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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.

BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 1, Cheilostomata-Anasca

(Plates 1-29)

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

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BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 1, Cheilostomata—Anasca

By Raymond C. Osburn, Ph.D., D.Sc.

A report based chiefly on the Bryozoa collected by the Allan Hancock Expeditions, 1933-1942, in the *Velero III*.

The ten cruises of the *Velero III* and shore collections extended from the coast of Oregon to San Juan Bay, Peru, and included the oceanic islands off the coast, Socorro, Clarion, Cocos and the Galapagos. Five visits were made to the Galapagos area, otherwise the most intensive collecting was done about the islands off southern California, southward along the coast of Lower California and in the Gulf of California, a total of more than 1500 dredge-stations and 2000 additional bottom samples.

Various other institutions have contributed Pacific coast specimens toward the completion of this work, usually local material. The United States National Museum has loaned the Bryozoa from a number of the "Albatross" stations and from the Alaska Crab Investigation. The American Museum of Natural History contributed a small amount of material from the "Albatross" expedition of 1911 along the coast of Lower California. The California Academy of Science gave free access to the Bryozoa collection, made chiefly by Dr. Alice Robertson. The Hopkins Marine Station at Pacific Grove, California, presented me with a large collection, mostly from that area, made by Miss Elizabeth A. Blagg. The Pacific Biological Station at Nanaimo, British Columbia; the Oceanographic Laboratory at Friday Harbor, Washington; the Pacific Marine Station at Dillon Beach, California; the Kerckhoff Marine Station at Corona del Mar, California; the Scripps Oceanographic Institution at La Jolla, California, and the Los Angeles County Museum have all aided by the contribution of specimens. Also Dr. Paul L. Galtsoff of the U. S. Fisheries and Wildlife Service has permitted me to study the Bryozoa on a collection of pearl oyster shells (*Margaritiphora mazatlanica*) from the Gulf of Panama, about 60 species. A large gap in our knowledge of the high northern species of the Pacific coast has been well filled by the contribution of 80 species from Point Barrow, Alaska, by

Professor and Mrs. G. E. MacGinitie of the Alaska Research Laboratory. To all of these the author is grateful for the opportunity to further our knowledge of the distribution of the Bryozoa of the Eastern Pacific area.

History

The Bryozoa of the Pacific coast of the Americas have received but little attention in the past, except in a few limited areas. The first record of species is that of Alcide d'Orbigny (Voyage l'Amérique Méridionale, 1841-7), who listed 14 species from the west coast of South America as far north as the coast of Peru but, unfortunately, due to incomplete descriptions and figures, some of his species cannot be determined positively. In 1856 Busk described and listed 15 species from Mazatlan, Mexico, and in 1857 Trask recorded 5 species from the vicinity of San Francisco. Fewkes in 1889 described *Clavopora (Ascorhiza) occidentalis* from southern California. A few other scattering records appear in the works of Busk, Hincks, Waters, etc.

In the years 1882-4 the first important study of Pacific Bryozoa appeared in Hincks' report on "Polyzoa of the Queen Charlotte Islands," the material having been collected by Dr. G. W. Dawson of the Canadian Geological Survey. In this report Hincks recorded about 95 species and varieties from the waters of British Columbia, many of them new.

Dr. Alice Robertson's important work began in 1899 with a short paper on the Entoprocta of San Francisco Bay, and this was followed in 1900 by a list of 36 species taken by the Harriman Alaska Expedition, but her greatest contribution was the series of three papers (1905, 1908 and 1910) on Bryozoa of the West Coast of North America. The area covered was practically that of the west coast of the United States from Puget Sound, Washington, to San Diego, California, though some more northern forms were discussed, a total of 98 species.

Dr. Chas. H. and Elsie O'Donoghue in 1923, "A preliminary list of Bryozoa from the Vancouver Island Region," listed 170 species and 22 varieties. This was followed in 1926 by a "Second List," in which the nomenclature was revised and 20 species added.

In 1930 there appeared two papers dealing with limited tropical areas. The first of these, "The Bryozoan Fauna of the Galapagos Islands," by Canu and Bassler, recorded 56 species, many of them new, from three dredge hauls made by the U. S. Str. "Albatross." The second, by Dr. Anna B. Hastings, "Cheilostomatous Polyzoa from the vicinity of Pana-

ma Canal collected by Dr. C. Crossland on the cruise of the S. Y. St. George," listed 62 species, 27 from the Gulf of Panama, 33 from Gorgona, Colombia, and 37 from the Galapagos Islands.

It appears that the only region of the Pacific coast that has been at all adequately covered is the area from Puget Sound to southern Alaska. Robertson apparently had very little dredged material at her disposal and the number of species along the coast of the United States recorded by her is limited almost entirely to shallow water forms. Of the several thousand miles of coast from southern California southward we have had no information except for the small areas covered by the papers of Hastings and Canu and Bassler. Similarly we have had only very limited knowledge of the bryozoan fauna from southern Alaska northward.

The very extensive material dealt with in the present report should give a fair picture of the occurrence of the coastwise Bryozoa of the Eastern Pacific area from northern Alaska to Peru. No doubt many species will be added in the future and certainly our knowledge of the distribution will be greatly increased.

Distribution

As might be expected, no sharp distributional barriers have been found; instead there are several areas which are more or less distinct in their faunas but which intergrade with the regions to the north and south. Still, when one considers a sufficient number of species from any one of the following regions, the bryozoan facies is distinct enough except where the boundaries overlap. There are some species which appear to disregard temperature and range from the arctic to the tropics.

1. The arctic area of the Pacific coast extends from Point Barrow, Alaska (71° 18′ N Lat.), the most northwesterly part of the North American coast, southward to the Alaska Peninsula and the Aleutian Islands. In the Bering Sea only a few scattering collections have been made, but all of the species are high northern or arctic forms. Our knowledge of this area has been recently much extended by the work of Professor and Mrs. G. E. MacGinitie of the Arctic Research Laboratory at Point Barrow. In the summer of 1948 they collected more than 80 bryozoan species, practically all of which are known to occur elsewhere in the North Polar seas. Several of these species extend their range southward to British Columbia and even to northern California.

2. A cool water region extends from the Alaska Peninsula southward to Point Conception, California (about 35° N Lat.). The northern part of this range is rather distinct from the southern portion, but so

many species are found through the whole area that no line of separation can be drawn. The more northern species tend to disappear south of Vancouver Island and the more southern ones at the same point, but Puget Sound and southern British Columbia show a great mixture, with even a few warm water species present. In spite of the latitude, there is cool water along the California coast, with occasional inlets where the temperature is somewhat higher.

3. A more temperate area extends from Point Conception and the northern Channel Islands off southern California to Cedros Island and Point Eugenia, half way down the peninsula of Lower California (27° 30′ N Lat.). In addition to numerous species characteristic of moderate temperature there is a great mixture, with some of the more northern species reaching their limit among the Channel Islands and an increasing number of tropical species south of the Mexican boundary.

4. The truly tropical area extends from Cedros Island and the same latitude (27° 30′) in the Gulf of California to the vicinity of San Juan Bay, Peru (15° 20′ S Lat.). Throughout this wide area there is much similarity in the bryozoan fauna and the great majority of the species are limited to tropical waters. Moreover, most of the species are found widely distributed along this coast and about the outlying islands (Socorro, Clarion and the Galapagos). No doubt there are endemic species which are limited to a narrow range, but it would be hazardous to predict this in any case, as continued dredging may recover them in unexpected areas. Species hitherto known only from the Galapagos Islands have been taken by the Allan Hancock Expeditions at various places along the mainland, even as far north as the coast of Mexico and the Gulf of California.

Acknowledgments

To Captain Allan Hancock, Director of the Allan Hancock Foundation, who through financial assistance has made possible this extended research, I owe a deep debt of gratitude. To Dr. Irene McCulloch of the Foundation, who has placed many facilities for work at my disposal and whose interest in the progress of the work has been an inspiration, I am also deeply thankful. Dr. Arthur D. Howard, Mr. John D. Soule, and Miss Mary G. Marsh have relieved me of much tedious sorting of material. I must here also record the valuable assistance of my friends, Dr. R. S. Bassler of the U. S. National Museum and Dr. Anna B. Hastings of the British Museum of Natural History; Dr. Bassler has given me access to valuable type material, Dr. Hastings has made numerous comparisons for me, and both have presented me with specimens important for this study.

Glossary

Many of the following list of terms have a special application in the Bryozoa and the beginner in this group may find the definitions useful.

Ancestrula. The primary individual of a colony, derived by metamorphosis from the free-swimming larva.

Aperture. The orifice through which the tentacles are protruded, usually closed by an operculum in the Cheilostomata.

Avicularium. A modified and usually much reduced individual of a colony, without a polypide and bearing a mandible. They may be vicarious (interzooecial) or dependent (borne on some part of a zooecium).

Cardelles. Lateral denticles in the aperture for the attachment of the operculum, often wanting in the Anasca.

Communication pore. See *Septulae* and *Dietellae.*

Costules. Radiating ridges forming the frontal pericyst in the Cribrimorpha, they are modified marginal spines.

Cribrimorphs. Zooecia with a costulate front (Cribrilinidae, etc.).

Cryptocyst. A calcified inward extension from the mural rim in the Anasca, often vestigial. Between it and the ectocyst is a space, the hypostege, which serves as a hydrostatic chamber when the tentacles are extended and withdrawn.

Cell. Old name for a zooecium.

Dietellae. Small cavities around the base of the zooecial wall, in which the communication pores are located.

Distal. In Bryozoa, directed toward the oral end of the zooecium.

Dorsal. The side of the zooecium opposite that on which the aperture is located.

Ectocyst. The chitinous membrane which covers the zooecium.

Endocyst. The thin membrane lining the zooecium and enclosing the body organs.

Endozooecial. Referring to a type of ooecium (ovicell) formed by the forward extension of the distal zooecial wall. (Compare with *Hyperstomial.*)

Front, frontal. The side of the zooecium on which the aperture is located.

Gymnocyst. The calcified area of the covering membrane in Anasca. It is usually limited to the proximal end and is often vestigial or wanting.

Gonozooecium. A modified zooecium specialized for reproduction.

Heterozooecium. An avicularium or vibraculum, a highly modified and usually much reduced individual of the colony, without polypide but

with powerful muscles to operate the mandible. They are sometimes vestigial.

Hyperstomial. Referring to external ovicells. These are often more or less embedded in the gymnocyst of the succeeding zooecium but careful dissection will show that they arise above the distal wall of the zooecium to which they belong.

Hypostege. A cavity between the ectocyst (frontal membrane) and the cryptocyst in the Anasca, the hydrostatic chamber.

Kenozooecium. A member of the colony in which there is no polypide and usually no aperture, such as the stalk segments of *Caulibugula,* the internodes of radicles, etc.

Lacunae. Pores between the costae of the cribrimorphs.

Lumen. A clear line or pore on the middle of a costule in the cribrimorphs.

Lucida. A clear area in a chitinized membrane such as the operculum or mandible.

Mandible. The chitinous movable part of an avicularium; it is homologous with the operculum of a zooecium.

Mural rim. The frontal edge of the side walls, often bearing spines in the Anasca.

Onychocellarium. An avicularium in which the mandible has lateral membranous expansions (winged).

Ooecium. Any structure containing the larva during its development; it may be either hyperstomial or endozooecial.

Operculum. A chitinous membrane which closes the aperture like a trap-door in the Cheilostomata. In the Anasca it is connected proximally with the frontal membrane.

Opesia. The large orifice beneath the frontal membrane of Anasca; often occupying nearly all of the frontal area.

Opesiule. A small perforation or notch in the cryptocyst for the passage of muscles to the ectocyst in Coilostega (e.g. *Thalamoporella*).

Ovicell. The same as *Ooecium.*

Pedunculate. Elevated on a stalk or pedicel, referring usually to avicularia.

Pericyst. A calcified frontal above the ectocyst in certain Anasca, usually formed by the fusion of marginal spines.

Peristome. An elevated rim around the aperture.

Polypide. That part of the individual freely movable within the body wall and including the tentacles and intestinal tract.

Pore chamber. See *Dietellae.*

Proximal. Directed toward the point of origin of the zooecium.

Radicle. A root-like structure in certain Anasca, serving for attachment, usually consisting of a series of kenozooecia.

Sclerite. A marginal or other thickening of the operculum or mandible.

Septulae. Very small communication pores in the zooecial walls; they are either scattered singly, or aggregated in groups (uniporous or multiporous rosette plates).

Spicule. A small spine without an internal canal.

Spine. A hollow projection, more or less elongate, either open or closed at the tip, marginal or oral.

Stolon. A creeping stem, consisting of kenozooecia, from which zooecia may arise.

Tentacles. Long ciliated projections around the mouth, serving to direct the food.

Umbo. A prominence on the frontal area usually a short distance proximal to the aperture (in the Anasca usually limited to the Cribrimorpha).

Unguiculate. Shaped like a claw or talon.

Vibraculum. A highly modified avicularium, in which the long lash-like mandible can be moved in various directions.

Vicarious. Referring to avicularia occupying a place in the zooecial series (interzooecial).

BRYOZOA Ehrenberg 1831

This is a very distinct phylum of the Invertebrata, separated by a number of important characters. The name was suggested by the erect, moss-like appearance of the colonies of some of the species, but as a matter of fact, most of the species are encrusting and more like lichens than mosses in their manner of growth. The term "Polyzoa," which is still in use by English authors, was applied in 1830 by J. V. Thompson and thus antedates Ehrenberg's name for the group, but has been generally discarded on the ground that Thompson did not use this term as a class name.

Cori (1929) separated the Entoprocta from the Bryozoa to form a distinct phylum Kamptozoa. Whether this arrangement will finally be accepted or not need not concern us here, as the bryozoologists will no doubt continue to include them in their studies.

With a few exceptions among the Entoprocta, the Bryozoa are highly colonial, budding in various ways (terminal, lateral, dorsal, frontal, stolonate) to produce colonies which frequently consist of many thousands

of individuals. The individuals (usually less than a millimeter in length) are provided with a calcified or chitinous outer wall (zooecium) into which the lophophore and tentacles are retractile (in the Entoprocta the polypide is naked and the tentacles are simply rolled inward). The great majority of the species are marine, distributed from the polar regions to the tropics and from the shore line down to great depths. They are abundant as fossils from the Ordovician to Recent time.

Classes of the Bryozoa

Polypide naked, stalked; tentacles rolled inward, not withdrawn into the zooecium; anal opening within the tentacle ring. . . . . ENTOPROCTA

Polypide enclosed in a chitinous or calcified wall (zooecium); tentacles retractile; anal opening outside of the tentacle ring. . . . . ECTOPROCTA

Orders of the Ectoprocta

Mostly marine, with a circular tentacle ring. . GYMNOLAEMATA

Fresh-water Ectoprocta, with a horse-shoe shaped tentacle ring. . . . . PHYLACTOLAEMATA

Suborders of the Gymnolaemata

1. Zooecium chitinous, its opening usually circular, closed by a puckering membrane . . . . . CTENOSTOMATA
2. Zooecium calcified, its opening circular, not closed by an operculum. . . . . CYCLOSTOMATA
3. Zooecial walls usually well calcified, opening by a movable opercular valve like a little trap-door. . . . CHEILOSTOMATA

Suborder CHEILOSTOMATA Busk, 1852

The cheilostomes form the dominant group among the recent Bryozoa. The zooecia are chitinized and usually calcified, often heavily so. In all but a few cases there is a chitinized operculum which operates like a trap-door to open and close the aperture through which the tentacles are extruded and withdrawn.

Hydrostatic apparatus. As the walls are rigid, compensation is necessary for the changes in internal pressure when the tentacles are protruded or withdrawn and this is accomplished by two methods: 1. there is a membranous area on the front of the zooecium which rises and falls with the changes in pressure (Anasca); 2. when the front is solidly bridged over (Ascophora), there is an internal water sac (compensation sac or compensatrix) which fills and empties through a special pore.

Communication pores. For physiological communication between adjacent individuals there are minute pores in the lateral and distal walls. These are of three kinds: 1. uniporous septulae which are arranged in a row or scattered; 2. multiporous septulae, in which case the pores are aggregated in small rounded areas known as "rosette plates;" 3. dietellae or "pore chambers," which are in the form of small cavities at the base of the vertical walls and within which the pores are located.

Polymorphism. This a common feature of this group and various names have been given to the different types of individuals: 1. autozooecia to the ordinary nutritive members of the colony; 2. gonozooecia to those specially modified for reproduction; 3. heterozooecia and kenozooecia to those modified for other functions of the colony (see glossary).

Ovicells. Ooecia or ovicells are usually present, though in some cases the eggs develop to the swimming larval stage within the zooecial cavity. Endozooecial ovicells are internal extensions of the distal wall to form small chambers, with the opening below the operculum; usually they are inconspicuous, but may be quite evident externally. Hyperstomial ovicells are developed above and distal to the aperture, usually reposing on the base of the next zooecium, and the orifice opens above the distal zooecial wall.

Avicularia and vibracula. These are highly modified and usually much reduced individuals of special function, serving as zooecial or colonial organs (see glossary).

Levinsen (1909) subdivided the Cheilostomata into the Anasca, which have a membranous frontal area and no compensatrix, and the Ascophora which have a rigid frontal area and in which the compensatrix regulates the internal water pressure.

ANASCA Levinsen, 1909

Levinsen (1909:91) defined the "Suborder Anasca" as follows: "A compensation sac is wanting, and the front wall is either wholly or in part membranaceous, or calcareous, depressed and surrounded by raised margins. In the heterozooecia the opercular and the subopercular areas are as a rule not separated by a continuous calcareous bar, but only partially by the hinge-teeth of the operculum." At the same time he set up three divisions: Malacostega, Coilostega and Pseudostega.

The Malacostega, Division I, was defined, "The individual zooecia are plainly marked off on the surface of the colony. The frontal wall quite or partially uncalcified and the operculum as a rule a membranous valve, the rim of which is chitinized, but which proximally passes over

into the frontal membrane." He included in the Division the families Aeteidae, Bicellariidae, Farciminariidae, Scrupocellariidae, Flustridae, Membraniporidae, and Cribrilinidae. It is quite evident that Levinsen included too wide a range of anascan forms within the division and Harmer later (1926) removed all but Levinsen's "Membraniporidae" and "Flustridae" to other divisions and arranged them in the following manner:

Division I. Inovicellata Jullien, 1888, Family Aeteidae.
II. Malacostega Levinsen, 1909, Membraniporidae, Flustridae and their allies.
III. Coilostega Levinsen, 1909, the Opesulidae of Jullien and related families.
IV. Pseudostega Levinsen, 1909, Cellariidae.
V. Cellularina Smitt, 1867, Scrupocellariidae, Bicellariellidae and related forms.
VI. Cribrimorpha Harmer, 1926, Cribrilinidae.

This arrangement has generally been accepted by later authors.

Still more recently Silen (1942:56), has set up another arrangement of the anascan groups, and introduced two new "sections." It is quite possible that his system may be nearer the truth, but as all of the species dealt with in this report fall within the scope of Harmer's system, that arrangement will be followed.

Division I **INOVICELLATA** Jullien, 1888

The zoarium is creeping, adnate and stolon-like. At intervals there are swollen, spindle-shaped enlargements, from each of which rises an erect zooecial tube with an operculum like a minute trap-door at the upper end. The zooecium consists of both the erect tube and the basal enlargement, as the polypide extends into both of them. There are no avicularia, vibracula, spines, nor permanent ovicells, though temporary membranous ovicells may be present until the eggs have undergone at least a part of the larval development. Polypide regeneration may occur, in which case a new "head" with a new operculum extends beyond the primary zooecial tube. One family and one genus in this Division.

Family **Aeteidae** Smitt, 1867
Genus **Aetea** Lamouroux, 1812
Genotype, **Sertularia anguina** Linnaeus, 1758:816

KEY TO THE SPECIES

1. Zooecial tube coarsely wrinkled or corrugate. . . . . *ligulata*
   Zooecial tube very finely or not all annulate. 2
2. Erect tube entirely without annulations. . . . . *truncata*
   Very fine annulations present 3
3. Terminal expansion spoon-shaped, base not annulated. . . *anguina*
   Terminal expansion narrower, basal expansion also finely annulated . . . . . *recta*

Aetea anguina (Linnaeus), 1758
Plate 1, fig. 3

Sertularia anguina Linnaeus, 1758:816.
Aetea anguina, Robertson, 1905:244.
Aetea anguina, O'Donoghue, 1926:39.
Aetea anguina, Hastings, 1930:702.

This little creeping species is practically cosmopolitan and has been listed in nearly every paper dealing with shorewise Bryozoa in the temperate and tropical regions.

The stolonate portion adheres to stems of hydroids, algae, other bryozoans and occasionally to shells and pebbles. The erect tube is often bent or curved snake-like and the expanded terminal portion has somewhat the shape of a snake's head, so that Ellis in 1755 named it the "snake coralline." The "head," stalk and basal portion all appear to be very finely punctate and the stalk finely annulated. It must be noted, however, that there are no punctations but instead there are minute tubercles which, under transmitted light, appear to be punctures. A flat membranous area occupies one side of the "head" and at the distal end of this area is the operculum which is also thickly "punctate." The ovicell is rarely observed, and apparently it is quite evanescent. I have found it on a few occasions with the embryo surrounded by a very delicate membrane which evidently disappears after the discharge of the ciliated larva.

Robertson noted its presence at San Pedro and San Diego, California; O'Donoghue recorded it from Puget Sound, and Gabriola Pass, British Columbia, and Hastings listed it from the Galapagos Islands. On the east coast of the Americas it is a common species from Maine (Osburn 1933:18) to Brazil (Marcus 1937: 26). Cosmopolitan.

In the Hancock Expeditions it was found at numerous stations from Oregon to Peru and the Galapagos Islands, from the shore line down to about 30 fathoms.

Aetea recta Hincks, 1861
Plate 1, fig. 2

?*Hippothoa sica,* Couch, 1841:102. (Unidentifiable.)
Aetea recta, Hincks, 1880:6.
Aetea sica, Osburn, 1914:186; 1927:124.
Aetea sica, Marcus, 1937: 28.
Aetea recta, Osburn, 1940:346.

Resembling *A. anguina* in appearance, but the "head" is narrower and the whole erect portion is straighter. The operculum is set more transversely across the end of the tube and the basal portion is annulated with the fine "punctations" like the stalk.

Couch may have had this species, but as Hincks points out (1880:7, footnote), the description was drawn from an imperfect specimen, which is entirely unidentifiable and Couch placed the species in the genus *Hippothoa.*

A. recta occurs on the coast of Europe from Norway southward and on the eastern American coast it has been reported from the Tortugas Islands, Florida and the Caribbean Sea (Osburn), and from the Bay of Santos, Brazil (Marcus). It seems not to have been noted on the Pacific side of the Americas.

Hancock Stations: 325-35; 333-35; 545-36; 1012-39; 1271-41; 1281-41 and 1295-41, from the islands off southern California, the Gulf of California and Galapagos Islands, from the shore down to 80 fathoms. Also from the San Juan Islands, Puget Sound, Dr. J. L. Mohr, collector.

Aetea truncata (Landsborough), 1852
Plate 1, fig. 1

Anguinaria truncata Landsborough, 1852:288.
Aetea truncata, Robertson, 1905: 246.
Aetea truncata, O'Donoghue, 1923:16; 1926:40.
Aetea truncata, Hastings, 1930:702.
Aetea truncata, Osburn, 1947:8.

The erect tubules are straight, truncate at the tip and vary widely in height. Both the erect and basal portions are very delicately "punctate," but lack entirely the minute annulations of *anguina* and *recta.*

It is a very widely distributed species, known from the coasts of Europe, the Indian Ocean, the western Pacific from Japan to Australia, the western Atlantic from Nova Scotia to Brazil, and on the American Pacific from British Columbia to the Galapagos Islands.

Hancock Stations: dredged at 66-33, Albemarle Island, Galapagos; 391-35, Lobos de Afuera Islands, Peru; off Octavia Rocks, Colombia; 998-39, 1155-40 and 1407-41, Santa Catalina Island, and 1271-41, Anacapa Island, southern California, 10 to 36 fms. Common along shore.

Aetea ligulata Busk, 1852

Plate 1, fig. 4

Aetea ligulata, Hincks, 1884:2.
Aetea fuegensis Jullien, 1888: 1.25.
Aetea crosslandi Waters, 1910: 253.
Aetea ligulata, Marcus, 1937:30.
Aetea sica, Canu and Bassler, 1928:51.
Aetea ligulata, Osburn, 1940:347.

The erect portion of the zooecium is straight and the "head" but little wider than the stalk. The stalk is coarsely wrinkled or corrugated, quite different in appearance from the fine annulations of *anguina* and *recta* in which the appearance of annulation is produced by the arrangement of minute tubercles ("punctations"); the basal portion is also sometimes wrinkled, and both basal and erect portions are also finely "punctate."

Silen (1941:12) has described another species (*A. boninensis*) from the Bonin Islands, which has a similarly corrugated stalk, but the head is widely expanded and the basal portion smooth.

A widely distributed species recorded from Patagonia and the Straits of Magellan (Busk), Queen Charlotte Islands, British Columbia (Hincks), Terra del Fuego (Jullien), Red Sea (Waters), Bay of Santos, Brazil (Marcus), Caribbean Sea (Osburn), and Magdalena Bay, Lower California (Osburn).

In the Hancock collections it occurred commonly along shore and about the islands of southern California, and was dredged also at the following stations: 132-34 and 924-39, Socorro Island; 155-34, Albemarle Island, 170-34, Chatham Island and 179-34, Bartholomew Island, Galapagos; 411-35, Gorgona, Colombia; and 531-36, San Francisquito Bay, Lower California. Also, Gulf of Panama, Galtsoff collection on pearl oysters.

Division II MALACOSTEGA Levinsen, 1909

This Division, according to Levinsen, is "characterized by retaining the original frontal membrane in its primitive form and by having the operculum incompletely differentiated from this membrane." Harmer (1926:187) includes the families Scrupariidae, Membraniporidae, Flustridae, Onychocellidae, and Lunulariidae. Bassler (1935:22-25) removes the Onychococellidae and Lunulariidae to the Coilostega and separates out from the Membraniporidae the following families: Electrinidae d'Orbigny, Hincksinidae Canu and Bassler, Alderinidae Canu and Bassler, Hiantoporidae MacGillivray, and Arachnopusiidae Jullien.

It is quite apparent that much more study will be required before a completely satisfactory classification can be established. The great difficulty in arriving at a proper taxonomic arrangement lies in the fact that usually we cannot as yet determine the evolutionary relationships between groups of species, and this difficulty extends throughout the whole phylum.

In the Malacostega it has generally been assumed that the genus *Membranipora* is basic because of its simplicity, though recently Harmer (1926:197) and Silen (1942:55) have given the Scrupariidae a more primitive position. It is true that in the genus *Membranipora* (*sens. str.*) there is a vestigial cryptocyst and gymnocyst, no true spines, no avicularia and no ovicells, but at the same time it has as a special character, a twinned ancestrula. In the Scrupariidae the zoarium is erect and the zooecia are tubular, which may be the primitive form of the zooecium and they also lack avicularia and spines. On the other hand *Scruparia* possesses hyperstomial ovicells which appear to be a specialization. Has *Membranipora* become secondarily simplified by the loss of structural characters? Has *Scruparia* developed a hyperstomial ovicell similar to that of other cheilostomes by parallel evolution? Are the tubular zooecium and erect zoarium primitive as Silen argues; what evidence we have from paleontology appears to be against it. This is a sample of the numerous problems involved in bryozoan taxonomy and at present the best we can do is to list the families and genera in what appears to be the order of complexity as a mark of increasing specialization.

Key to the Families of the Division Malacostega

1. Zoaria erect, uniserial or biserial, no avicularia. . . Scrupariidae
   Zoaria usually encrusting; if otherwise they are multiserial. . . 2
2. Ovicells entirely absent. 3
   Ovicells present, hyperstomial or endozooecial. 4
3. Gymnocyst wanting or very slightly developed. . Membraniporidae
   Gymnocyst well developed. . . . . Electrinidae

4. Ovicell endozooecial. . . . . Hincksinidae
   Ovicell hyperstomial. 5
5. Frontal membrane exposed, not covered by a pericyst. . . . 6
   Frontal membrane more or less covered by a pericyst, appearing like an ascophoran. 7
6. Ovicell elevated, a wide-open hood; mural rim thin and flared outward; strong distal spines. . . . . Chapperiidae
   Ovicell more complete; mural rim not flared outward; spines variable. . . . . Alderinidae
7. Pericyst developed from an enlarged spine and with 2 to 4 central pores. . . . . Hiantoporidae
   Pericyst with numerous large pores. . . . . Arachnopusiidae

Family **Scruparіidae** (Busk, 1852), Harmer, 1926

Busk established the family Scruparіidae for *Scruparia,* but included also the genera *Hippothoa, Aetea,* and *Beania* which are quite unrelated even to each other. Harmer (1926:197) limits the family to the genera *Scruparia, Eucratea* (*Gemellaria*), and *Brettia.*

"The family is characterised by the erect, frequently uniserial habit of its members, by the tendency of the zooecia to have a tubular form (perhaps a primitive feature), and by the correlated restriction of the opesia to a part of the frontal surface. Hyperstomial ovicells occur in some species, but there is no evidence that avicularia have been evolved in the family" (Harmer, 1926:197).

Key to the Genera

1. Zoarium with a creeping base and erect branches; zooecia uniserial; budding at the distal end and on the frontal immediately proximal to the opesia; ovicell hyperstomial on a dwarfed zooecium. . . . . *Scruparia*
2. Zooecia uniserial, budding usually in pairs on the dorsal side at the distal end. . . . . *Brettia*
3. Zooecia biserial, back to back; branches arise from the sides of the zooecia near the distal end. . . . . *Eucratea*

Genus **SCRUPARIA** Oken, 1815

Zoarium primarily creeping, adnate to algae and stems of hydroids and other Bryozoa, etc., but erect branches are often abundant. Zooecia tubular, nearly transparent, narrow at the proximal end where they are often slightly wrinkled, widening gradually toward the distal end. The

oval opesia occupies about half of the frontal surface. No avicularia. Ovicell hyperstomial, borne on a somewhat reduced zooecium. Genotype, *Sertularia chelata* Linnaeus, 1758.

Scruparia ambigua (d'Orbigny), 1841

Plate 1, fig. 5

Eucratea ambigua d'Orbigny, 1841: pl. 3, figs. 13-17; 1847:11.
Eucratea chelata, Robertson, 1905:248.
Eucratea chelata, O'Donoghue, 1926:42.
Scruparia chelata, Hastings, 1930:702.
Scruparia ambigua, Hastings, 1941:470.

Zoarium creeping, with erect branches; the creeping base consisting of zooecia (no stolon). The proximal end of the zooecium is tubular and gradually expanding; the opesia occupying one-third to one-half of the zooecial length and nearly parallel to the dorsal surface. Budding takes place either dorsally at the distal end or frontally immediately proximal to the opesia, the latter giving rise to erect branches.

The ovicell is hyperstomial, the fertile zooecium only slightly reduced.

This species has been much confused with *S. chelata* (Linnaeus) and Dr. Anna B. Hastings has pointed out the differences (1941). In *chelata* stolons are present, the opesia is set at a rather sharp angle to the dorsal wall, the zooecia are shorter and not so slender, and the fertile zooecia are more modified, with a much reduced opesia.

D'Orbigny described the species from the Falkland Islands (Iles Malouines), and Hastings shows that it has a very wide distribution around the world. Robertson recorded it as *Eucratea chelata* from the coast of southern California; Hastings listed it from the Galapagos Islands; O'Donoghue found it at Union Bay, Vancouver Island region, which is the northernmost record for the Pacific coast.

In the Hancock collections it is a common form about the islands off southern California and along the coast of the mainland, from low tide mark down to 150 fathoms.

Genus **BRETTIA** Dyster, 1858

The zoarium is erect and branching, the branches usually arising in pairs near the distal end on the dorsal side of a zooecium and facing in the same direction. The zooecia are uniserial, subtubular and elongate, with the opesia subterminal. In the genotype (*B. pellucida* Dyster) there are small spines, but this is not a constant character in the genus. No ovicells nor avicularia.

Brettia pellucida Dyster, 1858

Brettia pellucida, O'Donoghue, 1923:17.

Zoarium erect. The zooecia are transparent, chitinous, tubular, narrow at the base and rather evenly enlarged toward the distal end which is somewhat rounded. The opesia is parallel with the frontal surface, near the distal end, and is surrounded by 6 or 8 short spines which bend somewhat over the aperture. Daughter zooecia arise singly or in pairs from the distal end of the dorsal side.

O'Donoghue has recorded this species from Northumberland Channel and Departure Bay, British Columbia. Otherwise it is known from England. It did not appear in the Hancock collections.

Brettia tubaeformis Hincks, 1880

Brettia tubaeformis, O'Donoghue, 1923:17 and 1926:42.

The zoarium is erect, attached by radicles. Zooecia transparent, tubular, somewhat trumpet-shaped with a rounded opesia set at an angle to the axis of the zooecium. The aperture is surrounded by 8 or 10 short spinules which do not bend over the opesia.

Hincks recorded the species from the British Isles. O'Donoghue lists it from Cape Ebenshaw, Cape Lazo, and Ruxton Pass, British Columbia. Not taken in the Hancock collections.

Genus **EUCRATEA** Lamouroux, 1812

Gemellaria, Savigny, 1826, of most authors.

Harmer (1923:307 and 310) has straightened out the synonymy of this genus and indicates that *Gemellaria loricata* (*Sertularia loricata* Linnaeus, 1758) is the genotype.

There is a question whether this genus should be placed in the Scrupariidae, but its presence in any other known family would be even more questionable.

Eucratea loricata (Linnaeus), 1758

Plate 1, figs. 6 and 7

Sertularia loricata Linnaeus, 1758: 815.
Gemellaria loricata, Hincks, 1884:3.
Gemellaria loricata, Robertson, 1900:224.
Gemellaria loricata, O'Donoghue, 1923:17.

The zooecia occur in pairs, back to back, and branches arise from the sides of the zooecia near the distal end. The proximal end of the zooecium is tubular and gradually expanding, the opesia occupies about half the zooecial length and slopes downward to the distal rim. There are no ovicells, spines nor avicularia. The zoaria form bushy colonies sometimes nearly 100 mm in height, of a light yellowish color.

It is circumpolar in distribution and ranges down the Atlantic coasts of Europe to France and to Cape Cod in North America. On the Pacific coast it extends to southern British Columbia. Furthermore, Marcus (1937:31) has taken it at Santos, Brazil, the only positive record for the southern hemisphere, and Norman (1909:238) reported it questionably from Madeira.

Hincks and O'Donoghue listed it from a number of localities in British Columbia, Robertson from Prince William Sound and Juneau, Alaska, and Osburn (1923) from Point Barrow, Alaska.

In the Hancock collections there are specimens from Kodiak, the Pribilof Islands and Point Barrow, Alaska.

Family **Membraniporidae** Busk, 1854

There has been much dispute in regard to this family and it is difficult to draw a diagnosis. In general the simplicity of its members is the most striking character. The opesia is nearly as large as the zooecial front and the frontal membrane covers the whole surface; the gymnocyst is wanting or much reduced except in *Desmacystis;* the cryptocyst varies from scarcely discernible to filling half of the opesia; ovicells are entirely wanting; avicularia are wanting in most of the species, but incipient vicarious avicularia, little modified and as large as the zooecia, are found in a few species; in *Desmacystis* there is a median frontal avicularium, and in *Cupuladria* there are highly specialized vibracula. Mural spines are wanting, but tubular processes or low tubercles may be present at the distal corners.

Key to the Genera of Membraniporidae

1. Zoarium free, cupuliform, long vibracula present. . . *Cupuladria*
   Zoarium attached, encrusting or erect. 2
2. Gymnocyst covering proximal half of zooecium, a median avicularium proximal to the opesia. . . . . *Desmacystis*
   Gymnocyst wanting or little developed. 3
3. Triangular open areas, or triangular or rounded knobs on the basal corners, developed on a small gymnocyst. . . *Conopeum*

Knobs or tubular spines, if present, developed usually by the folding of the distal rim, gymnocyst usually wanting. . . . . *Membranipora*

Genus MEMBRANIPORA Blainville, 1830

Biflustra d'Orbigny, 1852.
Nitscheina Canu, 1900 (*Nichtina* by error, according to Canu).
Acanthodesia Canu and Bassler, 1920.

Blainville erected the genus *Membranipora* to include 6 species all of which, except *membranacea* Linnaeus, have been placed elsewhere, leaving *membranacea* as the genotype.

Canu, under the impression that *Membranipora* was not properly founded, replaced it by *Nitscheina* (*Nichtina* by a printer's error) with *M. membranacea* as the genotype.

Biflustra d'Orbigny was not figured; the description is unrecognizable, was apparently meant to include bilaminar forms, and has been discarded.

Canu and Bassler separated *Acanthodesia* from *Membranipora* or *Nitscheina* (*Nichtina*) by the following diagnosis: "No ovicell. The opesium is garnished laterally by small spinous processes and inferiorly by a serrate denticle. Fifteen tentacles." The description was based on *Flustra savartii* Audouin as the genotype and no other species included. Since 1920 Canu and Bassler, Harmer, Hastings, Marcus and Osburn have added numerous species with the lateral cryptocystal spinules.

Borg (1931:1-30) has thoroughly investigated the status of *Flustra membranacea* Linnaeus and the species with which it was confused by older authors and concludes that *Membranipora* is a good genus with *membranacea,* as now understood, as the genotype, an opinion with which the present writer is in accord.

With *Biflustra* and *Nitscheina* discarded, the only question that remains is that of the status of *Acanthodesia* and, frankly, I am unable to draw any definite line between *Membranipora* and *Acanthodesia,* though if there were not a continuous series of intergradations between *membranacea* and *savarti* the distinction would be clear enough.

1. Both species have twinned ancestrulae.
2. Mural spines are wanting in both.
3. The gymnocyst is wanting or vestigial.
4. The cryptocyst is well developed in *savarti* and barely visible in *membranacea,* but other species show all the intermediate conditions and the proximal dentate tooth of *savarti* is frequently wanting on both

the erect and the encrusting stages. The spinules margining the inner edge of the cryptocyst are variable in the extreme; rarely seen in *membranacea*; in other species there may be a few small ones, a few larger ones, or they may be numerous along the sides to the level of the operculum; sometimes they fringe the edge of a broad cryptocystal shelf.

5. The generic description of *Acanthodesia* indicates only two differential characters, the proximal dentate tooth and the lateral cryptocystal spinules, both of which are frequently wanting on the erect stage and especially on the encrusting stage of the genotype *A. savarti*. Furthermore the erect character of *savarti* cannot be considered of much importance since the zoarium is often broadly encrusting and some other species which have been placed under *Acanthodesia* may rarely develop bilaminate folds or frills.

As a result of the above analysis I feel obliged to return the species of *Acanthodesia* to *Membranipora*. It is a question of retaining *Membranipora* for the whole series or of placing them all under *Acanthodesia*, unless some more positive differential character can be determined. As *Membranipora* appears to be properly established, *Acanthodesia* must go into synonymy.

Key to Species of *Membranipora*

1. Cryptocyst narrow or wanting. 2
   Cryptocyst better developed, usually extending forward around the aperture. 5
2. Cryptocyst wanting, rarely a trace; tubular distal short spinous processes. . . . . *membranacea*
   Cryptocyst present forming a narrow shelf. 3
3. Cryptocyst smooth; no tubercles; thick brownish ectocyst . *pachytheca*
   Edges of cryptocyst serrate. 4
4. Frontal membrane with chitinous spinules; distal spines long, acute, the bases often calcified. . . . . *villosa*
   Only the distal spines present, short and tubular . . *serrilamella*
5. Distal tubercles heavily calcified, often fused across the middle, sometimes spine-like. . . . . *tuberculata*
   Tubercles, if present, low rounded knobs. 6
6. A flat shelf extends inward from the edge of the descending cryptocyst. 7
   The descending cryptocyst only, with a few spinules. 8
7. Cryptocyst very broad and evenly developed on the sides, with long, evenly distributed spinules. . . . . *hastingsae*
   Cryptocyst broad proximally, very irregular, with spinules of various sizes and forms. . . . . *tenuis*

8. Zoarium encrusting only, a pair of low distal tubercles, operculum with dark brown border. . . . . *fusca*
   Zoarium erect from encrusting base; no tubercles. 9
9. Erect part of zoarium forming complex bilaminate frills, zooecial walls thin, proximal cryptocyst narrow. . . . *perfragilis*
   Narrow, ligulate or forked, bilaminate erect branches, or encrusting; proximal shelf broader, walls heavier. . . . *savarti*

Membranipora membranacea (Linnaeus), 1767

Plate 1, figs. 8 and 9

Flustra membranacea Linnaeus, 1767:1301.
Membranipora membranacea, Hincks, 1884:11.
Membranipora membranacea, Robertson, 1908:267.
Membranipora membranacea, O'Donoghue, 1923:26.

The zoarium encrusts almost any object that will afford attachment, though the surfaces of the broader algae are the usual habitat and here the colonies may cover several square inches. The zooecia are very simple in structure, especially in younger and rapidly proliferating colonies. Characteristically they are elongate-quadrate and straight, with very thin walls and the opesia occupy the whole frontal surface. The gymnocyst and cryptocyst are wanting (vestigial) and there are no avicularia and no ovicells. At each distal corner there is usually a knob or process which appears to be formed by a fold of the terminal wall as the distal side is membranous in younger stages. Occasionally these knobs may be produced into hollow tubes or pointed short spinous processes. Not infrequently there appears on the frontal membrane, a tall membranous tube, as much as 0.50 mm high, closed at the end, the "tower cells," or "Thurmzooecien" of Nietsche. What may be the function, if any, of these structures, unique among the Bryozoa, is still a question, though they may be homologous with the large chitinous spines of *M. villosa.* (Pl. 1, fig. 11).

It has been reported from various regions around the world, though with what certainty it is difficult to determine. Definitely it occurs on the coasts of Europe, along the Atlantic coast of North America south to the Caribbean Sea, and on the Pacific coast. It is fairly common along the shores of southern California. Hincks listed it from the Queen Charlotte Islands and O'Donoghue from Ucluelet, British Columbia, and Robertson recorded it from Alaska, Puget Sound, and California.

Hancock Stations: 1370-41 and 1406-41, Catalina Island, California, and 287-34, Cedros Island, Lower California. Abundant on the larger frondose algae along the California coast.

Membranipora villosa Hincks, 1880

Plate 1, figs. 10 and 11

Membranipora villosa Hincks, 1880a:84.
Membranipora villosa, Robertson, 1908:268.
Membranipora villosa, O'Donoghue, 1923:26; 1926:29; 1926:250.

The zoarium is encrusting, especially on the larger kelps, the colonies often coalescing to cover considerable areas. The zooecia are of moderate size, thin-walled; the gymnocyst is wanting or limited to the proximal corners; the cryptocyst narrow proximally and laterally, finely crenulate and often with a few minute spinules; the opesia occupying practically all of the front. A characteristic feature is the chitinous spinules; minute spinules arise on the frontal membrane almost anywhere except on the operculum; slightly larger ones, often nearly as long as the width of the zooecium, arise just within the lateral margins; a still larger and heavier spine is located at each proximal corner, and one still larger, 0.50 mm or more is frequently found in a median position. All of these spines are elongate-acuminate, the basal ones sometimes forked, and without calcification except the bases of the larger ones in the proximal corners.

The development of this species has been well discussed by Robertson (1908:269-275) and O'Donoghue (1926a:249-261). There is a twin ancestrula, the earlier zooecia are somewhat hexagonal in form, but the later zooecia are elongate-quadrilateral much like those of *M. membranacea* and the spinules are less marked, often nearly wanting on the later zooecia.

Hincks described the species from California; Robertson listed it from Puget Sound to San Diego, California, and O'Donoghue from numerous British Columbia localities.

It did not occur in the Hancock dredgings but it is abundant on the kelps all along the California coast.

Membranipora serrilamella new name

Plate 1, figs. 12 and 13

Membranipora membranacea form *serrata* Hincks, 1882:469.
Membranipora serrata, Robertson, 1908:268.
Membranipora serrata, O'Donoghue, 1923:26; 1926:29.
Conopeum serrata, Okada, 1929:11.
Membranipora serrata, Okada, 1934:4.
Acanthodesia serrata, Marcus, 1937:44.
(Not *Membranipora serrata* MacGillivray, 1868:6).

Zoaria encrusting, especially on the broader algae where the colonies often coalesce to cover nearly the whole frond. The zooecia are of moderate size, about 0.50 mm long by 0.20 to 0.25 mm wide, usually not so regularly elongate-quadrate as in *M. membranacea* but otherwise resembling that species. The walls are thicker and there is a narrow cryptocyst on the proximal and lateral sides which is irregularly serrated with short laterally directed spinules; there is often a somewhat longer spinule at the proximal end. There is consistently a short hollow spine or protuberance at each distal corner, developed by the folding of the distal rim; in older stages of calcification these spines may become closed at the tips. The ancestrula is twinned like that of *M. membranacea.*

Hincks' specimens were from Virago Sound, British Columbia; Robertson records it from Puget Sound to southern California; O'Donoghue lists it from numerous localities in British Columbia; Marcus found it at several localities in Brazil, and Okada records it at a number of places in Japan. The form which Hastings listed as *Acanthodesia serrata* from Balboa, Canal Zone, belongs elsewhere (see under *Membranipora hastingsae* n. sp.).

The name *serrata* as applied to this species is preoccupied by *Membranipora serrata* MacGillivray, 1868:6, and a new name is necessary.

Excessively abundant on the floating fronds of kelp and dredged on a few occasions down to 10 fathoms.

Membranipora tuberculata (Bosc), 1802

Plate 2, figs. 4, 5 and 6

Flustra tuberculata Bosc, 1802:143.
Flustra tehuelcha d'Orbigny, 1839-46:17.
Membranipora tehuelcha, Robertson, 1908:265.
Nichtina tuberculata, Harmer, 1926:208.
Nichtina tuberculata, Hastings, 1930:706.
Membranipora tuberculata, Osburn, 1947:9.

This is the well-known "Gulfweed" bryozoan which Bosc described as occurring "en immense quantité sur les fucus nageans sur l'Atlantique."

The zoarium forms a white lace-work on Sargassum floating over the wide oceans and occurs on attached algae along shore in warmer waters. The zooecia are quadrangular, but shorter and wider than in *M. membranacea* and the walls are much more heavily calcified. Characteristically there is a pair of tubercles at the distal corners, which appear to be formed as folds of the distal rim as they are open and covered by

membrane on the distal side. They are very variable, frequently fusing across the end of the zooecium and occasionally they are cornuate, extending forward with the points curved toward each other, and more rarely a third tubercle is developed between these in the midline. A short gymnocyst is sometimes present and the cryptocyst, with lateral spinules is usually well developed at the proximal end.

Found wherever Sargassum drifts over the warmer seas; along shore on the Atlantic coast from North Carolina to Brazil; on the Pacific coast from California to Peru and the Galapagos Islands; southern Japan, Indian Ocean and the East Indies.

Dredged in shallow water, usually on algae, by the Hancock Expeditions at numerous stations from California to Peru.

Membranipora perfragilis (MacGillivray), 1881

Plate 2, fig. 8

Biflustra fragilis MacGillivray, 1869:138.
Biflustra perfragilis MacGillivray, 1881:27 (changed the name).
Membranipora perfragilis MacGillivray, 1895:39.
Membranipora crassimarginata var. *erecta* Busk, 1884:63.
Membranipora perfragilis, Hincks, 1884:278.
Amphiblestrum perfragile, Ortmann, 1890:29.
Membranipora serrata, Robertson, 1908:269 (in part).
Acanthodesia perfragilis, Hastings, 1945:98.

The zoarium encrusting and rising free into richly convoluted or frilled and variously contorted masses, the frills often anastomosing; bilaminar, the layers back to back, but occasionally one layer may extend slightly beyond the other. In the free frills the zooecia are regularly disposed, quite regular in form, the lateral walls parallel, the distal wall arcuate; 0.50 to 0.60 mm long by 0.25 to 0.30 mm wide. The zooecia of the encrusting base vary greatly in size and proportions, sometimes being as wide as they are long. The mural rim is finely crenate, the distal as well as the lateral walls. The cryptocyst is distinct, narrow on the sides but continued around the distal end of the opesia; usually broader at the proximal end, but sometimes limited to the proximal corners.

There are incipient interzooecial avicularia, smaller than the zooecia, with a spatulate mandible which is without pivot. They appear to be rare and I have found them only on the encrusting base.

It is recorded as common in Australian waters and is known also from Japan. Robertson (1908:269), under *M. serrata,* reports of that

species, "at Monterey, California, it occurs free, very much folded and contorted foliaceous masses," and it seems probable that these specimens were *perfragilis*.

A remarkable colony, shaped like a large pompon, was collected in shallow water at San Pedro, California. The zoarium measures about 140 mm in length by 100 mm in width and height, and is remarkably convoluted. It is attached to a large pebble, the encrusting base being more than half as wide as the erect portion and spreading down over the sides of the pebble. The specimen is deposited in the Cabrillo Beach Marine Museum of the City of Los Angeles and the author is indebted to Dr. W. L. Lloyd, Director of the Museum, for the privilege of studying the specimen. Some fragments of the zoarium are deposited in the Hancock collections.

Membranipora fusca new species

Plate 1, fig. 14

Zoarium encrusting on shells and stones, covering considerable areas; at first the thick ectocyst is clear, then the operculum develops a heavy dark border and later the whole ectocyst becomes yellowish brown, then darker to nearly black.

The zooecia are moderate in size, usually ranging between 0.50 and 0.70 mm in length and 0.30 to 0.45 mm in width, the opesia occupying nearly all of the front; a narrow brown line separates the zooecia even in younger stages. The descending cryptocyst is broadest at the proximal end and continues more narrowly along the sides, finely granulated and without spinules. The basal gymnocyst is only wide enough to bear a pair of transversely elongate low tubercles, which in final calcification may fuse in the midline or become heavy rounded knobs. The operculum is semicircular, about 0.20 mm in width, heavily chitinized like the frontal ectocyst and with a conspicuous black border. Multiporous septulae are present in both the lateral and distal walls. No spines nor avicularia and no ovicells.

Type, AHF, no. 9.

Type locality, Mussel Point, northern California, 36°37′20″ N, 121° 54′15″W. Also at Del Monte, California, 36°37′00″N, 121°53′00″W, intertidal to 6 fms, collected by Miss A. E. Blagg and Dr. R. L. Bolin, numerous colonies; also at Tomales Bay, California, 5 fms (Osburn).

Membranipora tenuis Desor, 1848

Plate 2, figs. 9 and 10

Membranipora tenuis Desor, 1848:66.
Membranipora denticulata Busk, 1856:176.
Biflustra denticulata, Smitt, 1873:18.
Hemiseptella denticulata, Canu and Bassler, 1928:62.
Acanthodesia denticulata, Hastings, 1930:707.

The *M. denticulata* of Busk from the Pacific coast and the *Biflustra denticulata* of Smitt from the Atlantic are definitely the same species and the same as the *tenuis* of Desor, according to Dr. Anna B. Hastings (*in litt.*) who has examined Busk's type material and a large number of other specimens in the British Museum from various Atlantic and Pacific localities.

Zoarium encrusting anything that affords attachment, but most common on shells and stones; occasionally rising in free, bilaminate frills similar to those of *M. perfragilis* but more delicate. The zooecia are moderate in size, 0.45 to 0.50 mm long by 0.20 to 0.25 mm wide, but often with a much wider range. The walls are moderately high and the mural rim roughly and irregularly granulated; usually there is no evidence of a gymnocyst; the cryptocyst is well developed and exceedingly variable, proximally it forms a broad shelf which extends more narrowly along the sides and then becomes somewhat broader around the distal border. Occasionally the shelf may fill in the whole basal half of the opesia, or it may be limited to a narrow band; the border of the shelf bears very irregular and sometimes branched spinules, which may extend laterally half way across the opesia or the border may be merely irregularly serrate. The proximal shelf is flat and smooth except for a few to many minute tubercles. The ectocyst is slightly brownish and often there is a distinct brown line separating the mural rims. The operculum is slightly more heavily chitinized than the frontal membrane and has a thick brown border; width 0.13 mm.

No ovicells, no avicularia, no spines, no dietellae. Small rough processes may occur at the proximal corners, but these are extremely variable in size and occurrence. The variations in zooecial size and form, the extent of the cryptocyst, and the presence or absence of the tubercles have led to the description of several supposed new species; *Membranipora danica* Levinsen, from Denmark, and *Hemiseptella africana, H. hexagonalis* and *H. grandicella* of Canu and Bassler appear certainly to belong under *tenuis.*

It is an abundant species along the Atlantic coast from Cape Cod to Brazil, in shallow water along the shores and entering estuaries where the salinity may be reduced to less than one-half that of sea water. It does not appear to be as abundant anywhere on the Pacific coast. Busk's material of *denticulata* came from Mazatlan, Mexico, and Hastings recorded it from several localities in the Canal Zone and from the Galapagos Islands. Probably because it is a shallow water species it did not appear frequently in the Hancock dredgings, as it was not taken below 16 fathoms.

Fairly common along the coast of southern California and down the west coast of Lower California; at Stations 1044-40 (Tiburon Island), 1049-40 (Angel de la Guardia Island) and 1071-40 (San Felipe Bay) in the Gulf of California; Station 374-35 at Independencia Bay, Peru. Also at Acapulco Bay, Mexico, specimens collected by Captain F. E. Lewis.

Membranipora savarti (Audouin), 1826

Plate 2, fig. 7

Flustra Savartii Audouin, 1826:240.
Biflustra Savartii, Smitt, 1873:20.
Acanthodesia savartii, Canu and Bassler, 1920:100; 1930:4.
Acanthodesia savartii, Marcus, 1937:40.
Acanthodesia savarti, Osburn, 1947:9.

The zoarium is erect, with narrow ligulate or bifurcate bilaminate fronds rising from an encrusting base which may spread over an area of a square centimeter or more. The zooecia of the erect fronds are regularly elongate-quadrangular, moderate in size, the walls rather heavily calcified and granulated. The cryptocyst forms a horizontal shelf at the proximal end with a denticulate process projecting into the opesia, and there are also denticles projecting from the narrower lateral cryptocyst.

The proximal horizontal dentate process of the cryptocyst is a very striking character when it is present, and the genus *Acanthodesia* was founded on it. However it is very often wanting entirely, or present on only a few zooecia of a colony. I have failed to find any evidence of it in Pacific coast specimens which otherwise agree perfectly. On the other hand, Silen (1941:19) found "the proximal denticle prominent in all specimens" from the Bonin Islands, Japan.

It is a common species around the world in warmer shallow waters.

Dredged at 14 Hancock stations: off Point Loma, California; Tiburon Island, Gulf of California; Lower California at Dewey Channel

and Fraile Bay; Port Culebra, Costa Rica; Secas Islands and Bahia Honda, Panama; James, Hood, Indefatigable and Chatham Islands, Galapagos, the greatest depth being 40 fms.

Membranipora pachytheca new species

Plate 2, figs. 2 and 3

Zoarium encrusting shells, white in the young, brownish in color when fully developed. The zooecia are large (average about 0.85 mm long, but ranging from 0.65 to 1.10 mm, and in width ranging from 0.45 to 0.65 mm); ellipsoid with the distal end evenly rounded and slightly elevated; distinct; the walls very thin; opesia occupying all of the front; no evident gymnocyst; a slight horizontal cryptocyst, usually in the proximal corners but often there is no evidence of it. The mural rim is smooth and exceedingly thin, there is no evidence of a descending cryptocyst and the horizontal cryptocyst is minute and perfectly smooth. The frontal ectocyst is thick, pale brownish, and covers the whole of the frontal surface, forming a thin brown line above the adjoining mural rims and continued more heavily around the distal end of the zooecium. The operculum is heavily chitinized and brownish in color, slightly arcuate in cross-section, very large (0.25 to 0.30 mm in width by 0.25 to 0.30 mm in length) thinner at the edges, with a sclerite on either side a little way within the margin. In the side walls there are 4 multiporous rosette plates, while in the distal wall there are numerous single pores which form a band across it at its middle. The tentacles are numerous, about 20. There are no avicularia and no ooecia; developing ova can be observed in the body cavity.

This is an unusual appearing species, looking at first sight like an encrusting *Alcyonidium;* on being calcined the thin walls and large opesia suggest *Aplousina* but there is no evidence of endozooecial ovicells. The negative characters, such as the absence of the gymnocyst, the vestigial cryptocyst, the absence of spines, denticles, avicularia and ooecia, the reduced calcification and the nature of the communication pores all appear to indicate *Membranipora* as the proper genus.

The most striking characters are the large, arched, leathery operculum, the rounded distal ends of the large zooecia and the unusually thin walls.

Type, AHF no. 10.

Type locality, Canoe Bay, Alaska, 40 fathoms, on shells, several colonies, one more than an inch across (Alaska Crab Investigation).

Membranipora hastingsae new species

Plate 2, fig. 1

Acanthodesia serrata, Hastings, 1930:707.

Zoarium encrusting. The zooecia are moderate in size, elongate and quite regularly quandrangular in form; walls very thin. The most characteristic feature is the very extensive development of the cryptocyst, which extends broadly on the sides to the level of the operculum, with numerous elongate spinules, rather evenly spaced, which nearly meet across the opesia and which occur on the entire lateral cryptocyst as far as to the operculum. The polypide chamber is thus almost enclosed beneath the cryptocyst and its horizontal spinules. At each corner there is a triangular area which appears to occupy all of the gymnocyst and which develops into a nodule, according to Hastings, or a short spine.

Dr. Hastings has described incipient avicularia of the same size as the zooecia and possessing a polypide, but with a greatly enlarged and somewhat modified operculum. The small specimen in my possession does not show the avicularia, but otherwise the agreement with her description and excellent figures (Plate 4, figs. 13-15) is perfect.

Dr. Hastings was evidently in error in listing this form under the *serrata* of Hincks for the following reasons: (1) the cryptocyst is remarkably broad and evenly developed on the sides and extends to the distal wall, where it leaves only space for the operculum (in *serrata* the cryptocyst is always narrow); (2) the spinules are long, extending nearly or quite to the median line, very equally developed and evenly spaced to the opercular area (in *serrata* the edge of the cryptocyst is crenate, with occasional shorter denticles irregularly distributed); (3) the spines at the corners are much less developed than in *serrata.* Furthermore I have examined large numbers of *serrata* and found no evidence of "incipient avicularia."

It is a pleasure to name this species for Dr. Anna B. Hastings of the British Museum of Natural History, who has done so much to further our knowledge of the Bryozoa.

The type material consists of a single colony from Balboa, Canal Zone, sent to me for identification by the William F. Clapp Laboratories of Duxbury, Massachusetts. Dr. Hastings recorded it as *Acanthodesia serrata,* also from Balboa "docks, buoy and shore."

Type, AHF no. 11.

Type locality, Balboa, Canal Zone. Also from Perlas Islands, Gulf of Panama, F. H. Bradley, collector.

Genus CONOPEUM Gray, 1848

This genus is especially characterized by the development of triangular cavities on the surface of the gymnocyst at its proximal corners ("interopezial cavities"). In the early growth of the zooecium the small gymnocyst is smooth, then calcified walls begin to enclose a triangular space, sometimes in each basal corner, sometimes in only one corner, and very frequently they may be wanting over a large portion of a colony. As calcification becomes complete, triangular or rounded knobs, with a small membranous aperture, are formed. These may even become closed and also they may be fused across the basal part of the zooecium to form irregular quadrangular lumps or knobs. Avicularia and mural spines are wanting. (See Marcus 1937:36, and Osburn 1940:350). Genotype, *Flustra lacroixii* Audouin, 1826.

Conopeum commensale Kirkpatrick and Metzelaar, 1922

Plate 2, figs. 12, 13, 14 and 15

Kirkpatrick and Metzelaar, 1922:985.
Marcus, 1937:35, 1938:16, 1939:126 (discussion).

The zoarium usually encrusts shells, especially gastropod shells inhabited by hermit crabs; white in earlier stages, becoming yellowish and finally brown; multilaminar.

The zooecia are rather regular in arrangement, roughly quadrangular or elongate-hexagonal, the outlines marked by a very distinct dark brown line. The membranous ectocyst covering the frontal surface is thickly studded with chitinous, villose spinules, especially around the border; these spinules are semierect, pointed toward the center of the zooecial area, and do not occur on the mural rim. The zooecial walls are heavily calcified and the mural rim as well as the descending cryptocyst is granulated. The opesia is ovoid in form and the operculum well chitinized, with a somewhat heavier border, yellowish in color.

Originally found at a number of localities in northwest Africa. Marcus (1937:36) records it from various places in Bahia de Santos, Brazil, and gives an excellent account of it.

There is much variation in the form of the tubercles and they may be single or double, large or small, and may often be wanting over considerable areas of a colony. The chitinous ectocystal spinules also show much variation, usually numerous in our material, but sometimes wanting altogether. Kirkpatrick and Metzelaar did not mention them in

their description, but a specimen from Cape Blanco, West Africa, the type locality, received through the kindness of Dr. Anna B. Hastings of the British Museum, shows a very few delicate, almost transparent spinules.

The Hancock Expeditions recovered this species from off Guaymas (Station 1092-40) and Tepoca Bay (Station 1078-40), Sonora, Mexico; Santa Maria Bay, Lower California (Station 1031); Cocos Bay, Costa Rica (Station 116-33), and La Plata Islands, Ecuador (Station 212-34). Dr. Howard R. Hill of the Los Angeles Museum has presented the writer with a specimen from San Felipe, western Mexico. It is therefore widely distributed in warm waters along the Pacific coast from northern Mexico to Ecuador. Depth 2 to 45 fathoms.

Conopeum reticulum (Linnaeus), 1767

Plate 2, fig. 11

Millepora reticulum Linnaeus, 1767:1284.
Membranipora lacroixii, Robertson, 1908:261, (? part).
Membranipora lacroixii var. *triangulata,* O'Donoghue, 1923:25.
Conopeum reticulum, Harmer, 1926:211, synonymy and discussion.
Conopeum reticulum, Osburn, 1940:350-352, discussion.

Zoarium encrusting on various substrata. Zooecia of moderate size, usually about twice as long as the width but occasionally short and wide, usually ranging in length between 0.40 and 0.50 mm. There is a short gymnocyst (often vestigial), which typically bears a pair of triangular areas in the proximal corners. These triangular structures are at first open with a membranous covering, but later they often become closed and knob-like, or they may be fused into a single knob, often they are wanting, sometimes over considerable areas of a colony. They may be readily confused with the minute or vestigial avicularia of some species of *Antropora* but they are merely surface structures on the basal gymnocyst and are probably homologous with the basal tubercles of some species of *Membranipora.*

The opesia is elliptical, oval or rounded. The walls are rather heavily calcified and the descending cryptocyst coarsely granular, sometimes with conical points projecting laterally inward. Ovicells are wanting. Small avicularia have been mentioned by some authors, but I have never been able to find them in either Atlantic or Pacific specimens and I am inclined to believe the authors were mistaken or had some other species.

In the literature up to 1926 this species was generally confused with *lacroixi* Audouin, and most of the references are under that specific name.

Robertson's description and figure are inconclusive; she may have had this species or *Antropora tincta* (Hastings), which is much more abundant on the southern California coast, or both of them. O'Donoghue's record from British Columbia is probably correct for his variety *triangulata,* but the varieties *paucispina* and *multispina* doubtless refer to some other species, probably *Electra crustulenta* (Pallas).

This cosmopolitan species has been somewhat doubtfully recorded from Alaska to southern California, where Robertson states that it is "quite abundant."

It did not appear in the Hancock dredgings, but the writer has observed it in shore collections at Monterey Bay, Newport Harbor, and La Jolla, California. Mr. R. J. Menzies collected it at 5 fms in Tomales Bay, California, rather common, one specimen covering more than 8 square inches of the inside of a clam shell. Apparently it is not an abundant species and has been taken only in shallow water.

Genus **DESMACYSTIS** new genus

Zoarium encrusting. Zooecia thin walled; an extensive gymnocyst which is strengthened by a median carina and lateral transverse ribs. Opesia broad, its side walls extended laterally above the bases of adjoining zooecia. Cryptocyst apparently wanting. A median, sessile, transverse avicularium on the distal border of the gymnocyst. No ooecia; no spines; no dietellae. Genotype, *Membranipora sandalia* Robertson.

Where to place Robertson's *M. sandalia* has puzzled me greatly. It cannot remain in *Membranipora* since that genus, as now defined, has a very limited gymnocyst and no avicularia; *Electra* is suggested by the very extensive gymnocyst, but the presence of an avicularium and the total absence of spines apparently exclude *sandalia* from the genus; the absence of any form of ovicell seems to limit it to the simpler Membraniporidae, but it cannot be accepted in any modern genus of that group. The Membraniporidae (*sens str.*) are in so much need of careful, detailed revision, that it is with extreme hesitation that I inject another generic description into this difficult group.

Desmacystis sandalia (Robertson), 1900

Plate 3, fig. 1

Membranipora sandalia Robertson, 1900:324; 1908:264.

Zoarium encrusting, but not closely attached, forming fan-shaped colonies of a rather rough appearance. The zooecia are large, elongate, narrowed on the proximal half, length 0.85 (0.65 to 1.00) mm, width

0.40 (0.26 to 0.50) mm. Opesia variable in form and size (0.25 to 0.50 mm long by 0.25 to 0.45 mm wide), irregularly rounded or ovate and occupying approximately the distal half of the front. The mural rim flares outward on the sides over the bases of the adjoining zooecia. The proximal half, more or less, of the front is occupied by the extensive gymnocyst. When first formed this is smooth but soon a series of ribs (4 to 7 in number, with a median one which forms a sort of keel) grows inward from the border to become attached to the median keel; these ribs are apparently developed from the surface of the gymnocyst, as a part of it, and while they may have some resemblance to the costae of the cribrimorphs, they are in no sense homologous. There is no evidence of a cryptocyst. The frontal membrane is somewhat chitinized and the operculum (about 0.20 mm broad) has a heavier brown border.

The distal border of the gymnocyst bears a peculiar large, sessile, median, transverse avicularium with a short-triangular mandible which is hooked at the tip. There are no ooecia; no spines; no dietellae.

Robertson described the species from Yakutat, southern Alaska, and apparently it has not been noted since.

Our specimens are from Yakan Point, Queen Charlotte Islands, British Columbia, low tide, Dr. E. F. Ricketts, collector, three colonies.

Genus **CUPULADRIA** Canu and Bassler, 1919

The name *Cupularia* (*Cupulaire* Lamouroux, 1821), used to include species of *Cupuladria* and *Discoporella* for many years, has been shown by Hastings (1930:717) to be untenable. In 1919:77 Canu and Bassler established the genus *Cupuladria,* with *C. canariensis* Busk as the genotype, to include the membraniporid species with a wide open front.

Cupuladria canariensis (Busk), 1859

Plate 3, figs. 2 and 3

Membranipora canariensis Busk, 1859:66.

Cupuladria canariensis, Hastings, 1930:714.

Zoarium free, unilaminar; shaped like a cup or saucer, varying greatly in this respect, sometimes almost plate-like, at other times quite cupuliform; usually quite circular but occasionally elliptical or distorted. The zooecia are rhomboidal, as a rule very regularly arranged, each with a long chitinous flagellum at the distal end. The opesia is large, without any trace of a horizontal cryptocyst. The walls are thin and high, with a narrow descending cryptocyst which is distinctly granulated but which never bears spinules. The vibracula are very long and rather stiff and

often move in unison and when stimulated they may stand erect for some time. The vibracular chamber is prominent and its aperture is lunate, with one side higher than the other. The vibracula and the frontal membrane, especially near the walls, are brownish in color. The dorsal side shows small quadrangular areas with usually four pores in each area.

While the form of the colony and the arrangement of the zooecia are usually quite regular, exceptions are not uncommon. The larvae usually attach themselves to small objects, especially sand grains, and grow free and symmetrically beyond the edges, but occasionally they attach on larger irregular objects and become distorted. The *C. elongata* of Sakakura (1935:6) is an example of the same sort of irregularity in *C. guineensis* (Busk). The writer has a specimen of canariensis which became attached to the inside of a shell where it followed the curvature of the shell, becoming concave on the frontal surface.

This species appears to be limited to the Atlantic and the Mediterranean Sea and the Pacific coast of North America. It is an abundant form in the Gulf of Mexico, but it has hitherto escaped notice on the Pacific coast except for Hastings' record at Gorgona, Colombia. Robertson's record (1908:314) is due to a misidentification, as she undoubtedly had *Discoporella unbellata* (Defrance).

The range of the species on the Pacific coast, as determined by the Hancock dredgings, is from Cedros (Cerros) Island, half way down the coast of Lower California, to Ecuador and the Galapagos Islands. Intermediate stations, more than 30, include the Gulf of California, Clarion and Socorro Islands west of Mexico, the west coast of Mexico, Costa Rica, Panama, and Colombia. It occurs in shallow water and down to 40 fathoms, but appears to be more abundant from 10 to 20 fathoms.

Family **Electrinidae** d'Orbigny, 1851

The zoarium is usually encrusting, but may be erected from an encrusting base. The zooecia are usually provided with a well-developed gymnocyst but this is sometimes vestigial and both extremes may sometimes be seen on the same colony. There are no ovicells, no avicularia, and no dietellae. Spines are usually present around the border of the opesia, occasionally wanting, in some cases limited to a single strong median proximal spine which may be reduced to a mere tubercle or be very greatly elongated. The simple nature of the zooecia, except for the spines, relates this group to the more primitive membranipores.

ELECTRA Lamouroux, 1816

Genotype, *Flustra verticillata* Solander, 1786:15.

Key to the Species of *Electra*

1. No proximal spines, lateral ones long and numerous; the operculum bears a pair of long furcate, delicate chitinous spinous processes. . . . . *anomala*
   Proximal spines present (but see *crustulenta* var.). 2
2. A single median proximal spine. 3
   More than one proximal spine. 5
3. A single proximal spine only; operculum calcified, white. . . . . *crustulenta* var. *arctica*
   Lateral spines also present. 4
4. Proximal spine regularly present, strong; 1 to 4 pairs of weaker lateral spines, the distal ones erect. . . . . *hastingsae*
   Proximal spine weak or wanting, others slender and varying in number, often wanting; operculum weakly calcified. . . . . *crustulenta* var.
5. A transverse row of several stout proximal spines; a strong branched scutiform spine on each side of the operculum. . *biscuta*
   A long furcate spine on each side of the median proximal one, varying greatly. . . . . *bellula* var. *bicornis*

Electra crustulenta (Pallas), 1766

Plate 3, figs. 4 and 5

Eschara crustulenta Pallas, 1766:39.

Membranipora lacroixii, O'Donoghue, 1923:25 (? part).

Electra crustulenta, Borg, 1931:29.

Membranipora crustulenta, Osburn, 1944:31.

This species, which is common on both sides of the North Atlantic appears not to have been recorded definitely from the Eastern Pacific. The synonymy is so confused that it is not always possible to be certain of the reference. The work of Borg (1931, "On some species of *Membranipora*") has cleared up a great many points, especially concerning the numerous variations.

The zoarium is encrusting in a thin layer, often with narrow ramifying branches of one to several rows of zooecia. The zooecia are rather regular in distribution, elliptical in form, and separated by deep grooves. The walls are moderately thick as a rule, finely granulated on the mural rim and narrow cryptocyst. The smooth gymnocyst is often well developed, but under crowded growth conditions may be reduced to the vanishing point. The mural spines vary exceedingly, from none to as many as 6 on each side. The operculum is often more or less calcified and shows white against the rest of the frontal membrane.

Dr. Borg discusses six varieties, all but one of which were once considered species and in several of these the median proximal spine and the calcification of the operculum are wanting. Our specimens resemble the variety *baltica* in general appearance, but in the lack of the proximal spine and in the very weak calcification of the operculum they suggest the variety *stammeri* (See Plate 3, fig. 5).

Hancock Station 1478-42, Yaquina Bay, Oregon, on shells along shore. The species has also been taken at Dillon Beach, and Monterey Bay, California.

Electra crustulenta var. **arctica** Borg, 1931

Plate 3, fig. 4

This well-marked variety, characterized by a single strong spine in the midline proximal to the opesia, is abundant at Point Barrow, Alaska, G. E. MacGinitie, collector; at Punuk Island, Bering Sea; Nunivak Island, Nash Harbor, Alaska and south to Dillon Beach, California.

Electra anomala new species

Plate 3, fig. 6

Zoarium encrusting, thin and delicate. The zooecia are moderate in size, averaging about 0.50 mm in length by 0.30 mm in width, but there is a wide range in both dimensions; distinct with deep separating grooves; walls thin, the mural rim narrow and somewhat inflected, smooth or slightly granular. The gymnocyst is variable from one-fourth the zooecial length to almost wanting; cryptocyst not evident. The opesia is elliptical, narrowed at the base of the operculum, which is well chitinized. From the middle of the front surface of the operculum arises a pair of very elongate, bifurcate chitinous spines which extend far over the base of the distal zooecium; this anomalous condition is without parallel in the writer's experience.

At the distal end, on either side, is a short, stout, erect spine, which often appears to belong to the distal zooecium. The marginal spines are extremely variable; in the same colony the zooecia of the central area for several generations are spineless; there follows a narrow transitional zone in which there are a few spines, increasing in size and number outward; and finally a climax is reached with 8 to 10 long, slender spines on each side which bend low across the opesia until their points may pass each other; frequently these are briefly bifurcate at their tips, but there never appears to be any fusion of the tips. No avicularia; no ooecia; multiporous septulae are present in both lateral and distal walls.

In most of its characters it resembles *E. angulata* Levinsen (1909: 149) from Siam, but that species has an evident cryptocyst, shorter, simple spines, and lacks the extraordinary opercular decoration of *anomala.*

Type, AHF no. 12.

Type locality, Balboa, Canal Zone 8 colonies encrusting wood, the largest 20 mm in diameter. The specimens were received from the W. F. Clapp Biological Laboratories.

Electra biscuta new species

Plate 3, figs. 7 and 8

Zoarium thin, encrusting shells, the colonies small.

Zooecia small (length 0.26 to 0.30 mm, width 0.18 to 0.22 mm), distinct with well-marked grooves. The gymnocyst is usually very limited, but may occupy one-fourth or more of the zooecial length; cryptocyst narrow, not expanded, smooth or finely granulated; the mural rim low, thin and slightly granulated. The distal wall is strongly arched forward on the dorsal side. The opesia is irregularly ovate, straighter on the proximal border and conspicuously narrowed in the region of the operculum; occasionally more elliptical.

The spines are heavy, broad at the base and without joints and are of three kinds: (1) a broad spine, often cervicorn with three points, sometimes only bifid or again simply broadened; these are situated one on each side of the operculum and when fully developed bend across the opesia like a pair of scuta; (2) just distal to these on each side is a short, stout, conical, erect spine opposite the distal end of the operculum; (3) on the gymnocyst immediately proximal to the opesia is a transverse series of short, stout conical spines which project forward in a row at a slight angle above the opesia, these usually number 3 or 4 but vary from 1 to 5; often their bases are more or less fused, and their tips often briefly bifurcate.

The generic relationship of this species is somewhat in doubt. No ooecia have been observed and there are no avicularia. The communication pores are in the form of round multiporous rosette plates. The absence of ooecia and avicularia and the presence of a gymnocyst, mural spines and thin lateral and dorsal walls, without dietellae, suggest the genus *Electra,* though there is little resemblance in appearance to any others of that genus.

Type, AHF no. 13.

Type locality, Mazatlan, Mexico, 23°19′00″N, 106°23′00″W, intertidal, two colonies, Miss A. E. Blagg, collector. Also taken at Hancock Station 341, three colonies, Secas Islands, Panama, 7°53′10″N, 82°12′05″W, 30 fms.

Electra bellula var. **bicornis** (Hincks), 1881

Membranipora bellula var. a (*bicornis*) Hincks, 1881a:149.
Electra bellula var. *bicornis,* Hastings, 1930:706.

This is a thin-walled, rather delicate species with a small, short, median spine proximal to the opesia. The variety *bicornis,* in addition to the median spine, has a longer forked or branched spine on either side of the central one, bending forward over the opesia, (the median spine sometimes wanting).

The species and variety have a wide distribution. It did not occur in the Hancock dredgings, but Dr. Hastings has recorded it from the Galapagos Islands.

Electra hastingsae Marcus, 1938

Electra hastingsae Marcus, 1938:17, synonymy.
Electra monostachys, Hastings, 1930:706.
(Not *Membranipora monostachys* Busk, 1854, and numerous later authors).

This species has been confused with *Electra* (*Membranipora*) *crustulenta* (Pallas), the variety with a single proximal spine, which it resembles, but in that form there is a well-calcified operculum often of striking white appearance, while in *hastingsae* the operculum is entirely membranous. There is usually a pair of small distal spines opposite the operculum and some small marginal spines; the single proximal spine is smaller and not as much enlarged at the base as in *crustulenta.*

This species was not found in the Hancock collections, but Hastings recorded it from Balboa, Canal Zone, along shore. It is a common species along the shores of western Europe and eastern North America, and Marcus records it from Santos Bay, Brazil.

Family **Flustridae** Smitt, 1867

The zoarium is erect, free, frondose and flexible with little calcification (rarely encrusting and loosely attached). Zooecia membraniporine, the opesia occupying all or nearly all of the front; walls thin, usually with uniporous septules. Avicularia interzooecial, usually simple and

primitive (wanting in some genera). Ooecia, when present, endozooecial and embedded either in the base of the succeeding zooecium or in an avicularian chamber. Levinsen, 1909:122-125, and Silen, 1941:49-54, have presented the best discussions and analyses of this family and have erected a number of new genera.

Silen, 1941:49-54, retains the old genus *Carbasea* Gray for species with unilaminar zoaria which lack both aviacularia and ooecia. He erects a new genus, *Terminoflustra,* for the species with squared avicularian chambers, which are located at the bifurcation of zooecial rows, the genotype being *Flustra barleei* Busk. The genotype of *Carbasea* is *Flustra carbasea* Solander.

Genus CARBASEA Gray, 1848

The zoarium is frondose with lobate branches, unilaminar. There are no avicularia and no ooecia.

Carbasea carbasea (Solander), 1786

Plate 3, fig. 9

Flustra carbasea, Hincks, 1880:123.

The zoarium is usually a broad, thin, sheet, more or less subdivided into lobes, with a narrow short stalk which is attached by a narrow base. There is a single layer of zooecia, all facing the same direction. The zooecia are large, 0.90 to 1.25 mm long and about 0.40 mm wide, in quite regular alternating series, the narrow base of one between the expanded distal halves of those on either side; the walls thin and the distal wall strongly curved forward; opesia occupying all of the frontal area, with sometimes a slight development of a proximal cryptocyst. No spines; no avicularia; no ovicells.

The "Lawn Sea-mat" of Ellis and Solander's Zoophytology is a common high-northern species in the North Atlantic and adjacent Arctic Ocean. Recorded frequently from Spitzbergen south to the British Isles and west to Greenland, Osburn (1932:7) extended its range to Loubyrne, Hudson Bay. It now appears in collections from Alaska and no doubt is circumpolar in distribution.

Dall Alaska Collection 3623-1670, U. S. National Museum, and Albatross Collection, Cordova, Alaska, June 28, 1914, Common at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Genus TERMINOFLUSTRA Silen, 1941

Avicularia squared and situated at the bifurcations of zooecial rows; ooecia endozooecial, embedded in the bases of the succeeding zooecia. Genotype, *Flustra barleei* Busk, 1860:120.

Terminoflustra membranaceo-truncata (Smitt), 1867

Plate 3, fig. 10

Flustra membranaceo-truncata Smitt, 1867:358.

Flustra membranaceo-truncata, Robertson, 1905:292.

Flustra membranaceo-truncata, O'Donoghue, 1923:24; 1926:47.

The zoarium is erect and consists of irregularly flabellate fronds, unilaminar and thin. The zooecia are irregularly quadrate or elongate-hexagonal, truncate at both ends, usually narrower at the proximal end. The walls are thin, with a minute spine, often wanting, at each distal corner. The avicularia, which are rather rare, are usually situated at the bases of new rows of zooecia; nearly square in outline and about one-third as large as the zooecia; the mandible is semicircular, directed distally, with a continuous chitinized border.

Ooecia endozooecial, embedded in the bases of the succeeding zooecia, small, inconspicuous except in transmitted light.

Circumpolar. Robertson recorded it from the Pribilof Islands, Bering Sea; O'Donoghue listed it from Banks Island and China Hat, in British Columbia waters.

In studying the material from the U. S. Alaska Crab Investigation, I find two small colonies from Alitak Bay, Alaska, at 30 fms.

Family Hincksinidae Canu and Bassler, 1927

This family includes membranipores of simple structure, similar to the Membraniporidae except for the presence of an endozooecial ovicell. The ovicell is usually a narrow, transverse, shallow structure, opening widely into the zooecial cavity and closed by the operculum, but sometimes it is merely a rounded expansion of the zooecial cavity into the base of the succeeding zooecium. Spines, avicularia, and dietellae may be present.

Key to Genera of Hincksinidae

1. No avicularia, no dietellae. . . . . *Aplousina*
   One or both of these present. 2
2. Tall pedunculate avicularia among the spines. . . *Cauloramphus*
   Avicularia sessile, vicarious. 3
3. Avicularia usually paired at the proximal corners, cryptocyst strongly developed. . . . . *Antropora*

Avicularia not paired, or if paired they are on the lateral walls; cryptocyst less developed. 4
4. Avicularia large, or paired on the lateral walls; ovicells small but evident on the surface. . . . . *Hincksina*
Avicularia single at distal ends of zooecia, ovicells not evident on the surface. 5
5. Mandible very long and winged. . . . . *Cranosina*
Mandible short, pointed, not winged. . . . . *Ellisina*

Genus **HINCKSINA** Norman, 1903

Zooecia encrusting, entire area membranous, mural rim with or without spines. Ovicell endozooecial, occasionally conspicuous but usually small, short and sometimes scarcely evident. No dietellae. Avicularia usually interzooecial. Genotype, *Membranipora flustroides* Hincks, 1880.

Key to Species of *Hincksina*

1. Avicularian mandible very elongate. 2
Mandible not extremely elongate. 4
2. Mandible setiform and winged on both sides. . . . . *alba*
Mandible not winged. 3
3. With numerous spines bending over the opesia. . . . . *pallida*
Spines wanting. . . . . *pacifica*
4. Avicularia lateral and paired. . . . . *nigrans*
Avicularia not lateral and not paired. 5
5. Mandible triangular, usually with one side longer than the other. . . . . *velata*
Mandible semicircular. 6
6. Numerous spines bending low over the opesia. . . . *polacantha*
No spines. . . . . *minuscula*

Hincksina alba (O'Donoghue), 1923

Plate 5, fig. 2

(*Membranipora alba*), O'Donoghue, 1923:28.
Callopora alba, O'Donoghue, 1926:34.

Encrusting, white to light yellow. Zooecia large, 0.75 to 1.08 mm long by 0.40 to 0.55 mm wide; walls high, rather thick and conspicuously elevated on the distal border; opesia oval and occupying nearly all of the frontal surface, 0.55 to 0.65 mm long; gymnocyst small; cryptocyst limited to the border of the opesia, granular and minutely crenate at its lower edge. The operculum is large, about 0.20 mm in either dimension, with a conspicuous yellow bordering sclerite.

The avicularium is vicarious, taking a place in the zooecial series, and has the appearance of a symmetrical onychocellarium; it is nearly as long

as a zooecium, but much narrower, only 0.26 to 0.30 mm in width; its opesia is elliptical and partially divided near its middle, the border of the proximal portion minutely crenate. The mandible is very elongate, usually about 1 mm, the rachis slender and without denticles, strongly curved downward near the tip, the base is triangular, about 0.20 mm wide, and is hinged to the frontal surface of the chamber; the rachis is winged equally on both sides, continuing nearly to the curved tip.

The ovicell is high and prominent, transverse, 0.35 to 0.40 mm wide by 0.20 mm long, endozooecial and closed by a special membrane, occasionally there is a small tuberosity on the top.

Dietellae are present in the lateral walls and multiporous septulae in the distal wall.

O'Donoghue described the species under *Membranipora* and changed it later to *Callopora*. However, the ooecia are definitely endozooecial, as shown by dissection, and the species is here transferred to the genus *Hincksina*. Recorded from off Protection Gap and Schooner Bay, British Columbia, down to 30 fathoms.

In the Hancock collections there are several colonies on a shell labelled "local," but without further data. Also off Santa Catalina Island, southern California, on a brachiopod shell.

Hincksina nigrans (Hincks), 1882

Plate 5, fig. 5

Membranipora nigrans Hincks, 1882:248.
Membranipora macilenta Jullien, 1802:25.
Membranipora macilenta, Waters, 1900:61.
Callopora nigrans, Osburn, 1919:608; 1923:8; 1932:8.
Adenifera nigrans, Canu and Bassler, 1920:102.

Zoarium encrusting, coarse, light brown to nearly black. The zooecia are large, 0.70 to 1.00 mm long by 0.45 to 0.55 mm wide; distinct; mural rim raised and granulated, the distal wall arched forward and its rim somewhat elevated; opesia occupying nearly all of the front; gymnocyst vestigial; cryptocyst sometimes forming a narrow proximal shelf, but often not evident. Large multiporous septules are present, usually two in the distal wall and the same in each half of the lateral wall, but more rarely some uniporous septulae are found. Small lateral avicularia are present on practically all of the zooecia, one on each side opposite the distal end of the operculum, the rostrum elevated and the triangular mandible directed backward. No spines.

The endozooecial ovicell is very shallow, inconspicuous and is formed by the elevation of the distal mural rim, closed by a special membrane. The position of the ooecium is rendered very conspicuous by the development of a thick-walled, bilobate ooecial cover which rises from the base of the succeeding zooecium. This structure resembles the ooecial cover in the genus *Tegella,* as it does not fuse with the ovicell, but it is not developed in connection with an avicularium and there is a dumb-bell-shaped membranous area on the top. The infertile zooecia do not possess this structure, but it appears on every ovicell. The center of the colony presents an altogether different appearance from the fertile area. In the infertile zooecia the operculum extends to the distal wall, but in the fertile ones it is somewhat remote and the frontal membrane distal to it appears to rise to close the ovicell.

The *M. macilenta* of Jullien and Waters is merely the infertile stage of *nigrans.* Osburn followed Nordgaard in placing *nigrans* in the genus *Callopora,* but the endozooecial ovicell and the lack of pore chambers preclude that association. Canu and Bassler included it under their genus *Adenifera,* but it definitely has a small ooecium and otherwise differs from *Biflustra armata* Haswell, which is the genotype of *Adenifera.* Because of the nature of the ovicell this unusual species appears to conform more nearly to the definition of the genus *Hincksina.*

Hincks described the species from the Houston Stewart Channel, British Columbia. Jullien's record of *macilenta* from north of Spain, and Waters' from Wilczek Land refer to the young stage. Osburn has recorded it from Etah, Greenland; Port Burwell, Ungava, Canada, and from the Canadian Arctic Expedition Sta. 23, 70°24′N Lat., 161°25′W Long. It is doubtless another circumpolar species.

Dall, Alaska collection, 1623-1670, one mature colony on a shell. It is abundant at Point Barrow, Alaska, at 18 to 25 fms, G. E. MacGinitie, collector, Alaska Research Laboratory.

Hincksina pacifica new species

Plate 5, fig. 1

Zoaria encrusting on shells, white to light yellow in color. Zooecia moderately large (0.55 to 0.80 mm long), distinct; opesia occupying nearly all of the front, oval or elliptical; mural rim somewhat thickened, finely beaded, the narrow descending cryptocyst similar in texture; gymnocyst vestigial. Operculum thin, semicircular, with yellow bordering sclerite. Avicularia vicarious, scattered, the chamber more or less rhombic in form, sides of the rostrum thin and elevated, the narrow tip often

projecting above the succeeding zooecium; mandible elongate-triangular, symmetrical, 0.30 to 0.40 mm long by 0.18 mm wide at the base, yellow with a bordering sclerite, the tip much decurved and ending in a fine point; attached by a pair of cardelles.

Ovicell endozooecial, but moderately prominent, short and transverse (semilunate), the surface slightly roughened, but without an umbonate process. Dietellae present. No spines.

It is apparently very similar to *H. pallida* (Hincks) but that species is well provided with spines, both erect and curved, and the ovicells, according to O'Donoghue (1926:31) are so immersed as to be invisible on the surface. It is also related to *H. velata* Hincks but in that species the avicularium is shorter and the ovicell has a different form.

Type, AHF no. 14.

Type locality, Albatross Station 2984 near the Guadalupe Islands off Lower California, 28°57′15″N, 118°15′45″W, at 113 fms, two colonies.

Hincksina velata (Hincks), 1881

Plate 5, figs. 3 and 4

Membranipora velata Hincks, 1881:130.

Callopora triangulata O'Donoghue, 1926:35.

The description and figure by Hincks (pl. 5, fig. 3) and that of O'Donoghue (pl. 3, fig. 28) agree in practically every detail and are correct with one exception. In spite of Hincks' figure and the statement by O'Donoghue, the ovicell is not hyperstomial but endozooecial, as both dissection and growth stages show no mural rim beneath the aperture of the ovicell; the latter is very definitely closed by the operculum, and the cavity is formed by the forward extension of the upper part of the distal zooecial wall.

The figure by Hincks shows the avicularian mandible curved while that by O'Donoghue represents it as straight, but both conditions may occur in the same colony and it is often slightly asymmetrical, one side being longer than the other. There are two very strong hinge denticles. Measurements were not given, but in our material the zooecia measure 0.60 to 0.70 mm long by 0.35 to 0.50 mm wide, and the opesia 0.40 to 0.50 mm long by 0.30 to 0.35 mm wide. The ovicell is at first transverse and arcuate, but assumes a triangular form by additional calcification. The opesia occupies most of the frontal area; the walls rather thick and granulated; gymnocyst present but often much reduced; spines wanting, dietellae present; avicularia vicarious.

Hincks described the species from Santa Cruz, California, and O'Donoghue lists *triangulata* from "Gabriola Pass; Brotchie Ledge, Victoria, B.C."

Hancock Stations: 1187-40 and 1325-41, off Santa Catalina Island, 1269-41, Anacapa Island, California; 2167, Dewey Channel off Point San Eugenio, and 2168, Cabeza Ballena, Lower California, and 431-35, off Octavia Rocks, Colombia. The known range is therefore from British Columbia to Colombia, and down to 60 fms.

Hincksina pallida (Hincks), 1884

Plate 23, fig. 2

Membranipora pallida Hincks, 1884:39.
Membranipora acifera form *multispinata* Hincks, 1884:8.
Membranipora pallida, O'Donoghue, 1923:25.
Hincksina pallida, O'Donoghue, 1926:31.

Zoarium loosely attached by dorsal processes, thin. Zooecia elongate, elliptical, length 0.60 to 0.70 mm, width 0.25 to 0.30 mm; gymnocyst and cryptocyst vestigial; the walls thin and smooth, beset with 5 to 8 slender, pointed spines which bend somewhat over the opesia, except the most distal pair which are erect. Avicularia appear at the base of many of the zooecia, the chamber more or less quadrate, the mandible broad at the base and tapering rapidly into a very long acicular point; at first glance the avicularia appear to be mounted on the zooecial base, but their mode of development shows them to be interzooecial, and the extent of their chambers can readily be seen on the dorsal side. The mandibles average 0.35 mm in length, with a strongly decurved tip.

The ooecia are endozooecial, low and inconspicuous, cucullate with a wide aperture, 0.18 mm wide by 0.10 mm long.

Hincks first considered this to be a form of *M. acifera* MacGillivray, but later described it as a new species; his discussion and figure (pl. 19, fig. 4) are good but he did not have the ovicell and did not discuss the nature of the avicularian chamber (Virago Sound, British Columbia). O'Donoghue discovered the ovicell and removed the species to *Hincksina* (a number of localities in British Columbia, the San Juan Islands northward). Neither Hincks nor O'Donoghue mentions the peculiar mode of attachment which is by means of a short chitinous tube growing from the middle of the dorsal side of many of the zooecia.

Hancock collections,—a number of colonies dredged near Friday Harbor, Puget Sound, Dr. J. L. Mohr, collector.

Hincksina polacantha O'Donoghue, 1926

O'Donoghue, 1926:31.

Zooecium oval, elongate; margin slightly raised. As a rule there are two pairs of small erect distal spines, and on each side 10 to 13 longer spines which curve over the aperture and overlap in the midline. The aperture is completely membranous. Ooecium a marked dilatation, a little more than a hemisphere, free from ridges or perforations. Apparently it is of the separated endozooecial type. (After O'Donoghue).

O'Donoghue questions somewhat the generic relationship on account of the prominence of the ooecium and it may be that the species should be referred to *Callopora.* It is reported only from Snake Island, British Columbia, and did not appear in the Hancock dredgings.

Hincksina minuscula (Hincks), 1884

Membranipora minuscula Hincks, 1884:11.
Hincksina minuscula, O'Donoghue, 1926:30.

Zooecia small, oval; margin a good deal raised, thin, smooth, no spines; on an oblong area, placed above the cell, occasionally a small circular avicularium, slightly raised, the mandible directed upward. Ooecium semicircular, shallow, just covering the extremity of the cell, smooth, with a subcircular membranous space at the back (? avicularium). (Condensed from Hincks.) O'Donoghue adds the information that the "membranous space" on the ovicell is usually occupied by an avicularium, though this structure is occasionally separated from the ooecium.

Described by Hincks from Houston Stewart Channel and listed by O'Donoghue from Gabriola Pass and Bentinck Island, British Columbia. It did not appear in the Hancock dredgings.

Genus **APLOUSINA** Canu and Bassler, 1927

The genus is characterized by the presence of endozooecial ovicells and the absence of spines, avicularia and dietellae (pore chambers). The zooecial walls are vertical and thin, with the mural rim and the very narrow cryptocyst slightly beaded. Proximally the cryptocyst usually merely rounds out the corners at the proximal end, but in narrower zooecia it may extend a short distance. There is a single multiporous communication pore in the distal wall and two or three in the lateral wall. Jullien figured *A. (Membranipora) filum* with a pair of vestigial

spines but these are usually wanting. The characters therefore are those of a simple membranipore except for the endozooecial ovicell. Genotype, *Aplousina gigantea* Canu and Bassler, 1927.

Aplousina filum (Jullien), 1903

Plate 4, fig. 1

Membranipora filum Jullien, 1903:41
Biflustra lacroixii, Smitt, 1873:18.
Aplousina filum, Canu and Bassler, 1930:5 (synonymy).

Zoarium encrusting shells. The zooecia are distinct, rounded, ovate or elliptical; varying greatly in their dimensions, ranging in lengths from 0.60 to 0.80 mm and in width from 0.40 to 0.55 mm, shorter zooecia usually being wider. The walls are thin, the cryptocyst usually a mere granulated border but sometimes a little broader proximally; gymnocyst small or wanting; the opesia occupying nearly all of the front. A minute pointed spine is rarely present on the mural rim at each side of the operculum. No avicularia.

The ovicell is endozooecial but prominent, lunate, the aperture wide and closed by a special membrane; about 0.25 mm wide by 0.14 mm long, very finely granulated.

Known from the eastern Atlantic region, from the Gulf of Mexico (*Biflustra lacroixii,* Smitt, non Audouin), and from the Galapagos Islands, Albatross Sta. D. 2813 (Canu and Bassler).

Hancock Stations: 557-36, Isla Partida and 267, San Esteban Island, Gulf of California; 328, Cocos Island, Costa Rica; 431-35, Octavia Rocks, Colombia; 155-34, Albemarle Island and 788-38, Daphne Major Island, Galapagos; 14 to 60 fms.

Aplousina major new species

Plate 4, fig. 2

The zoarium forms a thin yellowish or brownish crust on shells. Zooecia very large, averaging in length about 0.90 mm (range 0.80 to 1.20 mm) and in width about 0.70 mm. There is great variation in the shape, as wide as long to twice as long as wide. A narrow brown line separates the mural rims which are thin and beaded all around the border except that the distal rim is sometimes smooth. The opesia occupies all of the front; gymnocyst wanting; cryptocyst narrow, descending sharply, often scarcely evident. The chitinous ectocyst is unusually thick, yellow to brownish in color; the operculum very large (0.25 mm wide), thicker

and browner toward the border, and the border of the aperture is also thick and brown. Dietellae present. No spines, no avicularia.

The ovicell is inconspicuous, transverse, very shallow, smooth or becoming roughened, or with a small median callosity.

This species resembles *A. gigantea* Canu and Bassler (1928:20) from the Gulf of Mexico, but it is even larger and the operculum is much larger (0.20 mm wide in *gigantea*). It is still larger than in *A. filum,* the other species from the Pacific coast.

Type, AHF no. 15.

Type Locality, Hancock Station 1271-41, off Anacapa Island, southern California, 33°59′50″N, 119°24′30″W, 26 fms. Also Stations 1284-41, Santa Rosa Island, and 1190-40, Anacapa Island, southern California; 275-34, Tenacatita Bay, Mexico, and 810-38, Barrington Island, Galapagos, 15 to 48 fms. The type colony from Anacapa Island, southern California, measured about 50 mm across, practically covering a dead shell.

Genus **CRANOSINA** Canu and Bassler, 1933

The ovicell is endzooecial. A setiform transverse avicularium surmounts each zooecium. The dietellae are extremely conspicuous and about four in the distal half of the lateral wall, their openings to the zooecia often large. Genotype, *Membranipora coronata* Hincks, 1881 (after Canu and Bassler).

The genus is here referred to the Family Hincksinidae with endozooecial ovicells.

Cranosina colombiana new species

Plate 4, fig. 3

Zoarium encrusting on shell, thin and white. Zooecia elongate ovoid, varying considerably in form and size, average length 0.55 mm (0.50 to 0.65), width 0.30 mm (0.25 to 0.40); separated by narrow grooves; mural rim thin, beaded in advanced calcification, slightly more elevated distally; gymnocyst and cryptocyst usually vestigial. There are 4 or 5 weak spines on each side, somewhat curved over the opesia, but no distal spines.

At the distal end of each zooecium (occasionally wanting) and occupying a position in the zooecial series, is an avicularian chamber, usually more or less square and measuring about 0.15 mm in each dimension, though there is much variation in the size. The avicularium is transverse, the mandible decurved strongly (sometimes slightly curved side-

ways also), triangular at its base and much narrowed beyond, never longer than the breadth of the opesia and not winged; the mandible is attached by prominent hinge teeth.

There is no external indication of ovicells except a slight elevation and thickening of the distal rim. The dietellae are large and open widely.

Spines are not known in the other species which have been assigned to this genus, but the nature of the avicularium and the endozooecial ovicells seem to place the present species in *Cranosina* without question. It resembles *C. coronata* (Hincks) in general appearance, but in *coronata* the mandible is very elongate (nearly as long as the zooecia) and winged, and there are no spines. It also resembles *Copidozoum transversum* Silen (1941:41), which may have to be placed in *Cranosina,* but it is evidently a different species.

Type, AHF no. 16.

Type locality, Hancock Station 431-35, off Octavia Rocks, Colombia, 6°47′20″N, 77°41′40″W, at 45 fms, several colonies on pebbles.

Genus **ELLISINA** Norman, 1903

Ellisina Norman, 1903: 596.
Ellisinidra Canu and Bassler, 1933:18.
Ellisina, Hastings, 1945:87.

Genotype, *Membranipora levata* Hincks, 1882:249. "Zooecia membraniporine, ovicells endozooecial and closed by the zooecial operculum, avicularia vicarious and pointed, pore chambers present. It appears that the ovicell may be immersed in a kenozooecium (*E. levata*), a vicarious avicularium (*E. antarctica*) or an autozooecium (*E. incrustans*)" (Hastings, 1945:87).

The above description may now stand for this genus, which has been much misunderstood even by its original author. Norman erected the generic name, giving *levata* Hincks from the Queen Charlotte Islands as the genotype, but unfortunately drew his description from a Gulf of St. Lawrence specimen which was misidentified and which belongs elsewhere. Norman's description of the genus is therefore in error, but his selection of *levata* as the type definitely attaches the name *Ellisina* to the species *levata.* Hastings (1930:713) pointed out Norman's error in identification, but wrongly accepted his description as fixing the generic name to the St. Lawrence specimen. More recently Hastings (1945:87) has corrected her error because "a genotype explicitly named in the introduction of a genus must stand despite any such discrepancies in the defi-

nition." In the meantime Canu and Bassler (1933:18) mistakenly renamed the genus *Ellisinidra* with *levata* Hincks as the genotype. These authors apparently did not examine material of *levata* since they indicate that the "ovicell is hyperstomial."

The avicularia are definitely members of a zooecial series, each one arising at the distal end of the preceding zooecium. This is clearly shown at the margin of the zoarium where a complete zooecium is followed by a developing avicularian chamber. Avicularia are usually present distal to the zooecia but they are sometimes absent and the latter condition seems to negate the supposition of Canu and Bassler that "they are necessary in the opening of the opercular valve."

Ellisina levata (Hincks), 1882

Plate 4, fig. 4

Membranipora levata Hincks, 1882:249; 1884:10.
Ellisinidra levata, Canu and Bassler, 1933:18.
Ellisina levata, Hastings, 1945:87.

Zoarium encrusting, smooth, white. Zooecia of moderate size (length 0.40 to 0.53 mm and width 0.25 to 0.30 mm), very distinct with broad separating grooves. Gymnocyst small and smooth, cryptocyst narrow, thin and slightly granulated. Opesia oval or elliptical, occupying nearly all of the frontal area, the walls thin and the mural rim smooth, no spines. Pore chambers present. The avicularia are interzooecial, the chambers go down to the level of the dorsal side and each chamber has a large distal pore connecting with the next distal zooecium. The chamber is more or less square (0.10 to 0.13 mm in either dimension), the avicularium mounted near the middle of the frontal surface, the rostrum elevated and the triangular mandible directed transversely (with some variation).

According to Hastings, who has examined the type material, the ovicell is endozooecial and embedded in a kenozooecium (avicularian chamber without an avicularium), and is closed by the zooecial operculum.

While this species has been the subject of so much discussion, it apparently has been known only from Hincks' material, "Houston Stewart Channel, 15-20 fathoms; Cumshewa; very abundant," British Columbia.

Hancock Station 1064, off Santa Barbara Island, California, 27 fms, one colony on a shell, not in reproduction.

Genus ANTROPORA Norman, 1903

Antropora Norman, 1903:87.
Membrendoecium Canu and Bassler, 1917:17.
Dacryonella Canu and Bassler, 1917:28.
Antropora, Harmer, 1926:232.
Canua Davis, 1934:215.
Antropora, Marcus, 1937:50.
Antropora, Silen, 1941:43.

Norman indicated the heavy cryptocyst, surrounding the aperture; the paired avicularia at the distal ends of the zooecia; the presence of dietellae, and the genotype, *Membranipora granulifera* Hincks. Harmer's description is more complete, adding the fact that the ovicells are endozooecial and vestigial and that the avicularia do not always face each other. However, he refers to the avicularia as "adventitious" which is incorrect since dissection proves them to be interzooecial.

I am unable to draw any line of distinction between *Antropora, Membrendoecium* and *Dacryonella,* and *Canua* is merely a new name for *Membrendoecium* which was improperly founded and which Canu and Bassler have corrected. In all of these the cryptocyst is heavy, broad proximally and continued, at least narrowly, around the aperture; the ovicell is endozooecial and vestigial; all have small interzooecial avicularia at or near the proximal corners; all are provided with dietellae, and all are heavily calcified.

Dacryonella has a large cryptocystal lamina, but not larger than it often is in some species that have been allotted to *Antropora* and *Membrendoecium,* and it has the same form. The avicularia of *Antropora* are not "adventitious," as stated by Norman and Harmer, since both dissection and the manner of development at the growing edge prove them to be interzooecial in origin.

Antropora granulifera (Hincks), the genotype, occasionally has larger interzooecial avicularia, and this is also true of other species, such as *A. (Crassimarginatella) tincta* (Hastings), *A. (Membrendoecium) claustracrassa* (Canu and Bassler), *A. (Membrendoecium) compressa* (Osburn) and *A. (Crassimarginatella) leucocypha* (Marcus). None of the above species have the hyperstomial ovicell and the type of avicularium with a complete hinge bar of *Crassimarginatella crassimarginata* (Hincks).

Through the kindness of Dr. R. S. Bassler, who has shown similar courtesies on many occasions, the writer has had the opportunity to make

dissections of both fossil and recent types of *Dacryonella* (*D. octonaria* Canu and Bassler, *D. typica* Canu and Bassler and *D. trapezoides* Canu and Bassler), all of which show the fundamental characters of *Antropora*. Marcus (1937:50) placed *Dacryonella minor* (Hincks) under *Membrendoecium;* Osburn (1940:358) placed *Dacryonello typica* Canu and Bassler in *Canua (Membrendoecium)*, and Silen (1941:43) comes to the conclusion that *Membrendoecium* "cannot be kept apart from *Antropora*."

KEY TO THE SPECIES OF *Antropora*

1. Avicularium with a triangular mandible. 2
   Avicularium with a semicircular or very slightly triangular mandible, small but varying greatly in size, not regularly oriented, usually minute and vestigial. . . . . *tincta*
2. Avicularia with a triangular mandible, usually paired and directed forward, frequently vestigial and often wanting on one or both sides. . . . . *claustracrassa*
   Avicularia with acute triangular mandible, usually paired and directed toward each other across the proximal end of the zooecium, occasionally vestigial or wanting. . . . *granulifera*

Antropora granulifera (Hincks), 1880

Plate 4, fig. 5

Membranipora granulifera Hincks, 1880a:72.
Antropora granulifera, Norman, 1903:87.
Antropora granulifera, Harmer, 1926:232.
Antropora granulifera, Hastings, 1930:714.

Zoarium encrusting. Zooecia variable in size, but usually from 0.35 to 0.40 mm long by 0.25 to 0.30 wide; outlined by a thin mural rim; walls heavily calcified. Gymnocyst vestigial; cryptocyst thick and coarsely granulated, extending for about half the length of the zooecium and continued around the aperture; opesia subtriangular, its proximal border straight or slightly arched, the sides contracted slightly opposite the opercular attachment. The small avicularia vary somewhat, but characteristically there is a pair immediately distal to each zooecium, the mandibles sharply triangular, the rostra slightly elevated and directed toward each other, their points frequently touching. Norman (p. 88) describes them as "in the extreme upper part of the zooecium." Harmer (p. 233) considers them to be "proximal avicularia belonging to the succeeding zooecium." However, they do not "belong" to either zooecium, and dissection and development at the growing edge both show them extending to the dorsal wall, and at the edge the young avicularian

chamber can be seen to develop separately before the zooecium distal to it is calcified. They are therefore definitely interzooecial in origin, whatever their later surface relations may appear to be. They are not always paired, especially near the center of the zoarium, nor are they always directed toward each other.

The ooecia are vestigial, represented by a small transverse rib between the avicularia. Dietellae are present.

Probably distributed around the world in warmer waters; Madeira and Cape Verde Islands; Indian Ocean; Ceylon; Japan; East Indies at various localities; and recorded by Hastings from Jicaron Island, Panama. It has not been noted on the Atlantic coast of the Americas.

Hancock Station 264, south of White Friars Islands, off Petatlan Bay, Mexico, 25 fms, on a shell, and 457-35, Secas Islands, Panama, 12 fms, on shells; also, Gulf of Panama, Galtsoff collection, on pearl oysters.

Antropora claustracrassa (Canu and Bassler), 1930

Plate 4, fig. 6

Membrendoecium claustracrassum Canu and Bassler, 1930:7.

The zoarium encrusts shells, corals and coralline nodules, multilaminar, white and glistening. The zooecia are of moderate size, about 0.40 to 0.50 mm long, but there is much variation; distinct with deep furrows; mural rim thin; cryptocyst granular, broad proximally and extending on the sides along the operculum, crenulated on the inner margin. Opesia oval, the distal end narrower. At the proximal end there is, on one or both sides, a small interzooecial avicularium with a triangular mandible which is usually directed straight forward. From their position the avicularia often appear to be frontal, especially when only one is present, but disssection shows the minute cavity of the chamber extending to the level of the dorsal side.

The ovicell is small, endozooecial and scarcely noticeable, but the operculum of the fertile zooecium is considerably larger and more heavily chitinized. Small dietellae are present. There are no spines, but occasionally small nodules occur in place of avicularia. The ancestrula is only about half as large as the later zooecia, but the "false ancestrulae" of the secondary lamina are noticeably larger than the ordinary zooecia.

Canu and Bassler described the species from the Galapagos Islands. The present work shows it to be a common species, ranging from Guaymas, Mexico, 27°56′N Lat. to La Libertad, Ecuador and the Galapagos Islands.

Hancock Stations: 143-34, Wenman, 155-34, Albemarle, and 170-34, Chatham Islands, Galapagos; 212-34, La Plata, and 12-33, La Libertad, Ecuador; 411-35, Gorgona Island, Colombia; 298-34, Clarion Island, west of Mexico; 276-34, Tenacatita Bay, Mexico; 283-34 and 286-34, Thurloe Head, west cost of Lower California; 591-36, Puerto Escondido, 659-37, Agua Verde Bay, and 1088, Ensenada de San Francisco, Gulf of California; from shore to more than 100 fms.

Antropora tincta (Hastings), 1930

Plate 4, fig. 7; plate 29, figs. 7 and 8

Crassimar ginatella tincta Hastings, 1930:708.
Membranipora lacroixii Robertson, 1908:261, (in part).

The zoarium encrusts shells especially and on dead gastropod shells inhabited by hermit crabs it sometimes develops erect irregular branches as much as 50 mm in height; multilaminar to a high degree; color ranging from white in younger stages through light pink to pinkish-brown. The zooecia are irregularly oval, with one or two triangular or somewhat rounded areas at the proximal end of each zooecium (vestigial avicularia), the appearance being similar to that of *Conopeum (lacroixii) reticulum.* The areas, however, are not developed on the gymnocyst, as dissection shows a tube descending to the dorsal side. Small functional interzooecial avicularia are scattered irregularly among the zooecia in a similar position, or replacing a zooecium at the beginning of a series; they are often wanting over large areas, or there may be several of them in the field of the microscope at once. There are no spines and the ovicells are endozooecial. The mural rim is thin, but the rather heavy descending cryptocyst is granular and there may be a narrow horizontal shelf which sometimes develops minute denticles on its margin. The avicularian mandible is semicircular or somewhat triangular in form with a rounded tip; there is no pivotal bar, but well-marked hinge denticles are present. Because of the endozooecial ovicell this species cannot remain in *Crassimarginatella,* and it has the appearance of a species of *Antropora* with somewhat larger and less pointed avicularia.

Described by Hastings from Balboa, Canal Zone, from the Galapagos Islands, and also recorded from Mazatlan, Mexico, in the Busk collection.

Hancock Stations: Occurring in 47 of the Hancock dredging stations from Point Conception, California, to Peru and the Galapagos Islands, at depths from 2 to 78 fms.

Genus CAULORAMPHUS Norman, 1903

The frontal area entirely membranous, the walls comparatively thick with numerous spines; avicularia stalked, tall and slender with a narrow base, situated among the lateral spines but arising just outside of the row of spines on the lateral area of the wall. Pore chambers present. Ovicell endozooecial or wanting. Genotype, *Flustra spiniferum* Johnston.

Key to Species of *Cauloramphus*

1. Zooecia well separated by deep grooves. 2
   Zooecia closely set, interzooecial grooves inconspicuous. . *spiniferum*
2. Moderately large, walls high, spines all long and nearly erect, avicularium tall and gradually enlarged above the narrow . . . *cymbaeformis*
   :d over the opesia, ... expanded. 3
3. The two distal pairs of spines stout and erected, the others sharp-pointed and curved strongly over the opesia, usually brown in color. . . . . *brunea*
   The distal pair of spines directed forward, the others more or less curved over the opesia, all the spines slender. . . *echinus*

Cauloramphus spiniferum (Johnston), 1832

Plate 5, fig. 9

?*Membranipora variegata* Hincks, 1889:8.
Membranipora spinifera, Robertson, 1900:324; 1908:265.
Membranipora spinifera, O'Donoghue, 1923:26; 1926:39.
Cauloramphus spiniferum, Hastings, 1930:713.

It is a moderately large species, the colonies often covering several square centimeters. The zooecia are large, the opesia measuring 0.40 to 0.55 mm in length. The stalked avicularia are usually abundant, erect and at first glance may be mistaken for stout spines. The distal spines around the opercular area are more or less erect, those around the proximal half of the opesia are smaller, sharp pointed and curve over the opesia; the usual complement of spines is 4 or 6 oral and the same number of the more proximal spines.

This well-known North Atlantic species is distributed abundantly along the west coast of North America from Alaska (Robertson) to southern California, and thence more sparingly to the Galapagos (Hastings) and Chile.

In the Hancock collections it was found at 25 stations, chiefly about the Channel Islands off the coast of southern California. Also found

abundant on rocks along shore in the region of Monterey Bay and at La Jolla, California. Also, Gulf of Panama, Galtsoff collection on pearl oysters.

Cauloramphus echinus (Hincks), 1882

Plate 5, fig. 8

Membranipora echinus Hincks, 1882:250; 1884:8.
Cauloramphus echinus, O'Donoghue, 1926:39.

Resembling *C. spiniferum* (Johnston) but much smaller with shorter and more slender spines; the zooecia more separated; the avicularia are shorter, more bulbous, with shorter stalk, and the rostrum is more strongly hooked. The opesia measures 0.25 to 0.30 mm in length. The stalked avicularia are less numerous than in *spiniferum.* The full complement of spines is about 8 on each side, the terminal ones directed forward, the next two pairs more or less erected, and the remainder bending over the opesia; all of the spines are more slender than those of *spiniferum.*

Described by Hincks from the Queen Charlotte Islands and recorded by O'Donoghue from numerous localities in the Vancouver Island region, low tide to 30 fms.

The above comparison is from a specimen in the author's collection, "Virago Sound, British Columbia, Queen Charlotte Islands, 8-15 fath., G. M. Dawson," and is no doubt from the same material as Hincks' type.

Hancock Station 1281-41, east of Santa Rosa Island, California, 23 fms. Also collected at Tomales Bay, California, R. J. Menzies, collector.

Cauloramphus brunea Canu and Bassler, 1930

Plate 5, fig. 6

Cauloramphus brunea Canu and Bassler, 1930:10.

The zoaria are small, encrusting shells, pebbles and corallines. The zooecia are comparatively small, averaging 0.45 mm long by 0.35 mm wide; the separating grooves very broad so that the opesia are about as far apart as their own width. The mural rim is elevated and thick; the opesia elliptical, about 0.30 mm long by 0.15 mm wide; the descending cryptocyst granulated. A closely set row of spines surrounds the whole opesia; the distal 4 or 6 are longer and more erect, projecting somewhat forward; the remaining ones, 4 to 6 on each side, are smaller, more sharply pointed, and curve rather high over the opesia. The stalked avicularia, which are not abundant, are slender and elongate, the pedicel often longer than the expanded portion.

Canu and Bassler named this species because of the striking brown color of the spines in their specimens, but all gradations of color occur; some colonies have pale brown spines, others have the brown only at the base and others are pure white. The avicularia are always white and glistening. The species was originally described from the Galapagos Islands, Albatross Sta. D. 2815.

Hancock Stations: 137-34, Clarion Island, west of Mexico; 155-34, Albemarle Island, 167-34 and 451, Charles Island, 182-34 and 462, James Island, Galapagos; 431-35, off Octavia Rocks, Colombia; 14 to 100 fms. Also, Gulf of Panama, Galtsoff collection, on pearl oysters.

Cauloramphus cymbaeformis (Hincks), 1877

Plate 5, fig. 7

Membranipora cymbaeformis Hincks, 1877:99; 1888:217.
Membranipora cymbaeformis, Osburn, 1912:230.
Callopora cymbaeformis, Osburn, 1919:614; 1923:8D.
Cauloramphus cymbaeformis, Osburn, 1932:9.

The zoarium encrusts the stems and fronds of Bryozoa, hydroids, etc., especially on the dorsal side of *Dendrobeania murrayana* (Johnston). The zooecia are moderately large, up to 0.75 mm long, the walls high and the mural rims well separated. The gymnocyst is variable, sometimes one-third of the zooecial length but usually much shorter; cryptocyst narrow, smooth or faintly granular; 4 to 6 spines on each side, tall and slender (the distal ones may be 0.40 mm long), the proximal ones curved more or less over the opesia, the distal ones directed forward. The avicularia are tall, with a slender stalk which is graduated into the avicularian body, rising among the spines but taking their origin just outside of the row of spines.

A common species on the Atlantic coast of North America from Cape Cod, Massachusetts, to Greenland. Recorded from Icy Cape, Alaska (Osburn, Canadian Arctic Expedition).

Common at Point Barrow, Alaska, G. E. MacGinitie, collector, Alaska Research Laboratory.

Cauloramphus variegatum (Hincks), 1884

Membranipora variegata Hincks, 1884:8.

Jelly's Catalog makes this a synonym of *M. echinata* d'Orbigny, presumably with Hincks' approval. It is a *Cauloramphus* as Hincks mentions the presence of stalked avicularia. *Cauloramphus spiniferum* (Johnston) is a very common species all along the coast and frequently has the bases of the spines dark colored as in Hincks' description of *variegata*. It seems probable that *variegata* is merely a color form of *spiniferum*. The *M. echinata* (*eschinata* in the text) of d'Orbigny from Chile, is described and figured as having only three pairs of spines, all of which are on the distal half of the zooecium.

Family **Alderinidae** Canu and Bassler, 1927

In establishing this family the authors state simply, "We propose this new family for all the Membraniporae in which the ovicell is hyperstomial." This appears to be the only constant character in the midst of much diversity, but as it represents a type of reproduction different from other membranipores it is sufficiently definite.

The gymnocyst in the Alderinidae is usually small, but may cover half or more of the frontal length (*Doryporella*). The cryptocyst, in most cases, is confined to the descending portion, but it may expand to form a considerable proximal lamina. Spines are extremely varied both in number and form; occasionally they are wanting; usually they are simple in form, but they are sometimes branching and cervicorn. Avicularia are often present on the proximal gymnocyst, less frequently they occur on the lateral walls; in several genera they are interzooecial, or they may be wanting entirely.

In the following classification the genera are separated, first, on the mode of interzooecial communication, either pore chambers or rosette plates; second, on the manner of the closure of the ovicell, by the operculum or by a special membrane; third, by the nature of the avicularia, interzooecial or adventitious on the zooecial front. Some of these characters require close observation, but they appear to be the most fundamental features of the family, and the techniques are not difficult to acquire.

Key to the Genera of Alderinidae

1. Pore chambers (dietellae) present. 2
   Multiporous or uniporous septulae. No dietellae. 6
2. No avicularia, no spines. . . . . *Alderina*
   Avicularia present. 3

3. Avicularia interzooecial. 4
   Avicularia dependent, basal or lateral or both. 5
4. Avicularium associated with a kenozooecium. . . . . *Parellisina*
   Avicularium normal, interzooecial. . . . . *Copidozoum*
5. Gymnocyst small, less than one-third of the front. . . *Callopora*
   Gymnocyst extensive, one-half or more of front. . . *Doryporella*
6. Ovicell closed by the operculum. . . . . *Membraniporidra*
   Ovicell closed by a special membrane. 7
7. Avicularia and spines wanting. . . . . *Mollia*
   Avicularia and spines present. 8
8. Avicularia interzooecial, with rounded or spatulate mandible; fenestrae usually present between the zooecia. . . *Retevirgula*
   Avicularia dependent, basal or lateral or both. 9
9. Spines present, basal avicularium covers front or ovicell (except in *T. magnipora*). . . . . *Tegella*
   No spines; dorsal wall with white punctuations. . . *Bidenkapia*

Genus ALDERINA Norman, 1903

The front wall is entirely membranous, side walls crenulated; no spines, but nodular processes sometimes present; no avicularia. Dietellae present. Ovicell usually bearing a rib or depressed area. Genotype, *Membranipora imbellis* Hincks, 1880:275.

Alderina smitti new name

Plate 6, fig. 2

Membranipora irregularis, Smitt, 1873:8 (not d'Orbigny, 1839:17).
Alderina irregularis, Canu and Bassler, 1928:27.
Alderina irregularis, Hastings, 1930:708.
Alderina irregularis, Osburn, 1940:363; 1947:13.

It has been recognized for a long time (see Canu and Bassler, 1920: 142) that Smitt's *M. irregularis* is not that of d'Orbigny and a new name should be given it. It seems proper that it should be named after the great Swedish bryozoologist who described and figured it carefully.

Zoarium encrusting on stones, shells and corallines. Zooecia of moderate size, 0.45 to 0.55 mm long by about 0.35 mm wide; gymnocyst small, usually wanting, cryptocyst broad, descending, without horizontal lamina, continuing on the sides rather broadly to the operculum, the margin crenulated. The opesia is ovate and narrowed at the level of the operculum which has a brown bordering sclerite. Dietellae present. No spines, no avicularia.

The ovicell is prominent, thick walled, not closed by the operculum, 0.26 mm wide.

In the Atlantic area the species has been recorded by Smitt, Osburn, and Canu and Bassler from the Gulf of Mexico, Florida Straits, north of Cuba and the south shore of the Caribbean Sea, and Hastings recorded it from Gorgona, Colombia, in the Pacific.

Hancock Stations: 1325-41, Santa Catalina Island, California; 2167, Dewey Channel, west coast of Lower California; 591-36, Puerto Escondido, Gulf of California; 129-34, Socorro Island and 219, Clarion Island, west of Mexico; 155-34, Albemarle Island and 170-34, Chatham Island, Galapagos; shore to 60 fms. Also, Galtsoff collection, Gulf of Panama, on pearl oysters. The known distribution on the Pacific coast is from southern California to the Galapagos Islands.

Alderina brevispina (O'Donoghue), 1926

Plate 6, fig. 3

Callopora brevispina O'Donoghue, 1926:35.

Membranipora lacroixii var. *triangulata,* O'Donoghue, 1923:25, part.

This species very definitely belongs in the genus *Alderina.* It might readily be mistaken for the more southern *A. smitti* (*A. irregularis,* Smitt, non d'Orbigny) but for its much larger dimensions. It has the same zooecial and opesial form, the cryptocyst is of the same type and the operculum is a counterpart of that of *smitti* except for size. Dietellae present. A minute spine, sometimes reduced to a tiny nodule and usually entirely wanting, on each side opposite the operculum. Zooecial length 0.65 to 0.80 mm, width 0.50 to 0.60 mm.

The ovicell is more transverse than that of *smitti,* less rounded on the distal side and it is much broader, 0.40 mm.

Known only from British Columbia waters, Gabriola Pass and Banks Island. A specimen from Cadboro Bay, Victoria, British Columbia, in the writer's possession, extends the range slightly southward.

Genus MOLLIA Lamouroux, 1916

Zooecia more or less separated and connected by lateral and proximal tubes; cryptocyst extensive; operculum attached to strong condyles; short dorsal tubes for attachment to the substratum; no avicularia, no spines. Ovicell hyperstomial. Genotype, *Eschara patellaria* Moll, 1803:75.

The position of this genus in the classification has always been questionable. Lamouroux (1816:115) removed *patellaria* from the old Linnaean genus *Eschara* where Moll had described it and placed it next to *Flustra.* Heller (1867:94) redescribed it as a new species, *Diachoris simplex,* placing it in that genus because of the connecting tubules. Smitt

(1873:12) retained the genus *Mollia* and placed it next to *Membraniporella.* Waters (1897:667) discarded *Mollia* and listed *patellaria* under *Membranipora,* which appears to be the best guess to date. Canu and Bassler (1928:69), because of the appearance of the frontal associated it tentatively with the Division Coilostega, in the family Aspidostomatidae.

The simplicity of *M. patellaria,* which lacks most of the characters commonly used in classification, is responsible for most of the difficulty. However, the absence of characters which would relate this form to any of the Coilostegan species is important, for there is no polypide tube and I have been unable to find any trace of opesiular muscles or of their dorsal attachments and there are no opesiular notches or slits. Canu and Bassler recognized this difficulty in their statement "the genus could just as well be classed next to *Amphiblestrum.*" It is similar to *Retevirgula* in the tubular connections between the zooecia and in the tubular dorsal attachment processes but that genus possesses avicularia and spines.

Because of the hyperstomial ovicell, the general membraniporoid simplicity and the absence of characters which would definitely locate it elsewhere, I suggest that its proper place is somewhere in the family Alderinidae and probably near to *Alderina,* with which it agrees in the hyperstomial ovicell and the absence of avicularia and spines. It agrees with *Alderina* also in the presence of pore chambers, which appear to replace the connecting tubules when the latter are absent.

Mollia patellaria (Moll), 1803

Plate 4, figs. 8 and 9; Plate 29, fig. 6

Eschara patellaria Moll, 1803:75.
Diachoris simplex Heller, 1867:94.
Mollia patellaria, Smitt, 1873:12.
Membranipora patellaria, Waters, 1898:667.
Membranipora patellaria, Calvet, 1902:12.
Mollia patellaria, Canu and Bassler, 1928:69.

Zoarium encrusting loosely, attached by tubular dorsal processes, pale and shining. Zooecia small, averaging about 0.40 mm long by 0.26 mm wide, ovate with the distal end evenly rounded and slightly raised. The earlier zooecia near the center of the colony are more or less disjunct and connected by 6 or 8 short tubules, one at each end and 2 or 3 on each side; outside of the central area the side walls of the zooecia are in direct contact. The mural rim is moderately thick and coarsely granulated, somewhat thinner at the distal end. The cryptocyst covers about two-thirds of the frontal length, distinctly granular, its distal end more

or less transverse; the opesia is trifoliate, the operculum very small (0.08 mm wide), semicircular and attached to conspicuous cardelles. Avicularia and spines wanting.

The species is known from the Mediterranean Sea, the Gulf of Mexico and Australia.

Hancock Station 1662-48, Santa Cruz Island, southern California, 23 fms, several colonies on shells. Also one colony on a shell from San Felipe, Mexico.

Genus MEMBRANIPORIDRA Canu and Bassler, 1917

"The operculum always closes the ovicell. No dietellae. No avicularia. One large distal septula; two pairs of lateral septulae" (C. and B.). Genotype, *M. porrecta* Canu and Bassler, 1917.

The ovicell is hyperstomial but is deeply excavated in the base of the distal zooecium, seeming to extend almost to the dorsal wall. The genus appears much like *Alderina,* with which it may readily be confused, but there are no dietellae and the ovicell is closed by the operculum.

Membraniporidra porosa new species

Plate 6, fig. 1

Zoarium forming a thin incrustation on a gastropod shell.

Zooecia large, 0.75 to 0.90 mm long by 0.55 to 0.65 mm wide; very distinct, the walls sloping strongly inward and upward, and separated by a broad and deep sulcus; the mural rim and small gymnocyst smooth and shining; cryptocyst slightly granulated (scarcely evident). The mural rim is thin, without spines (one zooecium bears a pair of small tubercles opposite the distal end of the operculum; these are on the outside of the mural rim and do not rise above its level). The opesia is large, length 0.65 to 0.80 mm, width 0.45 to 0.55 mm, rather regularly elliptical in form. The frontal ectocyst is moderately thick and pale yellow in color; the operculum more heavily chitinized and with a thickened brown border, width 0.20 mm. No avicularia. No dietellae.

The ovicell is hyperstomial, closed by the operculum, prominent, subglobular, thick-walled, smooth and shining and perforated by numerous pores; width 0.30 to 0.35 mm, length 0.25 to 0.30 mm.

This species is placed in the genus *Membraniporidra* because of the absence of avicularia and spines and the presence of a hyperstomial ooecium closed by the operculum. The general appearance of the zooecia is similar to that of species of *Aplousina,* but the well-developed hyperstomial ooecium excludes it from that genus. The perforation of the

ooecium is an unusual character in Alderinidae. The genus is well represented in the American Tertiary, but no recent species has hitherto been recorded from American waters.

Type, AHF no. 17.

Type locality, Hancock Station 1914-39, off Pyramid Cove, San Clemente Island, California, 78-110 fms, encrusting a gastropod shell.

Genus **CALLOPORA** Gray, 1848

Genotype, *Flustra lineata* Linnaeus.

Gray's genus was neglected almost entirely for many years until reestablished by Norman (1903:588). The characters given by Norman are: front wall entirely membranous, marginal walls more or less thickened and crowned with a few or many spines. Ovicell commonly with a rib across the front. Sessile avicularia with acute mandible at the bottom of the zooecium and above the ovicell or in a lateral position on one or both sides of the oral opening, or in both positions in the same species. Usually two pairs of lateral and one distal dietellae.

Canu and Bassler (1920:146) included the *tenuirostris* group of Waters, but Harmer has established the genus *Copidozoum* for this group and his judgment is accepted here. This excludes those species in which the avicularia are large, vicarious and replace zooecia in the series. *Callopora* has been much misunderstood and many species have been listed under this genus which properly belong elsewhere.

Key to Species of *Callopora*

1. Avicularia wanting, accessory distal spines outside of the main row. . . . . *whiteavesi*
   Avicularia present 2
2. Lateral (distal) avicularia only. 3
   Proximal avicularia present. 4
3. Avicularia minute, marginal, spines long and numerous. . . . . *corniculifera*
   Avicularia somewhat larger, spines fewer and shorter. . . . *exilis*
4. Proximal avicularia only, single or paired. 5
   Both proximal and lateral avicularia present. 9
5. Avicularia large, often curved around the opesia. 6
   Avicularia smaller, mandible straight. 7
6. Zooecia well separated, with areolations between. . *circumclathrata*
   Zooecia closer together, no interzooecial areolations. . . *horrida*
7. Spines 1 to 3, ovicell with a v-shaped area. . . . . *aurita*
   Spines numerous. 8

8. Spines usually 7 on each side, distal ones erect, proximal ones directed somewhat forward, meeting over opesia. . . . *craticula*
   Spines 5 or 6 on each side, directed more laterally and not meeting over the opesia. . . . . *lineata*
9. Lateral avicularia elevated, at the side of the operculum. . *armata*
   Lateral avicularia proximal to the operculum, little elevated; ovicell very small. . . . . *inconspicua*

Callopora armata O'Donoghue, 1926

Plate 6, fig. 10

Callopora armata O'Donoghue, 1926:34.

The zoarium is moderately thin, encrusting and white. Zooecia distinct, with occasional small interzooecial fenestrae; moderate in size (0.50 to 0.60 mm long by 0.26 to 0.30 mm wide); the opesia elliptical (0.35 to 0.40 mm long by 0.30 to 0.26 mm wide), constricted rather sharply at the operculum which is 0.13 to 0.15 mm in width. The walls are moderately thick, the mural rim low and smooth; the descending cryptocyst thin but conspicuously and evenly crenate to the region of the operculum; gymnocyst occupying about one-fourth of the frontal length. Spines: a small erect one at each distal corner, along each side 4 or 5 more or less arched over the opesia, and a similar median proximal spine. Avicularia: one of moderate size on the front of the gymnocyst, often replaced by a pair of smaller ones; one on each side near the distal corners with the mandible directed forward and inward; occasionally an additional small avicularium on one or both sides at about the middle of the opesia.

Ovicell hyperstomial, somewhat immersed, the ectooecial layer not quite complete, slightly granular and without transverse rib; the avicularium distal to the ovicell is only slightly enlarged.

This description differs somewhat from that of O'Donoghue, especially in the number and arrangement of the avicularia, but as he found no ooecia he was doubtless describing a younger stage. Some doubt is therefore attached to the present identification. The species was described from a single specimen from Bull Passage, British Columbia in 30-35 fms. The general appearance of this species is similar to that of *Tegella arctica* (d'Orbigny), but it differs in the possession of pore chambers and in the nature of the ooecial cover.

Off Cadboro Bay, British Columbia, several colonies collected by G. E. MacGinitie.

Callopora aurita (Hincks), 1877

Plate 7, fig. 2

Membranipora aurita Hincks, 1877:213.
Membranipora aurita, Osburn, 1912:230; 1933:21.

Zoarium encrusting, usually on shells, forming very regular rounded colonies when not crowded. Zooecia moderate in size, ovate, considerably narrowed toward the distal end; walls high and strongly calcified; in older stages the cryptocyst forms a narrow shelf; gymnocyst occupying about one-fourth of the zooecial length. Usually with a single erect spine just proximal to the operculum on one or both sides, occasionally an additional smaller spine is present. Avicularia: when an ovicell is present there is a pair of small avicularia on the gymnocyst, directed forward and outward; in the absence of an ovicell there is a single larger avicularium with its mandible directed backward.

The ovicell is rounded, more or less immersed, with a strong raised rib which encloses a triangular area above the orifice and which may rise to form an umbo on the top.

This is a common species on both sides of the North Atlantic but its presence in the Pacific has not hitherto been noted.

Canoe Bay, Alaska, 125 fms, U. S. Alaska Crab Investigation, Sta. 24-40. Also at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Callopora circumclathrata (Hincks), 1881

Plate 8, fig. 2

Membranipora circumclathrata Hincks, 1881:131.
Membranipora circumclathrata, Robertson, 1908:259.
Membranipora circumclathrata, O'Donoghue, 1923:24.
Callopora circumclathrata, O'Donoghue, 1926:33.
Callopora circumclathrata, Canu and Bassler, 1923:43.
Retevirgula circumclathrata, Brown, 1948:110.

Zoarium encrusting on shells, stones and algae, but loosely attached. Zooecia about 0.50 mm long by 0.30 mm wide, well separated by deep grooves, or disjunct and united by short tubules with small fenestrae between them; walls moderately thick; mural rim smooth or slightly granular, the descending cryptocyst somewhat crenulate on its inner border; gymnocyst well developed, frequently covering one-third of the zooecial front; opesia oval to elliptical. Spines: one or two distal pairs more or less erect; three to five on each side, much flattened and bending strongly across the opesia, their points often touching.

A small avicularium, with some areolations about the base of the chamber, situated on the gymnocyst just proximal to the opesia, the mandible usually triangular but occasionally rounded; in the presence of an ovicell the avicularium becomes much larger, elongated and its chamber unites with the distal surface of the ectooecium.

The ovicell is prominent, rounded, the usual transverse rib present but reduced in size and there are fine longitudinal striae on the otherwise smooth surface. The ovicell, with the distal avicularium, resembles that of the *Tegella* species.

This species has recently been placed by Brown in his new genus *Retevirgula,* on the basis of disjunct zooecia with connecting tubules. That, however, appears to be the only character in common with that genus. Among the numerous colonies at my disposal I have found no zooeciules, though the avicularian chambers sometimes suggest that nature; they are very definitely frontal avicularia developed on the surface of the gymnocyst, and the tubules which appear to connect with them really are connected with the zooecium below the bases of the avicularian chambers. The ovicells of *circumclathrata* are not like those of *Retevirgula* as they lack the fenestra in the ectooecium; they have a fairly close resemblance to those of *Tegella,* but the presence of large dietellae removes them from that genus.

Hincks described the species from "Santa Cruz, California," Robertson listed it from "various localities near the coast of southern California," and O'Donoghue recorded it from numerous localities in British Columbia.

Hancock Station 1410-41, Santa Barbara Island, California, 20 fms. Numerous specimens from Del Monte, California, 25 feet, (in Miss Blagg's collection); also in shallow water at Palos Verdes, Redondo Beach and Santa Monica, California. Pleistocene of Santa Monica Canyon, California (Canu and Bassler). There is also a specimen labelled merely "off Colombia"; the datum is probably correct as all of the other species in the lot are definitely tropical.

Callopora corniculifera (Hincks), 1884

Plate 7, fig. 1

Membranipora corniculifera Hincks, 1884:11.

?*Cauloramphus triangularis* Canu and Bassler, 1923:48.

Zoarium encrusting. Zooecia moderately large, 0.60 to 0.70 mm long by 0.40 to 0.50 mm wide, distinct with broad separating grooves; gymnocyst usually small but occasionally as much as one-third of the zooecial

length; cryptocyst narrow, sharply descending, delicately crenated. Opesia oval, narrower at the distal end. Spines all tall, especially the distal ones, usually 8 or 9 on each side but often only 5 or 6; also there are 2 or 3 smaller spines distal to the oral spines, often wanting. The avicularia are minute, sessile, on the outer side of the mural rim usually a little proximal to the operculum, with a short-triangular mandible.

The ovicell is prominent, subglobose, 0.24 mm wide, and when completely calcified it has a pointed umbonate process just above the aperture. (Hincks' figure, 4a, plate 20, is misleading as the "horn-like projection from the center of the oral margin" appears to be horizontal).

Canu and Bassler were aware of the similarity to *corniculifera* in describing their *Cauloramphus triangularis* from the Pleistocene of Santa Barbara, but they could not know the range of variation in *corniculifera.* Except for the difference in size, the characters of *triangularis* fall within the range of variation in *corniculifera.* It cannot be a *Cauloramphus* on account of the hyperstomial ovicell, and the "semicircular area" is similar to that of *corniculifera* before calcification is complete.

Apparently this species has not been noted living since Hincks described it from Cumshewa, British Columbia.

Hancock Station 1171-40, Catalina Island, California, 38 fms, on brachiopod shells. Also at Tomales Bay, California, 6 fms, on a clam shell.

Callopora craticula (Alder), 1857

Plate 6, fig. 7

Membranipora craticula Alder, 1857:144.
Membranipora craticula, Hincks, 1880:147.
Callopora craticula, Osburn, 1923:8D.

Zoarium encrusting, forming a very spiny delicate layer on shells, stones, etc. Zooecia usually quite regularly disposed, 0.40 to 0.55 mm long by 0.25 to 0.30 mm wide; gymnocyst well developed; cryptocyst small; mural rim raised and narrow and beset with 7 to 9 spines on each side, the two anterior pairs long and erect, the others progressively shorter toward the proximal end and recumbent over the opesia; opesia oval, 0.25 to 0.30 mm long. There is a salient avicularium, with triangular mandible, on the gymnocyst in the midline or on either side; when an ovicell is present the avicularian chamber is usually enlarged and partially covers the distal end of the ooecium and the mandible is enlarged. The ooecium is large, hyperstomial, not closed by the operculum, smooth, with a raised rib across the middle.

It is a common species on the coasts of Europe and the Arctic seas and Osburn has recorded it from arctic America and down the east coast as far as to Cape Cod. It does not seem to have been noted on the Pacific coast, but there are specimens in the Hancock collections from Punuk Island in the Bering Sea and Cleveland Passage, Frederick Sound, Alaska. Common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Callopora exilis (Hincks), 1882

Plate 6, fig. 8

Membranipora exilis Hincks, 1882:249.
Callopora exilis, O'Donoghue, 1926:33.

Zoarium encrusting, thin. Zooecia distinct, rather regularly elliptical; the opesia occupies nearly all of the front and averages 0.40 mm long by 0.26 mm wide; walls low, well calcified, the descending cryptocyst narrow and smooth on its inner border; gymnocyst often well-developed. There are two pairs of small distal erect spines, and on each side are 4 to 6 small spines which bend slightly over the opesia. Occasionally there is a small avicularium on the side of the lateral wall, just outside of the row of spines; it is so obscure that it is easily overlooked.

The ooecia are small, rounded, prominent, without a rib, and smooth or with minute striations, 0.26 mm wide by 0.20 mm long.

Hincks described the species from Houston Stewart Channel, Queen Charlotte Island and O'Donoghue recovered it from Banks Island, Victoria, British Columbia and added to Hincks' description.

Canoe Bay, Alaska, 125 fms, U. S. Alaska Crab Investigation, Sta. 24-40.

Callopora lineata (Linneaus), 1758

Plate 6, figs. 4 and 5

Membranipora lineata, Hincks, 1880:143.
Callopora lineata, Osburn, 1923:7D.
Callopora lineata, O'Donoghue, 1926:32.

Zoarium encrusting. Zooecia moderate in size, averaging about 0.60 mm long by 0.35 mm wide; gymnocyst usually well-developed, occupying about one-third of the length; cryptocyst moderate, granulated, without horizontal lamina. Opesia elliptical or a little narrowed distally; walls beset with about 7 spines on each side, the two distal ones erect, the others bending somewhat over the opesia. Avicularia elevated on the gymnocyst, usually single (sometimes a smaller pair) with triangular mandible.

Ovicell prominent, rounded, smooth with a transverse rib, width about 0.25 mm.

This species has some resemblance to *C. craticula,* but Hincks (1889: 46) has indicated the differences: *M. lineata* differs in the larger size, the less regular arrangement of the zooecia, the spines rounded and much less recumbent.

It is a common Atlantic species, on the American coast from Cape Cod to Greenland and Osburn has recorded it as far west in the Arctic Ocean as Bernard Harbor, Northwest Territory (about 115 degrees W). O'Donoghue lists it at a number of localities in British Columbia.

Hancock Station 1662-48, Santa Cruz Island, southern California. Specimens also from Dillon Beach, California, Menzies, collector, and Nunivak Island, Alaska. It does not appear to be a common species on the Pacific coast.

Callopora horrida (Hincks), 1880a

Plate 6, fig. 9

Membranipora horrida Hincks, 1880a:82; 1884:7.
Membranipora californiensis Waters, 1898:681.
Membranipora horrida, Robertson, 1908:260.
Membranipora horrida, O'Donoghue, 1923:24.
Callopora horrida, O'Donoghue, 1925:97; 1926:33.

Zoarium encrusting shells, stones, sponges, etc. Zooecia ovate, very distinct with wide grooves; opesia more or less ovate, the mural rim thick, elevated and slightly crenate. Dietellae in the lateral and distal walls. Two or three pairs of stout erect distal spines and the same number of lateral ones which are smaller, sharp-pointed and curved over the opesia. A large avicularium is located on the basal gymnocyst, its long pointed mandible, which is often curved laterally, directed forward to one side of the opesia; occasionally smaller avicularia of similar form are present in the same position.

Ooecium rather small, globular, with a transverse rib near its aperture; the avicularium of the distal zooecium is often attached partly to the ooecium, but does not cover it as in the genus *Tegella.*

There is much variation in the number and size of the spines and in the width of the separating grooves.

Hincks described this species from California, as did Waters his *californiensis.* Robertson listed it from Puget Sound southward to Pacific Grove, California. O'Donoghue recorded it from numerous localities, Puget Sound northward in British Columbia.

Hancock Stations: 147-34, Tagus Cove, Albemarle Island, Galapagos, 30 fms; 788-38, Daphne Major Island, Galapagos, 70 to 80 fms; 1232-41, off San Pedro breakwater, California, 19 fms; 1410-41, Santa Rosa Island, California, 17 fms; and 275, Raza Isla, Gulf of California, 40 fms. Apparently it is much more abundant in its northern range.

Callopora whiteavesi Norman, 1903

Plate 6, fig. 6

Callopora whiteavesi Norman, 1903:589.
Membranipora lineata, Smitt, 1867 (in part, Pl. 20, fig. 26).
Membranipora whiteavesi, Levinsen, 1916:443.
Callopora whiteavesi, Osburn 1932:8.

Zoarium encrusting. Zooecia of moderate size, 0.50 to 0.60 mm long by 0.35 to 0.40 mm wide, the oval to elliptical opesia occupying about three-fourths of the length. The zooecia are well separated by rather broad grooves; the cryptocyst granulated and without horizontal lamina, the gymnocyst smooth. The spines, 8 to 11 on each side, are long and more or less erect, the distal ones directed forward; a few smaller terminal spines are sometimes present beyond the distal rim. Avicularia apparently are entirely wanting.

The ovicells are globose, prominent, smooth or delicately frosted with minute tubercles; in complete calcification there may be a slightly raised rib enclosing a triangular area on the front.

Described by Norman from East Finmark, Norway; since recorded by Levinsen from Greenland, and by Osburn from Ungava, Hudson Strait, and Port Churchill, Manitoba. The present records indicate that it probably has a circumpolar distribution.

Canoe Bay, Alaska, along shore, (U. S. Alaska Crab Investigation); Point Barrow, Alaska, 12 fms, G. E. MacGinitie, Arctic Research Laboratory.

Callopora inconspicua (O'Donoghue), 1923

Membranipora inconspicua O'Donoghue, 1923:29.

The small zooecia are oval, tending toward polygonal. The edges are covered by a thin, almost transparent, white lamella, which passes upward to a fairly regular oval aperture. The opesia has a sort of curved border around it, wider at the posterior end. Commonly two small avicularia are borne on this border, one on each side about one-third of the way from the distal end; their rounded mandibles face upward and

slightly inward and forward; sometimes, when an ooecium is present, a third slightly larger avicularium is produced at the end of this, its mandible facing upward and forward. Spines, 3 pairs of distal ones, long and erect, and back of these about 5 pairs of small pointed spines directed inward over the aperture. Ooecium small, but prominent, smooth, subglobular. (After O'Donoghue).

This species cannot remain in *Membranipora,* as that genus is now understood and, while its author did not discuss all the characters of generic importance, it appears to be best allocated to *Callopora.* Described from Northwest Bay and off Snake Island, British Columbia.

Callopora (?) verrucosa Canu and Bassler, 1930

This is a very unusual species which has not appeared in the Hancock collections. Canu and Bassler (1930:9) state that "The ovicell is hyperstomial, globular," which would indicate the genus *Callopora.* On the other hand, there are small interzooecial avicularia in the corners between the zooecia and some of these are vestigial, while around the zoarial border there is a band of similar heterozooecia, many of which bear avicularia with a short triangular mandible. The nature of the interzooecial avicularia and their vestigial counterparts suggests the genus *Antropora,* but the hyperstomial ovicell prevents inclusion in that genus. It was described from the Galapagos Islands, Albatross station D.2813.

Genus **COPIDOZOUM** Harmer, 1926

"Zooecia with greatly reduced gymnocyst, the membrane covering almost the entire frontal surface. Cryptocyst most developed proximally, moderate to extensive. Spines present, absent or vestigial. Avicularia vicarious, numerous, alternating with the zooecia, the rostrum triangular proximally, usually narrow and linear distally, the mandible of corresponding form. Ovicells hyperstomial." (Harmer, 1926:226). Genotype, *Membranipora plana* Hincks.

Key to Species *Copidozoum*

1. Spines wanting. 2
   Spines present. 3
2. Zooecia large, cryptocyst moderately developed, opesia elliptical. . . . . *planum*
   Zooecia moderate size, cryptocyst thick and coarsely granulated, opesia oval. . . . . *tenuirostre*
3. Spines all simple. . . . . *spinatum*
   Distal spines forked or alcicorn. . . . . *protectum*

Copidozoum tenuirostre (Hincks), 1880a

Plate 7, fig. 4

Membranipora tenuirostris Hincks, 1880a:70; 1884:7.
Callopora tenuirostris, O'Donoghue, 1926:33.
Callopora tenuirostris, Canu and Bassler, 1929:8.
Copidozoum tenuirostre, Marcus, 1937:48.

Zoarium encrusting. Zooecia of moderate size, usually between 0.45 and 0.55 mm in length, and 0.30 to 0.40 mm wide. Distinct, the walls thick and the descending cryptocyst heavy and coarsely granulated, without a horizontal lamina; gymnocyst little developed. Opesia ovate, usually distinctly narrowed at the operculum. Dietellae are usually present, one in the distal and one or two in the lateral wall, but the pore chambers may be absent leaving only large multiporous rosette plates, which appears to agree with the observations of Waters (1898:685) on Mediterranean specimens. The avicularia are interzooecial, occupying the place of zooecia; the chamber usually diamond-shaped; the rostrum long, elevated toward the tip and with a narrow groove; the mandible is elongated, almost filiform, with a triangular base attached to a pair of strong denticles. Spines wanting.

The ovicell is prominent, globose, minutely porous and decorated with minute knobs or merely granulated; not closed by the operculum.

The original description by Hincks (1880:70) states that there is "an acuminate spine at the bottom of the aperture bending inward, and usually two or three on each side." Spines are entirely wanting on all of the Pacific coast specimens; Waters (1898:685) found no lateral spines, except occasionally a small one proximal to the ovicell in Mediterranean material; and Marcus (1937:49) found no spines on specimens from Brazil, though they were present, as Hincks illustrated them, in specimens from St. Helena Island (1939:201).

Distributed around the world in tropical and temperate waters. Hincks and O'Donoghue recorded it from several localities in British Columbia and Canu and Bassler from the Galapagos Islands.

In the Hancock collections it occurred at 56 stations, distributed from northern California to Peru and the Galapagos Islands, and from low tide to 70 fms.

Copidozoum planum (Hincks), 1880

Membranipora plana Hincks, 1880a:81.
Copidozoum planum, Hastings, 1930:713.

"Zooecia large, oval, distinct, surrounded by a narrow border, which is rounded and finely crenate, sometimes slightly produced below the aperture and pointed; front wall wholly membranous, very much on a level with the margin of the cell, so as to give a flattened appearance to the surface of the zoarium. Avicularia scattered, placed in somewhat lozenge-shaped intercellular spaces; beak elongate, straight, occupying the center of the area, traversed by a narrow groove which expands toward the lower extremity; mandible with an enlarged base, above it setiform, slightly curved at the top. Ooecium rounded, rather large, frosted." (Hincks 1880a:81).

The species was described from Australia and has since been recorded from the Mediterranean (Canu and Bassler 1928:32); from Japan (*Membranipora vibraculoides* Okada, 1923:223), and Hastings has listed it from Coiba, Panama; Gorgonia, Colombia; the Galapagos Islands, and also mentions specimens from California in the British Museum. In all the numerous specimens I have examined from all along the coast from California to the Galapagos Islands there are none that I can positively separate from *tenuirostre* except on the basis of the lack of spines. I have found occasional specimens with thinner walls, but these were not larger than *tenuirostre.* This raises the question whether only those with heavy spines, as shown by Hincks (1880, plate 9, fig. 3) and Marcus (1937, text fig. 7) should be included in *tenuirostre* and those without spines under *planum,* regardless of the width of the cryptocyst. On this basis all of the Pacific coast specimens belong under *planum.*

Copidozoum protectum (Hincks), 1884

Plate 7, fig. 5

Membranipora protectum Hincks, 1884:10.
Membranipora protectum, O'Donoghue, 1923:25.
Amphiblestrum protectum, O'Donoghue, 1926:38.

Zoarium encrusting. Zooecia very distinct, moderate in size, 0.40 to 0.50 mm long by 0.25 to 0.30 mm wide. Gymnocyst and cryptocyst both small and the opesia occupies nearly all of the frontal area. The mural rim is thin and high, the descending cryptocyst narrow, without horizontal shelf, granulated. Spines: one erect, simple or slightly bifid, at each distal corner; one on each side of the operculum, also erect and

bifid; one more proximally on each side, alcicorn with 3 to 6 points, recumbent over the opesia; in advanced stages the points may fuse, as stated by O'Donoghue. The avicularia are interzooecial, with a very elongate narrow rostum, and the mandible is similarly long (as much as 0.40 mm) and attenuated or filiform. Dietellae present.

Ovicell rather large, averaging 0.20 mm wide, prominent, the surface delicately granulated.

O'Donoghue placed this species "provisionally" under *Amphiblestrum,* but the opesia occupies all of the frontal area; there is no horizontal cryptocyst, and the avicularia are vicarious.

Described by Hincks from British Columbia and recorded by O'Donoghue from numerous localities from Victoria and the San Juan Islands northward.

Hancock Stations: Distributed along the whole western coast of the United States and south along the peninsula of Lower California, and in the Gulf of California.

Copidozoum spinatum new species

Plate 7, fig. 3

The only colony completely encrusts a rounded object. The zooecia are of moderate size, 0.45 to 0.55 mm long by 0.26 to 0.30 mm wide; distinct and the mural rims never in contact; opesia elliptical; mural rim thin and the cryptocyst very narrow and scarcely granulated. The rim is beset with numerous spines of equal size, 5 to 7 on each side. The interzooecial avicularia are small, the rostrum short (0.13 mm), but otherwise similar to those of *tenuirostre.* Multiporous septulae.

Ovicell globular and very prominent, about 0.18 mm wide; perforated with minute pores and delicately granulated. The pores are definitely larger than in *tenuirostre* where they are usually visible only by transmitted light in balsam mounts.

The zooecia have much the appearance of *C. (Membranipora) planum,* as shown in Hincks' plate 11, fig. 2 (1880), but they are much smaller and the array of marginal spines is an important difference. Apparently all of the spines are simple and of about the same size, judging by the bases; the specimen was dead and only the bases of the spines remain.

Type, AHF no. 18.

Type locality, Hancock Station 339, Gulf of Dulce, Costa Rica, 8°24′20″N, 83°13′40″W, 48 fms. One colony.

Genus **PARELLISINA** Osburn, 1940

This genus was erected by Osburn (1940:360) to include those species, formerly listed under *Membranipora* and *Callopora,* in which the avicularium is always associated with a heterozooecium or kenozooecium. The avicularian chamber is proximal to that of the kenozooecium and separated from it by a vertical wall. Besides the genotype, *Membranipora curvirostris* Hincks, the following species seem to belong here: *M. falcata* MacGillivray, *M. albida* Hincks, *Callopora tenuissima* Canu and Bassler, *C. subalbida* Canu and Bassler, *P. latirostris* Osburn and *Ellisina latirostris* Silen (not Osburn).

Parellisina curvirostris (Hincks), 1862

Plate 8, fig. 8

Membranipora curvirostris Hincks, 1862.
Ellisina curvirostris, Harmer, 1926:228.
Callopora curvirostris, Canu and Bassler, 1928:32.
Ellisina curvirostris, Hastings, 1930:711.
Parellisina curvirostris, Osburn, 1940:361.

Zoarium encrusting. Zooecia separated by grooves, gymnocyst small or wanting; mural rim thin, little raised; a vestigial spine on either side of the aperture, often wanting, and occasionally others on the lateral walls; a narrow granulated cryptocyst. Ovicell hyperstomial, small but prominent, globose, the frontal surface delicately granulated. The avicularium is interzooecial, large and more or less curved sideways; followed in series by a kenozooecium which varies considerably in size and form and which is covered by a membrane; its opesium is usually more or less triangular and a delicate mural rim may be present. Hastings recorded the species from the Galapagos Islands. Otherwise it is known around the world in warmer seas.

Hancock Stations: 142-34, Clipperton Island, west of Mexico, and 147-34, 155-34, 198-34 and 362-35, all from the Galapagos Islands. Also in the Galtsoff collection on pearl oyster shells from the Gulf of Panama.

Genus **BIDENKAPIA** new genus

Zoarium encrusting and loosely attached or rising in flabellate expansions or contorted frills. Zooecia large, walls very high and thin with multiporous rosette plates; dorsal wall smooth with numerous white punctations; gymnocyst and cryptocyst well developed; no spines; usually a single large avicularium covers the whole breadth of the gymno-

cyst, but occasionally this may be replaced by a pair of smaller ones in the proximal corners. Ooecium prominent, hemispherical, smooth, hyperstomial and not closed by the operculum. In the presence of the ovicell, the larger avicularium appears to be always absent, but when the smaller avicularia are present one of these is usually located at one side distally and its chamber is not involved in the ooecial cover. Genotype, *Membranipora spitsbergensis* Bidenkap, 1897.

While definitely a member of the family Alderinidae, the combination of characters presented by *M. spitsbergensis* will not permit its inclusion in any known genus.

Bidenkapia spitsbergensis (Bidenkap), 1897

Plate 8, fig. 6

Membranipora spitsbergensis Bidenkap, 1897:619.
Membranipora spitsbergensis, Nordgaard, 1900:9.
Membranipora spitsbergensis, Kluge, 1906:38.
Callopora spitsbergensis, Nordgaard, 1918:44.
Callopora spitsbergensis, Osburn, 1919:609; 1923:8D; 1932:8.

The zoarium is encrusting but loosely attached or rising in bilaminate or unilaminate frills or flabellate expansions, rough, conspicuous and yellow to orange in color when fresh.

The zooecia vary much in dimensions but are usually large, averaging about 0.80 mm long by 0.45 mm wide, occasionally more than 1. mm in length, and the zooecia are unusually deep. The walls are all comparatively thin, the mural rim thin and smooth or granulated, the dorsal wall thin, smooth, shining and thickly punctate with white dots. In the absence of ovicells and avicularia the gymnocyst is usually little developed; the cryptocyst varies greatly, sometimes filling a third of the proximal end of the opesia and again it is scarcely noticeable. Large multiporous septulae are present, about a third of the distance above the dorsal wall. Spines are entirely wanting.

Two sizes of avicularia are known. Usually a large one occupies the whole width of the proximal end of the zooecium, the short rostrum elevated and the bluntly triangular mandible directed backward or laterally; frequently this type is wanting and they are never present when an ovicell is developed on the preceding zooecium. Instead of the single large avicularium there is sometimes a pair of smaller ones, one in each proximal corner, and one of these is rarely present at the distolateral side of the ovicell. There is some intergradation between the two types of avicularia, single median ones occasionally present among the smaller avicu-

laria, and small lateral ones rarely on colonies with the large median type, but as a rule only one type of avicularium is present in any one colony.

The ovicell is prominent, hemispherical, about 0.40 mm wide, hyperstomial, the aperture wide and covered by a special membrane; the ectooecial wall smooth and shining, with a slightly elevated collar around the ooecial aperture when complete.

Originally known from Spitsbergen, its range has been extended (Osburn 1919, 1923) to west Greenland and Hudson Strait, and from Icy Cape, Alaska.

Punuk Island, Bering Sea, 15 fms on shells. Prof. G. E. MacGinitie has recently collected it also at Point Barrow, Alaska, 18 to 25 fms, common.

Bidenkapia spitsbergensis var. **alaskensis** new variety

Plate 8, fig. 7

This variety, partially discussed above, occurs with the typical variety, along the coast of northwestern Alaska. Since some colonies present only the smaller avicularia, it seems advisable to give it a varietal name. The difference was first noted by Osburn (1923:8D), in a specimen from Icy Cape, Alaska (Canadian Arctic Expedition Sta. 23). "In this one small specimen the zooecia are smaller, the avicularia are smaller, and there are sometimes two of them at the distal corners of the zooecium and faced toward each other. The ooecium and the zooecial characters are similar to those of *spitsbergensis* and the dorsal wall is similarly perforated."

Type, AHF no. 19.

A number of colonies, with those of the typical form at Point Barrow, Alaska, 23 fms, G. E. MacGinitie, Arctic Research Laboratory.

Genus **TEGELLA** Levinsen, 1909

"The zooecia, which have spines and a slightly developed cryptocyst, are provided with multiporous rosette plates. Hyperstomial ooecia with an incompletely calcified ectooecium, which are again surrounded by an avicularium." (Levinsen). The most important generic character is the absence of pore chambers, which separates the species of this genus from *Callopora.*

Levinsen's statement concerning the ovicell is not quite clear; the ectooecium usually does not fully cover the entooecium, but it is usually heavily calcified; the avicularian chamber may cover the distal end of

the ooecium and be so completely fused with it as to appear as one structure, or it may be partially separated by a groove. The gymnocyst is well developed and bears a large avicularium; small lateral avicularia on the mural rim are also present in some of the species. *Flustra unicornis* Fleming is the genotype.

Differentiation of the species depends chiefly on the arrangement of the spines and avicularia, which are often of uncertain value but which appear to be fairly constant in this genus. This is especially true of the avicularia; lateral avicularia present or wanting; if present they may be directed forward or backward in different species. The spines are not so constant but erect tubular spines may be present or absent; other spines may curve closely over the opesia as in *arctica,* or stand more or less erect, and there is considerable variation in the number present. In the ovicell the transverse rib which is the proximal end of the ectooecium varies so much with calcification that its importance is doubtful, but it serves to differentiate certain species from others which lack the strong rib.

Key to the Species of *Tegella*

1. Small lateral avicularia opposite the operculum. 2
   No lateral avicularia. 3
2. A strong, erect, tubular spine, usually on one side only; one or more pointed, curved spines, often wanting. . . . . *armifera*
   No erect tubular spines; 2 to 4 flattened, pointed spines on each side bent low over the opesia. . . . . *arctica*
3. Avicularia wanting; ovicell with a large fenestra or uncalcified area at the top. . . . . *magnipora*
   Pointed avicularia on the basal gymnocyst, more or less covering the ovicell when this is present. 4
4. No erect tubular spines; 1 to 3 curved spines bending over the opesia, often wanting; ovicell prominent. . . . *aquilirostris*
   An erect tubular spine present on one or both sides. 5
5. Ovicell small, deeply immersed, avicularia large. . . *robertsonae*
   Ovicell larger and prominent, avicularia smaller. . . . *unicornis*

Tegella unicornis (Fleming), 1828

Plate 9, fig. 2

Flustra unicornis Fleming, 1828:536.

Membranipora unicornis, Hincks, 1884:7.

Tegella unicornis, Osburn, 1923: 8D.

Zoarium encrusting. Zooecia moderately large, the opesia large and oval, slightly narrowed at the distal end; rim broad and finely crenulate, especially on its inner side; usually bearing 4 spines at the distal end, the more anterior pair small, erect and often wanting, the other pair larger,

erect, one usually larger than the other. An avicularium on the proximal gymnocyst, mounted on a raised projection; when an ovicell is present the avicularium appears to arise from the ovicell.

The ovicell is prominent, smooth with a transverse rib and the distal avicularian chamber forms a part of the cover.

In many respects this species is so similar to *T. armifera* (Hincks) that the latter was described as a variety. However, the distolateral paired avicularia of *armifera* are never present in *unicornis* and there are other slight differences.

Hincks listed the species from Houston-Stewart Channel, British Columbia. A common species in the northern Atlantic; on the North American side from Greenland south to Cape Cod, Massachusetts; in the Arctic west to the Northwest Territory, Canada.

Hancock Stations: 1234, Santa Rosa Island, and 1245, Santa Cruz Island, southern California; southern Alaska; Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Tegella armifera (Hincks), 1880

Plate 9, figs. 1 and 7

Membranipora armifera Hincks, 1880a:82.
Membranipora sophiae var. *armifera,* Waters, 1889:680.
Callopora unicornis var. *armifera,* Norman, 1903:27.
Membranipora cassidata O'Donoghue, 1923:27.
Tegella cassidata, O'Donoghue, 1926:36.
Tegella unicornis var. *armifera,* Osburn, 1933:24.

This species is very similar to *unicornis* Johnston, except for the presence of the lateral avicularia. This difference is so constant that I believe *armifera* should be given specific standing. There is one other character that may be of some importance and that is the occasional presence of a curved, pointed spine which bends somewhat over the opesia and which I have never observed in *unicornis;* also *armifera* is considerably larger.

The zoarium encrusts shells, stones, algae and occasionally even small stems. The zooecia are rather large and have a wide range in measurement, length 0.60 to 0.80 mm, width 0.35 to 0.50 mm, and occasionally transcending these measurements in either direction; shorter zooecia are usually correspondingly wider, the ovate opesia varying with the form of the zooecium. The basal gymnocyst is well developed and bears an avicularium; the descending cryptocyst is somewhat thick and granulated. The spines are as follows: a small erect spine at or near each distal corner, frequently wanting; a tall stout spine on either side near the attachment

of the operculum, one of these often smaller or wanting; a pointed spine curving somewhat over the opesia at about its middle, very inconstant, usually some on the zoarium but occasionally wanting entirely. Lateral avicularia are present on one or both sides, mounted on an elevated base close to and distal to the stout spine, often wanting on one side; the triangular mandible directed proximally and somewhat vertically and outward.

The ovicell is large and prominent; the ectooecial layer forming a ridge across the middle, varying greatly in the amount of calcification and in the form and amount of curvature. The median avicularium is greatly increased in size, with a long-triangular mandible which is turned somewhat sideways; the avicularian chamber united with the ectooecial layer to a greater or less extent, sometimes surmounting the ovicell and seeming to arise from it.

I am unable to distinguish *cassidata* O'Donoghue from *armifera* by any constant character after direct comparison with colonies of the latter from the Atlantic coast. O'Donoghue says of the lateral avicularia, "the mandible lies almost vertically and is directed anteriorly and slightly inward," which must be a *lapsus calami* as his figure (pl. 2, fig. 15) clearly shows it directed proximally and outward. There is considerable variation in size and elevation and in the erection of the mandible, but in all cases they are turned backward and outward as in *armifera.*

Hincks described *M. armifera* from the Gulf of St. Lawrence; and Osburn listed it under *M. arctica* from Cape Cod, Massachusetts, and it has been reported from the arctic seas of Europe and America. O'Donoghue listed *cassidata* from numerous localities in British Columbia, "a fairly common species and a very characteristic one."

Hancock Station 1245, Gull Island off Santa Cruz, California; off San Pedro, California; Nash Harbor, Nunivak Island, Alaska, and Punuk Island, Bering Sea. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Tegella magnipora new species

Plate 9, figs. 3 and 4

Zoarium encrusting, reddish brown in color. Zooecia moderately large, varying in length from 0.65 to 0.90 mm and in width from 0.35 to 0.45 mm; mural rim thin and smooth or slightly granulated; gymnocyst moderately developed, sometimes almost wanting; descending cryptocyst granulated, narrow, occasionally a little expanded laterally at the proximal corners. The opesia occupy nearly all of the frontal area, ellipti-

cal or oval in form. The frontal membrane is thick and brownish, the operculum heavily chitinized and 0.20 mm or more in breadth.

The usual complement of spines is 4 on each side, very evenly spaced, stout and erect or nearly so; the second pair, opposite the operculum, are somewhat taller and much stouter than the others. No avicularia are to be found on the several colonies studied.

The ovicell is of striking appearance, even for a *Tegella*: very prominent, somewhat transverse (0.30 mm wide by 0.25 mm long), thick and heavily calcified, with a thick, elevated rim on the top surrounding a large, irregularly rounded area which is covered by a membrane, and frequently the distal side of the rim rises into a point. The endooecium is smooth, thin and only slightly calcified and is not perforated, and it is not fused with the outer layer. The ectooecium is very irregular in complete calcification and the area varies in form from perfectly circular to transversely or longitudinally elliptical, or it may be more or less irregularly rounded. On the distal aspect of the ooecium there is another rounded fenestra in the position usually occupied by an avicularium in this genus, but it is covered by a smooth membrane.

There are large multiporous rosette plates in the lateral and distal walls.

By the definition of the genus *Tegella,* the ovicell is surrounded by an avicularium. In the present species there is no evidence of an avicularian mandible, but the distal fenestra referred to may possibly be interpreted as the vestige of an avicularium. In other characters the species appears to agree in all respects.

Type, AHF no. 20.

Type locality, Canoe Bay, Alaska, 125 fms on dead shells, several colonies. Also at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Tegella robertsonae O'Donoghue, 1926

Plate 9, fig. 5

Membranipora unicornis, Robertson, 1900:324.

Membranipora occultata Robertson, 1908:262 (not *M. occultata* Waters).

Membranipora occultata, O'Donoghue, 1923:25.

Tegella robertsoni O'Donoghue, 1926:36.

Zoarium encrusting shells, sponges and larger algae. Zooecia moderate in size, 0.55 to 0.65 mm long, distinct only in young stages. Gymnocyst well developed, usually about one-third of the frontal length; crypto-

cyst granulated, without horizontal lamina; walls high, the rim thin when young. Opesia elliptical or oval. There is an erect hollow spine on one side at the base of the operculum and frequently a smaller one on the opposite side; proximal to these on the sides are frequently 1 to 3 smaller curved spines bending somewhat over the opesia. An avicularium is usually present on every zooecium, large, about half the zooecial length, the mandible elongate triangular, its tip slightly rounded and strongly decurved, pointing forward and to one side of the opesia.

The primary ovicell is small; the ectooecium forms a complete cover separated from the endooecium. The wall of the distal avicularium usually fuses completely with the ectooecium.

Miss Robertson first listed the species from Alaska and Queen Charlotte Islands as *M. unicornis* and later described it as *M. occultata,* overlooking the fact that Waters had previously applied that name to another species. O'Donoghue listed it for a number of British Columbia localities, and Sakakura (1935:8) recorded it from Japan.

Hancock Station 1662-48, Santa Barbara Island, California. Also from Monterey Bay, (Robertson), Dillon Beach, (Menzies), California, and Clayoquot Sound, British Columbia (E. F. Ricketts). The known range is from southern Alaska to southern California.

Tegella arctica (d'Orbigny), 1851

Plate 9, fig. 6

Membranipora conferta Hincks, 1882:249.
Membranipora sophiae form *matura,* Hincks, 1884:9.
Callopora arctica, Osburn, 1919:608.

Zoarium encrusting on rocks and shells. Zooecia of moderate size, about 0.60 mm long; the opesia elliptical or ovate, averaging about 0.40 mm long; gymnocyst well developed; descending cryptocyst narrow and granulated; the mural rim bears on each side 2 to 4 stout flattened spines which bend down closely over the opesia, the pointed tips sometimes overlapping; the absence of erect hollow spines distinguishes this species readily from others of the genus in this region, though a minute vestigial spine may occur at the base of the lateral avicularium. The mural rim also bears on each side a small elevated avicularium with a triangular mandible which is directed distally and somewhat toward the midline. A larger avicularium may be present in the usual position on the gymnocyst, but is never so much enlarged as in the other species, nor does the chamber cover the ovicell to such an extent; often they are wanting over most of the zoarium.

The ovicell is broad, not prominent, and the proximal edge of the ectooecium forms a slightly arcuate ridge across the middle. In advanced stages of calcification the ovicell tends to become immersed.

Hincks recorded this species from Houston-Stewart Channel, British Columbia. It is known from the northern coasts of Europe and ranges down the east coast of North America from Greenland to Cape Cod, Massachusetts.

Punuk Island, Bering Sea, and Cleveland Passage, Frederick Sound, Alaska. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Tegella aquilirostris (O'Donoghue), 1923

Membranipora aquilirostris O'Donoghue, 1926:28.
Tegella aquilirostris, O'Donoghue, 1926:37.

Zoarium encrusting on stones, shells or kelp. Zooecia of moderate size, opesia large, oval, walls raised, smooth; gymnocyst well developed; no erect spines, one to three pointed spines curving over the opesia. Ovicell prominent, with a strong transverse frontal ridge. The basal avicularium is large and when an ovicell is present the chamber becomes more or less united with the ectooecium. (After O'Donoghue.)

This species appears to be rather closely related to *robertsonae* but the prominent ovicell and the absence of erect tubular spines seem sufficient to differentiate it. Possibly it may vary into *robertsonae.* O'Donoghue found it at several localities in British Columbia waters. It has not been noted in the Hancock collection.

Genus **DORYPORELLA** Norman, 1903

This is a peculiar genus among the Alderinidae, as the reticulated gymnocyst is so extensive that it often limits the opesium so much that older authors placed the one species then known, *spathulifera* Smitt, under genera of Ascophora. Pore chambers are present; small frontal avicularia; four to six distal spines. Ovicell hyperstomial, not closed by the operculum. Levinsen (1909:150) submerged this genus in *Callopora* but as the genera in the Alderinidae are now understood *Doryporella* appears to have a satisfactory basis. Genotype, *Lepralia spathulifera* Smitt, 1867:20.

Doryporella spathulifera (Smitt), 1867

Plate 8, figs. 4 and 5

Lepralia spathulifera Smitt, 1867:20.
Microporella spathulifera, Waters, 1900:87.
Doryporella spathulifera, Norman, 1903;106.
Membranipora spathulifera, Levinsen, 1916:441.
Callopora spathulifera, Osburn, 1919:608.

Zoarium encrusting, especially on shells. The zooecia present a very unusual appearance for an anascan form. The gymnocyst extends over most of the frontal surface, occupying half or more of the proximal end and extending widely forward on either side of the aperture, the surface reticulated. The opesia is quite variable in form, usually shaped somewhat like a horseshoe, but may be a regular ellipse. The gymnocyst and ovicell are granulated. A broad, lanceolate spine, jointed at the base, arises on the median line near the proximal border of the opesia, and just behind this is a small oval avicularium, also in the midline. There are 4 to 6 oral spines, the lateral ones sometimes enlarged at the base. At either side of the operculum is a small oval avicularium. The ovicell is hemispherical, hyperstomial but not prominent. Well distributed in high northern waters.

In the Hancock collections there is a specimen from Cleveland Passage, Frederick Sound, Alaska, 12 fms. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Doryporella alcicornis (O'Donoghue), 1923

Plate 8, fig. 3

Membranipora alcicornis O'Donoghue, 1923:26.
Amphiblestrum alcicorne, O'Donoghue, 1926:38.

Zoarium encrusting on shells and pebbles. The zooecia are distinct with well-marked separating grooves, averaging about 0.45 mm in length by 0.30 mm in width. The proximal half of the zooecium is covered by a strongly reticulated gymnocyst which extends along the sides of the opesia, as in *D. spathulifera.* The opesia is rather regularly oval, ranging in length from 0.18 to 0.22 mm and in width from 0.16 to 0.18 mm, its rim thin and slightly raised. The cryptocyst is vestigial. At each distal "corner" is an erect, simple or bifurcate spine; on either side of the operculum another erect spine with 2 to 4 points, and toward the proximal end of the opesia there is another spine with 4 to 6 points which bends over the opesia. The avicularia are small, salient, with short-triangular mandible, situated on the gymnocyst at one side of the median

line, and resembling those of *D. spathulifera* except that they are more elevated. The ovicell is prominent, globular, 0.18 to 0.20 mm in breadth, and its surface is reticulated like the gymnocyst. Pore chambers are present, as in *D. spathulifera.*

O'Donoghue described the species in the genus *Membranipora* and later removed it to *Amphiblestrum.* It cannot, however, be associated with that genus as the calcified frontal enclosure is a gymnocyst and there is no evidence of an expanded cryptocyst. Aside from the spines its essential characters are those of *D. spathulifera.*

It was recorded by O'Donoghue from numerous localities in British Columbia, from Victoria northward.

A specimen in the Hancock collections is from Cadboro Bay, Victoria, British Columbia.

Genus **RETEVIRGULA** Brown, 1948

Retevirgula Brown, 1948:109.

This genus has been recently established to include those membraniporine species which are similar to *Callopora,* but in which the zooecia are more or less dissociated and united by tubular connecting processes; which have mural spines; rounded vicarious avicularia on zooeciules occupying a place in the zooecial series; a hyperstomial ovicell with a frontal fenestra, and which are without dietellae. The genotype is *Membranipora acuta* Hincks, 1885:249.

The species have hitherto been distributed by various authors in *Membranipora, Beana, Pyrulella, Mystriopora* (?), *Hincksina* and *Cauloramphus.* The genus seems to have a closer relation to *Pyrulella* than to any other but the species of that genus have frontal avicularia and are without connecting tubules.

Key to Species of *Retevirgula*

1. Zooecia large and broad, opesia oval, interzooecial fenestrae and zooeciules rather rare. . . . . *lata*
   Zooecia smaller and narrower, opesia elliptical, fenestrae and zooeciules frequent. 2
2. Zooecia always disjunct and connected by tubules, with conspicuous fenestrae; the proximal 4 pairs of spines curved over the opesia. . . . . *tubulata*
   Zooecia disjunct or in contact; proximal spines long, not curved, but lean somewhat over the opesia. . . . . *areolata*

Retevirgula tubulata (Hastings), 1930

Plate 8, fig. 1

Pyrulella tubulata Hastings, 1930:709.
Pyrulella tubulata, Osburn, 1940:14.
Retevirgula tubulata, Brown, 1948:110.

The zoarium is thin and unilaminar, encrusting, but loosely attached by dorsal tubular processes. The zooecia are of moderate size with a considerable range, 0.45 to 0.60 mm long. In some zooecia there is a well developed smooth gymnocyst; in others this is almost wanting. The zooecia are disjunct and connected by tubes, but here there is also much variation and frequently the neighboring zooecia are in contact. Large fenestrae between the zooecia are common, but they are often small or wanting. The avicularia are vicarious on zooeciules which are connected to zooecia or to each other by tubules; mandible semicircular. The spines are usually 6 on each side, the distal pair directed forward, the following one or two erect and the rest bending over the opesia.

The ovicell is about 0.18 mm wide, prominent, globular, with an upturned lip, and there is a large rounded fenestra situated somewhat distally on the top.

Dr. Hastings described the species from the Galapagos Islands and recorded it also from Gorgona, Colombia. Our specimens agree closely with her description.

Hancock Stations: 59-33, Charles Island, 310-35, Bindloe Island, 352-35, Chatham Island and 432, Albemarle Island, Galapagos; 225-34, Gorgona, Colombia; 457-35; Secas Islands, Panama; 132-34, Socorro Island and 223, Clarion Island, west of Mexico; 125-33, Isabel Island, Mexico; 263 and 270, Angel de la Guardia Island, Gulf of California (the most northerly record); shallow water to 80 fms. Also Gulf of Panama, Galtsoff collection on pearl oysters.

Retevirgula lata new species

Plate 7, fig. 7

Zoarium thin, unilaminar, encrusting but very loosely attached, the dorsal surfaces of the zooecia bearing short attachment processes. Zooeciules of various sizes are frequent. The zooecia are large, 0.75 to 1.00 mm in length by 0.55 to 0.65 mm in breadth; distinct, their side walls usually in contact, but frequently more or less separated by small fenestrae, in which case they are connected by short tubular processes. The gymnocyst varies greatly in extent and this accounts almost entirely for the variation in zooecial length; proximal to the opesia there is frequently

a blunt tubercle. The opesia is oval, large, about 0.65 mm long by 0.35 mm wide, the mural rim thin and the descending cryptocyst narrow and granulated. There are usually six spines on each side. Avicularia are few and widely scattered, vicarious on zooeciules, the chamber rather large (about 0.40 by 0.50 mm); the avicularium small, short oval, with an elevated rounded rostrum which is crenated on the distal edge; the mandible semicircular, with strong hinge denticles.

The ooecium has a large circular membranous area on its distal end. This is not due to incomplete growth as the border of the fenestra is thickened and finely beaded and the same characters appear on all of the ooecia. The ooecium is very prominent, hyperstomial, broader than long, averaging 0.30 mm wide by 0.26 mm long, the surface smooth and shining, the proximal edge slightly elevated to form a lip, the aperture not closed by the operculum.

Type, AHF no. 21.

Type locality, Hancock Station 446, James Bay, James Island, Galapagos Island, 54 fms. Also at Sulivan Bay, James Island, and at 450, 0°55′S, 90°30′W, Galapagos, 14 to 60 fms.

Retevirgula areolata (Canu and Bassler), 1923

Plate 7, fig. 6

Mystriopora ? areolata Canu and Bassler, 1923:19.

Zoarium thin, unilaminar, encrusting but loosely attached by the short dorsal tubercular processes of the zooecia; zooeciules of various sizes are of frequent occurrence. The zooecia, while often in contact on the sides, are in general more loosely attached to each other than in *R. lata*; the fenestrae are larger and the connecting tubes longer. Zooecium moderately large, 0.65 mm long by 0.40 mm wide, the gymnocyst is usually well developed, narrowed proximally to the tubular process which connects it with the preceding zooecium. The opesia is distinctly narrower in proportion than in *lata,* elliptical, averaging about 0.55 mm long by 0.26 mm wide. The mural rim is elevated, moderately thin and the cryptocyst narrow and granulated. There are 6 or 7 tall strong spines on each side, the two distal pairs erect and the others leaning somewhat over the opesia. There are also small spines on the avicularian rims. The avicularia are small, rounded, elevated, the mandible semicular and attached by strong hinge denticles.

The ooecia are prominent, but difficult to see among the tall spines, globular and smooth, with a rounded or elliptical fenestra near the middle of the front, width and length about 0.26 mm.

This species differs from *R. lata* in the looser connection of the zooecia, the smaller size, the narrower opesia, the position of the ooecial fenestra and especially by the extensive development of the spines.

This species was described from the Pleistocene of Santa Monica, California, by Canu and Bassler, who were uncertain as to its generic relationships. The ovicell and avicularium are lacking in their material, but the other characters correspond fairly well.

Hancock Stations 1283-41, off Santa Rosa Island, California, 28 fms, 10 colonies on large coralline; Redondo Beach, California, shallow water; Point Vicente, California, 14 fms. Also Monterey Bay, California (Blagg collection).

Family **Chapperiidae** Bassler, 1935

Represented by the one genus, *Chapperia.* Usually this genus has been associated with other membraniporine forms in the Anasca, but Canu and Bassler (1927) separated it widely and placed it under their new suborder Hexapogona on what appears to be a very insufficient character, viz. "The ancestrula engenders six zooecia." It is true that the usual number of buds on the cheilostome ancestrula is five, but the number varies all the way from one to six among the encrusting species, and also varies somewhat within a single species. I have noted as few as four in one colony of *Chapperia patula* (Hincks), and six are occasionally found in other anascan species.

The most unusual character of the group is the presence of "occlusor-laminae" (Harmer), a pair of horizontal projections arising from the lateral walls opposite the operculum and considerably beneath it. They afford attachment for the occlusor muscles of the large operculum; there is much variation in size and in some species they are scarcely noticeable, often obscured by the lateral cryptocyst above them; at their fullest development they may unite to form a continuous shelf around the distal end. Spines, simple, forked or cervicorn, are present on all of our species. Avicularia may be either sessile or pedunculate, and both types are sometimes present on the same colony. The ovicell is hyperstomial, prominent, cucullate and not closed by the operculum. Large multiporous septulae are located rather high in the lateral and distal walls.

The general characters of this group appear to be anascan and I am therefore returning the Chapperiidae to the Anasca following the Alderinidae, to which they seem to have the closest affinity.

Genus CHAPPERIA Willey, 1900

Willey 1900:5, (to replace *Chaperia* Jullien 1881, preoccupied).

This genus has been the subject of much controversy and I shall not be able here to settle the disputed points. Jullien's brief description is as follows: "Two internal calcareous plates, with extremities fixed and serving for the insertion of the retractor muscles of the operculum" (transl. by Canu and Bassler). These plates lie beneath the anterior part of the opesia and usually fuse at their distal ends, sometimes forming a curved shelf. Spines, usually very strong, are present on the distal rim. Avicularia usually present, more or less fused with the distal rim. The operculum, usually well chitinized, occupies much of the opesia. The ovicell is prominent, conspicuous even among the spines, hyperstomial and somewhat cucullate. Genotype, *Flustra acanthina* Quoy and Gaimard, 1825.

Key to Species of *Chapperia*

1. Zooecia large (0.70 to 0.85 mm long), red or brownish, the mural rim widely flared. . . . . *patula*
   Zooecia moderate in size, not over 0.60 mm long. 2
2. Spines and frontal processes fuse to form a cover above the opesia. . . . . *frontalis*
   Spines simple, not fused, more or less erect. 3
3. Spines very elongate and erect; avicularia elevated on tall pedicels; no pigment. . . . . *longispina*
   Spines not usually long, curved or straight. 4
4. Heavily red or brown pigmented; spines stout, proximal pair curved over opesia; opesia broader than long; "cardelles" large. . . . . *condylata*
   Slightly brown or not at all pigmented; spines straight; opesia longer than broad; "cardelles" wanting. . . . . *californica*

Chapperia patula (Hincks), 1881

Plate 10, figs. 1 and 2

Membranipora patula Hincks, 1881:150.
Membranipora patula, Robertson, 1908:263.
Chapperia galeata, Canu and Bassler, 1923:52 (part, Pl. 34, figs. 9, 10).
Membranipora patula, O'Donoghue, 1923:25.
Amphiblestrum patulum, O'Donoghue, 1926:37.

The zoarium forms rough, reddish brown or reddish purple incrustations on almost anything that will afford attachment, occasionally even on stems; loosely attached, the dorsal side with rough protuberances which have no regularity. The zooecia are large, 0.70 to 0.85 mm long by 0.50 to 0.75 mm wide, ogival in form, the mural rim on the sides expanded, somewhat saucer-shaped, and the distal rim much raised and

thick. The membrane covers the whole frontal surface, as the gymnocyst is vestigial. The heavily calcified, granular cryptocyst is broad proximally and extends around the opesia, narrowly on its distal border. The opesia occupies about half the length of the front, more or less rounded, but usually a little broader than long (length 0.30 to 0.38 mm, width 0.33 to 0.40 mm). Within the opesia, below its distal border is a calcified shelf, the "occlusar-lamina" of Harmer, to which the opercular occlusal muscles are attached. Just above the proximal ends of these laminae are rounded knobs, often wanting, which present the appearance of cardelles, but as they lie much below the level of the operculum, even in the contracted state, their function is problematical. There are four or six tall tubular spines, with dark joints, on the distal rim; rarely one of these is short-bifurcate.

The avicularia are proportionately small, median, triangular, fused with the border of the distal rim and pointing forward (length 0.15 to 0.18 mm); often wanting and apparently never present when there is an ovicell.

The ooecia are large, 0.38 to 0.42 mm wide by 0.26 to 0.30 mm long, hyperstomial, cucullate with a wide open front; the ectocyst does not quite cover the endooecium and leaves a crescentic area next to the border.

Hincks described the species from California and the Queen Charlotte Islands; Robertson listed it from southern California, and O'Donoghue from numerous localities in British Columbia.

In the Hancock collections it is abundantly represented at 38 stations, from the coast of Oregon to Thurloe Head, Lower California; from shallow water to 47 fms.

Chapperia condylata Canu and Bassler, 1930

Plate 10, fig. 3

Chapperia condylata Canu and Bassler, 1930:44.

The zoaria form reddish to deep purple irregular incrustations on various objects. The zooecia are moderate in size, 0.35 to 0.45 mm wide by 0.40 to 0.50 mm long, ogival in form, the mural rim erect and not spreading out laterally as it does in *C. patula*. The gymnocyst is vestigial, only large enough to support the avicularia in the proximal corners; the cryptocyst broad proximally and extends forward around the sides of the opesia. The mural rim is moderately thick and elevated on the distal border. The opesia is noticeably transverse, 0.28 to 0.30 mm wide by 0.18 to 0.22 mm long, though occasionally more nearly round. Within the opesia are the "occlusar-laminae" and at their proximal ends are

rounded knobs, the "condyles" of Canu and Bassler, which as in *C. patula* appear to be too far below the level of the operculum to serve as hinge denticles; they are often wanting. The avicularia are usually paired in the proximal corners, triangular and directed forward or laterally. When ooecia are present the avicularia are more or less fused with the ectooecium and are directed proximally or laterally. In addition there is often a larger frontal avicularium with a longer triangular mandible; this is occasionally mounted on a tall peduncle. Six distal spines with black joints.

The ooecia are hyperstomial, prominent, with the usual crescentic area around the orifice, length 0.18, width 0.26 mm.

Described by Canu and Bassler from the Galapagos Islands.

Distributed along the coast and about the islands from Santa Catalina Island, southern California, to Colombia and the Galapagos Islands; Thurloe Head, Lower California; San Francisco Island, Gulf of California; Petatlan and Tenacatita Bays, Mexico; Socorro Island, west of Mexico; Pinas Bay, Panama; taken at 28 stations, most common about the Galapagos Islands. Shore to over 100 fms.

Chapperia californica new species

Plate 10, fig. 5

Chapperia galeata, Canu and Bassler, 1923:52 (part, Pl. 34, fig. 8, but not figs. 9 and 10 which are *C. patula*).

Zoarium encrusting stems, or bilaminate, white to reddish brown. Zooecia moderate in size, 0.45 to 0.60 mm long by 0.35 to 0.40 mm wide, often elongate and narrowed proximally; the mural rim thin and high and somewhat flaring in the sides, elevated distally. The cryptocyst broad proximally, continued around the sides of the opesia, granulated. Opesia short elliptical, oval or rounded, but averaging longer than broad, 0.35 to 0.40 mm long by 0.25 to 0.35 mm wide. The occlusar-laminae beneath the distal end of the opesia are rather long, their borders nearly straight and converging at the distal end. The spines are 4 to 6 in number, tall and slender, jointed at the base and more or less directed forward or erected.

The avicularia, frequently wanting, are sessile or slightly elevated, median, directed distally, the mandible short to long triangular (0.08 to 0.18 mm long), with small cardelles; always absent distal to an ooecium.

The ooecium is hemispherical, cucullate, prominent, hyperstomial, with a wide aperture. The usual crescentic area is present above the aperture. The ectooecium is transversely lightly rugose and there are longitudinal small striae, making a faint lattice-work on the surface.

There is considerable resemblance to *C. galeata* (Busk), especially in form of the opesia and the arrangement of the spines, but in the specimens figured and described by Busk and by Jullien from the Falkland Islands (Iles Malouines) the ovicell is always covered distally by an avicularium which presents the form of a crest on the galea. There are no avicularia associated with ovicells on the several colonies which I have studied. Also I find no mention of the decoration of the ectooecium in *C. galeata.*

The figure presented by Canu and Bassler (1923, pl. 34, fig. 8) of Pleistocene specimens from California show no avicularia associated with the ovicells.

Type, AHF no. 22.

Type locality, off San Pedro, California, several colonies encrusting hydroid stems and small worm tubes. In addition there is a bilaminate colony from Station 1250-41, one mile south of San Benito Island, off the coast of Lower California, 28°17′N, 115°35′40″W, at 49 fms; and Stations 1187-40 and 1431-41, off Santa Catalina Island, California. Also a specimen from the Lower Pleistocene at Timm's Point, California (San Pedro), collected by G. P. Kanakoff.

Chapperia frontalis new species

Plate 10, fig. 4

This is a remarkable little species, characterized by the fusion of spinous processes to form a sort of pericyst high above the opesia and extending forward over the aperture and ooecium. The zoarium is encrusting, small, white and shining. The zooecia are small (0.40 mm long by 0.25 mm wide) and very deep so that the zooecia appear to stand almost on end. The opesia is transversely oval, somewhat straighter on the distal border, 0.20 mm wide by 0.15 mm long, its border smooth and little raised. The occlusar-laminae within the aperture are narrow and diagonal. The gymnocyst is short and bears a raised median avicularium with a triangular mandible directed upward and backward. The cryptocyst is a moderate, smooth shelf, extending forward on the sides to the level of the operculum.

The striking feature of this species is found in the nature of the fenestrated frontal cover like a pericyst high above the opesia. There is a pair of long flattened spines opposite the operculum which curve upward and forward, the tips meeting and often fusing. From around the base of the avicularium about 5 (4 to 6) flat, hollow processes extend in a radiating manner, sometimes bifurcating, and fusing with each

other at their tips and also with the large lateral-oral spines to form a shield in which there are several (3 to 5) elongated fenestrae. In addition there is a pair of widely separated distal oral spines which are round and more or less erect; when ooecia are present these spines fuse to some extent with the sides of the ovicells.

The ooecium is characteristic of the genus, large (0.20 mm wide), prominent, cucullate and wide open at the aperture, smooth, and the ectooecium is not quite complete leaving a triangular area immediately above the opening. The fused tips of the lateral-oral spines sometimes extend beyond the ovicell. Reproduction begins early in the colony formation with the second or third row of zooecia; the largest colony consists of only 36 zooecia of which 24 bear ovicells.

The ancestrula is membraniporoid, the opesia occupying the whole of the front, and with 3 rather strong erect spines on each side.

Type, AHF no. 23.

Type locality, Sta. 473, off Hood Island, Galapagos, 1°22′40″S, 89°37′00″W, 75 fms, two colonies on a cinder. Also at Sta. 461, off Tagus Cove, Albemarle Island, Galapagos, 80 fms, one colony on a coral fragment; and Sta. 406, 1°03′30″S, 90°17′30″W, 60 fms, one colony on a coralline fragment.

Chapperia longispina new species

Plate 10, figs. 6 and 7

Zoarium encrusting, white, the zooecial characters, obscured by the close array of tall, slender white spines. The zooecia are of moderate size, 0.45 to 0.60 mm long by 0.40 to 0.45 mm wide; closely set; the walls high but not conspicuously flaring. The gymnocyst is usually limited to the area covered by the base of the avicularium; the cryptocyst broad proximally, decreasing in width to the level of the operculum; the opesia is more or less rounded (about 0.30 mm in each dimension), the occlusar-lamina moderately developed and no indication of condyles. There are usually 4, occasionally 6, tall, tubular oral spines, slender only in comparison with their length, the longest measuring as much as 0.90 mm, the average being about 0.70 mm. The spines are all nearly erect, never more than slightly curved, and the distal pair is not lost in the presence of an ovicell.

The avicularia are of two kinds. In the absence of an ovicell the avicularium on the basal gymnocyst is only slightly elevated and has a short-triangular mandible. When an ooecium is developed, the avicularium distal to it rises in tubular form to the height of the ooecium; the

mandible is irregularly spatulate and broadened at the tip; the edge of the rostrum often becomes irregularly spinulose. Also from the base of the avicularian chamber lateral furcate spinose processes are developed. The erect chamber or pedicel may be free or it may be fused with the ectooecium. Its nature is very similar to that described by Busk (1884: 78) and Waters (1888:12) for *C. (Electa) cylindracea.*

The ovicell is typical of *Chapperia,* rounded, prominent, cucullate, smooth, but the ectooecium is more complete than in most other species; it measures about 0.26 mm in width.

By the similarity of the avicularia this species appears to be most nearly related to *C. cylindracea* (Busk) from the Indian Ocean, but it differs in the nature of the spines which are much longer and entirely unmodified; in the absence of a widely flaring mural rim, and in the narrower cryptocyst, as well as in the form of the avicularian mandible.

Type, AHF no. 24.

Type locality, Hancock Sta. 1385-41, 13 miles SSE of East Point, Santa Rosa Island, southern California, 75 fms. Two colonies, one encrusting a hydroid stem and the other on a shell fragment.

? Chapperia varians (O'Donoghue), 1923

Membranipora varians O'Donoghue, 1923:29.
Chaperia varians (O'Donoghue), 1926:40.

The generic relationship of this species is in doubt, due to the lack of important characters in the description. Ovicells were not found and there is no mention of the nature of the communication pores nor of the method of attachment of the opercular muscles. O'Donoghue transferred it from *Membranipora* (where it cannot belong) to *Chapperia* at Waters' suggestion, but it might as well be a *Callopora* or *Hincksina.* Whatever it is, it appears to be a good species, and I append a brief list of the characters in the hope that some one may later recognize it and have sufficient material to complete the description.

A smooth thin cryptocyst occupies about one-third of the frontal area; the opesia is oval with a thin, low rim and occupies nearly all of the remaining front; a few small lateral and distal spines are present; a proximal avicularium is borne on a short truncated conical base in the midline (suggesting *Chapperia*) and a minute stalked avicularium is situated on either side opposite the operculum. Off Protection Gap and off Snake Island, British Columbia (O'Donoghue).

Family **Arachnopusiidae** Jullien, 1888

An arched calcified frontal shield or pericyst which is perforated by numerous large pores above the membranous ectocyst. The pericyst is formed by irregular projections originating from the lateral and proximal margins. Levinsen (1909:160) states that the projections in *Arachnopusia* are at first hollow spines which later become solid. In the other two genera here considered there is no evidence of hollow spines at any time.

There is much uncertainty whether these two genera belong with *Arachnopusia,* and also whether the family is properly placed. It is possible that it should be included among the cribrimorphs, but the pericyst is not formed of parallel or radial costae.

Genus **EXECHONELLA** Canu and Bassler, 1927

"The frontal pores are orbicular. A peristome very much developed, surrounds an orifice closed by a true operculum. The ectocyst is hidden under the frontal" (Canu and Bassler, 1926:4). Genotype, *Hiantopora magna* MacGillivray, 1895.

The external appearance is that of a member of the Ascophora, but careful dissection exposes the ectocyst which covers the full breadth of the opesia beneath the pericyst. The dorsal wall is provided with tubular processes for attachment.

Exechonella antillea (Osburn), 1927

Plate 10, figs. 9 and 10

Lepralia antillea Osburn, 1927:128.
Exechonella pumicosa Canu and Bassler, 1928:70.
Exechonella antillea, Osburn, 1940:366.

Zoarium encrusting on shells, corals, etc., forming a coarse yellowish or grayish layer; attached by dorsal processes, one or more on each zooecium. Zooecia large, 0.70 to more than 1.00 mm in length by 0.60 to 0.70 mm in width; well separated by deep grooves even in older stages. The whole area of the gibbous pericyst is coarsely perforated, each pore being surrounded by a broad collar. A thick-walled peristome, usually considerably elevated but lower on the proximal border, often bearing tubercles, and occasionally the whole rim flared outward. The aperture is large, about 0.20 to 0.25 mm in either dimension, varying in form but usually slightly quadrate with the corners rounded. The operculum is

well chitinized, with a pair of strong sclerites which reach forward from the heavy cardelles; it is complete on the proximal border, but is attached to the ectocyst from which it is easily separated; in dried or alcoholic specimens the contraction usually detaches it from the ectocyst. There is a row of uniporous septulae in the lateral and distal walls. No ovicells.

Osburn described the species from Curacao Island in the southern Caribbean Sea and in the following year, before the description of *antillea* was available, Canu and Bassler named it *pumicosa* from southern Florida. It is widely distributed in the West Indian region. Pacific coast specimens appear to agree in every particular.

Albatross Stations: D.2824 and D.2825, Gulf of California.

Genus ANEXECHONA new genus

Zoarium encrusting, often multilaminar, rarely with erect, flat branches. Frontal wall a pericyst, with large funnel-shaped pores, above the frontal membrane or ectocyst which covers the whole opesia; peristome wanting, the operculum on a level with the zoarial surface; side walls with multiporous, the distal wall with uniporous septulae. Avicularia large, vicarious, occupying a place in the zooecial series. No spines nor tubercles. No ooecia. Genotype, *Anexechona ancorata* Osburn, new species.

This genus is evidently related to *Exechonella* by the manner of forming the porous pericyst, which grows inward from all sides without any evidence of spines. It differs in the absence of a salient peristome, in the nature of the operculum, and in the presence of large vicarious avicularia. Since Canu and Bassler selected the name *Exechonella* because of the raised peristome, I am adopting *Anexechona,* not salient, for the present genus.

Anexechona ancorata new species

Plate 11, fig. 1

The zoarium encrusts shells, stones and occasionally algae; often several layers in thickness, rarely erect and bilaminate, back to back; dorsal surface smooth; frontal surface flat and smooth; light yellow to brownish in color.

Zooecia distinct, but the interzooecial grooves very shallow; the brown opercula and avicularian mandibles standing out prominently. The zooecia are large, 0.65 to 0.80 mm long by 0.40 to 0.50 mm wide; the frontal nearly flat, consisting of a smooth pericyst with large infundibular pores evenly arranged. The region about the aperture is

slightly higher, but there is no peristome and the operculum is at the level of the frontal surface except at the proximal border where it drops slightly below. The aperture is large, about 0.18 mm long by 0.20 mm wide, subquadrangular, nearly straight on the sides with the proximal and distal borders slightly arcuate; the strong cardelles situated about one-third of the way from the proximal border. The operculum is brownish with a heavy dark brown band continuous around the border; proximally it is attached to the ectocyst but is easily separable from it.

The avicularia are unusually large, interooecial, scattered, occupying a place in the zooecial series, the chamber 0.60 to 0.80 mm long by 0.40 to 0.50 mm wide; the dark brown mandible usually from 0.40 to 0.50 mm long, spatulate in form, with 3 strong unguiculate teeth at the end and 2 or 3 smaller ones along the sides, somewhat resembling a grappling hook; it is broadened at the base and attached to a strong pivot.

No ovicells, no spines.

Type, AHF no. 25.

Type locality, Hancock Station 1049-40, Angel de la Guardia Island, Gulf of California, 29°32′47″N, 113°34′35″W. Also dredged at Stations 650-37, San Francisco Island and 2180, off Magdalena Bay, Gulf of California; 136-34, Clarion Island, west of Mexico; 217, Tenacatita Bay, Mexico; 468-35, Port Parker, Costa Rica and "off Colombia." Also Albatross Sta. D.2825, Gulf of California. Shore to 50 fms.

Family **Hiantoporidae** MacGillivray, 1895

In the genus *Hiantopora* MacGillivray, 1887, there is a pericyst formed by the fusion of branching spines above the ectocyst; these often form an almost complete cover, with large irregular pores. Marginal and interzooecial avicularia may be present. Dorsal tubular processes are for attachment. The ovicell is not closed by the operculum.

Tremopora Ortmann, 1890 is similar in appearance to *Hiantopora,* but the spines are less developed, the ectocyst more exposed, and the ovicell is closed by the operculum.

In *Tremogasterina* Canu, 1911, the pericyst is formed in a different manner, there is no evidence of origin from spinous processes and the front is solidly bridged over except for the presence of 2 or 3 large central pores. The ovicell is hyperstomial and closed by the operculum.

The first two genera are apparently closely associated, but *Tremogasterina* differs so much that its position is questionable. Like the cribrimorphs and the Arachnopusiidae it has an external resemblance to the Ascophora, but the ectocyst extends over the opesia beneath the pericyst.

Genus TREMOGASTERINA Canu, 1911

The ovicell is hyperstomial and closed by the operculum. The aperture bears two small cardelles; the operculum, often chitinized, is attached to the ectocyst. The frontal is a pericyst extending over the ectocyst or frontal membrane; the central area is perforated by 2 or 3 large reniform or rounded pores. Large avicularia arise from the lateral walls and assume an interzooecial appearance. Genotype, *T. problematica* Canu, 1911.

Tremogasterina granulata var. subspatulata new variety

Plate 10, fig. 8

Zoarium encrusting, usually on sponges, usually unlaminar, white to light yellow in color, often covering several square inches.

Zooecia ventricose, distinct with deep separating grooves in the young stage, but becoming nearly level with increased calcification. On both sides and around the proximal end there is a row of rather large rounded pores, resembling the areolar pores of the Ascophora, and from the distal pore on one side arises the avicularian chamber; with increased calcification the frontal outlets of the pores of neighboring zooecia usually unite so that there seems to be but one row, a fact which no doubt explains the statement of Canu and Bassler (1929:119) in regard to *T. celleporoides* (Busk) that "there is only a single range (of pores) between two adjacent zooecia." In balsam mounts of marginal zooecia the two rows are very distinct in the youngest zooecia and in older ones the separate pores may be seen at the bottom of the single opening. Even the secondary pores often become completely closed off in older zooecia.

The frontal is a pericyst, above the frontal membrane, and appears to be formed in a different manner than any other pericyst. Acicular spicules are laid down inside from the zooecial walls, at first conforming to the "areolae," then becoming concentric about the central pores, while more distally they conform to the aperture and even extend around it on the distal border. When first formed this layer is thin and smooth, but it very soon becomes heavily calcified and much roughened, and the furrows between the zooecia are filled; the depression about the central pores remains evident at all stages. The whole process resembles the formation of the olocyst and pleurocyst of the Ascophora, as first stated by Canu and Bassler (1928:44) and later (1929:117) corrected by them.

The aperture is somewhat quadrate, the sides straight, the distal end rounded, the proximal end slightly arcuate and broader, length 0.22 to 0.26 mm, width 0.18 to 0.20 mm; peristome low and very thin with 2

to 4 small distal spines; a pair of strong cardelles; the pericyst forms a thick, low wall around the peristome but without fusing with it. The operculum is well chitinized, with a narrow border and a pair of heavier sclerites which extend forward from the cardelles within the lateral borders and meet at some distance back of the distal border. The operculum is connected with the frontal membrane, but is detachable.

The large elongate avicularia are so regularly disposed between the zooecia that they appear to alternate with them in series, but they are interzooecial only in arrangement and not vicarious, as shown by their manner of budding and by the fact that the avicularian chamber does not descend below the level of the primary layer of the pericyst. The mandible is elongate and narrowly spatulate, its tip much decurved with its point usually fitting into the central depression; a triangular lucida in its base, and hinged to strong cardelles which occasionally meet to form a bar; the mandible measures 0.35 to 0.50 mm long by 0.13 to 0.16 mm wide at the base.

The ovicell is rounded, about 0.25 to 0.30 mm wide; at first prominent, but later becoming immersed, the surface roughly reticulate; closed by the operculum.

There is close agreement between the typical *granulata* Canu and Bassler, 1928:45, from the Florida Straits, and the present variety in all points, except in the avicularia which are broader, the sides parallel to near the tip which is suddenly rounded at the hooked beak.

Type, AHF no. 26.

Type locality, Hancock Station 136-34, Clarion Island, 18°20′05″N, 114°44′40″W, 32 fms. Also at Station 137-34, Clarion Island, and 539-36, Angeles Bay, Lower California, 20 fms.

Division III COILOSTEGA Levinsen, 1909

In this group the horizontal lamina of the cryptocyst is highly developed, in some cases even extending forward around the aperture, and above this lies the frontal membrane. The lateral muscles which operate the membrane pass downward to the dorsal wall distally to the lamina, or through notches at the sides, or through special foramina at either side known as the opesiules. When the opesiules are well developed the distal end of the polypide is more or less enclosed in a calcified polypide tube. Avicularia or vibracula are usually present and always interzooecial. Ooecia may be either hyperstomial or endozooecial.

KEY TO FAMILIES

1. Ovicells hyperstomial. 2
   Ovicells endozooecial or wanting. 3
2. Ovicells very large, very prominent; avicularia large, replacing zooecia; opesiules closed. . . . . Thalamoporellidae
   Ovicells normal in size and appearance; opesiules joining the opesia (sometimes scarcely evident); avicularia smaller (sometimes wanting) . . . . . Aspidostomidae
3. Zoarium discoidal, free, saucer-shaped or short conical; distal to each zooecium is an auriculate avicularium with long setose mandible. . . . . Lunulariidae
   Zoarium encrusting; avicularia replacing zooecia. 4
4. Zooecia of two kinds, one with a much enlarged operculum; polypide tube complete. . . . . Steganoporellidae
   Zooecia of one kind; avicularia various; polypide tube incomplete. . . . . Microporidae

Family **Microporidae** Hincks, 1880

There is much variation in the extent of the cryptocyst in this family and the opesial area may be moderately large or nearly wanting except for the opesiules, which may be separated from the opercular area (closed) or united with it (open). Avicularia may be large or small, sometimes with long slender mandibles which are winged on one or both sides at the base (onychocellaria). The ooecium when present is endozooecial.

KEY TO GENERA OF MICROPORIDAE

1. Avicularian mandible winged at the base (onychocellarium), subfamily Onychocellinae. 2
   Avicularian mandible not winged, Subfamily Microporinae. . . 4
2. Avicularian mandible falciform, asymmetrical with wing on one side. . . . . *Onychocella*
   Avicularium symmetrical or wanting. 3
3. Opesiular notches very distinct, directed laterally. . . . *Floridina*
   Opesiular notches shallower and directed more proximally. *Velumella*
4. No avicularia; opesiules long parallel slits. . . . . *Caleschara*
   Avicularium small, distal to aperture; cryptocyst complete except for the aperture and very small opesiules. 5
5. Encrusting, ovicells conspicuous but endozooecial. . . *Micropora*
   Erect and branching, no ovicells. . . . . *Microporina*

Genus **ONYCHOCELLA** Jullien, 1882

The cryptocyst is extensive, depressed, not differentiated from the oral shelf and continued broadly around the distal border of the aperture; opesia reduced to little more than the orifice, opesiules open, often in-

distinct. Avicularia more or less asymmetrical, cryptocyst not divided, the wing developed on one side of the mandibular rachis.

The species under discussion, *O. alula,* does not quite conform to the generic description, as the rachis is usually straight and there is occasionally a vestigial wing opposite to the developed one. Otherwise it agrees with the genotype, *O. marioni* Jullien, 1882.

Onychocella alula Hastings, 1930

Plate 11, figs. 5 and 6

Onychocella alula Hastings, 1930:715.

Zoarium encrusting yellow to brown in color. The zooecia are irregularly hexagonal, distinct; cryptocyst depressed and tuberculate, continued around the sides and in front of the aperture; proximal border of the aperture nearly straight, the opesiules indistinct. The operculum is well chitinized, brown, with a bordering sclerite except proximally, and it is well separated from the cryptocyst; it is surrounded at a little distance by a chitinous framework which extends proximally to contact with the cryptocyst. The avicularian chambers are symmetrical and without a raised rostrum; opesia single and variable in size and form; the mandible thin and straight, strongly hooked at the tip, sharply marked off from the triangular base and toothed on the under side nearly its whole length; wing narrow, very delicate and extending nearly to the tip, occasionally a trace of a wing on the opposite side.

Measurements: zooecial length 0.45 to 0.50, width 0.35 to 0.40 mm; onychocellaria length 0.35 to 0.40 mm, width 0.20 mm; length of mandible 0.40 to 0.50 mm.

Dr. Hastings recorded the species from Gorgona, Colombia, and Balboa, Canal Zone, 15 fms.

Hancock Stations: 23-33, La Plata Island, Ecuador, 10 fms; 114, Catalina Island, southern California, 41 fms. Also Panama, Galtsoff collection, Sta. 23, covering several square inches on a pearl oyster shell.

Genus **FLORIDINA** Jullien, 1881

The cryptocyst is nearly complete, extending around the aperture, with a strong angular process on each side; the opesiules are large and usually very evident, marked off by the angular processes and extending laterally from the proximal end of the aperture. There is much variation in the form of the opesia. The avicularian chambers (onychocellaria) are straight, without a distal canal and rounded at the tip; the mandible is broadly and equally bimembranous. Genotype, *Mollia antiqua* Smitt, 1873.

Floridina antiqua (Smitt), 1873

Plate 11, fig. 4

Mollia antiqua Smitt, 1873:12.
Floridina antiqua, Canu and Bassler, 1928:60.
Floridina antiqua, Hastings, 1930:715.
Floridina antiqua, Osburn, 1947:17.

Zoarium encrusting, usually on shells. Zooecia of moderate size, rather broad, length 0.40 to 0.50 mm by 0.35 to 0.40 mm in width; the onychocellarium 0.35 to 0.40 mm in length; mandible about 0.25 mm long; all of the measurements vary greatly. The granulated cryptocyst rises slightly proximal to the aperture as if to form the roof of an incipient polypide tube; it extends for half the length or more of the zooecium and is continued broadly all around the aperture, forming on each side of the latter a strong projection, partly cutting off the opesiules and forming a somewhat trifoliate opesia. The operculum is situated in advance of the cryptocystal process; it is rather thin with a bordering sclerite except on the proximal border where it is continuous with the frontal membrane. The onychocellarium is moderately elongate, usually ovoid at the proximal end and pointed distally; there is much variation in their distribution and frequently they may be absent over much of the zoarium; the mandible is dark brown and strongly hooked; the two wings are very fragile and symmetrical, forming an oval.

Smitt identified the species with *Membranipora antiqua* Busk, but pointed out the differences and gave an excellent figure. He recorded it from Florida at 36 fms. Canu and Bassler listed it from the Gulf of Mexico, the Straits of Florida and south of Miami, Florida, down to 56 fms. and Osburn found it at several stations in the southern Caribbean. On the Pacific coast it has been recorded only by Hastings, from Gorgona, Colombia.

Hancock Stations: It is a fairly common species, taken at 25 stations, ranging from Cedros Island (N Lat. 28°) on the west coast of Lower California and Angel de la Guardia Island (N Lat. 29°) in the Gulf of California, to La Libertad and La Plata Island, Ecuador (1°15′S Lat.) Intermediate localities are Isabel Island, Tenacatita Bay and Petatlan Bay, Mexico; Socorro and Clarion Islands, west of Mexico; and Gorgona and Port Utria, Colombia. The bathymetric range extends from the shore line to 55 fms.

Genus **VELUMELLA** Canu and Bassler, 1917

"The retractor muscles of the polypide are attached in the median axis of the zooecium; the opesiular indentations are symmetrical. The onychocellaria are straight, without distal canal; the rachis of the mandible bears two broad membranes; the opesium of the onychocellarium is elliptical and entirely denticulated" (C. and B.) Genotype, *Onychocella levinseni* Canu and Bassler, 1917.

Velumella americana Canu and Bassler, 1928

Plate 12, figs. 7 and 8

Velumella americana Canu and Bassler, 1928:54.
Vincularia abyssicola Smitt, 1873:6 (part, fig. 60, not 61).
Smittipora abyssicola, Osburn, 1914:195; 1927:125.
Velumella americana, Osburn, 1947:17.

Zoarium encrusting, yellowish to light brown in color. Zooecia rather large, 0.70 to 0.80 mm long by about 0.45 mm wide, distinct with a deep furrow; mural rim thin and somewhat elevated; cryptocyst depressed, smooth in younger stages, becoming granulated with age. The opesia is moderately large, measuring about 0.25 mm in either dimension, the proximal border more or less straight, the opesiular indentations distinct. The onychocellarium is about as long as the zooecia, but usually narrower; its opesia is long oval, narrower proximally and crenulate; the mandible is long, 0.60 to 0.65 mm, curved at the tip, and with two membranous wings which together form an oval with the point forward; the base of the rachis is broad, 0.20 mm, triangular and bears a triangular lucida. Ovicell small and endozooecial, not conspicuous.

The species is common and well distributed in the West Indian region. Our Pacific specimens do not seem to differ, except in the heavier granulation of the cryptocyst.

Hancock Stations: 170-34 and 401, Chatham Island, Galapagos, 17 to 32 fms. Also Gulf of Panama, Galtsoff collection, on pearl oysters.

Genus **CALESCHARA** MacGillivray, 1880

This genus has been redefined by Harmer (1926:221) as follows: "Frontal membrane occupying the entire surface, the operculum small and Membraniporine. Spines wanting. Cryptocyst extensive, imperforate, tuberculate, its proximal part produced into a Steganoporelliform median process, free distally or uniting with the lateral cryptocyst. Opesia trifoliate, or opesiules complete, according to the character of the median

process. Avicularia wanting. Ovicells entozooecial, large. Communication-plates uniporous septula." Genotype, *Eschara denticulata* MacGillivray, 1868.

Harmer places the genus "in the Membraniporine series" apparently allying it to *Acanthodesia,* and Silen (1929:134) appears to agree with this arrangement. Canu and Bassler (1929:134) assign it to the Opesiulidae, assuming that the anterior process of the cryptocyst is an incomplete polypide tube. It certainly has this appearance since it is transversely convex and flared upward at the tip. The large endozooecial ovicell would seem to remove the genus from any close association with *Acanthodesia.*

Caleschara mexicana new species

Plate 11, fig. 11

Zoarium encrusting in a thin layer, flat and white. Zooecia of moderate size (0.40 to 0.50 mm long by about 0.26 mm wide), separated by very narrow shallow grooves, the sides nearly parallel. The mural rim is thin, regularly beaded; gymnocyst not evident; the cryptocyst is coarsely granulated and fills the proximal half of the front, extending narrowly around the distal border of the aperture. The anterior process of the cryptocyst extends nearly to the aperture, transversely convex (like the roof of a polypidian tube), the tip elevated and somewhat spatulate and bordered by numerous lateral spinules which give it a slightly fimbriate appearance. The opesiules are open, elongate and somewhat slit-like, the outer border crenulate and often with a few spinules; usually there is a pair of larger spinules in the position of cardelles. At each proximal corner of the cryptocyst there is a smooth, shining, subglobular tubercle, occasionally wanting on one or both sides. No avicularia; no dietellae, and in our specimens no ooecia have been observed.

This species appears to be rather close to *C. levinseni* Harmer (1926: 221) but that species is evidently larger (Harmer merely states "zooecia large") and appears to lack the horizontal spinules of the process and opesular borders.

Type, AHF no. 28.

Type locality, Mazatlan, Mexico, 23°09′N, 106°23′W, shore collection, 4 colonies encrusting the smooth surfaces of shells. (Miss A. E. Blagg, collector.) Also from Panama, Galtsoff collection, Sta. 23, several colonies covering the whole inside of a pearl oyster shell, an area about 75 mm in either direction.

Genus **MICROPORA** Gray, 1848

Zoarium encrusting. Zooecia with an elevated mural rim which ends in a knob-like enlargement on either side of the aperture. Cryptocyst covering the entire frontal area except the aperture and small opesiules. Ovicells endozooecial but very prominent. A small avicularium just distal to the aperture. Genotype, *Flustra coriacea* Esper.

Micropora coriacea (Esper), 1791

Plate 11, fig. 3

Micropora coriacea, Hincks, 1884:12.
Micropora coriacea, Robertson, 1908:275.
Micropora coriacea, O'Donoghue, 1923:30; 1926:49.
Micropora coriacea, Canu and Bassler, 1923:58.
Micropora coriacea, Hastings, 1930:719.

Zoarium encrusting. Zooecia usually very regularly disposed, short and broad, somewhat hexagonal in outline; mural rim high and thin, but ending in a small knob-like structure at the sides of the aperture; cryptocyst flat, depressed distally to the level of the minute opesiules and then suddenly elevated to the proximal border of the aperture. The operculum is semicircular. A small avicularium is situated just distal to the zooecium, often wanting over much of the zoarium. The ovicells are large, elongate, conspicuous and endozooecial.

Distributed around the world in warmer and temperate waters; common at many places in the Gulf of Mexico and the Caribbean Sea. On the Pacific coast it is known from British Columbia (Hincks and O'Donoghue), Santa Catalina Island, California (Robertson), and the Galapagos Islands (Hastings).

In the Hancock collections it is represented at 56 stations all along the coast from the Channel Islands, California, to the Galapagos Islands and the coast of Peru.

Genus **ROSSELIANA** Jullien, 1888

"*Flustra rosselii* Audouin, qui a son cryptocyste à moitié developpé et son orifice semicirculaire (type du genre *Rosseliana*), n. gen." Jullien, 1888:78.

Canu and Bassler, 1920:288, accept this genus and place it in the family Microporidae, with the additional description: "The frontal of the zooecium is a cryptocyst of little depth. The opesium is semicircular. The ovicell is endozooecial but prominent. Septulae uniporous. No avicularia." Genotype, *Flustra rosselii* Audouin, 1826.

Rosseliana rosselii (Audouin), 1826

Membranipora rosselii, Hincks, 1884:7.

"Houston-Stewart Channel, British Columbia, on shells, not uncommon," Hincks. The species has not been found on the Pacific coast since, nor has it been reported from any areas except the Mediterranean and western Europe.

Genus MICROPORINA Levinsen, 1909

Erect colonies, often branching profusely to a height of several inches; jointed, the internodes terete, tapered at the proximal end and rounded at the tip. Zooecia with the cryptocyst filling the frontal area nearly to the aperture which is almost semicircular; in younger stages small opesiules may be seen but these are usually closed by later calcification. A small avicularium occurs just distal to the aperture. No spines. No ovicells. Genotype, *Salicornaria borealis* Busk, 1855.

Microporina borealis (Busk), 1855

Plate 11, fig. 2

Cellaria borealis, Robertson, 1900:322; 1905:287.
Cellaria borealis, O'Donoghue, 1923:23.
Microporina borealis, O'Donoghue, 1926:49.

Zoarium erect and branching, often in luxuriant growth several inches in height; the rounded internodes averaging about 1 cm in length, the joints chitinous. The zooecia are moderately large, about 0.75 mm long by 0.30 mm wide, arranged in 12 to 16 rows around the internode, alternating regularly so that they appear to form spiral as well as longitudinal series. The margins are little raised, more so about the distal end. The front, beneath the ectocyst, is a flat porous cryptocyst which fills the whole front almost to the operculum. The aperture is nearly semicircular, slightly rounded on the proximal border. Distal to the aperture and in line with it is a small avicularium with the triangular mandible directed proximally. There are no ovicells.

It is a northern species abundant in Greenland waters, but ranges south on the Pacific coast from Bering Sea to British Columbia (Robertson and O'Donoghue).

A couple of small fragments occurred in the Dall collection labeled only "Bering Sea." Also at Point Barrow, Alaska, 14 fms, G. E. MacGinitie, collector, Alaska Research Laboratory.

Family **Steganoporellidae** Smitt, 1873

The zooecia are dithalamic, the cavity more or less divided by a cross-wall or partition, the descending lamina of the cryptocyst, into proximal and distal cavities. The horizontal lamina of the cryptocyst is complete above the proximal cavity; the descending lamina perforated by the polypide tube, which is more or less calcified, sometimes only the roof of the projecting distal portion being calcified. The opesia is confined to the distal cavity and is further limited to a greater or less extent by the surrounding cryptocyst. In the genus *Steganoporella* there are two kinds of zooecia, the "B" zooecia having an enlarged operculum provided with chitinous teeth, apparently an incipient avicularium. In other genera, *Labioporella* and *Siphonoporella,* there are large vicarious avicularia which replace zooecia in the series.

Genus **STEGANOPORELLA** Smitt, 1873

This genus is distinguished from others in the family by the presence of two kinds of zooecia. Among the ordinary zooecia (A type) there are others (B zooecia) which resemble them in most respects but which have a much enlarged operculum with a heavy chitinous border beset with chitinous teeth and which are undoubtedly incipient avicularia. Genotype, *Steganoporella (Steginoporella) legans* Smitt (=*Membranipora magnilabris* Busk).

Steganoporella cornuta new species

Plate 12, figs. 3, 4, 5 and 6

Zoarium encrusting, pale yellow. Zooecia of moderate size, 0.65 to 0.75 mm long by 0.40 to 0.65 mm wide, elongate-hexagonal, distinct; mural rim high, especially at the distal end, moderately thick and finely granulated. A salient, strong, pointed tubercle at each distal corner. Cryptocyst coarsely granulated, the main lamina extending about half the length of the zooecial cavity, descending gradually; the frontal process is elevated slightly and united with the roof of the polypide tube. The remainder of the polypide tube is uncalcified. The frontal process is not connected with the lateral walls and there is an elongated open opesiule on each side symmetrically; the process, except for its tip, is granulated like the remainder of the cryptocyst, which is continued narrowly around the opesia.

The operculum is thin, with a heavy border sclerite which bears a strong flange on either side a little above the point of attachment to the condyles; no marginal teeth, length 0.13 mm, width 0.18 mm.

The B zooecia, to use Harmer's term for the slightly modified avicularian zooecia, are not larger than the largest of the normal zooecia, but are broader distally to accommodate the large operculiform mandible; the cryptocystal lamina is shorter and the frontal process also, leaving a much larger opesia; the distal mural rim is raised into a shallow hood and the tubercles are wanting at the distal corners. The mandible (B operculum) is rounded distally and on the sides, well chitinized; the main sclerites are only slightly arcuate outward, running from the condylar attachment to the distal border where they fail to meet by about 0.07 mm, the gap being bridged by a thinner extension of the chitin. There are no teeth on these sclerites, but there is a strong flange a little beyond the point of attachment to the condyles. An accessory strong rib curves inward proximally from a short distance above the attachment and reaches the proximal border where it is connected with the ectocystal sclerite on each side. The border sclerite is heavy distally, where it bears 8 strong, short teeth, but fades out before reaching back to the condyles. The mandible is somewhat intermediate between the U and V or Y types of Harmer. It measures 0.26 mm long by 0.30 mm wide.

Because of the uncalcified polypide tube, except for the roof, the lack of lateral connections with the frontal process, and the narrow circumopesial cryptocyst, this appears to be a very primitive member of this genus. There can be no doubt of its generic relationships, however, since the differentiation of the A and B zooecia is characteristic. Harmer (1900:253) described *S. simplex* from the Amirante Islands, which resembles *cornuta* in the characters just mentioned, but which is otherwise very different.

Type, AHF no. 27.

Type locality, off Acapulco, Mexico, 15 fms, Captain Fred S. Lewis, collector. Also Gulf of Panama, Galtsoff collection, on shells of pearl oysters, (station 26, Coiba, Canal Coibita, northern end, south of Isla Rancheria).

Genus **LABIOPORELLA** Harmer, 1926

Labiopora Levinsen, 1909:171, 174 (preoccupied).

Zooecia with distinctly raised walls. Gymnocyst wanting. Cryptocyst porous, not extending as a shelf around the opesia. A vertical cryptocystal lamina separates the proximal and distal cavities, perforated near the middle by the polypide tube; inner borders of the walls heavily granulated or crenulate. Avicularia large, vicarious, with spatulate mandibles. No ooecia. Multiporous septules present. Genotype, *Labiopora crenulata* Levinsen, 1909.

Labioporella sinuosa Osburn, 1940

Plate 11, fig. 12

Labioporella sinuosa Osburn, 1940:377.

Zoarium encrusting rather loosely on various surfaces, yellowish to light brown, white and glistening in the absence of the ectocyst. Zooecia with sinuate lateral walls when crowded or on rough surfaces, but perfectly regular and with parallel walls when growth conditions permit. The walls are elevated, the mural rim delicately beaded, the inner border of the walls coarsely beaded even on the distal wall. Gymnocyst wanting. The cryptocyst covers the entire proximal chamber with a thick, perforated and granulated layer, which ceases abruptly at the descending lamina. Distal to this the cover of the polypide, longitudinally rugose, with the tip elevated and finely crenulate, projects for a short distance; this is connected with the lateral walls by a narrow shelf which is imperforate. The descending lamina of the cryptocyst is vertical, straight, complete except for the perforation of the polypide tube, and divides the zooecial cavity into two subequal chambers. The distal wall is slightly arched on the dorsal side, strongly on the frontal side and overlies the base of the distal zooecium; on the proximal side of the distal wall just beneath the tip of the operculum is a distinct rounded tubercle. The operculum is longer than wide (0.15 by 0.13 mm), with a dark brown border sclerite, widely separated from the walls on the sides but nearly touching the distal wall. Multiporous septulae present. No ooecia. No ovicularia have been observed in either Atlantic or Pacific specimens from various localities.

Originally described from the Tortugas Islands, Gulf of Mexico, the species proves to be well distributed on the Pacific coast from the Gulf of California to Ecuador. It appears to be nearly related to *L. spatulata* Harmer, 1926:283, but it differs from Harmer's description and illustration (pl. 21, fig. 6) in the presence of coarse crenulation on the inner border of the walls, even around the distal end; in the form of the operculum which is noticeably longer; the descending lamina is always simple, and the tubercle beneath the operculum is never doubled or tripled. The complete absence of avicularia renders it difficult to ally this form with any of the other species, which have been described from Ceylon, Australia, the East Indian region and Japan. Possibly the absence of avicularia may be a specific character, since none have been found throughout the range on either coast.

Hancock Stations: 596-36, 599-36, 637-37, 650-37 and Albatross sta-

tions 2824 and 2825, all in the southern part of the Gulf of California; 132-34, Socorro Island and 136-34, Clarion Island, west of Mexico; and 212-34, La Plata Island, Ecuador. Also Gulf of Panama, Galtsoff collection on pearl oysters. The known range on the Pacific coast is from 25° 57′00″N, in the Gulf of California, to 1°15′00″S, Ecuador; shore down to 47 fms.

Family **Thalamoporellidae** Levinsen, 1909

Levinsen, 1909:175-178, gives an extended discussion which it is not necessary to repeat here. The opesiules are closed, often unsymmetrical in size and form and often extend to the dorsal wall; the cryptocyst extends far forward leaving a rounded opesia, most of which is occupied by the operculum. At the side of the operculum are adoral areas, often vestigial, which may bear tubercles. In the body cavity occur peculiar spicules shaped like wide-open compasses and curved calipers. The avicularia are large, replacing zooecia in the series. Ooecia very large and prominent, somewhat bilobate, and closed by a special membrane.

Genus **THALAMOPORELLA** Hincks, 1887

Characters of the family. Genotype. *Flustra rozieri* Audouin, 1826.

Thalamoporella gothica (Busk), 1856

Plate 12, fig. 1

Membranipora gothica Busk, 1856:176.
Thalamoporella rozieri var. D (*gothica*) Levinsen, 1909:184.
Thalamoporella gothica, Harmer, 1926:302.

Zoarium encrusting or erect. Zooecia large (0.80 to 1.10 mm long by 0.30 to 0.50 mm wide), the sides usually parallel. The cryptocyst covers two-thirds or more of the front, thickly perforated to the level of the opesiules. The opesiules are large, often differing in size, the wall of one usually descending to the dorsal side. The opesia is distinctly sinuate on the proximal border, 0.30 to 0.35 mm in each dimension, occasionally with adoral tubercles on the side, but usually the aperture occupies the full width within the mural rim and leaves no adoral areas. The operculum is thin with a well chitinized rim and the sclerite of the proximal border is complete but narrow.

The avicularia are large, the chamber about as long as the Zooecia but narrower; the mandible varies, 0.40 to 0.55 mm long by about 0.25 mm wide at the base; the main sclerites are straight and extend forward to their junction near the curved tip; the condyles are strong and partially

divide the opesia, the proximal part of which is slightly the larger. The rostrum is somewhat variable in form but is shaped like a gothic arch, slightly elevated and distinctly notched at the tip.

The peculiar spicules are abundantly developed; the curved calipers are of various sizes, ranging from 0.04 to 0.15 mm, and the wide open arms of the compasses may measure as much as 0.50 mm but are usually much smaller.

Ovicells are wanting on our material, but Busk noted them on specimens from Mazatlan, Mexico, the type locality.

Hancock Station, 545-36, Puerto Refugio, Angel de la Guardia Island, Gulf of California, one large colony covering a shell, shore collection. Also at Bahia San Francisquito, near Guaymas, Sonora, Mexico, low tide, E. Yale Dawson, collector.

Thalamoporella californica (Levinsen), 1909

Plate 12, fig. 2

Thalamoporella rozieri var. *californica,* Levinsen, 1909:184.
Steganoporella rozieri form *gothica,* Hincks, 1880:277.
Thalamoporella rozieri, Robertson, 1908:277.
Thalamoporella californica, Hastings, 1930:716.

The zoarium is at first encrusting, usually on algae, frequently rising in erect, branching, articulated form; the free branches are divided into internodes by chitinous joints. The zooecia are of moderate size, usually between 0.50 to 0.65 mm in length by 0.30 to 0.34 mm in width, the lateral walls nearly straight, the distal rim arcuate, conforming to the aperture. The perforated cryptocyst extends for half or more of the zooecial length, beyond which the imperforate roof of the polypide tube rises sharply and forms the proximal border of the opesia. The opesiules vary considerably in size and form, usually one larger than the other and the descending wall of the larger one usually extends to the dorsal wall where it forms a "shepherd's crook." The opesia is nearly round, about 0.18 mm in each dimension, arcuate but not sinuate on the proximal border; the operculum thin with a broad chitinized border, the sclerite on the proximal border strong at the sides, usually incomplete at the middle. The adoral areas are always small, frequently wanting and when tubercles are present they may be short and blunt, tall and thin, pointed or tubular.

The avicularia are nearly as long as the zooecia; at the division of a series; the mandible is elongate and varies considerably in size and form,

the average length being about 0.30 mm, its tip is usually more rounded than in *gothica*. The tip of the rostrum is complete, not notched, and encloses the tip of the mandible.

The spicules are all curved calipers; many specimens from different localities have been examined and none of the straight compasses have been observed.

The ooecia are very conspicuous, large, bilobate, and prominent, smooth or faintly striate on the surface, with a longitudinal keel; the fertile zooecia reduced somewhat in size.

While this and the preceding species resemble each other closely in general appearance, *T. californica* is smaller, has an arcuate instead of sinuate proximal opesial border, has only caliper-like spicules and lacks a notch at the tip of the avicularian rostrum. The main sclerites of the mandible are also slightly incurved instead of being straight as in *gothica*. Hincks had the species from Santa Monica, California, and Robertson listed it from San Pedro and San Diego, California; Levinsen studied Hincks' material and Hastings recorded it from the Galapagos Islands.

In the Hancock collections (24 stations) it ranges all the way from the northern Channel Islands, California, southward to Gorgona, Colombia, and the Galapagos Islands. I find no record of it from north of Point Conception, California, but it is often excessively abundant from there southward, especially in shallow water along shore, and continuing down to 47 fms. The writer has also identified it in the Pleistocene of Playa del Rey, California.

Family **Lunulariidae** Levinsen, 1909

Free, discoidal, saucer-shaped or conical zoaria; zooecia with the cryptocyst more or less developed, each zooecium preceded in the series by an auriculate vibracular chamber with a long setose vibraculum. Ovicells endozooecial or wanting.

Genus **DISCOPORELLA** d'Orbigny, 1852

The zoarium is free and discoid, convex on the frontal side, but varying indefinitely from cup to saucer-shaped, sometimes nearly flat, the dorsal side concave or flat. The zooecia are ranged in radial rows, each with a vibraculum at its distal end; cryptocyst nearly complete except for a number of opesiules on each side. The colonies resemble those of *Cupuladria* but are distinguished at once by the presence of a cryptocyst. Genotype, *Lunulites umbellata* Defrance, 1823.

Discoporella umbellata (Defrance), 1823

Plate 11, figs 7, 8, 9 and 10

The *Cupularia umbellata* of most older authors.
Cupularia canariensis, Robertson, 1908:314.
Cupularia robertsoniae Canu and Bassler, 1923:82.
Discoporella umbellata, Hastings, 1930:718.

The zoarium is usually shaped like a miniature umbrella, but is often much deeper, bowl-shaped, or even cup-shaped, or it may be a flat disc and I have seen small colonies which were actually inverted when attached on the inside of a shell. The latter habitat is rare as the larva almost without exception is attached to a sand grain or other minute object which it soon covers and extends beyond to become free, but still carries its original attachment about with it at the center of the dorsal side. The color varies from pale yellow in younger colonies to brown, the color being in the ectocyst and especially in the avicularian mandibles.

The zooecia are roughly rhombic in form and are spirally arranged; younger zooecia at the center of the colony are more elongate. The mural rim is thin and smooth; the descending cryptocyst heavy and granulated and the horizontal lamina is formed from a number of spinous processes which meet and fuse, leaving irregular opesiules on the sides; these opesiules are irregular in form and vary in number from 2 to 5, the usual arrangement being 3 or 4 on each side with a median proximal one; the distal process forms the proximal border of the aperture. At the distal end of every zooecium there is a vibraculoid avicularium, the brown mandible of which sometimes measures as much as 1 mm long.

Distributed around the world in warmer waters. Common in the West Indian region from the northern coast of South America to Beaufort, North Carolina. Recorded from the Pacific coast only by Robertson (*Cupularia canariensis*) from San Pedro and Santa Catalina Island, California, and by Hastings from Gorgona, Colombia, the Galapagos Islands and Panama. Canu and Bassler recorded it from the Pleistocene of Santa Monica, California, under the name *Cupularia robertsoniae,* but I am unable to accept this as a new species after examining over a thousand specimens from both the Pacific and Atlantic coasts. The elongated zooecia of *robertsoniae* are duplicated on the young colonies of many specimens of *umbellata,* the number of opesiules varies considerably and the size of the zoarium is merely due to age.

The range of distribution on the Pacific coast appears to be from Point Conception, California, to Point Santa Elena, Ecuador, as none were taken beyond these limits. Between these points the species is abun-

dant; represented in the Hancock collections at 151 stations from the northern Channel Islands, California, to Santa Elena Bay, Ecuador, the Galapagos Islands, Colombia, Panama, Costa Rica, Mexico, and the Gulf of California. Dredged from 5 to 100 fms, but most abundant at 20 to 40 fms.

Family **Aspidostomidae** Canu, 1908

"The zooecia have a raised margin, often indistinctly or incompletely developed. The two opesiules appear as narrow incisions which join the zooecial aperture; the short polypide tube, which is not continued under the cryptocyst cover, is in most cases provided with marginal flanges. Avicularia are always present. Ovicells are hyperstomial" (Canu and Bassler 1920:252).

The one genus here included, *Euritina,* differs from the above description in having very minute opesiules which are scarcely noticeable at the proximal corners of the opesia, and in the one species recorded no avicularia have been found. The other characters are similar to those of the family.

Genus **EURITINA** Canu, 1900

"Ovicell hyperstomial, never closed by the opercular valve; avicularium interzooecial; cryptocyst well developed, with three facets separated by two longitudinal grooves; no dietellae" (Canu and Bassler, 1920: 256). Genotype, *Eschara eurita* d'Orbigny, 1852.

Euritina arctica new species

Plate 29, figs. 5 and 5a

Discopora (?) *impressa,* Smitt, 1871:1126.
Not *Escharina impressa* Reuss, 1846:68.

Encrusting, unilaminar, white to brown in color. Zooecia moderately large, 0.60 to 0.70 mm long by 0.40 to 0.50 mm wide, but these limits are transcended in both directions; regularly arranged in quincunx, very distinct, irregularly ovate, the distal end rounded or ogival, the proximal end usually narrowed between adjoining zooecia. The front wall is a heavy cryptocyst with three areas, a broad rounded lateral area on each side and a central area which occupies half or more of the width and is separated on each side by a shallow groove which runs forward to the corner of the aperture; the central area slopes downward to the level of the aperture. The whole surface of the cryptocyst, even the whole margin of

the opesia, is granulated like the border. The opesia is only slightly larger than the operculum, which is free from the border at all points; semi-elliptical, widest at the proximal border which is transverse or slightly arcuate and often with a minute opesiular angle at the proximal corners. The operculum is thin with a narrow bordering sclerite, somewhat more than a semicircle, straight on its proximal border where it is attached to the frontal membrane a short distance in advance of the margin of the cryptocyst. The mural rim is continued broadly around the aperture and often bears two short stout tubular spines. There are no avicularia on our specimens and Smitt does not mention them. Dietellae are present, one large distal and several smaller lateral ones, all quite conspicuous at the edges of the zoarium.

The ovicell is hyperstomial, prominent, rounded, 0.30 mm in width, the ectooecium thick, granulated like the frontal and continuous with the frontal wall of the succeeding zooecium; it is not closed by the operculum.

Our specimens appear to agree in every detail with Smitt's illustrations (Pl. 21, figs. 17-19), though he does not mention the dietellae. His specimens were from Spitsbergen or at least north of Norway, "Fran 1868 ars Spetsberg-expedition," and I have not been able to find a more recent reference to the species.

The generic relationship of this species may be questioned because of the absence of dietellae and the somewhat longer opesia in the fossil species which have been allocated in this genus, but all of the other characters seem to conform absolutely. No other recent species is known, though Canu in his description of the genus did mention *Membranipora trifolium* var. *minor* Hincks which, however, is a synonym of *Amphiblestrum papillatum* Busk.

Type, AHF no. 49.

Point Barrow, Alaska, 18 fms on shells, G. E. MacGinitie, collector, Alaska Research Laboratory. Evidently it is an arctic species with circumpolar distribution.

Division IV PSEUDOSTEGA Levinsen, 1909

The cryptocyst covers most of the frontal area. There are no spines or pores; the avicularia are vicarious (replacing zooecia in the series), with usually a transverse pivot. The ooecia are embedded in the base of the succeeding zooecia and open by special pores distal to the aperture. The group is a comparatively small one, with only a few genera.

Family Cellariidae Hincks, 1880

The zoaria are erect and branched, with chitinous joints, the internodes long and rounded.

Genus CELLARIA Ellis and Solander, 1786

Genotype, *Eschara fistulosa* Linnaeus, 1758.

Key to Species of *Cellaria*

1. Avicularian mandible long-triangular. . . . . *veleronis*
   Avicularian mandible short, rounded. 2
2. Avicularium larger than a zooecium, the mandible semicircular and brown in color. . . . . *mandibulata*
   Avicularium much smaller than a zooecium, the mandible semicircular, without color. . . . . *diffusa*

Cellaria mandibulata Hincks, 1882

Plate 13, fig. 1

Cellaria mandibulata Hincks, 1882:462; 1884:203.
Cellaria mandibulata, Robertson, 1905:288.
Cellaria mandibulata, O'Donoghue, 1923:23.
Cellaria mandibulata, Canu and Bassler, 1923:86.

Zoarium erect, 25 to 75 mm in height; much branched, the branches arising at any point on an internode but usually near the distal end; the chitinous joint dark brown or black; internodes usually long.

Zooecia moderately large, 0.45 to 0.60 mm in length by about 0.20 mm in greatest width, narrowed to about 0.10 mm at the proximal end; cryptocyst flat and roughened; aperture semicircular (0.10 mm wide), the cryptocyst forming a slightly raised shelf on the proximal border. The chief distinguishing character is the very large avicularium which is broader than a zooecium, the brown semicircular mandible (0.15 to 0.20 mm in width) usually being very conspicuous.

Hincks described the species from Virago Sound, British Columbia; Robertson states that it is most common in southern California; O'Donoghue lists it for several British Columbia localities, and Canu and Bassler record it from the Pleistocene of Los Angeles, California. Recorded by Osburn (1947:18) from Hancock Station A18-39, Aruba Island in the Caribbean Sea; otherwise it has not been found outside of the Eastern Pacific area.

Hancock Stations: It is abundant and generally distributed from along shore to a depth of 80 fms all along the coast and about the islands

of southern California, where it was dredged at 69 stations. It continues to be a common form as far south as Cedros, Natividad and San Benito Islands (11 stations), but was not noted in the warmer waters south of Point San Eugenio, Lower California.

Cellaria diffusa Robertson, 1905

Plate 12, fig. 9

Cellaria diffusa Robertson, 1905:289.
Cellaria diffusa, O'Donoghue, 1923:25.
Cellularia diffusa, O'Donoghue, 1925:100; 1926:50.
Cellaria diffusa, Canu and Bassler, 1923:86.
Cellaria fissurifera Canu and Bassler, 1923:85.

Zoarium with comparatively few branches; internodes stout and usually elongate (often more than 25 mm); branching irregular, the joints brown or black.

The zooecia are rather large, 0.60 to 0.80 mm long by 0.28 mm in width, narrowed to about 0.17 mm at the proximal end; the marginal walls high, the cryptocyst flat and granulated and strongly elevated into a rounded lip on the proximal border of the aperture. Just beneath this upturned lip there is a strong, short denticle on either side on the proximal border. The avicularium is small and inconspicuous, about as wide as the proximal end of the zooecium, roughly quadrangular in form, with a semicircular colorless mandible.

The ooecium opens by a special pore distal to the aperture; the pore usually rounded with a slightly projecting proximal lip, but occasionally the pore is more or less oval or elliptical.

The *C. fissurifera* of Canu and Bassler is placed in synonymy for the following reasons: (1) the measurements are not sufficiently different to be significant; (2) the avicularia appear to be identical in size and form; (3) the adjacent mural rims are often separated by a furrow; (4) the cryptocyst is deep and flat; (5) the ooecial aperture is often elongate in *diffusa* especially in older specimens.

Robertson recorded the species from Puget Sound and from San Pedro and San Diego, California; O'Donoghue found it at several localities in British Columbia and Puget Sound; Canu and Bassler list it as *C. diffusa* and *C. fissurifera,* both from the Pleistocene of Santa Monica, California.

Hancock Stations: Rather common in the dredgings along the coast and among the islands of southern California (17 stations). Farther south it occurred at Station 182-34, off James Bay, James Island, Ga-

lapagos, 30 fms; 299, San Jose del Cabo, Lower California, Mexico, 82 fms; 2167, Dewey Channel, San Eugenio Point, Mexico, 23 fms; 2160, and 1250-41, 1 mile south of San Benito Islands, Mexico, 44 to 49 fms. The known vertical distribution is from near shore down to 118 fms.

Cellaria veleronis new species

Plate 13, fig. 2

Zoarium erect (to 25 mm in height); sparingly dichotomous, the branches curved at their proximal ends so that the bifurcations are shaped like "tuning forks"; internodes slightly sinuate, slender and elongate about 0.50 mm wide and 5 or 6 mm long), consisting of 4 to 6 series of zooecia.

The zooecia measure about 0.65 mm long by 0.30 to 0.35 mm wide, shorter and wider in the fertile zooecia; cryptocyst deep, flat in the middle area but on either side of this is a curved ridge which extends forward to opposite the aperture. The front is smooth or nearly so and shining. The aperture is semi-circular, with a raised proximal lip of the cryptocyst and a pair of strong proximal denticles. The avicularium is about as large as a zooecium; the rostrum broadly triangular at the base but somewhat elongate and attenuate distally, the thin edges raised to form a groove; at the proximal end these edges turn inward at right angles to form the hinge denticles, but leave a distinct sinus between them. The mandible is similar in form to the rostrum, even to a proximal projection which fits into the sinus.

The fertile zone of the internode is swollen, the ooecia not conspicuous and opening by a broad lunate aperture on the front.

The avicularium in this species appears to be the exact counterpart of that of *C. tecta* Harmer (1926:340), but the ooecium is different, the zooecial front is not granulated and it is a smaller and more slender species (the internodes of *tecta* measure 0.80 mm wide by 13 mm long).

Named for Captain Allan Hancock's yacht "Velero III" in which the collecting expeditions were made.

Type, AHF no. 29.

Type locality, Hancock Station 155-34, Albemarle Island, Galapagos, 0°16′45″S, 91°22′52″W, 50-60 fms. Also taken at Stations 142-34, off Clipperton Island, 65 fms; 310-35, off Bindloe Island, Galapagos, 15 fms; 788-38, SE of Daphne Major Island, Galapagos, 55 fms; 795-38, Sulivan Bay, James Island, Galapagos, 50-60 fms.

Division V CELLULARINA Smitt, 1867

The zoarium is erect, flexible or jointed and attached by radicles (loosely encrusting in a few cases); zooecia not heavily calcified, as a rule, and all facing in the same direction (except in Farciminariidae where they form rounded stems); avicularia sessile or pedunculate (both in the Epistomiidae), sometimes modified into vibracula; spines occur in most of the species, sometimes modified into frontal scutes above the opesia. Ovicells usually hyperstomial.

Key to Families

1. Avicularia pedicellate on a jointed stalk. 2
   Only sessile avicularia present. 3
2. Stalked avicularia only; ovicells hyperstomial. . . Bicellariellidae
   Avicularia of two kinds, stalked and sessile; no ovicells, reproduction by slightly enlarged gonozooecia. . . . Epistomiidae
3. Zooecia in 4 or 6 series around a central axis; avicularia usually paired on the gymnocyst. . . . . Farciminariidae
   Zooecia usually biserial, all facing the same way, usually with a scutum. Ooecia hyperstomial or endozooecial. .Scrupocellariidae

Family Farciminariidae Busk, 1852

Zoaria erect, dichotomously branched, the zooecia arranged in longitudinal rows (generally 4 to 6) around an axis formed by the separating walls; uniporous septulae; avicularia frontal (dependent), ovicells endozooecial. (After Levinsen. 1909).

Genus NELLIA Busk, 1852

The zoarium is erect, four-sided, jointed at the bifurcations. The zooecia are arranged in alternate pairs, the two of each pair opening in opposite directions; spines wanting; a pair of avicularia on the basal gymnocyst; ooecia endozooecial and small but moderately conspicuous. Genotype, *Nellia oculata* Busk, 1852.

Nellia oculata Busk, 1852

Plate 13, fig. 4

Nellia oculata Busk, 1852:18.
Nellia oculata, Harmer, 1926:240.
Nellia oculata, Canu and Bassler, 1928:26.
Nellia oculata, Osburn, 1940:400.

The zooecia are elongate, varying considerably, from 0.45 to 0.60 mm in length; in width they are fairly constant, about 0.18 mm, and main-

tain the same width for most of their length. The opesia is long elliptical, the mural rim thin and slightly raised; there is a narrow cryptocyst proximally and laterally. The avicularia are oval, small and inconspicuous, scarcely raised, one on each side of the proximal gymnocyst a little in advance of the terminal rim of the preceding zooecium. The ovicell is small (width 0.14 mm), short and cap-shaped.

Widely distributed around the world in warmer waters; common in the West Indian region, Smitt 1873:3; Levinsen 1909:120 (*N. tenella*); Osburn 1914:191 and 1940:400, and Canu and Bassler 1928:26. It has not hitherto been reported from the Pacific coast of America.

Hancock Station 500, La Plata Island, Ecuador, 20 fms, several portions of a very characteristic colony.

Nellia tenuis Harmer, 1926

Plate 13, fig. 3

Nellia tenuis Harmer, 1926:245.
Nellia tenuis, Osburn, 1940:400.

Zoarial habit characteristic of the genus, erect jointed stems arising from creeping stolons; internodes shorter than in *N. oculata* and increasing in breadth gradually from the very narrow base. Zooecia comparatively short and wide (length 0.45 mm); opesia somewhat ovate, the cryptocyst well developed proximally and narrower laterally. The most striking feature is found in the avicularian chambers which are long, extending backward in a slight curve to embrace the distal end of the preceding zooecium; the rostrum elevated and hooked and the triangular mandible decurved at the tip.

The ovicell is larger (0.16 mm broad) and more complete than in *oculata.*

Recorded by Harmer for Paternoster Islands, Borneo, Mindanao and the China Sea. Osburn reported it from Porto Rico. It has not hitherto been known from the Pacific coast of the Americas.

Hancock Station 114-33, Bahia Honda, Panama, shallow water, several colonies.

Family **Scrupocellariidae** Levinsen, 1909

Of the eight genera commonly associated with this family, four fall within the scope of the present work. The zoarium is erect or more or less spreading, usually jointed at the bifurcations; the zooecia in two or more series and all facing in the same direction; frontal and lateral avicularia are usually present; dorsal vibracula or avicularia are present

on all of our genera except *Tricellaria*; spines are usually present at the distal end, and a scutum (modified spine) usually protects the opesial area.

Key to Genera

1. No dorsal vibracula or avicularia. . . . . *Tricellaria*
   Dorsal vibracula or avicularia present. 2
2. Zoarium regularly provided with chitinous joints at a bifurcation, rarely a joint may be wanting. . . . . *Scrupocellaria*
   Zoarium not regularly jointed, occasionally a joint may appear. . 3
3. Zoarium biserial (occasionally triserial near the end of an internode); radicles forming a single bundle in the middle of the dorsal side. . . . . *Caberea*
   Zoarium multiserial (usually, but see *A. biseriata,* new species), radicles forming two marginal bundles and leaving the median dorsal area free. . . . . *Amastigia*

Genus **TRICELLARIA** Fleming, 1828

This is *Menipea,* in part, of numerous authors, but is now separated from that genus because of the difference in the manner of branching. In *Tricellaria* the joint crosses the base of a branch far proximal to the opesia of both outer and inner zooecia, while in *Menipea* the opesia of the inner zooecium is traversed by the joint, and there is no scutum. (See Harmer, 1923.)

The zoarium is erect and spreading, much branched, the internodes typically consisting of 3 zooecia, but the distal branches especially often have a larger number. The zooecia are usually much narrowed below the opesia. There are no dorsal vibracula or avicularia and the radicles are on the frontal side. The ovicells are hyperstomial. Genotype, *Cellaria ternata* Ellis and Solander, 1786.

Key to Species of *Tricellaria*

1. Internodes usually with 3 ooecia. 2
   Internodes longer, usually 5 or more zooecia. 5
2. Scutum attached well below the middle of the opesia. 3
   Scutum attached at middle of opesia or above. 4
3. Scutum narrow, simple or with 1 to 3 points. . . . *occidentalis*
   Scutum broader, 3 to 5 points. . . . . var. *catalinensis*
4. Joints light colored; usually 3 outer and one or two inner spines. . . . . *ternata*
   Joints dark colored; usually 2 outer and one inner spines. . *pribilofi*
5. Zooecia elongate at base, slender. . . . . *gracilis*
   Zooecia stouter and closely set, branches stiff. 6
6. A proximal scutum, no frontal avicularia, ovicell with a few large pores. . . . . *praescuta*
   Scutum not proximal, frontal avicularia present, ovicells imperforate. . . . . *erecta*

Tricellaria occidentalis (Trask), 1857

Plate 13, figs. 6 and 7

Menipea occidentalis Trask, 1857:113.
Menipea compacta form *triplex,* Hincks, 1882:461; 1884:208.
Menipea occidentalis, Robertson, 1905:254.
Menipea occidentalis, O'Donoghue, 1923:17.
Tricellaria occidentalis, Silen, 1941:79.

Zoarium bushy, usually not more than 25 mm in height; the branching unusually regular; internodes of 3 zooecia, though 5 or 7 may occasionally be present. The zooecia have about the same size and character as in *T. ternata,* the opesia usually a little less than half as long as the front. The scutum is diagnostic in position, as its base is attached much below the middle of the opesia; it varies greatly in form from a mere spine or simple fork (typical form) to a broadly branched structure with as many as 8 points (var. *catalinensis*). There are usually 3 outer and 3 inner spines.

Lateral avicularia large, the triangular mandible and the rostrum both hooked at the tip; frontal avicularia wanting.

The ooecia are globular and prominent, with a number of small pores.

Trask listed the species from Cape Flattery, Washington, to Santa Barbara, California. Robertson records it as far south as San Diego, California, and Hincks and O'Donoghue from British Columbia.

Hancock Station 287-34, South Bay, Cedros Island, Lower California, 10 to 15 fms, is the most southerly station. It occurs abundantly along the shores and around the islands of southern California and northward to British Columbia.

Tricellaria occidentalis catalinensis (Robertson), 1905

Plate 13, figs. 8 and 9

Menipea occidentalis catalinensis Robertson, 1905:255.

This appears to be merely a nominal variety, as suggested by Silen (1941:80). Every character mentioned by Robertson appears to intergrade; the number of zooecia in an internode is not constant, the form of the scutum ranges all the way from a curved spine to as many as 8 points and the forked spines are not constant.

O'Donoghue found that northern specimens of *occidentalis* varied toward *catalinensis.* Okada (1929:15) found the same variation in Japanese specimens.

The name *catalinensis* may be retained as a nominal variety to include the forms with a more highly branched scutum, which appears to be more constant in warmer waters. The larger scutes are dominant in southern California, but occur less frequently north of Point Conception.

Tricellaria ternata (Solander), 1786

Plate 14, figs. 1 and 2

Menipea ternata, Hincks, 1882:3.
Menipea ternata, Robertson, 1900:316; 1905:251.
Menipea ternata, O'Donoghue, 1923:17; 1926:42.

Erect and more or less spreading colonies, usually less than 25 mm in height. The internodes, especially near the base of the colony, consist of 3 zooecia, but farther out on the branches there are often as many as 5 or 7; the joints cross the narrow bases of both outer and inner zooecia at some distance proximal to the opesia.

The zooecia measure about 0.40 mm in length; they are slender and much narrowed proximally; the opesia occupies usually less than half of the frontal length; the scutum varies from a mere spine to a curved spatulate form, which may end in 2 or 3 points; the stalk of the scutum is attached well above the middle of the opesia and curves slightly downward; spines are 2 or 3 outer and 1 or 2 inner, sometimes quite elongate. Frontal avicularia usually present only on the axial zooecium below a bifurcation, small, and slightly elevated. The lateral avicularia are much larger, present on nearly all of the zooecia.

The ovicells are globose, prominent, smooth and without pores.

This is an abundant species in the cooler waters on both sides of the North Atlantic (from southern New England northward to the Arctic region), and has been listed on the Pacific coast from British Columbia southward to Lands End, California, by Hincks, Robertson and O'Donoghue.

Hancock Station 1283-41, South Point, Santa Rosa Island, California, 23 to 28 fms, is the most southerly record. It does not appear to be a common species along the California coast but occurs rather regularly from Oregon northward to southern Alaska.

Tricellaria gracilis (Smitt), 1867

Plate 14, figs. 3 and 4

Menipea ternata, Hincks, 1884:3.
Menipea ternata gracilis, Robertson, 1900:317.
Menipea gracilis, Robertson, 1905: 253.
Menipea gracilis, O'Donoghue, 1923:17; 1926:42.

Zoarium more diffuse than in *ternata,* with longer internodes. Zooecia often very elongate, occasionally as much as 1 mm, though within the same colony there may be internodes with zooecia not more than 0.40 to 0.50 mm in length, in any case the length is due chiefly to the extension of the preopesial region. The opesia is elliptical, its rim slightly raised and the cryptocyst well developed. The scutum varies greatly, from a mere curved spine to broadly spatulate, and often it is wanting; the same is true of the spines, two, one or none on the outer angle and one or none on the inner corner. Small lateral avicularia are quite constant, but the frontal ones occur only rarely near the end of an internode. The ovicell is subglobose, not so much elongated as in *M. ternata,* the surface lightly striated longitudinally.

The difference between *gracilis* and *ternata,* which have often been confused, are as follows in the Pacific coast specimens: in *gracilis* the zooecia are much more elongate and less robust; the internodes are longer with a larger number of zooecia, though *ternata* is not limited to three; the lateral avicularia are noticeably smaller, and the ovicell is somewhat shorter and slightly striated. They do not seem to intergrade, though admittedly they are closely related.

Hincks' record of *M. ternata* for "Cumshewa Harbor," British Columbia, is for the "form with many cells in an internode," and in the synonymy he gives *"Menipea gracilis."* Robertson separates *gracilis* and records it from Prince William Sound. O'Donoghue also considers it distinct and records it from several localities in British Columbia waters.

Off Hallo Bay, Alaska, 28-40 fms, Station 139-40, and Icy Straits, east end of Pleasant Island, 32-35 fms, Station C.5-41, U. S. Alaska Crab Investigation.

Tricellaria pribilofi (Robertson), 1905

Menipea pribilofi Robertson, 1905:257.
Menipea pribilofi, O'Donoghue, 1923:18.

Internodes consisting of 3 zooecia except the ooecial internodes which usually consist of 5; joints dark colored. Zooecia relatively short and stout, broad at the top, attenuated below, aperture occupying less than

half of the front surface, with 3 spines on its upper margin. Scutum simple, often a mere spinous process, sometimes broadened at the extremity; spines and scuta distinctly jointed. Frontal avicularia few and only on the axial zooecia below a bifurcation, large, raised, the beak oblique or transverse. Lateral avicularia usually present, large. Ooecia globose, smooth. (After Robertson.)

Described by Robertson from the Pribilof Islands, Bering Sea (Kincaid collection), and recorded also from Homer, Unalaska, and Yakutat, Alaska. O'Donoghue reported it as far south as Ucluelet, British Columbia. Not taken in the Hancock dredgings.

Tricellaria praescuta new species

Plate 14, figs. 5 and 6

Zoarium erect, dichotomous, branches stiff and not incurved; internodes of 3 to 15 zooecia, the basal ones short; joint crossing bases of both zooecia far below the opesia; radicles developed only on the more basal internodes.

Zooecia closely set and uniform; axis of the branch a straight line; zooecial length 0.40 mm (basal zooecia of a branch about 0.55 mm), and the width of a branch also about 0.40 mm. The ovate opesia occupies about half of the zooecial length, the mural rim narrow and little raised. The arrangement of the spines is unusual (1) a broad scutum with a stout pedicel, attached at the inner side on the proximal border, extends diagonally upward to cover most of the proximal third of the opesia (sometimes narrower but always stout); (2) at about the middle of the opesia on each side there is a stout, hollow spine which is somewhat scutiform (i.e., broader above its base) which curves upward and partially across the opesia, extending often beyond the aperture, occasionally these spines are bifurcate at the tip; (3) a short, stout, hollow spine at each distal angle (often an additional smaller spine on the outer angle) directed forward. There are no frontal avicularia. Moderately large, elevated marginal avicularia abundant, the rostrum and the triangular mandible both hooked. The axial zooecia bear scuta and spines similar to the others, with the addition of a short median terminal spine.

Ooecia are present on all of the zooecia except on the bases of the internodes and the axial zooecia; prominent but a little flattened on the front, which bears irregularly radiating lines and a few conspicuous pores; about 0.20 mm broad and extending to the opesia of the succeeding zooecium.

There is a general resemblance to *T. (Menipea) erecta* Robertson, but in *erecta* the ovicells are imperforate and the sculpturing is different,

there is no proximal scutum, and there are numerous frontal avicularia.

Type, AHF no. 30.

Type locality, Scorpion Harbor, Santa Cruz Island, California, 2 to 3 fms, one well-developed colony. W. G. Hewatt, collector.

Tricellaria erecta (Robertson), 1900

Plate 14, figs. 7 and 8

Menipea erecta Robertson, 1900:317; 1905:256.

Scrupocellaria scabra, Robertson, 1900:318.

Menipea erecta O'Donoghue, 1923:18; 1925:98; 1926:42.

The form of the zoarium is that of *Scrupocellaria,* as the internodes are longer, the zooecia more closely set and the branches are broader at their bases than is usual in *Tricellaria.*

Zooecia biserial, narrowed below, aperture occupying more than half of the front; margin raised, crenulate, with one of two blunt spines at the outer angle; scutum a flattened spine which is sometimes broadened and bifid. Lateral avicularia often wanting, or feebly developed, or sometimes rather large. Frontal avicularia generally present on each zooecium. Ooecia large, globose, more or less striated and imperforate. (After Robertson.)

The basal zooecia of the branches are shorter than is usual in the genus and the joint sometimes involves the base of the opesia of the outer zooecium.

The species was described from Alaska and later reported by Robertson from Puget Sound. O'Donoghue recorded it from numerous localities in British Columbia and Puget Sound. Okada, 1933:215, also records it from the Kurile Islands, Japan.

It is an abundant species at Point Barrow, Alaska (G. E. MacGinitie, collector, Arctic Research Laboratory). It has not been found in the Hancock dredgings, nor reported south of Puget Sound.

Genus **AMASTIGIA** Busk, 1852

The zoarium is usually without joints. The frontal surface of the pluriserial branches is convex so that the marginal zooecia are faced somewhat outwardly; the dorsal surface nearly flat. The dorsal heterozooecia are avicularia, or vibraculoid avicularia, usually directed toward the midline and more or less proximally. The radicles arise on the margins and pass downward as marginal bundles. Genotype, *Amastigia nuda* Busk, 1852.

The genus has not hitherto been recorded from the Eastern Pacific region.

Amastigia rudis (Busk), 1852

Plate 16, figs. 3, 4 and 5

Caberea rudis Busk, 1852:377.
Amastigia rudis, Harmer, 1923:322; 1926:349.
Amastigia rudis, Silen, 1941:80.

Zoarium bushy, flabellate, coarse, 2 series of zooecia at the base to 8 in the terminal branches; joints wanting.

Zooecia moderate, 0.40 to 0.50 mm in length, closely set; opesia ovoid, narrowed distally; cryptocyst broad. Scutum more or less rounded, attached distal to the middle of opesia. Spines, 3 outer and 1 or 2 inner, all small.

Frontal avicularia varying in size, those on the inner rows usually small, with an acute triangular mandible oriented distally; on the outer rows there are similar small avicularia, but these are often replaced by giant avicularia which are oriented proximally; marginal avicularia wanting. The dorsal avicularia are vibraculoid in form, oriented toward the median line and proximally, the rostrum very narrow and extending nearly to the midline of the branch, the mandible long and setiform.

The ooecia are a little longer than broad, smooth and glossy, the ectooecium covers only the distal end and extends around the sides leaving a large area of the endooecium exposed.

This species is apparently common and widely distributed in the Western Pacific from Australia to Japan, but has not been reported from the Eastern Pacific region.

Hancock Stations: 1250-41, 1 mile south of San Benito Islands, Mexico, 44 to 49 fms; 1245-41, 4 miles north of Todos Santos Island, Mexico, 41 fms; 1187-40, off Bird Rock, Santa Catalina Island, 31 to 40 fms; 874-38 northeast of Anacapa Island, 45 fms; 1269-41, 1 mile west northwest of Anacapa Island, 41 to 43 fms; 1281-41, 3 miles east of South Point, Santa Rosa Island, California, 23 to 26 fms; 116-33, Cocos Bay, Costa Rica, 2 fms.

Amastigia biseriata new species

Plate 15, figs. 1, 2 and 3

Zoarium erect, white, flexible, entirely without joints, dichotomously branched and the branches little divergent; biserial throughout the colony except for the axial zooecium, which is excluded from the dorsal surface, only its axial vibraculum appearing on the dorsal side; attached by radicles which run down the outer margins of the branches; the branches triangular in cross section, the dorsal side flat; the single colony 30 mm high.

Zooecia alternating in two series, except for the axial zooecium which makes three below a bifurcation; moderately large, 0.60 to 0.78 mm long, by 0.30 to 0.40 mm wide, narrowed slightly at the base; the opesia long elliptical, broadest and nearly straight across the distal end; there is a narrow gymnocyst, the mural rim is thin and high, the descending cryptocyst well developed and finely beaded; a short stout spine on the outer distal angle and occasionally a smaller one on the inner angle.

Four types of avicularia are present, frontal, lateral, dorsal and axial (dorsal): (1) the frontal avicularia, on nearly every zooecium, are situated on the inner corner of the gymnocyst, usually small with a triangular mandible but occasionally they are somewhat larger (scarcely "giant") and with a longer mandible; (2) lateral avicularia, small with a hooked triangular mandible, present on nearly all of the zooecia; (3) the dorsal avicularia (somewhat vibraculoid in appearance) are at the extreme bases of the zooecia, the chamber is short and nearly as wide as the zooecium, its mandible triangular at the base and ending in a long, fine point, 0.20 to 0.25 mm long and directed more or less transversely across the branch; the radicle chamber is at the outer side of the avicularian chamber and fused with it; (4) the axial avicularium is similar in structure to the other dorsal avicularia but is located near the distal end of the axial zooecium and its mandible is directed proximally.

The ovicell is directed in line with the zooecial axis, large, about 0.40 mm wide by 0.25 mm long, rather deeply embedded in the succeeding zooecium, thin walled and the surface decorated with fine concentric lines.

The absence of a scutum throws this interesting species into the small group with *A. antarctica* (Kluge) and *A. pateriformis* (Busk), but both of these species are multiserial, the ovicells are different, the frontal avicularia of *pateriformis* are larger and more elevated, and those of *antarctica* are paired. Neither Busk nor Kluge mentions the presence of a dorsal axial avicularium.

Type, AHF no. 31.

Type locality, Hancock Station 1422-41, east of Long Point, Catalina Island, California, 33°24′55″N, 118°13′25″W, 250 fms, one colony attached to a small pebble.

Genus CABEREA Lamouroux, 1816

The zoarium is rather coarse and usually without joints, though one or more may be present in a colony. The vibracula are large, covering a large part of the dorsal surface and exposed from the frontal view, the setae strong and elongate and minutely feathered toward the tip. The radicles pass downward along the midline of the stalk. Genotype, *Caberea dichotoma* Lamouroux, 1816.

Key to Species of *Caberea*

Without a scutum. . . . . *ellisi*
Scutum present. . . . . *boryi*

Caberea boryi (Audouin), 1826

Plate 15, figs. 4, 5 and 6

Caberia boryi, Harmer, 1926:362.
Caberea boryi, O'Donoghue, 1923:19; 1926:41.

The zoarium is small and delicate and is less flabellate than *C. ellisi.* The zooecia are comparatively small, 0.35 to 0.40 mm in length, the opesia occupying about three-fourths of the frontal length; the cryptocyst is broad, especially at the proximal end where it is shelf-like. The scutum presents a very diagnostic character, as its distal border extends straight across the opesia and unites with a prominence on the opposite side, thus forming a bar which closes off the aperture; the proximal lobe of the scutum is broadened to cover a considerable portion of the opesial area. There are two or three outer spines and one inner.

The frontal avicularia are usually small, elevated, with a triangular mandible, but among these, especially on the axillary zooecium below a bifurcation, are giant avicularia, much elevated, swollen, with a very strongly hooked rostrum. The lateral avicularia are minute.

The vibracular chamber covers only a little more than half of the dorsal side of a zooecium, but its groove extends to the midline of the branch. The seta is long and strong and the barbules extend nearly to its base.

The ooecia are rounded, smooth, imperforate, with a frontal area which is not covered by the ectooecium.

Reported by O'Donoghue at several stations in British Columbia waters. A cosmopolitan species, known from the coasts of Europe, Australia and the East Indies, Japan, Patagonia and elsewhere.

Hancock Stations, 287-34, South Bay, Cedros Island, Lower California, 10 to 15 fms; 1190-40, Anacapa Passage, southern California, 15 to 50 fms; 72, Guadalupe Island, Lower California, 17 fms. The writer also has a specimen from the Gulf of California, presented by Dr. H. R. Hill.

Caberea ellisi (Fleming), 1828

Plate 16, figs. 1 and 2

Caberea ellisi, Hincks, 1884:5.

Caberea ellisi, Robertson, 1905:263.

Caberea ellisi, O'Donoghue, 1923:19; 1925:98; 1926:41.

The zoarium is rather coarse, the branches fan-shaped, reaching an inch or more in height. The zooecia are well calcified, moderate in size (about 0.50 mm long by 0.20 mm wide), the elliptical opesia occupying about three-fourths of the frontal surface, and the scutum is entirely wanting. Spines strong, 2 or 3 outer and 1 inner.

Small frontal and lateral avicularia are present, the mandible rounded or short-triangular. The vibracular chambers are large, covering a large part of the dorsal surface, oriented diagonally and reaching nearly to the midline of the branch; the groove is long and narrow, its edges elevated; the seta is strong and elongate, usually more than 1.00 mm, and feathered toward the tip.

The ooecia are large, 0.20 to 0.25 mm broad, smooth, somewhat flattened, without pores and with an area on the frontal surface caused by the failure of the ectooecium to form a complete cover.

This species is common in the Atlantic Ocean from the British Isles northward and north of Cape Cod. On the west coast it was recorded by Hincks from Cumshewa and Vancouver Island, British Columbia; from Juneau, Alaska, by Robertson, and O'Donoghue lists it for numerous stations in British Columbia and Puget Sound. The writer has collected it along the shore at several places from Santa Monica to La Jolla, southern California.

Hancock Stations: 847-38, Anacapa Island; 1007-39, 1150-40 and 1316-41 from Santa Catalina Island; 1336-41, Cortez Bank; 1394-41 and 1397-41, Santa Rosa Island, and 1418-41, Santa Cruz Island, all off southern California. Station 2160, San Benito Island, Lower California, is the most southern record.

Genus **SCRUPOCELLARIA** van Beneden, 1845

Harmer has given such a complete diagnosis of this genus (1920: 364) that it is not necessary to mention more than a few essential points. The zoarium is biserial, with corneous joints crossing the proximal ends of the pair of zooecia on each side of a bifurcation, though occasionally the joint may be absent. The oval or elliptical opesia occupies from one-third to two-thirds of the frontal area and in most cases this is protected by a forked or oval scutum, though this is wanting in a few species. Distal spines are characteristic, in varying numbers and size. Both frontal

and lateral avicularia and dorsal vibracula are present, the avicularia occasionally much enlarged and modified (giant avicularia). Occasionally the frontal and lateral avicularia are of the same size, but more frequently either the frontal or the lateral series will be larger than the other. The ooecia are prominent, hyperstomial, and with or without pores.

The genus is remarkably well represented in the Eastern Pacific region. Genotype, *Sertularia scruposa* Linnaeus, 1758.

KEY TO SPECIES OF *Scrupocellaria*

1. Two axial vibracula. 2
   Only one axial vibraculum. 4
2. Scutum oval, without cervicorn decoration, ooecium imperforate. . . . . *harmeri*
   Scutum wanting. 3
3. Spines strong, radicle chamber proximal to vibracular chamber. . . . . *scruposa*
   Spines vestigial, radicle chamber lateral. . . . . *profundis*
4. Scutum wanting or vestigial. 5
   Scutum usually well developed. 6
5. Long curved lateral giant avicularia. . . . . *talonis*
   Very broad frontal giant avicularia. . . . . *ferox*
6. Scutum variously forked. 7
   Scutum broad, oar-shaped to broad oval. 10
7. Ovicell imperforate, giant elongate lateral avicularia. . . *varians*
   Ovicell with pores. 8
8. Vibracular chamber transverse, broader than long; outer and inner spines often bifurcate; no giant avicularia. . *panamensis*
   Frontal and sometimes lateral giant avicularia; vibracular chamber more or less triangular. 9
9. Giant frontal avicularia robust, rostrum hooked. . . *bertholetti*
   Giant frontal avicularia very elongate, mandible directed proximally. . . . . *bertholetti* var. *tenuirostris*
10. Giant lateral avicularia long and curved. . . . . *unguiculata*
    Lateral avicularia all normal in form. 11
11. Scutum small, oar-shaped; ooecia imperforate. . . . *californica*
    Scutum large, covering most of the opesia; ooecia with or without pores. 12
12. Vibracula very small; ooecia imperforate . . . . . *scabra*
    Vibracula larger, groove diagonal or longitudinal, ooecium with pores. 13
13. Vibracular chamber two-thirds as long as zooecium. . . *diegensis*
    Chamber shorter, not more than half zooecial length. . . 14
14. Groove of vibracular chamber diagonal. . . . . *mexicana*
    Groove longitudinal. 15
15. Ooecial pores unusually large, zooecia 0.50 to 0.65 mm long. . . . . *macropora*
    Ooecial pores smaller; zooecia shorter. 16

16. Zooecia slender, curved, spines very long. . . . . *spinigera*
Zooecia stout, closely set; joint across proximal half of outer zooecium. 17
17. Frontal avicularia all small, somewhat elevated, mandible triangular; scutum with retrorse points at the basal corners. . . . . *regularis*
Frontal avicularia more compressed and elevated, especially the larger one on the axial zooecium, mandible narrow; scutum with broadly wedge-shaped base. . . . . *obtecta*

Scrupocellaria pugnax. This species was accidentally omitted in the key. It works out at 5, frontal avicularia large and transverse, lateral avicularia wanting.

As additional aid in identifying the many species of *Scrupocellaria* the following grouping according to certain characters will be found useful.

Two axial vibracula: *S. harmeri* Osburn, *S. profundis* n. sp., *S. scruposa* (L.).

Vibracular groove more or less transverse: *S. bertholetti* (Audouin), *S. b. tenuirostris* n. var., *S. scabra* (van Beneden), *S. varians* Hincks, *S. panamensis* n. sp., *S. talonis,* n. sp.

Giant frontal avicularia: *S. bertholetti* (Audouin), *S. b. tenuirostris* n. var., *S. ferox* Busk, *S. pugnax* n. sp.

Giant lateral avicularia: *S. bertholetti* (Audouin), *S. unguiculata* n. sp., *S. varians* Hincks, *S. talonis* n. sp., *S. californica* Trask (but normal in form).

Scutum forked: *S. bertholetti* (Audouin), *S. panamensis* n. sp., *S. varians* Hincks, *S. b. tenuirostris* n. var.

Scutum oval, without cervicorn decorations: *S. californica* Trask, *S. diegensis* Robertson, *S. harmeri* Osburn.

Scutum wanting: *S. ferox* Busk, *S. profundis* n. sp., *S. scruposa* (L), *S. pugnax* n. sp., *S. talonis* n. sp. (or vestigial).

Ovicell imperforate: *S. californica* Trask, *S. harmeri* n. sp., *S. scabra* (van Beneden), *S. scruposa* (L.), *S. varians* Hincks.

Even with this additional grouping of characters identification is not always easy because of variation. Giant avicularia may be a dominant feature, or they may be comparatively rare in the same species. The shape and size of the scutum and the number and size of the spines are subject to much variation. Ovicells are wanting in colonies that have not reached reproduction. The vibracular chamber appears to vary less than other structures.

Scrupocellaria bertholetti (Audouin), 1826

Plate 15, figs. 7 and 8, and 21, fig. 8

Scrupocellaria bertholetti, Hastings, 1930:733.
Scrupocellaria bertholetti, Osburn, 1940:386.

Zoarium erect, branching, of moderate size. Zooecia somewhat elongate (0.40 to 0.45 mm long by 0.15 to 0.18 mm in width), a little narrowed proximal to the opesia which occupies somewhat more than half of the front. The spines vary greatly in number and length; usually there are three outer (occasionally 4 or only 2), and 1 or 2 inner, outermost and inner spines rarely briefly furcate. Usually there is a small inner spine a short distance above the attachment of the scutum. The scutum also varies from a single spine curving over the opesia to a triple-forked structure with 6 or more sharp points. Frontal avicularia are always present, either small ones with the mandible directed laterally, or giant avicularia which are elevated and directed either proximally or laterally and with strongly hooked rostrum. Occasionally these may appear lower on the internode. The lateral avicularia are small, with a triangular mandible, but here also giant avicularia may occasionally occur, having much the same structure and size as those on the front and with a strongly hooked rostrum. The vibracular chambers are small and short, somewhat triangular, with a transverse groove; the seta is small and usually less in length than a zooecium; the radicle chamber is rounded and situated at the proximal end of the vibracular chamber on the outer side.

The species is widely distributed in the Red and Mediterranean Seas, the eastern and western Atlantic and elsewhere. Hastings (1930) listed it for the Galapagos Islands.

The ooecia are subglobose, prominent, averaging 0.20 mm in width, with scattered tubular pores.

Hancock Stations: A common species dredged at 24 stations from southern California to the Galapagos Islands; intermediate localities, San Benito, Isabel and Clarion Islands off the west coast of Mexico, the Gulf of California as far north as Angel de la Guardia Island, Costa Rica, and Panama. Low tide to about 100 fms. It is common in shallow water and on the piles of docks about the harbors of southern California.

Scrupocellaria bertholetti var. **tenuirostris** new variety

Plates 18, fig. 8, and 21, fig. 6

The zoarium is erect, but rather loose and spreading, growing among hydroids, algae and other bryozoans, reaching a height of about 20 mm. Usually there are either 5 or 7 zooecia in an internode and the joint crosses the outer primary zooecium of a branch at the proximal end of the opesia, the inner zooecium below the opesia.

The zooecia are quite regular in size and form (length 0.40 mm to 0.45 mm, width 0.20 at the widest part and 0.10 at the proximal end), the outer margin nearly straight. The opesia is elliptical or slightly narrowed proximally, about three-fourths as long as the zooecial front. Spines 3 (2 to 4) outer and 1 or 2 inner, rather long and slender and jointed at the base. The scutum is attached at the middle of the opesia, branched as much as 4 times when fully developed, with as many as 16 sharp points, and covers nearly all of the opesia.

The frontal avicularia are of the "giant" type, somewhat elevated, greatly compressed, the rostrum very elongate with the sides raised to form a groove and without a recurved tip; the mandible is very long and narrow, extending beyond the rostrum and ending in a broadly curved needle-like point; length of mandible 0.25 to 0.40 mm. The rostrum is directed straight downward between the zooecial series. Usually there is only one frontal avicularium to an internode, but as many as three have been observed. The lateral avicularia are all of the normal triangular form, moderately large and present on all of the zooecia.

The vibracula occur on all of the zooecia; the chamber is small, somewhat triangular in outline, the groove nearly transverse; the seta is short, not much longer than a zooecium; the radicle chamber is on the outer side at the proximal end, the radicle (0.07 mm in diameter) with retrorse hooks.

Ooecia prominent, subglobose, about 0.20 mm long and wide, with scattered tubular pores.

This form resembles *bertholetti* in most of its characters, but when the frontal avicularia are of the extremely elongate type and the scutum is fully developed it appears to be a different species. However, there is so much recorded variation in *bertholetti,* and some variation in the avicularia and scuta of *tenuirostris* that it seems better for the present to record the latter as a well-marked variety.

The writer first observed this form at the Kerckhoff Laboratory at Corona del Mar, California, where it was abundant on the floats and piles of Newport Harbor. Later, in the Hancock collections, it was found

to be common along the coast from southern California southward to Costa Rica and Cocos Island.

Type, AHF no. 32.

Type locality, Newport Harbor, California.

Hancock Stations: 253-34, 254-34, 255-34, 799-38, off Costa Rica; 870-38, Isabel Island, Mexico; 540-36, 1045-40, 1053-40, Gulf of California; 287-34, Cedros Island, off Lower California, and various stations around Santa Catalina Island, California.

Scrupocellaria californica Trask, 1857

Plates 16, figs. 6 and 7, and 20, fig. 5

Scrupocellaria californica Trask, 1857:114.
Scrupocellaria brevisetis Hincks, 1882: 462.
Scrupocellaria californica, Robertson, 1905:259.
Scrupocellaria californica, O'Donoghue, 1923:18; 1926:40.

Zoarium erect, tufted, with numerous branches; internodes with usually 3 or 4 zooecia in a series; joint immediately proximal to the outer opesia, sometimes involving its lower border slightly.

Zooecia averaging 0.40 mm long by 0.20 mm wide, narrowed to 0.13 at the proximal end, the outer border nearly straight. Opesia elliptical, occupying half or more of the frontal length; cryptocyst moderately developed, finely granulated. Scutum small and narrow, sometimes a mere curved spine, at other times it is broadened distally (paddle-shaped), the proximal lobe only being developed; at its fullest development it covers only a small part of the opesia. Two strong outer spines, with occasionally a third smaller one, and one or two small inner spines.

The frontal avicularia are all small, located on nearly all of the zooecia. The lateral avicularia also are rather small, but these are frequently replaced, especially toward the ends of the branches, but giant avicularia of about the same form. In these giant avicularia the base may be more than half as long as a zooecium, the mandible is triangular and the rostrum is very strongly hooked.

The vibracular chamber is small, often wanting, its groove transverse; the seta short and weak, usually much less than the length of a zooecium. The radicle chamber is at the outer side of the proximal end of the vibracular chamber and about equal to it in size.

The ooecia are rounded, about 0.20 mm in width, without pores and smooth except for a trace of fine lines.

It is quite probable that the *S. brevisetis* of Hincks from Houston Stewart Channel, British Columbia, is identical with *californica,* but

Hincks did not figure it, nor was he able to observe the ovicell. Robertson lists the species from San Francisco to south of Point Conception, California. O'Donoghue records it from numerous places in British Columbia and Puget Sound.

Hancock Stations: 1250-41, San Benito Island, west coast of Lower California, the farthest south it occurred. Northward from this point it was taken at Stations 1059, 1951 and 1234 at San Miguel Island, 1191 at Cortez Bank, 1281-41 and 1283-41 at Santa Rosa Island, southern California, and 1492-42 at Cape Arago, Oregon. Since it did not occur regularly in dredge hauls, though it is common along shore, it is probably limited to rather shallow water.

Scrupocellaria diegensis Robertson, 1905

Plates 15, fig. 9, and 22, fig. 1

Scrupocellaria diegensis Robertson, 1905: 261.
Scrupocellaria diegensis, O'Donoghue, 1923:18; 1926:41.

Zoarium coarse, large (50 mm or more in height), bushy; internodes elongate, as many as 12 zooecia in a series; joint crossing the proximal part of the opesia of the outer zooecium.

The zooecia are moderately large, 0.45 to 0.55 mm long by about 0.26 mm wide, the outer margin straight. The opesia is large, oval, and occupies considerably more than half of the frontal surface, the cryptocyst broad and finely granulated. The scutum is ellipsoid in form, the proximal lobe longer, not quite covering the opesia and attached by a strong pedicel a little above the middle of the opesia; the cervicorn figure is only slightly developed. Spines, 3 outer and 2 inner, strong, and the first outer and inner spines frequently bifurcate.

The frontal avicularia are usually small, slightly raised, with a triangular mandible, but giant avicularia, more elevated, with a compressed rostrum and attenuated mandible which is strongly curved, occur especially on the axial zooecium. The lateral avicularia, on every zooecium, are small with a triangular mandible. The vibracular chamber is exceptionally large, elongate (as long as 0.30 mm), prominently exposed from the frontal view for about two-thirds of its length, its groove longitudinal; the setae are coarse and elongate, frequently more than 1.00 mm long. The radicle chamber is at the outer side of the proximal end of the avicularian chamber.

The ooecium is large, prominent, slightly broader than long, somewhat flattened and provided with numerous pores.

Recorded by Robertson from San Diego to San Francisco, California, and by O'Donoghue from a number of places in southern British Columbia.

Hancock Stations: Dredged at 11 stations among the islands off southern California; at 6 stations off the west coast of Mexico, Natividad Island, San Benito Island, Thurloe Head, Cedros Island and Tenacatita Bay; in the Gulf of California as far north as Angel de la Guardia Island (Isla Partita); rather surprisingly it occurred again at Station 885-38, Gorgona Island, Colombia. It is very abundant along the shores of southern California on floats and the piles of docks.

Scrupocellaria ferox Busk, 1852

Plates 18, fig. 11, and 19, fig. 4

Scrupocellaria ferox Busk, 1852:370.
Scrupocellaria cyclostomata, Kirkpatrick, 1890:16.
Scrupocellaria ferox, Waters, 1913:476.
Scrupocellaria ferox, Harmer, 1926:367.

The species is especially distinguished by the very large avicularium which broadens outward below the opesia and partly covers its proximal area; the rostrum is directed outward, curved and asymmetrical; the mandible very acute. The lateral avicularia are so small as to be almost vestigial. There is no scutum. Busk figured the species without distal spines, but Harmer indicated that there may be four vestigial spines; the present material shows the bases of two small spines, one outer and one inner. The vibracula are visible from the front, the groove slightly diagonal. Setae were wanting on our specimens, but Harmer states that they are much longer than the zooecium and curved at the tip. No ovicells on our material, but Harmer indicates that they are large with pores which are not tubular.

Busk had the species from the Louisiade Archipelago; Waters from Zanzibar; Kirkpatrick from the Tizard Bank, China Sea, and Harmer from numerous Siboga stations about the East Indies.

Hancock Stations: 435, Wreck Bay, Chatham Island Galapagos Islands, 22 fms. two internodes, dead; 450, Galapagos, 0°55′00″S, 90° 30′00″W, 60 fms, living; and 461, Tagus Cove, Albemarle Island, Galapagos, 80 fms. It is apparently a tropical species widely distributed in the Indian and Pacific Oceans.

Scrupocellaria harmeri Osburn, 1947

Plates 18, figs. 9 and 10, and 20, fig. 4

Scrupocellaria harmeri Osburn, 1947:20.

Zoaria loosely spreading the branches narrow, the internodes of moderate length, the joint crossing the outer zooecium just proximal to the opesia.

Zooecia slender, average length 0.40 mm, narrowed to about 0.09 mm in width at the proximal end, nearly straight but a little incurved on the outer border. Opesia decidedly less than one-half the frontal length, ovoid, slightly constricted distally, with a conspicuous cryptocyst. Scutum ovate, upper lobe small, attached well above the middle of the opesia, without an alcicorn decoration; wanting on many of the zooecia. Spines 3 (2 to 4) outer and 2 (1 to 3) inner, moderately developed.

Frontal avicularia small, with triangular mandible, wanting on most of the zooecia. Lateral avicularia large and prominent, all of one size, on all of the zooecia, rostrum and triangular mandible both hooked at the tip. Vibracular chamber elongate and slender, the groove longitudinal; seta small and weak, scarcely longer than a zooecium. Radicle chamber directly proximal to and in line with the vibracular chamber; radicles smooth. There are two prominent axial vibracula.

Ooecium somewhat elongate, 0.16 mm long by 0.13 mm wide, smooth, imperforate, with the distal end inclined toward the axis of the internode.

Pacific specimens appear to agree in every respect, though they are not in reproduction, with the type specimen from Aruba Island in the Caribbean Sea. The species is similar to *S. scruposa* (L.) in appearance but is more delicate and the presence of a scutum, the larger number of spines and the form and position of the ovicell appear sufficient to separate it.

Hancock Stations: 447, Albemarle Island, Galapagos, 32 fms; 1378-41, Santa Catalina Island, California, 2 to 3 fms; and at La Jolla, California, among algae, Dr. C. L. Hubbs, collector.

Scrupocellaria macropora new species

Plates 19, fig. 2, and 20, fig. 1

Zoarium erect, the branches more or less parallel; the internodes rather long, ranging from 3 to 9 zooecia in a series; the joint crosses the outer zooecium at the proximal end of the opesia.

The zooecia are somewhat elongate (0.50 to 0.65 mm long by 0.20 mm wide at the broadest part), narrowed somewhat below the opesia. The opesia is elliptical, scarcely narrowed proximally, about half or less as long as the frontal, the mural rim thin, slightly raised. The avicularia

are all normal in form with a triangular mandible, the lateral avicularia very small and median ones somewhat larger, slightly elevated and oriented laterally. Three spines are usually present, two (or three) outer and one inner, the first outer and inner ones sometimes sinuous and directed across above the aperture. The scutum is large, oval, covering most of the opesia, with a well-developed alcicorn area, the proximal lobe larger and the distal lobe slightly elevated above the operculum.

The vibracular chamber is small, about one-third the length of the zooecium, the groove longitudinal and somewhat on the inner side; the seta is small and about as long as the zooecia. The small radicle chamber is at the outer side of the proximal end of the vibracular chamber; radicle smooth, without hooks (diameter 0.05 mm).

The ooecium is very large and conspicuous (0.25 mm or more in length by about 0.20 mm in width), somewhat depressed and not elevated at its distal extremity; it extends to the opesia of the distal zooecium; the non-tubular pores are about twice as large as is usual in the genus.

Type, AHF no. 33.

Type locality, Hancock Station 1263-41, 1½ miles off north end of Cedros Island, Mexico, 45 to 55 fms, several branches without base. Also Station 1162-40, eleven miles south of Seal Beach, California, 82 fms, on sponge.

Scrupocellaria mexicana new species

Plates 18, figs. 1 and 2, and 21, fig. 3

Zoarium rather small and spreading; internodes of moderate length, 1 to 1.5 mm, averaging about 0.40 mm in width, joints yellow, crossing the proximal part of the opesia of the outer zooecium.

Zooecia small, short (0.26 to 0.30 mm long by 0.20 mm in width at the widest part), closely set, a little narrowed below the opesia which occupies about two-thirds of the frontal length. Opesia ellipsoid, a little narrowed proximally, the cryptocyst narrow and smooth. Scutum rounded, the basal corners slightly produced, not quite covering the opesia, alcicorn pattern well developed. Spines usually three outer and two inner, all small but the second and third outer spines somewhat enlarged; none of these are forked.

Frontal avicularia on nearly every zooecium, slightly elevated with a triangular mandible directed diagonally outward and downward. The avicularium of the axillary zooecium is of the same pattern, but somewhat higher and larger. The lateral avicularia are small and sometimes wanting. The vibracular chamber, on every zooecium, is small and not

visible from a frontal view, the groove diagonal; seta slender and as long as two or three zooecia. Radicle chamber small, situated at the outer proximal border of the avicularian chamber; radicles smooth, with a few retrorse barbs (diameter 0.03 mm). One axial vibraculum.

Ooecium flattened, very prominent, the tip elevated and extending upward and forward over the proximal one-third of the opesia above the scutum; the surface roughened by irregular lines and with small short-tubular pores.

Type, AHF no. 34.

Type locality, Acapulco, Mexico, 15 fms, Capt. Fred E. Lewis, collector. Also at Hancock Stations 270, Angel de la Guardia Island, 14 fms; 2180, Magdalena Bay, Gulf of California, 18 fms; 1281-41, Santa Rosa Island, southern California, 23 fms; and 1856-49, Santa Barbara Basin, 321 fms.

Scrupocellaria obtecta Haswell, 1880

Plates 18, fig. 7, and 21, fig. 4

Scrupocellaria obtecta Haswell, 1880:37.
Scrupocellaria obtecta, Harmer, 1926:378.

Zoarium much branched, spreading over sponges; internodes usually of 4 zooecia in a series but there may be 6 or more. The joint crosses the proximal part of the opesia of the outer zooecium, involving it to near the origin of the scutum; on the inner zooecium the joint crosses immediately proximal to the opesia and sometimes involves its lower border.

Zooecia stout and closely set, ranging from 0.30 to 0.40 mm long by 0.20 mm wide, narrowed to about 0.14 mm at the proximal end, the outer border nearly straight. The opesia is large, occupying two-thirds of the frontal length, its rim slightly raised and the cryptocyst well developed and finely granulated. The scutum, which does not conform in shape to the opesial area, is roughly triangular in outline with the corners rounded, the proximal lobe is longer, the alcicorn figure conspicuous and the stalk is strong. Spines usually 3 outer and 2 inner, the second and third outer and first inner spines are long and strong, the others much weaker, and all are jointed at a little distance above the base. There is no indication of bifurcation of any of the spines.

The frontal avicularia, wanting on many zooecia, are slightly elevated, considerably compressed, with a pointed rostrum and mandible, both of which are strongly hooked, directed laterally, those on the axial zooecia often larger and much elevated. The lateral avicularia, usually present, are small with a triangular mandible.

The vibracular chamber is elongate, nearly half as long as a zooecium, and visible from in front for half of its length; groove longitudinal; seta very long, occasionally more than 1.00 mm, but usually shorter. The radicle chamber is situated at the proximal outer border of the vibracular chamber; the radicles measure 0.03 mm in diameter and are provided with retrorse barbs throughout most of their length.

The ooecia are somewhat variable in form but are usually a little broader than long (average width 0.22 mm, length 0.20 mm), elevated at the tip and extending somewhat over the scutum of the distal zooecium, the front a little flattened and with non-tubular pores which are connected by wavy lines.

The species, described from Queensland, Australia, has been taken in the Red Sea, East Africa, Indian Ocean, the East Indies and the Island of Tahiti. It has not been previously recorded from the Eastern Pacific region and our material shows some differences, but not sufficient to warrant the erection of a new species. There are no bifurcate oral spines, while in *obtecta,* according to Harmer (l.c.) the second outer and first inner are forked; Harmer described the opesia as having "hardly any cryptocyst," which agrees very well with only the younger zooecia in our specimens, and he states that the ovicells are "rather elongate" while in our material they vary and are usually slightly broader than long. There is, however, a close agreement in the form of the zooecia, avicularia, vibracula and scutum and in the size of the opesia.

Hancock Station 557-36, off White Rock, Isla Partida, Gulf of California, 28°55′30″N, 113°05′35″W, 45 fms, several colonies.

Scrupocellaria panamensis new species

Plates 17, figs. 5 and 6, and 20, fig. 2

Zoarium somewhat recumbent, branching dichotomously, the internodes usually about 1 mm in length but occasionally as much as 2 mm, 6 or 8 zooecia in a series; the joint crossing the lower part of the opesia of the outer zooecium.

The zooecia are short and wide (0.26 to 0.30 mm long by 0.20 mm wide), a little narrowed proximal to the opesia, which occupies about two-thirds of the front. The opesia is elliptical in outline with a well developed cryptocyst which is finely granular and which is only slightly narrower distally. A broad, heavy, branched scutum covers practically all of the opesia when fully developed, with 3 to 5 main branches and these often branched twice or three times (as many as 26 points have been counted); the stalk large and attached at the middle or a little proximal to the middle of the opesia. The oral spines are usually 5 or 6

in number, 3 or 4 outer and 2 inner, the proximal outer and inner spines often bifurcate and erect.

Small triangular lateral avicularia are present on nearly all of the zooecia, behind the first outer spine. Frontal avicularia are all small, slightly elevated, proximal to the opesia, with a triangular mandible directed outward or somewhat downward; occasionally only the one just proximal to the bifurcation is present.

Vibracula are found on most of the zooecia, short but nearly as wide as the zooecium, the groove nearly transverse; setae short and weak; radicle chamber at the outer, proximal corner; radicles strong and without hooks. One axial vibraculum.

Ooecium large and prominent, its distal end elevated, definitely broader than long, covering the distal zooecium to its opesia; length 0.15 mm, width 0.18 to 0.20 mm; perforated by non-tubular pores.

This species closely resembles *S. reptans* (Linnaeus) but the joint crosses the opesia of the outer zooecium, the vibracular chamber is different; there are forked erect spines and other minor differences.

Type, AHF no. 35.

Type locality, Perlas Islands, Panama (author's collection). Also Hancock Station 850-38, off Cape San Francisco, Ecuador, 15 fms; and Station 470, one-half mile north from Black Beach, Charles Island, Galapagos, 9 fms.

Scrupocellaria profundis new species

Plates 17, fig. 7 and 21, fig. 1

Zoarium slender, the branches elongated, 3 or 4 zooecia in a series in an internode. Zooecia large and elongate (0.70 to 0.80 mm long by 0.25 mm at the widest part), narrowed below the opening to about 0.15 mm at the narrowest part. Opesia long, oval, more than half the frontal length, the mural rim high and thin, smooth, with a slight smooth cryptocyst. Spines vestigial or wanting; no scutum. Lateral avicularia very minute, often wanting; frontal avicularia wanting except for one minute avicularium usually present at the side of the proximal end of the opesia of the axial zooecium at a bifurcation. Two axial vibracula, their grooves parallel and as long as those of the lateral ones. The lateral vibracula are small, not visible from the front, about one-fourth as long as a zooecium, the groove slightly diagonal; seta not as long as a zooecium; radicle chamber on the outer side, rounded and bulbous, radicles smooth and slender. No ooecia present.

The zooecia bear a rather close resemblance to *S. simplex* Kluge (1914:607) from the Antarctic, but Kluge's description and figure indi-

cate that the frontal avicularia are differently distributed; there are no vibracula, but occasional radicle chambers occur in the usual position, and joints are usually absent. In *profundis* the joints are normally developed, the dorsal vibracula regularly present and the axial ones twined.

Type, AHF no. 36.

Type locality, Albatross Expedition to Lower California, 1911, Station 5682, off San Lucas Bay, Lower California, 22°48′20″N, 109°52′40″W, 491 fms.

Scrupocellaria pugnax new species

Plates 17, fig. 4, and 21, fig. 5

Zoarium erect with slender branches, the joint involving the proximal border of the opesia of the outer zooecium, internodes with 4 to 7 zooecia in a series.

The zooecia are slender, about 0.50 mm long by 0.14 mm wide and narrowed to about 0.08 mm at the base, the outer border nearly straight. The opesia is regularly elliptical, 0.18 mm long by 0.10 mm wide, the cryptocyst finely granulated. The spines are well developed, 2 or 3 outer and 1 or 2 inner. Lateral avicularia appear to be entirely wanting. On every zooecium, immediately proximal to the opesia, is a large salient avicularium, the chamber somewhat bulbous, the rostrum elongated and directed forward and outward over the base of the opesia, both rostrum and mandible hooked. The avicularium resembles that of *S. ferox* Busk, but is smaller and less elevated. The vibracular chamber is large and prominent, visible for half of its length from the frontal aspect, its groove longitudinal; the seta strong and about twice the zooecial length. The radicle chamber is at the proximal-lateral side and included in the outline of the avicularian chamber; the radicles numerous, without serrations, about 0.04 mm in diameter. The axial vibraculum is similar in size and form to the lateral ones. There is no evidence of a scutum.

While the large, transverse avicularia of *S. pugnax* suggest *S. ferox* Busk, the latter species has only vestigial spines, the opesia is pointed oval in form, the radicles are serrated and the zooecia are shorter and wider.

Type, AHF no. 37.

Type locality, Hancock Station 451, Post Office Bay, Charles Island, Galapagos, at 60 fms, one colony without ovicells.

Scrupocellaria regularis Osburn, 1940

Plates 18, figs. 3 and 4, and 20, fig. 3

Scrupocellaria regularis Osburn, 1940:384; 1947:19.
Cellularia cervicornis, Smitt, 1872:14 (non Busk).

Zoarium erect with flabellate branches; the internodes long with often 10 or more zooecia in a series; the joint crosses the base of the opesia of the outer zooecium.

Zooecia rather short (0.35 to 0.40 mm), half as wide as long, and closely set, very regular in the arrangement of all structures. The opesia, which is elliptical, occupies about two-thirds of the frontal length; mural rim thin and slightly elevated, the cryptocyst narrow and finely granulated; the scutum when fully developed covers nearly all of the opesia below the aperture, with a very symmetrical alcicorn decoration, and the proximal corners are pointed; the full complement of spines is six, 4 outer and 2 inner, rather strong, and the proximal outer and inner ones are occasionally bifurcate. The frontal avicularia are of moderate size, numerous and none of them enlarged; the lateral avicularia are all small, occasionally wanting. The vibracula, on practically every zooecium, are large (more than half of the zooecial length), visible from the frontal view, the groove longitudinal, the seta sometimes as long as 4 zooecia. The radicle chamber is large, located at the outside of the proximal end of the vibracular chamber; radicle fibers strong, straw colored, occasionally with retrorse hooks.

Ooecia large, conspicuous, covering the distal zooecia beyond the proximal lip of the opesia, the tip elevated, perforations moderately large and without tubules.

Known hitherto only from the Atlantic, Gulf of Mexico, Caribbean Sea and Bermuda. Pacific specimens do not appear to differ in any respect except that the bifurcating spines are rare.

Hancock Stations: 557-36, off White Rock, Isla Partida, Gulf of California, 45 fms, several colonies; also U. S. National Museum No. 1474 (other data lacking).

Scrupocellaria scabra (van Beneden), 1848

Plates 18, fig. 5, and 22, fig. 2

Cellarina scabra van Beneden, 1848:73.
Scrupocellaria scabra, Hincks, 1880:48.

Zoarium moderately stout, biserial, internodes 3 to 7 or more zooecia in a series, joint crossing immediately proximal to the opesia of the outer zooecium or involving it slightly. Zooecia moderate in size (0.40 to 0.55 mm long); the outer edge slightly curved. The opesia occupies about

half of the frontal length, oval, the descending cryptocyst well developed; the rim is elevated, with a large oval scutum which has an alcicorn decoration and is flared upward at the distal end. There are one or two strong spines at the outer angle and usually a smaller one at the inner corner. The marginal avicularia, on all of the zooecia, are large and conspicuous; the frontal ones small and wanting on most of the zooecia. The vibracula are small and inconspicuous, wedge-shaped, transverse, set just above the avicularian chamber, the groove transverse and the rather stout flagellum shorter than the zooecial length; they are rare and may often be wanting from a whole internode.

Ooecia subglobose, somewhat flattened on the front, a smooth triangular area above the aperture from which fine lines radiate.

Miss Robertson's record (1900:318) from Kodiak, Alaska, was later (1905:256) referred to *Tricellaria (Menipea) erecta* (Robertson). In the following record the specimen conforms closely to Atlantic specimens, except for the scarcity of the frontal avicularia.

Alitak Bay, Alaska, 30 fms, U. S. Alaska Crab Investigation, Station 100-40.

Scrupocellaria scabra var. **paenulata** Norman, 1903

Plate 18, fig. 6

Scrupocellaria scabra var. *paenulata,* Nordgaard, 1918:32.
Scrupocellaria scabra var. *paenulata,* Osburn, 1932:11.

This high northern variety agrees with the typical form in most respects, but it is somewhat larger in all measurements and the scutum is greatly expanded, flared upward at its tip and extends forward above the proximal border of the ovicell. It appears to replace the typical form in high northern waters; it is the common variety about Greenland and the American Archipelago.

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

Scrupocellaria scruposa (Linnaeus), 1758

Plates 19, fig. 1, and 21, fig. 2

Sertularia scruposa Linnaeus, 1758:815.
Scrupocellaria scruposa, Hincks, 1880:45.
Scrupocellaria scruposa, Hastings, 1930:703.

A rather stout species, the internodes of three or four zooecia in a series, the joint crossing the outer zooecia immediately proximal to the opesia.

The zooecia are rather closely set, 0.35 to 0.40 mm long, not greatly narrowed proximally; opesia elliptical, occupying about two-thirds of the front; the cryptocyst rather broad, especially proximally. There is no scutum. Two or three spines on the outer distal border. Frontal avicularia are entirely wanting and the lateral avicularia, present on all of the zooecia, are correspondingly large, with hooked rostrum and triangular mandible.

The vibracular chamber is elongate, about one-third the length of a zooecium, its groove slightly diagonal; seta not longer than a zooecium. The radicle chamber is situated at the proximal end of the vibracular chamber. Two axial vibracula.

The ovicells are small, smooth and imperforate.

This very widely distributed species had been noted once before in the Eastern Pacific region, as Hastings has recorded it from the Galapagos Islands at 5 fms.

Hancock Stations: 272-34, Tenacatita Bay, Mexico, 25 fms; 217-34 and 850-38, off Cape San Francisco, Ecuador; and a specimen in the author's collection from the "Gulf of California, W. Mexico." Also, Gulf of Panama, Galtsoff collection, on pearl oysters.

Scrupocellaria spinigera new species

Plates 19, figs. 7 and 8, and 21, fig. 7

Zoarium erect, with divergent slender branches; the internodes vary from 1.00 to 3.00 mm in length and consist of from 2 to 7 zooecia in a series; the joint crosses the outer basal zooecium immediately proximal to the opesia.

The zooecia are slender and curved (length 0.45 to 0.55 mm; breadth 0.18 at the widest part, narrowed to about 0.12 at the proximal end), the outer border evenly incurved from the tip of the lateral avicularium to the proximal end. The opesia is ellipsoid, length 0.18 to 0.20 mm, sometimes slightly narrowed proximally; the cryptocyst well developed on older zooecia and finely granulated. The scutum is oval with a double cervicorn figure, nearly covering the opesia, attached a little distal to the middle of the opesia, the lower lobe longer, the upper lobe slightly elevated at the tip. The spines usually are 4 outer and 2 inner, all elongate and slender; the first outer spine is the smallest and curved inward; the second and third outer and the first inner spine are very elongate (as much as 1.00 mm in length) and spread outward and curve forward somewhat like the fingers of a slightly closed hand.

Frontal avicularia all of moderate size, short pedunculate, with triangular mandible directed laterally; they are situated opposite the base

of the scutum of the adjoining zooecium and occur on practically all of the zooecia. The lateral avicularia also occur on every zooecium, small but prominent with triangular mandible. There are no giant avicularia. The vibracular chamber is elongate, one-third or more the length of a zooecium and visible from in front for about half of its length; groove longitudinal; the setae are strong and very elongate (as long as 1.80 mm, but usually shorter). The radicle chamber is situated laterally between the base of the vibraculum and the lateral avicularium; radicle 0.04 mm in diameter, with numerous strong retrorse barbs near the distal end.

Ooecium prominent (length 0.20 by width 0.18 mm) with a few small, short-tubular pores which are connected by wavy lines.

This species resembles *S. pusilla* (Smitt) of the Atlantic in the form of the zooecia and the exsertion of the vibracular chamber, but it is much larger in all of its measurements and has a full quota of frontal avicularia, none of which are enlarged or otherwise modified.

Type, AHF no. 38.

Type locality, Hancock Station 1340-41, Tanner Bank, off San Diego, California, 32°41′00″N, 119°06′30″W, 38 fms.

Also at Stations: 1112-40, San Gabriel Bay, Espiritu Santo Island, Gulf of California, shore; 1247-41, Ranger Bank, off Cedros Island, Mexico, 77 fms; 1150-40, Avalon Bay, Santa Catalina Island, southern California, 98 to 116 fms; 1896-49, middle of Tanner Bank, 22 fms.

Scrupocellaria talonis new species

Plates 17, fig. 3; 19, fig. 3, and 20, fig. 7

Zoarium erect, internodes of moderate length (1 to 2 mm), with 4 to 6 pairs of zooecia, the joint proximal to the opesia on both outer and inner zooecia of the branches.

Zooecia about 0.40 mm long by 0.20 mm wide at the widest part, narrowed to 0.13 mm or even less near the proximal end, the distal end rounded and without angulation. Opesia elliptical, large, occupying a little more than one-half of the frontal length; cryptocyst moderately developed, finely granulated. Spines small, weak, one outer and one inner, often wanting. The scutum is a small spine, occasionally slightly notched at the tip, curving over the opesia, attached somewhat above the middle of the opesial border, often wanting.

Frontal avicularia small, usually one on the axial zooecium below a bifurcation in the midline, the mandible triangular and directed laterally; rarely another avicularium down on the internode. The marginal avicularia are of two kinds, normal and giant. The normal triangular ones are moderate in size and occur on most of the zooecia; the giant avicu-

laria, which occasionally replace the normal ones, have a long, curved, talon-like rostrum 0.25 to 0.30 mm in length and both the rostrum and mandible are recurved at the tip.

The vibracular chamber is small and short, its distal end truncate, its groove transverse; the seta weak and not much longer than a zooecium; the radicle chamber is rounded and about as large as the vibracular chamber; the outer border of the double chamber is strongly sinuate. The radicles are smooth.

The form of the zooecia and the giant avicularia resemble *S. unguiculata* new species, from the Galapagos Islands, but *S. talonis* is much smaller, the scutum is vestigial or wanting, the spines very weak and the vibracular groove is transverse.

Type, AHF no. 39.

Type locality, Perlas Islands, Panama. (No other data.) Author's collection.

Scrupocellaria unguiculata new species

Plates 17, figs. 1 and 2, and 19, fig. 6

Zoarium rather large and coarse, the internodes elongate (1.00 to 4.50 mm in length) and broad (0.40 to 0.50 mm), straight and little divergent. Joints broad, immediately proximal to the opesia of the outer zooecium.

Zooecia large (0.50 to 0.60 mm long by 0.26 mm wide at the broadest part); the elliptical opesia occupying about half of the frontal length and the zooecium considerably narrowed proximally (about 0.15 mm). The descending cryptocyst is well developed and finely granular. Three long and very strong spines, jointed at the base, are present, two outer and one inner and the one on the outer angle is the smallest. The scutum is very broad, covering practically all of the opesial area, evenly rounded at both ends, attached slightly distal to the middle of the opesia by a very strong peduncle, and its alcicorn cavity is highly developed.

The frontal avicularia are infrequent, small, pointed and directed more or less laterally. The lateral avicularia are of two types. The normal ones are situated between the outer and distal spines, moderate in size, with hooked rostrum and triangular, hooked mandible. Giant avicularia are also present, scattered over the zoarium, sometimes several to an internode and sometimes wanting. This type has a very long, curved, talon-like rostrum or beak, strongly decurved at the tip, and the mandible is narrow or ligulate with a curved tip.

The vibracular chamber is short, about one-fourth as long as a zooecium, somewhat triangular in form, the radicle chamber at its outer

proximal corner and the short diagonal groove on the inner side. The seta is weak and not longer than two zooecia. There is a single axial vibraculum, of the same size and general form as the lateral ones, but more rounded proximally.

The ooecium is large, extending to the opesia of the distal zooecium, usually somewhat longer than wide, with a regular row of rather large pores around the base and a number of smaller ones scattered over the upper surface. These are connected by radiating lines and are not tubular.

Type, AHF no. 40.

Type locality, Station 795-38, Sulivan Bay, James Island, Galapagos Islands, 0°16′12″S, 90°34′50″W, 36 to 40 fms, one colony about 25 mm in height. Also taken at Sta. 450, Galapagos, 0°55′00″S, 90°30′00″W, 60 fms, and 451, Post Office Bay, Charles Island, Galapagos, 100 fms.

Scrupocellaria varians Hincks, 1882

Plates 19, fig. 5, and 20, fig. 6

Scrupocellaria varians Hincks, 1882:461.

Scrupocellaria varians, Robertson, 1905:260.

Scrupocellaria varians, O'Donoghue, 1923:18; 1926:41; 1925a:98.

Zoarium much branched and bushy, seldom as much as 20 mm in height; the internodes consisting of from 3 to 6 zooecia in a series; the joint crosses the outer zooecium proximal to the opesia.

Zooecia comparatively long and slender, 0.35 to 0.55 mm by 0.18 to 0.20 mm, narrowed to about 0.13 mm at the proximal end, the outer margin nearly straight. The long ovate opesia occupies about half of the frontal length, the cryptocyst moderately developed. The scutum is small and quite variable; usually it is three-pronged, but it ranges all the way from a simple curved spine to six points; it covers only a small portion of the opesia. There are two or three small outer and one inner spines.

Frontal avicularia are present on most of the zooecia, just proximal to the opesia, somewhat elevated, with a triangular mandible which is oriented laterally. The lateral avicularia are of two kinds, the usual form with a triangular mandible; and giant avicularia 0.30 to 0.40 mm in length, with a trough-like rostrum which varies in the form of the tip from rounded to three-pointed; mandible with a strongly hooked tip. Hincks' description indicates that the giant avicularia are "much the more abundant," but there is great variation and in some of our specimens the giant form is comparatively rare.

The vibracular chamber is very short, somewhat triangular in form, not visible from a frontal view; the groove is transverse and the seta weak and usually not longer than a zooecium. The radicle chamber is

located on the outer side at the proximal end of the vibracular chamber; radicles smooth, with a few small barbs at the distal extremities.

Ovicells 0.18 to 0.20 mm wide, broader than long, smooth, with a few irregular surface lines and without pores.

Hincks described the species from "Cumshewa Harbor," British Columbia. Robertson recorded it from Puget Sound to La Jolla, California, more abundant northward, and O'Donoghue found it at numerous localities in British Columbia.

Hancock Station: Numerous stations from Oregon south to San Diego, California. It is most abundant in shallow water but was dredged at Station 1228-41, off San Pedro, southern California, 126 to 138 fms. The only record south of California is Station 557-36, off White Rock, Isla Partida, Gulf of California, 28°55′30″N, 113°05′35″W, 45 fms.

Scrupocellaria inarmata O'Donoghue, 1926

Scrupocellaria inermis O'Donoghue, 1923:18, preoccupied by *S. inermis* Norman, 1868, and changed to *inarmata* by O'Donoghue, 1926:41.

This species, described from Trincomali Channel, British Columbia, is similar to *S. varians* Hincks, as indicated by O'Donoghue. The differences as pointed out by O'Donoghue are as follows:

Smaller than *varians;* absence of spines; absence of scutum; absence of frontal avicularia on the lower zooecia of an internode, and the lateral avicularia are all small. However, it agrees with *varians* in the characters of the vibracula and ovicells and may be merely a well-marked variety of that species. It has not appeared in the Hancock collections.

Family **Epistomiidae** Gregory, 1903

Genus **SYNNOTUM** Pieper, 1881

Zooecia in pairs back to back, each pair connected by tubular prolongations with the second pair below it. There are sessile lateral avicularia at the distal ends and frequently a stalked avicularium between the two zooecia at or near the distal end. No ovicells, but slightly expanded gonozooecia. Genotype, *Loricaria aegyptiaca* Audouin, 1826.

Synnotum aegyptiacum (Audouin), 1826

Plate 13, fig. 5

Loricaria aegyptiaca Audouin, 1826:243.

Synnotum aviculare, Robertson, 1906:286.

The zoarium spreads in small loose colonies among hydroids, bryozoans, algae, etc.; inconspicuous and probably frequently overlooked. The zooecia are small, about 0.40 mm long, delicate and little calcified, the area occupying nearly all of the front; attached in pairs back to back, a basal prolongation of each pair extending proximally to the second zooecium below. A small sessile avicularium at one or both distal corners, and occasionally a stalked avicularium arising distally on the dorsal side of one or both members of a pair. The stalked avicularia are short and bulbous, with a short hooked beak and very short hooked mandible. Radicle fibers also arise at the distal ends of the zooecia. No spines, no ooecia.

Distributed around the world in warmer water, usually recorded as *S. aviculare* Pieper. Robertson recorded it from off San Pedro and San Diego, California.

Hancock Stations: 881-38 and 1281-41, Santa Rosa Island, and 1219-40, San Nicolas Island, California; 577-36, Isla Partida, and 1072-40 and 1074-40, off Rocky Point, Sonora, Mexico; 847-38, southwest of Zorritos Light, Peru. Shore to 45 fms. A rather common shorewise species along the coast of southern California.

Family **Bicellariellidae** Levinsen, 1909

The genera included in this family are usually erect, occasionally more or less recumbent or even loosely encrusting; biserial, sometimes uniserial or multiserial. They are usually well chitinized and but little calcified. The zooecia take their origin from the dorsal side of the preceding zooecia in the series, so that the distal ends overlap more or less the bases of the succeeding zooecia. The opesia are usually large, frequently occupying the whole front, though the gymnocyst may be well developed in many cases. The sides of the zooecia are frequently rolled inward (turbinate). Spines, both terminal and lateral, are usually present, and pedunculate avicularia are characteristic, though both spines and avicularia may occasionally be wanting.

Various authors, notably Canu and Bassler, have separated this family into three, viz. Bicellariellidae, Bugulidae and Beaniidae, and the writer accepted this procedure in his 1940 paper, "Bryozoa of Porto Rico." Further study of the basic characters, however, leads me to the conclusion that such a separation is unwarranted, and the analysis of the

group by Harmer (1926:409) and the comments of Silen (1941:92) offer satisfactory evidence against such a wide separation of the evidently related genera.

KEY TO GENERA OF BICELLARIELLIDAE

1. Proximal end of zooecium narrow and tubular. 2
   Proximal end not narrowly tubular. 4
2. Tubular base of zooecium expanded abruptly, zoarium sprawling or repent and loosely attached. . . . . *Beania*
   Tubular base expanding gradually, zoarium erect. 3
3. Zooecium constricted into three definite regions, the terminal one expanded. . . . . *Bicellariella*
   Zooecium not differentiated into "segments." . . *Corynoporella*
4. Zoarium multiserial, erect, recumbent or encrusting; base of zooecium transverse at point of origin. 5
   Zoarium biserial to narrow multiserial, erect, base of zooecium forked or diagonal at point of origin. 6
5. Zoarium erect or recumbent, attached by radicles; a thickened dorsal area on either side of the distal zooecial wall. *Dendrobeania*
   Zoarium encrusting loosely, not attached by radicles; no thickened dorsal area; numerous proximal spines and paired avicularia on the gymnocyst. . . . . *Sessibugula*
6. Zoarium with segmented stalk, the segments are modified zooecia (kenozooecia); base of zooecium at point of origin diagonal. . . . . *Caulibugula*
   Zoarium erect and bushy, without segmented stalk; base of zooecium at point of origin strongly forked. . . . . *Bugula*

Genus **BICELLARIELLA** Levinsen, 1909

Bicellariella Levinsen, 1909:431, replacing *Bicellaria* Blainville, preoccupied.

Levinsen (1909:99), under *Bicellaria* Blainville, gives the following diagnosis of the genus: "Each zooecium consists of three sections, separated by constrictions, of which the middle one is elongated, cylindrical, while the distal one is obliquely funnel-shaped; the basal edge of the distal wall unequally asymmetrically angular; the radical fibers issue from the basal side of the zooecium." To this Harmer (1926:421) adds that the turbinate zooecia are typically provided with numerous oral and distal spines. Genotype, *Sertularia cilata* Linnaeus, 1758:815.

From the above description of the genus it becomes evident that no species of *Bicellariella* has been recorded from the Pacific coast. O'Donoghue tentatively placed two species here, but neither of them shows the zooecial constrictions and their ovicells are quite different from those of *Bicellariella*. As no opportunity has been offered to study specimens, I leave them here until more information is available.

? Bicellariella brevispina (O'Donoghue), 1923

Bicellaria brevispina O'Donoghue, 1923:19.
Bicellariella brevispina, O'Donoghue, 1926:43.

The zooecia are very slender and elongate, with the opesia extending about half the frontal length and the form is not at all turbinate in the bicellarian sense; there are no constrictions of the zooecial body; avicularia are wanting; the spines are not bicellarian, and the ooecium which is deeply embedded in the base of the succeeding zooecium is totally different. The sterile zooecia have considerable resemblance to those of certain species of *Brettia* but that genus is not known to have ovicells.

Gabriola Island, Union Bay and Bull Passage, British Columbia (O'Donoghue).

? Bicellariella stolonifera O'Donoghue, 1926

O'Donoghue 1926:43.

The zoarium consists of a creeping stolon from which arise the zooecial branches with a small number of zooecia. The form of the zooecium is somewhat turbinate, but the opesia occupies most of the length and there is no evidence presented of the constriction into three regions which is characteristic of *Bicellariella.* The distal spines are arranged in outer and inner groups like those of *Bugula,* but one or two proximal spines may also be present. The avicularia are lateral, half way up the side of the opesia. The ooecium is terminal instead of on the inner corner and "does not appear to be a pedunculate structure."

Cape Lazo to the San Juan Islands, British Columbia (O'Donoghue). Apparently this is not a *Bicellariella.*

Genus BUGULA Oken, 1815

Genotype, *Sertularia neritina* Linnaeus, 1758.

As at present understood, this genus includes a rather large series of species which are for the most part biserial, but with occasional uniserial or multiserial zoaria. The zoarium is unilaminar, with the zooecia all facing in the same direction. At the point of origin on the dorsal side, the zooecia are usually prominently forked, and the distal end of each zooecium extends above the base of the succeeding one. The opesia occupies nearly all of the frontal surface, and the side walls are somewhat reduced with mere angulation of the distal corners. The stalked avicularia are of the "birds-head" type and are often of diagnostic value. Ooecia are typically globular and attached by a short stalk at the distal end in

the median line, but a few species have them attached asymmetrically (e. g. in the type species *B. neritina*) at the inner corner, and occasionally they may be reduced to a small saucer-shaped cap. The mode of branching is also characteristic. In older colonies the lower branches are often lost and the radicles pass downward for attachment, giving the appearance of a stalk.

KEY TO THE SPECIES OF *Bugula*

1. No avicularia. Zoarium coarse and reddish-purple, conspicuous. Zooecia large, aperture extending to base; no spines but the outer corner angulated; ovicells large, set diagonally. . *neritina*
   Avicularia present. 2
2. Avicularia attached near the base of the zooecia. 3
   Avicularia attached higher up on the side. 5
3. Ovicell reduced, cap-like, in line with zooecial axis. . . . *pacifica*
   Ovicell not reduced, turned at an angle to zooecial axis. . . . 4
4. Aperture extending to zooecial base; zooecia of the two series turned slightly inward. . . . . *minima*
   Aperture about half of zooecial length; zooecia of the two series facing slightly outward. . . . . *uniserialis*
5. Avicularia slender and elongate, half the zooecial length. *longirostrata*
   Avicularia not unusually slender and elongate. 6
6. Zooecia biserial in arrangement. 7
   Zooecia in more than 2 series. 9
7. Ovicell complete, globular. . . . . *californica*
   Ovicell in the form of a hood or otherwise incomplete. 8
8. Ovicell well calcified, in the form of a hood. . . . . *cucullifera*
   Ovicell largely membranous, zoarium soft and flaccid. . . *mollis*
9. Distal end of zooecium truncate; ovicells prominent. . . *flabellata*
   Distal end of zooecium rounded, usually with a small terminal knob; no ovicells. . . . . *pugeti*

Bugula neritina (Linnaeus), 1758

Plates 23, fig. 3, and 24, fig. 3

Sertularia neritina Linnaeus, 1758:38.

Bugula neritina, Robertson, 1905:266.

Bugula neritina, Hastings, 1930:704.

The zoarium is rather coarse for a *Bugula* and often forms large tufts 100 mm or more in height. The color, when mature, is dark reddish purple. The zooecia are large, without spines except for the pointed process at the outer distal corner, and there are no avicularia. The ovicells are large, globular, attached at the inner corners of the zooecia, and they are often so plentifully developed that they seem to form a series of small beads along the branches.

This, the type species of the genus, is also the best known. It appears to be distributed everywhere in warmer waters along the shores. Along

the California coast from Monterey southward it is usually the most conspicuous bryozoan species, the dark reddish or purplish brown clusters clinging to anything that will afford attachment. It is also constant in its presence on piles of wharves and the under side of floats. Robertson records it for California from Monterey Bay southward. Hastings lists it for the Galapagos Islands and the Canal Zone.

In the Hancock collections it occurs abundantly from the Channel Islands, California, all down the Mexican coast and on to the Galapagos Islands and in the Gulf of California as far up as Angel de la Guardia Island. Although it is characteristically a shallow water species it has been dredged at a depth of 43 fms off Santa Cruz Island, California.

Bugula minima (Waters), 1909

Plates 22, fig. 8 and 23, fig. 5

Bugula neritina var. *minima* Waters, 1909:136.
Bugula neritina var. *minima,* Hastings, 1930:704.
Bugula minima, Hastings, 1939:334.
Bugula minima, Osburn, 1940:390.

Resembling *B. neritina* in its general aspects, but much smaller, lighter in color and with avicularia. It does not appear to be an abundant species, but it is distributed around the world in warmer waters; in the Red Sea, Indian Ocean, Malay and New South Wales; Osburn lists it from the Tortugas Islands, Florida, and Porto Rico, and Hastings recorded it from Gorgona, Ecuador, and the Galapagos Islands.

Hancock Station 779-38, off Nuez Island, Cocos Islands, Costa Rica, 30 to 50 fms. Also from the Gulf of Panama, Isla Santelmo, on pearl oysters (Galtsoff collection).

Bugula pacifica Robertson, 1905

Plates 22, fig. 6, and 23, fig. 4

Bugula pacifica Robertson, 1905:268.
Bugula purpurotincta, Robertson, 1900:320.
Bugula pacifica, O'Donoghue, 1923:20; 1926:45.

A northern species which Miss Robertson indicated as distributed from the Pribilof Islands, Bering Sea, to San Francisco Bay; she described it from material collected by Dr. W. E. Ritter at Orca, Prince William Sound, Alaska. O'Donoghue found it at numerous localities in British Columbia, and the writer has specimens taken by Prof. G. E. MacGinitie at Departure Bay, near Victoria, British Columbia. The species is easily recognized by the very incomplete ovicell which is barely large enough to cover the egg and not half large enough to cover the

developing larva. The avicularium attached near the base of the zooecium easily separates it from *B. longirostrata,* which also has an incomplete but somewhat larger ovicell.

Hancock Stations: 1478-42, Yaquina Bay, Oregon, 2 to 5 fms; 1480-42, mud flats, Yaquina Bay, Oregon, intertidal; 1493-42, North Beach, Cape Arago State Park, Coos Co., Oregon, intertidal; 1661-48 and 1662-48, Santa Cruz Island, southern California, 23 fms.

Bugula longirostrata Robertson, 1905

Plates 22, fig. 7, and 24, fig. 1

Bugula longirostrata Robertson, 1905:274.
Bugula longirostrata, O'Donoghue, 1923:21.

The slender, elongate avicularia, at least half as long as a zooecium, and the incomplete ovicell which is shaped like an overturned bowl, readily distinguish this species from other west coast Bugulas. Robertson recorded it from only one locality, "off La Jolla (California) at a depth of 125 fathoms," and O'Donoghue from Cape Ebenshaw, British Columbia.

The writer collected it on the piles of the Scripps Laboratory wharf at La Jolla, California. The known range of the species is from British Columbia to the Galapagos Islands at the equator, and from the shore to a depth of 125 fms. Judging by the records it would appear to occur regularly at greater depths than our other Bugulas.

Hancock Stations: 66-33, Tagus Cove, Albemarle Island, 2 to 20 fms, and 795-38, Sulivan Bay, James Island, 36 to 60 fms, Galapagos; 651-37, east of San Francisco Island, Gulf of California, 60 fms; 1259-41, south of Dewey Channel, Mexico, 49 fms; 1150-40, 1365-41 and 1407-41, Santa Catalina Island, southern California, at 21 to 116 fms.

Bugula californica Robertson, 1905

Plates 23, fig. 1, and 24, fig. 2

Bugula californica Robertson, 1905:267.
Bugula californica, O'Donoghue, 1923:20; 1926:45.
Bugula californica, Marcus, 1937:71.

The zoarium is in the form of spiral whorls as much as 50 mm high, similar to *B. turbinata* Alder of the west European coast and *B. turrita* (Desor) of the western Atlantic. The globular ovicell, attached at the middle of the distal end of the zooecium; the presence of three spines and the attachment of the avicularia at the middle of the zooecial wall easily separate it from other Pacific coast species. In addition, two sizes

of avicularia are usually present, those on the outer zooecial wall being much larger than those on inner zooecia below or just above a bifurcation, and occasionally nearly all of them are small.

Robertson records the species from Monterey Bay north to Dillon Beach, California. O'Donoghue lists it from a number of localities in British Columbia, which would appear to be the northern limit of distribution. Marcus found it in Bahia de Santos, Brazil.

Hancock Stations: 17-34, Stephens Bay, Chatham Island, Galapagos, 32 fms; 1067-40, off Consag Rock, Gulf of California, shore; 1410-41, 3 miles east of South Point, Santa Rosa Island, California, 17 to 20 fms. The writer has also collected it in Newport Harbor, California, on the piles of docks. Very abundant in Miss Blagg's collection from the vicinity of Monterey Bay, California. It appears to have a wide range along the Pacific coast, from British Columbia to the Galapagos Islands, and the record by Marcus from Brazil extends its range to the Atlantic.

Bugula flabellata (J. V. Thompson), 1847

Bugula flabellata, Robertson, 1905:270. (Not 1900:321, see *B. pugeti*).

Zoarium consisting of flabellate branches of varying width, usually 3 to 6 series of zooecia, the larger branches arising near the short base and more or less whorled. The zooecia are elongate, the membranous area occupying the whole front; the lateral margins are free from spines, but there are 2 to 4 on the distal end, the proximal ones often curved somewhat across the aperture. Avicularia on the marginal zooecia only, attached above the middle of the zooecial length, moderately large and robust with a strongly decurved beak.

Ovicell subglobose or somewhat hood-shaped, with broad, short base, directly in line with the zooecial axis.

This well-known species is definitely a *Bugula* in spite of the multiserial arrangement of the zooecia, as it lacks the special calcified dorsal walls of *Dendrobeania,* and the origin of the zooecium is long-forked, the prongs extending well down the sides of the preceding zooecium.

It is widely distributed over both shores of the Atlantic, southward to the Cape of Good Hope and Brazil, but has been recorded only once for the Pacific, where Robertson found it growing on piles in San Diego Bay, California.

Hancock Stations: 371-35 and 374-35, Viejas Island, Independencia Bay, Peru, 5 to 12 fms.

Bugula pugeti Robertson, 1905

Plate 23, figs. 7 and 8

Bugula pugeti Robertson, 1905:271.

Bugula flabellata, Robertson, 1900:321.

Bugula pugeti, O'Donoghue, 1923:21; 1925:100; 1926:45.

This multiserial species belongs to the genus *Bugula* for the same reasons given under *B. flabellata.* It differs from *flabellata* in a number of ways, the distal zooecial end is rounded instead of truncate, the spines are fewer, shorter and pointed, and the avicularia are somewhat longer, stouter, all of one size, and all on the outer zooecia. The most striking difference is in the entire absence of ovicells. As Miss Robertson pointed out, there is a small rounded knob at the middle of the distal end of most of the zooecia, but as this is lacking on the first few proximal rows of each branch it leads to the suggestion that it is the merest vestige of an ovicell.

Robertson recorded the species from Sitka, Alaska, to Puget Sound, and O'Donoghue lists it for numerous localities in British Columbia waters, low tide to 15 fms.

It did not appear in the Hancock dredgings, but there are specimens in the collection from Departure Bay and Five Fingers, British Columbia; Tomales Bay, California (R. J. Menzies), and also from San Francisco Bay, California, Albatross Station D 5770, which is the southernmost record.

Bugula mollis Harmer, 1926

Plates 22, fig. 3, and 23, fig. 6

Bugula mollis Harmer, 1926:445.

Bugula mollis, Hastings, 1930:704.

The zoarium is bushy (40 mm high in one specimen), with loosely turbinate branches, delicate and flaccid; the branches definitely jointed at the base. The zooecia are biserial, moderately large; the opesia reaches nearly to the proximal end, inclined toward the zoarial axis. Harmer (pl. 31, fig. 10) shows the species with three long distal spines, jointed at the base, but in our material these are represented by short pointed processes. The avicularia are situated on the outer rim half way or more above the base.

The ooecium is incomplete, lacking the front wall, but is circular in outline and projects forward on a pedicel. Harmer and Hastings have called attention to the differences between this species and *B. pacifica* Robertson which also has joints at the base of the branches. In addition to the lack of calcification in *mollis* and the position of the avicularia, which in *pacifica* are proximal to the opesia, it may be added that the ovicell of *mollis* is longer and more projecting while in *pacifica* it is a short

hemispherical cap set close against the distal end of the zooecium.

Described by Harmer from New Guinea and the Java Sea; recorded by Hastings from Coiba, Panama, and the Galapagos Islands.

Hancock Stations: 66-33, Tagus Cave, Albemarle Island, Galapagos, 10 to 20 fms. Also at Albatross Sta. 5771, San Francisco Bay, California, several colonies.

Bugula cucullifera Osburn, 1912

Plate 22, figs. 4 and 5

Bugula cucullifera Osburn, 1912:225.
Bugula cucullata Verrill, 1897:188 (preoccupied, Busk, 1867:241).
Bugula cucullifera, O.Donoghue, 1923:22; 1926:45.

The zoarium is erect and the branches little divergent. The zooecia are moderately elongate, narrowed gradually to the proximal end, the distal end more or less transverse; the opesia about three-fourths of the frontal length; two or three outer and one or two inner elongate spines. Avicularia large and longer than the width of a zooecium; the beak long, concave above and strongly hooked at the tip; situated about half way up the side of the opesia but varying considerably in position.

Ovicell in line with the zooecial axis, short and broad, shaped like a hood and widely open, its attachment very broad.

Verrill and Osburn recorded this species from Cape Cod, Massachusetts, northward to Labrador. O'Donoghue listed it from a number of localities on the British Columbia coast and south to Puget Sound. Not taken in the Hancock collections.

Bugula uniserialis Hincks, 1884

Bugula pedunculata O'Donoghue, 1925:17.
Bugula uniserialis, Hastings, 1930:705.

A small slender species in which the zooecia are much narrowed on the basal half and the opesia not more than half the zooecial length; the distal corners are sharply angulated but spines are wanting; the avicularia are attached at the proximal end and the peduncle is slightly longer than usual in other species. According to O'Donoghue's figure (Plate 2, fig. 3) the zooecia of the two series are turned slightly outward instead of toward each other as in most members of the genus.

Hincks described the species from West Australia. O'Donoghue redescribed it as *B. pedunculata* from La Jolla, southern California, and Hastings recorded it from two localities at Tagus Cove, Albemarle Island, Galapagos, shallow water. It has not appeared in the Hancock dredgings.

Bugula avicularia (Linnaeus), 1758

Bugula avicularia, Hincks, 1884:5.
Bugula avicularia, O'Donoghue, 1923:20.
Bugula avicularia, Hastings, 1930:703.

This species, recorded by Hincks and by O'Donoghue from several shorewise localities in British Columbia is close to *B. californica* Robertson. Both have turbinate colonies with biserial branches; the aperture occupies nearly all of the frontal length; the avicularia are situated at or beyond the middle of the zooecia, and the ovicells are similar. On the other hand, the avicularia of *californica* are shorter and more robust, with a shorter and more decurved beak, and there are usually two well-developed inner distal spines.

It is a species of northern distribution; in Europe from the Arctic to the Bay of Biscay; it has been only doubtfully recorded from the eastern coast of North America, and O'Donoghue (1925) did not find it in Puget Sound. Hastings lists it from Balboa, Canal Zone, but calls attention to certain differences. It has not appeared in the Hancock dredgings.

Genus CAULIBUGULA Verrill, 1900

Genotype, *Caulibugula armata* Verrill, 1900.

Bugulas with jointed stalks, the joints consisting of kenozooecia of varying length. The proximal zooecia of the branches usually differ more or less from distal ones. The ovicells are often incomplete and are attached near the inner corner of the zooecia and turned somewhat sidewise. The zooecia are more narrowed toward the base than in *Bugula* and the opesia is shorter, usually not more than half of the frontal area.

The species of this genus have usually been referred to *Stirparia* Goldstein, 1880, and *Stirpariella* Harmer, 1923, but Goldstein's use of the name was preoccupied by Leuckart 1841. Verrill's name *Caulibugula* was overlooked for many years and *Stirpariella* is a synonym.

Key to Species of *Caulibugula*

1. Aperture turned upward, 4 or 5 spines at the outer corner. . *ciliata*
   Aperture in line with the frontal surface, 2 or 3 spines at the outer corner. 2
2. Aperture occupying half of the frontal surface, avicularia half way up the side. . . . . *occidentalis*
   Aperture occupying three-fourths or more of the frontal surface, avicularia near base. . . . . *californica*

Caulibugula ciliata (Robertson), 1905

Plate 24, figs. 4 and 5

Stirparia ciliata Robertson, 1905:279.
Stirparia ciliata, O'Donoghue, 1923-22.
Stirparella ciliata, O'Donoghue, 1926:47.

This is a peculiar species, showing certain resemblances to *Bicellariella ciliata* (Linnaeus). The slanting, oval, opesial area, the rounded distal end without angulations, the attachment of the ovicell on the inner border of the distal part of the zooecium, all of these are found in *B. ciliata.*

On the other hand there are neither dorsal spines nor a proximal spine, and the basal zooecia of the colony as well as the proximal zooecia of the basal branches are modified into kenozooecia and form a stalk. The basal zooecia of the upper branches are not so modified. The stalk zooecia, well represented in Robertson's drawing, pl. 12, fig. 68, are only partially modified into kenozooecia and appear to have contained zooids. On the whole the resemblance is so great that the writer was once misled (Osburn 1923:7) to make the suggestion that this might be merely a variety of *B. ciliata* (Linnaeus).

Robertson had the species from a number of localities along shore on the California coast from Pacific Grove northward. O'Donoghue lists it for several British Columbia localities.

Hancock Station 1281-41, 3 miles east of South Point, Santa Rosa Island, southern California, 23 to 26 fms. Also from Dillon Beach, California (Menzies collection), and from Lands End, San Francisco Bay, California (Robertson collection).

Caulibugula occidentalis (Robertson), 1905

Plate 24, fig. 6

Stirparia occidentalis Robertson, 1905:280.
Stirparia occidentalis, O'Donoghue, 1293:22, 1925:100.
Stirpariella occidentalis, O'Donoghue, 1926:47.

This species has the segments of the stalk fully modified into kenozooecia and the first zooecium is also modified in the manner characteristic of the genus. The basal zooecium of a branch, however, is scarcely different from those distal to it.

The zooecia are elongate and curved and occasional individuals have the "joint" which is characteristic of the genus *Bicellariella.* The distal end of the zooecium is rounded, with two or three long, jointed, outer spines and one inner spine. The opesia occupies nearly half of the frontal

length. The avicularia are attached opposite the proximal end of the opesia. The hood-shaped ooecium is attached on the inner border just above the inner spine and is turned somewhat sideways.

Robertson gives its distribution as "several localities on the coast of California and Puget Sound," and O'Donoghue records it for several places in British Columbia and Puget Sound.

Hancock Stations: 1478-42, Yaquina Bay, off Yaquina, Oregon; 885-38, San Luis Obispo Bay, California, low tide to 14 fms, and 880-38, Santa Rosa Island, southern California, 16 fms.

Caulibugula californica (Robertson), 1905

Plate 24, figs. 7 and 8

Stirparia californica Robertson, 1905:281.
Stirparia californica, O'Donoghue, 1923:23.
Stirpariella californica, O'Donoghue, 1926:47.

This species belongs to the group in which the outer corner of the zooecium is strongly angulated. The angle is either continued into a short spine, or it is provided with an elongated spine, jointed at its base, and other spines are few or wanting. The stalk segments are highly modified kenozooecia, and the stalk may be as much as 50 mm long, with a palm-like cluster of branches at the top. The zooecium is not sharply narrowed proximally, the membranous area extends nearly to the base and the avicularia are basal in position. The primary zooecium of the branch does not differ from the distal ones, except that the outer corners are not angulated. In the absence of the stalked base with its highly specialized kenozooecia this species would undoubtedly be placed at once in the genus *Bugula.*

Robertson recorded the species from only one locality, "at a depth of 125 fathoms in the submerged valley of La Jolla," California. O'Donoghue recovered it at 8 localities in British Columbia, 8 to 40 fms.

Hancock Stations: 296, Agua Verde Bay, and 2186, Cabeza Ballena, Lower California, Mexico, 30 fms; 1150-40, Avalon Bay, Santa Catalina Island, southern California, 98 to 116 fms; 1479-42, Boiler Bay, north of Depoe Bay, Oregon, intertidal; 1249-41, San Benito Islands, west of Lower California; and 1249-41, Santa Cruz Island, southern California.

Genus CORYNOPORELLA Hincks, 1888

The zoarium is uniserial, slender and branched dichotomously. Zooecia all facing the same direction, more or less regular in form, elongate, the proximal half tubular, the terminal half somewhat expanded; opesia occupying about half of the zooecial length. Each individual arises from the dorsum of the preceding one near its end. Avicularia buguloid. Ooecia globose. Radicles arising on the side near the distal end. Genotype, *C. tenuis* Hincks, 1888:215.

Corynoporella spinosa Robertson, 1905

Plate 24, figs. 9 and 10

Corynoporella spinosa Robertson, 1905:284.
Corynoporella spinosa, O'Donoghue, 1922:23.

The zooecia are slender and elongate (0.50 to 0.65 mm long by about 0.20 mm wide), expanding from the narrow tubular base rather regularly to the distal end. Opesia long-ovate, narrower at the proximal end, surrounded by a slightly raised thin rim which usually bears three small terminal spines, one median and one at each corner; the cryptocyst is not evident. Avicularium (about 0.22 mm long) stout, on a very short pedicel, the point of the beak strongly decurved. Ooecia prominent, globose, with a few longitudinal striae.

The species is much like the genotype, *C. tenuis* Hincks (1888:215) from the Gulf of St. Lawrence, but the zooecia are more truncate at the distal end, spines are present and the beak of the avicularium is strongly decurved.

Robertson described the species from Alaska, "locality unknown," growing on a crab. The only other record is that of O'Donoghue, Swiftsure Shoal, British Columbia, 25 fms.

Big Koniuji Island, Alaska, Sta. 82-40, 25 to 30 fms, and off Hallo Bay, Alaska, Sta. 139-40, 28 to 40 fms, U. S. Alaska Crab Investigation.

Genus SESSIBUGULA new genus

Plate 26, figs. 1, 2 and 3

Zoarium encrusting, loosely attached, dorsal wall smooth, without radicles. Gymnocyst extensive and bearing buguloid avicularia and tubular spines; ooecium hyperstomial, buguloid; operculum wanting; septulae multiporous in the lateral and uniporous in the distal walls; calcification slight. Genotype, *S. translucens* new species.

In spite of its encrusting nature, this form definitely belongs in the *Bugula* complex. The absence of a calcified dorsal area on either side of

the distal wall is similar to *Bugula*. The ooecium is more like that of *Dendrobeania* and the close association of the zooecia in a broad layer resembles that of *D. (Bugula) laxa* (Robertson) and especially *D. (Flustra) lichenoides* (Robertson), both of which are repent. The encrusting zoarium, the very extensive gymnocyst which bears pedunculate avicularia and spines, and the absence of radicles appear to exclude it from any known genus.

Sessibugula translucens new species

Plate 26, figs. 1, 2 and 3

Zoarium loosely encrusting on smooth surfaces, forming flat colonies. Zooecia large but quite variable in size, 0.65 to 0.95 mm long by 0.30 to 0.45 mm wide, closely associated without any evidence of fenestrae, forming a smooth, thin and often almost transparent crust. The opesia is irregularly ovate or elliptical with a raised margin, occupying about the distal half of the front. The walls are very thin, the lateral walls scarcely separable. The gymnocyst is extensive, occupying the proximal half of the front and is quite transparent; bearing spines and stalked avicularia. The cryptocyst is barely traceable as a minutely beaded border.

Spines: a tall tubular spine on each side toward the distal end, bending slightly across the opesia; 1 or 2 erect spines on the sides, often wanting; a pair of similar spines on the distal border of the gymnocyst, sometimes only one median spine, occasionally 4 or 6, curving forward over the opesia.

Avicularia buguloid, moveable on a short peduncle, characteristically paired and well separated one on either side of the midline, only one may be present, either lateral or median, or occasionally both wanting; length 0.18 to 0.26 mm; rostrum decurved at the tip, the mandible evenly arcuate, with a small curved tip.

Ovicell hyperstomial, evenly rounded, attached to the distal end of its zooecium by a rather broad base; the surface faintly and radiately striate; width 0.22 mm, length 0.20 mm.

The frontal membrane is delicate and there is no evidence of a chitinized operculum. There are multiporous septulae in the lateral walls and a row of uniporous septulae in the distal wall. Radicles wanting.

Type, AHF no. 41.

Type locality, Hancock Station 557-36, off White Rock, Isla Partida, Gulf of California, 28°55′30″N, 113°05′35″W, 45 fms, four colonies; also at 468-35, Port Parker, Costa Rica, 5 fms, one colony; 147-34 and 155-34, Tagus Cove, Albemarle Island, Galapagos, 30 to 60 fms.

Genus DENDROBEANIA Levinsen, 1909

Genotype, *Flustra murrayana* Johnston, 1847.

This genus was separated from the old genus *Bugula* by Levinsen because of the presence of a distinct operculum and the nature of the distal wall which consists of a more horizontal part with a large multiporous rosette plate. In addition are the following characters: the proximal end of the zooecium is tubular and nearly transverse (i. e. the proximal end of the zooecium as seen on the dorsal side is not prolonged on either side to form a two-pronged fork, as it does in *Bugula*); there is a more heavily calcified area on the dorsal and lateral walls distally, and in this area are the large single terminal and one or two lateral multiporous rosette plates.

The species of *Dendrobeania* are usually multiserial and frond-like, erect or more or less recumbent, but occasionally may be biserial. Usually there are two sizes of the stalked avicularia, those on the outer zooecia being much the larger; occasionally, however, avicularia may be lacking.

Key to Species of *Dendrobeania*

1. Avicularia present. 2
   Avicularia absent. 4
2. Spines well developed, the distal pair erect, lateral ones curving over the opesia. . . . . *murrayana*
   Spines weak, lateral spines often wanting. 3
3. Occasional small lateral spines; avicularium, especially the beak, elongated. . . . . *curvirostrata*
   Only weak spines at distal corners; avicularia stout and bulbous; zoarial fronds very broad. . . . . *multiseriata*
4. A pair of very heavy spines at the distal corners pointing forward and outward, behind these 4 to 6 strong lateral spines on each side bending across the opesia. . . . . *longispinosa*
   Spines fewer, shorter and weaker. 5
5. Zooecia loosely connected, sometimes with small fenestrae between them; zoarium semi-erect or recumbent, with irregular branches of greatly varying width. . . . . *laxa*
   Zooecia closely connected; spines sometimes vestigial; zoarium recumbent with broad rounded lobes. . . . . *lichenoides*

Dendrobeania murrayana (Johnston), 1847

Plate 25, fig. 1

Bugula murrayana, Hincks, 1884:6.

Bugula murrayana, Robertson, 1900:320; 1905:266.

Bugula murrayana, O'Donoghue, 1923:20; 1925:99; 1926:44.

The zooecia are elongate, the opesia occupying most of the frontal area; an erect spine at the distal outer angle and a varying number of smaller ones on the inner and outer margins curving more or less over

the opesia. Pedunculate avicularia situated near the base, those on the outer margins considerably larger than those on the inner zooecia of a frond.

The ooecia are large, subglobose and marked by radiating lines.

This is a widely distributed species in northern seas. It shows much variation in the manner of growth, the typical form having erect or somewhat recumbent broad frond-like branches; the variety *fruticosa* (Packard) with narrower strap-like branches, and the variety *quadridentata* (Loven) uniserial to quadriserial, with all possible intermediate variations linking these different growth forms together.

Hincks, Robertson and the O'Donoghues have recorded the species at numerous localities from the Bering Sea to Puget Sound.

The species was not taken in the dredgings of the Allan Hancock Pacific Expeditions, but there is a specimen in the collections from Pavlov Bay, Alaska. Also in the material from the U. S. Alaska Crab Investigation, the varieties *fruticosa* and *quadridentata* occurred together at stations 60-40, Leonard Harbor, Alaska, 20 to 25 fms, and 139-40, off Hallo Bay, Alaska, 28 to 40 fms. It is an abundant species at Point Barrow, Alaska, G. E. MacGinitie, Arctic Research Laboratory.

Dendrobeania curvirostrata (Robertson), 1905

Plate 25, figs. 7 and 8

Bugula curvirostrata Robertson, 1905:272.

Bugula curvirostrata, O'Donoghue, 1923:21; 1925:99; 1926:45.

The growth habit is much like that of *D. murrayana* var. *fruticosa* (Packard), with strap-like branches consisting of about 4 to 8 series of zooecia. The spines are much weaker than in *murrayana,* often reduced to merely the projecting distal angles. Lateral spines are often wanting, but a short nearly erect weak spine may be present on one or both sides opposite the operculum. The most important differential character appears to be the form of the avicularium, which is much longer than that of *murrayana,* especially the beak. Both the beak and the mandible are so much curved that they meet only at their tips. This applies to both the large border avicularia and the smaller ones on the inner zooecia.

Robertson did not obtain it north of Monterey Bay, California, but O'Donoghue lists it for a number of localities in Puget Sound and British Columbia, at 6 to 20 fms.

Hancock Stations: 997-39, White Cove, Santa Catalina Island, 36 to 41 fms; 1150-40, Avalon Bay, Santa Catalina Island, 93 to 110 fms; 1187-40, off Bird Rock, Santa Catalina Island, 31 to 40 fms; 875-38, northwest of Anacapa Island, 50 fms; 990-39, San Miguel Passage, 37

to 39 fms; 1385-41, off East Point, Santa Rosa Island, 75 to 76 fms, southern California. Since the bathymetric range increases southward, it seems probable that this is a species of moderately northern distribution and that southern California may be about the southern limit.

Dendrobeania laxa (Robertson), 1905

Plate 25, figs. 2 and 3

Bugula laxa Robertson, 1905:275.
Bugula laxa, O'Donoghue, 1923:21; 1925:99; 1926:45.

This is a spreading, recumbent species, loosely attached by numerous radicles. The fronds vary greatly in width from 2 or 3 zooecia to many, and the intermediate variations appear to render the variety *attenuata* O'Donoghue (1923:21) merely a nominal one. All of the species of *Dendrobeania* that have come under our observation have this variability in width.

The zooecia are large, like those of the other species of the region, about 0.75 to 0.90 mm in length, and are more loosely connected with each other than in the other species. The absence of avicularia and the nature of the unusually heavy spines are the best diagnostic characters. The ooecia are large and prominent, length 0.24 mm, width 0.30 mm.

Robertson recorded the species from Puget Sound, Washington, to Monterey Bay, California, and O'Donoghue found it at several localities in British Columbia, shore to 20 fms.

Hancock Stations: 1232-41, 5 miles from San Pedro Breakwater, 17 to 19 fms; 1190-40, Anacapa Passage, 15 to 50 fms; 1271-41, Anacapa Island, 23 to 25 fms, southern California, and 1490-42, Cape Arago lighthouse, reef and bight, Coos Co., Oregon, intertidal.

Dendrobeania lichenoides (Robertson), 1900

Plate 25, fig. 6

Flustra lichenoides Robertson, 1900:322; 1905:291.
Flustra lichenoides, O'Donoghue, 1923:23; 1925:100; 1926:48.

This species is a typical *Dendrobeania* in the manner of budding, the large terminal and lateral rosette plates, the calcification of the lateral and basal terminal walls, and the nature of the ovicells.

The zoarium consists of very wide, lichen-like fronds which are recumbent and loosely attached by radicles. The zooecia appear to be thinner-walled and less heavily chitinized than is usual in the genus. The zooecia are large, 0.75 to 0.90 mm, occasionally more than 1.00 mm in length, considerably narrower on the proximal half and rather suddenly widened, the distal end rather evenly rounded. A minute spine, often

absent, is present on the outer angle and 2 or 3 small, weak spines on each side toward the distal end. As O'Donoghue indicates (1923:23) under his variety *spinosa,* there may be "a large number of more developed spines," but apparently this condition is not limited to "a much more slender and delicate habit of growth." Occasionally the spines may be entirely wanting.

The ovicell is characteristic of the genus, large, rounded and prominent with surface striations, and there are no avicularia.

Robertson indicated the range from Alaska to San Francisco, California, and O'Donoghue records it from numerous localities in British Columbia and Puget Sound.

Hancock Station 1490-42, Cape Arago lighthouse, reef and bight, Coos Co., Oregon, intertidal. Common at Dillon Beach, California, Menzies, collector, shallow water.

Dendrobeania longispinosa (Robertson), 1905

Plate 25, figs. 4 and 5

Beania longispinosa Robertson, 1905:277.

In spite of the occasional small irregular fenestrae and the general looseness of connection of the zooecia, this species belongs in the genus *Dendrobeania* for the following reasons: the distal ends of the lateral and basal walls are thickened and calcified and contain the large single distal and two disto-lateral rosette plates, as in *Dendrobeania,* and the ovicell is exactly like that of other species in this genus. Robertson indicates that the ovicell is small, but it is only small in comparison with the size of the zooecia, it measures 0.30 mm in width by about 0.24 mm in length, and it is striated in the pattern characteristic of the genus. The long and heavy distal spines are situated rather close together and point distally. The lateral spines, usually about 7 on each side, are strong, curved over the opesia and so long that they may reach beyond the opposite side of the zooecium. The zoarium is irregular, recumbent, the branches consisting of from one to six series of zooecia. There is no evidence of tubular connections, such as occur in the species of *Beania.*

Robertson had the species only from La Jolla, California, "in several fathoms of water."

Hancock Stations: 2158, north end of Ranger Bank off Cedros Island, Lower California, 81 fms; 1187-40, off Bird Rock, Santa Catalina Island, 31 to 40 fms; 1190-40, Anacapa Passage, 15 to 20 fms; 1271-41, three-fourths of a mile southeast of Cat Rock, Anacapa Island, southern California, 23 to 25 fms; 1896-49, Tanner Bank, 22 fms.

Dendrobeania multiseriata (O'Donoghue), 1925

Bugula multiseriata O'Donoghue, 1925:18.

This species evidently belongs in *Dendrobeania,* as O'Donoghue states that one zooecia arises from the other on the dorsal side by a quite straight transverse joint. Also the ovicell, in form, mode of attachment and surface decoration is typically that of a *Dendrobeania.* The very broad fronds and the presence of smaller avicularia on the inner zooecia suggest a close relationship to *B. murrayana* (Johnston). The absence of spines, except a very small one at each distal corner, and the form of the avicularia appear to distinguish it specifically, but it may prove to be only another variety of *B. murrayana.* Described from "St. Paul Island, Alaska."

Dendrobeania simplex (O'Donoghue), 1923

Flustra simplex O'Donoghue, 1923:24; 1926:48.

Zoarium erect, dichotomous, the branches consisting of 8 to 10 series of zooecia at their widest part; attached by radicles which arise from near the middle of the dorsal part of the zooecia.

Zooecia alternate, elongate, rounded distally and truncate at the base; aperture occupying the major part of the front. Spines absent or limited to small points at the distal corners. No avicularia.

Ooecia prominent, subglobose, with a slightly upturned lip, the surface with radiating striae (condensed from O'Donoghue's two accounts).

The ovicells in this species are very definitely hyperstomial, while those of the genus *Flustra* are endozooecial. The form, mode of budding (transversely across and closely attached to the distal end of the zooecium), and the nature of the decoration are all similar to the same characters in species of *Dendrobeania.* It is probably merely a variety of *D. lichenoides* (Robertson) in which the spines are often much reduced or wanting over much of the colony.

It was described from north of Gabriola Island and later listed from off Cape Lazo and Bull Passage, British Columbia. It did not appear in the Hancock dredgings.

Genus BEANIA Johnston, 1840

Genotype, *Beania mirabilis* Johnston, 1840.

In this genus the zooecia are more or less separated and connected by tubular extensions. In some species the connecting tubes are so short that at first view they may appear to be wanting; in other species the tubular portion may be as long or longer than the body of the zooecium. The

proximal end of the zooecium is always narrow and tubular where it takes its origin from dorsal side of the preceding zooecium. The distal end of the zooecium is raised, extended forward above, and not resting on the succeeding zooecium. Stalked, moveable avicularia are usually present, but occasionally absent. Ovicells are usually wanting or vestigial, but may be well developed. The species are recumbent, spreading over various types of substrata and attached by radicles which have their origin on the dorsal side.

KEY TO SPECIES OF *Beania*

1. Zooecia in a single series. 2
   Zooecia forming a network. 3
2. Basal tubule about as long as zooecial body, terminal spines short and weak. . . . . *mirabilis*
   Basal tubule only about one-third as long as body, terminal spines long and strong. . . . . *alaskensis*
3. Avicularia present, spines vestigial. . . . . *magellanica*
   Spines long and very numerous. 4
4. Connecting tubules nearly as long as the zooecia, 3 dorsal spines. . . . . *columbiana*
   Connecting tubules only one-fourth as long as the zooecia, 5 dorsal spines . . . . . *hirtissima*

Beania mirabilis Johnston, 1840

Plate 26, fig. 8

Beania mirabilis, Robertson, 1905:276.

Beania mirabilis, O'Donoghue, 1926:45.

Beania mirabilis, Hastings, 1930:705.

The zoarium is uniserial, irregularly branched, spreading over algae, hydroids and other bryozoa, and attached by radicles which have their origin on the dorsal side near the proximal end of the zooecial body. The zooecia are tubular proximally for about one-half of their total length and expand rather suddenly to form the zooecial body which averages about 0.60 to 0.65 mm in length. The total length including the tube is usually well over 1.00 mm. The origin of the zooecial tube is on the dorsal side of the preceding zooecium at about the middle of its length. There are two pairs of short oral spines and 4 to 6 longer spines on each side which bend over the opesial area. Avicularia and ooecia not known.

This species is distributed around the world in temperate and tropical seas. On the west coast of the Americas it has been recorded previously from British Columbia to Colombia as follows: O'Donoghue, Gabriola Pass, British Columbia, 6 to 8 fms; Robertson, Dead Mans and Santa Catalina Islands, southern California, and Hastings, Gorgona, Colombia, 15 fms.

Hancock Stations: 147-34, Tagus Cove, Albemarle Island, Galapagos, 30 fms; 133-34, Braithwaite Bay, Socorro Island, west of Mexico, 20 fms; 1238-41, off Wilson Cove, San Clemente Island, southern California, 14 to 16 fms. The writer has also collected it on the piles of wharves in Newport Harbor, southern California. Also Gulf of Panama, Galtsoff collection, on pearl oysters.

Beania alaskensis new species

Plate 26, figs. 6 and 7

This species resembles *B. mirabilis* in form and mode of growth, but is much larger, the tubular proximal end much shorter and thicker, the distal spines are very elongate (nearly half as long as the zooecial body), and the lateral spines bifurcate at the base with the outer branch directed outward and the inner one curved over the opesia.

The total zooecial length is about the same as that of *B. mirabilis,* 1.00 to 1.10 mm, but the proportions of stalk and body are quite different as the tubular stalk is only one-third as long as the body, and the stalk is comparatively thick, 0.10 mm in diameter (0.05 mm in *mirabilis*). The very elongate terminal spines and the double lateral ones are also striking differential characters.

Type, AHF no. 42.

Type locality, Shuyak Strait, Afognak, Alaska, "U. S. National Museum 85/652."

Beania magellanica (Busk), 1852

Plate 25, fig. 9

Diachoris magellanica Busk, 1852:54; 1884:59.
Beania magellanica, Harmer, 1926:412.

The zoarium forms a network, or reticulum, the zooecia being separated from each other by fenestrae about one-third as large as the zooecia. The lateral connecting tubes vary somewhat, but average about 0.15 mm in length. Each zooecium begins in a narrow tube arising from the dorsal side of the preceding one and suddenly expanding into the "boat-shaped" zooecium. The zooecium (body) is moderately large, 0.65 mm long by 0.30 to 0.40 mm wide, slightly narrowed at the distal end where it projects above the succeeding one, and the opesia occupies the whole of the frontal surface. Vestigial spines are present, two at the distal end and one (occasionally two) on either side of the operculum. The avicularia are large and somewhat elongated (about 0.35 mm in length), with a

short stalk and sharply decurved beak, attached one on either side just proximal to the operculum. Harmer (1926:412) described extremely vestigial ovicells for this species, but these were not noted in our material.

This species is distributed around the world in the southern hemisphere and as far north as the Mediterranean Sea and Japan. In American waters it has hitherto been noted only at the Straits of Magellan (Busk), and Terra del Fuego and the Falkland Islands (Calvet).

Hancock Stations: 394-34, 843-38, and 844-38, Lobos de Afuera Islands, Peru, shore to 25 fms.

Beania hirtissima (Heller), 1867

Plate 26, figs. 4 and 5

Diachoris hirtissima Heller, 1867:94.
Beania hirtissima, Marcus, 1937:62.
Beania hirtissima, Osburn, 1940:397.

The zoarium usually forms a loosely attached spreading spinous mat, sometimes rising free and unilaminar, occasionally tubular in form, bristling like a porcupine. The zooecia are of moderate size, about 0.60 mm long from septum to septum, of which the proximal tubular portion is about one-fourth; widely separated by fenestrae which are about one-half as large as the zooecia, and connected by tubular lateral processes of the same length as the basal tubular portion but narrower. The astonishing array of spines shows three types: (1) distal straight spines projecting forward, laterally and more or less erect, 8 or 10 in number; (2) lateral spines 8 to 12 on each side, which curve over the opesia with their points often interlacing; and (3) dorsal spines, 5 in number, with the following arrangement,—one on each side between the distal and disto-lateral tubes, another between the disto- and proximo-lateral tubes, and one in the midline about the middle of the zooecium. Occasionally there is another single median spine near the proximal end of the zooecium, and this one frequently develops a branching hold-fast at its tip.

Avicularia and ovicells are wanting.

The species has a wide distribution in warmer waters, occurs on the Atlantic coast from Bermuda to Brazil, but has not been recorded previously from the Pacific coast of the Americas.

Hancock Stations: 303, Port Culebra, Costa Rica, 17 fms, 2 small colonies on a coralline nodule, and Station 313, Secas Islands, Panama, 25 fms.

Beania columbiana O'Donoghue, 1923

Beania columbiana O'Donoghue, 1923:22; 1926:46

This species has much resemblance to the widely distributed *B. hirtissima* (Heller), but O'Donoghue (1926:46) points out the differences as follows: much longer connecting tubules, the number and distribution of the marginal spines, and in the limitation of the dorsal spines to three.

The zoarium is a network loosely attached, the zooecia being connected by six tubules, each nearly as long as the zooecium, to the neighboring zooecia. The membranous frontal area is surrounded on the sides and distally by long chitinous spines, 21 to 30 in number, many of which are bifurcate; on the dorsal side are three bifurcate spines regularly located between the distal and lateral connecting tubules. Banks Island, Cape Ebenshaw and China Hat, British Columbia (O'Donoghue). Not in the Hancock collections.

Division VI **CRIBRIMORPHA** Harmer, 1926

This Division was established by Harmer to include all of the genera in which the frontal shield, or pericyst, is formed by the union of hollow spines or costae, more or less fused, with pores (lacunae) between the costae, the "cribrimorphs" of Lang. Opinions vary as to where in the evolutionary series this group should be placed. Marcus (1922:47) included it in the Ascophora, but has since returned it to the Anasca. Canu and Bassler (1929:27-30) divided the group between the Anasca and Ascophora, and Bassler (1935:29) includes all of the cribrimorphs in his Division I of the Ascophora.

In separating this Division, Harmer discussed the possible evolution of the compensation sac of the Ascophora through conditions which are found in the reduction of the costal area of *Figularia,* which almost bridge the gap between the Anasca and Ascophora. He considers that "the Cribrilinidae are a transitional group, and it is thus a matter of legitimate doubt whether they should be placed in the lower or the higher of the two groups which they connect." Silen (1942:41-52) discussed the formation of the ascus (compensation sac) and the calcified frontal and concluded that the ascus has been evolved from the space between the membraniporidan frontal membrane, which forms the floor of the sac, and the inner layer of the calcified frontal wall, which forms its roof.

Since practically all of the Cribrilinidae, the recent cribrimorphs, have a broad membraniporidan frontal membrane below the pericyst (some of the genus *Figularia* seem to be exceptions), it appears more logical to retain this group in the Anasca, even though they suggest the evolution of

the Ascophora. Certainly such typical cribrimorphs as *Cribrilina, Lyrula* and *Reginella* with a large costal area above a broad frontal membrane cannot properly be included in the Ascophora.

The family Cribrilinidae includes practically all of the recent genera.

Family **Cribrilinidae** Hincks, 1880

Key to the Genera of Cribrilinidae

1. No ooecia, no dietellae, avicularium large, vicarious, spatulate. . . . . *Lyrula*
   Ooecia present, hyperstomial; avicularia not spatulate. 2
2. Avicularia present. 3
   Avicularia wanting (in the species here considered). 4
3. Avicularia vicarious or pedunculate at side of aperture . *Colletosia*
   Avicularia minute, mandible setose. . . . . *Puellina*
4. Costules separated for most of their length. . . *Membraniporella*
   Costules more or less fused for their entire length. 5
5. Costate area reduced, costae closely united, no dietellae, gymnocyst well developed. . . . . *Figularia*
   Costate area covering nearly the whole front. 6
6. Ooecia large, prominent, no dietellae. . . . . *Reginella*
   Ooecia small, not prominent, dietellae present. . . . *Cribrilina*

Genus **MEMBRANIPORELLA** Smitt, 1873

The frontal membrane is overarched by a series of costules which are free from each other for much of their length, but more or less fused at their tips; the distal pair forming the proximal lip of the aperture. Paired avicularia may occur at the sides of the aperture, but are not found in our species. The ovicell is hyperstomial. Dietellae present or wanting. Genotype, *Lepralia nitida* Johnston, 1847:319.

Membraniporella aragoi var. **pacifica** new variety

Plate 27, figs. 3 and 4

Encrusting, especially on shells. It has all the appearance of a membranipore with an arched lattice-work above the frontal membrane. The zooecia are moderate in size, but show much variation, 0.40 to 0.65 mm long by 0.30 to 0.40 mm wide. The frontal shield or pericyst is formed by the fusion of the branched tips of large, flattened, hollow spines which arise on the mural rim, curve over the frontal membrane and interlock, leaving usually 6 or 8 more or less ellipsoid lacunae in the central area. The usual complement of the spines or costulae is 4 on each side, but there may be as few as 3 or as many as 6 in the same zoarium; frequently there is a single median costa proximally; the costae are separated at

their bases and for half or more of their length by long slits. There is a short, flattened spine at each side of the aperture, with 2 or 3 very short points; in the ovicelled zooecia these spines are more or less fused with the sides of the ooecia. In the absence of ooecia there is a small median spine on the distal border. There are no avicularia.

The ooecia are hemispherical, prominent and wide open; the ectooecium does not form a complete cover but leaves a somewhat v-shaped frontal area which, in complete calcification, terminates in a pointed umbo at the top. The ooecium is about 0.20 to 0.25 mm broad by 0.13 mm long.

The general appearance is that of Savigny's figure of *Flustra aragoi* Audouin, with the exception that the ovicell is somewhat longer and the lateral oral spines are short and end in 2 or 3 tubercles, instead of being branched in alcicorn fashion and extended backward on the sides of the aperture. There appears to be a tendency toward a greater number of costae, but Savigny's figure 1, shows 5 costae on a side. Marcus, 1938:30, has recorded *aragoi* from Santos Bay, Brazil, with two pairs of costae and 3 to 4-branched lateral oral spines. Harmer, 1926:473, described *aragoi* from the East Indies with 3 to 5 pairs of costae and short-bifurcate oral spines. Also Canu and Bassler (1928-35) have described, from north of Cuba, *M. petasus,* in which the costae are usually 4 to 6, the lateral oral spines short-bifid (occasionally trifid in the writer's specimens from the Caribbean Sea), but the central area of the front is usually more closed and a lacunae smaller. I am inclined to the view that all of those are to be considered varieties of *aragoi,* especially as I have a colony from the Caribbean which is almost the exact counterpart of Savigny's figure with the 4-pronged lateral spine which extends backward on the side of the aperture, sometimes even fusing with the proximal branch of the first costa; but in the same colony there are occasional shorter trifid spines.

Type, AHF no. 43.

Type locality, Hancock Station 924-39, Socorro Island, 18°41′52″N, 110°55′20″W, 17 to 46 fms. Also at Stations 129-34, Socorro Island, and 135-34 and 219, Clarion Island, west of Mexico; 143-34, Wenman Island and 224, Albemarle Island, Galapagos; 270, Angel de la Guardia Island, Gulf of California; and 224, San Benito Island, Lower California. Bathymetric range, 2 to 100 fms.

Membraniporella pulchra new species

Plate 27, figs. 5 and 6

The zoaria are small, encrusting, on the dorsal side of *Cupuladria canariensis* (Busk). The zooecia are moderately small, averaging 0.40 mm in length (range 0.35 to 0.44); well separated, with narrow interopesial areas; costa very regular, 6 to 8 pairs, situated close together, sometimes almost closing the lateral lacunae; central area comparatively large and regular in form, with 10 or 12 or even a larger number of small lacunae. The lateral oral spines are flattened at the base but usually end in a single point, occasionally short-bifid; a small median terminal tubercle in the absence of the ooecium. The distal pair of costae form the proximal border of the aperture, which is slightly arcuate and without an umbonate process. A slight median keel is occasionally present.

The ooecium is hemispherical, 0.18 to 0.20 mm wide by 0.15 mm long, with the usual v-shaped area on the front.

The species is evidently related to *M. aragoi,* but the much smaller size, the larger number of costae, the much narrower lateral lacunae, the larger and more regular central area and the simplicity of the lateral oral spines seem sufficient to require specific standing. Whether the peculiar habitat on the dorsal side of *Cupuladria* has any meaning is a question.

Type, AHF no. 44.

Type locality, Hancock Station 135-34, Sulphur Bay, Clarion Island, west of Mexico, 18°20′20″N, 114°44′25″W, 25 fms. Also at Sta. 921-39, north of Clarion Island, 30 to 33 fms.

Membraniporella crassicosta Hincks, 1888

Plate 27, figs. 1 and 2

Membraniporella crassicosta Hincks, 1888:216.
Membraniporella crassicosta, Osburn, 1912:279.

Zoarium a coarse reddish brown incrustation which may rise in bilaminate frill-like folds to the height of an inch. The zooecia are large, 0.60 to 0.90 mm long by 0.45 to 0.55 mm wide, and coarse. The aperture is large, 0.25 mm long by 0.30 mm wide, rounded distally with the proximal border somewhat straighter. The spines forming the pericyst are unusually broad and heavy, ordinarily fused only at the tips, the first pair forming the border of the aperture. In young colonies there are usually three pairs of spines (occasionally an extra 1 or 2) and there is some resemblance to *M. aragoi* (Audouin), as Hincks points out, though the zooecia are much larger. Away from the center of the colony only the two distal pairs are fully developed, the others represented by

mere stubs or absent. There is a peculiarity in the distal pair of spines, the bases of which are continued forward to form the lateral borders of the aperture; these are fairly regular but other spines vary widely in form, size and amount of fusion.

No ovicells have been observed. No oral spines, no avicularia, no dietellae.

Described from the Gulf of St. Lawrence (Hincks), and reported from Shoal Tickle, Labrador (Osburn). The occurrence of this species from northwestern Alaska indicates that it is probably circumpolar in distribution.

Point Barrow, Alaska, 20 fms, G. E. MacGinitie, Arctic Reasearch Laboratory, common and forming large colonies.

Genus **CRIBRILINA** Gray, 1846

Costules generally closely attached throughout their length, leaving lacunae of various sizes (more or less irregularly spaced in the type). Ovicell hyperstomial and closed by the operculum. The proximal rim of the orifice often with a mucro. Avicularia, when present, at either side of the orifice. Dietellae present. Genotype, *Lepralia punctata* Hassall, 1841:368.

Cribrilina annulata (Fabricius), 1780

Plate 28, fig. 7

Cellepora annulata Fabricius, 1780:436.
Cribrilina annulata, Osburn, 1933:32.
Not *C. annulata,* Robertson, 1900:280 (see *Lyrula hippocrepis*).
Cribrilina annulata, O'Donoghue, 1923:30; 1926:50.

The zoaria encrust shells and stones, forming small rounded colonies of a reddish or brownish color, *"pulcherrima et perfectissima haec omnium visarum"* (Fabricius, *Cellepora annulata,* 1780:436).

The zooecia vary greatly in size, 0.45 to 0.65 mm long by 0.30 to 0.40 mm wide, and in addition the ovicelled zooecia are often much reduced. The pericyst is formed by about 8 pairs of costae which are transverse distally but radiate at the proximal end; the costae are separated by rather deep grooves which extend across the whole of the front, except when interrupted at the median line by a low carina. In the grooves on each side there are about 4 (3 to 6) small rounded lacunae. The distal pair of costae form the proximal border of the aperture which usually bears an umbonate process more or less developed. The aperture is transverse (about 0.18 mm wide), somewhat semicircular, and on each side is a short strong spine; a pair of similar but somewhat smaller spines at the distal corners. There are no avicularia.

The ooecium is small and low and the distal spines are usually fused with it on the sides.

It is a common species on both sides of the North Atlantic, down to Cape Cod, Massachusetts, in the high Arctic it extends from the Kara Sea to the American Arctic, and has been recorded by O'Donoghue at several localities in British Columbia.

Collected by the "Albatross" at Cordova, Alaska, June 28, 1914, specimens in the National Museum and the Hancock collections. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Cribrilina corbicula (O'Donoghue), 1923

Membraniporella corbicula O'Donoghue, 1923:30.
Cribrilina corbicula, O'Donoghue, 1926:51.

Zoarium forming rough light brown patches on the leaves of *Zostera.* Zooecia of moderate size, oval and closely packed. Pericyst formed by 6 or 7 pairs of spines, uniting in the midline and at several points on each side, leaving 3 or 4 lacunar pores in each groove, presenting the appearance of basket-work. The aperture is semicircular, the apertural bar forming a sort of lip. Oral spines 3 or 4. Ovicell small, hemispherical, with 2 minute frontal pores; another pair of broad ribs grows across it and almost hides the ovicell. (Condensed from O'Donoghue's two accounts.)

This may be a different species, as O'Donoghue states that it is "a much larger form than *C. annulata.*" However, the nature of the small ovicell and the apertural bar and frontal rib of the ovicell in the form of raised lips suggest a close relationship to that species. Recorded from Nanaimo, Victoria and Nanoose Bay, British Columbia, by O'Donoghue. Not in the Hancock collections.

Genus **REGINELLA** Jullien, 1886

Zooecia with the frontal formed by voluminous ribs much in relief on the exterior surface, with the pores diminishing in size from the talon of the rib to its extremity; between each pair of ribs transversely is found a furrow often as broad as the rib, at the bottom of which each pore occupies the middle of a calcareous polygonal cell. These intercostal furrows traverse entirely the zooecium and separate completely each pair of transverse ribs. Orifice arched in front with the inferior lip mucronated, marginal spines. Avicularia unknown (Transl. Canu and Bassler). Genotype, *Cribrilina furcata* Hincks.

Jullien apparently drew his generic description entirely from Hincks' brief description and figure of *C. furcata* and the species and genus do not seem to have been given any later study. It may be added that the fertile zooecia have a wider aperture than the infertile ones (see Hincks' illustration, 1882, pl. 20, fig. 5); the lateral oral spines are not always bifurcate and are often wanting, and that communication is by multiporous septiulae.

There is a question as to whether *Metracolposa* Canu and Bassler (1917:34) is congeneric with *Reginella*. The Eocene, Middle Jacksonian, genotype, *M. robusta* Canu and Bassler, 1917:33, and some other Eocene species have vicarious avicularia. Otherwise they appear to be similar to *Reginella*.

Key to Species of *Reginella*

1. Short, strong, flattened spinous processes on either side of the aperture. 2
   Spinous processes wanting. 3
2. A single spine, usually bifurcate, on each side; ooecium with numerous pores, its width 0.30 mm. . . . . *furcata*
   Two spines on each side, not or only slightly furcate; ooecium with few pores, its width 0.40 mm. . . . . *spitsbergensis*
3. Apertural bar (proximal border) heavy, broad and mucronate. . . . . *mucronata*
   Apertural bar not unusually heavy, not mucronate. 4
4. Zooecia large (0.60 to 0.80 mm long), lacunar pores rounded, large. . . . . *nitida*
   Zooecia smaller (0.40 to 0.55 mm long), lacunar pores narrow and slit-like. . . . . *mattoidea*

Reginella furcata (Hincks), 1884

Plate 28, fig. 3

Cribrilina furcata Hincks, 1884:12.
Cribrilina furcata, O'Donoghue, 1923:30.
Reginella furcata, O'Donoghue, 1926:52.

Zoarium encrusting. Zooecia moderate in size, 0.50 to 0.65 mm long by 0.35 to 0.45 mm wide, distinct with deep grooves, regularly arranged in quincunx. The pericyst is considerably inflated, formed by the fusion of 6 to 8 pairs of costae, with or without a median keel. Each costa bears 2 to 4 oval lumen pores and between the costae there are 5 to 6 rounded lacunar pores. The pair of costae which form the proximal border of the aperture are not enlarged nor umbonate, but at most are slightly bowed forward. The aperture is transverse, about 0.18 mm wide by 0.12 mm long, rounded distally and transverse or a little incurved on the proximal

border. On either side of the aperture is a short, broad spine which is sometimes bifurcate, often merely pointed and frequently wanting. There are no avicularia.

The ovicell is prominent, 0.25 to 0.30 mm broad, sometimes longer than broad and a little pointed at its distal extremity, with a low broad keel and with larger pores around the border and smaller ones on the top.

Described by Hincks from Cumshewa and Houston-Stewart Channel, and listed by O'Donoghue from numerous other localities in British Columbia.

Hancock Stations: 1119-40, off San Benito Islands, west coast of Lower California, and 1303-41, Santa Cruz Island, off southern California. Also at Middle Bank, Puget Sound, Dr. J. L. Mohr, collector. Shallow water to 87 fms.

Reginella mucronata (Canu and Bassler), 1923

Plates 28, fig. 4 and 29, fig. 3

Metracolposa mucronata Canu and Bassler, 1923-926.

Zoarium encrusting, usually on stones and shells. The zooecia are ventricose and prominent, sharply set off from each other by deep grooves. The frontal shield or pericyst is formed by the fusion of 5 or 6 pairs of rather regularly arranged costae which meet at the midline either smoothly or with a low median keel. Each costa bears two small rounded lumen pores and between the costae there are 5 or 6 rounded or somewhat slit-like pores (lacunae). The pair of costae which form the proximal border of the aperture are elevated into a bimucronate lip. There are no spines, no avicularia and no dietellae. Zooecial length, average, 0.50, width 0.35 mm.

The ooecium is large and conspicuous, 0.26 to 0.30 mm wide, rather deeply embedded and bears a variable number of pores, irregularly distributed, the marginal ones being somewhat larger. Often a carina is present and the area just distal to the aperture may be flattened on each side and irregularly striated longitudinally. The ooecium is usually noticeably longer than broad, but in crowded areas the reverse may be true.

Canu and Bassler described *M. mucronata* from "Pleistocene: Santa Barbara, California, (rare)." I have not been able to find any constant difference between recent and fossil material. The original description does not mention the pores of the ovicell, but fossil specimens sent me by Dr. Bassler show the character of the pores, usually occluded by fossilization. The variations in measurement transcend in both directions those of Canu and Bassler.

This species is here placed in the genus *Reginella* since it resembles *R. furcata* (Hincks) in all fundamental characters, except in the absence of the lateral oral spines, which are also often wanting in *furcata.* It is more heavily calcified and the proximal lip of the aperture is stronger and more or less bimucronate. In the very young zooecia it is difficult to distinguish the two species and I can find no differences in the ancestrulae.

It is a common species, occurring at 29 of the Hancock dredging stations and also along shore, from the northern Channel Islands off southern Calfornia southward to Cedros Island, Lower California, and also at San Esteban Island in the Gulf of California. It is present in the Pleistocene from Santa Barbara to Newport Harbor, southern California. The known distribution is from about 35 N Lat. to 28 S Lat. and from shallow water to 121 fms.

Reginella nitida new species

Plate 28, fig. 1

Zoarium encrusting. Zooecia moderately large (0.60 to 0.80 mm long by 0.40 to 0.55 mm wide), distinct and regularly disposed. The pericyst is lower, less arched, than in *mucronata* and is smooth and shining even in older stages; occasional traces of a carina. There are 6 to 8 pairs of costae, with often a median one at the proximal end, each with 3 small lumen pores which are often obscured. The intercostal grooves are broad and extend across the front in full width; lacunae 6 (5 to 7), not much reduced toward the midline, round or elliptical in form. The proximal border of the aperture is thin in younger zooecia, but becomes heavier with age and forms a vertical rim which often terminates in a low median umbonate process; it does not extend forward toward the aperture but projects directly upward. The aperture of the infertile zooecia measures 0.18 to 0.20 mm in width, while that of the fertile ooecia is about 0.24 mm. The ovicell appears to be exactly like that of *mucronata* but larger, 0.30 to 0.35 mm wide. There are no spines, no avicularia, and no dietellae.

In general appearance it is like *R. mucronata,* but it is much larger, less ventricose and is smooth and shining at all stages; there are one or two more pairs of costae and usually two more lacunae in each row. The appearance is neater than in *mucronata* which is much rougher and more irregular even when growing on a smooth surface.

Type, AHF no. 45.

Type locality, Hancock Station 1181-40, off Howlands Landing, Santa Catalina Island, southern California, 33°28′15″N, 118°26′48″W, 49 fms. Also at Stations 1251-41, five and a half miles south of San Benito

Islands, Lower California, 28°12′35″N, 115°34′35″W, 69 fms, and Raza Island, 28°48′00″N, 113°00′00″W, Gulf of California, 40 fms. Also at Middle and Hein Banks, Puget Sound, Washington, Dr. J. L. Mohr, collector.

Reginella mattoidea new species

Plate 28, fig. 2

Zoarium encrusting on shells, worm tubes and nullipores, dull white (mattoid) like a delicate patina, even the youngest zooecia very little shining. Zooecia of moderate size, 0.40 to 0.55 mm long by 0.35 to 0.40 mm wide, the smallest of our species. The pericyst is ventricose but less so than in *mucronata;* costules usually 6 pairs (5 to 7), broad at the base and narrowing nearly to a point at the center of the front, the lumen pores small, 1 to 3 in number, often only the outer one present; grooves broad and extending in full width across the front, the lacunae 7 to 10 on each side, narrow and slit-like; rarely there is a trace of a carina. The costae forming the proximal border of the aperture are broad, with a strong vertical raised rib across its upper surface and extending slightly around the angles of the aperture. The aperture is comparitively small (0.12 mm long by 0.14 mm wide in the infertile zooecia, and 0.16 mm wide in the fertile zooecia).

The ovicell is round, moderately large (0.26 mm in either dimension) with numerous pores, roughened and with the same texture as the pericyst.

It is more delicate and neater in appearance than the other species of the genus; the narrower aperture, the finer character of the pericyst with a larger number of lacunae, are evident. No spines, no avicularia and no dietellae.

Type, AHF no. 46.

Type locality, Hancock Station 1064, off Santa Barbara Island, California, 33°39′01″N, 119°02′20″W, 27 fms, 7 colonies. Also at Stations 137-34, Clarion Island, west of Mexico, 57 fms, and 275, Raza Island, Gulf of California, 28°48′00″N, 113°00′00″W, 40 fms. Albatross Station 2994, Revillagigedo Islands, west of Mexico.

Reginella spitsbergensis (Norman), 1903

Plate 28, figs. 5 and 6

Cribrilina annulata var. *spitsbergensis* Norman, 1903:103.
Cribrilina annulata, Waters, 1900:64.
Cribrilina annulata var. *spitsbergensis,* Nordgaard, 1918:50.

Zoarium encrusting on shells, one colony covers an area 20 by 25 mm, light reddish brown in color. The zooecia are large, averaging 0.78 mm long by 0.47 mm wide, very regular in arrangement. The pericyst is thick, formed of about 7 pairs of costae, the proximal ones radiate and the distal ones transverse; the distal pair of costae unite to form the proximal border of the aperture which is a little elevated and sometimes forms a low mucro. The aperture measures about 0.25 mm in width by 0.17 mm long, roughly semicircular, straighter on the proximal border. The peristome is low, with four short, strong, flattened spinous processes which bend slightly over the aperture; the proximal pair, usually smaller, are opposite the proximal border of the aperture, the distal pair opposite the distal end of the aperture. The costae are strong with three to five irregularly rounded lacunar pores between; the lumen pores usually two.

The ooecium is large (0.40 mm wide), the front usually a little flattened with a narrow keel and a few pores, partially embedded in the base of the distal zooecium. The distal pair of spinous processes unite more or less with the front of the ovicell, but do not enter into its formation; instead they "form two outspread wings overhanging the oral opening." (Norman, p. 104). The fertile zooecia are not reduced in size (as in *C. annulata*) but are similar in all respects to the others, except for the slightly wider aperture.

In raising this form to specific rank the following characters are of importance: the large size of the zooecia (noted by Waters and Norman), the replacement of spines of *annulata* by broad processes with the proximal pair in a different position, and the nature of the ovicell which is very much larger, of different form and not surrounded by a small kenozooecium. For these reasons also, as well as the agreement with *Reginella furcata,* the species is transferred from *Cribrilina* to *Reginella.* Waters, under *Cribrilina annulata,* noted the presence of the lateral oral processes. These structures are homologous to the costae and in series with them but are short and nearly erect. Norman considered it a variety of *annulata* but questioned whether it should not be "regarded as a species." It has been recorded from Franz-Josef Land, Spitzbergen, Greenland and the White Sea. No doubt it is circumpolar in distribution, and it has not been observed out of the high Arctic region.

Collected by Prof. G. E. MacGinitie at Point Barrow, Alaska, several colonies on shells, at 22 fms, Arctic Research Laboratory.

Genus **LYRULA** Jullien, 1886

Costules large, separated by broad furrows which extend across the front; orifice shaped like an inverted lyre. Avicularia interzooecial, large and spatulate, often wanting. No ooecia. Dietellae wanting, but multiporous septules are present in both distal and lateral walls. Genotype, *Cribrilina hippocrepis* Hincks.

Lyrula hippocrepis (Hincks), 1882

Plate 27, figs. 7 and 8

Cribrilina hippocrepis Hincks, 1882:470.
Cribrilina annulata, Robertson, 1900:326.
Cribrilina hippocrepis, Robertson, 1908:280.
Cribrilina hippocrepis, O'Donoghue, 1923:30.
Lepralia regularis, O'Donoghue, 1923:40.
Lyrula hippocrepis, O'Donoghue, 1926:52.

The species has been well described by Hincks and by Robertson, but without calling attention to the variability, which is very marked. In older stages the calcification is exaggerated and takes various forms, one of which led O'Donoghue to describe it as a new species, which he corrected later (1926:52).

Zoarium encrusting, or rarely erect and bilaminate. The zooecia are regularly disposed in alternating series when not crowded; distinct, but the separating grooves may become filled in old specimens; moderately large, 0.50 to 0.75 mm long by about 0.40 mm wide; ventricose when young but becoming nearly flat with age. The pericyst is formed by 5 (4 to 6) pairs of broad costae, each with a large pore (pelma) at its base; the separating grooves are broad and each bears 5 or 6 small slit-like longitudinal lacunae. The distal costae, which form the aperture bar, are unusually broad; there is no median umbo, but in older zooecia there is often a lateral umbonate protuberance which develops in connection with the lateral costal pore. In older stages all of the lateral costal pores may be surrounded by short, stout, erect collars. The aperture, about 0.20 to 0.20 mm is widest and straight on its proximal border, narrowed to form lateral indentations, then evenly rounded to conform with the border of the operculum; the latter is well chitinized, with a strong bordering sclerite, but incomplete proximally.

Large vicarious avicularia, often wanting even in whole colonies, occupy a position in the zooecial series; the mandible long and subspatulate, with a long-triangular basal sclerite and attached without pivot or cardelles.

Robertson described the ovicell as "globose, or medium wide, punctured with a few large pores," but Hincks failed to find them, O'Donoghue did not mention them, and in the numerous specimens at my disposal there are none. Frankly, I do not know how to interpret Dr. Robertson's illustration (pl. 15, fig. 31); it shows a narrow costal border to the aperture and omits the large basal pores (pelmata) of the costae, and shows ovicells similar to those of *Reginella,* but also shows the larger avicularium. As Miss Robertson did not mention the very common *Reginella mucronata* (Canu and Bassler), it is possible that she confused it with *Lyrula hippocrepis* and combined them in her illustration.

Various British Columbia localities, Hincks and O'Donoghue; Yakutat, Alaska, and San Pedro and Coronados Islands, southern California, Robertson.

In the Hancock expeditions this species was recovered at 38 different stations ranging from the coast of Oregon to the Gulf of California. It is very abundant about the Channel Island region off southern California. The known range is from Yakutat, southern Alaska (Robertson), to about the 26th N parallel of latitude; the bathymetric range is from shallow water to 79 fms.

Genus **PUELLINA** Jullien, 1886

Jullien erected this genus to include *Cribrilina gattyae* Busk, the only species known to him, which therefore becomes the genotype. Later other species were added by various authors. Most of these, however, appear to fall more properly in the genus *Colletosia* Jullien, 1886, which had been neglected until resurrected by Harmer (1926:474). *Colletosia,* of which *Lepralia endlicheri* Reuss is the genotype, has quite a different frontal shield.

In *Puellina* the costal area does not occupy all of the frontal, but has a comparatively broad gymnocyst border, especially at the proximal end; there is a small setose avicularium ("vibracellaire," Jullien) at each side of the aperture, and no interzooecial avicularia. The frontal usually bears a distinct rounded umbo near the center of the pericystal area, and oral spines are present.

Puellina setosa (Waters), 1899

Plate 29, fig. 4

Cribrilina setosa Waters, 1899:8.
Cribrilina radiata var. *a* Hincks, 1880:186.
Cribrilina radiata, form *innominata,* form with *vibraculoid setae,* Hincks, 1884:14.

Zoarium encrusting in a thin white layer on shells and stones. The zooecia are small, averaging about 0.40 mm long by 0.30 mm in width though there is much variation and shorter zooecia may be as broad as long, and their inflated costate areas cause them to appear very distinct. A smooth border, often quite conspicuous at the proximal end, surrounds the area which often is almost round. The pericyst is formed by 6 to 8 spines on each side, the distal pair uniting to form the proximal border of the aperture, while the others unite at the center of the front where they usually produce a small round low umbo at some distance back of the oral border. The lacunae are rounded, 2 to 4, except on the apertural bar where there is usually only one in the middle (occasionally 2 or 3). The aperture is small, semicircular, 0.08 mm wide by 0.05 mm long; the operculum thin with a slightly thickened border which is continuous except on the proximal margin; the peristome low, with 3 to 5 small slender spines. A minute setose avicularium is situated on either side of the aperture about opposite the proximal border; the chamber is minute and, though muscles are present, I have been unable to determine their mode of operation.

The ovicell is hyperstomial, hemispherical, prominent, about 0.18 mm wide and long, with a low longitudinal keel from which delicate striae radiate.

The species has much resemblance to *P. gattyae* (Busk) from the coasts of Europe, but comparison with Mediterranean specimens of that species shows the costal area of *setosa* to be larger, the spines smaller, and the zooecia somewhat larger.

Recorded by Waters from Madeira and Naples, and by Hincks from the British Islands and British Columbia.

Hancock Stations: 431-35, off Octavia Rocks, Colombia; 155-34, Albemarle Island, Galapagos; 873-38 and 1269-41, Anacapa Island, and 1050, San Miguel Island, southern California; and Albatross Sta. 2886, off the coast of Oregon, 20 to 60 fms. Also several colonies collected by Dr. John L. Mohr at Friday Harbor, San Juan Island, Puget Sound, Washington.

Genus **COLLETOSIA** Jullien, 1886

Costae separated by a row of small lacunae. Orifice semicircular with oral spines. Avicularia vicarious or absent. The ovicell is hyperstomial. Dietellae present. (After Harmer, 1926:474). Genotype, *Lepralia endlicheri* Reuss, 1874.

Jullien's genus *Colletosia* was submerged for many years under *Puellina* Jullien, 1886, but Harmer (1926:474) resurrected it. After studying the genotype of *Puellina,* (*Lepralia gattyae* Busk), I fully agree with Harmer that "this species does not seem to be congeneric with *C. radiata.*"

Jullien's original description of the genus does not conform in all respects to that of Harmer, given above, as he states that the furrows, or intercostal grooves, are entirely without pores and that there are no oral spines. These are characters that are readily obscured in fossilization, however, and as Harmer has made a careful study of the case the genus *Colletosia* may be considered acceptable for *radiata.*

Colletosia radiata (Moll), 1803

Plate 29, figs. 2 and 2a

Cribrilina radiata, Hincks, 1884:14.
Cribrilina radiata, O'Donoghue, 1923:30.
Puellina radiata, O'Donoghue, 1926:51.
Colletosia radiata, Harmer, 1926:475.
Colletosia radiata, Osburn, 1947:26.

Zoarium encrusting, small white colonies on shells, worm tubes, pebbles, etc. The zooecia are distinct, separated by deep grooves; costate area convex and covering nearly all of the frontal; costae usually 7 or 8 pairs and between them radiating rows of small lacunae which are often somewhat slit-like; one or more small lacunae in a median position near the aperture; an umbonate process sometimes present. Aperture semicircular, straight on the proximal border, with about 5 oral spines. Vicarious avicularia, with an elongate mandible, irregularly distributed and often wanting even on whole colonies.

Ovicell rounded, smooth or radiately roughened, usually with a small carina or umbo.

There is a great deal of variation in most of the characters; size, number of costae, amount of calcification, number and form of the preapertural pores, the size and form of the avicularium, the size and distribution of the setae, etc. and a number of nominal varieties have been described. The best known of these is the *Lepralia innominata* Couch, 1844, which has been accepted as a distinct species by most authors, on

the basis of a single lunate suboral pore. However, there is too much variation in the number, size and form of these pores to be of specific value; often there is a single larger pore, which may be lunate in form (*innominata*), but which is more often round and varies greatly in size; again instead of a single pore there may be 2 to 4 smaller ones, and the two near the middle may be partially united to form a dumb-bell shaped central pore.

The vicarious avicularia are variable in size and number, the mandible usually long triangular, but may be hastate in form (var. *flabellifera* Kirkpatrick). Several fossil varieties have also been given names, and Canu and Bassler (1923:98, 90) list var. *scripta* Reuss, and var. *rarecosta* Reuss from the Pleistocene of California.

It is a cosmopolitan species. Hincks and O'Donoghue listed it, in the typical form, from a number of British Columbia localities.

In the Hancock collections it appears abundantly, 59 stations, from the coast of Oregon south to the Galapagos Islands and the coast of Peru, shallow water down to 136 fms.

Colletosia bellula new species

Plate 29, fig. 1

Zoarium forming small white, glistening colonies on shells and pebbles. The largest colony observed was only two and one-half mm across and those less than two mm may be mature with ovicells.

Zooecia separated by broad, deep sulci; moderate in size, 0.35 to 0.50 mm long; the gymnocyst is scarcely visible, nearly the whole front being covered by the pericyst, which consists of 6 or 7 pairs of costulae which radiate toward the center. Between the costulae are rows of about 8 slit-like lacunae; the outer ends of the costules are only slightly elevated.

The aperture is decidedly lepralioid in form (0.12 mm long by 0.08 mm wide), rounded anteriorly, with a pair of large "cardelles," proximal to which is a broad transverse poster with a nearly straight border. The apertural bar is slightly raised to form a thin, smooth lip and distal to the cardelles a low thin peristome extends around the aperture; 2 to 4 small oral spines are present in young zooecia but these soon disappear.

Another striking character, in addition to the form of the aperture, is the pair of minute, pedunculate avicularia, one on either side opposite the distal end of the aperture; the mandible is triangular, pointing more or less inward and forward.

The primary ovicell is small (about 0.15 mm in either dimension), smooth, hemispherical and appears to be closed by the operculum; it soon

becomes covered by an ectooecium which is composed of 3 or 4 pairs of radiating costules similar to those of the front and with similar lacunae. The costules form strong buttresses around the outer border and meet at the top in a small umbonate process. The sides of the ectooecium extend backward to the avicularian processes.

The ancestrula is membraniporoid with 4 minute spines on either side; it measures 0.26 mm long by 0.18 mm wide.

In six colonies studied no vicarious avicularia were observed. The oral avicularia appear to arise from the zooecial border just outside of the peristome. Dietellae similar to those of *C. radiata* are present.

Notwithstanding the form of the aperture and the presence of frontal avicularia, this species appears to be congeneric with *C. radiata,* as the nature of the frontal, the dietellae and the closure of the ovicell are those of *Colletosia.*

Type, AHF no. 47.

Type locality, Hancock Station 270, east coast of Angel de la Guardia Island, Gulf of California, 29°29′00″N, 113°27′00″W, 14 fms, two colonies. Also at Station 155-34, off Tagus Cove, Albemarle Island, Galapagos Islands, 50 to 60 fms, 3 colonies; 275, Raza Island, Gulf of California, 40 fms, and off Magdalena Bay, Gulf of California, 18 fms. Also from the Pleistocene of Newport Harbor Mesa, southern California, 1 colony complete with ovicell, within the cup of *Discoporella umbellata,* G. P. Kanakoff, collector.

Genus **FIGULARIA** Jullien, 1886

Pericyst with well-defined costae, usually with numerous fusions giving rise to a row of lacunae, occasionally without lateral fusions, the costae then separated by undivided slits. Orifice closed by a completely chitinized operculum which articulates with lateral condyles. Oral spines usually wanting. Ovicells large, hyperstomial, the ectooecium generally with membranous fenestrae. Avicularia, when present vicarious. No dietellae. The gymnocyst usually covering a considerable portion of the frontal area. (After Levinsen, 1909). Genotype, *Lepralia figularis* Johnston, 1847:314.

Figularia hilli new species

Plate 28, fig. 8

Zoarium unilaminar, encrusting shells, pebbles and occasionally algae, yellowish in color. Zooecia moderately large and convex, separated by broad sulci. The gymnocyst is well developed, occasionally occupying half or even more of the frontal area, but usually not more than one-fourth, smooth and imperforate. The frontal shield is raised above the level of the gymnocyst and varies greatly in size, a character common to the species of this genus. At its fullest development it consists of 7 costulae (3 pairs and one median), but 5 or 6 is a common number and as few as 3 have been observed. The distal pair form the apertural bar, usually thicker than the others, but not elevated into a prominent lip. The remaining costules are usually completely fused for their entire length, but some small slit-like lacunae may be present and small pores occur at the center of the shield. The fused tips of the costules may be elevated into a low, irregular umbonate process at their point of fusion. Each costule bears a large membranous pelma (lumen pore), shaped like an elongated tear-drop, narrow and pointing toward the center, the ones on the apertural bar being similar in size and form. On the proximal, median costule the proximal border of the pelma is often elevated into a small umbonate process.

The aperture is nearly circular, slightly straighter on the proximal border, with distinct cardelles, distal to which there is a slightly raised, thin, smooth peristome. In the fertile zooecia the side walls of the aperture bear a pair of much abbreviated costules, each with a short, wide pelma. No spines nor avicularia have been observed.

The ovicell is only slightly elevated, transverse, very short, scarcely longer than the one pair of costules of which the ectooecium appears to consist. The characteristic "tear-drop" pelma of the costules form the fenestra on each side. The ovicells are so inconspicuous that they are most easily located by noting the larger aperture of the fertile zooecia.

Measurements. Zooecial length 0.65 (0.50 to 0.75) mm; width 0.40 (0.35 to 0.50) mm. Aperture length 0.15 to 0.18 mm; width 0.18 mm. Aperture of ovicelled zooecia, length 0.15 to 0.18 mm; width 0.20 to 0.22 mm. Ooecial length 0.10 to 0.15 mm; width 0.30 to 0.35 mm.

The species is dedicated to Dr. Howard R. Hill of the Los Angeles County Museum, who presented me with the first specimen, collected at Redondo Beach, southern California.

Type, AHF no. 48.

Type locality, Hancock Station 1130-40, off Laguna Beach, California, 33°32′40″N, 117°48′45″W, 29 fms. Other stations are 1139-40, off Redonda Beach, 20 fms; 1232-41, San Pedro Breakwater, 18 fms; 1271-41, Anacapa Island, 25 fms; 1295-41, Santa Cruz Island, 19 fms; 1303-41, Santa Cruz Island, 47 fms. Other records are: Monterey Bay, A. E. Blagg, collector, Newport Harbor, R. C. Osburn, collector, and Santa Catalina Island. All of the above localities are in California waters, and as far as our records go this species is limited to southern California shores and islands, from Monterey Bay to Santa Catalina Island, and from low tide to 47 fms.

REFERENCES

1. Papers dealing only with Pacific Coast Bryozoa

Busk, George

1856. Zoophytology. Quart. Jour. Micr. Sci. Vol. 4, pp. 176-80.

Canu, F. and R. S. Bassler

1930. The Bryozoan Fauna of the Galapagos Islands. Proc. U.S. Nat. Mus. Vol. 76, Art. 13, pp. 1-78, pls. 1-14.

Fewkes, J. Walter

1889. New Invertebrata from the Coast of California. Bull. Essex Institute, Vol. 21.

Hastings, Anna B.

1930. Cheilostomatous Polyzoa from the vicinty of the Panama Canal Collected by Dr. C. Crossland on the Cruise of the S.Y. "St. George." Proc. Zool. Soc. London for 1929, Pt. 4, pp. 697-740, pls. 1-17.

Hincks, Thos.

1882. Polyzoa of the Queen Charlotte Islands: Preliminary notice of New Species. Ann. Mag. Nat. Hist. ser. 5, 10; pp. 248-256.
Report on the Polyzoa of the Queen Charlotte Islands, *ibid.,* pp. 459-471.

1883. Report on the Polyzoa of the Queen Charlotte Islands, *ibid.,* 11, pp. 442-451.

1884. *Idem, ibid.,* 13, pp. 203-215.

O'Donoghue, Chas. H. and Elsie

1933. A Preliminary List of the Bryozoa from the Vancouver Island Region. Contr. Canadian Biol., n.s., 1, pp. 143-201, pls. 1-4.

1926. A Second List of Bryozoa from the Vancouver Island Region. *Ibid.,* 3, pp. 49-131, pls. 1-5.

1926a. Observations on the early Development of *Membranipora villosa* Hincks. *Ibid.,* 3, pp. 249-63.

1925. Notes on certain Bryozoa in the Collection of the University of Washington Pub. Puget Sd. Mar. Biol. Sta. 5, pp. 15-23.

1925a. List of Bryozoa from the Vicinity of Puget Sound, *Ibid.,* pp. 91-108.

Robertson, Alice

1900. Papers from the Harriman Alaska Expedition. vi, The Bryozoa. Proc. Washington Acad. Sci. 2, pp. 315-40, pls. 19-21.

1900a. Studies in Pacific Coast Entoprocta. Proc. Calif. Acad. Sci., Zool. 2, No. 4, pp. 323-348, pl. 16.

1902. Some observations on Ascorhiza occidentalis Fewkes. *Ibid.,* 3, No. 3, pp. 99-107, pl. 14.

1905. Non-incrusting Chilostomatous Bryozoa of the West Coast of North America. *Ibid.,* Zool. No. 5, pp. 235-320, pls. 4-16.

1908. The Incrusting Chilostomatous Bryozoa of the West Coast of North America. *Ibid.,* 4, No. 5, pp. 253-344, pls. 14-24.

1910. The Cyclostomatous Bryozoa of the West Coast of North America. *Ibid.,* 6, No. 12, pp. 225-284, pls. 18-25.

Trask, J. B.

1857. On some New Microscopic Organisms. Proc. Calif. Acad. Sci. 1-2, pp. 99-102, pls. 4-5.

2. General References

ALDER, J.

1857. Catalog of the zoophytes of Northumberland and Durham. Trans. Tyneside Field Club, pp. 93-162.

AUDOUIN, V.

1826. Explication sommaire des Planches de Polypes de l'Egypte et de la Syrie. In Description de l'Egypte, Hist. Nat., vol. 1, pt. 4, pp. 225-249. Paris.

BIDENKAP, OLAF

1897. Bryozoen von Ost-Spitzbergen. Zool. Jahresber. 10, pp. 609-39.

BORG, F.

1931. On some species of Membranipora. Ark. Zool. 22A (4), pp. 1-35.

BOSC, L. A. G.

1802. Histoire naturelle des Vers, Ed. 1, vol. 3, Paris.

BROWN, D. A.

1948. Six New Recent and Tertiary Genera of Cheilostomatous Polyzoa from New Zealand. Ann. Mag. Nat. Hist., Ser. 12, 1, pp. 108-22.

BUSK, GEORGE

1852. Catalog of the Marine Polyzoa in the collection of the British Museum, Cheilostomata, Part 1, pp. 1-54, pls. 1-68.

1854. *Idem,* Part 2, pp. 55-120, pls. 69-124.

1859. Zoophytology. Quart. Jour. Micro. Sci., 7, pp. 65-7.

1884. Report on the Polyzoa collected by H.M.S. Challenger, during the years 1873-1876. Part 1, Cheilostomata. Zool. 10, Part 30, pp. i-xxiv, 1-216, pls. 1-36.

CALVET, L.

1902. Bryozoaires marins des côtes de Corse. Trav. Inst. Zool. Univ. Montpellier (2), Mém. 12, pp. 1-52.

CANU, F. AND R. S. BASSLER

1917. Synopsis of American early Tertiary cheilostome Bryozoa. Bull. U. S. Nat. Mus. 96, pp. 1-87.

1920. North American early Tertiary Bryozoa, Bull. U. S. Nat. Mus. 106, pp. 1-879, pls. 1-162, text figs. 1-279.

1923. North American later Tertiary and Quaternary Bryozoa. Bull. U. S. Nat. Mus. 125, pp. 1-302, pls. 1-47.

1928. Fossil and Recent Bryozoa of the Gulf of Mexico Region. Proc. U. S. Nat. Mus., 72 (Art. 14), pp. 1-199, figs. 1-35.

1929. Bryozoa of the Philippine Region. Bull. U. S. Nat. Mus. 100, pp. 1-685. pls. 1-94.

1933. The Bryozoan fauna of the Vincentown Limesand. Bull. U. S. Nat. Mus. 165, pp. 1-108, pls. 1-21.

DEFRANCE, M.

1823. Dictionaire des Sciences Naturelles. "Zoophytes." Paris.

DESOR, E.

1848. Ascidioidian polyps or Bryozoa (from Nantucket). Proc. Boston Soc. Nat. Hist. 3, pp. 66-7.

ESPER, E. J. C.

1791. Die Pflantzenthiere . . ., ou Histoire Naturelle des Zoophytes (1791-7).

FABRICIUS, O.
1770. Fauna grönlandica (Bryozoa confused with other groups on pp. 428-48).

FLEMING, J.
1828. A History of British Animals, pp. xxiii, and 1-565. Edinburgh.

GRAY, J. E.
1848. List of the specimens of British Animals in the collection of the British Museum. Part 1, Centroniae or Radiated Animals, pp. 1-173 (Bryozoa, pp. 91-151).

HARMER, S. F.
1900. A revision of the genus *Steganoporella.* Quart. Jour. Micro. Sci., n.s. 43, pp. 225-97.
1923. On Cellularine and other Polyzoa. Jour. Linnaean Soc., Zoology 25, pp. 295-361.
1926. The Polyzoa of the Siboga Expedition. Part 2, Cheilostomata, Anasca. Res. Siboga Exped. 75, monograph 28b, pp. 181-501, pls. 13-34.

HASTINGS, ANNA B.
1941. The British Species of *Scruparia.* Ann. Mag. Nat. Hist. Ser. 11, vol. 7, pp. 465-72.
1945. Notes on Polyzoa (Bryozoa). 2. *Membranipora crassimarginata,* auctt., with Remarks on some Genera. Ann. Mag. Nat. Hist. Ser. 11, vol. 12, pp. 70-013.
1947. Notes on Polyzoa (Bryozoa). 3. On some Species of *Cellaria,* with Remarks on G. Busk's Grouping of the species of this Genus. Ann. Mag. Nat. Hist. Ser. 11, vol. 13, pp. 217-41.

HASWELL, W. A.
1880. On some Polyzoa from the Queensland Coast. Proc. Linn. Soc. New S. Wales, 5, p. 33.

HELLER, C.
1867. Die Bryozoen des Adriatischen Meeres. Verh. k. k. zool.-bot. Ges. Wien, 17, pp. 77-136.

HINCKS, T.
1862. A Catalog of Zoophytes of South Devon and South Cornwall. Ann. Mag. Nat. Hist., Ser. 3, vol. 9, pp. 22-30.
1862. *Idem, Ibid.,* pp. 200-7.
1862. *Idem, Ibid.,* pp. 303-10.
1862. *Idem, Ibid.,* pp. 467-75.
1862. *Idem, Ibid.,* Ser. 3, vol. 10, pp. 360-3.
1877. On British Polyzoa. Part 1. Ann. Mag. Nat. Hist., Ser. 4, vol. 20, pp. 212-18.
1877. *Idem,* Part 2, *Ibid.,* pp. 520-32.
1880. A History of the British Marine Polyzoa. Vol. 1, text, pp. i-cxli and 1-601. Vol. 2, plates 1-83. London.
1880a. Contributions toward a General History of the Marine Polyzoa. Ann. Mag. Nat. Hist., Ser. 5, vol. 6, pp. 69-92.
1880a. *Idem, Ibid.,* pp. 376-84.
1881. *Idem, Ibid.,* Ser. 5, vol. 7, pp. 147-61.
1881. *Idem, Ibid.,* Ser. 5, vol. 8, pp. 1-14.
1881. *Idem, Ibid.,* pp. 122-136.
1882. *Idem, Ibid.,* Ser. 5, vol. 10, pp. 160-70.

1882. Polyzoa of the Queen Charlotte Islands: Preliminary Notice of Some New Species. Ann. Mag. Not. Hist., Ser. 5, vol. 10, pp. 248-56.

1882. Report on the Polyzoa of the Queen Charlotte Islands. Ann. Mag. Nat. Hist., Ser. 5, vol. 10, pp. 459-71.

1883. *Idem, Ibid.,* Ser. 5, vol. 11, pp. 442-51.

1884. *Idem, Ibid.,* Ser. 5, vol. 13, pp. 49-58.

1884. Report on the Polyzoa of the Queen Charlotte Islands. The above papers bearing this title and issued by the Geol. and Nat. Hist. Surv. of Canada, pp. 1-44.

1888. The Polyzoa of the St. Lawrence, a study of Arctic forms. Ann. Mag. Nat. Hist., Ser. 6, vol. 1, pp. 214-27.

1889. *Idem, Ibid.,* Ser. 6, vol. 3, pp. 424-35.

1892. *Idem, Ibid.,* Ser. 6, vol. 9, pp. 149-57.

JOHNSTON, G.

1832. A descriptive catalog of the recent Zoophytes found on the coast of North Durham. Trans. Nat. Soc. Northumberland, Durham and Newcastle-upon-Tyne, 2, pp. 239-72.

1838. A History of British Zoophytes. (Ed. 1). pp. 1-333, pls. 1-44. London, Edinburgh.

1847. *Idem* (Ed. 2), vol. 1, text, pp. 1-488; vol. 2, pls. 1-74. London.

JULLIEN, J.

1882. Dragages du Travailleur. Bryozoaires; espèces dragués dans l'océan Atlantique en 1881. Bull. Soc. Zool. France, 7, pp. 497-529.

1886. Les Costulidés, nouvelle famille de Bryozoaires. Bull. Soc. Zool. France, 11, pp. 601-20.

1888. Mission scientifique du Cap Horn, 1882-3. 6, Zool Bryozoaires, pp. 1-92.

JULLIEN, J. AND L. CALVET

1903. Bryozoaires provenant des campagnes de l'Hirondelle (1886-8). Rec. Sci. Camp. Sci. Prince de Monaco, fasc. 23, pp. 1-120 by Jullien, 120-88 by Calvet.

KIRKPATRICK, R. AND J. METZELAAR

1922. On an Instance of Commensalism between a Hermit Crab and a Polyzoon. Proc. Zool. Soc. London 1922, pp. 983-90.

KLUGE, H.

1906. Zoologische Ergebnisse einer Untersuchungsfahrt des deutschen Seefischerei-Vereins nach der Bäreninsel und Westspitzbergen. . . .auf S.M.S. Olga. Wiss. Meeresuntersuch. (n.s.) 8, pp. 31-55.

LEVINSEN, G. M. R.

1909. Morphological and systematic studies on the Cheilostomatous Bryozoa, pp. 1-431, pls. 1-27. Copenhagen.

1916. Bryozoa. Danmark-ekspeditionen til Grönlands Nordöstkyst 1906-8 Medd. Grönland 43 (16), pp. 432-72. (Posthumous, edited by A. S. Jensen).

LINNAEUS, C.

1758. Systema naturae, Ed. 10, vol. 1. Zoophyta, pp. 799-821.

MACGILLIVRAY, P. H.

1868. Descriptions of some new genera and species of Australian Polyzoa; to which is added a list of species found in Victoria. Trans. Proc. Roy. Soc. Victoria, 9, pp. 126-48.

MARCUS, ERNST

1937. Bryozoarios Marinhos Brasileiros, 1. Bol. Fac. Phil., Sci., Letr., Univ. Sao Paulo, Zool. 1, pp. 1-224, pls. 1-29.

1938. Bryozoarios Marinhos Brasileiros, 2. *Ibid.,* Zool. 2, pp. 1-196, pls. 1-29.

1939. Bryozoarios Marinhos Brasileiros, 3. *Ibid.,* Zool. 3, pp. 111-353, pls. 5-31.

MOLL, J. P. C.

1803. Eschara zoophytozoorum seu phytozoorum. . . .etc., pp. 1-70.

NORDGAARD, O.

1918. Bryozoa from the Arctic regions. Tromsö Mus. Aarshefter 40 (1), pp. 1-99.

NORMAN, A. M.

1903. Notes on the natural history of East Finmark. Ann. Mag. Nat. Hist., Ser. 7, vol. 11, pp. 567-98.

1903. *Idem, Ibid.,* Ser. 7, vol. 12, pp. 87-128.

1905. *Idem, Ibid.,* Ser. 7, vol. 15, pp. 341-60.

OKADA, Y.

1929. Report of the Biological Survey of Mutsu Bay, 12. Cheilostomatous Bryozoa of Mutsu Bay. Sci. Rep. Tôhoku Imp. Univ. (4), 4, pp. 11-35.

1934. Bryozoan fauna in the vicinity of the Shimoda Marine Biological Station. Sci. Rep. Tokyo Bunrika Daigaku, Sect. B, 2 (26), pp. 1-20.

ORBIGNY, A.d'

1841. Voyage dans l'Amérique-Méridionale. Zoophytes, vol. 5, part 4, pp. 1-28. Paris.

ORTMANN, A. E.

1890. Die Japanische Bryozoen-Fauna. Arch. Naturgesch., 1 Band, 1 Heft, pp. 1-74.

OSBURN, R. C.

1912. Bryozoa from Labrador, Newfoundland and Nova Scotia collected by Dr. Owen Bryant. Proc. U. S. Nat. Mus., 43, pp. 275-89.

1914. The Bryozoa of the Tortugas Islands, Florida. Papers, Tortugas Lab., Carnegie Inst. 5, pp. 181-222.

1919. Bryozoa of the Crocker Land Expedition. Bull. Am. Mus. Nat. Hist. 41, pp. 603-624.

1924. Bryozoa. Rep. Canadian Arctic Expedition 1913-8, southern party, vol. 8 (D), pp. 1-13. Ottawa.

1932. Bryozoa from Hudson Bay and Strait. Biological and oceanographic conditions in Hudson Bay 6. Contr. Canadian Biol. Fish. 7 (29), pp. 363-76.

1940. Bryozoa of Porto Rico with a résumé of the West Indian Bryozoan Fauna. New York Acad. Sci., Sci. Surv. Porto Rico and Virgin Is., 16 (3), pp. 321-486, pls. 1-9.

1947. Bryozoa of the Allan Hancock Atlantic Expedition, 1939. Report No. 5, pp. 1-66, pls. 1-6. Univ. S. Calif., Los Angeles.

PALLAS, P. S.

1766. Elenchus Zoophytorum. La Haye. (German translation, Wilckens, 1787, Nuremburg).

SILEN, L.

1941. Cheilostomata Anasca collected by Prof. Dr. Sixten Bock's Expedition to Japan and the Bonin Islands, 1914. Ark. Zool. 33A (12), pp. 1-130, pls. 1-9, text figs. 1-183. Stockholm.

SMITT, F. A.

1867. Kritisk förteckning öfver Skandinaviens Hafs-Bryozoer. 3. Öfvers K. Vetensk.-Akad. Forh. 24 (5), pp. 279-429, pls. 16-20.

1872. Floridan Bryozoa, collected by Count L. F. de Pourtales. Part 1. K. Vetensk.-Akad. Handl. 10 (11), pp. 1-20, pls. 1-5. Stockholm.

1873. *Idem,* Part 2. *Ibid.,* Handl. 11 (4), pp. 1-84, pls. 1-13.

SOLANDER, D.

1786. The Natural History of many curious and uncommon Zoophytes, collected. . . ., by the late John Ellis, systematically arranged and described by Daniel Solander, pp. 1-206, pls. 1-63.

THOMPSON, J. V.

1847. In: Gray, British Museum, MSS description of *Avicularia (Bugula) flabellata.*

TRASK, J. B.

1857. On some new Microscopic Organisms. Proc. Calif. Acad. Sci. 1-3, pp. 99-102. (Reprinted in 1873, Proc. Calif. Acad. Sci. pp. 110-5.)

VAN BENEDEN, P. J.

1848. Bull. Acad. Roy. de Belgique, 15 (2), p. 73.

VERRILL, A. E.

1879. Notice of recent additions to the marine invertebrata of the northeastern coast of America, etc. Proc. U. S. Nat. Mus. 2 (Bryozoa on pp. 188-96).

1900. Additions to the Tunicata and Molluscoidea of the Bermudas. Trans. Connecticut Acad. Arts, Sci. 10, Part 2, pp. 588-94.

WATERS, A. W.

1889. Supplementary report on the Polyzoa collected by H.M.S. Challenger during the years 1873-6. Rep. Sci. Res. Voyage H.M.S. Challenger, Zoology 31 (part 79), pp. 1-41.

1898. Observations on Membraniporidae. Jour. Linn. Soc. London, Zool. 26, pp. 654-93.

1900. Bryozoa from Franz-Josef Land, collected by the Jackson-Harmsworth Expedition in 1896-99. Part 1. Jour. Linn. Soc. London, Zool. 28, p. 43-106.

1909. Reports on the Marine Biology of the Sudanese Red Sea 12. The Bryozoa, part 1, Cheilostomata. Jour. Linn. Soc. London, Zool. 31, pp. 123-81.

ILLUSTRATIONS

The figures have all been drawn, under the author's direction, by the following artists on the Hancock Foundation staff: Mr. Anker Peterson, Miss Mary Taylor, Mr. Mitchell Crawley and Mr. Russell D. Cangialosi. Their careful work is here recognized with sincere thanks.

In order to facilitate size comparison, all of the figures were outlined under the camera lucida at the same enlargement, with the exception of a few which are specially indicated in the descriptions of the plates. All of the figures are from Pacific coast specimens.

TYPES

Type specimens are all deposited in the Allan Hancock Foundation, unless otherwise indicated in the text.

PLATE 1

Fig. 1. *Aetea truncata* (Landsborough).

Fig. 2. *Aetea recta* Hincks.

Fig. 3. *Aetea anguina* (Linnaeus).

Fig. 4. *Aetea ligulata* Busk.

Fig. 5. *Scruparia ambigua* (d'Orbigny).

Fig. 6. *Eucratea loricata* (Linnaeus), frontal view and branching.

Fig. 7. The same, side view.

Fig. 8. *Membranipora mebranacea* (Linnaeus).

Fig. 9. The same, showing a "tower cell."

Fig. 10. *Membranipora villosa* (Hincks), normal zooecium above with chitinous frontal spinules, below the twinned ancestrula with bases of five buds.

Fig. 11. The same, showing chitinous corner spines and a larger one at the division of a series of zooecia.

Fig. 12. *Membranipora serrilamella,* new name, average development of the cryptocyst.

Fig. 13. The same, showing development of the tubercles by folding of the distal wall.

Fig. 14. *Membranipora fusca,* new species.

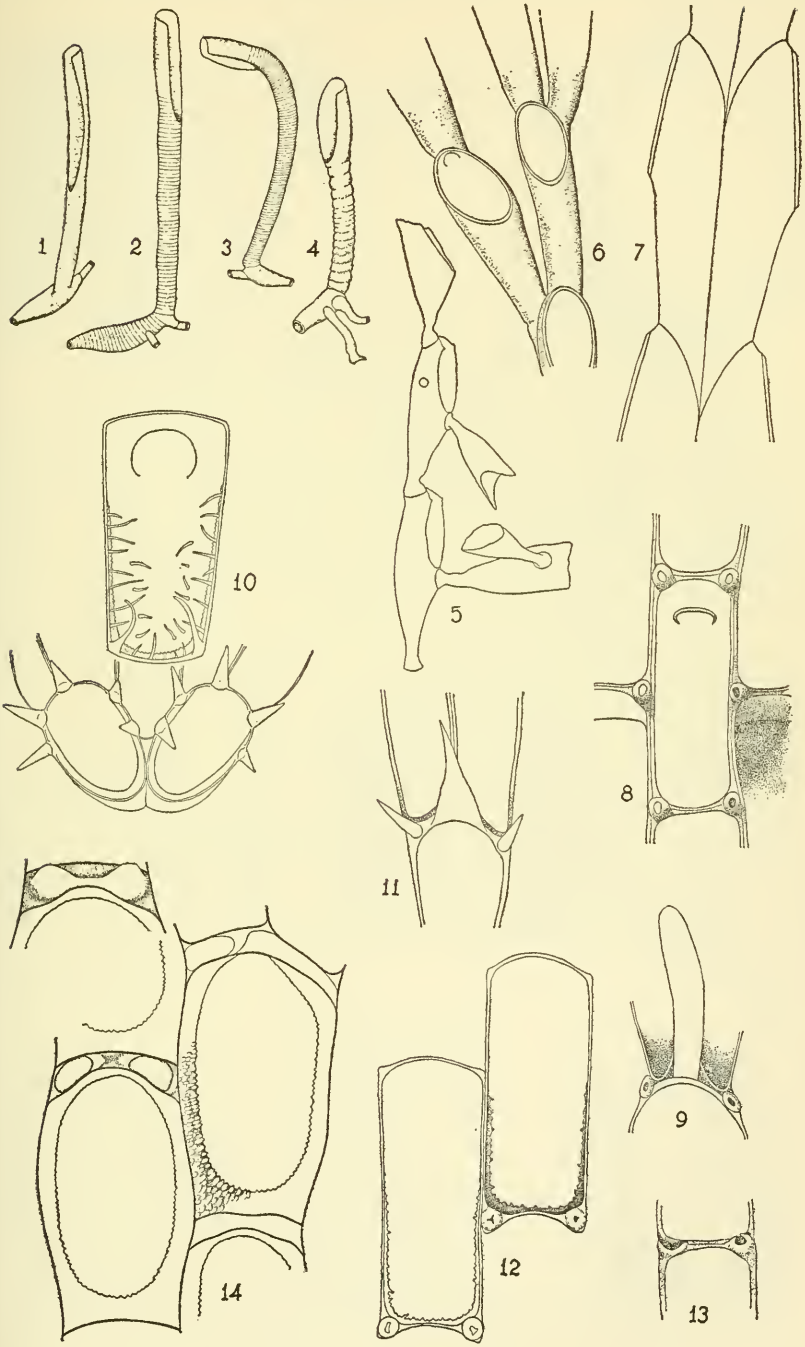
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PLATE 2

Fig. 1. *Membranipora hastingsae,* new species.

Fig. 2. *Membranipora pachytheca,* new species, with frontal ectocyst.

Fig. 3. The same, ectocyst removed.

Fig. 4. *Membranipora tuberculata* (Bosc), with tubercles, cryptocyst and internal spinules.

Fig. 5. The same, young with partially developed tubercles.

Fig. 6. The same, with three elongate tubercles.

Fig. 7. *Membranipora savarti* (Audouin).

Fig. 8. *Membranipora perfragilis* (MacGillivray).

Fig. 9. *Membranipora tenuis* Desor.

Fig. 10. The same, older stage of calcification.

Fig. 11. *Conopeum reticulum* (Linnaeus), showing development of tubercles on the basal gymnocyst.

Fig. 12. *Conopeum commensale* Kirkpatrick and Metzelaar, with ectocyst decorated with chitinous spinules.

Fig. 13. The same, ectocyst removed.

Figs. 14 and 15. The same, showing basal tubercles.

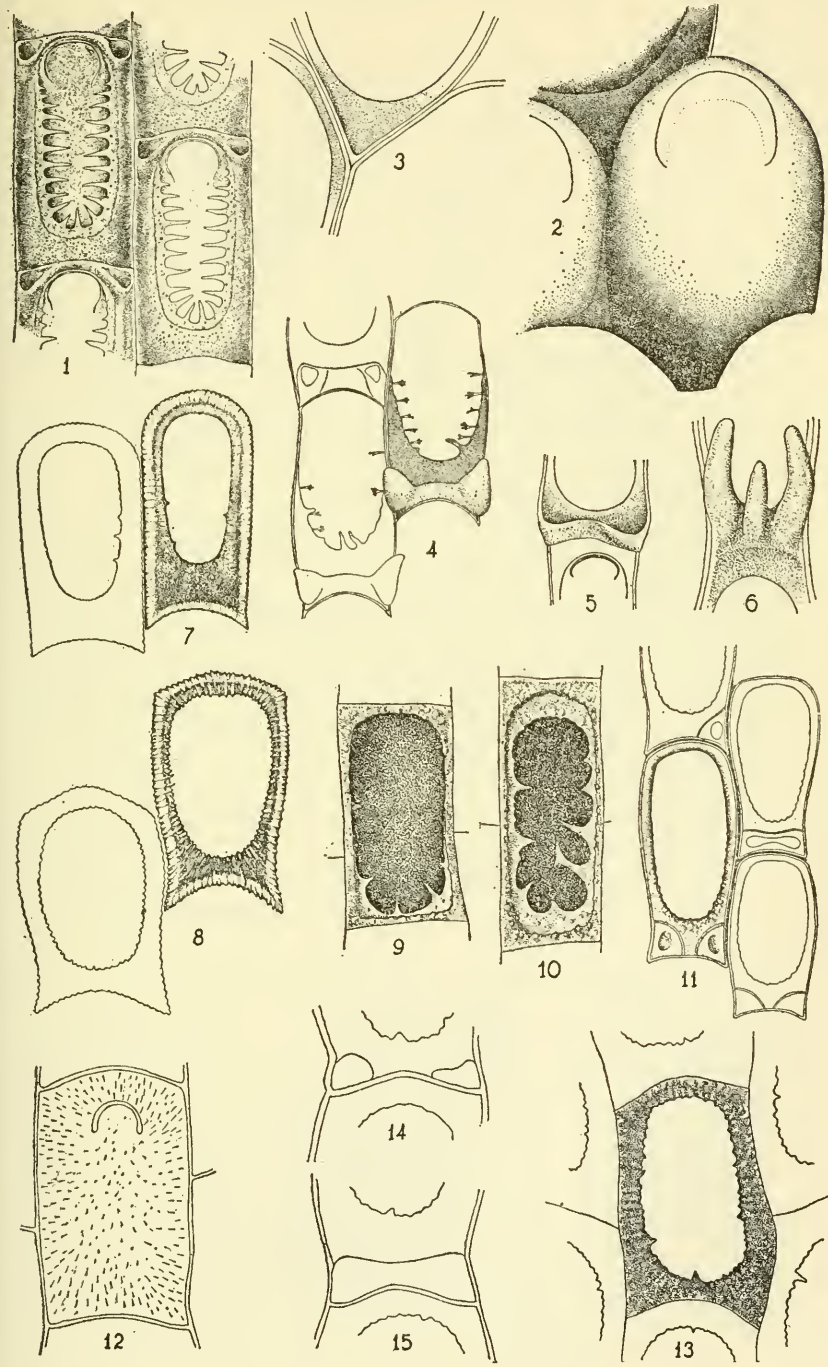
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PLATE 3

Fig. 1. *Desmacystis sandalia* (Robertson), with ribbed gymnocyst and median avicularium.

Fig. 2. *Cupuladria canariensis* (Busk), zooecia and distal vibracular chambers.

Fig. 3. The same, dorsal side showing pores.

Fig. 4. *Electra crustulenta* (Pallas), var. *arctica* Borg.

Fig. 5. The same, another variety.

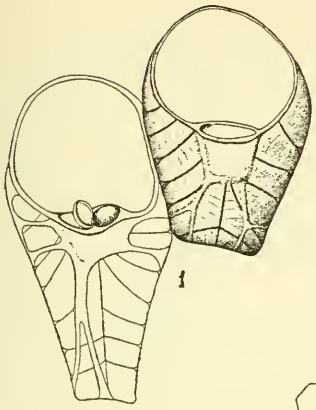
Fig. 6. *Electra anomala* new species, with remarkable decoration of branched chitinous spines on the operculum.

Fig. 7. *Electra biscuta* new species, complete development with branched spines.

Fig. 8. The same, young stage.

Fig. 9. *Carbasea carbasea* (Solander).

Fig. 10. *Terminoflustra membranaceo-truncata* (Smitt), showing the vicarious avicularium.
(Figs. 9 and 10 reduced ½ in comparison with other figures.)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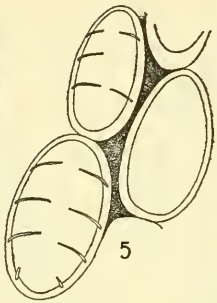
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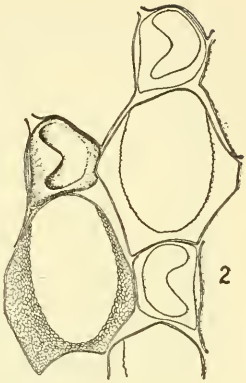
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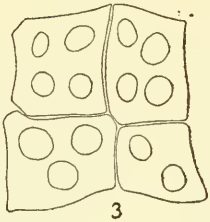
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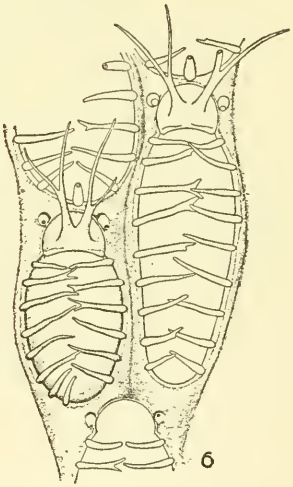
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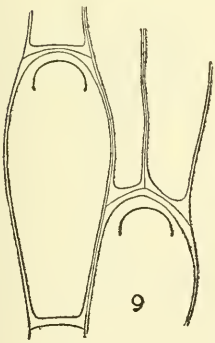
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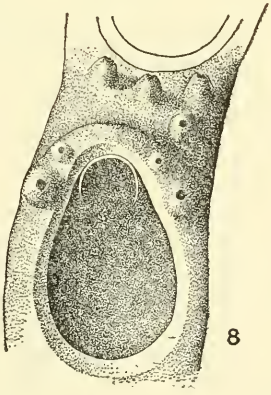
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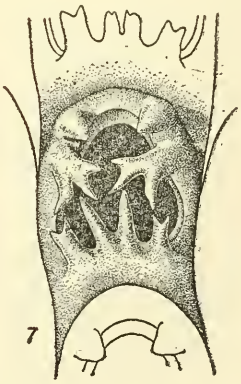
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PLATE 4

Fig. 1. *Aplousina filum* (Jullien) with minute endozooecial ovicell.

Fig. 2. *Alplousina major,* new species.

Fig. 3. *Cranosina colombiana,* new species, showing spines, dietellae and vicarious avicularia.

Fig. 4. *Ellisina levata* (Hincks), showing the vicarious avicularia,

Fig. 5. *Antropora granulifera* (Hincks). The avicularia appear to be frontal, but dissection shows them to be vicarious in origin.

Fig. 6. *Antropora claustracrassa* (Canu and Bassler). The interzooecial position of the avicularia is apparent.

Fig. 7. *Antropora tincta* (Hastings).

Fig. 8. *Mollia patellaria* (Moll), outer portion of zoarium without connecting tubules.

Fig. 9. The same, near center of zoarium, showing connecting tubules and dorsal attachment processes.

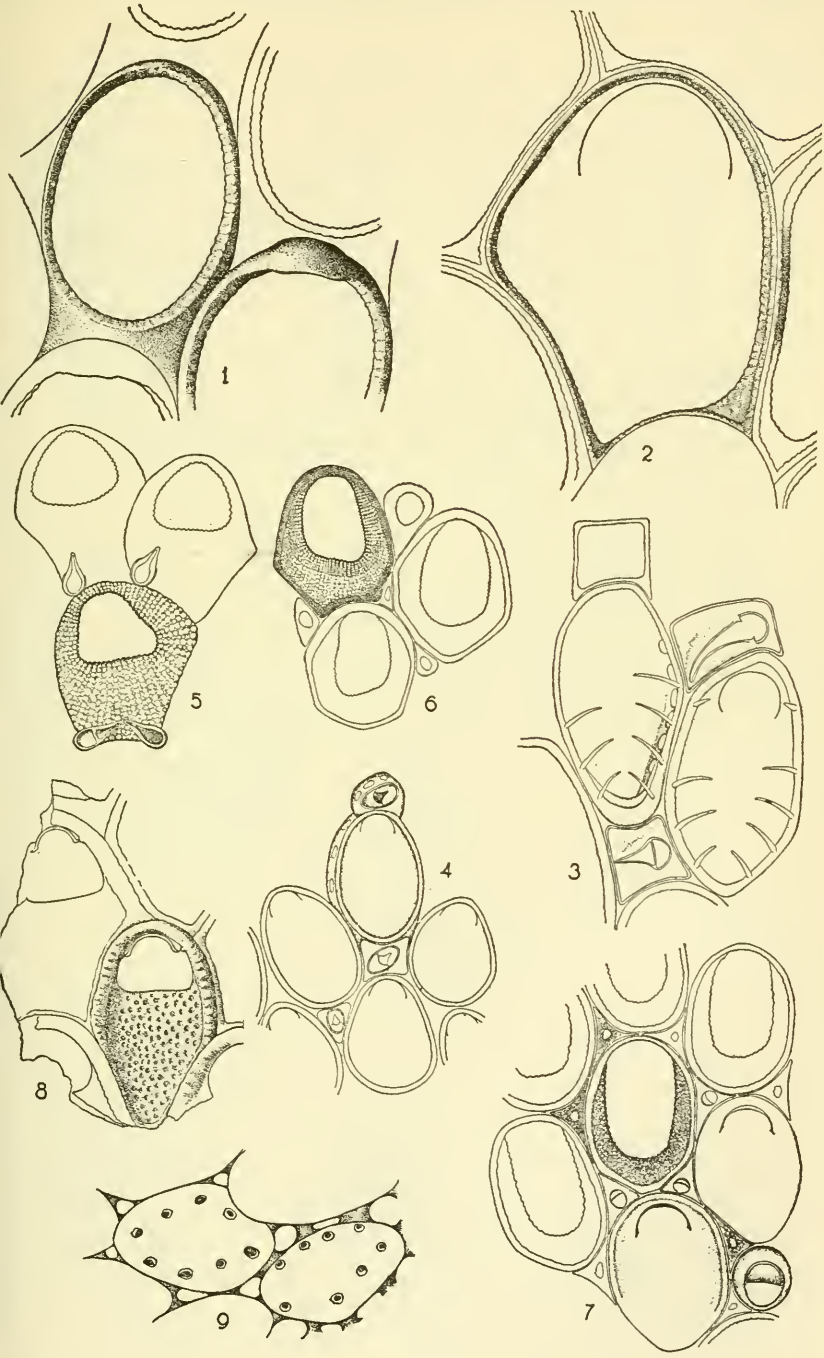
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PLATE 5

Fig. 1. *Hincksina pacifica* new species. Endozooecial ovicell.

Fig. 2. *Hincksina alba* (O'Donoghue). Endozooecial ovicell.

Fig. 3. *Hincksina velata* (Hincks), showing distorted mandible.

Fig. 4. The same, endozooecial ovicell.

Fig. 5. *Hincksina nigrans* (Hincks), lateral avicularia and endozooecial ovicell.

Fig. 6. *Cauloramphus brunea* Canu and Bassler.

Fig. 7. *Cauloramphus cymbaeformis* (Hincks).

Fig. 8. *Cauloramphus echinus* (Hincks).

Fig. 9. *Cauloramphus spiniferum* (Johnston).

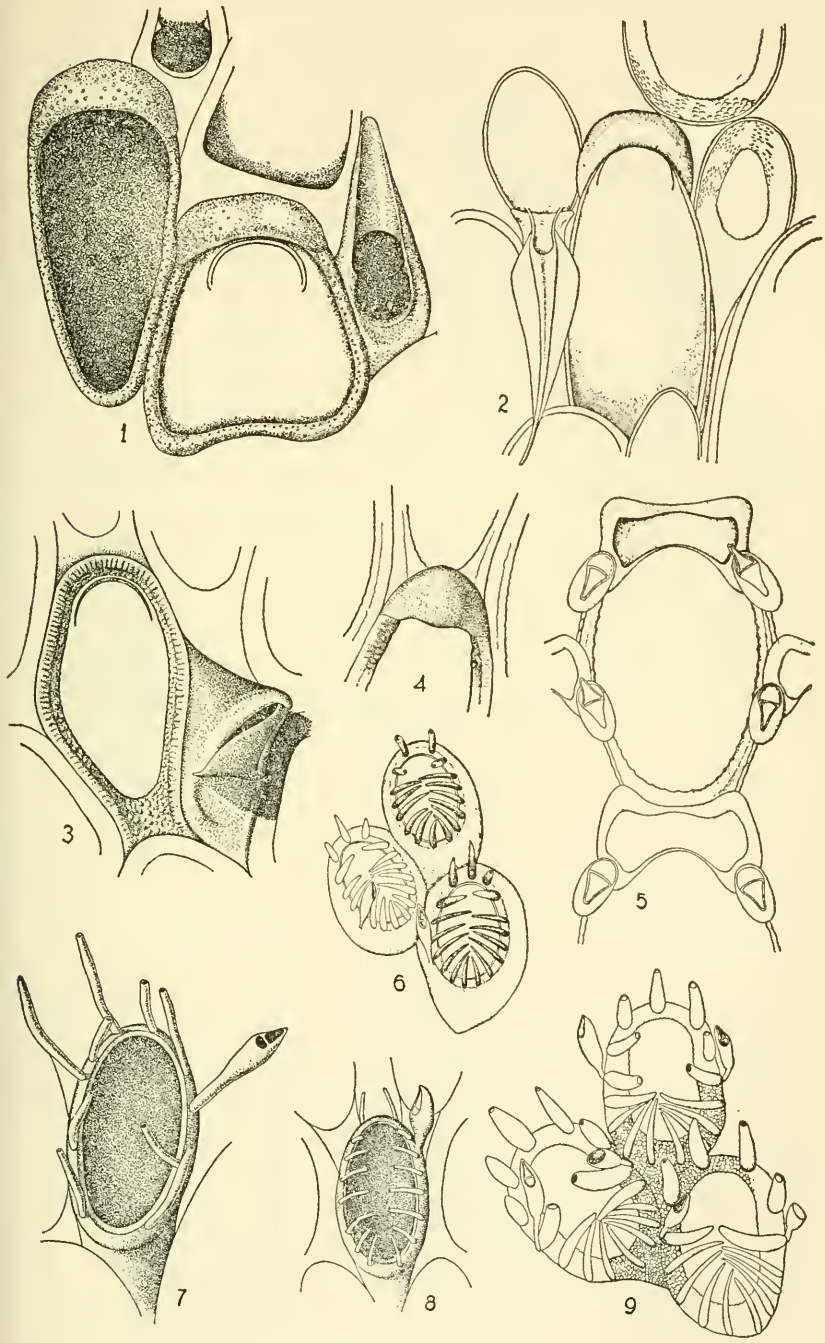
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PLATE 6

Fig. 1. *Membraniporidra porosa* new species.

Fig. 2. *Alderina smitti* new name.

Fig. 3. *Alderina brevispina* (O'Donoghue).

Fig. 4. *Callopora lineata* (Linnaeus).

Fig. 5. The same, showing ovicell and avicularium.

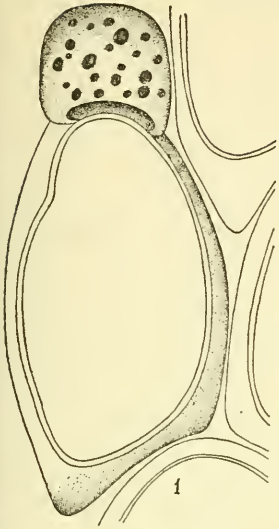
Fig. 6. *Callopora whiteavesi* Norman.

Fig. 7. *Callopora craticula* (Alder).

Fig. 8. *Callopora exilis* (Hincks).

Fig. 9. *Callopora horrida* (Hincks).

Fig. 10. *Callopora armata* O'Donoghue.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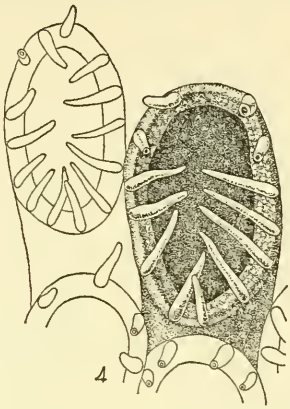
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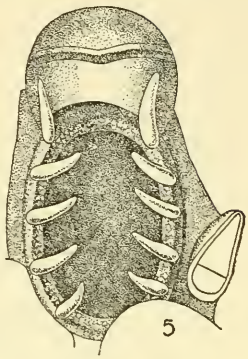
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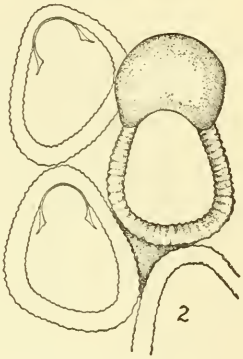
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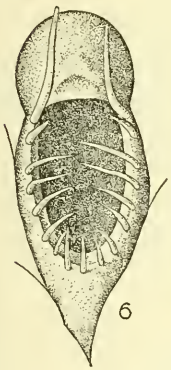
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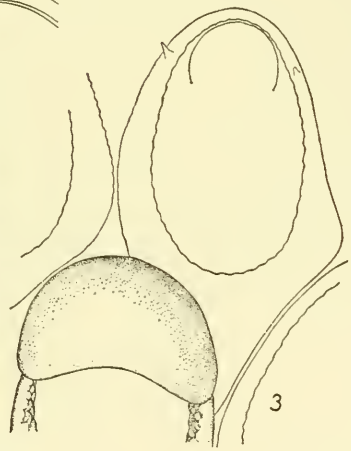
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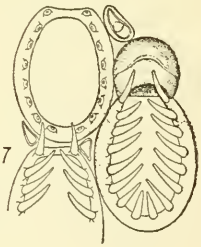
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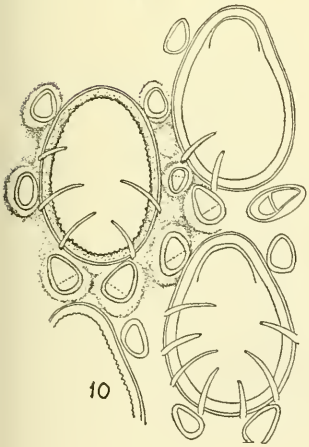
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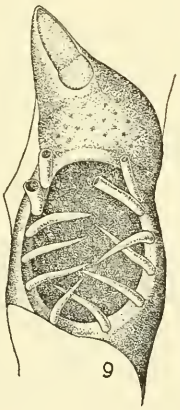
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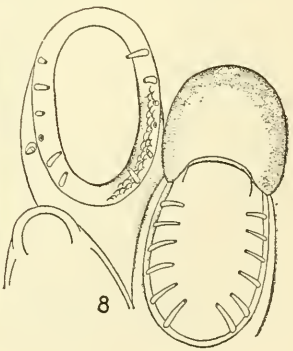
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PLATE 7

Fig. 1. *Callopora corniculifera* (Hincks), ovicell and two sizes of lateral avicularia.

Fig. 2. *Callopora aurita* (Hincks). Note difference in orientation of avicularia in presence or absence of ovicell.

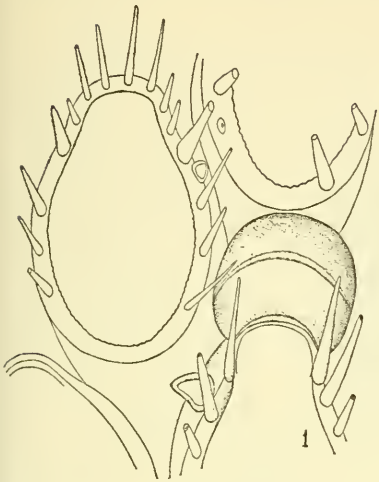
Fig. 3. *Copidozoum spinatum* new species. Note vicarious avicularium and array of spines.

Fig. 4. *Copidozoum tenuirostre* (Hincks).

Fig. 5. *Copidozoum protectum* (Hincks).

Fig. 6. *Retevirgula areolata* (Canu and Bassler), showing vicarious avicularia, connecting tubules and fenestrated ovicell.

Fig. 7. *Retevirgula lata* new species. Zooecium and ovicell and two kenozooecia, one with an avicularium.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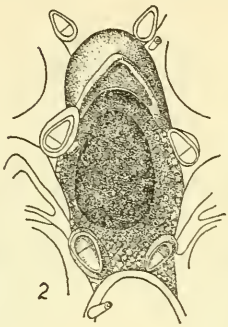
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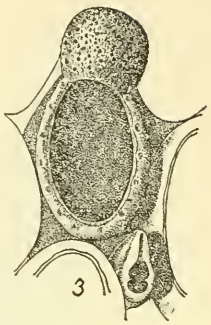
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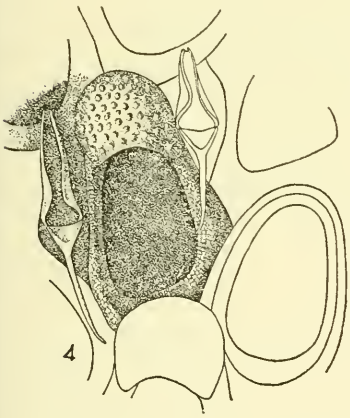
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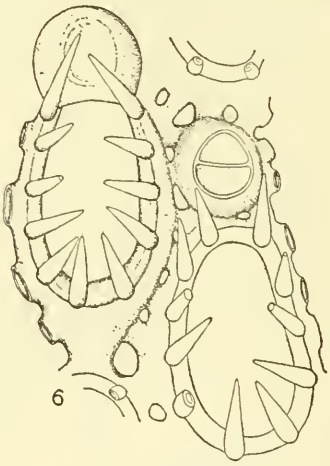
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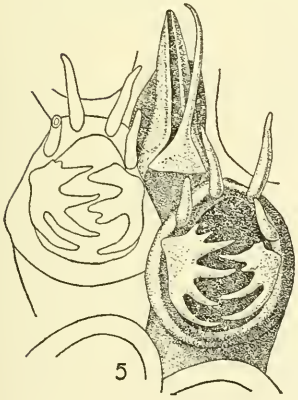
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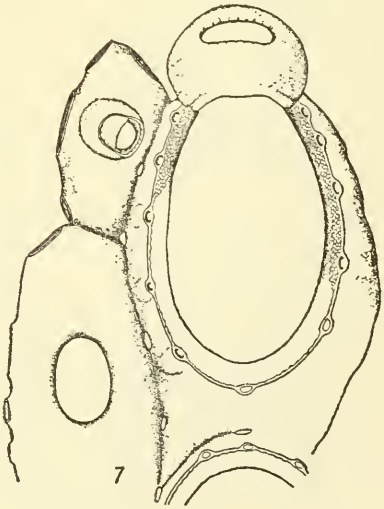
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PLATE 8

Fig. 1. *Retevirgula tubulata* (Hastings).

Fig. 2. *Callopora circumclathrata* (Hincks).

Fig. 3. *Doryporella alcicornis* (O'Donoghue), with branched spines and lateral avicularia.

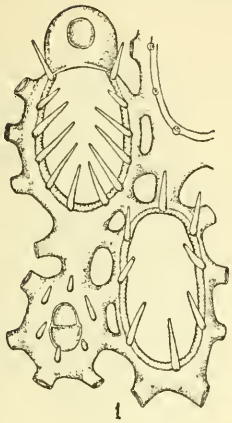
Fig. 4. *Doryporella spathulifera* (Smitt), with paired lateral avicularia and the bases of median avicularium and spine.

Fig. 5. The same, median avicularium and hastate spine, jointed at the base.

Fig. 6. *Bidenkapia spitsbergensis* (Bidenkap).

Fig. 7. *Bidenkapia spitsbergensis* var. *alaskensis* new var. Note small avicularia, even in the presence of an ovicell.

Fig. 8. *Parellisina curvirostris* (Hincks).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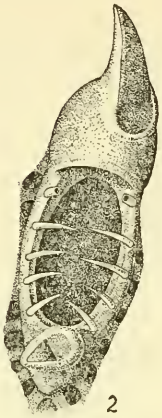
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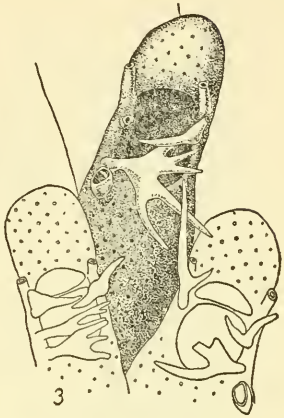
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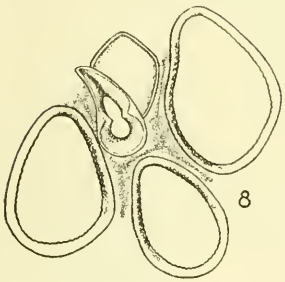
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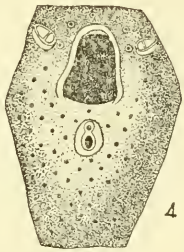
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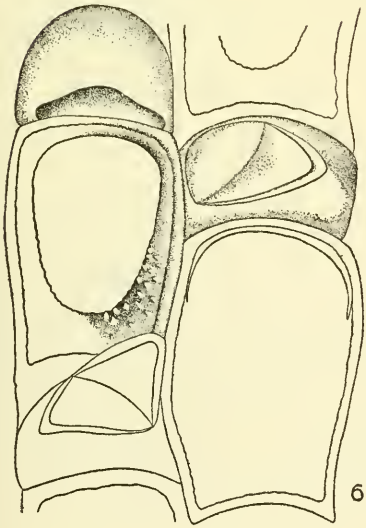
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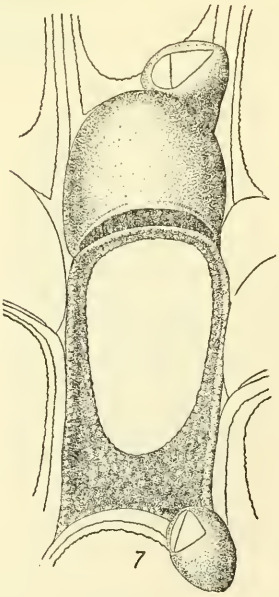
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PLATE 9

Fig. 1. *Tegella armifera* (Hincks), lateral avicularia directed backward.

Fig. 2. *Tegella unicornis* (Fleming).

Fig. 3. *Tegella magnipora* new species. Note absence of avicularia and the presence of a large fenestra or pore at distal end of ovicell.

Fig. 4. The same, showing secondary calcification of ovicell.

Fig. 5. *Tegella robertsonae* O'Donoghue.

Fig. 6. *Tegella arctica* (d'Orbigny), with lateral avicularia directed forward and smaller ovicell.

Fig. 7. *Tegella armifera* var. *cassidata* (O'Donoghue), with more elevated avicularia.

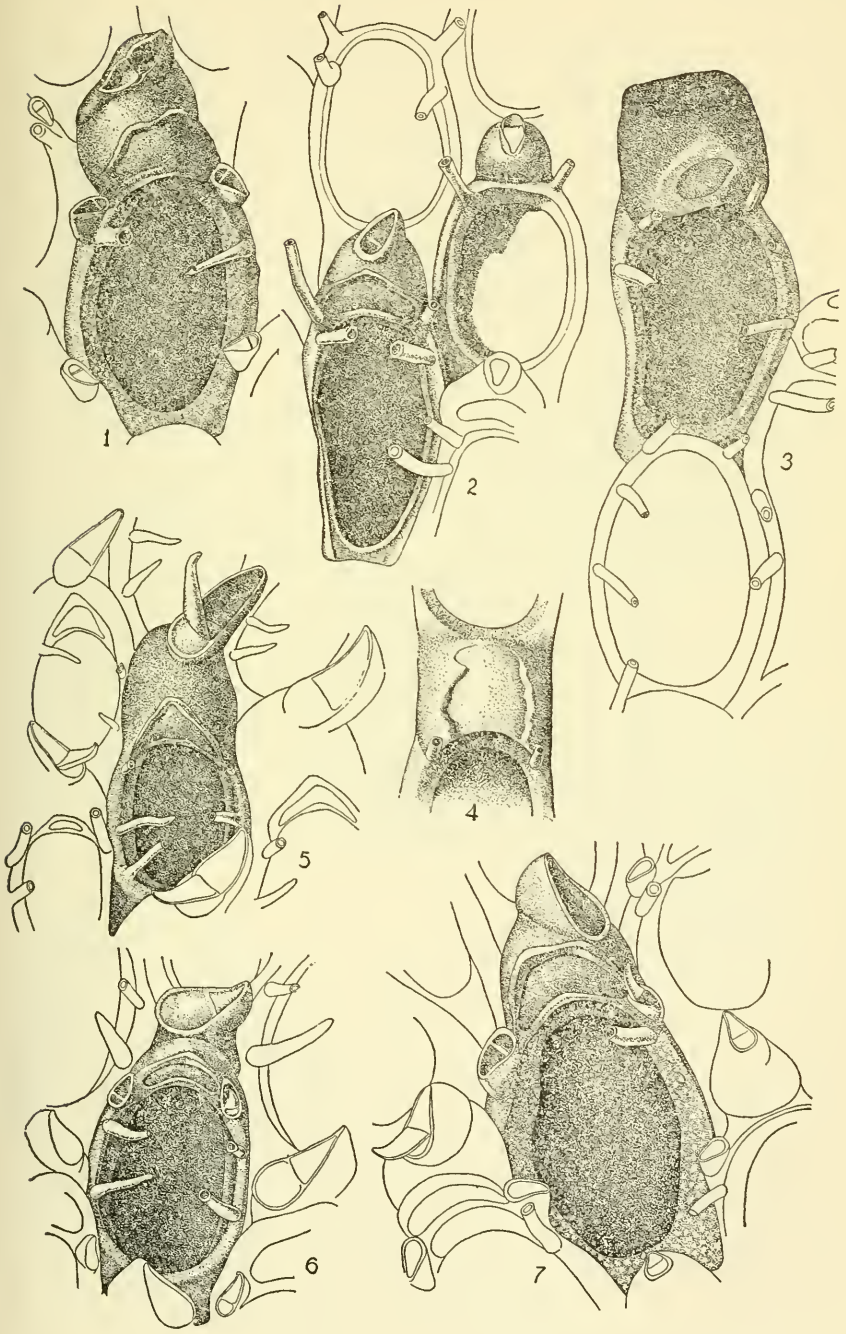
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PLATE 10

Fig. 1. *Chapperia patula* (Hincks).

Fig. 2. The same, showing details of the skeleton.

Fig. 3. *Chapperia condylata* Canu and Bassler, showing avicularia in the presence and absence of ovicell.

Fig. 4. *Chapperia frontalis* new species. Branching spines fuse to form a shield above the opesia.

Fig. 5. *Chapperia californica* new species. Note elongated opesia and form and decoration of ovicell.

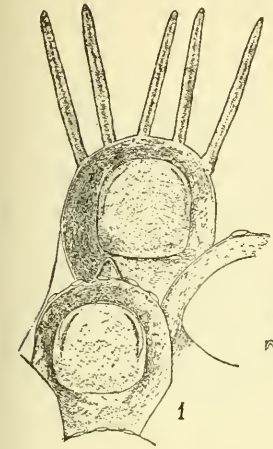
Fig. 6. *Chapperia longispina* new species. Two forms of avicularia in presence or absence of ovicell.

Fig. 7. The same, showing the distal side of the ovicell with its peculiar avicularium.

Fig. 8. *Tremogasterina granulata* var. *subspatulata* new var.

Fig. 9. *Exechonella antillea* (Osburn).

Fig. 10. The same, dorsal side showing the attachment processes.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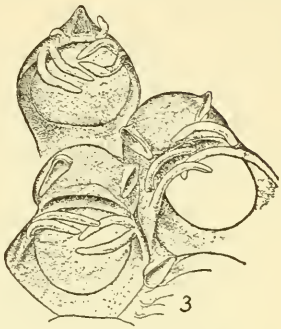
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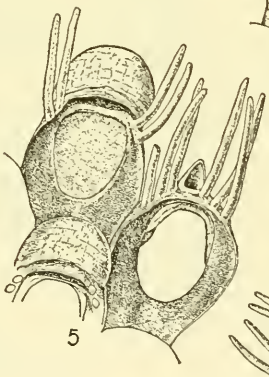
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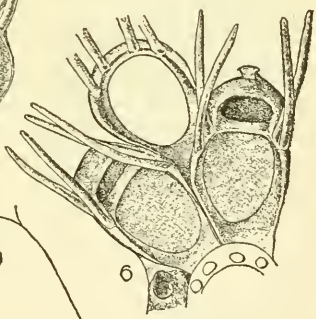
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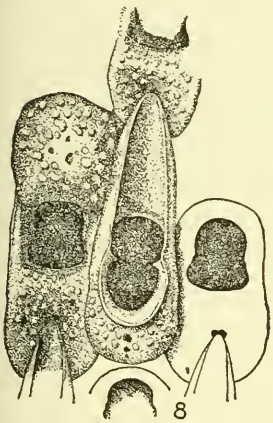
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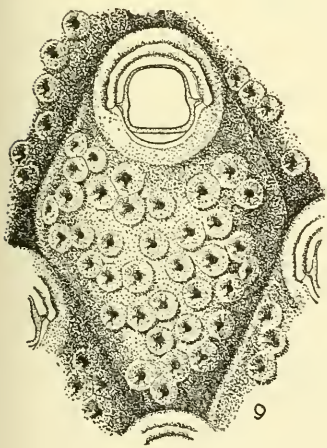
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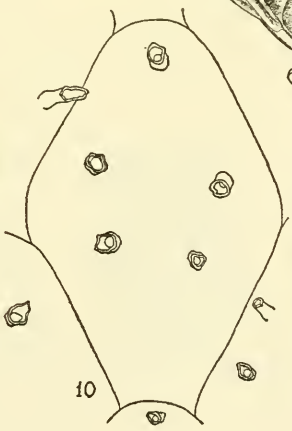
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PLATE 11

Fig. 1. *Anexechona ancorata* new species. Note especially the large vicarious avicularia with "grappling-hook" mandibles.

Fig. 2. *Microporina borealis* (Busk), zooecium and avicularium.

Fig. 3. *Micropora coriacea* (Esper), zooecium, avicularium and ovicell.

Fig. 4. *Floridina antiqua* (Smitt), zooecium and avicularium.

Fig. 5. *Onychocella alula* Hastings, zooecium and avicularium.

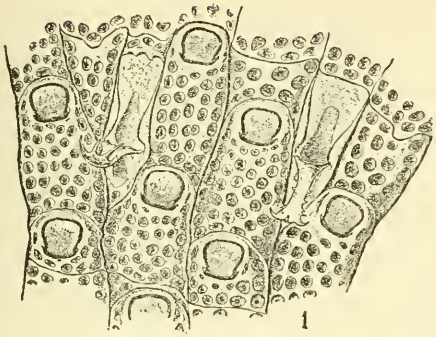
Fig. 6. The same, details of mandible.

Fig. 7. *Discoporella umbellata* (Defrance), zooecium and vibracular chambers.

Figs. 8, 9, 10. The same, variations in zoarial form.

Fig. 11. *Caleschara mexicana* new species, details of zooecium.

Fig. 12. *Labioporella sinuosa* Osburn.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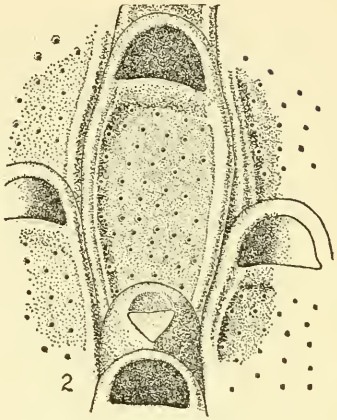
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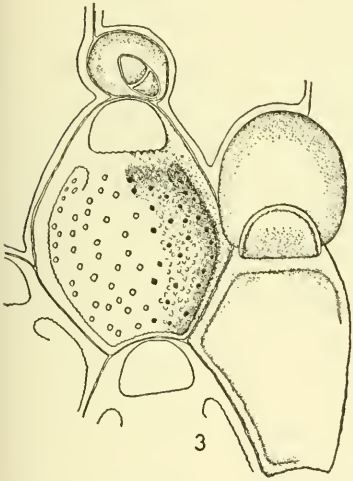
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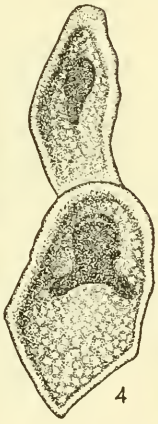
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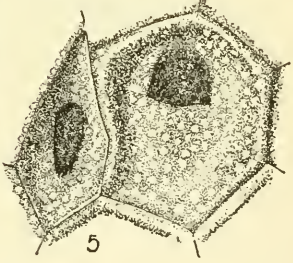
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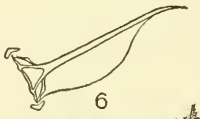
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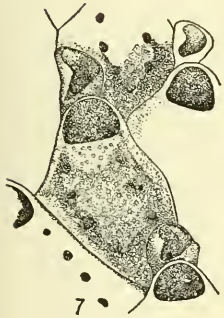
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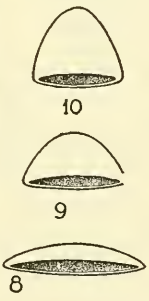
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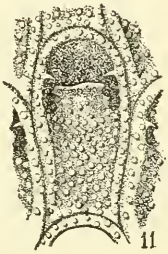
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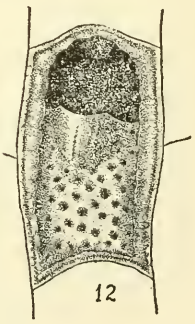
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PLATE 12

Fig. 1. *Thalamoporella gothica* (Busk), zooecium, avicularium, caliper and compass.

Fig. 2. *Thalamoporella californica* (Levinsen), zooecium, avicularium and caliper.

Fig. 3. *Steganoporella cornuta* new species. Details of ordinary zooecium.

Fig. 4. The same, "B zooecium," showing much larger aperture and absence of spines.

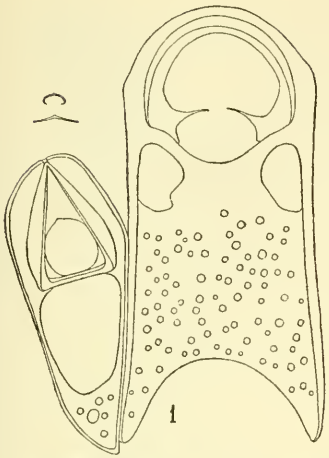
Fig. 5. The same, balsam mount of operculum with portion of attached frontal membrane.

Fig. 6. The same, operculum of "B zooecium" showing the heavy supporting sclerites and toothed border.

Fig. 7. *Velumella americana* Canu and Bassler, zooecium and avicularian chamber.

Fig. 8. The same, winged mandible of avicularium.

Fig. 9. *Cellaria diffusa* Robertson.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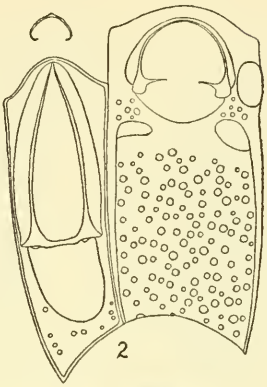
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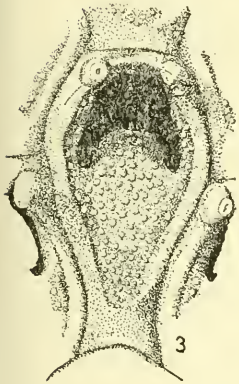
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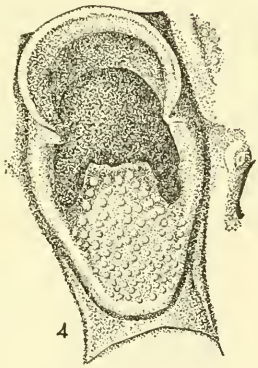
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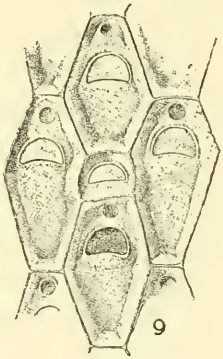
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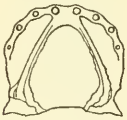
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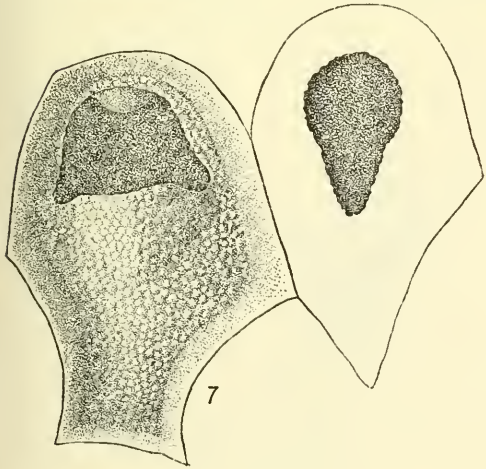
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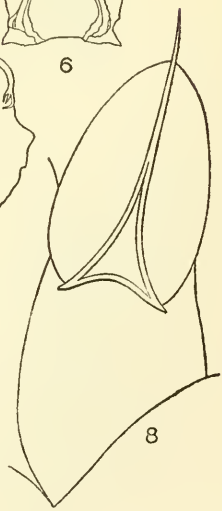
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PLATE 13

Fig. 1. *Cellaria mandibulata* Hincks.

Fig. 2. *Cellaria veleronis* new species.

Fig. 3. *Nellia tenuis* Harmer.

Fig. 4. *Nellia oculata* Busk.

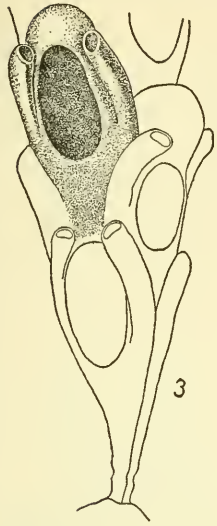
Fig. 5. *Synnotum aegyptiacum* (Audouin), with sessile and pedunculate avicularia.

Fig. 6. *Tricellaria occidentalis* (Trask).

Fig. 7. The same, with ovicell.

Fig. 8. *Tricellaria occidentalis* var. *catalinensis* (Robertson), showing much branched scutum.

Fig. 9. The same, with ovicell.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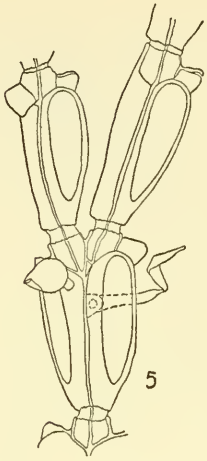
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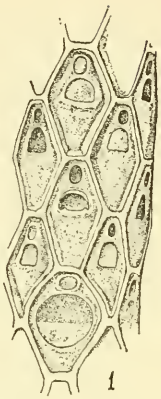
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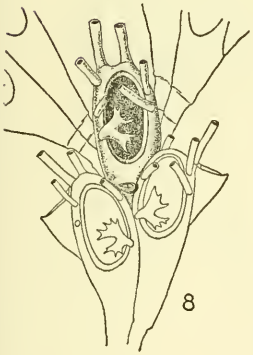
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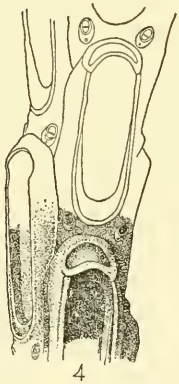
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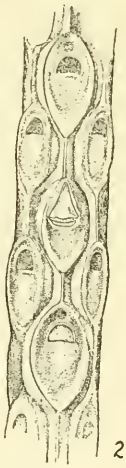
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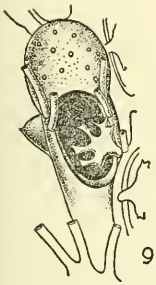
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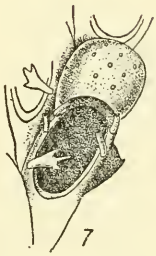
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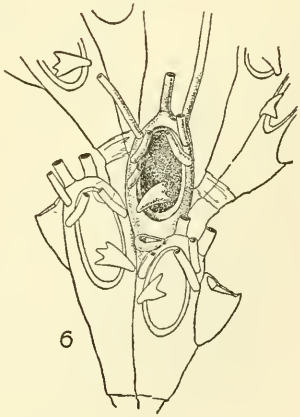
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PLATE 14

Fig. 1. *Tricellaria ternata* (Solander).

Fig. 2. The same, dorsal view.

Fig. 3. *Tricellaria gracilis* (Smitt).

Fig. 4. The same, dorsal view.

Fig. 5. *Tricellaria praescuta* new species. Note broad proximal scutes and absence of frontal avicularia.

Fig. 6. The same, dorsal view.

Fig. 7. *Tricellaria erecta* (Robertson), showing large size, scarcity of spines and smooth ovicell.

Fig. 8. The same, dorsal side, reduced.

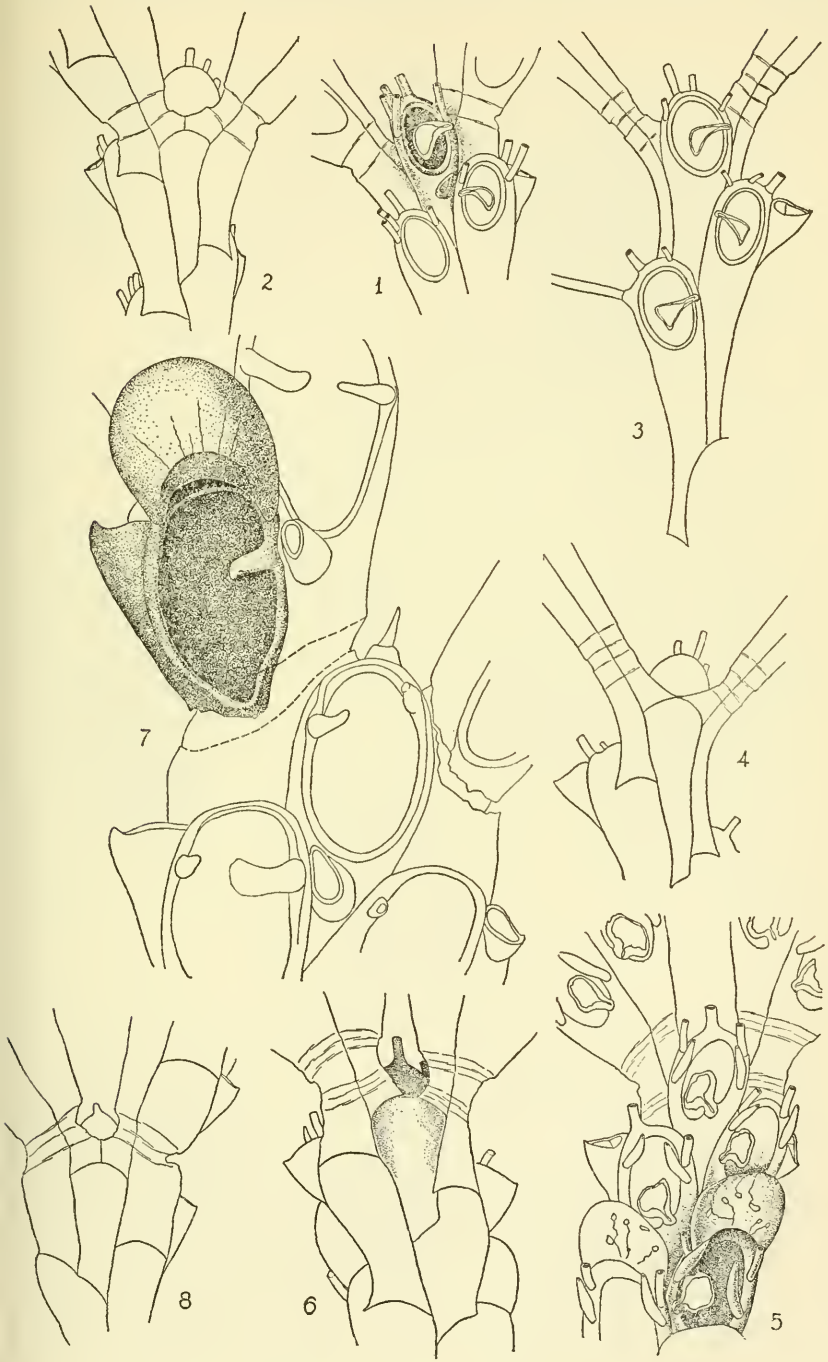
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PLATE 15

Fig. 1. *Amastigia biseriata* new species.

Fig. 2. The same, dorsal view, showing the peculiar median avicularium and short dorsal ones.

Fig. 3. The same, ovicell.

Fig. 4. *Caberea boryi* (Audouin), showing scutum, normal frontal avicularia and ovicell.

Fig. 5. The same, dorsal view of the vibracular chambers.

Fig. 6. The same, giant avicularium.

Fig. 7. *Scrupocellaria bertholetti* (Audouin).

Fig. 8. The same, showing giant avicularium.

Fig. 9. *Scrupocellaria diegensis* Robertson, ovicell, scutum and avicularium.

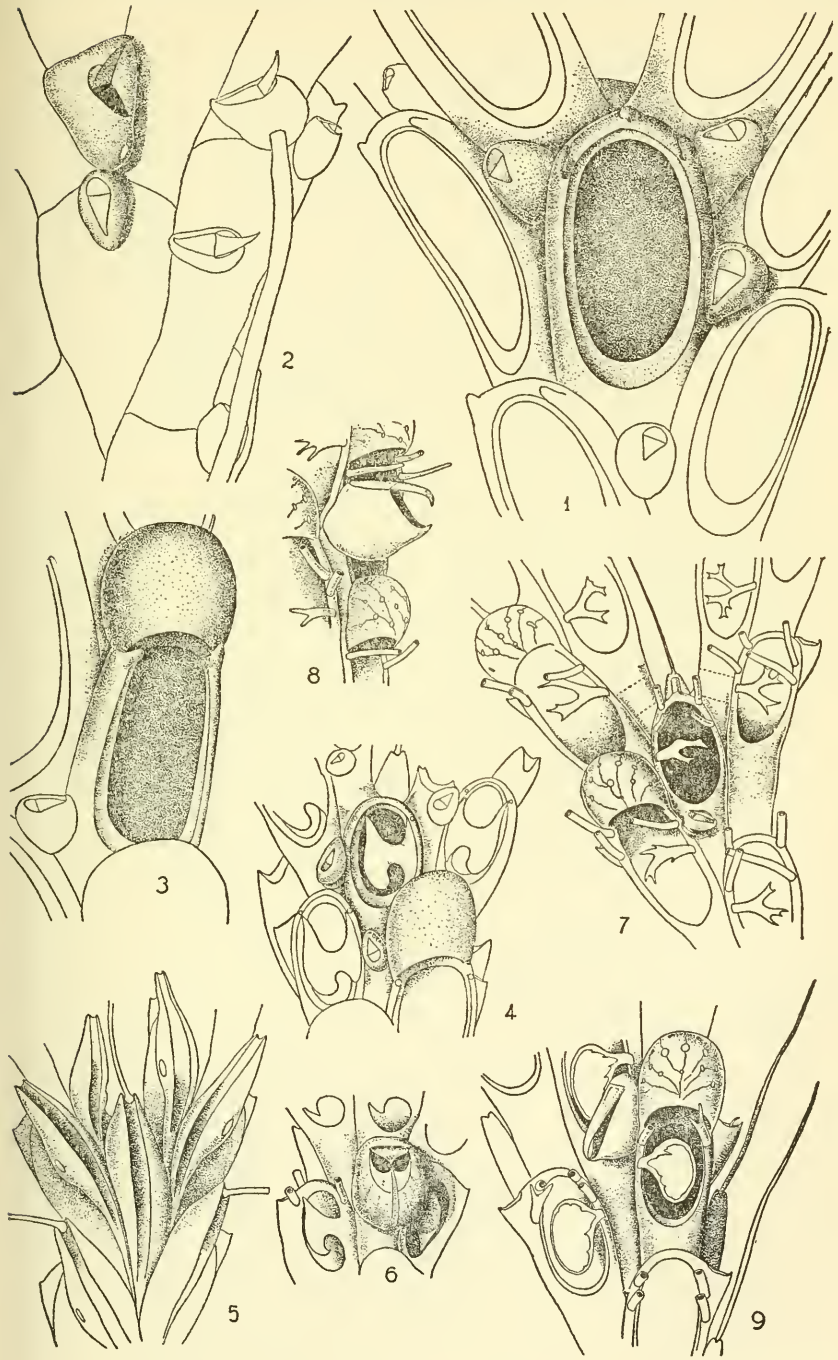
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PLATE 16

Fig. 1. *Caberea ellisi* (Fleming), note the absence of a scutum.

Fig. 2. The same, dorsal view showing the vibracular chambers.

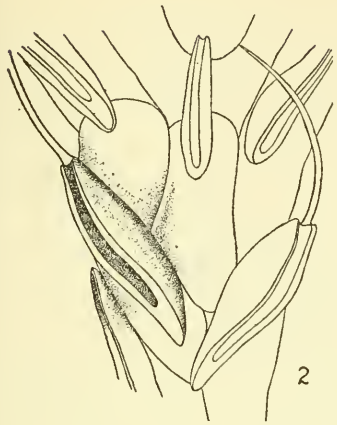
Fig. 3. *Amastigia rudis* (Busk).

Fig. 4. The same, dorsal view, vibraculiform avicularia.

Fig. 5. The same, ovicell and different sizes of avicularia.

Fig. 6. *Scrupocellaria californica* Trask, dotted lines show position of joint.

Fig. 7. The same, giant lateral avicularium.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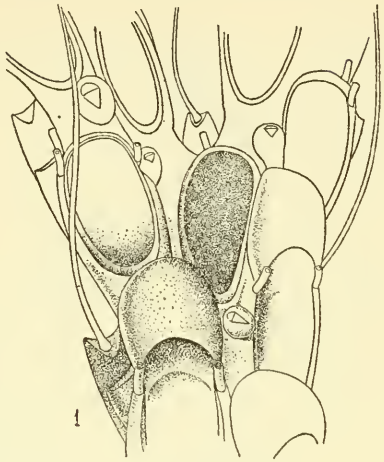
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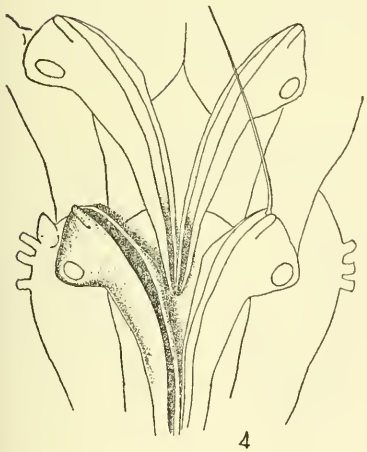
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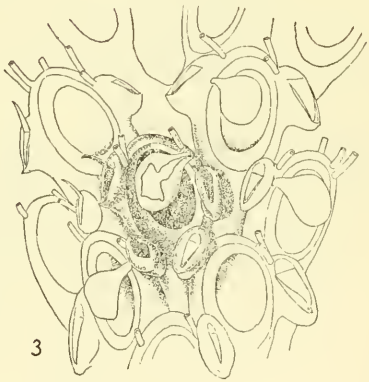
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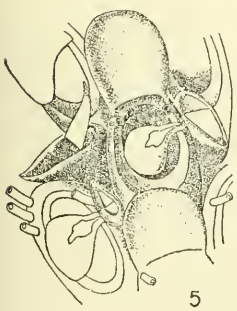
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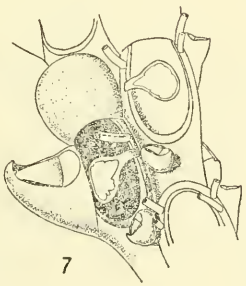
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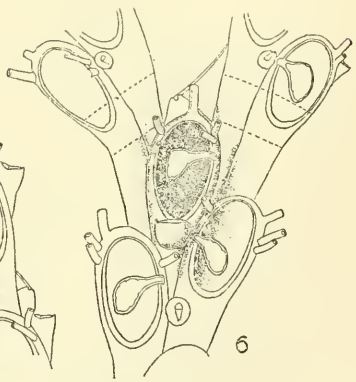
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PLATE 17

Fig. 1. *Scrupocellaria unguiculata* new species.

Fig. 2. The same, ovicell, scutum and giant lateral avicularia.

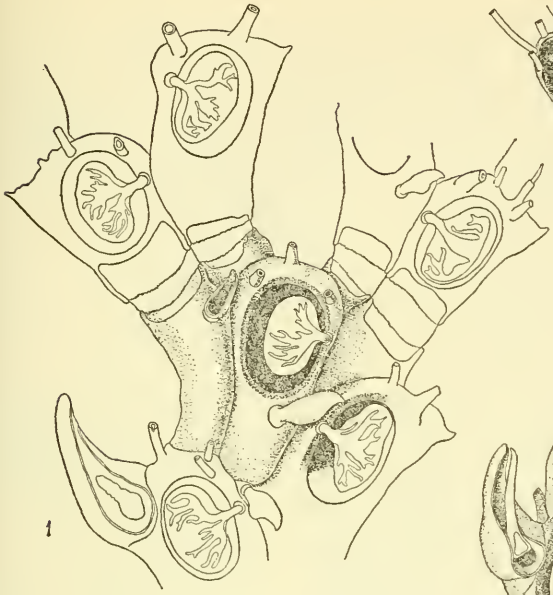
Fig. 3. *Scrupocellaria talonis* new species, small frontal and giant lateral avicularia and absence of scutum.

Fig. 4. *Scrupocellaria pugnax* new species, salient giant frontal avicularia, strong spines and absence of scutum.

Fig. 5. *Scrupocellaria panamensis* new species.

Fig. 6. The same, ovicell.

Fig. 7. *Scrupocellaria profundis* new species, twin median vibracula, small frontal avicularium, elongate opesia and absence of scutum.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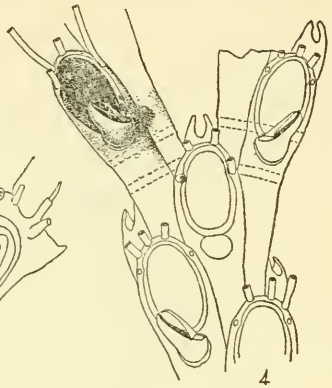
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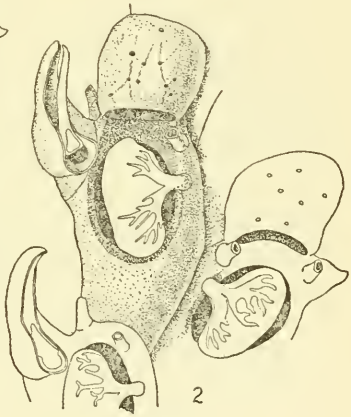
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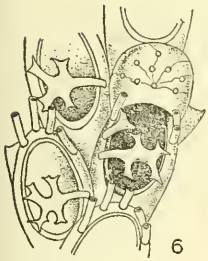
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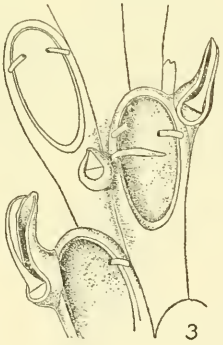
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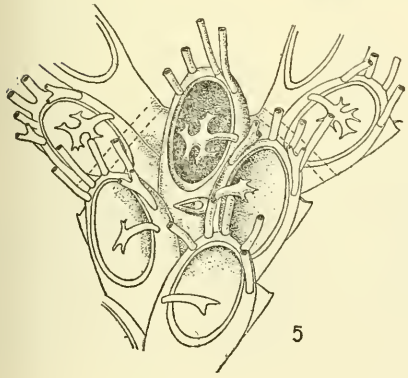
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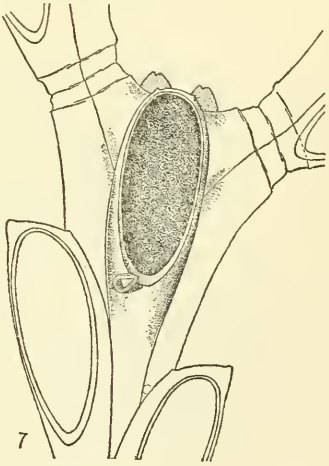
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PLATE 18

Fig. 1. *Scrupocellaria mexicana* new species.

Fig. 2. The same, ovicells.

Fig. 3. *Scrupocellaria regularis* Osburn.

Fig. 4. The same, ovicells.

Fig. 5. *Scrupocellaria scabra* (van Beneden).

Fig. 6. *Scrupocellaria scabra* var. *paenulata* Norman, greatly expanded scutum.

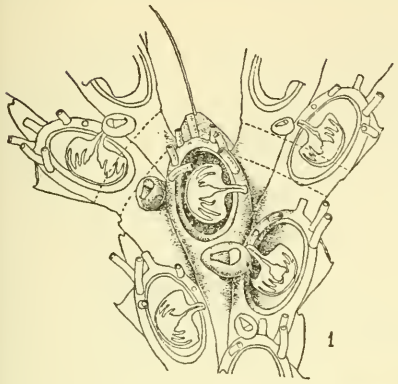
Fig. 7. *Scrupocellaria obtecta* Haswell.

Fig. 8. *Scrupocellaria bertholetti* var. *tenuirostris* new var., showing more complete scutum and elongate median avicularium.

Fig. 9. *Scrupocellaria harmeri* Osburn, frontal view of zooecium with spines and lateral avicularium.

Fig. 10. The same, ovicell and scutum.

Fig. 11. *Scrupocellaria ferox* Busk, broad transverse giant avicularium and absence of scutum.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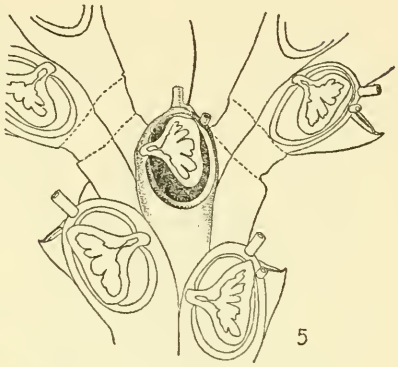
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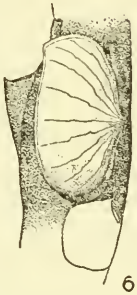
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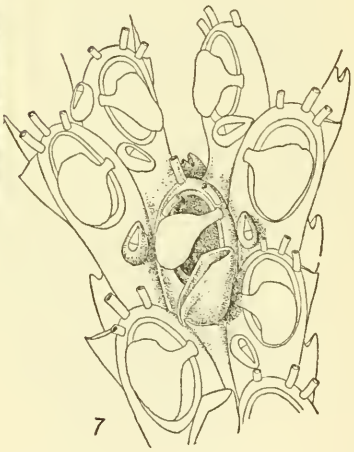
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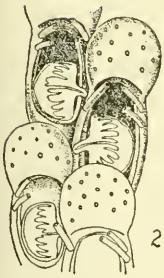
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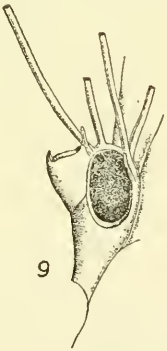
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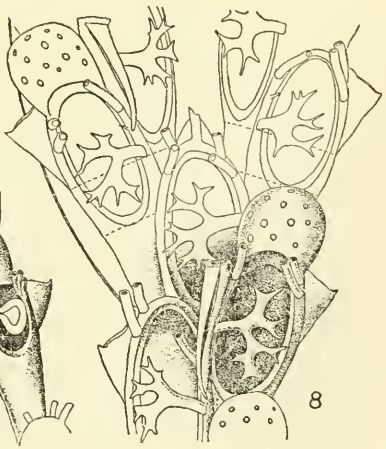
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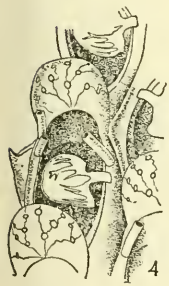
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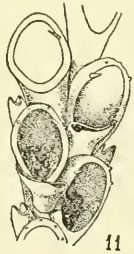
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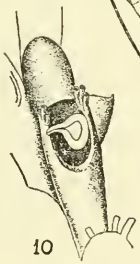
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PLATE 19

Fig. 1. *Scrupocellaria scruposa* (Linnaeus), twinned axial vibracula and absence of scutum.

Fig. 2. *Scrupocellaria macropora* new species.

Fig. 3. *Scrupocellaria talonis* new species, frontal and lateral avicularia and absence of scutum.

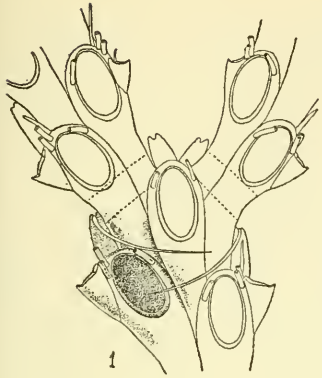
Fig. 4. *Scrupocellaria ferox* Busk, vibracular chamber and position of radicle chamber.

Fig. 5. *Scrupocellaria varians* Hincks, varying scuta, normal frontal and lateral and giant lateral avicularia.

Fig. 6. *Scrupocellaria unguiculata* new species, vibracular and radicle chambers and normal lateral avicularia.

Fig. 7. *Scrupocellaria spinigera* new species.

Fig. 8. The same, with ovicell.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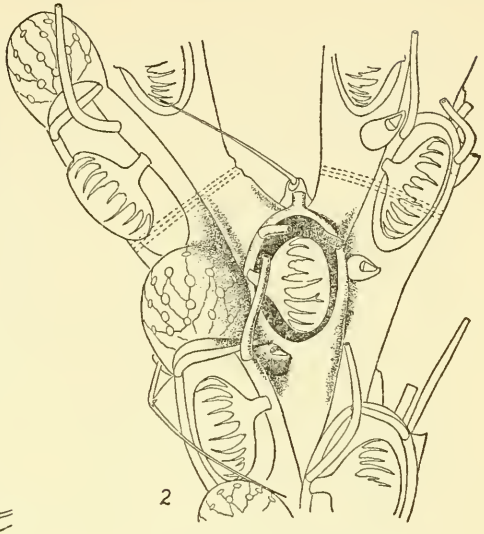
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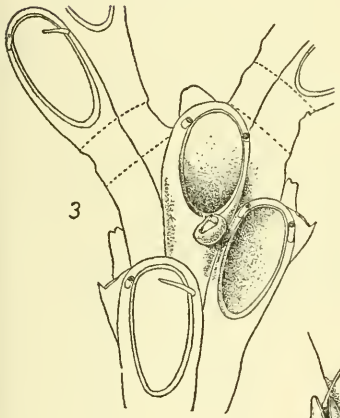
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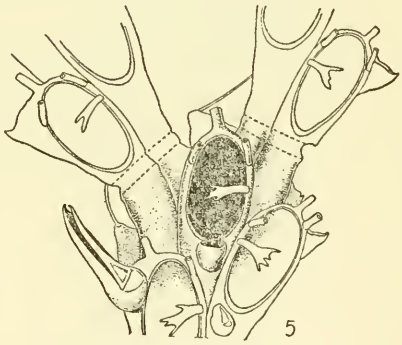
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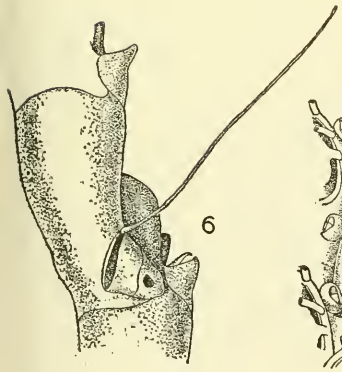
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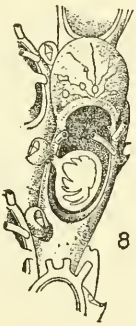
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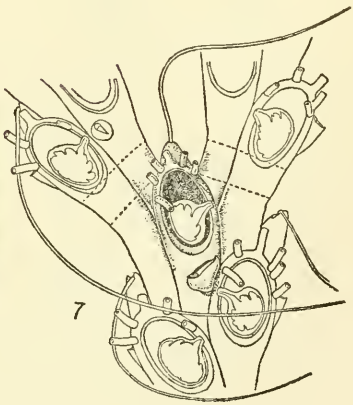
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PLATE 20

Fig. 1. *Scrupocellaria macropora* new species, lateral and axial vibracula.

Fig. 2. *Scrupocellaria panamensis* new species, lateral and axial vibracula.

Fig. 3. *Scrupocellaria regularis* Osburn, lateral and axial vibracula.

Fig. 4. *Scrupocellaria harmeri* Osburn, lateral and twinned axial vibracula.

Fig. 5. *Scrupocellaria californica* Trask, lateral and axial vibracula.

Fig. 6. *Scrupocellaria varians* Hincks, lateral and axial vibracula, and giant lateral avicularium.

Fig. 7. *Scrupocellaria talonis* new species, lateral and axial vibracula.

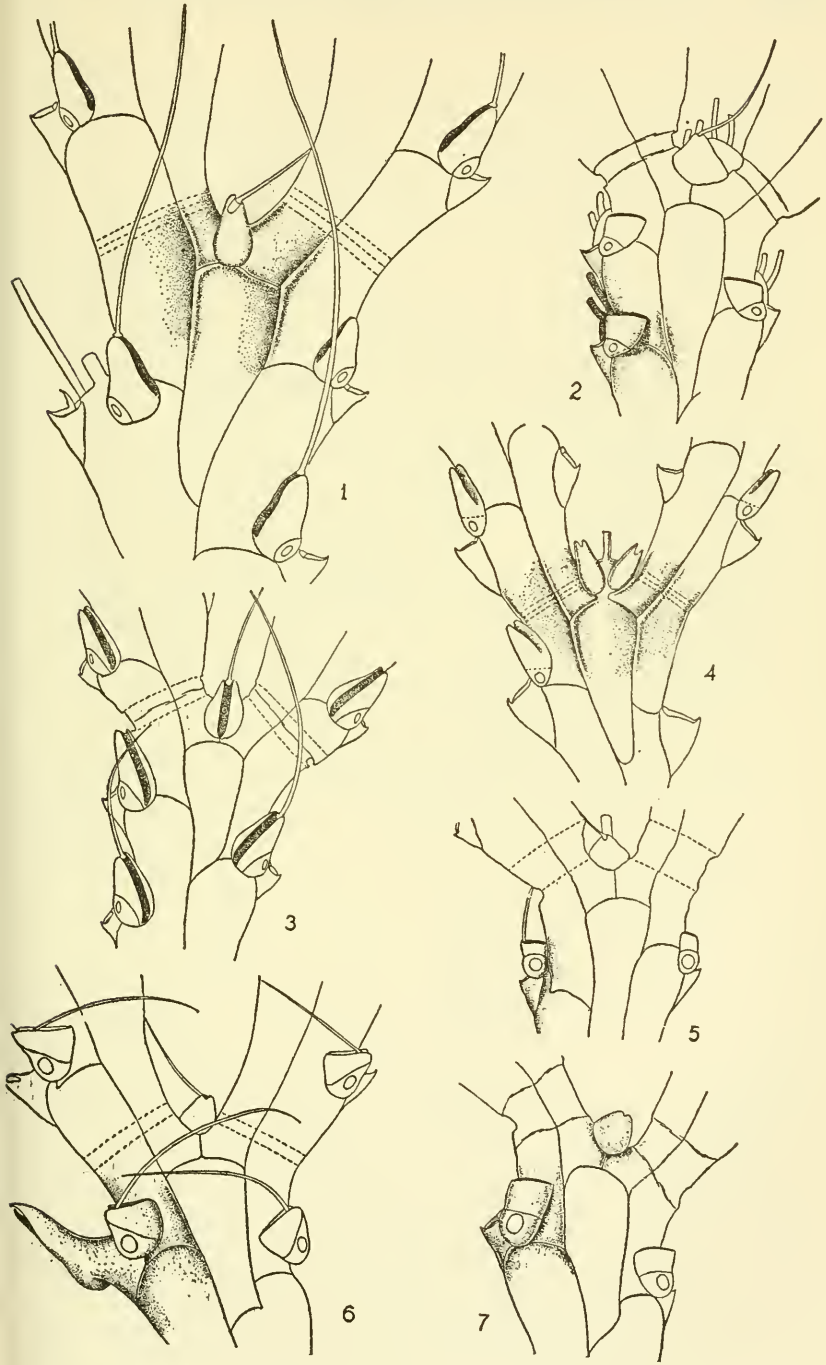
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PLATE 21

Fig. 1. *Scrupocellaria profundis* new species, lateral and twinned axial vibracula.

Fig. 2. *Scrupocellaria scruposa* (Linnaeus), lateral and twinned axial vibracula.

Fig. 3. *Scrupocellaria mexicana* new species, lateral and axial vibracula.

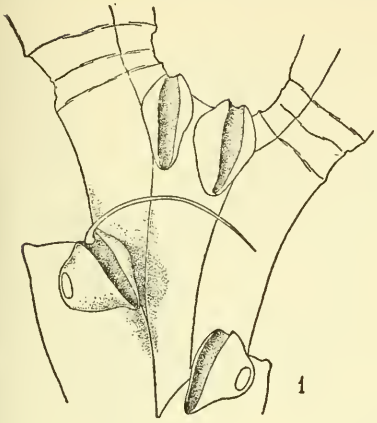
Fig. 4. *Scrupocellaria obtecta* Haswell, lateral and axial vibracula.

Fig. 5. *Scrupocellaria pugnax* new species, lateral and axial vibracula.

Fig. 6. *Scrupocellaria bertholetti* var. *tenuirostris* new variety, lateral and axial vibracula.

Fig. 7. *Scrupocellaria spinigera* new species.

Fig. 8. *Scrupocellaria bertholetti* (Audouin), lateral and axial vibracula.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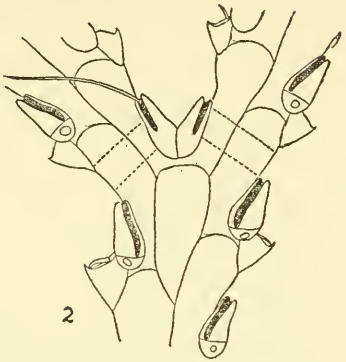
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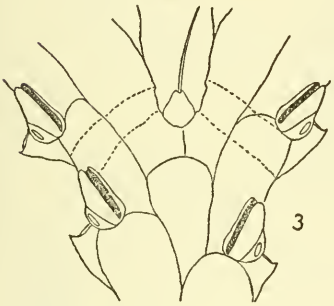
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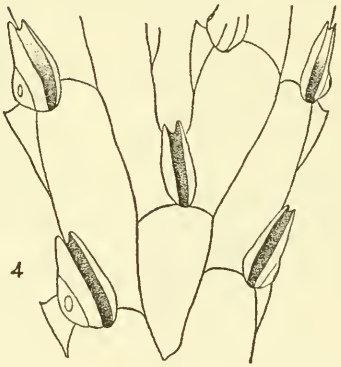
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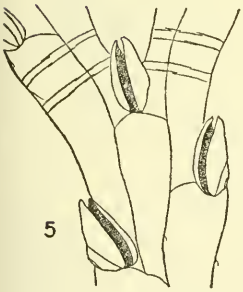
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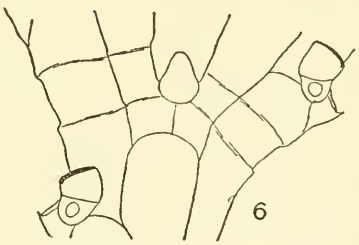
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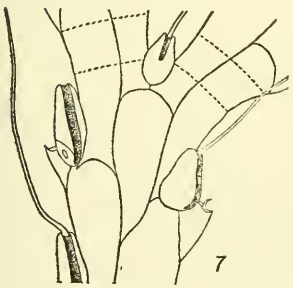
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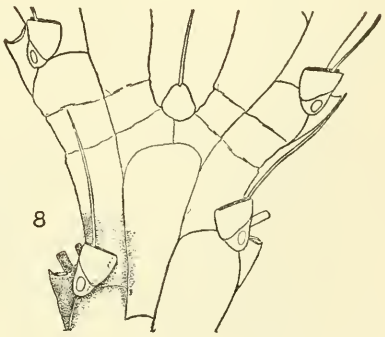
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PLATE 22

Fig. 1. *Scrupocellaria diegensis* Robertson, lateral and axial vibracula.

Fig. 2. *Scrupocellaria scabra* (van Beneden), lateral and axial vibracula.

Fig. 3. *Bugula mollis* Harmer, incomplete ovicell and joint at base of branch.

Fig. 4. *Bugula cucullifera* Osburn, hooded ovicell.

Fig. 5. The same, spines at tip of branch.

Fig. 6. *Bugula pacifica* Robertson, diminutive, cap-like ovicell.

Fig. 7. *Bugula longirostrata* Robertson, vestigial ovicell and elongate avicularia.

Fig. 8. *Bugula minima* (Waters), absence of spines, small proximal avicularia.

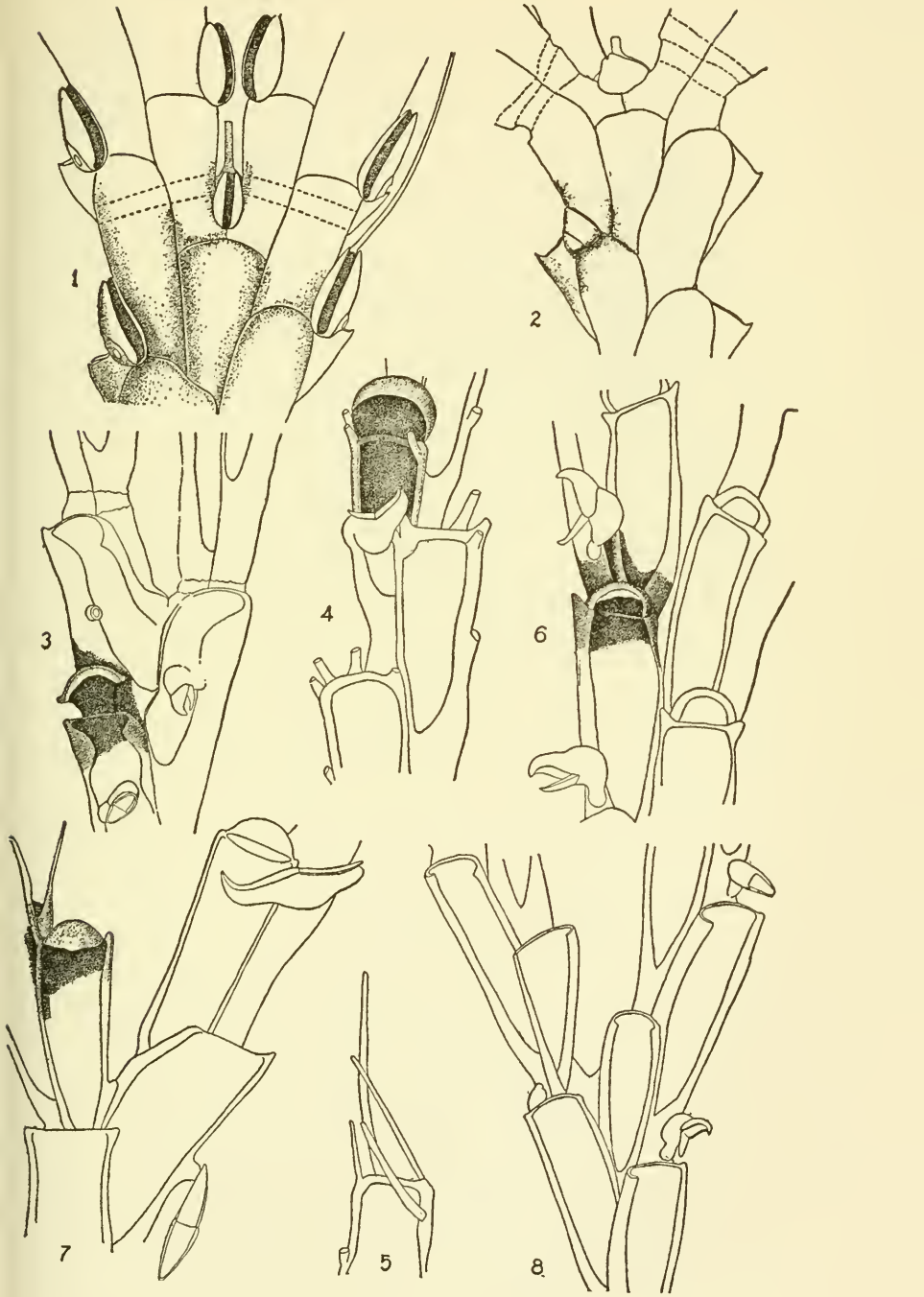
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PLATE 23

Fig. 1. *Bugula californica* Robertson.

Fig. 2. *Hincksina pallida* (Hincks). Note large interzooecial avicularium and outline of submerged ovicell.

Fig. 3. *Bugula neritina* (Linnaeus), ovicell.

Fig. 4. *Bugula pacifica* Robertson, dorsal view.

Fig. 5. *Bugula minima* (Waters), dorsal view.

Fig. 6. *Bugula mollis* Harmer, dorsal view.

Fig. 7. *Bugula pugeti* Robertson, vestigial ovicell and variation in size of avicularia.

Fig. 8. The same, dorsal view.

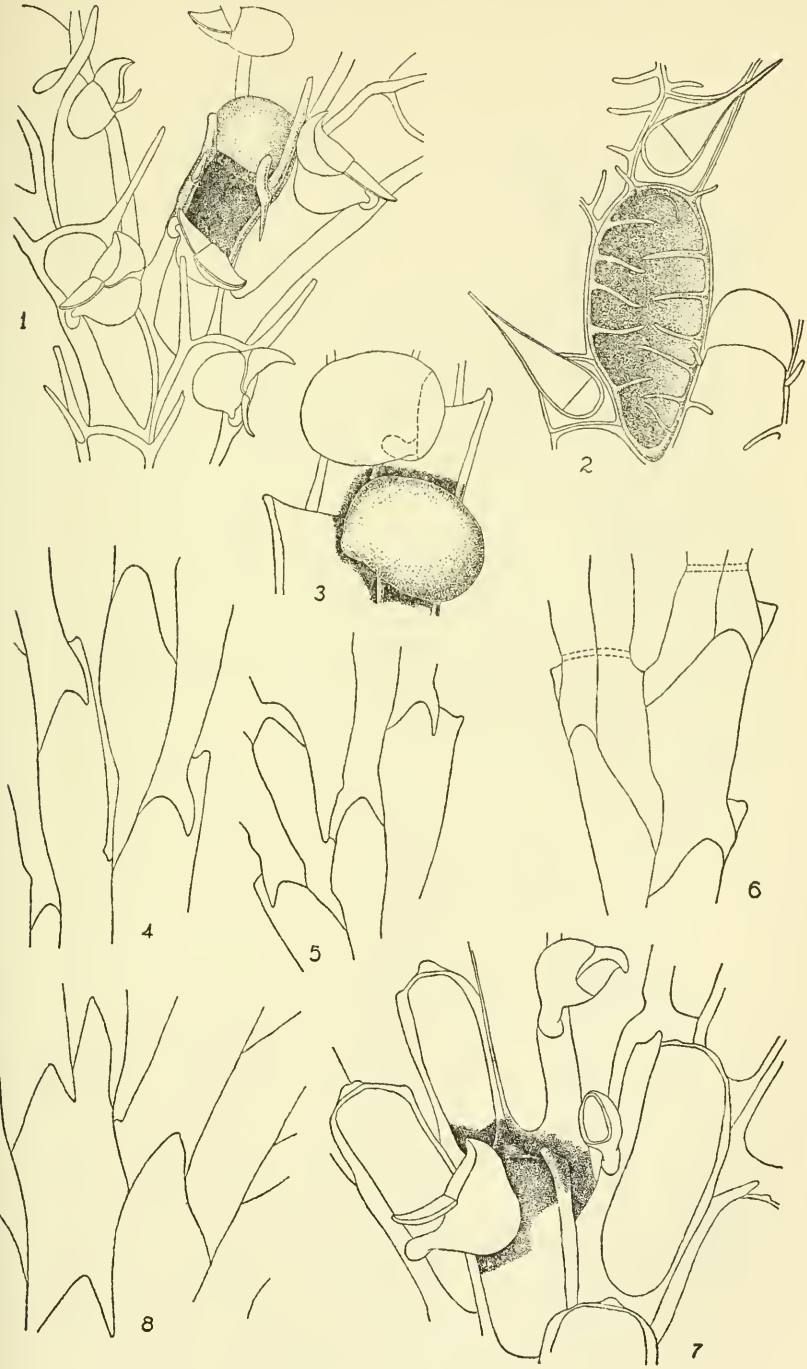
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PLATE 24

Fig. 1. *Bugula longirostrata* Robertson, dorsal view.

Fig. 2. *Bugula californica* Robertson, dorsal view.

Fig. 3. *Bugula neritina* (Linnaeus), dorsal view.

Fig. 4. *Caulibugula ciliata* (Robertson).

Fig. 5. The same, with ovicell.

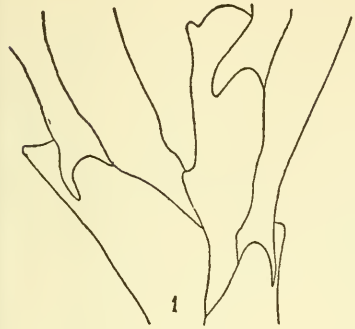
Fig. 6. *Caulibugula occidentalis* (Robertson), with ovicell.

Fig. 7. *Caulibugula californica* (Robertson).

Fig. 8. The same, stalk internodes (kenozooecia).

Fig. 9. *Corynoporella spinosa* Robertson, zooecium showing mode of branching and short spines.

Fig. 10. The same, stalked lateral avicularium.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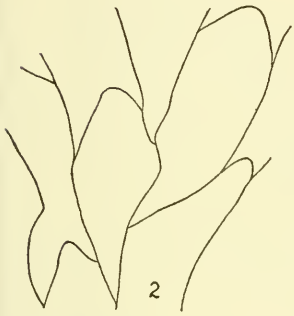
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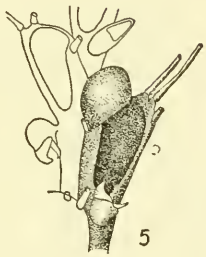
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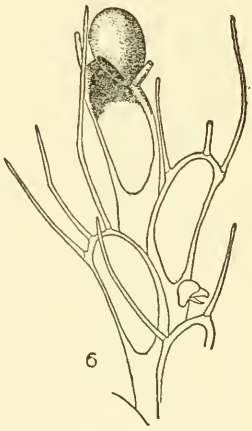
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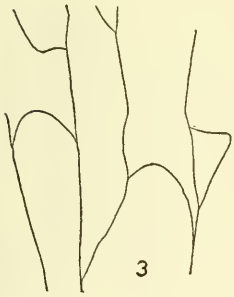
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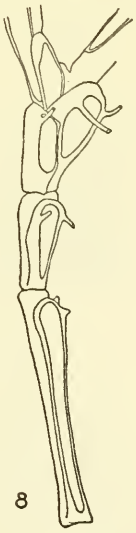
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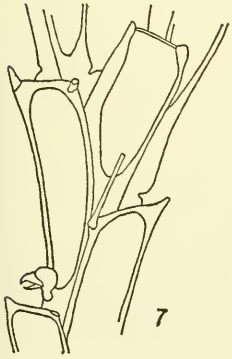
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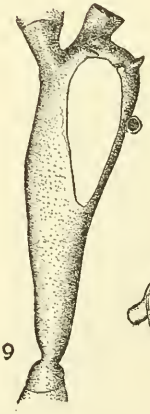
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PLATE 25

Fig. 1. *Dendrobeania murrayana* var. *fruticosa* (Packard), two sizes of avicularia, median and lateral.

Fig. 2. *Dendrobeania laxa* (Robertson), with ovicell.

Fig. 3. The same, infertile zooecium.

Fig. 4. *Dendrobeania longispinosa* (Robertson).

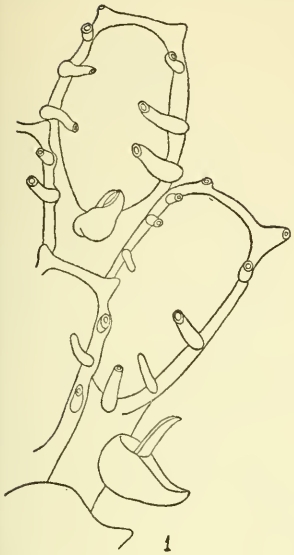
Fig. 5. The same, ovicell.

Fig. 6. *Dendrobeania lichenoides* (Robertson), with ovicell.

Fig. 7. *Dendrobeania curvirostrata* (Robertson), with ovicell and elongate avicularium.

Fig. 8. The same, at growing tip.

Fig. 9. *Beania magellanica* (Busk), showing paired avicularia and connecting tubules.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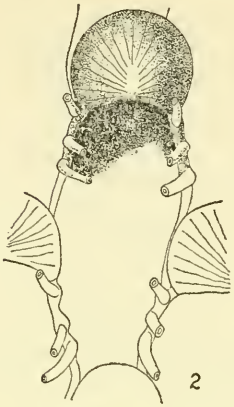
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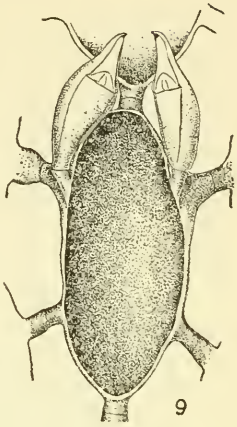
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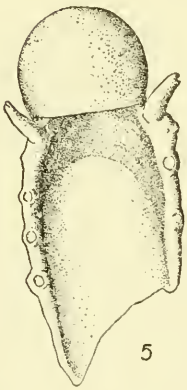
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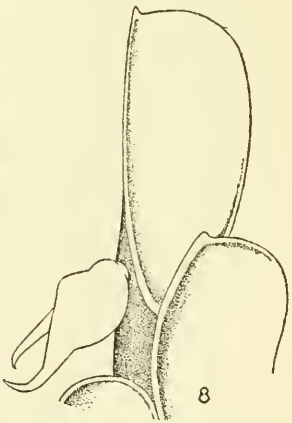
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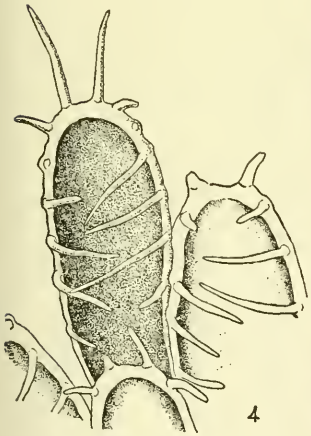
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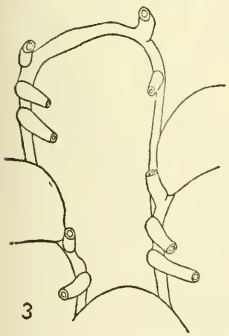
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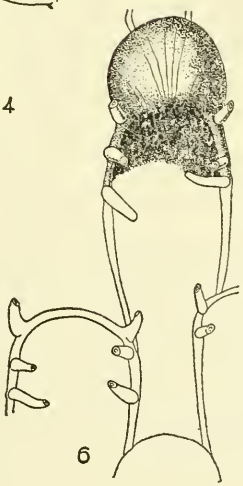
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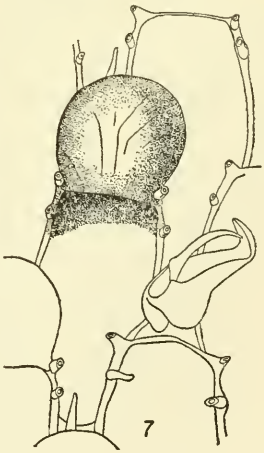
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PLATE 26

Fig. 1. *Sessibugula translucens* new species, outline of zooecium near edge of zoarium, with ovicell and paired, stalked avicularia on the gymnocyst.

Fig. 2. The same, old and fully developed zooecium in a more crowded part of the zoarium, with strong, jointed spines which are sometimes branched; small avicularia. Below an avicularium with the mandible everted.

Fig. 3. The same, dorsal view showing overlapping of zooecia and the arrangement of communication pores.

Fig. 4. *Beania hirtissima* (Heller), frontal view.

Fig. 5. The same dorsal view showing dorsal spines and the transformation of one into a holdfast.

Fig. 6. *Beania alaskensis* new species, side view showing the elongate terminal spines and thick basal tubular portion.

Fig. 7. The same, frontal view showing the strong terminal spines and the twinned lateral ones.

Fig. 8. *Beania mirabilis* Johnston, side view showing narrow proximal tubule, small terminal and single lateral spines.

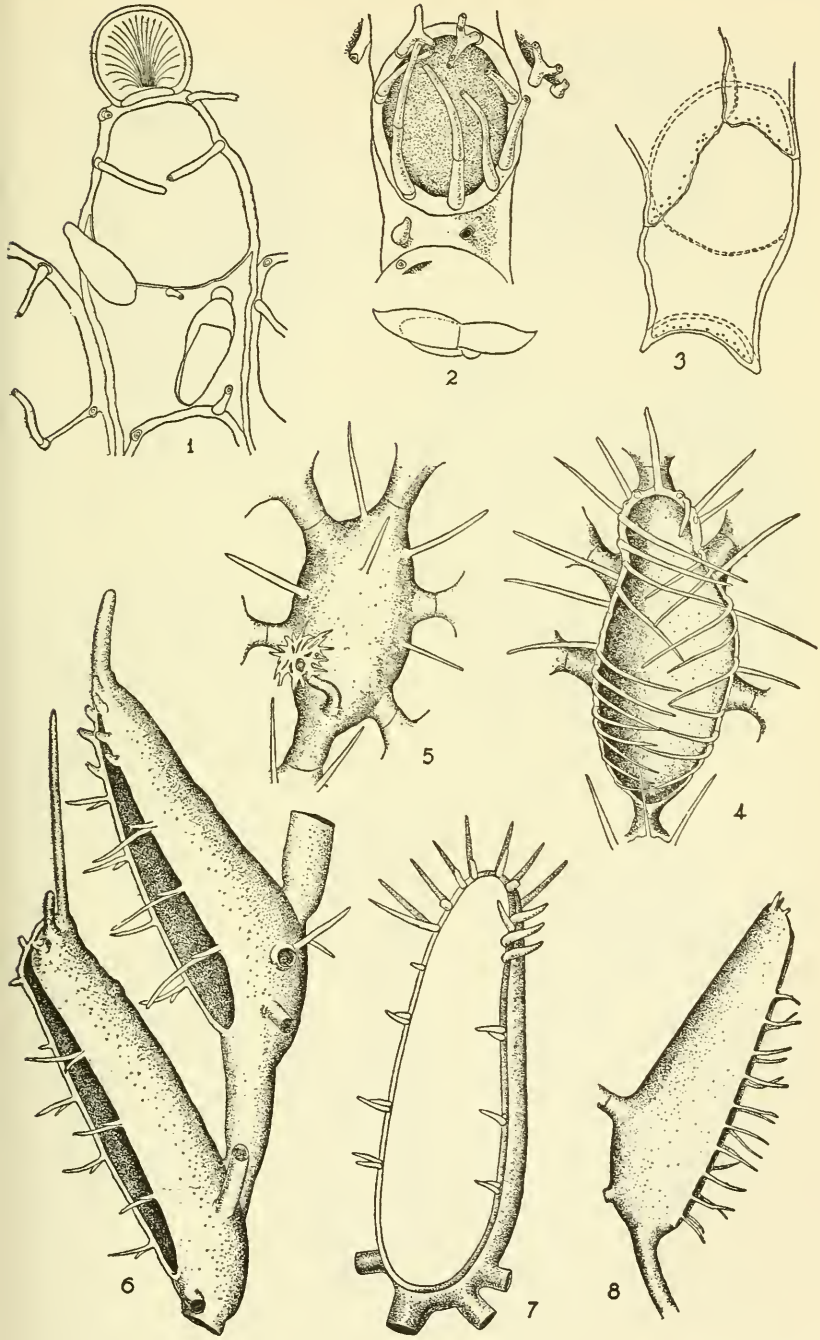
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PLATE 27

Fig. 1. *Membraniporella crassicosta* Hincks, usual appearance with heavy spines little developed upward.

Fig. 2. The same, a zooecium near the center of the zoarium, with the spines united above the opesia.

Fig. 3. *Membraniporella aragoi* var. *pacifica* new variety.

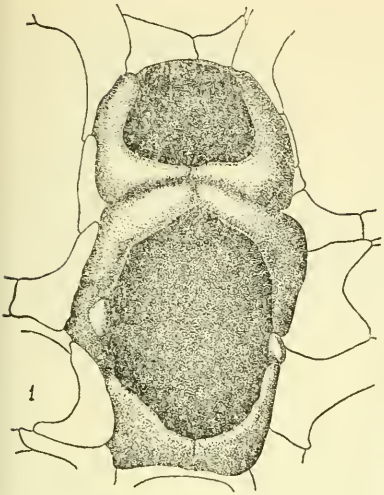
Fig. 4. The same, showing ovicell and the fully developed lateral oral spines.

Fig. 5. *Membraniporella pulchra* new species.

Fig. 6. The same, with ovicell.

Fig. 7. *Lyrula hippocrepis* (Hincks), normal appearance with large vicarious avicularium.

Fig. 8. The same, old stage of calcification.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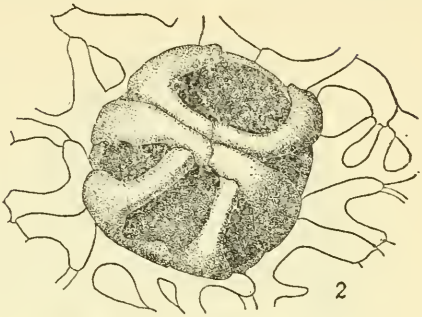
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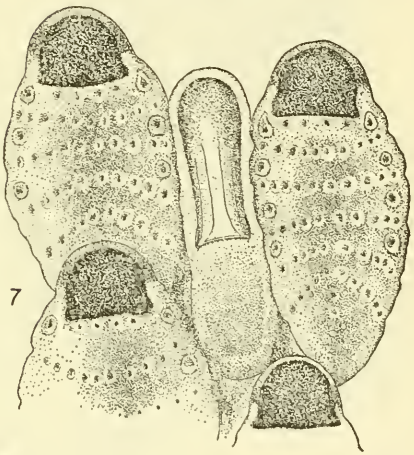
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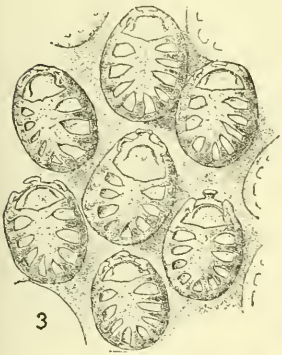
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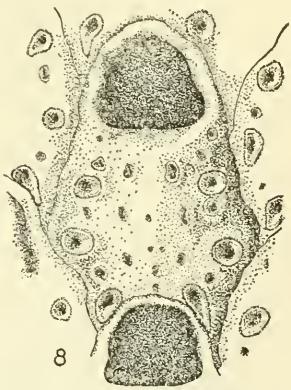
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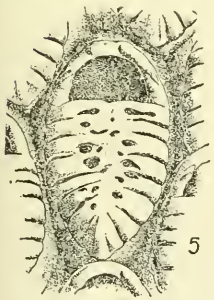
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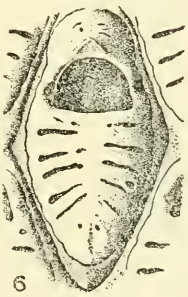
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PLATE 28

Fig. 1. *Reginella nitida* new species.

Fig. 2. *Reginella mattoidea* new species.

Fig. 3. *Reginella furcata* (Hincks), with short bifid spines.

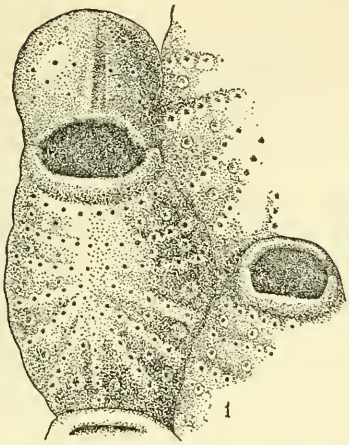
Fig. 4. *Reginella mucronata* (Canu and Bassler), with mucronated oral bar, drawn to a somewhat smaller scale.

Fig. 5. *Reginella spitsbergensis* (Norman), with ovicell and two pairs of short lateral oral spines.

Fig. 6. The same, young zooecia at growing edge.

Fig. 7. *Cribrilina annulata* (Fabricius), zooecia and ovicell.

Fig. 8. *Figularia hilli* new species, drawn to a somewhat smaller scale.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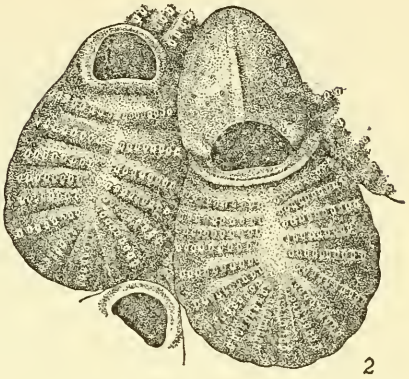
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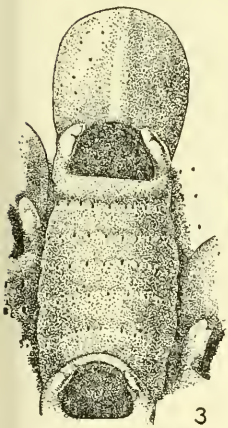
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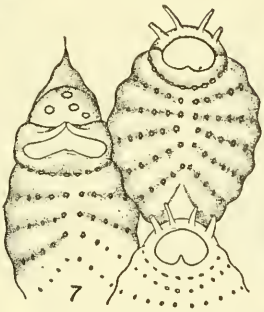
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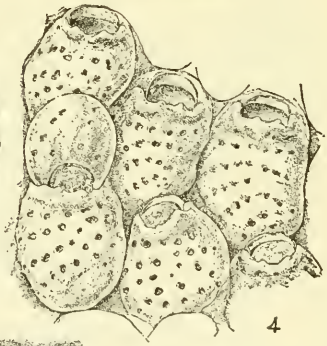
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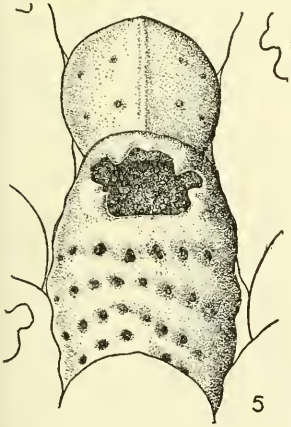
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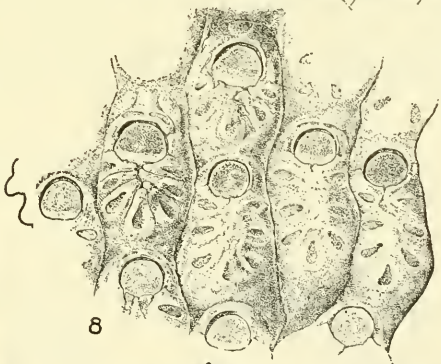
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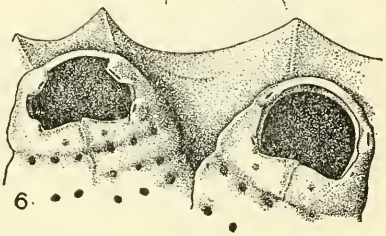
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PLATE 29

Fig. 1. *Colletosia bellula,* new species. Note form of aperture and lateral-oral pedunculate avicularia.

Fig. 2. *Colletosia radiata* (Moll), the form *innominata* (Couch).

Fig. 2a. The same, interzooecial avicularium.

Fig. 3. *Reginella mucronata* (Canu and Bassler), young zooecia at margin of zoarium.

Fig. 4. *Puellina setosa* (Waters). Note especially the minute bristle-like avicularia opposite the aperture.

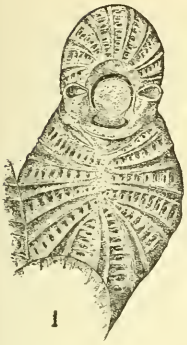
Fig. 5. *Euritina arctica* new species. Details of skeleton, with base of ovicell.

Fig. 5a. The same, showing hyperstomial ovicell, larger aperture and the attachment of the operculum.

Fig. 6. *Mollia patellaria* (Moll), details of young zooecia.

Fig. 7. *Antropora tincta* (Hastings). Area with vestigial avicularia.

Fig. 8. The same, showing details of zooecium and avicularium and variations in size and form of avicularia and vestigial avicularian chambers.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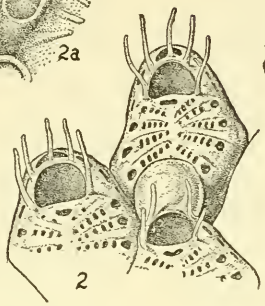
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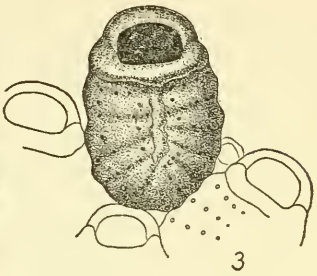
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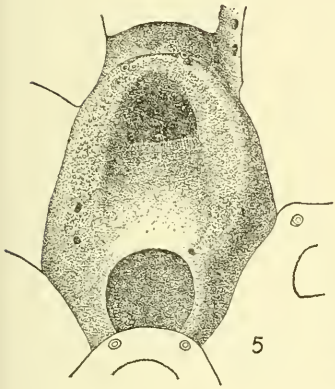
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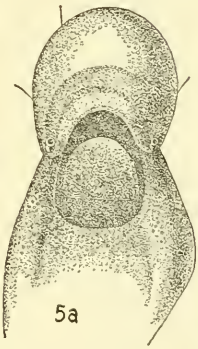
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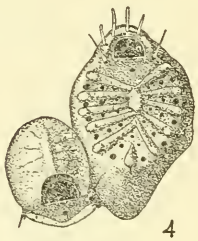
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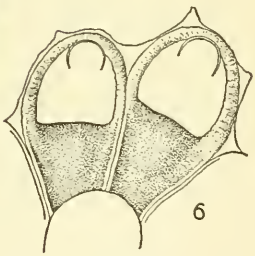
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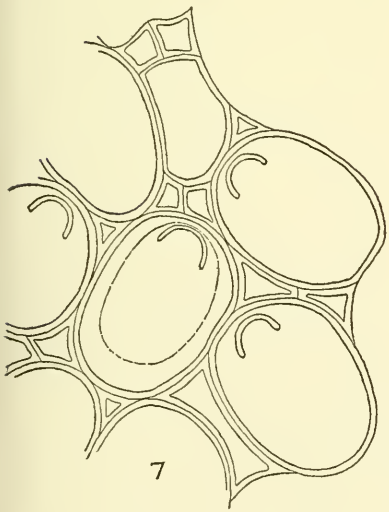
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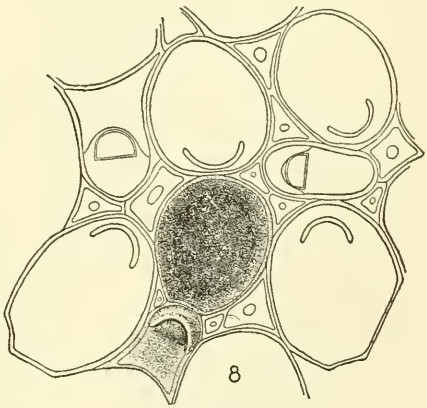
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Plate illustrations are in bold face.

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.

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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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 interzooecial (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 endozooecial and formed by the distal extension of the zooecial cavity and opening below the level of the operculum; in a few genera ovicells appear to be entirely absent, the larvae developing within the zooecial 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 dietellae, 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. Zooecia with very long basal tubular prolongations . . *flagellum*
   Basal prolongations usually not longer than the zooecial body . 3
3. Zooecia large, with a broad calcareous expansion along the . .
   sides . . . . . *expansa*
   Zooecia 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 zooecia 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 zooecia.

There is so much variability in this species that it often presents a difficult problem to the beginner, but marginal zooecia 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 ooecia 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 zooecial 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 Brogniartii* 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 zooecium and to the ooecium 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 zooecium 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 ooecia 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 ooecium. 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 ooecia 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 zooeciules 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 zooeciule 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 in 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 ooecia. 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, occlusar 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 zooecial 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 ooecium is endozooecial, 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 endozooecial, 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

"Zooecia 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

"Zooecia 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 zooecium—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. Zooecia 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 membrance. 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 ooecia are hyperstomial, very prominent, hemispherical or slightly elongate, resting on the olocyst of the succeeding zooecium, 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 ooecia, 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; ooecia 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 ooecia. 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 hybroids (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 zooecium 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 zooecium 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 ooecium 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

Cyclicopora(?) *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 aperture 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 ooecium 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.

Levinsen's unfortunate error in describing the ovicell as endozooecial 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 zooecium 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 zooecia 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 zooecium, 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 ooecium 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 zooecium 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 subquandrangular, 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 restudied 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.
Discopora 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 bilaminate 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. Zooecia 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 zooecia. 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 zooecium, with the rostrum directed laterally.

The primary ooecium is globular, smooth, 0.15 mm wide, but very soon becomes covered by the pleurocyst of the succeeding zooecium, 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 zooecial 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 semicircular 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 peristomice 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 . . . . . *Semihaswellia*

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; Punuk 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 palmate . . . . . *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 zooecia 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 zooecia the border of the aperture is elevated slightly into a thick rim which is connected with the sides of the ooecium.

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 Abreojos 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 peristomice 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 peristomice 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, *Myriozoum 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. (Myriozoum) 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 multilaminar, 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 endozooecial 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 zooecia 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 *Gemelliporidra*), 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*
   Ovicell normal, not covering the aperture . . . . *Arthropoma*
3. Ovicell not closed by the operculum 4
   Ovicell closed by the operculum 5
4. Avicularia in the midline proximal to the aperture . *Schizomavella*
   Avicularia not in the midline . . . . . *Schizoporella*
5. Aperture with a v-shaped sinus . . . . . *Schizolavella*
   The sinus, or poster, is wider, not v-shaped 6
6. The poster is concave, moderately deep and much narrower than the anter . . . . . *Gemelliporidra*
   The poster is wide, a broadly arcuate border 7

7. Avicularia wanting (but see also some species of *Hippodiplosia)* . . . . . *Dakaria*
   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*
   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. Zooecial 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 zooecia 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 zooecium 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

Reptescharellina 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 statious.

Schizoporella dissimilis new species

Plate 37, figs. 12-13

Zoarium encrusting, multilaminate (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 zooecium, 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°16′38″S, 91°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°30′00″N, 111°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 zooecium 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 zooecium 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 zooecium 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 Albatross 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 zooecia 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 zooecia 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 zooecia. 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 zooecia. 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 separted 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 zooecium 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 semicircular 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 cecilii* Audouin, 1826.

Arthropoma cecili (Audouin), 1826

Plate 38, figs. 1-3

Schizoporella cecilii, Hincks, 1884:17.
Schizoporella cecilii, Robertson, 1908:288.
Schizoporella cecilii, O'Donoghue, 1923:35.
Arthropoma cecilii, O'Donoghue, 1926:58.

Zoarium encrusting, forming thin, smooth, white layers. Zooecia 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 ooecial 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, *Gemelliporidra typica* Canu and Bassler, 1927:7.

Gemelliporidra 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 zooecium, 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.

Gemelliporidra colombiensis new species

Plate 40, figs. 11-12

Zoarium encrusting small shell fragments, the surface rough, pale yellow. Zooecia 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 *Gemelliporidra,* 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 zooecium 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 ooecium 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. Zooecia erect and cumulate . . . . . *Hippoporidra*
   Zooecia 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. Zooecia large, more than 1 row of areolar pores, poster a broad deep arc . . . . . *ampla*
   Zooecia 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 zooecia 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 zooecia 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 semicircular area above the orifice, but the whole ovicell becomes embedded in the thick frontal wall of the distal zooecium and completely buried within it when calcification is complete.

There is much variation in the size of the zooecia, 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 synonymity 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 ooecia 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 zooecia 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. Multilaminate colonies are nodular and the zooecia oriented in every direction.

The ovicell is hyperstomial, prominent when young but becoming more or less embedded, inperforate; 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°16′45″S, 91°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 zooecia 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 zooecium which often leaves exposed a small area of the endozooecium.

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 zooecia 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 interzooecial avicularia are acuminated," 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 zooecia, 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. Zooecia 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 zooecia 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 zooecia 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 zooecia 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 ooecium 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. Zooecia 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 zooecium, 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 zooecia, 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 zooecia 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 semicircular 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 zooecium 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, marginated 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 *Hippomenella 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 chitinzed, 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 zooecium; 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 zooecia 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 marginated 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 zooecia. It opens above the apertura by an especial orifice. The frontal is a smooth olocyst. No spines. The ovicelled zooecia 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 *Stephanellosa (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 multilaminate 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 zooecium, 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. Zooecia 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 peristone 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 zooecium 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 zooecia 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°20′45″N, 121°06′15″W, at 208 fms, Bolin and Budd, collectors, several colonies. Also at Hancock Station 1387-41, east of Santa Rosa Island, southern California, 33°54′05″N, 119°54′10″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 de-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 varying 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 semicircular, 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 zooecia 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 (Menzies, 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 mm long by 0.35 mm 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 mm 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 mm in width (0.33 to 0.38 mm), the base of young undeveloped ones measuring 0.28 mm 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 ooecium 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 zooecial 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 zooecia differ strikingly in appearance due to the extension of the peristome which continues distally across the front of the ooecium 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 zooecia 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 semicircle, 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 zooecial margin, the chamber small and rounded, the rostrum short, the mandible setose and usually less than half as long as a zoocium, 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 asocopore 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 synonomy 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 zooecia 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 zooecia, 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 kenozooecium, 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 zooecium. Giant interzooecial 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 ooecial 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 suboral . . . . . *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, bilaminate 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 mm 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 kenozooecium); 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); Punuk 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. Zooecia 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 zooecia). 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 zooecia 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°47′35″N, 110°32′20″W, at 47 fms; and 1258-41, Natividad Island, off Lower California, 27°44′17″N, 115°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 multilaminar, 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 zooecia 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 . . . . . *prolifica*
   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 zooecia which have additional pores inside from the areolar row the pleurocystal layer is seen to develop from the border toward the center; young marginal zooecia 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 interzooecial; not infrequently there may be several forms and sizes on a single zooecium; 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, ooecium, 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 multilaminate 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 subspatulate 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 ooecia 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 zooecium, with a heavy cross-bar and becoming deeply sunk in the crust in older zooecia; 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 zooecium, 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 subspatulate 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 zooecium.

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 spathulate 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 zooecia 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* Bidenkap, *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. Zooecia of moderate size, frontal little granulated . . . . *ovata*
   Zooecia 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 peristome . . . . . *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 bilaminate 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. Zooecia 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 ooecium.

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 quincunx; 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; Punuk 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 zooecium, 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 zooecia 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 zooecia; 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, bilaminate. Zooecia 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 zooecia.

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 "Zooecia 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 ooecial 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 ooecial 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 ooecium; the peristome is a raised lip the full width of the ooecium, 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 ooecial 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 kenozooecia, 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 sinusus 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 nonfenestrate 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 kenozooecia 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 kenozooecia, 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 zooeciules 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 peristomice 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; ooecium 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 ooecial 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, suberect. 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 zooecium, 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 ectooecium 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 ooecia, 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 **RHYNCHOZOON** 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 uncinate 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 (dietellae), 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 ooecial 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 uncinate process in the aperture at the base of the oral avicularium, oral sinus indistinct . . . . . *bispinosum*
   Uncinate process wanting, oral sinus distinct, suboral erect processes usually very numerous . . . . . *spicatum*
4. Zooecia large, 0.65 to 0.80 mm long, oral avicularian process broad and long, projecting far over the aperture . . *grandicella*
   Zooecia 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 zooecia 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 uncinate 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 zooecia 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 uncinate 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 uncinate 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. Zooecia large (young zooecia 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 uncinate 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 uncinate 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. Zooecia 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 uncinate 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 endozooecial, 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 hy Levinsen under the mistaken idea that the ovicells of *Hippopodina feegeensis* (Busk) are endooecial, 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 endozooecial 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; zooecia remarkably deep; operculum thick, without sclerites, muscle attachments remote from the border . *Veleroa*

Genus CHEILOPORA Levinsen, 1909

Ovicell endozooecial. 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. Zooecia 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 persistome 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 zooecia 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 zooecia and some whole colonies are devoid of avicularia, some zooecia 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 kenozooecium, 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 kenozooecium 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 endozooecial. 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 zooecial 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 endozooecial 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 zooecial 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 semicircular, 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 zooecium, 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 zooecial 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 *C. 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 Viscaino Bay, Lower California, and at Salina Cruz, Oaxaca, Mexico, in shallow water (E. Yale Dawson, collector).

Genus **WATERSIPORA** Neviani, 1895

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 zooecial 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 ooecia; 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 zooecial 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 endozooecial. 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 endozooecial 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. Zooecia 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 multilaminar, white. Zooecia 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 zooecia 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°07′25″S, 77°11′30″W, at 5 fms; more than 30 colonies encrusting three pebbles.

Family Crepidacanthidae Levinsen, 1909

The ooecium is hyperstomial and recumbent. Pore chambers and septulae sometimes alternate. Zooecial 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. Zooecia 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 zooecia 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 zooecium 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 zooecium 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. Zooecia 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 zooecia 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 zooecium 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 ooecium 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 zooecia are usually erect and irregularly disposed though at the growing edge they may be horizontal and oriented. Ordinarily the zooecia are heaped upon each other in irregular layers and turned in all directions in the most irregular manner. The ooecia 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 . . . . . *Trematooecia*
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°30′50″N, 101°29′56″W, at 25 fms; 450-35, Secas Islands, Panama; and 1250-41, San Benito Islands, west of Lower California, 28°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; interzooecial avicularia unusually long, sides nearly parallel, spines small . . . *hancocki*
   Zoarium encrusting; interzooecial 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; interzooecial avicularia large, long-elliptical, the mandible with a dark brown spade-shaped columella; 2 spines . . . . . *brunnea*
   Unpigmented; interzooecial 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 assymmetrical). 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 zooecia of the secondary layers. The interzooecial 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 zooecia 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 semicircle, the proximal border broadly arcuate, the operculum thin and colorless with narrow linear sclerites close to the border. The interzooecial 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. Interzooecial 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 autozooecia; 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 interzooecial 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 multilaminar. 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, Albemarle 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 semicular 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 ooecia "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

Costazzia 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 interzooecial 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 interzooecial 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 ooecial 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 interzooecial 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 **MYRIOZOUM** 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 zooecium, 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.

Myriozoum subgracile d'Orbigny, 1852

Plate 64, figs. 3-4

Myriozoum subgracile d'Orbigny, 1852 ;662.
Myriozoum subgracile, Waters, 1900 :69.
Myriozoum subgracile, Robertson, 1908 :296.
Myriozoum subgracile, O'Donoghue, 1923 :39 :75.

Zoarial form and general appearance similar to that of *M. coarctatum.* The zooecia 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 zooecium 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.

Myriozoella plana (Dawson), 1859

Plate 64, figs. 1-2

Lepralia plana Dawson, 1859:256.
Myriozoum crustaceum Smitt, 1867:18.
Myriozoum planum, Hincks, 1892:157.
Leieschara plana, Norman, 1903:110.
Myriozoum crustaceum, Robertson, 1908:295.
Myriozoum crustaceum, Osburn, 1919:609; 1923:9D.
Myriozoella 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 zooecia 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 zooecium but usually evident as a distinct rounded swelling, perforated like the frontal.

Smitt, in describing *Myriozoum 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 interzooecial 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 interzooecial, as their chambers are continued to the dorsal side parallel to the zooecial 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 interzooecial as their chambers descend to the dorsal side parallel to the zooecial 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 zooecium 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.

REFERENCES

1. Papers dealing only with Pacific Coast Bryozoa.

BUSK, GEORGE

1856. Zoophytology. Quart. Jour. Micr. Sci. vol. 4, pp. 176-180.

CANU, F. and BASSLER, R. S.

1930. The Bryozoan Fauna of the Galapagos Islands. Proc. U. S. Nat. Mus. vol. 76, Art. 13, pp. 1-78, pls. 1-14.

HASTINGS, ANNA B.

1930. Cheilostomatous Polyzoa from the vicinity of the Panama Canal collected by Dr. C. Crossland on the Cruise of the S. Y. "St. George." Proc. Zool. Soc. London for 1929, Pt. 4, pp. 697-740, pls. 1-17.

HINCKS, THOS.

1882. Polyzoa of the Queen Charlotte Islands: Preliminary notice of New Species. Ann. Mag. Nat. Hist., ser. 5, 10; pp. 248-256. Report on the Polyzoa of the Queen Charlotte Islands, *ibid.*, pp. 459-471.

1883. Report on the Polyzoa of the Queen Charlotte Islands, *ibid.* 11, pp. 442-451.

1884. *Idem, ibid.* 13, pp. 203-215.

O'DONOGHUE, CHAS. H. and ELSIE

1923. A Preliminary List of the Bryozoa from the Vancouver Island Region. Contr. Canadian Biol., n.s., 1, pp. 143-201, pls. 1-4.

1925. Notes on certain Bryozoa in the Collection of the University of Washington. Pub. Puget Sd. Mar. Biol. Sta. 5, pp. 15-23.

1925a. List of Bryozoa from the vicinity of Puget Sd., *ibid.*, pp. 91-108.

1926. A Second List of Bryozoa from the Vancouver Island Region. Contr. Canadian Biol., n.s., 3, pp. 49-131, pls. 1-5.

ROBERTSON, ALICE

1900. Papers from the Harriman Alaska Expedition, vi. Proc. Washington Acad. Sci. 2, pp. 315-40, pls. 19-21.

1908. The Incrusting Chilostomatous Bryozoa of the West Coast of North America. Proc. Calif. Acad. Sci., Zool. 4 No. 5, pp. 253-344, pls. 14-24.

2. General References.

AUDOUIN, V.

1826. Explication sommaire des Planches de l'Egypte et de la Syrie. In Description de l'Egypte, Hist. Nat., vol. 1, pt. 4, pp. 225-249. Paris.

BARROSO, M.G.

1924. Notas sobre Briozoos de Tanger. Bol. Real Soc. Española de Hist. Nat. Tomo 24, pp. 291-298. Madrid.

BIDENKAP, OLAF

1900. Die Bryozoen, 1 Teil, Die Bryozoen von Spitsbergen und Koenig-Karls-Land, Fauna Arctica, vol. 1, Lief 3, pp. 503-540, pls. 9-10.

BASSLER, R. S.

1934. Notes on fossil and recent Bryozoa. Jour. Washington Acad. Sci. vol. 24, No. 9, pp. 404-408.

1935. Bryozoa. Fossilium Catalogus, Pars 67, pp. 1-229.

1936. Nomenclatorial notes on fossil and recent Bryozoa. Jour. Washington Acad. Sci. vol. 26, No. 4, pp. 156-162.

Brown, D. A.

1949. On the Polyzoan Genus *Hippomenella* Canu and Bassler and its Genotype *Lepralia mucronelliformis* Waters. Linn. Soc. Jour. Zool. vol. 41 (No. 281), pp. 513-520.

Busk, George

1852. Catalog of the Marine Polyzoa in the collection of the British Museum, Cheilostomata, Part 1, pp. 1-54, pls. 1-68.

1854. *Idem,* Part 2, pp. 55-120, pls. 69-124.

1855-1867. Zoophytology. A series of smaller papers. Quart. Jour. Micr. Sci.

1859. A Monograph of the Fossil Polyzoa of the Crag. Paleontographical Soc. London, pp. 1-136, pls. 1-22.

1884. Report on the Polyzoa collected by H. M. S. "Challenger" during the years 1873-1876. Part 1, Cheilostomata. Zool. 10, Part 30, pp. i-xxiv, 1-216, pls. 1-36.

Calvet, L.

1902. Bryozoaires Marins de la Region de Cette. Inst. de Zool. de Montpellier et Stat. Zool. de Cette, 2nd ser., No. 11, pp. 1-103, pls. 1-3.

1902a. Bryozoaires Marins des Cotes de Corse, *ibid.,* No. 12, pp. 1-52, pls. 1-2.

1907. Bryozoaires (Travailleur and Talisman Expeditions). Expedition scientifique *"Travailleur"* et *"Talisman,"* vol. 8, pp. 355-495, pls. 26-30.

1927. Bryozoaires de Monaco et environs. Bull. de l'Institut Oceanographique, Manaco, No. 503, pp. 1-46.

Canu, F.

1916. Les Bryozoaires fossiles des Terrains du Sud-Ouest de la France. Bull. Soc. Geol. France, ser. 4, vol. 15, pp. 320-334, pls. 3-4.

1918. *Hippaliosina.* Un nouveau genre de Bryozoaires. Bull. Soc. Geol. de France, ser. 4, vol. 18, pp. 88-94.

Canu, F. and Bassler, R. S.

1917. A Synopsis of American Early Tertiary Cheilostome Bryozoa. U. S. Nat. Mus. Bull. 96, pp. 1-87, pls. 1-6.

1920. North American Early Tertiary Bryozoa. Bull. 106, U. S. Nat. Mus., 2 vols., 879 pp., 162 pls.

1923. North American Later Tertiary and Quaternary Bryozoa. U. S. Nat. Mus. Bull. 125, pp. 1-302, pls. 1-47.

1925. Les Bryozoaires du Maroc et de Mauritanie. Memoires de la Soc. Sci. Nat. du Maroc, No. 10, pp. 1-79, pls. 1-9.

1927. Classification of the Cheilostomatous Bryozoa. Proc. U. S. Nat. Mus. 69 (14), pp. 1-42, pl. 1.

1927a. Bryozoaires des Iles Hawai. Bull. de la Soc. Sci. de Seine-et-Oise, fasc. 7 supplem. 1927 et fasc. 7 supplem. 1928, pp. 1-46, pls. 1-10.

1928. Fossil and Recent Bryozoa of the Gulf of Mexico Region. Proc. U. S. Nat. Mus. 72 (Art. 14), pp. 1-199, pls. 1-35.

1928a. Bryozoaires du Brésil Bull. Soc. Sci. du Seine-et-Oise IX, fasc. 5, pp. 58-100, pls. 1-9.

1929. Bryozoa of the Philippine Region. U. S. Nat. Mus. Bull. 100, vol. 9, pp. 1-685, pls. 1-94.

1930. The Bryozoan Fauna of the Galapagos Islands. Proc. U. S. Nat. Mus. 76, Art. 13, pp. 1-78, pls. 1-14.

1933. The bryozoan fauna of the Vincentown Limesand. Bull. U. S. Nat. Mus. 165, pp. 1-108, pls. 1-21.

Dawson, G. M.

1859. Polyzoa. Geol. Surv. Canada for 1858, pp. 255-257.

DESOR, E.

1848. Ascidioidian polyps or Bryozoa (from Nantucket). Proc. Boston Soc. Nat. Hist. 3, pp. 66-67.

ESPER, E. J. C.

1791-1797. Die Pflantzenthiere . . ., ou Histoire Naturelle des Zoophytes.

FLEMING, J.

1828. A history of British Animals, pp. i-xxiii, 1-565. Edinburgh.

GABB, W. M. and HORN, G. H.

1862. The Fossil Polyzoa of the Secondary and Tertiary Formations of N. A., Jour. Acad. Nat. Sci. Philadelphia, vol. 5, part 2, pp. 111-179, pls. 19-21.

GRAY, J. E.

1848. List of the specimens of British Animals in the collection of the British Museum. Part 1, Centroniae or Radiated Animals, pp. 1-173 (Bryozoa, pp. 91-151).

GREGORY, J. W.

1893. On the British Palaeogene Bryozoa. Trans. Zool. Soc. of London, vol. 13, part 6, No. 1, pp. 219-279, pls. 29-32.

HARMER, S. F.

1934. The Polyzoa of the Siboga Expedition. Part 3, Cheilostomata Ascophora 1, Reteporidae. Siboga Exped. 28c, pp. 502-640, pls. 35-41.

HASSALL, A. H.

1842. Remarks on the genus Lepralia, etc. Ann. Mag. Nat. Hist., vol. 9, pp. 407-414.

HASTINGS, ANNA B.

1930. Cheilostomatous Bryozoa from the vicinity of Panama Canal. Proc. Zool. Soc. London (1929), pp. 697-740, pls. 1-17.

1944. Notes on Polyzoa, 1. *Umbonula verrucosa auctt.,* etc. Ann. Mag. Nat. Hist., ser. 11, vol. 11, pp. 273-284.

1949. Notes on Polyzoa, 4. *Discopora* Lamarck and *Umbonula* Hincks. Ann. Mag. Nat. Hist., ser. 12, vol. 2, pp. 205-212.

HASWELL, W. A.

1880. On some Polyzoa from the Queensland Coast. Proc. Linn. Soc. New South Wales, 5, p. 33.

HINCKS, T.

1877. On British Polyzoa. Part 1. Ann. Mag. Nat. Hist. ser. 4, vol. 20, pp. 212-218.

1877a. *Idem,* Part 2, *ibid.,* pp. 520-32.

1879. On the Classification of the British Polyzoa. Ann. Mag. Nat. Hist. ser. 5, vol. 3, pp. 153-164.

1880. A History of the British Marine Polyzoa. vol. 1, text, pp. i-cxli and 1-601, vol. 2, plates 1-83.

1880a to 1885. Contributions toward a General History of the Marine Polyzoa. A series of papers under this title in Ann. Mag. Nat. Hist. ser. 5, vols. 6 to 15.

1882. Polyzoa of Queen Charlotte Islands: Preliminary Notice of some New Species (pp. 248-56), and Report on the Polyzoa of the Queen Charlotte Islands (pp. 459-71), Ann. Mag. Nat. Hist. ser. 5, vol. 10.

1883. Report on the Polyzoa of the Queen Charlotte Islands. Ann. Mag. Nat. Hist., ser. 5, vol. 11, pp. 442-51.

1884. *Idem, ibid.,* vol. 13, pp. 49-58.

1884a. Report on the Polyzoa of the Queen Charlotte Islands, the last three above papers collected and issued by Geol. and Nat. Hist. Surv. of Canada. Ottawa.

1888. The Polyzoa of the St. Lawrence, a study of Arctic forms. Ann. Mag. Nat. Hist., ser. 6, vol. 1, pp. 214-27.

1889. *Idem, ibid.,* ser. 6, vol. 3, pp. 424-35.

1892. *Idem, ibid.,* ser. 6, vol. 9, pp. 149-57.

JOHNSTON, G.

1832. A descriptive catalog of the recent Zoophytes found on the coast of North Durham. Trans. Nat. Hist. Soc. Northumberland, etc., 2, pp. 239-72.

1838. A History of British Zoophytes (Ed. 1), pp. 1-333, pls. 1-44.

1847. *Idem* (Ed. 2), vol. 1, text, pp. 1-488; vol. 2, pls. 1-74.

JULLIEN, J.

1882. Dragages du "Travailleur." Bryozoaires. Bull. Soc. Zool. France, 7, pp. 497-529.

1886. Les Costulides, nouvelle famille de Bryozoaires. Bull. Soc. Zool. France, 11, pp. 601-20.

1888. Mission scientifique du Cap Horn, 1882-3, vol. 6, Zool., pp. 1-92, pls. 1-15.

JULLIEN, J. and CALVET, L.

1903. Bryozoaires provenant des campagnes de l'Hirondelle (1886-8). Rec. Sci. Camp. Sci. Prince de Monaco, fasc. 23, pp. 1-120 by Jullien, 120-188 by Calvet, pls. 1-18.

KLUGE, H.

1906. Zoologische Ergebnisse einer Untersuchungsfahrt des deutschen Seefischerei-Vereins nach der Bäreninsel and Westspitzbergen, etc. Wissensch. Meeresuntersuchungen, new ser., vol. 8, Abt. Helgoland, pp. 31-55, figs. 1-10.

LAMOUROUX, J. V.

1812. Extrait d'un memoire sur la classification des polypiers coralligenes. Bull. des sci. pour la Soc. Philomatique.

1821. Exposition méthodique des genres de l'ordre des polypiers.

LEVINSEN, G. M. R.

1909. Morphological and systematic studies on the Cheilostomatous Bryozoa, pp. 1-431, pls. 1-27. Copenhagen.

1916. Bryozoa. Danmark-ekspeditionen til Grönlands Nordöstkyst 1906-8. Medd. Grönland 43 (16), pp. 432-73, pls. 19-24.

LINNAEUS, C.

1758. Systema Naturae, Ed. 10, vol. 1. Zoophyta, pp. 799-821.

LONSDALE, W.

1845. Report on the corals from the tertiary formations of N. A., Quart. Jour. Geol. Soc. London, vol. 1, pp. 495-509 (Bryozoa on pp. 500-509).

LORENZ, L. VON

1886. Bryozoen von Jan Mayen. K.-K. Akad. der Wissenschaften zu Wien. Die Internationale Polarforschung 1882-83, Bd. 3.

MacGillivray, J.
1842. Catalog of Zoophytes of Aberdeen. Ann. Mag. Nat. Hist.

MacGillivray, P. H.
1859-1889. New or little-known Polyzoa, 16 papers in Trans. Roy. Soc. Victoria.
1895. A Monograph of the Tertiary Polyzoa of Victoria. Trans. Roy. Soc. Victoria, vol. 4, pp. 1-166, pls. 1-22.

Manzoni, A.
1870. Bryozoi pliocenici italiani. Sitzb. der K. Akad. Wissensch. Wien. (4 parts, 1869-70).

Maplestone, C. W.
1900. Further descriptions of the Tertiary Polyzoa of Victoria, Part 3, Proc. Roy. Soc. Victoria, new ser., vol. 12, pp. 162-169; vol. 13, pp. 1-9.
1902. *Idem, ibid.,* vol. 15.

Marcus, Ernst
1937. Bryozoarios Marinhos Brasileiros, vol. 1, Bol. Fac. Phil., Sci., Letr., Univ. Sao Paulo, pp. 1-224, pls. 1-29.
1938. *Idem, ibid.,* vol. 4, No. 2, pp. 1-131, pls. 1-29.
1939. *Idem, ibid.,* vol. 13, No. 3, pp. 113-299, pls. 5-30.

Michelin, H.
1840-7. Iconographie Zoophytologique . . . des polypiers fossiles de France. pp. 348, atlas of 79 pls. Paris.

Milne-Edwards, H.
1836. Recherches anatomiques, physiologiques et zoologiques sur les Eschares. Ann. sci. nat., ser. 2, vol. 6 (Zool.), pp. 5-53, pls. 1-5.

Moll, J. P. C.
1803. Eschara zoophytozoorum seu phytozoorum . . ., etc., pp. 1-70.

Neviani, A.
1895. Boll. Soc. Romana Studi Zool., parts 2, 4. 1895, p. 231.

Nordgaard, O.
1906. Bryozoa from the second "Fram" expedition, 1898-1902. Rept. 2nd Norwegian Arctic Exped. in the "Fram," No. 8, pp. 1-44, pls. 1-4.
1918. Bryozoa from the Arctic regions. Tromsö Mus. Aarshefter, vol. 40, No. 1, pp. 1-99.

Norman, A. M.
1864. On undescribed British Hydrozoa, Actinozoa and Polyzoa. Ann. Mag. Nat. Hist., ser. 3, vol. 13, pp. 82-90.
1869. Last report on Shetland Dredgings, part 2. Rept. Brit. Assoc. for 1868.
1894. A month on the Trondhjem Fjord. Ann. Mag. Nat. Hist., ser. 6, vol. 13, pp. 112-133, pls. 6-7.
1903. Notes on the Natural History of East Finmark. Ann. Mag. Nat. Hist., ser. 7, vol. 11, pp. 567-598, pl. 13; vol. 12, pp. 87-128, pls. 8-9.
1905. *Idem, ibid.,* vol. 15, pp. 341-60, pl. 27.
1906. Greenlandic Polyzoa. Ann. Mag. Nat. Hist., ser. 7, vol. 17, pp. 90-93.
1909. Polyzoa of Madeira and neighboring Islands. Jour. Linn. Soc. London, Zool., vol. 30, pp. 275-314, pls. 33-42.

Okada, Y.

1929. Report of the Biological Survey of Mutsu Bay, 12, Cheilostomatous Bryozoa of Mutsu Bay. Sci. Reports, Tohoku Imperial Univ., 4th ser., Biology, vol. 4, Fasc. 1, pp. 1-33, pls. 1-5.

1934. Bryozoa Fauna in the vicinity of the Shimoda Marine Biological Sta. Sci. Reports Tokyo Univ. of Lit. and Sci., Section B, vol. 2, No. 26.

Orbigny, Alcide d,

1841. Voyage dans l'Amérique Méridionale. Zoophytes, vol. 5, part 4, pp. 1-28.

Ortmann, A. E.

1890. Die Japanische Bryozoen-Fauna. Arch. Naturgeschichte, Bd. 1, Heft 1, pp. 1-74.

Osburn, R. C.

1912. Bryozoa of the Woods Hole Region. Bull. U. S. Bureau of Fisheries, vol. 30, pp. 205-266, pls. 18-31.

1912a. Bryozoa from Labrador, Newfoundland and Nova Scotia collected by Dr. Owen Bryant. Proc. U. S. Nat. Mus. 43, pp. 275-89.

1914. The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Inst. of Washington, No. 182, pp. 181-222, text figs. 1-23.

1919. Bryozoa of the Crocker Land Expedition. Bull. Am. Mus. Nat. Hist., vol. 40, pp. 603-624.

1924. Bryozoa. Rep. Canadian Arctic Expedition 1913-18, southern party, vol. 8 (D), pp. 1-13. Ottawa.

1932. Bryozoa from Hudson Bay and Strait. Biological and oceanographic conditions in Hudson Bay 6. Contr. Canadian Biol. Fish. 7 (29), pp. 363-76.

1940. Bryozoa of Porto Rico with a résumé of the West Indian Bryozoan Fauna. New York Acad. Sci., Sci. Surv. Porto Rico and Virgin Is., vol. 16 (3), pp. 321-486, pls. 1-9.

1947. Bryozoa of the Allan Hancock Atlantic Expedition, 1939. Report No. 5, pp. 1-66, pls. 1-6. Univ. S. Calif., Los Angeles.

Packard, A. S.

1863. List of animals dredged near Caribou Island (Labrador). Canadian Naturalist and Geologist for 1863, pp. 406-12.

Pallas, S.

1766. Elenchus zoophytorum. Hagae Comitum.

Pourtales, L. F. de,

1867. Contributions to the fauna of the Gulf Stream at great depths. Bull. Mus. Comp. Zool. 1 (6), pp. 106, 110, 111.

Ridley, S. O.

1881. Polyzoa in the Zool. Coll. H.M.S. "Alert." Proc. Zool. Soc. London, pp. 43-61, pl. 6.

Sars, M.

1851. Beretning om en i Sommeren 1849 foretagen zoologisk Reise Lofoten og Finmarken. Nyt Mag. f. Naturv., vol. 6, pp. 121-211.

Smitt, F. A.

1867. Kritisk förteckning öfver Skandinaviens Hafs-Bryozoer. Öfversigt af Kongl. Vetenskaps-Akademiens Förhandl., 1867. Bihang, pp. 1-230, pls. 24-28.

1871. *Idem, ibid.,* 1871, No. 9, pp. 1115-1134, pls. 20-21.

1872. Floridan Bryozoa, collected by Count L. F. de Pourtales. Part 1. K. Vetensk.-Akad. Handl. 10 (11), pp. 1-20, pls. 1-5.

1873. *Idem,* Part 2, *ibid.,* Handl. 11 (4), pp. 1-84, pls. 1-13.

SOLANDER, D.

1786. The Natural History of . . . Zoophytes, collected . . . by the late John Ellis, systematically arranged and described by Daniel Solander, pp. 1-206, pls. 1-63.

SOWERBY, G. B.

1806. British Miscellany, 1, p. 83, pl. 41.

WATERS, A. W.

1879. On the Bryozoa of the Bay of Naples. Ann. Mag. Nat. Hist., ser. 5, vol. 3, pp. 27-43, 114-126, 196-202 and 276-281.

1899. Bryozoa from Madeira. Jour. Roy. Micr. Soc. London for 1899, pp. 6-16, pl. 3.

1900. Bryozoa from Franz-Josef Land, collected by the Jackson-Harmsworth Exped., 1896-97. Jour. Linn. Soc. London, Zool., vol. 28, pp. 43-105, pls. 7-12.

1909. Bryozoa. Reports on the Marine Biology of the Sudanese Red Sea. Jour. Linn. Soc. London, Zool. Cheilostomata, pp. 123-181, pls. 10-18.

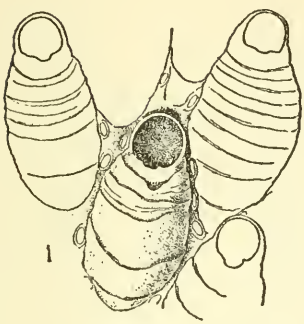
1913. The Marine Fauna of British East Africa and Zanzibar, Bryozoa, Cheilostomata, Proc. Zool. Soc. London, pp. 458-537, pls. 64-73.

1918. Some Collections of the Littoral Marine Fauna of the Cape Verde Islands, etc. Jour. Linn. Soc. London, Zool. Bryozoa, pp. 1-45, pls. 1-4.

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.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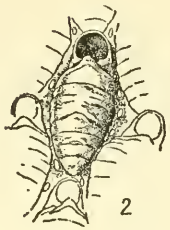
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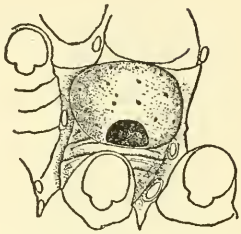
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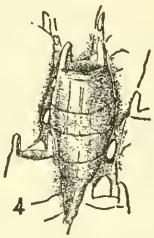
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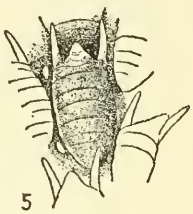
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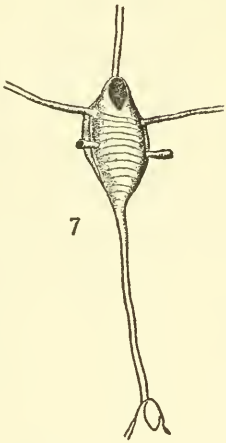
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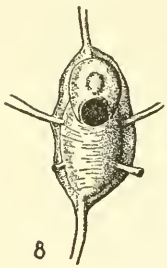
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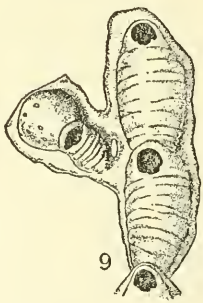
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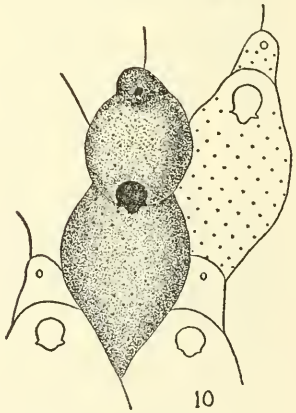
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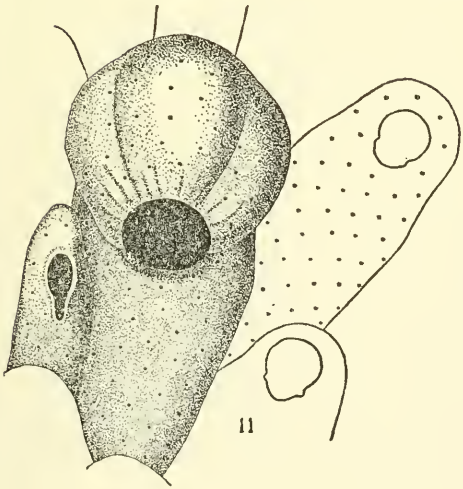
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PLATE 31

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.

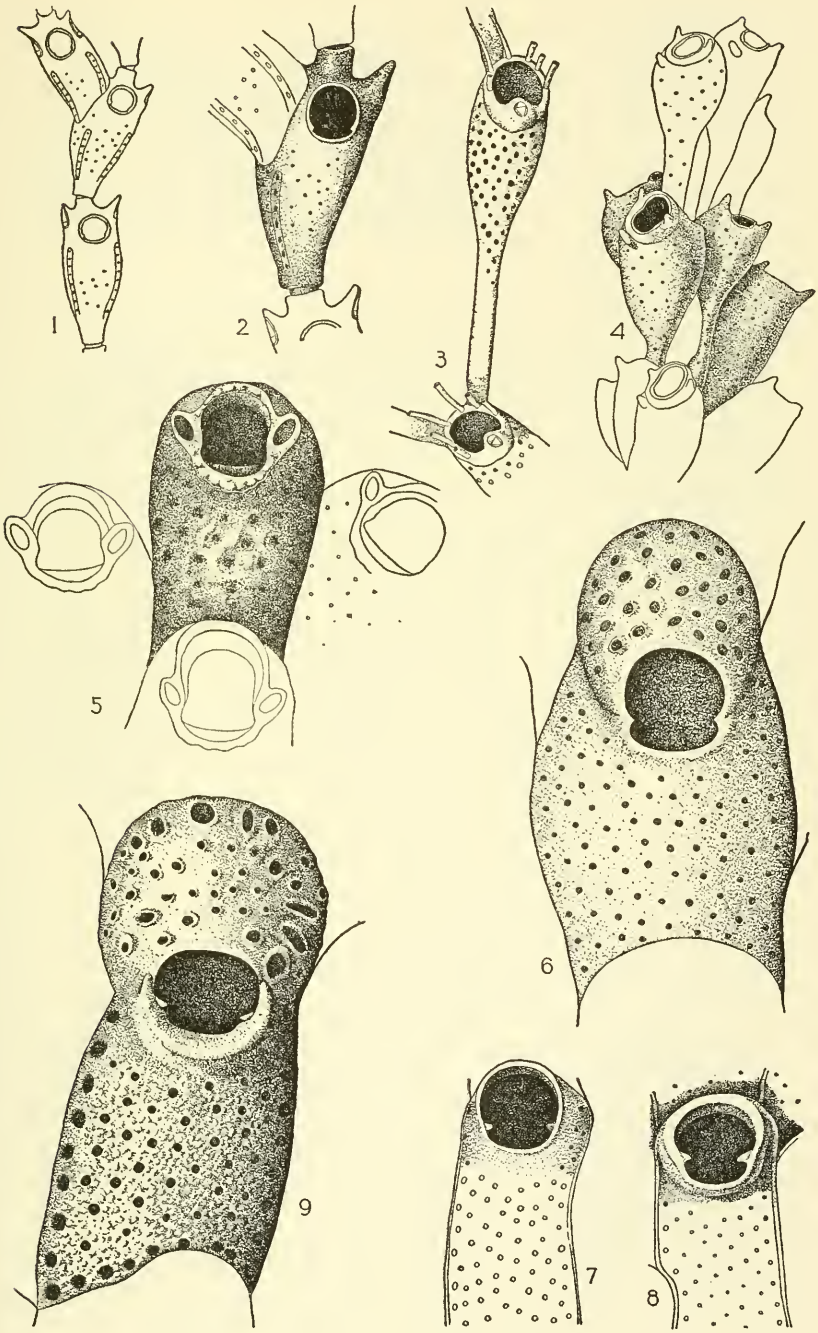
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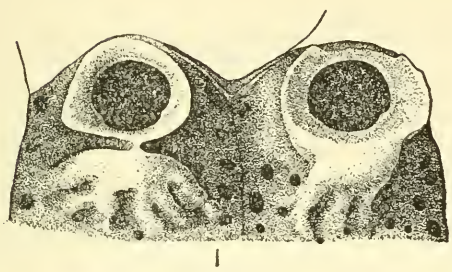
PLATE 32

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 peristone and peculiar decoration of ovicell, reduced ½.
Fig. 10. The same, operculum.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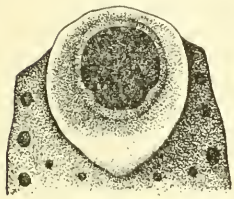
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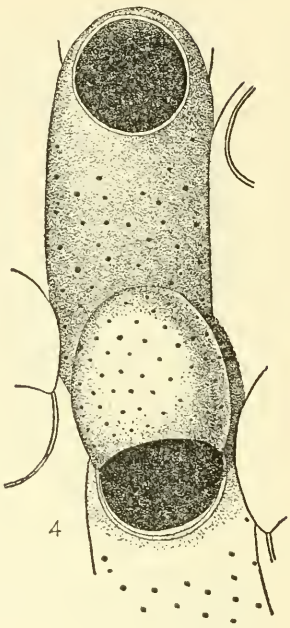
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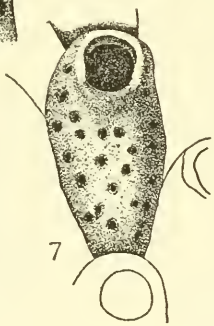
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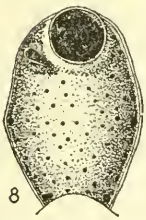
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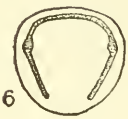
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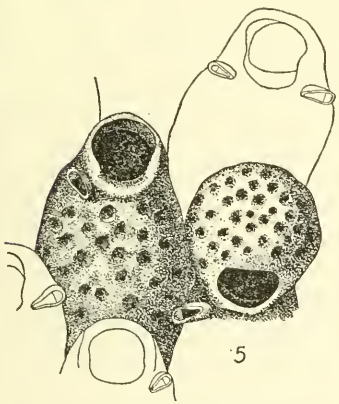
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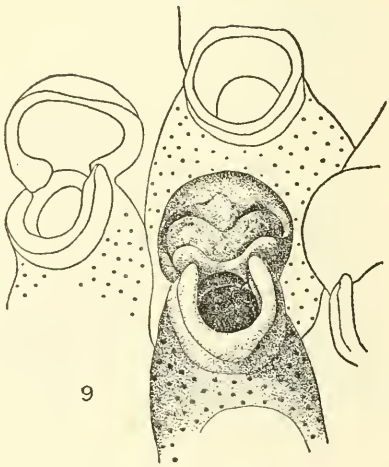
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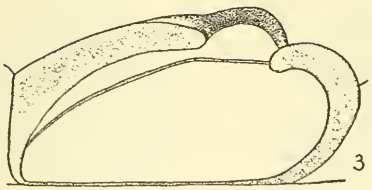
PLATE 33

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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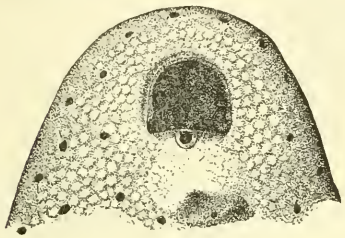
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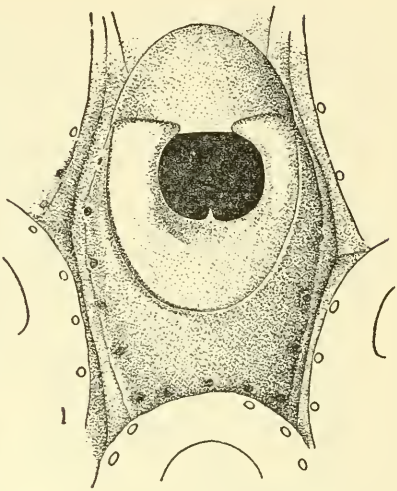
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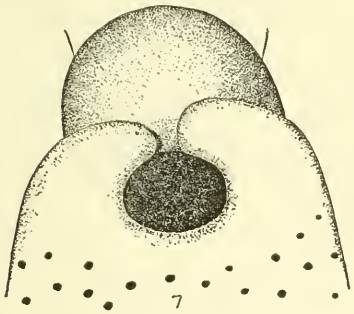
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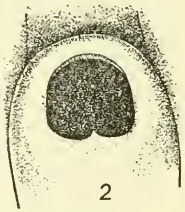
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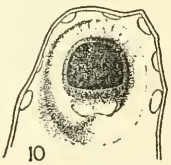
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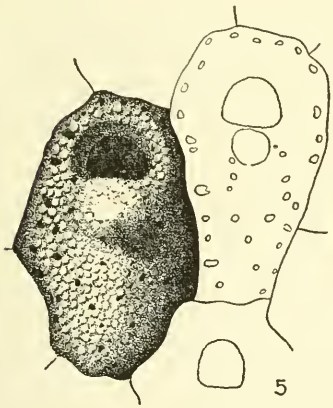
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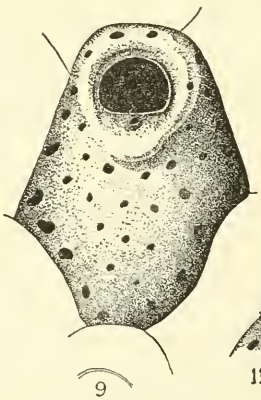
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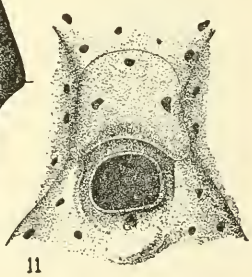
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PLATE 34

Fig. 1. *Stomachetosella cruenta* (Norman), zooecium with rough tuberosities, outline of operculum.

Fig. 2. *Stomachetosella limbata* (Lorenz), zooecium with ovicell, outline of operculum.

Fig. 3. *Stomachetosella sinuosa* (Busk), zooecia with ovicell and form of aperture.

Fig. 4. *Stomachetosella abyssicola* new species, infertile zooecium.

Fig. 5. The same, ovicell.

Fig. 6. The same, operculum.

Fig. 7. *Stomachetosella distincta* new species, zooecium and ovicell with umbos.

Fig. 8. The same, operculum with muscle attachments.

Fig. 9. *Robertsonidra oligopus* (Robertson), zooecium with ovicell and lateral avicularium, reduced ½.

Fig. 10. The same, dorsal side showing tubular attachment processes.

Fig. 11. The same, operculum and mandible with central lucida.

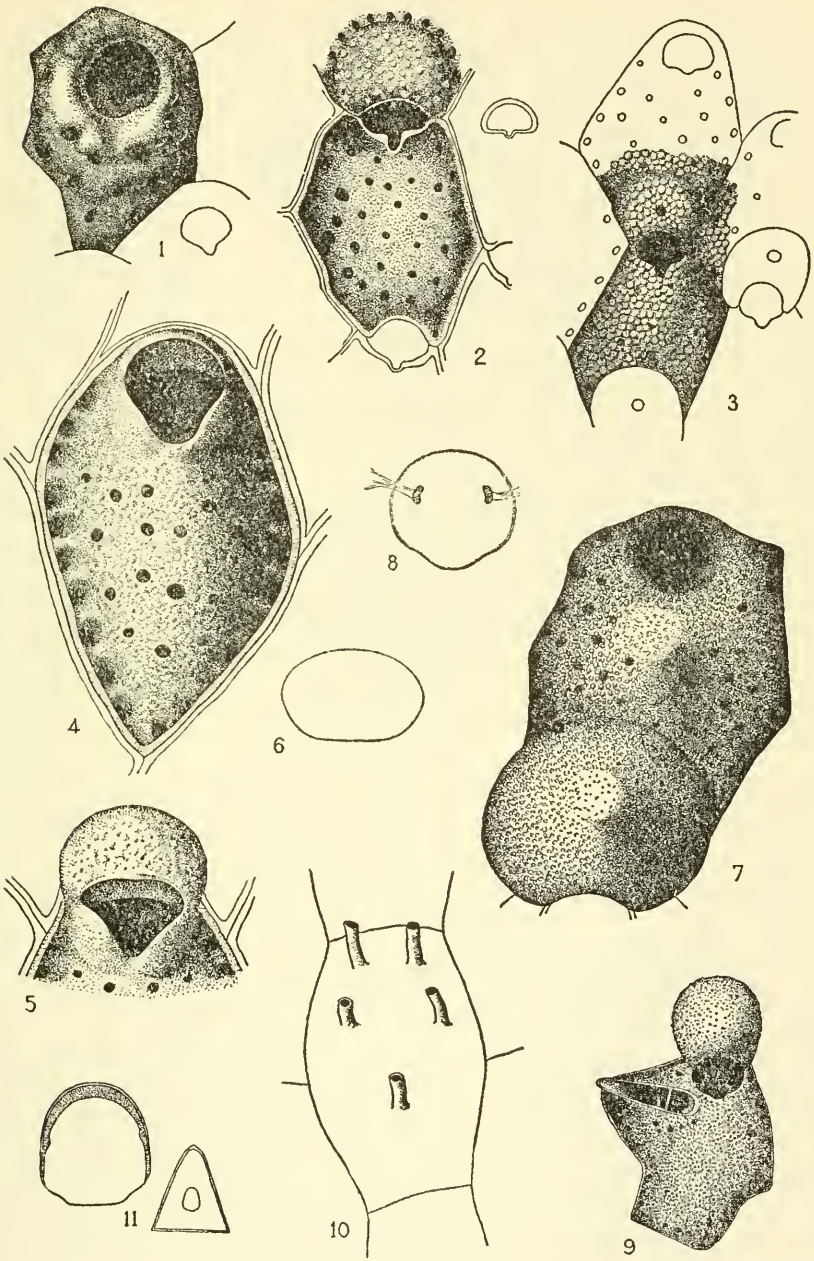
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PLATE 35

Fig. 1. *Robertsonidra oligopus* (Robertson), ovicell.

Fig. 2. *Cylindroporella tubulosa* (Norman), zooecia, ovicell and high peristome with ascopore.

Fig. 3. *Semihaswellia 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.

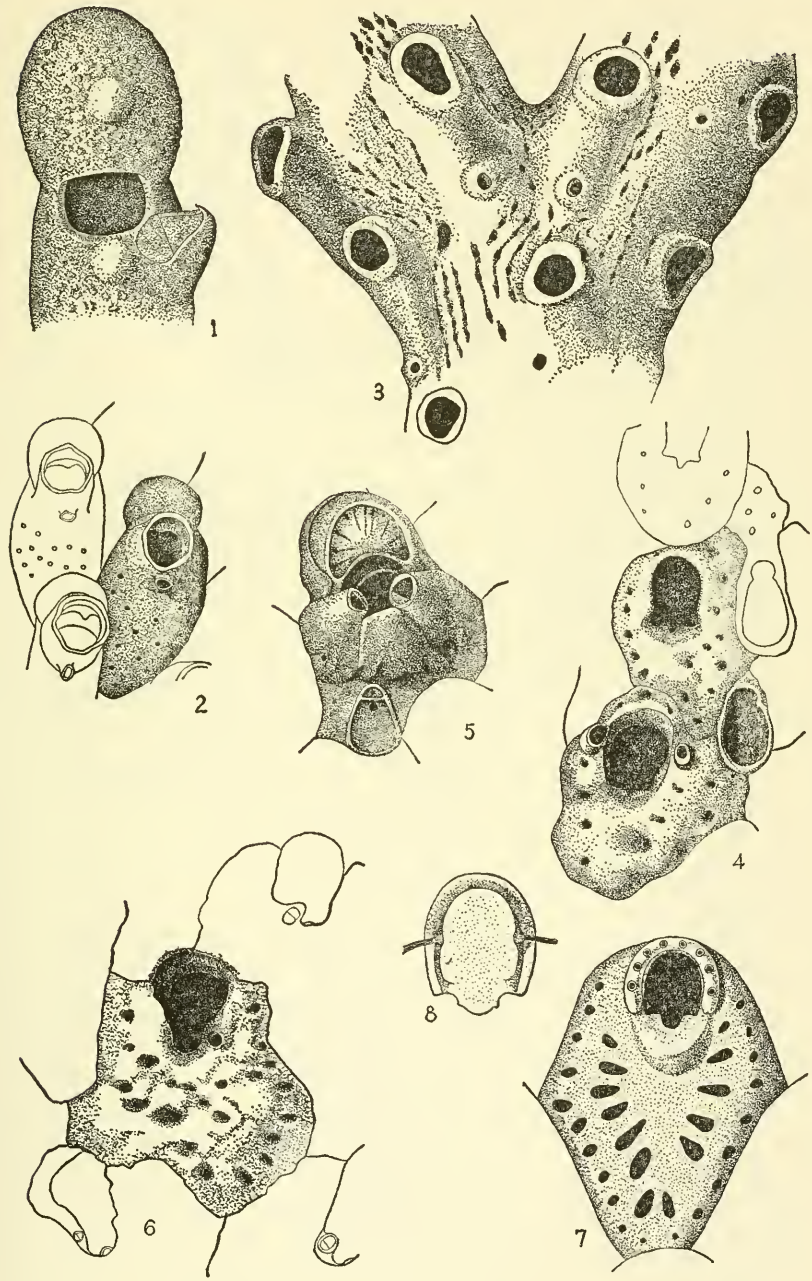
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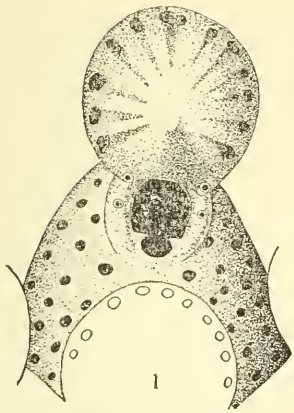
PLATE 36

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. *Ragionula 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.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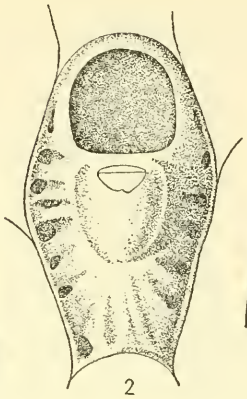
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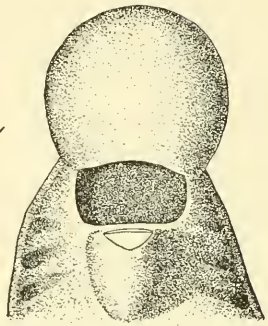
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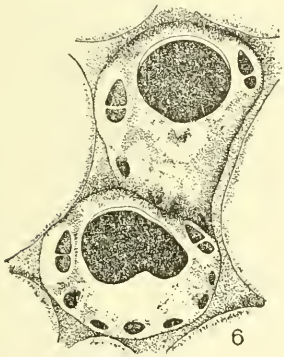
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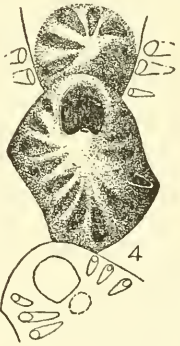
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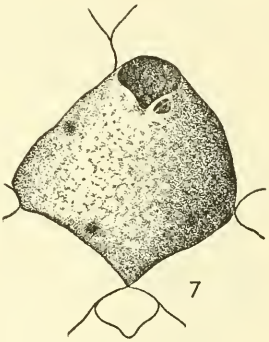
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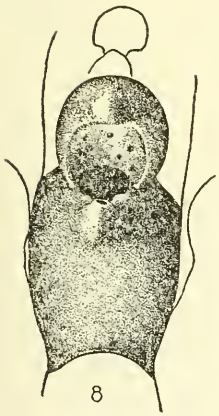
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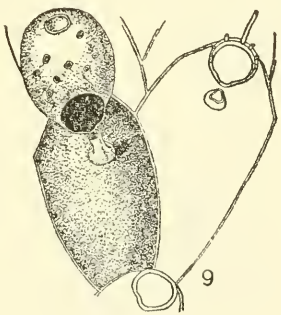
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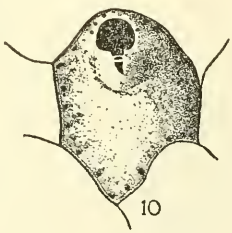
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PLATE 37

Fig. 1. *Schizoporella unicornis* (Johnston), infertile zooecium 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), zooecium with ovicell.

Fig. 5. The same, showing aperture and regularly roughened frontal.

Fig. 6. *Emballotheca altimuralis* new species, zooecium and ovicell.

Fig. 7. The same, details of aperture and high separating wall.

Fig. 8. *Schizoporella dissimilis* new species, marginal zooecium 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 zooecium 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.

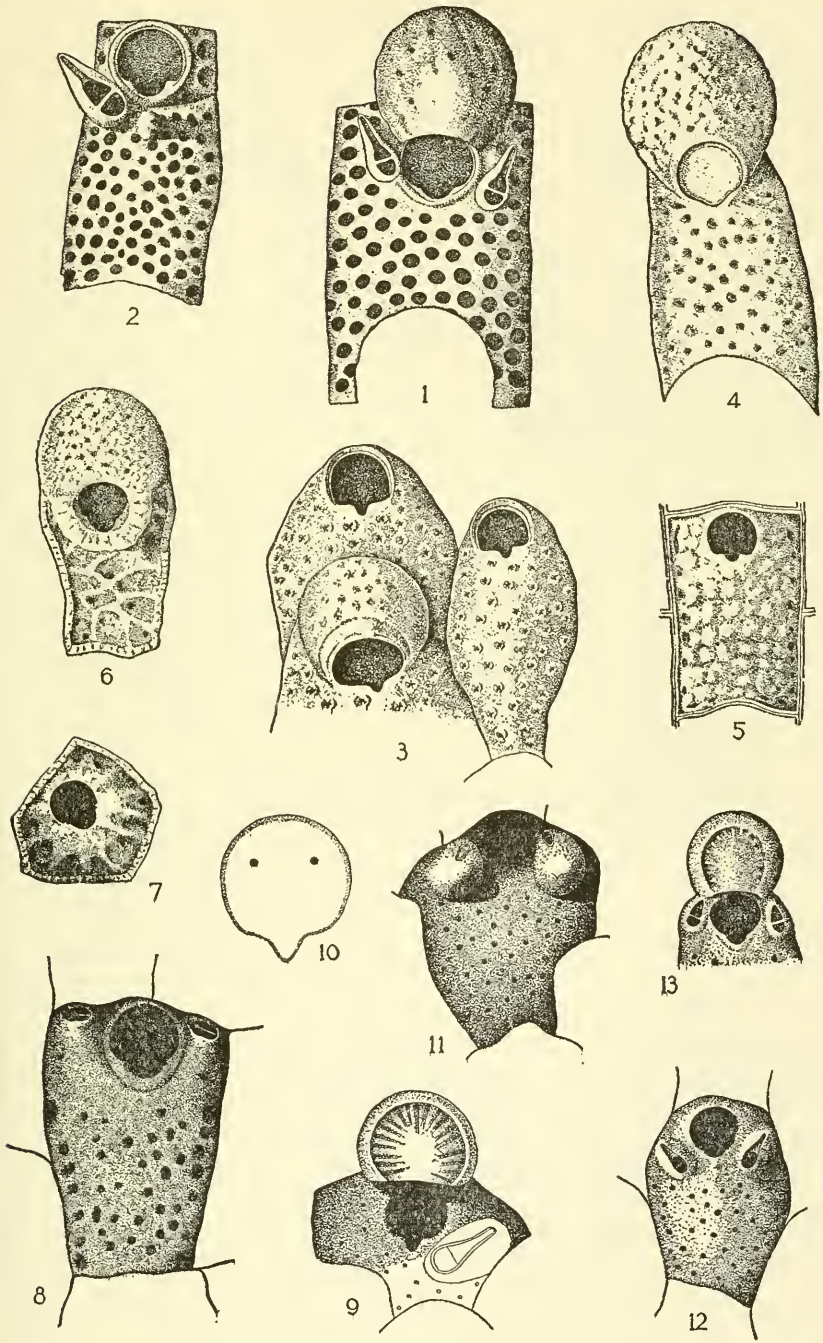
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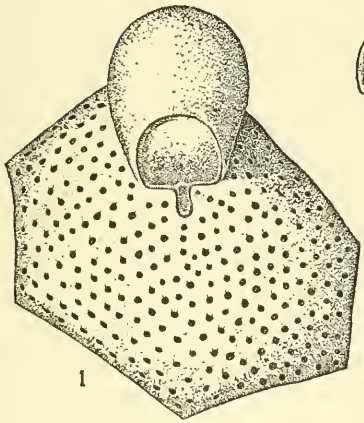
PLATE 38

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.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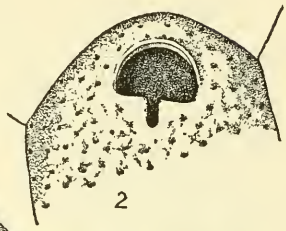
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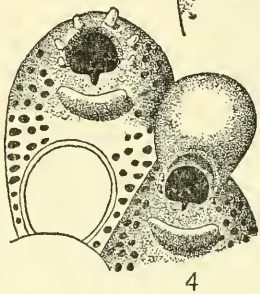
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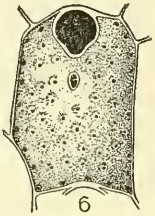
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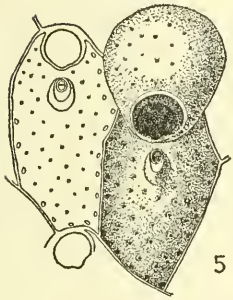
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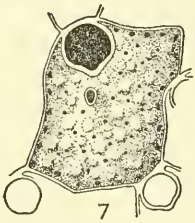
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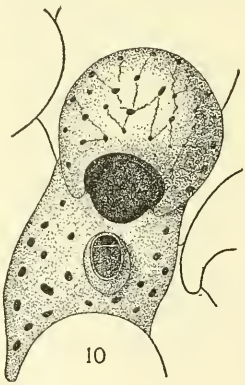
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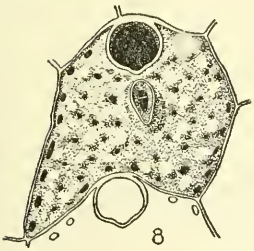
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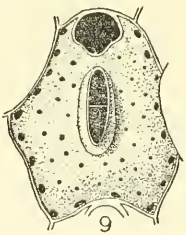
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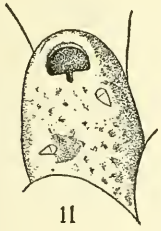
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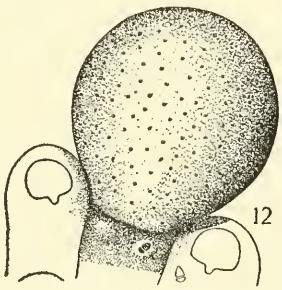
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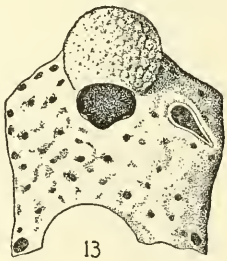
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PLATE 39

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), zooecium with ovicell.

Fig. 6. The same, details of aperture with two rows of oral spines.

Fig. 7. *Dakaria apertura* new species, infertile zooecium with rounded aperture.

Fig. 8. The same, ovicell with broader aperture and large area with irregular pores.

Fig. 9. The same, operculum of infertile zooecium.

Fig. 10. *Emballotheca latifrons* new species, showing form of aperture and small lateral-oral avicularia.

Fig. 11. The same, ovicell and avicularium distant from aperture.

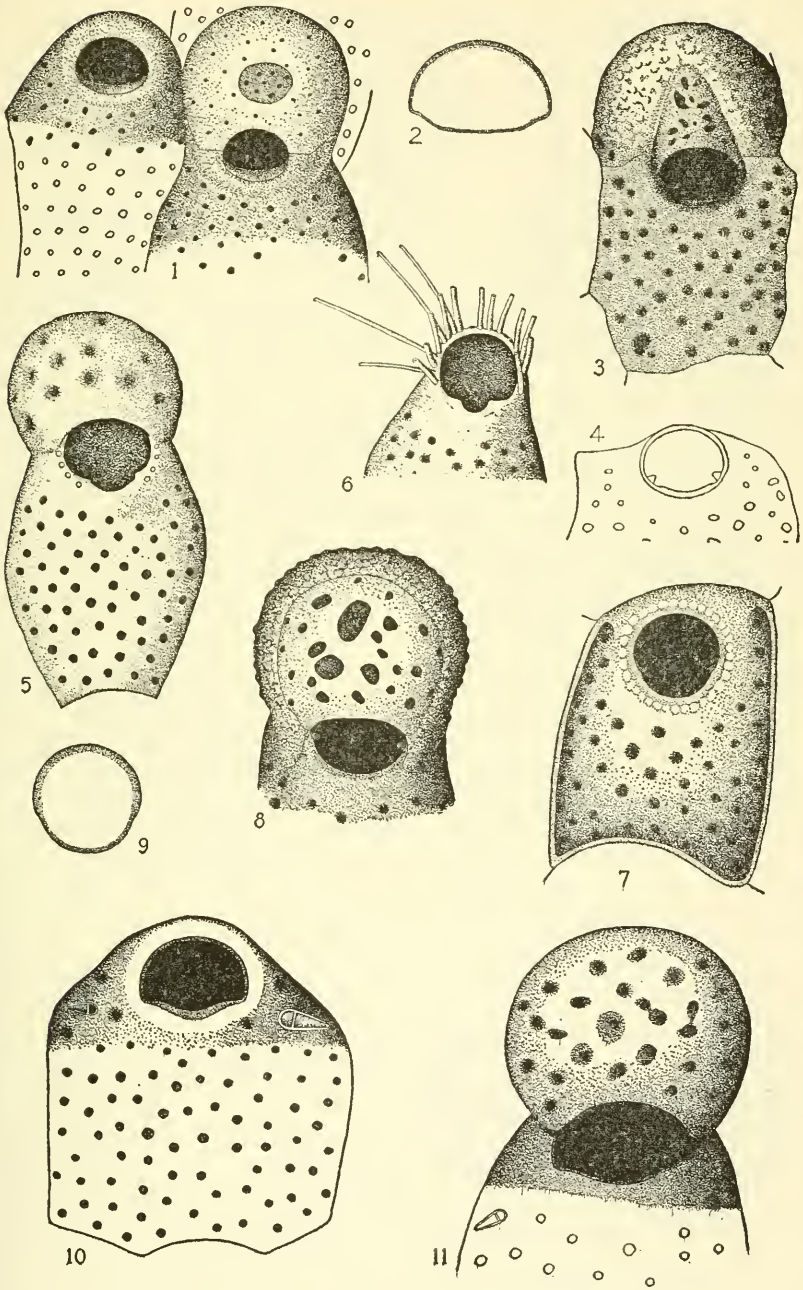
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PLATE 40

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. *Emballotheca obscura* new species, zooecia with ovicell, aperture and suboral avicularium.

Fig. 10. The same, operculum.

Fig. 11. *Gemelliporidra 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.

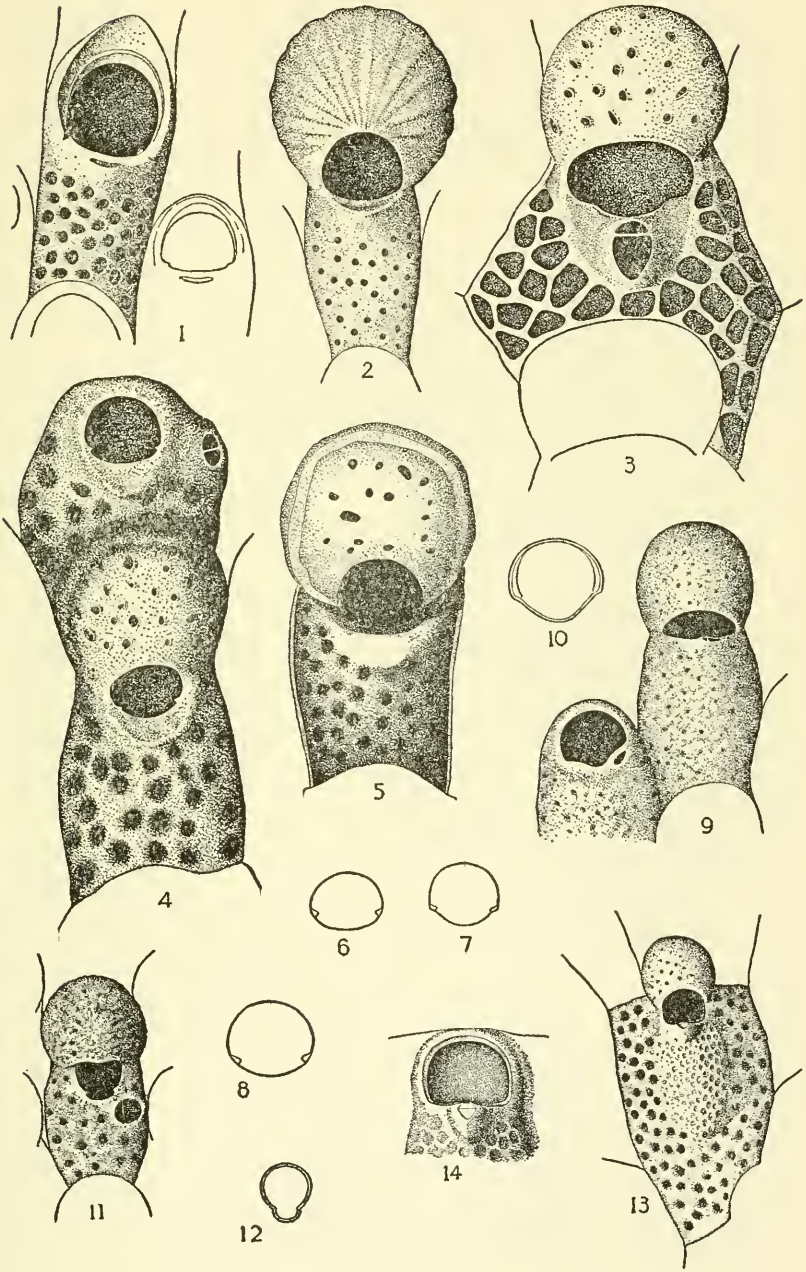
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PLATE 41

Fig. 1. *Hippoporina porcellana* (Busk), highly calcified zooecium 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), zooecium, aperture, spines and different types of avicularia.
Fig. 5. The same, ovicell.
Fig. 6. *Hippoporina ampla* new species, operculum.
Fig. 7. The same, zooecium 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 zooecium with two types of avicularia.
Fig. 11. The same, ovicells.
Fig. 12. The same, operculum.
Fig. 13. *Gemelliporina monilia* new species, zooecium, ovicell, aperture and graded spines.

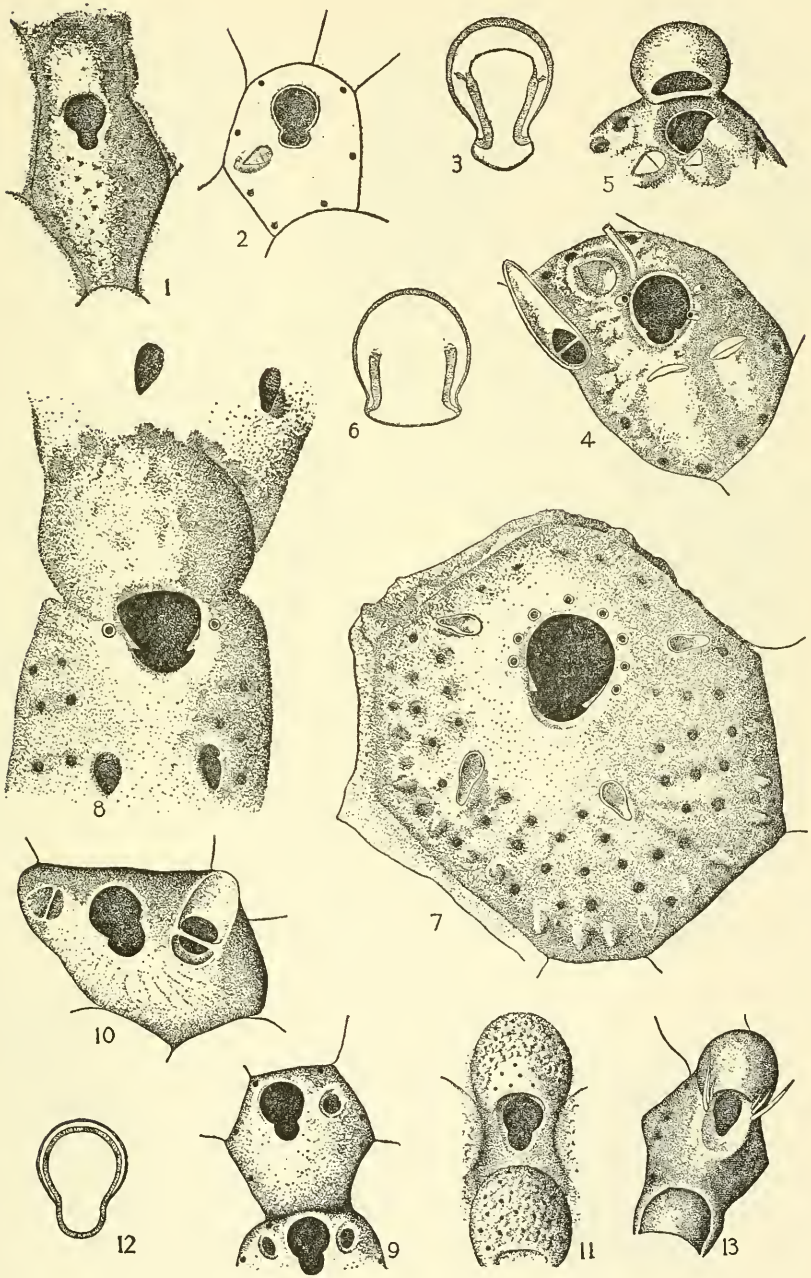
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PLATE 42

Fig. 1. *Stephanosella biaperta* (Michelin), infertile zooecium with aperture, lateral-oral avicularia and areolar pores.
Fig. 2. The same, ovicell and frontal avicularium.
Fig. 3. *Stephanosella bolini* new species, zooecium, aperture, oral and frontal avicularia.
Fig. 4. The same, ovicell and avicularia.
Fig. 5. The same, operculum.
Fig. 6. *Stephanosella vitrea* new species, infertile zooecium, 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 zooecium with details of aperture, spines, avicularium and encircling umbo.
Fig. 11. The same, operculum much enlarged.
Fig. 12. *Hippoporidra granulosa* Canu and Bassler, marginal zooecium showing spines, aperture and frontal granulation.
Fig. 13. The same, very advanced calcification.
Fig. 14. The same, operculum much enlarged.

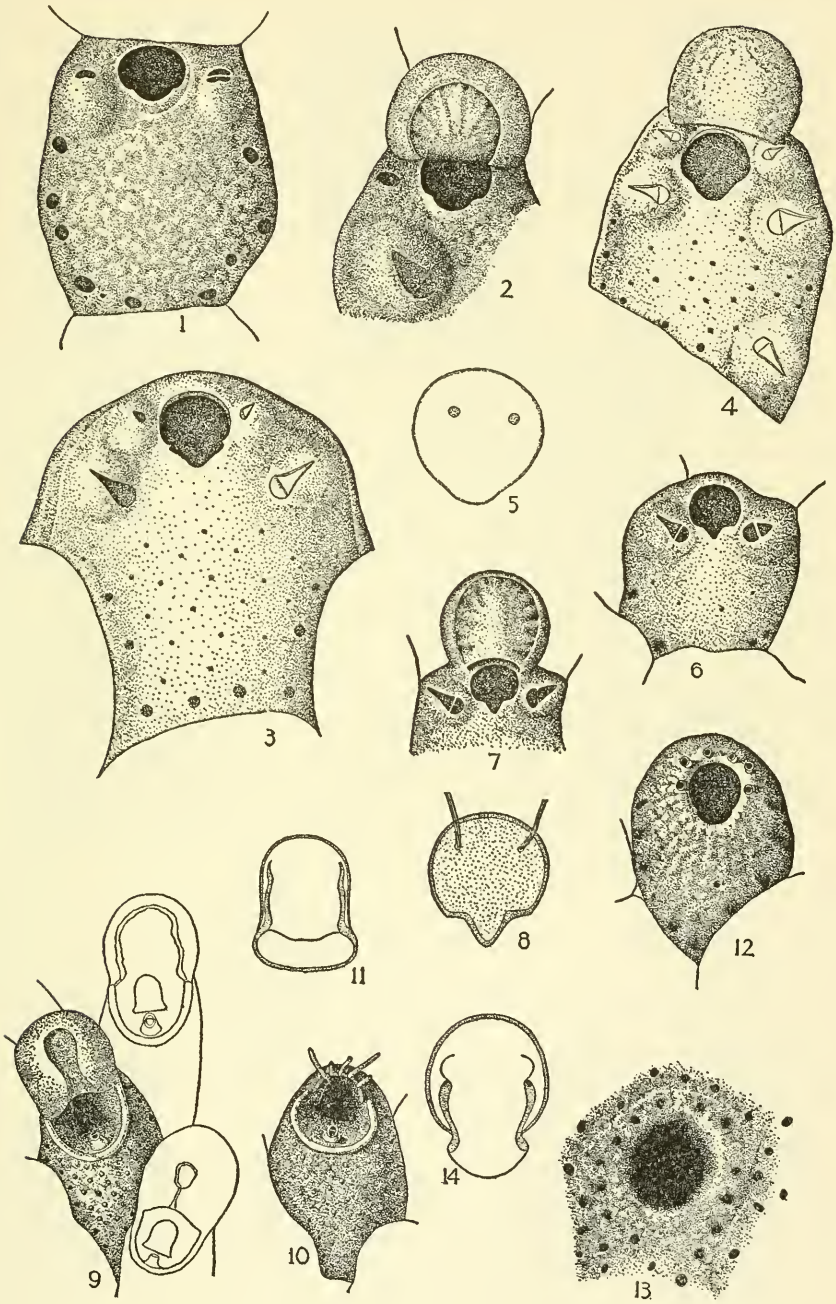
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PLATE 43

Fig. 1. *Hippomonavella longirostrata* (Hincks), zooecia, paired avicularia and ovicell.
Fig. 2. The same, details of frontal, aperture and avicularium.
Fig. 3. The same, operculum.
Fig. 4. *Hippomonavella 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.

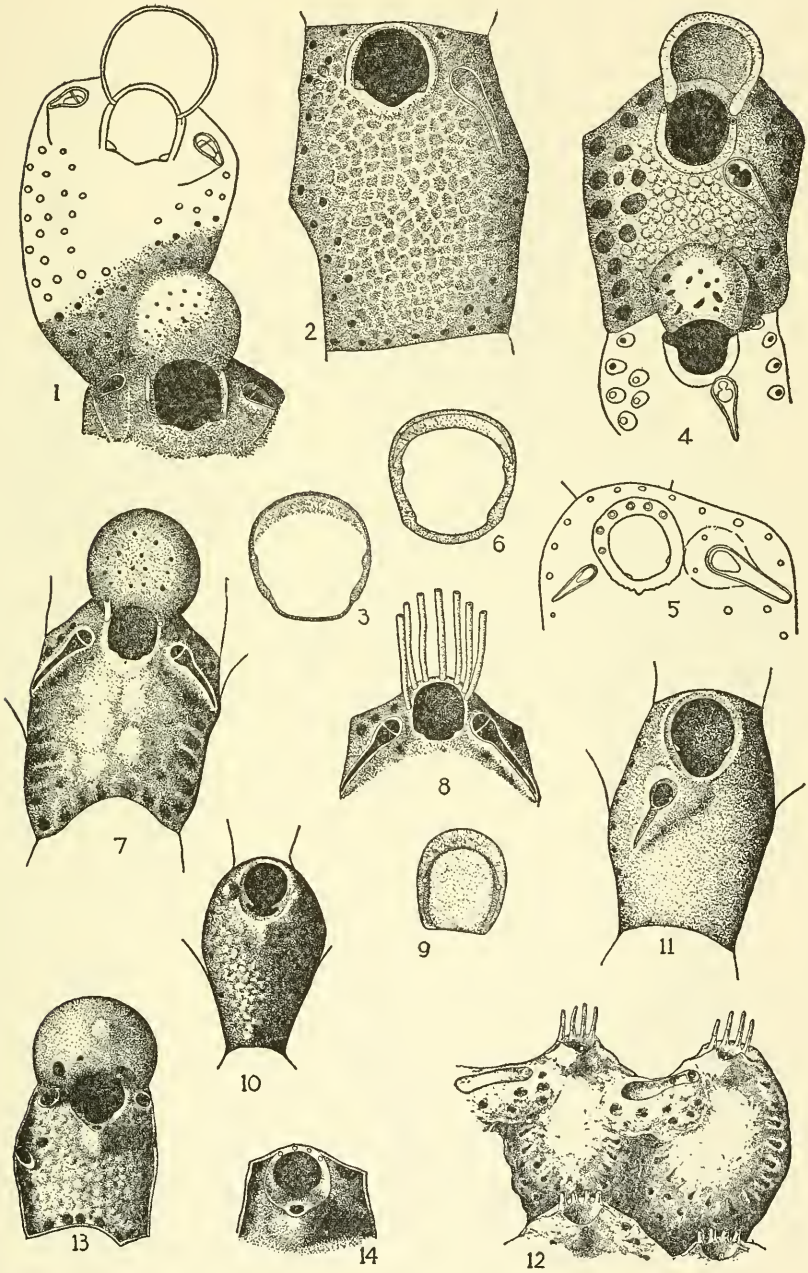
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PLATE 44

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.

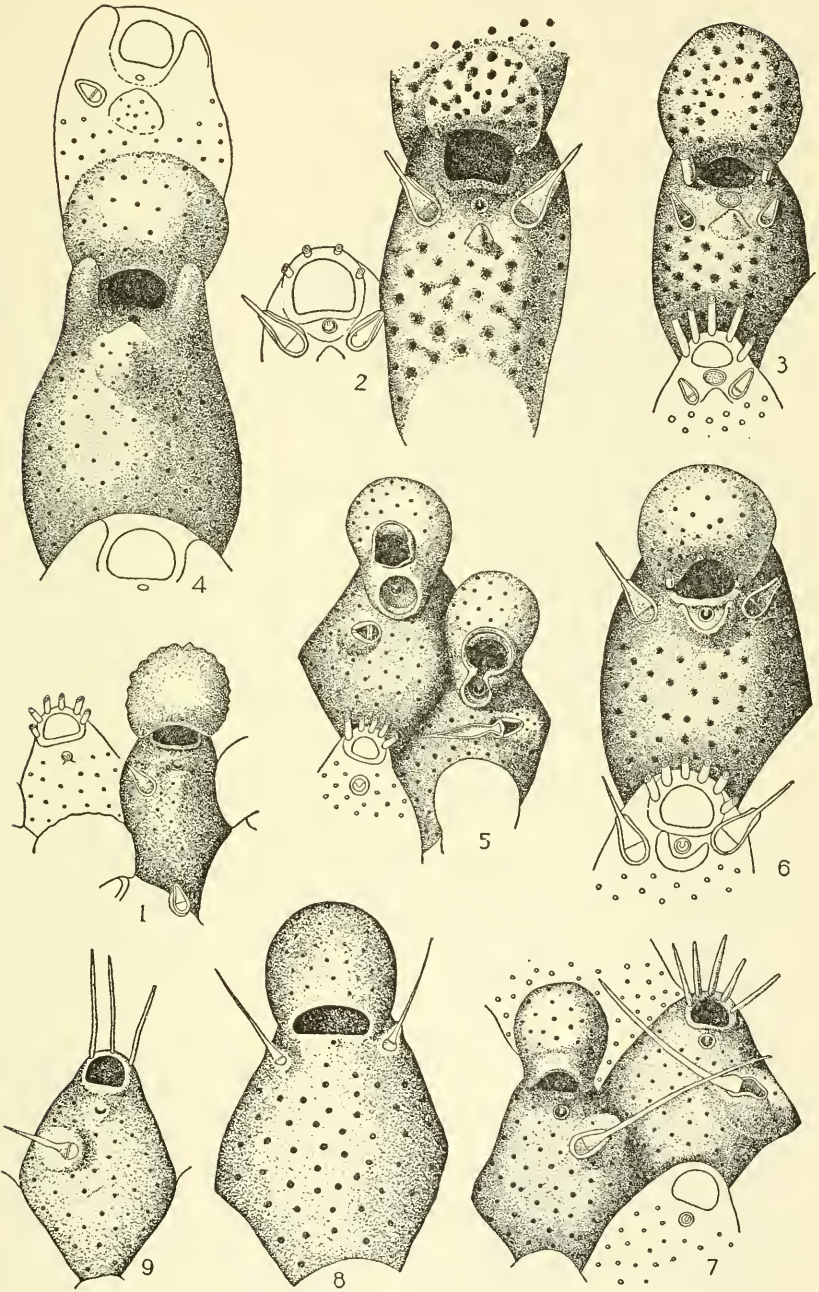
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PLATE 45

Fig. 1. *Microporella coronata* (Audouin), zooecium, 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 malusi* (Audouin), zooecium, and ovicell; note presence of pores between ascopore and aperture.

Fig. 4. *Hippoporella nitescens* (Hincks), zooecium, form of aperture and two types of avicularia.

Fig. 5. The same, operculum.

Fig. 6. *Hippoporella rimata* new species, zooecia, form of aperture with small avicularium and tubercles; ovicell with elongate membranous area.

Fig. 7. The same, operculum.

Fig. 8. *Hippoporella hippopus* (Smitt), zooecium with frontal tubercles, avicularium, spines and aperture.

Fig. 9. The same, operculum.

Fig. 10. *Hippoporella gorgonensis* Hastings, marginal zooecium showing spines and paired avicularia.

Fig. 11. The same, zooecium and ovicell in full calcification.

Fig. 12. The same, operculum, much enlarged.

Fig. 13. *Hippoporida janthina* (Smitt), young marginal zooecia.

Fig. 14. The same, zooecium of secondary layer with ovicell.

Fig. 15. The same, operculum, greatly enlarged.

Fig. 16. *Aimulosia uvulifera* (Osburn), young zooecium, showing aperture, avicularium and simple umbonate process.

Fig. 17. The same, complete calcification, with ovicell.

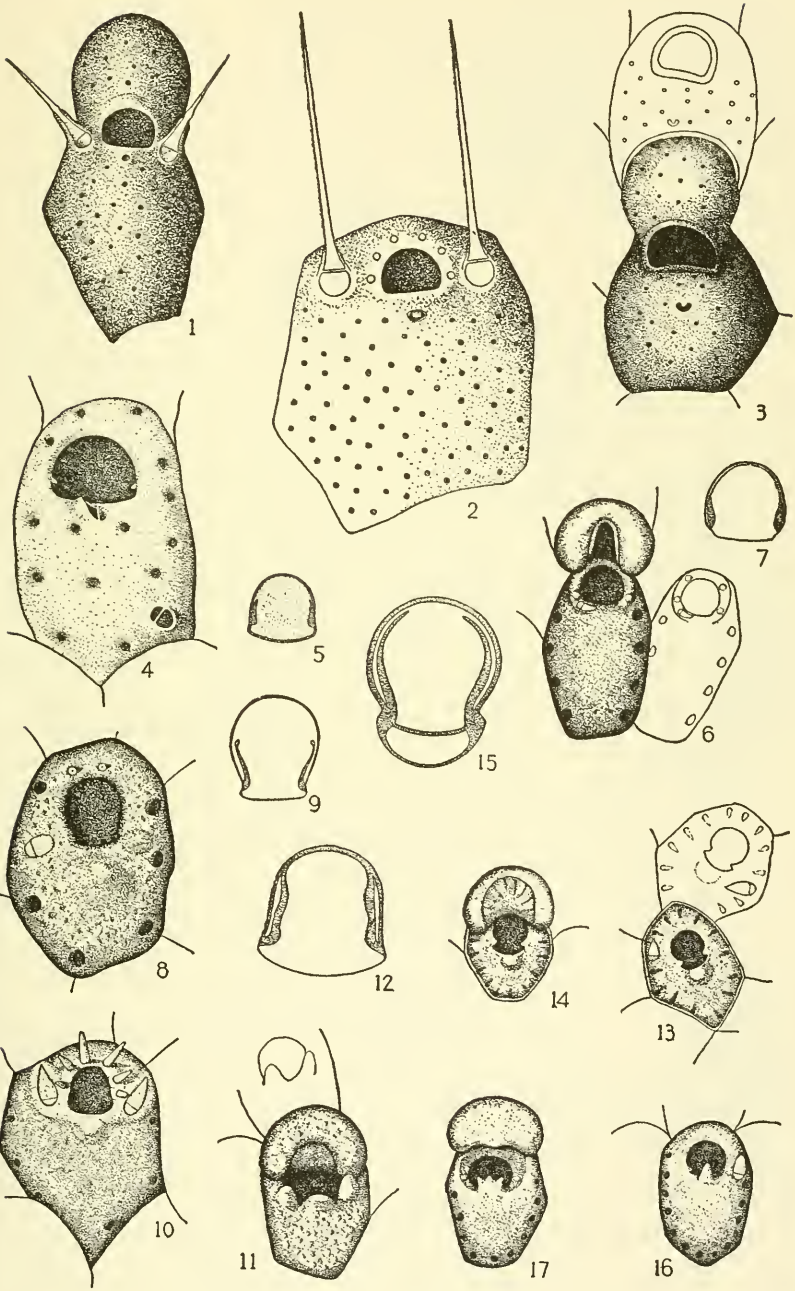
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PLATE 46

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.

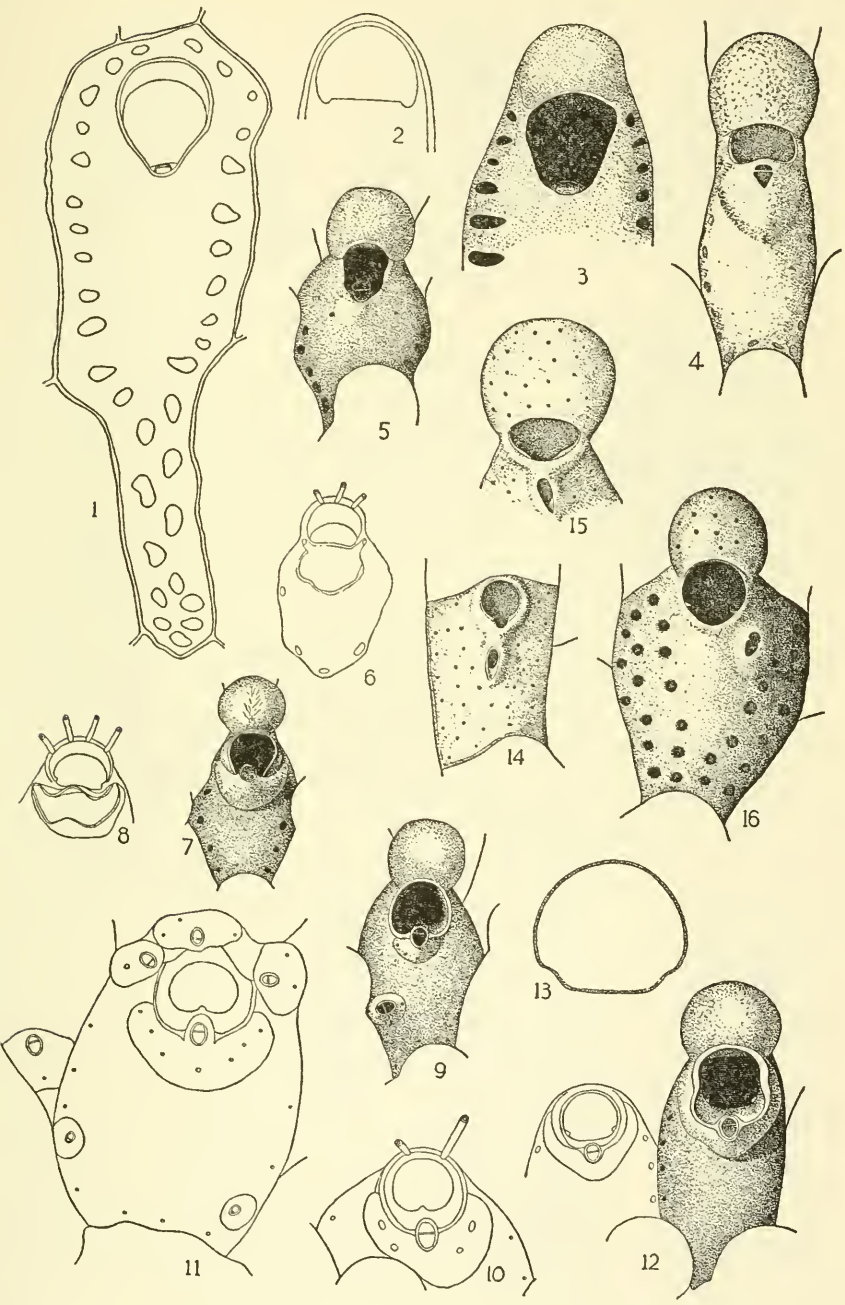
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PLATE 47

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.

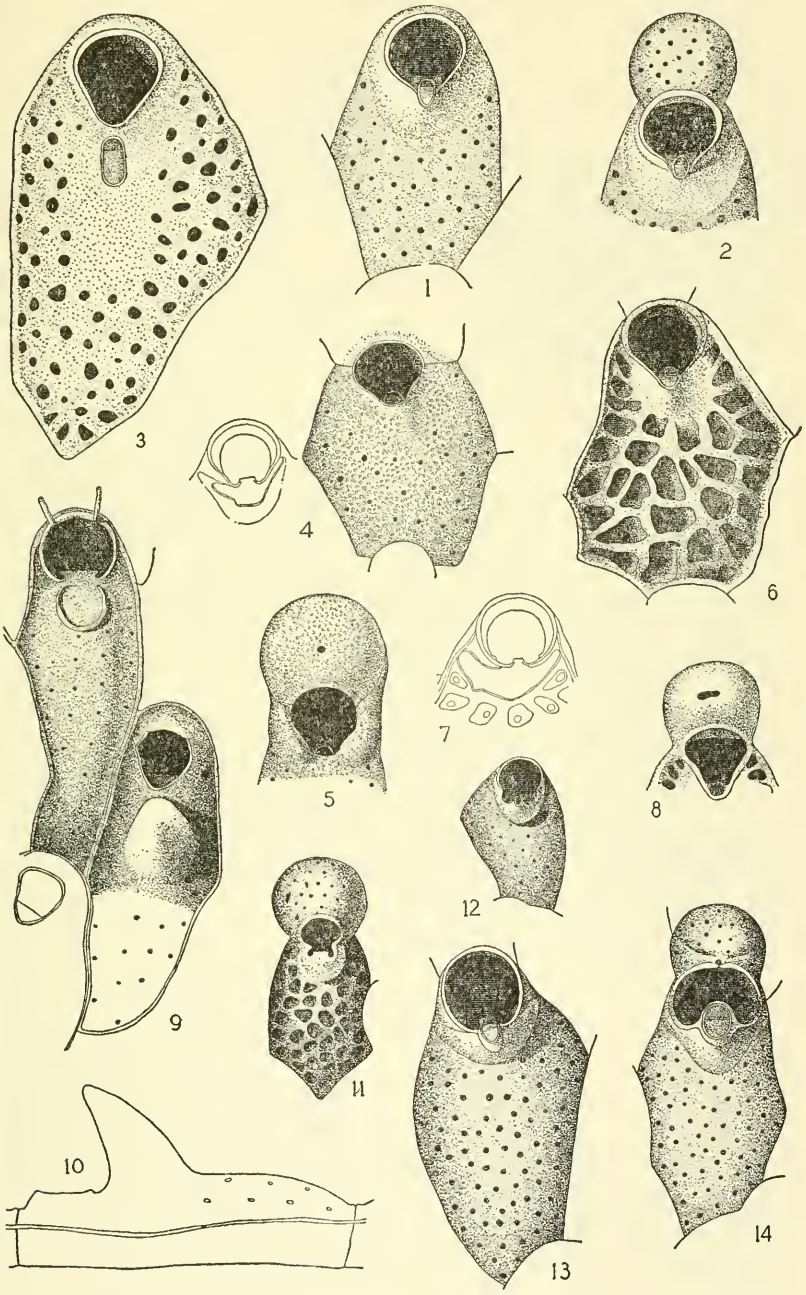
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PLATE 48

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.

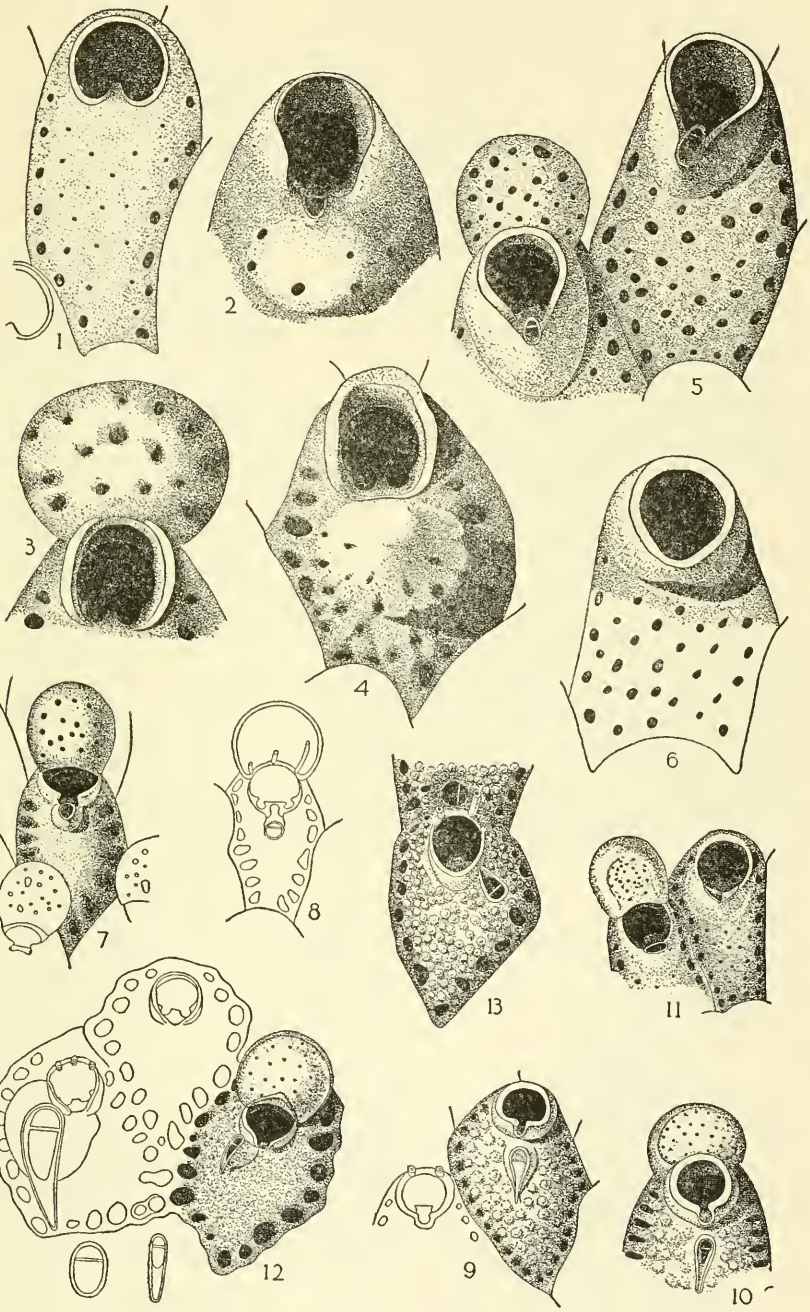
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PLATE 49

Fig. 1. *Parasmittina tubulata* new species, zooecium 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), zooecium, details of aperture, avicularia and spines.
Fig. 6. The same, ovicell.
Fig. 7. *Parasmittina trispinosa* (Johnston), zooecium, ovate avicularium.
Fig. 8. The same, characteristic large pointed avicularium.
Fig. 9. *Parasmittina collifera* (Robertson), zooecium, 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), zooecium 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, zooecium and depressed ovicell, with details of aperture and avicularia.

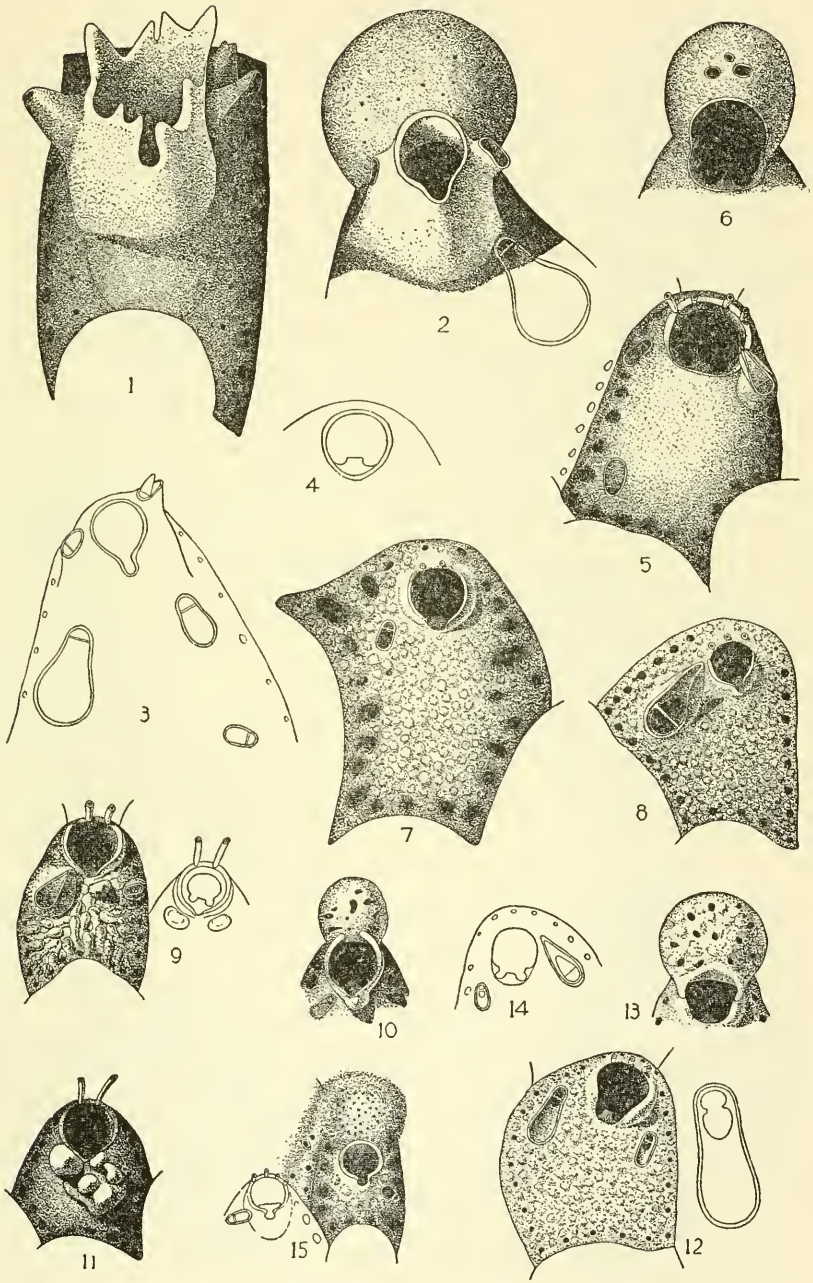
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PLATE 50

Fig. 1. *Rhamphostomella fortissima* Bidenkap, zooecium, ovicell and avicularia; reduced one-half.

Fig. 2. The same, giant avicularium, not reduced.

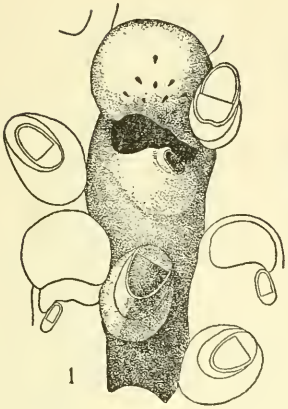
Fig. 3. *Rhamphostomella hincksi* Nordgaard, zooecium with ovicell.

Fig. 4. *Rhamphostomella curvirostrata* O'Donoghue, showing the lyrula, ovicell and avicularium.

Fig. 5. *Rhamphostomella gigantea* new species, showing aperture, ovicell, avicularium and costate front with a few pores, reduced one-half.

Fig. 6. *Rhamphostomella ovata* (Smitt), zooecium with scattered pores, aperture and avicularium.

Fig. 7. *Rhamphostomella costata* Lorenz, zooecium, avicularian umbo and aperture.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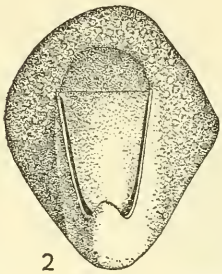
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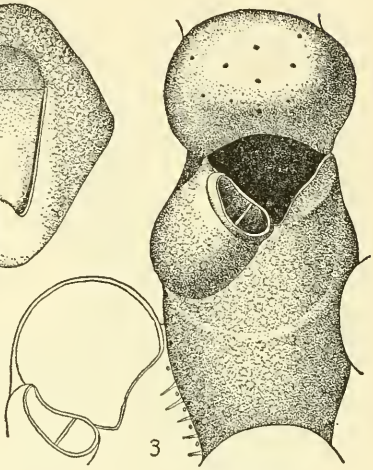
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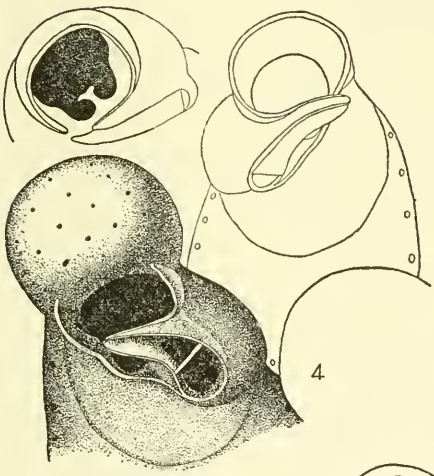
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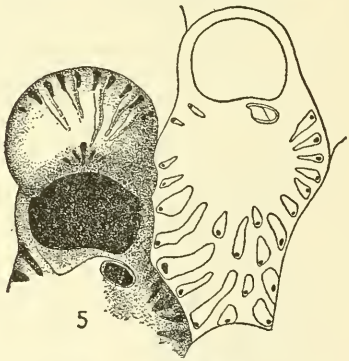
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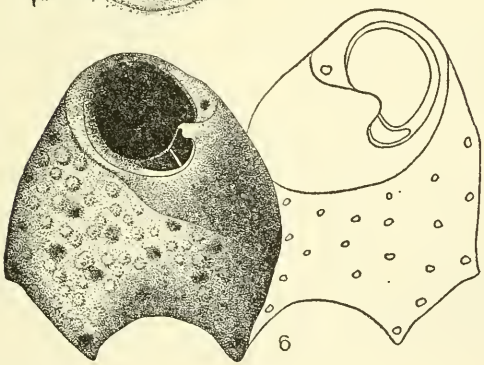
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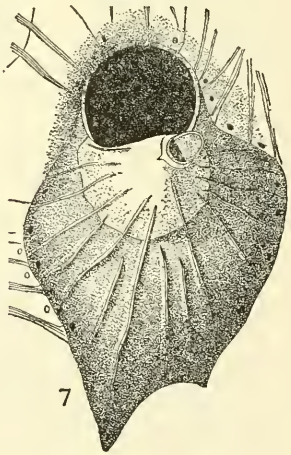
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PLATE 51

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.

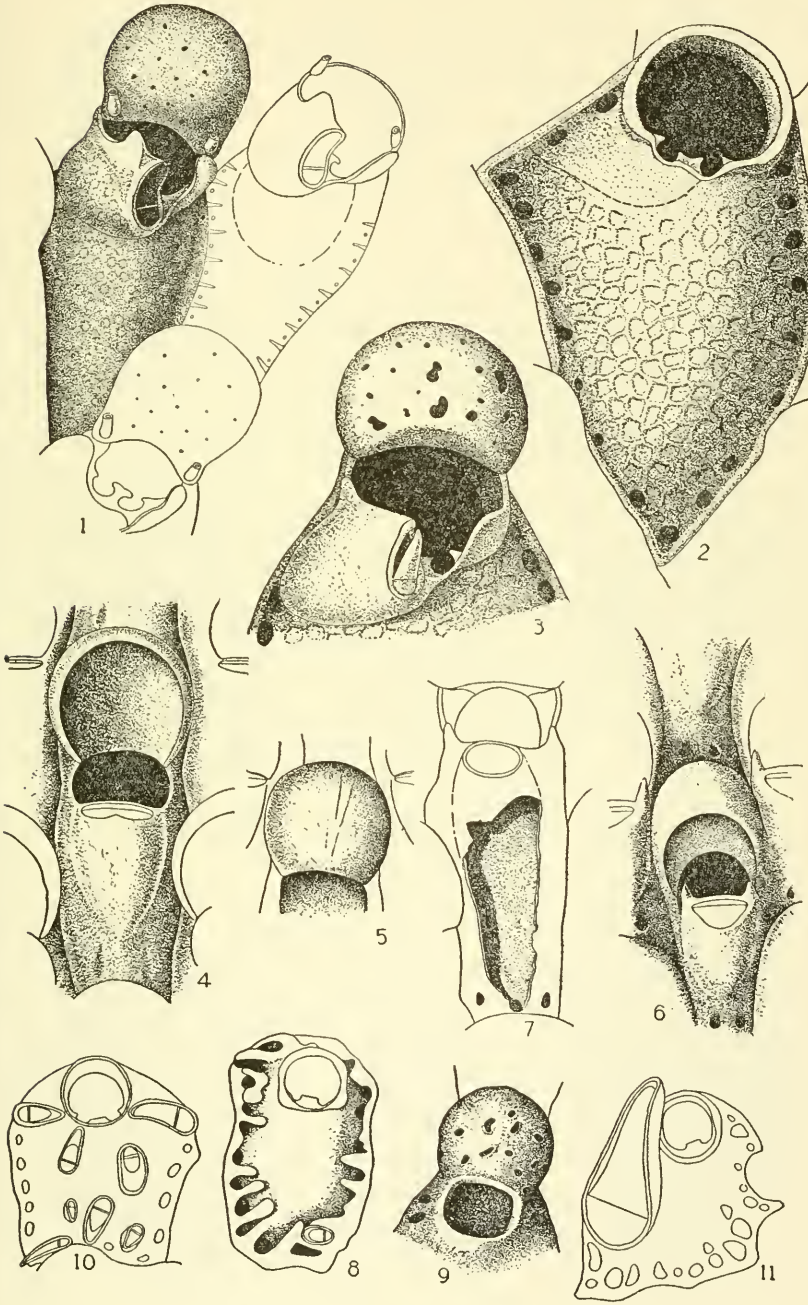
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PLATE 52

Fig. 1. *Mucronella labiata* (Boeck), zooecium with ovicell.

Fig. 2. The same, diagramatic side view.

Fig. 3. *Mucronella ventricosa* (Hassall), zooecium, ovicell and details of aperture.

Fig. 4. *Mucronella major* (Hincks), zooecium 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), zooecium and ovicell.

Fig. 7. The same, diagram of young marginal zooecium showing details of aperture and the very elongate dietellae.

Fig. 8. *Hemicyclopora polita* (Norman), zooecium and ovicell.

Fig. 9. *Rhamphostomella cellata* (O'Donoghue), with details of aperture; note especially the minute avicularium conforming to the peristomial rim.

Fig. 10. *Rhamphostomella bilaminata* (Hincks), zooecium with ovicell; note secondary aperture with high peristomial lappet and elevated avicularium.

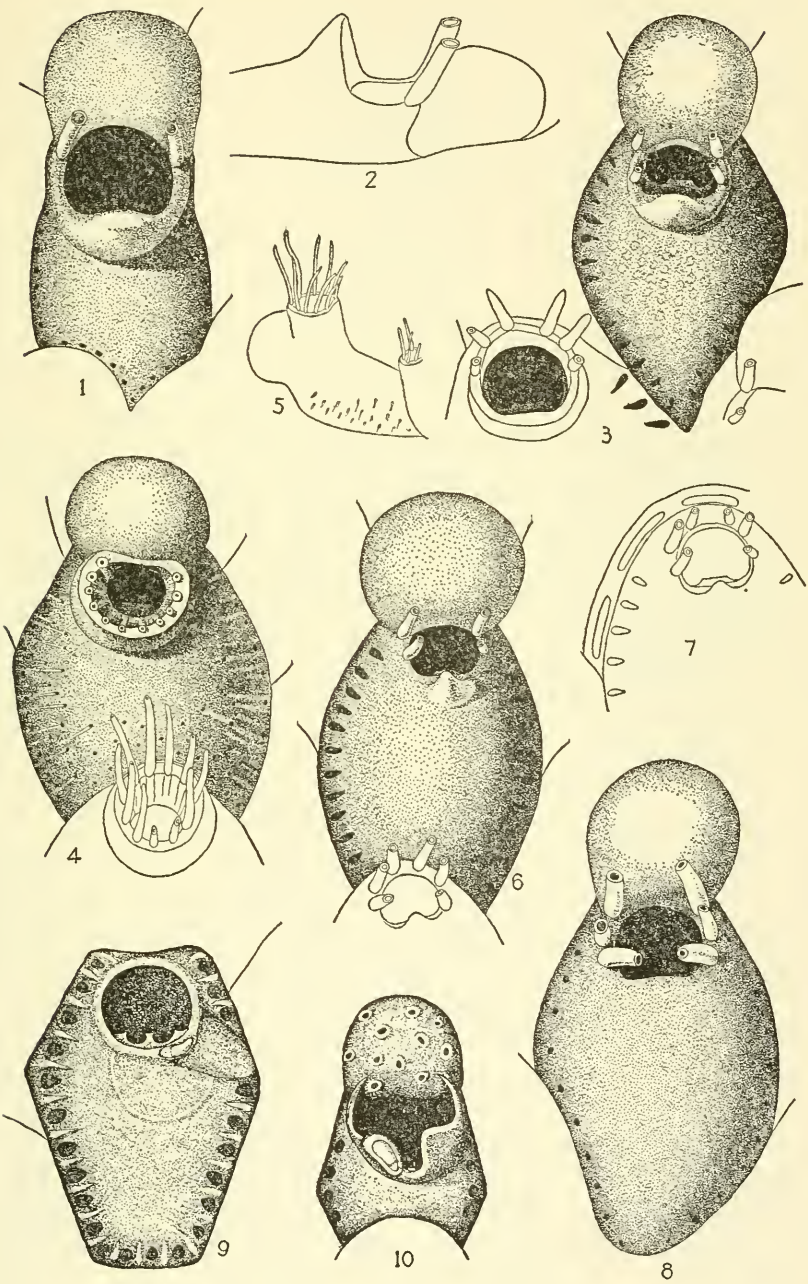
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PLATE 53

Fig. 1. *Phidolopora pacifica* (Robertson), zooecium with ovicell and large frontal avicularium.

Fig. 2. The same, zooecium and ovicell from another part of the same colony.

Fig. 3. *Lepraliella contigua* (Smitt), old zooecium with ovicell partially covered by adjoining zooecia.

Fig. 4. The same, young marginal zooecium showing spines, form of aperture and developing avicularian chamber.

Fig. 5. *Lepraliella bispina* (O'Donoghue), young zooecium 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 zooecia.

Fig. 8. *Reteporellina denticulata gracilis* new variety, adult zooecium with ovicell, labial avicularium and ovate frontal avicularium.

Fig. 9. The same, young zooecium.

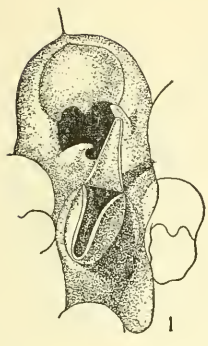
Fig. 10. The same, dorsal zooeciule (kenozooecium) with ovate avicularium.

Fig. 11. *Reteporellina bilabiata* new species, adult zooecium with ovicell, large pointed frontal avicularium and high lateral oral flanges.

Fig. 12. The same, young zooecium at tip of branch.

Fig. 13. The same, dorsal zooeciule with pointed avicularium.

Fig. 14. The same, habit sketch showing form of branching.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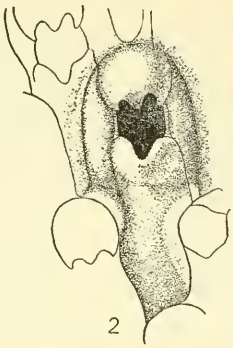
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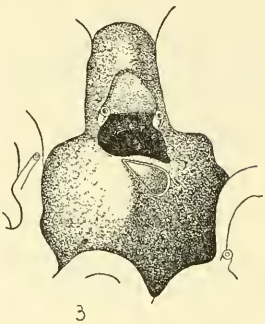
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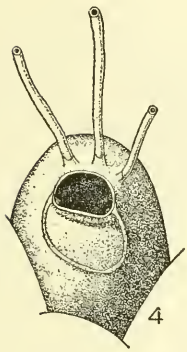
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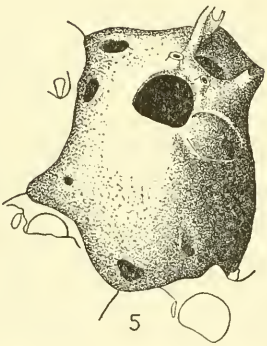
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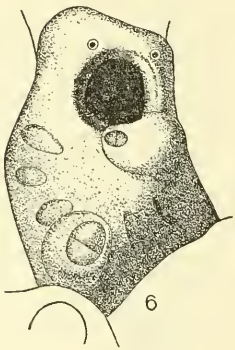
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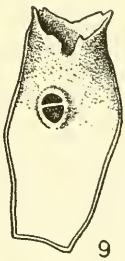
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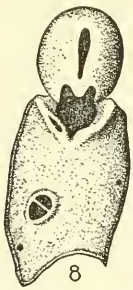
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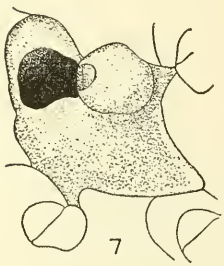
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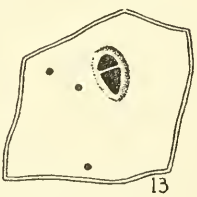
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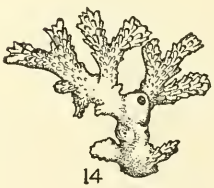
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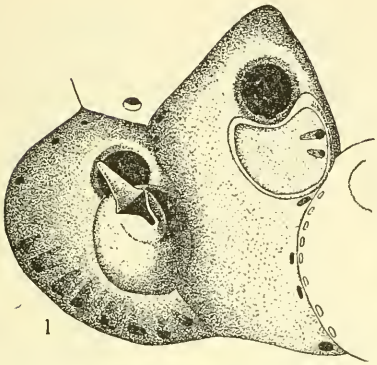
PLATE 54

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.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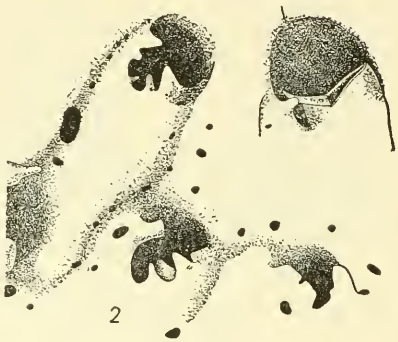
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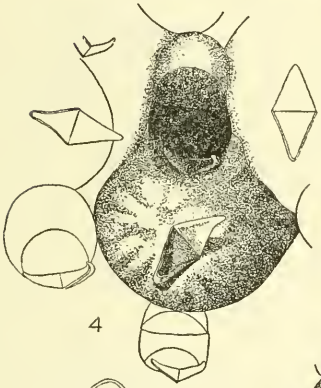
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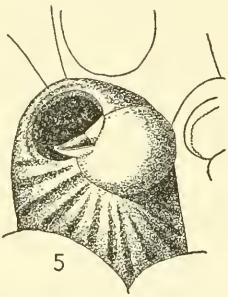
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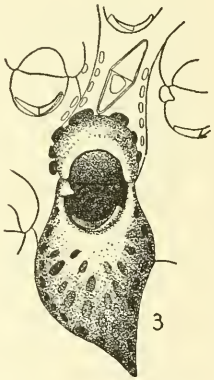
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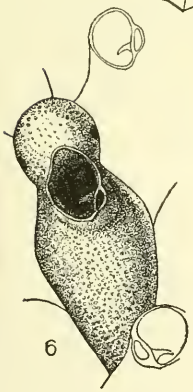
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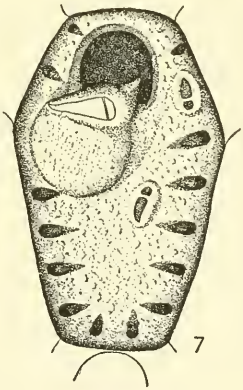
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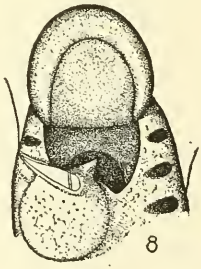
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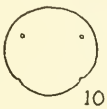
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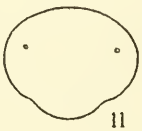
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PLATE 55

Fig. 1. *Rhynchozoon spicatum* new species, zooecium 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, zooecium with ovicell and tall erect umbo.

Fig. 5. *Schizotheca fissurella* (Hincks), zooecium with ovicell and frontal avicularium.

Fig. 6. *Rhynchozoon bispinosum* (Johnston), young zooecia, form of aperture, position of spines and avicularia.

Fig. 7. The same, older zooecium of secondary layer with ovicell.

Fig. 8. *Hippoporidra spiculifera* (Canu and Bassler), young zooecia with spines and frontal avicularium.

Fig. 9. The same, older zooecium 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 zooecium, spines, form of aperture, suboral avicularium, form and position of frontal avicularium.

Fig. 13. *Gemelliporella aviculifera* new species, zooecia with ovicell and erect pedicellate avicularian chamber.

Fig. 14. *Gemelliporidra lata* new species, zooecia, form of aperture, ordinary frontal avicularia and giant avicularium.

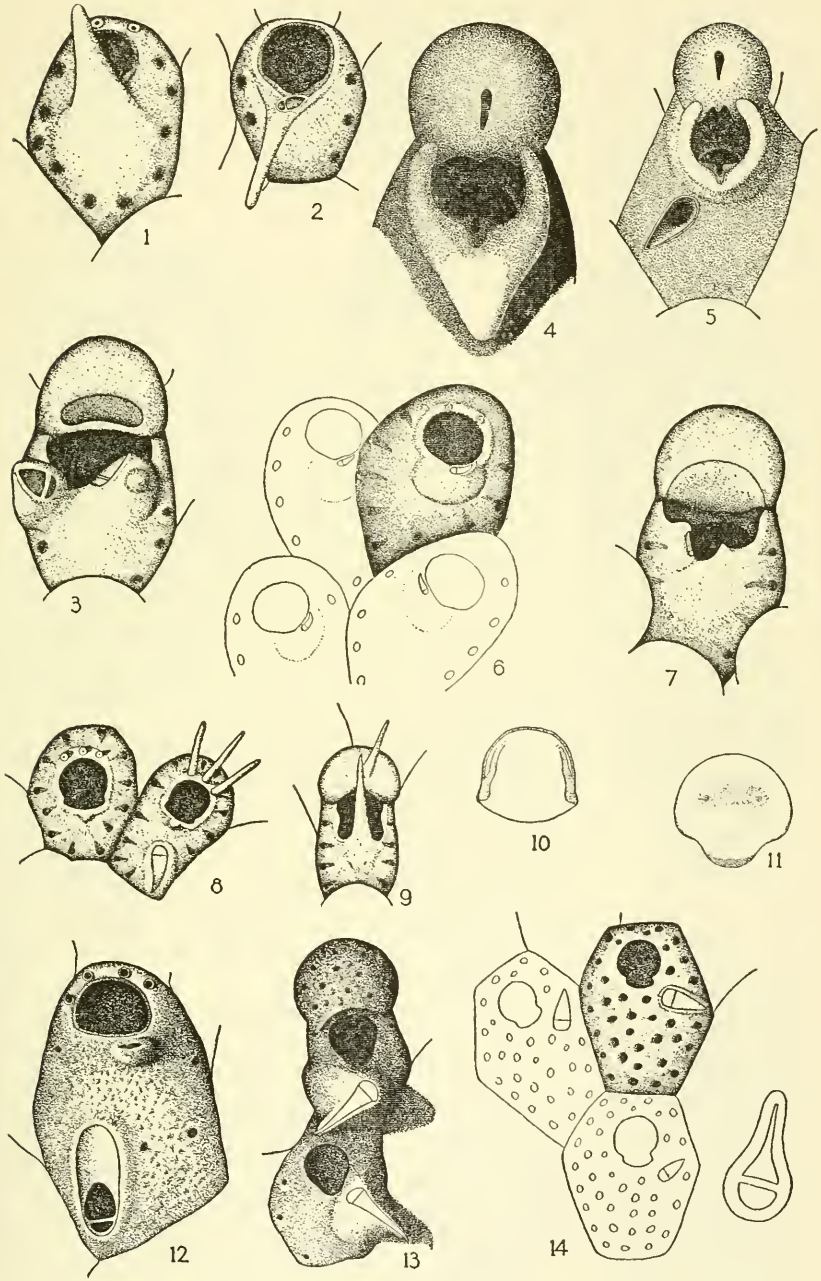
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PLATE 56

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 ½.
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.

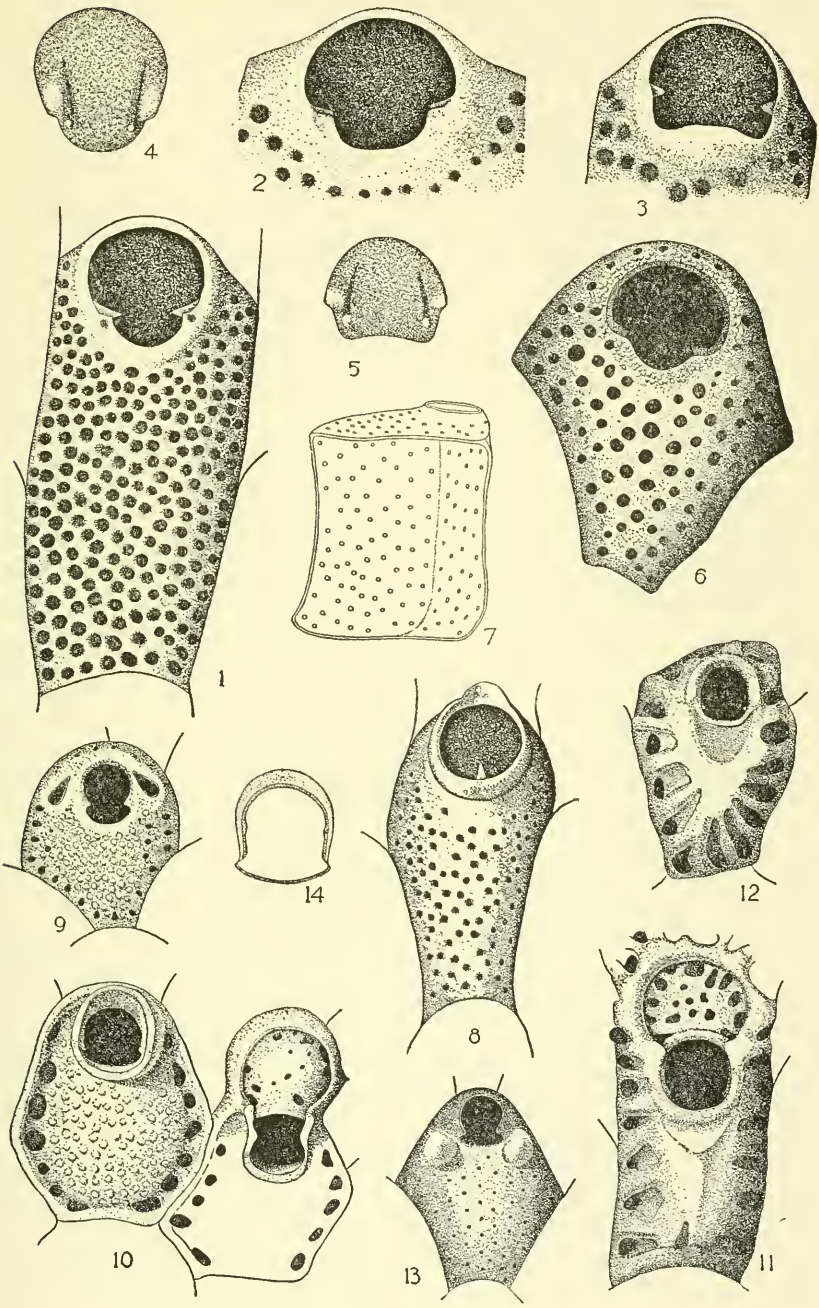
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PLATE 57

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.*

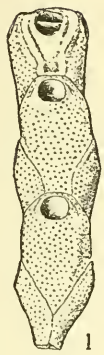
Fig. 9. The same, operculum.

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.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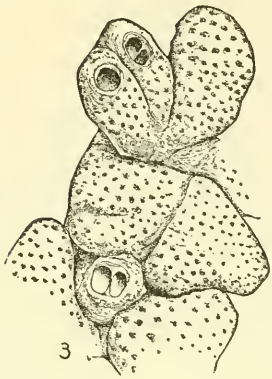
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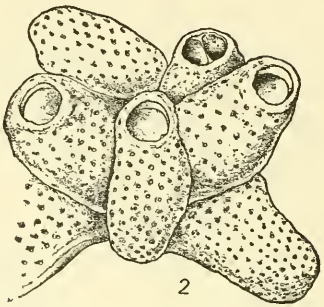
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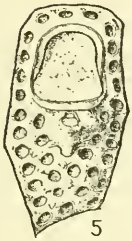
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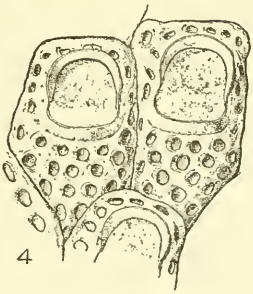
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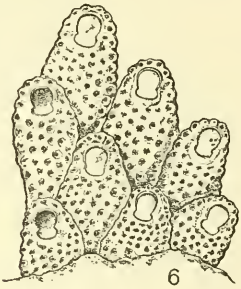
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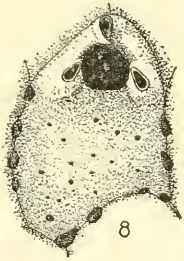
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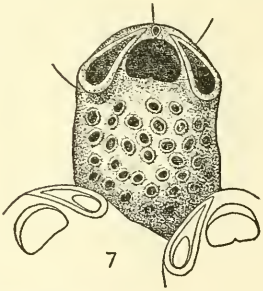
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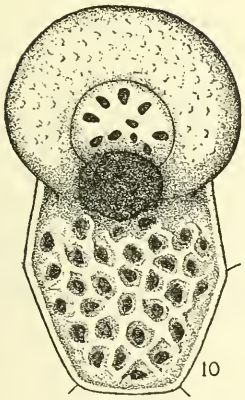
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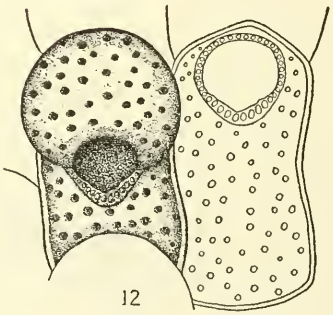
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PLATE 58

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), zooecium with large elongate vibraculum.

Fig. 5. *Eurystomella bilabiata* (Hincks), infertile zooecium.

Fig. 6. *Adeona violacea* (Johnston), adult zooecium 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 gonozooecium with ovicell and wide aperture.

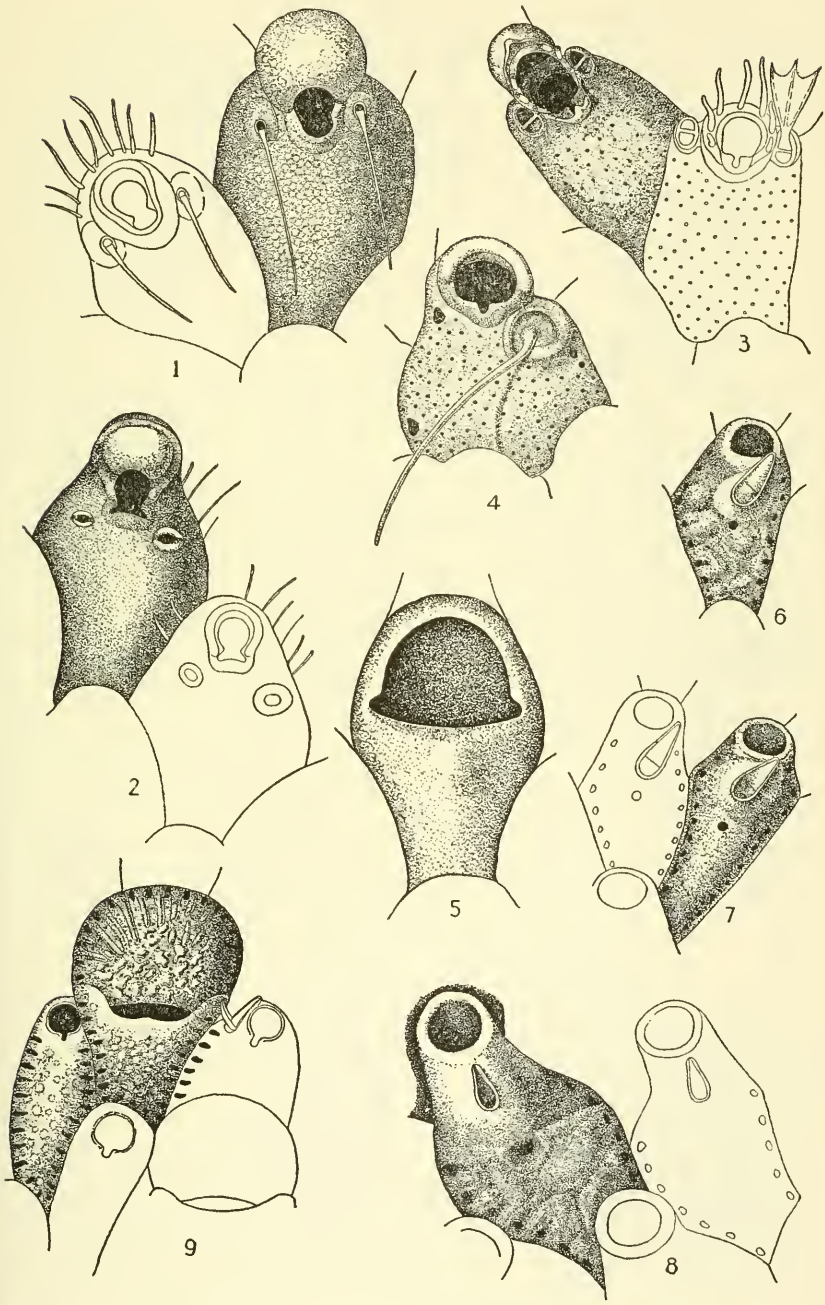
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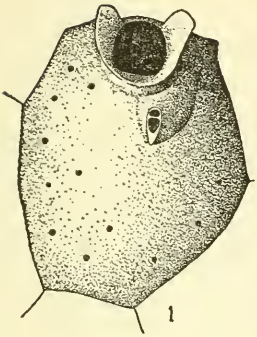
PLATE 59

Fig. 1. *Phylactella aperta* new species, zooecium, aperture and asymmetrical avicularium.
Fig. 2. The same, ovicell and symmetrical avicularium.
Fig. 3. *Phylactella alulata* new species, zooecium 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 zooecium.
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.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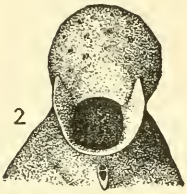
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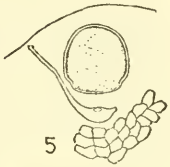
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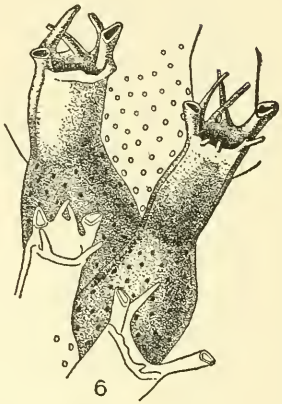
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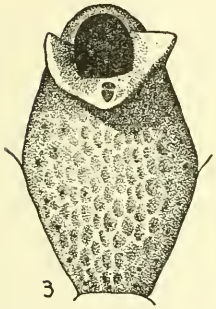
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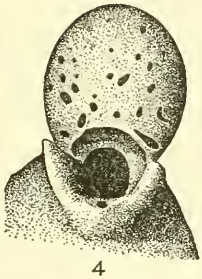
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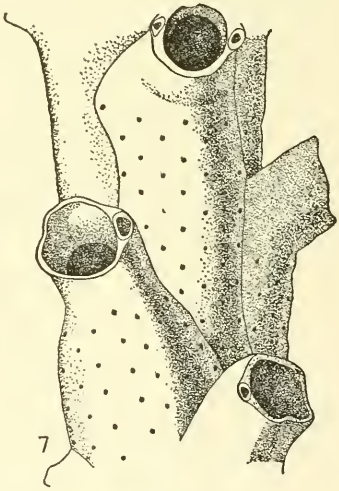
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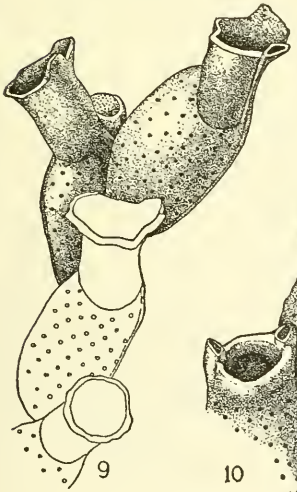
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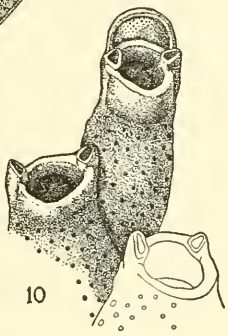
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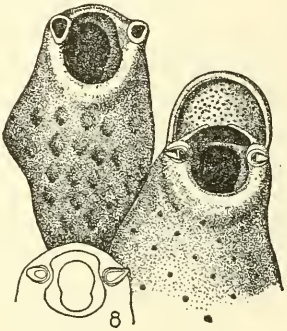
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PLATE 60

Fig. 1. *Lagenipora punctulata* (Gabb and Horn), portion of erect branch, reduced ½.

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.

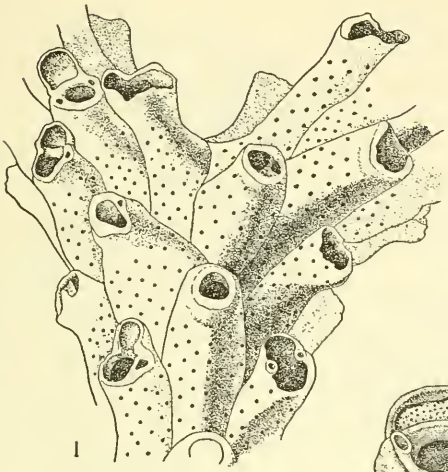
Fig. 5. *Lagenipora hippocrepis* (Busk), young zooecia with ovicell.

Fig. 6. The same, diagram of side view.

Fig. 7. *Trematooecia hexagonalis* (Canu and Bassler), zooecium with ovicell and spinous tubercles.

Fig. 8. *Trematooecia 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.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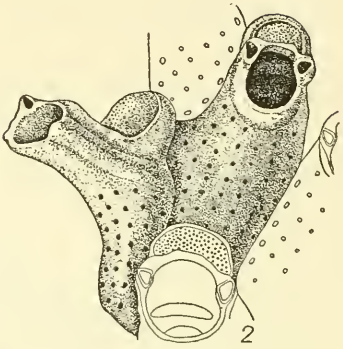
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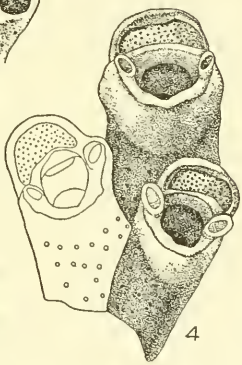
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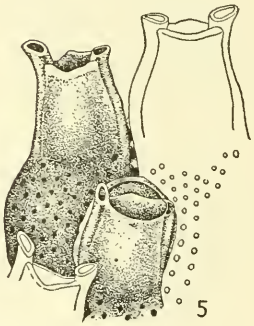
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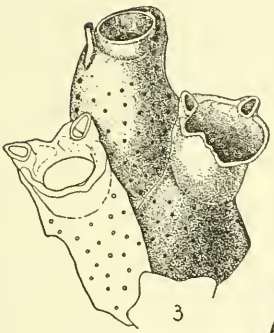
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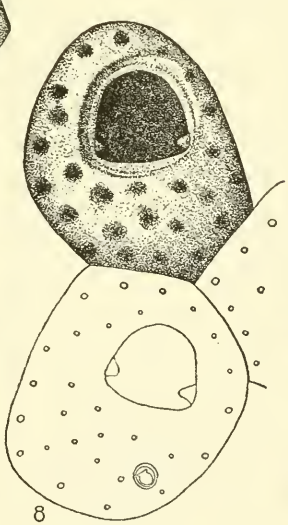
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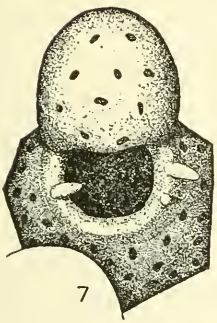
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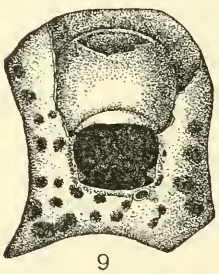
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PLATE 61

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.

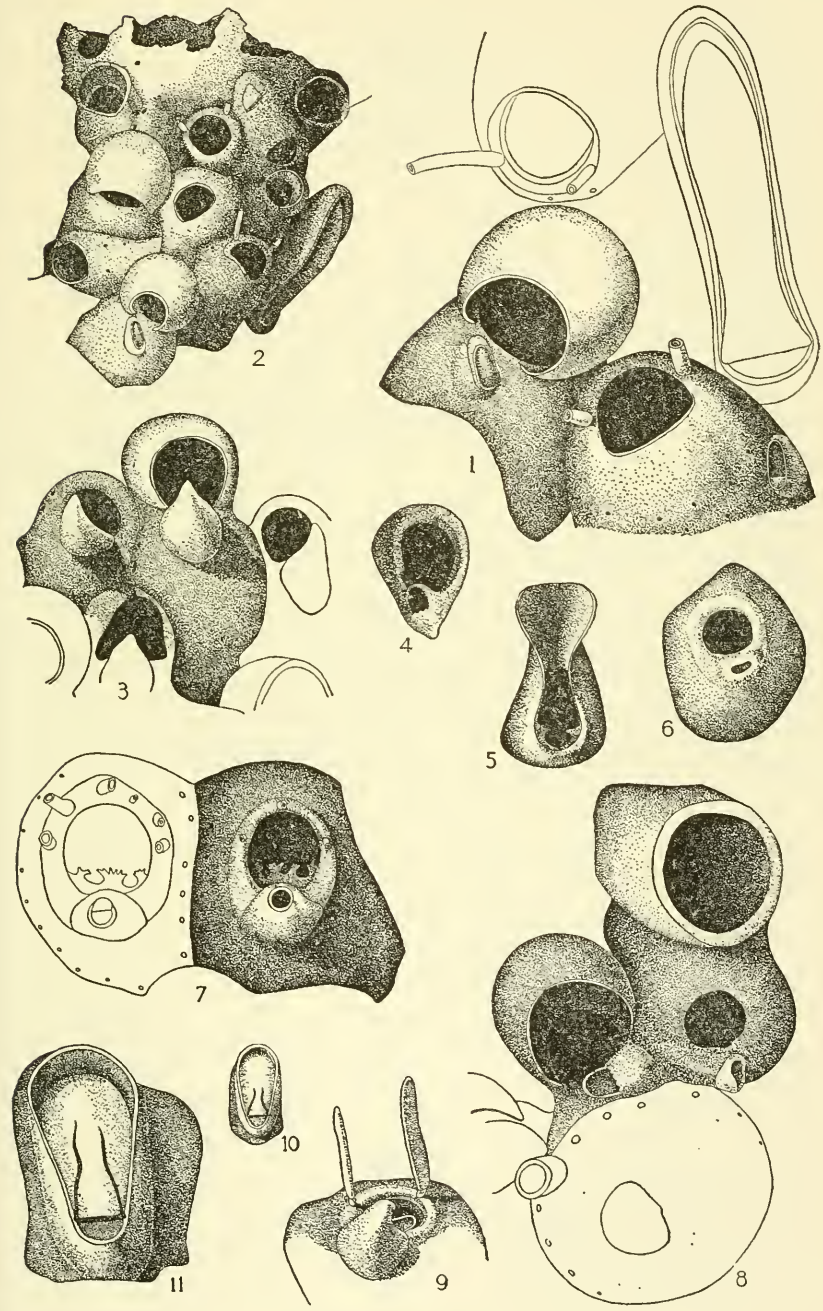
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PLATE 62

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. *Schizmopora 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. *Schizmopora margaritacea* (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.

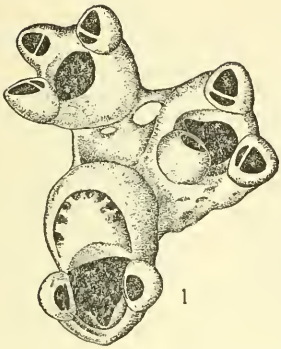
Fig. 11. The same, very young marginal zooecium.

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.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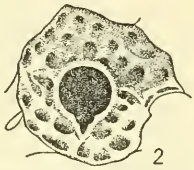
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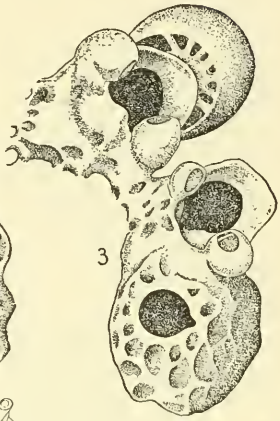
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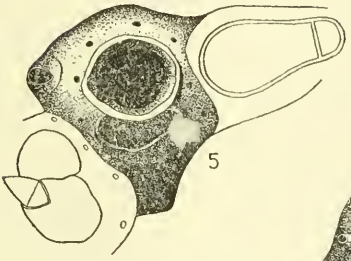
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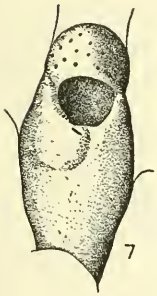
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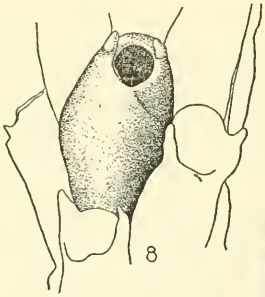
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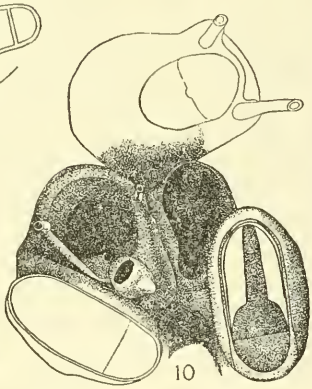
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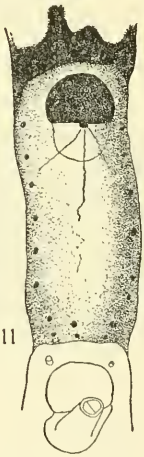
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PLATE 63

Fig. 1. *Costazia surcularis* (Packard), zooecium with ovicell and lateral-oral avicularia.

Fig. 2. The same, younger zooecium showing form of aperture.

Fig. 3. The same, giant interzooecial avicularium.

Fig. 4. *Costazia ventricosa* (Lorenz), zooecium with ovicell, form of aperture and avicularia.

Fig. 5. The same, young zooecia.

Fig. 6. *Costazia nordenskjoldi* (Kluge), zooecium with ovicell and high lateral-oral avicularia.

Fig. 7. The same, young zooecium, showing form of aperture and development of ovicell and peristome.

Fig. 8. *Costazia procumbens* new species, zooecia, form of aperture and flaring peristome.

Fig. 9. The same, with ovicell and inflected peristome (from the same colony as fig. 8).

Fig. 10. The same, interzooecial avicularium.

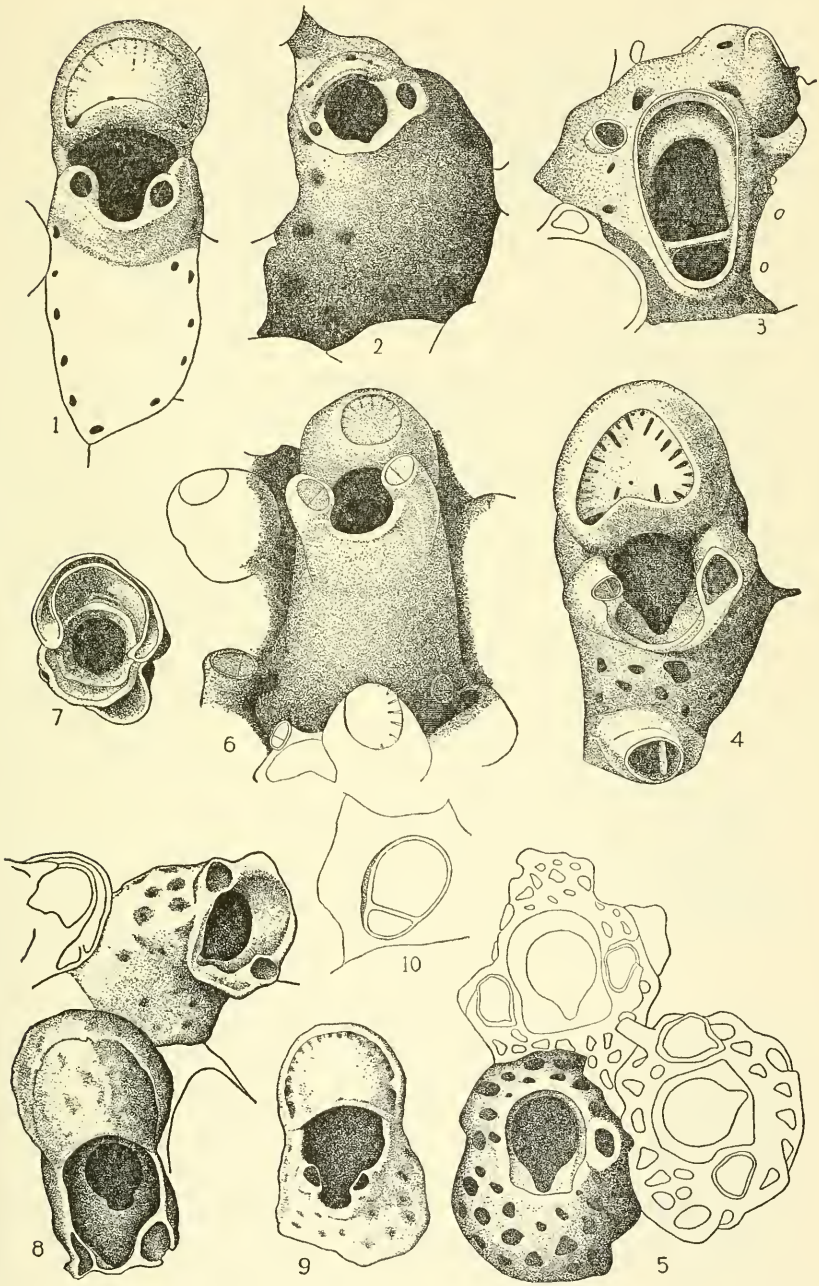
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PLATE 64

Fig. 1. *Myriozoella plana* (Dawson), elongate zooecium at margin of colony.

Fig. 2. The same, from more crowded area of secondary layer.

Fig. 3. *Myriozoum subgracile* d'Orbigny, zooecium showing form of aperture and position of small paired avicularia.

Fig. 4. The same, form of operculum and median small avicularium.

Fig. 5. *Myriozoum coarctatum* (M. Sars), zooecium and large median avicularium.

Fig. 6. The same, form of operculum and large median avicularium.

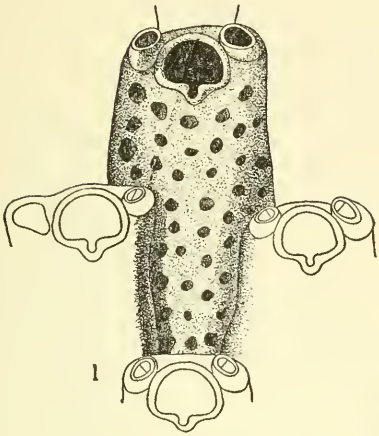
Fig. 7. *Myriozoum tenue* O'Donoghue, zooecium with ovicell and position of small paired avicularia.

Fig. 8. The same, portion of branch showing the irregular swollen reproductive area.

Fig. 9. The same, form of operculum.

Fig. 10. *Mamillopora cupula* Smitt, zooecia with ovicell and avicularia.

Fig. 11. The same, dorsal view showing zooeciules with avicularia of different sizes.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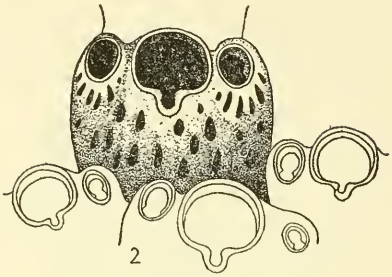
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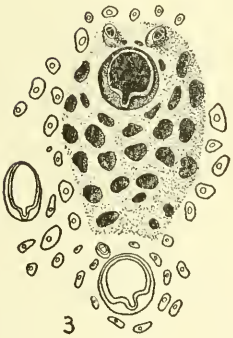
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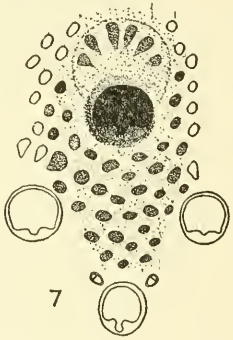
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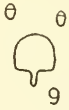
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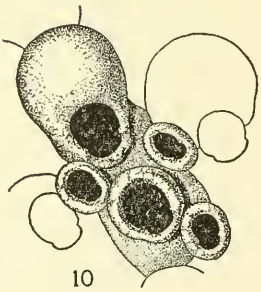
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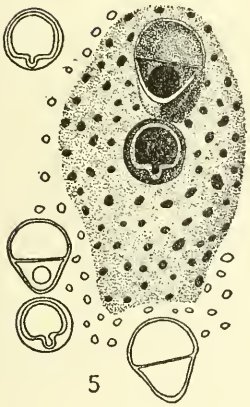
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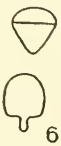
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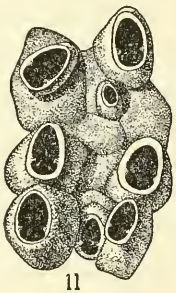
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Plate illustrations are in bold face

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.

BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 3, Cyclostomata, Ctenostomata, Entoprocta, and Addenda

BY

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

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BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 3, Cyclostomata, Ctenostomata, Entoprocta, and Addenda

By Raymond C. Osburn, Ph.D., D.Sc.

Plates 65 - 82

A report based chiefly on the Bryozoa collected by the Allan Hancock Expeditions, 1932-1941, in the *Velero III* (see pages 1-2 of Part I) and in the *Velero IV* in 1949-1952.

Additional material received from several sources has greatly enlarged the scope of this study. Especially should be mentioned contributions from the U. S. National Museum, the collections of the Alaska Crab Investigations from southern Alaska, and those from the Point Barrow, Alaska, Arctic Research Laboratory. Also practically every museum and marine laboratory on the Pacific coast of the United States and Canada has contributed some specimens of interest in this extensive survey.

Order Cyclostomata Busk, 1852

Busk in 1852 proposed the name Cyclostomata for this group of Bryozoa, since which time until rather recently it has generally been considered a suborder of the order Ectoprocta. In 1926 Borg pointed out striking anatomical differences between the Cyclostomata and the Cheilostomata-Ctenostomata and gave the former ordinal status under the name Stenolaemata. At the same time Borg (1926:490) included in the Stenolaemata the old fossil order Trepostomata of Ulrich, but did "not wish to give any decided opinion on this point." Later (1944:18-19) Borg definitely made the Trepostomata a suborder of the Stenolaemata, parallel with the Cyclostomata, and included in it the Horneras, Heteropores, Lichenopores and their allies.

While it is now generally recognized that the cyclostomes are sufficiently different from other bryozoans to warrant their separation in a distinct order, the merging of the Trepostomata with this order and the inclusion of the Horneras, Heteropores and Lichenopores in the Trepostomata has not been accepted. The Trepostomes are all Palaeozoic and do not occur above the level of the Permian.

If the Trepostomata are not to be included in the same order with the Cyclostomata, there appears to be no good reason for the use of the new name Stenolaemata and, at least until there is substantial confirmatory evidence on this question, I prefer to continue the use of "Order Cyclostomata." Marcus (1941:12) suggested the name Stenostomata to replace Cyclostomata, which has been used also for a group of vertebrates, but since the rules of priority are not concerned with ordinal names, there seems to be no very good reason for substituting a new term for one which has been well-known and acceptable to zoologists for a century.

Borg's separation of the Cyclostomata (1944:20) into five divisions, based on anatomical studies, follows closely that of older authors and is logical and well-founded, but he seemed to think it necessary to set up a whole new series of divisional names. Since it appears that Borg simply confirmed, by added histological evidence, the distinctions already made in the past, there seems to be no necessity for the discarding of well-known terms and the coinage of a new series of divisional names.

The following table gives a brief digest of the essential characters of the five divisions of the Cyclostomata under the old established names, with those of Borg in parenthesis, to indicate the synonymy.

1. Zoarium adnate, suberect or erect, never jointed, the first few tubules, at least, always adnate. Wall of the zoarium simple; the ovicell a gonozoid varying from simple to broadly expanded and often lobate, its polypide degenerating after first reaching maturity. Tubuliporidae, etc. (Acamptostega Borg, 1926).

   Tubuliporina Hagenow, 1851.

2. Zoarium slender, erect from the first zoid, always jointed, branched, rhizoids present. Wall of the zoarium simple; gonozoid simple (somewhat expanded in *Crisulipora*), its polypide degenerating before reaching maturity. Crisiidae. (Camptostega Borg, 1926).

   Articulata Busk, 1859.

3. Zoarium erect from the beginning, branched tree-like or wine-glass shaped, never jointed. Wall of zoarium double, increasing in thickness throughout life; gonozoid strongly dilated and usually situated more or less on the dorsal side. Horneridae, etc. (Pachystega Borg, 1926).

   Cancellata Gregory, 1896.

4. Zoarium usually erect, sometimes adnate, often cylindrical and branching, composed of autozoids and kenozoids with the apertures of both at the surface. Wall double; brood chamber zoarial formed by the

absorption of kenozoids around a fertile zoid. Heteroporidae, etc. (Heteroporina Borg, 1944).

Cerioporina Hagenow, 1851.

5. Zoarium adnate or short stipitate, discoid or semiglobular, sometimes complex by the formation of subcolonies; zoids radiating in all directions from the center and separated by alveoli (cancelli). Brood-chamber zoarial by the fusion of alveoli around a fertile zoid. Lichenoporidae. (Calyptrostega Borg, 1926).

Rectangulata Waters, 1887.

In this order the older workers based their descriptions and classification almost solely on zoarial characters, and even Hincks in the 1880s paid little attention to the ovicells. Waters insisted on the importance of the reproductive characters and Harmer, Calvet, Canu and Bassler, Marcus, Borg, Silen and others, including the writer, have accepted this point of view.

The difficulty with zoarial characters is their variability, depending partly on their adaptation to the substratum and other features of the environment, and partly on the stage of growth. In the Crisiidae, the younger stages are so much alike that, in the absence of ovicells, the determination of the species is often impossible.

In the encrusting species the nature of the substratum may determine the size and form of the zoaria, and the environment often modifies the appearance of erect species. Among the Tubuliporidae, encrusting species are usually flat and regular on flat surfaces, but when the same species develops on a small stem the zoarium may be variously contorted. In deeper, quiet water, erect species are usually more slender and more elongate, sometimes giving quite a different zoarial appearance from the same species in the surf area along shore. In protected areas the peristomes are usually much more elongate, and in crowded areas or on rough surfaces the zoaria may be much reduced in size. Numerous "species" have been described on such differences.

By far the most constant characters in this order are found in the ovicells or brood-chambers, either zoidal or zoarial. In the Heteroporidae and Lichenoporidae the brood-chambers are interzoidal or zoarial spaces surrounding a gonozoid and their position in the zoarium and the gonopores and their tubes (ooeciostomes) are fairly constant. In all the others the ovicell is an expanded gonozoid, sometimes only slightly enlarged, or again it may be greatly expanded over a considerable portion of the zoarial surface and may surround some of the autozoid tubules. There may be marked variation in the size and form of these ovicells,

even on different parts of the same colony, but the position and form of the gonopores (ooeciopores) and their tubes (ooeciostomes) are again fairly constant. With most of the species of this order these reproductive organs are essential for exact determination, and even here a certain amount of caution is necessary.

The order is ancient, dating back at least to the Ordovician, and the number of fossil species that have been described far outnumbers those that exist today. How many of these, both fossil and recent, may eventually go into synonymy, no one can even guess, but undoubtedly a very large number of them, described from fragments, young colonies, or without ovicells, may eventually be properly placed.

Glossary

A few terms which are not included in preceding glossaries, or which have a different use in the Cyclostomata.

Alveoli. Pores of various sizes distributed between the zoids (see cancelli).

Autozoid. The functional nutritive individuals of the colony.

Basis rami. A small wedge-shaped base of a branch, characteristic of the crisias.

Brood-chamber. A cavity, usually large, surrounding a gonozoid which opens into it (not an expansion of a gonozoid).

Cancelli. See alveoli.

Capitulum. An expanded "head" at the tip of an erect branch, usually with an ovicell or brood-chamber.

Disc. The frontal area of a zoarium in the lichenopores; in complex colonies there are often numerous discs.

Fascicle. A series or bundle of connate tubules or peristomes.

Gonozoid. A reproductive individual, often greatly expanded to harbor the developing larvae.

Kenozoid. Various types of greatly modified individuals without polypides, which serve other purposes in the colony, e. g., the joints of radicles in the crisias, and the alveoli (cancelli) in the heteropores and lichenopores.

Nannozoid. A much reduced individual similar in appearance to an autozoid.

Ooeciopore. The aperture of an ovicell.

Ooeciostome. The tube surrounding an ooeciopore, the morphological end of a gonozoid (ovicell).

Pellicle. A thin calcareous layer.

Proancestrula. A rounded knob formed by the metamorphosis of the larva, which buds off the first tubule of a colony.

Peristome. The projecting end of a tubule (autozoid). Not homologous with the peristome of Cheilostomata.

Radicle. Root-like or pedunculate structure for attachment.

Radii. Radiating series of tubules, especially in lichenopores.

Rhizoid. See radicle.

Subcolony. Branches or areas similar to the primary zoarium produced by budding of the zoarium, often very numerous in the lichenopores.

Tubule. The main part of a zooecium which contains the polypide, usually embedded and ending in a "peristome."

Zoid. A functional nutritive individual.

Division I. **Tubuliporina** Hagenow, 1851
(Acamptostega Borg, 1926)

This group appears to be the most primitive among recent Bryozoa, as noted by various authors. The zoarium, whether it remains adnate or becomes erect, is always adnate at first, the first tubule arising laterally without a joint from the ancestral disc and attached for most of its length; and at least a few daughter tubules have this position. The resulting zoaria may take almost any form, uniserial or broadly flabellate, flat or contorted, semierect or erect, and sometimes profusely branched. The apertures are always on the frontal side, with the exception of the Entalophoridae, where they are distributed evenly around the erect stem. The ovicells vary from simple pyriform expansions of the middle portion of the gonozoid to very broad, sometimes lobate, expansions which may cover considerable areas of the zoarium; and frequently they surround and enclose the erect portions of neighboring tubules. In *Entalophora* and *Fasciculipora* the ovicells are narrow and greatly elongated.

Key to the Families of Tubuliporina

1. Zoaria adnate or more or less erect, the apertures opening only on the frontal side 2
   Zoaria erect, the zooecial tubes forming cylindrical stems with the apertures opening on all sides . . . . . *Entalophoridae*

2. Zoaria adnate, linear or flabellate, ovicells simple 3
   Zoaria adnate or erect, usually flabellate but sometimes with narrow, erect branches; ovicells expanded 4
3. Tubules not seriated nor fasciculate; ovicells slender-pyriform or only slightly expanded . . . . . *Oncousoeciidae*
   Tubules single or in small erect fascicles; ovicell short, between fascicles . . . . . *Frondiporidae*
4. Zoaria usually adnate and flabellate, but may be erect and branched; tubules not fasciculate; ovicells expanded laterally, ooeciostome terminal or central . . . . . *Diastoporidae*
   Zoaria adnate, with few exceptions, the tubules usually fasciculate or in series; ovicell usually ramifying among the tubules, sometimes more simple . . . . . *Tubuliporidae*

Family **Oncousoeciidae** Canu, 1918

"The axis of the ovicell is parallel to that of the tubes. The ovicell is developed at the same time as the adjacent tubes which are not disarranged in their respective positions." (Canu and Bassler, 1920:687).

The ovicell is a simple inflation of the gonozoid, with a terminal or sub-terminal ooeciostome, and is often as primitive as that in the genus *Crisia*. The development of the ovicell has some influence on that of the adjoining tubes, separating them to some extent, and, in the linear species, the tubules at the sides of the ovicell may be increased in number.

Only three genera with recent representatives concern us here, viz.:

1. *Stomatopora*. Zoarium uniserial throughout, except around the ovicell which has tubes on both sides, no doubt for additional nourishment of the developing larvae.
2. *Proboscina*. Zoarium uniserial for only a short distance at the proximal end, then becoming biserial or with additional tubes over most of the length of the linear lobes.
3. *Oncousoecia*. Zoarium rounded, flabellate or with flabellate lobes; the ovicells either narrow or sometimes slightly lobed.

It is evident that this separation is largely based on zoarial characters but the groups present rather distinct facies and it is convenient to treat them separately. In *Oncousoecia* the ovicells are more embedded between the adjacent tubules than in the other genera, where they are usually ventricose. In all cases the ooeciopore is terminal or nearly so.

Genus STOMATOPORA Bronn, 1825

Alecto Lamouroux, 1821, preoccupied.

This genus was described and has generally been considered as uniserial, adnate and branching. Some authors have introduced into it various linear adnate branching species with a biserial or multiserial zoarium, which preferably belong elsewhere. The only part of the *Stomatopora* which is biserial is the expansion about the ovicell. Genotype, *Alecto dichotoma* Lamouroux, 1821.

There has been no description of the ovicells until recently, but Borg, 1926:358, has discovered them in *S. eburnea* (d'Orbigny) and *S. granulata* (Milne-Edwards). They are very simple in nature, differing but little from those of *Crisia* except that they are more or less embedded.

It is true that the zoarium of species of the Tubuliporidae *(sens lat.)* originates in a single zooecium and sometimes the uniserial condition is continued for several generations of zooecia before the biserial or multiserial condition is developed. While the generic distinction is not too sharply defined, it seems better to retain *Stomatopora* for the strictly uniserial species.

The three genera, *Stomatopora, Proboscina* and *Oncousoecia* have so much in common, especially in the nature of the ovicells, that sharp distinctions are difficult. For the purposes of the present treatise they will be considered as genera on the following zoarial basis:

Stomatopora, uniserial, except immediately around the ovicell, which is simple, inflated, and may be slightly lobate, the ooeciostome terminal.

Proboscina, biserial, or the linear branches may have several rows of tubules, the ovicell simple, inflated, sometimes slightly lobate, the ooeciostome terminal or nearly so.

Oncousoecia, broadly multiserial, the zoarium rounded or with fan-shaped lobes, the ovicell simple or slightly lobate, more depressed between the adjoining tubules, the ooeciostome terminal.

Stomatopora granulata (Milne-Edwards), 1836

Plate 65, figs. 1 and 2

Alecto granulata Milne-Edwards, 1838:205.
Alecto granulata, Busk, 1875:24.
Stomatopora granulata, Hincks, 1880:425.
Stomatopora granulata, O'Donoghue, 1923:11; 1926:17.
Stomatopora granulata, Borg, 1926:359.
Stomatopora granulata, Sakakura, 1935:37.

The zoarium is adnate, uniserial except around the ovicell which has a series of tubules on each side of it, branching more or less at right angles. The branches are straight or curved, anastomosing when they come into contact. The peristomes curve up from the adnate tubules, becoming more or less erect, the diameter at the tip 0.15 to 0.18 mm, that of the aperture 0.12 to 0.14 mm; the base of the peristome somewhat broader according to the amount of calcification. The distance from one peristome to the next varies greatly, usually 0.40 to 0.50 mm, but may be as much as 1.0 mm. The tips of younger peristomes are finely reticulate; in older parts the peristomes and adnate tubules are irregularly roughened.

The ovicell, first described and figured by Borg (1926:359), is simple, the proximal end narrow, irregularly pyriform with small lobes extending between the peristomes at the sides. The ooeciostome is an erected tube, shorter than a peristome, its tip free and the aperture circular. In young ovicells the pore is a semicircular slit at the base of the peristome.

It appears to be a widely distributed species in the northern hemisphere, reported from the coasts of Europe from Norway to the Mediterranean Sea; Cape Verde Islands (Norman); British Columbia (O'Donoghue); Japan (Sakakura); and Waters listed it as a fossil from New Zealand.

Hancock Station 1316-41, off Santa Catalina Island, 45 fms; and off San Pedro, southern California, on shells.

Genus **PROBOSCINA** Audouin, 1826

Peristomoecia Canu and Bassler, 1920:692.

"The zoarium consists of multiserial elongate bands, which are simple or branched, and are always flat and adnate. The zooecia are cylindrical and narrow. The peristomes are flush with the surface of the zoarium, or slightly raised; and they are usually distributed irregularly, but are occasionally quincuncial or in transverse linear series." (Canu and Bassler, 1920:658.) Genotype, *Proboscina Boryi* Audouin, 1826:236.

This genus differs but little from *Stomatopora* except in biserial-multiserial disposition of the zooecial tubules. It is true that the zoarium begins with a single series of tubules, but this soon becomes expanded into two or more series, while in *Stomatopora* the expansion is limited to the area immediately around the ovicell. The mode of branching is much the same except that in *Proboscina* the origin of the branch is usually at least biserial while in *Stomatopora* only a single tubule is involved.

Again there is but little difference in the nature of the ovicells. The fertile zooecium arises like any other tubule and is narrow at its proximal end, broadens to various degrees in the different species, and terminates in a slightly elevated and more or less terminal ooeciostome. The terminal expansion of the gonozoid misled Canu and Bassler into believing that the enlargement was a part of the peristome, and on this basis they created a genus *Peristomoecia* which has since been discarded.

The genus also has a close relationship to *Oncousoecia* Canu and Bassler *(q. v.),* which similarly has simple ovicells of much the same nature, but has a flabellate zoarium.

Whatever may be the ultimate disposition of these three groups of species, it seems better for the present to allow them generic status—for convenience in classification if for no better reason!

Large numbers of "species" have been created on incomplete material, probably most often on immature specimens. It is practically useless to attempt to identify such specimens since only the mature ones with the characters of the ovicells show specific characters.

Proboscina major (Johnston), 1847

Plate 65, fig. 5

Alecto major Johnston, 1847:281.
Alecto major, Busk, 1875:24.
Stomatopora major, Hincks, 1880:427; 1884:204.
Stomatopora major, O'Donoghue, 1923:11.
Diaperoecia major, O'Donoghue, 1926:23.
Oncousoecia major, Canu and Bassler, 1930:46.

The zoarium is adnate, strap-shaped, the branches narrow and widening slightly, sometimes a little elevated at the tips on rough substrata. Zooecia in two to four series, the tubules distinct with well-marked grooves, and sometimes in more or less transverse rows; the peristomes moderately high, free, with round apertures. The diameter of the aperture varies greatly, from 0.14 to 0.20 mm and the peristome likewise from 0.20 to 0.26 mm on the same colony.

The ovicells are located near the ends of the branches or just proximal to a bifurcation. The narrow proximal end is comparatively short; the middle portion expanded and rather bulbous; the ooeciostome subterminal, erect, rather short, smaller than the peristome, its aperture about 0.12 mm in diameter. Usually the inflated area is simple in form, but it may be slightly lobed between the surrounding zooecial peristomes, and occasionally a peristome may be surrounded.

It is a widely distributed species in the northern hemisphere, in European waters from Norway to the Mediterranean Sea and the Cape Verde Islands, and in the Pacific from British Columbia to the Galapagos Islands. As a fossil it is known as far back as the Miocene of Italy.

Hancock Stations: 155-34, 324-35 and 450, Albemarle Island, 45 to 70 fms; 183-34, between Albany and James Islands, 50 to 70 fms, and Barrington Island, 52 fms, Galapagos; 328, Cocos Island, Costa Rica, 14 fms; 1150-40, 1187-40 and 1316-41, Santa Catalina Island; 1064, Santa Barbara Island; and 1268-41, Anacapa Island, southern California. Also collected by Miss A. E. Blagg at Monterey Bay, California, and by Dr. John L. Mohr at the San Juan Islands, Puget Sound.

Proboscina sigmata new species

Plate 65, figs. 3 and 4

A very delicate species. The zoarium is encrusting and consists of linear biserial to quadriserial branches with very symmetrical sigmoid lateral curves; the curvature is evidently due neither to the substratum nor to lateral branching, as there is evidence of only one such branch on the outside of a curve. The dorsal side, which is not extended laterally, measures about 0.25 mm in width, and is only slightly wider in the region of the ovicells.

The zooecial tubules are narrow, slightly embedded, the separating grooves distinct. Their peristomes are thin, about 0.10 mm in diameter, very elongate, averaging about 0.65 mm in length but sometimes more than 1.0 mm, semi-erect, their walls thin and the aperture about 0.08 mm in diameter. There is a tendency for the peristomes to arise in alternate pairs; the bases of such a pair may be connate for a short distance but the tips are widely divergent.

The ovicell is an ellipsoid swelling, pointed at the base where it disappears among the tubules and narrowed more roundly at the distal end where it ends in the terminal ooeciopore, near the base of a peristome. In the two ovicells in my material there is no evidence of an ooeciostome, but this may be due to incomplete development. Length of ovicell 0.65 mm, width 0.33 mm.

Type, AHF no. 57.

Type locality, off Rocky Point, southern California, at 45 fms, on the surface of a sunken buoy, Earl Fox, collector, two small colonies, both in reproduction.

Proboscina incrassata (Smitt), 1866

Plate 66, figs. 1 and 2

Proboscina incrassata Smitt, 1866:402 and 458.
Tubulipora (Proboscina) incrassata Smitt, 1871:1119.
Alecto retiformis Hincks, 1871:81.
Stomatopora incrassata, Hincks, 1880:436.
Stomatopora incrassata, O'Donoghue, 1923:11.
Proboscina incrassata, O'Donoghue, 1926:17.

The zoarium is white, adnate, much branched, the branches short, anastomosing to form often a fairly close network; on the basal part the branches are usually two tubules in width, but at the distal ends they may be 4 to 6 tubules wide. The peristomes are very irregular in arrangement, single or 2 or 3 in a transverse line; sometimes a few are clustered but they are never connate except occasionally at the base; sometimes also these clusters are elevated into short fascicles, especially at the ends of branches. The peristomes are usually quite erect, 0.50 to 1.0 mm in height, 0.26 mm in diameter, and aperture about 0.20 mm.

The ovicells, which seem not to have been noticed previously, are simple ventricose expansions near the ends of branches and surrounded by a row of tubules on each side (occasionally a peristome may be enclosed in the expansion); the ooeciostome is a small erect tube much shorter than the peristomes, terminal or nearly so, usually connate with a peristome at its base but the tip always free, the aperture round and about 0.13 mm in diameter.

Described from Spitsbergen and recorded from Norway, Nova Zembla, Kara Sea, and the British Islands from Cornwall to Scotland and the Shetland Islands. On the Pacific coast O'Donoghue listed it for several localities in British Columbia. Point Barrow, Alaska, Arctic Research Laboratory, 328 feet, a common species, especially on stones, G. E. MacGinitie, collector.

Proboscina lamellifera Canu and Bassler, 1930

Plate 66, fig. 3

Proboscina lamellifera Canu and Bassler, 1930:46.

"The zoarium incrusts shells and is formed of sinuous branches joined together by a smooth calcareous lamella. The tubes are indistinct, short, seriated and terminated by a long peristome perpendicular to the zoarial plane. Measurements, — diameter of orifice, 0.12 mm; diameter of peristome, 0.16 mm; internal separation of tubes, 0.20 - 0.30 mm; width of branches 1.5 mm." (Canu and Bassler, 1930:46).

This short description by the above authors and their photographs of the species (Plate 11, figs. 1 and 2) are sufficient for identification, though they did not have the ovicell. In our specimens the lamella, while it extends somewhat from the borders, does not come anywhere near connecting them. This may be due to the fact that our colonies are much smaller and probably younger.

Four ovicells are present in our specimens. They are small, short and very bulbous, raised as high as the peristomes surrounding them, thick-walled and shining; the ooeciostome is a short, round tube, its diameter nearly that of the peristomes, and terminal, which, in this case, is nearly on the top of the semiglobular ovicell. One of the ovicells is slightly enlarged and its border encloses two peristomes.

Described from Albatross Station D. 2813, Galapagos Islands.

Hancock Stations: 143-34, off Wenman Island, 1°23′10″N, 91°48′45″W, at 100-150 fms; 155-34, off Tagus Cove, Albemarle Island, 0°16′45″S, 91°22′52″W, at 50-60 fms; and 453, Gardner Island, 35 fms, Galapagos Islands.

Genus **ONCOUSOECIA** Canu, 1918

The zoarium is adnate, broadly multiserial, rounded or with flabellate lobes; the zooecial tubes are long, distinct on the surface, quincuncially arranged, the peristomes short and more or less erect. The ovicell is simple, often differing only slightly from the zooecial tubules, the proximal end embedded between the neighboring tubules, distally expanding gradually between the adjacent tubules and sometimes extending laterally above them for a short distance. The ooeciostome is terminal, not associated with a peristome, usually short, erect, smaller than the peristomes, round, and not expanded at the tip.

The genotype is *Alecto dilatans* Thompson (Johnston, 1847:281), and not *Tubulipora lobulata* Hincks, 1880, as indicated by Canu, 1918: 325. Hincks confused two species in his Plate 61, and the figure 5, from which Canu evidently drew his description, is that of *Alecto dilatans* Thompson. (For details see Osburn, 1933:9-12).

Oncousoecia diastoporides (Norman), 1868

Plate 66, fig. 4

Alecto diastoporides Norman, 1868:310.
Stomatopora diastoporides, Hincks, 1880:434.
Stomatopora diastoporides, Osburn, 1912:218.
Oncousoecia diastoporides, Osburn, 1933:9.

Zoarium a flat fan-shaped or lobulate incrustation on shells and stones; moderately thick, usually with two rows of incomplete zooecia bordering the outer functional ones. The zooecial tubules are elongate and horizontal for most of their length, about 0.30 mm wide, convex and the separating grooves distinct, finely punctured. The peristomes are short, suberect, quincuncial in arrangement, the aperture about 0.15 mm in diameter.

The ovicells resemble the zooecial tubules, elongate, pointed at the proximal end, only a little swollen and more thickly punctate; they were overlooked for many years, probably because of their resemblance to the tubules, but they are definite enough when one knows what to look for. The ooeciostome is terminal, short, erect, round and about 0.08 mm in diameter, not associated with a peristome.

Described from the Shetland Islands by Norman and recorded also by Hincks from the British Islands. On the west coast of the North Atlantic it ranges from Cape Cod northward to Mount Desert Island, Maine, to the Gulf of St. Lawrence and Baffin's Bay.

Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector; also at Canoe Bay, southern Alaska, U. S. Alaska Crab Investigation, Sta. 25-40 at 25 fms.

Oncousoecia canadensis Osburn, 1933

Plate 65, figs. 10 and 11

Oncousoecia canadensis Osburn, 1933:12.
Stomatopora diastoporides, Whiteaves, 1901:110.

The zoarium is flabellate or irregularly lobate, entirely adnate on shells and stones, the primary region, 2 or more tubules in width, is usually short; thinner than in *O. diastoporides*. The tubules are comparatively thin-walled, somewhat hyaline and vitreous, conspicuously perforated. They are more slender than those of *diastoporides* (width about 0.18 mm), and never does more than one row of incomplete ones appear at the margin. The peristomes are short, thin-walled, the aperture about 0.10 mm in diameter, and never connate nor seriated.

The ovicells are usually like small thin-walled blisters; the fertile zooecium arises in the same manner as the infertile ones but soon expands both frontally and laterally and the adjacent tubules appear as if separated by the growth of the expansion. Sometimes the expansion extends in very short lobes on either side of the ooeciostome, but occasionally it may be as simple as in *diastoporides*. The ooeciostome is

situated terminally, between but not in contact with the adjacent peristomes; it is rounded or slightly elliptical transversely, short, erect or slightly bent proximally; the aperture 0.06 mm in diameter.

Described from Mount Desert Island, Maine, and recorded by Osburn from the Bay of Fundy and the Gulf of St. Lawrence (for details see Osburn, 1933:13).

Point Barrow, Alaska, Arctic Research Laboratory, to a depth of 50 fms, G. E. MacGinitie, collector, common on shells.

Oncousoecia ovoidea new species

Plate 65, figs. 8 and 9

The zoarium is broadly flabellate; the ancestrula produces a single short tubule; from this two tubules arise, and then four tubules begin the wide expansion. They are arranged in quincunx, the peristomes all well separated. The embedded tubules are about 0.13 mm in diameter, the peristomes 0.11 mm and the apertures 0.08 mm. The tubules are very definitely cross striated, the peristomes smooth and semierect, the longest ones 0.13 mm.

There are two ovicells on one colony, the expanded portion ovate, ventricose, 0.15 to 0.18 mm in width, the distal end rounded, the ooeciostome terminal, short, erect, the aperture rounded and 0.05 mm in diameter. The proximal part of the gonozoid is like the other tubules for about half or two-thirds of the length and the expansion appears suddenly.

Type, AHF no. 58.

Type locality, Hancock Station 276, San Esteban Island, Gulf of California, 28°38′30″N, 112°36′W, at 32 fms. Two colonies encrust smooth shell fragments, while a third is on the rough pebbled surface of an echinoid spine; the largest colony is less than 2 mm in width.

Oncousoecia abrupta new species

Plate 65, figs. 6 and 7

The zoarium is small, delicate and entirely adnate; the proximal portion very slender (0.45 mm at the widest part) for a distance of 5 mm, then abruptly becoming broad and round, about 2.5 mm in either direction. The proximal part, just above the pro-ancestrula, which is wanting, is 2 tubules in width, alternating, and widens to 4 tubules near the expansion; the peristomes moderately short and free. On the expanded area the peristomes are much higher (to 0.50 mm), rather regularly

distributed and not seriated, free with a few exceptions where two are connate at the base, slender with an outside measurement of 0.09 mm. The apertures are round and about 0.07 mm in diameter. The tubules are so much embedded that their measurements cannot be determined, the surface with minute pores and light transverse striae.

There are 3 ovicells side by side, occupying practically the full width of the terminal border, each broadly pyriform and with short lobes between the surrounding peristomes; a little ventricose and cross-striated and the surface with minute pores. The ooeciostome is erect and moderately high, situated beside a peristome with which it is connate at the base and the upper portion free, its base cylindrical and about 0.05 mm in diameter, the tip expanded transversely and its aperture measuring about 0.09 by 0.03 mm.

The basal portion alone would readily be mistaken for a species of *Proboscina,* but the expanded part is similar to that of *Oncousoecia* in the nature of the ovicells and ooeciostomes.

Type, AHF no. 88.

Type locality, off Rocky Point, southern California, about 33°49′N, encrusting a sunken buoy recovered from a depth of 45 fms, one colony by Earl Fox. Also one colony collected at Santa Barbara Island by Dr. H. R. Hill.

Family **Diastoporidae** Gregory, 1899

Diastopora Lamouroux, 1821; *Berenicea* Lamouroux, 1821; *Mesenteripora* Blainville, 1830; *Bidiastopora* d'Orbigny, 1849; *Actinopora* d'Orbigny, 1853; *Microecia* Canu, 1918; *Plagioecia* Canu, 1918; *Diaperoecia* Canu, 1918; *Diplosolen* Canu, 1918.

Diastopora, genotype *D. foliacea* Lamouroux, 1821:42, though it was described from a fossil without ovicells, has rather definite zoarial characters and has been much used for recent as well as fossil species. In the absence of an ovicell, however, it is impossible to place this genus except as a member of the present group. It is useful to the paleontologists when ovicells are wanting, but should not be used when the ooecial characters are present.

Berenicea, genotype *B. prominens* Lamouroux, 1821:80, is so indefinite as to be meaningless. Norman, 1903:569 and 1909:299, and Borg, 1944:61, have maintained that *Berenicea* is not even a cyclostome but a cheilostome form. *Diastopora* and *Berenicea* have been used rather indiscriminately for the same species. If they are synonymous, *Di-*

aperoecia takes precedence by its earlier appearance in Lamouroux's work, but owing to the uncertainty as to its nature *Berenicea* had better be discarded.

Mesenteripora, genotype *M. michelini* Blainville, 1830:397, was proposed for erect contorted forms otherwise similar to *Diastopora.* Here again the genotype is a fossil without ovicells.

Bidiastopora, genotype *Diastopora cervicornis* Michelin, 1846:241, was founded to include erect diastoporas with bilaminate folds, and the genotype is a fossil without ovicells.

Actinopora, genotype *A. regularis* d'Orbigny, 1853:763, was based on the arrangement of the zoids in regular radiating series and like the preceding included only fossil species without ovicells. The ovicelled species which have later been placed in this genus have the ovicells and ooeciostomes definitely of the *Plagioecia* pattern.

The above generic names were all properly founded but only on zoarial characters, so their complete nature is uncertain. They may still be useful when it is necessary to catalog specimens which are incomplete in reproductive characters.

In 1918 Canu attacked the problem of the old *Diastopora* complex with the ovicells as the basis, and proposed a number of additional genera, *Microecia, Plagioecia, Diaperoecia* and *Diplosolen.*

Microecia Canu, 1918:326, was mistakenly founded on *Diastopora Sarniensis* Norman, 1864:89, and is synonymous with *Plagioecia.*

The other three genera agree in the mode of early development in the tubuliporoid manner, in the closure of numerous older peristomes by a calcified porous membrane, and by at least the occasional enclosure of peristomes by the ovicell.

Canu went so far as to propose several new families, Mecynoeciidae, Plagioeciidae and Diaperoeciidae among the diastoporid forms. The first of these, which included *Microecia,* has already been reduced to synonymy by Bassler, 1935:10. While Canu's analysis of the ovicell is of the greatest importance in the separation of species of this group, he apparently was not sufficiently familiar with the intraspecific and interspecific variation in the ooecia and ooeciostomes.

For the purpose of the present work I propose to accept only the old family Diastoporidae with the following genera:

1. *Diastopora* Lamouroux, 1821, reserved for species in which the reproductive characters are unknown.

2. *Plagioecia* Canu, 1918, ovicell usually much broader than long, not proliferated beyond the level of the ooeciopore; ooeciostome terminal, at or near the middle of the distal border; one or more peristomes often surrounded by the lateral prolongation of the ovicell.

3. *Diaperoecia* Canu, 1918, the ovicell completes its development by proliferating distally in advance of the ooeciopore and surrounds few or many distal peristomes in the process; the ooeciostome, which represents the morphological distal end of the gonozoid, is usually located somewhere near the middle or occasionally even near the proximal end of the ovicell.

4. *Diplosolen* Canu, 1918, miniature zooecia (zooeciules) present, scattered among the normal tubules of the zoarium; ooeciostome subterminal at or near the middle; peristomes occasionally surrounded. *Diplosolen* differs from *Plagioecia* in appearance only by the dimorphic nature of the zooecial tubules.

It is sometimes difficult to assign a species to one of the above genera, owing to variation in the size and form of the ovicell and especially in the occasional occurrence of ovicells as simple as those of *Oncousoecia.* When these occur on the same zoarium with more highly developed ovicells, the latter has been accepted as the proper generic association. The simple ovicells usually occur on the older parts of the colony and if only this form of ovicell is present the species would necessarily be assigned not only to another genus but to a different family. A rather exaggerated case of this is found in *Plagioecia ambigua* new species (q. v.), but examples may be found in other species of this genus and also in *Tubulipora.* The enclosure of peristomes by the ovicell, on which Canu (1918) based the genus *Diaperoecia,* is subject to much variation, and this condition is also found to a greater or less extent in *Plagioecia* and several genera of the Tubuliporidae.

In spite of these variations, where a fully developed ovicell is present, the position of the ooeciostome is usually diagnostic, median and terminal or subterminal in *Plagioecia,* more centrally located in *Diaperoecia,* in which genus the ovicell continues to develop distally beyond the ooeciostome. The ooeciostome must be considered the morphological distal end of the gonozoid.

Genus **PLAGIOECIA** Canu, 1918

"The ovicell is a long transverse sack obliterating a certain number of zooecial tubes and developed in the vicinity of the zoarial margins. The ooeciostome is small, equal to or less than the zooecial diameter. The

tubes are isolated from each other. No adventitious tubes." (Canu and Bassler, 1922:26). Genotype, *Tubulipora patina* Lamarck, 1816.

The above description, drawn from *P. patina* and correct for that species, requires some modification as the ovicells are not always much expanded laterally and sometimes in other species may even be longer than broad. The ovicells are symmetrically developed and the ooeciostome is terminal in the midline at or near the distal border and the ooecial expansion is not continued beyond it. The inflation often surrounds one or more, sometimes several, peristomes; even in the same species the shape of the ovicell and the number of the included peristomes may vary considerably due to the amount of lateral expansion. There is much closure of the older peristomes by a calcified membrane which is either perforated by a number of small pores, or provided with a small erect central tubular pore.

The zoarium is usually adnate, but may be erect or semierect and more or less contorted and either unilaminar or bilaminate.

Key to the Species of *Plagioecia*

1. Zoarium more or less free, erect or semierect 2
   Zoarium entirely adnate or sometimes free at the edges . . . 4
2. Zoarium with narrow, bilaminate, contorted branches which form a free reticulum . . . . . *meandrina*
   Zoarium with broad bilaminate lobes, contorted 3
3. Zoarium erect from a rather narrow base, sometimes stipitate, contorted, the folds thicker than in other species . . *grimaldii*
   Zoarium beginning with a broad adnate base from which erect, contorted folds arise, much thinner than in *P. grimaldii* . . . *tortuosa*
4. Except near the center of the zoarium the peristomes are in uniserial, radiating rows, connate only at the base . *anacapensis*
   Peristomes not in radiating series 5
5. Zoarium broad and thin, irregular, with occasional smooth areas containing aborted tubules without apertures; peristomes very short; ovicell low and flat, surrounding a few peristomes, irregularly rounded . . . . . *tubiabortiva*
   Zoarium rounded or with flabellate lobes, ovicell conspicuous and usually transverse 6
6. Ovicell usually several times as broad as long and slightly arcuate to conform to the zoarial border, the lateral ends often enclosing peristomes . . . . . *patina*
   Ovicell narrower, sometimes nearly round 7

7. Zoarium irregularly rounded, peristomes thin, 0.09 mm at their tips; ovicell only moderately broad . . . . . *sarniensis*
Zoarium lobate, peristomes 0.13 mm at their tips; in the one specimen there are two simple, narrow ovicells and one expanded one, the ooeciostome slightly subterminal . . *ambigua*

Plagioecia patina (Lamarck), 1816

Plate 73, fig. 4

Tubulipora patina Lamarck, 1816:163.
Diastopora patina, Hincks, 1880:458; 1884:206.
Diastopora patina, O'Donoghue, 1923:14.
Plagioecia patina, O'Donoghue, 1926:21.

Zoarium variable in form, rounded or lobate; entirely encrusting, or partially free. The zoids are embedded for most of their length, the free part of the tubules, "peristomes," being semierect and usually short. The apertures are somewhat elliptical or nearly round, measuring about 0.10 by 0.12 mm. The embedded portions of the zoids are slightly convex and are perforated by minute pores. The peristomes show no tendency to be arranged in series, and are not connate even at the base. In older parts of the colony, especially, the apertures become closed by a peculiar calcified membrane which is perforated either by a number of pores or by a single larger tubular pore. The basal lamina often forms a distinct border beyond the functional zoids.

The ovicell is a prominent swelling, moderately large and distinct, the edges usually sharply outlined. Normally it is transversely very elongate, several times as wide as long, but varying considerably in size and form. Usually a number of peristomes are surrounded, 0 to 7 in my specimens. The ooeciostome is terminal and free between the zooecial series, ordinarily occupying a small notch in the middle of the distal side; it is rather short and either erect or flexed slightly toward the proximal part of the zoarium, the aperture rounded and 0.06 to 0.08 mm in diameter.

This well-known Atlantic species resembles *P. sarniensis* in its general appearance, but the zooecia are distinctly larger with shorter peristomes, and the ovicell is much wider transversely. On the Pacific coast it was first noted by Hincks at Cumshewa, and later by O'Donoghue at Bull Passage, British Columbia.

Hancock Stations: 143-34, Wenman Island, 100 fms, 147-34, Albemarle Island, 30 fms, and 352-35, Chatham Island, 35 fms, Galapagos; 299, San Jose del Cabo at the southern tip of Lower California, 82 fms; 72, Guadalupe Island off Lower California, 17 fms; Santa Barbara

and San Miguel Islands and various other places off shore along southern California, 15 to 76 fms. Also collected in Puget Sound, Washington, by Dr. J. L. Mohr, and two colonies from Cleveland Passage, Frederick Sound, southern Alaska.

Plagioecia sarniensis (Norman), 1864

Plate 73, fig. 3

Diastopora Sarniensis Norman, 1864:89.
Diastopora sarniensis, Hincks, 1880:463; 1884:206.
Berenicea sarniensis, Harmer, 1915:114.
Microecia sarniensis, O'Donoghue, 1926:21.
Plagioecia sarniensis, O'Donoghue, 1926:22.

The zoarium is usually encrusting but sometimes the borders are free and slightly contorted; the basal lamina forms a distinct border. There is much resemblance to *P. patina* in the zoarial form, but the smaller size of the zooecia and the form of the ovicell easily distinguish them.

The zooecia are embedded for most of their length. The semierect "peristomes" become suddenly smaller, their diameters only 0.09 mm and their apertures 0.07 mm in diameter. The peristomes are usually longer than those of *patina,* never connate and not in series.

The ovicell varies in form from irregularly rounded to short transverse, occasionally somewhat bilobate, and often one or two peristomes are surrounded. The ooeciostome is terminal or sub-terminal at the distal border, isolated, erect or curved proximally, the ooeciopore round and 0.05 mm in diameter.

Norman and Hincks both figured a small oval or rounded ovicell, though the latter states (1880:463) "Ooecia transversely elongate, subelliptical inflations of the zoarium, of a considerable size." Doubtless it was the small size of the ovicell figured that led Canu (1918:326) to select this species as the genotype of his new genus *Microecia,* which he placed in his new family Mecynoeciidae, now discarded. If there is such a fossil group of species of generic value, the selection of *sarniensis* as the genotype was most unfortunate and the generic name *Microecia* is invalidated, for *sarniensis* is certainly congeneric with *patina.* While the ooecial characters are of the greatest importance in the study of the cyclostomatous species, it is necessary to recognize the fact that these characters, like all others in nature, are subject to variation, and this is especially true of the size and form of the ooecial expansion. I have seen several cases of simple ooecia on the same zoaria with those of larger

size in *sarniensis,* and in *patina* there is much variation in width.

P. sarniensis has now been found in so many parts of the world that its distribution must be considered cosmopolitan. Hincks first listed it for Pacific waters at Cumshewa, British Columbia, and O'Donoghue recorded it from Banks Island and Lowe Inlet, British Columbia, and the San Juan Islands, Puget Sound.

Hancock Stations: 484, Barrington Island, Galapagos, 0°49′S, 90° 06′40″W, 52 fms; 423-35, off Port Utria, Colombia, 5°59′20″N, 77° 21′50″W, at 20 fms; 276, San Esteban Island, Gulf of California, 28°38′50″N, 112°36′W, at 32 fms; 72, Guadalupe Island, off Lower California, 29°N, at 17 fms; Santa Barbara, Anacapa and San Clemente Islands, off southern California; and San Juan Islands, Puget Sound, Washington.

Plagioecia tortuosa new species

Plate 67, figs. 8 and 9

Mesenteripora meandrina, Robertson, 1910:251 (not Wood, 1844:14).

Dr. Alice Robertson has given an excellent description of the zoarium: "Zoarium bilaminate, forming a contorted, convoluted mass . . . beginning as a simple, primitive disk from which there grow tubular zooecia curving in opposite directions, and forming a fan-shaped expansion similar to any young tubuliporidian colony. The two layered condition results from the ridges which occur at irregular intervals over the unilaminar sheet, . . . and which growing upward form the erect, bilaminar layers, the laminae becoming highly convoluted." The encrusting base sometimes covers a considerable area before the bilaminate folds are formed.

The zooecia are alternate, in quincunx, embedded but with the frontal surface convex, with numerous pores and sometimes transversely ribbed. The erect tubules or "peristomes" are usually short but may be as much as 0.50 mm in length, narrowing only slightly, perforated only near the base, about 0.13 mm in outside diameter; the aperture short oval or round and about 0.10 mm in diameter.

The ovicell, partially described by Robertson, is a distinct inflation which is usually considerably broader than long, surrounding 6 to 12 peristomes. The ooeciostome, which Robertson was unable to find, is sub-terminal, median, somewhat removed from the distal border, short, erect and slightly expanded at the tip, the pore round, 0.08 mm in diameter and the tip expanded to 0.13 mm.

In all characters, zoarial and reproductive, except the bilaminate adult zoarium, this species agrees closely with *P. patina* and must be considered congeneric with it.

Robertson recorded it from three localities in southern California, down to a depth of 32 fms.

Type AHF no. 107.

Type locality, Hancock Station 1662-48, off Santa Cruz Island, southern California, 33°55′45″N, 119°31′05″W, at 23 fms. Also taken at 1130-40, off Laguna Beach, southern California at 25 fms; at Cortez Bank, 32°24′N, 119°22′30″W, at 131 fms; and at 1190, Puerto Escondido, Gulf of California, 25°48′04″N, 111°18′53″W, in shallow water. Another fine specimen from Station 275, Raza Island, Gulf of California, 28°48′N, 113°W, at 40 fms has 4 ovicells more or less centrally located and 3 others partially developed near the margins of the zoarium.

Plagioecia grimaldii (Jullien), 1903

Plate 66, fig. 5

Mesenteripora Grimaldii Jullien, 1903:118.
Plagioecia grimaldii, Osburn, 1936:540.
? *Mesenteripora meandrina,* Smitt, 1866:432.

The zoarium consists of erect contorted folds arising from an encrusting base to a height of 1 or 2 cm. The folds are bilamellar, the growing edge showing the basal lamina with the tubules arising on both sides. The colony may be stipitate, as in Jullien's figure, plate 15, fig. 4, but is often broad and irregular. The embedded tubules are convex and quite distinct on the surface of the zoarium, 0.25 to 0.30 mm in width, with moderately deep separating grooves and perforated by numerous small pores. The peristomes are usually very short, often rising scarcely above the zoarial surface, but in protected areas they may rise, semierect, to a length of 0.40 mm. The apertures vary considerably, from 0.14 to 0.18 mm and are often closed by the characteristic diaphragm with a small tubule at the center.

The ovicells, here described from Baffin Bay specimens, are variable in size and form, large enough to surround 5 or 6 peristomes, prominent and sharply outlined; the ooeciostome smaller than a peristome and scarcely elevated above the surface, median and terminal in position. There is a tendency for the ovicells to be slightly broader than long but in one case the length is 50% greater than the width; another much smaller ovicell, which encloses only one peristome, is round. Since so

much attention has been given to the shape of the ovicells by Canu and Bassler it is important to note the amount of variation in form.

Jullien described the species from the Grand Bank of Newfoundland, at 155 meters. The only other positive reference is that in Osburn's report on dredgings by Captain R. A. Bartlett in Baffin Bay, three colonies with ovicells, (previously unknown), at 140 to 210 feet. It is probable that Smitt's *Mesenteripora meandrina* in the Torell collection from Greenland (1866:432) should now be referred to *grimaldii* rather than to the fossil *Diastopora meandrina* of Wood.

Point Barrow, Alaska, Alaska Research Laboratory, at 217 feet, G. E. MacGinitie, collector, several fragments agreeing with Baffin Bay specimens in all other details but without ovicells. The range of distribution is evidently high northern and probably circumpolar.

Plagioecia meandrina (Canu and Bassler), 1930

Plate 66, figs. 6 and 7

Diaperoecia meandrina Canu and Bassler, 1930:51.

The zoarium has a very striking appearance, consisting of a broad encrusting base from which arise at intervals narrower bilaminate branches or fronds which often anastomose to form large quadrangular, pentagonal or hexagonal fenestrae. The branches are usually at right angles to the plane of the zoarium. On the encrusting base the zooecia are arranged in quincunx, but on the erect branches they tend to run in rather regular series more or less transverse to the branch; they are not connate but well separated. The peristomes of the base are short but on the branches, especially near the growing edge, they are moderately elongate and nearly erect. The basal lamina of the base extends rather broadly beyond the functional zooecia and on the branches there is a similar but much narrower lamina projecting from between the two zooecial layers on one edge of the branch. The zooecial tubules are very little inflated and their outlines are often obscure. The peristomial apertures are round and about 0.10 mm in diameter.

The ovicell is a distinct inflation, irregularly elliptical, transverse and parallel to the edge of the branch and surrounding a number of the peristomes, most of which are closed, like those of *P. patina,* with a calcified membrane in the middle of which is a minute tubule. The ooeciostome is small, short, nearly erect, situated near the middle and terminal, free between the peristomes, and measures 0.08 mm.

Canu and Bassler placed the species in their genus *Diaperoecia* because of the peristomes surrounded by the ovicell, but indicated that "It is not yet a true Diaperoecia." As a matter of fact, the ovicell is almost exactly like that of *Plagioecia patina* in form and location as well as the nature of the ooeciostome. The perforation of the ovicell by the peristomes sometimes occurs in its relatives, *patina* and *sarniensis*, and in a specimen of *P. (Microecia) tubiabortiva* (Canu and Bassler, 1930) I have observed as many as 8 such enclosed peristomes. The closure of the peristomial apertures also is exactly like that in *patina,* a porous calcified membrane with a minute short tubule at the middle.

Our best developed specimen measures about 35 mm across the encrusting base and the fenestrate erect portion is about 60 mm high and wide, with 7 complete fenestrae. In most cases the growing edges of the branches are oriented in the same direction.

Described from the Galapagos Islands, Albatross Station D. 2815.

Hancock Stations: 143-34 Wenman Island; 170-34, Chatham Island; 201-34, Hood Island; 450, Albemarle Island; 452, Charles Island, and 453, Gardner Island, all from the Galapagos. Also at 1662-48, Santa Cruz Island, southern California; and collected by Dr. Carl L. Hubbs at Guadalupe Island, off Lower California. The geographic range is wide, from Santa Cruz Island, southern California (33°35′45″N) to Hood Island, (1°21′55″S), and the bathymetric range from 23 to more than 100 fms.

Plagioecia tubiabortiva (Canu and Bassler), 1930

Plate 73, fig. 2

Microecia tubiabortiva Canu and Bassler, 1930:48.

The zoarium is broad and flat, with a very irregular outline; the surface even, with smooth areas free from apertures and consisting of aborted tubules. The zooecial tubes are completely immersed, except for the very short, semierect peristomes which usually project only slightly above the crust. The diameter of the peristomes is 0.12 or 0.13 mm, that of the apertures 0.10 or 0.11 mm. The aperture is rounded to slightly elliptical. The peristomes are irregularly spaced, never connate and not in series. The basal lamina usually forms a distinct border.

The ovicell is a low inflation, rounded, expanded laterally or irregular in outline, usually surrounding a few peristomes (8 in one case). The ooeciostome rises barely above the surface, median and terminal in position, its aperture measuring about 0.06 mm.

This species is evidently congeneric with *patina* and *sarniensis,* judging by the nature of the tubules and especially by the characters of the ovicell.

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

Hancock Stations 143-34, off Wenman Island, Galapagos, 1°23′10″N, 91°48′45″W, at 100 to 150 fms, several colonies on shells.

Plagioecia anacapensis new species

Plate 66, figs. 9 and 10

? *Diastopora catillus* J. Y. Johnson, 1897:61.

The zoarium is round and flat but the margin is more or less turned up to produce small saucer-shaped colonies, which are attached by a comparatively small peduncle. The basal lamina is of moderate width. The zooecia about the center, with short peristomes, are arranged quincuncially, but beyond this area they form uniserial radiating rows which extend to the margin, similar to the fossil *Unitubigera* of d'Orbigny, 1853. Additional shorter series are interpolated toward the margin. The tubules are embedded, convex on the frontal surface, the walls perforated and later often transversely ribbed. The peristomes are semierect and beyond the central area become longer (0.25 mm or more). The central peristomes are always free and isolated, those in the radiating series sometimes connate at the base but the tips always free; diameter at the tip 0.13 mm, the aperture round and 0.10 mm in diameter.

The ovicell is inflated, its outlines distinct, transversely elongate (usually more than twice as wide as long), surrounding one or more peristomes. The ooeciostome is terminal at the middle of the distal border, short, erect, its rim flared like the bell of a cornet, the ooeciopore round and 0.08 mm in diameter, the rim circular and about 0.13 mm across.

When this material was first examined I placed it at once under *Unitubigera* d'Orbigny, 1853, but the large non-seriated central area is different and the nature of the ovicells (unknown in *Unitubigera*) is distinctly like that of *Plagioecia patina.*

There is a possibility that this species may be the *Diastopora catillus* of J. Y. Johnson (1897:61) from Madeira; his description is fairly similar, but he did not give a figure and did not mention the ovicell.

Type, AHF no. 113.

Type locality, Hancock Station 874-38, off Anacapa Island, southern California, 34°01′30″N, 119°21′W, at 45 fms, one colony on a shell. Also two colonies recovered from a sunken buoy off Rocky Point, south-

ern California, 45 fms. One of the latter is almost exactly like the type specimen except that the ovicell encloses three peristomes. The other colony differs only in having the 3 or 4 marginal rows of peristomes suddenly much elevated.

Plagioecia ambigua new species

Plate 66, fig. 8

The zoarium is flat and thin, entirely adnate, encrusting the smooth surface of a shell. The proximal portion is narrowly flabellate, with a very simple ovicell; beyond this the zoarium becomes broadly flabellate with a similar simple ovicell at one side and a very broad ovicell occupying much of the width of the lobe. The zooecial tubes are elongate, moderately distinct on the surface, slightly cross-striated and perforated with small pores, 0.20 mm in width. The peristomes are only suberect and directed strongly forward, the diameter 0.15 and the round aperture 0.13 mm; arranged in quincunx. There is only a single row of incomplete tubules at the margin.

The simple proximal ovicell is about 0.40 mm in width by 0.75 mm long; the simple lateral ovicell 0.30 mm wide by 0.70 mm long and the large ovicell is about 1.60 mm broad by 0.80 mm long. The ooeciostome is terminal in the small ovicells, erect at the proximal side of a peristome; in the large ovicell the ooeciostome is similarly situated, but is somewhat subterminal as the ooecial cavity has extended slightly beyond it; diameter of aperture 0.08 mm.

Type, U. S. Nat. Mus. no. 11049.

Type locality, Point Barrow, Alaska, 130 feet, Arctic Research Laboratory, G. E. MacGinitie, collector, one colony.

This is a very unusual specimen, with characters of several genera. There are two simple ovicells like slightly expanded zooecial tubules and with terminal ooeciostomes, much like *Oncousoecia diastoporides,* except that the ooeciostome is associated with a peristome. There is also a much expanded ovicell, transverse, surrounding several peristomes, with a subterminal ooeciostome and resembling *Plagioecia,* except for the position of the ooeciostome proximal to a peristome. The latter character is more like that of *Tubulipora.* The ovicell surrounds a number of peristomes, which would place the species under *Diaperoecia.*

With such a combination of characters, one is naturally in doubt as to the generic relationship, but I am accepting as the most important character the fullest development of the ovicell, expanded laterally and with a subterminal, median ooeciostome.

I have observed a number of cases of similar ambiguity among the Diastoporidae and Tubuliporidae, but never quite to this extent. Presumably all such cases may be interpreted as examples of the repetition of ancestral characters and therefore useful in tracing the evolution of the group. At the same time they present a problem in identification, for if only the simple ovicell is present the species must necessarily be assigned to a different genus and even a different family than if the expanded ovicell is developed, according to Canu's analysis.

? Plagioecia lactea (Calvet), 1903

Diastopora lactea Calvet, 1903:163; 1907:466.
Plagioecia lactea, Canu and Bassler, 1930:48.

The zoarium is flat and discoidal, with a narrow basal lamina, and is attached by a peduncle. The zooecial tubules are immersed for most of their length, their surfaces rather coarsely cross-striated and punctured. The peristomes are moderately short, semi-erect and well separated. Occasional apertures are closed with a lamella with a central minute tubule. The orifices are round or slightly elliptical and measure about 0.08 mm; the peristomes 0.10 to 0.12 mm in diameter, depending on the amount of calcification.

While no ovicells have been noted in the Hancock specimens, the descriptions and figures given by Calvet and Canu and Bassler, and measurements by the latter are all in agreement.

Recorded by Calvet from the Gulf of Gascony at 300 meters and from Cape Spadel, Morocco, at 717 meters, and by Canu and Bassler from the Galapagos Islands, Albatross Sta. D.2813, at 40 fms.

Hancock Station 143-34, off Wenman Island, Galapagos, 1°23′10″N, 91°48′45″W, at 100 to 150 fms.

Genus DIPLOSOLEN Canu, 1918

Diplopora Jullien, 1903:115 (preoccupied by Gümbel, 1866).

Interspersed among the autozoids are nannozoids or reduced individuals, irregularly distributed, their minute peristomes shorter than those of the normal tubules and often inconspicuous. The ovicell is a prominent swelling, usually surrounding a number of peristomes; the ooeciostome smaller than the peristomes, short, erect and isolated. Genotype, *Tubulipora obelia* Johnston, 1838.

Older authors placed the species under *Tubulipora, Berenicea* and *Diastopora,* but the constant presence of nannozoids, the function of which is unknown, appears sufficient for generic standing.

Diplosolen obelium, (Johnston), 1838

Plate 73, fig. 1

Tubulipora obelia Johnston, 1838:269.
Diastopora obelia, Hincks, 1880:462.
Berenicea obelia, Okada, 1917:352.
Diastopora obelia, O'Donoghue, 1923:14.
Diplosolen obelium, O'Donoghue, 1926:24.

The zoarium is thin and flat, rounded or irregularly lobate. The zooecia are embedded for most of their length, though the semierect peristomes project well above the surface; the aperture is round or slightly elliptical, 0.08 to 0.10 mm in diameter. In Alaska specimens the aperture is noticeably larger, 0.10 to 0.12 mm in diameter (var. *arctica* Waters, 1904a:171) than in southern specimens, but there seem to be no other differences of importance. The nannozoids are similar in form to the autozoids, but are minute in size; their peristomes are much shorter and are only about 0.03 mm in diameter.

The ovicell is considerably inflated, varying in size, oval or arcuate, transverse, and encloses a number of peristomes of both autozoids and nannozoids (as few as 2 and as many as 20 have been counted). The ooeciostome is isolated, short, its aperture rounded and intermediate in size between those of the autozoids and nannozoids, usually more or less central in position.

It is a well-known North Atlantic species, extending into the Arctic, and reported from Japan. On the Pacific coast it has been recorded by O'Donoghue from several places in British Columbia and from the San Juan Islands in Puget Sound.

Hancock Stations: 1194-40, 43 fms, and 1294-41, 34 fms, at Santa Cruz Island, southern California. Also among the collections are specimens from Puget Sound; from Alitak Bay, Alaska (U. S. Fisheries Alaska Crab Investigation); from Nash Harbor, Nunivak Island, Alaska; from the Bering Sea, and from Point Barrow, Alaska (Arctic Research Laboratory, G. E. MacGinitie, collector).

The species is common in Alaska waters, less frequent farther south, and Santa Cruz Island, southern California (34°N. Lat.) is the most southern record.

Genus **DIAPEROECIA** Canu, 1918

The ovicell continues to develop after the calcification of the tubes distal to it and often surrounds a considerable number of peristomes. The ooeciopore is usually not terminal and is often proximal or near

the middle of the ooecial swelling. There are several types of ooeciostomes, which may eventually result in the separation of the genus as suggested by Canu and Bassler (1920:740). (1) In some species the ooeciostome is not associated with a tubule but is quite independent among them; (2) in others it is a high tube at the side of a peristome and more or less connate with it; and (3) in still others it is a transverse or arcuate pore at the base of a peristome and without an ooeciostome.

Pustulopora intricaria Busk, 1875:22, which is the genotype, is an erect, branching species with the ooeciostome isolated and situated a little proximal to the middle of the long ovicell, which surrounds a large number of peristomes.

In my opinion Canu and Bassler have depended too much on a single character, that of the ovicells surrounding peristomes, for this character appears not infrequently to a lesser extent among other genera, even in species of genera that do not ordinarily show it, such as *Tubulipora, Plagioecia, Fasciculipora, Frondipora,* etc. Even in *Plagioecia patina,* the genotype of that genus, a peristome may occasionally be surrounded. It is also true that in *Diplosolen* and *Crisulipora,* which usually have a number of included peristomes, ovicells occasionally occur which have failed to surround any peristomes.

The erect species of our eastern Pacific members of this genus agree in having an elongate ovicell which extends much beyond the isolated and more or less centrally placed ooeciostome. Others, such as those described from the Galapagos Islands by Canu and Bassler, *D. striatula, D. subpapyracea* and *D. meandrina,* with transversely broad ovicells and terminal, median ooeciostomes, more properly belong under *Plagioecia* notwithstanding the inclusion of some peristomes.

It would appear to be true of any species that when the ovicell continues to grow forward around a distal peristome, the walls may come together and coalesce to enclose it. However this may be, there is certainly a group, *Diaperoecia,* with a well-defined facies which shows an extended ovicell enclosing numerous peristomes and with a non-terminal ooeciostome.

The species of the present list show two distinctly different types of ooeciostome; in *D. intermedia, johnstoni* and *claviformis* the ooeciostome is a narrow tube at the side of a peristome and is proximal in position, while in *californica* and *floridana* the tube is wider, broadly flared at the tip, entirely free from the peristomes and situated more medially.

Key to the Species of *Diaperoecia*

1. Slender, erect or semierect, branching species, rising from a small encrusting base, ooeciostome free 2
   Adnate species, with expanded lobes, the lobes sometimes short-erect, ooeciostome at the side of a peristome 3
2. Branches very narrow, seldom as much as 1.0 mm in width, apertures of peristomes about 0.13 mm in width . . *floridana*
   Branches wider, 2 mm or more, apertures of peristomes 0.20 mm or more, the lateral peristomes usually in short connate series . . . . . *californica*
3. Zoarium adnate and branched laterally, with short, erect fertile branches which expand into small capitula containing the ovicell . . . . . *intermedia*
   Fertile lobes adnate 4
4. Fertile lobes flabellate, usually more or less triangular, peristomes projecting high above the ovicell . . . . *johnstoni*
   Fertile lobe rounded, peristomes projecting only slightly above the ovicell . . . . . *claviformis*

Diaperoecia californica (d'Orbigny), 1852

Plate 67, figs. 1 and 2

Idmonea Californica d'Orbigny, 1853:732.
Idmonea Californica, Conrad, 1855:441.
Idmonea californica, Gabb and Horn, 1862:168.
Tubulipora dawsoni, Hincks, 1884:205.
Idmonea californica, Robertson, 1910:253.
Idmonea californica, Canu and Bassler, 1923:199.
Idmonea californica, O'Donoghue, 1923:12; 1926:27.
Idmonea palmata, O'Donoghue, 1923:12.
Diaperoecia intricata, Canu and Bassler, 1928:41.

The zoarium is composed of erect or spreading branches which frequently reach a height of 25 mm and occasionally as much as 50 mm. The branches may anastomose and often form reticulated masses. Usually, in deeper water, the branches are narrow in proportion to their length, 2 to 3 mm in breadth, but in exposed places along shore the zoarium is more consolidated and the branches shorter and wider and less erect (*Idmonea palmata* O'Donoghue); sometimes procumbent and attached to the substratum by the radicles (*Diaperoecia intricata,* Canu and Bassler, 1927:41). Radicles or supporting processes are frequently

present on the dorsal sides of the branches and these may fuse with the substratum or with another branch. The dorsal side is more or less striated transversely.

The zooecia are large, their outlines distinct on the frontal surface; the peristomes curved into an erect position, arranged in fascicles of usually 4 or 5 zoids on either side of the midline, sometimes connate to their tips but often only at their bases. Or they may be entirely free from each other, and there are often isolated peristomes in the midline. The apertures are large, round, averaging about 0.22 mm in diameter.

The ovicell is a large inflation, usually spread across the whole width of the branch below a bifurcation and frequently continuing on one or both branches; it surrounds often a large number of isolated peristomes. The ooeciostome is isolated, sub-terminal, moderately short, usually bent distally but it may be tipped in any direction, large, its base wider than a peristome, its tip flared and compressed, as much as 0.60 mm in diameter in the long direction, the pore long elliptical. There is much variation in the form of the pore, which is sometimes round, and the tip of the ooeciostome may be trumpet-shaped without compression.

This is an extremely common species all along the California coast and I have examined hundreds of specimens, ranging all the way from the short, palmate form to tall, slender branches from sheltered localities and deeper water. It is common in various Pleistocene formations, where it was noted by Conrad, Gabb and Horn, and by Canu and Bassler. I can find no difference between the Pleistocene and recent specimens and I have even found the ooeciostome, which was overlooked by the paleontologists, except by Canu and Bassler, 1923:199, who show it in Plate 43, fig. 6.

The *Diaperoecia intricata* of Canu and Bassler from the Hawaiian Islands is undoubtedly *californica,* as the differential characters by which they distinguish it are exactly those of *californica,* "par ses colonies reticulées, par son grand ooeciostome et par son ovicelle perforée par des tubes écartés les uns des autres."

Hincks' description of *Tubulipora dawsoni* from British Columbia fits the zoarial characters of *californica* perfectly. He made no mention of the ovicell.

Hancock Stations: dredged at more than 100 stations and found at shore stations in abundance. The northern limit of its range, as far as known, is British Columbia, including the records of Hincks *(Tubulipora dawsoni)* and O'Donoghue (both *Idmonea californica* and *I. palmata.)* It is common in the Gulf of California and along the west coast

of Mexico; the most southern record is Hancock Station 460-35, at Playa Blanca, Costa Rica. The bathymetric range is from low tide to about 100 fms.

Diaperoecia floridana Osburn, 1940

Plate 67, fig. 3

Idmonea Milneana, Smitt, 1872:8 (*non* d'Orbigny).
Diaperoecia radicata, Canu and Bassler, 1928:160 (*non* Kirkpatrick).
Diaperoecia floridana Osburn, 1940:331; 1947:5.
? *Diaperoecia rugosa* Osburn, 1940:332.

The zoarium is erect or sprawling, idmoneiform, irregularly branched, the branches slender, 0.60 to 1.0 mm in width, sometimes anastomosing; both dorsal and ventral sides more or less wrinkled; strong unjointed radicles developed on the dorsal side. The tubules are elongate; in younger branches the outlines are definite but the lines disappear with age; 4 or 5 to 6 or 7 tubules make up the width of a branch; the peristomes are curved, sometimes more than 1.0 mm long but usually about 0.40 mm, varying in diameter from 0.16 to 0.20 mm, the aperture varying from 0.13 to 0.17 mm; in older specimens transversely wrinkled nearly to the tips, perforated at the base.

The ovicell is elongate, usually located near the end of a branch and may extend up both branches at a bifurcation, usually surrounding one or more peristomes; but smaller ones may fail to enclose any. The ooeciostome is independent of the peristomes, usually situated near the middle of the ovicell; but when this is branched it is located near the base of the fork. It has the same width as the peristomes, usually bent sharply toward the base but in the forked ovicells it is more or less erect. The tip of the ooeciostome in any case, when fully developed, is broadly flared, irregularly elliptical, and measures from 0.20 to 0.35 mm wide by about 0.16 mm in the shorter dimension.

Pacific specimens have been compared with those from the Atlantic and seem to show no essential differences. Also I am inclined to place *D. rugosa* in synonymy, since in our abundant material there is much variation in the size of the peristomes, the amount of striation, and the form and position of the ooeciostome.

Described from off Beaufort, North Carolina, and recorded also by Osburn from the southern shore of Porto Rico and from several localities on the southern shore of the Caribbean Sea; by Smitt *(Idmonea milneana)* from Florida, and by Canu and Bassler *(D. radicata)* from the Gulf of Mexico and the Straits of Florida.

Hancock Stations: 275, Raza Island, Gulf of California, 40 fms; 305-34, Clarion Island, west of Mexico, 15 fms; 1978-50, Ranger Bank, Lower California, 71 fms; and 1143-40, off Portuguese Point, near San Pedro, 34 fms, 1413-41, San Miguel Island, 34 fms, 1064, Santa Barbara Island, 38 fms, and 1240, off San Diego, all from southern California.

The O'Donoghues have recorded under this genus a number of other species from British Columbia which have not appeared in our material.

D. *(Entalophora) capitata* (Robertson, 1900), 1926:22.
D. *(Entalophora) clavata* (Busk, 1859), 1926:23.
D. *(Stomatopora) expansa* (d'Orbigny, 1851), 1926:23.
D. *(Stomatopora) depressa* (O'Donoghue, 1923), 1926:23.
D. *(Tubulipora) labiata* (O'Donoghue, 1923), 1926:23.
D. *(Tubulipora) striata* (O'Donoghue, 1923), 1926:24.
D. *(Entalophora) vancouverensis* (O'Donoghue, 1923), 1926:23.

Diaperoecia johnstoni (Heller), 1867

Plate 67, fig. 4

Criserpia Johnstoni Heller, 1867:126.
Stomatopora Johnstoni, Hincks, 1880:430.
Stomatopora johnstoni, O'Donoghue, 1923:11.
Diaperoecia johnstoni, O'Donoghue, 1926:23.

Our specimens agree very closely with the *Stomatopora johnstoni* of Hincks from the British Isles, though Hincks did not have the ooeciostome.

The zoarium is encrusting, branching usually dichotomously; the branches short, narrow at the base with 1 or 2 rows of tubules for a short distance, beyond which they suddenly become fan-shaped or triangular with 4 to 6 or 8 tubules in cross-section. The tubules are about 0.26 mm in diameter, convex and conspicuously perforated; the peristomes are moderately high, more or less erect, not connate and not seriate, 0.18 to 0.22 mm in diameter, the aperture about 0.17 mm.

The ovicells are as Hincks described them, "dilated and very ventricose, wedge-shaped," though there is considerable variation in the form; thickly perforated with conspicuous pores; surrounding from 1 to 5 peristomes. The ooeciostome, located near the middle of the ovicell, is as high as the peristomes and about half as large in diameter, the orifice 0.09 mm, situated at the side of a peristome and connate with it for a short distance at the base.

Heller described the species from the Adriatic Sea, Hincks redescribed it from Great Britain, and O'Donoghue listed it from several localities in British Columbia and Puget Sound. It is possible that the species should be placed in the genus *Tubulipora,* but our specimens are incomplete in certain respects which prevent a final judgment. It has much resemblance to *D. intermedia* O'Donoghue but the measurements are larger and the fertile branches are adnate.

Point Barrow, Alaska, 21 fms, Arctic Research Laboratory, G. E. MacGinitie, collector. Also two specimens from Nash Harbor, Nunivak Island, Bering Sea, 8-10 fms, on a shell.

Diaperoecia intermedia (O'Donoghue), 1923

Plate 70, fig. 5

Tubulipora intermedia O'Donoghue, 1923:10.
Diaperoecia intermedia, O'Donoghue, 1926:23.

The zoarium is encrusting and branching, with short erect or semierect branches which form small capitula. The zooecial tubes are all on the ventral side. The stalks of the free branches are about 0.60 to 0.70 mm wide and the capitula may reach a maximum width of 3 mm. The peristomes are all free and moderately long to a maximum of 0.90 mm, width 0.16 mm, the aperture 0.13 mm.

The ovicell has its origin on the ventral side and expands upon the top of the capitulum where it surrounds several peristomes; it is considerably inflated and thickly perforated. The ooeciostome is more or less connected with a peristome at its base, nearly as tall as a peristome, and noticeably smaller, its aperture 0.10 mm in diameter, varying in its position but usually somewhere near the middle of the expansion.

O'Donoghue very properly questioned the generic position of this species, as the adnate portion of the zoarium is similar to that of *Proboscina* and the ovicell bears some resemblance to that of *Tubulipora.* The nature of the ovicell, enclosing a number of tubules, and especially the position of the ooeciostome near the middle of the expansion (occasionally quite proximal to it) suggest *Diaperoecia* where O'Donoghue finally placed it. It may possibly be one of the various northern species which have been described without the ovicell but there is at present no proof of synonymy.

The species was described from Departure Bay, British Columbia.

Our specimens are from Point Barrow, Alaska, 125 to 522 feet, G. E. MacGinitie, collector, common on shells and rocks.

Diaperoecia claviformis new species

Plate 66, fig. 11

Zoarium encrusting on a shell, consisting of a ligulate branch, 0.65 mm wide, which terminates in an asymmetrical rounded expansion 2 mm in width. The tubules are short, their outlines inconspicuous, 2 rows on the basal portion; the peristomes moderately high and unusually close together, not connate and not seriated, 0.16 to 0.18 mm in diameter, the apertures 0.13 mm; the younger tubules have the walls perforated with small pores but these become closed with age.

The ovicell is a conspicuous, ventricose area covering most of the expanded part of the lobe and enclosing 12 peristomes which are quincuncial in arrangement; among these the narrow lobes of the ovicell are evenly distributed around the peristomes. The ooeciostome is near the proximal end, a cylindrical erect tube, connate with a peristome at its base only, the orifice round and 0.10 mm in diameter.

The species has some resemblance to *D. johnstoni,* especially in the narrow ligulate branch and suddenly expanded lobe, but the measurements are smaller, the peristomes much more closely associated, and the meandering branches of the ovicell very narrow.

Type, AHF no. 92.

Type locality, Hancock Station 1624-48, off Santa Catalina Island, southern California, 33°23′48″N, 118°21′05″W, at 36 fms, one colony on a shell.

Family **Tubuliporidae** Johnston, 1838

"Zoarium entirely adherent, or more or less free and erect, multiform, often linear, or flabellate, or lobate, sometimes cylindrical. Zooecia tubular, disposed in contiguous series, or in single lines. Ooecium an inflation of the surface at certain points, or a modified cell." (Hincks, 1880:424).

"Cyclostomata in which the zooecia are restricted to one surface of the colony and are commonly arranged in connate alternating series. Cancelli are absent in the majority of the species. The ovicell is a modified zooecium which is usually much dilated in the region where the embryos undergo their development." (Harmer, 1915:119).

This is a large and difficult family and its analysis is complicated by the great number of fossil forms, often without ovicells, that have been described. As a rule they are adherent to the substratum, more or less lobate, with the zooecial tubes arranged in fascicles, and the ooecium

lobate among the fascicles. The early development is characteristic as they all begin with a few adnate tubules radiating in a flabellate form from one side of the pro-ancestrula; later the zoaria may assume various forms and even become erect and branched. The tubules are usually in connate series or groups but may be single over a large part of the zoarium or its entire surface, and may be biserially arranged or scattered. While the ovicells are usually broad and lobate between the fascicles, examples may be found in which they are almost as simple as in *Crisia* or *Oncousoecia,* and even in species with lobate ooecia, simple ovicells may appear on the same zoarium with lobate ones. Also the ovicells may occasionally surround tubules or fascicles as in *Diaperoecia.* The ooeciostomes are very important in the determination of the species, but in the various genera they may be terminal, subterminal or more centrally located.

Key to the Genera of Tubuliporidae

1. Zoarium adnate with slender lobes; tubules in connate single series, on each side of the midline; ooecium spreading the full width of the lobe between the fascicles, the ooeciostome proximal to the first tubule of a fascicle . . . . . *Platonea*
   Ooecium not so arranged 2
2. Ooecium arcuate and much depressed between the fascicles, the ooeciostome terminal at the middle of the arcuate ooecium; zooecial tubes thick-walled . . . . . *Bathysoecia*
   Ooecium not arcuate, the surface inflated 3
3. Zoarium composed of extremely high, folded fascicles; ovicell very elongate, simple, like a somewhat enlarged tubule . . . . . *Fasciculipora*
   Zoarium usually flat and adnate, rarely erect and branched; tubules in clusters, radiating series or single; ooecium usually broadly lobed between the tubules or fascicles, sometimes smaller and simple . . . . . *Tubulipora*

Genus **TUBULIPORA** Lamarck, 1816

Zoarium variable, encrusting and lobulate, repent and branching, or erect and branching. Zooecia all on the frontal surface, arranged more or less in transverse series or in groups, usually single near the ancestrula and occasionally over the whole zoarium. The ovicell is an inflated gonozoid between the tubules on the frontal surface, simple and pyriform

to broadly lobate with the lobes extending between clusters of tubules; the ooeciostome is usually located at the side of a zooecial tube, sometimes free from it or more or less connate, varying in size, height and form among the different species. Genotype, *T. transversa* Lamarck, 1816 (=*T. liliacea* Pallas, 1766).

Key to Species of *Tubulipora*

1. Zoaria comparatively large and coarse, often irregular in form, the ovicell usually much ramified, ooeciostome tall 2
   Zoaria smaller, often simply lobate, ovicell little ramified, the ooeciostome shorter 5
2. Ooeciostome high, much compressed, the aperture slit-like . . 3
   Ooeciostome high, little compressed, aperture ovate 4
3. Peristomes connate in series or bundles, ooeciostome tall and conspicuous, connate with a tubule at its base, enlarging upward and slightly flared, the aperture compressed (including var. *fasciculifera)* . . . . . *tuba*
   Peristomes sometimes in series, ooeciostome smaller and less conspicuous, its aperture more narrowly slit-like and not flared . . . . . *flabellaris*
4. Peristomes connate, forming high fascicles, the tips free; ooeciostome scarcely compressed, tall, about as wide as a peristome (0.25 mm), slightly expanded at the tip . *admiranda*
   Peristomes not at all connate; ooeciostome slightly smaller than a peristome, not compressed, its tip slightly expanded, not connate with a peristome . . . . . *egregia*
5. Zoarium with erect slender branches, idmoneiform; ovicell small, ooeciostome slightly distal to the first member of a fascicle, short, flared . . . . . *flexuosa*
   Zoarium adnate, small neat-appearing species 6
6. The dorsal side of the zoarium has numerous short attachment processes and near the base these give the edge a serrated appearance . . . . . *pulchra*
   No attachment processes 7
7. Zoarium widely flabellate; ooeciostome comparatively short, connate at base and widely diverging, flared at the tip to a width of 0.18 mm . . . . . *pacifica*
   Zoarium lobate, ooeciostome short erect, connate at base or free, flared at the tip to a width of 0.12 mm . . . . *concinna*

Tubulipora tuba (Gabb and Horn), 1862

Plate 68, fig. 9

Semitubigera tuba Gabb and Horn, 1862:169.
Tubulipora occidentalis Robertson, 1910:249.
Tubulipora occidentalis, O'Donoghue, 1923:8.
Tubulipora tuba, Canu and Bassler, 1923:198.
Tubulipora tuba, O'Donoghue, 1926:24.

The zoarium of this abundant species is always adnate, flat and rather regularly rounded or sometimes lobate on flat surfaces, variously contorted on stems; rather coarse, white, gray or purplish in color. The "peristomes" are nearly erect, 0.12 mm in diameter, varying greatly in length, as much as 2 mm in sheltered locations but usually much less; single near the primary zoid and sometimes over a considerable area, then connate in small fascicles of 2 or more, the marginal fascicles increasing in the number of peristomes to 6, 12 or even as many as 30. The fascicles are usually uniserial or biserial and radiating, but occasionally occur in rounded or irregular clumps; sometimes they are more or less biradial in arrangement, but this is rare.

The ovicell is usually a large lobate inflation extending between several fascicles, but not infrequently it is smaller, and even simple *Crisia*-like ooecia may occur on the same zoarium with the larger normal ones. The ooeciostome is tall, straight, compressed, regularly increasing in size toward the tip, usually a little flared at the top, the pore elongated in the direction of the fascial axis; in typical *tuba* the ooeciostome arises at the side of the first tube of a fascicle and is usually free for most of its length. The variations are discussed under the variety *fasciculifera* (Hincks).

Gabb and Horn described the species from the Pleistocene of Santa Barbara, California, and while their description and figure are incomplete, there can be no doubt. I have compared abundant recent and numerous Pleistocene specimens. Canu and Bassler listed both *tuba* and *fasciculifera* from the Pleistocene of California. Robertson described *occidentalis* (= both *tuba* and *fasciculifera)* and listed it from southern California to Puget Sound, and O'Donoghue recorded both from numerous localities in British Columbia.

In the Hancock Collections it is by far the most abundant species of the genus, taken at shore stations and dredged down to a depth of 117 fms. It is evidently a species of cooler waters as the most southerly record is that of Station 275, Raza Island, Gulf of California, 28°48′N, 113°W.

Tubulipora tuba var. fasciculifera (Hincks), 1884

Plate 68, fig. 10

Tubulipora fasciculifera Hincks, 1884:206.
Tubulipora occidentalis Robertson, 1910:249 (in part).
Tubulipora fasciculifera, Canu and Bassler, 1923:197.
Tubulipora fasciculifera, O'Donoghue, 1923:8; 1926:24.

The zoarium is very similar to that of *T. tuba,* presenting the same variations in form. The zooecia are also similar, the free portions of the tubules varying much in length and having the same diameter (0.12 mm). The only zoarial difference is that made use of by Canu and Bassler, the fascicles "never composed of more than 6 tubules," while in *tuba* there may be "from 6 to 20."

The ovicell, like that of *tuba,* is expanded into lobes which extend between the fascicles, and here also there is the occasional occurrence of simpler ooecia. The ooeciostomes are usually situated proximal to the first tubule of a fascicle, connate with it for a short distance, with the flattened ooeciopore transverse to the axis of a fascicle, the top of the ooeciostome sometimes a little flared.

After studying more than a hundred specimens from various localities, I am unable to distinguish sharply between *tuba* and *fasciculifera.* The above diagnoses are for well-marked specimens, but intermediate conditions occur in all of the diagnostic characters. Many colonies have only the smaller fascicles, others mostly small ones with a few larger fascicles, and still others have chiefly the larger numbers. Occasionally the long fascicles arise near the center of the zoarium, while in other specimens they are nearer the edge. The ooeciostomes of *tuba* are usually lateral to a tubule with the pore in line with the fascicle, but may be proximal to a tubule with the pore transverse, and in *fasciculifera* both of these conditions may sometimes be seen on the same zoarium. The form of the ooeciostome is variable though it is always more or less compressed; sometimes it is slightly flared at the tip, or it may be perfectly straight (possibly those in the latter condition have not quite completed their growth). If the size of the fascicles and the position of the ooeciostome were constant they would be considered good specific characters, but I do not find them so.

Hincks described *T. fasciculifera* from British Columbia, the exact locality not stated. Robertson mentions it under her description of *T. occidentalis,* which embodies some of the characters, and lists *occiden-*

talis from Puget Sound to southern California. O'Donoghue recorded it along with *occidentalis* from numerous places in British Columbia and Puget Sound.

The variety, if the varietal distinction is really worthwhile in this case, appears to occur throughout the range of *tuba,* in the same habitat, and they are found together in the Pleistocene at a number of places in southern California.

Tubulipora pacifica Robertson, 1910

Plate 68, fig. 1

Tubulipora pacifica Robertson, 1910:248.
Tubulipora pacifica, O'Donoghue, 1923:8; 1926:25.

The zoarium is encrusting, usually on algae; small (rarely more than 3 mm across), white and rather delicate; fan-shaped to nearly circular, or occasionally with lobes of the same form. The immersed zooecial tubules are long and slender, transversely arched and thickly punctate. The peristomes are moderately high, about 0.12 mm in diameter; near the center of the colony they are single but farther out they are usually fasciculate, with one or two rows of peristomes which are connate with the tips divergent; there is a tendency for them to be distributed biradiately, on either side of the zoarial axis.

The fully developed ovicell appears to be considerably larger than in *T. pulchra,* with as many as 3 or 4 lobes between the fascicles, but frequently they are much simpler, pyriform, and resemble those of *Crisia,* only more immersed, and all the intermediate conditions may be observed. The ooeciostome is comparatively short and is very briefly connate with the succeeding tubule at its base, sharply diverging proximally, or as Robertson expressed it, "It seems to emerge from the side of a zooecium at right angles to it." It is flared outward at the tip, compressed, the ooeciopore elliptical and about 0.18 mm in its greatest diameter.

At first glance the species has much the appearance of *pulchra* but the dorsal side is smooth without attachment processes, there is no serration of the margin at the base, the peristomes are larger, stiffer-looking and in adult colonies there is always some fusion of the peristomes into small fascicles. Robertson described and listed it from various shorewise localities in southern California, and O'Donoghue recorded it from numerous places in British Columbia. It has a wide distribution along the coast to as far south as Colombia; apparently a shallow-water species, but dredged down to 47 fms.

Hancock Collections: numerous shore stations and shallow-water dredgings about the off-shore islands of southern California; Station 225-34, Gorgona, Colombia, 2°58′55″N, the most southern record. Also Albatross collections, 1911 cruise, at San Francisquito Bay and San Esteban Bay, Lower California.

Tubulipora pulchra MacGillivray, 1885

Plate 68, figs. 2, 3, and 4

Tubulipora pulchra MacGillivray, 1885:95.
Tubulipora fimbria forma *pulchra,* Waters, 1887:258.
Tubulipora pulchra, Robertson, 1910:250.
Tubulipora pulchra, O'Donoghue, 1923:8; 1926:25.

A beautiful small, white, delicate species which adheres loosely to the substratum, usually a kelp, but frequently to shells. The zoaria are small, usually only 2 or 3 mm in extent, more or less fan-shaped or ovate, sometimes with lobes of the same size and form. A peculiarity of the dorsal surface is the presence of numerous short attachment processes which support the zoarium "on tiptoe," as Miss Robertson suggests; on the marginal zoids these are larger and project laterally to give the border a serrated appearance, especially near the ancestrula. The tubules are small, elongate and very slender; the peristomes are long and slender (0.08 to 0.09 mm in diameter), not connate and not seriated.

The ovicell or gonozoid is simple and little expanded, its form frequently resembling that of a *Crisia* but more embedded; at its fullest development there are 2 or 3 short lobes extending laterally between the peristomes. The ooeciostome is erect and moderately high; at the base it is about as wide as a peristome and at the tip it flares out into a compressed trumpet shape about twice the width of the base; it is never connate with another tubule.

MacGillivray described the species from Australia, Robertson recorded it from the southern California coast, and O'Donoghue found it at a number of localities in British Columbia.

Hancock Stations: numerous stations along the coast of California and among the Channel Islands; Station 72, Guadalupe Island, and 136-34, Clarion Island, west of Mexico; 468-35, Port Parker, Costa Rica; 462, James Island, Galapagos. Shore to a depth of 35 fms.

Tubulipora flexuosa (Pourtales), 1867

Plate 71, fig. 11

Idmonea flexuosa Pourtales, 1867:111.
Idmonea atlantica var. *flexuosa,* Smitt, 1872:6.
?*Idmonea atlantica* var. *tenuis* Busk, 1875:11.

? *Idmonea atlantica* var. *tenuis,* Hincks, 1880:452.
Tubulipora atlantica var. *flexuosa,* Harmer, 1915:127.
Idmonea atlantica var. *flexuosa,* Osburn, 1940:333.
Idmidronea atlantica var. *flexuosa* Osburn, 1947:5.

Pourtales gave only a brief description, in which the most important points are the slender, flexuous and round branches. Smitt re-worked Pourtales' material and gave a good description and figures. Unfortunately, to the present time, no one has observed the complete ovicell with ooeciostome. It is on the basis of the latter character, chiefly, that I am elevating it once more to full specific standing.

The zoarium presents the same general characters as the well-known *atlantica,* erect and branching from a small base, but the branches are very slender, much flexed and sinuous, and in cross-section they are round instead of being flattened on the dorsal surface. The fascicles are short, the tubules 2 or 3 in series (rarely 1 or 4), while in *atlantica* they are 3 or 4 to as many as 6, and they average a trifle smaller in diameter, connate to the tips and slightly narrowed upward from the base.

The ooecium and the ooeciostome (which is here described for the first time) are quite different from those of *atlantica.* The ooecium is short, usually occupying only two interfascicular areas, into which it spreads more or less, while that of *atlantica* is usually very elongate and is limited to the axis of the branches and not lobed laterally; the perforations of the ovicell wall also appear to be more minute and more numerous. The ooeciostome presents the most striking difference, as it is very short, erect, with a widely flared and rather thick border; it is located just medial to the first tubule of a fascicle and slightly separated from it. In *atlantica* the ooeciostome is about as tall as the tubules, curved distally, expanded gradually, situated on the distal side at about the second tubule of the fascicle, and its base connate with a tubule for a short distance; in the several ooeciostomes I have observed there is no intergradation.

This form was described by Pourtales and by Smitt from north of Cuba and later recovered by Osburn from Porto Rico and the southern shore of the Caribbean Sea. Harmer's reference (1915:127) from the Netherlands East Indies appears undoubtedly to be the same, for, while he did not have a complete ooeciostome, his fig. 1, plate 10, shows the base and pore in the characteristic position. Any attempt at a complete synonymy would be useless, and it will even be uncertain whether Busk's variety *tenuis* is the same as *flexuosa* until the ovicells are carefully studied. Also, there is no certain record of *Tubulipora (Idmonea) atlantica* from the eastern Pacific.

Hancock Stations: Raza Island, Gulf of California, 28°48′N, 113° W, at 40 fms, numerous colonies in reproduction; also one colony from James Island, Galapagos, at 54 fms.

Tubulipora concinna MacGillivray, 1885

Plate 67, fig. 5

Tubulipora concinna MacGillivray, 1885:94.
Tubulipora concinna, Harmer, 1915:123.

The zoarium is entirely encrusting on erect stems and on flat surfaces, the branches narrowly lobate and curved laterally, a small and delicate species. The slender peristomes are very elongate, 0.40 to 0.75 mm, strongly curved and often sinuate, sparsely punctate, about 0.09 mm in diameter and the aperture about 0.07 mm. On flat surfaces the peristomes are usually directed somewhat outward from the midline of the lobes, but on small stems they are very irregular in arrangement; for the most part they are distinct, but on the broader portion of the lobe they are frequently in series of 2 to 4 and connate to the tips.

The ovicells are small, almost as simple as in *Crisia,* narrow proximally and gradually expanded and sometimes slightly lobed between the peristomes, the frontal surface inflated and thickly punctate with very small pores. The ooeciostome is nearly terminal, free or in contact with a peristome, short, the aperture expanded and ovate in form, transverse and about 0.12 mm wide by 0.07 mm long.

Hitherto recorded only from Australia and the East Indies. Our specimens appear to agree in every detail with the description and with Harmer's beautiful illustration (plate 10, fig. 10), except that the ovicells are even simpler and less lobate; the ooeciostome is an exact counterpart.

Hancock Stations: 1924-49, off Guadalupe Island, west of Lower California, 28°54′08″N, 118°15′36″W, 25-30 fms, on algae, several colonies. Also on a sunken buoy brought up from 45 fms at Rocky Point (Earl Fox, collector), several colonies; one colony from "off San Pedro," without other data; and 12 colonies on a kelp stem washed up on shore at Palos Verdes (R. C. Osburn, collector), all from southern California.

Tubulipora egregia new species

Plate 67, figs. 6 and 7

The zoaria are encrusting, surrounding the stems of a coralline alga, in one case spreading across free from one branch to another; usually rough and irregular but one specimen has two flabellate lobes. The most

unusual feature is the size of the peristomes, which reach a length of as much as 0.75 mm (usually 0.40 to 0.60), and a diameter of 0.26 mm (0.30 at the base). The peristomes are entirely free at the tips and only rarely connate at the base, nearly erect, perforated with small pores nearly to the tips and the basal half or more transversely corrugated. The zooecial tubes are correspondingly large, 0.30 to 0.40 mm wide, arched in cross-section, thickly perforated and transversely corrugated.

The ovicell is irregularly lobate, rather flat and its surface thickly punctured, enclosing a few peristomes; the ooeciostome is an erect tube, distant from and smaller than the peristomes, slightly enlarging upward, the aperture ovate in form and its longest dimension about equal to that of the peristomes, finely wrinkled, thin-walled and not punctate.

The large dimensions of the non-connate and non-seriate peristomes, and the nature of the ovicell and ooeciostome easily distinguish this species.

Type, AHF no. 115.

Type locality, Hancock Station 22-33, La Plata Island, Ecuador, 1°16′S, 81°05′10″W, shore collecting, four colonies all with ovicells, Jan. 22, 1933. Another colony, with ovicell, from Hancock Station 136-34, Clarion Island, west of Mexico, at 32 fms.

Tubulipora admiranda new species

Plate 68, figs. 5, 6, and 7

The zoarium is rounded, slightly irregularly lobate, 10 mm broad, attached over most of its dorsal side but with the edges free. The center of the zoarium over a width of 4 mm bears only 5 free peristomes, due to the great length of the embedded tubules; outside of this area the peristomes rise in clusters of varying size, giving the surface a lobate appearance, though there are many free peristomes between the clusters. In the clusters the peristomes are connate for most of their length, but usually free at the tips.

The pro-ancestrula is round and measures 0.40 mm in width; the first tubule, which arises from its side, is 0.26 mm wide and 0.78 mm long, its peristome 0.55 mm in height. The succeeding tubules are remarkable for their length, the embedded portion 1.0 to 2 mm in length and the more or less erect peristomes usually about 1.0 mm but may be as much as 2 mm. The embedded tubules average 0.40 mm in width, slightly arched in cross-section, and are thickly punctate. The peristomes are about 0.25 mm in diameter, the pores extending nearly to the tips, slightly wrinkled, the apertures round and 0.20 mm in diameter.

The ovicells, three of which are complete, vary in size, with lobes extending between the fascicles, their surface rather flat and very thickly punctate. The ooeciostome is a large erect tube, about as wide as a peristome at the base, connate, tall, punctate to its tip, somewhat compressed and broader at the tip, its aperture about 0.30 mm wide by 0.18 mm long, and the edges of the long sides slightly inflexed; arising proximal to the base of a peristome; in one case the ooeciostome curves around the side of the adjacent peristome to open on its distal side.

The nearly free central area, the great length of the large tubules and the semi-erect clustered connate peristomes give this species an unusual appearance. The ooeciostome with its broad base resembles somewhat that of *T. phalangea,* but it is much larger and is not hooded as in that species.

Type, AHF no. 114.

Type locality, Corona del Mar, southern California, 33°36'N, one colony on the broad hold-fast of a kelp, washed up on the beach, R. C. Osburn collector.

Tubulipora flabellaris (Fabricius), 1780

Plate 68, fig. 8

Tubipora flabellaris Fabricius, 1780:430.
Tubulipora flabellaris, Harmer, 1899:99 (synonymy).
Tubulipora flabellaris, Robertson, 1910:247.
Tubulipora flabellaris, O'Donoghue, 1923:8; 1926:24.

The zoarium ranges in form from flabellate in younger colonies to round in older ones, completely adnate and attached to shells, stems, worm tubes, algae, etc., on flat surfaces usually very symmetrical and reaching as much as 8 mm in diameter. The central part of the colony is rather small, the first few peristomes free and often sinuate; beyond this area the peristomes are arranged in linear series (occasionally in small groups) of 2 or 3 or longer, irregularly radiating. The peristomes are high, slender, the apertures about 0.12 mm, connate for most of their length but the tips usually free.

The ovicell is more or less lobate, usually spreading between 3 or 4 fascicles, its surface rather coarsely punctate, and there is rarely any evidence of striation; the ooeciostome is a tall slender tube at the side of and partially connate with a peristome, much compressed toward the top and the aperture slit-like, measuring about 0.13 mm long by 0.04 or 0.05 mm wide.

It is a common species in the northern Atlantic, on the European coast, the American coast as far south as Cape Cod, and in the Arctic area from Spitsbergen west to Icy Cape, Alaska. Robertson recorded it from Puget Sound to southern California, and O'Donoghue from several localities in British Columbia.

Hancock Collections: dredged only once, Station 1122-40, off San Nicolas Island, southern California, 33°18′N, 119°24′10″W, at 30 fms. Also from Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Genus **BATHYSOECIA** new genus.

Ovicell depressed between the erect tips of the zooecial tubules, irregularly arcuate in form with the ends of the arc prolonged distally into narrow lobes between the fascicles; ooeciostome at the distal border of the arc, median, small, erect and connate to a tubule only at its base. Zoarium rounded or lobate; the ancestrula and first few single tubules tubulipora-like; then the tubules become more or less erect in small groups, connate to their tips. Peristomes are often wanting except in older stages, when they arise around the aperture of the partially closed end of the tubules. Genotype, *Bathysoecia bassleri* Osburn, new species.

In the genotype the erect tubules are so closely connate that there is no exposure of the tubules except at their tips, where they produce a reticulum. In younger zooecia, near the zoarial margin the tubules are thin-walled and wide open; later the walls become thick at the tips and form an infundibular depression with a rounded aperture; still later around the aperture there rises a thin-walled peristome which projects upward from the bottom of the funnel.

The ovicell appears to be different from that of any other form among the Tubuliporidae. It is developed directly on the basal lamina before the tubules distal to it are formed. Later the connate tubules rise high around it on all sides of the ovicell, which appears as a depressed and irregularly arcuate area with a flat thin-walled surface. The ooeciostome is distal, median and connate with a tubule or between two of them, narrow and moderately high.

The only other species with similar tubules and ooecia that has come to my attention is the "? *Tubulipora (Tubularia* by error) *lobulata*" Osburn, 1933:16, from the Atlantic Coast of North America, which

appears to be congeneric; described below as *Bathysoecia hastingsae* new species. The status of *Tubulipora lobulata* Hassall and *T. lobulata* Hincks is also discussed under that species.

Bathysoecia bassleri new species

Plate 69, figs. 4, 5, and 6

Zoarium encrusting on shells, irregularly rounded or with short lobes; a narrow basal lamina; surface reticulated. The zooecial tubules are completely connate to their tips, nearly vertical, so closely set that their exposed ends occupy all of the frontal surface; more or less hexagonal, separated by strong ridges and their apertures widely funnel-shaped over most of the zoarium. The tubules arise from the basal lamina, at first prone but immediately curving upward to become more or less erect. They are completely connate from their origin and are so closely united that no line of separation is visible. As they approach maturity the distal exposed ends become partly closed by a funnel-shaped thickening which leaves a large rounded aperture at the bottom of the funnel. Most of the tubules remain in this condition, but in older areas some of them develop short, cylindrical peristomes inside of the funnel and may project slightly above it. The exposed ends of the zooecia, from ridge to ridge, measure 0.20 to 0.35 mm across, the apertures 0.18 to 0.20 mm, and the cylindrical peristomes of older zooecia 0.13 to 0.15 mm in diameter.

The ovicell is irregularly arcuate in form and so deeply submerged between the high walls formed by the connate tubules that it has none of the usual appearance of an ovicell. The frontal layer is thin in comparison with the wall of the tubules, and is perforated by minute pores (the only pores visible on the whole zoarium). The ooeciostome is located at the distal border in the middle of the arc, compressed and nearly as high as the tubules, connate with a tubule or often between two tubules; the ooeciostome slit-like, its long diameter paralled to the zoarial radius, the pore 0.15 to 0.20 mm long by about 0.06 mm wide.

The species is dedicated to Dr. Ray S. Bassler, whose extensive studies of the Bryozoa have been of great service to the author.

Type, U. S. Nat. Mus. no. 11050; paratype, AHF no. 116.

Type Locality, Lenard Harbor, Alaska, a branch of Cold Bay, Alaska Crab Investigation Sta. 60-40, 55°10′N, 163°30′W, at 25 fms, 4 colonies on shells. Also from Hein Bank, near Friday Harbor, Puget Sound, Washington, one colony, Dr. J. L. Mohr, collector.

Bathysoecia hastingsae new species

Plate 69, fig. 7

Tubulipora (Tubularia by error) *lobulata,* Osburn, 1933:16.

? *Tubulipora lobulata,* Whiteaves, 1874:215; 1901:111.

The zoarium is irregularly fan-shaped or lobed, completely adnate on stones and shells; thick, especially so near the middle, and sloping downward to a narrow basal lamina. The zooecial walls are heavily calcified, the tubules thick and the only exposed areas (near the ancestrula) transversely ribbed. There is no evidence of pores except slightly in the primary zooecial area. The peristomes are moderately high, erect, single, especially near the primary area; farther out they may be single, or connate in short lines or small groups. The erect portion appears to consist partly of the upturned distal end of the tubule, as in *B. bassleri,* new species, but the condition is not so striking; the remaining portion is the peristome, which is considerably smaller than the base on which it arises, diameter 0.16 mm; the peristome is present on most of the tubules (wherein it differs from *B. bassleri,* in which most of the tubules bear no peristomes).

The ovicell is similar to that of the genotype but its surface is less depressed, a flat, white, finely perforated layer; the chamber extends downward to the basal lamina, as it does in *B. bassleri.* The form of the ovicell is like that of *bassleri,* usually beginning with an arcuate portion and extending into narrow lobes which ramify more or less between the fascicles; in one case a fascicle has been completely surrounded. The ooeciostome differs sharply from that of *B. bassleri,* as it is a short erect cylindrical tube, not at all compressed, connate only at its base, and its tip circular and noticeably flared, 0.12 mm across and the pore 0.07 mm in diameter.

Twenty years ago Dr. Anna B. Hastings, after examining a specimen from Mount Desert, Maine, wrote me that "it is likely that it is *T. lobulata* Hassall," (Osburn, 1933:16). Now, with very mature judgment, Dr. Hastings has re-examined the whole problem and writes again (March 8, 1952) in part as follows:

"This time I say with confidence that three species are involved.

1. *T. lobulata* Hincks (not Hassall). Excellently described by Hincks. I need only to add that the ooeciostome is of similar diameter to the zooecial tubes, but shorter, and is attached to the side of one of them. It is widely open, directed upwards or a little obliquely with a slight out-turned rim.

2. *T. lobulata* Hassall. Differs from *T. lobulata* Hincks in having long oblique series of connate zooecia. (Hassall, 1841, pl. X, fig. 2). I think Norman may well have been right (MS. note) in referring it to *T. serpens (T. liliacea* Pallas).

3. *T. lobulata* ? Osburn. Resembles *T. lobulata* Hincks in its stout zooecia with thick transversely striated walls, and in the arrangement of the zooecia in the colony, separately or in small groups, but not in connate series; and in the depressed ooecia. Differs in its less ramified ovicell with the ooeciopore placed more or less symmetrically at the center of the distal border of the ooecium closer to, and behind rather than beside, a zooecial tube; in the small size of the ooeciostome and in the absence of an out-turned rim to the ooeciostome." (The last item must now be corrected as I have a complete ooeciostome with a slightly out-turned rim. R.C.O.)

It is a pleasure to be able at last to solve the long-standing problem of the position of the West Atlantic specimens of *"T. lobulata,"* which could not have been done without the careful analysis by Dr. Hastings, to whom I gratefully dedicate the species.

The species is now known to be distributed on the Atlantic coast from Mount Desert Island, Maine (Osburn, 1933:16); Gaspe (Canada), Hincks Collection (Hastings, in litt., British Museum), and Greenland, "Valorous," 1875, Norman Collection, (Hastings, in litt., British Museum). Now I am able to add the Bering Sea, and the species is certainly high northern and possibly circumpolar in its distribution.

Type, AHF no. 117.

Type Locality, Nunivak Island, Bering Sea (a large island off the west coast of Alaska, about 60°N, and 116° W) at 8 to 10 fms, on shell, 4 colonies. Another specimen is marked merely "Behring Sea," on shell.

Genus **PLATONEA** Canu and Bassler, 1920

Platonea Canu and Bassler, 1920:759; 1929:548.
Reptotubigera d'Orbigny, 1853:751 (in part).
Reptotubigera, Calvet, 1911:4.
Reptotubigera, Harmer, 1915:119.
Reptotubigera, Okada, 1928:492.
Reptotubigera, Borg, 1944:26.

This genus has been accepted by the above authors to include narrow, fasciculate species that are entirely adnate to the substratum, as described by d'Orbigny. But d'Orbigny made no reference to the ovicell, the first

species which he discussed, *R. neocomiensis,* does not appear to belong to the genus, and his fourth species, *R. ramosa* d'Orbigny, 1853:754, has been selected as the genotype of *Reptotubigera.* Since there must always be uncertainty when based only on zoarial characters, Canu and Bassler erected the genus *Platonea* with the description of the ovicell and ooeciostome and with *Reptotubigera philippsae* Harmer as the genotype. The ovicell is broadly lobed between the fascicles and extends to the borders of the zoarium on both sides and the ooeciostome is short, erect, more or less expanded and is located proximal to the first peristome of a fascicle and separated from it.

If we are to accept this type of ovicell as distinctive of the genus, the zoarial description must be modified to include several species which are only partly adnate or semierect, but which have the special characters of a broad ovicell extending between the fascicles and an ooeciostome which is short, isolated and located near a first peristome of a fascicle. This last character, however, is shared by some species of *Tubulipora.* Also the marginal basal lamina, which is characteristic of the adnate species, is wanting in the suberect species.

As with many of the Tubuliporidae it is difficult to draw sharp distinctions in all cases but, dismissing the other characters, the idmoneiform arrangement of the fascicles and the nature of the ovicell and ooeciostome, together present a very characteristic facies sufficient to give this group a distinct place among the genera of the Tubuliporidae.

While it is possible that some of the fossil species included by d'Orbigny under *Reptotubigera* will be found to agree with *Platonea,* there is no indication in his description or figures of an ovicell and all of his figures represent the peristomes as short and non-connate. I am therefore following Canu and Bassler in the use of *Platonea* for species in which the reproductive characters are present.

Platonea veleronis new species

Plate 69, fig. 2

Zoaria adnate, apparently attached to algae; usually consist of a single lobe but occasionally a single branch occurs; maximum length 5 mm, width 1.5 to 2 mm; the dorsal side not expanded beyond the lateral peristomes. The peristomes are arranged in series of 4 to 7, closely connate, except for one or two at the outer ends of the series; the aperture more or less quadrangular, measuring about 0.09 mm wide by 0.12 mm long. At the proximal end the peristomes are single or in short series. The fascicles are high, 0.50 to 0.70 mm, very regular, usually alternating on the opposite sides of the midline, the interspaces averaging about 0.35 mm in width.

The ovicell usually occupies 3 (sometimes 2, or 2 on one side with 3 on the other) of the interfascicular areas on each side toward the distal end and extends laterally the full width of the lobe, smooth or slightly wrinkled and perforated with very numerous minute pores. The ooeciostome is short, erect, about as wide as a peristome, the aperture suddenly expanded transversely and 0.09 mm long by 0.18 mm wide; located slightly proximal and medial to the first peristome of a fascicle and not connate with it. The ovicell is usually situated near the tip of the lobe, but in two cases there is an additional one situated more proximally, smaller and separated from the distal one by 2 or 3 fascicles.

Type, AHF no. 118.

Type locality, Hancock Station 450, Albemarle Island, Galapagos, 0°55′S, 90°30′W, at 60 fms. Also dredged at stations 190-34, Albemarle Island; 201-34 and 473, Hood Island; 411, Duncan Island; 452, Charles Island; 453, Gardner Island, and 484, Barrington Island, all from the Galapagos, at 25 to 75 fms. It is evidently well distributed among the Galapagos Islands but has not been noted elsewhere.

Platonea expansa new species

Plate 69, fig. 3

The zoarium consists of somewhat clavate lobes about 2 mm in width near the extremity, the tip rounded, loosely attached, apparently always on algae. The fascicles are unusually long, very regular and alternating in arrangement on each side of the midline of the lobe; the fascicles near the proximal end with 4 to 6 tubules, the more distal ones with about 7, closely connate to their tips, except for 1 or 2 at the outer ends which are either connate only at the bases or are entirely free. There is a moderately broad basal lamina. The apertures of the tubules are quadrangular in the connate series, round in the free ones, and measure about 0.14 mm in diameter. Distance between the fascicles averages about 0.24 mm.

The ovicell is very broad, extending to the outer ends of the fascicles, and occupying three interfascicular areas on one side and two on the other, smooth with numerous very small pores. The ooeciostome, proximal to the first peristome of a fascicle, is short, not connate, its diameter at the base noticeably wider than a peristome, directed somewhat proximally, flared widely at the tip, the opening transversely elliptical.

The length and regularity of the high fascicles is the most striking feature of the species.

Type, AHF no. 120.

Type locality, Hancock Station 190-34, Albemarle Island, Galapagos, 0°55′S, 90°30′W, at 58 fms. Also at Station 201-34, Hood Island; and 453, Gardner Island, Galapagos, 35 to 65 fms.

Platonea elongata new species

Plate 69, fig. 1

Zoarium adnate, slender, unbranched; the dorsal lamina narrow, 0.95 mm at its widest part, while the high fascicles project much beyond it to a width of 1.50 mm. The fascicles are regular and alternating on each side of a distinct midline, moderately high (0.40 to 0.50 mm); the peristomes all connate in series of 6 (5 to 7), their apertures rounded or slightly quadrate, 0.09 to 0.10 mm in diameter. There are no free peristomes or vestigial tubules at the lateral margin.

The ovicell is very elongate, its lobes occupying 7 interfascicular areas on each side and extending laterally the width of the lobe. The ooeciopore is located in the usual position beside the first peristome of a fascicle, but unfortunately the ooeciostome is broken away.

The zoarial characters are much like those of *P. veleronis* n. sp., but the lobe is much narrower. The most important character is the great length of the ovicell, covering 7 interfascicular areas on each side, while in the 11 specimens of *veleronis* from the Galapagos Islands there are never more than 3. There are no intermediate conditions presented and, until contradictory evidence is discovered, this must be considered a different species.

Type, AHF no. 119.

Type locality, Hancock Station 1064, off Santa Barbara Island, southern California, 33°30′01″N, 119°02′20″W, at 27 fms, one colony. Also at Station 1143-40, off Portuguese Point, southern California, 33°44′59″N, 118°22′35″W, at 16 fms, one colony.

Genus FASCICULIPORA d'Orbigny, 1847

Like most of d'Orbigny's descriptions, this one is very brief, "well characterized by its shell-like (testacés) branches, smooth exteriorly, terminating at the upper extremity in a fascicle of rounded, open cells." (Transl.)

Canu and Bassler, 1920:808, add the following: "This genus differs from *Frondipora* in its long fascicles not arranged on a single side of the zoarium."

Borg, 1926:303 and 382, gives a complete description of the genotype, *F. ramosa,* including the first information about the ovicell, which had not previously been noticed, no doubt for the reason that it is but little differentiated from the zooecial tubules. It is very elongate and slender, slightly expanded on the side of a fascicle, the aperture terminal and directed forward.

Borg is quite justified in removing this genus from the Frondiporidae, as the position and nature of the ovicells are very different. However there is no justification for Borg's resurrection of d'Orbigny's "Family Fascigeridae," since there appears to be no genus *Fascigera,* and the proancestrula and early development, which were hitherto unknown, are similar to those of the Tubuliporidae.

Fasciculipora pacifica new species

Plate 70, figs. 1, 2, 3, and 4

The zoarium is fungiform from a narrow base, the largest colony in my possession (somewhat broken) measures about 25 mm in height by 45 mm in the longest diameter, and the longest fascicles are 30 mm. The base, broken away, is evidently small. The primary branches are comparatively narrow at the base and gradually enlarge, either branching or becoming flabellate or folded into contorted fascicles which frequently coalesce at their tips or are bridged by small flabellate horizontal branches consisting of a few zoids. The surface of the adult colony resembles the meandering contortions of the human cerebrum.

The tubules are excessively elongate, 0.30 to sometimes 0.40 mm in diameter, in cross-section compressed and hexagonal, on the surface of the fascicles rounded and more or less indicated by separating grooves. At the tops of the fascicles the tubes do not project, but on the sides the occasional tubes which appear to be left behind in the elongation of the branch usually show a definite short peristome which is more or less erected and with a round aperture. The walls of the tubules are thickly perforated by small pores, but on the bases of the older fascia these are obscured by a secondary thickening which is more or less ribbed transversely.

The ovicells are little modified and resemble the ordinary tubules so much that they are easily overlooked. As they emerge on the lateral surface of a fascia they take their place among the normal tubules and are only slightly larger. They continue upward on a level with the tubules, becoming gradually wider until they are twice or three times as wide and with a nearly flat frontal surface. The ooeciostome is a

little sub-terminal and consists of a short tube more erect than the lateral peristomes and somewhat larger; the aperture is rounded but modified by irregular folding of the rim. The terminal portion of the ovicell usually extends a short distance beyond the ooeciostome and may be slightly lobate, and in one case it even surrounds the peristome of a neighboring tubule. Borg (1926:383, text figs. 83 and 84) shows the ovicell bifurcating at a branch in *F. ramosa,* with the ooeciostome terminal on one of the branches, but I have not observed this condition in *F. pacifica.*

Fortunately there are several stages in the development of young colonies, two of which show the ancestrula which has not been previously observed in this genus. These are typically tubuliporoid, with the first zoid emerging from the side and the several succeeding generations of zoids encrusting fan-shaped, as in *Tubulipora.* I would undoubtedly have mistaken them for young stages of that genus if I had not had a continuous succession of stages as well as the adult condition, from the same collection (Station 1193-40), for comparison. The tubules of the first few zoids are at first encrusting, then become semierect with elongate peristomes as in *Tubulipora.* After 3 or 4 generations of zoids, the fascicles begin to make their appearance and the zoarium becomes very irregular. D'Orbigny was not far wrong in his belief that this genus should be "partie de la même famille que les Tubulipores" (1847:20).

Type, AHF no. 121.

Type locality, Hancock Station 1193-40, Santa Cruz Island, southern California, 34°N. Lat., shore collection at low tide, numerous young stages encrusting stems, and fragments of the adult stage. Also a large colony from San Felipe, Mexico, 31°N. Lat., near the head of the Gulf of California, shallow water, presented by Dr. A. E. Noble.

Family **Entalophoridae** Reuss, 1869

Zoarium erect, branched, without joints; zooecial tubes elongate, opening on all sides of the rounded stem and branches; gonozoids usually situated near the tip of a branch or below a bifurcation, simple and elongate or swollen and perforated by zooecial tubes. The arrangement of the tubules on all sides of the cylindrical stem is the easiest diagnostic character.

The first stage of development is encrusting and tubuliporoid, and from this small base the erect portion of the zoarium arises. Owing to the mode of development there has been much difference of opinion as

to whether the family Entalophoridae should be maintained or whether *Entalophora* should be considered a genus of the Tubuliporidae. On the basis of the simple ovicell, alone, *Entalophora* would go very nicely under Oncousoeciidae, but *Bientalophora* Borg, with an expanded ovicell surrounding some peristomes, would necessarily be synonymous with *Diaperoecia* Canu. As so few species are known perfectly I am leaving the family to stand on the basis of the special zoarial character of a round, erect stem, with peristomes opening on all sides.

Genus **ENTALOPHORA** Lamouroux, 1821

Zoarium slender, erect, usually only 4 to 8 series of zooecial tubes constitute the stems and branches; the embedded tubes are very elongate, parallel, their peristomes curved sharply outward. Gonozoid simple, elongate, sometimes only a little wider than the zooecial tubes, located usually just below a bifurcation or near the end of a branch; the ooeciopore terminal. Genotype *E. cellarioides* Lamouroux, 1821:81.

Entalophora symmetrica new species

Plate 70, figs. 6 and 7

The zoarium is thick-stemmed, about 1.50 mm in diameter, branched twice dichotomously at about 90 degrees, the branches as thick as the main stem. The secondary branches are at right angles to the primary ones. The tubules are elongate and distinct, with well marked separating grooves, the pores numerous and conspicuous; about 12 tubules surround the stem equally on all sides and arranged more or less in quincunx. The peristomes are moderately high, inclined distally, somewhat tapered toward the tips and porous like the frontal for most of their length; diameter of the aperture 0.15 to 0.17 mm.

The ovicell is simple, pyriform, not extended between the peristomes, moderately inflated, its surface smooth; the ooeciostome is terminal, slightly elevated, more erect than the peristomes and slightly smaller, its aperture rounded and 0.12 mm in diameter.

This species has the zoarial form of a *Bientalophora,* but there are no covering kenozooecia, the tubules are evident throughout their length, and the gonozoid is of the simple type characteristic of *Entalophora.*

Type, AHF no. 122.

Type locality, Hancock Station 170-34, Stephens Bay, Chatham Island, Galapagos, 0°47′30″S, 89°31′W, at 32 fms, one colony without base.

Entalophora proboscideoides Smitt, 1872

Plate 70, figs. 8 and 9

Entalophora proboscideoides Smitt, 1872:11.
Entalophora proboscideoides, Canu and Bassler, 1928:160.
Entalophora proboscideoides, Osburn, 1947:4.

Zoarium erect, slender, branching widely, the stem composed of 6 to 8 very elongate tubules; the embedded tubules about 0.13 mm in diameter and the peristomes, which open on all sides of the stalk, about 0.10 mm. The longest peristomes are about 0.50 mm, perforated and lightly wrinkled like the embedded tubules.

The ovicell is simple, a distinct elliptical swelling of the distal end of a long tubule, 0.55 mm long by 0.35 mm wide, thickly perforated. The peristome is terminal, bent forward sharply, the aperture transversely elliptical, 0.13 by 0.06 mm.

Described by Smitt from west of the Tortugas Islands, Florida, at 68 fms. Recorded by Osburn (1947:4) from 8 stations along the southern shore of the Caribbean Sea (Hancock Atlantic Expedition, 1939), and by Canu and Bassler (1928:160) from the Pliocene of Bocas Island, Panama. Our one ovicelled specimen appears to agree in all details with those from the Caribbean Sea.

Hancock Station 457-35, Secas Islands, Panama, 12 fms.

Entalophora capitata Robertson, 1900

Entalophora capitata Robertson, 1900:328 (Plate 21, fig. 12 only); 1910:257.
Entalophora capitata, O'Donoghue, 1923:13.
Diaperoecia capitata, O'Donoghue, 1926:22.

Dr. Robertson's 1900 description is practically worthless as she confused this form with another species which Borg has since described (1933:325) as *Heteropora pacifica alaskensis.* In 1910 Robertson corrected the error and based her re-description on the specimen from which figure 12 of her former account was taken. O'Donoghue in 1926 placed the species under *Diaperoecia,* where, if only the nature of the ovicell is considered, it would seem to belong. The species has not appeared in the Hancock collections and I am unable to form a definite opinion.

Robertson's 1910 description is as follows:

"Zoarium arising from a flattened or encrusting base and growing from 5 to 8 mm in height. Zooecia tubular, uniting in a short, stout column terminating in a broad somewhat rounded head; distal ends free, usually extending for a considerable distance beyond the surface of the colony,

both of the supporting column and of the head. Ooecium an inflation of the surface of the head. Ooeciostome and ooeciopore slightly compressed, opening beside the zooecial aperture." Orca, Prince William Sound and Sitka, Alaska.

O'Donoghue listed it from several localities in British Columbia.

Entalophora sp.

Zoarium slender, nearly straight, 4 or 6 tubules constituting the stem, width 0.75 to 0.90 mm; the peristomes elongate, nearly at right angles to the stem axis, perforated like the tubules nearly to their tips. On the surface the tubules are more or less distinct, the whole surface transversely wrinkled and perforated with small pores; on the older part of the stem the peristomes also are wrinkled on the basal portion. There is a tendency toward spiral arrangement, though 2 or 3 peristomes may arise at nearly the same level. Width of stem 0.75 to 0.90 mm; width of tubules on the stem 0.30 mm; width of apertures 0.16 to 0.20 mm; longest peristome 0.65 mm but the average about 0.25 mm.

The specimen consists of part of a stem 20 mm in length, both base and tip wanting and without an ovicell. It has some resemblance to *E. proboscideoides* Smitt, 1872:11, but it is much larger, the apertures nearly twice as broad. The large size of the tubules, the width and length of the peristomes and the coarse transverse striation of the stem seem to indicate it as an undescribed species, but in the absence of an ooecium I hesitate to give it a name.

Hancock Station 450, Cartago Bay, Albemarle Island, Galapagos, 0°55′S, 90°30′W, at 70 fms.

Entalophora raripora d'Orbigny is listed by Robertson 1910:256 from Monterey, California, and by O'Donoghue, 1923:13, from several places in British Columbia.

Entalophora clavata Busk is also recorded by O'Donoghue, 1923:13, from several British Columbia localities.

Entalophora vancouverensis O'Donoghue, 1923:13, is described and recorded for Cardale Point, Round Island, British Columbia. From its appearance as judged by figure 7 (plate 1) it may be a species of *Bientalophora,* but O'Donoghue does not mention the presence of kenozoids on the stalk.

The Entalophoras are evidently much in need of a thorough restudy.

Genus BIENTALOPHORA Borg, 1944

"Zoarium erect, branching repeatedly, branches originating through forking of the stem; zoarium composed of autozoids, kenozoids and gonozoids. Kenozoids smaller and shorter than autozoids, always closed, numerous, forming greatest part of surface of zoarium. Autozoids protruding through layer of kenozoids, distal portions of their cystids arranged in quincunx or spirally, opening all around the stem. Gonozoids with middle portion large, strongly dilated, traversed by numerous autocystids; distal portion seemingly not terminal." (Borg, 1944:114). Genotype *Entalophora regularis* MacGillivray, 1887:219.

The two striking characters which distinguish this genus are: (1) the greater development of the ovicell which extends over a capitulum or broader area of the stem and surrounds some peristomes, and (2) the presence of a thin layer of completely closed small kenozoids over the zoarium between the peristomes.

The nature of the ovicell, enclosing peristomes, would place the members of this genus in *Diaperoecia* Canu, but as this character appears in a number of other genera which are zoarially quite distinct, I have come to the conclusion that parallel evolution may apply to the development of the ovicell as well as to the zoarium.

Bientalophora cylindrica new species

Plate 70, figs. 10 and 11

The zoaria are erect, with round straight stems and branches 1.50 to 1.60 mm in diameter; dichotomous, the branches diverging at an angle of about 60 degrees, the distance between branches about 1.50 cm; in one case two branches have fused where they came in contact. The branches are very slightly widened toward the tip. The bases of both of our colonies are broken away, but the remaining longest portion measures 17 mm in length. The general appearance is much like that of a *Myriozoum*.

The zooecia are distributed all around the stem, irregularly quincuncial, their tubes not visible on the surface. The peristomes are very short, the longest not more than 0.10 mm high, 0.15 to 0.17 mm in diameter, the apertures 0.12 or 0.13 mm. There are frequent small areas which are free from peristomes. The whole surface between the peristomes, clear up to the growing tips, is covered by a layer of small kenozooecia which are thickly perforated by small pores and their outlines marked by slightly raised lines. These kenozooecia form the

"lamina" which Waters, 1914:842, described under *B. (Entalophora) regularis*. The kenozooecia are smaller than the autozooecia, irregular in size and form but usually somewhat diamond-shaped.

There are no ovicells on our specimens so complete identification is impossible. There is considerable resemblance to *B. regularis* (MacGillivray), the genotype, as figured by Borg (1944, plate 11, figs. 3 and 4), but the diameter of the apertures is distinctly smaller, the diameter of the stems somewhat greater, and the peristomes noticeably shorter. Since *B. regularis* is known only from the Australian area, it seems preferable to give this California form a name.

Type, AHF no. 123.

Type locality, Monterey Bay, California, 36°N, 122°W, at 40 fms, F. P. Shepard, collector, two fragments.

Family **Frondiporidae** Busk, 1875

The zoarium consists of an encrusting, branched, ramifying base from which arise erect cylindrical fascicles which are usually separated by well-marked interfascicular spaces. The ovicell is developed between the fascicles, either simple or lobate, and is sometimes perforated by one or more tubules; the ooeciostome is but little elevated, in *Filifascigera* remote from any of the zoecial tubules, while in *Frondipora* Borg (1926, text fig. 81) shows it as a crescentic pore adjacent to the base of a tubule.

Genus **FILIFASCIGERA** d'Orbigny, 1852

"The colonies are creeping, narrow, linear, or curved. The tubes are grouped in salient, orbicular, or elliptical fascicles, regularly spaced. The orifices are polygonal. The ovicell is a vesicle placed between the fascicles and perforated by closed tubes." (Canu and Bassler, 1929:523). Genotype, *Filifascigera dichotoma* d'Orbigny, 1852.

This genus has been much neglected since d'Orbigny's time and until very recently has been known only as a fossil. Canu and Bassler (1928: 44) described *F. robusta* from Hawaii and found the ovicell for the first time. Later (1929:524) they described two other recent species, *F. pluripora* and *F. parvipora,* from the Philippines.

The above generic description requires a few additions. The orifices are not polygonal except in the fascicle and at its tip where the tubules are compressed together. The free peristomes, which rise as much as 0.40 mm above the tips of the fascicles, are cylindrical with circular apertures, all separated and curving outward. The fascicles are not always evenly

spaced and on a rough background may be quite irregular in distribution, anywhere from 0.20 mm to more than 1.00 mm apart. Apparently the genus is widely distributed over the central area of the Pacific.

Filifascigera clarionensis new species

Plate 69, figs. 8, 9, and 10

The zoarium is encrusting, tortuous, the branches narrow, averaging about 0.60 mm in width between the fascicles. The basal portions of the zooecial tubules are completely embedded with no separating grooves, the distance between the fascicles varying greatly, from 0.26 to 1.10 mm and averaging about 0.60 mm. The fascicles, or bundles of tubules, are nearly erect to a height of 0.40 to 0.50 mm, round or elliptical in cross-section, and consist of 2 to 8 tubules (6 is a characteristic number). The outlines of the tubules are evident only on the upper part of the fascicles. At the top of the fascicles the tubules end in free peristomes which are cylindrical, uniform in diameter or slightly flaring at the tips, and curved outward from the center, the longest being as much as 0.40 mm. The apertures are circular, about 0.11 mm in diameter, and the peristomes 0.14 mm in diameter.

The ovicell is a rather conspicuous non-lobate swelling between the fascicles and extending from one fascicle to the next, the peristomial tubes rising above its level; it measures about 0.55 by 0.80 mm. The ooeciostome is somewhat off-center, a short tube which flares outward at the edges, with a short-elliptical aperture; it is completely dissociated from any of the zooecial tubules.

The description is taken from two colonies from Clarion Island, one on a worm tube, the other on a coralline. Another colony from Santa Barbara Island, southern California, without an ovicell, appears to be the same, as the measurements agree, and it also encrusts a worm tube.

Type, AHF no. 125.

Type locality, Hancock Station 137-34, Clarion Island, 18°19′05″N, 114°44′25″W, at 25 fms. Also at 1067, Santa Barbara Island, southern California, 33°22′30″N, 119°03′45″W, at 55 fms; another at 1624-48, Santa Catalina Island, 36 fms, on a shell, and still another at 1914-49, San Cristobal Bay, Lower California, 27°24′48″N, 114°34′40″W, at 40 fms.

Filifascigera fasciculata (Hincks), 1880

Stomatopora fasciculata Hincks, 1880:441.
Proboscina fasciculata, O'Donoghue, 1926:17.

O'Donoghue gave no description of this species, but his illustration (plate 2, fig. 12) certainly shows a *Filifascigera* and it may well be the *S. fasciculata* of Hincks. The description of the species by Hincks is very complete, showing the erect arrangement of the tubules in bundles, well spaced and elevated, and he also figures the ovicell (plate 59, fig. 4) set between the fascicles with the ooeciostome off center and separated from the tubules. The ovicell has much the same appearance as that of *F. clarionensis* new species, described above, but the ooeciostome is much compressed and its pore almost slit-like.

The only question is whether O'Donoghue's species is that of Hincks, and that cannot be determined here as the species has not appeared in the Hancock material.

O'Donoghue records the species from Northumberland Channel and Gabriola Pass, British Columbia, and the San Juan Islands, Puget Sound.

A specimen from southern Alaska, U. S. Fisheries Alaska Crab Investigation, Sta. 82-40, may belong here, but in the absence of complete ovicells the identification is questionable. It is a much larger species than the preceding, the apertures measuring 0.16 to 0.18 mm in diameter. The one ovicell is properly located for this genus, but is incomplete and lacking the ooeciostome.

? Filifascigera sp.

Another species which probably belongs to this genus but may be a *Frondipora* was taken at Hancock Station 1914-49, off Guadalupe Island, west of Lower California, 28°52′N, 118°19′W, at 5-15 fms. The fascicles are larger and higher than those of *F. clarionensis* (the aperture 0.14 mm in diameter), and several fascicles sometimes arise from a single base to form a complex fascicle. The peristomes usually rise free above the top of the connate portion of the fascicle, as they do in *F. clarionensis*. The ovicell lies in the space between the fascicles of a complex fascicle with lobes extending among them. Unfortunately there is no evidence of an ooeciostome.

The material is too imperfect for positive identification but it is certainly different from either of the species mentioned above, especially in the nature of the complex fascicles and the ovicell. The small fascicles, usually of less than 8 tubules, would seem to remove it from *Frondipora*.

Division 2. **Articulata** Busk, 1859
(Camptostega Borg, 1926)
The Crisias

"Primary zoid erect, separated by a chitinous joint from the proancestrula; zoarium jointed; rhizoids present. Body wall a gymnocyst; vestibular sphincter present; brood chamber a gonozoid, moderately dilated in its middle part; polypide of gonozoid degenerating before having been fullgrown." (Borg 1944:133).

This division is clearly distinguished by the jointed zoarium, by the presence of rhizoids, which are formed of jointed series of kenozoids, and by the mode of development from the larva, all of which are different from the other divisions. On attachment the larva forms a dome-like structure, on the top of which the first functional zoid is produced and from which it is separated by a chitinous joint. There is only one family, the Crisiidae, with a number of genera, depending chiefly on the structure of the internodes.

The erect, jointed zoarial form is so strikingly different from any other cyclostome type of growth that the members of this Division are easily placed at once.

Family **Crisiidae** Johnston, 1838

The zoarium is erect and jointed, the zooecia in a single series or alternating in two series, or without definite arrangement in the older branches of *Crisulipora;* the internodes consist of one zooecium to many; attached by jointed radicles, rhizoids, which consist of a series of elongated, tubular kenozooecia. The ovicell is an enlarged zooecium (gonozoid) more or less pyriform in shape, with the ooeciostome (pore) terminal or nearly so. The characters of the ovicell and its ooeciostome are essential for the positive determination of most of the species of this family.

Key to the Genera of Crisiidae

1. Internodes of 1 or 2 zooecia; elongate filiform spines present . . 2
   Internodes with 1 to many zooecia; no filiform spines 3
2. Only one zooecium to an internode . . . . . *Crisidia*
   Two zooecia to an internode, fertile internodes may have 3 to 5; the ovicell is free for much of its length and the ooesciostome is on the dorsal side . . . . . *Bicrisia*

3. Sterile internodes of 1 to 3 zooecia, fertile ones of 3 to 5; ovicell adnate for its whole length and its ooeciostome terminal . . . . . *Filicrisia*
   Internodes of 3 to many zooecia, usually 5 or more except at the base; ovicell adnate for its entire length, the ooeciostome more or less terminal 4
4. Internodes with 2 alternating series of zooecia; ovicell prominent, expanded dorso-ventrally . . . . . *Crisia*
   Internodes with 2 to 8 or more zooecia in cross-section, not regularly arranged; ovicell expanded laterally between the tubules . . . . . *Crisulipora*

Genus **CRISIDIA** Milne-Edwards, 1838

Genotype, *Sertularia cornuta* Linnaeus, 1758.

Crisidia cornuta (Linnaeus), 1758.

Plate 71, fig. 1

Sertularia cornuta Linnaeus 1758:810.
Crisia cornuta, Hincks, 1884:203.
Crisia cornuta, O'Donoghue, 1923:7.
Crisidia cornuta, O'Donoghue, 1926:18.
Crisidia cornuta, Borg, 1926:260 and 349.

The zoarium is delicate, branching dichotomously, each branch consisting of a single series of zooecia, each zooecium constituting an internode. The zooecium is slender, elongate (0.60 to 0.80 mm long), distinctly arcuate; the succeeding zooecium arises on the dorsal side toward the distal end, paired when branching. Long filiform processes (1.0 mm or longer) often arise beside the zooecial base, jointed at the base and usually twice more; from their position and mode of origin these processes would seem to be vestigial zooecia; at any rate they are not homologous with the spines of other bryozoan orders.

The ovicell is a gonozoid, free with a terminal ooeciostome, and represents an internode; it never bears a spinous process.

Hincks and O'Donoghue have listed this species from several localities in British Columbia waters; otherwise it has not been noticed previously on the Pacific coast.

Hancock Stations: 1269-41, off Anacapa Island, at 41 fms; 1279-41, off San Miguel Island, at 40 fms; and 2042-51, off Long Beach Light, at 14 fms; all from southern California. Also off Pescadero Point, outside of Monterey Bay, California, A. E. Blagg, collector.

Genus **BICRISIA** d'Orbigny, 1853

Genotype, *Crisidia edwardsiana* d'Orbigny, 1839.

Bicrisia edwardsiana (d'Orbigny), 1839.

Plate 71, fig. 2

Crisidia edwardsiana d'Orbigny 1839:8.
Crisia cornuta, Robertson, 1900:328.
Crisia edwardsiana, Robertson, 1910:237.
Crisidia edwardsiana, O'Donoghue, 1926:18.
Bicrisia edwardsiana, Borg, 1926:260 and 351.

The zoarium is usually bushy, much branched, reaching a height of 50 to 75 mm, the tips of the branches curved forward. The zooecia are tubular, 0.50 to 0.70 mm long, somewhat arcuated, usually 3 to 5 to an internode (basally 1 or 2). Jointed "spinous processes," 1.0 mm or more in length, similar to those of *Crisidia,* are apparently vestigial zooecia.

The ovicell is somewhat elliptical in form and is free for nearly its entire length; a characteristic feature is the position of the ooeciostome on the dorsal side near the distal end.

Robertson evidently confused this species with *Crisidia cornuta.* Her specimens with "Internodes consisting typically of a single zooecium" must have been *cornuta,* while those of "two, three, four or five zooecia" are undoubtedly *edwardsiana.* Her figure of the ovicell, 1910, plate 19, fig. 10, is definitely *edwardsiana.*

Robertson listed this species (and *cornuta)* from Alaska to San Diego, California. O'Donoghue recorded it from the San Juan Islands, Puget Sound. It appears to be more common than *cornuta* on the California coast and extends farther southward.

Hancock Stations: 1320-41 and 1370-41, off Santa Catalina Island, shore to 18 fms; 1210, at La Jolla, shallow water; San Diego Jetty, shore (Dr. H. R. Hill); Newport Harbor on floats (R. C. Osburn); all from southern California. Also at 843-38, Lobos de Afuera Islands, Peru, 6°53′50″S, 80°43′30″W, at 25 fms. This beautiful but inconspicuous little species is probably more common than the number of stations indicates and possibly extends along the whole Pacific coast.

Genus **FILICRISIA** d'Orbigny, 1853

Genotype, *Crisia geniculata* Milne-Edwards, 1838

In younger stages of growth this genus resembles *Bicrisia* except for the absence of the spinous processes, but older specimens are readily

distinguishable by the conspicuous black joints and by the ovicell, which is more slender, adnate to the internode for its full length, and with a terminal ooeciostome.

Filicrisia geniculata (Milne-Edwards), 1838

Plate 72, fig. 5

? *Crisidia gracilis* Trask, 1857:113.
Crisia geniculata, Robertson, 1910:235.
Crisia geniculata, O'Donoghue, 1923:7; 1926:18.
Filicrisia geniculata, Borg, 1926:263 and 351.

Zoarium bushy, the branches nearly straight, reaching a height of 15 to 25 mm. The zooecia are tubular, straight, 0.60 to 0.90 mm long, 3 to 5 to an internode (except basally). In the older zooecia the joints are black and conspicuous.

The ovicell is long and but little inflated, adnate for its entire length, the ooeciostome situated near the dorsal border with its tube bent forward (sometimes straight). In the absence of the ovicell it is impossible to distinguish positively between this species and *franciscana.* For this reason the *Crisidia gracilis* of Trask must remain in doubt, though it appears to be one of these two species.

Robertson first noted the presence of this species on the Pacific coast and recorded it from Dillon Beach, north of San Francisco, to San Pedro, California. O'Donoghue listed it from numerous localities in British Columbia.

Hancock Stations: Not taken in dredging, but found at numerous shore stations in shallow water about the islands of southern California and along shore from Monterey Bay south to San Pedro, California; well distributed in this area, but never abundant. It appears to be more common farther northward.

Filicrisia franciscana (Robertson), 1910

Plate 72, fig. 4

Crisia franciscana Robertson, 1910:233.
Crisia occidentalis, Robertson, 1903:116.
? *Crisidia gracilis* Trask, 1857:113.
Crisia franciscana, Okada, 1917:338.
Crisia franciscana, O'Donoghue, 1923:7.
Crisidia franciscana, O'Donoghue, 1926:19.

This species resembles *C. geniculata* in practically all respects except for the ovicell. The zoarial form and the number of zooecia to the

internode are the same, and both have the characteristic black joints. The zooecia of *franciscana* are slightly larger and are usually more expanded toward the distal end.

The ovicell is more inflated than in *geniculata* and the ooeciostome is situated on the frontal border with its tube curved backward.

Reported by Robertson from Orca, Alaska, to southern California at numerous places, and by O'Donoghue from British Columbia. It is one of the most common crisias along the California coast from low tide to 25 fms. Okada also found it common in Japanese waters.

Hancock Stations: Numerous stations about the islands and along the coast of southern California from San Francisco southward to San Diego; Dillon Beach, north of San Francisco (R. J. Menzies); Mussel Point, northern California (A. E. Blagg); San Juan Islands, Puget Sound (J. L. Mohr); much more abundant than *C. geniculata,* often occurring in considerable masses on piles and floats; low tide to 50 fms.

Genus **CRISIA** Lamouroux, 1812

Genotype, *Sertularia eburnea* Linnaeus, 1758:810. In this well-known genus the internodes are longer, with 5 to as many as 30 or more zooecia in some of the species. These are arranged very symmetrically in two alternating series, the short projecting peristomes giving the edges a serrated appearance. The ovicells or gonozoids are usually in the midline of the frontal surface, between the rows of zooecia. It is unfortunate that the ovicells, which are often lacking, are necessary for the positive determination of most of the species. Dr. Alice Robertson gave an excellent account (1910:229-245) of the Pacific coast species known to her and her key is used here, with additions and slight modifications.

The little shrub-like colonies of the crisias are often abundant in shallow water, attached to anything that may afford a lodging place and conspicuous because of their chalky whiteness.

Key to the Species of *Crisia*

1. Ooeciostome with a cap-like flap extending forward above the aperture . . . . . *operculata*
   Aperture of ooeciostome without covering flap 2
2. Ovicell very short and wide, ooeciostome almost wanting, pore round; internodes long and slender . . . . . *elongata*
   Ovicell elongate and gradually expanding 3

3. Ooeciostome curved or bent forward 4
   Ooeciostome straight, though the opening may be directed somewhat forward 6
4. Branches of zoarium strongly curved forward; ooeciostome curved forward, its aperture elliptical and its proximal lip somewhat inflected . . . . . *eburnea*
   Branches straight and more divergent 5
5. Ooeciostome long, slender, conspicuously bent forward, its pore round . . . . . *pugeti*
   Ooeciostome short, pore elliptical; internodes long . . *serrulata*
6. Branches of zoarium curved inward or spicate at the tips; ooeciostome short, pore round or short elliptical . . *occidentalis*
   Branches straight and stiff, internodes long 7
7. Ooeciostome distinctly flared at the tip, transversely long-elliptical; a northern species . . . . . *cribraria*
   Ooeciostome not flared, short and inconspicuous, pore round and opening forward . . . . . *maxima*

Crisia serrulata, new name

Plate 72, fig. 2

Crisina serrata Gabb and Horn, 1862:174. (Preoccupied by d'Orbigny, 1853:598).

? *Crisia denticulata,* Hincks, 1884:203.

Crisia pacifica Robertson, 1910:242.

Crisia pacifica, O'Donoghue, 1923:7.

Crisia serrata, Canu and Bassler, 1923:196.

Crisia serrata, O'Donoghue, 1926:18.

Zoarium forming bushy tufts reaching a height of 25 mm. The internodes are long, ranging from 12 to more than 30 zooecia, the longer ones slightly sinuate and not inflected; joints yellow to brownish; *basis rami* of a branch short and wedged in between the zooecia without disturbing their position. The zooecia are connate nearly to their tips which turn forward sharply, the aperture facing frontally; the dorsal lip of the aperture sometimes with a low point. The frontal surface of the branch bears a median keel and the distance between the zooecial apertures is less than the width of the branch.

The ovicell is large, a little flattened, inclined in the axis of the branch and adnate for its whole length; the tube of the ooeciostome is short, opening either ventrally or distally, the aperture more or less elliptical.

Gabb and Horn described the species from the Pleistocene of Santa Barbara, California, overlooking d'Orbigny's previous use of *serrata;* Canu and Bassler listed it from the Pleistocene of Santa Barbara and Santa Monica, and the writer has found it in the Pleistocene of San Pedro and Newport Harbor, California. Robertson described *pacifica* from the "San Diego region only." O'Donoghue recorded it from numerous British Columbia localities, and it is a common species all along the coast from British Columbia southward to Cedros Island (28°N), and less commonly to the Galapagos Islands.

Hancock Stations: Dredged at more than 30 stations and taken at numerous shore stations, most abundant about the island region off southern California. Galapagos Islands, 5 stations: 152-34, Albemarle Island, shallow water; 170-34, Chatham Island, 32 fms; 193-34 and 198-34, Charles Island, 10-65 fms, and 804-38, Onslow Island. Also at 1051-40, Angel de la Guardia Island, Gulf of California, 21 fms.

Crisia occidentalis Trask, 1857

Plate 71, figs. 3, 4, and 5

Crisia occidentalis Trask, 1857:113.
Crisia eburnea, Robertson, 1903:116.
Crisia occidentalis, Robertson, 1910:239.
Crisia occidentalis, O'Donoghue, 1923:7; 1926:18.

Zoaria forming dense tufts reaching a height of 25 mm, the tips of the branches often inflected, especially in ovigerous colonies. The internodes consist of 3 to 5 zooecia near the base, the more terminal ones from 7 to 12; joints white to yellow; *basis rami* not wedged in between the zooecia but extending along the outer side of its mother zooecium, though there is some variation in this respect. The frontal surface of the internode is slightly keeled and the distance between zooecial apertures is about equal to the width of the branch. The zooecia are connate for their entire length, the tips directed forward; frequently there is a short point back of the dorsal lip of the tube, and the tips of the terminal branches often end in spinous points.

The ovicell is moderately large, elongate pyriform, inclined in the axis of the internode; the ooeciostome is situated a little back of the summit of the ovicell, with a short, straight or slightly curved tube, the circular aperture opening more or less upward.

One might conclude from Robertson's discussion that ovigerous colonies have only inflected branches and that only the male colonies have the terminal spinous points. This is not the case, however, as

ovigerous colonies frequently bear the pointed tips and their branches may be perfectly straight. Sex differentiation does not seem to be the answer to these variations.

Trask described the species from San Francisco, very inadequately. Miss Robertson accepted the name and redescribed the species, recording it from Puget Sound, Washington, to San Pedro, California. O'Donoghue listed it from Banks Island and Gabriola Pass, British Columbia. It is a common species along the California coast from low water to 30 fms, and south rarely to the Galapagos Islands.

Hancock Stations: Dredged at 12 stations, mostly about the islands off southern California. Station 470-35, Port Parker, Costa Rica, 5 fms, and 85-33, North Seymour Island, Galapagos, shore collection. The number of the dredging stations does not indicate the abundance of the species, as it is much more common in shallow water near shore.

Crisia operculata Robertson, 1910

Plate 71, figs. 6 and 7

Crisia operculata Robertson, 1910:240.
Crisia operculata, O'Donoghue, 1923:7.

The zoarium is fragile, with irregular tufts reaching a height of about 20 mm; internodes consist of about 10 to 20 zooecia, though the number may reach 30 or more; the frontal surface rounded but not keeled, the *basis rami* exposed for most of its length. The zooecia are very slender, connate for most of their length, though the free tips are longer than in most crisias. The distance between the zooecial apertures is considerably greater than the width of the internode.

Ovicell elongate pyriform, inclined to one side of the internodal axis; "the dorsal wall of the ooecium extending upward and forward covering the ooeciostome as with a lid or cap, the *operculum*" (Robertson). The ooeciopore is a semicircular slit beneath the cap.

The species was described from "one station on the southern California coast, depth not known." O'Donoghue recorded it from Houston Passage, British Columbia, 15 fms.

Hancock Stations: dredged at only 4 stations: 1378-41, Santa Catalina Island, southern California, 2-3 fms; 1049-40, Angel de la Guardia Island, Gulf of California, shore; 675-37, Pulpito Rock, Gulf of California, 55 fms, and San Francisco Island, Gulf of California, 47 fms, 24°47′35″N, 110°35′55″W, the most southern record. Apparently it is not a very common species.

Crisia maxima Robertson, 1910

Plate 72, fig. 3

Crisia maxima Robertson, 1910:243.
Crisia maxima, O'Donoghue, 1923:7, 1926:18.

Zoarium coarse, stiff, with straight, long internodes, resembling *C. serrulata* in its manner of growth, but coarser and larger, occasionally more than 50 mm in height. The internodes are elongate, usually with from 12 to 20 zooecia but may contain more than 40; older joints dark brown; *basis rami* not wedged in between the zooecia. The zooecia are closely connate to their tips, which are turned sharply forward; the distance between their apertures is greater than in *serrulata,* usually distinctly greater than the internodal width. The front of the internode is slightly arcuate in cross-section and not keeled.

The ovicell is large, the frontal surface prominent, the distal end more or less truncate; the tube of the ooeciostome is short, straight, slightly tapered and opens more or less ventrally.

Recorded by Robertson on the southern coast of California from between tide marks at Escondido, Deadmans Island (San Pedro), and White's Point, and dredged from San Pedro to Coronado Island down to 40 fms. O'Donoghue lists it from several British Columbia localities down to 25 fms.

Hancock Stations: 31-33 and 362-35, Hood Island, Galapagos, 1°22′52″S, 89°39′15″W, at 4 to 20 fms (the most southerly record); also at 352-35, Chatham Island, 35 fms; and 810-38, Barrington Island, 48 fms, Galapagos. Station 1051-40, Angel de la Guardia Island, Gulf of California, 21 fms; 870-38, Isabel Island, west of Mexico, 10-15 fms; and 894-38, San Miguel Island, 5-15 fms, 1238-47, San Clemente Island, 14 fms, and 1232-47, off San Pedro, 18 fms, southern California. Also off Pescadero Point, near Monterey Bay, California (A. E. Blagg, collector).

Crisia eburnea (Linnaeus), 1758

Plate 71, fig. 10

Sertularia eburnea Linnaeus, 1758:810.
Crisia eburnea, Hincks, 1880:420; 1884:203.
Crisia eburnea, Osburn, 1912:215; 1923:5D.

Zoarium forming dense bushy tufts, the branches characteristically curved forward. The internodes are short, usually 5 to 7 zooecia, the joints yellow, sometimes dark near the base. Zooecia almost entirely connate, the short free portions nearly at a right angle to the tubules.

Ovicell large, curved forward, usually replacing the second zooecium of an internode; the ooeciostome curved forward, widest at its base, the pore transversely elliptical and the proximal margin somewhat inflected.

This is a very common species on the coasts of Europe and North America (Atlantic coast) and entering the Arctic Ocean, common in Greenland waters. Recorded for Icy Cape and Point Barrow, Alaska by Osburn, 1923:5D. Hincks (1884:203) reported it from Virago Sound, British Columbia, but this record appears to be questionable as the species has not been recovered south of northern Alaska, and he may well have confused it with *C. occidentalis* Trask, which has the same growth form of incurved branches and is common in British Columbia waters.

Point Barrow, Alaska, 18 fms, Arctic Research Laboratory, G. E. MacGinitie, collector.

Crisia cribraria Stimpson, 1853

Plate 72, fig. 1

Crisia cribraria Stimpson, 1853:18.
Crisia eburnea var. *cribraria,* Verrill, 1879:28.
Crisia eburnea var. *cribraria,* Whiteaves, 1901:110.
Crisia cribraria, Osburn, 1912:215; 1912a:276; 1933:8.

The zoarium consists of nearly erect, straight and stiff flabellate branches rising to a height of 20 to 25 mm. The internodes are long, usually about 18 or 20 zooecia, the joints occasionally wanting. The zooecia are almost completely fused, with only a very short peristome which curves abruptly forward and slightly toward the axis of the branch, a sharp projection often present on the outer border of the aperture.

The ovicells are large, elongate, the distal end prominently rounded and more or less obscuring the ooeciostome from a frontal view. The ooeciostome is short and broad, the aperture almost slit-like, the tip somewhat flared outward.

Stimpson described the species from Grand Manan Island, Maine, and it is a fairly common species along the east coast of North America as far south as Cape Cod.

Point Barrow, Alaska, 7 fms, Arctic Research Laboratory, G. E. MacGinitie, collector; two colonies in reproduction.

Crisia elongata Milne-Edwards, 1838

Plate 71, fig. 9

Crisia elongata Milne-Edwards, 1838:203.
Crisia elongata, Harmer, 1915:96 (synonymy).
Crisia elongata, Canu and Bassler, 1928:157.
Crisia elongata, Osburn, 1940:328; 1947:3.

Zoarium with long, slender, sprawling branches; the internodes elongate, usually with about 14 to 16 zoids but ranging from 6 to 30 or more, the joints of both branches and radicles jet black (brownish in younger areas of the colony). The tubules of the zooecia are embedded and their outlines scarcely visible, their peristomes short and turned sharply forward, with usually a small denticle behind the distal border.

The ovicell is situated usually near the middle of an internode, short, suddenly and broadly inflated; the ooeciostome is little or not at all elevated and its pore is a transverse slit.

Our rather scanty material agrees well with Harmer's excellent description (1915:96) and with specimens from the West Indian region. It is my opinion that the *C. eburnea* forma *denticulata* of Smitt (1872: 4), the *C. denticulata* of Osburn (1914:185) and the *C. denticulata* of Canu and Bassler (1928:156), all from the Gulf of Mexico and the West Indian region, should be referred to *C. elongata.*

Hancock Station, 277-34, off Isabel Island, Gulf of California, 21° 51′35″N, 105°30′W, at 10-25 fms. It is apparently a circumtropical species.

Crisia pugeti Robertson, 1910

Plate 71, fig. 8

Crisia pugeti Robertson, 1910:244.
Crisia pugeti, O'Donoghue, 1923:8; 1926:18.

The zoarium is rather stiff and straggling in appearance, the internodes varying greatly from 7 to more than 30 zooecia. The joints are colorless or slightly brownish in older zoaria. The branches are rather numerous, 3 or 4 to an internode, the *basis rami* usually exserted but sometimes short, always a branch immediately above the top of the ovicell.

The ovicell is usually situated low in the internode, most frequently the third member of the internode; elongate, expanding rapidly near the base and maintaining the same width for most of its length; considerably inflated and adnate to the internode for its full length. The

ooeciostome is longer than usual, turned forward sharply, the aperture round or slightly elliptical; when the ooeciostome is fully developed this is the most striking character of the species.

Described from Friday Harbor, Puget Sound. O'Donoghue has also recorded it from a number of localities in British Columbia at 10 to 25 fms.

Hancock Collections: Clayoquot Sound, British Columbia, at low tide, E. F. Ricketts, collector.

Crisia denticulata (Lamarck), 1853

Hincks (1884:203) reported this species from Houston-Stewart Channel, British Columbia, without description. As it has not been noticed since on the Pacific coast it seems probable that he had another species, possibly *C. serrulata* Osburn, which is common in that area and which has some of the characters of *denticulata.*

Crisia californica d'Orbigny, 1853

Crisia californica d'Orbigny, 1853:599.
Crisia californica, Busk, 1875:8.

What this species from "Basse-Californie" may be is altogether problematical, as d'Orbigny's description is so indefinite as to be useless and is without illustration. Busk merely translates d'Orbigny's description and questions whether it may refer to *C. denticulata,* which is not at all likely. The name should be dropped.

Crisia punctata d'Orbigny, 1853

Crisia punctata d'Orbigny, 1853:600.

This species is also entirely unrecognizable from the very short description and lack of figures. It was recorded from the Gulf of California "Ile du Venado, mer Vermeille, en Californie." The name should be dropped.

Genus CRISULIPORA Robertson, 1910

"Zoarium erect, dendroid, composed of internodes united by chitinous joints. Zooecia tubular, disposed in several alternate rows. Ooecium an inflation of the surface of an internode." (Robertson, 1910:254). Genotype, *Crisulipora occidentalis* Robertson.

In addition it should be stated that, similar to *Crisia,* there are jointed rhizoids or radicles consisting of tubular kenozooecia; the primary disc is separated from the primary zoid by a joint; the primary zoid arises from the top of the primary disc and not from its side; the lower internodes of the colony and its branches are uniserial or biserial; and the rhizoids, which are exactly like those of *Crisia,* often give rise to branches. For these reasons I agree with Borg (1926:475-6) in placing *Crisulipora* in the family Crisiidae.

On the other hand, the ovicell usually resembles that of the Diaperoeciidae where Canu and Bassler (1920:749) have placed the genus. The gonozoids are more or less embedded between the autozoids and sometimes they are expanded and surround a few peristomes. In narrower branches, however, they are simple, as those of *Crisia,* the only difference being that they are more embedded between the neighboring tubules.

Crisulipora occidentalis Robertson, 1910

Plate 72, fig. 6

Crisulipora occidentalis Robertson, 1910:254.
Crisulipora occidentalis, Okada, 1917:342.
Crisulipora occidentalis, Marcus, 1937:21.

The zoaria form large, stiff, often tangled masses, to a height of 30 mm, attached by jointed radicles; additional zoaria are often produced from creeping radicles. Internodes long, separated by chitinous joints, the terminal ones gently curved backward, the more proximal ones shorter and straight. In the proximal internodes the zooecia number from 1 to 3 or 5, but terminal ones may have 40 or more. The zooecia are not symmetrically arranged as they are in *Crisia,* but are irregularly distributed. Cross sections of fertile internodes may show as few as 4 or 5 zooecia, or as many as 8 to 10 at the widest part. Branching is like that of *Crisia,* with a more or less exserted *basis rami.*

The zooecial tubes are slender and elongate, the frontal surface rounded in cross-section and the separating grooves quite distinct. The peristomes are moderately long, gently curved forward, a little narrower than the tubules, the aperture round and about 0.12 mm in diameter; in the basal internodes the tubules often show a rather regular alternate arrangement.

The ovicells are elongate, narrowly wedge-shaped proximally and widening gradually upward, with much variation in size and form; and

there may be as many as 3 to an internode. In the narrower internodes they may be as simple as those of *Crisia* (though more embedded), with a terminal ooeciostome which is smaller than a peristome and may terminate simply, or the rim may be expanded and slightly bell-shaped, the pore round. On broader internodes the ovicells are more expanded laterally and sometimes extend beyond the ooeciostome, and occasionally a few of the neighboring peristomes are surrounded.

". . . at low tide almost anywhere on the coast of Southern California. . . . It has been dredged off the coast, from San Pedro to San Diego in depths ranging from 2 to 17 fathoms." (Robertson). Okada has recorded the species from the Bay of Sagami, Japan, and Marcus reports it from Santos Bay, Brazil.

Hancock Stations: Dredged at 28 stations, all the way from Point Conception, California to Peru. Station 844-38, Lobos de Afuera Islands, Peru, 6°55′40″S, 80°43′50″W, shore to 30 fms, the most southerly record; 31-33, Hood Island, Galapagos, 1°22′52″S, 89°39′15″W, at 4 fms; 308, Bahia Honda, Panama; Clarion Island, west of Mexico; 7 stations in the Gulf of California; Dewey Channel west of Lower California; and abundant about the Channel Islands off southern California as well as along shore; from low tide mark to a depth of 47 fms.

Division 3. Cancellata Gregory, 1896
(Pachystega Borg, 1926)
The Horneras etc.

The primary zoid is erect but not separated from the ancestral disc by a joint; the zoarium is not jointed, erect, usually branched like a tree. The "wall of zoarium double, consisting of a gymnocyst and cryptocyst, the latter undergoing a process of secondary calcification, by which the zoarium in its older parts becomes very strongly calcified." (Borg, 1944:175). The ovicell or brood-chamber is a much expanded gonozoid, usually situated on the dorsal side or between two branches.

Borg (1944:179) included the families Horneridae and Crisinidae, and erected three new families, Steghorneridae, Pseudidmoneidae and Calvetiidae, but did not discuss the Cytisidae.

The only families we have to deal with are the Horneridae and Cytisidae.

Family **Horneridae** Smitt, 1867

The zoarium is erect, branching like a tree, with rounded stems and branches; the zoids opening on the frontal side only; the inflation of the gonozoid or ovicell on the dorsal side of the zoarium. The family has not hitherto been recorded from the Pacific coast of America.

Genus **HORNERA** Lamouroux, 1821

With the characters of the family. Genotype, *Hornera frondiculata* Lamouroux, 1821. The zoarium with a moderate encrusting base, an erect round stem which branches like a tree with the successive branches diminishing in diameter, and the zooecia all opening on one side, easily distinguish the genus. The species are usually highly colored red or purple.

Hornera pectinata Busk, 1861

Plate 72, figs. 10, 11, and 12

Hornera pectinata Busk, 1861:79; 1875:18.
Hornera pectinata, Johnson, 1897:61.
Hornera pectinata, Norman, 1909:280.

The zoarium is erect, flabellate, the short main stem rising from a slightly expanded base; height 25 mm; the base measures 5 by 7 mm, the main stem 3 mm, the larger branches about 2 mm, the terminal branches just below the tips 0.50 to 0.60 mm. The branching is in one plane, irregular with a tendency toward dichotomy; the main branches are rather regularly tapered from base to tip; all of the branches are round even in the youngest stages. Stunted branches rare. Apparently purple when living.

The zooecia are irregularly arranged in more or less transverse rows of 2 to 4 tubules, connate or separated and often single. All of the peristomes are short, but the outer ones are slightly longer. On older branches the apertures are nearly level with the surface, the apertures round, 0.20 to 0.24 mm in diameter, the rim of the peristome thin, often slightly flared and delicately serrate (never incised), the points being the tips of the parallel ridges or thickenings of the peristome. The longest marginal peristomes are seldom as much as 0.20 mm in height. The sulci are strongly developed on both frontal and dorsal sides and the pores are round or slightly elongate. The ridges between the sulci are very irregular on the frontal surface, but are continuous and more or less parallel on the dorsal side. Complete calcification of the zoarium

extends only about one third of the distance above the base and the peristomes protrude above the level of the front on the whole upper two thirds of the zoarium. Ovicells are not developed on any of our specimens, and in their absence positive identification is impossible. However, the zoarial characters given by Johnson (1897:61) in his amplification of Busk's description of *pectinata* apply very well to our specimens:

"branches terete . . . ultimate branches tapering . . . Anterior surface pierced by numerous oval pores, which are sunk in depressions and have slightly raised borders. Between the pores the surface is irregularly ridged. The pores on the dorsal surface are larger and are partially filled up inside. The peristome is minutely dentate."

Johnson also describes the ovicell, "dorsal, brownish, semiglobular, and the surface is thickly set with warts, each of which has a depression at the top with a perforation therein."

The species has been recorded only from the Madeira Islands.

Hancock Stations: 1397-41, Santa Rosa Island, 33°38′40″N, 119° 58′30″W, at 77 fms; 1299, off Point Firmin, 33°41′45″N, 118°17′50″ W, at 18 fms; and off Santa Catalina Island, 33°24′15″N, 118°13′30″ W, at 228 fms; all from southern California.

Hornera pinnata Canu and Bassler, 1929

Plate 72, figs. 7, 8, and 9

Hornera pinnata Canu and Bassler, 1929:550.

The zoarium is erect from a very small base, the branching dichotomous and irregular, the branches with short pinnules of various sizes. There are usually two rows of peristomes on each side of the midline, sometimes only one row, irregularly alternating, the outer ones the longer. The frontal surface is deeply grooved, the pores conspicuous and 3 to 5 in number on each tubule. The peristomes measure about 0.12 mm in diameter and the aperture about 0.10 mm. The pinnules (dwarfed branches) vary greatly in size and the number of their tubules varies from 3 to 8; sometimes a pinnule ends in a blunt point with a peristome medially placed at the tip. The dorsal side of the zoarium is deeply grooved longitudinally, with conspicuous pores at the bottom of the grooves.

Ovicells are wanting on all of our specimens, so it is impossible to be absolutely certain of the species, but the zoarial characters seem to agree closely with the description of *pinnata*. Also I have for comparison an ovicelled specimen from Hawaii which is undoubtedly *H. pinnata*. The

diameter of the peristomes is only slightly larger, the arrangement and number of the tubules and pores is the same, and the nature of the pinnules corresponds.

It was described from the Philippines, the China Sea and Borneo.

Hancock Stations: 1323-41, off Santa Catalina Island, southern California, 33°14′40″N, 118°12′15″W, at 152 fms; 2158, Ranger Bank off Cedros Island, west of Lower California, 81 fms; and 299, San Jose del Cabo, near the southern tip of Lower California, 22°56′15″N, 109°47′15″W, at 83 fms.

Family **Cytisidae** d'Orbigny, 1854

Genus **DISCOCYTIS** d'Orbigny, 1854

D'Orbigny (1854:1061) gave an unusually careful and full description of this genus, in which he mentioned the attached base upon which rises a narrow peduncle expanding upward into a cupuliform head, the whole zoarium shaped like a wine-glass; the upper surface very concave or infundibuliform at the center and the margin with numerous simple or branched fascicles. He also observed and figured (Plate 798, fig. 8) the unusual position of the ovicell on the under side of the cup above the peduncle. Genotype, *Pelagia eudesii* Michelin, 1844:123.

This genus has been known only as a fossil from the Cretaceous until O'Donoghue (1926:26) described *D. canadensis* as a recent form from British Columbia. In the Hancock Collections there are several zoaria which are similar and which fill all the requirements of *Discocytis*.

Discocytis californica new species

Plate 69, fig. 11

The zoarium is attached by a round thin disc, from the center of which rises a comparatively thin cylindrical peduncle; at the upper end this widens gradually into a funnel-shaped head or capitulum like an inverted cone, the whole structure resembling a minute and moderately short-stemmed wine glass. On its upper surface the capitulum is concave and the whole central area is occupied by rather large cancelli with thick walls and rounded apertures. Around the rim of the cup the functional tubules are arranged in short fascicles, 8 to 10 in number, completely connate, the apertures measuring about 0.10 mm in diameter. The base and stem show no open tubules and appear as if covered by a thin pellicle. The measurements of the various zoarial parts are, on

our largest specimen: height 1.75 mm, width of base 1.20 by 1.30 mm, width of stem 0.53 mm, length of stem 0.60 mm, height of capitulum 1.15 mm, width of capitulum 1.57 by 1.70 mm, height of fascicles 0.25 mm.

The ovicell is very large, conspicuous, rounded and bulbous and is situated on the under (dorsal) side of the capitulum close to the base of the fascicles, its width 0.55 by 0.65 mm. A portion of the wall is broken away and the ooeciostome is wanting. On another, somewhat smaller, specimen there is a smaller ovicell of similar appearance, and it also has been injured.

At first I presumed this to be *D. canadensis* O'Donoghue, 1926:26, but it is much smaller, the ovicell is strikingly different in form, and O'Donoghue describes the capitulum as broad and flattened.

Type, AHF no. 124.

Type locality, off Rocky Point, southern California, about 33°49′N, encrusting on a sunken buoy at a depth of 45 fms, three colonies.

Discocytis canadensis O'Donoghue, 1926

Supercytis digitata, O'Donoghue, 1923:16.
Discocytis canadensis O'Donoghue, 1926:26.

This species has not been found in the Hancock Collections, but the following digest of O'Donoghue's description is here given to indicate the differences. Zoarium cupuliform; base small, flat and circular; stalk short, narrow, expanding into a broad, flattened funnel-shaped capitulum, from the edge of which a number of pinnules radiate outward; each pinnule (fascicle) consists of 12 to 20 tubes closely connate. Largest specimen 4 mm high, the stalk 1.75 mm thick, and the capitulum 7.25 mm across.

Ooecium transversely elongate, sinuous, running up slightly between the bases of the fascicles, its breadth one fifth to one fourth of the circumference. Ooeciostome a circular aperture surrounded by a flattened ring-like margin, sub-terminal near the middle of the ooecium.

Recorded by O'Donoghue from a number of localities on the British Columbia coast and south to the San Juan Islands in Puget Sound.

Division 4. Cerioporina Hagenow, 1851
(Heteroporina Borg, 1933)
The Heteropores

"Primary zoid adnate or partially erect; zoarium varying in shape, adnate, suberect or erect, composed of zoids of two kinds, autozoids and kenozoids, the latter at least as numerous as the former, both autozoids and kenozoids opening at about right angles to the surface of the zoarium; wall of the zoarium double, consisting of gymnocyst and cryptocyst; brood chamber a coelomic space, formed by the absorption of the subdistal portions of some autozoids and numerous kenozoids outside the fertile, ovigerous zoid (zoarial brood-chamber)." (Borg, 1944:208).

Family Heteroporidae Waters, 1880

"Zoarium erect, pedunculate and capitate, or arborescent; autozoids and kenozoids about equally numerous or the former less in number; apertures of both kinds of zoids scattered over the surface of the zoarium, not forming clusters, circular or polygonal in shape; brood chamber zoarial, not visible from surface except in form of a slight swelling of that part of the zoarium." (Borg, 1944:209).

Two genera are represented in our material, *Heteropora* Blainville, 1830, and *Borgiola* Strand, 1933 *(Canuella* Borg, 1933, preoccupied), the latter having the autozoids often forming small clusters instead of being more regularly distributed. One species of this genus forms a heavy incrustation without any erect branches.

Genus HETEROPORA Blainville, 1830

"The zoarium is erect, arborescent, its surface smooth or slightly rugose, honeycomb-like when the cystids are open; the kenozoids much more numerous than the autozoids, located between them and thus separating them, aperture circular or polygonal." (Borg, 1944:210). Genotype, *Ceriopora cryptopora* Goldfuss, 1827.

Robertson (1910:258) gave a very clear statement of certain zoarial details: "If one examines the growing tips of a branch, the tubular openings found there are for the most part those of zooecia in various stages of maturity. Between them, formed by minute triangular spaces where the walls of zooecia do not come into contact, are the interstitial spaces (kenozooecia). As growth proceeds, both zooecia and interstitial canals

curve outwards, and although at the growing tip these tubes are parallel to the axis of the branch, when adult they curve almost at right angles with the axis of the branch and the apertures open laterally, the larger zooecial apertures being surrounded with a circle of small interstitial openings."

Borg (1932, 1933 and 1944) has made a very detailed study of the anatomy, development and the brood-chambers of recent species of *Heteropora* and related genera. He rejects the genus *Tretocycloecia* Canu, 1918a:346, erected to include the species with ovicells and leaving the old genus *Heteropora* for those in which the ovicells are unknown, as "inadmissible."

Heteropora magna O'Donoghue, 1923

Plate 73, fig. 13

Heteropora magna O'Donoghue, 1923:14.
Tretocycloecia magna, O'Donoghue, 1926:29.
Heteropora pelliculata, Robertson, 1910:258 (part).
Heteropora magna, Borg, 1933:326.
Tretocycloecia pelliculata, Canu and Bassler, 1922:110.

"Zoarium stout, densely branched, more or less spherical in outline; distal ends of autozoids not or only slightly protruding; apertures of kenozoids mostly open, but sometimes, in older portions of the zoarium, closed." (From Borg's key, 1933:284).

The encrusting base gives rise to erect cylindrical stems, 3 to 5 mm in diameter, which branch dichotomously while retaining their original thickness, but a little swollen at the tips. The zoarium thus has a more or less spherical form, except when modified by the substratum. There is occasional anastomosis of the branches, "but not so frequently as in *H. pelliculata* (now *H. pacifica* Borg, q.v.) and the colony as a whole has a much more stout and compact appearance . . . and may measure 100 by 70 mm." (After O'Donoghue). Zoarium purplish-brown in color.

Ovicells were not observed by either O'Donoghue or Borg. They are large irregular areas on the sides of the branches near the tips and partially surrounding the branches, only slightly elevated, but conspicuous because of the closure of the kenozoids; appearing as a complete, calcified, thin, whitish cover of the brood-chamber, with the exception of the peristomes of the autozoids which are not displaced. The peristomes are more prominent than elsewhere on the zoarium and are often slightly

flared at the tips and thus appear somewhat larger than the ordinary ones. I have not been able to find any aperture on the four brood-chambers in my material which I can positively identify with ooeciopores, and it is therefore probable that they are similar to the ordinary apertures. On the removal of the roof of the brood-chamber an extensive, broad cavity is revealed, with the bases of the absorbed kenozoids at the bottom. The peristomes of the autozoids usually traverse the cavity without modification, but I have found a few which have become closed, within the chamber, by a membrane with a central raised pore similar to those of *Diastopora.* The apertures of the autozoids average about 0.18 mm in diameter.

This species did not appear in the Hancock dredgings, but I have a fine specimen from Friday Harbor, Puget Sound, 70 mm long by 45 mm wide and 40 mm high, without further data, but evidently dredged locally. The encrusting base is 7 by 9 mm across, and there is a secondary attachment of similar appearance by a branch, 5 mm across. Another portion of a colony, loaned by Dr. R. E. Foerster, Director of the Pacific Biological Station, Nanaimo, British Columbia, and bearing O'Donoghue's identification, is from Gabriola Pass, B. C. This specimen also has a brood-chamber.

Heteropora pacifica Borg, 1933

Heteropora pacifica Borg, 1933:317.
? *Heteropora* sp. Whiteaves, 1882:279.
Heteropora pelliculata, Robertson, 1910:258 (part).
Heteropora pelliculata, O'Donoghue, 1923:14 (part).
Tretocycloecia pelliculata, O'Donoghue, 1925:96; 1926:28 (part).
(The synonymy according to Borg).

Borg separated the more slender, more intricately branched and more highly anastomosed form mentioned by Robertson and O'Donoghue as a distinct species. As I have not had an opportunity to study *H. pacifica,* I can only indicate the essential points of difference given in Borg's description.

The zoarium is erect, branching profusely and dichotomously or in an irregular way. The branches frequently anastomose, giving the whole colony a complexly reticulated appearance which is highly characteristic of the species. The diameter of old stems is about 5 mm, of younger ones 3 mm on an average. Color of dried zoaria grayish, the tips pink. Autozoids with the apertures usually on a level with the surface, but

in more sheltered areas the peristomes are very evident. The apertures are about 0.17 mm in diameter, in older parts of the colony they are usually closed. The kenozoids never project above the surface and are usually closed except toward the growing ends of the branches. Brood-chamber not known.

While this species may have a considerable range along the Pacific coast from Alaska to California, as suggested by O'Donoghue, the only positive records are those of the material studied by Borg, Vancouver Island region to Middleton Island, southern Alaska, down to a depth of 25 meters.

There is in the Hancock collection a very small fragment labelled *Heteropora pelliculata* Waters by Robertson, from "San Diego, Californica," which may belong to *H. pacifica* as the zoids have the same measurement, 0.17 mm. There are also several much worn fragments from Hancock Station 1278-41, off San Miguel Island, southern California, at 35 fms, which present the same zooecial measurements and with stems 2 to 3 mm in diameter, which may belong here. But none of these specimens is in condition for determination beyond the genus.

There are also several much worn fragments from Hancock Stations 143-34, Wenman Island, and 170-34, Chatham Island, Galapagos Islands, which present about the same measurements, but which are not identifiable beyond the genus *Heteropora.*

Heteropora alaskensis (Borg), 1933

Plate 73, figs. 10, 11, and 12

Heteropora pacifica var. *alaskensis* Borg, 1933:325.
Heteropora pelliculata, Robertson, 1910:258 (part).
? *Heteropora pelliculata,* O'Donoghue, 1923:14 (part).

The zoarium is very irregular and much smaller than that of *H. magna* or *H. pacifica.* Our largest colony measures 16 mm in height by 25 mm in width, with 16 branches which average about 2 mm in diameter, but most of the 10 colonies are shorter and more compact; the branches, beyond a bifurcation, are 2 to 4 mm long (in one case 7 mm); only a few cases of anastomosis occur.

The essential characters which differentiate this form from other species of *Heteropora* are: (1) the peristomes of the autozoids project to a marked degree on the branches all the way up to the margins of the cancellated tops, and on older basal branches they still rise slightly above the level of the zoarial surface; diameter of apertures 0.14 (0.13 to 0.17) mm; (2) the kenozoids are covered and closed over the whole

surface of the colony up to the margin of the cancellated tops of the branches. In these characters our specimens agree with Borg's description of *H. pacifica* var. *alaskensis,* and the differences are so striking and constant as to warrant the elevation of the "variety" to specific standing.

On protected areas the peristomes may be as much as 0.25 to 0.30 mm long, though usually they are much shorter. The tips of the branches are sometimes evenly rounded, but more frequently they are somewhat clavate or spatulate, slightly excavated on one side where a brood-chamber is located, and the rim may extend beyond and give off two or three branches, thus leaving the brood-chamber in the broad fork of a branch. Other brood-chambers are found on the sides of branches, as shown in Borg's figure 5 (plate 10).

The brood-chamber is typically that of *Heteropora,* a low, more or less flat swelling, through the roof of which the peristomes of the autozoids penetrate and are slightly elevated above it. On the removal of the calcified membrane, or roof of the chamber, a considerable cavity is exposed, traversed by the autozoid tubules and showing the remains of the partially absorbed kenozoids. I have not been able to find on any of our specimens the large ooeciostome figured by Borg and cannot determine the location and form of the ooeciopore.

This species differs from *H. pelliculata* Waters, 1879, which it somewhat resembles, by the elevation of the peristomes over the whole surface and by the complete closure of the kenozoids over the whole colony up to the level of the margins of the cancellated tops of the branches. The same characters, as well as the smaller size, distinguish it from *H. pacifica* Borg. As the color of our preserved specimens is white, this may be the lemon-colored form recorded by Robertson (1910:259) from "Channel Rock, Puget Sound."

Our specimens are from Bentinck Islands, British Columbia, without further data, loaned by Dr. W. A. Clemens of the University of British Columbia, ten colonies of various forms and sizes. Also 2 fragments, with ovicells, from Clayoquot Wharf, British Columbia, E. F. Ricketts, collector.

Hancock Station 1490-42, off Cape Arago lighthouse, Oregon, 43° 20′26″N, 124°22′24″W, at very low tide, 5 fragments.

Genus **BORGIOLA** Strand, 1933

Canuella Borg, 1933:331, (preoccupied by Scott, 1893).

"Zoarium erect, arborescent, branching sparsely; its surface strongly rugose, showing numerous irregularly shaped elevated areas and between

them well-marked depressions; autozoids frequently forming small clusters; their apertures oblique, prolonged at one side into an erect pointed process; kenozoids much more numerous than the autozoids, thick-walled, mostly with open apertures," Borg, 1933:331. Genotype *Canuella rugosa* Borg, 1933:332.

The genus is certainly close to *Heteropora* and possibly may be found to intergrade. However any means of separating the members of this family, and especially if it is found to apply to the very numerous fossil species, is welcome.

The generic description requires modification to include an encrusting species, without erect branches, *B. pustulosa* new species, which is described below.

Borgiola rugosa (Borg), 1933

Plate 76, fig. 11

Canuella rugosa Borg, 1933:331.

The zoarium of our single specimen measures 25 mm in height and 20 to 25 mm in width, rising from a broad encrusting base 20 by 10 mm across, with numerous irregular branches which are sometimes bifurcate; and there is a single anastomosis. Several small subcolonies arise from the lateral extension of the base. The main stem is about 5 mm in diameter, the branches becoming progressively smaller until the terminal ones measure 2 mm or less. Color pure white.

The autozoids, or functional zooecia, tend to occur in small groups or clusters, sometimes in radiating lines, though single autozoids are also common. The peristomes usually rise slightly above the surface, with the rim higher on one side and often extending into a sharp point; or the rim may be evenly rounded. The zooecial tubes are long, those in the rounded branches have their origin in the center and curve outward as in *Heteropora;* those which form the basal expansion arise on the lamina and curve upward. There is a moderately broad basal lamina surrounding the basal expansion. The apertures of the autozoids are about 0.13 to 0.15 mm in diameter. The kenozoids are much more numerous than the autozoids, always noticeably smaller but varying in size, never rising above the surface and seldom entirely closed. The brood-chamber has not been observed.

A striking feature of the zoarium is the peculiar type of rugosity produced by the irregular elevation of areas with increased numbers of autozoids, while between these are smooth areas of lower level in which there are fewer autozoids.

I presume this to be the same species as that from Japan described by Borg, since the zoarial and zooecial characters appear to agree closely, but in the absence of brood-chambers the identification is necessarily tentative.

The species has hitherto been known only from Sagami Bay, Japan.

Hancock Station, 310-35, off Bindloe Island, Galapagos, 0°18′20″N, 90°31′10″W, at 15 fms, rocky bottom.

Borgiola pustulosa new species

Plate 73, figs. 5, 6, 7, 8, and 9

Zoarium encrusting on rocks and shells, with no evidence of erect branches, the surface with numerous low rounded or elliptical elevations which are rather evenly spaced, the elevated areas about as wide as the lower areas between them. The largest colony (type) measures about 70 mm long by 50 mm wide by 10 mm thick, but is broken and was evidently considerably larger. Another fragment is 50 mm in width, and a third fragment which is on a shell, is 25 mm long by 10 mm wide and appears to have been about twice that width. The color is white to yellowish red.

On the lower, general, surface the apertures of the autozoids are often quite regularly spaced and surrounded by a single row of kenozoids about half as large as the autozoids; on the pustules the autozoids are irregularly disposed and the kenozoids more numerous and irregular in size, and occasionally there are small areas consisting entirely of kenozoids. Over most of the surface the tubes of the autozoids project very slightly above the level of the surrounding kenozoids, the rim round or nearly so; but around the borders of the pustules they are noticeably higher and produced on one side into a pointed process, "giving the aperture a distinctly oblique appearance," as Borg describes them in *C. rugosa* (1933:335). On older areas both autozoids and kenozoids are frequently closed, slightly below the level of the rim. The apertures of the autozoids are about 0.18 mm in diameter but vary considerably. The kenozoids vary excessively, from 0.03 to 0.12 in diameter, but average about 0.08 mm, and they also vary in form.

The autozoids arise on a basal lamina which extends rather narrowly around the margin of the zoarium, at first prone but curving upward at once into an erect position.

The brood-chambers are spacious cavities, as much as 2.50 mm in width and 0.50 mm in depth, resembling those of *Heteropora* with the kenozoid walls absorbed and closed on the floor of the cavity, and most

of the autozoid tubes continued through the chamber and on above it. In the broken walls of old thick zoaria the chambers appear at different levels, some just beneath the surface, but others buried deeply by the regeneration of the zoarium above them. There is little or no surface evidence of the position of the brood-chambers, and the pustules appear to have no relation to them, as shown by dissection. Borg could not be certain as to the brood-chamber in his material of *B. rugosa*, but that of his figure 2 (plate 3) appears to be similar to those of *pustulosa*. I have observed no differentiation of ooeciostomes.

Borgiola is certainly close to *Heteropora* in most of its characters, but the roughened nature of the zoarial surface, the grouping of the autozoids and heterozoids and the pointed processes of the taller zooecial tubes separate it.

The occurrence of this species is of unusual interest, since no member of the Family Heteroporidae has hitherto been recorded from the Arctic Ocean.

Type, U. S. Nat. Mus. no. 11051.

Type locality, Point Barrow, Alaska, Arctic Research Laboratory, 453 feet, encrusting a stone, G. E. MacGinitie, collector. Also on a stone from 295 feet and on a shell at 60 feet.

Division 5. **Rectangulata** Waters, 1887
(Calyptrostega Borg, 1926)
The Lichenopores

"They fool me to the top of my bent." Shakespeare.

"Primary zoid adherent to the substratum, never separated by any joint from the pro-ancestrula; zoarium wart-like, its basal wall adnate, simple; frontal wall double consisting of gymnocyst and cryptocyst; between zoids special coelomic cavities (alveoli) limited by calcareous extrazoidal walls; no vestibular sphincter; brood-chamber zoarial, a coelomic space corresponding to numerous alveoli, outside the fertile zoid; polypide degenerating first after having been functional for some time." (Borg, 1944:211).

The Lichenopores have always been a "thorn in the flesh" to those who have attempted to work with them. Defrance established the genus *Lichenopora* in 1823. Before this time the species were usually referred to *Madrepora* (a coral), or to *Tubulipora* Lamarck. Since then a large number of generic names have been proposed; d'Orbigny was especially lavish in this respect, separating out ten "genera" on trivial

zoarial characters. Some of these have proved to belong in other families and others placed in synonymy until only two genera, *Lichenopora* Defrance, 1823, and *Disporella* Gray, 1848, have survived the research of later authors. Most recent authors have used only *Lichenopora,* but Borg, 1944:234-5 and 249, has given what appear to be good reasons for the retention of *Disporella.* Borg even goes so far as to propose a new family, Disporellidae, to include only this genus, but this appears to me to be unwarranted on the basis of the characters.

A few citations will indicate the difficulty others have had: "One cannot help feeling despair when trying to determine the *Lichenoporae.*" (Waters, 1889:282); "The determination of the species of *Lichenopora* is admittedly very difficult." (Harmer, 1915:160); "The determination of the species, even the recent ones, presents much difficulty." (Canu and Bassler, 1920:812); "The discrimination of the species . . . has scarcely but begun." (Borg, 1944:213).

Family **Lichenoporidae** Smitt, 1866

Zoaria rounded or ovate, occasionally otherwise modified in outline by the nature of the substratum; more or less convex, sometimes dome-shaped; attached the full width of the basal lamina, or the basal lamina free and turned upward at the edge, or, when on small stems, they may be attached by a short central stipe of variable width. The central part of the zoarium, varying in size with the species, is occupied by cancelli (alveoli, Borg), and outside of this area the functional zooecia are arranged in radiating series or more or less in quincunx. The "peristomes" are usually much higher next to the central area and decrease in height regularly to the margin; usually the basal lamina extends in a thin rim around the outer edge. Zoarial budding occurs in some species, either vertically or near the edge, and sometimes very complex zoaria may be formed in this manner. The ovicells are brood-chambers of considerable size, occupying the central area, branching out in lobes between the rays, or located entirely between the rays; covered by a thin calcified layer with minute pores, which may be obscured by the development of secondary cancelli above it.

As stated above, Borg has indicated two families on the following basis:

Lichenoporidae, alveoli soon "roofed in" by a porous calcified layer, with secondary alveoli above them; the one central brood-chamber, which may have lobes extending between the rays; zoarial budding vertical.

Disporellidae, alveoli not roofed in but partially closed "iris-like" with a round hole at the center; brood-chambers between the rays; zoarial budding lateral.

This separation seems to work very well with the few species treated by Borg, but, unfortunately for taxonomic purposes, the three characters used by him to distinguish *Lichenopora* and *Disporella* do not appear to be constant throughout the series. Thus in *Lichenopora buskiana, novae-zelandiae* and *intricata,* which have irregular cancelli closed by a membrane, the budding is lateral with the sub-colonies beyond the margin of the primary disc. The location of the ovicells, in the central area or interradial, shows frequent variations. Also the closure of the cancelli, by a thin porous membrane or by an iris-like diaphragm, is not constant, as both types may occur on the same zoarium. In *L. intricata* Busk, the interradial cancelli and those of the central area of infertile discs have the rounded cancelli, while the fertile discs present the irregular cancelli above the ovicells; in several of the elongated discs of this species both kinds of cancelli are present, the irregular ones covering the ovicell at one end and the rounded cancelli at the opposite infertile end.

Apparently the only character that seems to hold absolutely is the presence of irregular, thin-walled secondary cancelli covering the ovicells in *Lichenopora.*

Genus **LICHENOPORA** DeFrance, 1823

Brood-chambers, one or more, occupy the central area and may extend somewhat into the interradial areas; in older zoaria secondary small brood-chambers may appear between the rays toward the margin. Cancelli (alveoli) of the primary layer thin-walled, irregular in form and size, and closed by a thin, perforated, calcified layer; secondary cancelli above these may be similar to these or may be thicker-walled with large rounded apertures. Marginal zoarial budding sometimes occurs but vertical budding is the rule. The distribution of the functional zoids varies much among the species, in short or longer connate or non-connate rays or in irregular quincunx. Genotype, *L. turbinata* Defrance, 1823: 257.

Key to the Species of *Lichenopora*

1. Radiating rows of tubules biserial . . . . . *buskiana*
   Rays uniserial or more or less in quincunx 2

2. Ooeciostome hooded over the top and opening on the side; tubules distinct, high on proximal border and with one to several sharp points . . . . . *canaliculata*
   Ooeciostome wide open 3
3. Zooecial tubules not connate and, except near the center, they are usually scattered or in quincunx . . . . . *verrucaria*
   Zooecial tubules in series only, connate to the tips 4
4. Cancelli distinctly larger than the zooecial apertures; radii in regular series; pin-head spicules abundant . . *novae-zelandiae*
   Cancelli smaller; radii regular only close to the central area; very complex and intricate colonies formed by lateral budding; pin-head spicules almost wanting . . . . . *intricata*

Lichenopora canaliculata (Busk), 1876

Plate 76, figs. 3 and 4

Discoporella canaliculata Busk, 1876:118; 1879:199.
Lichenopora grignonensis, Ridley, 1881:57.
Lichenopora fimbriata, Borg, 1926:184.
Lichenopora canaliculata, Borg, 1944:235.

Busk's description is very brief, "Zoarium circular, bordered, slightly convex; tubes very irregularly uniserial, with a raised canalicular fillet on one side, interspaces cancellous." Borg, 1944:235, had very rich material from the Swedish Antarctic Expedition and has given an extended discussion of the species.

The zoaria are circular, somewhat elevated at the center and sloping regularly to the basal lamina which is broad and thin; encrusting on shells and attached to stems. The basal lamina is traversed nearly to the edge by the bases of young zooecia. The central area of the zoarium is comparatively small, a little depressed in the young, but later filled in by the flat-topped brood-chamber. The zooecial tubes are irregularly distributed or in short radiating lines and never connate; they are moderately high, usually much elevated on the proximal (central) side and low on the side toward the border, thus forming a channel above the aperture; the proximal side with one to several "fillets" or longitudinal ribs which end in points; aperture rounded and 0.10 to 1.12 mm in diameter. The cancelli are large and irregular in form, often twice as large as the apertures of the zooecia, the walls thin and the whole giving a reticulated appearance.

The brood-chamber covers the central area, with a thin calcareous layer which is very minutely perforated; a coarsely reticulated layer of secondary cancelli later may cover it. The ooeciostome appears to be unique in this genus; it has the short erect cylindrical base but the orifice is on the side, with a peculiar "helmet" or hood-shaped cover which arches widely over the top, closing the orifice entirely from above; also just inside from the rim of the hood there is a transverse row of minute pores, as described by Ridley under *L. grignonensis* (= *L. canaliculata)*.

This species has been recorded only for Antarctic and far southern waters; Kerguelen Island; Strait of Magellan; Kap Adare, Victoria Land; and New South Wales. It is therefore of special interest to discover it in the Arctic region. The nature of the tubules and especially the form of the ooeciostome with its row of perforations seem sufficient for positive identification.

Point Barrow, Alaska, Arctic Research Laboratory, 110 to 522 feet, several colonies, only one of which is mature, G. E. MacGinitie, collector.

Lichenopora verrucaria (Fabricius), 1780

Plate 74, fig. 3

Madrepora verrucaria Fabricius, 1780:430.
Discoporella verrucaria, Busk, 1875:31.
Lichenopora verrucaria, Hincks, 1880:478; 1884:207.
Lichenopora verrucaria, Robertson, 1900:329; 1910:263.
Lichenopora verrucaria, O'Donoghue, 1923:15; 1926:28.
Lichenopora verrucaria, Canu and Bassler, 1923:205.

Zoaria small, rarely more than 3 mm in width; encrusting on algae, stems, stones and shells; high near the center and rounding off gradually to the margin where there is a narrow basal lamina. In younger colonies there is a depressed cancellous central area, but in the sexually mature this area is filled in with one or more brood-chambers. The zooecia are irregularly arranged, often in short radiating series, especially near the central area, but never connate; moderately elevated, carinated on the side toward the center, the keel rising into a point. The cancelli vary greatly in size, sometimes larger than the zooecial apertures but often not half as large.

Usually only one brood chamber fills the central area, but as many as three have been observed, in which case they fuse externally so that the number of ooeciostomes is the only obvious clue to the number of

chambers; they do not extend between the zooecial rays farther than the central ones. The ooecial cover is a thin inflated calcareous plate with numerous minute pores; secondarily the ooecial roof may be covered by a layer of cancelli which form a very irregular reticulum. The ooeciostome is more or less excentric in position, a short erect cylinder with a flaring lip which varies from nearly round to elliptical, the ooeciopore 0.10 to 0.12 mm in diameter.

A common northern and arctic species, extending south to Cape Cod on the Atlantic coast and to California on the Pacific coast; abundant in the Arctic seas.

Hancock Station, 1416-41, San Miguel Island, southern California, 34°02′45″N, the most southern record. Hein Bank, Puget Sound, J. L. Mohr, collector; British Columbia (Hincks and O'Donoghue); southern Alaska (U. S. Crab Investigation); Bering Sea; and abundant at Point Barrow, Alaska, shallow water to 85 fms, G. E. MacGinitie, collector.

Lichenopora buskiana Canu and Bassler, 1928

Plate 74, figs. 1 and 2

Lichenopora buskiana Canu and Bassler, 1928:164.
Not *Unicavea Californica* d'Orbigny, 1853:972.
Lichenopora Californica, Conrad, 1855:441.
Lichenopora californica, Gabb and Horn, 1862:176.
Discoporella californica, Busk, 1875:32.
Lichenopora californica, Canu and Bassler, 1923:203.
Lichenopora buskiana, Borg, 1944:219 and 224.

The misidentification of this species with d'Orbigny's *Unicavea californica* has led to much misunderstanding; *Unicavea* was described as having only uniserial radii, "Toutes les lignees n'ont qu'une seule ligne de cellules" (d'Orbigny, 1853:970).

The zoaria are attached to algae especially, sometimes to shells, worm tubes, etc. The central frontal area is comparatively small and rounded, with large cancellae which are slightly larger than the zooecial apertures. The radiating rows of zooecial tubes are connate and biserial, except that they may begin with a single tube which sometimes is not connate, and also that rarely there may be three series near the outer ends of the radii. Near the center the tubules are unusually high and nearly erect. There are usually 8 to 12 primary radii, with shorter rays originating between these toward the margin. As a rule the rays are very regular

in form, size and arrangement, and separated by 1 or 2 rows of cancellae, often with "pin-head" spicules. The apertures of the tubules are somewhat irregular in form and about 0.06 to 0.08 mm in diameter.

The brood-chamber (ovicell) in smaller zoaria occupies only the central area, with the ooeciostome a little excentric or frequently nearer the border of the area. The ooeciopore is about as large as the zooecial apertures; the ooeciostome is erect with a short cylindrical stalk which flares, trumpet-shaped, slightly ovate, 0.13 to 0.16 mm by 0.16 to 0.20 mm in breadth at the tip. The roof of the brood-chamber is thin and perforated by numerous small pores, and above this are secondary cancellae of irregular size and form. Strong irregular raised lines often give the area a coarsely reticulated appearance.

The zoaria are often complex, with daughter colonies budding off from the sides, and these are frequently very irregular, both in shape and in the arrangement of the uniserial rays. In the daughter colonies the brood-chambers are irregularly situated, often small and situated between the series of tubules, sometimes near the margin. Even in larger simple colonies there may be small secondary brood-chambers near the margin.

The biserial rays with high peristomes, the large and irregular cancelli which frequently bear "pin-head" spicules within their apertures, and the closure of older cancelli by a thin calcified porous membrane, readily distinguish this species from any other of the Pacific coast, even in the absence of an ooeciostome.

It is a common species along the shore and about the islands of southern California, extending southward to Lower California and the Gulf of California; common also in the Pleistocene deposits of the same area; but there are only two dredging records, which indicates that it is definitely a shallow water species.

Hancock Stations: 1378-41, Catalina Island, 2 to 3 fms; 1071-40, San Felipe Bay, Gulf of California at 2½ fms.

Lichenopora novae-zelandiae (Busk), 1875

Plate 74, fig. 4

Discoporella novae-zelandiae Busk, 1875:32.
Lichenopora radiata, Robertson, 1910:262.
Lichenopora novae-zelandiae, Harmer, 1915:155 (references).

Zoarium encrusting on shells and stems; on small stems there is a very short stipe, and the margin of the basal lamina is turned upward, saucer-shaped; zoarial budding rarely occurs at the margin. The tubules

are in radiating uniserial rows, high next to the central area (often 1.0 mm or more in height), and sloping gradually to the edge, which is surrounded by a moderately broad basal lamina. Shorter rays appear between the main ones toward the margin. The tubules are connate to the tips, and slightly compressed, the apertures about 0.08 mm in diameter, the tips prolonged into points on the central side and often also on the outer side. The cancelli are extremely variable in size and form, producing an irregular network; the largest are more than twice the width of the zooecial apertures and the smallest are even less than the apertural width. There is no evidence of closure of the cancelli by an "iris" diaphragm, but instead they often become closed by a thin calcified membrane with numerous small pores like that which covers the ovicell, and this is true for some of the cancelli near the outer border beyond the brood-chambers. "Pinhead" spicules are present within the apertures of the cancelli, often in nearly every one but sometimes more rare; usually they are present slightly above the closing membrane, and it may be that these cancelli are regenerated. Between the rays there are one or two rows of cancelli. In old and more heavily calcified specimens the walls of the cancelli are thicker but not closed by an iris-like diaphragm.

The brood-chambers occupy the central area but often extend for a considerable distance into the interradial spaces; the roof consists of a thin calcified and perforated membrane and soon becomes covered with a secondary layer of cancelli. The ooeciostome is excentric in position, the tube short, the orifice round and about as large as that of a zooecial tube, the lip round or elliptical and slightly flared.

Harmer, 1915:155, includes *L. holdsworthi* under *L. novae-zelandiae;* Waters, 1918:36, reverses this and includes *novae-zelandiae* under *holdsworthi,* though the former has page priority in publication. From Busk's figures of these species, 1875, plate 30, figs. 2 and 4, there appear differences in the height of the peristomes, the mode of closure of the cancelli, and especially in the size of the central area, sufficient to warrant their separation. *L. holdsworthi* has the appearance of a *Discoporella.* The *L. holdsworthi* of Canu and Bassler, 1929, plate 88, fig. 11, has short biserial rays and probably should go elsewhere.

The species was described from New Zealand and later recorded from Australia, Ceylon and Japan. While it has not been listed from the American Pacific, our specimens conform so closely to the descriptions and illustrations of Busk and Harmer that they appear to belong to this species. Also I believe that the *L. radiata* of Robertson from southern California belongs here, and possibly that of O'Donoghue (without description) from British Columbia.

Hancock Stations: 468-35, Charles Island, Galapagos; 1399-41, Santa Catalina Island; 1242, Anacapa Island; 1002, San Clemente Island; Palos Verdes, near San Pedro, all from southern California; Acapulco Harbor, Hubbs Sta. 46-244, west coast of Mexico; and Colombia (without further data); shore to 77 fms.

Lichenopora intricata (Busk), 1856

Plate 76, figs. 5, 6, 7, 8, and 9

Defrancia intricata Busk, 1856:179.

Apparently this species has never been referred to since Busk described it. In December, 1946, Dr. E. Y. Dawson, while collecting algae at Mazatlan, Mexico, the type locality of *D. intricata,* recovered several specimens on algae. Again, in 1949, the "Velero" dredged more than 100 specimens at Magdalena Bay, on the west coast of Lower California.

These specimens conform to Busk's meager description: "Disc very irregular in form, rows of cells radiating irregularly; orifices of cells and interstitial pores of equal size. The small irregular patches appear to be constituted by the confluence of several sets of costae, with their corresponding interstices, each set radiating from a depressed central point."

The form of the encrusting complex zoaria varies to such an extent as to baffle description; adnate on algae, worm tubes, corallines, other bryozoans, etc., the largest colonies 3 cm or more in length, the margins of the zoaria sometimes extending free. The subcolonies are very numerous, more than 70 having been counted on one large zoarium, and vary in form from nearly round to very elongate-elliptical. The radii ("costae," Busk) are high, closely set, and rather regularly arranged about the low central area; in general they are uniserial, but often they are biserial next to the central area and rarely biserial for the whole length of the radii; separated by one or two rows of cancelli. The outer ends of the radii are often extended with short tubules into meandering series which break up into short, separate series or sometimes form small clumps. The subcolonies often arise in the midst of this intricate meandering series, or they may be closely associated, with the low outer ends of their radii in contact.

The central area is flat and low, even when ovicells are present. When an ovicell is present it is covered by a thin lamina and above this the secondary cancelli are large, thin-walled and irregular in form, in true *Lichenopora* fashion. The cancelli between the radii and in the central area, in the absence of ovicells, are rounded and partially closed, sug-

gesting *Disporella.* In some elongate central areas I have observed an ovicell at one end covered by the irregular cancelli, while the other end of the area, free from the ovicell, shows the rounded, partially closed cancelli. This throws some doubt on the complete validity of *Disporella,* as infertile subcolonies would undoubtedly be referred to that genus. On the complex zoaria the fertile discs are easily seen because of their irregular secondary cancelli, and I have not been able to find any evidence of ovicells in discs with the uniformly rounded cancelli.

The ovicells occupy all or a part of the central area and can often be seen through the large irregular cancelli; occasionally two ovicells are present in the same area. The ooeciostome is a short, thin-walled, erect tube, situated near the border of the central area.

Collected by Dr. E. Y. Dawson at Mazatlan, Mexico (the type locality), about 23°11′ N. Lat., shore collection, 4 zoaria, 1 on a shell fragment, the others on algae; the ones on algae are much thinner than those on solid substrata.

Hancock Station 1714-49, two miles east of Entrada Point, Magdalena Bay, west coast of Lower California, 24°32′30″N, 112°01′45″ W, at 17 fms, more than 100 complex zoaria, in a single dredge haul.

Genus **DISPORELLA** Gray, 1848

Brood-chambers, one or more, occupying interradial areas and sometimes extending over parts of the central area; cancelli thick-walled, partially closed by an "iris-like" growth of the rim toward the center but leaving always a small round aperture, never closed by a perforated flat calcified membrane; lateral zoarial budding is common. As in *Lichenopora* the functional zoids may be in radiating series, uniserial, biserial or multiserial and connate or non-connate, or they may be more or less in quincunx. Genotype, *Discopora hispida* Fleming, 1828:530.

Key to Species of *Disporella*

1. Radii uniserial or the tubules in quincunx 2
   Radii with 2 or more (2 to 4) series of tubules, sometimes arranged in short clumps 5
2. Tubules not connate, except sometimes at the base only . . . 3
   Tubules closely connate to their tips, rays longer 4

3. Peristomes slightly expanded at the tips and bearing a number (3 to 5) of long thin spines . . . . . *fimbriata*
   Peristomes not expanded at the tips, sometimes prolonged into a single process, but never fimbriated . . . . . *hispida*
4. Pores of the central cancelli larger than the tubule apertures; pin-head spicules very abundant . . . . . *californica*
   Pores of cancelli small, the walls more heavily calcified; pin-head spicules rare or wanting . . . . . *ovoidea*
5. Radii usually prominent in the form of short fascicles 2 to 4 tubules in width 6
   Radii more elongate and less prominent, with 2 to 4 rows of tubules, zoaria often very complex 8
6. Zoarium high, cylindrical, with a terminal crown of high marginal radii, the encrusting base larger than the erect stem; central, vertical budding . . . . . *astraea*
   Zoarium low, without an erect stem 7
7. Radial fascicles small and low, cancelli of central area nearly closed by a funnel-shaped diaphragm . . . . . *octoradiata*
   Fascicles larger, with more tubules, and higher; cancelli large and nearly wide open . . . . . *alaskensis*
8. Zoarium highly complex, composed of numerous lateral sub-colonies which are separated by rows of cancelli; radii moderately high, 2 to 4 rows of tubules . . . . . *separata*
   Zoarium simple; radii usually forming a low ridge of 2 to 4 series of tubules; central area ovoid and moderately large; sub-colonies superposed vertically . . . . . *stellata pacifica*

Disporella fimbriata (Busk), 1875

Plate 75, figs. 2 and 3

Discoporella fimbriata Busk, 1875:32.
Lichenopora fimbriata, Busk, 1886:26.
Disporella spinulosa Jullien, 1888:83.
Lichenopora fimbriata, Waters, 1904:96; 1905:250.
Lichenopora fimbriata, O'Donoghue, 1923:15.
Disporella fimbriata, Borg, 1944:229.

Busk's original description is as follows: "Zoarium almost conical; cells very indistinctly serial, distant; interstitial pores almost obsolete; mouth expanded, peristome fimbriated."

When the brood-chamber fills the central area the zoarium is "nearly conical," as shown in Busk's illustration (1875, Pl. 27, figs. 1 and 2), but in the absence of the chamber the area is depressed and slightly concave. The "cells" or zoids are often in short radial series of 3 or 4, but frequently are irregularly quincunical. The "interstitial pores" or cancellae are much less numerous than in other species and usually more widely separated; when young they are as large as the apertures but later become partly closed, with a small central pore. The peristomes project strongly and are somewhat flared ("mouth expanded") and fimbriated with 2 to 5 marginal spines. The basal lamina is very broad and turned upward at the edge, as shown in Busk's figure 2.

The brood-chambers, 1 to 3 or 4 in number, are prominent, usually coalesced to more or less fill the central area, but in one of our specimens the 3 chambers are distinct; there are numerous pores in the ooecial cover; the ooeciostomes situated more or less between the inner ends of the rays, the aperture about the size of those of the zoids, the tube short and very slightly flaring but without a distinct lip.

The zoaria are all small, the largest slightly over 4 mm in diameter, the peristome and ooeciostome about 0.10 mm.

Busk described the species from the southern tip of South America, Chonos Archipelago, Tierra del Fuego, Cape Horn and Chiloe, and later added Tristan da Cunha. The *Disporella spinulosa* of Jullien was dredged between the Falkland Islands and the Strait of Magellan. It has also been recorded from Australia, Tasmania, New Zealand, the Azores and Cape Verde Islands; O'Donoghue has recorded it from Round Island, British Columbia. If these identifications are all correct, the species has a very wide distribution.

Hancock collections: not dredged, but taken in low tide collecting by the writer at Palos Verdes near Los Angeles; by Miss A. E. Blagg at Pescadero Point outside of Monterey Bay; and recovered from a sunken buoy brought up from 45 fms, off Rocky Point, near Los Angeles, all from southern California.

Disporella hispida (Fleming), 1828

Plate 75, fig. 1

Discopora hispida Fleming, 1828:530.
Discoporella hispida, Busk, 1875:30.
Lichenopora hispida, Hincks, 1880:473; 1884:207.
Lichenopora hispida, O'Donoghue,1923:15; 1926:28.
Lichenopora hispida, Canu and Bassler, 1923:203.
Lichenopora hispida, Osburn, 1923:5D; 1933:18.
Disporella hispida, Borg, 1944:249.

The zoarium is usually rounded, attached more or less over the whole dorsal surface but sometimes only by a very short stipe, surrounded by a moderate bordering basal lamina which is sometimes turned slightly upward; the central part of the colony in young stages is a little depressed and with rounded cancelli which become partially closed. Adult colonies, with brood-chambers, are usually evenly rounded over the top. The tubules vary much in their arrangement, sometimes occurring in radiating uniserial rows in which, however, the tubes are not connate, or at least are free at their tips; for the most part they are irregularly quincuncial, and they are separated by rounded cancelli about as large as the apertures of the zoids, about 0.08 mm in diameter. The peristomes are a little elevated, rising on the central side into a pointed cusp which is sometimes double or tricuspidate.

The ovicells, or brood-chambers, are located at the edges of the central area and extend outward between the zooecial tubes; occasionally, when more than one is present (I have noted as many as 4) their expanded inner ends may cover the central area. The ooeciostome is situated at the edge of the central area or farther out between the tubules, short, cylindrical, with a round aperture which is somewhat larger than that of the tubules, about 0.10 mm in diameter. The chamber at first is covered by a thin, minutely perforated calcified layer, but later this may secondarily be covered with a cancellous layer.

It is a well known northern and arctic species, extending on the Pacific coast south to Lower California.

Hancock Stations: 1260-41, off San Eugenio Point, Lower California, 27°49′50″N, 115°06′05″W, the southernmost record; off Santa Catalina, Santa Barbara and San Miguel Islands, and Albatross Sta. 2938, all from southern California; from near shore to 34 fms. Also a specimen labelled "Bering Sea," with no other data.

Disporella californica (d'Orbigny), 1853

Plate 74, figs. 7, 8, and 9

Unicavea Californica d'Orbigny, 1853:972.
Not *Lichenopora californica,* Gabb and Horn, 1862:176.
Not *Discoporella californica,* Busk, 1875:32.
Not *Lichenopora californica,* Waters, 1889:282.
Not *Lichenopora californica,* Robertson, 1910:261.
Lichenopora californica, Borg, 1944:219.

D'Orbigny's description, without illustration, reads: "Espèce très-convexe en dessus, ayant le centre excavé, et pourvue de pores intermédiares énormes. Madelaine, Basse-Californie."

The *californica* of d'Orbigny was placed by him in the genus *Unicavea,* which indicates that his species has uniserial rays. On the other hand the *californica* of Busk, Gabb and Horn, Waters, and Robertson is definitely stated to have biserial or triserial rays and has been redescribed as *Lichenopora buskiana* by Canu and Bassler, 1928:164. The description of the zoarial form by d'Orbigny might apply to numerous species, but his final statement of the large size of the cancelli is more definite and is an exact statement of their nature. In older colonies the cancelli become partially closed by an "iris-like" thickening of the internal wall, but the outlines of the large pores are evident in the raised separating ridges. Moreover, the species is common in the area where d'Orbigny obtained his material, Lower California, and we are fortunate to have ten specimens from three stations in Santa Maria Bay and Magdalena (Madelaine) Bay, that is, in the type locality of *californica.* It appears very probable, therefore, that after a century d'Orbigny's species has been resurrected.

The zoaria are round, low dome-shaped with the central area flat or somewhat depressed in the young. The colonies are all small, not over 4 mm in width, the central area one-fourth to one-third as wide as the zoarium; the radiating rows of tubules are all definitely uniserial, about 10 primary rows with shorter ones between them toward the margin. The peristomes are only moderately elevated, slightly higher toward the central area, connate to their tips which usually are truncate but sometimes are extended into short points on their distal borders; the apertures are slightly elongated in the direction of the rays, about 0.10 mm long by 0.08 mm wide. The cancelli of the central area are noticeably larger than the tubules, the apertures round and as much as 0.13 mm in diameter, partially closed by the characteristic "iris" diaphragm; the pin-head spicules are abundant. Between the rays there are two rows of cancelli, occasionally only one, which are somewhat smaller than at the center.

The brood-chambers are interradial or extending somewhat into the central area, the roof a thin calcified membrane with minute pores, later covered by secondary cancelli of the usual type. The ooeciostome is short, round, thin-walled and a little larger than the zooecial apertures.

There is a peculiar type of zoarial budding which I have not seen described and which I have observed in only one other species, *D. alaskensis* new species, described in this report. The sub-colonies arise on the frontal side toward the margin but do not extend beyond it and in the three colonies at hand they are exactly similar in origin. When I

first observed one of these I thought it might be a monstrosity or perhaps due to the attachment of an ancestrula, but the discovery of three similar triple colonies and a very young bud on another proves it to be a normal process. The sub-colonies are short stipitate with their borders and most of the dorsal side entirely free. Thus they have some resemblance to d'Orbigny's "genus" *Tecticavea,* except that the sub-colonies arise near the margin and are not superposed on the central area. In each case the first sub-colony bears another similar to it but smaller. They present the same characters as the primary one, with uniserial radii, large central cancelli, moderately low connate peristomes and inter-radial brood-chambers.

Hancock Stations: 279-34, Santa Maria Bay, Lower California, 24°44′45″N, 112°15′20″W, and 1714-49 and 2180, Magdalena Bay, the type locality of *californica* d'Orbigny, 10 to 18 fms. Also at 1242, Anacapa Island, and 1662-48, Santa Cruz Island, southern California; 1889-49, Cortez Bank at the United States-Mexican boundary; 275, Raza Island, 675-37, Carmen Island, and 1044-40, Tiburon Island, Gulf of California; and 468-35, Port Parker, Costa Rica. Depth 5 to 77 fms. Also 3 colonies from Tobago Island, Panama, each consisting of several sub-colonies, Helen Hoyt, collector.

Disporella ovoidea new species

Plate 75, figs. 4 and 5

Lichenopora radiata, Canu and Bassler, 1928:163; 1930:56.
Lichenopora radiata, Osburn, 1940:334; 1947:6.

Zoarium more or less ovate, in older stages becoming low dome-shaped; the central area large, distinctly elongate, ovoid to elliptical, much depressed in the young but thick and elevated nearly to the tips of the zooecial tubes in older colonies; 3 to 5 mm in the longest dimension. The zoids are in very definite uniserial rays, the longest ray noted having 7 zoids. The tubes are moderately short and are connate to their tips, which are without spinous projections or notches; the apertures elongated in the direction of the rays, averaging 0.07 mm wide by 0.10 mm long, those at the outer ends of the rays usually larger than those near the central area. The cancelli are large, about twice the size of the zooecial apertures, but very soon become partially closed by an iris-like diaphragm so that their apertures are funnel-shaped and surrounded by hexagonal separating ridges. "Pin-head" spicules are sometimes present.

I have not been able to determine the nature of the primary brood-chambers near the central area, but the secondary chambers near the border are covered in the usual manner by a calcified porous membrane; here they lie between the rays, in some cases extending on both sides of a short secondary ray. They are soon covered by secondary cancelli. The ooeciostome is hardly distinguishable from the cancelli in height and size, but the orifice is wide open, rounded and its wall thin.

I must agree with Borg (1944:223) that the *L. radiata* of Canu and Bassler (1928:163 and plate 29, figs. 1-2) from north of Cuba, and those of Osburn (1940:334) from Porto Rico, cannot be identified with *Discoporella radiata* of Waters (1879:276) from the Bay of Naples, nor with the *Melobesia radiata* of Audouin (1826:235). Waters states: "In most specimens the cancelli appear open; but in well-preserved ones a delicate calcareous cover is found covering the aperture: and this is perforated with about 2-10 holes," which is clearly shown in his plate 24, fig. 11a. The figures of *Melobesia radiata* Audouin show a round zoarium with a small round central area; a central brood-chamber covered by a calcareous porous membrane and with lobes extending between radii; the radii high, elongate and uniserial, the tubes connate to the tips and ending in sharp points. Apparently there is no other species recorded from the Mediterranean or Red Seas with which Waters could have confused his *D. radiata,* and we must conclude that it is Audouin's *M. radiata* and is a *Lichenopora* in the strict sense.

On the other hand, the *L. radiata* of Canu and Bassler and of Osburn, from the West Indies, has an ovate or rounded zoarium with a large ovate central area; the cancelli thick-walled and without a covering calcified membrane; the brood-chambers not centrally located; the uniserial connate radii much less elevated. These West Indian specimens appear to conform in every particular with *Disporella ovoidea,* as described above, and it is probable that Canu and Bassler's reference to *L. radiata* from the Galapagos Islands is also to the same species, since Dr. Bassler informs me *(in litt.)* that it has "a large, slightly elongate central area, with the cancelli and rows of tubules as in the Cuban one." How many other references to *radiata* are untenable it is impossible to say, as it has often been recorded without description or figures, but it seems safe to state that it has not been found on the Pacific coast of the Americas.

Our material consists of 4 colonies, 2 from the Galapagos Islands, 1 from Colombia and 1 from southern California, a wide distribution to be sure, but they all agree in the elongate form of the central area, the

short uniserial connate rays, the size and form of the zooecial apertures, and the size, form and nature of the closure of the cancelli. It is very different from any other Eastern Pacific species, but it may represent some of the too numerous lichenoporid species that have been inadequately described from all around the world.

Type, AHF no. 126.

Type locality, Hancock Station 432, Tagus Cove, Albemarle Island, Galapagos, 80 to 100 fms, two colonies, with ovicells. Also 1662-48, Santa Cruz Island, 33°55′45″N, 119°32′30″W, southern California, 23 fms; and one colony from Colombia without further data.

Disporella alaskensis new species

Plate 75, figs. 7 and 8

The zoarium is round, 3 mm in diameter, high at the central area, the broad cancellated thin border turned up all around, shaped like a miniature Mexican straw hat; attached over most of the dorsal surface. The radii are multiserial (2 to 4), consisting of elevated ovoid clumps which are regularly arranged about the central area. The outer ends of the radii descend sharply to the thin bordering lamella. In our two specimens, the smaller has 4 radii with 2 developing between these at the edges, the larger has 8 rays with several smaller incomplete ones. The tubules are completely connate to their tips, which are not extended into points, the apertures rounded or slightly hexagonal and about 0.10 mm in diameter.

The central area is moderate in size, short-ovate in form, with large rounded cancelli (0.13 mm) and the cancelli of the bordering area are of the same size and form (occasional smaller ones are present on the central area and between the radii); there are 2 to 4 rows of cancelli between the radii. Small pinhead spicules are present. There is very little closure of the cancelli of the central area, just enough to suggest an "iris-like" diaphragm, and the bordering cancelli are wide open.

A small sub-colony is present on the front, situated at the outer end of one of the rays and well within from the border; this has the same form, with edge strongly turned up and the tubules and cancelli similar to those of the primary colony.

The ovicell is interradial, extending somewhat into the central area and covered by a thin membrane with minute pores. Unfortunately the ooeciostome is broken away.

Type, U. S. Nat. Mus. no. 11052.

Type locality, Stepovak Island, Alaska, Alaska Crab Investigation, Sta. 84-40, 15 fms. Another colony, the older one, is from Cleveland Passage, Alaska, 10 fms, W. Williams, collector.

The older colony differs from the type specimen only in the larger number and greater prominence of the radii and in the absence of an ovicell.

Disporella stellata var. **pacifica,** new variety

Plate 76, fig. 10

Defrancia stellata Reuss, 1847:37.

Defrancia stellata, Canu and Bassler, 1930:57.

Defrancia Bronn, 1825, is considered synonymous with *Apsendesia* Lamouroux, 1821, by Bassler, 1935:48.

Canu and Bassler, 1930:57 and Plate 14, figs. 7-12, described a specimen of this Miocene form as *Defrancia stellata,* from the Galapagos Islands. As they remark, "It is quite remarkable to rediscover in the recent seas this European fossil." However, the measurements agree with those of the fossils and the specimen photographed (fig. 9) corresponds in a remarkable way to the figures of the fossil specimens shown beside it. It is possible that a species may have continued to live from Miocene time and be distributed half way round the world, but the chances are very much against it. Since we know nothing of the ovicells of *stellata,* it seems better to give the recent form at least a varietal name, pending the discovery of the ovicells of *stellata.*

From the Hancock dredgings at the Galapagos Islands 12 specimens have been recovered from 4 different stations, similar to that discussed by Canu and Bassler, but bearing ovicells which are definitely those of a *Disporella.*

The zoaria are attached to corallines; discoid in form, thick, with a narrowly extending basal lamina; the central area large, nearly flat, round or ovate in form, and the radii on the slope of the zoarium; the colonies are of moderate size, from 2 to 4 mm in diameter. The radii are multiserial with 2 to 4 (usually 3) series of tubules which are closely connate to their tips, and which form elevated ridges separated by 2 to 4 rows of cancelli. The apertures measure 0.08 mm in diameter and the cancelli 0.08 to 0.10 mm, depending on the amount of closure.

Vertical budding appears to be a constant character, as even the smallest colonies have at least one sub-colony superimposed and arising near the center of the frontal area; as many as 3 sub-colonies are present in one specimen, vertically arranged. In one specimen a second bud is present at the edge of the central area, indicating the beginning of a

branched colony. In another case what appears to be lateral budding involves 3 colonies (or sub-colonies); these might have been produced by the fusion of separate colonies, but if so there is no definite line of demarcation.

The ovicells or brood-chambers, shown at or near the surface in two of our specimens, are either at the edge of the central area and extending between the rays or are farther out and entirely interradial or both; they show the calcified bottom layer, which covers the submerged cancelli, and the minutely perforated roofing layer. The roof of the ovicell is again closed by secondary cancelli of the usual type.

The ovicells appear to place this form definitely in *Disporella,* and the character of the cancelli with thick walls (though they are but little closed) also suggests this disposition. At the same time, the normal vertical arrangement of the sub-colonies indicates *Lichenopora* but, as has been shown above, this character does not appear to have positive generic importance.

Recorded by Canu and Bassler at Albatross Station D. 2815, Galapagos Islands.

Type, AHF no. 127.

Type locality, Hancock Station 143-34, Wenman Island, Galapagos, 1°23′10″N, 91°48′45″W, 100-150 fms.

Also at Hancock Stations: Galapagos Islands, 155-34, Albemarle Island; 453, Gardner Island, and 454, Hood Island; 30 to over 100 fms.

Disporella separata new species

Plate 74, figs. 5 and 6

Zoarium a very complex colony of the kind known as *Radiopora* by d'Orbigny, Busk, etc. It consists of about 30 sub-colonies rather regularly arranged over a rounded area about 15 to 20 mm, attached loosely and spreading over the surface of a small dead barnacle and the shell to which the barnacle is attached; most of the basal lamina is free. The sub-colonies are all well separated from each other by a few rows of cancelli and are quite regular in size and form; the discs are short-ovate, about 2.5 by 2 mm in diameter, with the radii varying in number from 8 to 12. The rays consist of small ovate clusters of peristomes, biserial or triserial, which often become uniserial at the outer end; not infrequently uniserial rays are present, and sometimes these may become biserial at the outer ends; while the triserial cluster appears to be the dominant form, all of these variations may be found on a single sub-colony and on any part of the complex zoarium. The peristomes are

moderately high near the center and become gradually shorter outward, connate to their tips, which form a single acuminate spine at the point of junction; the apertures about 0.10 by 0.08 mm.

The central area is concave in younger stages to nearly flat in older sub-colonies, elliptical in outline; the cancelli about as large as the apertures of the tubules, partially closed by an "iris-like" diaphragm with a large central pore. The interradial and intercolonial cancelli do not differ from those of the central area, except that they vary more in size and the amount of closure.

The ovicells are interradial and covered by a layer of secondary cancelli, and the ooeciostome is short, thin-walled, round, without a flaring border, barely elevated above the level of the cancelli, and measures 0.08 mm in diameter.

Young marginal sub-colonies develop near the border along with the proliferation of the lamina after 3 or 4 rows of cancelli are formed. There are several such incomplete discs at the edge of the zoarium, with the first few radii outlined on the side toward the center of the zoarium.

This species belongs to the *"Radiopora"* group in which the sub-colonies are distinct (the discs not confluent) and their discs similar to that of the primary colony (see Waters, 1918, plate 4, figs. 1-4), but appears to be different from any of the recent *"Radiopora"* species described, *Discopora meandrina* Peach, *Radiopora irregularis* J. Y. Johnson, *Discoporella pristis* MacGillivray, and *Lichenopora bullata* and *L. magnifica MacGillivray.*

Type, AHF no. 128.

Type locality, Hancock Station 1889-49, Cortez Bank, west of the United States-Mexican boundary, 32°27′05″N, 119°08′04″W, at 15 to 20 fms.

? Disporella octoradiata (Waters), 1904

Plate 75, fig. 6

Lichenopora octoradiata Waters, 1904:97.

Disporella (?) *octoradiata,* Borg, 1944:257.

Waters' description is as follows: "The zoarium is very solid and much raised, with the base narrower than the disk. There are a number of biserial rays, formed by a few zooecia, and in a well developed colony there are 8 main rays, with indications of the commencement of another series. The rays do not extend to the border of the zoarium, nor are the zooecia around the border of the disk elevated, while in the center of the zoarium the openings are round and vary in size." As far as it goes this is as fairly complete a description of our two young specimens as could be wished. The radii are regularly arranged in a short-elliptical

form around the central area, and vary in size from 2 to 6 tubules, considerably elevated above the central area which is somewhat concave. The zooecial apartures measure 0.10 mm in diameter. The larger cancelli are of about the same size, but most of those in the central area are partially closed, with a smaller rounded central pore; there are usually two rows of cancelli between the radii. The zoids around the border are not at all elevated and in most cases are indistinguishable from the cancelli. There is a narrow basal lamina.

The zoaria are evidently young, as there are no ovicells, and there is a question whether the species is the same as *L. octoradiata* Waters. The nature of the closure of the cancelli appears to relate it to *Disporella* rather than to *Lichenopora.*

Waters described the species from 71°09′ S. Lat., 89°15′ W. Long., and Borg recorded it questionably from 63°57′S, 61°50′W; both of these records are from the area between South America and Antarctica.

Hancock Station 481, Cartago Bay, Albemarle Island, Galapagos, at 12 fms, two colonies.

Disporella astraea, new species

Plate 76, figs. 1 and 2

Zoarium encrusting with a broad base and rising by vertical budding into a short cylindrical stalk which, with the radiating fascicles, gives the appearance of a minute Astraeid coral. The central area is flat with numerous thick-walled and rather wide open round cancelli, which extend between the rays in two or three rows. The flat top is surrounded by a ring of 10 high, short fascicles. The fascicles are groups composed of 4 to about 10 zooecial tubes which are all closely connate, their apertures about 0.07 mm in diameter; the apertures of the cancelli are about the same size, occasionally larger. The encrusting base is 2 mm in width; the primary zoarium arising from it 1.30 mm wide and about 0.60 mm high; the secondary zoarium or vertical bud is 1.10 mm in diameter and about 0.80 mm high.

There is no evidence of an ovicell, and therefore the disposition of the species in *Disporella* is questionable and based merely on zoarial characters.

Type, AHF no. 129.

Type locality, Hancock Station 451, off Post Office Bay, Charles Island, Galapagos, at 100 fms, one colony. Another somewhat smaller colony at Station 461, off Tagus Cove, Albemarle Island, Galapagos, at 80 fms; this specimen has 9 slightly smaller and higher fascicles, but otherwise is similar.

REFERENCES

1. Papers dealing only with Pacific Coast Bryozoa

Busk, G.

1856. Zoophytology. Quart. Jour. Micros. Sci. vol. 4, pp. 176-180, pls. 7-8.

Canu, F. and R. S. Bassler

1930. The Bryozoan Fauna of the Galapagos Islands. Proc. U. S. Natl. Mus. vol. 76 (13), pp. 1-78, pls. 1-14.

Hincks, T.

1884. Report on the Polyzoa of the Queen Charlotte Islands. Ann. and Mag. Nat. Hist. ser. 5, vol. 13, pp. 203-215.

O'Donoghue, C. H. and Elsie O'Donoghue

1923. A Preliminary List of Bryozoa (Polyzoa) from the Vancouver Island Region. Contr. Canad. Biol. Fish. new ser., vol. 1, pp. 143-201 (1-59), pls. 1-4.

1925. List of Bryozoa from the Vicinity of Puget Sound. Wash. [State] Univ. Puget Sound Biol. Sta. Pubs. vol. 5, pp. 91-108.

1926. A Second List of the Bryozoa (Polyzoa) from the Vancouver Island Region. Contr. Canad. Biol. Fish. new ser., vol. 3, pp. 49-131 (1-85), pls. 1-5.

Robertson, Alice

1900. Papers from the Harriman Alaska Expedition. VI. The Bryozoa. Proc. Wash. Acad. Sci. vol. 2, pp. 315-340, pls. 19-21.

1910. The Cyclostomatous Bryozoa of the West Coast of North America. Calif. Univ. Pubs. Zool. vol. 6, pp. 225-284, pls. 18-25.

Trask, J. B.

1857. On some new Microscopic Organisms. Proc. Calif. Acad. Sci. vol. 1 (ed. 2, 1873), pp. 110-115, pls. 4-5.

2. General References

Audouin, V.

1826. Explication sommaire des Planches de Polypes de l'Égypte et de la Syrie. *In* Description de l'Égypte (Savigny). Histoire Naturelle. vol. 1 (4), pp. 225-244.

Bassler, R. S.

1935. Bryozoa. Fossilium Catalogus. I. Animalia. Berlin. pars 67, pp. 1-229.

Blainville, H. M. de

1830. Dictionnaire des Sciences Naturelles. Strasbourg, Paris. vol. 60, pp. 1-631.

Borg, F.

1926. Studies on recent Cyclostomatous Bryozoa. Zool. Bidr. Uppsala. vol. 10, pp. 181-507, pls. 1-14.

1933. A Revision of the Recent Heteroporidae (Bryozoa). Zool. Bidr. Uppsala. vol. 14, pp. 253-394, pls. 1-14.

1944. The Stenolaematous Bryozoa. *In* Further Zoological Results of the Swedish Antarctic Expedition 1901-1903. Stockholm. vol. 3 (5), pp. 1-276, pls. 1-16.

BUSK, G.

1861. Description of New Polyzoa, collected by J. Y. Johnson, Esq., at Madeira, in the years 1859 and 1860. Quart. Jour. Micros. Sci. new ser., vol. 1, pp 77-80, pls. 32-33.

1875. Catalogue of Marine Polyzoa in the Collection of the British Museum. Part 3, Cyclostomata. London. pp. 1-41.

1876. Descriptions of some new species of Polyzoa from Kerguelen's Island. Ann. and Mag. Nat. Hist. ser. 4, vol. 17, pp. 116-118.

1879. An Account of the Petrological, Botanical, and Zoological Collections made in Kerguelen's Land and Rodriguez during the Transit of Venus expedition . . . in the years 1874-75. Zoology. Polyzoa. Phil. Trans. Roy. Soc. London. vol. 168, pp. 193-199, pl. 10.

1886. Report on the Polyzoa collected by H. M. S. Challenger during the years 1873-1876. Part II.—The Cyclostomata, Ctenostomata, and Pedicellinea. *In* Report on the Scientific Results of the Voyage of H. M. S. Challenger during the years 1873-76. Zoology. vol. 17 (3), pp. 1-29.

CALVET, L.

1903. (see Jullien and Calvet)

1907. Bryozoaires (Travailleur and Talisman Expeditions). *In* Expéditions scientifiques du "Travailleur" et du "Talisman" pendant les années 1880, 1881, 1882, 1883. vol. 8, pp. 355-495, pls. 26-30.

1911. Diagnoses de quelques espèces nouvelles de Bryozoaires Cyclostomes, provenant des Campagnes scientifiques accomplies par S. A. S. le Prince de Monaco, à bord de la *Princesse-Alice* (1889-1910). Bul. Inst. Océan. Monaco. no. 215, pp. 1-9.

CANU, F.

1918. Les Ovicelles des Bryozoaires Cyclostomes. Études sur quelques familles nouvelles et anciennes. Bul. Soc. Géol. France. ser. 4, vol. 16, pp. 324-335, pl. 9.

1918a. Études sur les Ovicelles des Bryozoaires Cyclostomes (2e contribution). Bul. Soc. Géol. France. ser. 4, vol. 17, pp. 345-347, pl. 10.

CANU, F. and R. S. BASSLER

1920. North American Early Tertiary Bryozoa. U. S. Natl. Mus. Bul. 106. 2v.

1922. Studies on the Cyclostomatous Bryozoa. Proc. U. S. Natl. Mus. vol. 61 (22), pp. 1-160, pls. 1-28.

1923. North American Later Tertiary and Quaternary Bryozoa. U. S. Natl. Mus. Bul. 125, pp. 1-244, pls. 1-47.

1927-1928. Bryozoaires des Iles Hawai. Bul. Soc. Sci. Seine-et-Oise. ser. 2, vol. 8 (7), pp. 1-32, pls. 1-5, 1927; pp. 33-56, pls. 6-11, 1928.

1928. Fossil and Recent Bryozoa of the Gulf of Mexico Region. Proc. U. S. Natl. Mus. vol. 72 (14), pp. 1-199, pls. 1-34.

1929. Bryozoa of the Philippine Region. U. S. Natl. Mus. Bul. 100, vol. 9, pp. 1-567, pls. 1-94.

1930. The Bryozoan Fauna of the Galapagos Islands. Proc. U. S. Natl. Mus. vol. 76 (13), pp. 1-78, pls. 1-14.

CONRAD, T. A.

1855. Note on the Miocene and Post-Pliocene deposits of California, with descriptions of two new Fossil corals. Proc. Acad. Nat. Sci. Phila. vol. 7, 1856, p. 441.

DEFRANCE, M.

1823. Dictionnaire des Sciences Naturelles. Strasbourg, Paris. vol. 26, pp. 1-555.

FABRICIUS, O.
1780. Bryozoa confused with other groups. *In his* Fauna Groenlandica. Hafniae et Lipsiae. pp. 428-448.

FLEMING, J.
1828. A History of British Animals. Edinburgh, London. pp. xxiii, 565.

GABB, W. M. and G. H. HORN
1862. Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America. Jour. Acad. Nat. Sci. Phila. vol. 5 (2), pp. 111-179.

GRAY, J. E.
1848. Bryozoa. *In his* List of the specimens of British Animals in the collection of the British Museum. Part 1, Centroniae or Radiated Animals. London. pp. 91-151.

GREGORY, J. W.
1899. Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum. The Cretaceous Bryozoa. London. vol. 1, pp. 1-457, pls. 1-17.

HARMER, S. F.
1891. On the British Species of Crisia. Quart. Jour. Micros. Sci. new ser., vol. 32, pp. 127-181, pl. 12.
1899. On the Development of Tubulipora, and on some British and Northern species of this Genus. Quart. Jour. Micros. Sci. new ser., vol. 41, pp. 73-157, pls. 8-10.
1915. The Polyzoa of the Siboga Expedition. Part 1, Entoprocta, Ctenostomata and Cyclostomata. *In* Siboga-Expeditie. Leyden. Mon. 28a, pp. 1-180, pls. 1-12.

HASSALL, A. H.
1841. Supplement to a Catalogue of Irish Zoophytes. Ann. and Mag. Nat. Hist. vol. 7, pp. 276-287, 363-373, pls. 6-10.

HELLER, C.
1867. Die Bryozoën des adriatischen Meeres. Verhandl. Zool.-Bot. Gesell. Wien. vol. 17, pp. 77-136, pls. 1-6.

HINCKS, T.
1871. Supplement to a "Catalogue of the Zoophytes of South Devon and South Cornwall," with Descriptions of New Species. Ann. and Mag. Nat. Hist. ser. 4, vol. 8, pp. 73-83.
1880. A History of the British Marine Polyzoa. London. 2v.

JOHNSON, J. Y.
1897. New Cyclostomatous Bryozoa found at Madeira. Ann. and Mag. Nat. Hist. ser. 6, vol. 20, pp. 60-65.

JOHNSTON, G.
1838. A History of the British Zoophytes. London, Edinburgh. pp. 341, 44 pls.
1847. *Idem.* (ed. 2) London. 2v.

JULLIEN, J.
1888. Bryozoaires. *In* Mission Scientifique du Cap Horn, 1882-3. Paris. vol. 6, pp. 1-92, pls. 1-15.

JULLIEN, J. and L. CALVET
1903. Bryozoaires provenant des campagnes de l'Hirondelle (1886-1888). *In* Résultats des Campagnes scientifiques accomplies sur son yacht par Albert 1er, prince de Monaco. Monaco. fasc. 23, pp. 1-120 by Jullien; 121-188 by Calvet; pls. 1-18.

LAMARCK, J. B. P. A. DE

1816. Histoire naturelle des animaux sans vertèbres. Paris. vol. 2, pp. 1-568.

LAMOUROUX, J. V.

1812. Sur la classification des Polypiers coralligènes non entièrement pierreux. Nouv. Bul. Soc. Philom. vol. 3, pp. 181-188.

1821. Exposition méthodique des genres de l'ordre des Polypiers. Paris. viii, 115p., 84 pls.

LINNAEUS, C.

1758. Zoophyta. *In his* Systema natura, ed. 10. Holmiae. vol. 1, pp. 799-821.

MACGILLIVRAY, P. H.

1868. Descriptions of some new Genera and Species of Australian Polyzoa; to which is added a List of Species found in Victoria. Trans. and Proc. Roy. Soc. Victoria. vol. 9, 1869, pp. 126-148.

1885. Descriptions of New, or Little Known, Polyzoa. Part VII. Trans. and Proc. Roy. Soc. Victoria. vol. 21, pp. 92-99, pls. 1-3.

1887. A Catalogue of the Marine Polyzoa of Victoria. Trans. and Proc. Roy. Soc. Victoria. vol. 23, pp. 187-224.

1895. A monograph of the Tertiary Polyzoa of Victoria. Trans. Roy. Soc. Victoria. vol. 4, pp. 1-166, pls. 1-22.

MARCUS, E.

1937. Bryozoarios Marinhos Brasileiros I. São Paulo Univ. Bol. Faculd. Filos. Cien. Letr. vol. 1 (Zool. 1), pp. 1-224, pls. 1-29.

1939. *Idem* III, *ibid.* vol. 13 (Zool. 3), pp. 111-299, pls. 5-31.

1941. Bryozoarios Marinhos do Litoral Paranaense. Arq. Mus. Paranaense. vol. 1 (1), pp. 7-36, 2 pls.

MICHELIN, H.

1840-47. Iconographie Zoophytologique, description . . . des polypiers fossiles de France. Paris. 348p., 79 pls.

MILNE-EDWARDS, H.

1838. Mémoire sur les Crisies, les Hornères et plusieurs autres Polypes vivans ou fossiles dont l'organisation est analogue à celle des Tubulipores. Ann. Sci. Nat. Zool. ser. 2, vol. 9, pp. 193-238.

NORMAN, A. M.

1864. On undescribed British Hydrozoa, Actinozoa, and Polyzoa. Ann. and Mag. Nat. Hist. ser. 3, vol. 13, pp. 82-90.

1868. Shetland Final Dredging Report.—Part II. On the Crustacea, Tunicata, Polyzoa, Echinodermata, Actinozoa, Hydrozoa, and Porifera. Class Polyzoa. Rpt. Brit. Assoc. Adv. Sci. 38th meeting, 1869, pp. 303-312.

1894. A month on the Trondhjem Fiord. Ann. and Mag. Nat. Hist. ser. 6, vol. 13, pp. 112-133, pls. 6-7.

1903. Notes on the Natural History of East Finmark. Ann. and Mag. Nat. Hist. ser. 7, vol. 11, pp. 567-598, pl. 13.

1909. The Polyzoa of Madeira and neighbouring Islands. Jour. Linn. Soc. London. Zool. vol. 30, pp. 275-314, pls. 33-42.

OKADA, Y.

1917. A Report on the Cyclostomatous Bryozoa of Japan. Annot. Zool. Jap. vol. 9, pp. 335-360.

1928. Report of the Biological Survey of Mutsu Bay. 8, Cyclostomatous Bryozoa of Mutsu Bay. Sci. Rpts. Tohoku Imp. Univ. ser. 4, vol. 3, pp. 481-496.

ORBIGNY, A. D'

1839-47. Zoophytes. *In* Voyage dans l'Amérique Méridionale . . . exécuté pendant les années 1826, 1827, 1828, 1829, 1830, 1831, 1832 et 1833. Paris. vol. 5 (4), pp. 1-28.

1851-54. Paléontologie Française. Terrains Crétacés. Paris. vol. 5, pp. 1-1191.

ORTMANN, A. E.

1890. Die Japanische Bryozoenfauna. Arch. f. Naturgesch. vol. 66 (1), pp. 1-74.

OSBURN, R. C.

1912. The Bryozoa of the Woods Hole Region. Bul. U. S. Bur. Fisheries. vol. 30, pp. 205-266, pls. 18-31.

1912a. Bryozoa from Labrador, Newfoundland, and Nova Scotia, collected by Dr. Owen Bryant. Proc. U. S. Natl. Mus. vol. 43, pp. 275-289.

1914. The Bryozoa of the Tortugas Islands, Florida. Carnegie Inst. Wash. Dept. Mar. Biol. Papers. vol. 5 (publ. 182), pp. 181-222.

1923. Bryozoa. *In* Report of the Canadian Arctic Expedition 1913-1918. Ottawa. vol. 8 (D), pp. 1-13.

1933. Bryozoa of the Mount Desert Region. Repr. from the Biological Survey of the Mount Desert Region. Philadelphia. 67p., 15 pls.

1936. Bryozoa collected in the American Arctic by Captain R. A. Bartlett. Jour. Wash. Acad. Sci. vol. 26, pp. 538-543.

1940. Bryozoa of Porto Rico with a Résumé of the West Indian Bryozoan Fauna. *In* Scientific Survey of Porto Rico and the Virgin Islands. New York. vol. 16 (3), pp. 321-486, pls. 1-9.

1947. Bryozoa of the Allan Hancock Atlantic Expedition. Rpt. Allan Hancock Atlantic Expedition. no. 5, pp. 1-66, pls. 1-6.

POURTALES, L. F. DE

1867. Contributions to the Fauna of the Gulf Stream at great depths. Harvard Univ. Bul. Mus. Compar. Zool. vol. 1, pp. 106, 110, 111.

REUSS, A. E. VON

1847. Die fossilen Polyparien des Wiener Tertiärbeckens. Naturwissen. Abhandl. vol. 2, 1848, pp. 1-109.

RIDLEY, S. O.

1881. Polyzoa in the Zool. Coll. H. M. S. "Alert." Proc. Zool. Soc. London. pp. 44-61, pl. 6.

ROBERTSON, ALICE

1903. Embryology and embryonic fission in the genus Crisia. Calif. Univ. Pubs. Zool. vol. 1, pp. 115-156, pls. 12-15.

SAKAKURA, K.

1935. Pliocene and Pleistocene Bryozoa from the Bôsô Peninsula. (I) 1. Bryozoa of the Dizôdô Beds. Tokyo Univ. Facult. Sci. Jour. Sect. 2. Geol. vol. 4, pp. 1-48, pls. 1-7.

SMITT, F. A.

1865. Kritisk förteckning öfver Skandinaviens Hafs-Bryozoer. Öfversigt af Svenska Vetensk. Akad. Förhandl. vol. 22, pp. 115-142, pl. 16.

1866. *Idem, ibid.* vol. 23, pp. 395-533, pls. 3-13.

1871. *Idem, ibid.* vol. 28, pp. 1115-1134.

1872. Floridan Bryozoa, collected by Count L. F. de Pourtales. Part I. Svenska Vetensk. Akad. Handl. vol. 10 (11), pp. 1-20, pls. 1-5.

STIMPSON, W.

1853. Bryozoa. *In his* Synopsis of the marine invertebrata of Grand Manan: or the region about the mouth of the Bay of Fundy, New Brunswick. Smithson. Contr. Knowledge. vol. 6 (5), pp. 17-19.

VERRILL, A. E.

1879. Preliminary Check-list of the Marine Invertebrata of the Atlantic Coast, from Cape Cod to the Gulf of St. Lawrence. New Haven, Conn. pp. 28-31.

WATERS, A. W.

1879. On the Bryozoa (Polyzoa) of the Bay of Naples. Ann. and Mag. Nat. Hist. ser. 5, vol. 3, pp. 28-43, 114-126, 192-202, 267-281, pls. 8-15, 23-24.

1887. Bryozoa from New South Wales, North Australia, etc. Ann. and Mag. Nat. Hist. ser. 5, vol. 20, pp. 253-265, pl. 7.

1889. On the Ovicells of some Lichenoporae. Jour. Linn. Soc. London. Zool. vol. 20, 1890, pp. 280-285.

1904. Bryozoa. *In* Résultats du Voyage du S. Y. Belgica en 1897-1899. Rapports scientifiques. Zoologie. Anvers. pp. 1-114, pls. 1-9.

1904a. Bryozoa from Franz-Josef Land, collected by the Jackson-Harmsworth Expedition, 1896-1897. Jour. Linn. Soc. London. Zoology. vol. 29, pp. 161-184, pls. 19-21.

1905. Bryozoa from near Cape Horn. Jour. Linn. Soc. London. Zool. vol. 29, pp. 230-251.

1910. Reports on the Marine Biology of the Sudanese Red Sea, xii. Jour. Linn. Soc. London. Zool. vol. 31, pp. 231-256, pls. 24-25.

1914. The marine fauna of British East Africa and Zanzibar, from collections made by Cyril Crossland . . . in the years 1901-1902. Bryozoa —Cyclostomata, Ctenostomata and Endoprocta. Proc. Zool. Soc. London. pp. 831-858, pls. 1-4.

1918. Some Collections of the Littoral Marine Fauna of the Cape Verde Islands, made by Cyril Crossland . . . in the Summer of 1904.— Bryozoa. Jour. Linn. Soc. London. Zool. vol. 34, pp. 1-45, pls. 1-4.

WHITEAVES, J. F.

1874. On recent Deep-sea Dredging operations in the Gulf of St. Lawrence. Amer. Jour. Sci. ser. 3, vol. 7, pp. 210-219.

1882. On a recent species of Heteropora from the Strait of Juan de Fuca. Amer. Jour. Sci. ser. 3, vol. 24, pp. 279-280.

1901. Catalogue of the marine invertebrata of eastern Canada. Rpt. Geol. Surv. Canada [sep. pubn.] Polyzoa. pp. 91-114.

WOOD, S. V.

1844. Descriptive Catalogue of the Zoophytes from the Crag. Ann. and Mag. Nat. Hist. vol. 13, pp. 10-21.

Order ECTOPROCTA

Suborder CTENOSTOMATA

By RAYMOND C. OSBURN, PH.D., D.Sc. and JOHN D. SOULE, PH.D.

This taxonomic report on the Pacific Coast Ctenostomata was prepared by Dr. Soule under the immediate direction of the senior author. The work was done in connection with a study of postlarval development and histogenesis and the bearing of the results on the classification of this group. The data on which the taxonomic changes are based will be published elsewhere and bear the full approval of the senior author. The new species which have appeared during the progress of the work are all to be credited to the careful work of Dr. Soule.

R. C. O.

Sub-Order CTENOSTOMATA Busk, 1852

The chitinous zoaria may be incrusting, erect, stolonate or burrowing. The zooecial aperture is essentially simple, being closed by the inversion of the tentacle sheath on retraction of the polypide. In some genera specialized apertures are present, including those that are bilabiate, produced or even operculate. The operculum present in one genus of burrowing ctenostomes is analogous to the opercula of the cheilostomes. No avicularia or true external ovicells are present, although specialized gonozoids do occur. Kenozooecia, modified as stolons, are present in the stolonate groups, or as spines in the carnose forms.

Division 1. Carnosa Gray, 1841

Ctenostomata that have in common a comparatively heavy noncalcareous cuticle, giving the zoaria a fleshy or leathery appearance. The colonies included within this group are usually incrusting, but they may rise in thin flabellate or palmate fronds, sac-like expansions, or they may be cylindrical or pedunculate structures.

KEY TO THE FAMILIES OF THE DIVISION CARNOSA

1. Zoaria primarily incrusting 2
   Zoaria erect, clavate, with kenozooecial peduncle . . *Clavoporidae*
2. Zooecia with aperture closed by simple folds . . . *Alcyonidiidae*
   Zooecia with modified apertures 3
3. Aperture bilabiate, zooecia with kenozooecial spines . *Flustrellidae*
   Aperture raised, quadrangular, zooecia with multiporous septulae . . . . . *Pherusellidae*

Family Alcyonidiidae Johnston, 1849

Zoaria incrusting or erect in sacculate or cylindrical expansions. Aperture closed by simple folds formed by the invagination of the tentacle sheath when retracted, producing a puckered or drawn appearance.

Genus ALCYONIDIUM Lamouroux, 1812

Zoaria incrusting, coriaceous or gelatinous in appearance, forming a soft cover over the substrata, or arising into lobed sac-like, or cylindrical expansions. Zooecia closely united, not stolonate. The aperture may be in the center of raised papillae, or the entire ventral surface of the zooecia may present a smooth surface, a slight puckering at the distal end indicative of the aperture. Genotype: *Alcyonium gelatinosum* Linnaeus, 1767.

Key to the Species of *Alcyonidium*

1. Zoaria primarily incrusting, spreading irregularly 2
   Zoaria primarily erect, or disc-shaped, limited 4
2. Zoaria flat, incrusting, zooecia irregularly hexagonal . . *polyoum*
   Zoaria flat, incrusting, zooecia with raised apertures 3
3. Zoaria argillaceous, zooecia with fine papillate border . *parasiticum*
   Zoaria clear, zooecial aperture mammillate . . . *mammillatum*
4. Zoaria disc-shaped, flattened . . . . . *disciforme*
   Zoaria primarily erect 5
5. Zoaria sacculate, expanded, lobed . . . . . *pedunculatum*
   Zoaria elongate, cylindrical . . . . . *enteromorpha*

Alcyonidium polyoum (Hassall), 1841

Plate 77, fig. 1

Sarcochitum polyoum Hassall, 1841:484.
Alcyonidium mytili, Robertson, 1900:329.
Alcyonidium polyoum, Robertson, 1900:330.
Alcyonidium mytili, O'Donoghue, 1923:191; 1926:54.
Alcyonidium columbianum O'Donoghue, 1926:56.

The zoaria of the specimens in the collection show a great deal of color variation, ranging from transparent to brown or gray. In size the colonies ranged from 1 to 6 cm in breadth depending upon the size and type of subtrate. These zoaria are found incrusting rocks, mollusk shells, algal holdfasts and sometimes on the larger Crustacea.

The zooecia are irregularly hexagonal, but zooecia that are pentagonal, quadrangular and some that are nearly square are not uncommon. This wide variation in shape may account for the differences found in the measurements that have been previously cited in the literature.

The zooecial walls are usually distinct. The apertural openings in some of the zoaria are found on small raised papillae, distally located on the ventral wall, while in other zoaria there are no papillae, the ventral surface being smooth. In the latter case, the openings are either easily discerned, or are very obscure. One recent author (Silen, 1942:9-11) considers *A. polyoum* one of the species with a smooth ventral surface. Other authors (Hincks, 1880:501; Osburn, 1933:61; 1944:16; Marcus, 1941:68) have all noted the presence of a raised oral papilla. It is possible that the presence or absence of the oral papillae may be due to the degree of retraction of the tentacle sheath. If so, a given living zoarium could exhibit no oral papillae at one time, and have them at another.

The tentacle number poses another problem in this species. The vexing question is, does this species have a fixed number of tentacles, a variable number of tentacles, or are there two or possibly three species similar in external appearance being lumped together as *A. polyoum*? The reported tentacle number varies from 12 (Harmer, 1915:38) to 20 (Silen, 1942:11). The original description (Hassall, 1841:484, 485) reports the tentacle number as 20. If then the number to be considered as correct is 20, what is to be the disposition of those with 16 tentacles (Marcus, 1941:68; Rogick, 1949:47), unless *A. polyoum* is considered as having a wide variation in tentacle number. In order to determine the number of tentacles in the specimens from the eastern Pacific found in the Hancock collection, comprising at this time 9 stations (5 from Alaska, 4 from northern California), a sample of each of the best preserved specimens with the external characteristics of *A. polyoum* was sectioned. None of the specimens had 20 tentacles. Two Alaskan specimens, one with raised papillae, and one without, had 17 tentacles. One Californian specimen with definite oral papillae had 17 tentacles. Three others, all from Californian waters, without oral papillae, had 15, rarely 16 tentacles. Until such time as additional material can be obtained of both Pacific and Atlantic origin, the only safe conclusion is that *A. polyoum* does have a variable number of tentacles.

Alcyonidium polyoum is widely distributed in the colder waters of both the Atlantic and the Pacific. In the eastern Pacific it has been

previously reported by Robertson, 1900, and O'Donoghue, 1923, 1926, in the waters off Alaska, British Columbia, and Puget Sound.

The specimens in the Hancock collection are from off Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie collector; Lenard Harbor, Alaska, Canoe Bay, Alaska, Tomales Bay, California, AHF stations 1607-48 and 1656-48 in depths ranging from intertidal to 40 fathoms. (8 stations.)

Alcyonidium parasiticum (Fleming), 1828

Plate 77, fig. 2

Alcyonium parasiticum Fleming, 1828:518.
Alcyonidium parasiticum, O'Donoghue, 1923:191.

The collection has one large zoarium, thin, incrusting upon an eroded mollusk shell. The individual zooecia may be distinguished with some difficulty, due to the deposit of sand and mud which covers most of the zoarium. The zooecia are small, irregular in morphology, the variation ranging from nearly square zooecia to those that are elongated to nearly diamond-shaped. All of the zooecia that could be examined possessed raised oral papillae on the ventral surface, and minute border papillae. The argillaceous cover upon the cuticle prevented sectioning of a portion of the specimen.

This species is well distributed throughout the colder Atlantic waters and has been reported by O'Donoghue from the Pacific northwest.

The specimen in the Hancock collection came from Tomales Bay, California, at a depth of 5 fathoms, collector R. C. Osburn.

Alcyonidium mammillatum Alder, 1857

Plate 77, fig. 4

Alcyonidium mammillatum Alder, 1857:154.
Alcyonidium mamillatum, O'Donoghue, 1923:191; 1926:54.

The zoaria form dark brown, thin, rough, irregular incrustations upon mollusk shells. The zooecial walls are well defined, except in the portions of the zoaria that are covered by foreign matter. The zooecia vary in shape from an elongated irregular oval to rectangular. Distally the zooecial apertures are raised upon short cylindrical, transversely wrinkled projections.

The literature reveals that this species is moderately well known from the cold waters of the Atlantic. On the Pacific coast of North America, O'Donoghue has reported it from the vicinity of Vancouver Island, 1923, 1926.

Hancock Station 1642-48, off Point Vicente, southern California; also Friday Harbor, Puget Sound, J. L. Mohr, collector; Cold Bay, Alaska, U. S. Alaska Crab Investigation; and off Newport, southern California, which well may be the southern extension for this species. The known depth range is 15 to 70 fms.

Alcyonidium pedunculatum Robertson, 1902

Plate 77, fig. 3

Alcyonidium pedunculatum Robertson, 1902:106.
Alcyonidium pedunculatum, O'Donoghue, 1926:55.

The zoaria of this unusual species are erect, arising from a short "peduncle" into wide flat saccate expansions, the largest of those in the Hancock collection, from Puget Sound, Washington, measuring 6.5 cm high and 4.5 cm wide. The largest from Alaska measures 11 cm long and 3 cm in width. The "peduncles" are wrinkled, rough, coriaceous in appearance, short, stout, cylindrical, and contain a loose reticular connective tissue. The zooecia are not modified as they are in the true peduncle of *Clavopora, i.e.,* for bending and swaying the colony. The expanded portion of the zoarium is sac-like, filled with loose connective tissue, and may have several finger-like projections, or it may be a single foliaceous lobe. These lobes are smooth, light brown in color. The zooecial outlines are well marked, an irregular hexagonal shape. Sectioning disclosed the tentacle number to be 17.

Miss Robertson's specimens were from the Pribilof Islands, Alaska. O'Donoghue (1926) reported the species from the Vancouver Island region.

The specimens in the Hancock collection are from Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector, and Puget Sound, Washington, J. L. Mohr, collector. There are 10 stations ranging in depth from 20 to 35 fathoms.

Alcyonidium disciforme (Smitt), 1871

Plate 77, figs. 5 and 6

Alcyonidium mammillatum var. *disciforme* Smitt, 1871:1122, 1123.
Alcyonidium disciforme, Osburn, 1936:540.

The mature zoaria have a very distinctive, characteristic morphology. Resembling a common wide rubber washer or large coin with a circular hole punched from its center, these zoaria form circular, slightly convex discs, which apparently rest upon soft sandy substrata. Young colonies lack the central hole. Minute, fine root-like extensions from the basal

side help to anchor the colony in place. These kenozooecial filaments are most easily found near the periphery of the zoaria. The zoaria in the collection measured between 2.6 and 3.0 cm in diameter. The zooecia are small, hexagonal, usually bearing the apertures raised on papillae which occupy nearly all of the ventral surface. The tentacle number is 16, determined from sections.

Described by Smitt from Scandinavian waters, and recorded by Osburn from Captain R. A. Bartlett's dredgings in Wakeham Bay, Ungava, Canada.

Hancock collection specimens are from Point Barrow, Alaska, Arctic Research Laboratory, 13 fms, collected by G. E. MacGinitie. The species evidently has a circumpolar distribution.

Alcyonidium enteromorpha Soule, 1951

Plate 77, figs. 7 and 8

Alcyonidium enteromorpha Soule, 1951:367.

The zoaria are elongate without lateral branching, bearing a superficial resemblance to the intestinal tract of a small mammal. Of several zoaria in the collection the longest measured 61 cm in length and from 4 to 6 mm in width. Coiled in several loose folds the zoaria are attached to the substrate without a differentiated "peduncle." The cuticle is firm, mottled light brown to tan in color, and only moderately thick. The zoaria are cylindrical and filled with a loose reticular connective tissue. Within this meshwork of connective tissue may be found numerous brown bodies, the product of degenerated zoids that have entered the central cavity when the thin dorsal zooecial walls were ruptured. From the ventral surface the zooecia are well defined, most easily found in the portions of the zoaria where the cuticle is thin. On the greater part of the zoaria, the lateral zooecial walls can be only faintly discerned, and while not totally obscured, they are rather difficult to trace. The ventral zooecial walls are smooth, with no oral papillae present. As noted before, the dorsal zooecial walls are thin, almost to the point of transparency. In shape the zooecia are varied, ranging from rectangular to irregularly hexagonal, those containing mature polypides measuring between 0.23 and 0.40 mm in length, and from 0.11 to 0.25 mm in width. The tentacle number obtained from serial sections is 17. It differs from *A. pedunculatum* Robertson, by virtue of its cylindrical form, its extreme zoarial length, and its complete lack of a "peduncle."

All of the specimens in the Hancock collection are from Alaska, off Point Barrow, Arctic Research Laboratory, collector G. E. MacGinitie. Collected at depths ranging from 80 to 123 fathoms.

Family **Flustrellidae** Hincks, 1880

Zoaria incrusting or rising in flabellate extensions. The aperture is bilabiate, closed by two lip-like flaps that are supported by chitinous rims. The analogy has been drawn by earlier authors, commenting on the resemblance of the aperture of the Flustrellidae to the opening of an old fashioned clasp purse. Chitinous spines are present.

Genus **FLUSTRELLA** Gray, 1848

Zoaria incrusting, or rising in flattened fan-shaped projections. The zoaria are hispid, with many flexible chitinous spines, which vary in morphology and frequency with the species. The spines originate from kenozooecia. The aperture is bilabiate as described above. Genotype: *Flustra hispida* Fabricius, 1780.

Flustrella corniculata (Smitt), 1871

Plate 77, fig. 9

Alcyonidium corniculatum Smitt, 1871:1123.
Alcyonidium cervicornis Robertson, 1900-330.
Alcyonidium spinifera O'Donoghue, 1923:192.
Alcyonidium cervicorne, O'Donoghue, 1926:56.
Flustrella corniculata, O'Donoghue, 1925:15.

The zoaria are found in various modes of growth, depending upon the types of substrata. The shape varies from small cylindrical clavate colonies to large foliaceous flattened expansions. The color may range from pale tan to dark brown. Macroscopically, the zoaria have a coarse "fuzzy" appearance due to the presence of numerous chitinous spines. These spines arise from modified zooecia scattered abundantly among the functional zooecia. Most commonly the spines have four prongs. However, there are also spines bearing six prongs, and some with but one. The zooecia range in form from an elongated ovoid to hexagonal, usually with distinct lateral walls. The aperture is a narrow transverse slit. Occasionally specimens are found with the apertures slightly raised, at the summits of low papillae. The tentacle number, determined from sections, is 18.

This species, described from cold European waters, has appeared in the Pacific literature under several different names. Robertson found it in the Alaskan collection of the Harriman Expedition, and O'Donoghue described it from the Vancouver Island region and Puget Sound.

Specimens in the Hancock collection are from off Point Barrow, Alaska, Arctic Research Laboratory, collector, G. E. MacGinitie; British Columbia; and Dillon Beach, Tomales Bay, California. Depth range, from intertidal to 36 fathoms.

Flustrella gigantea Silen, 1947

Plate 78, fig. 1

Flustrella gigantea Silen, 1947:134.

The zoaria are incrusting or arise into erect, flattened lobate, bilaminar expansions measuring 3 to 4.5 cm in height, and 0.5 to 1.0 cm in width. Macroscopically all the dark brown zoaria have a hirsute appearance due to the presence of branching chitinous spines. The zooecia are arranged in alternating series, varying in form from an irregular rectangle to an uneven hexagon; in length they range from 0.97 to 1.25 mm, and in width from 0.70 to 0.83 mm. In younger portions of the zoaria the zooecia are distinct, but in the older areas the lateral zooecial walls are obscured by the pigmented cuticle. Each zooecium has a distal raised oral papilla with the bilabiate aperture at its summit. The hollow spines, arising from kenozooecia, are variable in morphology, and have a location pattern that is only moderately uniform. Distally, about the raised oral papilla on each zooecium, are 2 to 4 of the multibranched spines. The number of terminal prongs may vary from 9 to 21, the most frequent range being 11 to 14. Some spines, as well as having the normal numerous prongs, are modified so as to have one large grossly extended, thorn-like spike, giving the spine an over-all length of 1.38 to 2.05 mm. This spectacular form of the spine is scattered at random in generous quantity over the zoaria, from the growing tip to the most mature portions of the zoaria. Sections revealed the tentacle number to be 26.

The specimens described by Silen were from the Bering Sea. The material in the Hancock collection is also from Arctic waters, off Point Barrow, Alaska, G. E. MacGinitie collector. Depth, 36 fathoms.

Family **Pherusellidae** Soule, new family

Zoaria incrusting or arising into flattened flabellate, bilaminar extensions. Aperture square or quadrangular, raised upon a stout tubular process. Prominent compound communication pores (multiporous septulae), supported by heavy chitinous rings, connect adjacent zooecia, piercing the distal as well as the lateral walls. No spines present. Prior to this time the genus *Pherusella* has been placed under the family

Flustrellidae, but the morphological differences in the aperture, the presence of the prominent communication pores, and the lack of kenozooecial spines warrant the separation of this genus into a distinct family.

Genus **PHERUSELLA** Soule, 1951

Zoaria coriaceous, incrusting, or arising from incrustations in branching flabellate, flattened projections. The distal ends of the zooecia rise into prominent tubular processes, which bear the aperture. When the polypide is retracted, the apertures appear square to transversely quadrangular in shape. The lateral walls and the distal walls are pierced by prominent multiporous septulae provided with heavily chitinized rims, apparently a unique character in the Ctenostomata. Genotype: *Flustra tubulosa* (Solander), 1786. The genus *Pherusa* Lamouroux, 1816, is preoccupied by *Pherusa* Oken, 1807. The name *Pherusa* had also been proposed by Leach, 1814, and Rafinesque, 1815.

Pherusella brevituba Soule, 1951

Plate 78, fig. 2

Pherusella brevituba Soule, 1951:368.

The chitinous zoaria are a light brown in color, leathery in appearance, and form prominent incrustations upon the holdfasts and blades of algae. When the zoaria are strictly incrusting, they are unilaminar, or they may form erect fan-like "fronds" that are bilaminar, back to back, where the zoarial growth exceeds the limits of the algae thalli.

The zooecia are elongate with considerable variation in shape, from imperfectly rectangular to hexagonal, averaging about 0.80 mm in length and 0.40 mm in width. Normally the individual zooecia are distinct, clearly defined by the lateral walls. The zooecial walls are perforated by well marked compound interzooecial communication pores having an average diameter of 0.02 mm. The rims of the communication pores are strengthened by heavy chitinous rings. Within this ring are four minute perforations piercing a thin chitinous diaphragm.

The distal portion of each zooecium is raised to form a short but prominent tubular process bearing the aperture. The upper extremity of this tubular process is square to transversely quadrangular in shape. The tentacles number 23.

This species has been taken off Portuguese Bend, California; collected in the intertidal zone at Punta Baja, Rosario, Lower California, by E. Y. Dawson; and found on the holdfast of algae washed ashore near the Santa Barbara-San Luis Obispo county line, southern California. The range in depth is from intertidal to 8 fathoms.

Family **Clavoporidae** Soule, new family

Zoaria erect, arising from a basal plate. Each zoarium is differentiated into two anatomically distinct portions, a capitulum composed of autozoids supported by an annulated peduncle composed of muscular kenozoids. Zoaria may be solitary or in groups but are never compound. The aperture of each zooecium is similar to that found in the family Alcyonidiidae, and is usually located at the center of a small papillate process. The presence of two anatomically distinct regions within a zoarium, a situation not found elsewhere in the carnose families, justifies the proposal of a new family.

Genus **CLAVOPORA** Busk, 1874

Zoaria usually small, erect, coriaceous, clavate, arising from basal discs. As noted above, each zoarium has an annulated peduncle of muscular kenozooecia capable of bending and flexing the erect portion of the colony in any direction, and a capitulum of functional autozooecia capable of feeding and reproduction. The kenozooecia of the annulated peduncle are arranged in a series of rings, the central portion of the peduncle being a hollow fluid-filled tube. This tube forms a communication between each feeding autozoid of the hollow capitulum and the muscular kenozooecia. Fluid containing dissolved nutriments and cellular elements may pass into the kenozooecia by means of minute simple pores (septulae) located in the internal zoid walls. The musculature of the kenozooecia consists of modified parietal muscles that run parallel to the long axis of the peduncle. Contraction of the muscles on one side, with reciprocal relaxation of the musculature of the opposite side, will bend the entire erect portion of the colony. In the capitulum, at the apex of the peduncle, the autozoids are densely packed. On the outer wall of the capitulum the cuticle is comparatively thick and leathery. The lateral walls and the internal walls of the zooecia, submerged within the body of the capitulum, are, in contrast, thin, lightly chitinized, and delicate in appearance. Genotype: *Clavopora hystricis* Busk, 1874.

Clavopora occidentalis (Fewkes), 1889

Plate 78, fig. 3

Ascorhiza occidentalis Fewkes, 1889:1.
Ascorhiza occidentalis, Robertson, 1902:106.
Ascorhiza occidentalis, O'Donoghue, 1923:192.
Clavopora occidentalis, O'Donoghue, 1926:57.

The zoaria are stalked, arising directly from small irregularly cylindrical adherent basal discs. The basal discs are firmly attached to the substrata; rocks, mollusk shells, or, as in the case of some of those in the Hancock collection, attached to colonies of the cheilostome bryozoan *Discoporella umbellata* (Defrance), 1823. The zoaria are a pale brown to light tan in color. The zoarial length is variable, ranging from 8 to 5.8 cm. The zoaria may be solitary, or secondary zoaria may grow attached to the pedunculate portion of an older zoarium, where they have developed from settled larvae.

Anatomically, a zoarium may be divided into two distinct sections, a peduncle composed of muscular kenozooecia, and a capitulum at the apex of the peduncle, composed of functioning autozooecia. The peduncle is cylindrical, stout, and strongly annulated in the older zoaria. According to the figure in Fewkes' original description, the stalk is extremely slender. This is not the case with specimens in the Hancock collection, the peduncular portions of the mature zoaria having a diameter ranging from 0.50 to 0.75 mm. The capitulum, ranging in length from 2 mm to 3.5 cm, is an expanded ovoid structure, bulb-like in appearance with a coriaceous cuticle. It is composed of the functional autozooecia, closely united, somewhat indistinct, with the aperture located within the center of a low papillate process. The tentacle number, determined by means of serial sections, is 18.

The specimens reported by Miss Robertson (1902) were dredged off Santa Catalina Island, California, while those recorded by O'Donoghue came from the vicinity of Vancouver Island. The specimens in the Hancock collection are from Hancock station 924-39, Socorro Island, Mexico; Guadalupe Island, Mexico, collector C. L. Hubbs; and Dillon Beach, California; in depths ranging from 17 to 46 fathoms.

Division 2. **Paludicellea** Allman, 1856

Zooecia connected by stolon-like tubular extensions that may or may not possess internodes separated by septulae. A zooecium may form a daughter zooecium by means of a bud produced near its distal extremity.

Family **Nolellidae** Harmer, 1915

"The Family Nolellidae is characterized by the great development of the peristomial part of the zooecium. This region is typically much elongated and its ectocyst frequently includes muddy particles. The

adnate portion of the zooecium is represented by a delicate stolon-like tube and by the base of the peristome into which it usually passes abruptly, although it more rarely dilates gradually as it approaches this part. The branching is of the cruciform type. Gizzard absent." Harmer, 1915:52.

Genus NOLELLA Gosse, 1855

Zooecia cylindrical, elongate, with considerable variation in size within the same zoarium. The proximal ends of the zooecia are prolonged, narrowed to form connecting tubular extensions. The cuticle may, on occasion, be covered by a very fine argillaceous coat. Genotype: *Nolella stipata* Gosse, 1855.

Nolella stipata Gosse, 1855

Plate 78, fig. 5

Nolella stipata Gosse, 1855:35-36.
Farrella gigantea Busk, 1856:93.
Farrella dilatata, Hincks, 1860:279.
Cylindroecium giganteum, Hincks, 1884:208.
Cylindroecium papuense Busk, 1886:38.
Cylindroecium giganteum, O'Donoghue, 1926:60.

Zoaria with stolonal portion adhering to varied substrata ranging from hydroids and algae to eroded mollusk shells and cheilostomatous bryozoans. The zooecia are chitinous, erect, cylindrical. The cuticle is covered with an extremely fine layer of silt, which does not, however, totally obscure the view of the polypide in alcoholic or wet-mount preparations. The zooecia are extremely variable in length, with mature specimens ranging in length from 0.90 to 3.80 mm, and in width from 0.17 to 0.25 mm. The proximal portion of the zoid, the basal area, is expanded (dilated) forming a junction point for 2, 4, or even 6 of the stolons. The only stolon that is not set off from the basal dilation by a distinct diaphragm is the one from which the zoid arises. The degree of basal dilation seems to be correlated with the type of substratum. The specimens in the collection that are adherent to a soft substrate, such as the algae or the hydroids, have a much less prominent dilation than those adhering to a hard mollusk shell, where the proximal dilation is very great. (See Hincks, 1880:537, pl. 77, figs. 1 & 2, and pl. 79, figs. 1-3).

This species is liberally represented in the cooler waters of the Atlantic on both the European side and the North American. On the Pacific

coast of North America it has previously been reported by Hincks from the Queen Charlotte Islands, and by O'Donoghue from the vicinity of Vancouver Island.

In the Hancock collection specimens are from Puget Sound, Washington, Gulf of California, and the west coast of Lower California. Hancock stations, 650-37, San Francisco Island, Gulf of California, and 1714-49, Magdalena Bay, Lower California. Depth range from 17 to 47 fathoms.

Genus **ANGUINELLA** van Beneden, 1845

Zoaria erect, branching irregularly. Zooecia cylindrical, arising from a small adnate proximal base. Zooecia bud directly from other zooecia. Genotype: *Anguinella palmata* van Beneden, 1844.

Anguinella palmata van Beneden, 1845

Plate 78, fig. 4

Anguinella palmata van Beneden, 1845:34.
Anguinella palmata, Osburn, 1912:253.

Zoaria palmate, chitinous, opaque, brown in color, consisting of erect single stalks with zooecia branching irregularly to all sides. The zoarial length of the specimens in the Hancock collection ranges from 2.0 to 3.1 cm. The zooecia are cylindrical, elongate, rounded distally, the aperture terminal. The cuticle is characteristically covered with a fine coat of silt, rendering examination of the polypide difficult even under optimum conditions of fixation and preservation. The zooecia bud directly from the sides of older mature zooecia. The polypides of the zooecia in the older basal and axial portions of the zoaria are suppressed, and these zooecia serve as support for the younger lateral and distal zooecia that are functional.

No difference could be detected in the morphology of the Pacific specimens when compared with the Atlantic specimens collected at Beaufort, North Carolina, by R. C. Osburn, or those collected at New River, North Carolina, by A. S. Pearse. This is believed to be the first record of this genus and species from the Pacific Coast of North America. According to Hincks, 1880:540, it is moderately abundant in the waters about the British Isles and off the coast of Belgium and France.

Hancock Stations: 277-34, Isabel Island, Mexico; 447-35, Panama City, Panama; 847-38, off Zorritos Light, Peru; 1449-42, Newport Harbor, and 2020-51, Seal Beach, southern California. Depth range, intertidal zone to 25 fathoms.

Division 3. **Vesicularina** Johnston, 1847

The ctenostomes included within the limits of this grouping characteristically have relatively heavy, thickened, usually branching, septate stolons. The zooecia bud directly from the stolon. Polypide usually provided with a gizzard, or as Harmer, 1915:60, stated, "Gizzard present in most of the genera, perhaps in all."

Family **Vesiculariidae** Johnston, 1838

Zoaria erect or creeping, consisting of two types of zooecia, the kenozooecia constituting the stolons, and the autozoids the feeding individuals. From within each internode of a stolon arise several zooecia, the arrangement being characteristic within the genera.

Genus **VESICULARIA** J. V. Thompson, 1830

Zoaria erect, the main stolon or stolons supported on the substrate by a number of kenozooecial rhizoid-like runners. Zooecia ovoid to elongate cylindrical, distinct, arranged within an internode in a single series. Zooecia are contracted at the base, and the polypide is provided with a prominent gizzard. Genotype: *Sertularia spinosa* Linnaeus, 1758.

Vesicularia fasciculata Soule new species

Plate 78, fig. 6

Diagnosis: Zoaria erect, unbranched, arising from a base supported by tubular, root-like, kenozooecial fibers. The main axis of the zoarium is composed of a series of 6 to 8 stout parallel or entwined stolons adherent to each other so as to form an elongated bundle. Zooecia elongate, cylindrical, arising from the stolons in a linear series, containing polypides each bearing 12 short tentacles and a prominent gizzard.

Description: Of the three zoaria representing this species in the Hancock collection, the longest measured 2.80 cm in height, prior to the removal of portions for sectioning and for whole-mounts, while the shortest measured barely 0.6 cm. The remaining zoarium was in a very poor state of preservation.

The zoaria arise in a single, non-branching axis of growth, from a base supported by kenozooecia in the form of tubular radiculate fibers. The main axis mentioned above consists of a series of 6 to 8 or more robust stolons adherent to and twisted about each other to form an

elongate sheaf. Examination of a cross section of a stolonal sheaf from an older portion of the colony revealed stolons of uniform diameter, while cross sections made close to the growing tip of the colony disclosed one larger principal stolon surrounded by 4 to 6 secondary stolons of narrower diameter. An individual stolon does not as a rule traverse the entire length of a zoarium. One stolon will give rise to a second at a point located just below (proximally) a septum terminating an internode. The newly arisen stolon gains mature diameter at once and proceeds distally paralleling its "parent" and the other stolons of the zoarium. The zooecia arise from the stolons, originating in a linear series within an internode in variable numbers. They are deciduous, the stolons characteristically marked with the scars of departed zooecia. The zooecia are constricted slightly at the point of fusion with the stolon. Morphologically they are elongate, cylindrical, ranging in length from 0.94 to 1.10 mm, and in width from 0.24 to 0.28 mm. The polypide contains a prominent gizzard. The tentacles are short, and 12 in number.

Vesicularia fasciculata differs in two major aspects from the other species in the genus, having an unbranched zoarium, as compared to the branched zoaria of *V. spinosa* Linnaeus, *V. papuensis* Busk, and *V. harmeri* Silen, and it has 12 tentacles as compared to 8 tentacles in *V. spinosa* and *V. papuensis.*

Holotype: U. S. N. M. no. 11053; Paratype, AHF no. 134.

Repository: The United States National Museum, Washington, D. C.

Paratype: The Allan Hancock Foundation, The University of Southern California, Los Angeles, California.

Type locality: Off Point Barrow, Alaska, 18 February 1950, depth 162 feet, collector, G. E. MacGinitie. Also Point Barrow, Alaska, August 1, 1949, depth 321 feet, July 1, 1950, depth 118 feet, collector, G. E. MacGinitie.

Genus **AMATHIA** Lamouroux, 1812

Zoaria erect, stolons robust, stiff. Zooecia in biserial arrangement, forming a spiral within an internode. Polypide provided with a gizzard. Genotype: *Sertularia lendigera* Linnaeus, 1758.

Amathia convoluta Lamouroux, 1816

Plate 78, fig. 7

Amathia convoluta Lamouroux, 1816:160.
Amathia convoluta, Harmer, 1915:64.

The zoaria of this well known species are large, erect, prominent, light brown in color. The zooecia are arranged biserially, paired, forming a loose spiral that encircles the stolon within the limits of an internode. An internode is limited to one series of zooecia. The zooecia are completely connate along their entire length when the tentacles are completely retracted. The zooecia are of uniform length, ranging from 0.71 to 0.74 mm. In width, the range is from 0.08 to 0.09 mm. The polypide has a gizzard.

This species appears to be widely distributed, having been previously reported from European waters of the Atlantic and in North and South America from Chesapeake Bay to Santos Bay, Brazil. In the Pacific there have been several reports from the Australian region. This is the first report of its occurrence in the waters of the eastern Pacific.

Hancock Stations: 133-34, Socorro Island, west of Mexico; 253-34, and 257-34, Port Culebra, Costa Rica; 265-34, Petatlan Bay, Mexico, and 486-35, Tenacatita Bay, Mexico. Depth, 5 to 20 fms.

Amathia vidovici (Heller), 1867

Plate 79, fig. 2

Valkeria Vidovici Heller, 1867:128-129.
Amathia vidovici, Osburn, 1940:340.

Zoaria erect, tall, with elongate internodes. The zooecia are small, biserial, forming a spiral in the distal portion of the internode, leaving for the most part the proximal portion of the internode bare. Zooecia connate only at their point of origin and attachment to the stolon. Their length ranges from 0.32 to 0.41 mm.

This species has not appeared in the literature as frequently as some of the other species of the genus *Amathia.* It was originally reported from the Adriatic Sea by Heller. On the Atlantic coast of North America it has been reported by Osburn and by Hutchins. Osburn also reported it from Puerto Rico.

The specimens in the Hancock collection are from about 20 stations, ranging geographically from Santa Rosa Island, southern California (in the northern Channel Islands), to Ecuador and the Galapagos Islands.

Amathia distans Busk, 1886

Plate 79, fig. 1

Amathia distans Busk, 1886:33.
Amathia distans, O'Donoghue, 1925:16.
Amathia distans, Osburn, 1940:339.

The zoaria are comparatively small, low, straggling, with a moderately regular dichotomous mode of branching. The zooecia are found in biserial spirals that may, but usually do not, fill an internode, most frequently occupying only the distal portion. The zooecia are short, ranging in length from 0.35 to 0.46 mm, closely connate, except at the tips. This species differs from *A. convoluta,* whose zooecia are also connate, in its smaller size, its reptant habit, and in having the proximal half of the internode usually devoid of zooecia.

A. distans has been reported previously from the South Atlantic by Busk, 1886:33; from Australian waters by MacGillivray, 1889:30; Java, Harmer, 1915:68; Puerto Rico by Osburn, 1940:339; and Puget Sound, O'Donoghue, 1925.

The specimens in the Hancock collection (20 stations) range geographically from Santa Rosa Island, southern California, to the Gulf of California.

Genus **ZOOBOTRYON** Ehrenberg, 1831

Zoaria loosely spreading, flaccid, not creeping, branching in an irregular fashion. Zooecia ovoid, narrowed at the point of origin and attachment to the stolon. Polypide with a prominent gizzard. Genotype: *Hydra verticillata* delle Chiaje, 1828.

Zoobotryon verticillatum (delle Chiaje), 1828
Plate 79, fig. 3

Hydra verticillata delle Chiaje, 1828:203.
Zoobotryon pellucidus Ehrenberg, 1831: no pagination.
Zoobotryon pellucidum, Osburn, 1940:341.

The zoaria are flaccid, lavishly branching into tangled masses. The stolons are transparent, very flexible, only lightly chitinized, ranging in diameter from 0.40 to 0.70 mm. At intervals both the stolon and the zooecia may be partially obscured due to a deposit of silt. The zooecia are usually found arranged bilaterally along the stolons, but not infrequently they occur in scattered clumps. The zooecia range in length from 0.36 to 0.48 mm, and in width from 0.12 to 0.17 mm; elongated-ovoid, rather narrow at the point of origin and attachment to the stolon, tapering to a bluntly square tip at the distal apertural orifice. The polypide is provided with a prominent gizzard. While this is the first direct description of this species from the Pacific coast of North America, Miss Alice Robertson, 1921:63, mentioned in her paper on the Bryozoa of the Bay of Bengal that she had seen this species in San Diego, California, and had received specimens from Hawaii.

According to Osburn, 1940:342, this species is circumtropical. It has been recovered from the warm waters of the Mediterranean, from Bermuda, Florida, Puerto Rico, Gulf of Mexico, and Brazil.

Specimens in the Hancock collection are from San Diego, California, no further data given.

Genus **BOWERBANKIA** Farre, 1837

"Zooecia arising irregularly from an erect or creeping axis, commonly in definite groups. Tentacles 8-10. Gizzard present." Harmer, 1915:70. Genotype: *Sertularia imbricata* Adams, 1800.

Bowerbankia imbricata (Adams), 1800

Plate 79, fig. 4

Sertularia imbricata Adams, 1800:11.
Bowerbankia imbricata, Robertson, 1900:331.
Bowerbankia imbricata, O'Donoghue, 1925:93.

The zoaria form irregular tangled masses, with reptant stolons having a diameter ranging from 0.06 to 0.09 mm. The stolons are divided into internodes of variable length, separated by a diaphragm perforated by a single pore. The zooecia are elongate-tubular, straight or slightly curved, and have a square distal extremity. The proximal zooecial portion may be extended to form a short caudate process of one or two prongs. The zooecia are constricted at the point of origin on the stolon. The zooecial length of the eastern Pacific specimens ranges from 0.92 to 1.15 mm. A gizzard is present. The tentacle number is 10, as determined from serial sections.

This species appears to be well distributed in the cooler European waters. In the eastern Pacific, it has been previously reported from Alaska and Puget Sound.

In the Hancock collection, the specimens of this species are from British Columbia, E. F. Ricketts, collector, no bathymetric data available.

Bowerbankia gracilis Leidy, 1855

Plate 79, fig. 5

Bowerbankia gracilis Leidy, 1855:142.
Bowerbankia gracilis, O'Donoghue, 1923:192; 1925:93.
Bowerbankia gracilis, Osburn, 1940:341.

The zoaria consist of tangled gray masses of stolons and zooecia, repent, not erect, with extremely irregular branching. The zooecia are tubular, narrow, tapering slightly at both the distal and the proximal ends. The distal extremity is square in most cases. The polypide is provided with a prominent gizzard, measuring between 0.08 and 0.09 mm in diameter. The zooecial length ranges from 1.02 to 1.52 mm. None of the zoaria had specimens of mature zoids with a measurement of less than 1.0 mm. As a rule, the specimens with a caudate appendage proximally were the longest. The zooecia are attached to a creeping stolon with or without a lateral extension. The zooecia may occur single, in pairs, or in dense clusters. The stolonal diameter is variable, ranging from 0.03 to 0.05 mm. The stolons have internodes of variable length, separated by diaphragms which are perforated by a single pore.

In the eastern Pacific specimens in the collection, it was found that both caudate and non-caudate individuals occur within the same zoaria, with the non-caudate form predominant. No zoaria were found in which the caudate individuals occurred solely.

Bowerbankia gracilis is a "cosmopolitan species," having been previously reported from Greenland to Puerto Rico to Brazil.

Specimens in the Hancock collection are from Puget Sound, Washington; Dillon Beach, Tomales Bay, California, R. C. Osburn collector; Los Angeles Harbor; and the Gulf of California. All collections were made in the intertidal range. Hancock station, 510-36, Espiritu Santo Island, Gulf of California.

Bowerbankia gracilis aggregata O'Donoghue, 1926

Plate 79, fig. 6

Bowerbankia gracilis var. *aggregata* O'Donoghue, 1926:58-60.

The zoaria form dense tangled masses which completely obscure the substrata. The stolons, as in *B. gracilis* Leidy, have internodes of variable length, limited by diaphragms perforated by a single pore. The zooecia are very greatly elongated, ranging in length from 1.77 to 2.25 mm. The tentacle number is 8.

This variety was described by O'Donoghue from the Vancouver Island region.

The specimens in the Hancock collection are from Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector; Puget Sound, Washington, J. L. Mohr, collector; Dillon Beach, Tomales Bay, California, R. C. Osburn collector; and Los Angeles harbor, California. The depths range from intertidal to 9 fathoms.

Division 4. Stolonifera Ehlers, 1876

Zoaria with delicate creeping stolons, with occasional points of expansion where a diaphragm occurs and either stolonal branches or zooecia may arise. A gizzard may or may not be present.

Family Valkeriidae Hincks, 1877

"Zooecia contracted below, deciduous, destitute of a membranous area." Hincks, 1880:551.

Genus VALKERIA Fleming, 1823

Zoaria repent, with creeping stolons. Zooecia ovoid to cylindrical, originating at the distal end of a short internode close to the diaphragm. No gizzard present. Genotype: *Sertularia uva* Linnaeus, 1767.

Valkeria tuberosa Heller, 1867

Plate 79, fig. 7

Valkeria tuberosa Heller, 1867:129.
Valkeria tuberosa, Harmer, 1915:76.

Zoarium stolonate, internodes of variable length, ranging from 0.52 to 0.94 mm in length. At the internodes the stolon is expanded slightly, with lateral branches arising immediately distal to the diaphragm. Here the zooecia arise. The zooecia are small, ranging from 0.43 to 0.55 mm in length, and have a narrow wrinkled base 0.03 to 0.04 mm in width. Tentacles are 8 in number. Polypide lacking a gizzard.

Previously reported from the Adriatic Sea, Red Sea, and Borneo. It has not been previously recorded from the eastern Pacific.

The specimens in the Hancock collection are from Lower California, C. L. Hubbs, collector, no bathymetric data given.

Genus AEVERRILLIA Marcus, 1941

Zoaria creeping, minute. Stolons with short lateral peduncles to which the zooecia are attached. Polypide with a prominent gizzard. Genotype: *Buskia setigera* Hincks, 1887.

Aeverrillia setigera (Hincks), 1887

Plate 79, fig. 8

Buskia setigera Hincks, 1887:127.
Buskia setigera, Osburn, 1940:343.
Aeverrillia setigera, Marcus, 1941:74.

The zoaria are adherent to the substrate, minute, delicate, rather difficult to see without the aid of a lens. The zoaria consist of primary and secondary stolons, usually at right angles to each other, with the secondary stolons originating in pairs, one stolon on either side of the primary stolon, adhering closely to the substrate. The primary stolons are septate, divided into internodes. Septa are also found at the junction of the secondary or lateral stolons. The internodes are of variable length. The diameter of the stolons ranges from 0.02 to 0.05 mm. The zooecia arise in pairs from kenozooecia placed at each side of either a primary or secondary stolon. In a number of instances in the eastern Pacific material, the substrate was *Amathia convoluta* and *Amathia vidovici,* and thus did not permit paired zooecia to arise consistently. The zooecia range in length from 0.57 to 0.62 mm, and in width from 0.16 to 0.20 mm. The basal portion of the zooecia is rounded, somewhat swollen, and usually bears 2 spine-like processes. Distally, the zooecia taper, and each bears upon the oral extremity 4 spine-bearing protuberances that encircle the aperture. A long setigerous collar may or may not project from the aperture. The polypide contains a prominent gizzard. The tentacles number 8.

Aeverrillia setigera, previously unreported from the eastern Pacific, is a semitropical species, having been reported from the warmer waters of the southwest Pacific (Ceylon, New Guinea, Gulf of Bengal, China Sea), from the waters off Puerto Rico, from the Suez Canal, from Brazil, and as far north as Long Island Sound, Connecticut, and New Bedford and Woods Hole, Massachusetts, on the Atlantic Coast of North America.

Hancock Stations: 133-34, Socorro Island, west of Mexico; 445-35, Panama City, Panama; and 847-38, southwest of Zorritos Light, Peru. Depth, intertidal to 35 fms.

Family **Buskiidae** Hincks, 1880

"Zooecia contracted below, not continuous with the creeping stolon, with an aperture on the ventral surface." Hincks, 1880:531. In the light of present knowledge of this family, the above diagnosis must be modified: Zooecia contracted proximally, arising directly from the stolon, aperture terminal.

Genus **BUSKIA** Alder, 1857

Zoaria repent or erect, stolonate. Zooecia arising directly from the stolon. Polypide with a prominent gizzard. Genotype: *Buskia nitens* Alder, 1857.

Buskia nitens Alder, 1857

Plate 80, fig. 1

Buskia nitens Alder, 1857:156.
Buskia nitens, Hincks, 1884:208.
Cylindroecium repens O'Donoghue, 1923:192.
Buskia nitens, O'Donoghue, 1926:60.

Zoaria minute, repent, inconspicuous. Stolons thin, thread-like, subdivided by septa into internodes. Zooecia very small, ranging in length from 0.31 to 0.50 mm. The zooecia arise directly from the stolons and in most cases, but not invariably, the proximal one-third of a zoid is adherent to the stolon and the substrate, with the distal two-thirds free. In some cases the entire zoid arises directly away from the stolon and is free in its entirety. Proximally, some zooecia exhibit one or two pairs of short thorn-like protuberances. Distally, some zooecia show a short setigerous collar projecting from the aperture.

This species is evidently well distributed in both warm and cool marine waters, but because of its minute size is easily overlooked. It has been reported from England, Brazil, Puerto Rico, and British Columbia.

Hancock Stations: 277-34, Isabel Island, Mexico, and 1407-42, Coos County, Oregon, intertidal to 25 fms.

Buskia seriata Soule, new species

Plate 80, fig. 2

Diagnosis: Zoaria erect, branching. Stolons robust, septate, bearing clusters of short stocky zooecia arranged in a paired linear series, alternate, and arising directly from the stolon. Zooecia wrinkled distally and may exhibit a setigerous collar protruding from the aperture. The polypide contains a prominent gizzard. The tentacle number is 8.

Description: The zoaria are large, branching, erect, macroscopically bearing a superficial resemblance to specimens of the genus *Amathia.* The stolons are robust, septate, with internodes of variable length, ranging from 0.90 to 1.30 mm, and in width from 0.07 to 0.09 mm. The zooecia, which are arranged in clusters, arise from the stolon in an irregular alternate, paired linear series. These zooecial clusters may contain from 5 to 14 short, stout zooecia, with 11 occurring most frequently. On the younger stolonal branches only 1 or 2 developing zooecia may be in evidence. Invariably, there is but a single zooecial cluster to each stolonal internode. The zooecia arise directly from the stolon. The proximal portion of the zooecium is constricted, but the body proper rarely adheres to the stolon or substrate for any distance,

although individuals of this type do occur. The zooecia are small, ranging in length from 0.35 to 0.45 mm, and in width from 0.11 to 0.13 mm proximally, and 0.09 to 0.11 mm distally. All of the zooecia have a broad rounded proximal portion, where 1 or 2 small, pointed, spine-like protuberances may appear. The zooecia gradually taper distally, where, shortly beyond the point midway between the two extremities, they become wrinkled transversely. Some of the zooecia exhibit a setigerous collar protruding from the aperture. The polypide is provided with a large and prominent gizzard. The tentacle number is 8, as determined from examination of serial sections.

Although erect, *Buskia seriata* has comparatively short zooecia, differing from *B. socialis* which, according to Marcus, has zooecia measuring 0.75 mm in length. Being erect, it is easily distinguished from the reptant *B. nitens* with its minute creeping zooecia.

Holotype: AHF no. 133.

Repository: Allan Hancock Foundation, The University of Southern California, Los Angeles, California.

Type locality: Galapagos Islands, N. Seymour Island, January 16, 1931, tidepools.

Additional distribution: Hancock station 1111-40, February 14, 1940, San Lorenzo Channel, Gulf of California, west coast, 24°21′55″N, 110°15′15″W, depth 6-13 fathoms, bottom sandy, shells.

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

"Stolon delicate without free branches, zooecia erect with a long slender base-like pedicel, with a flattened membranous frontal area and without spines at the distal end around the oral aperture." Osburn, 1944:26.

Genus **TRITICELLA** Dalyell, 1848

Zoaria with creeping stolons. Zooecia pedicellate, erect, attached to the stolon by means of a movable joint. Zooecia are elongate, ovoid, with a membranous frontal area. No gizzard. Genotype: *Triticella flava* Dalyell, 1848.

Triticella pedicellata (Alder), 1857

Plate 80, fig. 4

Farrella pedicillata Alder, 1857:158.
Triticella pedicellata, O'Donoghue, 1923:193, 1926:61.

The zoaria are stolonate, creeping. The zooecia may be clustered, arising from short lateral internodes of the stolon. The pedicel is slender, measuring between 0.03 and 0.04 mm in diameter near the base, becoming slightly enlarged toward the zooecia proper. At the point of junction with the zooecia, the pedicel becomes transversely wrinkled. The zooecia are elongate, elliptical, ranging in length from 0.80 to 1.25 mm, and in width from 0.16 to 0.23 mm. A flattened frontal area extends the full length of the zooecia proper. The polypide does not have a gizzard. The tentacles number 12.

There is some variation in the length of the pedicels, but they are usually about twice the length of the zooecia. The longest measured 2.40 mm, which when combined with its zooecial measurement of 1.19 mm, gave a total height of 3.59 mm.

This species has been previously reported in the cool waters of England and northern Europe. In the eastern Pacific it has been previously reported from the Vancouver Island region.

The specimens in the Hancock collection are from Canoe Bay, Alaska, and Union, Washington. The depth of the Alaskan specimens is unknown; those from Washington were collected at 10 fathoms.

Triticella elongata (Osburn), 1912

Plate 80, fig. 5

Hippuraria elongata Osburn, 1912:256.
Triticella elongata, Osburn, 1944:26.

Zoaria living in the gill chambers of the pea crab, *Scleroplax granulata* Rathbun. The adnate stolons give rise to erect zooecia, which are usually paired in clusters. The zooecia arise from short internodes, rather than directly from the stolons. The zooecia range in length from 0.90 to 1.80 mm, including the pedicel. The length of the zoids proper ranges between 0.50 and 0.90 mm. In width, the zooecia range from 0.18 to 0.24 mm. The polypide has 16 to 18 tentacles.

Osburn, 1944:26, reports this species from Chesapeake Bay, and its geographical distribution on the Atlantic coast of North America from Vineyard Sound, Massachusetts to Beaufort, North Carolina. It has not been previously reported from the eastern Pacific.

Specimens in the Hancock collection are from Elkhorn Slough, California, collector R. I. Smith. No depth data available. Found on *Scleroplax granulata* Rathbun.

Genus **FARRELLA** Ehrenberg, 1838

Zoaria with reptant stolons. Zooecia arising within the internodes along the entire length of the stolon. No gizzard. Genotype: *Lagenella repens* Farre, 1837.

Farrella elongata (P. J. van Beneden), 1845

Plate 80, fig. 3

Laguncula elongata van Beneden, 1845a:26.
Triticella tegeticula O'Donoghue, 1923:193.

The zoaria are comprised of creeping stolons, which may in the older colonies form a dense mat-like network upon the substrate. In the young zoaria the zooecia are seen to arise from the creeping stolons within the internodes, budding forth laterally and vertically without apparent order. In the older colonies, this lack of arrangement packs the pedunculate zooecia closely together. The zooecia are robust, elongate, ovoid to subcylindrical in form, and are situated at the end of a long peduncle that may attain a length of from 0.50 to 0.80 mm. The peduncle is transversely wrinkled and gradually widens into the zooecia proper without a definite joint. The overall length of the zooecia ranges from 1.16 to 1.35 mm, while the width varies from 0.32 to 0.39 mm. The diameter of the primary stolon is about 0.03 mm. The polypide lacks a gizzard. The tentacle number of 16 was determined from serial sections.

A striking feature of this species is the morphology of the zooecial aperture. The aperture deviates from the typical rounded or squared form of the stolonate ctenostomes in that it is bilabiate. Close examination of the apertural area will reveal a pair of lip-like structures, each reinforced by a thin but definite chitinous rim. These "lips" are found only in the zooecia that have reached maturity. Farre, 1837:403, in his work on *Lagenella repens* (Farre), 1837, a very closely related species, considered the labiate structure to be opercula.

Marcus, 1926:50, using *Farrella repens* (which according to Farre, van Beneden, and Hincks, has only 12 tentacles) and experimentally causing unfavorable conditions, produced the "Form" *elongata* and at the same time reduced the tentacle number. Marcus overlooked the fact that van Beneden reported 16 tentacles for *Farrella elongata,* the same number that was found in the Pacific specimens.

Triticella tegeticula O'Donoghue, 1923, is here suggested as a possible synonym of *F. elongata,* because of its habit of growth as well as the morphology of the zooecia. Although O'Donoghue failed to mention

in his description the presence of a bilabiate aperture, the figure of his specimen strongly suggests the bilabiate type of structure.

Farrella elongata appears to be well represented in the cooler European waters in the vicinity of England and the Adriatic Sea.

Hancock Station, 1489-42, Coos County, Oregon; also taken at Tomales Bay, California, by R. J. Menzies. Intertidal.

Division 5. **Terebriporina** Soule, new division

Ctenostomes with stolonate zoaria that are characteristically imbedded within the calcareous shells of living or dead mollusks, brachiopods, or barnacles, their presence marked by the apertural openings of the zoids appearing at the surface of the shell. The stolons are thin, thread-like, septate.

The three families that are placed under the Terebriporina cannot be readily differentiated by the pattern of the tracings that appear upon the surface of the shell in which the zoaria are immersed. The only means of postive identification of the families and the genera is examination of zoaria that have been removed from shells by decalcification. The identification of species involves not only the study of zoid anatomy, but serial sections of the autozoids to determine definitely the tentacle number. The family Penetrantiidae can be anatomically identified by its zoaria with primary and secondary stolons, its typical gonozoids, and the operculated autozoids. Terebriporidae, also with primary and secondary stolons, lacks the operculated autozoids, while Immergentiidae, having autozoids with typical ctenostomatous apertures, has zoaria devoid of true gonozoids, the colonies being composed of a series of zoids joined by stolon-like tubules that are direct extensions of the zoids.

Family **Terebriporidae** d'Orbigny, 1847

Zoaria burrowing, stolonate. The zooecia are connected to the primary or main stolons by means of short secondary stolons emitted from near the distal zooecial extremity.

Genus **TEREBRIPORA** d'Orbigny, 1847

Zoaria stolonate, consisting of primary stolons joined to the zoids by secondary stolons, with the point of union being nearly midway between the distal and proximal extremities, but always closer to the distal end. Polypide provided with a gizzard. Genotype: *Terebripora ramosa* d'Orbigny, 1847.

Terebripora comma Soule, 1950

Plate 80, fig. 6

Terebripora comma Soule, 1950:380.

The zoaria have successive zoids alternately placed to the right and left of the primary stolon at the end of a short secondary stolon. The short lateral stolon has a septum at the junction point where the stolon meets the zoid. The secondary stolons enter the zoids about midway between the distal and proximal extremities of the zoids, but always nearer to the distal end. Two types of zoids are in evidence, the autozoids (feeding individuals) and zoids modified for reproduction that may be termed gonozoids for convenience. Anatomically, the autozoids are typical of the usual ctenostomate type. The polypide bears a prominent globular gizzard. In length the autozoids range from 0.32 to 0.35 mm, and in width from 0.06 to 0.08 mm. The tentacles are short, and are 8 in number. The autozoids are elongate, with the distal aperture bluntly square, and the proximal portion terminating in a tapering rounded point. No brown bodies were seen. The reproductive zooecia or gonozoids have a prominent, large, oval embryo measuring about 0.06 mm in diameter at maturity. In length, the gonozoids range from 0.29 to 0.33 mm, and in width from 0.07 to 0.08 mm.

Hancock Station, 1937-50, Anacapa Island, southern California. Also off Newport, southern California. Depth, 18 to 43 fms.

Family **Immergentiidae** Silen, 1946

Zoaria with only primary stolons, that are not stolons in the strict sense, being prolongations of the zoids. These stolons arise directly from the distal tips of the preceding zoids, and connect one zoid with another in a series.

Genus **IMMERGENTIA** Silen, 1946

Zoaria imbedded in the shells of both living and dead mollusks. The stolonal connections between zoids are slender, thread-like, originating at the distal ends of the zooecia. The zoids are small in size, elongate, narrow. The proximal end may be bluntly rounded or tapered to a narrow point. The distal tip bears a centrally placed square shaped aperture. No zoid specifically modified for reproduction is known to occur. Genotype: *Immergentia californica* Silen, 1946.

Immergentia californica Silen, 1946

Plate 80, fig. 7

Immergentia californica Silen, 1946:6.
Immergentia californica, Soule, 1950:364.

The specimens of *I. californica* in the Hancock collection are identical in all important respects with the paratype material generously donated by Dr. Lars Silen. The zoaria have the zoids arranged in straight rows, with lateral rows branching to the sides at rather irregular intervals. In length the zoids range between 0.32 and 0.34 mm, and in width the range is from 0.08 to 0.09 mm. The tentacle number is 10 as determined by serial sections.

This species was originally described by Silen from material collected at Pacific Grove, California.

Specimens in the Hancock collection are from San Pedro and Portuguese Bend, southern California. All intertidal.

Family Penetrantiidae Silen, 1946

Zoaria with septate stolons. Zoids joined to the main stolons by means of short lateral stolons entering the zoids near the distal extremity. Zoids have a double cuticle and are provided with an operculum. The polypide has a gizzard. Reproductive zoids, the gonozoids, have rudimentary polypides and bear large ovoid embryo chambers.

Genus PENETRANTIA Silen, 1946

Zoaria are imbedded in the shells of both living and dead mollusks and cirripeds. The zoids are connected by thin septate stolons. From a primary stolon a short thin lateral branch enters the zoid laterally at the distal end. A zoid modified for reproduction, the gonozoid, is present. The zoids are operculated. The polypide is provided with a gizzard. Genotype: *Penetrantia densa* Silen, 1946.

Penetrantia densa Silen, 1946

Plate 80, fig. 8

Penetrantia densa Silen, 1946:2.
Penetrantia densa, Soule, 1950:360.

The zoaria characteristically have the zooecial openings crowded closely together. These openings in the molluscan shells vary in shape from circular to strongly oval. The primary stolons are serrated upon

their upper surfaces. From a primary branch short lateral branches extend to the zoids, entering them at the distal end. The autozoids (feeding individuals) are usually straight, or only slightly curved. In length they range from 0.47 to 0.55 mm, and in width they vary from 0.09 to 0.11 mm. Infrequently, an autozoid with a sharply pointed rather than a bluntly rounded proximal end will be found. The tentacles are 12 in number, determined from serial sections. The reproductive zoid, the gonozoid, is usually as long as but may be slightly shorter than the autozoid. Its proximal portion, extending below the embryo chamber, is long, thin and slightly curved in the direction of the embryo chamber. The embryo chamber is globular, giving the gonozoid a "pot-bellied" appearance. The tentacle number of the gonozoid is 8, but only in immature gonozoids will they be found, where the polypide has not completely degenerated.

The specimens described in the original report by Silen were collected from South Africa and the Cape of Good Hope, and there was one "doubtful" specimen from Panama.

The specimens in the Hancock collection are from numerous localities from San Pedro to La Jolla, southern California, all intertidal.

Penetrantia concharum Silen, 1946

Plate 80, fig. 9

Penetrantia concharum Silen, 1946:5.
Penetrantia concharum, Soule, 1950:360.

The zoids of the colonies are well spaced, without the crowding noted in *P. densa.* The openings in the shell are well defined, reniform in shape. The autozoids are straight, slender, with the proximal extremity tapering to a point. The autozoids range in length from 0.46 to 0.54 mm, and in width from 0.08 to 0.10 mm. The tentacles number 10, as determined from sections. The gonozoids are comparatively rare. The proximal extremity of the gonozoids is straight and visibly thicker than the gonozoid of *P. densa.*

Penetrantia concharum was found by Silen to occur in numerous localities in Sweden and Norway.

The specimens in the Hancock collection are from several localities ranging from San Pedro to La Jolla in southern California and southward to Rosarito, Lower California, Mexico (Hancock station 1597-47). All are intertidal.

Penetrantia sileni Soule, 1950

Plate 80, fig. 10

Penetrantia sileni Soule, 1950:361.

The openings in the scaphopod shell made by this species vary considerably in shape, from a simple circular to a highly exaggerated reniform appearance. The stolon is thin, not serrated on its upper surface, and is in general circular in cross section. The zoids are placed close to each other but are not crowded. The autozoid ranges in length from 0.35 to 0.36 mm, and in width from 0.07 to 0.08 mm. The autozoids may be slightly curved, and they may have a pointed rather than a rounded proximal extremity. The tentacle number, as determined from serial sections, is 11. The mature gonozoid has a very characteristic morphology. It is little more than one-half the length of the autozoid, ranging from 0.19 to 0.20 mm in length. The narrowed proximal portion barely reaches below the swollen embryo chamber.

Specimens in the Hancock collection are from off the San Benito Islands, Mexico, Hancock station 1010-39, 28°12′05″N, 115°33′45″W. The depth range is from 71 to 86 fathoms. It is as yet known only from the eastern Pacific.

REFERENCES

1. Papers dealing only with Pacific Coast Bryozoa

FEWKES, J. W.

1889. A Preliminary notice of a Stalked Bryozoon *(Ascorhiza occidentalis)*. Ann. and Mag. Nat. Hist. ser. 6, vol. 3, pp. 1-6, pl. 1.

HINCKS, T.

1884. Report on the Polyzoa of the Queen Charlotte Islands. Ann. and Mag. Nat. Hist. ser. 5, vol. 13, pp. 49-58, 203-215.

O'DONOGHUE, C. H. and ELSIE O'DONOGHUE

1923. A Preliminary List of Bryozoa (Polyzoa) from the Vancouver Island Region. Contr. Canad. Biol. Fish. new ser., vol. 1, pp. 143-201 (1-59), pls. 1-4.

1925. Notes on certain Bryozoa in the collection of the University of Washington. Wash. [State] Univ. Puget Sound Biol. Sta. Pubs. vol. 5, pp. 15-23.

1925a. List of Bryozoa from the vicinity of Puget Sound. Wash. [State] Univ. Puget Sound Biol. Sta. Pubs. vol. 5, pp. 91-108.

1926. A Second List of the Bryozoa (Polyzoa) from the Vancouver Island Region. Contr. Canad. Biol. Fish. new ser., vol. 3, pp. 49-131 (1-85), pls. 1-5.

ROBERTSON, ALICE

1900. Papers from the Harriman Alaska Expedition. VI. The Bryozoa. Proc. Wash. Acad. Sci. vol. 2, pp. 315-340, pls. 19-21.

1902. Some observations on *Ascorhiza occidentalis* Fewkes, and related Alcyonidia. Proc. Calif. Acad. Sci. ser. 3, Zool. vol. 3, pp. 99-108, pl. 14.

SOULE, J. D.

1950. Penetrantiidae and Immergentiidae from the Pacific (Bryozoa: Ctenostomata). Trans. Amer. Micros. Soc. vol. 69, pp. 359-367, pls. 1-2.

1950a. A new species of *Terebripora* from the Pacific (Bryozoa: Ctenostomata). Jour. Wash. Acad. Sci. vol. 40, pp. 378-381, figs. 1-3.

1951. Two new species of incrusting ctenostomatous Bryozoa from the Pacific. Jour. Wash. Acad. Sci. vol. 41, pp. 367-370, figs. 1-4.

2. General References

ADAMS, J.

1800. Descriptions of some Marine Animals found on the Coast of Wales. Trans. Linn. Soc. London. vol. 5, pp. 7-13, pl. 2.

ALDER, J.

1857. A catalogue of the Zoophytes of Northumberland and Durham. Trans. Tyneside Nat. Field Club. vol. 3, pp. 93-162, pls. 3-9.

BENEDEN, J. P. VAN

1845. Recherches sur l'anatomie, la physiologie et le développement des Bryozoaires qui habitent la côte d'Ostende. Nouv. Mém. Brussels Acad. Roy. de Belg. vol. 18, pp. 1-44, pls. 1-5.

1845a. Recherches sur l'organisation des *Laguncula*. Nouv. Mém. Brussels Acad. Roy. de Belg. vol. 18, pp. 1-29, pls. 1-3.

BUSK, G.

1852. An account of the Polyzoa, and Sertularian Zoophytes, collected . . . on the coasts of Australia and the Louisiade Archipelago. *In* MacGillivray, J. Narrative of the Voyage of H. M. S. Rattlesnake . . . during . . . 1846-50. Appendix. London. vol. 1 (4), pp. 343-388.

1856. Zoophytology. Quart. Jour. Micros. Sci. new ser., vol. 4, pp. 93-96, pls. 5-6.

1874. On *Clavopora hystricis*—a new Polyzoon belonging to the family Halcyonelleae. Quart. Jour. Micros. Sci. new ser., vol. 14, pp. 261-262, pl. 9.

1886. Report on the Polyzoa collected by H. M. S. Challenger during the years 1873-1876. Part II.—The Cyclostomata, Ctenostomata and Pedicellina. *In* Report on the Scientific Results of the Voyage of H. M. S. Challenger during the years 1873-76. Zoology. vol. 17 (3), pp. i-viii, 1-47, pls. 1-10.

DELLE CHIAJE, S.

1828. Memorie sulla storia e notomia degli Animali senza vertebre del Regno di Napoli. vol. 3.

EHRENBERG, C. G.

1831. Symbolae Physicae . . . Pars Zoologica. Anim. evert. exclus. insect Berolini. pls. 1-10 with descr. letterpress.

FARRE, A.

1837. Observations on the Minute Structure of some of the higher forms of Polypi, with views of a more natural arrangement of the Class. Phil. Trans. Roy. Soc. London. vol. 127 (2), pp. 387-426, pls. 20-27.

FLEMING, J.

1828. Zoophyta. *In his* A History of British Animals. Edinburgh, London. pp. 505-554.

GOSSE, P. H.

1855. Notes on some new or little known Marine Animals. (Fascis II.) Ann. and Mag. Nat. Hist. ser. 2, vol. 16, pp. 27-36, pls. 3-4.

HARMER, S. F.

1915. The Polyzoa of the Siboga Expedition. Part 1, Entoprocta, Ctenostomata and Cyclostomata. *In* Siboga-Expeditie. Leyden. Mon. 28a, pp. 1-180, pls. 1-12.

HASSALL, A. H.

1841. Description of two new genera of Irish Zoophytes. Ann. and Mag. Nat. Hist. vol. 7, pp. 483-486.

HELLER, C.

1867. Die Bryozoën des adriatischen Meeres. Verhandl. Zool.-Bot. Gesell. Wien. vol. 17, pp. 77-136, pls. 1-6.

HINCKS, T.

1860. Descriptions of new Polyzoa from Ireland. Quart. Jour. Micros. Sci. vol. 8, pp. 275-285, pls. 30-31.

1880. A History of the British Marine Polyzoa. London. 2v.

1887. The Polyzoa of the Adriatic: a supplement to Prof. Heller's "Die Bryozoën des adriatischen Meeres." Ann. and Mag. Nat. Hist. ser. 5, vol. 19, pp. 302-316, pl. 9.

1887a. On the Polyzoa and Hydroida of the Mergui Archipelago. Jour. Linn. Soc. London. Zool. vol. 21, pp. 121-134, pl. 12, figs. 1-13.

JOHNSTON, G.

1838. A History of the British Zoophytes. London, Edinburgh. 341p., 44 pls.

1847. *Idem,* (Ed. 2). London. 2v.

LAMOUROUX, J. V. F.

1816. Histoire des polypiers coralligènes flexibles, vulgairement nommés zoophytes. lxxxiv, 559p., 19 pls.

LEIDY, J.

1855. Contributions towards a knowledge of the Marine Invertebrate Fauna of the coasts of Rhode Island and New Jersey. Jour. Acad. Nat. Sci. Phila. ser. 2, vol. 3, pp. 135-152, pls. 10-11.

MACGILLIVRAY, P. H.

1889. On some South Australian Polyzoa. Trans. and Proc. Roy. Soc. So. Austral. vol. 12, pp. 24-30, pl. 2.

MARCUS, E.

1926. Beobachtungen und Versuche an lebenden Meeresbryozoen. Zool. Jahrb., Abt. f. System., Geog. u. Biol. Tiere, vol. 52, pp. 1-102, pls. 1-2.

1941. Sôbre Briozoa do Brasil. São Paulo Univ. Bol. Faculd. Filos. Cien. Letr. vol. 22 (Zool. 5), pp. 3-208, pls. 1-18.

OSBURN, R. C.

1912. The Bryozoa of the Woods Hole region. Bul. U. S. Bur. Fisheries. vol. 30, pp. 205-266, pls. 18-31.

1933. Bryozoa of the Mount Desert Region. Repr. from the Biological Survey of the Mount Desert Region. Philadelphia. 67p., 15 pls.

1936. Bryozoa collected in the American Arctic by Captain R. A. Bartlett. Jour. Wash. Acad. Sci. vol. 26, pp. 538-543, 1 fig.

1940. Bryozoa of Porto Rico with a Résumé of the West Indian Bryozoan Fauna. *In* Scientific Survey of Porto Rico and the Virgin Islands. New York. vol. 16 (3), pp. 321-486, pls. 1-9.

1944. A survey of the Bryozoa of Chesapeake Bay. Chesapeake Biol. Lab. Contr. no. 63, pp. 1-55, pls. 1-5, text figs. 1-28.

ROBERTSON, ALICE

1921. Report on a Collection of Bryozoa from the Bay of Bengal and other Eastern Seas. Rec. Indian Mus. vol. 22, pp. 33-65.

ROGICK, M. D. and H. CROASDALE

1949. Studies on Marine Bryozoa III, Bryozoa associated with Algae. Biol. Bul. vol. 96, pp. 32-69, figs. 1-10.

SILEN, L.

1942. *Carnosa* and *Stolonifera* (Bryozoa) collected by Prof. Dr. Sixten Bock's expedition to Japan and the Bonin Islands, 1914. Arkiv för Zool. vol. 34A (8), pp. 1-33, text figs. 1-24.

1946. On two new Groups of Bryozoa living in Shells of Molluscs. Arkiv för Zool. vol. 38B (1), pp. 1-7, text figs. 1-12.

1947. On the spines of *Flustrella* (Bryozoa). Zool. Bidr. Uppsala. vol. 25, pp. 134-140, pl. 1, text figs. 1-7.

SMITT, F. A.

1871. Kritisk förteckning öfver Skandinaviens Hafs-bryozoer. Öfversigt af Svenska Vetensk. Akad. Förhandl. vol. 28, pp. 1115-1134, pls. 20-21.

THOMPSON, J. V.

1830. On Polyzoa, a new animal discovered as an inhabitant of some Zoophites—with a description of the newly instituted genera of *Pedicellaria* and *Vesicularia,* and their Species. *In his* Zoological Researches IV. Memoir 5, pp. 89-102, pls. 1-3.

ZIRPOLO, G.

1924. *Zoobotryon pellucidum* Ehrbg. = *Z. verticillatum* (delle Chiaje). Bol. Soc. Nat. Napoli. vol. 36 (Commun. verb.), pp. 6-7.

Phylum Entoprocta

By Raymond C. Osburn, Ph.D., D.Sc.

Phylum **ENTOPROCTA** Nitsche, 1869

Subphylum Entoprocta, various authors.
Phylum Entoprocta, Hatschek, 1888.
Phylum Calyssozoa Clark, 1921:19 and 23.
Phylum Kamptozoa Cori, 1929:5.
Phylum Entoprocta, Hyman, 1951:521.

Until recent years this group has generally been considered a subphylum or subclass of the Bryozoa, although Hatschek as early as 1888 (Text-book of Zoology) separated the Phylum Entoprocta. In 1921 Clark recognized the differences and proposed the Phylum Calyssozoa. Again Cori in 1929, though he was familiar with the name Clark had suggested, thought it necessary to rename the group as Phylum Kamptozoa. These writers considered the Entoprocta to be much simpler than the Ectoprocta and separated them widely. Marcus (1939:208-288) raised objections to this wide separation and gave some very cogent reasons for retaining the group as a subphylum of the Bryozoa. Recently Dr. Libbie Hyman, in the third volume of "The Invertebrates" (1951: 521-554) again separates the group as a phylum. She assigns it to a place much lower in the scale and retains the name Entoprocta for the very good reason that it is unnecessary to invent a new name when a perfectly good one already exists. Hyman's discussion is a very satisfactory analysis of the knowledge of the Entoprocta, and it seems unnecessary to argue the matter further at present.

Whether or not the entoprocts are closely allied to the ectoprocts and wherever they may eventually be placed in the taxonomic scale, it happens that the only taxonomists who have paid much attention to them are the bryozoologists, and for this reason the species which are known from the Pacific coast are appended to the Bryozoa. The list is small as the species are not numerous, and the littoral species are rarely found among the dredgings.

The Entoprocta are stalked, with naked heads or calyces (polypides), the tentacles rolled inward instead of being withdrawn into a zooecium, and the anal opening is within the ring of tentacles instead of outside as it is in the Ectoprocta.

The family Loxosomatidae is unique in that the individuals live singly and do not form colonies, and they live as epizoites on other animals, usually on sponges, worms, other Bryozoans, etc. The only other family, Pedicellinidae, is colonial and is represented among our material by 4 genera and 8 species.

Family **Loxosomatidae** Hincks, 1880

The individuals are not colonial but live singly, attached to some other animal by a muscular sucking disc at the base of the stalk. They are unchitinized, flexible and capable of bending in any direction, and some of them, at least, are capable of moving about and re-attaching themselves. They produce buds from the sides of the calyx, but these sever their connections when their growth is complete and live singly thereafter. They are all small, some of them microscopic in size. There are two genera, *Loxosoma* Keferstein and *Loxocalyx* Mortensen, depending on whether the foot-gland disappears after attachment or remains functional.

Genus **LOXOSOMA** Keferstein, 1863

Loxosoma davenporti Nickerson, 1898

Loxosoma Davenportii Nickerson, 1898:220.
Loxosoma Davenporti Nickerson, 1899:368.
Loxosoma davenporti Nickerson, 1901:351.
Loxosoma davenporti, Osburn, 1912:212.

This species has been noted only once on the Pacific coast, by O'Donoghue at low tide in Hammond Bay Lagoon, British Columbia. It is a commensal in worm tubes.

The entire animal is about 2 mm long, somewhat vase-shaped, the pedicel cylindrical and about as long as the calyx into which it merges gradually; foot-gland wanting in the adult; lophophore with 18 to 30 tentacles, the body somewhat narrowed below the lophophore; usually with a pair of flask-shaped glandular organs on the ventral side of the body near the lower end of the stomach. The species was originally obtained by Nickerson and later by Osburn in the Woods Hole region, Massachusetts.

? **Loxosoma** sp.

A small species which was epizoic on an annelid worm at Point Barrow, Alaska, and on account of the preservation is unidentifiable even to the genus. The calyx expands gradually from the pedicel upward; width of calyx at the upper end 0.18 to 0.22 mm, height 0.33 to 0.40 mm, length of pedicel about 0.40 mm. Apparently there is no foot gland, and the tentacles cannot be counted.

Genus **LOXOCALYX** Mortensen, 1911

In this genus the foot-gland is evident and functional throughout life. Genotype *Loxosoma raja* Schmidt, 1876.

Loxocalyx sp.

Three individuals attached to the parapodia of an annelid worm, *Gattyana cirrosa,* from Puget Sound. The calyx expands abruptly, and its base is rounded; width of calyx 0.26 mm, height 0.33 mm, length of pedicel 0.40 mm. The foot-gland is present, but the tentacle number cannot be estimated.

Family **Pedicellinidae** Johnston, 1847

Colonial, the individuals erect from a creeping segmented stolon, the pedicels and stolon more or less chitinized. In the genera *Myosoma* and *Pedicellina* the pedicel is muscular and flexible, without a special muscular enlargement at the base, while in *Barentsia* and *Coriella* the pedicel is more chitinized and bears an enlarged, barrel-shaped muscular enlargement at its base. In *Barentsia* daughter individuals are often produced by budding from joints of the pedicel.

Key to Genera of Pedicellinidae

1. Pedicels not heavily chitinized, muscular and flexible, rising directly from the stolon without a specialized muscular base . 2
   Pedicels usually stiff and inflexible, with an enlarged cylindrical, somewhat barrel-shaped base 3
2. The lophophore (tentacle crown) is diagonally placed on the ventral side; the pedicel thick and with strong diagonal muscles . . . . . *Myosoma*
   The lophophore is terminal, the pedicel narrower and without diagonal muscles . . . . . *Pedicellina*
3. Individuals always arising from short stolon internodes; erect branches formed by the fusion of stolons; pedicels never jointed . . . . . *Coriella*
   Individuals arising from short stolon internodes, or from the sides of the pedicels; erect branches sometimes formed by enlarged pedicels; the stolons do not fuse to form erect branches . . . . . *Barentsia*

Genus **MYOSOMA** Robertson, 1900

"Zoarium with stolon composed partly of successive polypide-bearing segments and partly of alternate non-polypide-bearing segments; both stalk and calyx muscular, the muscle fibers continuous from one into the other; polypide oblique." (Robertson, 1900:324). Genotype, *M. spinosa* Robertson, 1900:324.

The pedicel is unusually thick, flexible, and has a conspicuous set of diagonal muscles in addition to longitudinal ones. The stolon is entirely adnate.

Myosoma spinosa Robertson, 1900

Plate 82, fig. 1

Myosoma spinosa Robertson, 1900:324.

The creeping stolon gives rise to branches which sometimes unite side by side but more frequently ramify and cross each other, forming a rather close mat; all of the internodes are comparatively short, ranging from 0.20 to 0.70 mm, the infertile internodes 0.08 to 0.12 mm in diameter, the fertile ones somewhat thicker, especially near the origin of zooecial buds. The zooecia arise from the internodes without any special differentiation, and even the muscles extend down into the stolon. The pedicels are exceptionally large, as much as 0.26 mm in diameter, narrowing upward to about 0.13 mm below the calyx, varying greatly in height to as much as 2.50 mm. They are highly muscular, with the unique diagonal muscles in addition to the longitudinal ones.

The calyx is moderately large, ovoid in shape, averaging about 0.65 mm long by 0.40 mm in width, the dorsal side more curved; the lophophore is diagonally placed on the shorter ventral side; the tentacle number is apparently 16. Chitinous spines, varying in number, are present on the dorsal side of the calyx and also on the stolon.

Robertson listed the species from Dillon Beach, Tomales Bay, and from Fort Point and San Diego, California.

Hancock collections, numerous specimens from Dillon Beach, California, the type locality, Dr. R. J. Menzies, collector. The writer has also taken it at Newport Bay and at La Jolla, California. It is a littoral species and, as far as known, occurs only on the coast of California.

Genus **PEDICELLINA** M. Sars, 1835

The zoarium is entirely adnate, consisting of fertile and infertile internodes, the latter rather regularly 0.40 mm in length; lateral stolons sometimes cause the zoarium to cover a considerable area. The pedicel

is large, as much as 0.25 mm in diameter at the base and about half as wide as its distal end, as much as 2 mm long but usually much shorter; flexible and with longitudinal muscles only which do not extend into the calyx. The expanded calyx is cup-shaped, with the tentacle crown transverse at the top. Spines present on the stalk and calyx, or wanting on one or both of them. Genotype, *Brachionus cernuus* Pallas, 1771.

Pedicellina cernua (Pallas), 1771

Plate 82, fig. 2

Brachionus cernuus Pallas, 1771:57.
Pedicellina americana Leidy, 1855:143.
Pedicellina nutans, Robertson, 1900:332.
Pedicellina echinata, Robertson, 1900:344.
Pedicellina cernua, O'Donoghue, 1926:7.

The stolon is slender, more or less transparent, branching, consisting of an irregular succession of fertile and infertile internodes, the fertile ones shorter than the others, as a rule, and somewhat swollen. The pedicel is broadest at the base, about 0.25 mm in diameter but often smaller, diminishing in size upward to about half of the basal width; thin walled and flexible, with longitudinal muscles which do not enter the calyx. Usually there is a slight constriction between the pedicel and calyx. The pedicel may be 2 mm or more in length but is usually shorter.

The calyx is cup-shaped with a well-marked gibbosity on the dorsal side, varying greatly in size, in our largest specimens about 0.55 mm long by 0.40 mm in diameter. The lophophore is terminal and transverse, with the tentacle number varying from 14 to 24.

Spines are sometimes present on the stalk and also on the calyx, and this feature has led to the erection of several species names, *P. echinata* M. Sars, 1835:5, *P. glabra* Hincks, 1880:565 and *P. hirsuta* Jullien, 1888:13. However there is so much variation in the presence and distribution of the spines that these must be considered merely nominal varieties. In our material, which extends from British Columbia to southern California, most of the zooecia are without spines, while a few spines occur occasionally even on the same colonies with bare zooecia.

The species is cosmopolitan. Robertson listed it as *P. nutans* (?) from Yakutat, Alaska, and as *echinata* from Tomales Bay, California, and O'Donoghue recorded it from several localities in British Columbia.

Hancock collections: Five Fingers, British Columbia; Tomales Bay and Lime Point, California; and the writer has obtained it at Newport Harbor and La Jolla, southern California. It is a littoral species, usually found on the piles of docks or at low tide.

Genus **BARENTSIA** Hincks, 1880

Pedicellinopsis Hincks, 1884.
Ascopodaria Busk, 1886.
Gonopodaria Ehlers, 1900.
Arthropodaria Ehlers, 1900.

This genus is distinguished by the presence of a large, barrel-shaped, muscular swelling at the base of the pedicel (a character which it also shares with *Coriella* Kluge) and by the adnate stolons which never fuse to form erect branches (as they do in *Coriella*). The pedicel is narrow above the muscular base and is usually well chitinized and stiff; joints occasionally appear in most of the species and in some of them are characteristic. In most of the species the pedicel appears to be more or less perforated, but the outer chitinous layer is complete and there are no pores; the cavities are limited to the internal layer. The calyx is more or less ovoid or vase-shaped, the lophophore terminal and transverse, and at its base the calyx is separated from the chitinized pedicel by a short flexible portion. The muscular base permits swinging back and forth, and the short flexible base of the calyx also permits the head to move freely on the pedicel. In at least one species, *B. laxa* Kirkpatrick, the pedicel is only slightly chitinized, provided with longitudinal muscles, and can be bent or looped in any direction. Genotype, *B. bulbosa* Hincks, 1880a:285.

The differences in the jointing and branching of the pedicel caused the erection of several other generic names, but there is so much variation in this character that it is often not even of specific value. Some species (*e.g. discreta* Busk) very rarely are jointed, some others (*ramosa* Robertson) are very regularly jointed and branched; sometimes the joints are enlarged and muscular, or the muscular enlargement may be wanting. These characters have some value for the determination of species but are scarcely valid for the separation of genera.

Key to Species of *Barentsia*

1. Upper half of the basal internode and the whole of the short second internode thin-walled and flexible; base of the lower internode well chitinized . . . . . *subrigida*
   Stalks with chitinized walls, not flexible 2
2. Stalks never branched, usually without joints 3
   Stalks more or less jointed and branched, the nodes often much enlarged 5

3. Stalk short, basal bulb as long as or longer than the following internode, calyx large . . . . . *robusta*
   Stalk usually much longer than the basal bulb 4
4. Small species, seldom 2 mm in height, the internode little or not at all "perforated," joints simple, rare . . . . . *gracilis*
   Taller species, 2 to 4 mm high, internode very thickly "perforated," joints simple, rare . . . . . *discreta*
5. Zoarium very large, reaching a height of 5 centimeters, profusely branched; muscular bulbs of varying size, sometimes gigantic; high Arctic . . . . . *gorbunovi*
   Branches few, arising from enlarged stem nodes, basal bulbs of one size 6
6. Tall slender species, long internodes, nodes moderately swollen; branching occasionally at the nodes, the basal bulb short and ovate . . . . . *geniculata*
   Stouter species, internodes shorter, the nodes much enlarged, nearly every stalk bears one or more branches; the internodes with a few "perforations" . . . . . *ramosa*

Barentsia gracilis (M. Sars), 1835

Plate 82, fig. 3

Pedicellina gracilis M. Sars, 1835:6.
Pedicellina gracilis, Hincks, 1884:208.
Ascopodaria gracilis, Robertson, 1900:345.
Gonypodaria nodosa, O'Donoghue, 1923:5.
Barentsia gracilis nodosa, O'Donoghue, 1926:7.
Barentsia gracilis, Marcus, 1938:8.

A small, delicate species, usually less than 1.0 mm in height. The stolon is creeping, usually among hydroids and other bryozoans. The basal bulb is of moderate size; the stalk short and lightly chitinized with few or no "perforations." The largest calyx in our specimens measures 0.25 mm high by 0.18 mm wide; the pedicel 0.95 mm high; the basal bulb 0.35 mm high by 0.12 mm in diameter. The pedicel usually bears no "perforations" but a few may be present. The joints, which mark the variety *nodosa* Lomas, 1886, are rare in our material, and they are only slightly enlarged.

Cosmopolitan. Recorded by Hincks and by O'Donoghue from a number of localities in British Columbia, and by Robertson from Lime Point and San Pedro, southern California.

Hancock Stations: 1274-41, Point Hueneme, 30 fms, and 1292-41, Santa Rosa Island, 28 fms, southern California. Also collected by the writer at low tide, Corona del Mar, southern California.

Barentsia discreta (Busk), 1886

Plate 82, fig. 8

Ascopodaria discreta Busk, 1886:44.
Pedicellina australis Jullien, 1888:13.
Barentsia timida Verrill, 1900:594.
Barentsia discreta, Osburn, 1912:214; 1940:327.
Barentsia discreta, Harmer, 1915:29.
Barentsia discreta, Marcus, 1937:15.
Ascopodaria misakiensis Oka, 1890:234.
Barentsia misakiensis, Oka, 1895:76.

The zoarium consists of a slender creeping stolon and erect slender zoids which may reach a total height of 3 mm, but usually range between 1.0 and 2 mm. The variation in height is almost entirely in the length of the slender stalk. The muscular basal bulb is moderately large, averaging about 0.50 mm high by 0.18 mm in width; the slender stalk from less than 1.0 mm to more than 2 mm; the calyx in our largest specimens measures 0.78 mm in height by 0.60 mm in width, but it is often much smaller. The slender stalk is straight, widening slightly and gradually upward, and is especially characterized by the large number of "perforations" of the inner layer of the stalk. The stalk is rarely jointed, but simple joints sometimes occur to the number of 2 or 3. Harmer states that the tentacle number is "about 20-24," but in smaller calyxes the number may be as few as 14.

It is a widely distributed species, occurring around the world in tropical and temperate waters. On the Atlantic coast it occurs from Cape Cod to Brazil, and Jullien described his *Pedicellina australis* from Cape Horn. Oka had it from near Tokyo, Japan, and Harmer from the East Indies. It has not been previously known from the Pacific coast, except for Waters' record at Magellanes, Chili.

Hancock Stations: 391-35, Lobos de Afuera Islands, Peru, 6°55′40″S, shore collection; 401-35, Mantua Bay, Ecuador, 1 fm; 1217-40, Point Fermin, California, shore collection, 33°42′30″N, and 1232-41, off San Pedro Breakwater, 17 fms, California. Also on piles of docks at Corona del Mar (R. C. Osburn) and Upper Newport Bay, shallow water, (J. D. Soule), southern California.

The known range on the Pacific coast is from 33°42′30″N, southern California, to Ecuador, Peru and Cape Horn. It appears to be a species of shallow waters, though Busk described it from Tristan de Cunha Island at a depth of 100-150 fms.

Barentsia ramosa (Robertson), 1900

Plate 82, Figs. 5 and 6

Gonypodaria ramosa Robertson, 1900:337.
Gonypodaria ramosa, O'Donoghue, 1923:6.
Barentsia ramosa, O'Donoghue, 1926:8.

The stolon is creeping and adherent, becoming heavily chitinized and brown, 0.07 mm in width. From this arise erect, jointed, and branched sub-colonies, with 3 or 4 joints in series, and these usually give rise to 1 or 2 branches which in turn may develop secondary branches. The internodes vary much in length, from 0.65 to 2.60 mm; in width they measure 0.06 mm at the base and 0.10 to 0.13 mm near the tips. The muscular nodes vary in length from 0.24 to 0.30 mm and in width from 0.15 to 0.20 mm. The basal bulb is short, 0.30 to 0.35 mm long by 0.20 to 0.26 mm wide. The calyx is short and wide, the height, excluding the tentacles, 0.35 to 0.50 mm and the width 0.40 to 0.55 mm. Tentacle number, 16-20. The total height of the tallest sub-colonies is about 5 mm.

Conspicuous features of the internodes are the heavy chitinization of the wall, the brownish color, and the conspicuous "pores," which are larger than in *B. discreta;* also the sub-colonies appear to be more rigid than in other members of the genus.

The species was described by Robertson from Pacific Grove (Monterey Bay), California, and recorded also from Fort Point and Land's End, California and from Channel Rocks, Puget Sound. O'Donoghue recorded it from several localities in British Columbia.

Hancock Collections: Carmel Cove, south of Monterey Bay, California, on the stems of the hydroid Garveia. It is a littoral species, but O'Donoghue dredged it at 20 fms.

Barentsia gorbunovi Kluge, 1946

Plate 82, figs. 10-12

Barentsia gorbunovi Kluge, 1946:153 and 157.

This is a remarkable species growing in bushy form to a height of 5 cm or more. There is an adherent stolon, 0.10 to 0.20 mm in width, from which arise very complex sub-colonies. At the bases of these there are gigantic muscular bulbs of the usual shape, but with a height of 1.0

to 2 mm and a diameter of as much as 0.80 mm. In other parts of the sub-colony the bulbs are much smaller, from 0.40 to 0.65 mm high and from 0.13 to 0.26 mm in diameter.

The erect branches should be homologous with the stalks of other barentsias, but they differ in bearing a series of zoids throughout their length without joints or septa; they appear like erect stolons, except for the large muscular basal bulb. These erect stems bear branches, all in the same plane, up to the fifth generation of zoids. The unbranched internodes are comparatively short, usually less than 1.0 mm and about 0.08 mm in diameter. The calyx is similar to those of other barentsias, 0.40 to 0.50 mm high by 0.35 to 0.40 mm in width.

The unusual features of this species are the large size and complexity of the colony, the nature of the branching, the absence of nodes, and the variation in the size of the basal bulbs.

Known only from Kluge's record (Drifting Ice Expedition in the central Arctic Ocean in the Ice-breaking Str. "G. Sedov," 1937-40).

Point Barrow, Alaska, Arctic Research Laboratory, 246 feet, G. E. MacGinitie, collector, several colonies.

Barentsia robusta new species

Plate 82, fig. 7

The stolon adnate, ramifying, 0.08 mm wide. The individual zooecia are short-stalked with large calyces, reaching a total height of about 2 mm. The stalks are disproportionate, as the basal bulbs are longer than the narrow internodes. The basal muscular bulbs are unusually long and measure rather regularly 0.90 mm in height by 0.18 mm in diameter. The internode is 0.70 to 0.78 mm long; at the base it varies from 0.06 to 0.08 mm wide and gradually enlarges to 0.11 to 0.13 mm in diameter at the top; the internode wall is moderately chitinized and its inner layer is punctured by scattering conspicuous "pores," similar to those of *B. discreta* but larger and much fewer in number. The calyx is large, the height to the base of the tentacle ring as much as 0.65 mm, and its width varying from 0.52 to 0.65 mm, cup-shaped, widest at the top and the base rounded, the dorsal side curved, the ventral side much straighter. The tentacles cannot be counted accurately but apparently they number about 20 to 24.

The larger calyces all contain embryos in August. The stout appearance of the zooecia, all about the same height, the large calyces (nearly one third of the total height) and the very long and comparatively slender basal bulbs which are consistently longer than the internodes,

distinguish the species. It was collected by the writer in 1902 and has remained unidentified in his collection for the past 50 years awaiting a proper place for publication.

Type, AHF no. 131.

Type locality, near Port Renfrew, Vancouver Island, at the site of the former University of Minnesota Biological Station; from the rocky wall of a deep tide-pool, R. C. Osburn, collector.

Barentsia geniculata Harmer

Plate 82, fig. 4

Barentsia geniculata Harmer, 1915:33.

? *Ascopodaria macropus,* Robertson, 1900:345.

The creeping stolon is thick-walled and brown, 0.06 or 0.07 mm in width; the fertile internodes short, 0.30 to 0.40 mm long, the infertile ones varying greatly in length to as much as 1.30 mm. The zoids are tall, reaching a total length of 5.20 mm, the stalk with 1 to 4 bulbous muscular joints. The stalk internodes are slender, only 0.04 mm at the base and enlarging slightly upward, with a few "pores"; the basal stalk internodes are long, from 1.50 to 1.70 mm, the later ones somewhat graduated in length, the shortest terminal one only 0.45 mm. The stalk nodes are enlarged, muscular and bulbous, the swelling about 0.20 mm long by 0.15 mm in width. The basal bulb is short and wide, about 0.40 mm high by 0.30 mm in diameter, coarsely wrinkled. The calyx is 0.30 mm high by 0.25 mm wide. The tentacle number cannot be determined accurately but they are numerous, at least 20.

One stalk is branched twice, at the first node and again at the first node of a branch. This feature resembles *B. ramosa,* but the nodes are much smaller and the internodes more slender, while the basal bulb is strikingly different.

This is probably the *Ascopodaria macropus* of Robertson, for which she gives no description, but states that it occurs at San Pedro, southern California. I believe it to be the *B. geniculata* of Harmer, as it agrees in the thick wall of the internodes, the form of the joints, the small number of "pores" ("tubercles," Harmer), the form of the muscular base and the size and form of the calyx. It differs in the longer internodes and in the rare formation of branches at the internodes.

Harmer described the species from the East Indies (Siboga Expedition).

Hancock Station 1292-41, near Santa Rosa Island, southern California, 33°53′30″N, 120°W, at 28 fms, two fragments.

Barentsia subrigida new species

Plate 82, fig. 9

A large species, reaching a height of more than 5 mm; it is especially characterized by the stalk which possesses regularly two internodes; the basal one is very elongate, 1.30 to more than 4 mm; the basal half, more or less, has the wall chitinized and rigid while the upper part remains thin-walled, muscular and flexible; this is followed by a somewhat expanded muscular joint, and above this is a short thin-walled and wrinkled flexible internode, only 0.40 to 0.55 mm in length. When completely developed, the top of the basal internode and the base of the terminal internode are both enlarged to about twice the width of the stem with a short muscular section between them; the terminal one has a definite diaphragm just above the node, similar to the one at the base of the first internode. Very old basal internodes may become chitinized for the full length, but I have seen only two such internodes. In any case the short terminal internode is always transparent and flexible. The basal internode usually bears a few "perforations," scattered and generally disappearing entirely on the upper half.

The basal muscular bulb varies greatly in height, from 0.25 to 0.55 mm, probably depending on the nature of contraction, and the width is about 0.15 mm.

The calyx is large, averaging about 0.35 mm high to the base of the tentacle crown, by 0.40 mm in width; the largest calyx measures 0.50 mm high by 0.52 mm wide; the dorsal side is more rounded than the frontal side, and the base is broadly rounded and attached by a rounded bulb to the upper internode. The tentacle number cannot be counted accurately but it appears to be at least 20.

The very regular disparity in the length of the two internodes, the thin-walled flexible upper ends of the basal internodes and the constant thin-walled, muscular, short terminal internodes, together with the large size, apparently mark this as a hitherto unknown species. It is possible that the *Ascopodaria macropus* of Robertson may belong here instead of under *B. geniculata.* The only other known species with flexible internodes is *B. laxa* Kirkpatrick, which has no joints in the stalk, no "perforations," and the stalk is not heavily chitinized basally.

Type, AHF no. 132.

Type locality, Hancock Station 1274-41, three and one-half miles south of Hueneme, southern California, 28°23′20″N, 115°11′52″W, at 55 fms, two colonies. Another specimen in the collection is labeled simply "California."

Genus CORIELLA Kluge, 1946

Stolon adnate and creeping, but giving off clusters of erect stolons which fuse into complex sub-colonies. The zoids arise from the fertile internodes of the erect stolons in large numbers on all sides of the complex branch. The zoids are simple and unbranched, with the usual muscular basal bulbs, and the stalks are provided with scattering "pores" similar to those of some species of *Barentsia*.

Genotype, *C. stolonata* Kluge, 1946:155.

The genus appears to be similar to *Barentsia* in all essential characters except the fusion of erect stolons to form branches.

Coriella stolonata Kluge, 1946

Plate 82, figs. 13 and 14

Coriella stolonata Kluge, 1946:155 and 157.

The complex erect branch varies greatly from 3 to 10 or 12 stolons, to a height of more than 1 cm in our specimens. The calyx is large, reaching 0.80 mm high by 0.65 mm in width; the stalk attains a length of 2 mm and a diameter of 0.06 to 0.08 mm, with rather numerous "pores"; the basal bulb measures 0.40 to 0.45 mm in height by 0.16 to 0.22 mm wide; it arises from a cup-shaped enlargement which is set at an angle on the side of a fertile stolon internode. The total height of the tallest zoid is 3.25 mm, but they are usually much shorter. The tentacle number, according to Kluge, is 22 to 24.

The erect clustered stolons distinguish this species from all members of the Pedicellinidae.

The only record is that by Kluge (Drifting Ice Expedition in the central Arctic Ocean in the Ice-breaking Str. "G. Sedov," 1937-40).

Point Barrow, Alaska, Arctic Research Laboratory, 295 feet, G. E. MacGinitie, collector.

REFERENCES

Busk, G.

1886. Report on the Polyzoa collected by H. M. S. Challenger during the years 1873-1876. Part II.—The Cyclostomata, Ctenostomata, and Pedicellinea. *In* Report on the Scientific Results of the Voyage of H. M. S. Challenger during the years 1873-76. Zoology. vol. 17 (3), pp. 1-44.

Clark, A. H.

1921. A New Classification of Animals. Bul. Inst. Océan. Monaco. no. 400, pp. 1-24.

Cori, C. J.

1929. Kamptozoa. *In* Kükenthal, Handbuch der Zoologie. vol. 2 (6), pp. 1-64.

Ehlers, E.

1890. Zur Kenntniss der Pedicellineen. Abhandl. K. Gesell. der Wiss. Göttingen. Phys. Kl. vol. 36 (1), pp. 1-200.

Harmer, S. F.

1915. The Polyzoa of the Siboga Expedition. Part 1, Entoprocta, Ctenostomata and Cyclostomata. Siboga-Expeditie. Leyden. Mon. 28a, pp. 1-180, pls. 1-12.

Hincks, T.

1880. A History of the British Marine Bryozoa. London. 2v.

1880a. On new Hydroida and Polyzoa from Barents Sea. Ann. and Mag. Nat. Hist. ser. 5, vol. 6, pp. 277-286, pl. 15.

1884. Report on the Polyzoa of the Queen Charlotte Islands. Ann. and Mag. Nat. Hist. ser. 5, vol. 13, pp. 203-215.

Hyman, L. H.

1951. The Invertebrates. New York, Toronto, London. vol. 3, pp. 521-554.

Jullien, J.

1888. Bryozoaires. *In* Mission Scientifique du Cap Horn, 1882-3. Paris. vol. 6, pp. 1-92, pls. 1-15.

Keferstein, W.

1863. Untersuchungen über niedere Seethiere, VIII. Ueber *Loxosoma singulare* gen. et sp. n., den Schmarotzer einer Annelide. Ztschr. f. Wiss. Zool. vol. 12, pp. 131-132.

Kluge, H.

1946. *Kamptozoa* from the Arctic Ocean. *In* Buinitski, V. Kh., ed. Trudy Dreifuiushchei èkspeditsii glavsevmorputi na ledokol' nom parokhode "G. Sedov" 1937-1940 gg . . . Moskva. [Works of the Expedition to Drifting Ice in the Central Arctic Ocean in the Ice-breaking Steamer "G. Sedov" from 1937 to 1940, ed. by V. Kh. Buinitski.] vol. 3, pp. 149-155 (English summary, pp. 156-157).

Leidy, J.

1855. Contributions towards a knowledge of the Marine Invertebrate Fauna of the coasts of Rhode Island and New Jersey. Jour. Acad. Nat. Sci. Phila. ser. 2, vol. 3, pp. 135-152, pls. 10-11.

Marcus, E.

1937. Bryozoairios Marinhos Brasileiros I. São Paulo Univ., Bol. Faculd. Filos. Cien. Letr. vol. 1 (Zool. 1), pp. 1-224, pls. 1-29.

1938. *Idem* II, *ibid.* vol. 4 (Zool. 2), pp. 1-137, pls. 1-29.

1939. *Idem* III, *ibid.* vol. 13 (Zool. 3), pp. 111-299, pls. 5-31.

1941. Sôbre Briozoa do Brasil. *Ibid.* vol. 22 (Zool. 5), pp. 1-169.

MORTENSEN, T.

1911. A new species of Entoprocta, *Loxosomella antedonis,* from North-East Greenland. [Denmark] Medd. Groenl. vol. 45, pp. 399-406. (Danmark-Exspeditionen til Groenlands Nordøstkyst 1906-08. vol. 5, no. 8).

NICKERSON, W. S.

1898. Preliminary Notice of a New Species of Endoproct—*Loxosoma Davenportii*—from the Massachusetts Coast. Science. new ser., vol. 7, pp. 220-221.

1899. Notes on *Loxosoma Davenporti.* Science. new ser., vol. 9, pp. 366-367.

1901. On *Loxosoma davenporti* (sp. nov.) Jour. Morph. vol. 17, pp. 351-380, pls. 32-33.

NITSCHE, H.

1869. Beiträge zur Kenntniss der Bryozoen. Ztschr. f. Wiss. Zool. vol. 20, 1870, pp. 1-36, pls. 1-3.

O'DONOGHUE, C. H. and ELSIE O'DONOGHUE

1923. A Preliminary List of Bryozoa (Polyzoa) from the Vancouver Island Region. Contr. Canad. Biol. Fish. new ser., vol. 1, pp. 143-201 (1-59), pls. 1-4.

1926. A Second List of the Bryozoa (Polyzoa) from the Vancouver Island Region. *Ibid.* new ser., vol. 3, pp. 49-131 (1-85), pls. 1-5.

OKA, A.

1890. [Title and article in Japanese] Zool. Soc. Japan, Tokyo, Dobutsugaki Zasshi. vol. 2, pp. 233-237.

1895. Sur la *Barentsia misakiensis.* Zool. Soc. Japan, Tokyo, Dobutsugaki Zasshi. vol. 7, pp. 76-86, pl. 12.

OSBURN, R. C.

1912. The Bryozoa of the Woods Hole Region. Bul. U. S. Bur. Fisheries. vol. 30, pp. 205-266.

1940. Bryozoa of Porto Rico with a Résumé of the West Indian Bryozoan Fauna. *In* Scientific Survey of Porto Rico and the Virgin Islands. New York. vol. 16 (3), pp. 321-486.

PALLAS, P. S.

1767-1774. Spicilegia Zoologica, quibus novae imprimis et obscurae animalium species iconibus descripsit atque commentariis illustrantur. Berlin. 2v.

ROBERTSON, ALICE

1900. Studies in Pacific Coast Entoprocta. Proc. Calif. Acad. Sci. ser. 3, Zool. vol. 2, pp. 323-348.

1900a. Papers from the Harriman Alaska Expedition. VI. The Bryozoa. Proc. Wash. Acad. Sci. vol. 2, pp. 315-340, pls. 19-21.

SARS, M.

1835. Beskrivelser og iagttagelser over nogle maerkelige eller nye i havet ved den Bergenske kyst levende dyr af Polypernes, Acalephernes, Radiaternes, Annelidernes og Molluskernes classer . . . Bergen. xii, 81p., 15 pls.

VERRILL, A. E.

1900. Additions to the Tunicata and Molluscoidea of the Bermudas. Trans. Conn. Acad. Sci. vol. 10, pp. 588-594.

Addenda

The following species in Ectoprocta-Cheilostomata have come to the author's attention since Parts 1 and 2 were prepared for publication. Also the ovicell of *Pachyegis brunnea* (Hincks), hitherto unknown, is figured (plate 81, fig. 11), and *Cheilopora praelucida* (Hincks), discussed on page 465 of Part 2, is illustrated on plate 81, fig. 12. All but one of these are from the last collections made at Point Barrow, Alaska, by Prof. and Mrs. G. E. MacGinitie. Their persistent efforts for two seasons resulted in 104 species from a very limited area around the Arctic Research Laboratory, which add greatly to our knowledge of circumpolar distribution of the Bryozoa.

No doubt careful collecting all along the American coasts, in special habitats and especially in deeper waters, will add many more species to the long list already recorded.

Cheilostomata

Anasca

Membranipora annae, new name

Acanthodesia serrata (Hincks), Hastings, 1930:707 (not *M. membranacea,* form *serrata* Hincks, 1882:469)

Membranipora hastingsae Osburn, 1950:29 (preoc. by *M. (Electra) hastingsae* Marcus, 1940)

Dr. Anna B. Hastings misidentified this species with the *M. serrata* of Hincks (1882:469, which was already preoccupied by the *M. serrata* of MacGillivray (1868:131). [See under *M. serrilamella,* new name, Part 1, p. 22] The present author renamed it *hastingsae* (Part 1, p. 29), overlooking the fact that Marcus (1940) had already used this name for another species. Dr. Marcus (*in litt.* Aug. 27, 1950) kindly called my attention to the error: "In Danmarks Fauna, 1940, *Electra* is treated as a subgenus of *Membranipora,* and *M. (Electra) hastingsae* is dealt with. So the specific name is preoccupied and your species will have to receive a new name."

I have taken the liberty of using Dr. Hastings' given name for this very attractive little species.

Hincksina gothica new species

Plate 81, fig. 1

Zoarium unilaminar, encrusting on shells, stones and bryozoans, white to light brown. Our largest colony, rounded and about 25 mm in

diameter, spreads across a frond of *Porella compressa*, the edges extending beyond the side of the frond but remaining unilaminar. The zooecia are large, 0.65 to 1.0 mm or more in length by 0.45 to 0.60 mm in width, arranged quincuncially. In the infertile zooecia the opesia occupies practically all of the frontal area; the side walls are very thin and finely granulated. Large interzooecial avicularia are scattered over the zoarium, usually at the beginning of the new series of zooecia. The chamber is nearly as long as the normal zooecia, 0.50 to 0.65 mm, but narrower, about 0.40 mm in width. The mandible, 0.35 to 0.50 mm long by 0.20 to 0.26 mm wide, has the shape of a gothic arch, the sides parallel and the pointed tip strongly decurved to fit inside the recurved tip of the rostrum. Minute avicularia (mandible 0.06 to 0.10 mm long) are situated at the distal zooecial corners and often there are one or two additional ones, with the mandible directed forward instead of backward as in *H. nigrans;* occasionally there are similar small avicularia on the side walls and in these the position of the mandible is reversed, pointing backward. Near the center of the colony there are 5 or 6 short stout spines and one or two of these may be present on the zooecia over the whole zoarium.

The endozooecial ovicells are similar to those of *nigrans,* but the covering transverse ridges are much less developed and there is always a pair of the small avicularia distally placed on either side of the ovicell with the mandible directed forward.

The species is evidently related to *H. nigrans,* but the differences in the avicularia and the cover of the ovicell and the presence of spines appear sufficient to give it specific rank. *H. nigrans* also has large interzooecial avicularia, but they are short with a short triangular mandible.

Type, U. S. Nat. Mus. no. 11048.

Type locality, Point Barrow, Alaska, 453 feet. Numerous colonies were obtained by Prof. G. E. MacGinitie at depths ranging from 216 to 522 feet.

Amphiblestrum trifolium (S. Wood), 1850

Plate 81, fig. 2

Flustra trifolium S. Wood, 1850:20.
Membranipora solida Packard, 1867:272.
Membranipora Flemingii var. *solida,* Verrill, 1879:29.
Membranipora trifolium, Hincks, 1880:167.
Membranipora trifolium, Whiteaves, 1901:97.
Membranipora trifolium, Osburn, 1912:279.
Amphiblestrum trifolium, Osburn, 1923:9; 1932:9; 1933:26.

Zoarium encrusting on stones and shells, the ectocyst sometimes with brown pigment. The zooecia are arranged more or less regularly in quincunx, length 0.60 to 0.80 mm, width 0.35 to 0.60 mm, varying much in form, separated by slightly elevated thin margins which are decorated with coarse granules. The most striking feature is the thick, finely granulated cryptocyst which covers the proximal half or more of the frontal area and extends narrowly around the sides of the trifoliate opesia. Spines are entirely absent from our specimens, though small ones are said to occur occasionally. Avicularia are rare, somewhat elevated, usually located near the proximal end and directed either forward or backward, the mandible short-pointed.

The ovicell is hyperstomial, prominent; in final calcification there is a strong arcuate transverse rib which often rises to a central point, and proximal to this is a semilunar smooth area; width 0.25 to 0.30 mm.

It is a northern and arctic species, evidently circumpolar; in Atlantic waters it extends southward to the British Isles and to the Maine coast of North America, but it has not been recorded from the Pacific coast before.

Point Barrow, Alaska, Arctic Research Laboratory, 262 to 328 feet, G. E. MacGinitie, collector.

Bugula flabellata acuminata new variety.

Plate 81, figs. 3 and 4

The zoarium is erect with broad flabellate branches, the secondary branches biserial but sometimes becoming quadriserial near the tips. The mode of branching is like that of *flabellata* and the origin of the zooecia is also similar, with long prongs extending distally down the dorsal sides of the preceding zooecium. Height of colony about 20 mm.

The zooecia are long and slender, length 0.55 to 0.75 mm, width at base 0.13 mm and widening gradually to 0.15 mm near the tip; the membranous area extends nearly but not quite to the proximal end, narrowing downward; there are no jointed spines, but the distal corners are extended into short, stout processes, sometimes wanting on the inner corner. The avicularia, present on nearly all of the zooecia, are attached by a short stalk more or less above the middle of the zooecium but not near the extremity; moderately large and somewhat compressed, length 0.20 to 0.30 mm, width 0.08 to 0.10 mm, height 0.13 to 0.15 mm; the beak sharply decurved at the tip with a narrow rounded point. The mandible, 0.15 to 0.20 mm long, is unique in my experience as it suddenly becomes constricted near its distal end into a long acuminate recurved process sharply differentiated from the basal part.

The ovicells, on nearly all of the zooecia, are set transversely across the distal end of the zooecia, rounded and prominent, 0.18 mm wide by 0.14 mm long, complete, but the orifice large, the surface not striated, in reproduction in February.

The complete absence of jointed spines, the form of the avicularium and especially the sharply acuminated mandible appear to separate this variety sufficiently from *B. flabellata.*

Type, AHF no. 130.

Type locality, Hancock Station 66-33, Tagus Cove, Albemarle Island, Galapagos, 0°16′17″S, 91°22′41″W, at 10 to 20 fms, several colonies.

ASCOPHORA

Pachyegis brunnea (Hincks)

Plate 81, fig. 11

See Part 2, p. 315.

The ovicells can now be described as I have found them at the margin of a large colony. They resemble those of *P. princeps* (Norman), hyperstomial and prominent but considerably depressed on the base of the succeeding zooecium. With increased calcification they become more submerged but lack the heavy collar which develops across the front of *P. princeps;* width and length about 0.40 mm.

Emballotheca stylifera (Levinsen), 1886

Plate 81, fig. 5

Escharella stylifera Levinsen, 1886:17.
Schizoporella condylata Nordgaard, 1906:18.
Schizoporella (Emballotheca) stylifera, Levinsen, 1916:453.
Schizoporella stylifera, Nordgaard, 1918:57.

Zoarium encrusting shells and stones, unilaminar, and the shining ectocyst with reddish-brown pigment. The zooecia are moderate in size, 0.60 to 0.75 mm long by 0.40 to 0.55 mm wide, elongate-hexagonal in form and rather regularly arranged in quincunx, separated by very thin raised lines. The moderately inflated frontal is a tremocyst with fewer pores than is usual in the genus. Beneath the rather thick ectocyst the frontal is finely granulated, but there are no other surface decorations, and spines and avicularia are both wanting. Dietellae conspicuous on the dorsal surface. The aperture is nearly round, 0.16 to 0.18 mm wide, somewhat transverse proximal to the prominent cardelles, and between these is a shallow arcuate sinus nearly half as wide as the aperture.

There is a narrow vestibular arch. The primary peristome is low and thin and becomes covered on the sides by the encroachment of the frontal wall, which modifies the form of the aperture only slightly.

The ovicell is hyperstomial, considerably depressed and is closed by the operculum; secondary calcification from the three adjacent distal zooecia produces three sutural lines on the surface, and often there is a pore or fenestra at the central junction of the sutures, width 0.26 to 0.30 mm.

The species was described from the Kara Sea and later recorded from northeast Greenland (Levinsen) and the North American Archipelago (Nordgaard).

Point Barrow, Alaska, Arctic Research Laboratory, 217 to 522 feet, G. E. MacGinitie, collector, rather common.

Hippodiplosia cancellata (Smitt), 1867

Plate 81, fig. 6

Escharella porifera forma cancellata Smitt, 1867:9.
Smittina cancellata, Nordgaard, 1906:29.

Apparently this species has not been seen since Smitt described it. Nordgaard placed it under *Smittina,* but without having seen it.

The zoarium is encrusting, spreading over shells, reddish-brown in color. The zooecia are moderately large, 0.65 to 1.0 mm long by 0.40 to 0.65 mm wide; the front a tremocyst with large pores which enlarge upward until the surface is coarsely cancellous or tessellated, with only narrow rims separating the pores. The only exception to this is the smoother area proximal to the aperture which is characteristic of the genus and upon which the secondary layer does not encroach. The aperture is large, 0.18 to 0.20 mm wide, usually a little wider than long, evenly rounded back to the small cardelles; the proximal border broadly arcuate, nearly straight, or often arched forward slightly above the operculum (this last feature gives the aperture somewhat the appearance of a *Smittina,* but it does not appear to be homologous with the lyrula of the Smittinidae). Smitt described the species *"Avicularia desunt,"* but small avicularia are frequently present (though often wanting over large areas), with a rounded mandible and located close to the aperture in the middle on the preoral smooth area. There are no spines or other surface structures.

The ovicells are large, about 0.40 mm wide, hemispherical, hyperstomial but rather deeply embedded, smooth at first but soon becoming covered with a cancellous layer similar to that of the frontal.

The species is related to *H. reticulato-punctata* (Hincks), but the measurements are larger, the aperture shorter and wider, the preoral area shorter and the cancellation of the front much more strongly developed.

Smitt described the species from Spitsbergen and carefully figured it (plate 24, figs. 40 and 41), but I have not been able to find any other record of its occurrence.

Point Barrow, Alaska, Arctic Research Laboratory, 438 feet, G. E. MacGinitie, collector, apparently rare.

Microporella arctica (Norman), 1903

Plate 81, fig. 7

Microporella arctica Norman, 1903:105.
Porina ciliata Smitt, 1867:6 (part).
Microporella ciliata var. *arctica,* Nordgaard, 1918:60.

Zoarium encrusting stones and shells, heavily calcified, and the ectocyst brown in color. The zooecia are much larger than those of *M. ciliata* in all their measurements, 0.65 to 0.80 mm long by 0.40 to 0.65 mm wide; the aperture 0.12 mm long by 0.15 mm wide; the ovicell averaging 0.40 mm in width. The frontal is a thick tremocyst with numerous small pores which often become occluded in complete calcification; inflated with deep separating grooves and smooth, except occasionally there is a minute umbo proximal to the ascopore. The aperture (except for size) and the ascopore are similar to those of *ciliata.* Avicularia, rarely present, are located near the lateral margin proximal to the aperture, the mandibles varying in length, the longer ones noticeably broader (more ligulate) than those of *ciliata.* Spines are usually wanting but I have noted 4 very minute (vestigial) ones on a few young marginal zooecia.

The ovicell is hemispherical, delicately ribbed radiately in the young stage but soon becoming very thick-walled and smooth, with a small umbo distally situated on the top.

Recorded previously by Smitt, Norman and Nordgaard from Spitsbergen and northern Norway. The differences mentioned above indicate that it should be separated from *M. ciliata,* and the following record shows that it is a circumpolar species.

Point Barrow, Alaska, Arctic Research Laboratory, 328 feet, G. E. MacGinitie, collector.

Escharoides jacksoni (Waters), 1900.

Plate 81, fig. 8

Smittia Jacksonii Waters, 1900:87.
Escharoides jacksoni, Nordgaard, 1918:55.
Peristomella (Escharoides) jacksoni, Osburn, 1923:10.

Zoarium encrusting, the ectocyst reddish-brown. The zooecia are large, 0.65 to 1.0 mm long by 0.50 to 0.65 mm wide; the frontal a pleurocyst with numerous large areolar pores between which narrow costal ridges extend upon the front, usually leaving a smoother central area but sometimes extending to the tip of the high lip of the peristome. The zooecia are considerably inflated and elevated toward the distal end, ovate in form and arranged in quincunx. The most striking feature is the form of the peristome which is unusually high above the proximal border of the aperture, where it is more or less pointed, and extends sharply downward on each side to the first spine, resembling an inverted scoop; it lacks the median denticle near the tip which is found in some others of the genus. There are 4 stout oral spines, the proximal pair usually remaining at the corners of the ovicell. The aperture is large, 0.20 to 0.26 mm in either direction, rounded proximally, and broader at the distal end, where it is broadly arcuate or sometimes nearly transverse. There are no condyles and no lyrula. The avicularia are large and conspicuous, situated characteristically at one or both sides of the peristome and directed laterally, but often located more proximally on the front and directed more or less backward, often wanting; the rostrum is elevated, the mandible hooked at its tip and measuring 0.25 to 0.30 mm in length and 0.15 to 0.20 mm wide at the base.

The ovicells are correspondingly large, averaging 0.40 mm in width and length, hyperstomial, hemispherical and conspicuous, perforated but with a small central imperforate area on the top.

It is an arctic species, described from Franz Josef Land and recorded from Greenland and the western part of the American Archipelago. The following record extends its distribution much farther to the west and it is evidently a circumpolar species.

Point Barrow, Alaska, Arctic Research Laboratory, 453 feet, G. E. MacGinitie, collector.

Porella minuta (Norman), 1868

Plate 81, fig. 9

Lepralia minuta Norman, 1868:308.
Porella minuta, Hincks, 1880:326.
Porella alba Nordgaard, 1906:25.
Porella minuta, Nordgaard, 1918:71.

Zoarium small, encrusting on stones and shells, white and glistening. The zooecia are small, 0.40 to 0.50 mm long by 0.25 to 0.30 mm wide; the front considerably inflated and delicately granulated; the areolar pores are few in number and conspicuous only in the younger stages. The zooecia are very distinct, with deep separating grooves which never become filled even in the oldest and most complete stages of calcification. The aperture is semicircular, 0.13 mm wide by 0.10 mm long, the proximal border straight or slightly arcuate and without any indication of a lyrula. The primary peristome is low and thin and there are no spines, even in young marginal zooecia. There is a rounded median avicularium with a prominent bulbous chamber which covers nearly half of the frontal area proximal to the aperture. In advanced calcification, the frontal becomes very thick, extends around the sides of the aperture, and sometimes forms a small umbonate process on the top of the avicularian chamber.

The ovicell at first is prominent, 0.24 mm wide by 0.22 mm long, but soon becomes more or less immersed, thick-walled and granulated like the frontal.

The species resembles *P. concinna* (Busk), but the smaller dimensions, the proportionally larger avicularian chamber, and the distinct separation of the zooecia at all stages clearly distinguish it. It is known from the British Islands (Norman and Hincks), and Nordgaard redescribed it as *P. alba* from the North American Archipelago.

Point Barrow, Alaska, Arctic Research Laboratory, at 216 to 522 feet, G. E. MacGinitie, collector, rather common.

Mucronella microstoma (Norman), 1868

Plate 81, fig. 10

Lepralia microstoma Norman, 1864:87.
Mucronella microstoma, Hincks, 1880:370.
? *Mucronella microstoma,* O'Donoghue, 1923:46.

This species bears much resemblance to *M. labiata,* but it is smaller; the primary aperture 0.13 mm wide by 0.10 long, semicircular, straight on the proximal border with a wide lyrula which is low and without denticles at the corners. The secondary aperture also is much smaller than in *labiata,* wider than long, and the peristome is more or less tubular, rising high on the proximal border and often continued into a central point. The dietellae are small and numerous. There are 2 to 4 short stout oral spines on the distal border of the aperture, the two median ones the largest.

The ovicell is prominent, about 0.40 mm in either direction, the surface finely granulated like the frontal.

The most characteristic feature is the spout-like peristome and the small secondary aperture, about 0.18 mm wide by 0.12 mm long (though there is considerable variation). It has been recorded positively only from the British Isles at depths from 80 to 205 fms. O'Donoghue listed it somewhat doubtfully from Northumberland Channel, British Columbia, at 15 to 18 fms, but as he did not give a full description and mentioned only a few variations this record must remain in doubt until the species is recovered from that area.

Point Barrow, Alaska, Arctic Research Laboratory, 48 to 80 fms, G. E. MacGinitie, collector, rather common.

REFERENCES

HASTINGS, A. B.

1930. Cheilostomatous Polyzoa from the Vicinity of the Panama Canal, collected by Dr. C. Crossland on the Cruise of the S. Y. 'St. George'. Proc. Zool. Soc. London. 1929, vol. 2, pp. 697-740, 17 pls.

HINCKS, T.

1880. A History of the British Marine Polyzoa. London. 2v.

1882. Report on the Polyzoa of the Queen Charlotte Islands. Ann. and Mag. Nat. Hist. ser. 5, vol. 10, pp. 459-471.

LEVINSEN, G. M. R.

1886. Bryozoer fra Kara-Havet. Adv. reprint from Dijmphe-Togtets zoologisk-botaniske Udbytte . . . Udgivet . . . ved C. F. Lütken. Kjøbenhavn, 1887.

1916. Bryozoa. [Denmark] Medd. Groenl. vol. 43, pp. 432-472, pls. 19-24. (Danmark-Exspeditionen til Groenlands Nordøstkyst 1906-08. vol. 3 no. 16.)

MACGILLIVRAY, P. H.

1868. Descriptions of some new Genera and Species of Australian Polyzoa; to which is added a List of Species found in Victoria. Trans. and Proc. Roy. Soc. Victoria. vol. 9, pp. 126-148.

MARCUS, E.

1940. Mosdyr (Bryozoa eller Polyzoa). Danmarks Fauna, Kjøbenhavn. no. 46, pp. 1-401, 221 figs.

NORDGAARD, O.

1906. Bryozoa from the second "Fram" expedition, 1898-1902. Rpt. of the Second Norwegian Arctic Expedition in the "Fram" 1898-1902. Kristiania, 1907. vol. 2 no. 8, pp. 1-44, pls. 1-4.

1918. Bryozoa from the Arctic regions. Tromsö Mus. Aarshefter. vol. 40, pp. 1-99.

NORMAN, A. M.

1864. On undescribed British Hydrozoa, Actinozoa, and Polyzoa. Ann. and Mag. Nat. Hist. ser. 3, vol. 13, pp. 82-90.

1868. Shetland Final Dredging Report.—Part II. On the Crustacea, Tunicata, Polyzoa, Echinodermata, Actinozoa, Hydrozoa, and Porifera. Class Polyzoa. Rpt. Brit. Assoc. Adv. Sci. 38th meeting, 1869, pp. 303-312.

1903. Notes on the Natural History of East Finmark. Ann. and Mag. Nat. Hist. ser. 7, vol. 12, pp. 87-128, pls. 8-9.

O'DONOGHUE, C. H. and ELSIE O'DONOGHUE

1923. A Preliminary List of Bryozoa (Polyzoa) from the Vancouver Island Region. Contr. Canad. Biol. Fish. new ser., vol. 1, pp. 143-201 (1-59), pls. 1-4.

OSBURN, R. C.

1912. Bryozoa from Labrador, Newfoundland, and Nova Scotia, collected by Dr. Owen Bryant. Proc. U. S. Natl. Mus. vol. 43, pp. 275-289.

1923. Bryozoa. *In* Report of the Canadian Arctic Expedition 1913-1918. Ottawa, vol. 8 (D), pp. 1-13.

PLATES

Practically all of the illustrations for the following plates, 65 to 82, are the work of Mrs. Virginia Sewell, to whom the author is much indebted for her careful attention to details and interested cooperation.

The scale of enlargement is not indicated on the plates, except in the Ctenostomata, but exact measurements are given for each species in the text.

PLATE 65

Fig. 1. *Stomatopora granulata* (Milne-Edwards), part of zoarium.
Fig. 2. The same, ovicell with ooeciostome.
Fig. 3. *Proboscina sigmata* new species, part of zoarium.
Fig. 4. The same, enlarged to show details of ovicell.
Fig. 5. *Proboscina major* (Johnston), part of zoarium with ovicell.
Fig. 6. *Oncousoecia abrupta* new species, zoarium.
Fig. 7. The same, enlarged to show details of 3 ovicells.
Fig. 8. *Oncousoecia ovoidea* new species, zoarium.
Fig. 9. The same, enlarged to show details of ovicell.
Fig. 10. *Oncousoecia canadensis* Osburn, showing usual type of ovicell.
Fig. 11. The same, at less magnification, with broader ovicell.

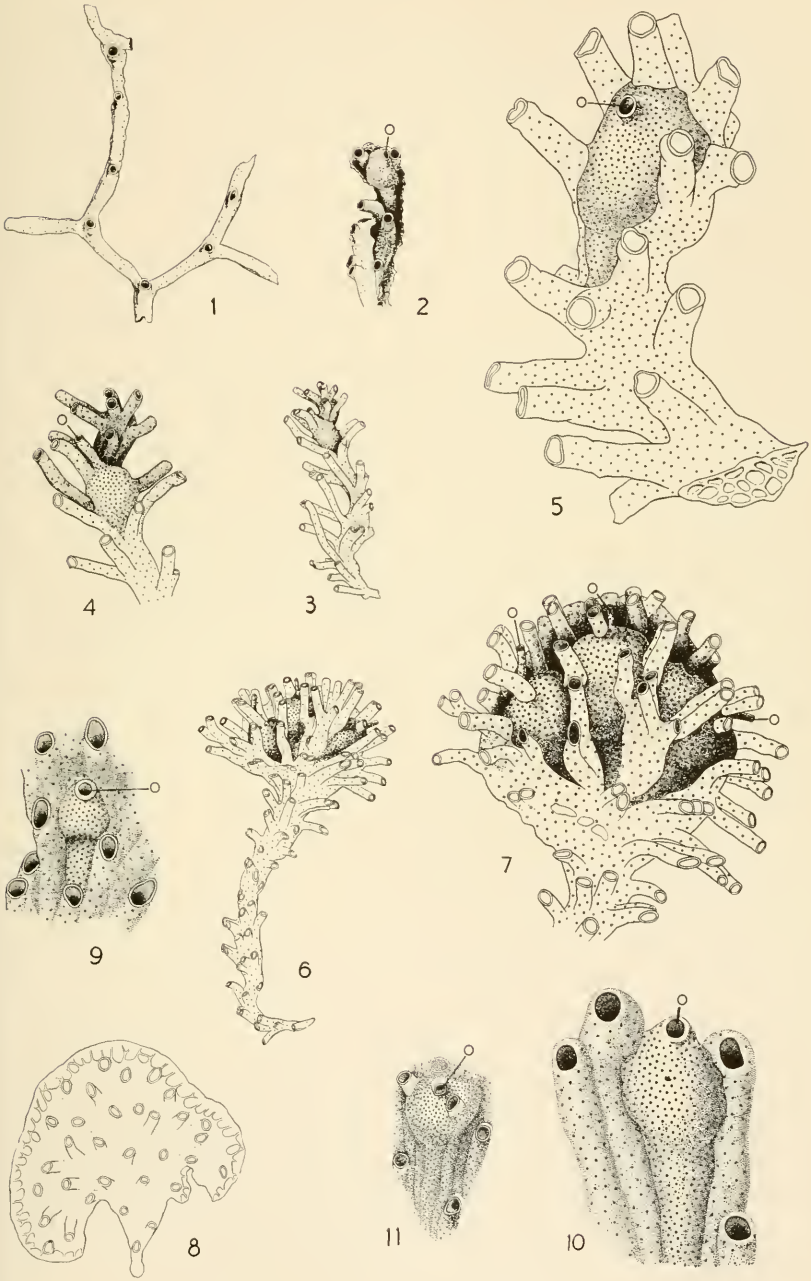
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PLATE 66

Fig. 1. *Proboscina incrassata* (Smitt), zoarium.

Fig. 2. The same, portion of a lobe with ovicell and ooeciostome.

Fig. 3. *Proboscina lamellifera* Canu and Bassler, part of lobe with ovicell and ooeciostome.

Fig. 4. *Oncousoecia diastoporides* (Norman), ovicell and ooeciostome.

Fig. 5. *Plagioecia grimaldii* (Jullien), showing terminal, median position of ooeciostome.

Fig. 6. *Plagioecia meandrina* (Canu and Bassler) showing erect branches and lobes.

Fig. 7. The same, part of a lobe showing position of ovicell and ooeciostome.

Fig. 8. *Plagioecia ambigua* new species, zoarium, with simple and expanded ovicells; note different positions of ooeciostomes.

Fig. 9. *Plagioecia anacapensis* new species, outline of zoarium and linear arrangement of tubules.

Fig. 10. The same, showing ovicell and ooeciostome.

Fig. 11. *Diaperoecia claviformis* new species, part of a lobe showing proximal position of ooeciostome.


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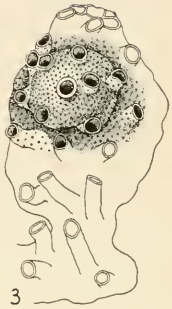
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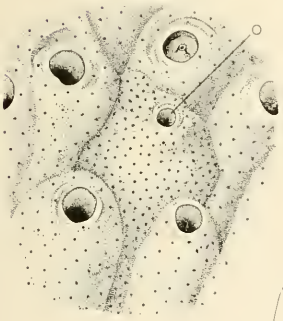
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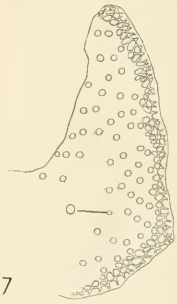
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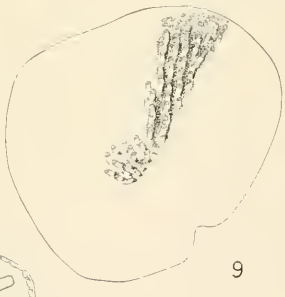
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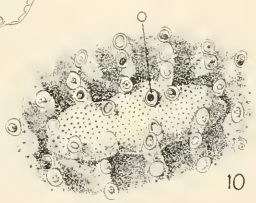
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PLATE 67

Fig. 1. *Diaperoecia californica* (d'Orbigny), showing arrangement of tubules and mode of branching.

Fig. 2. The same, ovicell and large, tall ooeciostome.

Fig. 3. *Diaperoecia floridana* Osburn, part of a branch with elongate ovicell and large, flared, reflected ooeciostome.

Fig. 4. *Diaperoecia johnstoni* (Heller), portion of a lobe with ovicell, and ooeciostome at the side of a peristome.

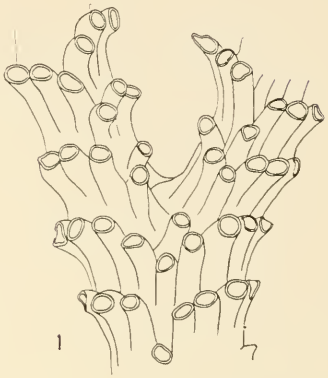
Fig. 5. *Tubulipora concinna* MacGillivray, ovicell with ooeciostome.

Fig. 6. *Tubulipora egregia* new species, an ovicell with ooeciostome which has an oval and slightly flared lip.

Fig. 7. The same, portion of a zoarium with lobate ovicells.

Fig. 8. *Plagioecia tortuosa* new species, outline of an irregular free lobe, with ovicell and ooeciostome.

Fig. 9. The same, outline of a zoarium, showing the beginning of a vertical bilaminate lobe and the position of four ovicells.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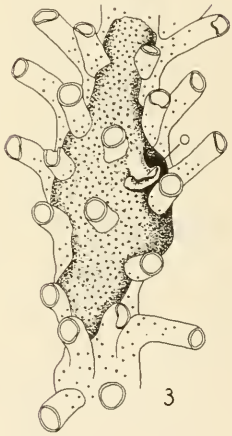
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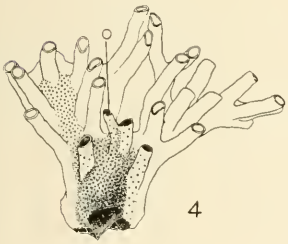
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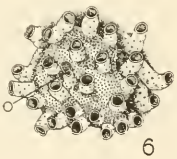
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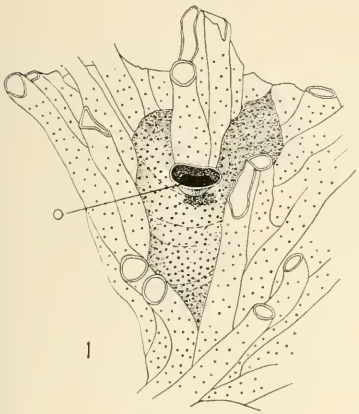
PLATE 68

Fig. 1. *Tubulipora pacifica* Robertson, with ovicell and ooeciostome.
Fig. 2. *Tubulipora pulchra* MacGillivray, ovicell and ooeciostome.
Fig. 3. The same, base of zoarium with lateral attachment processes.
Fig. 4. The same, portion of dorsal side with attachment processes.
Fig. 5. *Tubulipora admiranda* new species, form of zoarium and distribution of ovicells.
Fig. 6. The same, ovicell with large erect ooeciostome.
Fig. 7. The same, base of zoarium with primary zooecium.
Fig. 8. *Tubulipora flabellaris* (Fabricius), a small ovicell with narrow erect ooeciostome and slit-like aperture.
Fig. 9. *Tubulipora tuba* (Gabb and Horn), showing large fascicles and ovicell with ooeciostome.
Fig. 10. *Tubulipora tuba* var. *fasciculifera* (Hincks), with small fascicles and ovicell with ooeciostome.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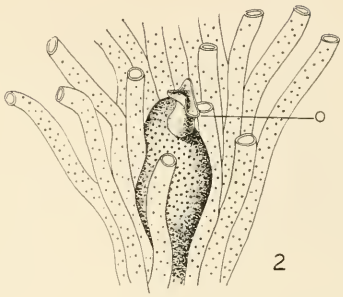
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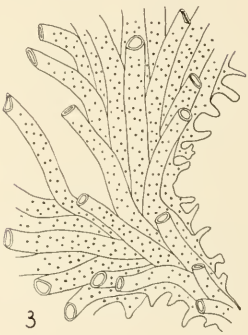
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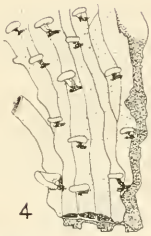
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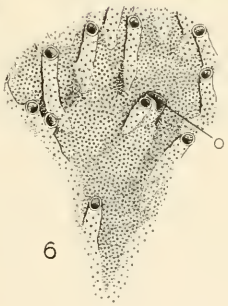
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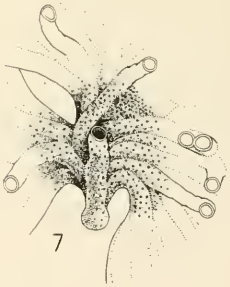
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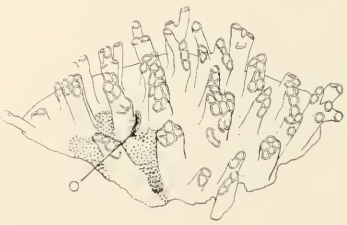
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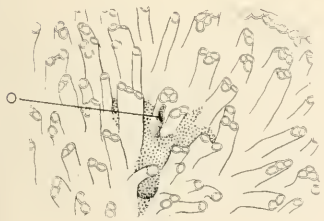
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PLATE 69

Fig. 1. *Platonea elongata* new species, with very elongate ovicell, and position of ooeciopore, ooeciostome broken off.

Fig. 2. *Platonea veleronis* new species, with short ovicell and position and form of ooeciostome.

Fig. 3. *Platonea expansa* new species, with long fascicles, broad marginal lamina and position and form of ooeciostome.

Fig. 4. *Bathysoecia bassleri* new species, outline of zoarium showing position of two ovicells.

Fig. 5. The same, depressed arcuate ovicell with slit-like ooeciostome, the two lobes surrounding peristomes and a fascicle; note the very short peristomes.

Fig. 6. The same, younger part of colony showing partially closed ends of erect tubes before the peristomes are developed.

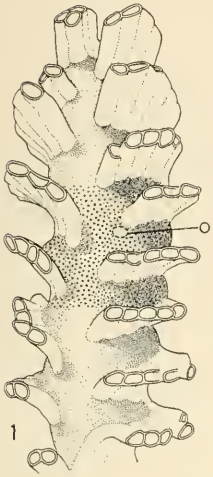
Fig. 7. *Bathysoecia hastingsae* new species, sketch of ovicell, the arcuate ovicell modified by several lobes. Note the position and form of the ooeciostome.

Fig. 8. *Filifascigera clarionensis* new species, portion of zoarium showing mode of branching and position of ovicell.

Fig. 9. The same, enlarged to show the details of the ovicell and ooeciostome.

Fig. 10. The same, a double erect fascicle, enlarged.

Fig. 11. *Discocytis californica* new species, with broad, thin base, short peduncle and the broad capitulum with the large rounded ovicell on its dorsal side.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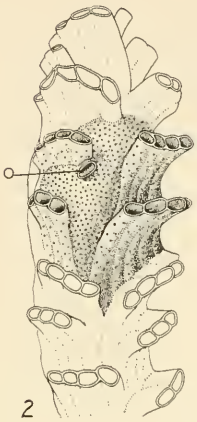
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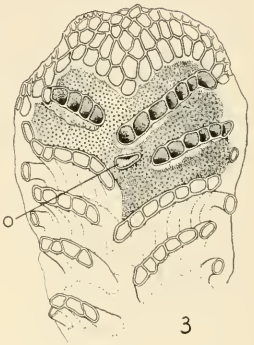
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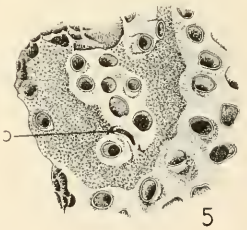
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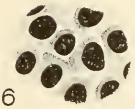
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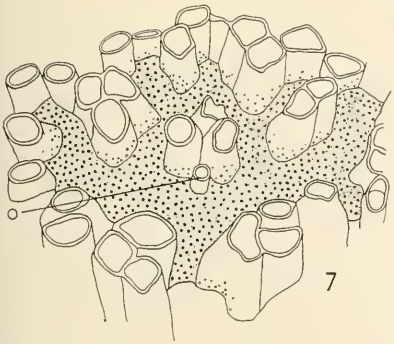
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PLATE 70

Fig. 1. *Fasciculipora pacifica* new species, young colony with about 7 branches beginning to form.

Fig. 2. The same, still younger with the beginning of branches at the right and left borders, more enlarged.

Fig. 3. The same, a very young colony with the proancestrula and first tubule; origin of secondary tubules on the right and the beginning of a branch on the left.

Fig. 4. The same, from an adult zoarium, showing a simple ovicell at the right and a broader one involving two peristomes at the left.

Fig. 5. *Diaperoecia intermedia* (O'Donoghue), an erect branch with ovicell and central ooeciostome. The capitulum here is narrower than usual.

Fig. 6. *Entalophora symmetrica* new species, showing method of branching at right angles and the position of the ovicell at the left.

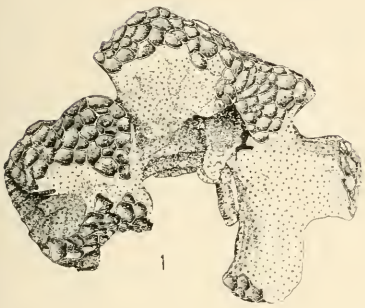
Fig. 7. The same, simple ovicell with terminal ooeciostome.

Fig. 8. *Entalophora proboscideoides* (Smitt), portion of zoarium with simple ovicell

Fig. 9. The same, side view of ovicell and ooeciostome.

Fig. 10. *Bientalophora cylindrica* new species, outline of zoarium; the left branch is beginning to branch again in the same plane.

Fig. 11. The same, showing arrangement of peristomes and the covering layer of closed kenozoids.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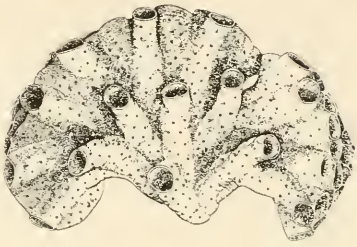
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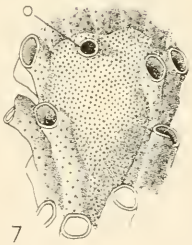
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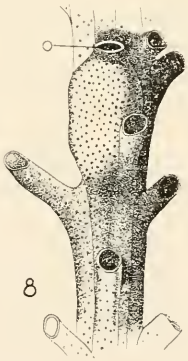
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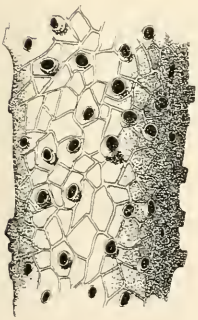
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PLATE 71

Fig. 1. *Crisidia cornuta* (L.), part of zoarium showing mode of branching and position of spine-like processes.

Fig. 2. *Bicrisia edwardsiana* d'Orbigny, with ovicell and spine-like processes.

Fig. 3. *Crisia occidentalis* Trask, showing mode of branching and normal form of ovicell.

Fig. 4. The same, distorted ovicell due to curved internode.

Fig. 5. The same, pointed tip of terminal internode, often present.

Fig. 6. *Crisia operculata* Robertson, frontal view of ovicell and ooeciostome.

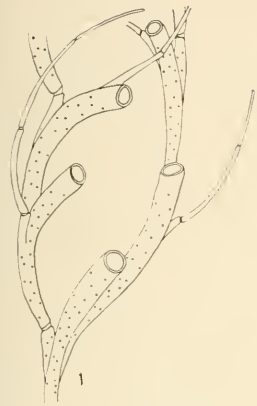
Fig. 7. The same, sketch of side view showing the cap or "operculum" above the ooeciopore.

Fig. 8. *Crisia pugeti* Robertson, frontal view of ovicell and, at left, a sketch of the side view with bent ooeciostome.

Fig. 9. *Crisia elongata* Milne-Edwards, frontal view with short, wide expansion of the ovicell.

Fig. 10. *Crisia eburnea* (L.), with short, transverse ooeciostome.

Fig. 11. *Tubulipora flexuosa* (Pourtales), a portion of a branch with short ovicell and ooeciostome distal to a peristome.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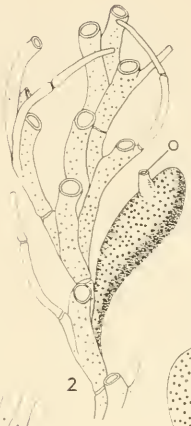
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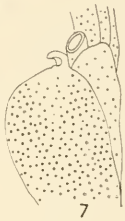
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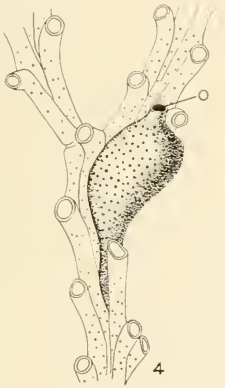
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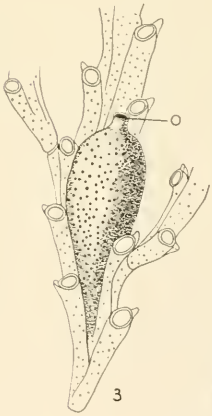
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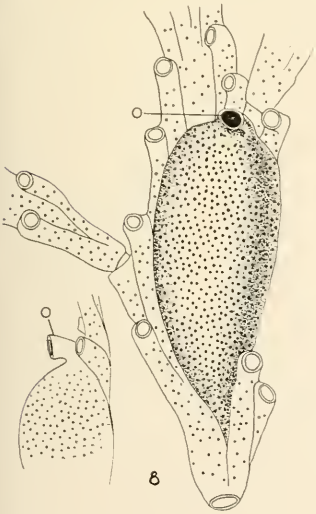
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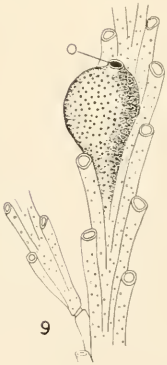
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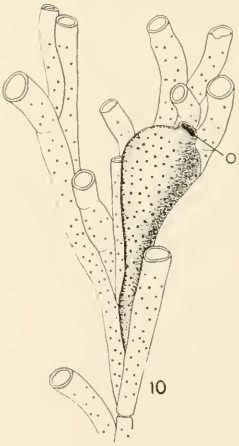
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PLATE 72

Fig. 1. *Crisia cribraria* Stimpson, mode of branching and ovicell.

Fig. 2. *Crisia serrulata* new name, ovicell and mode of branching; note at left the usual short inserted *basis rami*.

Fig. 3. *Crisia maxima* Robertson, ovicell and mode of branching; note long free end of the tubules and the small reflected ooeciostome.

Fig. 4. *Filicrisia franciscana* Robertson, mode of branching and frontal position of ooeciostome.

Fig. 5. *Filicrisia geniculata* (Milne-Edwards), infertile internode, ovicell with dorsal position of ooeciostome, and smaller dimensions.

Fig. 6. *Crisulipora occidentalis* Robertson, a fertile internode showing long peristomes and ovicell spreading among peristomes, ooeciostome centrally placed near distal end.

Fig. 7. *Hornera pinnata* Canu and Bassler, sketch of frond and base.

Fig. 8. The same, frontal view of branch with lateral pinnule.

Fig. 9. The same, dorsal view of tip of branch.

Fig. 10. *Hornera pectinata* Busk, sketch of frond and base.

Fig. 11. The same, frontal view of tip of branch, showing the irregular, pectinate tips of the tubules.

Fig. 12. The same, dorsal side of tip of branch.


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PLATE 73

Fig. 1. *Diplosolen obelium* (Johnston), ovicell enclosing peristomes of normal and diminutive tubules; ooeciostome near center.

Fig. 2. *Plagioecia tubiabortiva* (Canu and Bassler), ovicell with terminal ooeciostome.

Fig. 3. *Plagioecia sarniensis* (Norman), showing basal tubule and transverse expansion of ovicell and terminal ooeciostome; one peristome enclosed.

Fig. 4. *Plagioecia patina* (Lamarck), basal tubule and usual broad expansion of ovicell, with terminal ooeciostome.

Fig. 5. *Borgiola pustulosa* new species, surface view with "pustules," and broken edge of type specimen.

Fig. 6. The same, at broken edge showing brood-chamber traversed by tubules.

Fig. 7. The same, showing the occasional pointed peristomes at the edge of a pustule.

Fig. 8. The same, margin of zoarium.

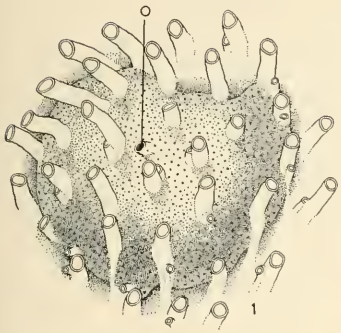
Fig. 9. The same, enlargement of a pustule.

Fig. 10. *Heteropora alaskensis* (Borg), terminal portion of branch with brood-chamber, the roof partly removed to show the cavity traversed by tubules; note also the high peristomes.

Fig. 11. The same, closure and partial closure of peristomes near base of zoarium.

Fig. 12. The same, mode of branching of a young zoarium.

Fig. 13. *Heteropora magna* O'Donoghue, a characteristic zoarium showing mode of branching and anastomosis; the primary base and two secondary attachments.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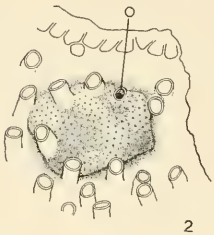
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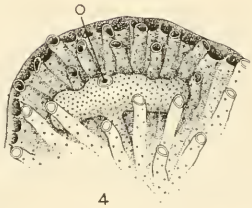
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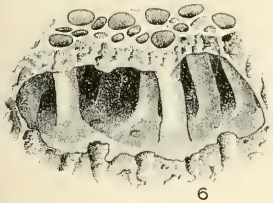
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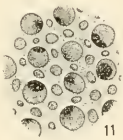
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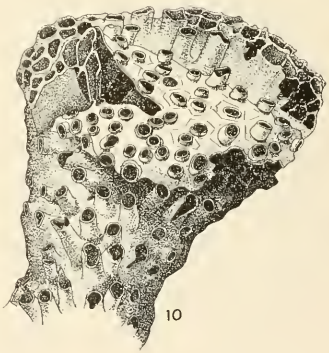
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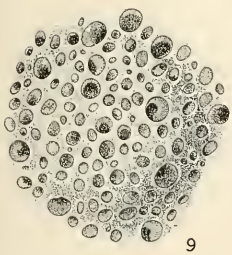
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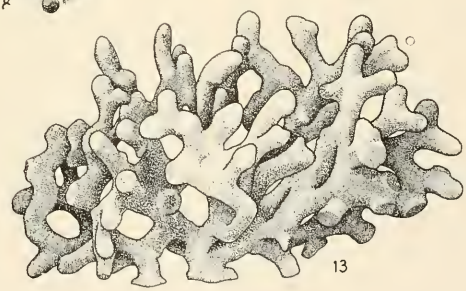
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PLATE 74

Fig. 1. *Lichenopora buskiana* Canu and Bassler, roof of ovicell broken away; the distribution of the radii on the disc is often irregular.

Fig. 2. The same, irregular secondary cancelli above ovicell, position and form of ooeciostome.

Fig. 3. *Lichenopora verrucaria* (Fabricius), showing quincuncial arrangement of peristomes, irregular cancellated cover of ovicell, and position and form of ooeciostome.

Fig. 4. *Lichenopora novae-zelandiae* (Busk), irregular secondary cancelli covering ovicell, position and form of ooeciostome, and occasional extra tubules in the uniserial radii.

Fig. 5. *Disporella separata* new species, small portion of zoarium showing form and separation of the discs.

Fig. 6. The same, enlarged, showing the irregular nature of the radii and the round partially closed cancelli.

Fig. 7. *Disporella californica* (d'Orbigny), diagram of complex zoarium with two complete discs and three incomplete marginal ones.

Fig. 8. The same, at margin of central area, showing ovicell with perforated cover (seen at left through the rounded secondary cancelli); position and form of ooeciostome.

Fig. 9. The same, enlargement of cancellar pores with pin-head spicules.


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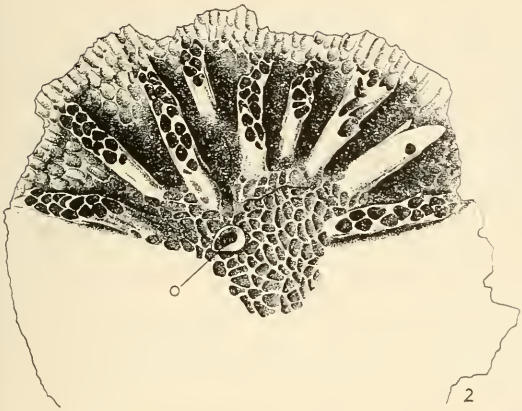
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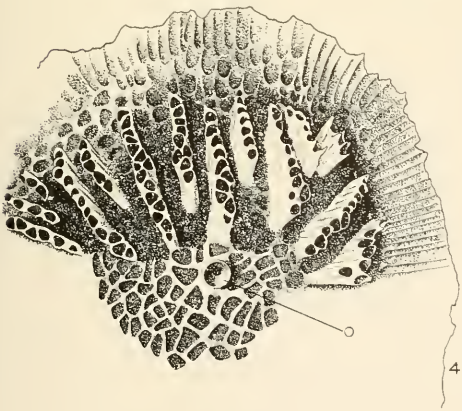
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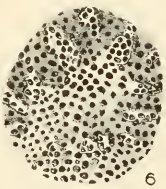
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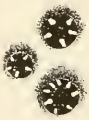
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PLATE 75

Fig. 1. *Disporella hispida* (Fleming), showing form of zoarium, scattered peristomes, small cancellar pores, and two ooeciostomes near the border indicating the presence of interradial ovicells.

Fig. 2. *Disporella fimbriata* (Busk), the ovicell obscured by heavy calcification of the secondary cancelli.

Fig. 3. The same, a younger zoarium with three ovicells occupying most of the central area, the ooeciopores marginal, ooeciostomes not developed.

Fig. 4. *Disporella ovoidea* new species, outline showing ovate form of zoarium and central area, uniserial radii and position of ovicell.

Fig. 5. The same, much enlarged, an interradial ovicell at left covered by rounded secondary cancelli, and interradial ooeciostome; beside this another interradial ovicell dissected away to show the cavity.

Fig. 6. ? *Disporella octoradiata* (Waters), a young zoarium without ovicell.

Fig. 7. *Disporella alaskensis* new species, side view, showing the height of the radii, the upturned margin and the small daughter zoarium.

Fig. 8. The same, frontal view, showing the complex nature of the radii, the position of the ovicell (roof broken away) and the position of the submarginal vertical bud of the daughter zoarium.


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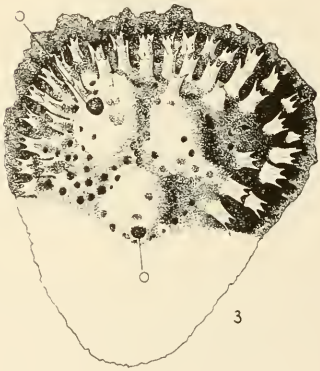
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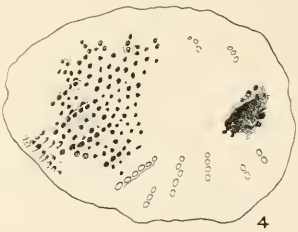
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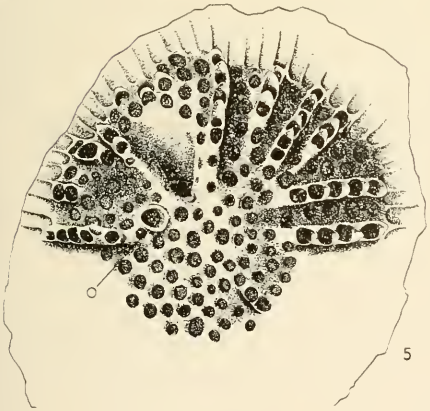
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PLATE 76

Fig. 1. *Disporella astraea* new species, showing attachment, vertical budding and crown from side view.

Fig. 2. The same, top view of crown (disc).

Fig. 3. *Lichenopora canaliculata* (Busk), view of disc with central ovicell and hooded ooeciostome.

Fig. 4. The same, enlargement of ooeciostome.

Fig. 5. *Lichenopora intricata* (Busk), portion of complex zoarium showing irregular distribution of peristomes between discs.

Fig. 6. The same, a fertile disc, with ooeciostome and irregular secondary cancelli covering ovicell.

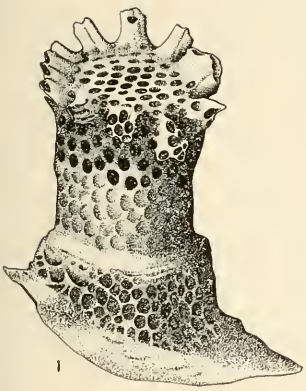
Fig. 7. The same, infertile disc with uniformly round small cancelli.

Fig. 8. The same, one end of a fertile disc with ooeciostome and irregular secondary cancelli covering ovicell.

Fig. 9. The same, the other end of the same disc with irregular cancelli over the end of the ovicell, and smaller rounded cancelli beyond the edge of the ovicell.

Fig. 10 *Disporella stellata pacifica* new variety, disc with large central area, multiserial radii and interradial position of ovicells.

Fig. 11. *Borgiola rugosa* (Borg), side view of zoarium with broad encrusting base and erect irregular branches; a small subcolony from the same base at the right.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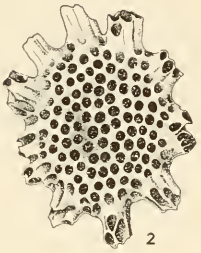
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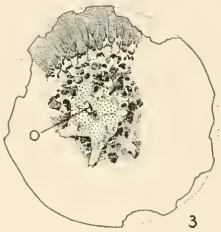
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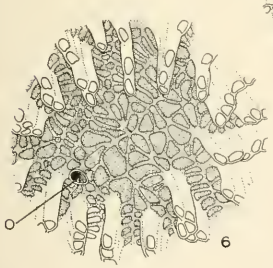
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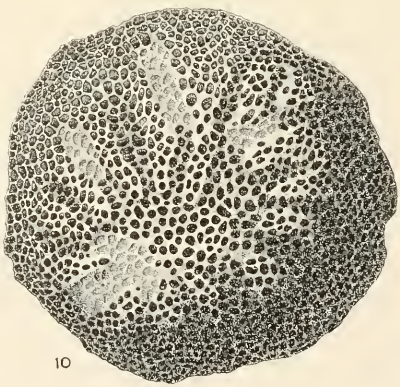
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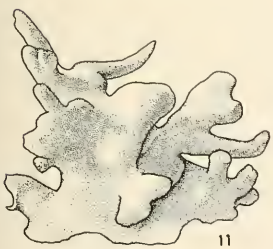
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PLATE 77

Fig. 1. *Alcyonidium polyoum* (Hassall), a portion of a zoarium with a zooecium in detail. X 46.

Fig. 2. *Alcyonidium parasiticum* (Fleming), note minute border papillae on detailed zooecium. X 46.

Fig. 3. *Alcyonidium pedunculatum* Robertson, a portion of a zoarium with one zooecium in detail. X 46.

Fig. 4. *Alcyonidium mammillatum* Alder, note aperture at apex of raised oral protuberance. X 46.

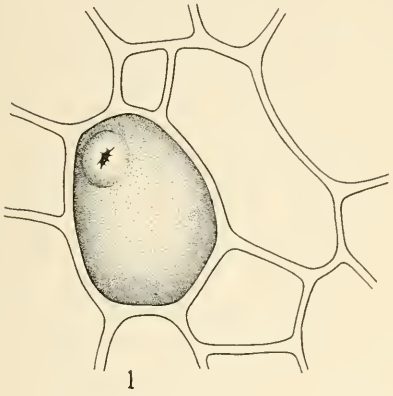
Fig. 5. *Alcyonidium disciforme* (Smitt), a portion of a zoarium with a zooecium in detail. X 46.

Fig. 6. The same, a drawing of a zoarium, ventral aspect, natural size.

Fig. 7. *Alcyonidium enteromorpha* Soule, a portion of a zoarium with one zooecium in detail. X 46.

Fig. 8. The same, dorsal view of dissected zooecium, showing the anatomy of the polypide. X 73.

Fig. 9. *Flustrella corniculata* (Smitt), a portion of a zoarium with a zooecium in detail. X 26.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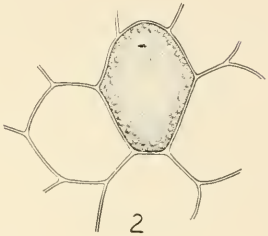
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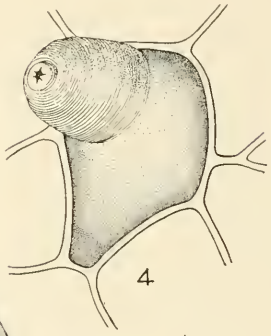
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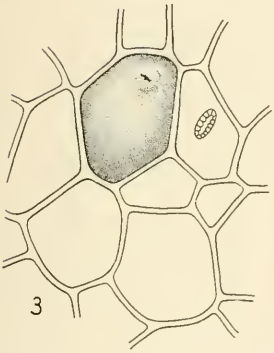
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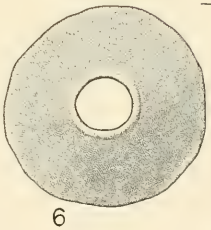
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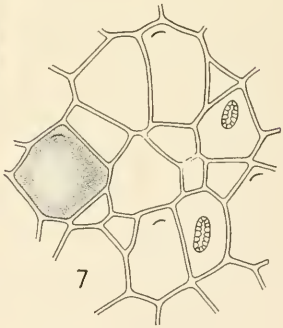
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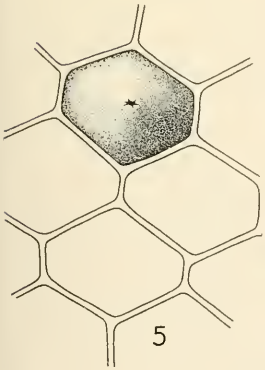
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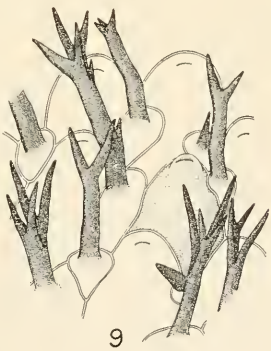
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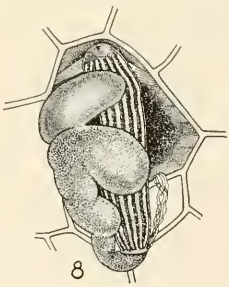
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PLATE 78

Fig. 1. *Flustrella gigantea* Silen, a portion of a zoarium with a zooecium in detail. X 26.

Fig. 2. *Pherusella brevituba* Soule, a portion of a zoarium with a zooecium in detail. X 46.

Fig. 3. *Clavopora occidentalis* (Fewkes), an entire zoarium. X 26.

Fig. 4. *Inguinella palmata* van Beneden, a portion of a zoarium showing the arrangement of the zooecia. X 26.

Fig. 5. *Nolella stipata* Gosse, a portion of a zoarium showing mode of growth, note polypide anatomy. X 26.

Fig. 6. *Vesicularia fasciculata* new species, a portion of a zoarium showing mode of growth, one zooecium with polypide anatomy. X 46.

Fig. 7. *Amathia convoluta* Lamouroux, a portion of a zoarium showing the characteristic spiral pattern of zooecial growth. X 46.


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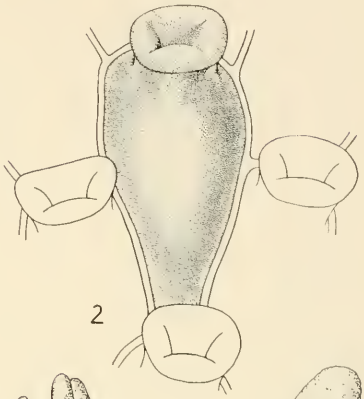
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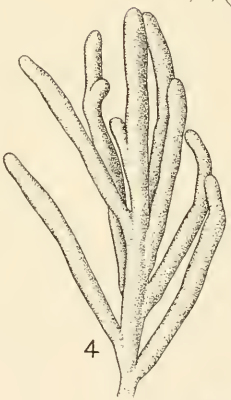
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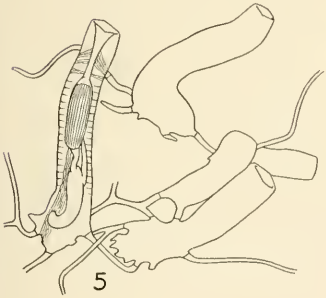
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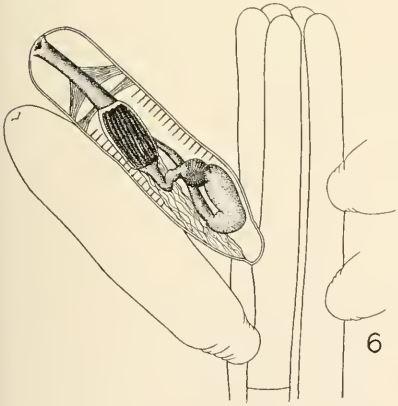
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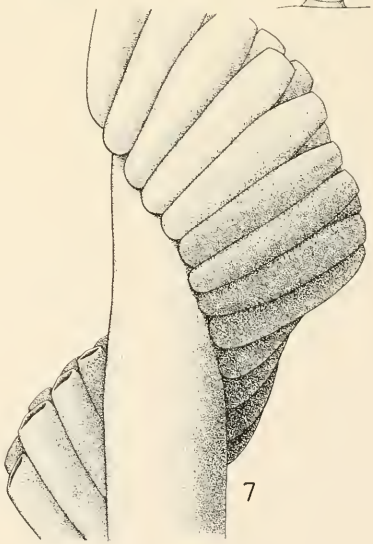
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PLATE 79

Fig. 1. *Almathia distans* Busk, a portion of a zoarium showing the position of the zooecia. X 46.

Fig. 2. *Almathia vidovici* (Heller), a portion of a zoarium showing the position of the zooecia. X 46.

Fig. 3. *Zoobotryon verticillatum* (delle Chiaje), a portion of a zoarium showing the placement of the zooecia. X 26.

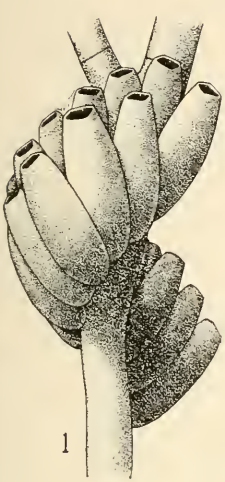
Fig. 4. *Bowerbankia imbricata* (Adams), a portion of a zoarium showing the position of the zooecia; note anatomical details. X 26.

Fig. 5. *Bowerbankia gracilis* Leidy, a portion of a zoarium showing the position of the zooecia. X 26.

Fig. 6. *Bowerbankia gracilis aggregata* O'Donoghue, a portion of a zoarium showing the mode of zooecial growth. X 46.

Fig. 7. *Valkeria tuberosa* Heller, a portion of a zoarium with one zooecium in detail. X 46.

Fig. 8. *Neoverrillia setigera* (Hincks), a pair of zooecia. X 46.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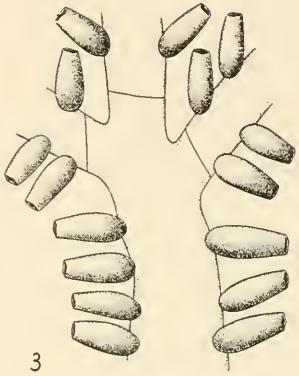
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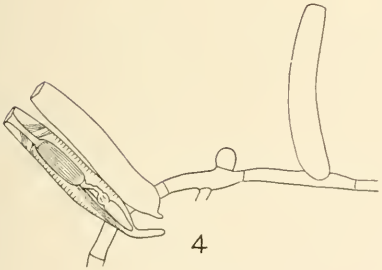
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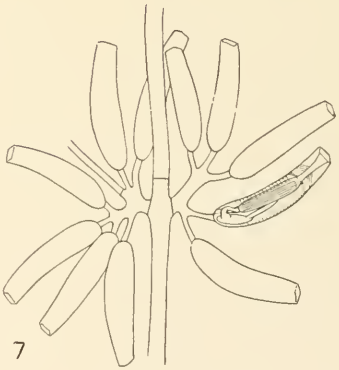
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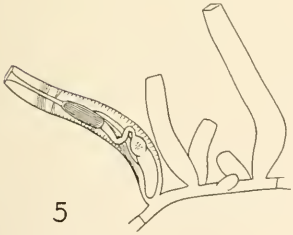
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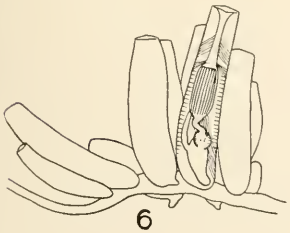
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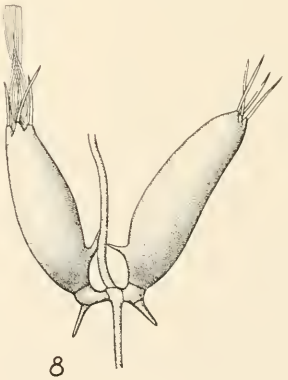
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PLATE 80

Fig. 1. *Buskia nitens* Alder, two zooecia showing mode of growth. X 46.

Fig. 2. *Buskia seriata* new species, a portion of a zoarium showing mode of zoarial growth, one zooecium with polypide anatomy. X 46.

Fig. 3. *Farrella elongata* (van Beneden), a portion of a zoarium, one zooecium showing the anatomy of polypide. X 26.

Fig. 4. *Triticella pedicellata* (Alder), a portion of a zoarium, one zooecium with anatomical details. X 26.

Fig. 5. *Triticella elongata* (Osburn), a portion of a zoarium, one zooecium showing details of polypide anatomy. X 26.

Fig. 6. *Terebripora comma* Soule, a portion of a zoarium removed from a mollusk shell, one zooecium with polypide anatomy. X 46.

Fig. 7. *Immergentia californica* Silen, a portion of a zoarium removed from a mollusk shell, one zooecium with anatomical detail. X 46.

Fig. 8. *Penetrantia densa* Silen, a portion of a zoarium removed from a mollusk shell, one zooecium with polypide anatomy, and also a typical gonozoid. X 46.

Fig. 9. *Penetrantia concharum* Silen, a portion of a zoarium removed from a mollusk shell, one zooecium with anatomical detail, and also a typical gonozoid. X 46.

Fig. 10. *Penetrantia sileni* Soule, a portion of a zoarium removed from a mollusk shell, one zooecium with polypide anatomy, and also a typical gonozoid. X 46.


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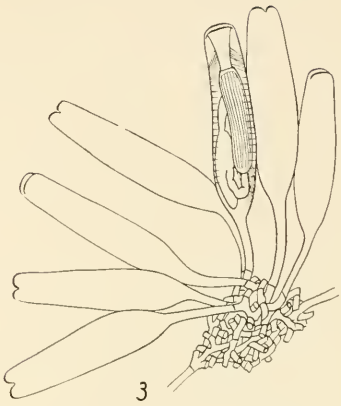
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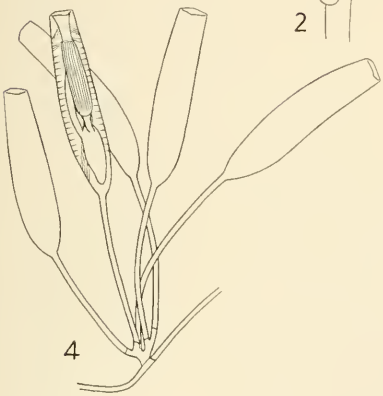
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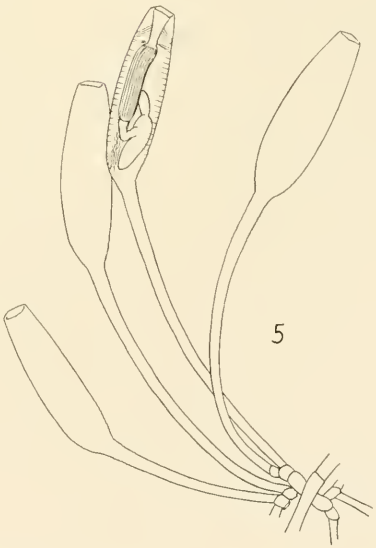
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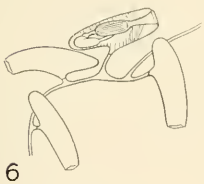
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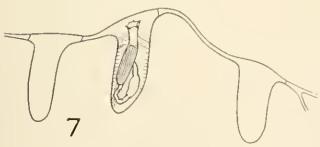
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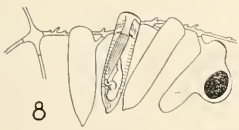
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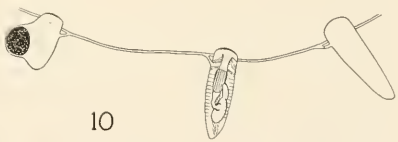
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PLATE 81

Fig. 1. *Hincksina gothica* new species, with zooecium, ovicell and large and small avicularia.

Fig. 2. *Amphiblestrum trifolium* (S. Wood), zooecia with trifoliate opesia and ovicell.

Fig. 3. *Bugula flabellata acuminata* new variety, part of zoarium with different sizes of avicularia.

Fig. 4. The same, large avicularium, partial side view, and front view of mandible with acuminate point.

Fig. 5. *Emballotheca stylifera* (Levinsen), zooecia with ovicell.

Fig. 6. *Hippodiplosia cancellata* (Smitt), zooecia with cancellate frontal wall, minute median suboral avicularium, and ovicell.

Fig. 7. *Microporella arctica* Norman, showing thick-walled frontal, ligulate avicularium, and ovicell.

Fig. 8. *Escharoides jacksoni* (Waters), zooecia with spout-like peristome, spines, avicularia and ovicell.

Fig. 9. *Porella minuta* (Norman), zooecia with suboral avicularium and ovicell.

Fig. 10. *Mucronella microstoma* (Norman), zooecia showing narrow aperture and spines.

Fig. 11. *Pachyegis brunnea* (Hincks), ovicell (for description of species see Part 2, p. 315).

Fig. 12. *Cheilopora praelucida* (Hincks), ovicell (for description of species see Part 2, pp. 464-65).


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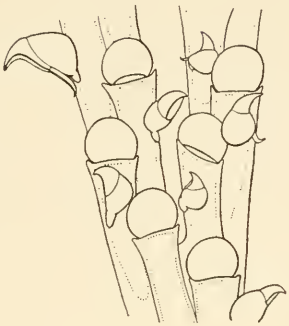
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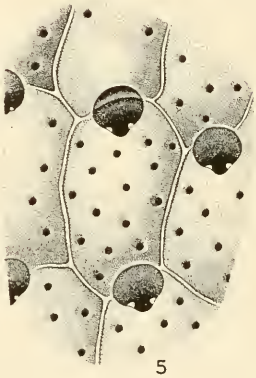
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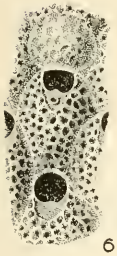
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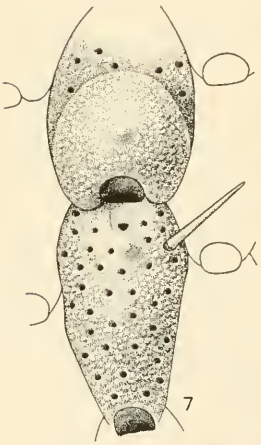
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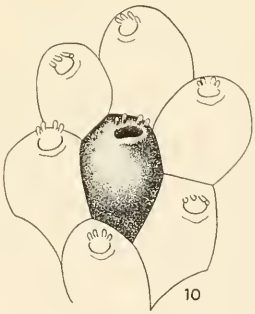
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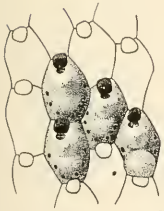
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PLATE 82

Owing to the nature of the material all of the figures are more or less diagrammatic, all to the same scale except figs. 6, 10 and 13.

Fig. 1. *Myosoma spinosa* Robertson, portion of zoarium, zoid, stolon and very young zoid. Note diagonal position of tentacle ring.

Fig. 2. *Pedicellina cernua* (Pallas), a fertile internode with zoid; the spines are irregular in distribution and often wanting.

Fig. 3. *Barentsia gracilis* (M. Sars), fertile internode and zoid; the stalk is often twice as long as that figured.

Fig. 4. *Barentsia geniculata* Harmer, short, wide basal bulb, muscular joints, comparatively small calyx.

Fig. 5. *Barentsia ramosa* (Robertson), details of joints and form of calyx.

Fig. 6. The same, habit sketch to show mode of branching.

Fig. 7. *Barentsia robusta* new species, showing large calyx, tall basal bulb and short internode (often shorter than the basal bulb), and attachment of bulb to stolon.

Fig. 8. *Barentsia discreta* (Busk), large calyx; very elongate internode with "pores" for its entire length.

Fig. 9. *Barentsia subrigida* new species, stalk walls thin and flexible except at the base of the lower internode; the proportions of the two internodes are very constant.

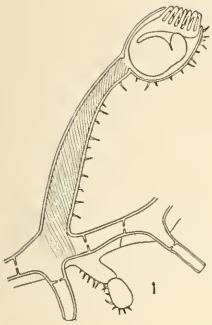
Fig. 10. *Barentsia gorbunovi* Kluge, habit sketch of branch, internodes without septa and three sizes of basal bulbs.

Fig. 11. The same, details of part of branch, with medium and small basal bulbs.

Fig. 12. The same, giant basal bulb at base of large branch, drawn to the same scale as fig. 11.

Fig. 13. *Coriella stolonata* Kluge, habit sketch of erect branch formed of connate stolons.

Fig. 14. The same, details of zoid; note that the basal bulb arises from a cup-shaped process of the fertile internode.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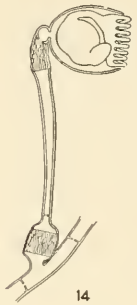
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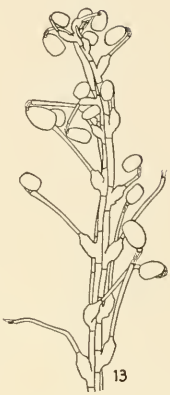
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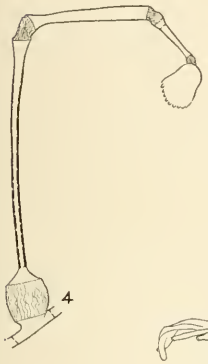
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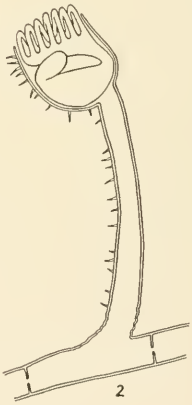
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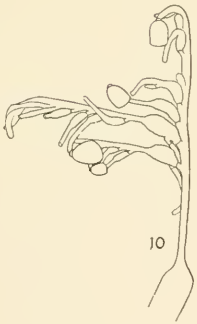
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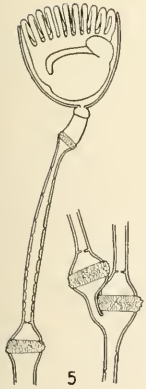
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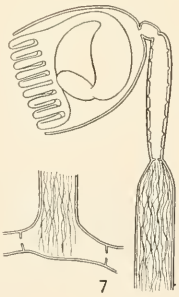
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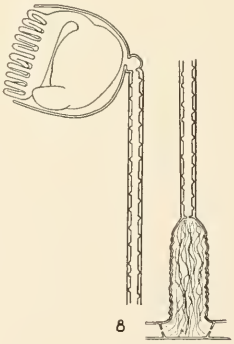
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ALLAN HANCOCK PACIFIC EXPEDITIONS
VOLUME 14 NUMBER 1

BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 1, Cheilostomata-Anasca

(Plates 1-29)

by

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

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BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 2, Cheilostomata-Ascophora

(Plates 30-64)

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NUMBER 3

BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 3, Cyclostomata, Ctenostomata, Entoprocta, and Addenda

(Plates 65-82)

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