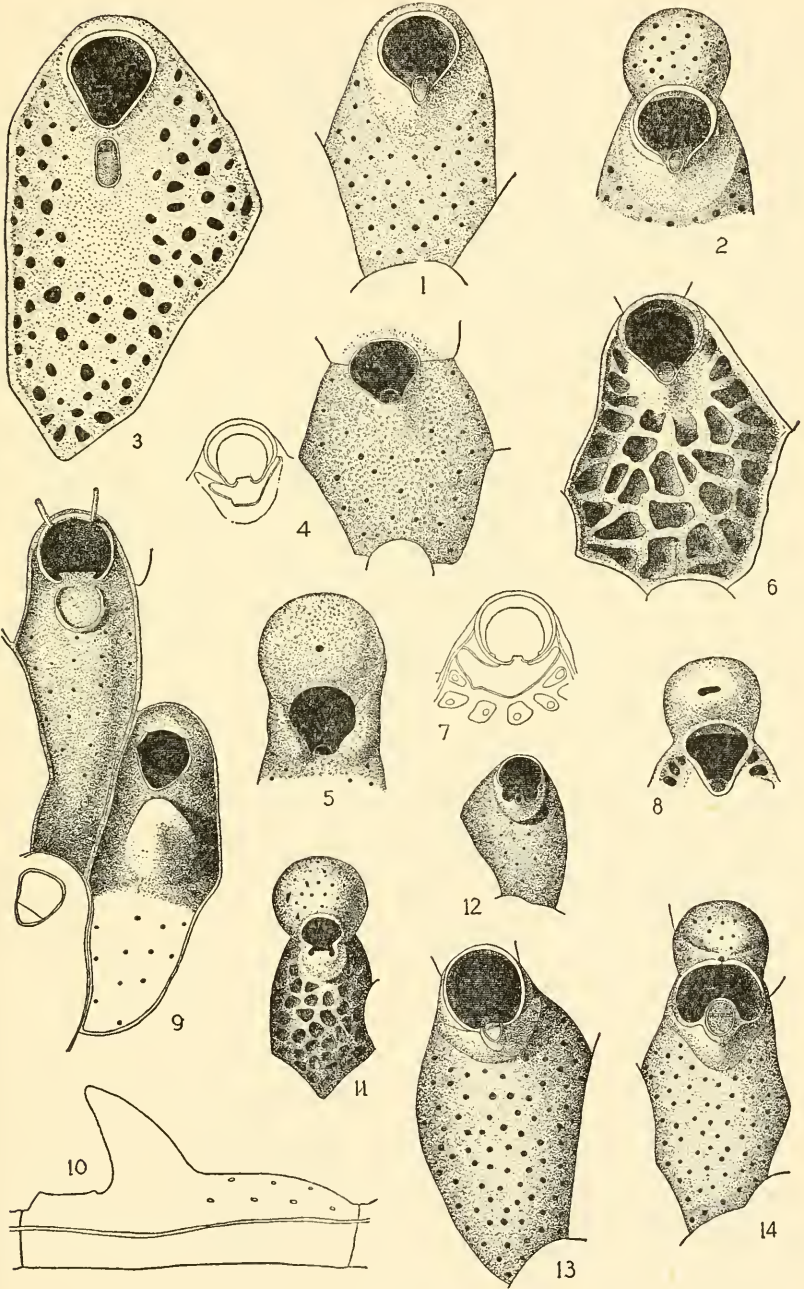
## PLATE 46

- Fig. 1. *Porella compressa* (Sowerby), outline of zooecium with secondary aperture and areolar pores.
- Fig. 2. The same, internal view of aperture with very broad low lyrula.
- Fig. 3. The same, with ovicell.
- Fig. 4. *Porella acutirostris* Smitt, with ovicell and avicularium.
- Fig. 5. *Porella concinna* (Busk), zooecium with ovicell and secondary aperture.
- Fig. 6. The same, young zooecium with primary aperture, spines and developing avicularian chamber.
- Fig. 7. *Porella columbiana* O'Donoghue, zooecium and ovicell.
- Fig. 8. The same, young zooecium showing aperture, spines and developing avicularian chamber.
- Fig. 9. *Porella porifera* (Hincks), zooecium and ovicell (the avicularian chamber is smaller than usual).
- Fig. 10. The same, details of aperture of young zooecium.
- Fig. 11. The same, zooecium with numerous avicularia, from marginal area of large colony.
- Fig. 12. *Porella patens* new species, zooecium with ovicell and flaring secondary aperture.
- Fig. 13. The same, operculum, much enlarged.
- Fig. 14. *Codonellina anatina* (Canu and Bassler), young zooecium.
- Fig. 15. The same, with ovicell.
- Fig. 16. *Codonellina cribriformis* (O'Donoghue), zooecium with ovicell and details of aperture.



## PLATE 47

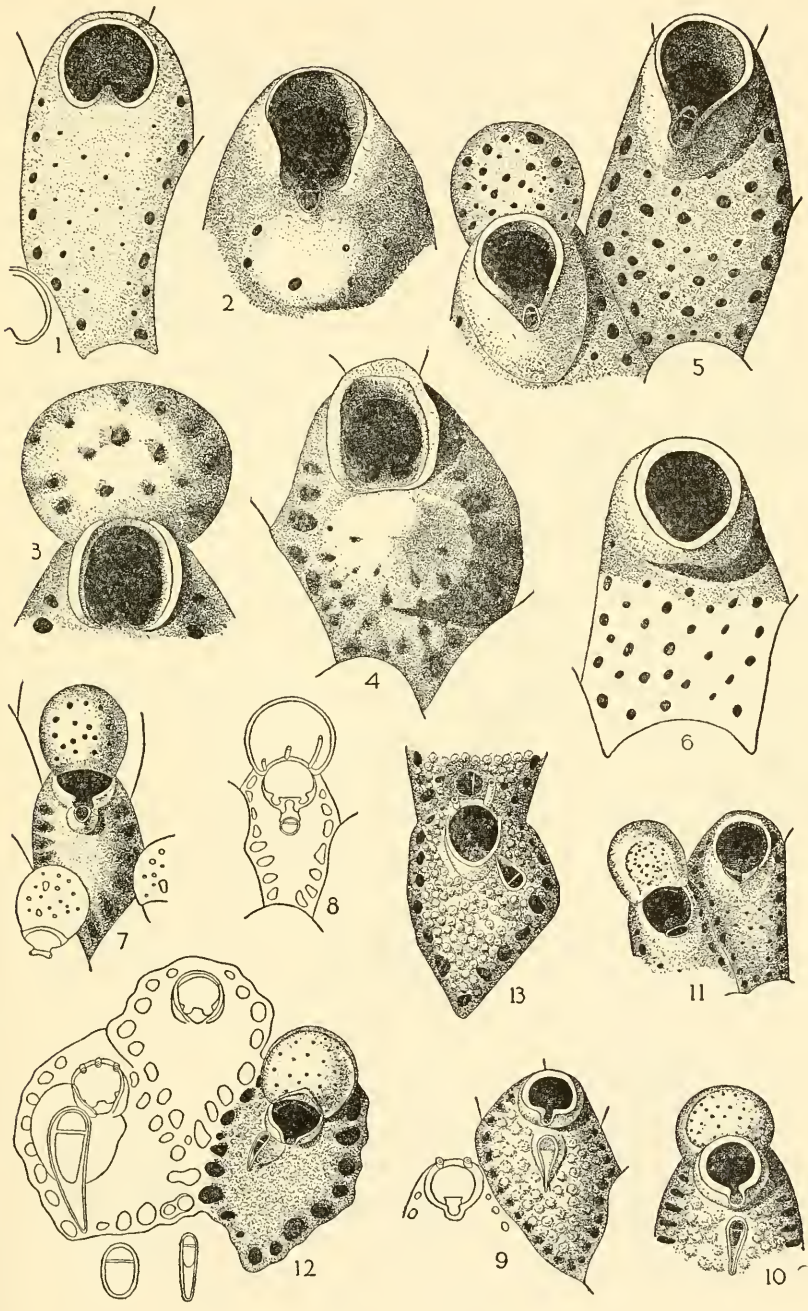
- Fig. 1. *Smittina landsborovii* (Johnston), infertile zooecium showing lyrula and avicularium.
- Fig. 2. The same, ovicell.
- Fig. 3. *Smittina spathulifera* (Hincks), with broad lyrula and avicularium remote from aperture.
- Fig. 4. *Smittina bella* (Busk), zooecium and details of aperture and avicularium.
- Fig. 5. The same, ovicell.
- Fig. 6. *Smittina retifrons* new species, adult infertile zooecium.
- Fig. 7. The same, showing details of aperture.
- Fig. 8. The same, ovicell.
- Fig. 9. *Smittina altirostris* new species, zooecia with details of aperture and avicularian umbo.
- Fig. 10. The same, diagram of side view with prominent umbo.
- Fig. 11. *Smittina smittiella* Osburn, adult zooecium with ovicell and serrate avicularian rostrum.
- Fig. 12. The same, young zooecium showing form of aperture and lyrula.
- Fig. 13. *Smittina arctica* (Norman), infertile zooecium with details of aperture and avicularium.
- Fig. 14. The same, ovicell.



## PLATE 48

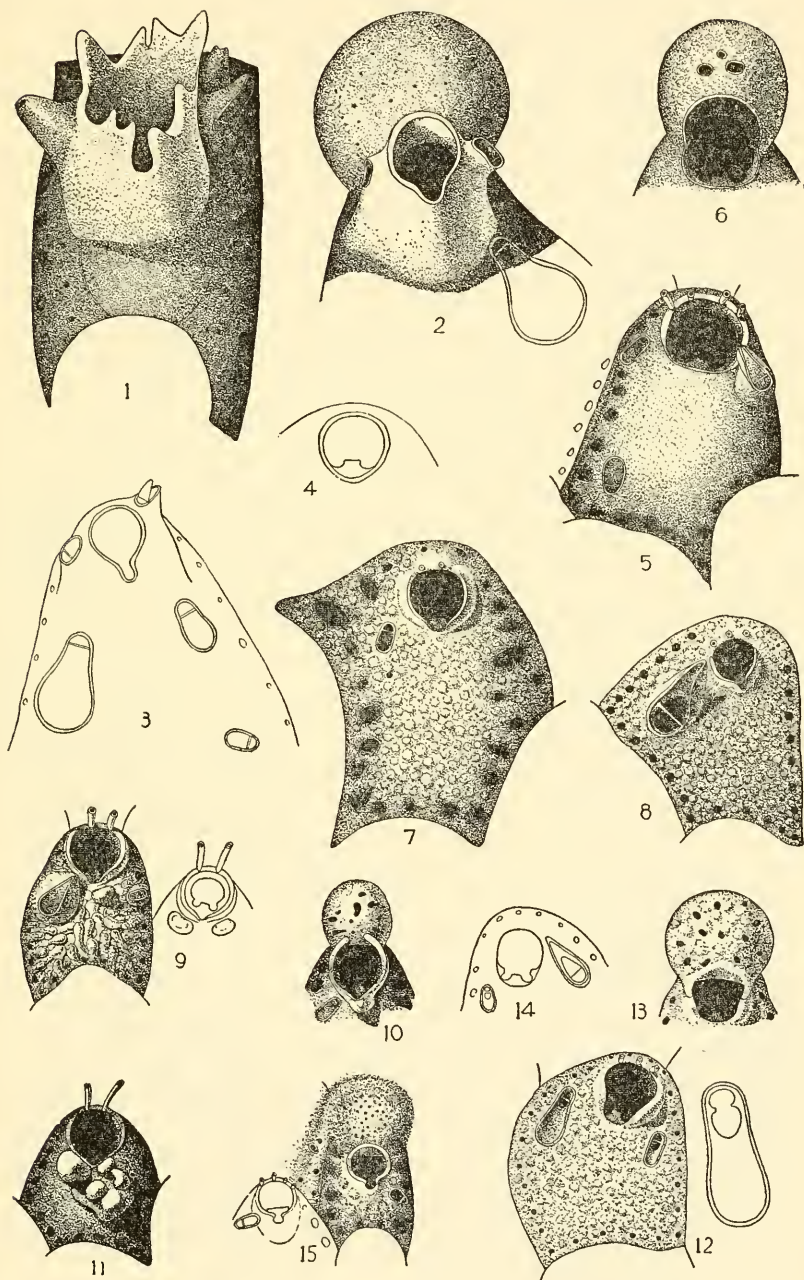
- Fig. 1. *Smittina cordata* new species, very young zooecium with details of the primary aperture.
- Fig. 2. The same, secondary aperture and suboral avicularium.
- Fig. 3. The same, ovicell.
- Fig. 4. The same, in high calcification with raised peristome and large umbo.
- Fig. 5. *Smittina maccullochae* new species, zooecia, ovicell and elevated avicularium and peristome.
- Fig. 6. The same, showing peristome in the absence of an avicularium.
- Fig. 7. *Smittoidea prolifica* new species, zooecium with ovicell and suboral avicularium.
- Fig. 8. The same, diagram showing details of aperture and spines.
- Fig. 9. *Smittoidea reticulata* (MacGillivray), zooecium with characteristic position and shape of avicularium, and diagram of aperture.
- Fig. 10. The same, ovicell.
- Fig. 11. *Smittoidea transversa* (Busk), zooecia, ovicell, transverse suboral avicularium and aperture.
- Fig. 12. *Parasmittina crosslandi* (Hastings), zooecium with ovicell, and diagram of aperture and different types of avicularia.
- Fig. 13. *Parasmittina alaskensis* new species, zooecium with secondary aperture, spines and two types of avicularia.





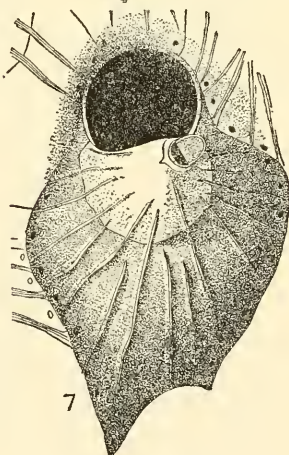
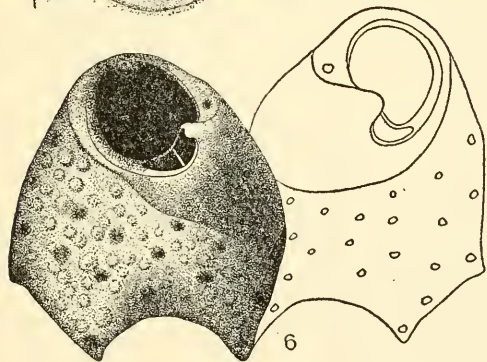
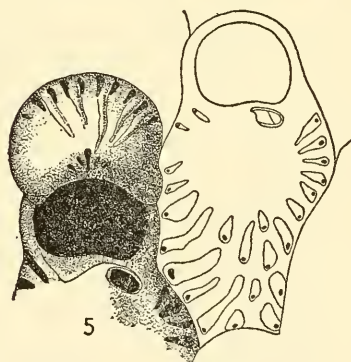
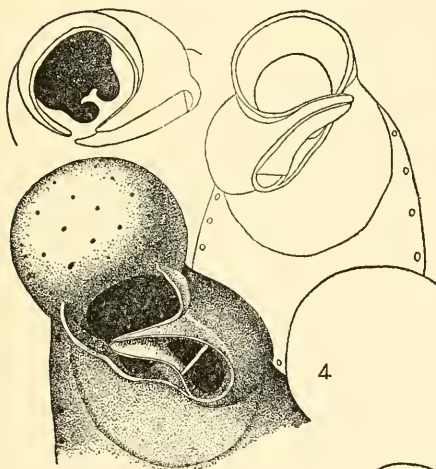
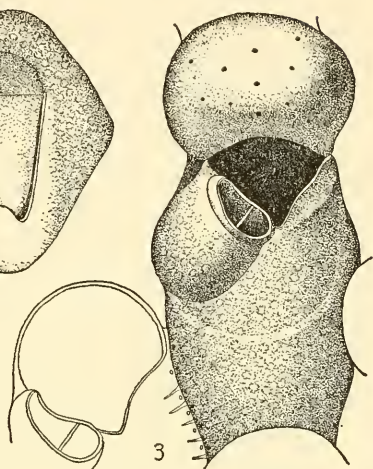
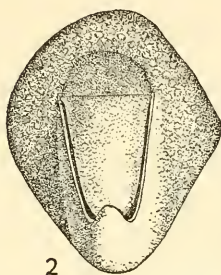
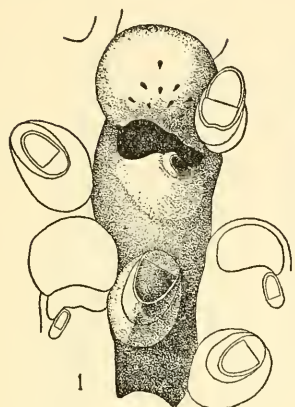
## PLATE 49

- Fig. 1. *Parasmittina tubulata* new species, zoecium and high peristome with avicularia.
- Fig. 2. The same, ovicell.
- Fig. 3. The same, sizes and forms of avicularia.
- Fig. 4. The same, details of aperture.
- Fig. 5. *Parasmittina jeffreysi* (Norman), zoecium, details of aperture, avicularia and spines.
- Fig. 6. The same, ovicell.
- Fig. 7. *Parasmittina trispinosa* (Johnston), zoecium, ovate avicularium.
- Fig. 8. The same, characteristic large pointed avicularium.
- Fig. 9. *Parasmittina collifera* (Robertson), zoecium, aperture, spines, avicularia and frontal.
- Fig. 10. The same, ovicell.
- Fig. 11. The same, more advanced development of tubercles (*colli*).
- Fig. 12. *Parasmittina spathulata* (Smitt), zoecium with two sizes of avicularia.
- Fig. 13. The same, ovicell.
- Fig. 14. The same, details of aperture and pointed avicularium.
- Fig. 15. *Parasmittina fraseri* new species, zoecium and depressed ovicell, with details of aperture and avicularia.



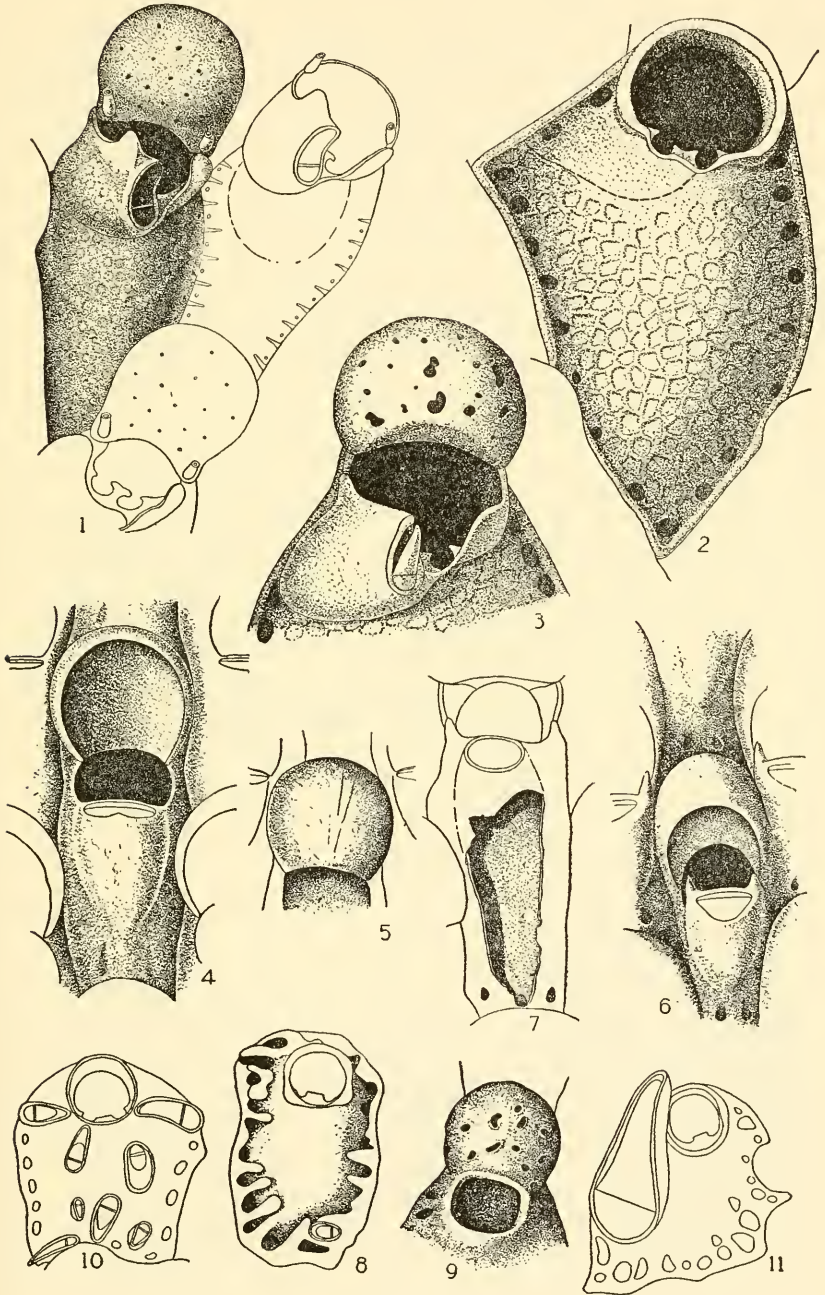
## PLATE 50

- Fig. 1. *Rhizophostomella fortissima* Bidekap, zoecium, ovicell and avicularia; reduced one-half.
- Fig. 2. The same, giant avicularium, not reduced.
- Fig. 3. *Rhizophostomella hincksi* Nordgaard, zoecium with ovicell.
- Fig. 4. *Rhizophostomella curvirostrata* O'Donoghue, showing the lyrula, ovicell and avicularium.
- Fig. 5. *Rhizophostomella gigantea* new species, showing aperture, ovicell, avicularium and costate front with a few pores, reduced one-half.
- Fig. 6. *Rhizophostomella ovata* (Smitt), zoecium with scattered pores, aperture and avicularium.
- Fig. 7. *Rhizophostomella costata* Lorenz, zoecium, avicularian umbo and aperture.



## PLATE 51

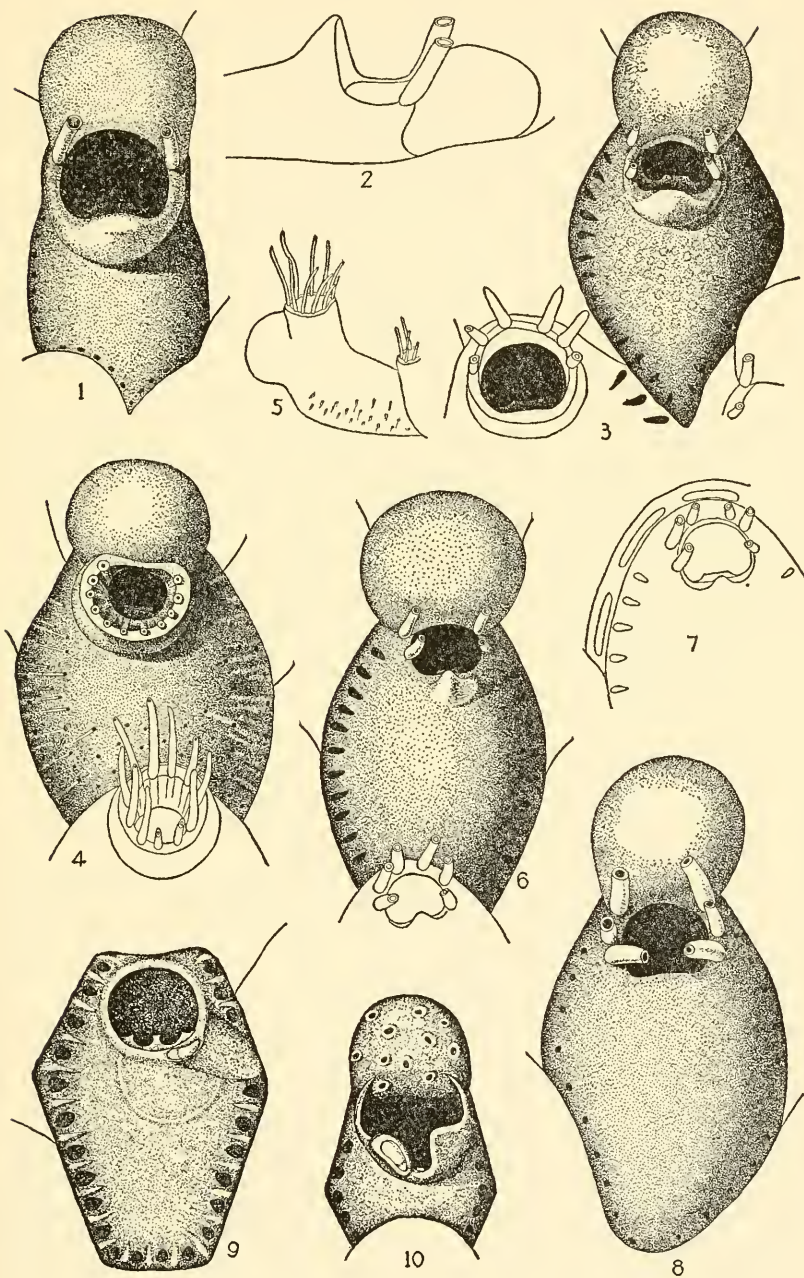
- Fig. 1. *Rhamphostomella spinigera* Lorenz, zooecia and ovicell with details of aperture, avicularia and spines.
- Fig. 2. *Rhamphostomella townsendi* new species, young zooecium, with details of aperture and frontal decoration.
- Fig. 3. The same, ovicell and avicularium.
- Fig. 4. *Cystisella saccata* (Busk), zooecium with incomplete ovicell.
- Fig. 5. The same, ovicell.
- Fig. 6. *Cystisella bicornis* new species, with ovicell, spinous processes and avicularium.
- Fig. 7. The same, front of avicularian chamber removed to show its mode of origin.
- Fig. 8. *Parasmittina californica* (Robertson), young zooecium showing aperture and mode of growth of the pleurocyst.
- Fig. 9. The same, ovicell.
- Fig. 10. The same, with numerous avicularia.
- Fig. 11. The same, giant avicularium.



## PLATE 52

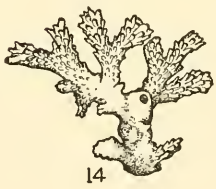
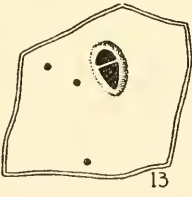
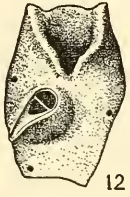
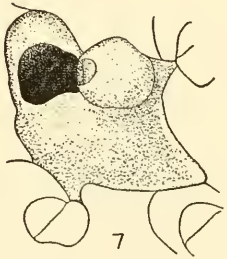
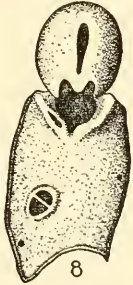
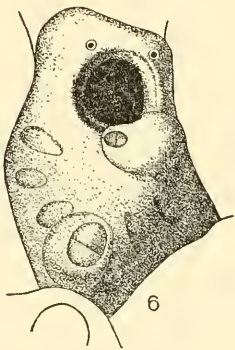
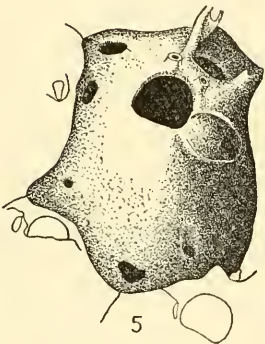
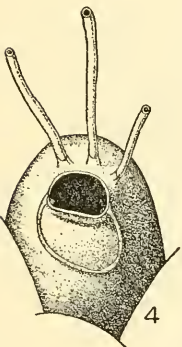
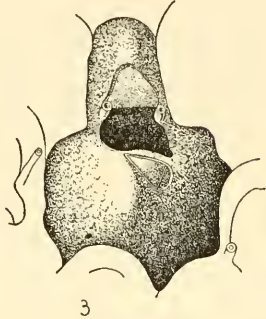
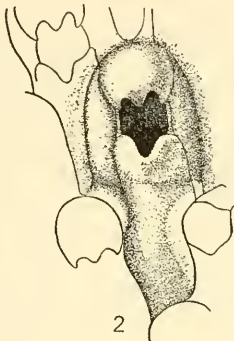
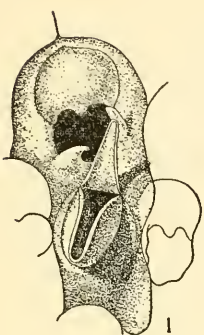
- Fig. 1. *Mucronella labiata* (Boeck), zoecium with ovicell.  
Fig. 2. The same, diagrammatic side view.  
Fig. 3. *Mucronella ventricosa* (Hassall), zoecium, ovicell and details of aperture.  
Fig. 4. *Mucronella major* (Hincks), zoecium and ovicell, the complete array of spines and the peculiar frontal pores.  
Fig. 5. The same, diagram of side view.  
Fig. 6. *Mucronella connectens* (Ridley), zoecium and ovicell.  
Fig. 7. The same, diagram of young marginal zoecium showing details of aperture and the very elongate dietellae.  
Fig. 8. *Hemicyclopora polita* (Norman), zoecium and ovicell.  
Fig. 9. *Rhizophostomella cellata* (O'Donoghue), with details of aperture; note especially the minute avicularium conforming to the peristomial rim.  
Fig. 10. *Rhizophostomella bilaminata* (Hincks), zoecium with ovicell; note secondary aperture with high peristomial lappet and elevated avicularium.





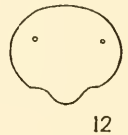
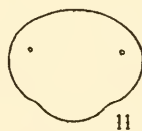
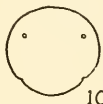
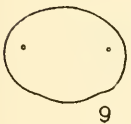
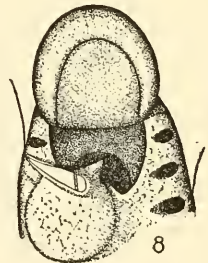
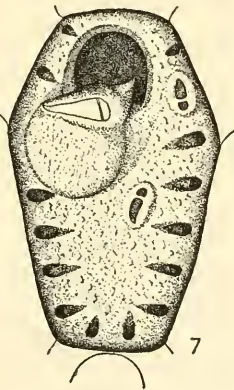
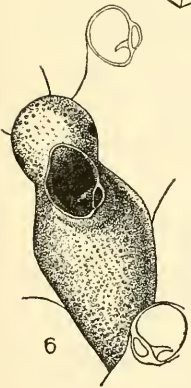
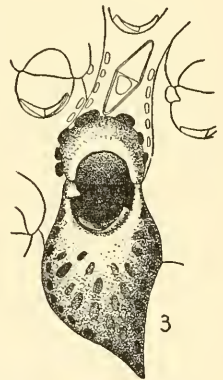
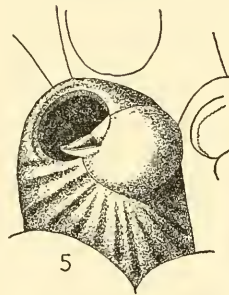
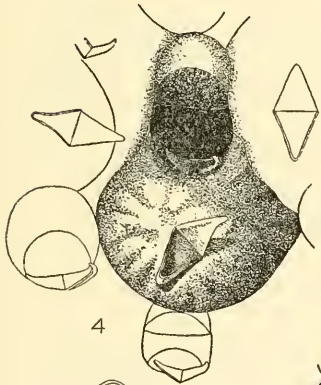
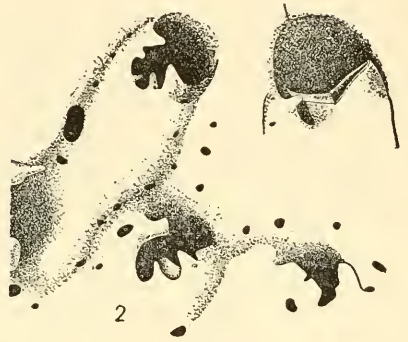
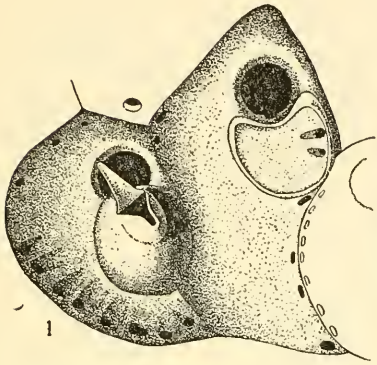
## PLATE 53

- Fig. 1. *Phidolopora pacifica* (Robertson), zoecium with ovicell and large frontal avicularium.
- Fig. 2. The same, zoecium and ovicell from another part of the same colony.
- Fig. 3. *Lepraliella contigua* (Smitt), old zoecium with ovicell partially covered by adjoining zoecia.
- Fig. 4. The same, young marginal zoecium showing spines, form of aperture and developing avicularian chamber.
- Fig. 5. *Lepraliella bispina* (O'Donoghue), young zoecium with spines, aperture and developing avicularian chamber.
- Fig. 6. The same, somewhat older, with frontal avicularium.
- Fig. 7. The same, with ovicell partially covered by adjoining zoecia.
- Fig. 8. *Reteporellina denticulata gracilis* new variety, adult zoecium with ovicell, labial avicularium and ovate frontal avicularium.
- Fig. 9. The same, young zoecium.
- Fig. 10. The same, dorsal zoeciule (kenozoecium) with ovate avicularium.
- Fig. 11. *Reteporellina bilabiata* new species, adult zoecium with ovicell, large pointed frontal avicularium and high lateral oral flanges.
- Fig. 12. The same, young zoecium at tip of branch.
- Fig. 13. The same, dorsal zoeciule with pointed avicularium.
- Fig. 14. The same, habit sketch showing form of branching.



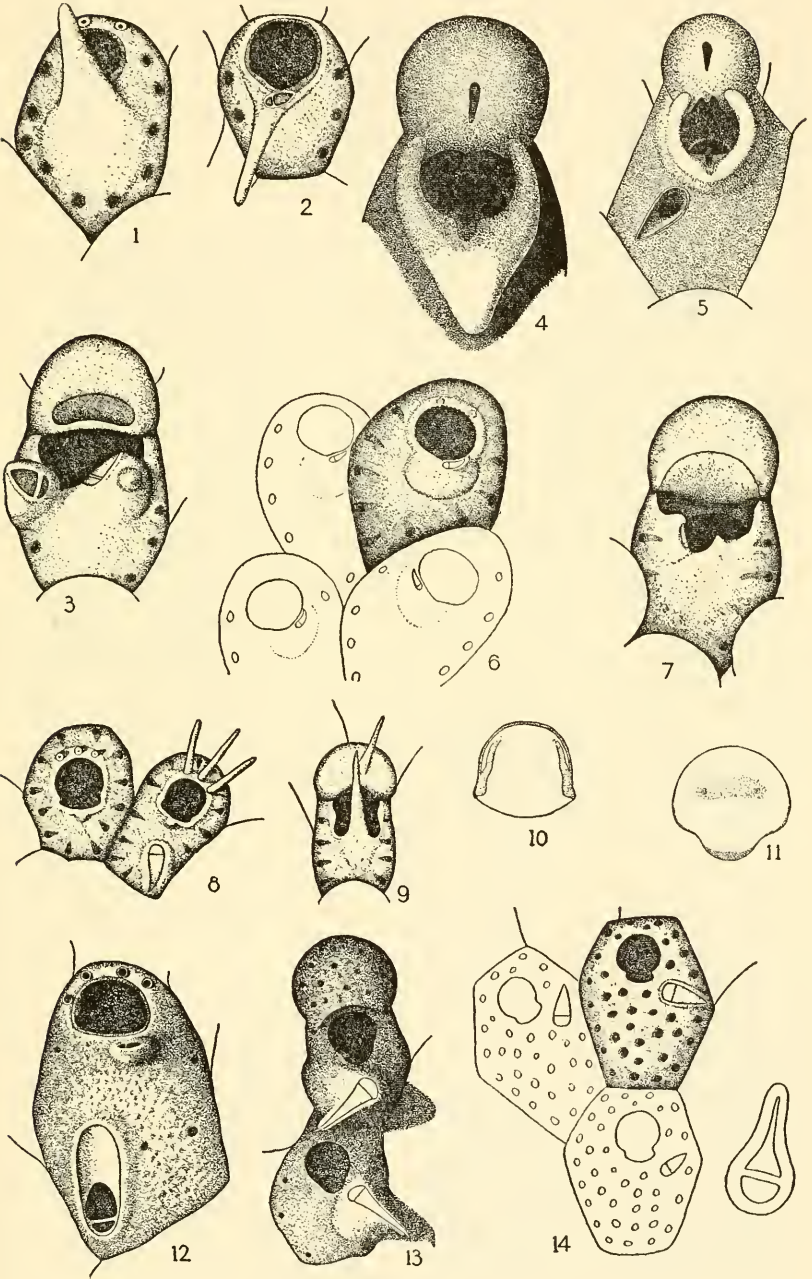
## PLATE 54

- Fig. 1. *Rhynchozoon rostratum* (Busk), young zooecia with details of aperture, suboral avicularium and chamber.
- Fig. 2. The same, old and heavily calcified, with tuberosities.
- Fig. 3. The same, zooecium with ovicell.
- Fig. 4. *Rhynchozoon tumulosum* (Hincks), zooecium with ovicell and suboral and frontal avicularia.
- Fig. 5. The same, young zooecium with characteristic bulbous avicularium chamber.
- Fig. 6. *Rhynchozoon tuberculatum* Osburn, young zooecium with ovicell and small suboral avicularium.
- Fig. 7. *Rhynchozoon grandicella* Canu and Bassler, young marginal zooecium with suboral and frontal avicularia (both types of avicularia are often larger).
- Fig. 8. The same, young zooecium with ovicell.
- Fig. 9. *Rhynchozoon bispinosum* (Johnston) operculum.
- Fig. 10. *Rhynchozoon spicatum* new species, operculum.
- Fig. 11. *Rhynchozoon grandicella* Canu and Bassler, operculum.
- Fig. 12. *Rhynchozoon tumulosum* (Hincks), operculum.



## PLATE 55

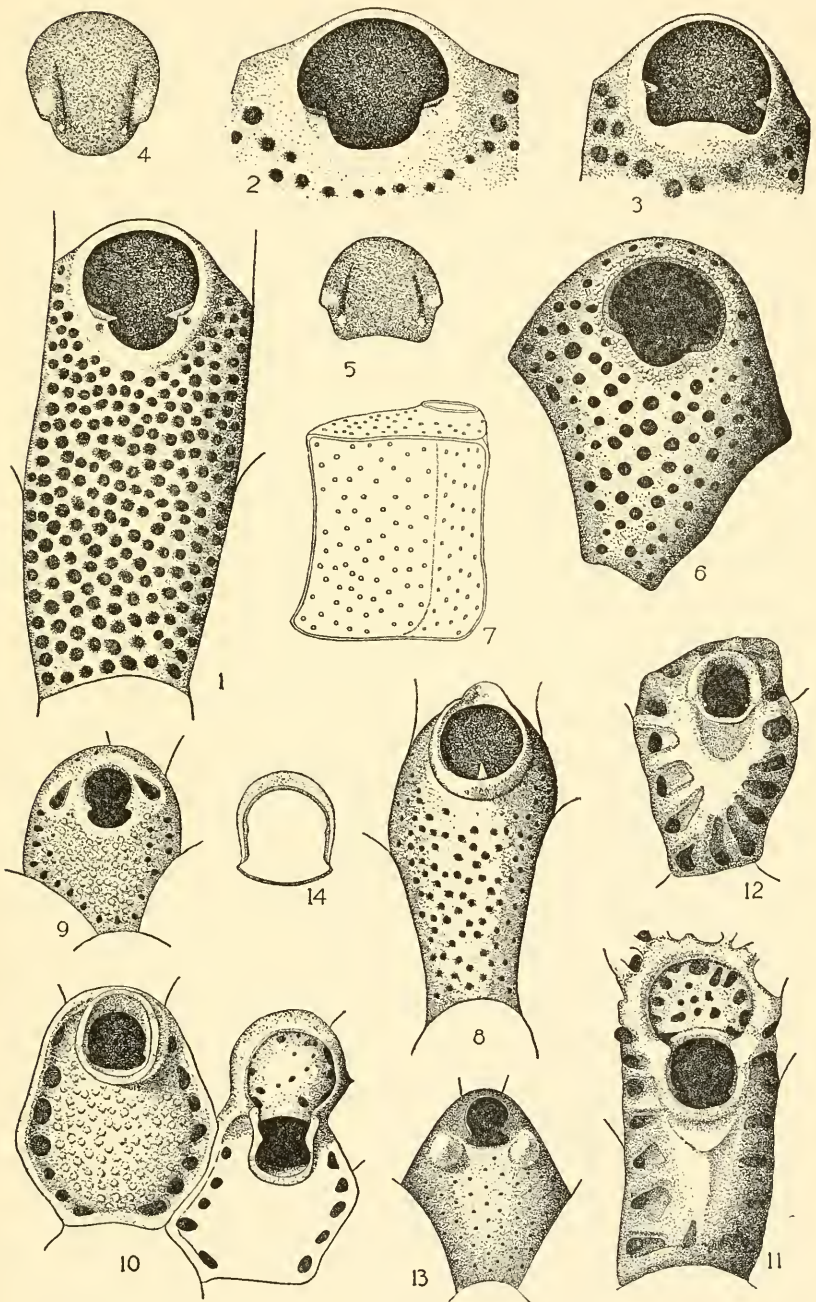
- Fig. 1. *Rhynchozoon spicatum* new species, zoecium with spicate avicularian umbo and bases of spines.
- Fig. 2. The same, tilted backward to show position of avicularium.
- Fig. 3. The same, ovicell and frontal avicularium.
- Fig. 4. *Schizotheca umbonata* new species, zoecium with ovicell and tall erect umbo.
- Fig. 5. *Schizotheca fissurella* (Hincks), zoecium with ovicell and frontal avicularium.
- Fig. 6. *Rhynchozoon bispinosum* (Johnston), young zoecia, form of aperture, position of spines and avicularia.
- Fig. 7. The same, older zoecium of secondary layer with ovicell.
- Fig. 8. *Hippoporidra spiculifera* (Canu and Bassler), young zoecia with spines and frontal avicularium.
- Fig. 9. The same, older zoecium with spiculate umbo on suboral border and ovicell.
- Fig. 10. The same, operculum.
- Fig. 11. *Veleroa veleronis* new species, operculum.
- Fig. 12. *Holoporella quadrispinosa* Canu and Bassler, marginal zoecium, spines, form of aperture, suboral avicularium, form and position of frontal avicularium.
- Fig. 13. *Gemelliporella aviculifera* new species, zoecia with ovicell and erect pedicellate avicularian chamber.
- Fig. 14. *Gemelliporidra lata* new species, zoecia, form of aperture, ordinary frontal avicularia and giant avicularium.



## PLATE 56

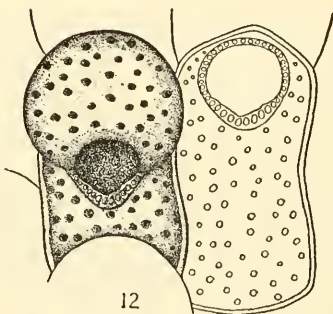
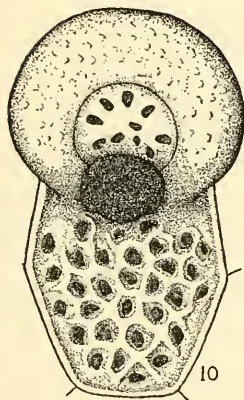
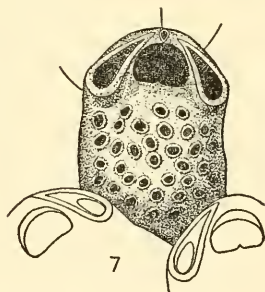
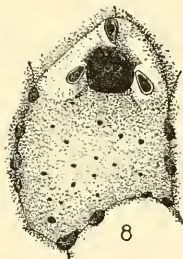
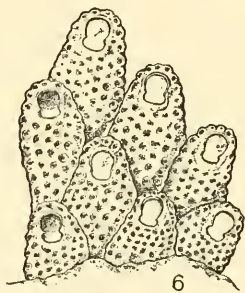
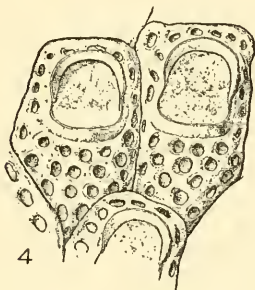
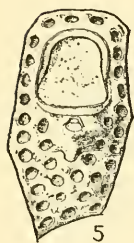
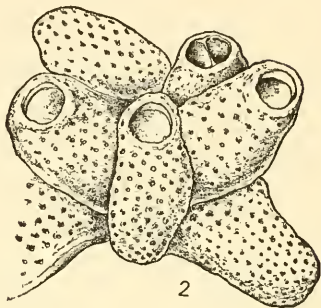
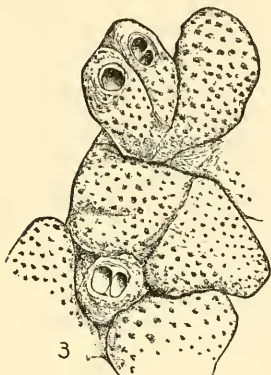
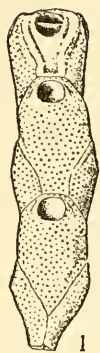
- Fig. 1. *Watersipora cucullata* (Busk), zooecium, details of aperture, Colombia.
- Fig. 2. The same, form of aperture, Galapagos Islands.
- Fig. 3. The same, form of aperture, Gulf of Mexico.
- Fig. 4. The same, operculum, Colombia.
- Fig. 5. The same, operculum, Gulf of Mexico.
- Fig. 6. *Veleroa veleronis* new species, zooecium, details of aperture.
- Fig. 7. The same, diagram of side view showing the great depth and the scattered uniporous septulae, reduced  $\frac{1}{2}$ .
- Fig. 8. *Cheilopora praelonga* (Hincks), zooecium, suboral denticle.
- Fig. 9. *Hippaliosina rostrigera* (Smitt), zooecium, aperture and avicularia.
- Fig. 10. *Hippaliosina inarmata* new species, zooecium and endozooecial ovicell.
- Fig. 11. *Hippaliosina costifera* new species, zooecium with endozooecial ovicell.
- Fig. 12. The same, infertile zooecium with details of aperture.
- Fig. 13. *Hippopodinella turrita* new species, zooecium showing small pores and high pointed tubercles.





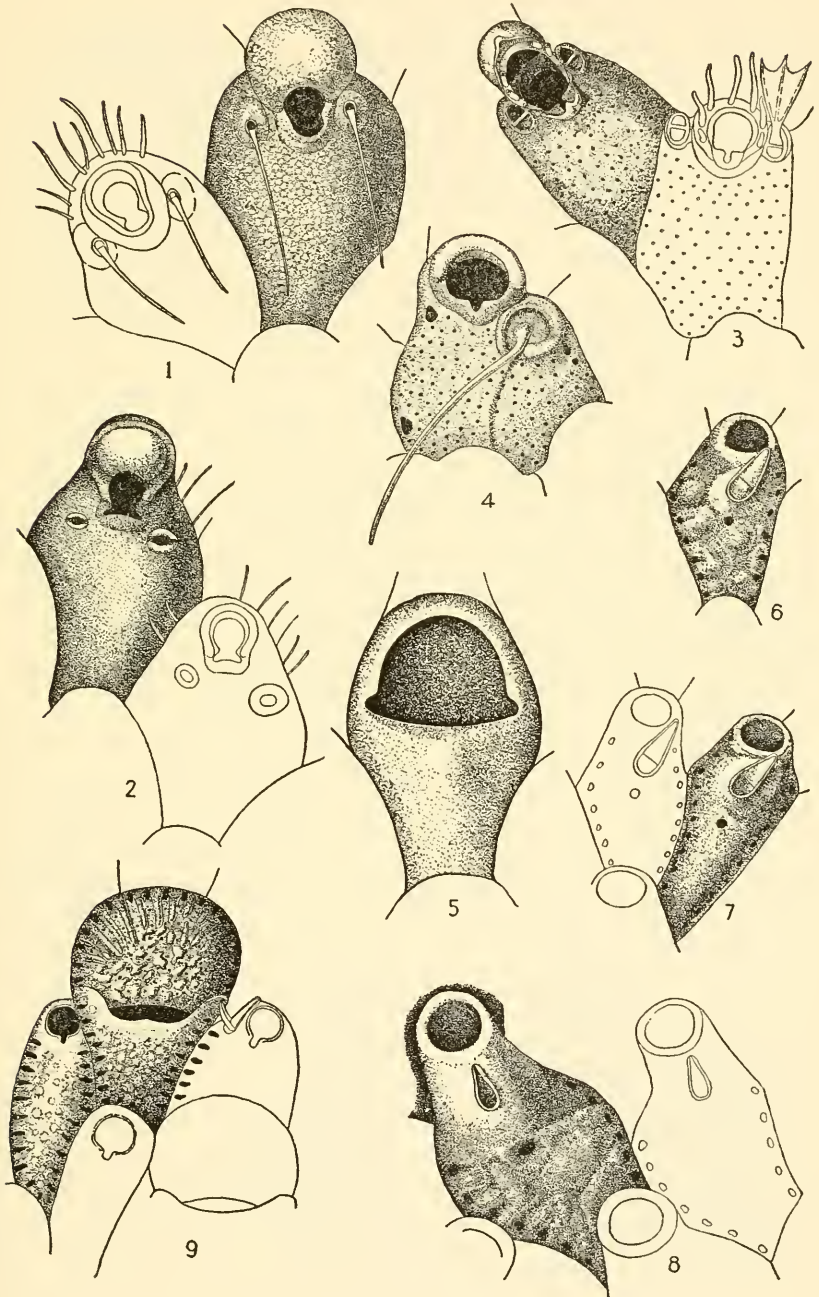
## PLATE 57

- Fig. 1. *Tetraplaria veleronis* new species, node of erect branch, showing origin of divergent branch at the top.
- Fig. 2. The same, central portion of encrusting base, with the ancestrula, two normal zooecia, two closed zooeciules and the base of an erect branch.
- Fig. 3. The same, another portion of the encrusting base with closed zooeciules, one functional zooecium and two bases of erect branches.
- Fig. 4. *Cryptosula pallasiana* (Moll), usual condition of zooecia.
- Fig. 5. The same, with small suboral avicularium and umbo.
- Fig. 6. *Hippopodinella adpressa* (Busk).
- Fig. 7. *Enantiosula manica* Canu and Bassler, zooecium, form of aperture, large lateral avicularia and minute median distal avicularium.
- Fig. 8. *Enantiosula plana* new species, the three oral avicularia of the same size and form, the aperture more elongate than in *E. manica*.
- Fig. 9. The same, operculum.
- Fig. 10. *Dakaria ordinata* (O'Donoghue), zooecium, form of aperture and the ovicell which is overlaid with an usually broad border from the adjoining zooecia.
- Fig. 11. The same, operculum.
- Fig. 12. *Dakaria sertata* Canu and Bassler, zooecia and ovicell and the characteristic "necklace" of small tubercles.
- Fig. 13. The same, operculum.



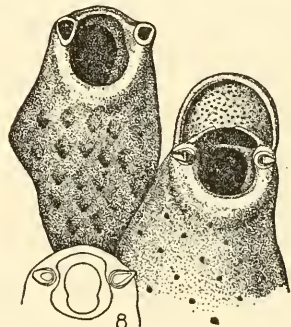
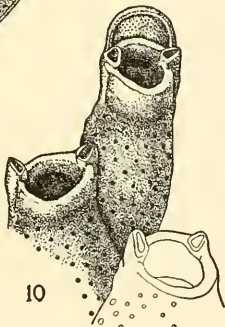
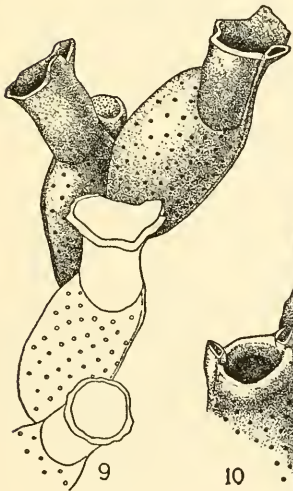
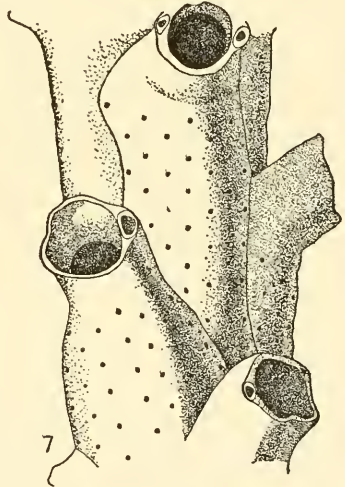
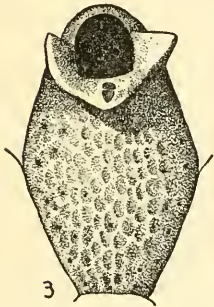
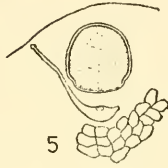
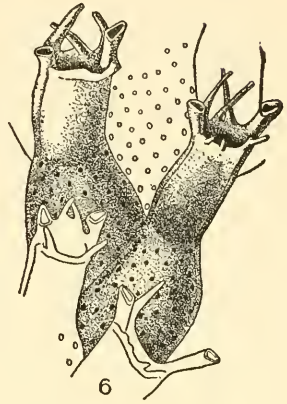
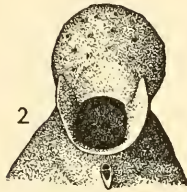
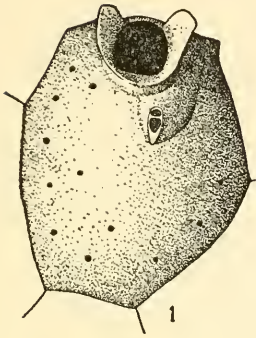
## PLATE 58

- Fig. 1. *Crepidacantha setigera* (Smitt), zooecia with ovicell, spines and setigerous avicularia.
- Fig. 2. *Crepidacantha poissoni* (Audouin), zooecia, ovicell, and avicularia proximal to aperture.
- Fig. 3. *Mastigophora pesanseris* (Smitt), zooecia, ovicell, spines and goose-footed avicularian mandible.
- Fig. 4. *Mastigophora porosa* (Smitt), zoecium with large elongate vibraculum.
- Fig. 5. *Eurystomella bilabiata* (Hincks), infertile zoecium.
- Fig. 6. *Adeona violacea* (Johnston), adult zoecium with tuberculated frontal.
- Fig. 7. The same, young zooecia.
- Fig. 8. *Adeona tubulifera* Canu and Bassler, showing high tubular peristome bearing the avicularium.
- Fig. 9. *Trigonopora pacifica* new species, zooecia, and gonozoecium with ovicell and wide aperture.



## PLATE 59

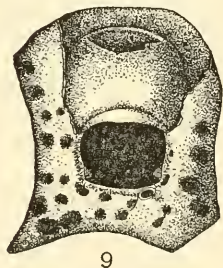
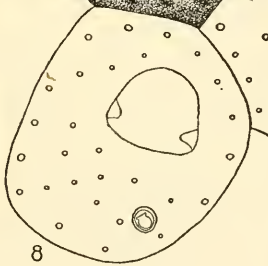
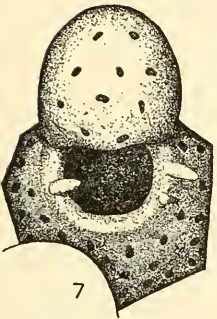
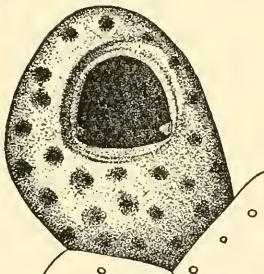
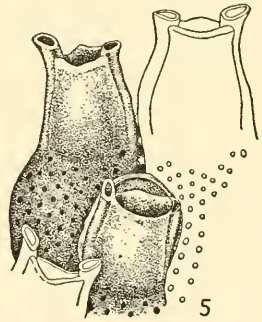
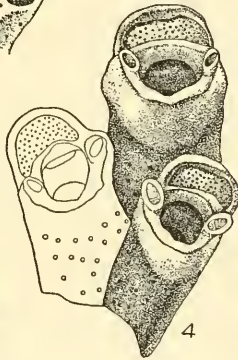
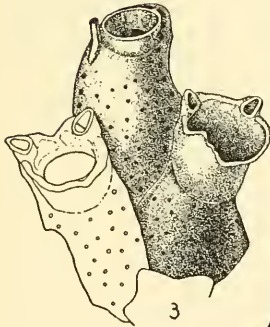
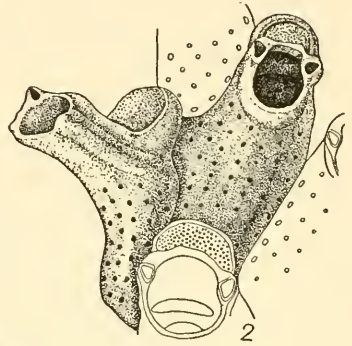
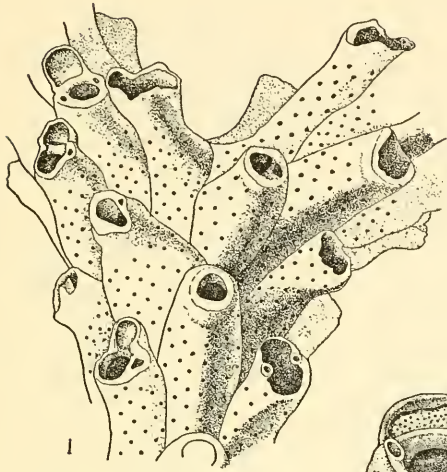
- Fig. 1. *Phylactella aperta* new species, zoecium, aperture and asymmetrical avicularium.
- Fig. 2. The same, ovicell and symmetrical avicularium.
- Fig. 3. *Phylactella alulata* new species, zoecium with tessellated frontal, aperture and median avicularium.
- Fig. 4. The same, ovicell.
- Fig. 5. The same, diagram of aperture, connecting tube of avicularian chamber and tessellated frontal of young zoecium.
- Fig. 6. *Lagenipora spinulosa* Hincks, zooecia, high peristome, avicularia and spines.
- Fig. 7. *Lagenipora mexicana* new species, zooecia of erect branch.
- Fig. 8. The same, aperture and ovicell.
- Fig. 9. *Lagenipora marginata* Canu and Bassler, uniserial zooecia with distinct margin and position of ovicell.
- Fig. 10. *Lagenipora lacunosa* Bassler, zooecia and ovicell.



## PLATE 60

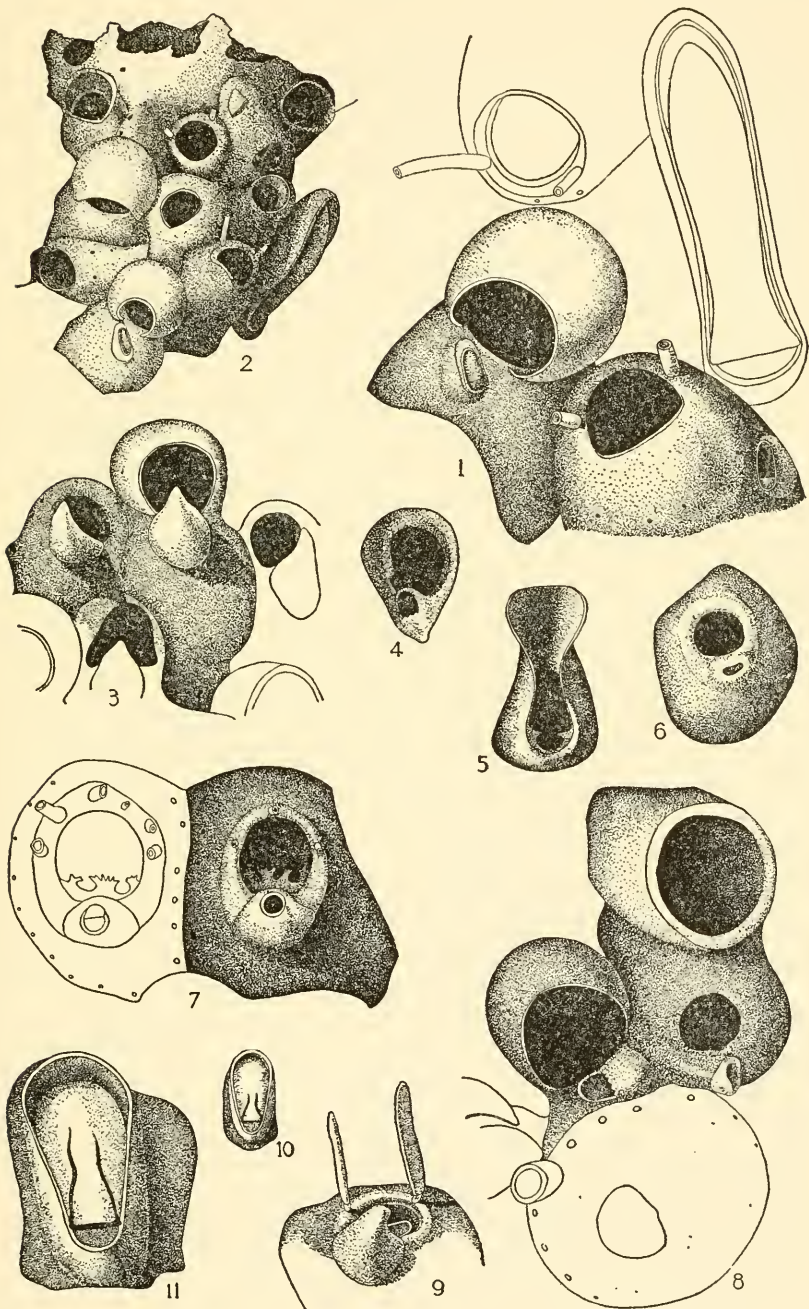
- Fig. 1. *Lagenipora punctulata* (Gabb and Horn), portion of erect branch, reduced  $\frac{1}{2}$ .
- Fig. 2. The same, showing tubular peristome and ovicells.
- Fig. 3. *Lagenipora socialis* Hincks, young zooecia.
- Fig. 4. The same, fully developed zooecia with ovicells.
- Fig. 5. *Lagenipora hippocrepis* (Busk), young zooecia with ovicell.
- Fig. 6. The same, diagram of side view.
- Fig. 7. *Trematoecia hexagonalis* (Canu and Bassler), zooecium with ovicell and spinous tubercles.
- Fig. 8. *Trematoecia porosa* (Canu and Bassler), zooecia showing form of aperture and minute frontal avicularium.
- Fig. 9. The same, young zooecium with partially developed ovicell and secondary cover; note also the minute suboral avicularium.





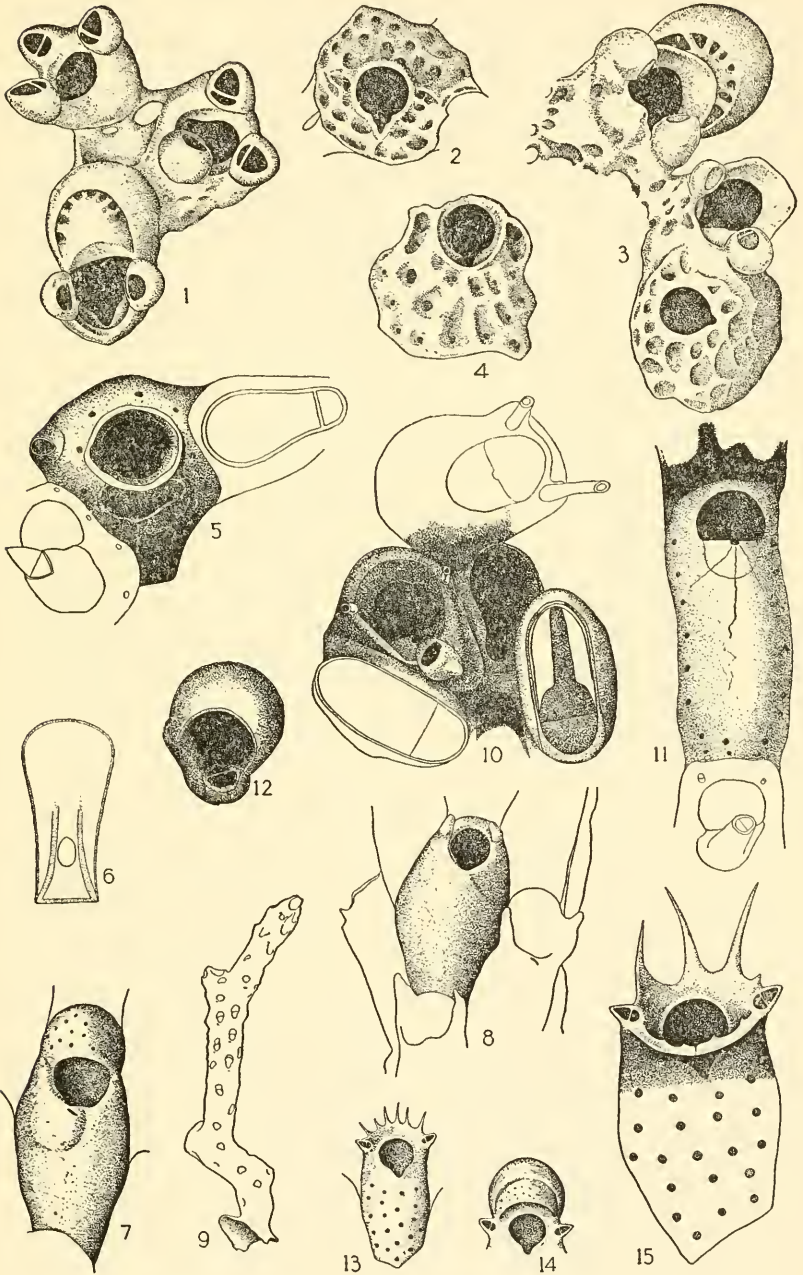
## PLATE 61

- Fig. 1. *Holoporella hancocki* new species, details of zooecia, ovicell, avicularia, and giant interzooecial avicularium.
- Fig. 2. The same, reduced one-half, showing irregularities in form and orientation of zooecia and side view of giant avicularium.
- Fig. 3. *Holoporella albirostris* (Smitt), zooecia with ovicell and high pointed avicularian umbo.
- Fig. 4. The same, a small umbonate process revealing the suboral avicularium with dentate beak.
- Fig. 5. The same, giant interzooecial avicularium.
- Fig. 6. The same, young zooecium, showing form of aperture.
- Fig. 7. *Holoporella tridenticulata* (Busk), details of zooecia, especially the denticulate border of the aperture.
- Fig. 8. *Holoporella peristomata* new species, zooecia, ovicell and large tubular extension of a peristome from a deeper layer.
- Fig. 9. The same, small avicularian umbo and flattened spines.
- Fig. 10. The same, small interzooecial avicularium.
- Fig. 11. The same, giant interzooecial avicularium.



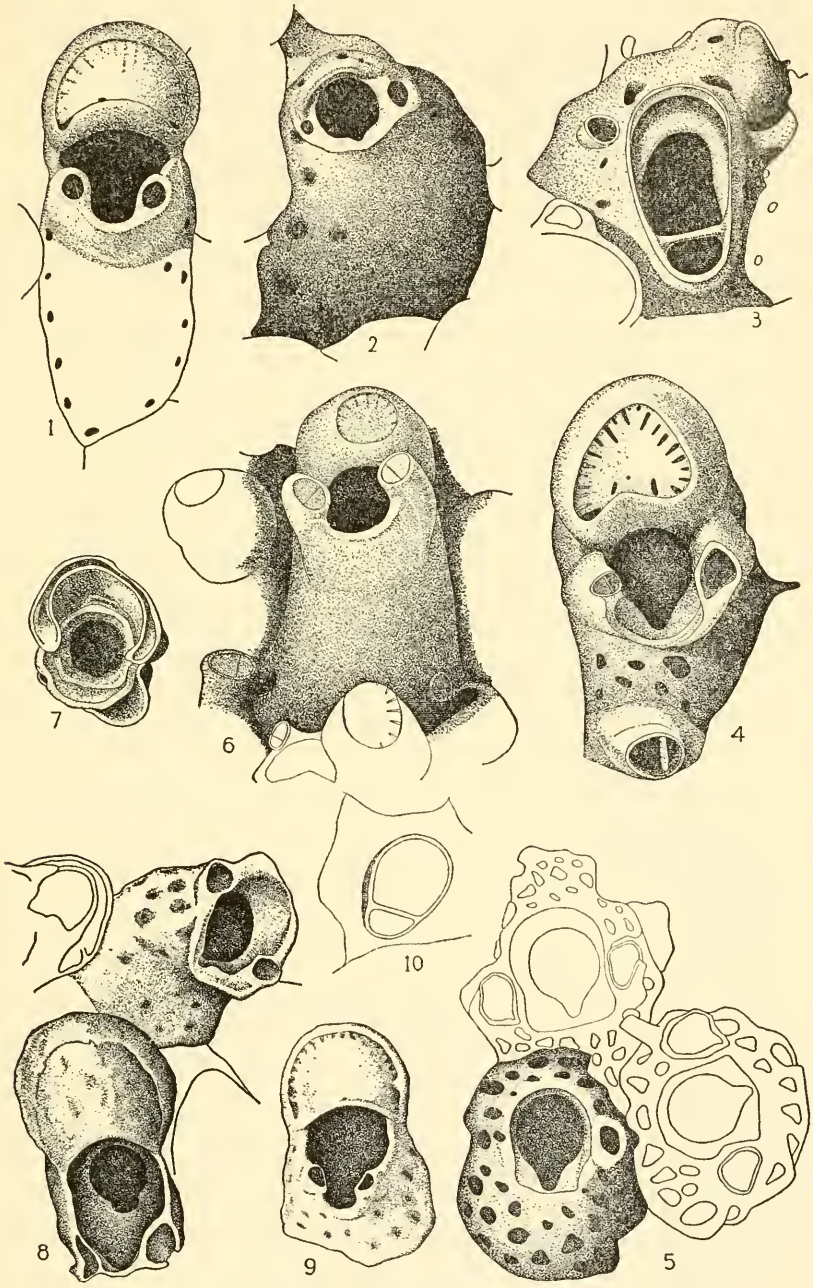
## PLATE 62

- Fig. 1. *Costazia robertsoniae* Canu and Bassler, zooecia and ovicell; note especially the median distal avicularium on infertile zooecia.
- Fig. 2. The same, young infertile zooecium, showing aperture and origin of avicularian chambers.
- Fig. 3. *Costazia costazi* (Audouin), zooecia and ovicell, only paired avicularia are present.
- Fig. 4. The same, young zooecium.
- Fig. 5. *Schizopora anatina* (Canu and Bassler), young zooecium, with three types of avicularia and developing chamber of suboral avicularium.
- Fig. 6. The same, mandible of giant avicularium.
- Fig. 7. *Schizopora margaritacca* (Pourtales), zooecium and ovicell.
- Fig. 8. The same, a portion of a branch, zooecium with tubercles and the position of the undeveloped avicularian chamber.
- Fig. 9. The same, diagram of erect branch, much enlarged.
- Fig. 10. *Holoporella brunnea* (Hincks), zooecia, aperture with proximal notch, suboral avicularium with dentate rostrum and giant avicularia with spade-shaped dark sclerite.
- Fig. 11. The same, very young marginal zooecium.
- Fig. 12. The same, ovicell.
- Fig. 13. *Lagenipora admiranda* new species, young infertile zooecium with frilled peristome and v-shaped sinus.
- Fig. 14. The same, ovicell.
- Fig. 15. The same, much enlarged to show the peculiar arch of the peristome above the aperture.



## PLATE 63

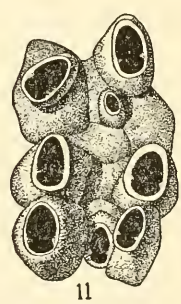
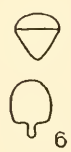
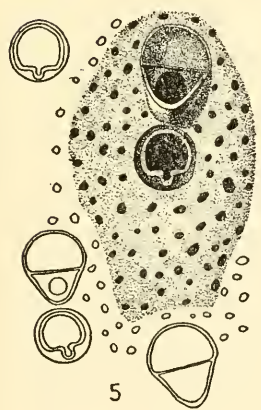
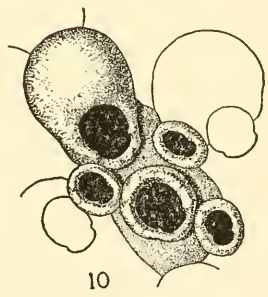
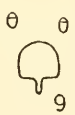
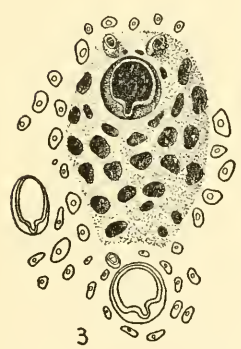
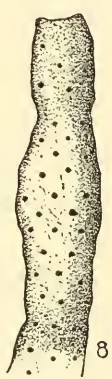
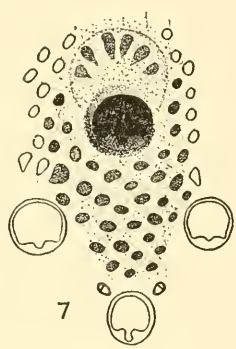
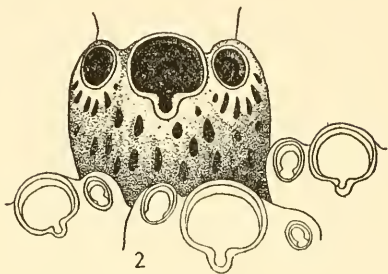
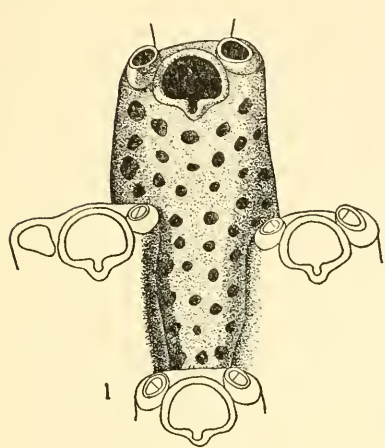
- Fig. 1. *Costazia surcularis* (Packard), zoecium with ovicell and lateral-oral avicularia.
- Fig. 2. The same, younger zoecium showing form of aperture.
- Fig. 3. The same, giant interzoecial avicularium.
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- Fig. 3. *Myriozoum subgracile* d'Orbigny, zooecium showing form of aperture and position of small paired avicularia.
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