THE HOLOTHURIOIDEA COLLECTED BY THE VELERO III DURING THE YEARS 1932 to 1938

Part I, Dendrochirota

(Plates 10-30)

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Introduction

The Panamic region, that is, the stretch of coast which extends from Cerros Island on the western coast of Lower California and southward (including the entire Gulf of California) to Ecuador (with the Galapagos Islands) and Peru, forms zoogeographically a natural unit. As far as holothurians are concerned, it has been almost unknown, undoubtedly because the coast in most localities is so exposed that many species live at a greater depth than in other places, as, for example, in the more sheltered bays and coves of the West Indies.

The study of the fauna has tempted zoologists for many years, and as early as 1866 Verrill began to compile lists of Echinoderms and Coelenterates from east and west of Central America. The purpose was chiefly to accumulate data to show the relation of the two faunas to each other. It was Alexander Agassiz's idea that, since so many forms, especially Echinoderms, in the two areas were closely related, one had here a chance to study the effect of separation, or isolation, on the origin of new species, since it was almost certain that the two faunas had once been identical—before the isthmus had been formed. Verrill's lists included 7 species from the Panamic region; of these, 3 are Dendrochirotes. Since then a few more have been described by various workers. The general impression gained was merely that the holothurian fauna was extremely poor and showed some affinities to that of the West Indian seas. It is only recently that the Allan Hancock Expeditions with the *Velero III* have been able to explode this myth and show that the holothurian fauna actually is as rich as that of the West Indies. During the past six years the *Velero III* has made extensive collections in the Panamic region and particularly dredgings in that zone hitherto so sadly neglected, between 10-100 fathoms. Almost all the species hitherto described from the region during the last hundred years have been secured and in addition a large number of new species. Thanks to the thorough and methodical way in which

the collecting has been undertaken—in most cases under the able leadership of Dr. Waldo L. Schmitt, with the enthusiastic support of several young collectors—the material now assembled appears to be so complete that one dares assert that very few additional species are to be expected. Future investigators must be content to secure more material of the species now known or additional information about the distribution of the individual species.

The collections consist chiefly of material collected in less than 100 fathoms, or what is usually referred to as shallow water, in contrast to the truly deep sea. The species are distributed among the following four orders—Dendrochirota, Aspidochirota, Molpadonia, and Apoda; the fifth order, Elasipoda, made up exclusively of deepwater forms and a few Arctic species from shallow water, was not met with by the *Velero*. The Dendrochirota and Aspidochirota have the greatest numbers of representatives. The material of the former order has proved to be the most interesting, because it includes a large number of new species which are restricted to the Panamic region or have close relatives in the West Indies, while the representatives of the Aspidochirota are mostly widespread species. The Molpadonia and Apoda have so few representatives that it is difficult to make any general statements about their relations to other faunas.

In the following account all the Dendrochirota hitherto known from the Panamic region are monographically treated. Besides the material secured by the *Velero III,* a few undescribed specimens from the M.C.Z. have been included to make the work complete. Much use has also been made of Selenka's old types and other material from the Panamic region which I have had occasion to examine at various times. Special attention has been paid to comparison with the holothurians from adjacent waters, that is, the West Indian, Californian, Chilean, and Hawaiian seas. As far as the Dendrochirotes are concerned, one may say that the affinities are definitely with the West Indian fauna, while a few forms have related representatives in Californian waters. Several species are also known from the Chilean coast, but relationship to the Hawaiian fauna seems to be nil. More extensive explorations may, however, show that a somewhat richer Dendrochirote fauna exists in Hawaii than has hitherto been supposed.

It is a great pleasure to thank the Allan Hancock Foundation for the privilege of studying this valuable collection, thus enabling me to realize my long-felt desire to write a monograph on the holothurians of the

Panamic region. Particularly do I wish to thank Dr. Irene McCulloch for her unflagging interest in this paper and for the amount of her own valuable time which she unstintingly has given whenever I worked in Los Angeles.

Composition of the Fauna

From the Panamic region 15 species of Dendrochirota, valid and dubious, were described up to 1936; during the following years 6 new species were added, thus bringing the total number up to 21.

The present monograph treats 43 species which are valid and 3 which are so poorly described that they must be completely rejected, unless the types should be rediscovered. Three of the 43 valid species are probably extraterritorial—*Pachythyone rubra* (H. L. Clark) and *Thyonepsolus nutriens* H. L. Clark, not known with certainty south of Santa Cruz Island, southern California, and *Psolus patagonicus* Ekman from the Cape Horn region. All the valid species have been examined; of these, 34 are represented in the Allan Hancock Foundation collections, while the remaining 9 have been studied in the M.C.Z. and in the U.S.N.M.; in five cases the types have been available. Of the 34 species in the Hancock collections 16 are new, while the 17th new species came from the collections of the *Stranger,* which are deposited in the M.C.Z.

List of Dendrochirota from the Panamic Region, Including a Few from the Adjacent Northern and Southern Waters†

† Dubious species are marked with an *; those not secured by the Allan Hancock Expeditions are marked with (0).

List of Stations at which Dendrochirote Holothurians Were Collected

11-32 (?). January 12, 1932. Conway Bay, Indefatigable Island, shore, Galapagos.
Thyonepsolus nutriens H. L. Clark
(Possibly some error in the station number.)

73-33. February 13, 1933. Albemarle Island, Cartago Bay, shore, Galapagos.
Pentamera chierchia (Ludwig)

80-33. February 15, 1933. Duncan Island, Smitty's Shore, collecting. In coral.
Pentamera chierchia (Ludwig)

132-34. January 4, 1934. Braithwaite Bay, Socorro Island, Mex., 40 fms.
Pentamera chierchia (Ludwig)
Neothyone gibber (Selenka)

143-34. January 11, 1934. Wenman Island, Galapagos, 100-150 fms.
Psolus diomedeae Ludwig

145-34. January 12, 1934. North end of Albemarle Island, Galapagos, 6-7 fms.
Pachythyone pseudolugubris, new species

147-34. January 13, 1934. South of Tagus Cove, Albemarle Island, Galapagos, 30 fms.
Thyonepsolus veleronis, new species

166-34. January 19, 1934. Charles Island, Galapagos; shore collecting on Black Beach.
Neothyone gibbosa, new species

189-34. January 25, 1934. Cartago Bay, Albemarle Island, Galapagos; shore, among *Porites.*
Pentamera chierchia (Ludwig)

190-34. January 26, 1934. Lat. 0°55'S., Long. 90°30'W., 58-60 fms. Sand.
Pentamera chiloensis (Ludwig)
Thyone neofusus, new species
Phyllophorus zacae Deichmann

209-34. February 9, 1934. North of Point Sta. Elena, La Libertad, Ecuador, 8-10 fms.
Pentamera chiloensis (Ludwig)

212-34. February 10, 1934. La Plata Island, Ecuador, dredging, 45-55 fms. Sand, shale, rock, mud.
Psolidium eubullatum, new species

213-34. February 10, 1934. La Plata Island, Ecuador, 7-10 fms.
Pentamera chiloensis (Ludwig)
Thyonepsolus hancocki, new species
Psolidium eubullatum, new species
Psolidium ekmani, new species
Psolus diomedeae Ludwig

244-34. February 21, 1934. Bahia Honda, Panama, dredging between Medidor and Pacora islands, 30-35 fms.
Thyonacta mexicana, new species

245-34. February 21, 1934. Bahia Honda, Panama, dredging off northwest point of Pacora Island, 15-25 fms.
Thyone bidentata, new species

249-34. February 22, 1934. Bahia Honda, Panama, dredging in 15-20 fms. Outside of island, south of bay. Rock.
Thyone bidentata, new species

251-34. February 22, 1934. Secas Islands, Panama, dredging south and west of group in 15 fms. Rock.
Thyone bidentata, new species

259-34. February 28, 1934. Tangola Tangola, Mex., 15-20 fms.
Leptopentacta panamica, new species

261-34. March 1, 1934. Tangola Tangola, Mex., 15-20 fms. In coral.
Cucumaria californica Semper
Euthyonidium ovulum (Selenka)
Thyonepsolus beebei Deichmann

264-34. March 2, 1934. South and west of White Friar Island, Petatlan Bay, Mex., 25 fms.
Pachythyone pseudolugubris, new species
Pentacta peruana (Semper)

272-34. March 4, 1934. Tenacatita Bay, Mex., dredging in 25 fms., between white rocks and bay. Coarse sand.
Thyone parafusus, new species

275-34. March 4, 1934. Off Navidad Head, Tenacatita Bay, Mex., 25-35 fms.
Leptopentacta panamica, new species
Thyone bidentata, new species
Thyone parafusus, new species

281-34. March 7, 1934. West coast of L. Calif., Santa Maria Bay, 35-40 fms., 1 mile west of Hughes Point.
Leptopentacta nova, new species

283-34. March 9, 1934. Off Thurloe Point, Thurloe Bay, west coast of L. Calif., 8-10 fms.
Cucumaria crax, new species
Pachythyone lugubris (Deichmann)
Thyonepsolus beebei Deichmann

286-34. March 9, 1934. Thurloe Point, west coast of L. Calif. Shore collecting.
Cucumaria californica Semper

287-34. March 10, 1934. Cerros Island, west coast of L. Calif., 10-15 fms. (close to kelp beds).
Pachythyone lugubris (Deichmann)

315-35. December 8, 1934. Indefatigable Island, opposite Gordon Rocks. In corals.
Pentamera chierchia (Ludwig)

365-35. January 10, 1935. Off southeast corner of Lorenzo Island, Callao, Peru, 10 fms.
Cucumaria dubiosa Semper

366-35. January 10, 1935. Between rocks south of Lorenzo Island, Callao, Peru.
Cucumaria dubiosa Semper

375-35. January 13, 1935. Independencia Bay, Peru, shore.
Pattalus mollis Selenka

384-35. January 14, 1935. Independencia Bay, Peru, 5 fms., ¾ mile off shore, east side of bay.
Cucumaria dubiosa Semper

391-35. January 17, 1935. Lobos de Afuera, Peru, shore of main island with lighthouse, rocks.
Neothyone gibber (Selenka)
Neothyone gibbosa, new species
Pattalus mollis Selenka

401-35. January 19, 1935. Manta, Ecuador, 1 fm., below first rocky point.
Pentamera chierchia (Ludwig)

423-35. January 25, 1935. Port Utria, Colombia, 20 fms., close to shore.
Leptopentacta panamica, new species
Thyone bidentata, new species

429-35. January 27, 1935. Octavia Bay, Colombia, 30-35 fms., north end of channel. Coarse sand and gravel.
Psolus diomedeae Ludwig

431-35. January 27, 1935. Octavia Bay, Colombia, 45 fms., north of Octavia Strait, south end of channel.
Psolus diomedeae Ludwig

464-35. February 8, 1935. Playa Blanca, Costa Rica, 2 fms., in coral, south shore of bay.
Pentamera chierchia (Ludwig)

465-35. February 8, 1935. Playa Blanca, Costa Rica, shale between beach and rocky reef.
Euthyonidium veleronis, new species
Neothyone gibbosa, new species

466-35. February 9, 1935. Parker Bay, Costa Rica, shore of small island at north side of bay.
Cucumaria californica Semper
Cucumaria dubiosa Semper
Neothyone gibber Selenka

467-35. February 9, 1935. Parker Bay, Costa Rica, 2 fms. Rock and algae.
Pentamera chierchia (Ludwig)

473-35. February 9, 1935. Parker Bay, Costa Rica, 2 fms., in coral.
Pentamera chierchia (Ludwig)
Neothyone gibber (Selenka)

517-36. February 25, 1936. East side of San Francisco Island, Gulf of Calif., 15 fms.
Phyllophorus zacae Deichmann

521-36. February 27, 1936. Agua Verde Bay, Gulf of Calif., 5-10 fms.
Thyonepsolus hancocki, new species

527-36. February 28, 1936. South of Mangles Anchorage, Gulf of Calif., shore.
Cucumaria californica Semper

529-36. March 1, 1936. Off San Francisquito Bay, Gulf of Calif., 165 fms.
Thyonepsolus hancocki, new species
Psolus diomedeae Ludwig

537-36. March 2, 1936. Spit, north of mill site, Angeles Bay, Gulf of Calif., shore.
Cucumaria californica Semper

540-36. March 3, 1936. Puerto Refugio, Angel de la Guardia Island, Gulf of Calif., shore.
Neothyone panamensis (Ludwig)

545-36. March 4, 1936. Puerto Refugio, Angel de la Guardia Island, Gulf of Calif., west of rock spit at river wash, shore.
Neothyone gibbosa, new species

554-36. March 8, 1936. Parallel to Angel de la Guardia Island, Gulf of Calif., east side, 10 fms.
Thyonacta mexicana, new species

557-36. March 8, 1936. Off White Rock, Isla Partida, Gulf of Calif., 45 fms.
Apentamera lepra, new species

562-36. March 10, 1936. North of San Esteban Island, Gulf of Calif., 20-70 fms.
Thyonacta mexicana, new species

591-36. March 16, 1936. Port Escondido, shore, L. Calif., rock.
Neothyone gibbosa, new species
Euthyonidium ovulum (Selenka)

596-36. March 16, 1936. Port Escondido, Gulf of Calif., 20 fms.
Pentamera chierchia (Ludwig)

617-37. March 2, 1937. San Juanico Bay, southern end of L. Calif., 24 fms.
Cucumaria californica Semper

623-37. March 4, 1937. Cabeza Ballena, east of Cape San Lucas, L. Calif., shore.
Cucumaria californica Semper

633-37. March 6, 1937. San Gabriel Bay, Espiritu Santo Island, Gulf of Calif., 18 fms.
Thyonacta mexicana, new species

677-37. March 15, 1937. Ildefonso Island, Gulf of Calif., 50 fms.
Pentamera chiloensis (Ludwig)

679-37. March 15, 1937. Outside of Concepcion Bay, Gulf of Calif., 30 fms.
Thyone bidentata, new species

683-37. March 15, 1937. Outside of Concepcion Bay, Gulf of Calif., 12 fms.
Cucumaria californica Semper
Pentamera chierchia (Ludwig)
Neopentamera anexigua, new species
Thyone bidentata, new species
Pachythyone pseudolugubris, new species

686-37. March 16, 1937. Concepcion Bay, L. Calif., 12 fms.
Thyone bidentata, new species

699-37. March 19, 1937, Angeles Channel, Gulf of Calif., 30 fms.
Cucumaria chilensis Ludwig

719-37. March 24, 1937. Consag Rock, Gulf of Calif., 6-8 fms.
Thyonacta mexicana, new species

744-37. April 1, 1937. Near Point Piaxtla, Sinaloa, Gulf of Calif., 6-8 fms.
Pachythyone pseudolugubris, new species
Psolidium dorsipes Ludwig

780-38. January 14, 1938. Chatham Bay, Cocos Island, Costa Rica, 40-47 fms.
Psolus diomedeae Ludwig

784-38. January 17, 1938. Darwin Bay, Tower Island, Galapagos, Middle Beach, shore.
Pentamera chierchia (Ludwig)

792-38. January 20, 1938. Off Daphne Minor Island, Galapagos, 70-80 fms.
Psolus diomedeae Ludwig

814-38. January 28, 1938. North of Hood Island, Galapagos, 20-40 fms.
Thyone neofusus, new species

816-38. January 29, 1938. North of Hood Island, Galapagos, 50-100 fms.
Phyllophorus zacae Deichmann

820-38. February 6, 1938. San Nicholas Bay, Peru, 10-25 fms.
Pattalus mollis Selenka

824-38. February 7, 1938. San Juan Bay, Peru, 15-20 fms.
Cucumaria californica Semper (poor specimen)

828-38. February 8, 1938. San Juan Bay, Peru, shore.
Athyonidium chilensis (Semper)
Pattalus mollis Selenka

831-38. February 9, 1938. Independencia Bay, Peru, east side of bay, shore.
Athyonidium chilensis (Semper)

833-28. February 10, 1938. Independencia Bay, Peru, off north entrance, 8 fms.
Pentamera chiloensis (Ludwig)

837-38. February 11, 1938. North Chincha Island, Peru, shore.
Pattalus mollis Selenka

844-38. February 14, 1938. Lobos de Afuera Island, Peru, shore.
Neothyone gibber (Selenka)
Neothyone panamensis (Ludwig)
Neothyone gibbosa, new species
Euthyonidium ovulum (Selenka)
Pattalus mollis Selenka

845-38. February 15, 1938. Sechura Bay, Peru, 9.5 fms.
Psolidium planum, new species

850-38. February 23, 1938. Cape San Francisco, Ecuador, 15 fms.
Leptopentacta nina, new species

854-38. February 24, 1938. Gorgona Island, Colombia, north of island, mud, rocks, 40-60 fms.
Thyonepsolus hancocki, new species
Psolidium planum, new species
Psolus diomedeae Ludwig

863-38. March 1, 1938. Bahia Honda, Panama, off North Island, 30-50 fms.
Apentamera lepra, new species
Psolidium dorsipes Ludwig
Psolidium ekmani, new species

Order DENDROCHIROTA

Diagnosis.—Plankton feeding holothurians with dendritic tentacles, rarely fingerlike; number varying from 10, the 2 ventral often smaller, in some cases less than 10, or 12-20, up to 30 in a few genera. Feet arranged along the ambulacra or also scattered in the interambulacra; terminal and dorsal ones often modified into papillae.

Internally a calcareous ring, simple, or complex, with shorter or longer posterior prolongations. One or more stone canals, one or more Polian vesicles; usually a well-developed muscle stomach; intestine with the 3 loops attached by mesenteries; that of the third loop may run along the right or the left side of the midventral muscle band. Retractor muscles well developed, distinctly separated from the longitudinal muscles. Respiratory trees mostly well developed, usually attached to the lateral interambulacra. Gonads forming 2 tufts with a shorter or longer genital stolon, and shorter or longer tubes, usually divided near the base.

Spicules tables, cups, buttons, or plates, et cetera, in some cases large scales covering the entire body, or the dorsal side and the ends. Feet with large end plate, or a vestige, or end plate completely reduced. Tentacles with larger or smaller plates or rods, often rosettes, or no spicules at all. In many forms the spicules disappear normally with advancing age, partly or completely.

Remarks.—The order seems to be comparatively young. The members occur with few exceptions in shallow water and the distribution of the individual species is rather restricted aside from the deepwater forms and certain Arctic and Antarctic forms.

Key to the Families of Dendrochirota

1. Part of the ventral side developed as a thin-walled creeping sole. . . . . III. *Psolidae* p. 135
1. No part of the ventral side developed as a thin-walled creeping sole. . . . . II.
2. Tentacles 10 in number or less. . . . . I. *Cucumariidae* p. 76
2. Tentacles more than 10 in number (12-20, 30). . . . . II. *Phyllophoridae* p. 122

Remarks.—The old division of dekachirote and polychirote forms, designating those with 10 tentacles (or less) and those with more than 10, has been abandoned, as it is completely artificial.

Characters Used for Identification

Macroscopical characters

Size.—Where full-grown specimens are available, size constitutes a fairly good character, although some caution must be used, as many species are able to contract their bodies to an unbelievable degree, while others rarely change much. Most Dendrochirotes are small forms, that is, less than 10 cm. long, a number measure between 10-15 cm., and few are large, above 20 cm. The largest forms are known to reach a length of 50 cm. when fully expanded. The chief difficulty about using size for identification is that one so often encounters young individuals. Specimens 1 cm. long are usually difficult to identify; the feet are frequently not distributed in their typical pattern, and the spicules may be very different from what they are in more mature individuals. Where very young specimens are involved, the characters, "feet ambulacral" or "feet interambulacral," cannot be used, as all the forms with interambulacral feet begin with feet in the ambulacra only. In some species the interambulacral feet begin to appear when the animal is less than 1 cm. long, but in others they appear much later, when the animal is 2-3 cm. long.

For that matter, very little is known about the growth rate of the Dendrochirotes or any order of seacucumbers. Mitsukuri found that the Japanese Aspidochirote form *Stichopus japonicus* reaches the unbelievable length of 25 cm. in a little over a year, but such a rapid growth is probably an exception, and under no circumstances can it be assumed to be the normal in the Dendrochirotes without definite proof. Smaller species may probably reach their full length in one or two years; larger forms, as, for example, *Thyone briareus* (Lesueur), require undoubtedly four to five years to reach their full size.

Tentacles.—The full number is quickly reached in the "dekachirote" forms. In the "polychirote" forms (those which have tentacles arranged in 2 well-defined circles and definitely of two sizes) seem to develop the full number before they have reached the length of about 1 cm., while in the species which have the 2 circles indistinctly set off and with tentacles of varying size the full number seems to be reached rather late. In many "dekachirote" forms the two ventral tentacles are much smaller than the others, and the difference in size is retained throughout the animal's life. In a few species the number of tentacles falls below ten in various deep sea forms and in that case the tentacles are often unbranched.

Tube feet.—The arrangement of the tube feet is of importance in reasonably mature individuals and constant for the different species. The

number of feet increases with advancing age. Many descriptions, "feet in 3-4 rows," "single row, etc.," are of little value except when the animal is well expanded and its size also is given. In some species the feet are heavily armed with spicules and unable to retract; in others equally well armed they may be withdrawn. Where the feet contain few spicules, the feet are often completely retractile. In younger individuals the arrangement of the feet is often untypical, as mentioned above.

Inner organs.—Much space has usually been devoted to the inner anatomy of the Dendrochirotes, but with the exception of the calcareous ring, the stone canal, Polian vesicle, and gonads, all other organs may usually be ignored. A few species are said to lack a muscle stomach, but I am not sure that the observation is correct. The course of the intestine and the attachments of the mesenteries to the body wall are fairly stable characters, although some variation has been noted, but the contracted, contorted condition wherein the material often is preserved, or the complete loss of inner organs, makes it impossible to use these structures consistently. The *Cucumariidae* seem typically to have the third mesentery attached on the right side of the midventral muscle band, the *Phyllophoridae* seem to have it attached to the left, and the *Psolidae* have it either way. The thickness or thinness of the longitudinal muscles, the place of attachment for the retractors, the shape of the branches of the respiratory trees, et cetera, are all characters of rather dubious value and the use of them has often caused misidentification.

Calcareous ring.—The calcareous ring presents a character of utmost importance, as certain types invariably seem to be combined with a certain arrangement of the tube feet and certain types of spicules.

The calcareous ring is designated as simple when the radials and interradials have fairly low, broad basal portions with shorter or longer anteriorly projecting teeth, while the posterior margin may be almost straight or undulated, sometimes with faint protuberances on the radials. In the complex ring the radials have distinct posterior prolongations, the so-called "tails"; and the body of the radials may be deeply cleft, sometimes almost to the base of the anterior tooth. In some species the tails may be secondarily more or less resorbed or hidden in the tissue and hence less noticeable. The interradials either are fairly broad, overlapping the radials as heart-shaped or diamond-shaped pieces, or are narrow, often quite tall, rectangular, and firmly united with the radials; rarely are they vestigial; the anterior tooth may be short or long. The complex calcareous ring may furthermore be composed of several smaller pieces as a

mosaic, but this "polyplacous" condition is perhaps not always an entirely reliable character, as in certain species some specimens have polyplacous rings, while in others the condition is little or not at all pronounced—observed in *Pentamera calcigera* (Stimpson).

Stone canal and Polian vesicle.—In most Dendrochirota there is a single dorsal stone canal with round or oblong head, attached to the dorsal mesentery, or free, and one or two ventral Polian vesicles. In a few species, particularly among the "polychirote" forms, there are several free stone canals and often a large number of Polian vesicles also. In some species the Polian vesicles have been found to be branching, but in most cases they are simple.

Gonads.—Only few and scattered observations have been made on the gonads in the holothurians and here also too much emphasis has been laid on the size of these organs in different animals. In *Stichopus japonicus* Mitsukuri observed that the sexually mature individuals, about 3 years old, in short time developed few long tubes of eggs and sperms, which were shed, and the tubes shriveled up and new ones developed in the following year. This condition is probably the typical one in the aspidochirote forms. In the larger Dendrochirota it seems as if the gonad tubes increase in size over a period of years. It is possible that some eggs or sperms are developed before the full size of the tubes is reached. In *Thyone briareus* (Lesueur) it has been observed (Kille, 1939) that the number of tubes increases slightly with advancing age. The increase takes place in the anterior part of the gonads, while a few shriveled-up tubes are found posteriorly. A similar observation has been made on *Athyonidium chilensis* (Semper). Very likely smaller, immature tubes will be found to be present in most Dendrochirotes, which continue their growth for several years. It is also possible that some of the so-called "hermaphroditic gonads" merely represent the mature and immature portions of a unisexual gonad. In the larger species the number of tubes is large, more than 100 in each tuft; in the smaller and supposedly more short-lived forms the number of tubes in each tuft is low, varying between 5-20 or thereabout, and no immature portion seems to be present. More observations are, however, needed before any definite statements can be made.

Microscopical characters

The spicules in the integument, feet, introvert, and tentacles form valuable characters for identification of Dendrochirota as well as most other holothurians. Certain types of spicules or derivates of these occur, usually together, and accompany certain anatomical features. The spicules

change considerably during the animal's life, either becoming more complex or degenerating; in some cases they disintegrate almost completely, with the exception of the end plate which normally seems to persist in the species where it is well developed from the beginning; when it is rudimentary in the young individual, it quickly becomes resorbed.

In the integument two layers of spicules are typically present, an external, the function of which is presumably to give roughness to the skin, and an inner layer, which gives stiffness. The spicules in the outer layer seem definitely fixed in their position, usually with the external side rough with spines, often perforating the skin, while the spicules in the inner layer are able to slide over each other when the animal contracts—as the cards in a deck—and these spicules are therefore more smooth and flat. Either layer or both may be reduced or lacking; the inner layer is never present in very young individuals, while the outer layer frequently is lost or reduced with age. Usually the spicules in the 2 layers are extremely different, in other cases they are less sharply differentiated. Common types in the external layer are: the table, a basal plate with a number of pillars (1-6) ending in a varying number of teeth, or the basket (or cup)—a hollow body usually with a number of spines developed on the edge. Other types are oval buttons and plates, often with spines or a rough reticulated mass on the external side. The inner layer consists of regular or irregular buttons or plates, smooth or knobbed. Sometimes also large and more complex bodies may be found.

A few forms have the body covered partly or completely by scales. In that case the external layer of spicules is usually quite insignificant, although it may contain rather interesting types of deposits.

In the tube feet a large end plate is almost invariably present in the species which have well-developed tails on the calcareous ring. Likewise, a well-developed end plate is usually accompanied by supporting tables with a curved disk and a spire of varying development—sometimes the spire is totally absent except in very young individuals, but it is usually possible to ascertain whether a supporting rod is derived from the table type or not. In more papilliform appendages the end plate is usually small or lacking.

No end plate, or a vestigial end plate is usually combined with a simple calcareous ring, and the supporting rods are either simple or provided with a third arm, more or less platelike, often irregularly star shaped.

The introvert (the thin-walled skin between the base of the tentacles and the anteriormost tube feet) often contains characteristic spicules. In the species where the spicules are reduced gradually they are frequently retained here. They usually resemble those found in the external layer of the skin but are often more delicate and more complex. The tentacles may be filled with large perforated plates or rods, or contain minute rods or delicate plates, rarely a mixture of both. Rosettes seem typical of certain species; they are apparently restricted to tropical and subtropical forms and occur often in both the introvert and the tentacles. In many cases the spicules in the tentacles become completely reduced with advancing age.

Family I. Cucumariidae

Key to the Genera of Cucumariidae Known from the Panamic Region

1. Body more or less globose, covered by large, reticulated scales. Deepwater forms. . . . . *Sphaerothuria* Ludwig
1. Body not globose, not covered by large, reticulated scales. . 2
2. Spicules spinous crosses. Deepwater forms. . . . . *Staurocucumaria* Ekman
2. Spicules not spinous crosses. 3
3. Feet restricted to ambulacra. 4
3. Feet also found in the interambulacra. 7
4. Feet retractile, soft, with end plate reduced or lacking. Spicules plates or buttons, often reduced. . . . . 1. *Cucumaria* Blainville *(partim)* p. 77
4. Feet not retractile. 5
5. Skin covered by huge reticulated plates and smaller spicules. Calcareous ring at most with short posterior prolongations. . . . . 5. *Leptopentacta* H. L. Clark p. 92
5. Skin not covered by huge reticulated bodies. Calcareous ring with long posterior prolongations. 6
6. Spicules 2-pillared tables, spire sometimes reduced. Feet with large end plate. Spicules rarely reduced. 2. *Pentamera* Ayres p. 84
6. Spicules knobbed buttons, or irregular. Feet with large end plate. . . . . 3. *Neopentamera,* new genus p. 90
7. Feet occur in interambulacra but chiefly in the dorsal ones. 8

7. Feet occur in interambulacra but chiefly in the ventral ones. (Thyone s. l.) 9

8. Dorsal feet normally developed, soft, retractile. Spicules plates or buttons, often reduced. 1. *Cucumaria* Blainville *(partim)* p. 77

8. Dorsal feet mostly papilliform. Spicules few or numerous. . 10

9. Dorsal interradial feet few, small, easily overlooked; radial feet numerous. Resembles *Pentamera*. . . . . 4. *Apentamera,* new genus p. 91

9. Dorsal feet partly large, wartlike or papilliform. Spicules crowded. . . . . 6. *Pentacta* Goldfuss p. 96

10. Spicules numerous, forming a crowded layer. 11

10. Spicules more or less reduced, scattered, or lacking. 14

11. Spicules as 2- or 4-pillared tables. Calcareous ring with long posterior prolongations. . . . . 8. *Thyone* Oken p. 102

11. Spicules as knobbed buttons. 12

12. Feet at first comparatively few, in distinct rows along the ambulacra, later crowded in the interambulacra, mostly papilliform. . . . . 7. *Thyonacta,* new genus p. 101

12. Feet numerous, but in almost indistinct rows along the ambulacra 13

13. No external plates covered by reticulum. Either baskets or buttons with spinous handle. . 9. *Neothyone,* new genus p. 108

13. External plates covered by a reticulum. . . . . 10. *Pachythyone,* new genus p. 114

14. Spicules swollen buttons, often obviously derived from tables. Calcareous ring with long, well-developed posterior prolongations. . . . . 11. *Athyone,* new genus p. 118

14. Spicules apparently lacking except the end plate in the feet. Calcareous ring with short posterior prolongations sometimes reduced. . . . . 12. *Anaperus* Troschel p. 120

Genus 1. CUCUMARIA Blainville

Diagnosis.—Dendrochirotes with 10 tentacles, of equal size or the ventral ones smaller. Feet large, soft, in 5 bands, in some forms also scattered in the interradii, particularly dorsally. Calcareous ring low, simple.

Spicules plates or buttons, knobbed or smooth, often reduced. Feet with a vestige of an end plate or none at all; walls supported by rods, often 3 armed, or plates. Introvert and tentacles with perforated plates and rods. The spicules show tendency to become reduced in many forms.

Type species.—*Cucumaria frondosa* (Gunnerus).

Remarks.—The diagnosis embraces only the members of the genus *Cucumaria* sensu strictiore. The well-known type species is the only representative of the genus in the northern Atlantic, while the northern Pacific, including Bering Sea, harbors 3 large species: *C. japonica* Semper, *C. fallax* Ludwig, and *C. miniata* Brandt. From the west coast of North America a number of smaller forms have been described: *C. vegae* Théel, *C. lubrica* H. L. Clark, *C. curata* Cowles, *C. pseudocurata* Deichmann. From the Panamic and Peruvian-Chilean region 4 species are reported with certainty, while a fifth species, from Chile, imperfectly described, is briefly discussed below.

Key to the Species of *Cucumaria* s. str. Known from the Panamic Region

1. Spicules small, crackerlike buttons or plates with marginal holes or incisions. . . . 4. *Cucumaria crax,* new species
1. Spicules larger plates and buttons, knobbed to smooth, often reduced in older individuals 2
2. Feet not restricted to the ambulacra, fairly numerous in the dorsal interambulacra. . . 3. *Cucumaria dubiosa* Semper
2. Feet restricted to the ambulacra. 3
3. Tentacles soft, bushy, of equal size. Spicules usually almost lacking in larger individuals (6-10 cm. long), in young individuals as knobbed oblong plates, often with a dentate handle; supporting rods in feet predominantly 3-armed rods. . . . . 1. *Cucumaria californica* Semper
3. Tentacles rigid with spicules, not bushy, ventral ones small. Spicules strongly knobbed circular plates or smooth ones, usually without a spinous handle. Feet with narrow, bandlike supporting rods. . . . . 2. *Cucumaria chilensis* Ludwig

Remarks.—Not included in the key is *Cucumaria godeffroyi* Semper, which possibly is a strictly southern form. See p. 83.

1. Cucumaria californica Semper

Plate 10, Figs. 6-8

Cucumaria californica Semper, 1868, p. 235, pl. 39, fig. 16; pl. 40, fig. 10.—Lampert, 1885, p. 147.—Théel, 1886, p. 109; 1886a, p. 8.

Nec *Cucumaria californica* Edwards, 1910, p. 601 (i.e., *C. fallax* Ludwig—an Arctic species, known from Bering Sea).

Diagnosis.—Medium-sized form (10 cm.), with soft, bushy tentacles of equal size. Skin soft, slippery; feet large, soft, completely retractile, restricted to the ambulacra. Calcareous ring simple, other anatomical features very nearly as in the type species. Spicules oblong knobbed plates, often with a spinous handle, and 4-holed buttons, frequently reduced or lacking. Feet with a vestige of an end plate and numerous 3-armed perforated supporting rods. Introvert and tentacles with perforated plates or rods, often completely reduced. Color varying from dark slate gray or black to almost white; tentacles seem always to be darkly pigmented.

Holotype.—Possibly in Germany.

Type locality.—Mazatlan, Mexico.

Distribution.—West coast of Mexico and Central America, possibly to Peru.

Depth.—From shore to about 100 fms.

Specimens examined.—Numerous in the U.S.N.M., and the following from the Allan Hancock Expeditions:

261-34. Tangola Tangola, Mex., 15-20 fms., March 1, 1934, 4 specimens.

286-34. Thurloe Bay, Thurloe Point, L. Calif., Mex., shore, March 9, 1934, 8 specimens.

466-35. Parker Bay, Costa Rica, shore, February 9, 1935, 3 specimens.

527-36. South of Mangles Anchorage, L. Calif., Mex., shore, February 28, 1936, 1 specimen.

537-36. Spit, north of mill site, Angeles Bay, L. Calif., Mex., shore, March 2, 1936, 10 specimens.

617-37. San Juanico Bay, L. Calif., Mex., 24 fms., March 2, 1937, 2 specimens.

623-37. Cabeza Ballena, east of Cape San Lucas, shore, March 4, 1937, 2 specimens.

683-37. Concepcion Bay, L. Calif., Mex., 12 fms., March 15, 1937, 1 specimen.

824-38. San Juan Bay, Peru, 15-20 fms., February 7, 1938, 1 specimen.

Remarks.—The species seems to be common in the Gulf of California and along the west coast of Mexico and Central America. A single record exists from Peru, possibly an error in labeling. Its soft skin, bushy tentacles, and usually dark coloration make it easy to recognize. In life it is often bright red; in alcohol it fades to white with dark tentacles.

The name *californica* has unfortunately been applied to the common *frondosa*-like form from Bering Sea, *C. fallax* Ludwig. During the *Albatross* expeditions a single specimen of this Arctic form evidently got mixed up with some material from the Galapagos Islands; Edwards, who worked over the material, gave the name *californica* to this specimen with the dubious locality, as well as to the larger individuals of *C. fallax* from Bering Sea (while the smaller individuals were identified as *C. fallax*). The supposedly Galapagos specimen, which shows strong signs of having been dried up, is a typical huge, brownish, *frondosa*-like form and cannot be separated from the individuals of *C. fallax* of the same size collected in the Bering Sea.[1] *Cucumaria californica,* on the other hand, is much smaller and either completely slate gray or black, or the tentacles and part of the anterior end are dark colored. Its spicules are entirely different from those found in *C. fallax.*

2. Cucumaria chilensis Ludwig

Plate 11, Figs. 3-5

Cucumaria chilensis Ludwig, 1875, pl. 6, fig. 11 (used only in the plate explanation).

Cucumaria exigua (partim) Ludwig, 1874, p. 84.—Lampert, 1885, p. 145.—Théel, 1886, p. 108.

Diagnosis.—Medium-sized form. Feet restricted to ambulacra, retractile. Tentacles not bushy, filled with spicules, the 2 ventral ones small. Calcareous ring simple; other anatomical features apparently typical of the genus.

Spicules 4-holed buttons and smooth to knobbed plates. Feet with rudimentary end plate and numerous slender supporting rods, slightly shorter in the dorsal appendages. Introvert and tentacles with large perforated plates and rods. Color yellow, with or without irregular spots, or mottled gray and brown.

Holotype.—Hamburg Museum.

Type locality.—Chile.

Distribution.—Various localities in Chile.

[1] Material in U.S.N.M.

Depth.—Not recorded for the type and paratypes.

Specimens examined.—A single specimen from *Velero III* Station 699-37, Angeles Channel, Gulf of California, 30 fms., March 18, 1937.

Remarks.—The name *chilensis* has been re-established, since it is almost unbelievable that the species from China is identical with the Chilean form. Ludwig evidently considered the 2 species as different and then decided to unite them in spite of the differences which they exhibited. It is not clear from his description whether he found any cross-shaped bodies in the Chilean specimens (present in *C. exigua* from China). The combination of characters, viz., simple ring and small ventral tentacles and the unusually narrow supporting rods in the feet, is such that it seems almost certain that the present species is identical with the one described by Ludwig. Most of the plates found in the *Velero* specimen are considerably more complex than indicated by Ludwig, but simple 4-holed buttons are also present, and it is well known that the spicules are often more or less reduced in this group. (The earlier authors, often on general principle, avoided figuring the more complex spicules, as study of certain holotypes has revealed, and figured only those which could be easily reproduced.)

The *Velero III* specimen measures 3 cm. in length, but is so strongly retracted that it probably measured 10 cm. or more when expanded. Ludwig's types measured about the same, but it is not known whether they were very strongly contracted or not.

3. Cucumaria dubiosa Semper

Plate 11, Figs. 1-2

Cucumaria dubiosa Semper, 1868, p. 238, pl. 39, fig. 19.—Lampert, 1885, p. 151.—Théel, 1886, p. 111.

Cucumaria leonina Ludwig, 1898, p. 36.—Ekman 1925, p. 52, text figure 10.

Nec *Cucumaria leonina* Semper, 1868, p. 53, pl. 15, fig. 9.

Diagnosis.—Medium-sized form, length up to 10 cm. Feet in 5 bands and numerous in the dorsal interambulacra. Tentacles bushy, of unequal size. Color uniformly parchmentlike (in alcohol). Calcareous ring simple, other features as in the typical forms. Spicules numerous, oblong, knobbed plates, often with spinous handle[2] and 4-holed buttons.

[2] In very young specimens (1 cm. long) a number of almost circular plates with a long narrow handle are found (see Ekman's text figure). Such plates with handles have not been discovered in *Cucumaria lubrica* from the western coast of North America.

Feet with rudimentary end plate, or none at all, and numerous supporting rods, mostly 3 armed. Introvert and tentacles with perforated plates and rods.

Type.—Possibly in Germany.

Type locality.—Coast of Peru.

Distribution.—From Peru to the south end of South America, including Falkland Islands, also Costa Rica. See Ekman, 1925.

Depth.—Not recorded for the type.

Specimens examined.—Numerous from the following stations of *Velero III:*

365-35. Callao, Peru, off southeast corner of Lorenzo Island, 10 fms., January 10, 1935, 21 specimens.

366-35. Callao, Peru, between rocks, south of Lorenzo Island, 8 fms., January 10, 1935, 1 young specimen.

384-35. Independencia Bay, Peru, ¾ mile off shore, east side of bay, 5 fms., January 14, 1935, 1 young specimen.

466-35. Parker Bay, Costa Rica, small island at north side of bay, shore, February 9, 1935, 1 specimen. This record so far north is unusual.

Remarks.—The examined specimens range in size from 1.5 cm. to 6 cm. Even the smallest individual has a number of tube feet scattered in the dorsal interambulacra and therefore cannot be mistaken for *C. californica* of the same size; the latter species has, moreover, darkly pigmented tentacles.

The spicules resemble those found in *Cucumaria lubrica* H. L. Clark (including *C. fisheri* Wells) from the west coast of North America, and it is rather difficult to express the differences in such variable forms. The northern form seems always to have numerous 4-holed buttons which apparently sometimes are lacking in the southern form.

The name *dubiosa* has been preferred to *leonina* against such authorities as Ludwig (1887 and 1898) and Ekman (1925). Semper's *leonina* is supposed to have come from Singapore, and it is only a surmise that it is identical with *C. dubiosa.* Since it is very unlikely that the same species occurs in both Singapore and Chile and since the Chilean (and Peruvian) locality is above reproach, it has been concluded that the locality Singapore was wrong. But it is quite possible that *C. leonina* came from Singapore; species with similar spicules are known from other places, for example, *C. köllikeri* from the Mediterranean Sea and *C. salmini* from Celebes. The latter was listed by Lampert, 1885, as occur-

ring in the Strait of Magellan, and since then it was concluded that the locality Celebes was wrong. Very likely *salmini* from Celebes is a synonym of *leonina* from Singapore but different from the species from Peru and Chile.

4. **Cucumaria crax,** new species

Plate 10, Figs. 1-5

Diagnosis.—Small form (?). Skin soft, smooth; feet large, soft, completely retractile, arranged in 5 bands, apparently not present in the interambulacra. Tentacles soft, bushy, of equal size. Calcareous ring low, simple, strongly undulated posteriorly; radials deeply incised; a single stone canal attached in the dorsal mesentery, 2 ventral Polian vesicles. Retractors short, fleshy, gonads attached near the middle of the body. Spicules, a scattered layer of small biscuit-shaped bodies, usually with 4-8 marginal holes, frequently incompletely closed, and knobbed margin. Feet with rudimentary end plate and short 3-armed supporting rods. Introvert and tentacles, respectively, with buttons and numerous narrow rods with perforated ends, large in the stem, small and almost hair fine in the ends of the tentacles. Color mottled brown with paler ambulacra; tentacles black.

Type.—Holotype, AHF no. 23, 6 paratypes.

Type locality.—Station 283-34, Thurloe Point, Thurloe Bay, west coast of L. Calif., 8-10 fms., March 9, 1934.

Distribution.—Known from the type locality.

Depth.—From 8-10 fms.

Specimens examined.—The type and 6 paratypes.

Remarks.—The type measures 1.5 cm. in length and is strongly contracted. The gonads are well developed, but this fact in itself constitutes no clue to the size which the species may attain when full grown.

Superficially it resembles a small specimen of *C. californica* Semper, but the spicules are entirely different. If the spicules disappear completely as the animals grow larger, it may become impossible to distinguish between the two forms.

5. **Cucumaria godeffroyi** Semper

Cucumaria godeffroyi Semper, 1868, p. 53, pl. 15, figs. 12, 14.—Lampert, 1885, p. 144.—Théel, 1886, p. 99.—Clark, 1910, p. 352.

Nec *Holothuria crocea* Lesson, 1830, p. 153, pl. 52. Suggested by Semper but not accepted by later writers.

Description.—Imperfectly known. Presumably the feet are restricted to the ambulacra and the tentacles probably of equal size. The calcareous ring is simple. The Polian vesicle is single; the stone canal attached in the dorsal mesentery. Spicules perforated plates with laciniated edge and one end narrower with long marginal spines, this end projecting through the skin.

Type.—Hamburg.

Type locality.—Iquique, Chile.

Distribution.—Coast of Chile.

Depth.—Not noted.

Specimens examined.—None.

Remarks.—No specimen seems to have been secured since the type was described. The type measured 3.5 cm. in length, possibly strongly contracted. The interambulacral feet may have been overlooked. The spicule figured could be interpreted as a degenerate plate from an aged *C. dubiosa.*

Genus 2. **PENTAMERA** Ayres, 1852

Pentamera Ayres, 1852, p. 207.—Deichmann, 1938, p. 373; 1938a, p. 105.

Diagnosis.—Small to medium-sized forms; ventral tentacles small; feet long, nonretractile, arranged in 5 bands but never scattered in the interambulacra. Calcareous ring with long posterior prolongations on the radials. Spicules 2-pillared tables or derivatives from these with the spire reduced or developed as acornlike bodies. Feet with large end plate and supporting tables, usually with well-developed spire; in some forms the spire is more or less completely reduced. Tentacles with rods or plates, in some forms devoid of spicules, at least in the older individuals. Spicules in most forms numerous throughout the animal's life, in some species the spicules are few and degenerate.

Type species.—*Pentamera pulcherrima* Ayres.

Remarks.—The diagnosis has been modified to include also *Pentamera chierchia* Ludwig and *P. zacae* Deichmann, the former with few and mostly reduced spicules, the latter with peculiar acorn-shaped bodies —as it seems unwise for the present moment to segregate these two forms which otherwise conform so well with the typical members of the genus.

The type species seems to be the only representative known from West Indian waters, while *P. calcigera* (Stimpson) is widespread in the northern Atlantic and Pacific oceans, and 7 related species have developed along the western coast of North America (see Deichmann, 1938).

From the Panamic region (and Chile) 4 species are known. One of these is closely related to the type species.

Key to the Species of *Pentamera* Known from the Panamic Region

1. Spicules in skin acorn-shaped bodies, possibly derived from tables. Feet with end plate and curved supporting tables with well-developed spire. Color white. . . . . 1. *Pentamera zacae* Deichmann
1. Spicules in skin 2-pillared tables or derivatives of these (with spire reduced to knobs or spines). 2
2. Spicules scattered, tables reduced to disks with spinous edge and mostly with 2 knobs or spines indicating the spire. Feet with large end plate and a few spectacle-shaped rods, rarely any trace of a spire. Color dark brown to black. . . . . 3. *Pentamera chierchia* (Ludwig)
2. Spicules crowded tables with well-developed spire, disk with smooth edge. Feet with end plate and supporting tables with well-developed to excessively developed spire. 3
3. Supporting tables in feet partly with excessively tall spire. Tables small. . . . . 2. *Pentamera beebei* Deichmann
3. Supporting tables in feet with moderately tall spire. Tables not small. . . . . 4. *Pentamera chiloensis* (Ludwig)

1. **Pentamera zacae** Deichmann

Plate 12, Figs. 10-17

Pentamera zacae Deichmann, 1938, p. 375, text fig. 9.

Diagnosis.—Small form (few cm. long) body strongly curved, tapering toward both ends. Feet cylindrical, nonretractile, in 5 bands, most numerous on the ventrum, more scattered on the dorsum and toward the oral and anal ends. Spicules a crowded layer of peculiar small bodies resembling acorns, with a tapering spire, mostly composed of 2 rods and a basal cup-shaped part. Feet with large end plate and numerous support-

ing tables with curved disk with 4 central holes and a small hole in each end, spire with 2 pillars and ending in a few lobes or blunt teeth which lie in one plane. Color white.

Type.—M.C.Z.

Type locality.—*Zaca* Sta. 196 D-17.

Distribution.—Tangola Tangola Bay, Mex.

Depth.—From 23 fms.

Specimens examined.—The type.

Remarks.—The type measures about 3 cm. in length. The skin is rigid with spicules. The oral end with the tentacles and calcareous ring is lost as well as most of the inner organs. It is therefore only tentatively that the species is referred to *Pentamera.*

2. **Pentamera beebei** Deichmann

Plate 12, Figs. 1-9

Pentamera beebei Deichmann, 1938, p. 374, text fig. 7.

Diagnosis.—Typical small pentamerid with minute tables (diameter 0.03 mm.) with mostly 4 larger holes and 4 smaller ones; spire 2 pillared, ending in a tuft of spines. Feet with large end plate and curved supporting tables with from 2-7 crossbeams in the spire and a terminal tuft of flat lobes. Color white.

Type.—M.C.Z.

Type locality.—*Zaca* Sta. 213 D-15.

Distribution.—Known from Ballena Bay, Gulf of Costa Rica.

Depth.—From 40 fms.

Specimens examined.—The type.

Remarks.—The type measures few cm. in length. Its striking spicules set it apart from all other species known from the Panamic waters.

3. **Pentamera chierchia** (Ludwig)

Plate 13, Figs. 19-21

Cucumaria chierchia Ludwig, 1887, p. 13, pl. 1, fig. 5.

Pentamera chierchia Deichmann, 1938, p. 374, text fig. 8.

Diagnosis.—Small form (about 3-4 cm. long) with numerous feet in 5 narrow bands. Calcareous ring with long posterior prolongations. Spicules in varying numbers, in some individuals almost completely lacking. Skin with 4-holed tables with dentate margin and 2-pillared spire with few irregular teeth; often the spire is reduced to knobs or com-

pletely lacking. Feet with large end plate and a varying number of mostly spectacle-shaped rods, often with 4 central holes incomplete or complete, and a number of smaller holes in the ends. Introvert with a few tables. Tentacles with curved perforated plates and rods. Color black, rarely brown with pale underside.

Type.—Possibly in Germany.

Type locality.—Coast of one of the islands in the Gulf of Panama. A single specimen secured.

Distribution.—From Ecuador and Galapagos to L. Calif.

Depth.—Shore to 40 fms.

Specimens examined.—The following from the Allan Hancock Expeditions:

73-33. North Beach, Cartago Bay, Albemarle Island, Galapagos, shore, February 13, 1933, 22 specimens.

80-33. Smitty's Shore, Duncan Island, Galapagos, shore, February 15, 1933, 15 specimens.

132-34. Braithwaite Bay, Socorro Island, Mex., 40 fms., January 4, 1934, 13 young specimens.

189-34. Cartago Bay, Albemarle Island, Galapagos, shore, January 25, 1934, 5 specimens.

315-35. Indefatigable Island, opposite Gordon Rocks, coral, 1-2 fms., December 8, 1934, 3 specimens.

401-35. Manta, Ecuador, below first rocky point, 1 fm., January 19, 1935, 5 specimens.

464-35. Playa Blanca, Costa Rica, 2 clumps of coral, south shore of bay, shore, February 8, 1935, 2 specimens.

467-35. Parker Bay, Costa Rica, rock and algae, 2 fms., February 9, 1935, 2 specimens.

473-35. Parker Bay, Costa Rica, coral, 2 fms., February 9, 1935, 39 specimens.

596-36. Port Escondido, L. Calif., 20 fms., March 16, 1936, 1 specimen.

683-37. Outside of Concepcion Bay, L. Calif., Mex., 12 fms., March 15, 1937, 17 specimens.

784-38. Darwin Bay, Tower Island, Galapagos, Middle Beach, shore, January 17, 1938, 7 specimens.

Also several from the *Zaca* expedition, 1938.

Remarks.—Apparently one of the most common forms in the Panamic region.

4. **Pentamera chiloensis** (Ludwig)

Plate 13, Figs. 15-18; text figure 1

Cucumaria chiloensis Ludwig, 1887, p. 12, pl. 1, fig. 4.—Deichmann, 1938, p. 373, *passim*.

Cucumaria tabulifera R. Perrier, 1904, p. 14; 1905, p. 17, pl. 1, figs. 4-5; pl. 3, figs. 1-5.

Diagnosis.—Typical pentamerid, resembles the type species. Spicules tables with oval to squarish disk (diameter 0.06 mm.) with 4 or 8 holes; spires 2 pillared with one or two crossbeams and a few short teeth at the top. Feet with large end plate and numerous curved supporting tables with low spire with 2 pillars and a few flat teeth on the top. Introvert with rosettes; tentacles with delicate rods. Color white.

Type.—Possibly in Germany.

Type locality.—Chiloe Island, Chile.

Distribution.—Cape Horn and vicinity to L. Calif.

Depth.—The type came from 40 m. depth; the *Velero* specimens were taken at from 8-60 fms. depth.

Specimens examined.—The following material from the Hancock Expeditions:

190-34. Lat. 0° 55′ S., 90° 30′ W., Galapagos, 58-60 fms., January 26, 1934, 1 specimen.

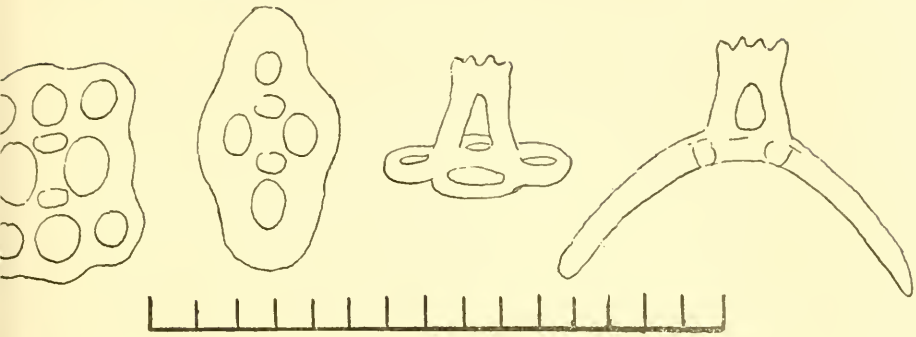
209-34. La Libertad, Ecuador, north of Point Sta. Elena, 8-10 fms., February 9, 1934, 1 specimen.

213-34. La Plata Island, Ecuador, north of anchorage, 7-10 fms., February 10, 1934, 1 specimen.

677-37. Ildefonso Island, L. Calif., Mex., 50 fms., March 15, 1937, 3 specimens.

833-38. Independencia Bay, Peru, off north entrance, sand and shell, 8 fms., February 10, 1938, 1 specimen.

Remarks.—The species resembles the type species from the West Indies. Ludwig's specimen measured only 9 mm., while Perrier had two specimens, 20 and 23 mm. long. The *Velero* material falls about within these limits. The species may be expected to reach a length of about 5 cm.; the tables in younger individuals may possibly have larger disks with 2 circles of holes; some tables have a dentate edge as if one row of holes had been resorbed. It differs from *C. pulcherrima* in the lack of perforated plates in the tentacles and the presence of rosettes in the introvert, and the smaller size—characters which may prove to be abso-



Text fig. 1. *Pentamera chiloensis* (Ludwig)? Spicules from juvenile individual. Scale divisions indicate 1/100 mm.

lutely worthless. A small specimen from Sta. 190-34, 1.5 cm. long, had the genital tubes packed with ripe eggs.

The very young individual from Station 209-34 had much smaller spicules than the other individuals, but it can hardly be doubted that it represents *P. chiloensis*.

Doubtful form:
Pentamera panamensis (Verrill)

Ocnus panamensis Verrill, 1867, p. 321.—Lampert, 1885, p. 132.—Théel, 1886, p. 116.

From Verrill's incomplete description it can only be learned that the type measured about 4 cm. in length; the feet were restricted to the ambulacra, in double rows on the ventrum, in single rows toward the ends and on the dorsum; the tentacles were 10 in number and the 2 ventral smaller. The skin was thin, coriaceous, filled with numerous minute calcareous grains or plates. The color was grayish brown, the tentacles yellowish brown.

Type.—Apparently lost.

Type locality.—Gulf of Panama.

Distribution.—Known only from the type locality.

Depth.—Presumably shallow water.

Specimens examined.—None.

Remarks.—This may be any of the species belonging to *Pentamera, Apentamera,* or *Neopentamera,* except *P. chierchia* and *A. lepra.* The

few feet on the dorsal side suggest *P. beebei,* while the description of the spicules suggests *P. zacae*. As it is completely impossible to place the species, the name must once and for all be rejected.

Genus 3. NEOPENTAMERA, new genus

Diagnosis.—Externally resembling *Pentamera* Ayres, with tube feet restricted to the 5 ambulacra (?). Calcareous ring with well-developed posterior prolongations. Spicules irregular, 4-holed, knobbed buttons; feet with end plate and narrow ribbonlike rods, possibly derived from tables.

Type species.—*Neopentamera anexigua,* new species.

Remarks.—The genus and species are based upon a number of small specimens, apparently adult, secured by the Hancock Expeditions. As the specimens are so small, there is of course the possibility that tube feet may appear later in the interradials, which will necessitate a modification of the diagnosis. The spicules bear some resemblance to those of *Eupentacta pseudoquinquesemita* Deichmann from the coast of Alaska but are so much smaller that I have felt justified in establishing a new genus for this species. It cannot be confused with any other dendrochirote form hitherto recorded from the Panamic region.

Neopentamera anexigua, new species

Plate 13, Figs. 11-14

Diagnosis.—Small form (few cm. long), externally as internally a typical pentamerid. Spicules numerous, irregularly knobbed buttons or plates. Feet with large end plate and ribbonlike supporting rods with no indications of a spire. Introvert with plates and rosettes. Tentacles with rosettes and delicate rods derived from rosettes. Tentacles dark brown. Color white.

Type.—Holotype, AHF no. 24, one paratype.

Type locality.—*Velero III* Station 683-37, outside of Concepcion Bay, L. Calif., Mex., 12 fms., March 15, 1937.

Distribution.—Known only from the type locality.

Depth.—Taken at 12 fms. depth.

Specimens examined.—The type and a paratype.

Remarks.—The types are poorly preserved and measure only 2 cm.

in length. In the type the gonads are large; many tubes measure almost 2 cm.; presumably it is a male, as no traces of eggs were seen.

It is possible that an external layer of more delicate spicules normally is present but has been destroyed. The spicules are slightly reminiscent of those characteristic of *Eupentacta pseudoquinquesemita* Deichmann, from the Alaskan waters, but they are smaller, and the tails on the calcareous ring are distinctly longer in the present species.

The name *anexigua* is given because it was at first glance assumed that the present species was identical with Ludwig's *Cucumaria exigua* from China and, supposedly, also Chile (see p. 81). The species from Chile is now called *C. chilensis,* as indicated in Ludwig's figures; it was actually rediscovered by the Allan Hancock Expedition (see p. 80). Dissection revealed, however, that the calcareous ring was entirely different—with long tails—and the species must therefore be regarded as new.

Genus 4. APENTAMERA, new genus

Diagnosis.—Small forms (few cm. long) with tube feet in 5 bands, papilliform toward the ends where 5 valves are formed; a few smaller papilliform tube feet are scattered in the dorsal interambulacra, may be lacking in small individuals. Tentacles 10, the 2 ventral smaller. Skin rigid, packed with spicules. Calcareous ring with long posterior prolongations; other internal features almost as in *Pentamera.*

Spicules an external layer of flattened baskets almost rosettelike, easily overlooked and may possibly be lost in older individuals, and an inner layer of regular 4-holed knobbed buttons. Feet with end plate smaller in the terminal appendages; walls packed with curved supporting tables with 2 pillars and a few blunt teeth. Introvert with oblong tables or plates with slightly knobbed edge. Tentacles packed with plates and rods which gradually decrease in size in the branches; apparently no rosettes.

Type species.—*Apentamera lepra,* new species.

Remarks.—The material of the type species was originally referred to 2 genera related respectively to *Pentamera* and *Pentacta,* possibly with affinities to some of the *Thyone*-like forms. After all other species had been classified, it became evident that these two "genera" represented only one, which in spite of its affinities to the *Thyone*-like forms could not be placed among these.

Apentamera lepra, new species

Plate 13, Figs. 1-10

Diagnosis.—As for the genus. Color white, mottled with reddish brown.

Type.—Holotype, AHF no. 25.

Type locality.—Station 557-36, off White Rock, Isla Partida, Gulf of Calif., in 45 fms., March 8, 1936.

Distribution.—Gulf of Calif. to Panama.

Depth.—From 30-50 fms.

Specimens examined.—The following material from the Hancock Expeditions:

557-36. Isla Partida, Gulf of California, 45 fms., type and 2 paratypes.

863-38. Bahia Honda, Panama, off North Island, 30-50 fms., March 1, 1938, 3 specimens (M.C.Z.).

Remarks.—The type specimens measure 3.5, 3.4, and 2.0 cm. in length; the gonads are well developed in the 3 individuals, so presumably the animals are full grown. The material has been carefully compared with the other forms with 4-holed knobbed buttons, but it seems impossible that it represents the juvenile stages of any of these. The only form which possibly could be considered is *Neothyone gibbosa* (see p. 113), but the latter has numerous interambulacral feet when it is as large as *A. lepra,* and its spicules are definitely larger; the buttons are more oblong and it has numerous rosettes in the tentacles.

Genus 5. LEPTOPENTACTA H. L. Clark, 1938

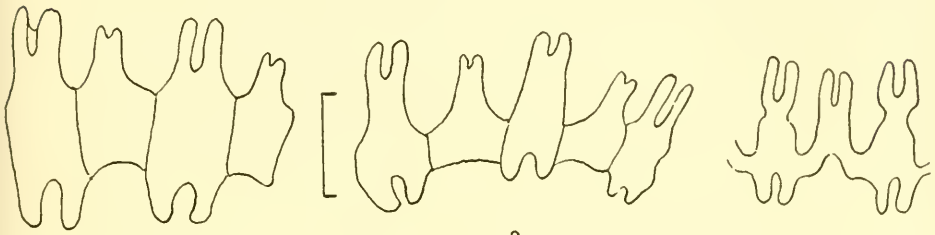
Synonym.—*Ocnus* Auctores. Nec *Ocnus* Forbes, 1841. See H. L. Clark, 1938, p. 453.

Diagnosis.—Body slender, skin rigid. Tentacles 10 (or 8), the ventral ones small (or lacking). Feet restricted to the ambulacra, rigid, filled with spicules, arranged either in single rows with feet well spaced or in more crowded or zigzaggy rows. Toward the oral and anal ends the feet are scattered and papilliform, often forming 5 valves as in *Pentacta.* Calcareous ring simple, or with short posterior prolongations. Retractors short, longitudinal musculature feebly developed. Gonads with few tubes in each tuft, attached near the middle of the animal.

Spicules reticulated bodies or baskets, larger or smaller, reticulated scales or grains and 4-holed buttons, swollen or knobbed. Feet with or without end plate, with or without supporting rods. Tentacles with large perforated rods or plates; sometimes also rosettes and smaller rods.

Type species.—*L. grisea* H. L. Clark, 1938.

Remarks.—The genus may possibly be further divided into two, viz., *Leptopentacta,* which includes the type species, *L. panamica* spec. nov., possibly also Sluiter's *"Ocnus" javanicus,* and a species listed here as *L. nina,* based on a juvenile individual from the Hancock Expeditions,—and another, for which the name *Parocnus* is proposed,—to accommodate *"Ocnus" imbricatus* Semper and *"Ocnus" typicus* Théel, which possibly are identical, and *L. nova,* spec. nov.



Text fig. 2. 1. Calcareous ring from *Leptopentacta grisea* H. L. Clark.
2. *Leptopentacta panamica,* new species.
3. *Leptopentacta javanica* (Sluiter).
Scale, 1 mm.; Sluiter's figure has no indication of what magnification is used; probably it is about as large as the other two.

"Ocnus" molpadioides Semper definitely does not belong in this genus, while *"Ocnus" pygmaeus* Semper, based upon a specimen 1 cm. long, has long and rather flexible feet and probably represents a juvenile specimen of some species of *Cucumaria* or *Thyone* (in the broad sense). It is not possible to ascertain whether the calcareous ring is simple or has posterior prolongations. Semper figures a simple ring but mentions that the ring has long posterior prolongations. His figures of the ring of *imbricata* show no posterior prolongations, and in his description he emphasizes the way in which the ring is cut off posteriorly. (See footnote, p. 94.)

Key to the Known Species of *Leptopentacta*

1. External layer of spicules consisting of small biscuit-shaped plates or rosettes. Feet with no supporting rods, and apparently without end plate. Calcareous ring simple (not known in *L. typica*) 2

1. External layer of spicules consisting of baskets, reticulated bodies, or hollow plates. Feet with supporting rods or plates, in some species also with end plate. Calcareous ring with short tails. 4

2. External spicules consisting of small biscuit-shaped bodies with 4-5 holes, often one side prolonged into a sharp tooth. Feet few, scattered, 5-6 in the dorsal ambulacra, 8-10 in the ventral ones. . . . . 1. *Leptopentacta nova,* new species

2. External spicules consisting of rosettes. Feet fairly numerous, although arranged in single rows. 3

3. Feet 24-26 in the ambulacra (in individuals 35-40 mm. long). . . . . *Leptopentacta imbricata* (Semper)

3. Feet 15-20 in the ambulacra (in individuals 40 mm. long). . . . . *Leptopentacta typica* (Théel)

4. External spicules consisting of simple, 4-spoked, deep baskets with knobbed to dentate rim. Feet with numerous supporting rods or plates. 5

4. External spicules consisting of complicated reticulated bodies or concave plates. 6

5. Buttons swollen or irregularly knobbed. Baskets comparatively large and delicate, with 4 marginal holes. . . . . *Leptopentacta grisea* H. L. Clark

5. Buttons predominantly strongly knobbed and regular. Baskets small, not delicate, and apparently never with marginal holes. . . . . 2. *Leptopentacta panamica,* new species

6. External spicules reticulated bodies[3]; feet 20-23 in ventral rows (in individual, 40-45 mm. long). . . . . *Leptopentacta javanica* (Sluiter)

6. External spicules large concave plates with a varying amount of reticulated bars. Inner layer knobbed buttons slightly irregular and large reticulated plate. Feet with oblong supporting plates smooth or knobbed, with a varying number of holes. . . . . 3. *Leptopentacta nina,* new species

[3] Sluiter's figure (1880, pl. 4, fig. 10) looks suspiciously as if it belonged to a *Paracaudina.* His description is not very clear, and in 1901, p. 79, he writes "*javanica* with *typica* and *imbricata,*" following Ludwig, 1887, p. 1221 (reprint p. 5). If one can trust Semper's figure (plate 14, fig. 12), *imbricata* must be different from *javanica,* as it has a simple calcareous ring. Although Ludwig's "*imbricata*" has distinct tails on the ring, it is not proved that it is identical with Semper's species or with Théel's.

1. Leptopentacta nova, new species

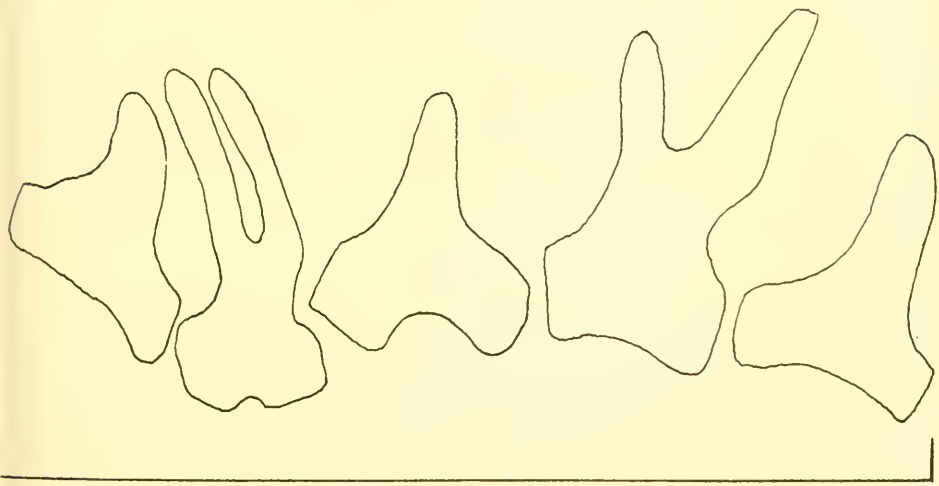
Plate 14, Figs. 13-22; text figure 3

Diagnosis.—Body slender, slightly curved with rigid body wall. Feet few, contracted into conical protuberances, well spaced. The ventral ambulacra possess from 8-10 feet, while the dorsal ones each have 4 feet anteriorly and one or two posteriorly. Skin with large cobblestone-like scales, and the space between them filled with masses of smaller spicules. Tentacles fingerlike (in the type which measures 2 cm. in length) and apparently only 8 are present, but the 2 small ones may have been overlooked. Calcareous ring low, with no indication of posterior prolongations. Inner anatomy not remarkable in any respect.

Spicules large scales or grains with reticulated structure, 4-holed buttons, irregular, swollen or with irregular knobs, and minute perforated biscuit-shaped plates with 4-5 holes and frequently a long spine developed on one side. Feet with no supporting plates and apparently no end plate. Introvert with reticulated plates which intergrade into rosettes; tentacles with curved perforated or branching rods which decrease in size toward the ends.

Type.—Holotype, AHF no. 26, 1 paratype.

Type locality.—Station 281-34, Santa Maria Bay, west of Hughes Point, L. Calif., 35-40 fms.



Text fig. 3. *Leptopentacta nova,* new species.
Scale, 1 mm.

Distribution.—Known from the type locality.

Depth.—Dredged at 35-40 fms.

Specimens examined.—The type.

Remarks.—The type and other specimen measure 2 cm. in length and 3 mm. in width. The surface of the skin appears mottled, because of the large scales' being glassy and contrasting with the solid white of the smaller spicules which are massed between them. The tentacles which are completely retracted are small and finger shaped; only 8 could be counted, but 2 small ones may possibly have been overlooked. The calcareous ring is low with no indication of posterior prolongations; the stone canal is small and attached as usual in the dorsal mesentery, and the Polian vesicle is single and ventrally placed. Other anatomical features are not remarkable. The gonads form few tubes of varying length, and are attached near the middle of the dorsal midline.

This species seems most closely related to *L. imbricata* (Semper) and *L. typica* (Théel). It differs in having small biscuit-shaped plates instead of rosettes in the external layer of the skin, fewer feet, and, presumably, in having simple tentacles. However, *L. nova, L. imbricata* (and *L. typica*) may well be placed in a separate genus for which the name *Parocnus* is proposed, with *imbricata* as type.

2. **Leptopentacta panamica,** new species

Plate 14, Figs. 6-12; text figure 2

Diagnosis.—Slender form with curved body, ambulacra forming 5 indistinct ridges. Feet in scattered double rows in the middle portion of the ambulacra, toward the ends in single rows, around the base of the introvert forming 5 large valves as in *Pentacta.* Tentacles 10, bushy, the 2 ventral smaller. Surface of skin rough on account of the numerous spinelike projections on the spicules which pierce the skin. Calcareous ring with short posterior prolongations. Other features also typical of the genus.

Spicules consisting of an external layer of strongly knobbed 4-holed buttons with minute holes and smaller buttons, less strongly knobbed and with larger holes and numerous 4-spoked baskets, and an inner layer of large, reticulated ovoid or spherical scales or grains. Feet possibly with an end plate (not discovered in type)[4] and numerous perforated supporting

[4] The type species has a large and well-developed end plate in the feet (overlooked by H. L. Clark), and one would expect that an end plate would also be present in the present species. Two tube feet have been examined, but the feet are strongly contracted and no trace has been found of end plates. Still it is possible that they may be present.

plates, and the same type of spicules as in the integument. Particularly numerous in the appendages, although also scattered in the skin are some peculiar oblong heavy plates with small holes and one end drawn out into a shorter or longer spine which pierces the skin (visible with low magnification). Introvert with rosettes, tentacles with large curved perforated plates and rods, also rosettes, and in the finer branches, delicate rods with perforated ends.

Type.—Holotype, AHF no. 27.

Type locality.—Port Utria, Colombia, close to shore, north of point and west of islands, 20 fms., January 25, 1935.

Distribution.—From Port Utria, Colombia, to Tenacatita Bay, Mex.

Depth.—From 20-35 fms.

Specimens examined.—The type and 3 other specimens from the following *Velero* stations:

259-34. Tangola Tangola, Mex., 15-20 fms., February 28, 1934, 1 paratype.

275-34. Tenacatita Bay, Mex., off Navidad Head, 25-35 fms., 2 specimens.

423-35. Port Utria, Colombia, close to shore, 20 fms., 1 specimen, type.

Remarks.—The type measures about 4 cm. in length; the other individuals are smaller. The color in alcohol is dirty yellow with large irregular brown patches. The gonads are ripe and filled with eggs. (Specimens collected in January.)

The species seems fairly closely related to the type species, *L. grisea* H. L. Clark, from Broome, West Australia (plate 14, figures 1-5). It differs chiefly in the presence of the peculiar, spine-bearing plates, the strongly knobbed buttons, and the much smaller and more simple baskets.

3. **Leptopentacta nina**, new species

Plate 15, Figs. 1-12

Diagnosis.—Small form (?), type measures 1.2 cm. with the tentacles contracted. Body curved, slender; skin rigid; feet cylindrical, retractile, restricted to the ambulacra (the type has about 25 tube feet in the ventral rows and considerably fewer in the dorsal). Calcareous ring with distinct posterior tails on the radials and long teeth, deeply grooved on radials and interradials (resembles that of Sluiter's species, see text figure 2).

Spicules an external layer of concave plates, often with a delicate reticulum across the hollow surface; an inner layer of knobbed, irregular buttons, and larger plates with knobbed surface, sometimes transformed into large convex bodies. Feet apparently devoid of end plate; walls with short, broad, perforated supporting rods. Introvert and tentacles not examined. Color of the preserved specimens white.

Type.—Holotype, AHF no. 28.

Type locality.—Station 850-38, Cape San Francisco, Ecuador, 15 fms., February 23, 1938.

Distribution.—Known only from the type locality.

Depth.—From 15 fms.

Specimens.—The type.

Remarks.—The type represents undoubtedly an immature individual. On account of its small size and its rigid skin it was almost impossible to dissect, and no attempt was made to study the tentacles and introvert. The inner organs were poorly preserved, and nothing can be said about the stone canal and Polian vesicle. The musculature is feebly developed, and the intestine and respiratory trees form a structureless mass; a well-developed muscle stomach could, however, be seen. The calcareous ring is highly reminiscent of the one figured by Sluiter for *javanica* (see text figure 2), and it is of course remotely possible that the present species has previously been described from the East Indies. As the various earlier descriptions are rather unsatisfactory, as also the figures hitherto published, it has been deemed wiser to designate the unique individual to a new species.

L. nina differs distinctly from both *L. nova* and *L. panamensis* in its calcareous ring as well as in its spicules. It cannot be confused with any other species at present described from the Panamic region.

Genus 6. **PENTACTA** Goldfuss, 1820

Pentacta Goldfuss, 1820, p. 177.—H. L. Clark, 1923, p. 416.

Colochirus Troschel, 1846, p. 64. (Type species.—*C. quadrangularis* Troschel.)

Cercodemas Selenka, 1867, p. 343. (Type species.—*C. anceps* Selenka.)

Diagnosis.—Body with more or less flattened ventral side with the tube feet arranged in 3 bands; dorsal side vaulted with feet of different size, often as large papillae, frequently scattered in the interambulacra. Around the base of the introvert and the anus the ambulacra form thick

valves. Tentacles 10, the 2 ventral smaller. Skin rigid, filled with spicules. Calcareous ring simple, posteriorly often strongly undulated but never with posterior prolongations.

Spicules consisting of an external layer of either baskets or delicate reticulated bodies, and inner layer of knobbed buttons, heavy plates, or reticulated bodies. Feet apparently with no end plate; walls supported by perforated rods or plates; dorsal papillae with mostly curved supporting plates. Tropical shallow water forms.

Type species.—*Pentacta doliolum* (Pallas).

Remarks.—The name has been used by various authors for members of the genus *Cucumaria* s.l., and Ludwig (1899, p. 344) claims that it ought to be used instead of Blainville's name, from 1835. H. L. Clark (1923, p. 416) has, however, called attention to the fact that Troschel's name *Colochirus* is a complete synonym of *Pentacta,* for Goldfuss designated Pallas' *doliolum* from Cape of Good Hope as the type species and the latter is generally accepted as the typical *"Colochirus."*

The genus *Pentacta* is most abundantly represented in shallow water in the East Indies. The type species represents the only form known from the South African waters, and only one form is known from Brazil and the West Indies. From the western coast of South America Semper described a new species which was never found again and hence was regarded as rather dubious. There is no doubt that it is the one which the Allan Hancock Expeditions now have brought back, thereby proving that Semper's specimens were correctly labeled.

The genus may possibly in the future be divided into 2, viz., one for those with more complicated spicules, and one for those with regular, knobbed buttons and simple baskets.

The 2 species known from the American waters both belong to the latter group.

Pentacta peruana (Semper)

Plate 16, Figs. 1-8

Colochirus peruanus Semper, 1868, p. 239, pl. 39, fig. 20.—Lampert, 1885, p. 126.—Théel, 1886, p. 123.—H. L. Clark, 1910, p. 353.

Diagnosis.—Small form, few cm. long, with cylindrical feet in 3 crowded bands on the greater part of the ventral side, transformed into papillae toward the ends, dorsally 2 bands of papillae and a number scattered in the interambulacra. Oral and anal ends closed by 5 distinct valves. Inner anatomy typical of the genus.

Spicules an external layer of regular baskets, the hollow part formed by broad bars, the narrow rim with few teeth. An inner layer of regular 4-holed knobbed buttons and larger knobbed plates and huge reticulated grains. Ventral feet mostly with a minute end plate and the walls packed with supporting rods mostly 3-armed, smooth to knobbed. Dorsal appendages apparently lacking end plate but with heavier 3-armed rods. Introvert with a few oblong buttons smooth or knobbed. Tentacles with stems packed with narrow plates or rods, smaller, curved and often 3-armed rods in the finer branches.

Type.—Possibly in Germany.

Type locality.—Peru, probably at comparatively low depth.

Distribution.—From Peru to Mexico.

Depth.—The Hancock material came from 25 fms.

Specimens examined.—The following specimens from the Allan Hancock Expeditions:

264-34. Petatlan Bay, Mexico, 25 fms., south and west of White Friars Island, rock with gorgonids, 4 specimens.

Remarks.—The 4 specimens measure between 3-4 cm. in length and are thus somewhat larger than the types which measured only 15-18 mm. Semper's description is not very detailed,[5] and his figure of a basket shows a more irregular type than the one which commonly occurs. He mentions hollow knobbed bodies and large smooth plates, the latter referring possibly to the smooth supporting plates. He gives, however, no reference to the regular 4-holed knobbed buttons, possibly because he considers them growth stages of the larger knobbed bodies; also they may possibly be more scarce in younger individuals. It must further be mentioned that the ventral tentacles in the present material are very slightly smaller in size than the other.

[5] Semper's original description: "Zehn Tentaklen, die zwei ventralen kleine. Habitus Ascidien-artig. Auf den Rücken stehen die Ambulacral-papillen regellos zerstreut, am Bauche in drei deutlichen Reihen, deren jede zwei Füsschen in der Breite zeigt. Es bleibt sich eine Art Bauchscheibe dadurch das die Füsschen hinten in Ambulacral-papillen übergehen. Farbe gelblich (im Spiritus). Drei Exsemplare, 15-18 mm. lang, 6-7 mm. breit.

Am Gefassring eine einzige Polische Blase, eine kleine dorsaler Steinkanal. Lungen fast so lang wie der Körper, mit wenig, aber sehr langen einfachen Nebenasten. Geschlechtsteile zwei Büschel sehr kleiner unverästelter Schlauche, ihre Basis am Mesenterium sehr weit nach vorne, vor dem Wassergefassring. Kalkring aus 10 einfachen Gliedern bestechend; die Radialen etwas breiter als die Interradialen, nicht nach hinten verlänget. Keine Kaumagen. Die Retraktoren inserieren sich in der Mitte des Körpers.

Grosse glatte Kalkplatten in der ganz starre Haut, darüber ein Schicht durchbrochenene, etwas knotiger Halbkugeln."

One specimen, which was opened, had few but well-developed genital tubes. The color of the 4 individuals is light brown with darker freckles; the general impression of the preserved material is a nondescript grayish-brown color.

Genus 7. THYONACTA, new genus

Diagnosis.—Medium-sized to large form, 10-15 cm. long in contracted condition. Skin thick, filled with spicules. Tube feet in 5 bands and in varying number in the interambulacra, depending on the animal's age; toward the oral and anal ends thickened valves are developed. Many tube feet are conical, papilliform. Tentacles 10, the 2 ventral smaller. Calcareous ring low but with short posterior projections; stone canal small, attached to the dorsal mesentery; Polian vesicle single, ventral in position; retractors exceptionally short, attached closely behind the calcareous ring (when the crown of tentacles is withdrawn). Gonads placed unusually far back, in the posterior third of the body.

Spicules consist of an external layer of simple baskets, and an inner layer of 4-holed buttons of different size, also a few larger plates; mostly regularly knobbed. Feet apparently without any end plate (at least in larger individuals); walls with numerous supporting rods and plates besides buttons and baskets. Introvert with rosettes; tentacles with large, mostly narrow perforated plates and rods which decrease in size toward the tips of the branches.

Type species.—*Thyonacta sabanillensis* (Deichmann).

Remarks.—At present 2 species have been referred to this genus, both restricted to the American waters. Very likely some of the members of the old genus *Thyone* from the western Pacific and Indian oceans ought to be transferred to this genus. The type species came from the West Indian seas, while the other species, described below, has been secured from various localities in the Panamic region.

Thyonacta mexicana, new species

Plate 17, Figs. 1-13

Diagnosis.—As for the genus. Spicules rather stout and deep baskets and buttons of 2 types, a large and strongly knobbed one and a smaller, less regularly knobbed and often with accessory holes. Color varying shades of brown.

Type.—Holotype, AHF no. 29, 5 paratypes.

Type locality.—Station 633-37, San Gabriel Bay, Espiritu Santo Island, L. Calif., 18 fms., March 6, 1937.

Distribution.—Widespread in the Gulf of California and as far as Panama.

Depth.—From 10-35 fms.

Specimens examined.—The type and 5 specimens from the following *Velero* stations:

244-34. Bahia Honda, Panama, 30-35 fms., February 21, 1934, 1 specimen.

554-36. Parallel to Angel de la Guardia Island, east side, 10 fms., March 8, 1936, 2 specimens.

562-36. North of San Esteban Island, L. Calif., 20-70 fms., March 10, 1936, 1 specimen.

633-37. San Gabriel Bay, Espiritu Santo Island, L. Calif., 18 fms., March 6, 1937, 1 specimen.

719-37. Consag Rock, L. Calif., 10-25 fms., March 24, 1937, 1 specimen.

Remarks.—The material shows to perfection how impossible it is to give an exact description of the general appearance of most holothurians. Two individuals are well expanded with tapering bodies, one is contracted to a short *Pentacta*-like form, and two resemble slightly deformed oranges. The spicules, however, are completely identical, and a closer study of the anatomical features, calcareous ring, etc., showed that the specimens also in these respects are alike.

T. mexicana is closely related to the type species but differs distinctly in the shape of the spicules. The extremely deep baskets and the large strongly knobbed buttons alone are sufficient to distinguish the present species from all other related forms known from the Panamic region.

Genus 8. **THYONE** Oken, 1815

Thyone Oken, 1815, p. 351.

Anaperus Troschel, 1846, p. 60 *(partim).*

Diagnosis.—Small to medium-sized forms (rarely more than 10 cm. long, many species smaller). Body thin skinned with numerous nonretractile fairly delicate feet, most numerous ventrally. Tentacles 10, the 2 ventral smaller. Calcareous ring with long posterior prolongations on the radials.

Spicules small 2-pillared tables or derivatives of these. Feet with large end plate and numerous curved supporting tables usually with a well-developed spire, which in some forms, however, is completely reduced. Tentacles with delicate rods and often rosettes. Spicules gradually reduced with age in certain species.

Type species.—*Thyone fusus* (O. F. Müller).

Remarks.—The genus is well defined and corresponds to *Pentamera* in *Cucumaria* sensu latiore. It is sometimes almost impossible to identify very young specimens of *Pentamera* and *Thyone,* as the latter passes through a *Pentamera*-stage. Fortunately that stage seems to be so short that one usually is able to find a few feet in the interambulacra. When dealing with specimens less than 1 cm. long, it is, however, wise to consider all the species of *Pentamera* and *Thyone* which are known in the region under consideration. Often the spicules in the introvert and tentacles differ in species which have spicules in the body wall which are alike, but this character cannot always be relied upon.

The type species is common in the eastern and northeastern part of the Atlantic Ocean, while a closely related species is known from the West Indies, but not reaching the coasts of New England (*T. fusus* ? Deichmann, 1930, p. 167). Another species with more robust tables, often with a handle on the inner side of the buttons, is likewise known from the West Indies (*T. pseudofusus* Deichmann, 1930, p. 168).

From the Panamic region the Hancock Expeditions have secured 3 new species, while a fourth was in the M.C.Z., collected by the *Stranger.* Of these 4 species, 2 are closely related to the West Indian species mentioned above.

Key to the Species of *Thyone* s. str. Known from the Panamic Region

1. Tables delicate with 4 to 8 holes; disk oval or squarish; spire of medium height usually with 6 diverging teeth. Supporting tables with spire completely reduced; disk curved, with 4 central holes and ends expanded with a varying number of minute holes. . . . . 1. *Thyone neofusus,* new species

1. Tables more or less stout; supporting tables in tube feet with well-developed spire. 2

2. Disk of table medium-sized to large, round, squarish, or oblong, with numerous holes and often with a few knobs or the entire

margin distinctly thickened; spire in most cases low, in process of becoming vestigial; supporting tables with an enormous conical spire. . . . . 4. *Thyone strangeri,* new species

2. Disk of tables small, oval or squarish in outline, with 4-8 holes, in some cases the disk is lozenge shaped with a few small holes in the ends; no knobs. 3

3. Disk oval or lozenge shaped; spire moderately well developed, mostly with few, indistinct teeth. Supporting tables with 2 pillars which unite into a tapering cone ending in 2 small diverging teeth (often broken off). . . . . 2. *Thyone bidentata,* new species

3. Disk oval with 4 central holes and a "handle" on the inner side; spire tapering with 3-4 small teeth at the top; supporting tables with 2-3 pillars in the spire which ends in 2-3 teeth. . . . . 3. *Thyone parafusus,* new species

1. Thyone neofusus, new species

Plate 18, Figs. 1-6

Diagnosis.—Small form (few cm. long?); feet delicate in 5 indistinct bands and scattered in the interambulacra. Calcareous ring typical; single small stone canal and single ventral Polian vesicle.

Spicules delicate tables with 4-8 holes and 2-pillared spire. Feet with large end plate and numerous curved supporting plates or rods with 4 central holes and a varying number in the expanded ends and no trace of a spire. Introvert with rosettes; tentacles with delicate rods and rosettes. Color of the preserved specimens white.

Type.—Holotype, AHF no. 30, 2 paratypes.

Type locality.—Station 190-34, Lat. 0° 55′ S.; Long. 90° 30′ W.; 58-60 fms.

Distribution.—Off the Galapagos and vicinity.

Depth.—From 20-60 fms.

Specimens examined.—The type and the following specimen from the *Velero* Expeditions:

190-34. Lat. 0° 55′ S.; Long. 90° 30′ W.; 58-60 fms., January 26, 1934, 1 specimen, type.

814-38. North of Hood Island, Galapagos, 20-40 fms., January 28, 1938, 2 specimens.

Remarks.—The type measures about 2 cm. with the tentacles withdrawn. The gonads form 2 well-developed tufts; so the animal may pos-

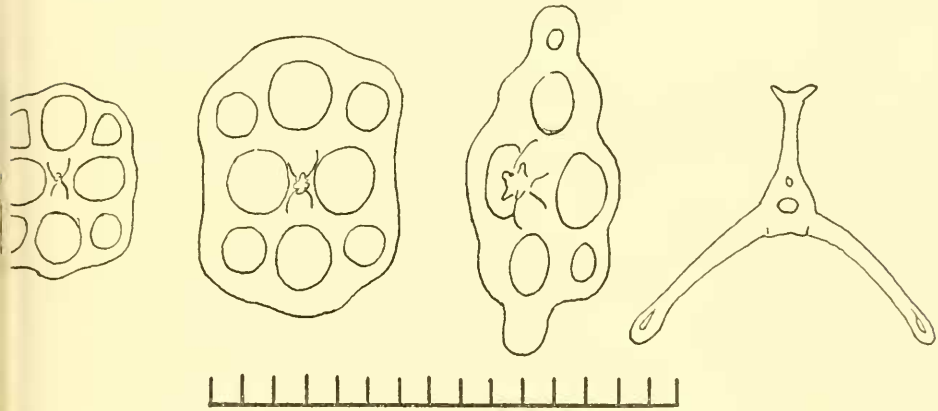
sibly have reached its full size. Other members of the genus, as for example *Thyone fusus,* reach a considerably greater length.

Thyone neofusus resembles *Thyone fusus*? from the West Indies (Deichmann, 1930, p. 167) but differs in the complete lack of a spire on the supporting plates; this may of course be a variable character. For the present it seems natural to segregate the various forms of *fusus* until different material has been gathered to permit a critical survey. So far no closely related species have been reported from the Californian and Chilean waters or from Hawaii.

2. **Thyone bidentata,** new species

Plate 18, Figs. 13-16; text figure 4

Diagnosis.—Small form (few cm. long) with delicate to fairly stout feet, often in distinct bands and also scattered in the interambulacra. Inner anatomy typical of the genus. Spicules tables with oval to lozenge-



Text fig. 4. *Thyone bidentata,* new species, juv.
1-3. Tables from integument.
4. Supporting table from tube foot.
Scale, 1/100 mm.

shaped disk with 4 central holes (and a few holes in the ends when the disk is lengthened); spire tapering to a cone with few teeth. Supporting tables with spire composed of 2 rods united into a slender spine, ending in 2 diverging teeth. Introvert with tables with numerous holes and low spire with diverging teeth; tentacles with a few rosettes. Color of preserved specimens pale brown.

Type.—Holotype, AHF no. 31.

Type locality.—Station 275-34, Tenacatita Bay, Mex., dredging in 25-35 fms., March 4, 1934.

Distribution.—From Gulf of Calif. to Colombia.

Depth.—From 12-30 fms.

Specimens examined.—The type and the following specimens from the *Velero* expeditions:

245-34. Bahia Honda, Panama, dredging 15-25 fms., February 21, 1934, 1 specimen.

249-34. Bahia Honda, Panama, 15-20 fms., February 22, 1934, 1 specimen.

251-34. Secas Islands, Panama, dredging in 15 fms., February 22, 1934, 1 specimen.

275-34. Tenacatita Bay, Mex., off Navidad, 25-35 fms., March 4, 1934, 3 specimens, type and paratypes.

423-35. Port Utria, Colombia, close to shore, 20 fms., January 25, 1935, 1 specimen.

679-37. Outside of Concepcion Bay, Gulf of Calif., 30 fms., March 15, 1937, 1 specimen.

683-37. Outside of Concepcion Bay, Gulf of Calif., 12 fms., March 15, 1937, 1 specimen.

686-37. Concepcion Bay, Gulf of Calif., 12 fms., March 16, 1937, 1 specimen.

Remarks.—The smallest paratype measures 0.5 cm. in length; the type and other larger specimens measure about 2 cm. In the smallest specimens the spicules are considerably smaller than in the larger as is so often the case, and many of the tables have a squarish disk with 4 accessory holes. In some of the larger individuals many tables are lozenge shaped with small accessory holes in the ends, while other individuals of the same size have almost exclusively oval disks with 4 holes.

The exterior of the animals shows considerable variation in regard to the size of the tube feet, which vary from delicate to fairly stout.

3. **Thyone parafusus**, new species

Plate 18, Figs. 7-12

Diagnosis.—Small form (few cm. long) with fairly stout feet, more or less distinctly arranged in bands and scattered in the interambulacra. Inner anatomy typical of the genus. Spicules form a crowded layer of

tables with oval disk with 4 holes and a well-developed handle on the inner side; spire tapering, ending in a few teeth. Feet with well-developed end plate and numerous supporting tables normally with 3 rods in the spire, which rapidly tapers into a short spine with a few teeth on the tip. Introvert with oblong tables with a varying number of holes. Tentacles packed with perforated plates of different sizes, with numerous holes; rosettes and delicate rods are present in the terminal branches.

Type.—Holotype, AHF no. 32, 1 paratype.

Type locality.—Station 272-34, Tenacatita Bay, Mex., 25 fms., March 4, 1934.

Distribution.—Tenacatita Bay, Mex.

Depth.—From 25 to 35 fms.

Specimens examined.—The type and one paratype from the *Velero* Expeditions:

272-34. Tenacatita Bay, Mex., 25 fms., dredging off Navidad Head, March 4, 1934, 1 specimen.

275-34. Tenacatita Bay, Mex., 25-35 fms., March 4, 1934, 1 specimen, type.

Remarks.—The type measures about 2 cm. with the oral end expanded. Several tentacles are torn off, and most of the inner organs are ejected.

The spicules resemble closely those found in *T. pseudofusus* Deichmann (1930, p. 168) from Yucatan, 25 fms. depth. The spicules differ in various respects; the West Indian form has tables with a short robust spire with numerous teeth and lacks apparently the numerous perforated plates in the tentacles.

4. **Thyone strangeri,** new species

Plate 19, Figs. 1-11

Diagnosis.—Medium-sized form; numerous delicate feet scattered all over the body wall, often with conical or wartlike base. Calcareous ring with long posterior prolongations; interradials broad, more or less heart shaped, united by sutures with the radials. Stone canal small with a small head with thickened edges coiled up like a ball; Polian vesicle single.

Spicules a crowded layer of oblong tables, often with thickened edge and a varying number of knobs; number of holes in disk variable; spire small, on the verge of being reduced; teeth almost completely lacking on

the tip. Feet with large end plate and numerous supporting tables with a conical spire. Introvert with oblong tables, disk with knobbed edge and low spire. Tentacles with rosettes and delicate rods. Color brown, tentacles dark, blackish.

Type.—M.C.Z.

Type locality.—Isle Grande, west coast of Mexico (Lat. 170° 46′ N.; Long. 101° 42′ W.).

Distribution.—Known from the type locality.

Depth.—From 7 fms.

Specimens examined.—The type.

Remarks.—The type measures about 4 cm. with the tentacles withdrawn. The anterior portion is well preserved, but most of the intestine and respiratory trees are eviscerated. The gonads form well-developed tufts near the middle of the dorsal midline.

The spicules are extremely characteristic and different from those found in all other species known from the Panamic region as well as the adjacent waters. Superficially they may be mistaken for those of *Phyllophorus aculeatus* Ludwig, but comparison of the figures (plate 25) shows that they are entirely different.

Genus 9. NEOTHYONE, new genus

Stolus Selenka *(partim),* 1867, p. 356.

Diagnosis.—Medium-sized forms with numerous feet; skin thick, packed with spicules. Tentacles 10, the 2 ventral smaller. Calcareous ring with posterior prolongations on the radials, in some species fairly short and soft, often inward curled, so that they easily escape notice. Single stone canal, one or more Polian vesicles, ventrally placed.

Spicules an external layer of specially modified buttons, with spines either on the outer handle or transformed into reticulated baskets, in some cases lost with advancing age. An inner layer consisting of numerous knobbed buttons, mostly with 4 holes; knobs distinct or almost obliterated. Feet with large end plate and numerous supporting tables with or without a spire. Introvert with a varying amount of tables or reduced buttons; tentacles with a varying number of heavy plates or rods, sometimes reduced with age. Rosettes seem to be present in certain species, at least in the younger individuals; possibly they represent a variable character.

Type species.—Neothyone gibber (Selenka).

Remarks.—The genus has been established to accommodate some of the species which have numerous buttons and distinct posterior prolongations on the radials. For the present 2 species from the West Indian waters and 3 from the Panamic region are placed in the genus. Of these latter, one may possibly deserve a genus of its own. No attempt has been made to discuss the various East Indian species with similar spicules that possibly belong in the genus.

Key to the Species of *Neothyone* Known from the Panamic Waters

1. Spicules large buttons, faintly knobbed; external layer of buttons with strongly spinous handle. Feet with stout supporting tables with well-developed spire. . . . . 1. *Neothyone gibber* (Selenka)

1. Spicules smaller or larger buttons strongly knobbed; external layer of buttons with few spines on the handle (often lost in older individuals) or transformed into baskets (the button itself is almost smooth with long delicate projections on the external side uniting into a delicate reticulum). 2

2. Feet with large smooth supporting rods with no trace of spire (except in some of the dorsal appendages). External layer of smooth buttons modified into baskets with the external side covered by a delicate reticulum; these deposits are apparently retained throughout the animal's life. . . . . 2. *Neothyone panamensis* (Ludwig)

2. Feet with curved, stout supporting tables with a varying amount of spire; spire often large and deformed in dorsal appendages; older individuals may lack spire completely, but often one side is expanded and lobate. External layer of buttons often with a few spines on the handle but this type is often rare or lacking in older individuals; often a few concave buttons with marginal spines form a simple type of baskets. . . . . 3. *Neothyone gibbosa,* new species

1. Neothyone gibber (Selenka)

Plate 20, Figs. 1-9; text figure 5

Stolus gibber Selenka, 1867, p. 356.

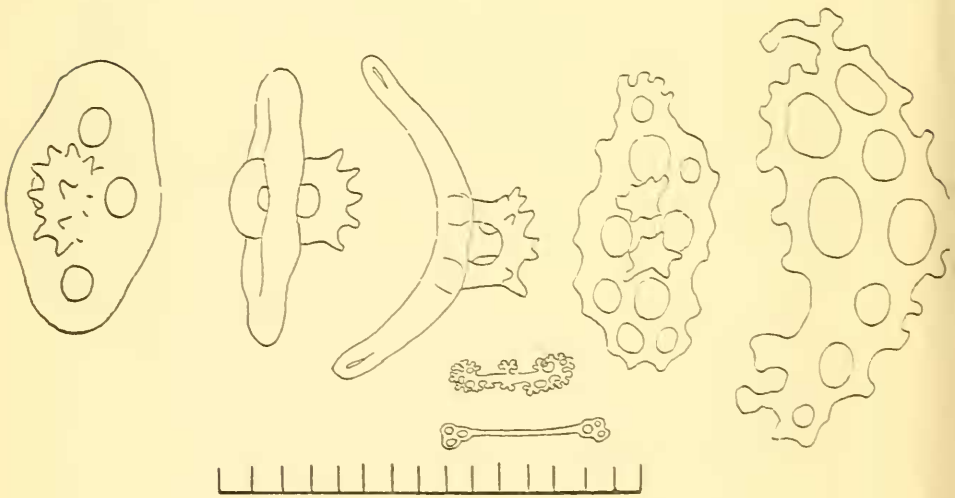
Thyone gibber Semper, 1868, p. 66.—Théel, 1886, p. 139.—Deichmann, 1936, p. 64 *(passim).*

Nec *Thyone gibber* Deichmann, 1938, p. 376, text figure 11 (*Neothyone gibbosa,* spec. nov., see below).

Thyone similis Ludwig, 1887, p. 23, pl. 2, fig. 7.

Diagnosis.—Medium-sized form, often with body strongly contracted and the blunt oral and anal ends upward curved. Calcareous ring fairly delicate with well-developed posterior prolongations on the radials; interradials narrow. Single dorsal stone canal, usually several Polian vesicles.

Spicules large 4-holed buttons varying from regularly knobbed to swollen; the latter are especially characteristic of the older individuals. The 2 knobs in the center of the button are often united to a handle on both sides of the button. The external layer of buttons has normally distinct teeth developed on the handle of the external side; sometimes accessory rods from the margin of the button connect with the spines. Feet with large end plate and numerous stout supporting tables with several rods in the spire and a varying number of teeth on the top. Introvert with



Text fig. 5. *Neothyone gibber* (Selenka), juv., still in the "Pentamera" stage.

1-2. Buttons.
3. Supporting table.
4. Table from introvert.
5. Plate from tentacle.
6-7. Rosette and rod from tentacle.
Scale, 1/100 mm.

delicate tables with low spire and lacelike disk approaching rosettes in complexity. Tentacles with perforated plates which often disappear in the older individuals; besides more delicate rods and plates in the branches, also rosettes. Color dirty white to almost black; oral end or at least the tentacles and the introvert are always dark purplish to black in color.

Type.—M.C.Z.; paratypes in Göttingen.

Type locality.—Panama, depth not reported.

Distribution.—Known from Acapulco, Mex., to Lobos de Afuera Island, Peru, often in the same locations as *N. panamensis* (Ludwig).

Depth.—Tidemark to few fms., clinging to rocks.

Specimens examined.—The type and several specimens in various collections (from Acapulco, Panama, etc.).

From the *Velero* Expeditions the following specimens have been examined:

132-34. Braithwaite Bay, Socorro Island, Mex., 40 fms., January 4, 1934, 5 small specimens.

391-35. Lobos de Afuera Island, Peru, shore of main island with lighthouse, rocks, January 17, 1935, 34 specimens.

466-35. Parker Bay, Costa Rica, shore, February 9, 1935, 14 specimens.

473-35. Parker Bay, Costa Rica, rocks and algae, 2 fms., February 9, 1935, 2 specimens.

844-38. Lobos de Afuera Island, Peru, shore, February 14, 1938, 14 specimens.

Remarks.—Selenka's description is exceedingly brief and not accompanied by any figures. A good description and excellent figures are given by Ludwig, who described the species as *Thyone similis,* also from Panama.

Neothyone gibber differs from the other species with knobbed buttons from the Panamic region in its larger buttons, with strong tendency to obliteration of the knobs and the presence of numerous spines on the external handle. Deichmann referred erroneously a specimen of *Neothyone gibbosa* to this species (see p. 113), but the latter has very distinct knobs on the buttons, and these are also much smaller as shown by the figures here given.

The smallest individuals, from Station 132-34, measure less than 0.5 cm., and the feet are restricted to the ambulacra. The spicules are considerably smaller than in the larger individuals.

2. Neothyone panamensis (Ludwig)

Plate 21, Figs. 1-6

Thyone panamensis Ludwig, 1887, p. 22.—Deichmann, 1936, p. 64 *(passim);* 1938, p. 378 *(passim).*

Diagnosis.—Medium-sized form with numerous cylindrical tube feet on the ventrum, fewer and most papilliform on the dorsum. Calcareous ring with relatively broad radials with short posterior prolongations, often inward curved, so that they are easily overlooked. Other anatomical features as in the other species.

Spicules an external layer of baskets derived from oval smooth buttons, which on their external side develop a number of delicate projections that unite into a fragile meshwork. Spicules in the inner layer small regular 4-holed buttons, strongly knobbed. Ventral feet with large end plate and numerous large, almost flat, smooth supporting plates or rods, obviously derived from supporting tables but with no trace of spire. In the dorsal appendages the end plate is smaller, and the supporting tables often show traces of a spire and are more curved. Introvert with delicate buttons with various projections on the external side; tentacles normally with heavy rods or plates with numerous small holes and in the finer branches smaller, more delicate rods and plates. Apparently no rosettes. Color of dorsum and tentacles black; ventral side mostly white except near the oral and anal ends.

Type.—Possibly in Italy.

Type locality.—Coast of one of the islands in the Gulf of Panama.

Distribution.—Ranging from Panama to Peru, often taken in numbers with *Neothyone gibber.*

Depth.—From tidemark to few fms. depth.

Specimens examined.—The following individuals secured by the *Velero* Expeditions:

391-35. Lobos de Afuera Island, Peru, shore of main island with lighthouse, rocks, January 17, 1935, 2 specimens.

540-36. Puerto Refugio, Angel de la Guardia, Gulf of Calif., shore, March 3, 1936, 1 specimen.

844-38. Lobos de Afuera Island, Peru, shore, February 14, 1938, 13 specimens.

Remarks.—The type measured only 23 mm., while the present material (which is well expanded) measures up to 6 cm. in length. It is with some doubt that the material is referred to Ludwig's species, as he main-

tains that the calcareous ring lacks posterior prolongations, and he does not mention the difference in the form of the dorsal and ventral appendages and the striking black and white coloration. The calcareous ring does, however, superficially look as if it lacks posterior prolongations, and the differences between the dorsal and ventral appendages and the coloring may quite well be less pronounced in younger individuals. On the other hand, the description of the spicules shows no discrepancies, and the present species is the only *"Thyone"*-like form with such spicules as those described by Ludwig. Also it speaks in favor of the identification that it is usually found in the same localities as *Neothyone gibber*.

Neothyone panamensis is easily recognized on account of its color and the arrangements of its feet. Also the spicules are very striking. The baskets seem to be retained throughout the animal's life and are numerous in all preparations, while the large, smooth supporting plates from the ventral feet form another character which is not easily overlooked.

The *Velero* specimens have large tufts of gonads and appear to be adult individuals.

3. **Neothyone gibbosa**, new species

Plate 21, Figs. 7-11; Plate 22, Figs. 1-8

Thyone gibber Deichmann, 1938, p. 376, text figure 11. Nec *Thyone* (*Stolus gibber* Selenka, 1867, p. 356, now *Neothyone gibber*, see above).

Diagnosis.—Medium-sized form superficially resembling *Thyone gibber* in its external and internal anatomy.

Spicules an insignificant layer of shallow knobbed baskets derived from buttons, easily overlooked, and an inner layer of regular 4-holed buttons strongly knobbed mostly with handle and some with a few spines of varying size on the handle. Feet with large end plate, walls with numerous heavy supporting tables, mostly with low spire composed of several rods, occasionally more well-developed spire may be found; especially in the dorsal feet in older individuals a number are developed as smooth plates often with one side expanded, with scalloped edge. Introvert with a varying number of mostly larger tables with numerous holes in the oblong disk and a low spinous spire. Tentacles with heavy perforated plates and rods decreasing in size in the branches; in many cases also rosettes. Color in alcohol dirty gray or reddish, often darker mottled in the interambulacra; tentacles rather darkly colored.

Type.—Holotype, AHF no. 33.

Type locality.—Station 545-36, Puerto Refugio, Angel de la Guardia Island, Gulf of Calif.

Distribution.—From the upper end of the Gulf of Calif. to Mazatlan, Mex.

Specimens examined.—The type and the following individuals from the *Velero* Expeditions:

465-35. Playa Blanca, Costa Rica, shore, February 8, 1935, 1 specimen.

545-36. In Puerto Refugio, Angel de la Guardia Island, west of rock spit at river wash, shore, March 4, 1936, type and 4 paratypes.

591-36. Port Escondido, L. Calif., Mex., shore, March 16, 1936, 2 specimens.

844-38. Lobos de Afuera Island, Peru, shore, February 14, 1938, 1 specimen.

Also a number of specimens in the M.C.Z. collection from Mazatlan, Mex., shore, Situantanejo Bay, Mex., and Costa Rica, shore.

Remarks.—It is with some doubt that the present material has been referred to a new species, for the spicules are—aside from the absence of heavy plates covered by a stout reticulum—highly reminiscent of those found in *Pachythyone pseudolugubris,* which is described below, and the latter does actually occur in the same localities as *Neothyone gibbosa.* The buttons have, however, more frequently 3 knobs on the external handle and show little tendency to become elongate as in *pseudolugubris* where the 2 central knobs frequently remain separate.

Genus 10. PACHYTHYONE, new genus

Diagnosis.—Small forms (few cm. long) with stout feet in 5 bands and numerous in the interambulacra; dorsally and toward the ends more papilliform. Ventral tentacles smaller. Calcareous ring with short posterior prolongations. Single stone canal, single Polian vesicle. Gonads forming 2 tufts of few tubes.

Spicules an external layer of oval buttons or plates with the external side covered by a dense reticulum; an inner layer of oblong 4-holed buttons regularly knobbed. Feet with end plate, reduced in the papilliform feet; walls supported by supporting tables with numerous rods in the reticulated spire; a few developed as plates. Introvert with oblong tables; tentacles with heavy perforated plates which gradually become smaller and more delicate in the branches.

Type species.—*Pachythyone rubra* (H. L. Clark).

Remarks.—Only 3 species have been referred to the genus; all are known from the western coast of North and Central America and two are viviparous.

KEY TO THE SPECIES OF *Pachythyone*

1. Color white ventrum and red dorsal side and ends. Spicules slightly larger and robust; plates in tentacles mostly knobbed. . . . . 1. *Pachythyone rubra* (H. L. Clark)
1. Color mottled brown. Spicules more delicate; plates in tentacles mostly smooth 2
2. Supporting tables with strongly branching spire, even in the ventral feet. . . . 2. *Pachythyone lugubris* (Deichmann)
2. Supporting tables with low spire, at least in the ventral feet. . . . . 3. *Pachythyone pseudolugubris,* new species

1. Pachythyone rubra (H. L. Clark)

Plate 23, Figs. 10-12

Thyone rubra (H. L. Clark), 1901, p. 166; text figures 1-5; 1901a, p. 494.—Deichmann, 1939, p. 5 *(passim);* text figure 3.

Diagnosis.—Small, robust form, few cm. long, with stout cylindrical feet in 5 longitudinal bands and scattered in the interambulacra; dorsally the feet show some tendency to become papilliform. External and internal anatomy typical of the genus. Spicules an outer layer of oval plates covered on the external side by a large reticulum; an inner layer of mostly regular 4-holed buttons with 10 marginal knobs and usually 2 central knobs; often the button is lozenge shaped with an accessory hole in each end. Feet with large end plate, reduced in some of the dorsal feet, and numerous large supporting tables with a huge reticulated spire; in some of the dorsal feet it covers almost the entire disk of the supporting table. Introvert with oblong tables with more or less completely reduced 2-pillared spire, sometimes with a few teeth. Tentacles with knobbed plates or rods. Apparently rosettes are not present. Color bright orange-red dorsum and ends, ventrum pure white. (Color retained in alcohol.) Viviparous; the body cavity of the female contains often about half a dozen embryos of different developmental stages.

Type.—M.C.Z.

Type locality.—Monterey Bay.

Distribution.—From Monterey Bay to Santa Cruz Islands, off Santa Barbara County, southern California.

Specimens examined.—The type and numerous individuals, preserved as well as living, from Monterey to Santa Cruz Islands.

Remarks.—Differs from the other 2 species in the color and the much heavier spicules.

2. **Pachythyone lugubris** (Deichmann)

Plate 23, Figs. 7-9; text figure 6

Thyone lugubris Deichmann, 1939, p. 1, text figures 1-2.

Diagnosis.—As for the genus. Color mottled brown. Spicules slightly smaller and more delicate than in *P. rubra;* tentacles without knobbed plates. Rosettes absent or rare. Viviparous.

Holotype.—U.S.N.M.

Type locality.—Magdalena Bay, west coast of L. Calif., 10-15 fms.

Distribution.—Between Magdalena Bay and Cerros Island, west coast of L. Calif.

Depth.—10-40 fms.

Specimens examined.—The types and the following specimens from the *Velero* Expeditions:

283-34. Thurloe Bay, L. Calif., 8-10 fms., off Thurloe Point, March 9, 1934, 5 specimens.

287-34. South Bay, Cerros Island, Mex., 10-15 fms., March 10, 1934, 12 specimens.

Remarks.—The type, a female, contained 13 embryos (collected in June). In the Hancock material collected earlier in the year no embryos were discovered.

While the type material appeared to be devoid of rosettes in the tentacles, a few were found in the Hancock material which came from a much more northern locality.

3. **Pachythyone pseudolugubris,** new species

Plate 22, Figs. 9-10; Plate 23, Figs. 1-6; text figure 6

Diagnosis.—Medium-sized form (up to 5 cm. long). Resembles *lugubris* in the external and inner anatomical features. Spicules an external layer of reticulated plates, an inner layer of regularly knobbed 4-holed buttons rarely elongate and with accessory holes in the ends. Feet with well-developed end plate; walls supported by numerous curved supporting tables with a low spire or none in the ventral feet; in the dorsal a number

have a well-developed complex spire, although rarely as large as in *lugubris*. Introvert with large tables with numerous holes and reduced spire. Tentacles exclusively with delicate rods or plates perforated by a large number of holes. Color mostly mottled brown, sometimes almost black; occasionally a pale faded specimen may be encountered in the preserved material.

Type.—Holotype, AHF no. 34.

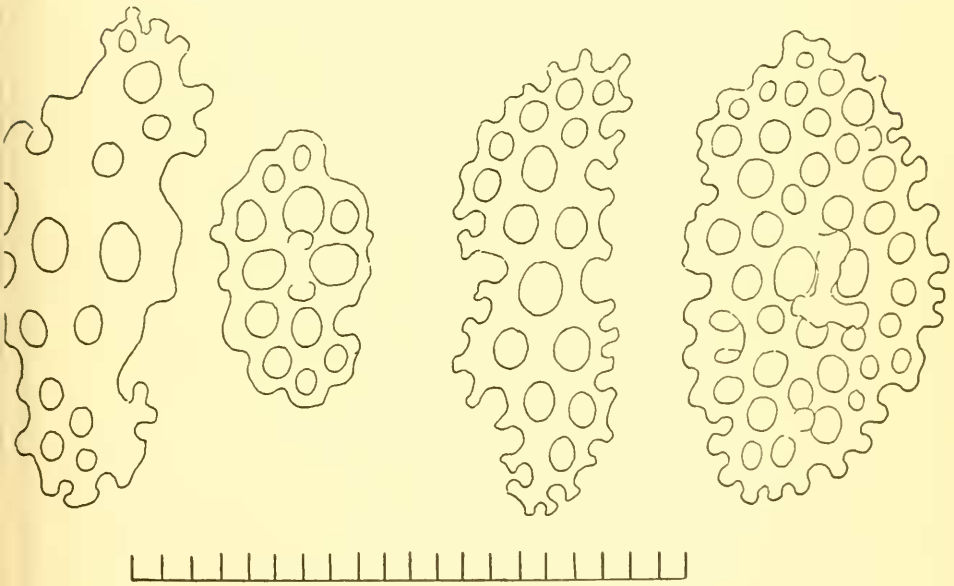
Type locality.—Station 744-37, near Point Piaxtla, Sinaloa, Mex., Gulf of Calif., April 1, 1937, 6-8 fms.

Distribution.—From the upper end of the Gulf of Calif. to the Galapagos.

Depth.—From 6-25 fms.

Specimens examined.—The type and paratypes and a number of individuals secured at the following *Velero* stations:

145-34. North end of Albemarle Island, 6-7 fms., January 12, 1934, 1 specimen.



Text fig. 6. *Pachythyone lugubris* (Deichmann).
1-2. Plate from tentacle and table from introvert.
Pachythyone pseudolugubris, new species.
3-4. Plate from tentacle and table from introvert.
Scale, 1/100 mm.

264-34. Petatlan Bay, Mex., 25 fms., March 2, 1934, 1 specimen.
683-37. Outside of Concepcion Bay, Mex., March 15, 1937, 30 specimens.
744-37. Near Point Piaxtla, Sinaloa, Mex., Gulf of Calif., April 1, 1937, 7 specimens.

Remarks.—The species resembles *lugubris* to an extraordinary degree, and future workers may decide that it merely represents a variety of that form. It is easily distinguished by the more simple supporting tables in the ventral feet, the shorter buttons which seem to lack all tendency to become lozenge shaped with accessory holes in the ends, and in the larger tables in the introvert and the absence of heavier rods and plates in the stem of the tentacles. The larger size and the darker color are, of course, quite useless characters, as *lugubris* possibly may be discovered to reach the same size and, although a dark color is common, paler individuals have been found. In no case have embryos been discovered, so presumably this species is not viviparous as are *lugubris* and *rubra.*

The species has in some localities been found with the larger and paler *Neothyone gibbosa,* and the possibility has been considered that the latter represents senescent specimens of *pseudolugubris,* in which the external layer of reticulated plates has been lost. The spicules seem, however, to be definitely different. *Pachythyone pseudolugubris* shows little tendency to form handles, and the buttons have rarely more than 2 central knobs (except in the lozenge-shaped buttons), while *Neothyone gibbosa* normally forms handles, and as often as not the external handle has 3 knobs. Also the latter species shows definitely a tendency to develop large, smooth supporting plates in the ventral feet, while such plates are almost unknown in *Pachythyone pseudolugubris,* where the few supporting plates which lack a spire are narrow, thick, and in most cases knobbed.

Genus 11. ATHYONE, new genus

Diagnosis.—Medium-sized to large forms. Feet numerous, fairly stout. Tentacles large, bushy, the 2 ventral smaller. Skin soft, with few spicules. Calcareous ring stout with broad radials with distinct posterior prolongations and tall interradials with short anterior tooth.

Spicules scattered swollen 4-holed buttons, often incomplete. Feet with loose-meshed end plate and numerous supporting rods, undoubtedly derived from tables. Introvert and tentacles with rosettes.

Type species.—Athyone glasselli (Deichmann).

Remarks.—The diagnosis is based on the type of *glasselli,* a single adult individual. More material is needed, especially of younger individuals, to complete the diagnosis. The genus is not related to any other form known from the Panamic region. From the west coast of North America a form with somewhat similar spicules is known, *Thyone benti* Deichmann, including a variety, var. *zacae,* from off Cerros Island, Lower California, but that species has a taller, more delicate calcareous ring, exceedingly small tentacles, and larger spicules.

Athyone glasselli (Deichmann)

Thyone glasselli Deichmann, 1936, p. 63, text figure 1; 1937, p. 170, text figure 2. (Comparison with *T. benti.*)

Diagnosis.—As for the genus. Color brownish. Resembles superficially *Thyone briareus* (Lesueur) from the coast of North America. Shallow-water form.

Type.—M.C.Z., cat. no. 736.

Type locality.—Punta Penasco, Sonora, Mexico.

Distribution.—Known only from the type locality.

Depth.—Shore, buried in sand.

Specimens examined.—The type.

Remarks.—The strongly contorted type specimen must have measured more than 10 cm. in expanded, normal condition. More material is necessary to explain from what type of spicules the buttons and rods are derived. Very likely younger individuals may have distinct spire on the buttons and the supporting rods and thus be derived from tables.

The species is not closely related to any other species known from the Panamic region. *Thyone benti,* from Puget Sound, and var. *zacae* from Cerros Island have similar spicules but much larger and definitely derived from tables; the calcareous ring is much more tubular and more delicate and the tentacles are unusually small. From the southern part of South America *Thyone lechleri* Lampert is known to have similar swollen buttons, but the calcareous ring is entirely different with no posterior prolongations at all.

The only other soft-skinned *Thyone* with few spicules described from the Panamic region is the dubious *Anaperus peruana* Troschel, possibly identical with Lesson's species (see discussion, p. 120).

Regarding *Thyone ovulum* Selenka, which Deichmann (1936, p. 65) mentioned as possibly the juvenile stage of *A. peruana,* the type has been re-examined and found to be a phyllophorid (see p. 125).

Genus 12. **ANAPERUS** Troschel

Anaperus Troschel *(partim),* 1846, p. 60.

Diagnosis.—Large form with soft skin and numerous feet distributed without order. Tentacles 10, the 2 ventral smaller. Anus with calcareous teeth. Calcareous ring with posterior prolongations (apparently short); retractor muscles fleshy. Spicules not numerous except in the stem of the tentacles.

Type species.—*Anaperus peruviana* (Lesson).

Remarks.—As type species for this dubious genus Lesson's large dendrochirote species from Payta, Peru, has been chosen since it is a question whether *Thyone briareus* (Lesueur) from the western Atlantic belongs in the genus; *Thyone fusus* (O. F. Müller)—the type species for *Thyone* s. str.—does definitely not belong here, and the fourth species, listed by Troschel as *Thyone cigaro* Troschel, from Labrador, cannot be identified.

It is furthermore doubtful whether Lesson's and Troschel's species are identical. Very likely Lesson's species is a phyllophorid (*Pattalus mollis* (Selenka)), while Troschel's species is a soft-skinned *Thyone* which resembles *T. briareus;* (Selenka actually united the 2 species after having examined Troschel's material in Berlin).

The only other soft-skinned large *Thyone* known from the upper end of the Gulf of California is *Athyone glasselli* (Deichmann), which possibly may occur as far south as Peru. If we discount Troschel's statements about the color and size of his *A. peruana*—as they seem to be borrowed from Lesson's description—the assumption is not unreasonable. If re-examination of Troschel's material in Berlin should prove that that is the case, the name *Athyone* becomes a synonym of *Anaperus;* in that case *Thyone briareus* is excluded from the genus, and Troschel's species must be named *Anaperus glasselli* (Deichmann), syn. *A. peruana* Troschel, nec *Holothuria peruviana* Lesson.

Another possibility is that Troschel's species is simply material of *Thyone briareus* which has been wrongly labeled. Such errors were by no means unusual in older times.

Anaperus peruviana (Lesson)

Holothuria peruviana Lesson, 1830, p. 124, pl. 46, fig. 1.
Trepang peruana Jaeger, 1833, p. 25.—Brandt, 1835, p. 57.
Anaperus peruanus Troschel, 1846, p. 61.—J. Müller, 1854, pl. 9, fig. 9.

Thyone peruana Selenka, 1867, p. 354.—Lampert, 1885, p. 160.—Semper, 1868, p. 242.—Théel, 1886, p. 140.—Deichmann, 1936, p. 65 *(passim)*.

Nec *Anaperus carolinus* Troschel, 1846, p. 62, nec *Thyone tenella* Selenka, 1867, p. 354, pl. 20, figs. 113-114. Referred to *Thyone peruana* by Selenka, 1868, p. 118 (both are synonyms of *Thyone briareus* and both came from the Atlantic coasts of North America).

Diagnosis.—No diagnosis can be given, as Lesson and Troschel possibly had two different species before them.

Type.—Probably lost, or in Paris.

Type locality.—Payta, Peru.

Remarks.—Lesson's description and figure refer to an exceptionally large form, 6 inches long, with 8 bushy tentacles, numerous feet, and soft skin. The color of the animal was deep purplish.

Troschel's numerous specimens in Berlin, likewise from Peru, refer apparently to a typical *Thyone*. They seem to resemble the West Indian *Thyone briareus* Lesueur and have similar short posterior prolongations on the radials and distinct anal teeth; the 2 ventral tentacles are smaller (according to Troschel they were probably overlooked by Lesson, since he figured only 8). The calcareous spicules were not studied; Troschel mentions merely that they were numerous in the stem of the tentacles. The size and color given by Troschel may very likely be quoted directly from Lesson.

Selenka re-examined Troschel's material and decided that *Anaperus carolinus* Troschel and his own *Thyone tenella* from, respectively, Carolina and Texas were synonyms of the Peruvian form (both names are synonyms of *Thyone briareus* Lesueur, the common large *Thyone* from the eastern coasts of the United States).

Lampert may possibly have examined some specimens of *T. briareus* and based his few remarks concerning *Thyone peruana* on a study of this material but not on the true Peruvian form; J. Müller discusses (1854, p. 85) the stone canal and figures (p. 9), one from *A. peruana,* possibly from Troschel's material, but nothing of importance can be gleaned from his drawing.

Whether Selenka for once was hasty in his identification or whether Troschel's material was mislabeled and actually represented material of *Thyone briareus* is impossible to decide. If the latter is true, it is obvious that the statements regarding the size and color came from Lesson's de-

scription. So far, no species which resembles *Thyone briareus* is known from the Pacific coasts of America except *A. glasselli.*

To solve the question it is necessary to re-examine Troschel's material in Berlin and possibly Lesson's type, if still extant. Very likely Lesson described *Pattalus mollis,* the only large purplish form, and overlooked some of the tentacles, while Troschel had either mislabeled material of *Thyone briareus* before him, an undescribed *Thyone,* or *Athyone glasselli.*

Family II. Phyllophoridae

Diagnosis.—Dendrochirota with more than 10 tentacles, the number ranging from 15 to 30. The tentacles either definitely of two sizes, large in the external circle, small in the inner, and appearing almost simultaneously, or the sizes intergrade, the 2 circles being indistinctly set off from each other, and the full number is reached comparatively late in life. Feet restricted to the ambulacra, or scattered also in the interambulacra. Calcareous ring simple, or with distinct posterior prolongations; stone canal and Polian vesicle often in large numbers.

Spicules of various kinds, mostly as tables, often reduced with age. Feet with end plate; walls with or without supporting tables or rods. Introvert with tables or plates, tentacles with or without spicules. The majority are shallow-water forms.

Remarks.—A preliminary revision has been undertaken (Deichmann, 1938) which includes all the genera known from the American waters. To this list is now added *Athyonidium,* established for the species formerly known as *Thyone chilensis* Semper. The latter is synonymous with *Eucyclus duplicatus,* new genus, new species, established by Lampert, 1885, pp. 290-292. Lampert was fully aware of the close similarity to Semper's species *Thyone chilensis* from Chile. Théel discussed the question; he believed the two species were identical but concluded that the number of tentacles possibly was more variable in the polychirote forms than generally known. Ludwig concurred in Théel's opinion and assumed that the tentacles were merely overlooked by Semper. He rejected, however, the genus *Eucyclus* as superfluous and united it with *Thyonidium* under *Phyllophorus.* The *Velero III* has procured ample material of a form which unquestionably refers to the species which Semper examined. As in the case of *Thyone ovulum* Selenka—now *Euthyonidium*—in which Selenka overlooked the inner circle of smaller tentacles, so here the inner

circle of smaller tentacles was completely missed by Semper and the species therefore likewise referred to *Thyone*.[6] The genus resembles the northern genus *Thyonidium* but is distinguished by the almost completely resorbed interradials. As *Eucyclus* is preoccupied, a new genus had to be established.

Key to the Genera of Phyllophoridae Known from the Panamic Region and Chilean Waters

All the genera known from this region have at utmost 20 tentacles, and the feet are numerous in the interambulacra as in the genus *Thyone*.

1. Tentacles distinctly of 2 sizes, i.e., 10 large ones in the external circle and either 5 small ones, more or less deeply divided, or 5 small pairs of equal size in the inner circle. 2
1. Tentacles of varying number and size, sometimes of almost the same size; the 2 circles are more or less confluent. 3
2. Calcareous ring low, simple (or with insignificant posterior projections); interradials well developed, often pentagonal or heart-shaped—in many cases overlapping the radials. Spicules derived from 2- to 4-pillared tables, often reduced to plates with 2-4 knobs or spines indicating the pillars. Feet with end plate but no supporting tables, sometimes a few rods. Tentacles with rosettes and delicate rods. 1. *Euthyonidium* Deichmann p. 124
2. Calcareous ring low, simple; radials with long anterior tooth, interradials completely vestigial, easily overlooked. Spicules apparently lacking except for the end plate and a few branching rods. . . . . 2. *Athyonidium,* new genus p. 127
3. Calcareous ring simple; radials tall, posteriorly slightly incised; interradials well developed. Spicules almost totally lacking, except for end plate and a few perforated plates. Tentacles 20, large, of almost equal size. Large reddish species. . . . . 3. *Pattalus* Selenka p. 129
3. Calcareous ring with long posterior prolongations. Tentacles of different size, fairly delicate. Spicules 2- to 4-pillared tables sometimes scarce in older individuals. Small- to medium-sized forms. . . . . 4. *Phyllophorus* Grube p. 132

[6] In other specimens Semper noticed the inner circle of smaller tentacles and these he referred to *Pattalus* with a comment on the variability of the tentacles in this genus.

Genus 1. **EUTHYONIDIUM** Deichmann

Euthyonidium Deichmann, 1938, p. 380.

Diagnosis.—Medium-sized form (length 10 cm. or less). Tentacles definitely arranged as 10 large ones in 5 external pairs and 5 inner pairs (or 5 single ones?)[7] which are smaller. Apparently all the tentacles appear at an early stage. Calcareous ring simple with tall rectangular radials, posteriorly with short protuberances which may be interpreted as rudimentary prolongations. Interradials well developed.

Spicules small tables with oval to squarish disk, often with dentate or branching margin; spire low, 2-4 pillared often reduced to knobs or spines or totally resorbed. Feet with large end plate and often a few small supporting rods, rarely with trace of being derived from tables. Introvert with tables with numerous holes in the disk and spire often reduced. Tentacles with rosettes and delicate rods. Spicules often reduced with advancing age. Shallow-water forms, restricted to the tropical waters.

Type species.—*E. seguroensis* (Deichmann).

Remarks.—From the West Indies 2 species are known, viz., the type species and *E. occidentalis* (Ludwig). From the Panamic region 2 species are now known; one represents the species which formerly was known as *Thyone ovulum* Selenka, and the other, which is new, is closely related to *E. occidentalis* from the West Indies.

Key to the Species of *Euthyonidium* Known from the Panamic Region

1. Spicules oblong tables with dentate edge; spire 2 pillared, low, often reduced to knobs or spines, or lacking. Color grayish. . . . . 2. *Euthyonidium veleronis,* new species
1. Spicules large tables with cross-shaped disk, often irregularly laciniated; spire mostly reduced to a few knobs or spines. Color reddish brown. . . . 1. *Euthyonidium ovulum* (Selenka)

1. **Euthyonidium ovulum** (Selenka)

Plate 24, Figs. 1-7

Stolus ovulum Selenka, 1867, p. 356, pl. 20, fig. 117.—Semper, 1868, p. 66.—Lampert, 1885, p. 162.—Théel, 1886, p. 138.

[7] The inner smaller pairs may possibly in some forms be found to be 5 single tentacles which are deeply divided as Heding (1936, p. 23) has found it to be the case in the type species of the closely related genus *Thyonidium* from the northern seas.

Thyone ovulum Deichmann, 1936, p. 64 *(passim).*
Euthyonidium ovulum Deichmann, 1938, p. 380, text figure 12.

Diagnosis.—Medium-sized form (probably about 10 cm. long) with soft, thick skin with numerous soft feet. Tentacles 10 large external ones and 10 inner ones which are much smaller and may be completely retracted into small pockets. Calcareous ring with radials posteriorly broad and deeply incised and tapering toward the anterior end; interradials unusually broad and heart shaped with a slight posterior incision, anteriorly tapering to a point. Stone canals numerous and free, also several Polian vesicles. Inner anatomy otherwise normal.

Spicules a scattered layer of tables with irregular disk varying from cross-shaped to a more or less branching or laciniated plate. Spire almost always reduced to a few spines. Feet with large end plate; supporting rods are apparently totally lacking. Introvert seems to lack spicules; tentacles with few rosettes and delicate rods. Spicules more or less completely reduced with advancing age and, except for the end plate, likely to be completely overlooked.

Type.—M.C.Z.

Type locality.—Acapulco, Mexico.

Distribution.—From Lower California to Peru.

Specimens examined.—Selenka's type specimens (3) and several specimens from the Allan Hancock Expeditions:

261-34. Tangola Tangola, Mex., 1 fm., March 1, 1934, 1 specimen.
591-36. Port Escondido, L. Calif., Mex., shore, March 16, 1936, 40 specimens.
844-38. Lobos de Afuera Island, Peru, shore, February 14, 1938, 1 specimen.

Remarks.—Re-examination of Selenka's type material of *Stolus ovulum* showed that Selenka had overlooked the inner circle of tentacles which were completely withdrawn into little pockets and that it was identical with various individuals collected by the Hancock Expeditions, and also by the *Zaca.*

Euthyonidium ovulum has the same reddish-brown color which is extracted in alcohol as the much larger species *Pattalus mollis* Selenka from Peru and Chile. It would therefore be correct to consider whether the two forms are merely growth stages of the form which possibly ought to be called *Pattalus peruana* (Lesson)—see discussion under *Pattalus* and *Anaperus.* Deichmann (1936) considered *ovulum* as possibly being identical with Lesson's species (which was figured as having 8 tentacles)

but was at that time unaware that *ovulum* was not a true *Thyone*. It would, however, be a hitherto unknown phenomenon that the smaller tentacles in the inner circle of a phyllophorid should be able to catch up in size with the large ones, and for that reason alone it would seem unlikely that *ovulum* could grow into *Pattalus mollis* usually with about 20 tentacles of almost identical size. Furthermore, the latter shows great variation in the number of tentacles, while *ovulum* invariably seems to acquire the full number at an early age.

2. **Euthyonidium veleronis**, new species

Plate 24, Figs. 8-11

Diagnosis.—Medium-sized form, up to 10 cm. long; body tapering toward both ends with numerous soft feet scattered over the interambulacra; toward the oral and anal ends arranged in a more orderly manner along the ambulacra. Tentacles 5 large external pairs, and 5 inner smaller pairs closely appressed.[8] Calcareous ring with 5, almost rectangular radials; posteriorly with short projections; interradials more or less heart shaped, with the point forward directed, and overlapping the radials. Stone canal single, attached in the dorsal mesentery; Polian vesicles usually 3 in number, muscle stomach delicate; intestine with normal course; retractors attached near the middle of the body where the 2 tufts of gonads are also attached.

Spicules a scattered layer of small tables with oval to squarish disk with about 8 holes and dentate edge; spire low, mostly with 2 pillars, often reduced to knobs. Feet with large end plate and occasionally a few supporting rods. Introvert with tables; tentacles with rosettes and small curved rods, mostly with perforated ends. Color mottled grayish.

Type.—Holotype, AHF no. 35.

Type locality.—Station 465-35, Playa Blanca, Costa Rica, shale beach between sand beach and rock reef, shore, February 8, 1935, 1 specimen.

Distribution.—The type locality.

Depth.—Shore.

Specimens examined.—The type.

Remarks.—The species is closely related to *E. occidentalis* (Ludwig) known from the West Indies.

[8] As only the type was available, the tentacles in the inner circle were not dissected out, but very likely this species has only 5 tentacles, deeply cleft, in the inner circle.

Genus 2. ATHYONIDIUM, new genus

Eucyclus Lampert, 1885, p. 290.—Théel, 1886, p. 268.—Ludwig, 1887, p. 1239 (reprint p. 23). Name preoccupied.

Diagnosis.—Large forms (25 cm. or more) with thick, soft skin and numerous stout feet. Tentacles 5 large external pairs and 5 small inner pairs. Calcareous ring with 5 stout, almost rectangular radials and 5 insignificant interradials, often completely concealed in the tissue. One large dorsal stone canal, often branched and one or two tufts of smaller stone canals with minute heads. Numerous tufts of branched Polian vesicles. Inner anatomy seems otherwise quite typical of the family.

Spicules large well-developed end plates, a few perforated spinous rods; tentacles with few rosettes in the younger individuals. Color grayish mottled to almost black, ventrum paler, tentacles dark. Shallow-water forms.

Type species.—*Athyonidium chilensis* (Semper).

Remarks.—The genus is monotypic and related to *Thyonidium* and *Euthyonidium,* but the strikingly reduced interradials give it a position almost unique among the Phyllophoridae. Very little can be said about the spicules, as they are reduced even in small individuals (5 cm. long). They may be present in still younger specimens, and one would expect them to be tables, possibly with the spire reduced.

Athyonidium chilensis (Semper)

Thyone (Stolus) chilensis Semper, 1868, p. 241, pl. 40, figs. 3-6.—Lampert, 1885, p. 156.—Théel, 1886, p. 139.

Eucyclus duplicatus Lampert, 1885, p. 250.—Théel, 1886, p. 268.

Diagnosis.—As for the genus.

Type.—Possibly in Germany.

Type locality.—Coast of Chile.

Distribution.—From Chile to Ancon, Peru.

Depth.—Shallow water, at tidemark, in sand.

Specimens examined.—The following material from the Allan Hancock Expeditions:

828-38. San Juan Bay, Peru, shore, February 8, 1938, numerous specimens.

831-38. Independencia Bay, Peru, shore, February 9, 1938, 3 specimens.

Also the following specimens in the M.C.Z.: 21 from Talcahuana, Chile; 3 thrown up on the beach in Ancon, Peru, with *Pattalus mollis.*

Remarks.—I have ventured to transfer Semper's *Thyone chilensis* to this genus, as his description of that unusual form agrees exactly with the numerous specimens I have had occasion to examine, and the species differs distinctly from *Pattalus mollis* Selenka, of which I have likewise had the opportunity to study a long series. My results are in complete agreement with Ludwig's conclusions, that Lampert's species is a synonym of Semper's *Thyone chilensis* (and probably some or all of his *Pattalus mollis*). But contrary to Semper's and Théel's belief, the number of tentacles is constant in this species.

The inner circle of tentacles is often completely withdrawn so that only the 10 larger ones are visible. The inner tentacles become quite stout with advancing age but remain, nevertheless, always distinctly smaller than the external ones, and the inner circle is well separated from the outer one. The radials, as Semper describes them, are slipper shaped, almost rectangular, broadest posteriorly with a large depression below the attachment for the retractors; the interradials are small in the young individuals; in the older they are completely concealed in the thick tissue, and the calcareous ring appears to be composed of 5 stout radials. Semper noticed only one tuft of small accessory stone canals but may possibly have failed to examine both sides of the mesentery. The Polian vesicles are distinctly arranged in tufts, and most of them are branched.

Except for the presence of end plate and a few rosettes in the tentacles, spicules are so rare that they often are difficult to find. Semper figures a few branching rods perforated by a few holes, and such spicules have been found.

The color is strikingly different from that of *Pattalus mollis* even in preserved individuals. It is mottled gray, sometimes almost black on the dorsal side, with paler ventral side and black tentacles. In freshly collected individuals the tube feet may have a reddish tinge, possibly caused by the hemoglobin contained in the water vascular system. The skin seems never to contain a reddish pigment as *Pattalus mollis,* nor does it ever fade to that uniform dull reddish brown which is so characteristic of Selenka's species.

Athyonidium chilensis seems to be the most common phyllophorid known from Chile. On the coast of Peru it is often known to occur in the same localities as *Pattalus mollis,* but buried in sand with the tentacle crown expanded on the surface, while the former clings to the rocks (H. L. Clark's observations).

The *Velero* material measures from 5 to 20 cm.; the largest individuals in the M.C.Z. measure more than 25 cm. in length.

The occurrence of this typical Chilean species in Peruvian waters makes it impossible to decide whether this species or *Pattalus mollis* represents Lesson's troublesome form, *Holothuria peruana*. Possibly a careful survey at Payta, the type locality for *peruana*, may show that only one of the 2 species occurs there. *Pattalus mollis* Selenka does occur in Payta (material in the M.C.Z.), but *A. chilensis* also may possibly be found there, for both species are known to occur in the same localities, i.e., at Ancon, Peru, and at Station 828-38.

Genus 3. **PATTALUS** Selenka

Pattalus Selenka, 1868, p. 113.

Diagnosis.—Large form (20 cm. or more) with up to 20 large tentacles of almost equal size. Skin thick with numerous tube feet. Calcareous ring with 5 tall rectangular radials, with posterior corners rounded into low protuberances; interradials with broad low basal part and a long anterior tooth, often concealed in the thick tissue. Dorsally a long stone canal with small head; Polian vesicles numerous, hanging as a fringe around the ring canal, a few are dichotomously divided. Other anatomical features typical of the family.

Spicules a few branched rods, feet with large end plate. Color reddish brown with a pigment which is dissolved in alcohol; specimens which have been preserved in alcohol for a long time are uniformly dull brown. Shallow water.

Type species.—*Pattalus mollis* Selenka.

Remarks.—The genus is monotypic and seems not related to any other form. It has in the course of time been confused with *Athyonidium chilensis* (Semper) but is definitely different from that species. It may possibly be identical with *Euthyonidium ovulum* (Selenka), although it seems impossible that the smaller inner tentacles should ever be able to attain the size of those in the external circle. The 2 species have the same reddish color with pigment which is extracted in alcohol. They differ as far as our present material shows in the more heart-shaped interradials in *E. ovulum*, with a short anterior tooth, while *P. mollis* has a remarkably long anterior tooth on the interradials. Also *E. ovulum* seems to lack a large, dorsally attached, stone canal which is so characteristic a feature in *P. mollis*. The large *P. mollis* is extremely common in Peru and is also

known from Concha, Chile, while the smaller *E. ovulum* is known from various localities in the Panamic region and has once been reported from Lobos de Afuera Island, Peru (see above, p. 125). (The M.C.Z. has further two lots marked "locality dubious" from, respectively, Hawaii, and Mazatlan, Mexico.) If *Pattalus mollis* is assumed to represent the full-grown stage of *Euthyonidium ovulum,* it is impossible to explain how that large species could have escaped discovery in the Panamic region. (See also under *E. ovulum.*)

Pattalus mollis Selenka

Pattalus mollis Selenka, 1868, p. 113, pl. 8, figs. 4-5.
Thyonidium peruanum Semper, 1868, p. 67, pl. 15, fig. 17.
Thyonidium molle Semper, 1868, p. 243.—Ludwig, 1874, p. 4; 1883, p. 163; 1887, p. 25.—Lampert, 1885, p. 174 *(partim).*—Théel, 1886, p. 144.
Anaperus peruana Verrill, 1867, p. 322.
Pattalus peruana Verrill, 1867, p. 376.
Phyllophorus peruvianus H. L. Clark, 1910, p. 351 *(partim).*

Diagnosis.—As for the genus. Color reddish purplish, pigment extracted in alcohol; preserved specimens usually dull brown.

Type.—Berlin.

Type locality.—Peru and Chile.

Distribution.—Common in Chile and Peru.

Depth.—Shallow water, to 25 fms., often collected at tidemark, clinging to rocks (H. L. Clark).

Specimens examined.—A large series in U.S.N.M. and M.C.Z. Also several specimens from the Allan Hancock Expeditions:

375-35. Independencia Bay, Peru, shore, January 13, 1935, 13 specimens.
391-35. Lobos de Afuera Island, shore, January 17, 1935, 8 specimens.
820-38. San Nicholas Bay, Peru, 10-25 fms., February 6, 1938, 4 specimens.
828-38. San Juan Bay, Peru, shore, February 8, 1938, 9 specimens.
831-38. Independencia Bay, Peru, shore, February 9, 1938, 3 specimens.
837-38. North Chincha Island, Peru, shore, February 11, 1938, 6 specimens.
844-38. Lobos de Afuera Island, Peru, shore, February 14, 1938, 2 specimens.

Remarks.—The species seems to be the most characteristic holothurian from the coasts of Peru and certain localities in Chile. In some cases it occurs in the same localities as *Athyonidium chilensis,* but the 2 species have an entirely different ecology. *Pattalus mollis* is found completely exposed, clinging to rocks, while *Athyonidium chilensis* is found buried in sand with its tentacles extending flatly on the surface (H. L. Clark, observed on the Hancock Expeditions in the spring of 1938). In preserved condition the 2 species are entirely unlike except in size; *P. mollis* is uniformly purplish red or faded brown, while the other species is mottled gray, sometimes with almost black dorsum, black tentacles, and more lightly colored ventrum. Internally *P. mollis* has large well-developed interradials with long anterior tooth, while *Athyonidium chilensis* has broad radials and the interradials are almost completely resorbed or hidden in the leathery tissue.

It would be tempting to select Lesson's name *peruanus* for this species so typical of Peru, especially since material in the M.C.Z. shows that *Pattalus mollis* does occur in Payta, Peru, the type locality for Lesson's species. But there is still the possibility that Lesson did have a true dekachirote form before him, with 2 smaller ventral tentacles which were overlooked, a form which has not as yet been rediscovered except possibly by Troschel. Furthermore, both *P. mollis* and *A. chilensis* often occur in the same localities, and Lesson's description and figures may refer to a composite species, the low number of tentacles—although incorrect—being taken from *A. chilensis,* while the color note "rouge violet éclatant et foncé" refers to *P. mollis.*

No other species has caused so much confusion in the literature as this species (including *A. chilensis*). It has usually been identified with Lesson's *Holothuria peruana,* although, if Troschel is correct, the latter is one of the members of the genus *Thyone* s.l.

Semper obviously referred some of his material of *A. chilensis*—those in which he observed the 10 inner small tentacles—to this species and commented on the variability of the number and size of the tentacles in this genus; Lampert did the same, as also H. L. Clark.

Verrill referred his material of *mollis* to *Anaperus peruanus* Troschel but realized the discrepancy in the number of tentacles and corrected the name to *"Pattalus peruanus*—closely related to Selenka's *P. mollis,"* without indicating wherein the 2 species differed.

The reasons why *P. mollis* cannot represent the mature stage of *Euthyonidium ovulum* Selenka are mentioned above (under that species).

Genus 4. PHYLLOPHORUS Grube, 1840

Phyllophorus Auctores. Nec *Phyllophorus* Heding, 1936 (*Thyonidium* Düben & Koren).

Thyonidium Auctores. Nec *Thyonidium* Düben & Koren, 1844, p. 303.

Diagnosis.—Medium-sized forms (6-15 cm.) with feet distributed in the interambulacra. Tentacles up to 20 in number, of varying size, not sharply set off into 2 circles; the complete number is reached late in the animal's life. Calcareous ring with distinct posterior prolongations on the radials; interradials well developed, of varying shape; ring often composed of smaller pieces, mosaiclike.

Spicules 2- to 4-pillared tables, spire usually retained. Feet with large end plate; walls with or without supporting tables, or a few rods. Introvert usually with tables with low spire and numerous perforations in the disk; tentacles with either perforated plates or delicate rods; rosettes seem normally to be present in the introvert and tentacles. Shallow-water forms, tropical and subtropical.

Type species.—*Phyllophorus urna* Grube.

Remarks.—The type species is common in the Mediterranean Sea. Grube's description and figures are not particularly convincing, but an excellent account is given by Sars (1846). Unfortunately it is written in the Norwegian language and is therefore not so well known as it deserves. A number of tropical species belong to this genus. (See Engel, 1933, and Deichmann, 1930 and 1938.)

From American waters 5 species are reported from the West Indies and coast of Brazil. From the tropical west coast of America 2 species are known. One was described by Ludwig in 1894, the other by Deichmann in 1938. The latter species is closely related to one of the West Indian forms, while that of Ludwig seems completely unrelated to all other members of the genus. No true *Phyllophorus* is known from the west coast of North America, or from Chile or Hawaii.

Key to the Species of *Phyllophorus* Known from the Panamic Region

1. Spicules tables with oval disk with an average of 8 marginal holes; spire distinctly 4 pillared, usually with a single cross-beam and ending in a large number of spines. Feet with large end plate and numerous supporting tables with broad elongate disk with numerous holes and a huge spire ending in a conical

tooth which often pierces the skin. . . . . 1. *Phyllophorus aculeatus* Ludwig

1. Spicules tables with oval disk with 4 large and 4 smaller holes, the latter often wedge shaped; spire usually with 2 pillars and ending in 2 tufts of few spines, sometimes ending in 4 spines. Feet with large end plate and a few supporting tables with broad elongate disk with numerous holes and comparatively low spire with a single crossbeam and ending in 2 diverging spines or horns, rarely in a single point. . . . . 2. *Phyllophorus zacae* Deichmann

1. **Phyllophorus aculeatus** Ludwig

Plate 25, Figs. 1-8

Phyllophorus aculeatus Ludwig, 1894, p. 128, pl. 13, figs. 6-11.—Deichmann, 1938, p. 381 *(passim)*.

Diagnosis.—Medium-sized form (type measured 6.5 cm. but was strongly contracted). Feet numerous, scattered almost uniformly over the body. Tentacles of varying size, up to 20 in number. Calcareous ring with long posterior prolongations on the radials; interradials with heart-shaped to almost rhomboid base and long anterior tooth; the basal part overlaps the radials.

Spicules numerous tables with oval disk with a varying number of marginal holes, usually 8; spire mostly with 4 pillars, a single crossbeam, and a wreath of small spines on the top. Feet with large end plate and heavy supporting tables with broad oval disk with numerous holes and an enormous spire which tapers into a conical tooth. Introvert with tables with oval, lacelike disk and spire composed of 2 to 4 pillars. Tentacles with a few rosettes and numerous delicate rods, rarely with the ends perforated. Color grayish with purplish tentacles.

Type.—U.S.N.M.

Type locality.—Gulf of Panama, shore.

Distribution.—Known from the type locality only.

Depth.—Shallow water.

Specimens examined.—The type, the only specimen known in existence in any collection.

Remarks.—The strongly contracted type measured probably more than 10 cm. in length in expanded condition. The inner organs are strongly distorted, and very little can be said about them. The gonads are well developed, forming long tubes, dichotomously divided near the base.

The spicules show some similarity to those characteristic of *Thyone strangeri* (see pl. 19), and for a while I thought that Ludwig had made a mistake in counting the tentacles. Re-examination of the type and comparison of the spicules showed beyond doubt that Ludwig was right and that the 2 species cannot possibly be confused as a glance at the figures of the spicules will show.

It is remarkable that this well-defined species has never been taken again, especially since the type locality is one of the most frequently visited collecting grounds in the Panamic waters.

2. Phyllophorus zacae Deichmann

Plate 24, Figs. 12-21

Phyllophorus zacae Deichmann, 1938, p. 381.

Diagnosis.—Medium-sized form, feet numerous scattered almost uniformly over the body, not crowded. Tentacles 15-20 in number, long, delicate, of varying size. Calcareous ring with well-developed posterior prolongations on the radials; the anterior tooth is long rectangular with a constriction at its base; the interradials are more or less heart shaped with a broad base, overlapping the radials and with a short tooth.

Spicules delicate tables with oval disk with 4 larger and 4 smaller holes, the latter often wedge shaped; spire with 2 to 4 pillars, a single crossbeam, and ending in 4 tufts of few spines, sometimes reduced to 4 undivided spines. Feet with large end plate and a few supporting tables with broad oblong disk with numerous holes; spire low or moderately high with one crossbeam, and usually ending in 2 diverging spines or horns or in a single point. Introvert with delicate tables; tentacles with delicate rods and rosettes. Color reddish to white.

Type.—M.C.Z.

Type locality.—Tangola Tangola Bay, Mex.

Distribution.—Ranging from L. Calif. to the Galapagos.

Depth.—The type came from 10 fms. depth.

Specimens examined.—The type, and 4 individuals from the following *Velero III* stations:

190-34. Galapagos, Lat. 0° 55′ S.; Long. 90° 30′ W., 58-60 fms., January 26, 1934, 2 young.

517-36. East side of San Francisco Island, Gulf of Calif., 15 fms., February 25, 1936, 1 specimen, oral end missing.

816-38. North of Hood Island, Galapagos, 50-100 fms., January 29, 1938, 1 specimen.

Remarks.—The species is closely related to *Phyllophorus destichadus* Deichmann from the West Indian waters. It differs in the presence of supporting tables in the feet and in minor details of the calcareous ring and the spicules.

A species with somewhat similar spicules was described from Hawaii by Fisher, 1907, and is now referred to *Neothyonidium* (Deichmann, 1938, p. 382). The Hawaiian species has tentacles in 2 separate circles and of 2 different sizes, and the calcareous ring is of another type, with long narrow interradials which are firmly joined to the radials, not overlapping them.

Family III. Psolidae

Diagnosis.—Dendrochirota with part of the ventral side developed as a thin-walled sole, with feet along the margin and in many forms also along the odd ambulacrum of the sole. Dorsal side (including the oral and anal ends) covered more or less completely by scales; in certain genera some scales are perforated for the passage of tube feet; in one genus no feet are developed on the dorsal side. Tentacles 10 (15 in one genus), the 2 ventral ones are often smaller; in the few deep water forms the tentacles are almost finger shaped, with few or no branches. Calcareous ring simple; retractors of unequal length; gonads in 2 tufts on the dorsal side opening on a papilla behind the tentacles.

Spicules in sole, perforated plates or buttons, smooth or knobbed; in some forms the external deposits may be cup shaped, in others gradually transformed into reticulated bodies; in certain species the spicules become scarce with age. Feet with end plate and a varying number of supporting rods or plates. Dorsal side with or without a layer of spicules outside the scales, as grains, cups, hourglass-shaped bodies, plates, etc. Dorsal appendages, if present, with or without end plate and supporting rods or plates. Tentacles with or without perforated plates or rods; sometimes the spicules disappear in older individuals; a few forms have rosettes.

Remarks.—The family comprises about half a dozen genera and represents a rather interesting series of evolutionary steps. Of the 3 genera which are known from the Panamic waters *Thyonepsolus* represents undoubtedly the most primitive group, indistinctly separated from *Psolidium,* while the highest evolutionary stage is represented by the genus *Psolus.* The inner anatomy of the 3 genera is very similar. The most striking difference is that in the 2 first-named genera the third loop of the

intestine is attached in the left ventral interambulacrum, while in the last genus it is attached in the right interambulacrum. This may indicate that the *Thyonepsolus-Psolidium* series represents an independent branch and the *Psolus* series another, or it may simply be that the mesenterial attachment has shifted completely over in the most advanced genus. Some of the members of the genus *Psolidium* have very few dorsal feet, and these have formerly partly been referred to the genus *Psolus*.

Key to the Genera of the Family *Psolidae* Known from the Panamic Region

1. Dorsal side (including oral and anal ends) without appendages (except the anal papillae and in some forms a few abortive feet on the introvert). . . . . 3. *Psolus* Oken p. 146
1. Dorsal side with a varying number of tube feet, usually perforating the scales. 2
2. Dorsal side characterized by the presence of large hourglass-shaped bodies. Tube feet on dorsal side with walls stiffened by numerous curved squarish or circular plates, sometimes reduced to crosses (also a few oblong supporting plates may be present); towerlike deposits present in most species, often reduced with age. . . . . 1. *Thyonepsolus* H. L. Clark p. 136
2. Dorsal side without large hourglass-shaped bodies, at utmost small cups or baskets. Dorsal tube feet in some forms supported by squarish plates, in others by oblong plates or rods, in others superficial deposits seem to be entirely lacking on the dorsum; towerlike deposits sometimes present. 2. *Psolidium* Ludwig p. 141

Genus 1. **THYONEPSOLUS** H. L. Clark, 1901

Thyonepsolus H. L. Clark, 1901, p. 169.—Deichmann, 1930, p. 192; 1937, p. 172.

Psolidium Ludwig, 1904, p. 689.

Lissothuria Verrill, 1867, p. 322.

Diagnosis.—Small to medium-sized forms with 10 tentacles, the 2 ventral smaller; sole sharply set off; feet numerous in 3 crowded bands. Dorsal scales few to numerous, covering the back more or less completely; feet numerous or few; a well-developed external layer of spicules covers the scales.

Spicules in sole perforated plates, knobbed or smooth, some may form shallow baskets; feet with end plate and perforated supporting rods or plates. Dorsal side with a varying number of large towerlike deposits, reduced with age, in some species shorter, approaching the shape of grains; also hourglass-shaped bodies and curved plates. Feet with a small end plate or none, and the walls supported by curved squarish plates, sometimes reduced to crosses and rods. Tentacles with heavy perforated plates and smaller plates and rods, in some species rosettes. Shallow-water forms.

Type species.—*Thyonepsolus nutriens* H. L. Clark.

Remarks.—The genus seems to be restricted to the American waters. The type species is known from Monterey Bay, California, and southward to Santa Cruz Islands; another species is known from the West Indian seas, while 3 occur in the Panamic region and adjacent waters. Two of these are here described as new. The type species is known to be viviparous; the life histories of the other species are yet unknown.

Key to the Species of *Thyonepsolus* Known from the Panamic Region and the Californian Waters

1. Dorsal scale covering incomplete in the midline (in the adult individuals). Scales numerous and small; dorsal feet numerous; external layer of spicules well developed. Sole with large perforated plates and an outer layer of flattened baskets. Perforated plates in tentacles decreasing in size, no rosettes. Viviparous; carries its large eggs in pits on the back. Californian waters (and Galapagos?). . . . . 1. *Thyonepsolus nutriens* H. L. Clark

1. Dorsal scale covering complete in the midline. Dorsal feet not remarkably numerous; external layer of spicules not remarkably crowded, varyingly developed. Sole without external layer of flattened baskets. Panamic waters. 2

2. Tentacles with rosettes and delicate rods besides heavy narrow rods; plates in sole with indented margin. Midventral band with feet crowded. . . 2. *Thyonepsolus beebei* Deichmann

2. Tentacles without rosettes and delicate rods, only heavy plates. Midventral band of feet with few feet. 3

3. Dorsal side with few (7-8) scales and fairly numerous feet. Hourglass-shaped bodies large, irregular. Sole with knobbed plates. (Towers were not found in the type.) . . . . . 3. *Thyonepsolus veleronis,* new species

3. Dorsal side with numerous scales (14 between oral and anal scales) but comparatively few feet, easily overlooked. Dorsal side with typical hourglasses of lacelike structure and large towers which in older individuals become shortened, so that they are thimble shaped. Sole with 4-holed buttons and plates with marginal knobs; holes comparatively small. . . . . 4. *Thyonepsolus hancocki,* new species

1. Thyonepsolus nutriens H. L. Clark

Plate 26, Figs. 1-5

Thyonepsolus nutriens H. L. Clark, 1901, p. 169; 1901a, p. 491, text figures.—Deichmann, 1930, p. 193 *(passim);* 1937, p. 174.

Psolidium nutriens Ludwig, 1904, p. 689.

Diagnosis.—Small form (length of sole 2 cm.); distinct sole with numerous feet in 3 crowded bands. Dorsal side with numerous small scales, lacking in the midline (except in very young individuals), feet numerous, and external layer of spicules well developed. Spicules in sole perforated plates (0.10-0.15 mm.) and smaller flattened baskets (0.06 mm.); feet with end plate and supporting rods. Dorsal side with scales and perforated plates (0.18 mm.) often slightly concave, and hourglass-shaped bodies (0.10 mm.). In most individuals a number of huge tower-like deposits (0.20-0.30 mm.) numerous in young individuals where the other types of external spicules may be scarce. Dorsal feet with rudimentary end plate and curved perforated plates or rods in the walls. Introvert and tentacles with perforated plates or buttons and rods.

Type.—M.C.Z.

Type locality.—Pacific Grove, California, in tide pools.

Distribution.—From the type locality southward, Santa Cruz Islands, off Santa Barbara, California.

Depth.—Tide pools to few fms. depth.

Specimens examined.—The type and about 50 from various localities.

The following material examined from the Allan Hancock Expeditions:

11-32. Conway Bay, Indefatigable Island, Galapagos, shore, January 12, 1932, 1 specimen.

Remarks.—A single specimen in the Allan Hancock Expeditions has been identified with this species, but the label says Station 11-32(?) which is Conway Bay, Indefatigable Island, Galapagos, shore.

As this discontinued distribution seems at most unbelievable, it is for the present assumed that the labeling is erroneous. The record is given here in case future investigation should prove that it is correct and a species closely related to *T. nutriens,* or identical with it, does occur in the waters around Galapagos Islands. Comparison with material from California has failed to reveal any tangible differences in the spicules.

The living animal (observed in Hopkins Marine Station) is brilliant red with a more pinkish sole. The inner anatomy is similar to that of *Psolidium.* The third mesentery is attached in the left ventral interambulacrum, close to the midventral ambulacrum. The respiratory trees are feebly branched and attached to the lateral interambulacra; the musculature is moderately developed, the retractors short and attached near the oral end. The genital organs form short tubes in 2 tufts near the oral end; they open on a papilla immediately behind the tentacles; small genital organs are present in specimens 0.6 mm. long. The eggs are huge, about 1 mm. in diameter, and reddish gray, opaque. The eggs are transferred to the back of the female and lodged in pits; about 10 eggs are hatched at a time; when ready to leave the mother in a few weeks, the young are pale rose colored and have their full number of tentacles and 6 large tube feet. Specimens 2 mm. long have developed a distinct sole; those 5 mm. long have 3 rows of feet on the ventral sole. In Monterey Bay the female has been observed brooding its eggs from March to November; very likely it broods during the remaining winter months also.

2. **Thyonepsolus beebei** Deichmann

Plate 28, Figs. 1-3

Thyonepsolus beebei Deichmann, 1937, p. 172, text figure 3, 1-10; 1938, p. 382.

Diagnosis.—Small form (length of sole few cm.). Exterior typical of the genus; dorsal side completely covered by scales. Ventral sole with flat plates with scalloped edge; dorsal side with large complicated lacelike hourglass-shaped bodies, towers and curved perforated plates; tube feet with end plate and curved plates with 4 central holes and numerous marginal ones. Tentacles with heavy rods in stem; branches with delicate rods and rosettes.

Type.—M.C.Z.

Type locality.—Off Arena Bank, L. Calif., 2.5 fms.

Distribution.—West coast of Lower Calif., Mex., Costa Rica, possibly also Panama (?*Lissothuria ornata* Verrill, 1867, p. 322).

Specimens examined.—From the following stations:

261-34. Tangola Tangola, Mexico, 15-20 fms., March 1, 1934, 1 specimen.

283-34. Thurloe Bay, West Coast of L. Calif., 8-10 fms., March 9, 1934, 3 specimens.

3. **Thyonepsolus veleronis,** new species

Plate 26, Figs. 6-8; Plate 27, Figs. 8-9

Diagnosis.—Small form (type less than 2 cm. long); distinct sole with feet in a double row along the edge and in a scattered row along the midventral ambulacrum; dorsal side with comparatively few large scales and relatively numerous feet; external layer of spicules well developed. Spicules in sole knobbed plates; dorsally huge irregular hourglass-shaped bodies, more cup shaped and less lacelike than in the other species. (Towers were not observed in the type.) Dorsal feet apparently without end plate, walls supported by squarish curved plates of the typical structure. Tentacles with heavy plates and rods with small holes; branches with delicate rods or plates; apparently no rosettes.

Type.—Holotype, AHF no. 36.

Type locality.—Station 147-34, Tagus Cove, Albemarle Island, Galapagos, dredging south of Cove, 30 fms., January 13, 1934.

Distribution.—Type locality.

Depth.—Dredged from 30 fms.

Specimens examined.—The type.

Remarks.—The single individual measures 1.8 cm. in length (somewhat distorted). Its exterior and its spicules are very characteristic, and it cannot be confused with any of the other species of *Thyonepsolus.* The lack of towerlike deposits may be accidental—it is not uncommon in older individuals of *Thyonepsolus nutriens.*

It is a question whether this species properly belongs in *Thyonepsolus* or *Psolidium,* but the large hourglass-shaped spicules are so much more reminiscent of those characteristic of *Thyonepsolus* than of the small cups which are found in *Psolidium* that I have preferred at present, at least, to refer it to the former genus.

4. **Thyonepsolus hancocki,** new species

Plate 27, Figs. 1-7

Diagnosis.—Comparatively large form (sole up to 4 cm. long); sole sharply set off; feet in a double row along the edge and in a scattered

band along the midventral ambulacrum. Dorsal side with numerous imbricating scales, about 14 between oral and anal apertures in the largest individual. Dorsal feet few, rudimentary, easily overlooked.

Spicules in sole varying from 4-holed buttons to irregular, perforated plates with marginal knobs and occasionally a few knobs near the center. Feet with end plate and perforated rods and plates. Dorsal side with scales, delicate hourglass-shaped cups of lacelike structure and huge towers which in the older individuals are partly resorbed from the tip, so that they become shorter, thimblelike. Feet apparently without end plate; walls supported by curved squarish plates with 4 central holes and a varying number of smaller marginal ones. Tentacles with heavy plates and rods; in the branches delicate plates and rods; apparently no rosettes.

Type.—Holotype, AHF no. 37, 19 paratypes.

Type locality.—Station 521-36, Agua Verde Bay, L. Calif., north of anchorage, 5-10 fms., February 27, 1936.

Distribution.—Gulf of Calif. to Ecuador.

Depth.—From 5-165 fms.

Specimens examined.—The following individuals from the Allan Hancock Expeditions:

213-34. La Plata Island, Ecuador, dredging north of anchorage, rocky, 7-10 fms., February 10, 1934, 3 small specimens.

521-36. Agua Verde Bay, L. Calif., Mex., 5-10 fms., February 27, 1936, 5 small specimens.

529-36. Off San Francisquito Bay, L. Calif., Mex., 165 fms., March 1, 1936, 12 large specimens.

854-38. Gorgona Island, Colombia, north of Island, 40-60 fms., February 24, 1938, 7 large and 2 small specimens.

Remarks.—A well-defined species which is easily recognized.

Genus 2. **PSOLIDIUM** Ludwig, 1887

Diagnosis.—Small forms (sole few cm. long); sole sharply set off; with feet along the edges and few or many in the midventral ambulacrum; dorsal side with numerous imbricating scales, and a varying number of tube feet which pass out through some of the scales. Spicules in sole plates or buttons, smooth to knobbed, usually also an external layer of small deep cups. Feet with end plate and supporting plates or rods. Dorsal side usually with an external layer of cups (possibly lacking in some species); besides grain or towers (more or less completely reduced with

age). Dorsal tube feet with or without end plate and supporting rods or plates in the walls (the type species has squarish plates of similar type as those in *Thyonepsolus*).

Type species.—*Psolidium dorsipes* Ludwig.

Remarks.—The genus comprises a number of species. A few of these have formerly been referred to *Psolus* because the few dorsal tube feet were overlooked. On the other hand, it seems as if *Psolidium convergens* Hérouard (1901, p. XXX) ought to be transferred to some other genus, judging from the description given by Perrier (1905, p. 38, pl. 2, figs. 2-4, text figures D-F).

The genus is closely related to *Thyonepsolus* H. L. Clark; actually Ludwig considered (1904) the latter as a synonym of *Psolidium*. The similarities between the 2 genera are even greater than assumed since it has been discovered that the curved plates in the type species are partly supporting plates for the dorsal tube feet and likewise that the characteristic towers also may be present (see below). Nevertheless, it seems justifiable for the present to retain the 2 genera on account of the more complex hourglass-shaped bodies which are typical in *Thyonepsolus,* while *Psolidium* has small cups or baskets.

Four species are discussed here, all represented in the Allan Hancock collections and all taken at moderate depth or even in shallow water. One is the type species, while 3 are described as new.

Key to the Species of *Psolidium* Known from the Panamic Region and Adjacent Waters

1. Tube feet fairly numerous in the midventral ambulacrum, also numerous on the dorsal side where the scales are small and numerous. Sole with plates with fairly large holes, smooth or knobbed, and deeply convex cups. Dorsal side with numerous deep cups and often also towerlike deposits; tube feet with numerous curved squarish supporting plates, a few are narrow, rod shaped. . . . . 1. *Psolidium dorsipes* Ludwig

1. Tube feet in midventral ambulacrum few. Dorsal feet easily overlooked. 2

2. Dorsal scales with a varying number of prominent pearllike projections. Spicules in sole 4-holed buttons or plates with knobbed surface and varying from delicate to stout. Oral opening with large triangular scales; many small scales inter-

calated between the larger scales. . . . . 3. *Psolidium ekmani,* new species

2. Dorsal scales smooth, without pearllike projections. 3

3. Dorsal side covered by numerous thimble-shaped grains with flat base (reduced towers). Sole with small flattened cups with lateral spines and a few larger plates with undulated surface or smooth. . . . . 4. *Psolidium planum,* new species

3. Dorsal side with no accessory spicules (?). Ventral side with heavy knobbed plates and buttons. . . . . 2. *Psolidium eubullatum,* new species

1. Psolidium dorsipes Ludwig

Plate 29, Figs. 1-12

Psolidium dorsipes Ludwig, 1887, p. 9, pl. 2, fig. 9; 1894, p. 135 *(passim).*—Perrier, 1905, p. 48, pl. 2, figs. 5-15, text figures G-H. —Ekman, 1925, p. 112, text figure 26.

Diagnosis.—Small form (sole 1 cm. long); ventral sole sharply set off with 3 crowded bands of tube feet. Dorsal side covered by imbricating scales, about 10 between oral and anal scales; dorsal feet numerous, often 2-3 perforating a single scale; external layer of deposits well developed.

Spicules in sole plates varying from smooth to knobbed, 2 types of plates, one with few holes, smooth or with few knobs, one with large holes and numerous pearllike knobs; also an external layer of cups with 4 knobs on the strongly convex side and a marginal brim of delicate teeth. Feet with end plate and oblong supporting plates, slightly curved, often with few knobs. Dorsal side with numerous baskets or cups of same size and type as in the sole; tube feet mostly with small end plate and walls packed with curved squarish plates, a few may be oblong. In some specimens numerous towers are present.

Type.—Probably in Italy.

Type locality.—Puntas Arenas, Strait of Magellan, 15-25 fms.

Distribution.—Strait of Magellan and vicinity. Also Panama and Gulf of Calif.

Depth.—From 6-60 fms.

Specimens examined.—The following from the Allan Hancock Expeditions:

744-37. Near Point Piaxtla, Sinaloa, Gulf of Calif., 6-8 fms., April 1, 1937, 4 specimens (poor).

863-38. Bahia Honda, Panama, off North Island, 30-50 fms., March 1, 1938, 1 specimen (fair).

Remarks.—The *Velero* material differs from the material examined by Ludwig and Perrier in the presence of the numerous towers with broad smooth base. The cups or baskets agree well with Ludwig's figure; possibly Perrier's drawing is somewhat inaccurate; the marginal teeth on the cups are too few and too coarse. It was a satisfaction to discover that the tube feet actually were packed with the curved squarish plates as was to be expected, not exclusively lying free in the skin as Perrier describes it; a few simple curved oblong plates may be found in the wall of the feet as in the other species.

2. **Psolidium eubullatum,** new species

Plate 28, Figs. 4-7

Diagnosis.—Small form (type measures about 1 cm.). Sole with feet restricted to the margin and the anterior end of the midventral ambulacrum. Dorsal side with about 14 scales between oral and anal scales; dorsal feet few.

Spicules in sole heavy buttons or plates with marginal and central knobs. Feet with end plate and perforated plates. Dorsal side apparently without any spicules except the scales; even the tube feet seem to lack spicules entirely.

Type.—Holotype, AHF no. 38, 3 paratypes.

Type locality.—Station 213-34, La Plata Island, Ecuador, 7-10 fms., north of Anchorage, rocky, February 10, 1934, 3 specimens.

Distribution.—Known from Ecuador.

Depth.—From 7 to 55 fms.

Specimens examined.—The type and 3 specimens from the following *Velero* stations:

212-34. La Plata Island, Ecuador, dredging 45-55 fms., sand shale, rock, mud, February 10, 1934, 1 specimen.

213-34. La Plata Island, Ecuador, 7-10 fms., February 10, 1934, type and 2 paratypes.

Remarks.—The specimens bear some resemblance to *P. bullatum* Ohshima, (1915, p. 282) from the Alaskan waters, 54 fms., and may possibly be found to be identical with that form. The unusually low depth at which it is taken is noteworthy, and information about the hydrographic conditions at La Plata Island is most desirable.

3. **Psolidium ekmani**, new species

Plate 30, Fig. 6

Diagnosis.—Small form (length of sole about 1 cm.). Oral and anal openings closed by indistinct valves; stout radial teeth present inside the oral plates; about 5 scales between the oral and anal valves. Scales strongly sculptured with several pearllike projections, firmly attached; dorsal tube feet few. Sole with rows of marginal feet and a row of few feet scattered along the midventral ambulacrum. Spicules in sole delicate 4-holed buttons and plates with a larger number of holes; a varying number of knobs are present on the surface. Feet with end plate and supporting rods. Dorsal side with no other spicules than the scales (?).

Type.—Holotype, AHF no. 39, 1 paratype.

Type locality.—Station 213-34, La Plata Island, Ecuador, 7-10 fms., dredging north of anchorage, February 10, 1934.

Distribution.—From Ecuador to Panama.

Depth.—From 7-10 fms.

Specimens examined.—The type and one other specimen from the following Hancock stations:

213-34. La Plata Island, Ecuador, 7-10 fms., February 10, 1934, 1 specimen.

863-38. Bahia Honda, Panama, off North Island, rock, mud, sand, 30-50 fms., March 1, 1938, 1 specimen.

Remarks.—The species was at first assumed to represent *Psolus patagonicus* Ekman, but comparison with the latter showed clearly that the spicules were entirely different (plate 30, fig. 8). Neither could it be referred to *Psolus squamatus* (Koren), var. *segregatus* Perrier because the projections on the scales were not loose but part of the scales. Also the presence of tube feet in the midventral ambulacrum separates it distinctly from both species mentioned above. Finally a few tube feet were discovered on the dorsal scales and the generic position thereby settled. The species is named in honor of Dr. Sven Ekman, the well-known zoogeographer and student of holothurians, from Upsala, Sweden.

4. **Psolidium planum**, new species

Plate 30, Figs. 1-5

Diagnosis.—Small form (sole up to 1.5 cm. long), body capable of becoming extremely flattened. Sole distinct; feet marginal and present as a scattered row of much smaller appendages in the midventral ambu-

lacrum. Dorsal side with smooth imbricating scales, gradually decreasing in size around the oral and anal openings; tube feet few, small, easily overlooked. Entire dorsal surface covered by numerous large grains and other deposits, easily rubbed off.

Spicules in sole an external layer of delicate smooth 4-holed flattened cups with marginal teeth. Beneath these a few larger plates may be found with several holes and smooth to undulating surface. Dorsal side closely packed with thimble-shaped grains with flattened basal plate (i.e., short, squat towers), besides numerous small baskets with delicate teeth and 4 apical knobs, sometimes united to a ring, thus approaching the hourglass shape. Tube feet with delicate end plate and circular or squarish curved supporting plates. (Tentacles not examined.)

Type.—Holotype, AHF no. 40.

Type locality.—Station 845-38, Sechura Bay, Peru, Lat. 5° 39′ 30″ S.; Long. 81° 01′ W., 9.5 fms., February 15, 1938.

Distribution.—From Peru to Colombia.

Depth.—From 9-60 fms.

Specimens examined.—The following specimens from the Hancock Expeditions:

845-38. Sechura Bay, Peru, coarse sand, worm tubes, red algae, 9.5 fms., February 15, 1938, 3 specimens.

854-38. Gorgona Island, Colombia, north of island, mud, rocks, 40-60 fms., February 24, 1938, 1 specimen.

Remarks.—The species has been referred to *Psolidium* because the cups in the dorsal integument are mostly simple and the feet on the sole are few. The dorsal spicules are easily rubbed off, but the spicules in the sole are so characteristic that it seems impossible to confuse it with any other species.

Genus 3. **PSOLUS** Oken, 1815

Diagnosis.—Typical psolids with distinct sole with marginal tube feet, often also a band of feet along the midventral ambulacrum. Dorsal side covered by scales, few to many; oral and anal apertures with or without an operculum of triangular scales; sometimes narrow radial teeth present inside of and between these valves. No appendages on dorsum except the anal papillae and in some forms a few tube feet on the introvert. Tentacles 10 in number, the 2 ventral may be smaller; in some deepwater forms the tentacles are unbranched, finger shaped. Inner

anatomy typical of the family; third loop of the intestine seems always to be attached in the right ventral interambulacrum.

Spicules in sole plates or buttons, smooth or knobbed, in some forms reduced with age, in others transformed into reticulated masses. Feet usually with end plate and supporting rods. Dorsal side has besides the scales often grains, rarely a few cups are present. Introvert and tentacles with or without rods or plates; sometimes spicules reduced, in older individuals.

Type species.—*Psolus phantapus* (Strussenfeldt).

Remarks.—The genus comprises about 30 different species and represents apparently the most successful and widespread of the genera included in the family. A number of the species are exceptionally large (sole more than 10 cm. long). The members of the genus occur in tropical as well as in Arctic seas.

The Hancock Expeditions have secured only one species, but 2 others are discussed below to emphasize the differences between the species. One represents a common form ranging from the Strait of Magellan to the southern part of Bering Sea; the other, although hitherto known only from the vicinity of Cape Horn, may possibly be expected in the southernmost part of the Panamic region although it is not likely.

Key to the Species of *Psolus* Known from the Panamic Region and West Coast of South America

1. Dorsal scales large but few (2-3 between oral and anal valves). Oral and anal valves large. Small form. Spicules in sole knobbed plates. . . . . 3. *Psolus diomedeae* Ludwig
1. Dorsal scales more numerous. 2
2. Spicules in sole slightly hollow buttons and plates with small holes and large marginal knobs. Distinct oral valves. . . . . 2. *Psolus patagonicus* Ekman
2. Spicules in sole flat, mostly 4-holed buttons reduced with age. Dorsal side with few large round grains; oral valves indistinct. . . 1. *Psolus squamatus* (Koren), var. *segregatus* Perrier

1. Psolus squamatus (Koren), var. segregatus Perrier

Plate 30, Fig. 7

Psolus squamatus (Koren), var. *segregatus* Perrier, 1905, p. 59.—Ekman, 1925, p. 136, text figure 33.

Psolus squamatus H. L. Clark, 1901, p. 165; 1901, p. 491.—Ohshima, 1915, p. 280.

Psolus pauper, Ludwig, 1894, p. 139.

Diagnosis.—Large form (sole up to 13 cm. long); scales thin, smoothly overlapping, about 12 between oral and anal scales. Oral and anal apertures surrounded by a number of triangular scales but not developed as regular valves, except in very young individuals. Sole thin, with marginal feet. Spicules in sole 4-holed delicate buttons (0.07-0.09 mm.) with shorter or longer marginal projections, sometimes with a few low warts; often the spicules disappear with age. Feet with end plate and few perforated rods. Dorsal scales covered by a varying number of loose grains.

Type.—Paris.

Type locality.—Patagonia.

Distribution.—From Cape Horn to the southern part of Bering Sea.

Depth.—In the Patagonian waters ranging from 7-207 fms.; in the northern waters taken between 155-603 fms.

Specimens examined.—About 50 in the U.S.N.M. and Hopkins Marine Station from various *Albatross* stations.

Remarks.—The specimens examined agree with Perrier's form *segregatus* from Cape Horn except in minor points (equal development of the gonads and slightly different position of the paired retractors, probably because of a different degree of contraction). The material has been compared with the typical form from Norway and shows the same differences as those which Ekman has tabulated.

Ludwig's *P. pauper* from the west coast of Mexico represents a small specimen of var. *segregatus* in which the spicules in the sole are unusually scarce. Ludwig's *"antarcticus"* from off Peru, which has always been regarded with suspicion, is most likely a small specimen of *segregatus* (or a specimen of *Psolus patagonicus* Ekman or of *Psolidium ekmani*). The young individuals of *P. squamatus,* var. *segregatus* may superficially resemble either of these two forms.

2. **Psolus patagonicus** Ekman

Plate 30, Fig. 8

Psolus patagonicus Ekman, 1925, p. 140, text figures 35-36.

Diagnosis.—Small form (sole up to 2 cm. long) with distinct oral and anal valves and radial teeth inside the valves. Few scales between oral and anal valves; often smaller scales intercalated between the pri-

mary scales. External side of scales with pearllike projections, rare or totally lacking in young individuals which may have a few loose grains. Sole distinct with 1-2 marginal rows of feet. Spicules in sole slightly concave 4-holed buttons (0.12 mm.) with relatively small holes and a varying number of knobs on the surface, sometimes the knobs are united by crossbars. Feet with end plate and perforated plates (0.18 mm.). Tentacles with broad perforated plates.

Type.—Hamburg.

Type locality.—Patagonian Bank, Lat. 46° S.

Distribution.—The type locality and various localities in the Strait of Magellan.

Specimens examined.—Various individuals from *Albatross* Station 2777, and 2 received from the Museum in Buenos Aires.

Remarks.—The species is mentioned because it resembles *Psolidium ekmani.* It was not secured by the Allan Hancock Expeditions and it seems not likely that it will be found in the Panamic region.

3. **Psolus diomedeae** Ludwig

Plate 11, Figs. 9-10

Psolus diomedeae Ludwig, 1894, p. 136, pl. 14, figures 1-3.—Fisher, 1907, p. 717 *(passim).*

Diagnosis.—Small form (sole less than 2 cm.) with enormous oral and anal valves; radial teeth present inside to the valves. Dorsal scales few and large, 2-3 between oral and anal valves; scales covered by few but large grains; sole with marginal feet. Spicules in sole strongly knobbed plates with 4 central holes and smaller marginal ones. (Feet and tentacles not examined.)

Type.—U.S.N.M.

Type locality.—Off Cocos Island, Costa Rica.

Distribution.—From Gulf of California to Ecuador including Galapagos.

Depth.—From 7-80 fms.

Specimens examined.—The type in Washington and the following specimens from the *Velero* stations:

143-34. Wenman Island, Galapagos, 100-150 fms., January 11, 1934, 1 specimen.

213-34. La Plata Island, Ecuador, 7-10 fms., February 10, 1934, 38 specimens.

429-35. Octavia Bay, Colombia, north end of channel, coarse sand and gravel, 35-40 fms., January 27, 1935, 1 specimen, young.

431-35. North of Octavia Bay, Colombia, south end of channel, 45 fms., January 27, 1935, 1 specimen.

529-36. Off San Francisquito Bay, Gulf of Calif., shale and gray mud, 165 fms., March 1, 1936, 1 specimen.

780-38. Chatham Bay, Cocos Island, Costa Rica, 40-47 fms., January 14, 1938, 3 specimens.

792-38. Off Daphne Minor Island, Galapagos, 70-80 fms., January 20, 1938, 1 specimen.

854-38. North of Gorgona Island, Colombia, 40-60 fms., February 24, 1938, 1 specimen, young.

Remarks.—The species is very striking and cannot be mistaken for any other Pacific form, except the closely related *P. macrolepis* Fisher from Hawaii, 154 fms. depth. The latter has almost smooth plates in the sole and small basal scales intercalated between the oral valves. The depth, 7-10 fms., for the specimens from La Plata Island, is unusually low for this species and may indicate that peculiar hydrographic conditions prevail in that locality.

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EXPLANATIONS OF PLATES

Magnification: Scale divisions indicate $\frac{1}{100}$ mm.

PLATE 10

Cucumaria crax, new species ..... p. 83

1. Supporting rod from tube foot.
2-5. Crackerlike button from integument.

Cucumaria californica Semper ..... p. 79

6-7. Knobbed plate from integument.
8. Supporting rod from tube foot.

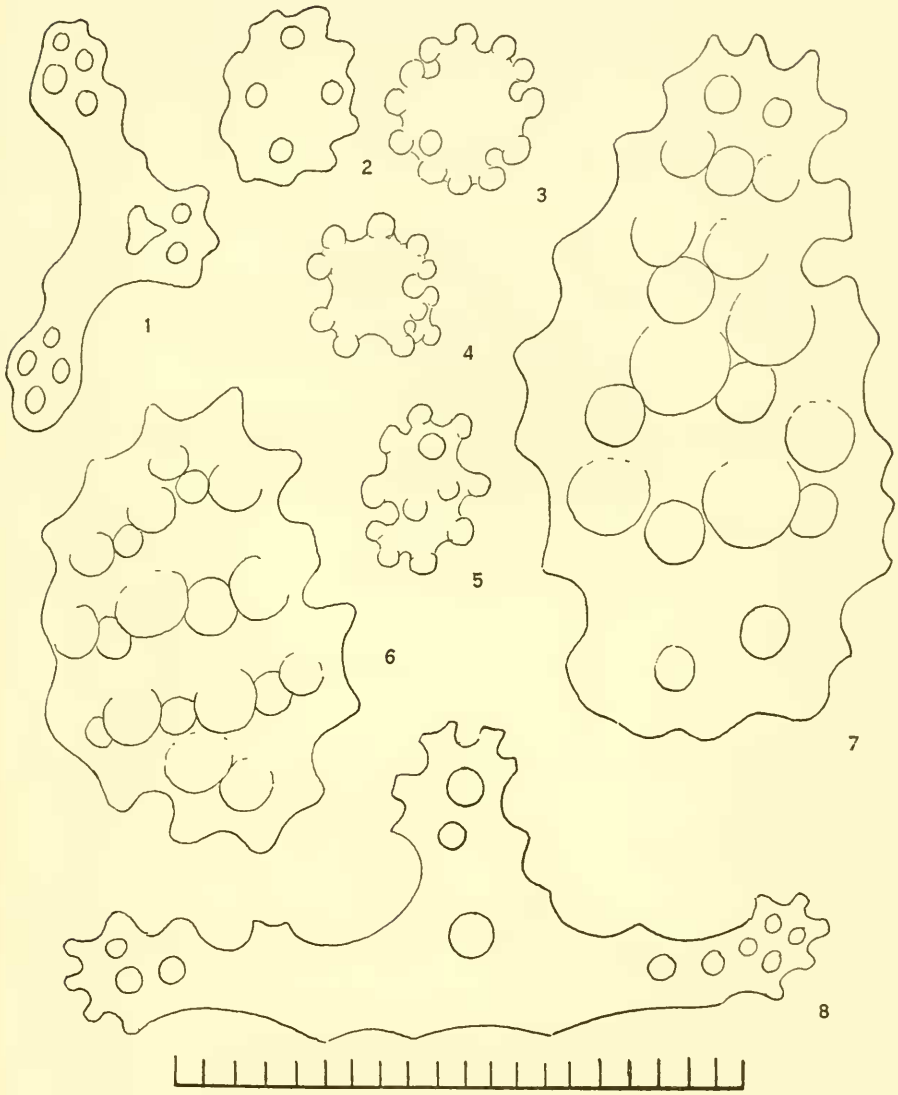
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PLATE 11

Cucumaria dubiosa Semper..... .....p. 81

1. Knobbed plate with handle from integument.
2. Supporting rod from tube foot.

Cucumaria chilensis Ludwig.....p. 80

3. Knobbed plate (medium sized) from integument.
4. Button from integument.
5. Supporting rod from tube foot.

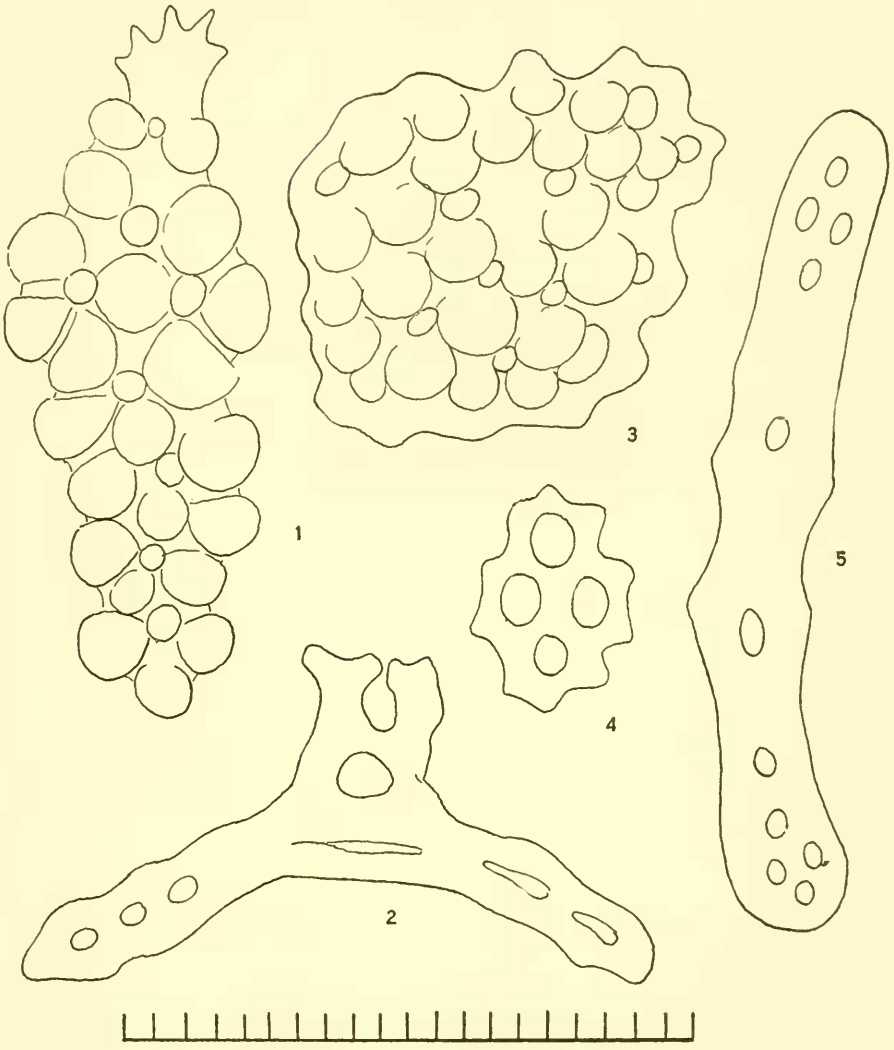
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PLATE 12

Pentamera beebei Deichmann ..... p. 86

1-6. Supporting tables from feet.
7-9. Tables from integument.

Pentamera zacae Deichmann ..... p. 85

10-11. Supporting tables from tube foot.
12-17. Acorn-shaped bodies from integument.

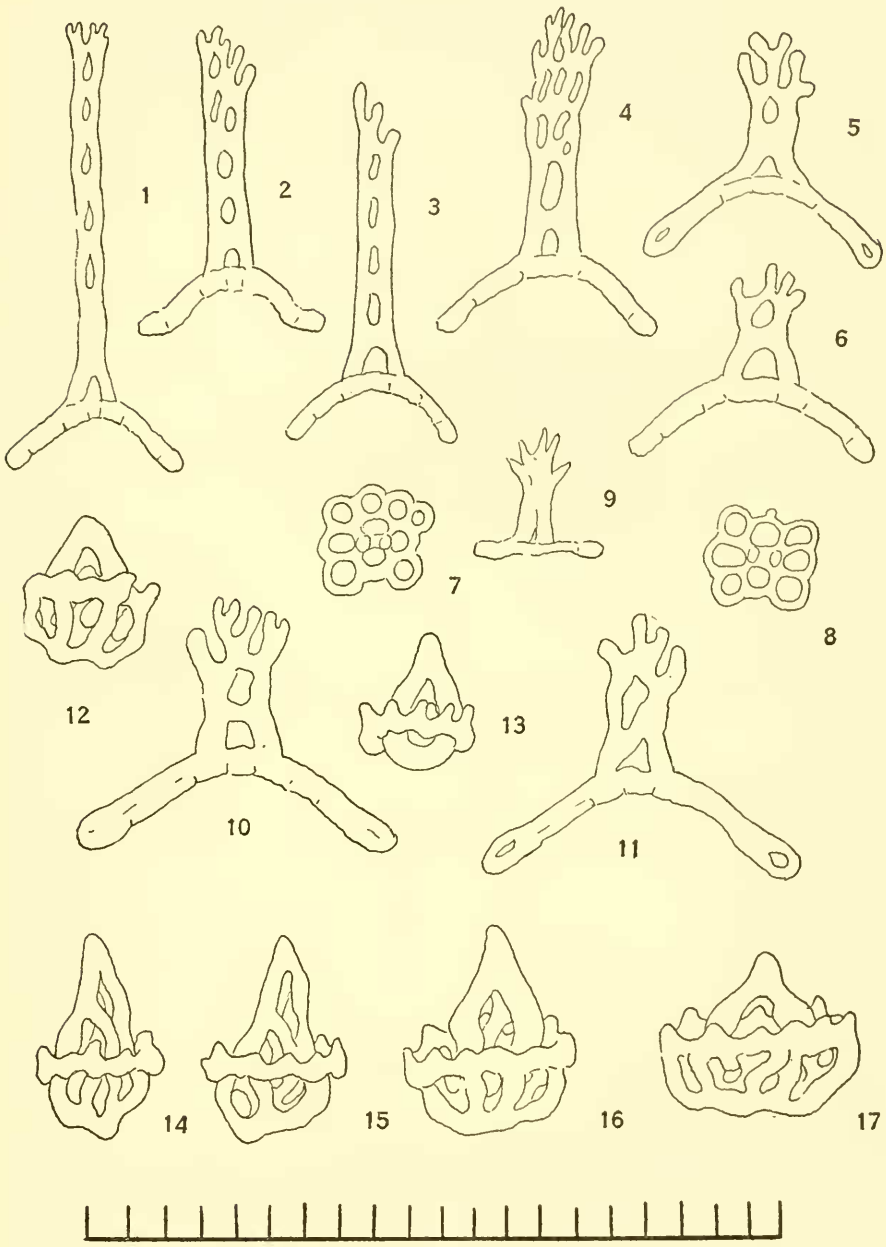
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PLATE 13

Apentamera lepra, new species ..... p. 92

1-2. Supporting tables from tube foot.
3-4. Rosettes (or flat baskets) from outer layer of spicules.
5-6. Knobbed plates from inner layer of spicules.
7-8. Tables from introvert.
9-10. Rod and plate from tentacles.

Neopentamera anexigua, new species ..... p. 90

11. Supporting rods from tube foot.
12-14. Knobbed buttons from integument.

Pentamera chiloensis (Ludwig) ..... p. 88

15-17. Tables from integument, lateral view and from above (spire omitted in the latter cases).
18. Supporting table from tube foot.

Pentamera chierchia (Ludwig) ..... p. 86

19-20. Tables from integument.
21. Supporting rod from tube foot.

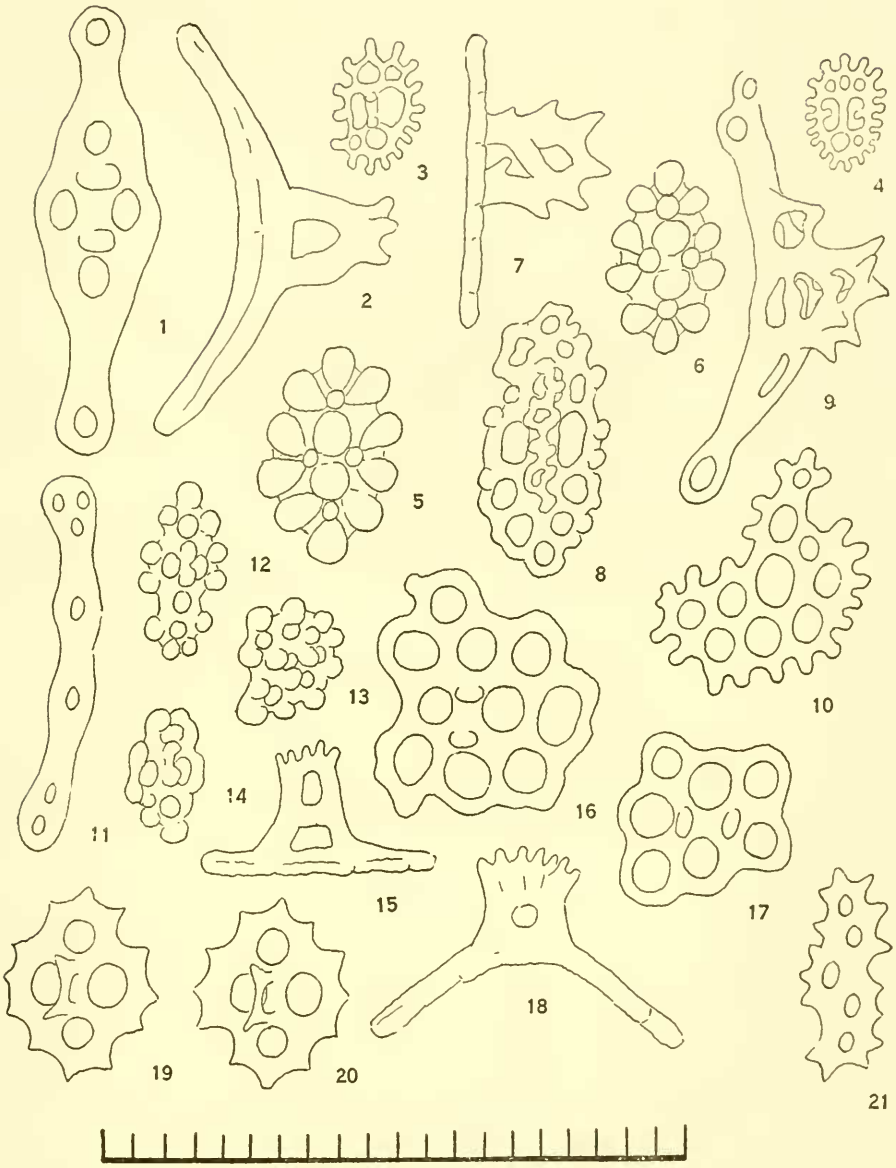
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PLATE 14

Leptopentacta grisea H. L. Clark.....p. 93

1-2. Baskets from external layer of integument.
3-4. Buttons from external layer of integument.
5. Supporting plate from tube foot.

Leptopentacta panamica, new species.....p. 96

6-7. Baskets from external layer of integument.
8-10. Knobbed buttons from external layer of integument.
11. Supporting table from tube foot.
12. Small-holed plate with spinelike projection, from external layer of integument or wall of tube foot.

Leptopentacta nova, new species.....p. 95

13-15. Irregularly knobbed button from external layer of integument.
16. Large swollen button from external layer of integument.
17-19. Biscuit-shaped plates from external layer of integument.
20-22. Biscuit-shaped plates with marginal tooth from external layer of integument.

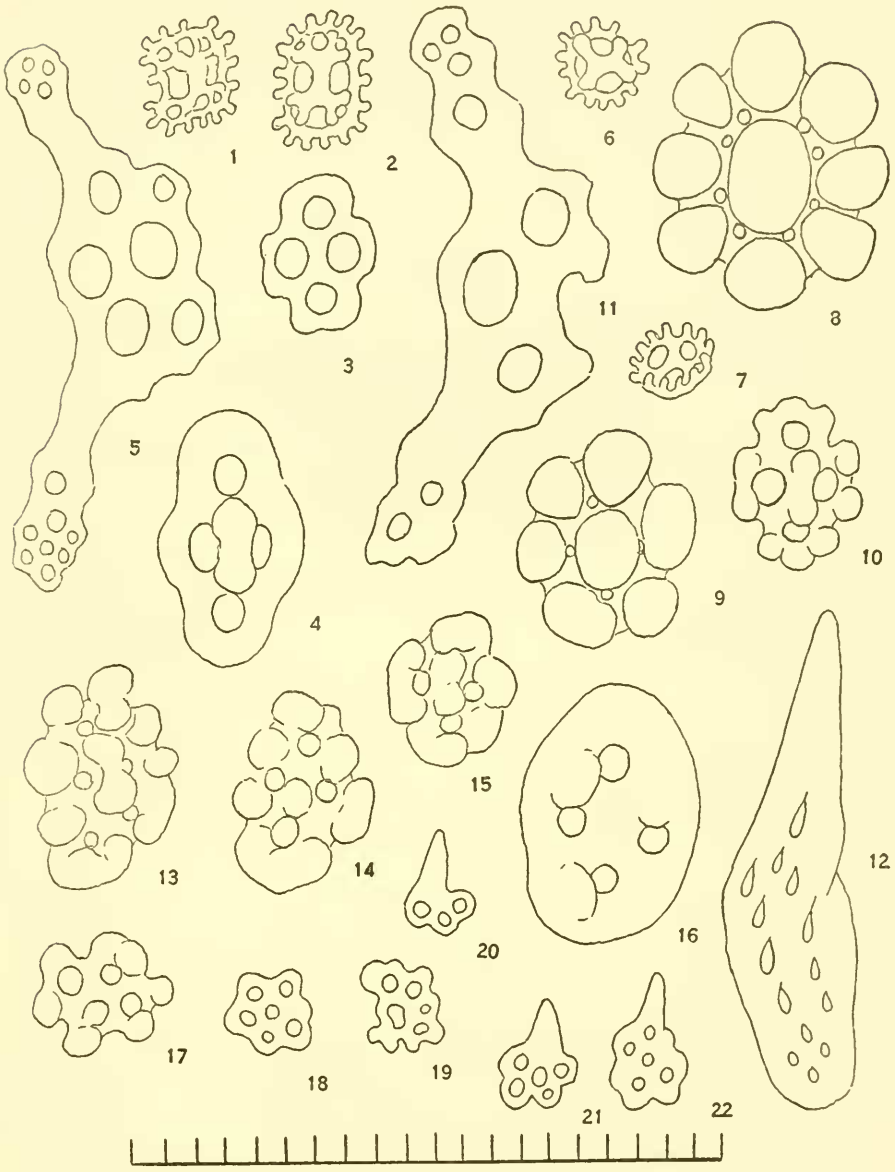
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PLATE 15

Leptopentacta nina, new species.....p. 97

1-2. Hollow plates or buttons from external layer of integument.

3. Larger plate from external layer of integument.

4-9. Irregular knobbed buttons from inner layer of integument.

10-12. Supporting plates from tube foot.

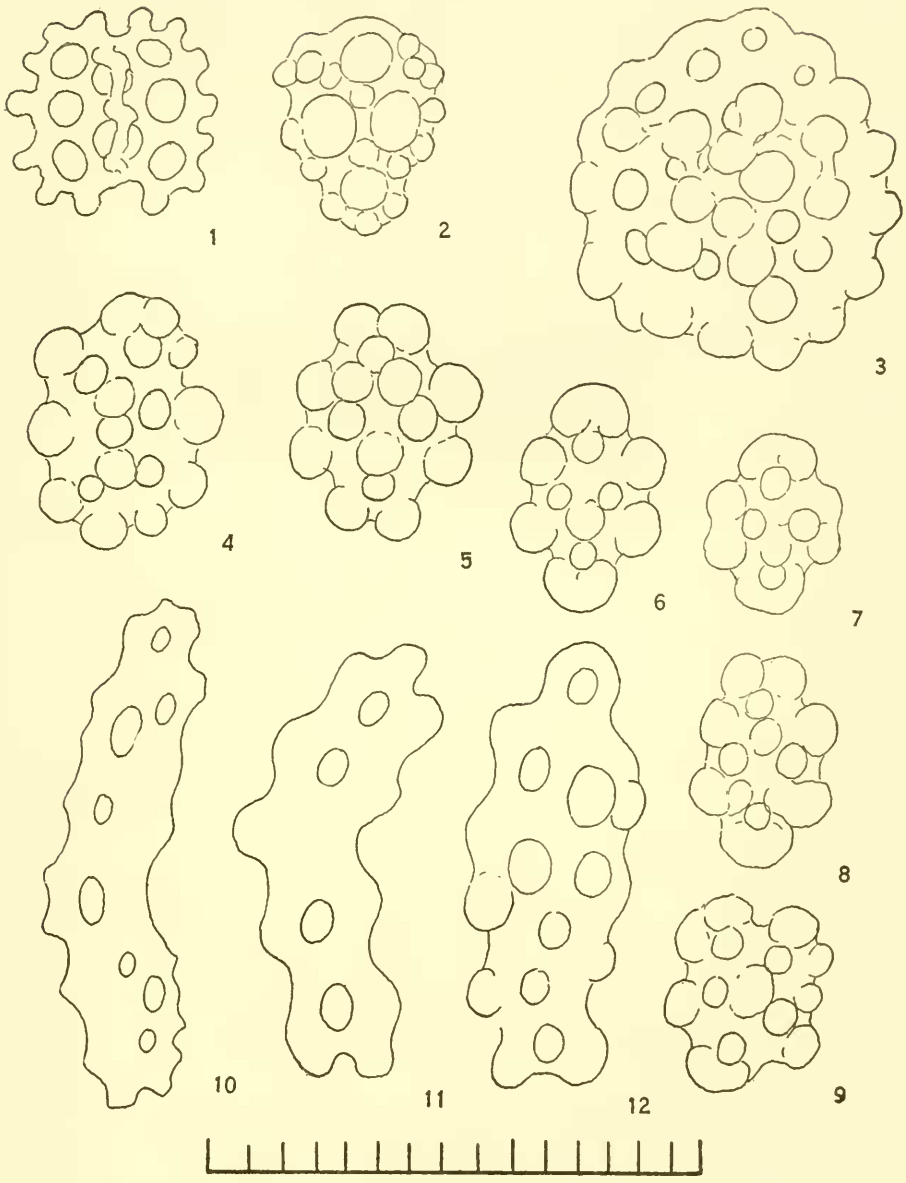
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PLATE 16

Pentacta peruana (Semper) ..... p. 97

1-3. Baskets from external layer of integument.
4-6. Knobbed buttons from inner layer of integument.
7. Supporting plate from tube foot.
8. Knobbed plate from inner layer of integument near base of tube foot.

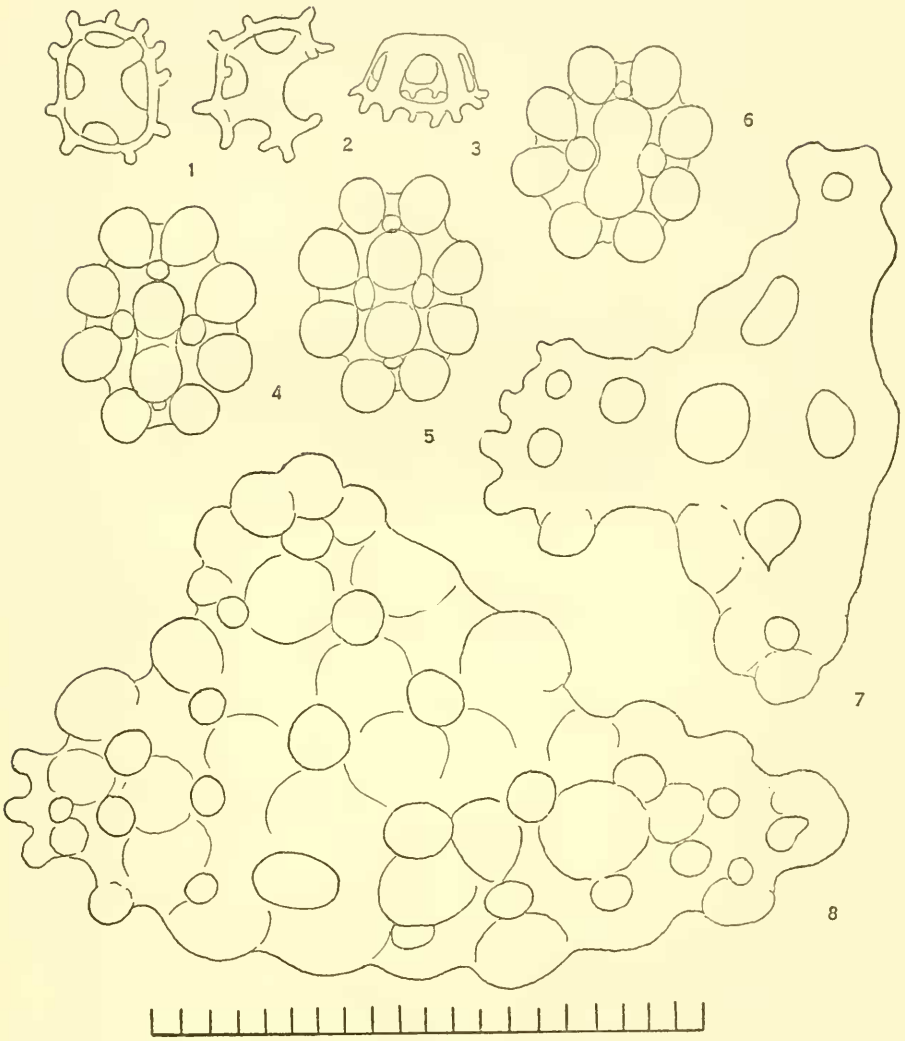
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PLATE 17

Thyonacta mexicana, new species.....p. 101

1-5. Baskets from external layer of integument.

6-9. Smaller knobbed buttons from inner layer of integument.

10. Large knobbed button from inner layer of integument.

11-13. Supporting plates, knobbed and smooth, from tube feet.

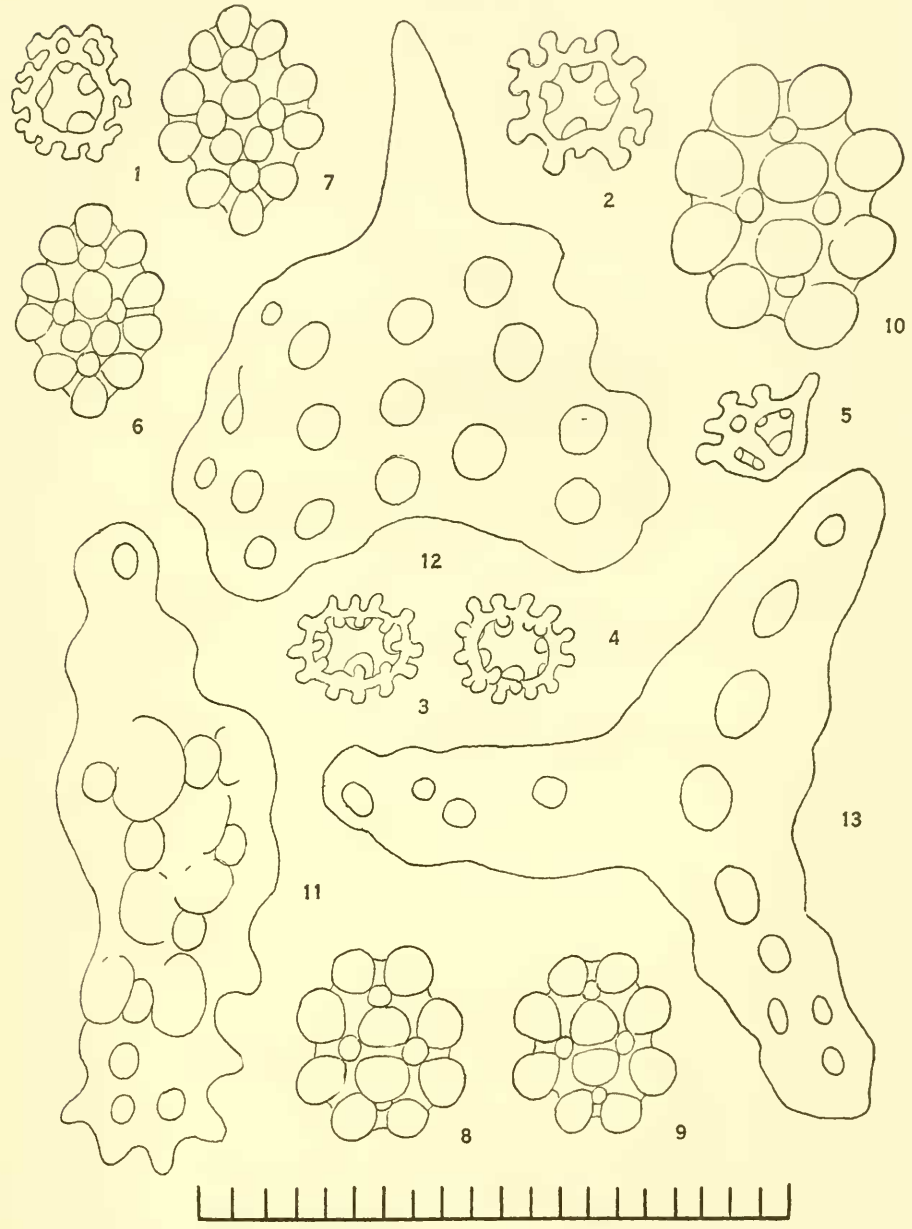
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PLATE 18

Thyone neofusus, new species.....p. 104

1. End plate from tube foot.
2-3. Tables from integument.
4-5. Supporting tables with no trace of spire.
6. Disk of table from introvert.

Thyone parafusus, new species.....p. 106

7-9. Oblong tables with tapering spire and "handle."
10-11. Supporting tables with 3 pillars in spire.
12. Disk of table from introvert.

Thyone bidentata, new species.....p. 105

13-14. Tables from integument.
15. Incipient table.

All from type.

16. Supporting table from a small individual less than 1 cm. long.

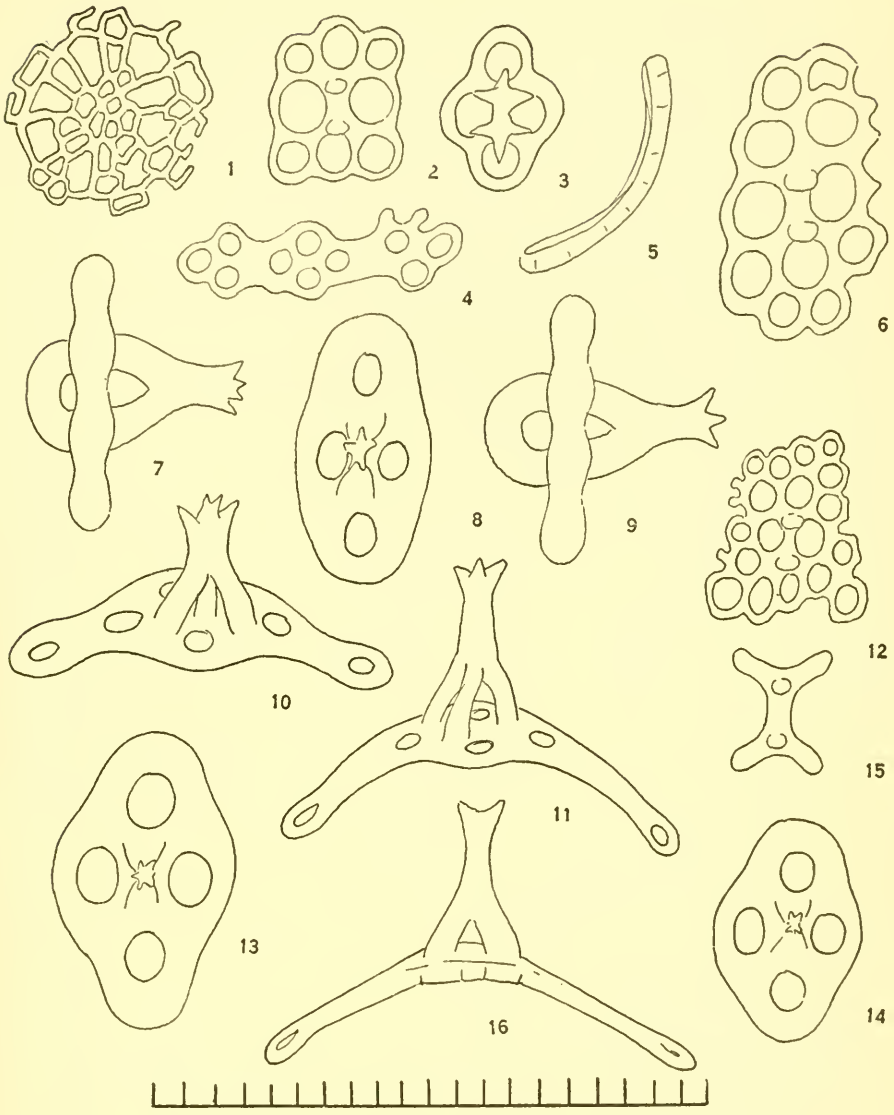
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PLATE 19

Thyone strangeri, new species.....p. 107

1-5. Tables from integument.
6-8. Tables from introvert.
9-10. Supporting tables with conical spire from tube foot.
11. Rosette from tentacle.

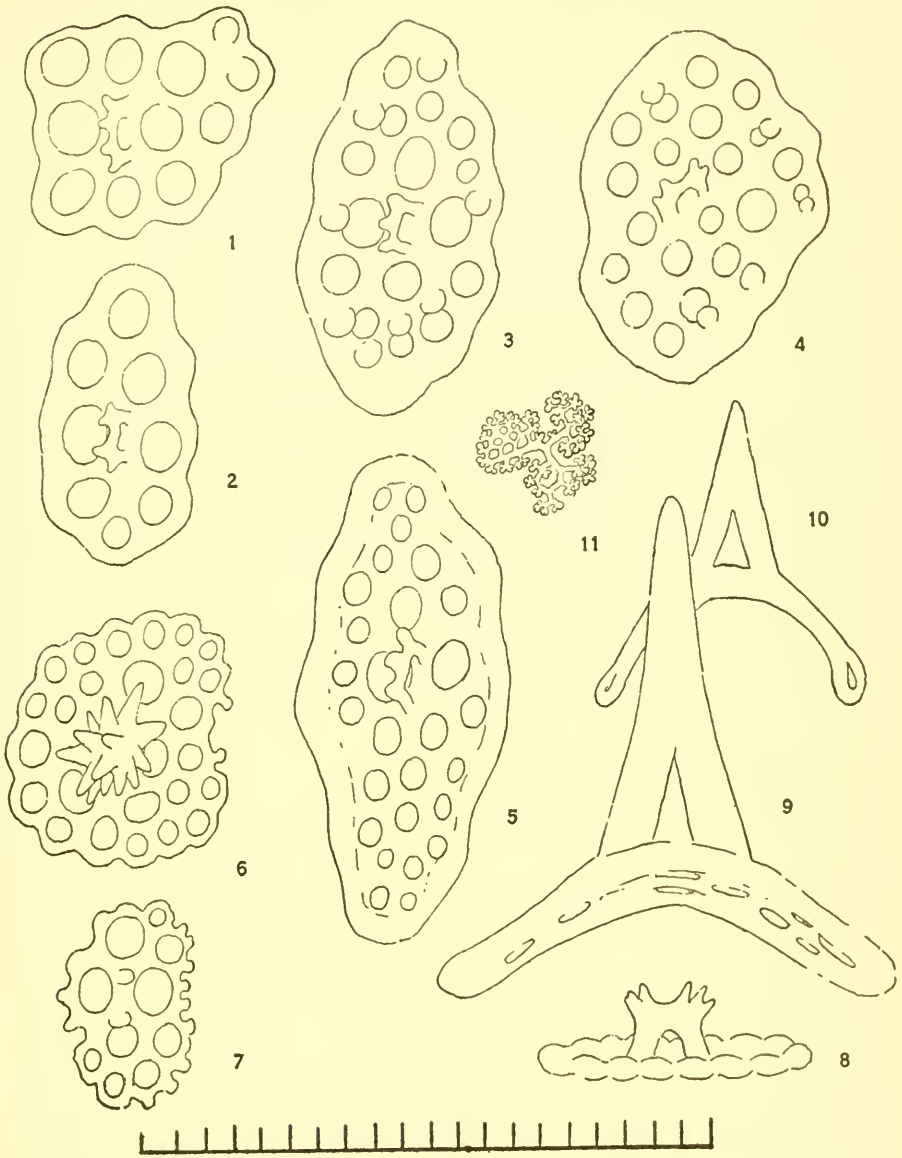
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PLATE 20

Neothyone gibber (Selenka) ..... p. 109

1-4. Knobbed to smooth buttons.

5-6. Knobbed button from external layer, lateral view showing the external cluster of spines and the inner "handle."

7. Supporting table from tube foot.

8. Table from introvert.

9. Supporting rod from tentacle.

All from Selenka's type in M.C.Z.

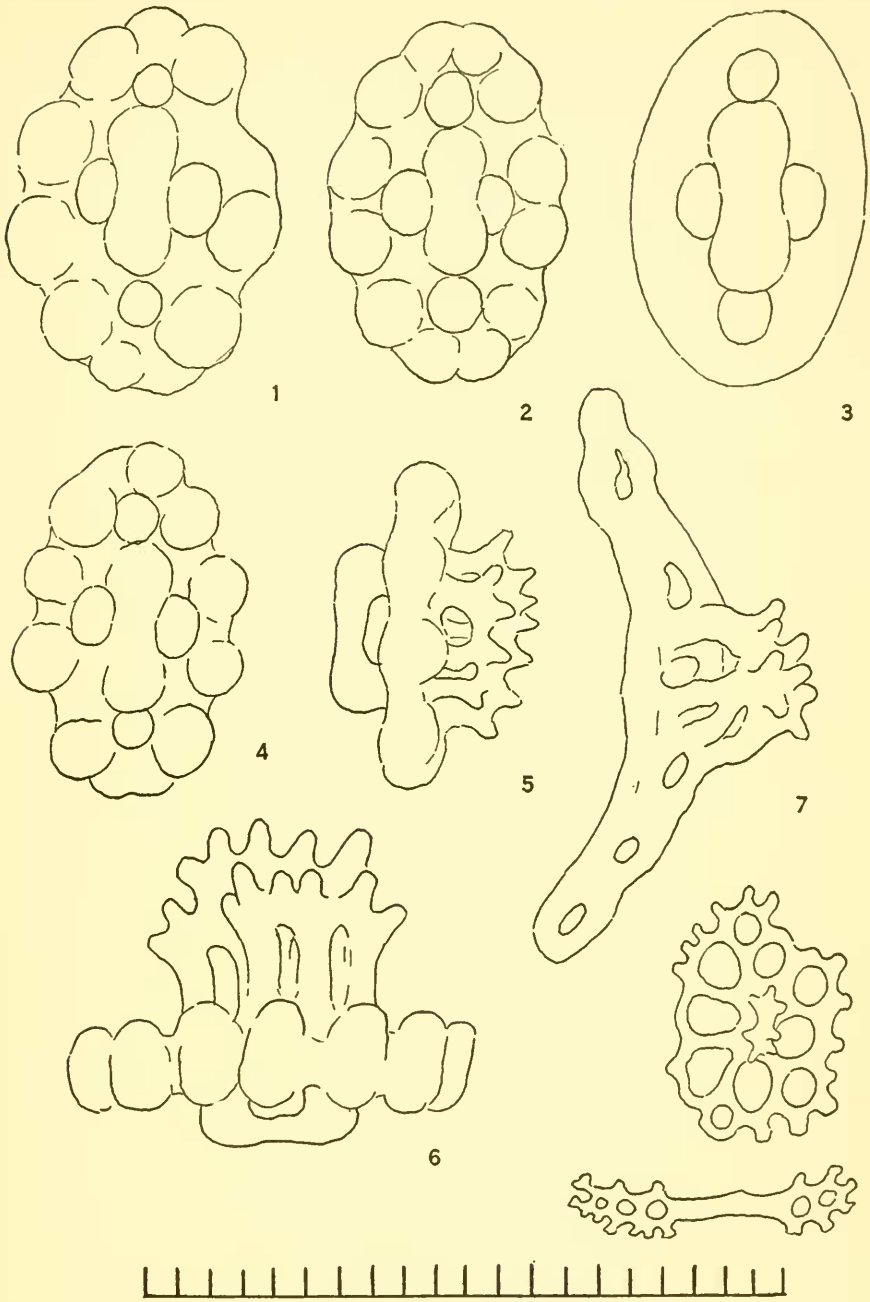
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PLATE 21

Neothyone panamensis (Ludwig) ..... p. 112

1-2. Supporting plates from ventral feet.
3-4. Knobbed plates from inner layer of integument.
5-6. Baskets derived from buttons from external layer of integument.

Neothyone gibbosa, new species ..... p. 113

7-8. Knobbed buttons (outer handle often with 3 knobs) from inner layer of integument.
9. Knobbed button from external layer of integument, with a few spines (rare).
10-11. Supporting tables from tube foot.

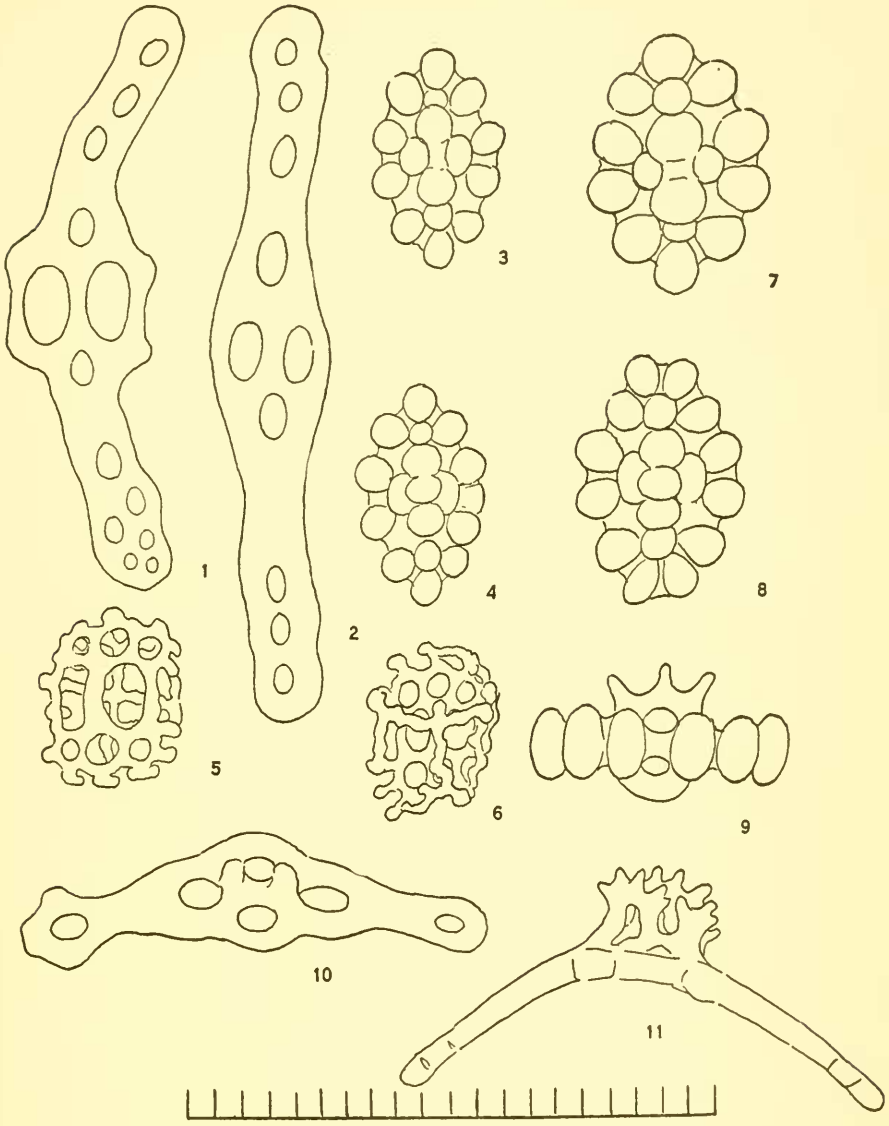
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PLATE 22

Neothyone gibbosa, new species.....p. 113

1-3. Large deformed supporting tables from dorsal feet of large individual from San Felipe, Gulf of California.

4. Basketlike buttons from outer layer of integument (rare).

5-6. Knobbed buttons from inner layer of integument.

7. Small smooth supporting plate from ventral tube foot.

8. Table from introvert (disk obviously somewhat reduced through reduction along the margin).

Pachythyone pseudolugubris, new species.....p. 116

9-10. Supporting tables from tube foot, dorsal and ventral, respectively, from large individuals from San Felipo, Gulf of California.

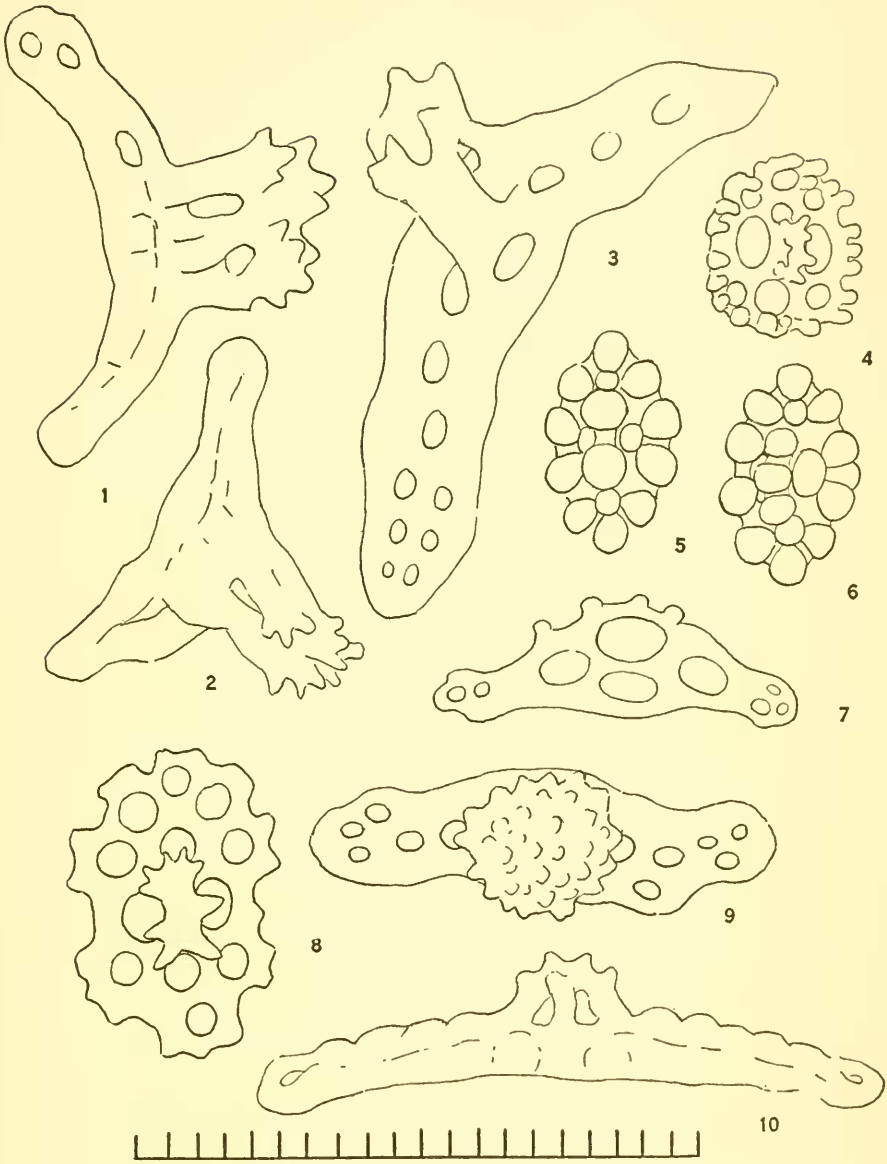
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PLATE 23

Pachythyone pseudolugubris, new species.....p. 116

1-2. Supporting tables from ventral tube feet of specimens few cm. long.
3-5. Knobbed buttons from inner layer of integument.
6. Knobbed plate from outer layer seen from the internal side (the reticulated external layer is not drawn).

Pachythyone lugubris (Deichmann).....p. 116

7-8. Elongate knobbed buttons from inner layer of integument.
9. Supporting table from ventral tube foot.

Pachythyone rubra (H. L. Clark).....p. 115

10. Supporting table from ventral tube foot.
11-12. Knobbed buttons from inner layer of integument.

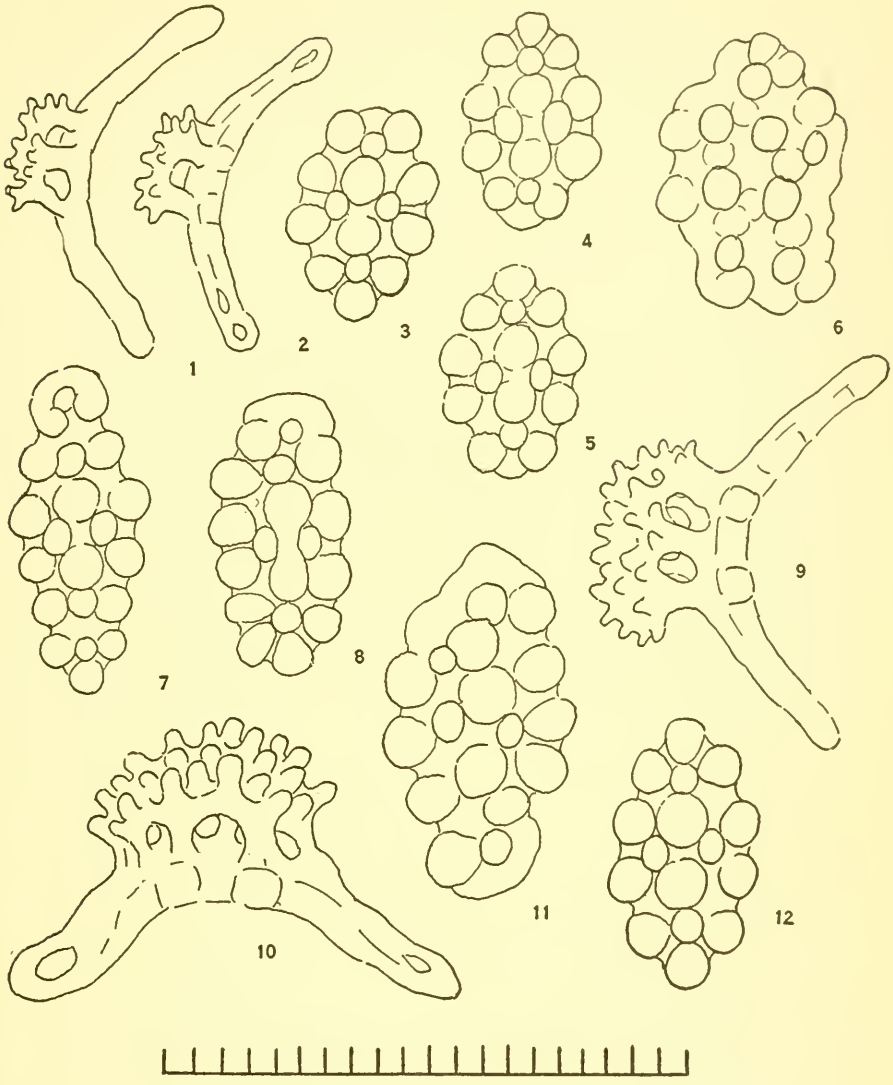
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PLATE 24

Euthyonidium ovulum (Selenka) ..... p. 124

1-6. Plates with or without trace of spire.
7. Supporting rod from tube foot.

Euthyonidium veleronis, new species ..... p. 126

8-10. Plates with few spires, indicating traces of a spire.
11. Plate from introvert.

Phyllophorus zacae Deichmann ..... p. 134

12-15. Disks of tables.
16-17. Tables, lateral view.
18. Disk of supporting table from tube foot.
19-20. Supporting tables, lateral view.
21. Rosette from tentacle.

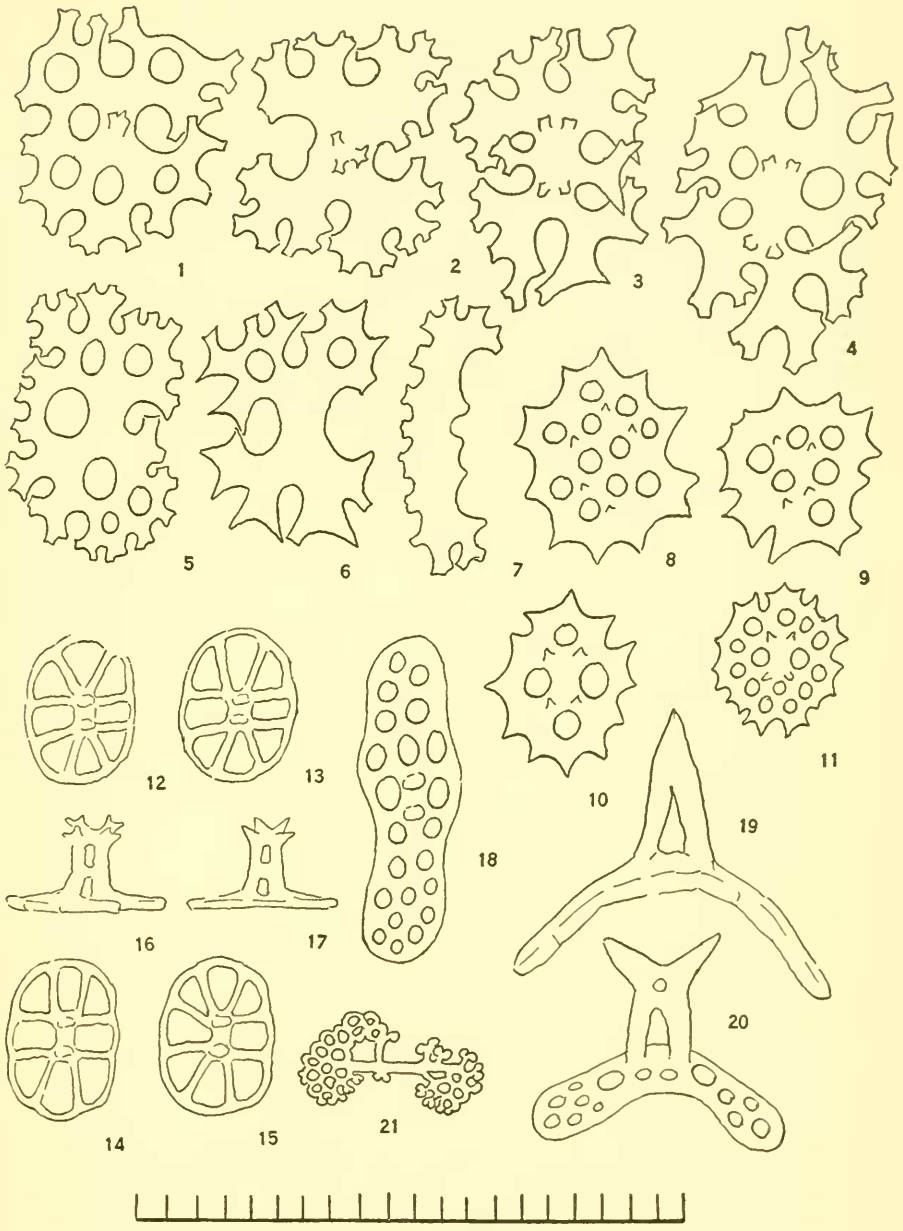
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PLATE 25

Phyllophorus aculeatus Ludwig.....p. 133

1-3. Tables seen from above.
4. Large supporting table from tube foot, lateral view.
5. Disk of supporting table, seen from above.
6. Disk of table from introvert.
7. Rosette from tentacle.
8. Delicate rods from tentacle.

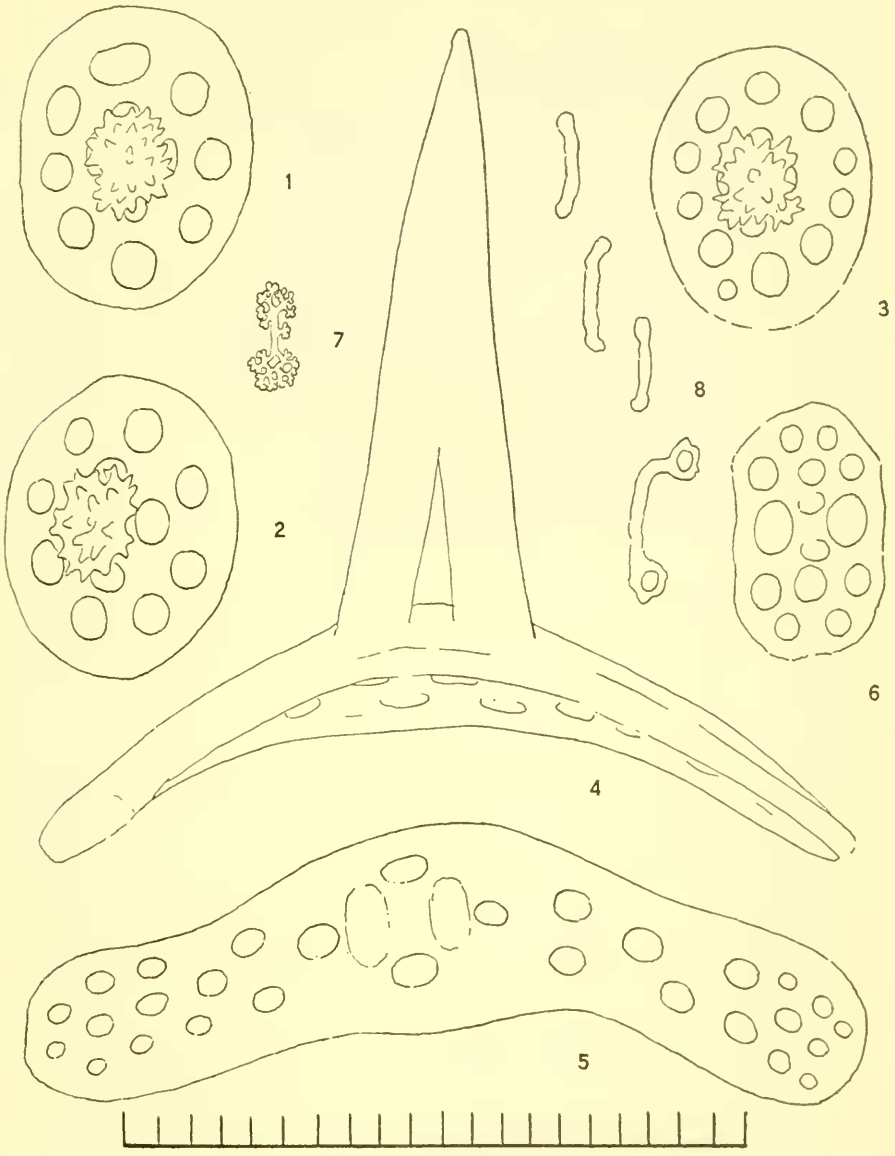
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PLATE 26

Thyonepsolus nutriens H. L. Clark.....p. 138

1. Curved supporting plate from dorsal tube foot.
2-3. Hourglass-shaped bodies from dorsal side.
4. End plate from dorsal tube foot.
5. Perforated plate from ventral sole.

Thyonepsolus veleronis, new species.....p. 140

6-8. Knobbed plates from ventral sole.

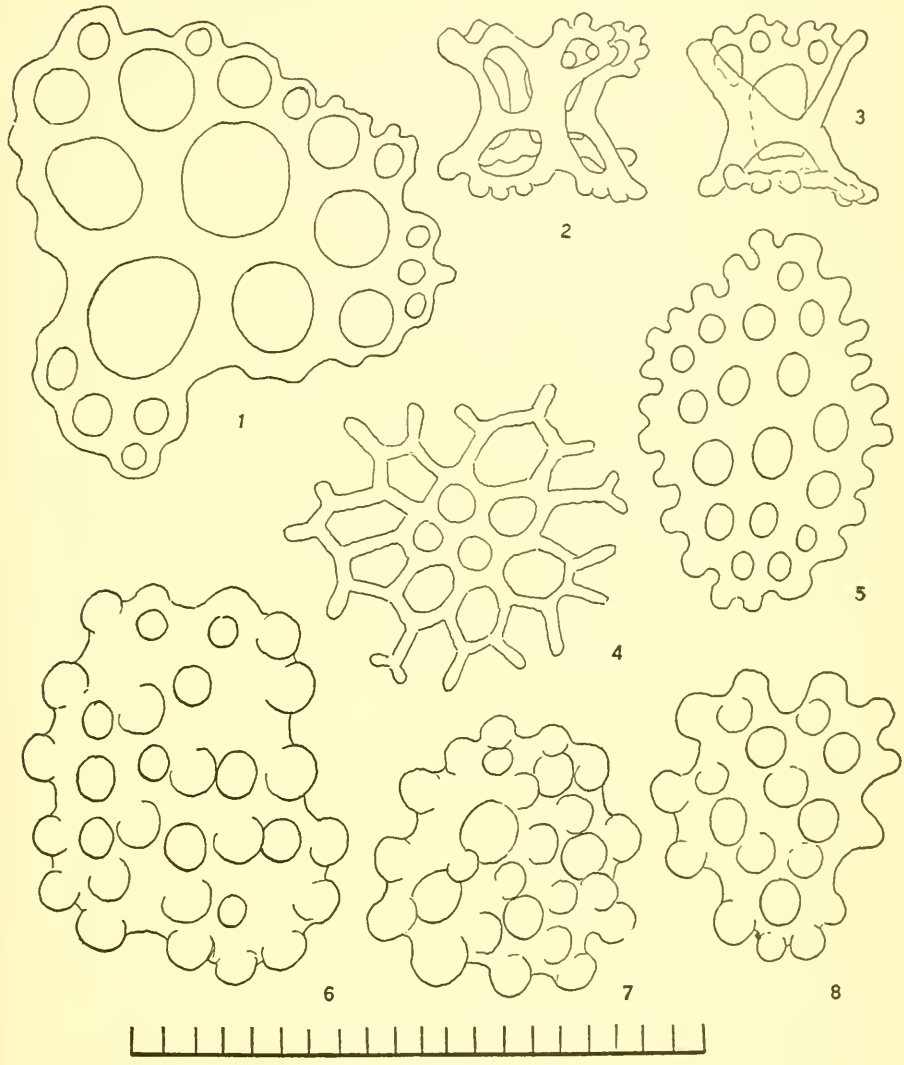
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PLATE 27

Thyonepsolus hancocki, new species.....p. 140

1-2. Knobbed buttons from ventral sole.
3. Curved supporting plate from dorsal tube foot.
4-5. Hourglass-shaped bodies from dorsal side.
6-7. Perforated plates from stem of tentacle.

Thyonepsolus veleronis, new species.....p. 140

8. Curved supporting plate from dorsal tube foot.
9. Hourglass-shaped body from dorsal side.

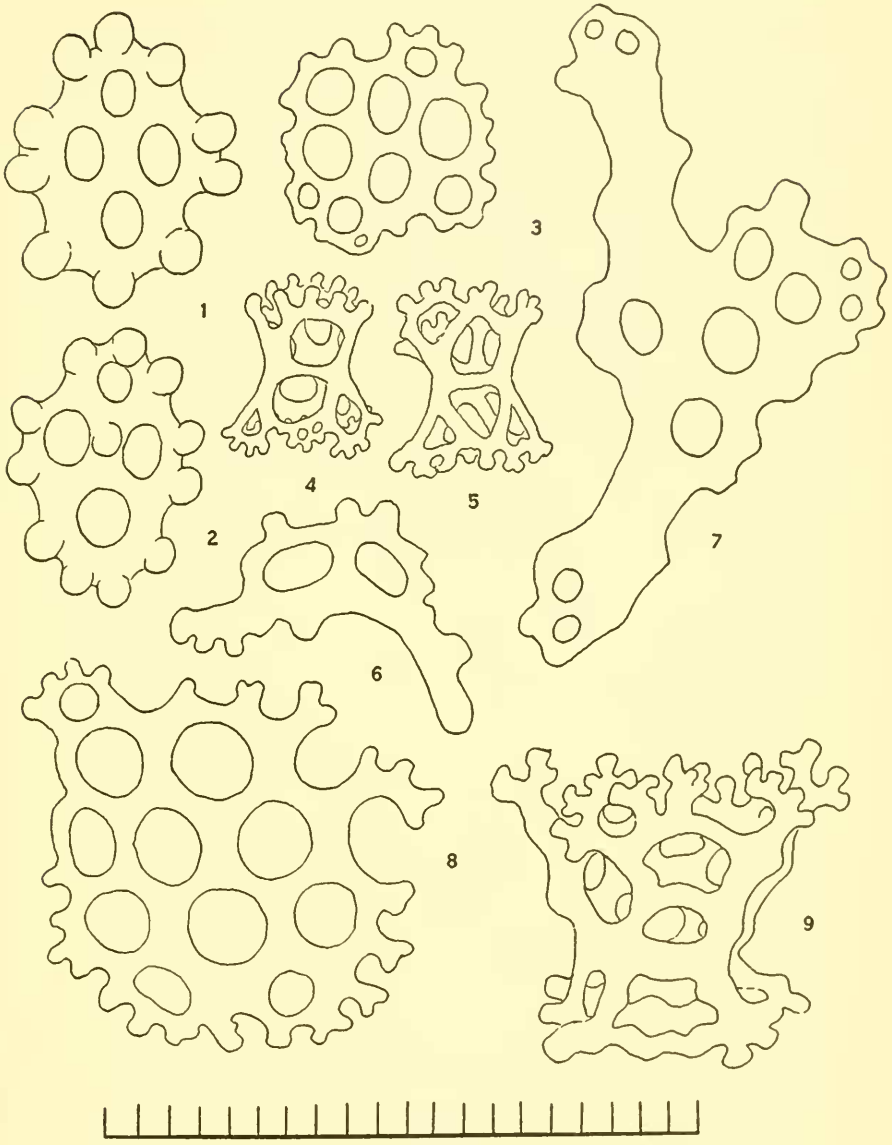
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PLATE 28

Thyonepsolus beebei Deichmann.....p. 139

1. Perforated plate from ventral sole.
2. Curved supporting plate from dorsal side.
3. Hourglass-shaped body from dorsal side.

Psolidium eubullatum, new species.....p. 144

4-7. Knobbed plates from ventral sole.

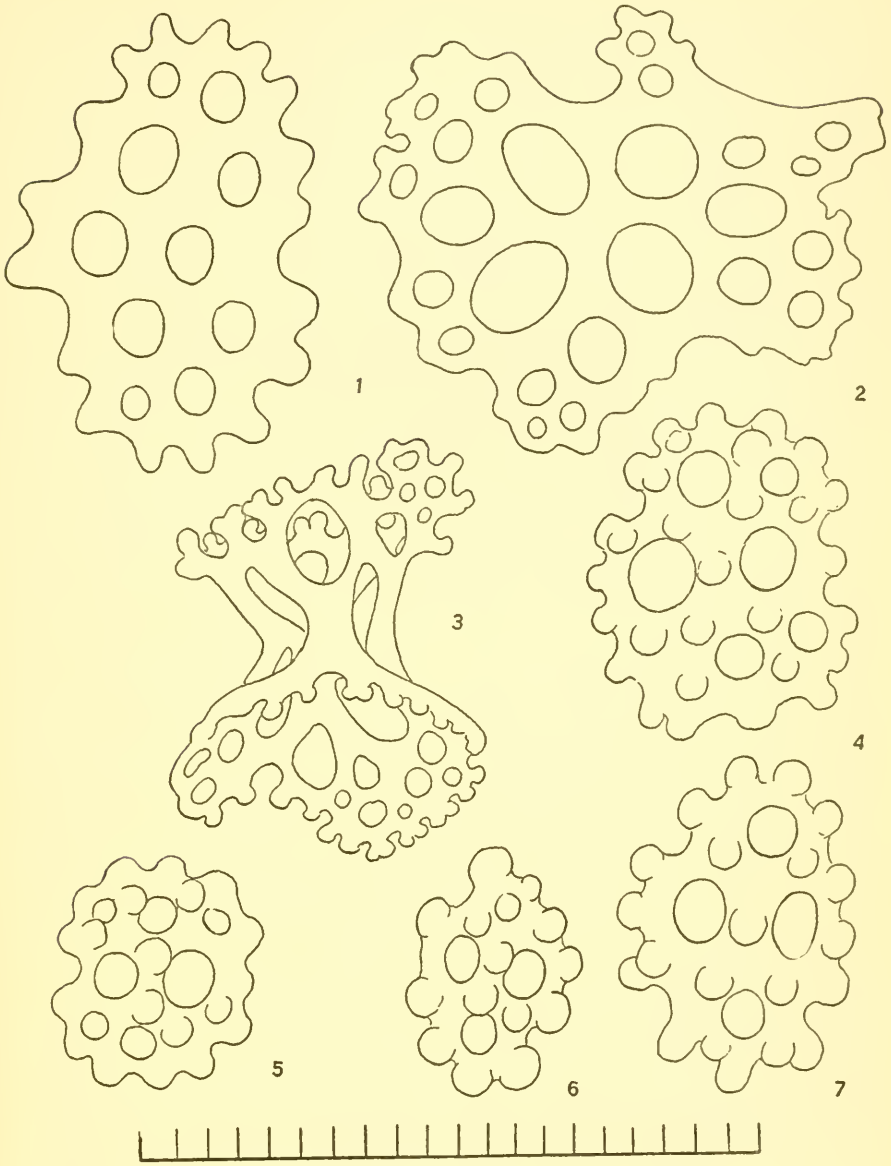
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PLATE 29

Psolidium dorsipes Ludwig.....p. 143

1-2. Knobbed and smooth plates from ventral sole.
3-4. Strongly knobbed plates from sole.
5. Supporting rod from ventral tube foot.
6. Towerlike body from dorsal side.
7. Curved supporting plate from dorsal tube foot.
8-10. Cups or baskets from external layer of sole and dorsal side.
11. Narrow, curved supporting rod from dorsal tube foot (rare).
12. End plate from dorsal tube foot.

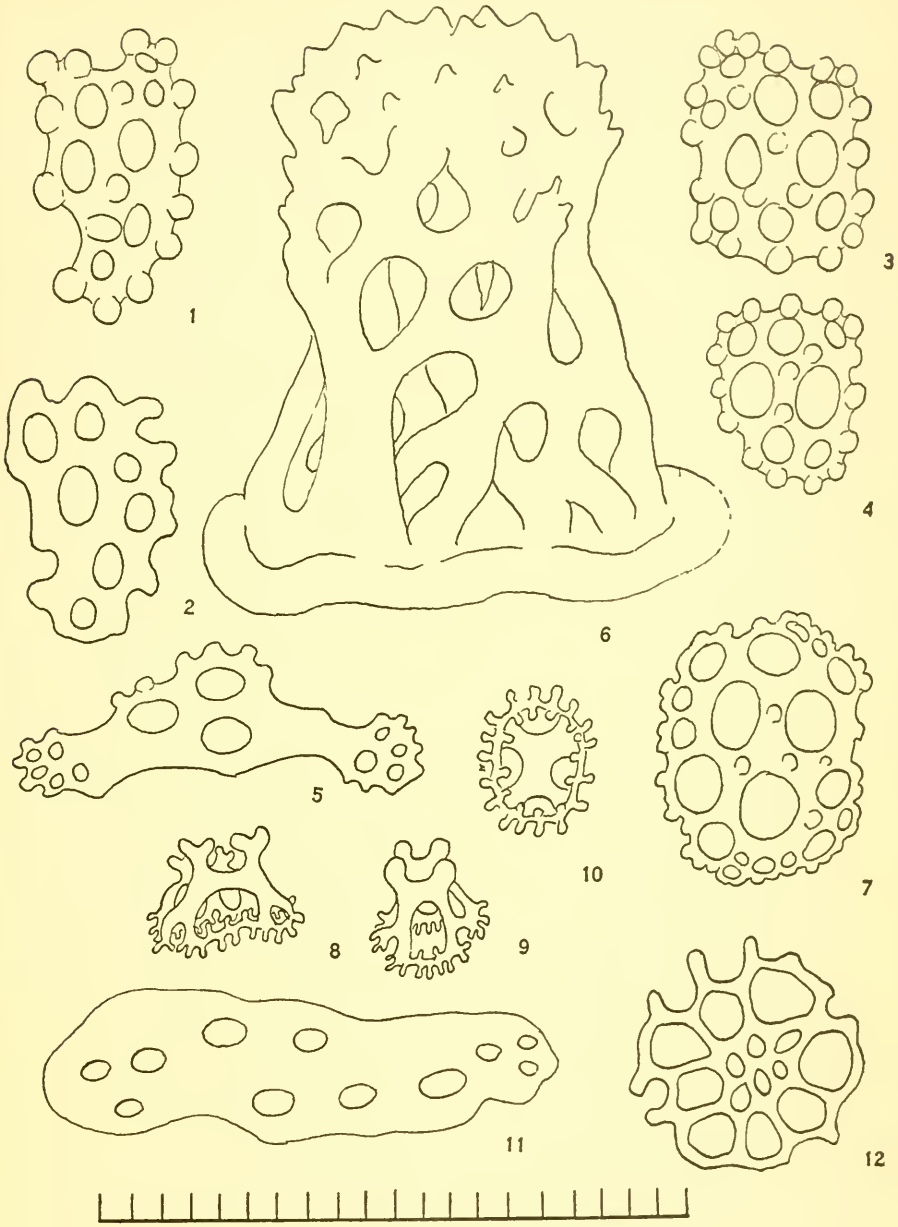
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PLATE 30

Psolidium planum, new species.....p. 145

1-3. Shallow buttons or baskets from external layer in sole.

4. Smooth plate in deeper layer of sole.

5. Curved plate from tube foot in dorsal.

Psolidium ekmani, new species.....p. 145

6. Knobbed button from sole.

Psolus squamatus (Koren), var. *segregatus* Perrier.....p. 147

7. Button from sole.

Psolus patagonicus Ekman.....p. 148

8. Slightly hollow button with marginal knobs from sole.

Psolus diomedeae Ludwig.....p. 149

9-10. Knobbed to almost smooth plates from sole.