THE HOLOTHURIANS OF THE HAWAIIAN ISLANDS.

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INTRODUCTION.

Holothurians or sea cucumbers are fairly plentiful in the tide pools among the lava rocks and on exposed reefs of the Hawaiian Islands and form a very characteristic portion of the more conspicuous shore fauna. They are almost sure to be found by the general naturalist who explores the reef between Honolulu and Waikiki or carries his investigations to remoter parts of the islands among the many pools and inlets that fringe the lava shores. Such forms as *Actinopyga mauritiana*, *Holothuria atra*, *H. fuscorubra*, *H. cinerascens*, *H. perricax*, *H. pardalis*, *H. impatiens*, and *Stichopus tropicalis* are common, especially the first two, which are large and take no pains to hide themselves. In Pearl Harbor, *Opheodesoma spectabilis*, which occurs in great numbers, is likely to attract the attention of anyone interested in natural history. Careful and systematic collecting on the reefs and in the tide pools should bring to light many characteristic tropical forms as yet unrecorded from the islands. Care should be taken to turn over large stones and to examine masses of seaweed. One form, at least, *Chiridota hawaiiensis*, lives buried in coral sand.

Holothurians are best preserved in fairly strong alcohol, rather than in formalin, because the latter is likely in time to partially dissolve the minute calcareous bodies which occur in the outer layer of the body wall and which are a necessity for the accurate identification of specimens. To kill the animals in an expanded condition, it is well to first narcotize them by gradually adding to the sea water in which they are contained a quantity of Epsom salts or about an equal volume of ether. The latter should be added gradually after the animals are expanded. When they are thoroughly numbed, they may be placed in about 60 per cent alcohol and after a few hours transferred to 90 per cent. Chloretone is a good narcotizing agent, but is expensive. Some species are so sensitive that acid reagents must be resorted to in

order to kill them in an expanded state. Glacial acetic acid serves very well. Acid, however, must be carefully avoided if it is intended to use the specimens for systematic purposes, because the absence of calcareous deposits in the skin usually renders exact determination impossible. If there is a possibility of acid being present in the alcohol, add to the bottle a small portion of bicarbonate of soda or some other harmless neutralizing agent.

It is necessary to use a compound microscope in the examination of holothurians, in order to determine the character of the calcareous deposits in the skin. In the case of most synaptids and related forms it is necessary merely to soak a piece of the body wall for a few moments in strong caustic potash solution and then mount it in glycerin, which further clears the tissues. Permanent mounts are conveniently made in glycerin jelly. Many holothurians, however, have so thick a body wall that only the outer pigmented layer should be taken. Often it is necessary to boil a piece of the skin in caustic potash, especially when there is considerable pigment and one wishes to free the deposits of encumbering tissue in order to draw or photograph them. Deposits are frequently so closely crowded in the perisome that unless they are freed of tissue and spread out on a slide it is impossible to gain an idea of their true character.

The holothurians collected by the United States fisheries steamer *Albatross* among the Hawaiian Islands during the summer of 1902 proved to be less numerous in species than the collection of starfishes.[a] Nor were there so many individuals. The entire collection numbers about 750 specimens and includes 37 species, of which 19 are new to science, 5 are for the first time recorded from the Hawaiian group and 2 are in too poor condition for naming beyond the genus. The United States fisheries steamer *Albatross* secured 11 forms already reported from the islands, but failed to find 9 species known to occur in the region. The Hawaiian fauna therefore includes 44 species of holothurians, of which only 20 were known previous to the visit of the fisheries steamer *Albatross*. To these may be added the two forms which are too imperfect to be identified specifically, making a total of 46 species.

The shore and reef fauna is unmistakably tropical. Excluding those littoral forms which appear to be confined to the Hawaiian Islands, namely, *Actinopyga obesa*, *Holothuria paradoxa*, *H. kapiolaniæ*, *H. humilis*, *H. hawaiiensis*, new species, *H. annulifera*, new species, *H. fusco-olivacea*, new species, *Opheodesoma spectabilis*,[b] new species, and *Chiridota hawaiiensis*,[c] new species, there remains a group of forms

[a] See U. S. Fish Commission Bulletin for 1903, Pt. 2, pp. 897 to 1130, June 30, 1906.

[b] Closely related to *Opheodesoma glabra* (Fiji Islands, Bohol, Guam, Saleyer, Bima).

[c] Near *Chiridota rigida*.

which are either cosmopolitan in tropical and semitropical waters or widely distributed over the warmer parts of the Pacific and Indian are oceans. The practically cosmopolitan forms are: *Actinopyga parvula*, *Holothuria impatiens*, and *Holothuria atra*, these being found in the Atlantic, Pacific, and Indian oceans. A general idea of the distribution of the remaining shore forms may be gained from the following table:

Distribution of shore forms of Holothurians.

Species.	Indian Ocean.	Indo-Chinese region (East Indies, Philippines, etc.).	Chinese-Japanese region.	South Sea (Polynesia, Micronesia, Melanesia).	Australia.	West coast of Middle and South America.
Actinopyga nobilis						
Actinopyga mauritiana						
Holothuria cinerascens						
Holothuria pervicax						
Holothuria monacaria						
Holothuria vagabunda						
Holothuria fuscorubra						
Holothuria arenicolaca						
Holothuria pardalis						
Holothuria inhabilis				[b]		
Holothuria verrucosa						
Labidodemas semperianum						
Stichopus chloronotos						
Stichopus tropicalis						
Synaptula keferstcinii						
Enapta godeffroyi						

[a] Also reported from north and east coasts of South America. [b] Society Islands.

It is hazardous to undertake to do more than indicate in a general way the relationships of the bathybial fauna, because some of the species are obscure and the identification of their nearest relatives is almost a matter of assumption. It is probably true that we have not, as yet, sufficient data upon which to map with any degree of accuracy the faunal relationships of deep-sea holothurians. The bottom of the ocean has been no more than scratched in a few places. Such forms as *Bathyplotes patagiatus*, *Pelopatides retifer*, *Scotodeima vitreum*, and *Lætmogone biserialis* appear to find their nearest relatives in the deep waters of the East Indies. *Orphnurgus insignis* has a related species in the Bay of Bengal (*O. glaber* Walsh), and another (*O. aspera* Théel) in the West Indies (Sombrero, British West Indies). *Mesothuria carnosa* shows great similarity in most of its characters to *M. intestinalis* of northern Europe, and *M. verrilli* of the Azores and warmer waters of Europe. *Punnychia pallida* is closely related to *P. moseleyi* of Australia and *Protankyra albatrossi* to *P. challengeri* of the Fiji Islands. *Pseudostichopus propinquus* seems nearest *Pseudostichopus mollis*, from Marion Island, southern Indian Ocean, and from the west coast of South America, near the southern end. *Anapta inermis* is distantly related to *A. subtilis*, bay of Batavia, and *Chiridota*

uniserialis to *C. purpurea* and *C. pisanii* from the Falkland Islands and Chonos Archipelago, respectively. Dredging was not carried into water deep enough to secure many of the characteristic abyssal types which undoubtedly must occur in the region. Only two of the deep-water forms are referable to previously known species. These are *Mesothuria murrayi* and *M. parva*, the former having been taken in the East Indies, near the Azores, off the Straits of Gibraltar, and near Juan Fernandez, and the latter from near Admiralty Island.

SYNOPSIS OF HAWAIIAN HOLOTHURIANS.

(Those marked with an asterisk (*) were not taken by the Albatross expedition.)

Order **ACTINOPODA** Ludwig.

Family HOLOTHURIIDÆ Ludwig.

Subfamily HOLOTHURIINÆ Ludwig.

Genus *Actinopyga* Bronn.

Actinopyga parvula (Selenka).
*nobilis** (Selenka).
obesa (Selenka).
mauritiana (Quoy and Gaimard).

Genus *Holothuria* Linnæus.

Holothuria paradoxa (Selenka).
*kapiolaniæ** (Bell).
cinerascens (Brandt).
pervicax Selenka.
atra Jäger.
*monacaria** (Lesson).
*vagabunda** Selenka.
*humilis** Selenka.
fusco-rubra Théel.
arenicola Semper.
pardalis Selenka.
*inhabilis** Selenka.
impatiens (Forskål).
*verrucosa** Selenka.
hawaiiensis, new species.
anulifera, new species.
fusco-olivacea, new species.

Genus *Labidodemas* Selenka.

*Labidodemas semperianum** Selenka.

Genus *Stichopus* Brandt.

Stichopus chloronotos Brandt.
tropicalis, new name.

Subfamily SYNALLACTINÆ Ludwig.

Genus *Mesothuria* Ludwig.

Mesothuria carnosa, new species.
murrayi (Théel).
parva (Théel).

Genus *Bathyplotes* Östergren.

Bathyplotes patagiatus, new species.

Genus *Pseudostichopus* Théel.
Pseudostichopus propinquus, new species.
Genus *Palopatides* Théel.
Palopatides retifer, new species.

Family ELPIDIIDÆ Théel.

Subfamily DEIMATINÆ (Théel) Ludwig.
Genus *Scotodeima* Ludwig.
Scotodeima vitreum, new species.
Genus *Orphnurgus* Théel.
Orphnurgus insignis, new species.
Genus *Lætmogone* Théel.
Lætmogone biserialis, new species.
Lætmogone, species.
Genus *Paunychia* Théel.
Paunychia pallida, new species.

Family CUCUMARIIDÆ Ludwig.

Subfamily CUCUMARIINÆ R. Perrier.
Genus *Thyonidium* Düben and Koren.
Thyonidium hawaiiense, new species.
alexandri, new species.
Subfamily PSOLINÆ R. Perrier.
Genus *Psolus* Oken.
Psolus macrolepis, new species.

Order **PARACTINOPODA** Ludwig.

Family SYNAPTIDÆ Burmeister.

Genus *Synaptula* Örsted.
Synaptula kefersteinii (Selenka).
Genus *Euapta* Östergren.
Euapta godeffroyi (Semper).
Genus *Opheodesoma*, new genus.
Opheodesoma spectabilis, new species.
Genus *Protankyra* Östergren.
Protankyra albatrossi, new species.
Genus *Anapta* Semper.
Anapta inermis, new species.
Genus *Chiridota* Eschscholtz.
Chiridota hawaiiensis, new species.
uniserialis, new species.
Genus *Taeniogyrus* Semper.
Taeniogyrus, species.

The nineteen species believed to be new are as follows:

Holothuria hawaiiensis.
Holothuria analifera.
Holothuria fusco-olivacea.
Mesothuria carnosa.
Bathyplotes patagiatus.
Pseudostichopus propinquus.
Palopatides retifer.
Scotodeima vitreum.
Orphnurgus insignis.
Lætmogone biserialis.
Paunychia pallida.
Thyonidium hawaiiense.
Thyonidium alexandri.
Psolus macrolepis.
Opheodesoma spectabilis.
Protankyra albatrossi.
Anapta inermis.
Chiridota uniserialis.
Chiridota hawaiiensis.

A new name, *Stichopus tropicalis*, is used to replace "*Stichopus godeffroyi*, variety b," this so-called variety being here considered a distinct species, as explained in the description of that form.

Species previously known but now for the first time recorded from the Hawaiian group are:

Actinopyga parvula.
Holothuria arenicola.
Mesothuria murrayi.
Mesothuria parva.
Euapta godeffroyi.

Previously reported species secured by the fisheries steamer *Albatross:*

Actinopyga obesa.
Actinopyga mauritiana.
Holothuria paradoxa.
Holothuria cinerascens.
Holothuria pervicax.
Holothuria atra.
Holothuria fusco-rubra.
Holothuria pardalis.
Holothuria impatiens.
Stichopus tropicalis.
(=*Stichopus godeffroyi* var. b, of authors.)
Synaptula kefersteinii.

Species recorded from the Hawaiian Islands, but not taken by the fisheries steamer *Albatross:*

Actinopyga nobilis.
Holothuria kapiolaniæ.
Holothuria monacaria.
Holothuria vagabunda.
Holothuria humilis.
Holothuria inhabilis.
Holothuria verrucosa.
Labidodemas semperianum.
Stichopus chloronotos.

All the known species of Hawaiian holothurians have been included in the keys in this report, and short diagnoses of those not taken by the fisheries steamer *Albatross* are inserted in the proper place, but are marked in all cases by an asterisk (*). It is believed that this method will render the report more useful to the general naturalist, since literature on the subject is often inaccessible. The various lists will prevent confusion concerning the species actually secured by the expedition of 1902.

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While correcting the galley proofs I received Kœhler and Vaney's important memoir entitled An Account of the Deep-Sea Holothuriodea collected by the Royal Indian marine survey ship *Investigator*. So far as possible I have taken account of Kœhler and Vaney's species in the descriptions of the *Albatross* material. It has not, at this late hour, been possible to accord to this work the space and attention that it deserves.

DESCRIPTION OF SPECIES.

Class HOLOTHURIOIDEA.

KEY TO FAMILIES AND GENERA OF HAWAIIAN HOLOTHURIOIDEA.

a. With pedicels or papillæ or both. All ambulacral appendages arise from the radial canals, appearing as a circle of tentacles about the mouth, and as pedicels or papillæ, or both, over rest of body ..... Order ACTINOPODA.

b. Tentacles more or less peltate. No retractor muscles.

c. Respiratory trees present ..... HOLOTHURIIDÆ.

d. Tentacle ampullæ well developed. Madreporic canals often numerous, never attached to body wall. Vascular system forming a rete mirable in connection with left respiratory tree ..... HOLOTHURIINÆ.

e. Genital tubes in a tuft on left side of dorsal mesentery.

f. Anal teeth present ..... ACTINOPYGA.

ff. Anal teeth absent.

g. Ambulacral appendages scattered over whole body and usually without arrangement in rows; less commonly arranged in longitudinal bands on ventral surface ..... HOLOTHURIA.

gg. Ambulacral appendages only on the radii, and in double rows. LABIDODEMAS.

ee. Gonad in a right and left tuft, no anal teeth; pedicels on the 3d ventral radii, mostly in longitudinal bands. Dorsal surface with papillæ, often on warts ..... STICHOPUS.

dd. No free tentacle ampullæ. Madreporic canal single and usually in connection with body wall; only exceptionally a rete mirabile present. SYNALLACTINÆ.

e. Genital tubes only in a left tuft. Anus not in a vertical furrow. Ventral surface somewhat flattened. Ambulacral appendages in form of many small scattered pedicels, usually largest on lateral ventral ambulacra. MESOTHURIA.

ee. Gonad in a right and left tuft.

f. Anus in a vertical furrow. Pedicels and papillæ unusually small, those of dorsum nearly rudimentary; pedicels of lateral ventral ambulacra more prominent than rest. Deposits often wanting. PSEUDOSTICHOPUS.

ff. Anus not in a furrow, terminal or subdorsal. Body more or less depressed, usually with a border or brim.

g. C-shaped deposits present ..... BATHYPLOTES.

gg. No C-shaped deposits. Pedicels only on middle and hinder part of midventral radius; deposits often wanting ..... PELOPATIDES.

cc. Respiratory trees absent. No rete mirabile. No tentacle ampullæ. Dorsal surface with large papillæ, ventral with very large pedicels, always in rows. Madreporic canal opening to exterior. Deep-sea forms ..... ELPIDIIDÆ.

d. In the stiff skin neither wheels nor tables. Above the pedicels of lateral ventral radii a series of large flank-papillæ.

e. Pedicels of ventrolateral radii in two series; remarkably long flank and dorsal papillæ; papillæ of dorsal radii in two series; deposits very large X and Y shaped rods, and in papillæ very long simple rods perforated at tips. Anus ventral ..... SCOTODEIMA.

ee. Pedicels of ventrolateral radii in a single series, those of dorsal in either one or two series. Deposits, large crowded spiny rods and spiny ellipsoids ..... ORPHNURGUS.

dd. Skin more pliable, with many wheels. Flank papillæ small or absent.

e. Midventral radius without pedicels.....LÆTMOGONE.

ee. Midventral radius with two rows of pedicels.....PANNYCHIA.

bb. Tentacles dendroid. Retractor muscles present.....CUCUMARIIDÆ.

c. Tentacles 20, five pairs of large alternating with five pairs of very much smaller ones. No large scales on dorsal surface, which always has scattered pedicels.....THYONIDIUM.

cc. Tentacles 10; ventral surface flattened, forming a creeping sole on which pedicles are arranged in two or three longitudinal bands. Dorsal surface with large scale-like plates which imbricate; no dorsal pedicels. Mouth and anus dorsal, often guarded by large plates or valves.....PSOLUS.

aa. No pedicels or papillæ, and no respiratory trees. Tentacles arise only partly from radial canals, and partly from ring canal.

Order PARACTINOPODA, SYNAPTIDÆ.

b. Calcareous deposits in the skin consisting of anchors and perforated plates.

c. Anchor arms smooth, without serrations; vertex with minute knobs; anchor plates symmetrical.

d. Handle of anchors with branches; cartilaginous ring absent, or present.

e. Calcareous ring without anterior projections; madreporic canal single (never many); cartilaginous ring absent; handle of anchor plates with 2 large and several small smooth holes.....EUAPTA.

ee. Calcareous ring with conspicuous anterior projections; numerous madreporic bodies; cartilaginous ring sometimes present; 2 large holes in handle of anchor plates absent.....OPHEODESOMA.

dd. Cartilaginous ring present; handle of anchor without branches.

SYNAPTULA.

cc. Arms of anchor usually serrate; anchor plates asymmetrical, the circumference uneven or incomplete; not narrowed into a handle; tentacles digitate.....PROTANKYRA.

bb. Calcareous deposits never anchors and plates, but wheels with six spokes, S-shaped rods, small C-shaped rods or simple rods, sometimes oval grains; sometimes wanting.

c. Deposits absent (sometimes present as oval grains).....ANAPTA.

cc. In addition to wheels collected in little heaps, often small curved, C-shaped, or straight rods, smooth, rough, or parted at tips; no sigmoid bodies.

CHIRIDOTA.

ccc. Sigmoid rods present; sometimes also wheels, either in heaps or scattered.

TÆNIOGYRUS.

Order ACTINOPODA Ludwig, 1891.

Family HOLOTHURIIDÆ Ludwig.

Holothuriidæ LUDWIG, Mem. Mus. Comp. Zool., XVII, 1894, p. 7.

Subfamily HOLOTHURIINÆ Ludwig.

Genus ACTINOPYGA Bronn.

Mülleria[a] JÄGER, Dissertatio de Holothuriis, 1833.

Actinopyga BRONN, Klassen u. Ordnungen des Thierreichs, 1860.

[a] Notwithstanding the fact that *Mülleria* Jäger is at least three times preoccupied (Férussac, 1823, mollusca; Desmarest, 1825, crustacea; Fleming, 1828, echinoderma, according to Agassiz's Index Universalis), some of the leading authorities still employ the name, although Professor Bell pointed out the error in Ann. Nat. His., (5) XX, p. 148.

The following is Théel's description:

Tentacles 20 to 27. Ambulacral appendages in the shape of pedicels on the ventral surface and papillæ on the dorsal. Seldom an arrangement of pedicels in longitudinal series visible. A single genital bundle present, situated on left side of dorsal mesentery. Anus surrounded by five calcareous teeth. No C-shaped deposits in the body wall.

KEY TO HAWAIIAN SPECIES OF ACTINOPYGA.

a. Among the deposits, tables.

b. Tentacles 20; calcareous deposits crowded tables (the spire of which is truncate, quadrate, armed with numerous teeth) and large, smooth buttons with six to eight holes ordinarily, but exceptionally four or five and as high as thirteen. *parvula*.

bb. Tentacles 20; calcareous deposits thinly scattered tables, the spire terminating in sixteen to twenty teeth, and hollow fenestrated ellipsoids forming a thick layer ..... *nobilis*.

aa. Deposits chiefly rods; no tables.

b. Tentacles 20; deposits finely granulated, simple rods ..... *obesa*.

bb. Tentacles 25; deposits in dorsal integument rods, with small processes running out at the sides and with ends spinous or dichotomous; in the ventral perisome small, smooth, oval grains and larger, smooth, unbranched rods with the ends slightly rough ..... *mauritiana*.

ACTINOPYGA PARVULA (Selenka).

Plate LXVII, figs. 2, 2*a–g*.

Mülleria parvula SELENKA, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. f. Wiss. Zool., XVII, 1867, p. 314, pl. xvii, figs. 17–18.

Body elongate ovoid, robust, but much contracted. Tentacles retracted, but mouth apparently somewhat ventral; anus terminal, surrounded by five small calcareous teeth. Tentacles 20 to 21, peltate, medium sized, rather crowded. Ventral surface well marked from dorsal, covered with pedicels of conspicuous size which are not arranged in definite order. Papillæ of dorsum much less numerous, without order, and contracted so that their size is not at once apparent. They seem to be slightly smaller than the pedicels and are without terminal plates. Integument thick, minutely roughened by the spires of the densely crowded tables. Deposits: Very numerous tables and buttons; the former with a central and about eight peripheral smaller holes and a well-developed spire terminating in a subquadrate crown of numerous (about thirty-six) teeth; the latter large, smooth, pierced by six to eight irregular holes. Pedicels and papillæ with perforated supporting plates and rods. The color in alcohol is very dark brown. Length of largest individual, much contracted, 40 mm., width, 28 mm.

Localities.—Napili, Maui (2); Necker Island? (6); Honolulu, reef (2); Laysan, reef (3).

Although the specimens are badly contracted it is evident that the crown of tentacles is surrounded by a collar, perhaps not so prominent

as in *A. mauritiana*. The pedicels continue to the very edge of the collar, on which the papillæ are larger than over rest of dorsum. Superficially the retracted papillæ resemble pedicels, but since there appears to be no perforated terminal plate such as is well developed in the pedicels, they are not to be ranked with the latter. The supporting rods and plates are, however, well developed toward the top of the papillæ. (See below.)

The calcareous ring has no posterior prolongations, but anteriorly is deeply scalloped. The exact shape is best shown by the figure. (Plate LXVII, fig. 2*g*.) There are two large Polian vesicles and one short, twisted, madreporic canal embedded in the dorsal mesentery. The madreporic body is prominent and lies on the left side of the mesentery. The gonad is still small, and forms a tuft on the left side of the mesentery, behind the madreporic canal. Left branch of respiratory tree much longer than right. Cuvierian organs relatively large.

Both tables and buttons are very numerous in the perisome, the edges of the former overlapping, or at least touching. The buttons which lie beneath the tables also imbricate irregularly. The disk of the tables is 0.08 to 0.09 mm. in diameter and is pierced by eight peripheral holes and a central larger one. Frequently there are several small accessory perforations. Rim is smooth, slightly undulating; the spire is robust, and is made up of four upright pieces slightly flaring at the crown, which is armed with numerous teeth, whose arrangement is best shown by the figures. Buttons are large, smooth, and vary considerably in size, but average 0.1 mm. in length. They are broadly elliptical and the six or eight holes are rather small in proportion to the whole button. Many of the buttons are rather wider in proportion to length than the figures here given. Some buttons have five holes, and a few four or nine. Occasionally a button is incomplete, a portion of the outer rim being wanting. Supporting rods and plates, two types of which are figured (Plate LXVII, fig. 2*f*), are abundant in the walls of the pedicels and papillæ, where also tables are present. The rods and plates grade into large buttons in the proximal portion of the pedicels and papillæ. In the pedicels the plates are more abundant than the supporting rods and are slightly larger than those in the papillæ, averaging 0.15 to 0.20 mm. longest dimension, although smaller ones are present. There are also very large buttons in the pedicels with twelve or thirteen holes. The terminal perforated plate of the pedicels is well developed and measures 0.5 mm. in diameter, the perforations about 0.015 mm.

This species is a shore form, inhabiting tide pools in lava rock and on coral reefs. Since the gonad is still very small the specimens are probably immature, as their size would suggest. This wide ranging form, which Bedford[a] believes includes *flavocastanea*, is found in

[a] Proc. Zool. Soc., 1898.

the Atlantic (Florida, Madeira), Red Sea (Kosseir), and over the greater part of the Indo-Pacific region (Seychelles Islands to Samoan, and Hawaiian Islands.)

* ACTINOPYGA NOBILIS (Selenka).

Holothuria (subgen. *Microthele*) *maculata* BRANDT, Prodr., 1835, p. 54. (Not to be confused with *Sporadipus* (*Acolpos*) *maculatus* Brandt, Prodr., 1835, p. 46, which is *Holothuria arenicola* Semper.)

Mülleria nobilis SELENKA, Zeit. für Wiss. Zoologie, XVII, 1867, p. 313, pl. XVII, figs. 13–15.

This species is attributed to the Hawaiian Islands by Selenka, but is not present in the collection brought home by the fisheries steamer *Albatross*. The following diagnosis is from Théel's monograph, page 198:

Color almost black, speckled with lighter tint. Dorsal papillæ more thinly scattered than the ventral pedicels, and of about the same size or smaller than these. In the contracted state the dorsal surface seems to have some low prouberances, especially along the sides of the body. The anal teeth are small and surrounded by five groups of papillæ, each group corresponding in position with a tooth. The tables are thinly scattered, consisting of an irregularly rounded disk with smooth undulated margin and pierced by a large central and several smaller peripheral holes; the spire, formed by four rods and one transverse beam, terminates in twenty or more teeth. (Teeth as few as 16.) The hollow fenestrated ellipsoids form a thick layer.

ACTINOPYGA OBESA (Selenka).

Plate LXVII, fig. 3.

Mülleria obesa SELENKA, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. für Wiss. Zool., XVII, 1867, p. 312

General form robust, oblong, blunt[a] at both ends. Mouth ventrally turned, probably not always so, as in some much contracted individuals it appears terminal. Anus terminal, surrounded by five calcareous teeth. Tentacles 20, rather broadly peltate. Ventral surface covered with numerous pedicels which are for the most part retracted within the body, but which appear to form three indefinite rows. Papillæ scattered (entirely retracted), less numerous than pedicels. Perisome thick and leathery. Deposits: Rather finely granulated simple rods. Color in alcohol, dark chestnut-brown. Largest contracted specimen 180 mm. long and about 70 to 80 mm. broad.

Locality.—Laysan Island (7 specimens).

All the specimens are too much contracted to furnish any details as to general habit. The tentacles seem to vary from 19 to 21. As indicated in the diagnosis the pedicels are mostly withdrawn. By slicing off a thin layer of the ventral surface the dark pigment is removed, and in the largest specimens the pedicels appear to be more crowded

[a] This species was not observed in the living state, and all the specimens are badly contracted. The general shape is evidently similar to that of *M. mauritiana*.

along a median longitudinal and two lateral areas, although these areas do not appear sharply defined by any means.

In the large specimen dissected there is but one madreporic canal, situated on the right side of the mesentery. The madreporic body is elongate (6 mm.) and is perfectly free in the body cavity. There is but one Polian vesicle. Calcareous ring without posterior prolongations. The radial pieces are considerably larger than the interradial. Genital glands form a large tuft on the left side of the dorsal mesentery. Right branch of respiratory tree longer than left, reaching to calcareous ring. Cuvierian organs present at left side of base of respiratory tree; tuft rather small.

The calcareous deposits are numerous but of a simple nature, consisting of straight or slightly curved, rather finely granulated rods, the granulations assuming the form of irregular protuberances at the ends. In the dorsal perisome the rods average slightly larger than in the ventral. They vary from 0.08 to 0.12 mm., the former being the average. Many are as small as 0.05 mm., and the smallest are about 0.03. Occasionally the rods are forked slightly at one or both ends. The rods of the ventral perisome average between 0.05 and 0.07 mm.

This species is apparently confined to the Hawaiian group. No specimens, however, were taken in the Windward Islands, where it is likely the type was secured.

ACTINOPYGA MAURITIANA (Quoy and Gaimard).

Plate LXVII, figs. 1, 1*a–d*.

Holothuria mauritiana Quoy and Gaimard, Voyage de l'Astrolabe Zoologie, IV, Zoophytes, 1833, p. 138.

Body elongate, robust, broadest posteriorly, or sometimes nearer middle, usually slightly constricted near anterior end. Mouth usually distinctly ventral, surrounded in life by a conspicuous, papillose collar. Anus terminal, with five white calcareous teeth. Tentacles about twenty-five (twenty-two to twenty-six), rather crowded, broadly peltate, the crests arranged in two irregular, concentric rows. Peristome broad. Pedicels densely crowded, and without order, confined to the flattish ventral surface. Dorsal papillæ much fewer than pedicels, about the same size and irregularly scattered. Integument tough and leathery. Deposits: In the dorsal integument longer and shorter rods, with small processes along the sides and with the ends dichotomous or spinous, together with numerous, much smaller rosettes, usually not very intricate; in the ventral perisome small, smooth, oval grains and larger unbranched rods with the ends slightly roughened. Ventral deposits much more numerous than dorsal. Color variable, usually an olivaceous brown, the bases of the papillæ encircled with whitish; blotched with whitish along the sides and distad (see p. 649).

Largest preserved specimen 165 mm. long, 50 mm. wide, 45 mm. dorso-ventrally.

Localities.—Tide pools in Puako Bay, Hawaii; Kealakekua Bay, Hawaii; Kamalino Bay, Niihau; Napili, Maui; Waialua, Oahu. Twenty-seven specimens.

It is apparently characteristic of this species to have the mouth open ventrally. The broad collar which surrounds it is always much contracted in the preserved specimens. The difference between the ventral surface, which is rather flat, and the dorsal, which is well arched, is very conspicuous and is heightened by a difference of color. The pedicels extend to within 15 to 20 mm. of the rim of the circumoral collar or ruff, and to within 8 to 10 mm. of the anal aperture. The papillæ are more numerous in some specimens than others, but tend to become rather more crowded toward the anus, and along the sides of the body adjacent to the pedicels, where they are also larger. The papillæ are also longer on the collar, particularly on its rim. The numerous specimens which belong to this species vary considerably in the shade of brown and in the amount of white. The more usual coloration is a rich raw umber. An unspotted individual had the dorsum deep olive brown, the ventral surface light pinkish brown; tube feet raw umber; tentacles greenish brown or raw umber translucent, with grayish effects in some lights. Near Kealakekua Bay, Hawaii, I collected one large specimen which is decidedly dark and spotted. An example from Kamalino Bay, Niihau, is light olivaceous brown, heavily blotched on the sides with white and with all the dorsal papillæ encircled with white.

Calcareous ring rather massive. There is scarcely any difference in size between the radial and interradial pieces. Ampullæ of tentacles long. Polian vesicles two. There are three madreporic bodies to the left of the dorsal mesentery, free in body cavity. One madreporic canal is usually much longer than the other two, more or less convoluted, and frequently is median in position, lying in the dorsal mesentery. Gonads form one cluster, resembling a swab of hempen tangles, on the left side of the mesentery. Right respiratory tree reaching to calcareous ring, left only half as long, but more bushy. Cuvierian organs present, forming a tuft to the left of the base of the respiratory tree.

The rods in dorsal perisome vary considerably in shape in the same individuals, the principal types being figured. They vary in length from 0.08 to 0.14 mm., or are sometimes even longer. The rosettes average from 0.02 to 0.03 mm., and are scattered among the rods. They are congregated, however, in dense masses about the base of the papillæ, giving the whitish color characteristic of some specimens. Consequently in those specimens having considerable whitish on the body, the rosettes are very numerous. A few of the larger papillæ

appear to possess rudimentary terminal plates, but the greater number show no trace of them. The rods in the walls of the papillæ are very few. The deposits in the ventral perisome, in the form of smooth oval grains and unbranched rods, are highly characteristic, and occur in great numbers, forming several layers. The rods are rather more numerous near the bases of the pedicels, which possess well-developed perforated terminal plates, but no supporting rods in the walls. Sometimes, however, a few grains are present near the end, and a few rods also. The grains vary considerably in size, ranging from 0.01 to 0.04 mm. in length. The rods do not generally exceed 0.1 mm. in length. Rosettes are not present in the ventral perisome of all the specimens. Théel found them present in examples from the Samoan, Fiji, and other islands of the South Seas. I find them fairly numerous in a medium-sized, dark, sparsely spotted specimen from Puako Bay, Hawaii, but in larger individuals with spots, from the same locality, they appear to be almost if not entirely wanting.

This species is found in tide pools in the lava rock, especially on the coast of Hawaii. We did not take any on coral reefs. It is one of the commonest and most characteristic invertebrate forms of the shore fauna, and does not take any special pains to hide itself.

Genus HOLOTHURIA Linnæus.

Holothuria Linnæus, Systema Naturæ, 10th ed., 1758.

The following description of the genus is taken from Théel:

Tentacles 20, exceptionally more or less. Ambulacral appendages, pedicels alone, papillæ alone, or both papillæ and pedicels; the papillæ placed on the dorsal surface, the pedicels on the ventral. These ventral pedicels are seldom arranged in longitudinal series. A single bundle of genital tubes placed on left side of dorsal mesentery. Anus devoid of calcareous teeth, but sometimes stellate. C-shaped deposits absent.

KEY TO HAWAIIAN SPECIES OF HOLOTHURIA.

a. Deposits simple or branched rods, the branches being sometimes united, the rods then acquiring the shape of irregular perforated plates; no tables.

b. In dorsal perisome branched X-shaped rods; in ventral, smooth rods in addition; the arms of X-shaped bodies branched and often united; one Polian vesicle. *paradoxa*.

bb. Deposits in the form of delicate, slightly curved, very spiny rods; two Polian vesicles ..... *kapiolanix*.

aa. Among the deposits, tables.

b. Tables and rods or irregular perforated plates, but no buttons.

c. Rods but no plates.

d. Tables with annular disk together with large rods branched at tips and covered with many small protuberances or granulations ..... *cinerascens*.

dd. Spire of tables often reduced. The small, more or less elongate rods are characterized by being uneven, warted, distinctly undulated, or deeply incised so as to form a row of loops or holes along each side ..... *pervicax*.

cc. In addition to tables with small annular disk and twelve teeth to crown of spire, small fenestrated plates, or branched X-shaped bodies. Blackish, and large in life ..... *atra*.

bb. Tables and buttons.

c. Buttons smooth, without knobs, granulations, or elevations on surface.

d. Buttons irregular, and occasionally more or less incomplete, often reduced to rods resembling central shaft of buttons.

e. Tentacles 20. Tables with one cross-beam to spire.

f. Buttons never complete; really flat rods irregular or deeply incised on sides; disk of table with smooth margin ..... *pervicax.*

ff. Most of buttons complete, many fairly regular. Disk of table with spinous rim.

g. Buttons accumulated in rings in integument, two rows of dark spots along dorsal surface ..... *pardalis.*

gg. Buttons scattered. Reddish brown to purplish brown, unspotted. *fusco-rubra.*

ee. Tentacles 30. Tables with one to three cross-beams to spire. *hawaiiensis.*

dd. Buttons regular.

e. Tables with four uprights and one beam to spire.

f. Disks of tables with smooth or undulating but not spinous margin.

g. Crown of spire ending in eight to ten teeth. Pedicels only.

h. Calcareous ring very small, with ten small, brown, round pieces. *humilis.*

hh. Calcareous ring of usual shape ..... *vagabunda.*

gg. Crown of spire ending in more than ten teeth.

h. Pedicels and papillæ arranged in series. Crown of spire ending in usually more than ten and less than twenty teeth ..... *monacaria.*

hh. Pedicels alone; arranged more or less in series. Spires terminating in more than twenty teeth. Two rows of dark reddish brown spots on back, in contrast to light skin ..... *arenicola*

ff. Disks of tables spinous on margin.

g. Buttons partly irregular, accumulated in rings ..... *pardalis.*

gg. Buttons all regular.

h. Only pedicels (a few tables with spinous disk) ..... *vagabunda.*

hh. Only papillæ ..... *verrucosa.*

ee. Many of tables with two cross-beams to spire. Buttons very regular. Only pedicel-like papillæ ..... *impatiens.*

cc. Buttons with granulations, knobs, or elevations on surface; not smooth. Disk of tables more or less spinous on margin.

d. Buttons all complete.

e. No supporting rods to pedicels, which are all over body. The solid tables with twelve spines on margin. Buttons uneven with flattened elevations on surface, margin deeply undulated ..... *inhabilis.*

ee. Papillæ on dorsal surface, pedicels on ventral, both with large smooth supporting rods having spinous edge. Tables of two kinds. Buttons variable in size, covered with numerous granulations ..... *fusco-olivacea.*

dd. A few buttons with comparatively few knobs along edge and central shaft; the rest in form of knobby incomplete buttons, warty rods, or even small +-shaped rods with ends very knobby ..... *anulifera.*

HOLOTHURIA PARADOXA Selenka.

Plate LXVII, figs. 4, 4*a–b*, 5; Plate LXIX, fig. 5.

Holothuria paradoxa Selenka, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. f. Wiss. Zool., XVII, 1867, p. 322, pl. xviii, fig. 41.

Size large; general form robust, subcylindrical; mouth directed ventrally, although retracted within collar; anus stellate, with five groups of papillæ (much expanded in specimen on account of mass of Cuvierian organs). Tentacles 19, fairly large, but much contracted, apparently surrounded in life by a papillose collar. Ambulacral appendages in the form of numerous pedicels; rather more numerous on ventral than on dorsal surface. Pedicels are without order and are fairly evenly distributed all over body with the exception of a narrow band along each radius of the dorsal surface and the mid-ventral; the two lateral radii are not so distinguished. Body wall thick. Color in alcohol, ventral surface greenish yellow; dorsal the same, verging upon raw sienna, but the pedicels and a circle around the base rather dark brown. This gives the dorsal surface a decidedly brownish appearance which renders the two surfaces easily distinguishable. Deposits: In the dorsal perisome dichotomously branched rods of small size, forming frequently more or less incomplete rosettes; in the ventral perisome simpler, rather stouter smooth rods, branched at the ends, the branches sometimes uniting and forming perforations, occasionally in the form of small plates with two or three perforations (see figures); in the walls of pedicels smooth, slightly curved supporting rods with branches or processes at the ends are present. Length, in a much contracted state, 250 mm.; width, about 65 mm.

Locality.—Station 3847, south coast of Molokai Island, 23 fathoms, sand and stones; 1 specimen.

Among pedicels of dorsum are somewhat larger conical appendages, with rudimentary terminal plate, which must be regarded as papillæ. They are very much less numerous than the pedicels. As indicated in the diagnosis, there is no bare streak separating the ventral pedicels from the lateral, but the two surfaces simply are continuous. The difference in color and in number of pedicels serves to indicate the transition.

Calcareous ring massive and of the usual shape; radial pieces larger than the interradial, but only a trifle broader on the posterior margin. They are 12 mm. long and of about the same width. The interradial pieces are 10 mm. long and 7 mm. wide, and as usual are excavated on the posterior margin. Polian vesicle single. Tentacular ampullæ long. Madreporic canal small, embedded in the dorsal mesentery. Branches of gonad fine, thread-like, and long. Respiratory tree with

left branch in relation with rete mirabile of intestine. Cuvierian organs large; having been ejected it is difficult to determine whether they are divided or not.

The calcareous deposits of the dorsal perisome comprise small rods with the ends several times dichotomously branched and with branches on either side at about the middle. These rods are about 0.041 to 0.046 mm. long, and form incomplete rosettes. Simpler rods are also present, as well as X-shaped bodies. I find no unbranched rods such as are present in the ventral perisome. Here the rods are thicker, simpler, and frequently without any branches whatsoever. Some of the commonest forms are figured. It will be seen from these that occasionally the rods assume the condition of small perforated plates owing to the fact that branches anastomose. I find no rods more complicated than those figured. The supporting rods of the dorsal pedicels average about 0.17 mm. in length. They are smooth and branched simply at the ends. Occasionally a rod will attain 0.29 mm., and I found one perfectly simple which equaled 0.47 mm. The rods of the ventral pedicels are rather smaller, and fewer in number. Toward the base of the dorsal pedicels numerous rather simple small rods, intermediate between the supports and the ordinary variety of the perisome, are present in considerable numbers. The majority of dorsal pedicels have a well-developed terminal plate, nearly if not quite as large as that of the ventral pedicels.

Although the specimen is large, it appears to answer fairly well the requirements of this species. The deposits of *H. vitiensis*, according to Semper's figures, appear to be considerably different. That is apparently the only other form with which this specimen might be confused.

*HOLOTHURIA KAPIOLANIÆ Bell.

Holothuria kapiolania Bell, Proc. Zool. Soc., June 23, 1887, p. 533.

This species is described by Professor Bell, as follows:

Body elongated, soft to the touch, covered with suckers more numerous below than above, scattered quite irregularly; obscurely marked papillæ around the anus. Œsophageal ring of ordinary type, the pieces simple and low, with a rather deep notch posteriorly; stone-canal not remarkably long; two Polian vesicles; genital tubes short, not numerous; Cuvierian organs absent or poorly developed. The spicules merely in the form of delicate, slightly curved, very spiny rods.

Color brownish gray, lighter below, with two rows of eight or nine dark patches on either side of the back. Length 60 mm., average width of 10 mm. Sandwich Islands.

Professor Bell further states that the species "appears to be most closely allied to *H. crinaceus*, from which, however, the much smaller stone-canal and very differently formed spicules are sufficient to distinguish it."

HOLOTHURIA CINERASCENS (Brandt).

Plate LXVIII, figs. 1, 1*a–f*.

Stichopus (*Gymnochirota*) *cinerascens* BRANDT, Prodr., 1835, p. 51.

General form robust, subcylindrical, dorsal and ventral surfaces sharply differentiated, the former with numerous papillæ, rather uniformly spaced, among which some are larger than others; the latter beset with crowded robust pedicels. Anterior end rather broad, the 20 tentacles being robust with large subglobose crowns when fully expanded. The mouth is turned slightly ventrad in life. Posterior extremity of body very blunt; anus surrounded by papillæ. Body wall thick, fairly smooth to the touch. Deposits: Tables, somewhat resembling those of *H. atra*, with a small annular disk (rarely a larger perforated one) and a spire consisting of four rods, one crossbeam, and a crown terminating in eight horizontal and four vertical prominent teeth; numerous slightly curved rods, finely granulated, with the tips frequently slightly branched. Color in life a reddish heliotrope purple to brownish purple; in alcohol, a dull purplish brown, lighter below. Length, about 160 mm.

Localities.—Honolulu Reef (5), Hanalei, Kauai (1), Hilo, Hawaii (1), Puako Bay, Hawaii (1). Eight specimens examined. Of these one is a trifle doubtful on account of absence of calcareous deposits.

There is no sign of any regular arrangement among the pedicels. The papillæ are unequal in size, some being somewhat longer and more pointed than others, which are truncate; the latter, however, may be simply contracted individuals. In one specimen the skin between the papillæ is raised in tiny wartlike eminences, which give the surface a roughened appearance. In a specimen killed with the tentacles fully expanded, the latter are 10 mm. long, and the expanded crowns are 6 to 10 mm. in diameter and almost "arborescent" in appearance. The collar surrounding tentacles is inconspicuous.

Calcareous ring of the usual form. Polian vesicles six in specimen dissected, two being larger than the rest; number reported to be very variable. One madreporic canal is present, on right side of mesentery. The Cuvierian organs are present in specimen examined. Longitudinal muscle bands rather thin. Interior of body cavity yellowish, irregularly spotted with black (alcoholic specimen). Left respiratory tree in relation with rete mirabile of intestine.

The rods are the most characteristic and conspicuous feature of the calcareous deposits. They are very numerous both in the dorsal and ventral perisome, and the supporting rods of the papillæ and pedicels are the same, but in the neighborhood of the terimal perforated plate are smaller. Typically the rods are simple, finely granulated, slightly to considerably curved, with the extremities often branched, or with

coarser tubercles. Occasionally triradiate rods occur, very rarely quadriradiate; again, one end may be considerably expanded and perforated, or along one side there may occur from one to several short "outgrowths" at right angles. The rods vary from 0.1 to 0.3 mm. in length; 0.15 to 0.25 is the commonest average. Tables with a simple annular disk, about 0.04 to 0.06 mm. in diameter, and with or without perforations at the base of the spire supports are most numerous. Rarely larger disks are present, 0.086 mm. in diameter and with twelve to fifteen holes around the rim. The rim of the reduced disks is nearly always very uneven, often irregularly spiney, the spines being short and broad. A few tables with only an incomplete spire are present, the supports branched at the bottom but not joined into a ring. The crown is subquadrate, about 0.045 mm. in diameter over all. The tables resemble those of *Holothuria atra*, but are smaller, the spires being relatively lower. The resemblance lies chiefly in the small disk and twelve teeth. The papillæ have a terminal perforated plate, and the pedicels a somewhat larger one.

This species has a wide distribution, as evidenced by the following localities: Hawaiian Islands, Philippines, Sunda Islands, Java, Tahiti, Batjan and Samoan Islands, Boninsima, Enosima, Mauritius, Seychelles, Zanzibar, Mozambique (Théel, Lampert), and several other intermediate localities. It occurs between tide limits, and on the west coast of Hawaii was found in rock pools. On the reef at Honolulu it occurs in pools near the outer edge, well toward Waikiki.

HOLOTHURIA PERVICAX Selenka.

Plate LXVIII, figs. 2, 2*a*–*c*.

Holothuria pervicax Selenka, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. f. Wiss. Zool., XVII, 1867, p. 327, pl. xviii, fig. 54.

Tentacles nineteen to twenty, usually twenty, with flat yellow crowns. Mouth directed ventrad, the circumoral collar not conspicuous. Dorsal surface arched, with scattered papillæ; the ventral with numerous pedicels which, under favorable conditions, can be seen to form four bands. Each lateral and the two dorsal interambulacra have an irregular series of low (in preserved specimens) tubercles surmounted by a good-sized papilla. The other papillæ are smaller. Body wall moderately thick, the surface smooth to the touch. Deposits: Tables not well developed, with small rounded disks, smooth but uneven on the margin, and with rather reduced spire, consisting of four upright pieces, one crossbeam, and a crown ending in four simple teeth or irregular. Frequently the upright pieces are not connected by transverse beams at summit. The small rods are irregular, deeply incised, warted or undulating along the margin; very numerous. Color in alcohol, very pale dull yellowish or grayish brown. The back is marked by about

six transverse irregular broad bands of dark olive brown, the intervals between being often much spotted with the same color, but sometimes much lighter. The whole integument is also finely dotted with olive greenish to brownish. In most specimens the bands on the back are decidedly greenish and the tubercles are marked by a yellowish-green base and a dark brown summit. Ventral surface finely dotted with olive, each pedicel being surrounded by an unmarked area at the base. Length about 100 mm.

Localities.—Honolulu, reef (9); Puako Bay, Hawaii (1); Laysan, reef (2).

The dorsal and ventral surfaces are well differentiated in this form. Just above the edge of the ventral area is a row of fifteen to twenty low tubercles, in some specimens hardly visible, in others easily seen by reason of their darker tips. The two dorsal series are very irregular in some examples, so that in the anterior half of the body no especial order seems to be present. The arrangement of pedicels in longitudinal bands is best made out in specimens which have been so hardened that the ventral surface is unwrinkled. The more numerous dots along the spaces between the bands make the latter all the more noticeable. In some examples, however, I find it impossible to distinguish any regular arrangement.

Calcareous ring of the usual form. Polian vesicle single, about 25 to 30 mm. long. Madreporic canal free, single, on right side of mesentery. Cuvierian organs present, forming a relatively very large bunch.

In this species both tables and buttons (if the peculiar rods may be so classed) are rather incomplete, although numerous so far as individuals are concerned. The disk is usually a subcircular but more or less irregular simple ring, with a fair-sized perforation at the base of each slender spire rod, and frequently supplementary holes between. The edge is usually smooth. Disks vary from 0.03 to 0.05 mm. in diameter; 0.038 to 0.046 mm. is the average. Spire has one cross beam, is frequently incomplete, and ends in four simple teeth. The crown may have no transverse pieces, in which case the spire is rather rudimentary, or there may be two or three of the teeth connected by transverse pieces (see figures). The rods commonly vary from 0.021 to about 0.072 mm. in length, although much larger rods, intermediate in size between the small ones and supporting rods, are present. These rods—or, as Lampert classes them, buttons—are very irregular. They are smooth and some of the commoner shapes are best seen from the figures. These forms are only a few among a great many variations. The pedicels possess well-developed terminal plates, but in the papillæ they are very rudimentary. The pedicels and papillæ, in addition to rather long, curved rods with short irregular processes scattered along the sides, have bilateral fenestrated plates,

and forms intermediate between the rods and plates are abundant. The simple rods are commonly about 0.3 to 0.35 mm. long. The processes along the sides may become more numerous and partially or wholly join, forming a series of irregular perforations. Rods of this sort are found intergrading with the small rods (see fig. 2*c*). The fenestrated plates, which are in the neighborhood of the terminal plate of the pedicels, are formed simply by the branching and joining of the lateral processes of the supporting rods. Théel does not mention these plates, but the other deposits agree so well with his description that I believe I have not erred in calling this form *perricax*. The small rods are certainly very characteristic.

This is another widely distributed form. Théel summarizes the distribution as follows: Tahiti, Pelew Islands, Philippine Islands, Hawaiian Islands, Samoan Islands, Zanzibar, Mauritius, Red Sea, Australia. Bedford[a] considers this form a variety of *fuscocinerea*, which he believes includes also *curiosa* and *depressa*. His specimens were taken at Rotuma.

HOLOTHURIA ATRA Jäger.

Plate LXX, figs. 2, 2*a–c*.

Holothuria atra Jäger, De Holothuriis, 1833, p. 22.

Body elongate, subcylindrical, capable of considerable extension, tapering to a blunt posterior extremity. Mouth rather small, ventrally directed, surrounded by a not very conspicuous papillose collar. Anus terminal. Tentacles of medium size, twenty in number, the well-developed peltate crowns forming a double row. Pedicels of ventral surface numerous and crowded. Papillæ of dorsal surface rather prominent in life, slightly thicker than the pedicels and less numerous, being more widely spaced. In alcoholic specimens they are often quite inconspicuous on account of contraction. Perisome rather thick, tough, and of a leathery consistency. Deposits: Tables with a small annular disk, usually forming a simple ring with a perforation at the base of each vertical spire support; spire terminating in eight horizontal and four vertical, rather long teeth; a single crossbeam to spire, situated slightly nearer disk than summit. In addition to tables are small, usually incomplete, fenestrated plates, often in the form of X-shaped bodies with the arms dichotomously branched. The incomplete plates appear rather more numerous than the fully developed ones. Color, a very dark brown, almost black. Peristome and disks of pedicels, yellowish. Length of a large preserved specimen, 210 mm.; thickness, about 55 mm. In life this specimen would be capable of expanding to at least 300 mm.

[a] Proc. Zool. Soc., 1898, p. 837.

Localities.—Puako Bay, Hawaii (17), tide pools in lava rock; Napili, Maui (2); Honolulu Reef (1); Waialua, Oahu (1); Kamalino Bay, Niihau (1); Laysan Island, reef (1). Specimens examined, 23.

The very dark color will serve as a distinguishing feature for this species, the only other forms approaching it in shade being *H. cinerascens* and *vagabunda*. *H. fuscorubra* is lighter and reddish. Along the middle of the ventral surface I find in most specimens a narrow band free from pedicels. The papillæ vary greatly in the degree of contraction, so that it is impossible to gain a correct idea of their size from a preserved individual. The crowns of the tentacles appear to be black to dark brown, but the peduncle is lighter, translucent brownish.

The radial pieces of the calcareous ring extend farther forward than the interradial, and are of the usual type. The anterior edge has an abrupt, rounded incision, while the interradial pieces have an anterior tooth. The posterior edge of each piece is emarginated. Polian vesicles two in one specimen examined. In another there are seven, six of which are quite small. The madrepor c canals form a tuft on each side of the dorsal mesentery, there being in one individual examined eight canals to each bunch. The right respiratory tree extends forward to the calcareous ring, and is firmly anchored to the body wall; the left is in connection with the extensive rete mirabile of the intestine. No Cuvierian organs are present in several specimens dissected.

The tables are numerous, but not crowded, and each possesses a small annular disk and a robust spire composed of four rods and one cross-beam. The latter is rather nearer the disk than the crown. The spire is surmounted by eight robust horizontal and four equally large vertical teeth, three at each corner of the subquadrate crown. The central hole of the crown is subcircular. Occasionally an extra tooth is present. The disks are about 0.055 mm. in diameter and most commonly consist of a simple ring with a perforation at the base of each spire rod. The spires are from 0.06 to 0.085 mm. high, and the crowns about 0.06 mm. broad, over all. The plates are small and irregular, varying in diameter from 0.019 to 0.045 mm. They are thus smaller than the plates figured by Clark,[a] presumably from Atlantic specimens. The tables of the Hawaiian examples, on the other hand, are larger, judging from the relative magnifications of my figures and Clark's. The disks of the tables, however, average relatively smaller to the proportions of the spire. The pedicels have a well developed terminal plate, and the papillæ a small one. Supporting rods are not abundant in the papillæ. They are usually curved, smooth (sometimes spinous) with the slightly dilated ends fenestrated.

[a] American Naturalist, XXXV, p. 493, fig. 26.

Close to the terminal plate of the pedicels a few fenestrated plates about 0.1 mm. in diameter are present. These are not infrequently bilateral.

This is one of the commonest holothurians inhabiting Hawaiian shores. It is rather common about the islands of Hawaii, on the leeward side at least, where it inhabits pools in the lava rock, in company with *Actinopyga mauritiana* and *Holothuria cinerascens*. In this region it does not appear to range out of the shore tide pools. The species is a very wide-ranging one, being found, according to Théel's and Lampert's summaries, in the following localities: Red Sea, Zanzibar, Madagascar, Djedda, and Indian Ocean, Querimba, Celebes, Java, Ualan, Radack Islands, Australia (Barrier Reef), Hawaiian Islands, Society Islands, Philippine Islands, Samoan Islands, Fiji Islands, Nicobar Islands, Amboina, Batchian, Molucca Islands, Macassar, Timor, Pedang, Pulo Tibul, Darros, Tahiti, Jamaica, Havana, Florida, Puerto Cabello.

*HOLOTHURIA MONACARIA (Lesson).

Psolus monacarius LESSON, Centurie Zoologique, 1830, p. 225, pl. LXXVIII.

Tentacles, 20; ventral surface with three longitudinal rows of pedicels; dorsal surface with four series of papillæ. Mouth surrounded by about twenty, often inconspicuous, papillæ. Deposits: Tables and buttons. Tables with rounded smooth disk, having a central hole surrounded by four to twelve peripheral holes; spire, consisting of four upright rods and one cross beam, terminates in twelve teeth or more. Oval smooth symmeterical buttons with three or four pairs of holes, mostly with three. Polian vesicle single; one small madreporic canal in dorsal mesentery. Brownish with ventral surface, the papillæ, and a space around them lighter; or dirty yellowish white, speckled with brown or greenish brown on back.

Théel[a] remarks that "in a small specimen from Mauritius, which is probably young, the pedicels are placed in three double or alternating rows on the ventral surface, an arrangement which is not so distinct in the remaining forms. Even the small dorsal papillæ do not always seem to be placed in very distinct rows. * * * The disks of the tables are slightly undulated on margin. The symmetrical or slightly asymmetrical buttons have often more than six holes, though this number is most common. The papillæ have a very rudimentary terminal plate, and curved, rod-like perforated deposits. Besides, both pedicels and papillæ contain numerous crowded buttons and tables, and near the ends bilateral perforated plates."

Not secured by *Albatross* expedition. This species has a wide range, extending from Zanzibar through the East India region to the Philippine Islands, east to Hawaii, and through the South Sea Islands to Australia. For a list of localities see Théel and Lampert.

[a] Challenger Holothurioidea, Pt. 2, p. 217.

*HOLOTHURIA VAGABUNDA Selenka.

Holothuria vagabunda SELENKA, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschaft. f. wiss. Zool., XVII, 1867, p. 334, pl. XIX, figs. 75–76.

Tentacles, 20. Ambulacral appendages, generally distributed pedicels. Deposits: Tables, and buttons. Tables with a not very large disk, and with the spire terminating in eight to ten teeth, placed around the nearly circular aperture in its top. Buttons of the usual form, with six holes. The dorsal pedicels alone have supporting rods, which are spinous and tapered toward the ends. Polian vesicles one to two; one free madreporic canal. Cuvierian organs brownish red to violet, very inconstant in number. Color, dark brown to light reddish brown, ventral surface whitish. Length about 200 mm.

Théel[a] states that in a number of specimens examined by him the ambulacral appendages appeared to be of nearly equal size on dorsal and ventral surfaces; but he always found the ventral ones cylindrical, and the dorsal ones more papilliform. "The ventral have a well developed terminal plate and bilaterally symmetrical, perforated supporting plates; the dorsal have a rudimentary terminal plate, and the ventral appendages are always more numerous than the dorsal. * * * The disks of the tables are sometimes not very well developed, sometimes round or angular with a large central hole and several peripheral ones, and their margin is often uneven."

Not taken by the *Albatross* expedition. Widely distributed, ranging from Panama and the west coast of South America and Hawaiian Islands through the South Sea Islands to east coast of South Africa, thence to Red Sea, East Indies, Philippines, and China (Hongkong).

*HOLOTHURIA HUMILIS Selenka.

Holothuria humilis SELENKA, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. f. Wiss. Zool., XVII, 1867, p. 339, pl. XIX, fig. 89.

Tentacles, 20; uniformly distributed pedicels. Deposits: Tables, and buttons. Tables with not very large disks and with spire terminating in eight teeth, similar to those of *vagabunda*. Buttons very flat, of usual shape. All pedicels with supporting rods, but ventral alone possessing terminal plates. Calcareous ring very small and of uncommon shape, its ten pieces being very small, round, and brown. Several Polian vesicles; free small madreporic canal. Grayish brown. Length, 130 mm.

"Distinguishable from *vagabunda* mainly by the peculiar calcareous ring, which is unlike that of any other holothurian." (Théel.)

Not secured by the *Albatross* expedition. The Hawaiian Islands constitute the only recorded locality.

[a] Challenger Holothurioidea, Pt. 2, p. 219.

HOLOTHURIA FUSCO-RUBRA Théel.

Plate LXVIII, figs. 3, 3*a–c*

Holothuria fusco-rubra Théel, Challenger Holothurioidea, Pt. 2, 1886, p. 182, pl. VII, fig. 2.

General form robust, subcylindrical. Mouth terminal, directed somewhat ventrally, surrounded by a slight collar. Anus terminal. Tentacles 20, rather long. Dorsal and ventral surfaces well differentiated, the former with rather well-spaced papillæ, the latter with crowded pedicels. In one specimen an indistinct indication of serial arrangement is present near the hinder end of the body. Body wall thinner than usual in the genus. Deposits: Incomplete tables with a spinous rimmed disk and rudimentary spire; occasionally the latter is entirely absent; buttons as a rule incomplete; when complete usually asymmetrical with six or seven holes. Larger buttons are present near the tips of pedicels. Well-developed Cuvierian organs. Color in alcohol purplish brown to a distinct dull magenta in a young example. Length, about 110 mm.; tentacles 10 mm. long.

Localities.—Laysan Island, reef (6 specimens); Necker Island (1 specimen); Hanalei, Kauai (1?, no calcareous deposits).

Most of the specimens are in a bad state of contraction, so that it is not possible to give many details of the external appearance. The papillæ appear to be slightly larger than the pedicels. Those near the tentacles are considerably larger than the rest. The integument is decidedly smooth to the touch, doubtless due to the absence of spires to tables or their feeble development.

The calcareous ring is of the usual form. Polian vessicle single in the specimen dissected. One madreporic canal is present on the right side of the mesentery.

The disks of the tables vary in diameter from about 0.045 to 0.06 mm., 0.05 to 0.055 mm. being the common dimension. The border is uneven and usually spiny. In the smallest tables the disk consists of a simple ring with four spokes meeting at the center. Then two of the crosspieces may have a perforation at the base. There is every gradation from this form to that in which there are numerous perforations about the edge. The simpler disks usually lack the spire, which is almost never complete, even when present. The spire varies from a tiny knob on each crosspiece of the disk to four low rods which are incompletely joined at the summit by transverse pieces. Rarely the crown is complete, when it presents the form of a simple ring with about eight irregular teeth on the border. The latter have no constant occurrence. The principal kinds of tables are figured. The buttons are very incomplete and vary so much that it is difficult to find two alike. They are numerous and are about 0.06 to 0.07 mm. long. In the ambulacral appendages larger buttons with eight or more holes are

present (0.095 mm.). Complete regular buttons have six holes in two rows. Some specimens have more complete buttons than others. The figures will show a few of the principal variations, although, as already mentioned, it is difficult to duplicate any of the irregular patterns. The pedicels have a well developed terminal plate. Near this plate are numerous irregular, but more or less bilateral, fenestrated plates, about 0.08 by 0.18 mm. The dorsal papillæ have the rudiments of a terminal plate and the walls are strengthened by numerous slightly curved rods with short branches along the sides, often uniting to form one or two holes. The tips are slightly expanded and have one or two perforations, or none. Frequently the lateral branches are very short and appear as spines. An average rod is about 0.35 mm. long, although much shorter and slightly longer forms occur. Grotesque incomplete buttons (or plates) of the large variety are present, with fewer complete examples.

According to Théel, this species is most nearly related to *Holothuria curiosa* Ludwig. There appear to be more tables and spires in the *Albatross* material than in the type specimen of Théel, which came from the "Sandwich Islands." Considering, however, the form of the buttons and color of the animals there is little doubt but that my specimens are referable to Théel's species. Clark [a] has recorded this form from Albemarle Island, Galapagos group, and Sluiter from Paternoster Island (Siboga Holothurioidea, p. 15).

HOLOTHURIA ARENICOLA Semper.

Sporadipus (*Acolpos*) *maculatus* Brandt, Prodr., 1835, p. 46.—Lampert, Seewalzen, 1885, p. 73.

Holothuria arenicola Semper, Holothurien, 1867, p. 81, pl. xx; pl. xxx, fig. 13; pl. xxxv, fig. 4.—Théel, Challenger Holothurioidea, Pt. 2, 1886, p. 222.

General form subcylindrical, elongate, blunt at both ends; body rather slender, the ventral surface arched, but not so much so as the dorsal. Mouth small, turned ventrally, the circlet of very small tentacles surrounded by an inconspicuous collar bearing blunt papillæ. Anus terminal, bordered by five angular groups of three to six short papillæ. Tentacles very much retracted, apparently about twenty (which is the normal number for this species). Ambulacral appendages in the form of pedicels more or less scattered. The two ventral ambulacra are well marked, the pedicels being larger and rather closer together than on dorsal surface. A faint indication of arrangement in series is seen. Body wall of medium thickness. Deposits: Buttons and tables; the former rather regular, smooth, with six holes and with the edge regularly indented between each pair of holes; the latter with an annular disk with a very large central hole and a small hole at base of each spire support; exceptionally with more holes;

[a] Proc. Wash. Acad. Sci., IV, 1902, p. 527.

spire made up of four rods, one crossbeam, and a crown ending in twenty to thirty teeth. Supporting rods of pedicels smooth, dilated at the ends and in the middle, where there are several perforations. Color of a well preserved specimen: ground color a grayish white, with a faint suggestion of green, dotted minutely with fine brownish specks. Along the back are two rows of brown spots, fifteen to a row. The fine dots are inconspicuous and less numerous on the ventral than on dorsal surface. Length 145 mm., breadth at middle of body 22 mm.

Locality.— Honolulu, reef, 2 specimens.

Near the extremities of the body on the ventral surface one can distinguish an irregular arrangement of pedicels in four rows. Near the middle this is not so obvious. The two ventral ambulacra are well marked, however, a line and a narrow area free from pedicels passing along the middle of the abdomen. I have not examined a specimen of *monacaria* which has the ventral pedicels in three rows, so do not know how much more obvious the arrangement may be in that species. A second and smaller specimen of *arenicola* has the general tint of the body light brownish and the dark purplish-brown dots much more conspicuous than in the first example. The large spots on the back are rather broken up, consisting of accumulations of smaller spots.

The calcareous ring is rather small. The radial pieces are a trifle longer than broad, truncate anteriorly, with the usual obtuse incision, which is small. Interradial pieces very much smaller than the radial, although about of the same width. They have one anterior tooth, while the posterior border is rather conspicuously excavated; that of the radialia less so; one Polian vesicle; one madreporic canal, free, on the right side of the dorsal mesentery. This agrees with Lampert's diagnosis. Théel mentions two Polian vesicles and a bunch of three small madreporic canals in a Samoan specimen. One of the specimens examined has no Cuvierian organs.

The oval, smooth buttons are very numerous. They vary slightly in length, 0.065 to 0.068 mm. being the average. The width is also variable, 0.027 to 0.0325 mm. being commonest. Although six regular holes are the rule, eight also occur. The disk of the tables has a smooth border and is quadrate-circular in outline. The commonest form is figured (Plate LXVIII, fig. 5). Occasionally there are more peripheral holes, but the regular form is remarkably constant. Viewing the disk from the bottom, the large central hole might be interpreted as four holes, on account of the spire rods. Viewed from the side the tables resemble those of *H. impatiens* with one crossbeam. The disk, however, is altogether different. The spire is about 0.046 mm. high, while the diameter of the disk varies from 0.051 mm. to about 0.065 mm. The number of teeth crowning the spire is variable, but always more than twenty. The supporting rods of the pedicles are smooth, often more simply or more elaborately perforated than

shown in the figure, which represents the average. Their length is about 0.15 to 0.2 mm. The terminal plates of the ventral pedicels are larger (0.37 mm. in diameter) than those of the dorsal pedicels (0.24 mm. in diameter).

This species, which is now, I believe, for the first time recorded from the Hawaiian Islands, ranges from the Red Sea and Indian Ocean to the west coast of tropical America, and in the Atlantic is found on the north and east coasts of South America. The following are the principal stations recorded: Kosseir (Red Sea), Mauritius, Zanzibar, Philippines, Bonin, and Marshall islands, Amboina, Rotti, Sula Besi, Fiji and Samoan islands, Cocos Island off Central America, Galapagos Archipelago, Surinam, and Bahia. The name *Holothuria maculata* (Brandt) is technically invalidated by *Holothuria maculata* Chamisso and Eysenhardt, 1821.

HOLOTHURIA PARDALIS Selenka.

Plate LXIX, figs. 1, 1*a–g*.

Holothuria pardalis Selenka, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. f. wiss. Zool., XVII, 1867, p. 336, pl. xix, fig. 85.

Apparently quite a variable species. Possibly the forms here considered should be classed under two species, *H. pardalis* and *H. lineata;* but without authentic specimens for comparison it is impossible to decide. The various characters grade into one another in such a way that it would seem best to consider the Hawaiian specimens as belonging to *pardalis*. Two of the specimens are quite typical *pardalis* according to descriptions.

Size medium to small; general form subcylindrical, tapering toward either end; mouth and anus terminal; the former surrounded by seventeen to twenty small tentacles, the latter by a crown of papillæ. Ambulacral appendages in the form of pedicels more or less obviously arranged in five longitudinal bands, especially at extremities of body. In half the specimens, however, this regular arrangement is not apparent or at least not obvious enough to be of importance. Ventral surface not clearly defined from dorsal in most specimens; the ventral pedicels with larger disks than the dorsal. Body wall not particularly thick, the exterior fairly smooth. Color variable; thus, a specimen, typical as far as deposits are concerned, was colored in life as follows: Tentacles light yellow; dorsal surface brownish straw color, lighter straw color about pedicels; ventral surface without the mottled appearance, lighter; along the dorsal surface are two rows of dark brown spots, twelve to fifteen in each row. Another specimen is a rather darker brownish, lighter about pedicels; no dorsal spots. Still another has small dark brown spots scattered all over the body irregularly, yellow about pedicels, the two rows of dorsal blotches being rather inconspicuous. Deposits: Tables with a spinous disk, usually somewhat

irregular in contour, and with the low spire ending in about eight teeth, commonly fewer. Buttons both regular and irregular, the latter most numerous, the former of the usual shape with six to eight holes. All buttons are accumulated into rings or circles, or sometimes only in groups. Supporting rods of pedicels, smooth, slightly curved, expanded and perforated at tips. Length, 80 mm.

Localities.—Honolulu, reef, under rocks at low tide (11); Puako Bay, Hawaii (2).

The variations in color and in the arrangement of pedicels have already been touched upon in the diagnosis above. The tentacles are very small, apparently smaller in some specimens than in others, but this is difficult to ascertain with any degree of exactness. The number is certainly variable, seventeen being the smallest number, and this in a specimen otherwise quite typical.

Calcareous ring comparatively small and delicate, the pieces being rather loosely joined. Interradial pieces rather wider than radial, or at least as wide, but of the usual shape. Each radial piece is prolonged slightly farther forward than the interradial and has the usual roundish incision. The anterior edge of the interradialia has a single tooth. Polian vesicles two, rather long. Madreporic canal small, single, free, on right side of mesentery. No Cuvierian organs. Respiratory tree with left branch in communication with rete mirabile of intestine. The gonad in one specimen is large and the strands have a moniliform appearance.

The most characteristic feature of the deposits is the accumulation of the buttons in small circles or circular groups, which may be seen with a hand lens in an ordinary alcoholic specimen. Here they appear as small whitish spots. The diameter of such a circle or group varies from 0.13 to 0.3 mm. The buttons are very frequently incomplete; usually more or less irregular even if complete, when they are of the usual form, with from five to eight holes in two rows. When the buttons are fairly regular, with six holes, the median pair is the larger. Rarely a button has two or three irregular, illy defined prominences on the surface. An average button measures 0.065 mm. in length; many are smaller than this, being only 0.045 mm.; some are as long as 0.08 mm. and appear to be confined to the ambulacral appendages. The irregularity of some buttons is enhanced by a slight twisting on the long axis. Some specimens appear to have a greater proportion of complete buttons than others, while in some individuals the proportion of regular buttons is greater. The form of the tables is better shown by figure than description. The disk is rather variable as to size, ranging from 0.054 to 0.085 mm. in diameter. The edge appears always to be spiny. As a rule the disk is rather stout and either has four perforations, one at the base of each spire support, or eight when the disk is larger and more nearly circular.

Small disks with no peripheral holes and with the spire reduced (1*d*) are not uncommon. All these are found in the same specimen. One or two specimens have the small disks (*d*) and slight variations of of "1*a*" preponderating, few of "1" type being present. In these specimens the spines of the disk are much more prominent and the spire is frequently rudimentary or incomplete. There are many buttons scattered between the circles. Still another specimen has tables of the "1*a*" type in greatest abundance, "1*d*" much less numerous. There is, however, so much variation in the shape of the tables of a single specimen that nothing can be made of slight differences in the deposits of different specimens. The supporting rods are very characteristic, their form being best appreciated by the figures. They vary from about 0.18 to 0.32 mm. in length. The dorsal pedicels have smaller terminal plates than the ventral.

* HOLOTHURIA INHABILIS Selenka.

Holothuria inhabilis Selenka, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitschr. f. wiss. Zool., XVII, 1867, p. 333, pl. XIX, figs. 73–74.

Tentacles 20. Pedicels numerous, uniformly distributed. Deposits: Tables and buttons. Solid tables with twelve spines on margin of disk. The very numerous buttons are of a more unusual shape, symmetrical swollen, with two rows of minute holes, about four holes in each row; the surfaces of the buttons are uneven, owing to the presence of flattened elevations (no knobs), and their margin is deeply undulated. Madreporic body free, very small. In the middle line of ventral surface is a deep longitudinal furrow. Skin thick and rough. Blackish brown. Length 80 mm.

Not secured by *Albatross* expedition. Recorded also from Society Islands.

HOLOTHURIA IMPATIENS (Forskål).

Plate LXIX, figs. 4, 4*a–d*.

Fistularia impatiens Forskål, Descriptiones animalium, etc., 1775, p. 121, pl. XXXIX, fig. B.

Holothuria impatiens Gmelin, Linnæi Systema Naturæ, 13th ed., 1788, p. 3142.

Body elongate; general form subcylindrical, broadest in posterior region. No superficial distinction between dorsal and ventral surfaces. Mouth and anus terminal, the former rather small. Tentacles, 18 to 20, crowded. Ambulacral appendages pedicel-like "papillæ," borne on warty protuberances, which are frequently conspicuously lighter in color than the rest of body. They are fairly evenly scattered over the surface, and do not form series. They have a terminal plate. Perisome wrinkled, and roughened by the spires of the tables, so that the texture is very characteristic. Deposits: Crowded tables and buttons; tables with a subcircular smooth disk pierced by a central and eight peripheral, slightly smaller holes; spire consisting of

four upright pieces and two transverse beams (more rarely one) and the rounded summit provided with numerous teeth. The rather symmetrical, smooth buttons with six holes. Supporting rods are present in the papillæ. Color in alcohol reddish brown; the protuberances being usually lighter. In one specimen they are light yellow, sharply defined against the purplish brown surface. Length, 100 mm.; thickness in widest part, 24 mm.

Localities.—Honolulu Reef (2 specimens), Necker Island (7), Laysan Island (2), Station 3834, south coast of Molokai Island, 8 fathoms (1).

Naturally enough the preserved specimens vary considerably in shape, because of the different degress of contraction. As a rule, however, the body is thicker toward the posterior end, and resembles a minature "summer squash" in general form. The circlet of tentacles is rather narrow. The protuberances of the body are conspicuous, and in some specimens there is an indication of their being confined, beyond the middle of the body, to the ambulacra. The so-called papillæ really resemble pedicels, as there is a terminal sucking disk and plate. Théel on page 181 of the second memoir calls them pedicels, and on page 233 papillæ. They are always found on protuberances however. Judging from alcoholic specimens the color is variable, especially as regards the relative shades of the general surface and the papillæ warts. In some individuals they are not noticeably lighter than the light purplish brown interspace. The ventral surface is a trifle lighter than the dorsal, but otherwise superficially very similar.

The radial pieces of the calcareous ring are much larger than the interradial and project much farther forward. The rounded margin has a deep obtuse incision. The interradial pieces have one short tooth. Madreporic canal single, on right side of mesentery, free for its whole length in body cavity. Polian vesicles two to four. Cuvierian organs in a relatively very large bunch. Longitudinal muscle-bands very thick.

The tables are so crowded that the edges of the disks touch or overlap slightly, and beneath these the buttons form an evenly distributed, crowded layer. The disks of the tables average between 0.08 and 0.95 mm. in diameter, and the robust spire is 0.09 mm. high and about 0.05 mm. in diameter, consists of four upright rods, two crossbeams, and the summit is surmounted by many teeth. A number of the teeth are on a level with the upper crossbeam. The disk is not exactly circular, but tends toward the subquadrate, and is typically pierced by nine holes, forming three rows, the central hole being a trifle larger than the rest. Occasionally as many as six or seven very small perforations are scattered around the margin, between it and the primary holes. The buttons average about 0.09 mm. in length. They are smooth, have slightly undulating margins and obtuse ends. There are

almost invariably six holes. Slightly curved supporting rods, dilated at the middle and perforated at the ends and in the middle, are present in the papillæ. Often the rods have two or three short branches in the middle, or the branches may meet, enclosing a hole. Frequently the tips are not perforated.

*HOLOTHURIA VERRUCOSA Selenka.

Holothuria verrucosa SELENKA, Beitrage zur Anatomie u. Systematik der Holothurien, Zeitschr. f. wiss. Zool., XVII, 1867, p. 338, pl. XIX, fig. 19.

Tentacles 20. Papillæ uniformly distributed. Deposits: Tables and buttons. Tables very solid, the disk with spiny rim. Spire with four upright rods and one crossbeam. Buttons smooth with scalloped margin. Papillæ with numerous spinous or perforated plate-like rods. Polian vesicles, two; one bunch of small madreporic bodies; tentacle ampullæ large. Skin rough. Black, the papillæ bright brown. Length, 180 mm. Lampert found the calcareous ring to be very small.

Not taken by *Albatross* expedition. Recorded also from Zanzibar and Indian Ocean. Sluiter records a specimen from Rotti.[a]

HOLOTHURIA HAWAIIENSIS, new species.

Plate LXVIII, figs. 4, 4*a–g*.

Size small; general form subcylindrical but flattened ventrally, well arched dorsally. Mouth directed somewhat ventrally; anus terminal. Tentacles 30, crowded, not very large. No evident circumtentacular collar. Ventral surface with not numerous, rather large pedicels more or less evidently arranged in three series. Dorsal surface with scattered papillæ, less numerous than the pedicels but of about the same size. Body wall rather thin, minutely roughened. Deposits: Tables and rather irregular buttons, with well developed and numerous supporting rods in the ambulacral appendages. Tables of two or three kinds: (1) Disk with a smooth undulating or irregular margin, with a large central hole and with eight to ten slightly smaller peripheral ones; spire made up of four rods and two or three crossbeams, the crown ending in twelve to sixteen teeth, sometimes irregular, with less. (2) Much smaller tables with usually an annular disk with a large central hole, and one at base of each spire support; sometimes with more; spire with only one crossbeam, the crown either truncate or pointed, irregular, ending in numerous teeth. Buttons accumulated in small rings or circles, or circular groups, and in larger rings about the base of ambulacral appendages; more or less irregular or sometimes slightly twisted, or one-sided, frequently fairly regular; holes vary from four to sixteen, average eight to fourteen; incomplete buttons are common. Color, ground tint light olive brown more or

[a] Siboga Holothurioidea, p. 13.

less marbled on back with raw sienna (yellowish); dark brown about base of papillæ, tip of latter light. Whole body closely dotted with white (the groups of buttons). A specimen from Necker (?) has the ground color Vandyke brown and the marbling is in the form of light yellowish-brown areas about the papillæ. Some papillæ of the type have a light circle about the base instead of one of brown. Length, 45 mm.; width, about 12 mm.

Localities.—Type (Cat. No. 21212, U.S.N.M.) from Station 3876, Auau Channel, between Maui and Lanai Islands, 28 to 43 fathoms; sand, gravel (6 specimens); 3872, same locality, 43 to 32 fathoms, yellow sand, pebbles, coral (2 specimens); Necker Island (probably), (2 specimens).

The tentacles in the dredged specimens seem quite constantly 30 in number, but in a specimen from Necker there appear to be only 25. Inasmuch as they are very retracted, it is entirely possible some have escaped notice or been lost. The form of the tentacle possesses nothing unusual. The pedicels are not always obviously arranged in three rows unless fully expanded. When fully expanded, the dorsal papillæ are pointed, the terminal plate being very rudimentary.

The radial pieces of the calcareous ring are more than twice as large as the interradial, but both elements are of the usual shape. Polian vesicle single, large. Madreporic canal single, free, on right side of mesentery. The gonad is well developed, showing that the specimens are adult. It consists of a thick tuft of simple strands, which are long. Cuvierian organs well developed, forming a tuft at the junction of the two branches of the respiratory tree. Left respiratory tree in connection with the retemirabile of the intestine.

The tables with a tall spire are numerous. There are also many intermediates, between forms *c* and *d* (fig. 4, Plate LXVIII), individuals with two crossbeams to the spire being more common than those with three. The disks of the large tables vary in size, as may be seen by comparing *b* and *d*, 0.073 and 0.063 mm. in diameter, respectively. The tall spires commonly terminate in a small crown of as many as sixteen teeth, frequently less regular than *b*. The small tables either have a pyramidal form (*e*) or are more truncate (*f*). In either case the disk hardly ever reaches 0.06 mm. in diameter, 0.055 being the average. The pyramidal form is commonest, and the crown has eight to twelve short teeth irregularly placed. Occasionally the rim of the tables has a few very short teeth on the margin. This form occurs in the same individual on which the smooth rims are prevalent. On the whole the tables are rather variable, but the average is summed up in the diagnosis. The most characteristic feature of the buttons is their accumulation in circular groups, or fairly large rings surrounding the base of pedicels and papillæ, recalling *H. pardalis*. The buttons vary greatly in size, the ordinary extremes of length being 0.034 to about 0.12 mm., the number of holes ranging from four to sixteen, or

even more. Generally speaking, the large buttons are found about the base of the pedicels and papillæ, being usually the innermost of the group, while the small ones are found in the small intermediate groups and around the outer edge of the ambulacral rings. The majority of the buttons are of the smaller sizes, and are frequently very irregular or even incomplete, the majority having about eight perforations. In a specimen from Necker the buttons average a trifle more regular than in the Auau Channel examples, and have about eight holes, but here, too, there are a great many incomplete, contorted, and generally irregular forms. A rather prevalent variation is shown in 4*f*′, where a loop is formed over the central shaft of the button, and odd processes grow out toward the center from the edge. The supporting rods of the pedicels and papillæ are numerous, curved, expanded slightly at the tips and in the middle, where there are one or two perforations on either side. The expanded tips are often perforated and the edge of the rods is thorny. Forms intermediate with the large buttons are sometimes present. They have a number of perforations along either side of the central shaft. In the papillæ the rods frequently are more elaborate and have branches at the middle which may or may not unite. When they do, a fenestrated plate, which, however, retains its rod-like character, is formed. In the papillæ also are many of the large tables. The end plate of the papillæ is very much reduced, but that of the pedicels is as usual well developed.

This species is characterized especially by having 30 tentacles, dorsal papillæ and ventral pedicels, two or three kinds of tables, one of which has two or three crossbeams, irregular buttons disposed in circular groups and rings. The number of tentacles and general character of the deposits, as well as the ambulacral appendages, ally this form to *H. discrepans* Semper, *H. immobilis* Semper, and *H. samoana* Ludwig. From *discrepans*, *hawaiiensis* differs in having two distinct kinds of tables, neither of which greatly resemble the figures given by Semper;[a] in having the buttons not only about the ambulacral appendages, but likewise in numerous intermediate groups, and in having the buttons very variable in size and frequently irregular and large; in having differently shaped supporting rods; and, finally, in color. The calcareous ring is very characteristic and may furnish an additional difference. Neither *immobilis* nor *samoana* are any more nearly related to *hawaiiansis* than is *discrepans*.

[a] Holothurien, 1868, pl. XL, fig. 7.

HOLOTHURIA ANULIFERA, new species.

Plate LXIX, figs. 2, 2*a–d*.

Size small; general form cylindrical, rather slender. Mouth and anus terminal. Tentacles 20, not large. Dorsal and ventral surfaces well differentiated, the former beset with slender papillæ, forming about six longitudinal, irregular series, the latter with more numerous pedicels in four single series. Body wall rather thin. Deposits: Tables, and small robust rods with knob-like processes, together with incomplete buttons bearing knobs, and very few complete buttons, the small knobby rods being by far the most numerous; these in small circular groups and rings. Tables with a simple annular disk, there being a perforation at the base of each spire support, with often a few additional small perforations; edge spinous. Spire low, as a rule, with four rods, one crossbeam, and the small crown ending in four to eight short, blunt teeth. Comparatively few of the tables have the spire much higher, ending in four teeth and the smooth disk reduced to a simple ring, often without any perforations. Simple and branched supporting rods in papillæ; fenestrated supporting plates in pedicels. Color in alcohol, dorsal surface yellow ocher, lighter about base of pedicels, splashed with small irregular spots of red; ventral surface grayish, more sparsely spotted with red. Length, 55 mm.; width, 8 mm.

Localities.—Type (Cat. No. 21213, U.S.N.M.) from Station 3872, Auau Channel, between Maui and Lanai islands, 43 to 32 fathoms, yellow sand, pebbles, coral; bottom temp., 74.6°; 2 specimens. Station 3876, same locality, 28 to 43 fathoms, sand and gravel; 1 specimen.

The calcareous ring is rather delicate, but the pieces are of the usual shape. The interradialia are much smaller than the radialia, and each are about equally excavated (in proportion to relative size) on the posterior margin. The anterior margin of radial pieces is deeply incised, while that of the interradial is in the form of a single tooth, as usual. Polian vesicle single. Madreporic canal one, on right side of mesentery, free. Gonad fairly well developed. Cuvierian organs present, apparently in a state of development.

The tables are rather delicate and small. When viewed directly from above or below, the spines of the margin are not so apparent as when the disk is seen from the side, because the teeth are directed upward. The disk has a cruciform central hole, and four peripheral ones at the base of each low spire support. Frequently one or two small accessory perforations are present near one or two of the peripheral holes. The diameter of the disk of this sort of table is about 0.04 to 0.048 mm. The spire commonly terminates in from four to eight teeth, eight when fully complete. Sometimes one or two sides

of the subquadrate crown lacks a crosspiece. Occasionally the crown is more circular. A much rarer form of table is shown in figure 2*b*, Plate LXIX. Here the disk is much reduced and the spire correspondingly elongated. This form is apparently confined to the walls of papillæ and to the center of the groups of rods, where there are commonly three or four. The rest of the calcareous deposits are in the form of small knobby rods or very incomplete buttons with knobs, the principal forms being shown in the figures. They vary in length from 0.02 to 0.038 or 0.04 mm. Rarely there is a complete button 0.05 mm. long. A characteristic feature of these deposits is their accumulation in small circular groups or in small rings. They also form large rings about the base of the ambulacral appendages. A relatively few are scattered between the groups, which are rather close together. The supporting rods of the papillæ are curved with a spinous margin; the tips being a trifle expanded, spinous, and commonly perforated. At the tip of the papillæ the rods become smaller, laterally branched, the branches sometimes joining to inclose meshes. Then the rods resemble very open plates. Very rudimentary terminal plates appear to be sometimes present. The papillæ are further strengthened by the peculiar long-spired, small-disked tables already mentioned. The pedicels (of the ventral surface) have very well developed terminal plates, and in the vicinity of these are numerous bilateral curved elliptical fenestrated supporting plates about 0.13 mm. long and with one or two tiers of holes on either side of the central shaft. The margin is often rough or toothed. The tables in the walls of the pedicels are of the ordinary shape with a smooth margin. None of the slender curved supporting rods found in the papillæ are present in the pedicels, except possibly on the transition area between pedicels and papillæ (lateral).

This species is especially characterized by the form of the tables, and the curiously knobbed, mostly incomplete buttons and rods, arranged in circular groups and rings. It is very perplexing and should probably be ranked in Théel's *Holothuria atra* group[a] along with *grisea*, *inornata*, and others. The deposits, especially the knobbed buttons and rods, are entirely different from those of *atra* or any nearly related form. *Anulifera* is also related to *pervicax*, perhaps more closely than to *atra*.

HOLOTHURIA FUSCO-OLIVACEA, new species.

Plate LXIX, figs. 3, 3*a–f*; Plate LXX, fig. 3.

General form stout; subcylindrical, blunt at both ends. Mouth directed ventrally; anus terminal. Dorsal surface well arched and covered with rather widely scattered papillae; ventral surface well

[a] Challenger Holothurioidea, Pt. 2, p. 213.

marked from dorsal and beset with more numerous pedicels without order; pedicels not crowded. Tentacles 18, with fairly large crowns. Circumoral collar slight or not at all present; impossible to tell from condition of specimen. Body wall very tough but not remarkably thick. Color in alcohol: Dorsal surface rather dark olive brown; papillæ surrounded by a lighter ring; ventral surface dull grayish brown or light sepia, tentacles yellowish. Deposits: Tables and rough buttons. Tables of two kinds: (1) Numerous small tables with a simple annular disk bearing blunt spines on the edge and with a cruciform central hole and a perforation formed by the forked base of each spire support; or the disks may be larger with a small perforation at either side of the larger peripheral ones; spire low, made up of four rods; one crossbeam, and a circular crown bearing about 8 teeth; crown often incomplete or irregular, sometimes quadrate; (2) a few very large tables with a large perforated disk, irregular margin, and a spire ending in a single (?) point. Buttons elliptical with two to twenty-two holes, usually four or five, the edge rough, and the surface covered with very many small granular elevations. Length about 65 mm.

Locality.—Station 3834, south coast of Molokai Island, reef near Kaunakakai.

Type.—Cat. No. 21214, U.S.N.M.

In addition to somewhat larger papillæ, comparatively few in number and each in the middle of a light spot, there are scattered between them more numerous smaller ones. The larger papillæ, easily seen by the light spots, form about five very irregular rows. There are also numerous small pedicels scattered among the larger ones. The anal aperture is without special groups of papillæ. Surrounding the tentacles there is a slight ridge with pedicels and papillæ, but it apparently did not form a collar before contraction.

The calcareous ring is moderately stout and of the usual form. The interradial pieces are considerably smaller than the radial. Both are excavated on the posterior margin. Anteriorly the interradials have a single tooth, the radials being deeply incised. Madreporic canal single, free, on the right side of the mesentery. Madreporic body elongate. Polian vesicle single. Gonad small. Cuvierian organs in a large tuft. Left branch of respiratory tree not intimately connected with intestinal vessels.

The disks of the smaller tables have a very characteristic form, as shown by fig. 3, Plate LXIX. The simplest forms have only the four peripheral holes, the larger disks possessing a small perforation on either side of one or more of these. The large central hole instead of being circular is always cruciform. The disks are usually between 0.056 mm. and 0.086 mm. in diameter. The spires are low, made up of four rods and one crossbeam, and a more or less circular crown (which is frequently incomplete), bearing normally eight teeth (hori-

zontal), but sometimes fewer, rarely more. The large tables are very scarce, and the tips of the few seen appeared to have been broken. The form is best shown by the figure. The disk is perforated with several tiers of holes and has no well-defined rim, being irregular from imperfectly inclosed perforations. The spire is about 0.12 mm. in height (relatively too small in drawing) and has two or three cross-beams. Apparently it ends in a single point. The buttons differ much in size. While a very few are smooth, the vast majority are irregularly beset with small protuberances, and the edge is minutely incised. Common forms are figured. The average length varies from about 0.05 to 0.09 mm., but buttons 0.135 mm. or even larger are present in the ambulacral appendages. An average button of the dorsal perisome measures 0.056 mm., but in buttons of this size the number of irregular holes varies from one to eight. Frequently asymmetry characterizes the number and position. The supporting rods of pedicels and papillæ are curved, robust, smooth, with a spiny or scalloped border. The middle is expanded and perforated on either side of the central shaft and the tips are slightly expanded also, commonly minutely perforated. In the pedicels the rods frequently have only lateral processes at the sides, with denticulate ends. These processes, by joining at the tips, form perforations. At base of pedicels and papillæ large rods or buttons of intermediate form are found, rather more sparsely knobbed than the regular buttons. They resemble the largest buttons rather more than rods. When the little protuberances begin to appear on the rods, it is at the edges. Pedicels have large terminal plates; the papillæ small rudimentary ones.

This species is apparently quite unique. At least there are no close relatives.

Genus LABIDODEMAS Selenka.

Labidodemas Selenka, Beiträge zur Anatomie u. Systematik der Holothurien, Zeitsch. f. wiss. Zool., XVII, 1867, p. 309. Type, *L. semperianum*.

Tentacles 20. Ambulacral appendages, pedicels and papillæ, the former in a double series along each of the three ventral radii, the latter in a double series along two dorsal radii, or pedicels alone. Interambulacra naked. Single genital bundle on left side of dorsal mesentery. C-shaped deposits. All deposits absent in one species. No anal teeth. The C-shaped deposits unlike those of Stichopus. Genus differs from *Holothuria* in arrangement of pedicels and papillæ.

*LABIDODEMAS SEMPERIANUM Selenka.

Labidodemas semperianum Selenka, Beiträge, p. 309, pl. xvii, figs. 1–3.

Tentacles 20, very small; pedicels in three ventral double series; papillæ in two dorsal double series. Deposits: Tables, buttons, and C-shaped bodies. Tables with a spire made up of five rods, one cross-

beam, and terminating in about ten teeth. Buttons smooth. Among the buttons many rods and C-shaped bodies. Radialia of calcareous ring much higher than interradialia. One Polian vesicle, one madreporic canal in dorsal mesentery; gonad branched. Color in alcohol (Sluiter) yellowish gray, darker brown at either end; pedicels and papillæ yellowish or bright reddish brown, ventral surface brighter than dorsal, and darker at anterior end.

This species was not secured by the *Albatross* expedition, which is to be regretted, since the type locality is the "Sandwich Islands." Sluiter[a] unites *semperianum*, *selenkianum*, and *dubiosum*. The deposits appear to be more or less variable. The same animal will possess tables with well-developed and small disks, the former having six or seven large holes. The so-called buttons are not typical, but rather to be considered perforated plates with several corners.

If these three forms represent a single species, it thus ranges from the Hawaiian Islands to Tahiti and Fiji Islands, and into the East Indies (Sluiter: Seba, Pulu-Passi-Tanette, Rotti, Timor, Salyer, Elat).

Genus STICHOPUS Brandt.

Stichopus BRANDT, Prodr. desc. animal. Mert., 1835, p. 50.

The following description is by Théel:

Tentacles, 18 to 20. Ambulacral appendages in the shape of pedicels and papillæ, the former arranged in three more or less distinct longitudinal series on the ventral surface, the latter mostly situated on the tops of larger or smaller protuberances, forming rows along the dorsal ambulacra or scattered all over the dorsal surface. Two bundles of genital tubes, one on each side of the dorsal mesentery. Anus devoid of calcareous teeth. C-shaped deposits often present in the perisome.

KEY TO HAWAIIAN SPECIES OF STICHOPUS.

a Dorsal ambulacral appendages present only on the ambulacra. No large tables, with the spire terminating in a single point ..... *chloronotus.*

aa Dorsal ambulacral appendages scattered on interambulacra as well as on ambulacra. Large tables in papillæ, with conical spire terminating in a single sharp point ..... *tropicalis.*[b]

*STICHOPUS CHLORONOTOS Brandt.

Stichopus (*Perideris*) *chloronotos* BRANDT, Prodr., 1835, p. 50.

Tentacles 20; mouth surrounded by a crown of papillæ. Dorsal ambulacral appendages, in the shape of conical warts or protuberances, distributed in a double alternating row along each side of the body, as well as along the dorsal ambulacra; their arrangement in a double row is more distinct in the dorsal ambulacra than on the sides. The odd interambulacrum and those of sides of body naked. Ventral pedicels crowded, the middle row twice as wide as the lateral ones (Lampert).

[a] Siboga Holothurioidea, p. 21.

[b] *S. godeffroyi* var. *b* of authors.

Color, olive brown (olive green, according to Lampert). A single madreporic canal and three Polian vesicles present. Deposits: Numerous C-shaped bodies; tables similar to the small tables of the following species, the truncate spire ending in eight to twelve, or even fourteen, teeth. Disk of tables small. Few incomplete rosettes are present. The pedicels contain spinous rods, very similar to those of *S. tropicalis*. The dorsal appendages are also strengthened by numerous curved, simple or branched rods. Rosettes are not recorded in typical examples.

The following is the distribution of this species as given by Théel and Lampert: Zanzibar (Selenka), Querimba and Mozambique (Semper), Indian Ocean (Ludwig), Mauritius (Haacke, Ludwig), Macassar (Ludwig), Lugunor and Guahan (Brandt), Sandwich Islands (Selenka), Pulo Tikul, Nicobar Islands, Pelew Islands, Molucca Islands, Samoa and Fiji Islands (Semper), Friendly Islands (Théel), and Darros Islands (Bell).

STICHOPUS TROPICALIS, new name.

Plate LXX, figs. 1, 1*a–i*.

Stichopus godeffroyi var. b SEMPER, Reisen im Archipel Philipinnen, Pt. 2, 1. Holothurien, 1868, p. 246.

Body cylindrical, elongate, flattened ventrally, arched dorsally, anteriorly untapered; slightly tapered but truncate posteriorly. Mouth anterior but ventral, surrounded by a fringed papillose collar; anus posterior. Mouth large; circle of tentacles, 20 in number, broad. Tentacles rather short; peltate; the crown convex. Pedicels numerous, disposed in three longitudinal bands on ventral surface, the median band twice as wide as the laterals. Papillæ scattered over dorsal surface. There are four rows (irregular) of very prominent protuberances, nearly as large as a small acorn in the living animal, a series along either side adjacent to ventral surface, and a row on both dorsal ambulacra. Small papillæ scattered over the interambulacra. Integument thick, very minutely roughened by spires of tables, especially on the conical protuberances, where the large tables are abundant. Deposits: Remarkably large robust tables with a conical spire ending in a single point, and much smaller tables of two or three sizes, with a small disk and a truncate spire terminating in eight to twelve points; besides these, C-shaped bodies and small dichotomously branched rods. In the pedicels and papillæ robust supporting rods, dilated and perforated at the middle. Color in life, tentacles, pale greenish gray to whitish; body dark olive green mottled with deep brownish green; in alcohol, dull yellow ocher. Length of preserved specimen, 160 mm.; breadth at anterior end, 32 mm.

Locality.—Honolulu Reef, outer edge (8 specimens); Puako Bay, Hawaii, tide pools (1 specimen).

In preserved specimens the tubercles, which are so characteristic and prominent in live animals, shrink to an insignificant size, except on the anterior end of the body. The collar near the edge is crowded with robust papillæ, which are smaller than the conical protuberances above noted. The papillæ of the interambulacra are scattered and average about 5 to 8 mm. apart. The four series of prominent protuberances are not very regular. In the ventro-lateral series there are twelve to fourteen, and on the two dorsal ambulacra usually two or three more. In the latter region the warts are often very irregularly placed. The tip terminates in a papilla. The pedicels are robust and have a terminal plate. The interval between the middle and lateral bands is equal to about half the width of the latter. In a carefully killed individual it is possible to distinguish a narrow area, running along the center of the ventral surface, free from pedicels, which thus divides the central area of pedicels into two parts. This line is, however, not nearly so conspicuous as the other two free areas. Pedicels extend up to the edge of the circumoral collar.

The calcareous ring varies somewhat with the size of the individual. The radial pieces are much larger than the interradial, and anteriorly the border has four blunt points; posteriorly two. In older individuals the posterior points are more prolonged. The anterior border of each interradial piece has a single point; the posterior border is deeply concave. Although Théel found two Polian vesicles in his Hawaiian specimen, there is but one in three examples I have examined. Madreporic canal and body single, lodged in dorsal mesentery. Gonad forms two tufts, one on either side of the mesentery. In one specimen, collected May 8, the gonad is very large. Respiratory tree very large, branches of the larger tube in connection with the vascular network of intestine.

The deposits are as follows: (1) Large tables, with a broad disk and tapering spire ending in a single or, rarely, in two or three points, and with two or three crosspieces. The spire varies considerably in length, but commonly lies between 0.12 and 0.19 mm. The disk is broad and is usually irregular in outline, rather longer one way than the other, and likewise varies much in size, 0.15 to 0.18 mm. being the average width. The numerous perforations vary from 0.003 to 0.015 mm. in width. These large tables are confined to the basal half of the papillæ of the dorsal and lateral surfaces, being absent from the ventral perisome. The points of the spires can be seen with a hand lens in preserved material, especially near the tips of the conical warts, where this sort of table is very abundant. (2) The small tables are abundant in both dorsal and ventral integument and measure about 0.04 to 0.05 mm. in height. The disk is small and subquadrate, with usually four peripheral holes at the base of the spire supports. The summit of the spire terminates in a variable number of teeth, often as

many as fourteen, but commonly only twelve. (3) Besides these there are still larger tables (Plate LXX, fig. 1*f*) of similar general appearance, but with the spire 0.08 to 0.1 mm. high and the disk about 0.08 mm. in diameter and with more numerous peripheral perforations. These are found at the bases of the papillæ, in a narrow zone, between the ordinary small tables and the large single-pointed variety. It is here that the large tables with two or three points or with the sides of the spire toothed are to be found, forming more or less perfect transitional stages. In the ventral perisome there are comparatively few tables without any, or with only rudimentary, spires. (4) Dichotomously branched rods, 0.03 to 0.04 mm. long, forming more or less incomplete rosettes, are common in the dorsal perisome, but appear to be absent from the ventral, or at least not numerous. (5) C-shaped bodies 0.09 to 0.14 mm. long are present in both dorsal and ventral perisome. (6) Besides these, near the tip of papillæ, and more abundantly in the pedicels, are stout supporting rods, more or less dilated at the center, and perforated. The edges of the rods are finely spinous. These supporting rods vary in length, averaging 0.35 to 0.5 mm. long in the ventral perisome, somewhat shorter in the dorsal, where they often lack the central plate-like expansion and have instead one or more branches with spinous margins. The terminal portion of each papilla is strengthened, not by the rods, but by perforated plates, about 0.9 mm. in diameter, the margins being irregular, often formed of spinous branches of incomplete trabeculæ. The perforations are relatively large. Thus, counting from the base of each papilla, the following deposits are found: Ordinary tables and rosettes, larger tables, transitional tables, conical-spired large tables, supporting rods, supporting plates.

This species lives in tide pools, and is found on the reef, between Honolulu and Waikiki, near the outer edge, where the pools are large and are not cut off from the ocean for any length of time. The animal is dark greenish and rather inconspicuous. One specimen was found to contain a fair-sized fish, *Fierasfer homei*, which had taken refuge in the large respiratory tree, and had its snout protruding through the anal aperture.

The species is apparently most nearly related to *Stichopus horrens* Selenka, from which it differs in having ambulacral appendages on the dorsal interambulacra, as well as on the ambulacra. From *Stichopus godeffroyi* it is distinguished by the C-shaped bodies, which are not found in that species. The present form has been known as *Stichopus godeffroyi* variety b, a cumbersome title, which does not indicate its true relationship. If the form is not a true species it would probably be united with *S. horrens* rather than with *godeffroyi*. There seems little doubt, however, that we have here a true species. *S. godeffroyi*,

lacking the C-shaped bodies, has not been detected in the Hawaiian group. Théel records the present species from the Friendly, Samoan, Fiji, and Pelew islands, and Lampert adds Cebu.

Subfamily SYNALLACTINÆ Ludwig.

Synallactinæ Ludwig, Mem. Mus. Zool., XVII, No. 3, 1894, pp. 8 and 26.

Genus MESOTHURIA Ludwig.

Mesites Ludwig, Zool. Anz., 1893, p. 79. Type, *M. multipes* Ludwig, *nomen nudum*.
Mesothuria Ludwig, Mem. Mus. Comp. Zool., XVII, No. 3, 1894, p. 31. Type, *M. multipes* Ludwig.

Body cylindrical or with slightly flattened ventral surface; no brim. Tentacles 12 to 20. Pedicels on lateral ventral radii always well developed; as a rule small on mid-ventral region (rarely absent); small, scattered and papilliform on back. Deposits: Tables. Body wall thin as a rule. Gonad in a single tuft on left of dorsal mesentery. No tenacle ampullæ. Longitudinal muscles undivided.

MESOTHURIA CARNOSA, new species.

Plate LXX, figs. 4, 4*a-f;* young, Plate LXXI, figs. 4, 4*a*.

Size rather large. General form cylindrical, oblong, tapering abruptly at either end. Body very limp and soft, but integument firm; dorsal body wall apparently thicker than ventral. Mouth terminal but directed ventralwards in life; anus terminal. Tentacles 18 to 20, with rather small peltate crowns. Ambulacral appendages in the form of small pedicels scattered rather thickly over the ventral surface, those of either ventrolateral ambulacrum somewhat larger than in midventral region, where they are very small; pedicels of dorsal surface few, widely scattered and small in size. Here and there are low thickenings of the integument suggesting wart-like swellings. Deposits: Tables of rather large size, very crowded, and composed of a broad disk, irregular in outline with numerous perforations, and a spire composed of four rods, one crossbeam (besides those of crown), and a crown of four upright often divergent teeth, with one to several smaller denticles on sides. In pedicels are comparatively very small tables with three or four uprights and reduced disks. Under the tables, and apparently in the subcutaneous muscle layer also, are smooth, scattered, simple, very delicate, and slender spicule-like rods. Apparently no supporting rods in pedicels. In oral disk and tentacles nearly straight to irregular spiny rods, 0.1 to 0.55 mm. long. (Plate LXX, fig. 4*f*.) Color in life: translucent pinkish white, more or less stained with brownish, often dirty whitish or shade commonly called flesh color. Ventral surface is darker on account of leaden purplish muscle bands of mid-ventral ambulacrum showing through body wall. Tentacles translucent grayish white; crown mottled yellowish white

and grayish brown. Length of largest specimen, nearly fully extended (preserved in formalin), about 250 mm.

Localities.—Type (Cat. No. 21215, U.S.N.M.) from Station 4130, vicinity of Kauai Island, 283 to 309 fathoms, fine gray sand, bottom temperature 46.1°; 13 specimens. Taken also at the following stations (in all 50 specimens):

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
3988	Vicinity of Kauai Island ...	469–195	Gray foraminiferous sand, pebbles.
3997	.....do.....	418–429	Fine gray sand, brown mud.
4021	.....do.....	286–399	Coral sand, foraminifera.
4041	West coast Hawaii Island ..	382–253	Gray mud, foraminifera.
4131	Vicinity of Kauai Island ...	309–257	Fine gray sand.
4132	.....do.....	257–312	Fine gray sand and mud.
4134	.....do.....	324–225	Fine coral volcanic sand.
4136	.....do.....	294–352	Fine coral sand.
4139	.....do.....	512–339	Fine gray sand, rocks.

As noted in the diagnosis above, the number of tentacles varies from 18 to 20, and is frequently 19. Branches of crown are all short, the latter being subcircular and rather flat topped. Width of circle of tentacles over all about 25 mm. Ambulacral appendages very scarce on dorsal surface and scattered, but at hinder end of body they become more numerous, yet remain inconspicuous. Over most of dorsal surface it is difficult to distinguish any pedicels at all without the aid of a glass; but some specimens appear to have more than others. The wart-like thickenings seem to represent much contracted papillæ possibly of a sensory nature, since they are more retracted than the pedicels. On median ventral region the pedicels are easy to see, but are very small, gradually increasing in size toward the ventral-lateral radii. In formalin specimens, which wonderfully retain the life appearance, the mid-ventral radial line is conspicuous owing to transparency of integument. Perisome is minutely roughened by spires of tables.

The calcareous ring is rather soft, and in alcoholic specimens is often much shrunken, giving an appearance of variability. Radial pieces much larger than interradial, with an abrupt deep notch on posterior border on either side of which is a little horn, forming an incipient posterior prolongation. This is apparently obsolete in some specimens. Anterior border has a central narrow notch and on either side a very shallow undulation. Interradial pieces with a prominent tooth anteriorly but not noticeably excavated posteriorly. One large Polian vesicle. Madreporic canal runs forward and upward in dorsal mesentery, the ovoid madreporic body being attached to body wall at anterior edge of mesentery. Ring canal and radial water canals between the former and calcareous ring large. No tentacle ampullæ extending into the body cavity, only rudiments, filling the anterior excavations in calcareous ring. Thus there are two larger ampullæ (interradial) alter-

nating with two smaller (radial), as Hérouard[a] has figured for his genus *Allantis*, but the tentacles do not differ a particle in size. Gonad forms a good-sized tuft on left side of dorsal mesentery. Intestine follows a long S-shaped course. Cloacal cavity large. Respiratory tree large, not in connection with intestinal vessel.

Tables are very crowded, the disks overlapping as much as possible, thereby bringing the spires unusually close together. In the general perisome there are tables with smaller and larger disks, the former about 0.08 to 0.1 mm. in diameter, the latter 0.13 to 0.15 mm. Smaller tables have a large central subcircular perforation and about eight to twelve primary peripheral ones. As the tables increase in size smaller perforations are interpolated at the end. Large disks have two to three series of holes. Margin of disks irregular and often, in large ones, produced into a few irregular tooth-like projections. The spire is composed of four (rarely three) rods; these, extending some distance above the transverse pieces of crown and often flaring somewhat, form the four prominent teeth of the crown. One or two accessory denticulations frequently occur near tip of primary tooth, and one tooth may be longer than the other three, especially in largest tables, thereby causing irregularity. Occasionally also a large tooth projects from the side of one or two of the rods near the crown beams; or a tooth may project from one or more of these transverse beams, but this is not common. The hole inclosed by the crown crossbeams is subcircular as seen from above. Spires of average tables are about 0.08 to 0.087 mm. in height. Pedicels apparently have no supporting rods, but their tables are much reduced in size, having a small annular disk about 0.056 mm. wide. The spire, made up of four or three uprights and one crossbeam, ends in four teeth, with occasionally an accessory horizontal tooth or two. At base of pedicels the tables are intermediate between this very reduced variety and the simpler forms of general perisome. As a rule the tables are variable (in same individual), scarcely two being alike, except in general features. This is especially true of larger disks, both the general contour and that of the perforations being subject to great variation. The figures will serve to show the typical forms. Beneath the tables occur very slender spicules of different lengths. They resemble sponge spicules very closely and are pointed at both ends or rounded. In length they range from 0.08 to 0.3 mm., or even more, in width from 0.002 to 0.004 mm. approximately. These spicules are scattered and appear to be a constant although inconspicuous part of the calcareous deposit. Terminal plates of pedicels resemble those of *Holothuria* rather more than the form figured by Ludwig for *Mesothuria multipes*. They are simple perforated plates with irregular outlines, often elliptical, about 0.28

[a] Holothuries provenant des Campagnes de la Princess Alice, Resultats Compag. Scientif. Prince Monaco, fasc. XXI, 1902, pl. 1, fig. 3 (*Allantis intestinalis*).

by 0.17 mm., although differing widely as to dimensions according to the size of the pedicel.

From *Mesothuria multipes* Ludwig, *M. lactea* (Théel), *M. thomsoni* (Théel), *M. murrayi* (Théel), *M. parva* (Théel), *M. marginata* Sluiter, *M. oktaknemus* Sluiter, and *M. holothurioides* Sluiter the present species differs especially in the form of the tables. These differences can be best appreciated by a comparison of figures. *M. marginata* and *M. holothurioides* have but three rods to the spire and the former has the spire ending in a long thorny point. *M. oktaknemus* has much less robust tables than *carnosa* with slenderer spire ending in longer points. The disks also are different. Other minor differences may be found in the distribution of pedicels and in the form of their terminal plates, although the latter feature may not be of any importance. In life *carnosa* is very soft and fleshy, almost jelly-like except for the firm perisome. This character is admirably retained in formalin specimens, but in alcohol, after the water is extracted from the tissue, the latter becomes thin and leathery. If it were not for this fact one might make comparisons in the character of the body wall of the different species. If one had only alcohol specimens of *carnosa* he would draw absolutely incorrect conclusions as to the appearance of the live animal.

From *M. abbreviata*, *M. incerta*, and *M. squamosa* Kœhler and Vaney, *carnosa* differs in the deposits and also in outward form.[a]

So far as the deposits are concerned, *carnosa* appears to be rather more closely related to *M. intestinalis* (Ascan.) as described and figured by Östergren[b], than to any other known member of the genus. As a comparison of figures will show, the deposits are very much alike, although the three and five rod spires appear not to be present in any specimens of *carnosa* that I have examined. The body wall of *carnosa* is thick and fleshy in life; that of *intestinalis* is described as thin; whether it is so in life I am unable to learn. *M. intestinalis* and *M. verrilli* are hermaphrodite, whereas in *M. carnosa* the sexes are separate.

There are two small specimens from Station 3839 (South coast Molokai Island, 259 to 266 fathoms, light brown mud, sand) much dilapidated, which have peculiar deposits (Plate VI, figs. 4, 4*a*). These specimens, much contracted and compressed, are about 30 mm. long, and so far as can be determined resemble *M. parva*. The disk of the tables is subcircular and pierced by a central and eight peripheral holes of nearly the same size. The spire is composed of four rods and one crossbeam, the crown ending in four slightly diverging spinous tips. Disks are usually not wider than 0.1 mm., and are commonly much more

[a] See Kœhler and Vaney, Deep-Sea Holothurioidea of the *Investigator*, 1905, pp. 10–14; pl. I, fig. 6; pl. IV, fig. 10; pl. IX, figs. 4–11; pl. XII, figs. 19, 20.

[b] Festskrift för Lilljeborg, 1896, p. 347, pl. XVIII, figs. 1–26.

regular than the figure. The specimens may be the young of this species. At least the tables approach nearer those of *carnosa* than those of *murrayi* or *parva*.

MESOTHURIA MURRAYI (Théel).

Plate LXXI, figs. 1, 1*a–b*.

Holothuria murrayi THÉEL, Challenger Holothurioidea, Pt. 2, 1886, p. 185, pl. x, figs. 16–18.

General form oblong, subcylindrical, tapering slightly toward anterior end; rather more so toward posterior extremity. Mouth and anus terminal, but the former directed ventrally. Tentacles 19 to 20, short, and with rather small circular peltate crowns. Ambulacral appendages in the form of different-sized, slender pedicels thickly scattered all over the body, those along either ventrolateral ambulacrum largest. Body wall rather thin in fully extended alcoholic specimens, very minutely roughened by spires of tables. Deposits: Tables with a large, open, subcircular, scalloped to substellate disk having a central subcircular hole and six to eight much larger ovate peripheral primary holes, and frequently in addition as many, or fewer, much smaller secondary perforations at the tips of the spokes separating the primary holes; spire made up of three rods and one crossbeam, flaring at summit, and each rod ending in two or three short multifid prongs. No supporting rods in pedicels, but very much reduced tables with a simple annular almost rudimentary disk and an irregular spire of three rods and one crossbeam. Color in alcohol, dirty whitish, brownish to purplish brown. Length of a preserved specimen, somewhat contracted, 95 mm.

Localities.—Thirty-five specimens were taken at the following stations:

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
		Fathoms.	
3472*a*	South coast Oahu Island	295	Fine white sand.
3813	....do	264–183	Coral sand, lava specks, shells.
3866	Pailolo Channel, between Molokai and Maui.	283–284	Gray mud, fine sand.
3883	....do	277–284	Globigerina ooze.
4088	North coast Maui Island	308–306	Fine gray sand.
4096	Northeast approach, Pailolo Channel	272–286	Do.

a Cruise of 1891, 3 specimens.

Since no specimens of this species were kept in formalin, it is not easy to surmise the form of the living animal. Breadth of circlet of tentacles about 10 to 12 mm. A characteristic feature of this species is the diversity in size of pedicels, those along either ventrolateral ambulacrum being much larger than any others and forming a well-defined band. The smaller, more or less papilliform, slender pedicels

of dorsal surface are rather numerous and are of several sizes, but all smaller than the ventrolaterals. Pedicels of mid-ventral region small and inconspicuous, and frequently more or less completely retracted into body wall.

Radial pieces of calcareous ring considerably larger than interradial, posteriorly rather deeply excavated, the anterior border with three notches, the central the deepest (lateral ones sometimes very small). Interradials are not excavated posteriorly, and have a prominent tooth anteriorly. Madreporic canal runs forward in the dorsal mesentery and gradually upward, the madreporic body being fastened to the body wall at the anterior edge of the mesentery. Polian vesicle single. No tentacle ampullæ extending into body cavity, the rudiments of these merely occupying the space in front of the calcareous ring. The "ampulla" on either side of the anterior tooth of interradial piece is much larger than those of radial pieces, as in preceding species, in consequence of difference in size of the component parts of calcareous ring; but there is no corresponding difference in size between the tentacles. Gonad forms a large tuft on left side of mesentery. Respiratory tree well developed. Intestine follows a simple S-shaped course. Longitudinal muscle bands rather small.

The disks of the larger tables of general perisome have a width of 0.135 to 0.18 mm., and the spires a height of 0.10 to 0.15 mm. In outline the disks are often fairly regularly scalloped (Plate LXXI, fig. 1*b*), especially when there are no secondary perforations. The primary peripheral holes are always larger than the central and are commonly ovate in outline, or subcircular. The secondary perforations are formed by the forking of the spokes separating the primary holes. The framework of disk is rather delicate, the spokes being heavier than rim. The spire flares more or less toward the summit, and the three rods terminate in two (sometimes three) irregular denticulate prongs; or the prongs are occasionally obsolete. The amount of divergence of the terminal portion of rods and the distance between their tips and the point where the three meet is subject to some small variation, the figures showing two typical examples. (Plate LXXI, figs. 1*a–b*.) The distance between the disk and crossbeam is always less than the distance between the latter and the point of divergence of the crown prongs (which depart from one point, as it were, since there is no hole between them, as is usually seen when viewing a table from above). In the walls of the pedicels the tables are small and irregular, as well as variable, many of them being reduced to lowest terms. The disk is a simple ring (no peripheral perforations) from which arise the three spire supports, which commonly terminate in a cluster of blunt teeth or in one or two sharp ones. The teeth are scattered along the side of terminal portion of the rod. Terminal plates of pedicels vary in size. They are simple circular perforated

plates, the perforations of center being largest and the edge more or less ragged from incomplete perforations. Sometimes there is a large central hole. In the smaller plates the perforations are more irregular as to size and shape, the trabeculae often being uneven in diameter. Diameter of plates range from 0.13 to 0.28 mm.

These specimens, if not actually *M. murrayi*, represent an exceedingly close relative. Some slight differences are discernible. For instance, the tables of Hawaiian specimens usually have larger disks, the framework of which is more delicate than in Théel's types, and the form of the crown presents a few minor points of difference, as can be appreciated by a comparison of figures. The deposits, however, are very variable, and the robustness of the tables seems to be at least partially correlated with the softness of the mud and sand upon which the creatures dwell, the more delicate tables being found in specimens taken from ooze or soft mud. Disks such as *h* (Plate LXXI, fig. 1) will be found in some parts of the perisome (usually near extremities of body) while 1 and 1a will be present in other parts. But some examples present a great predominance of the "*h*" type (without secondary perforations), while others will have the "1" type in greatest abundance. One or two specimens have the tables decidedly irregular, but are otherwise normal. Hawaiian specimens apparently have more dorsal pedicels than Théel's types, but this is a hazardous conclusion to draw from the description, however good the latter may be. Despite these small differences, which may be of specific importance, I prefer to range the specimens under *murrayi* and call attention to discrepancies. When a critical comparison of specimens from widely separated localities can be made, it may be desirable to recognize several nearly related species, which are now grouped under this name. Sluiter[a] has recorded the species from 400 and 522 meters in the East Indies, while Théel's types came from 1,375 fathoms, globigerina ooze, near Juan Fernandez. He also mentions, with doubt, a specimen from off the Straits of Gibraltar, but Héronard[b] records the species from near the Azores, thus confirming the presence of the form in the Atlantic.

As to the relationship of this with the following species a rather knotty problem arises. A few notes will be found under *Mesothuria parva*.

[a] Die Holothurien der Siboga-Expedition, 1901, p. 24.

[b] Holothuries provenant des Campagnes de la Princess-Alice, Résultats Campag. Sci. Prince Monaco, fasc. XXI, 1902, p. 23.

MESOTHURIA PARVA (Théel).

Plate LXXI, figs. 2, 2*a–c*.

Mesothuria murrayi var. *parva* THÉEL, Challenger Holothurioidea, Pt. 2, 1886, p. 187, pl. IX, fig. 2; pl. XVI, figs. 4, 5.

General form and appearance almost exactly like that of preceding species. Tentacles 18 to 20. Pedicels of divers sizes scattered all over body, those of ventrolateral ambulacra largest, there being one or two irregular series especially large. Median ventral pedicels extremely small and scattered, often very few in number; those of dorsal surface smaller than ventrolateral and fairly uniform as to size, though some difference is discernible; pedicels, on the whole, rather less numerous than in preceding species. Body wall rather thin. Perisome roughened by spires of tables. Deposits: Tables composed of a large disk with a central and numerous peripheral perforations, and a spire of three rods with spinous apices; one cross beam. (For shape of deposits see Plate LXXI, fig. 2.) No supporting rods to pedicels, whose tables are much reduced in size. Color in alcohol either yellowish white or purplish gray. Length about 95 mm. or less.

Localities.—Forty specimens from following stations:

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
3895	South of Molokai Island	252–429	Coral rocks.
3919	South coast Oahu Island	257–220	Gray sand.
3998	Vicinity of Kauai Island	235–228	Coarse brown coral sand, shells, rocks.
4081	North coast Maui Island	202–220	Gray sand, foraminifera.
4115	Northwest coast Oahu Island	195–241	Coral sand, foraminifera.
4122	Southwest coast Oahu Island	192–352	Coarse coral sand, shells.

Label lost from one bottle of 20 specimens.

The internal organization presents no marked points of difference from that of the preceding species. The calcareous ring is of the same general form; tentacle ampullæ same. The ring canal and proximal portion of the radial canals are large. Polian vesicle single. Madreporic canal, gonads, and respiratory tree practically identical with those of *M. murrayi*.

The tables differ from those of the preceding species in being much crowded. They overlap markedly as in *M. carnosa*, whereas in *M. murrayi* they are not nearly so closely placed. Besides the difference in form, which is more readily appreciated by a comparison of figures, the disk in *M. murrayi* is frequently considerably larger. The disk in *M. parva* is more robust, with a greater number of perforations, and the spire is lower and stouter, the crown being more compact and variable. Typical *parva* as figured by Théel has no central perforation in the crown, as is frequently the case with Hawaiian examples. Diameter of disk averages about 0.12 mm., height of spire about 0.085 mm.

Externally the species is practically indistinguishable from the foregoing. Some specimens of *parva* have apparently fewer pedicels on the midventral region, and less diversity, especially in small individuals, in size of dorsal pedicels. The species can always be readily separated, however, on the character of the tables. It will be noticed that *parva* lives on a hard bottom and *murrayi* on a soft. Just how much significance this fact has in accounting for differences in the structure of the calcareous deposits it is impossible to say. These two species exemplify very well one of the difficulties which constantly besets a systematist. Taking the specimens as a whole, two views are possible concerning them: (1) That the two forms represent one variable species; (2) that the two forms are specifically distinct. In the present case, (1) have we one variable species which differs widely according to the nature of its particular environment, whether it be soft, oozy mud, or hard sand and shells; or (2) have we two closely related but distinct species, each dwelling on a different sort of bottom? I have followed the latter view, since there appear to be no intermediate forms, and since I have no difficulty in separating the species, upon an examination of deposits. That the forms are very close is manifest; but it is a well-known fact, not generally appreciated, that all species are not necessarily separated from their nearest congeners by the same degree of difference. In the present case the question also arises as to whether these two species are to be identified with already known but distantly dwelling forms, or are to be regarded as new but closely allied kinds. Since this has to be decided by literature and not specimens I have chosen the more conservative course, although it may not be the correct one.

Mesothuria parva was taken by the *Challenger* in 150 fathoms, coral mud, near Admiralty Island.

Genus BATHYPLOTES Östergren.

Bathyplotes Östergren, Zur Kenntniss der Subfamilie Synallactinæ unter den Aspidochiroten, Zoologiska Studier, Festsch., Wilhelm Lilljeborg, 1896, p. 351. Type, *Stichopus natans* Sars.

Mouth ventral to subventral, anus subdorsal to nearly terminal. Ventral surface more or less flattened, with the rows of pedicels on all three or only on the two lateral ambulacra. Dorsal surface arched with a double row of papillæ along each radius, and often besides with small papillæ scattered sparingly over the interradii. Dorsal papillæ sometimes very irregular in distribution and a ventral-lateral series in addition to pedicels sometimes present. Tentacles 15 to 20. Gonad in two tufts (a right and a left). Longitudinal muscles undivided. Calcareous deposits: Tables with usually a four (three to eight) armed disk, bearing a spire of an equal number of rods; C-shaped spicules usually present.

BATHYPLOTES PATAGIATUS, new species.

Plate LXXII, figs. 1, 1*a–k*.

Body rather long and narrow, truncately rounded at either end; ventral surface flattened; dorsal somewhat arched in life. Mouth terminal but ventral; anus dorsal. Tentacles 19 to 20, rather small; crown subcircular, peltate. Median ventral ambulacrum without pedicels. A single, somewhat irregular series of numerous small pedicels along each ventrolateral ambulacrum, and immediately above these, on edge of body, another series of numerous small, warty excrescences, terminating each in a slender papilla. These form a narrow, overhanging brim to body, especially well marked at anterior end. On dorsal surface are widely scattered, fair-sized conical protuberances, terminating in a long, slender papilla. In life body wall is rather of a thick "jelly-fish" consistency, the external perisome being easily rubbed off. Deposits: In ventral perisome tables with small annular disk, sometimes incomplete, and a spire composed of four upright pieces, three to five crossbars and a crown ending in four simple teeth; in the dorsal perisome disk is transformed into a four-armed cross, perforated at tips, and the spire is frequently spiny along uprights. At base of papillæ disks are greatly enlarged, the ends of the four-armed crossbeam being much dilated, and the spires are also stouter and spiny on uprights. In papillæ the spires are very tall, with as many as nine or ten crossbeams, the disk becoming reduced by degrees to the annular form. In papillæ curved, spiny supporting rods in addition to tables; in pedicels well-developed terminal plates and small tables, similar to those of ventral perisome, in addition to a very few supporting rods near the end plate. In subcutaneous muscle layer, in walls of gonad, of cloaca, and intestine numerous C-shaped bodies are present. Color in life, outside jellylike tissue transparent grayish, with a tinge of pink, the central "core" of animal being bright rose pink, with a yellowish shade in places. Length, 155 mm.; breadth, 14 to 20 mm.

Localities.—Type (Cat. No. 21216, U.S.N.M.) from Station 4041, west coast of Hawaii Island, 382 to 253 fathoms, gray mud, foraminifera; bottom temperature 41.6°. Cotype (deposits), 3994, vicinity of Kauai Island, 330 to 382 fathoms, fine gray sand, foraminifera. Taken also at the following stations, 14 specimens, most of them in very poor condition:

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
		Fathoms.	
3824	South coast of Molokai Island	222–498	Coral rocks, broken shells.
3988	Vicinity of Kauai Island	469–165	Gray foraminiferous sand, pebbles.
4021	.....do	286–399	Coral sand, foraminifera.
4134	.....do	324–225	Fine coral sand and volcanic sand.
4140	.....do	339–437	Fine gray sand.

Owing to the fact that the animals have rid themselves of most of their viscera it is difficult to tell exactly what the life habit may have been. The body is much depressed, and on the best preserved specimen the narrow serrate brim is easily seen. This is especially well marked in the vicinity of the anterior end, and causes the mouth to be ventral. The marginal papillæ are here close together but farther caudad are more spaced. They arise from fairly broad conical bases and are about 2 to 3 mm. in length. Pedicels are about same length and have a well-developed terminal disk. Pedicels and lateral papillæ are apparently in about equal numbers, although on account of injuries to the margin some of the latter have been rubbed off. Dorsal papillæ are larger than the laterals, being about 4 to 5 mm. long in a contracted state. Although found in the neighborhood of each dorsal ambulacrum they are not at all regularly arranged, sometimes forming transverse rows of three or four, or occurring isolated here and there in the middorsal region.

Calcareous ring is rather small, the interradial pieces being very much reduced. The figure (Plate LXXII, fig. 1*j*) will sufficiently show the form. Madreporic canal single, running forward in dorsal mesentery to become attached by the madreporic body to body wall at anterior edge of mesentery. Ring canal and proximal portion of radial canals conspicuous. No tentacular ampullæ hanging free in body cavity. Polian vesicle single, large. Gonad divided into a right and a left tuft. Tubules twice dichotomously branched, their walls containing C-shaped deposits. Respiratory trees fairly well developed, composed of a right and left branch springing from a common base and over half as long as animal. Wall of cloaca crowded with C-shaped deposits, which are present also in the wall of intestine, but in not nearly so great numbers. Longitudinal muscle bands single, ribbon-shaped.

In the type specimen the calcareous deposits have been severely injured by acid. The figures have been drawn from deposits of a smaller specimen, which is much contracted and distorted. Most of the perisome had been scraped off of specimens from this station. The tables of the ventral perisome are smaller and simpler than those of papillæ and their intermediate neighborhood. These tables have usually an annular disk with four large holes formed by the simple diagonal bars, but occasionally the ring is incomplete, or one or more small peripheral holes may be present, as indicated in the figures. (Plate LXXII, figs. 1, 1*b*.) Disks of this type measure 0.046 to 0.08 mm. in diameter, and the spires (fig. 1*d*) are commonly 0.067 to 0.09 mm. high, with three to five crossbeams. The interval between the first and second beams is always greater than that between the others. The upright pieces are nearly parallel and terminate in four simple teeth. These tables are commonest in the ventral and lateral peri-

some, but whether they are confined wholly to this region it is impossible to say on account of the condition of available specimens. Tables of the dorsal perisome are of the type shown in fig. 1*a*, Plate LXXII. The disk is a four-armed cross, with the tips of the arms slightly expanded and one to five times perforated. The spire rods are toothed on the upper half, the spire itself being about 0.12 to 0.15 mm. high, with five crossbeams. Rarely the teeth are absent. At the bases of the large dorsal papillæ, and to a less extent of the laterals also, are relatively very large tables with four-armed disks and robust spiny irregular spires. (Plate LXXII, fig. 1*c*, *e*, *g*.) The disks are from 0.3 to 0.47 mm. in diameter, and the ends of the arms are much expanded and perforated. The general form of the tables is sufficiently indicated by the figures. The spire of this table is 0.2 mm. high, but there is considerable range on both sides of the dimension. The tables in the papillæ proper are more of the type of those of ventral perisome, although much exaggerated in height (fig. 1*f*). They are usually numerous and grade into the type of *a* and *e* at base of papilla. The spire is usually about 0.17 to 0.2 mm. high. Scattered among these tables are relatively few supporting rods with spiny tips (1*i*, 1*k*) about 0.5 mm. long. So far as examined the pedicels have scattered tables similar to fig. 1*d*, but with only one or two crossbeams. Frequently two or three supporting rods are present near terminal plate, though they may be entirely absent. The terminal plate is large, circular, and perforated.

This species is characterized by the distribution of the ambulacral appendages, by the presence of a narrow but easily detected margin or brim to body, by the form of the tables, and by the form of the calcareous ring. It differs from all known species by the form of the calcareous deposits. Sluiter (Siboga Holothurioidea) has described *B. sulcatus*, *B. rubicundus*, *B. monoclus*, and *B. phlegmaticus* from the East Indian region. The present species is apparently nearer *phlegmaticus* than any of the others, but differs in all the categories of characters mentioned above, besides having 20 tentacles while *phlegmaticus* has 15. Kœhler and Vaney have described from the *Investigator* collections, *B. profundus*, *B. crenulatus*, *B. assimilis*, *B. variabilis*, and *B. papillosus*. The deposits of all of these are different from those of *patagiatus*.

Patagiatus is more or less closely related to *B. natans* (Sars) which it resembles in the marginal papillæ and brim, but differs in numerous details of deposits, etc. (for figures of *natans*, see Östergren).[a]

[a] Zur Kenntniss der Subfamilie Synallactinæ unter den Aspidochiroten.

Genus PSEUDOSTICHOPUS Théel.

Pseudostichopus THÉEL, Challenger Holothurioidea, Pt. 2, 1886, p. 169. Type, *Pseudostichopus mollis* Théel.

Tentacles 19 to 20; no tentacle ampullæ; madreporic canal attached to body wall; ventral surface flattened (more or less); ambulacral appendages in the form of unusually small, inconspicuous pedicels and papillæ which are more or less clearly arranged in longitudinal series; gonad in two bundles (a right and a left); anus in a perpendicular furrow, without teeth; perisome without calcareous deposits, except in some species about anus; pedicels with terminal plates and deposits in one species; deposits sometimes present in walls of genital tubes and respiratory tree.

PSEUDOSTICHOPUS PROPINQUUS, new species.

Plate LXXI, figs. 3, 3*a–b*; Plate LXXII, figs. 2, 2*a*; Plate LXXIII, fig. 3; Plate LXXIV, fig. 1; Plate LXXVI, figs. 3, 3*a–b*.

Contour of body as viewed from above or below rather broadly elliptical; ventral surface slightly arched, dorsal surface decidedly so. Mouth directed ventrally, but terminal. Anus in a prominent vertical furrow at extremity of body; more ventral than dorsal. Anal furrow, caused by the body growing caudad on either side of anus, forming two prominent mammillated processes. Tentacles 18 (to 20 ?) with small circular peltate crowns; entirely retracted. Ambulacral appendages for the most part very inconspicuous and small, in the form of minute pedicels (?) and papillæ scattered along ambulacra; those of either ventro-lateral ambulacrum most prominent on account of a single irregular row of small mammiform tubercles extending from caudal process forward, and connecting with series of opposite side in front of mouth. In addition, minute, thread-like papillæ are scattered on either side of these tubercles which are capped by very slender pedicels or papillæ; and a very few are to be found in mid-ventral region; papillæ of dorsal ambulacra very slender, long, and thread like; apparently not regularly arranged. Perisome devoid of any calcareous deposits; no supporting rods or terminal plates in ambulacral appendages. Walls of gonad and respiratory trees contain branched rods. Body wall translucent, rather thin except along either edge, which is thickened by a subcutaneous jelly-like substance, forming a sort of rim to the body. More or less mud, sponge spicules, and foraminifera cling to integument, especially on ventral surface. Color in alcohol, translucent whitish. Length of largest specimen, about 50 mm.; width, about 25 mm.

Locality.—Station 3866, northeast approach to Pailolo Channel, between Maui and Molokai islands, 283 to 284 fathoms, gray mud, fine sand; bottom temperature 43.8°; 2 specimens.

Type.—Cat. No. 21217, U.S.N.M.

On account of the tentacles being entirely retracted, as well as small, it is difficult to compute the number exactly; 18 were found, but it is entirely probable the number is as high as 20. Crowns of tentacles are of the usual aspidochirot form. The mouth is decidedly ventral when tentacles are retracted. It is encircled in front (but not caudad) by the continuous series of small tubercular papilliform processes which mark the ventro-lateral ambulacra. Each of these processes is surmounted by one or sometimes two slender papillæ. When retracted partially they resemble pedicels. There appear to be numerous pedicels also, however, as determined by microscopic examination. The absence of any terminal plate in the ambulacral appendages as well as their small size renders any distinction rather risky. In the smaller specimen I was able to make out a number of very small papilliform pedicels along mid-ventral region, where the longitudinal muscle shows through body wall in larger example, but in the latter only a very few exceedingly minute pedicels are discoverable. Scattered along either side of the more prominent ventro-lateral pedicels and papillæ are numerous smaller very inconspicuous ones, to be seen readily only with a bright light and a strong glass. No regular arrangement can be made out. Along the two dorsal ambulacra are scattered a few long, very slender papillæ, which appear to form a double row in the anterior portion, at least. Some of these papillæ are very thread-like. On account of the difficulty in seeing them it is impossible to give a thoroughly accurate account of their arrangement. A few in anterior portion of body, just behind the supraoral collar, are larger than the rest.

The calcareous ring is a trifle variable and irregular. The dorsal radial pieces seem a trifle heavier than ventral and differ slightly in shape. The component pieces are delicate and readily injured. The form is seen better by figures (Plate LXXII, figs. 2, 2*a*) than description, both dorsal and ventral being shown. Some radial pieces have a slightly more deeply excavated posterior margin, but, as a rule, it is shallow (fig. 2*a*). Polian vesicle single. Madreporic canal minute, running forward in dorsal mesentery below genital duct; no madreporite was discovered. Ring canal large; proximal portion of radial canals large. No tentacle ampullæ, except mere rudiments. Gonad consists of about ten unbranched slender tubes on either side of dorsal mesentery, which is more or less perforated in this region. Eggs are fairly well developed, so this specimen is probably mature. Respiratory trees, two, springing from a common base. Longitudinal muscles form a single cylindrical band along each radius. Intestine large, gorged with mud and sand.

The only calcareous deposits are those contained in walls of gonad and respiratory tree. They are irregular branched rods, smooth

except for an occasional spine. No two are exactly alike. Those of gonad are apparently larger than those of respiratory tree. The former measure from about 0.09 mm. up to 0.22 mm., while the latter seldom exceed 0.12 mm. in length. Rarely a small rod is unbranched. The figures will give a good idea of typical shapes.

This species is probably closely related to *Pseudostichopus mollis* Théel. It differs, apparently, in having a row of small but fairly conspicuous wart-like processes forming an inconspicuous fringe, as shown in the figure. The calcareous ring is of a slightly different form, and the calcareous deposits of genital and respiratory tubes are more branched and smaller. The dimensions may vary with age, however. The dimensions given by Ludwig[a] are about twice as great as those attained by deposits in this species. The internal organs are much as described by Théel and Ludwig for *mollis*. This species differs, by the presence of the deposits, from *Pseudostichopus trachus* Sluiter and *Pseudostichopus pustulosus* Sluiter from the East Indian region. *Pseudostichopus occulatus* von Marenzeller from the region of the Azores resembles this form in its deposits, but differs in the outer character of form, distribution of ambulacral appendages, etc., as well as in the presence of end plates in pedicels and deposits around the anus.

Genus PÆLOPATIDES Théel.

Pælopatides Théel, Challenger Holothurioidea, Pt. 2, 1886, p. 154. Type, *P. confundens* Théel.

Tentacles 12 to 20, peltate, or subdigitate on the margin of crown; no tentacle ampullæ; body more or less depressed often with a conspicuous overhanging border bearing a single series of numerous papillæ; this border or brim obsolescent in some species except at fore and hind ends of body; pedicels form a double row on hinder third or two-thirds of mid-ventral radius, and in some species also a single row along either ventro-lateral radius, in addition to papillæ; single series of papillæ on dorsal ambulacra; gonad in two tufts, a right and a left; mouth ventral; anus dorsal or subdorsal. Deposits, when present, simple, triradiate or four-armed rods, either smooth or spiny, with slightly branched tips; deposits often entirely wanting. A rete mirabile sometimes present.

PÆLOPATIDES RETIFER, new species.

Tentacles, 19 to 20, rather large; crown subcircular, fleshy, four or five times divided, peltate. General form short and stout; length two and one-half to four times width. Ventral surface more or less flattened, the dorsal markedly convex. Mouth ventral, anus dorsal. Mid-ventral radius with a double row of good-sized, spaced pedicels (about 28)

[a] Mem. Mus. Comp. Zool., XVII, No. 3, 1894, p. 12.

which extend about two-thirds length of animal, from posterior end. Along each ventro-lateral radius is a series of about ten rather large pedicels which extend from posterior end to about middle of body. Above these on edge of body is a single continuous series of papillæ, which form a conspicuous brim only at anterior and posterior extremities, above mouth and below anus, respectively. Along each dorsal ambulacrum is a fairly regular series of widely spaced, slender papillæ usually difficult to discern. Body wall thick and jelly-like in life. External perisome very thin and easily rubbed off. No calcareous deposits of any description. *An extensive rete mirabile present.* Color in life, the mass of soft jelly-like tissue a milky pinkish, becoming a pale pinkish lilac about mouth and tentacles; viscera show a yellowish tinge through the translucent body wall; purple about tentacles, sometimes deeper in shade; perisome minutely dotted with dark purplish, the dots being numerous, but very inconspicuous unless examined with a glass. Length, 135 mm.; breadth, 35 mm.

Localities.—Type (Cat. No. 21218, U.S.N.M), Station 4151, vicinity of Bird Island, 800 to 313 fathoms, fine coral sand foraminifera, stones; bottom temperature, 38.8°. Cotype, Station 4110 Kaiwi Channel, between Molokai and Oahu islands, 449 to 460 fathoms, gray sand. Taken at following stations, in all 23 specimens, the majority very imperfect:

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
3887	North coast Molokai Island	552–809	Globigerina mud.
3979	Vicinity Bird Island	222–387	Fine white sand, foraminifera, rocks.
3995	Vicinity Kauai Island	427–676	Fine gray sand, rocks.
4019	do	550–409	Gray sand, foraminifera, rocks.
4022	do	399–374	Coral sand, foraminifera, rocks.
4028	do	444–478	Gray sand globigerina.
4038	West Coast Hawaii Island	689–670	Gray mud, foraminifera.
4039	do	670–697	Do.
4141	Vicinity Kauai Island	437–632	Volcanic sand, foraminifera.
4176	Vicinity Niihau Island	672–537	Gray sand, mud, foraminifera.
4187	Vicinity Kauai Island	508–703	Gray sand, foraminifera.

Most of the specimens are badly dilapidated on account of the extreme delicacy or softness of the outer portion of the body wall. Rough usage in the dredge has removed a large part of the perisome and many of the pedicels, papillæ, and even tentacles from the majority of specimens. The diagnosis and description are gathered from three specimens, reasonably well preserved. The absence of deposits makes the identification of this species a difficult matter, but I believe I am justified in considering it a new form, in view of the differences which appear to exist between it and its apparent nearest relative. The form of the body varies with the state of contraction, but seems to be thickest in the middle, the anterior and posterior ends being bluntly rounded, the former with a well defined rim of papillæ. Although the mouth is ventral, it is at the end of the body and is surrounded by a fairly broad peristome. The tentacles are about 5 to 8 mm. long, unless

contracted, and are surrounded by a narrow rim or collar independent of the papillæ and very inconspicuous. The crowns of the tentacles remind one of miniature cauliflowers. Pedicels of mid-ventral radius are usually retracted flush with level of perisome so that it is difficult to get an idea of their size. They are not exactly paired, but seem to alternate in the two rows. Between the anterior end of these series and the mouth I was able to discern, in one specimen, three or four widely separated, much smaller pedicels which seemed to continue the two series. The larger pedicels are about 8 mm. apart and the two series about 6 mm. Pedicels of lateral radii are wholly ventral in position and appear to increase in size as they proceed forward. In the only specimen in which they are at all expanded they appear to spring from a rather fleshy base, are about 6 mm. long, and appear larger than mid-ventral pedicels. As noted in the diagnosis this series does not extend farther forward than middle of body. Separated from the pedicels by about 6 or 7 mm. is the continuous series of numerous papillæ which form a border completely around body, but well marked only in the anterior and posterior portions. This border is very delicate and has been scraped off of the majority of specimens along sides of body. The only ambulacral appendages, therefore, on the lateral radii in anterior half of body are the papillæ. These are more numerous in the posterior half than the adjacent pedicels, are slender, and not particularly conspicuous. In vicinity of mouth the papillæ are about 10 to 12 mm. long, purple in color, and two or three appear often to spring from a common base, although this appearance may be due to injury. Papillæ along sides of body are very numerous, but on account of frequent imperfections it is impossible to ascertain exact numbers. It must be remembered that these papillæ do not form along the edge of the body such a conspicuous rim as is present in *P. confundens*. In fact, a brim is apparent only at the two extremities. Neither can the mouth with tentacles be retracted as is apparently the case with *confundens*. The longest dorsal papilla near anterior end of body is 18 mm. and very slender. The papillæ appear to decrease in size as they proceed caudad.

No calcareous ring. Madreporic canal single, in dorsal mesentery. No free tentacle ampullæ. Polian vesicles two, of about equal length, 40 mm. long; in one specimen of somewhat unequal length. Tissue between ring canal and base of tentacles dotted with purple. Gonad in two tufts, the tubules once dichotomously branched. Intestine with a large, lobed, fleshy diverticulum about 25 mm. behind ring canal. Respiratory tree very large, the right branch when perfect reaching as far forward as ring canal. The tube is large and the side branches, which are scattered along its whole length, have also rather wide tubes, ending in more finely branched dendritic vesicles. The left tree is not quite half so long as the right, but is much more intri-

cately and fully branched, having a very bushy appearance. It is in relation with an extensive and conspicuous rete mirabile of the intestine. This rete mirabile, which is as well developed as in some species of *Holothuria*, begins about 30 mm. behind the diverticulum of intestine and extends over 100 mm., occupying nearly all of the first large, backwardly directed U-shaped tract of the intestine. The vessels of the plexus are wonderfully numerous, being larger in the anterior portion of the rete mirabile than in the posterior (with reference to intestine, since the morphological posterior end of plexus is a little anterior to the front end, on account of U-shaped twist of alimentary canal). Longitudinal musele bands divided, the mid-ventral strand the narrowest, the two dorsal remarkably wide, about twice as wide as the mid-ventral. The ventrolaterals are intermediate in size. Cloacal dilation is large, extending about 40 mm. forward from anus.

This species differs from true *Pælopatides* in two very important particulars, namely, in the possession of ventrolateral pedicels in the hinder half of body (these being absent in typical *Pælopatides*) and in having a well-developed rete mirabile. One of the characters given for the subfamily Synallactinæ is the absence of a rete mirabile. There can be no doubt, however, that the present form is a *Pælopatides* or nearly related genus, because the outward habit, lack of free tentacle ampullæ, two unequal Polian vesicles, large intestinal cœcum, and absence of calcareous deposits all point to it. I am not so sure that the type of the genus is without a rete mirabile, for Théel says[a] in the description of *confundens:* "The left [respiratory] tree is shorter but more branched, its ramifications being in communication with the plexus of pseudhæmal vessels. The right tree attains almost the length of the body itself." So far as the trees are concerned this agrees exactly with *retifer*. Ludwig makes no comment on this in his diagnosis of the Synallactinæ. His specimens of *confundens* seem to have lost the left tree and most of intestine, so that naturally the rete mirabile would be missing. Sluiter, who lists *P. confundens* in his Siboga Holothurioidea, does not mention the rete mirabile or make any reference to the apparently unnoticed remark of Théel above quoted. Inasmuch as Sluiter's specimens lacked the intestinal diverticulum I think there are grave doubts as to their being true *confundens*. Théel's type came from off the coast of Chile, in the latitude of Valparaiso, while Sluiter's specimens were taken in the distant East Indian region (between 116° and 132° E., and 0°–8° S.). *Retifer* appears to be distantly related to *P. purpureo-punctatus* Sluiter. It differs from this form in having a single continuous series of papillæ all along the ventrolateral radii, in addition to about ten large pedicels, which form a separate series parallel with the above

[a] Challenger Holothurioidea, Pt. 2, p. 156.

in the hinder half of body. In Sluiter's species there is a single row of about thirty large pedicels all along these radii, and in addition numerous scattered slender and smaller papillæ and pedicels which do not appear to form a single series as in *retifer*. The lateral pedicels of *purpureo-punctatus* are apparently larger than in *retifer*, and there is no fringe of papillæ under the anus as in *retifer;* neither is the body wall so thick and jelly-like. Kœhler and Vaney have created a genus *Bathyzona*, to which this species is possibly referable. *Bathyzona* has the general form of *Pælopatides*, but the pedicels instead of being limited to the medium radius of the ventral surface, form 4 distinct rows, two median and two lateral, the latter near the border. Type is *B. incerta* Kœhler and Vaney, which has 9 tentacles and triradiate calcareous bodies not unlike those of *Pælopatides*. The internal organization is unknown. *Pælopatides purpureo-punctatus* is by no means typical, but does not seem to be referable to *Bathyzona*. Until the anatomy of this genus is better known I prefer to rank *retifer* in *Pælopatides*. The distribution of pedicels in connection with the absence of deposits will serve easily to distinguish it from any species referred to *Pælopatides*.

Family ELPIDIIDÆ Théel.

Elpidiidæ Théel, Challenger Holothurioidea, Pt. 1, 1882, p. 10.—Ludwig, Mem. Mus. Comp. Zool., XVII, No. 3, 1894, p. 39(=*Elasipoda* Théel).

Subfamily DEIMATINÆ (Théel) Ludwig.

Deimatidæ Théel, Challenger Holothurioidea, Pt. 1, 1882, p. 60.
Deimatinæ Ludwig, Mem. Mus. Comp. Zool., XVII, No. 3, 1894, p. 63.

Genus SCOTODEIMA Ludwig.

Scotodeima Ludwig, Mem. Mus. Comp. Zool., XVII, No. 3, 1894, pp. 74, 75. Type, *S. setigerum* Ludwig.

Twenty moderately large tentacles; along each ventrolateral radius a double row of large pedicels, and above them a series of long slender nonretractile papillæ (flank-papillæ); a double row of similar papillæ on each dorsal radius; median ventral radius with a few scattered smaller pedicels; mouth and anus ventral. Deposits: Stout simple rods and four-armed rods, more or less modified; all deposits of relatively large size. The genus stands between *Orphnurgus* and *Oneirophanta*.

SCOTODEIMA VITREUM, new species.

Plate LXXIV, figs. 2, 2*a*; Plate LXXV, figs. 1, 1*a–e*, 2, 2*a–c*, 3, 4; Plate LXXVI, figs. 1, 1*a–c*, 2.

General contour of body elliptical with nearly equally rounded anterior and posterior extremities. Ventral surface flattened; dorsal surface well arched; ventro-lateral margin as well rounded as permitted by relatively immense papillæ. Mouth and anus ventral, the former

encircled by 17 short tentacles with circular small flat crowns; the latter by a number of small pedicels. Ventrolateral ambulacra with 2 series of large robust pedicels, those of outer series two to three times as large as those of inner, which are rather irregularly arranged along a zigzag line; inner series with about 17 also, not counting the small pedicels surrounding anus. Median ventral ambulacrum with a small pedicel at interior third of body, one at posterior third, another a little nearer than midway between the last and anus, and three or four much smaller ones in front of the anus, three of which seem to form part of the group of anal pedicels. Above outer row of pedicels is a series, more or less irregular, of long flank papillæ (nonretractile), their walls strengthened by long slender spicules. The longer papillæ are 18 to 22 mm. in length and about 1.5 to 2 mm. thick at base. The larger alternate sometimes with shorter slender ones; in all there are 23 to one side and 28 or 29 to the other. With two or three exceptions all papillæ shown in fig. 2, Plate LXXIV, belong to flank series. Dorsal papillæ in an irregular double row along each ambulacrum; of about same length as laterals, but slenderer; 17 or 18 to outer row, about 30 to inner. Deposits: In papillæ, long slender rods with expanded spatulate tips; in pedicels slightly curved rods with short branches near tip; in ventral perisome, robust smooth rods forked at either end and notched, or twice to three times dichotomously branched, the tip with a few circular perforations; in dorsal perisome, smooth rods similar to those of papillæ, but averaging shorter and with tips frequently slightly forked, together with large dichotomously branched rods similar to but larger than those of the ventral perisome, and occasional rods branched only at one end; small spiny and branched rods in wall of gonad. Calcareous ring consisting of both radial and interradial pieces. Color translucent whitish, the pedicels tipped with orange; papillæ with a glassy appearance. Length, 45 mm.; breadth, about 16 mm.

Locality.—Station 3979, vicinity of Bird Island, 222 to 387 fathoms, fine white sand, foraminifera, rocks, bottom temperature 54°; one specimen.

Type—Cat. No. 21219, U.S.N.M.

The lateral or outermost series of pedicels is obviously irregular, but in the posterior region is considerably foreshortened. The inner series is not quite so regular, as may be seen from the figure. Outer pedicels average about 5 mm. in length, the inner 2 to 3 mm.; both are rigid, owing to rods in the walls. Pedicels of median ambulacrum considerably slenderer. Three pedicels very obviously belong to the series, since they are arranged along the line of the median ventral muscle band which shows through the body wall. Of the pedicels surrounding the anus some belong to the median and some to the lateral ambulacra. They are much shorter than any others. Walls of tentacles are strengthened by rods. Crowns do not appear to be

obviously subdivided into lobes. The body when viewed from below presents a lateral bristling fringe of the long, stiff, and remarkable papillæ, whose walls are exceedingly brittle from crowded, long, glassy spicules easily seen with the naked eye, as in fact are the rods of the larger pedicels. These papillæ when perfect are longest at about the middle of the body and decrease in length, forward and backward. They taper gradually but not evenly from a stout base to a rather finely-pointed extremity. The distal portion of the perfect papillæ has an inconspicuous lateral flange of tissue free from spicules, the latter being crowded into a very slender core at one side. In the posterior half of body a very few of the papillæ are a little slenderer than alternate ones, but there is no regularity in this. Near anterior extremity of body three or four smaller papillæ (*a*, *b*, *c*, fig. 2, Plate LXXIV) form a rudimentary second row of lateral papillæ. They stand just above the larger laterals and appear distinct from dorsals. At posterior extremity, as well as at anterior, the papillæ are rather crowded and many of the dorsal are matted down, forming an almost inextricable mass. Only the true lateral or flank papillæ are shown in the figure. Of these there appear to be more on the left side (right of figure), as indicated in diagnosis. The integument of ventral surface is rather thin, but rigid on account of the numerous rods which can just be discerned with the naked eye. With a moderately strong glass they can be clearly seen. A dorsal view of the animal presents a matted mass of long, slender, brittle papillæ. The bases of lateral papillæ extend well onto dorsal surface by reason of the fact that the dorsoventral diameter of base is much greater than the horizontal, being about 4 mm. The dorsum slopes off gradually onto the upper surface of the papillæ. Along either dorsal ambulacrum are about two irregular series of long papillæ similar in character to the laterals. The outer of the two series contains about seventeen or eighteen slender papillæ, about one-third or one-half the diameter of the larger laterals and 20 mm. in length. The spicules appear to be congregated along one side of each papillæ, the rest of wall being transparent. Papillæ of inner series are much more numerous (about thirty), are very irregularly arranged, and are considerably slenderer than the outer series, but appear to be of the same length. Owing to the fact that these papillæ are matted together very intricately it is difficult to make out with absolute accuracy their arrangement. Some papillæ of outer series have three of inner series opposite them, others only one or two. The essential feature is that the inner row of each ambulacrum contains more than twice as many papillæ as the outer and is very irregular in arrangement. The greater part of the dorsal surface is occupied by the flaring bases of the papillæ. The integument is somewhat translucent, the spicules being visible to the naked eye.

Calcareous ring very flexible and delicate, the radial and interradial pieces being joined apparently in one continuous piece; at all events, the line of demarkation is invisible. Form of ring is shown by figure. (Plate LXXIV, fig. 2*a*.) Anterior edge of pieces is so thin that it appears scarcely more than a translucent deposit of lime in the membrane; but the core of both radial and interradial pieces is thicker and is indicated by the lightly shaded portions of figure. Madreporic canal is of considerable thickness, running forward in dorsal mesentary and entering the body wall on level with calcareous ring. One rather large Polian vesicle. Ring canal and adjacent portions of radial canals conspicuous. Gonad forms two tufts on either side of dorsal mesentery, just behind ring canal, the genital duct running forward beneath madreporic canal. Walls of gonad contain comparatively few irregular thorny or slightly branched rods. Longitudinal muscle bands thin and weak.

Ventral perisome contains smooth robust rods dichotomously branched at extremities and with one to several perforations at the tips. The majority have the simpler form shown in figures, but many are thrice branched. The simpler forms usually have no terminal perforations. These rods vary from 0.4 to 0.57 mm. in length. Comparatively few are slightly longer. The figures were drawn from deposits along midventral line. Dorsal perisome is rendered rigid by long, stout, smooth, simple rods with the tips expanded and perforated; or the tips may be divided and each division slightly expanded and perforated. Fewer rods are branched at one end only, the branches being fairly long. Besides these there are comparatively few rods of robust form once or twice dichotomously branched, similar to but very much larger than some of the ventral deposits. These are usually symmetrical at either end and the tips are expanded and several times perforated. The simple rods are much the more numerous and measure about 0.95 to 1.3 mm. in length; some are as short as 0.8 mm. Rods branched at one end only are about 1.6 mm. long; those branched dichotomously vary from 0.9 to 1.3 mm. Rods in lateral and dorsal papillæ are of the same form but differ in size, those of the former being slenderer. The rods are simple, expanded at the tip into a spoon-shaped blade, many times perforated. Rods at base of lateral papillæ are remarkable as to size, many measuring 3.5 mm. in length. (Plate LXXV, fig. 1*d*.) At about middle they measure 1.6 mm. and gradually diminish in length and caliber toward extremity, where they are about 0.65 to 0.95 mm. long, and very slender (fig. 1*c*). In dorsal papillæ a few of the basal rods attain a length of 3.2 mm. They are practically identical with those of lateral papillæ. Rods in pedicels are curved and branched slightly at tips, occasionally with a perforation or two. The longest measure about 1 mm., the shortest about 0.2 mm. Rods in walls of gonad are irregular, about 0.2 to 0.4 mm. in length, with scattered prominent thorns and occasionally one or two short branches.

With the exception of one of the rods of wall of gonad all the accompanying figures represent the deposits enlarged sixty-five times. This affords an easy method of comparison for deposits from different parts of the body. Thus it is seen at a glance that the rods of the dorsal perisome are very much larger than those of the ventral, etc.

This remarkable species differs from *Scotodeima setigerum* Ludwig in the greater development of the papillæ, in the diversity in the number of dorsal papillæ of inner and outer series, in the form and greater size of the deposits, particularly those of the ventral and dorsal perisome, in the number of tentacles, and in the form of the calcareous ring, the latter being composed of radial and interradial pieces. The radial piece is pierced by a hole. If the figures of deposits of *vitreum* are compared with those of *setigerum*[a] (the magnification being taken into account), the difference in size is at once apparent, especially in the rods of dorsal perisome and of papillæ. The rods of the pedicels also present important points of difference, best appreciated by a comparison of figures. Possibly the difference in the calcareous ring is most important, the interradial pieces being absent in *setigerum*. *S. vitreum* differs from *S. protectum* Sluiter[b] in the outer form, number of tentacles, form of calcareous ring, and in the shape of the deposits. It must be remembered that the commonest form of rod in the dorsal perisome of *S. vitreum* is the simple unbranched one. In both the other species the four-armed kind appear to be the only ones, and are considerably smaller than in *vitreum*. On the whole *vitreum* appears more nearly related to *protectum*, which was taken by the Siboga expedition in latitude 0° 34′ 6″ north, longitude 119° 8′ 5″ east, 1,301 meters. *S. setigerum* was dredged by the fisheries steamer *Albatross* at Station 3362, east of Cocos Island, 1,175 fathoms.

Genus ORPHNURGUS Théel.

Orphnurgus Théel, Preliminary Report on the Holothuridæ of H. M. S. Challenger, Œfv. Ak. Forh., Bihang V, No. 19, 1879, p. 8; Challenger Holothurioidea, Pt. 1, 1882, p. 82. Type, *O. asper* Théel.

Tentacles 15 to 20, rather large, nonretractile. Lateral ambulacra of ventral surface with very large pedicels disposed in a single row all along each side of that surface, and with another series of slender, flexible processes placed above pedicels all along each side of body. Odd ambulacrum naked. Dorsal surface with a more or less crowded series of numerous long papillæ disposed in one or two rows along each dorsal ambulacrum. Integument with deposits in the form of smooth or spiny rods sometimes dichotomously branched, or rods transformed into solid large ellipsoids.

[a] Ludwig, Mem. Mus. Comp. Zool., XVII, No. 3, Oct. 1894, p. 72, pl. VII, figs. 7–13; pl. VIII, fig. 1–4.

[b] Siboga Holothurioidea, 1901, pl. II, fig. 7; pl. IX, fig. 4.

ORPHNURGUS INSIGNIS, new species.

Plate LXXIII, fig. 1; Plate LXXVII, figs. 1, 1*a–e*, 2, 2*a–c*, 3, 3*a–e*.

In general form resembling *Orphnurgus asper* Théel, but with dorsal papillæ arranged in a single series along each ambulacrum. Body subcylindrical, slightly broader anteriorly than posteriorly; ventral surface flattened, dorsal well rounded. Mouth terminal, but turned ventralward, large; anus terminal, large, somewhat dorsal. Tentacles, 17 to 20, rather long, nonretractile, with peltoid, divided crowns; ventral tentacles apparently shorter than laterals. Along margin of ventral surface 17 to 22, very large, slightly tapering, cylindrical pedicels with rounded tips, decreasing in length at posterior extremity. Just above these a row of 12 to 18 long, rather slender, tapering papillæ. Along each dorsal ambulacrum a single series of 12 to 36 long papillæ, usually unequal in size and somewhat smaller than the laterals; the longest, longer than width of body (in some specimens papillæ are comparatively short). Integument rather thin in fully expanded specimens, that of ventral surface roughened by the deposits, particularly near posterior extremity. Deposits: In dorsal perisome nearly straight smooth rods of widely varying thickness expanded slightly at tips, bearing several short branches once or twice dichotomously divided, the larger rods usually having a single perforation at either end (Plate XII, fig. 1, 1*a*, *b*, *c*); also four-armed rods dichotomously divided at tips, and rods intermediate between this and first variety (Plate XII, fig. 1*d*, *e*); in ventral perisome very much thicker and heavier rods, dumb-bell shaped with longer and shorter spines which are bifid to multifid at tips, scattered over the subspherical terminal portions; also very many smaller rods with a few or no spines at blunt tips. (Plate XII, fig. 2, 2*a*, *e*.) On posterior third of body these dumb-bell shaped deposits are gradually transformed into irregular ellipsoids spiny along one side and much larger and heavier than other deposits. Ellipsoids are of various sizes and are very crowded. (Plate XII, fig. 3, 3*a*, 3*c*.) In pedicels, stout, simple, or triradiate rods more or less spiny at tips (3*b*, *b'*, *d*, *e*); in papillæ simple slender rods once or twice divided at tips (1 *c*). Color in life, yellowish salmon-color, pinker on body and yellower on pedicels and papillæ. Toward tips of pedicels are small spots of yellowish brown. Tentacles yellow at tips. Length of largest specimen, about 160 mm. in contracted state.

Localities.—Type (Cat. No. 21220, U.S.N.M.) from Station 4134, vicinity of Kauai Island, 324 to 225 fathoms, fine coral sand, volcanic sand; bottom temperature, 43.3°; 5 specimens. Taken also at following stations, in all 118 specimens:

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
3836	South coast Molokai Island	238–255	Brownish gray mud, sand.
3839	....do	259–266	Light brown mud, sand.
3883	Pailolo Channel between Maui and Molokai islands.	277–284	Globigerina ooze.
3979	Vicinity of Bird Island	222–387	Fine white sand, foraminifera rocks.
3988	Vicinity of Kauai Island	169–165	Gray foraminiferous sand, pebbles.
3994	....do	330–382	Fine gray sand, foraminifera.
3997	....do	418–429	Fine gray sand, brown mud.
4015	....do	362–318	Gray sand, rocks.
4021	....do	286–399	Coral sand, foraminifera.
4025	....do	275–368	Fine gray sand, broken shells, foraminifera.
4041	West coast of Hawaii Island	382–253	Gray mud, foraminifera.
4083	North coast Maui Island	238–253	Gray sand.
4084	....do	253–267	Fine gray sand.
4085	....do	267–283	Sand, shells.
4086	....do	283–308	Do.
4096	Northeast approach to Pailolo Channel	272–286	Fine gray sand.
4123	Southwest coast of Oahu Island	352–357	Fine gray sand and mud.
4140	Vicinity of Kauai Island	339–437	Fine gray sand.
3475	South coast of Oahu Island	351	Fine white sand.

The general form of body varies, of course, with degree of contraction. In well expanded specimens dorsal surface is rather high and the lateral interambulacra are rather rounded. In a natural state the specimen shown in fig. 1, Plate LXXIII would be considerably longer.

The large pedicels appear to be pretty constantly 17 to a side for medium-sized individuals and 19 to 22 for the larger ones. In preserved specimens they are unequal in length, the longest being 33 mm. in type. Those near anterior extremity are longer than the more posteriorly situated ones. Lateral papillæ in type are longer than pedicels, 17 and 18 in number, to two sides respectively (pedicels 20). In many small specimens they are quite short and rather distantly spaced, the difference being not altogether due to contraction. Smaller specimens with 17 pedicels have 11 to 17 lateral papillæ. Number and size of dorsal papillæ is also variable, ranging from 12 (to one ambulacrum) in a 90 mm. individual to 36 in a 120 mm. specimen. In most of the small and medium sized individuals they are very much less numerous and conspicuous than in the figured (type) specimen. Some of this difference is due to contraction. In the type the papillæ are fully expanded and the anterior and posteriormost are longest of any. In all but two of the specimens the papillæ appear to be arranged in a fairly regular linear series along each of the two dorsal radii. The exceptions are two small specimens noted in a separate paragraph below. Normal number of tentacles appears to be 20, although they may be as few as 17. The walls are strengthened by spiny tipped rods. (Plate LXXVII, figs. 1*b*, 2*c*, 3*b'*, 3*d*.) Crown is oblique, subpeltate, with about ten branched divisions ending in small subglobular papillæ. The two distalmost branches are much the

largest, the others being graduated toward proximal edge of crown. Théel's figure[a] shows a contracted imperfect specimen.

Polian vesicle single, about 15 to 25 mm. long in medium sized specimens, slender. Madreporic canal rather conspicuous, lodged in dorsal mesentery, and running forward to enter body wall immediately between the two anteriormost, long dorsal papillæ. There appears to be no enlarged madreporic body such as Théel describes for *asper*. Ring canal and proximal portions of radial canals prominent. Calcareous ring rudimentary, consisting of slight deposits of lime in the tissue. Gonad composed of two small tufts on either side of dorsal mesentery immediately behind ring canal. Tubules short, simple, clavate. Genital duct runs forward just above madreporic canal, opening to the exterior by either one or two small papillæ usually situated just posterior to the two large dorsal tentacles. Longitudinal muscle bands *double*, rather slender. Ampullæ of pedicels and papillæ have the cæcal appendage in body cavity short, usually unbranched, except in largest individuals.

One of the commonest forms of spicules of dorsal perisome is that shown by fig. 1, Plate LXXVII, which ranges from 0.55 to 0.8 mm. in length. The number of branches varies, some having fewer, others more than shown in figure. Size of perforations also is variable. Rods of other shapes (*a*, *b*, *c*) are essentially like the first, only slenderer. Average lengths for *a*, *b*, and *c* are 0.6, 0.5, and 0.4 mm., respectively. They vary considerably in length. The four-armed rods, recalling those of *Scotodeima setigerum*, are numerous, and range from 0.35 to 0.5 mm. in length. More or less perfect triradiate forms with equal arms are common, as well as forms intermediate with straight rods (*c*) about 0.6 mm. long. In the region of the lateral tentacles forms intermediate between figs. 1 and 2, 1*a* and 2*a*, 1*c* and 2*b*, *c*, *e*, may be found, or either the one or the other, this being the region of transition between the dorsal and ventral surfaces. The ventral perisome is characterized by much heavier and more crowded deposits, especially toward the posterior end, where the relatively very large ellipsoids and dumb-bell rods are massed together as thick as possible, forming sometimes more than a single layer. Characteristic forms of rods are shown by figs. 2 to 2*e*, these gradually passing into such predominating forms as 3, 3*a*, 3*c*, in posterior third of ventral surface. Sometimes the latter forms predominate over the whole ventral surface, the slenderer rods taking second place. These ellipsoïds are highly characteristic of this species, and commonly attain a size of 0.9 by 0.6 mm., varying down to 0.3 mm. in length. The largest are irregularly spiny along one side and the surface is irregular. The proportion of ellipsoids varies in different individuals; usually various sizes of 3*a*, 2*b*, and 2*d* and intermediate forms predominate,

[a] Challenger Holothurioidea, Pt. 1, pl. XLIV, fig. 3.

with intermediate stages between 2 and 3*a*. The small ellipsoids and rods are very numerous, many as small as 0.18 mm. in length (2*c*). In a single individual all stages between fig. 1 of the dorsal surface and 3 of the ventral are present, the series being 1–2–3*a*–3. Since the deposits are so variable in minute detail, the figures give a far better conception than description can give. In the papillæ the rods are practically identical with 1*b* and 1*a*, and vary in length from 0.2 to 0.6 mm. In pedicels such forms as 3*b*, 3*b'*, 3*d*, 3*e* predominate, 3*b'* being at tip and about 0.2 mm. in length.

Variations.—There are two specimens out of the one hundred and twenty-three odd examples of this species, which, if seen without the others, might lead to some curious conclusions concerning the genus. One is from Station 4041, the other from 3836, both hauls containing also typical specimens. That from 3836 has about thirty pedicels along each ventro-lateral radius, disposed *in two irregular series*, somewhat as in *Scotodeima*. The inner pedicels, which are the smaller, usually alternate with the outer, forming with them a sharply zig-zag series. Scattered along mid-ventral radius are ten smaller pedicels, five of them being in anterior third of body. Along each dorsal ambulacrum about thirty papillæ *in a double row*. The specimen being rather small (50 mm.), there is something peculiar in the deposits. Those of dorsal surface are rather shorter and stouter than in typical form, being of the *a*, *b*, *c*, *d*, shapes (fig. 1); and in addition are many very short stout rods (0.18 mm.) unsymmetrically branched at either end. Deposits of ventral perisome are of 2*b*, 2*d*, 2*c*, 3*c*, 3*d* types, with few spines. In addition are a few very small simple rods (2*c*) 0.05 to 0.08 mm. long, possibly larger rods in course of development.

The second specimen (Station 4041) is 72 mm. long and has twenty-six very small pedicels along the mid-ventral line (recalling *Punnychia*) forming a double row for about two-thirds the length of body. There are about twenty-four pedicels along either side of ventral surface in a single row. The numerous dorsal papillæ form a double row along each ambulacrum. Deposits of dorsal perisome are slender, of the *a*, *b*, *c*, *d* types (fig. 1). Those of ventral perisome consist of stout and slender rods, the former modifications of fig. 2, 2*a* types, the latter of the 1*a* type. They range from 0.15 to 0.45 mm. long, and have unusually large robust spines. Of course the presence of a double ventro-lateral series of pedicels and median ventral pedicels is quite abnormal for this genus. Although the deposits are not typical they seem to belong in with those of the other specimens. The presence of a double row of dorsal papillæ recalls *O. asper* Théel, but the pedicels and madreporic canal, as well as deposits, are different. There seems to be no other course than to regard these specimens as very aberrent examples of *O. insignis*.

This species differs from *O. asper* in the form and size of the

deposits, and from *O. glaber* (Walsh) in having one instead of two rows of papillæ along each dorsal ambulacrum. In respect to deposits *insignis* resembles *glaber* more than *asper*. Kœhler and Vaney have very adequately described and figured *O. glaber*. The deposits of this species lack the large ellipsoids and the more elaborate cruciform rods. *O. invalidus* Kœhler and Vaney has 15 tentacles, has simple rods much like those of *Scotodeima*, and a double row of papillæ along each dorsal radius. In respect to the deposits the species, as noted by the describers, approaches *Scotodeima*.

Genus LÆTMOGONE Théel.

Lætmogone THÉEL, Preliminary Report on the Holothuridæ of H. M. S. Challenger, Œfv. Ak. Förth., Bihang., V, No. 19, 1879, pp. 9–10; Challenger Holothurioidea, Pt. 1, 1882, p. 73. Type, *L. wyville-thomsoni* Théel.

Tentacles 15 to 20, rather large, not retractile. Lateral ambulacra of ventral surface with large or medium-sized pedicels disposed in a simple series all along each side of that surface. Odd ambulacrum naked. Dorsal surface with long or short flexible processes or papillæ disposed in a single or double series all along each of the ambulacra. Perisome with numerous wheels and with rods and sometimes cruciform bodies.

LÆTMOGONE BISERIALIS, new species.

Plate LXXV, figs. 5, 5*a*; Plate LXXVIII, figs. 1, 1*a–e*.

Body rather elongate, four and one-half to five times as long as broad, tapering slightly at posterior end, which is bluntly rounded; anterior extremity rounded. Ventral surface flattened, dorsal well arched. Mouth terminal but ventral; anus terminal. Tentacles imperfect, but apparently not more than 15; crowns peltate. Pedicels slender, 8 to 10 mm. long at middle of body, numerous, about fifty to a side, forming a single series along each ventro-lateral radius. Midventral radius naked. Papillæ rather short (3 to 5 mm.), forming two series along each dorsal ambulacrum, about sixty-four papillæ to each radius. Deposits: In ventral perisome, small wheels with twelve short spokes and four rather large holes in the nave, two of the holes being larger than the other pair, together with simple rods smooth or uneven along sides and somewhat spiny and irregularly roughened at tips. In dorsal perisome large and small wheels, the former particularly about base of papillæ. Large wheels with usually twelve spokes, and a large nave with six equal perforations. Papillæ with crowded small wheels, a rudimentary terminal plate, and a few rods near tip. Pedicels with much less crowded, small wheels, and many slightly curved supporting rods, sparsely spiny on either terminal third; large perforated terminal plate present. Color of formalin specimen grayish violet. Length, about 90 mm.; width, about 20 mm.

Localities.—Type (Cat. No. 21221, U.S.N.M.) from Station 4141, vicinity of Kauai Island, 437 to 632 fathoms, volcanic sand, foraminifera; bottom temperature, 41°. Station 3988, vicinity of Kauai, 469 to 165 fathoms, gray foraminiferous sand, pebbles.

All but six of the tentacles have been rubbed off, so that it is impossible to give the exact number, which appears, however, to be in the neighborhood of fifteen. This species is especially characterized by the numerous pedicels which form a crowded series along either ventro-lateral radius. These pedicels are much slenderer than those of *Lætmogone wyville-thomsoni*, or of any other figured species, and are not spaced, the bases touching. They are largest in anterior two-thirds of body and decrease slightly in length toward the posterior extremity. Each pedicel has a flat, sole-like sucking disk about 1 to 1.5 mm. in diameter. Breadth of ventral surface between the two series of pedicels is 16 mm. Papillæ are decidedly small for genus, and their arrangement in two series on each dorsal radius is unusual for this group.

Calcareous ring is not divided into separate pieces, but forms a continuous ring as in *L. wyville-thomsoni*. It is thicker and heavier than in that species, and the radial portions present deep cup-shaped depressions on the anterior face. Polian vesicle single, 13 mm. long. Madreporic canal relatively shorter than in *wyville-thomsoni* (about 5 mm.), passing upward and backward to open near the middorsal line 18 mm. from anterior extremity of body. The canal on piercing the body wall divides into seven, or probably even more, minute canals, but inasmuch as the external perisome has been completely rubbed off it is impossible to tell whether each of these tubules ends in a papilla as in *wyville-thomsoni*. Gonad forms a large tuft on right and left sides of mesentery; tubules branched. The gonoduct opens to the exterior right beside the madreporic canal, but the papilla has been rubbed off. No spicules in walls of gonad or of alimentary canal.

The wheels of ventral perisome are rather scattered and are more numerous than the rods. Diameter varies from 0.054 to 0.065 mm., the wheels being thus all small and not greatly different in size. Generally there are twelve spokes, but occasionally thirteen or fourteen. The rim is on a different plane from center; in other words, the wheel is shaped like a shallow saucer, the edge being nearest surface of perisome. The large nave is quite constantly pierced by four holes, one pair being always larger than the other. The rods separating these holes form a convexity similar to that of the larger wheels (Plate XIII, fig. 1*a*). Rods vary in length from 0.12 to 0.3 mm.; their form is shown by figures. Owing to the fact that the outer perisome has been scraped off the back, except on the papillæ and on their immediate vicinity, it is not possible to give relative abundance of large and small wheels between the rows of papillæ. Papillæ are crowded with small

wheels (Plate LXXVIII, fig. 1*c*), the majority of which are from 0.04 to 0.068 mm. in diameter. The spokes are so short that, as in the ventral wheels, the interspaces appear sometimes as mere perforations. These wheels are essentially exactly like those of ventral perisome. The large wheels (fig. 1) vary from 0.148 to 0.27 mm. in diameter, and there are relatively few, intermediate in size with the small ones. The spokes are short and the large nave is centrally pierced by six symmetrical holes, forming a nave within a nave. A side view (fig. 1*a*) will give an idea of the form of the wheels. Nearly always there are twelve spokes. Wheels of pedicels are like those of ventral perisome, but rods are larger (fig. 1*c*), commonly attaining a length of 0.45 to 0.55 mm., and are thornier; thorns, however, are all short. There appear to be no X-shaped rods, and there are no rods in dorsal perisome, so far as discoverable. Walls of tentacles are strengthened by rods and the crown is crowded with them. Here they are of greatly diverse sizes and are never straight.

This species agrees with *L. enisus* Sluiter in having two rows of papillæ on each dorsal radius, but the papillæ are short, not long as in *enisus*, which further has 20 large pedicels to each ventrolateral radius instead of 50 or more small ones. In respect to the pedicels *biserialis* approaches *L. théeli* Ludwig. That form, however, has but one row of eight to ten spaced papillæ to each dorsal radius, not 64 in two series. Further, it may be added that the deposits of *biserialis* differ from those of the above two species, which are the only ones with which the Hawaiian form is directly comparable.

LÆTMOGONE, species.

There is a small specimen from Station 4043 (west coast of Hawaii, 236 to 233 fathoms, gray sand, broken shells, rocks), which has unfortunately lost all the calcareous deposits. It is therefore futile to attempt an accurate identification. Body rather long and slender; mouth subventral, anus injured, probably terminal. Tentacles 11, large, with circular crowns not greatly wider than the thick stalks. Pedicels long and rather slender, upward of 60 in a zigzag series along each ventrolateral radius; especially irregular on posterior portion of body. Papillæ contracted, shorter than pedicels, about 20 to 25 in a single series along each dorsal ambulacrum. Body wall thin. Color in life: Body translucent grayish or whitish, base of papillæ violet, tube feet transparent.

Of course the number of tentacles is very small. This, taken with the large number of pedicels and single row of dorsal papillæ, separates the former from both *enisus* and *théeli* (20 tentacles). There seems little doubt that the specimen is new.

Genus PANNYCHIA Théel.

Pannychia THÉEL, Challenger Holothurioidea, Pt. 1, 1882, p. 88. Type, *P. moseleyi* Théel.

Tentacles 20, rather large and nonretractile. Lateral ambulacra of ventral surface with large pedicels, disposed in a single row all along each side of that surface. Odd ambulacrum with a double row of pedicels. Dorsal surface with a crowded series of numerous scattered slender processes all along each side. Integument with numerous wheels and small wheel-shaped plates.

PANNYCHIA PALLIDA, new species.

Plate LXXVIII, figs. 2, 2*a–h*.

Nearly related to *P. moseleyi* Théel, which it resembles in general form and in the character of calcareous deposits, but it differs greatly in coloration, in having the median ventral series of pedicles much reduced in number, and in the presence of a well-defined calcareous ring. Number of tentacles unknown, but in form closely resembling those of *P. moseleyi*. Anus terminal, mouth turned ventralwards. Pedicels of ventrolateral radii unequal, not particularly large, about 20 or less to each radius. Pedicels of median ventral radius smaller, also unequal, apparently absent from anterior third or fourth of body, about twelve to sixteen in number, and unevenly scattered, the majority being in hinder half of body; not so arranged as to suggest a double row as in *moseleyi*, but rather a very irregular zigzag or meandering series. Papillæ large and small, about 90 on either side of middorsal line, the longest about 15 mm., the shortest about 2 mm. Arranged much as in *moseleyi* with an irregular flank series of short papillæ and about two irregular series of dorsals on either side. The latter are not so regular as in *moseleyi* and encroach upon middorsal region. Body wall of medium thickness. Deposits similar to those of *moseleyi* except in minor details; large wheels with usually fourteen spokes and the crown in center of nave with five or six radii. Color in life, translucent grayish with a yellowish tinge, especially on ambulacral appendages; soles of pedicels abruptly Indian red. Length, 105 mm.; breadth, 15 mm.

Localities.—Type (Cat. No. 21222, U.S.N.M.) from Station 4041, west coast of Hawaii Island, 253 to 382 fathoms, gray mud, foraminifera, bottom temperature 41.6°. Cotype (deposits) from 3994, vicinity of Kauai Island, 330 to 382 fathoms, fine gray sand, foraminifera.

The specimens are not in so good condition as might be desired, inasmuch as the tentacles are scraped off and the body wall badly lacerated. I do not think, however, that there are any more pedicels to the midventral radius than I have indicated. They are very irregularly arranged, especially as to distances between the different ones.

There are but two to four in the anterior half of the body, and as noted above, the anterior fourth of body appears to lack them. About seven or eight of these midventral pedicels are situated within 10 or 16 mm. of anus and are somewhat difficult to separate from the lateral pedicels. This will give an idea of how sparsely they are scattered along rest of odd radius. No fold or collar is apparent on dorsal surface above tentacles. Papillæ are rather long here. Flank papillæ are all rather short. The longest ones are scattered along the innermost series of dorsum.

Calcareous ring is not divided into separate pieces but forms a continuous ring. Radial and interradial portions are clearly discernible, however, the former having three prominent teeth anteriorly, and is pierced by a large hole. The exact form is best shown by fig. 2*g*, Plate LXXVIII. The ring is very delicate and sometimes the lower arms of interradial piece grow across the mouth of the posterior sinus, forming an irregular hole. Just how constant this form is I am unable to say. Madreporic canal opens to exterior by several (at least five) small tubules, just to the right of the genital papilla, which is about 12 mm. from anterior end of body. Canal runs backward and upward from ring canal, and the calcareous particles are much the same as in *P. moseleyi*, possibly a trifle less twisted and interwoven. Polian vesicle 20 mm. long, in left interradius of trivium. Gonad in a right and a left tuft; tubules slender and thread-like, eight to ten times dichotomously divided, extending to posterior extremity of body; not bushy. Longitudinal muscle bands undivided, all five of about equal width.

In general perisome are large wheels very similar to those of *P. moseleyi*, with 10 to 14 spokes, most commonly 14. Their shape is shown better by figures (Plate LXXVIII, fig. 2, 2*a*, 2*c*) than by description. The diameter of these wheels is usually from 0.13 to 0.19 mm. The crown, in center of nave, is made up of five or six arms, as is sometimes the case in typical *moseleyi*. In ventral perisome wheels are spaced, but in the dorsal they are more crowded. Small wheels or wheel-like plates (fig. 2*b*) with three or four central and seven to ten peripheral holes are especially abundant in walls of pedicels, but are common also among large wheels. Their diameter is about 0.046 to 0.065 mm. Plates similar to Théel's fig. 8, Plate XXXII[a] are found at tip of papillæ, and more or less deformed small wheels (fig. 2*d*) in addition, but no spicules like his fig. 9 are discoverable. No plates like his fig. 7 were found, but as the dorsal processes of available material have been under the influence of weak acid the plates are largely imperfect. The disks of the pedicels are strengthened by numerous perforated plates with wider and fewer meshes than Théel's fig. 11. There is but one layer of these plates, and in the smaller

[a] Challenges Holothurioidea, Pt. 1, 1882.

pedicels the central ones have commonly only a few holes and numerous peripheral diverging simple or branched processes. I can find no modified wheel plates similar to Théel's fig. 12. Around the edge of the disk of pedicels are a very few branched three or four armed rods, probably growth stages of the plates. In the oral disk are numerous rods similar to those herewith figured, about 0.12 to 0.165 mm. in length (fig. 2*h*). Besides these are many small wheel-like plates, sometimes irregular or imperfect (fig. 2*e*). In the end of the tentacles are many long, curved, irregular spiny rods (2*f*) which frequently have the ends forked. They vary much in size, but most of them are large, commonly attaining a length of 0.8 or 0.95 mm. Théel figures rods from tentacles, but does not give dimensions. Presumably his fig. 10 is drawn to scale, which would make the rods comparatively small. The difference in these rods is the most striking that is discoverable between the deposits of the two species.

Both *P. moseleyi* and Ludwig's variety *henrici* are of a very decided violet or rose violet tint, but *pallida* is practically colorless, except for a faint yellowish shade to the translucent body wall and the disks of the tube feet, which are abruptly Indian red. (The color was observed in the fresh animal by the writer.) This, combined with the feeble development of the midventral series of pedicels, the perfectly definite calcareous ring which is herewith figured, and some minor differences in the calcareous deposits, especially in the presence of long rods in the crown of the tentacles, seem to constitute specific differences. *Pallida* is undoubtedly nearly related to *moseleyi*, and only future explorations in other localities will decide whether the above differences are constant. *P. multiradiata* Sluiter has wheels with fifteen to eighteen spokes. *P. moseleyi* was taken by the *Challenger* off Sydney in 950 fathoms and off New Zealand in 700 fathoms, both from gray ooze.

Family CUCUMARIIDÆ Ludwig.

Cucumariidæ Ludwig, Mem. Mus. Comp. Zool., Harvard College, XVII, no. 3, 1894, pp. 7, 122.

Subfamily CUCUMARIINÆ R. Perrier.

Cucumariinæ Perrier, Holothuries, Exped. du Travailleur et du Talisman, 1893, p. 492.

Genus THYONIDIUM Düben and Koren.

Thyonidium Düben and Koren, Kongl. Vet. Akad. Handlingar, 1844, p. 214. Type, *Th. commune* Düben and Koren = *Th. drummondi* (Thompson).

According to Théel:

Tentacles 20, exceptionally fewer or more, five pairs of larger alternating with five pairs of smaller. Ambulacral appendages in the shape of pedicels sometimes densely crowded, sometimes more thinly scattered; often an arrangement of them in rows distinguishable along the ambulacra.

KEY TO HAWAIIAN SPECIES OF THYONIDIUM.

a Pedicels scattered all over body; no tables in pedicels.....*hawaiiense.*
aa Pedicels in double rows along ambulacra of trivium, absent from ventral interambulacra; pedicels crowded with modified tables.....*alexandri.*

THYONIDIUM HAWAIIENSE, new species.

Plate LXXIX, figs. 2, 2*a–e.*

Size small; general form subglobose, tapering very slightly toward either end, and abruptly narrowed at the neck; no conical caudal portion; contour of body very broadly elliptical; if neck and tentacles were eliminated, animal would resemble a large papillose gooseberry. Tentacles, five pairs of large, alternating with five pairs of very much smaller ones; only six large tentacles remaining, two pairs apparently having been scraped off. Pedicels numerous and scattered, but slightly more numerous on trivium and there arranged in irregular rows, especially at either end of body; the median line of either ventral interambulacrum nearly free from pedicels, thus forming an inconspicuous narrow naked band. Perisome minutely roughened by spires of tables. Deposits: Tables with a rather symmetrical, subcircular smooth disk pierced by four larger and four smaller alternating perforations; spire composed of two rods, a crossbeam at bottom and near summit, the crown ending in two or four teeth, sometimes irregular with three. At base of tentacles disks of tables elliptical, with four larger central holes and many (fifty or more) smaller perforations, the spire often solid or nearly so, ending in two or three teeth. No tables in pedicels, the latter having well-developed terminal plates. Color in alcohol, violet gray, the pedicels and tentacles brownish. Length, 21 mm.; width, 12 mm.

Locality.—Station 4101, Pailolo Channel between Maui and Molokai islands, 143 to 122 fathoms, coral sand, shells, foraminifera; bottom temperature, 59.7°; 1 specimen.

Type.—Cat. No. 21223, U.S.N.M.

The smaller tentacles are inconspicuous, being only about 1.25 mm. long, while the larger are about 4 to 4.5 mm. The former correspond to the radii, the latter to the interradii. Perisome is moderately thin and rather translucent, though not markedly so. Calcareous ring is very large compared with size of animal, being about 13 mm. long. Radial pieces have posterior prolongations which are rigidly fused with posterior portion of interradial pieces, both being composed of numerous smaller polygonal component plates. Anterior portion of radial pieces fairly solid; figure will show form of pieces. One small madreporic canal and one Polian vesicle. Respiratory trees rather small. Tubules of gonad once or twice dichotomously branched and containing well-developed eggs.

Nearly all the tables of general perisome have the disk similar to fig. 2*a*, Plate LXXIX. This varies in diameter from 0.075 to 0.095 mm.—not a great range. Usually one diameter is slightly greater than the other. The spire, which commonly has an irregular crown, ends in two to four teeth, and is about 0.06 mm. high. Tables are not at all crowded in perisome, but are well spaced. End plates of pedicels are circular and have a diameter of 0.135 mm. The numerous perforations decrease slightly in size toward periphery. The modified tables near base of tentacles have a major diameter of 0.1 to 0.12 mm. The spires vary considerably in height, but seldom exceed those of regular tables. Comparatively few of the latter appear to lack a spire entirely. In perisome between mouth and base of tentacles are numerous rods much branched and forming rosettes, or the branches join, forming irregular perforated plates. They are very irregular in outline and vary from 0.027 to 0.07 mm. in length (Plate LXXIX, fig. 2*e*). The tentacles themselves are devoid of deposits.

This species may be ranged, in Théel's classification,[a] along with *cebuense*, *magnum*, *parvum*, *occidentale*, and *caudatum*, which have deposits of body wall itself, tables, and "calcareous ring of ten simple or compound pieces, always with five radial posterior bifurcate prolongations, made up of several separate parts or joints." The present species differs from each of the above in details of calcareous ring, deposits, as well as in color. *Parvum* has but 18 tentacles. The disk of the tables of *hawaiiense* resemble somewhat those of *Thyonidium inflatum* (Sluiter), but the latter have four upright pieces to spire, and the animal itself, which is figured by Sluiter,[b] has a considerably different habit. On the whole, the present species appears very distinct from any previously described.

THYONIDIUM ALEXANDRI, new species.

Plate LXXIX, fig. 3; Plate LXXX, figs. 3, 3*a–e*.

Tentacles 20, five pairs of large ones, alternating with five pairs of extremely small ones. Body terete, tapering toward either extremity, the posterior being much slenderer than anterior and narrowed into a short caudal prolongation; anterior extremity (tentacles entirely retracted) truncate. Pedicels in a double series along each ambulacrum of trivium, the two ventral interambulacra being entirely naked; pedicels scattered all over dorsal and dorsolateral surface, there being no regular arrangement on two dorsal radii; pedicels larger than in preceding species. Body wall thick and minutely roughened with the densely crowded tables. General facies remarkably like *Cucumaria*. Deposits: Tables similar to those of preceding species, but crown

[a] Challenger Holothurioidea, II, p. 146.
[b] Siboga Holothurioidea, pl. II, fig. 10.

usually ending in about four teeth to each rod; many tables having symmetrical disks with numerous perforations; in pedicels numerous modified tables with elongate, curved, rod-like disk broadened in center with four perforations and with either extremity narrowed, spatulate, and perforated with numerous small holes; spire much as in normal tables; tables, unlike those of preceding species, very densely crowded. At base of tentacles are a few rods with expanded, much perforated extremities, these becoming oblong, oval, subcircular, or regular perforated plates in perisome surrounding base of tentacles, many with and many without spires, and grading into normal tables in neck. Color in alcohol whitish, tube feet yellowish. Length, 20 mm.; greatest breadth, 6 mm.

Locality.—Station 4044, west coast of Hawaii Island; 233 to 198 fathoms, fine gray sand, bottom temperatue 47°; 1 specimen.

Type.—Cat. No. 21224 U.S.N.M.

The larger tentacles are 4.5 mm. long, the smaller about 1 mm. Of course in life these dimensions would be somewhat greater. The body wall is considerably wrinkled, so that it is probable that the animal is considerably contracted. The entire absence of pedicels on the two ventral interambulacra and the fairly regular arrangement along the three radii of trivium, especially the midventral, gives to the species the general appearance of *Cucumaria*. The tentacles, however, are typical of *Thyonidium*. The calcareous ring is large (8 mm. long) and the radial pieces have long posterior prolongations which are composed of many irregular plates. These prolongations of adjacent radial pieces are fused for a part of their length, the interradial pieces being small and wedged in between anterior portions of radials. For exact form see Plate LXXII, fig. 3. One madreporic canal and one Polian vesicle. Gonad very large; tubules unusually short, thick, and branched once or twice.

The tables with regular disks have a major diameter of about 0.086 to 0.1 mm. (Plate LXXX, fig. 3*a*), this type being very similar to the normal tables of the preceding species. The larger irregular disks attain 0.012 mm. (3*b*). Spires are about 0.057 mm. high, the two uprights being joined by a crossbeam near summit and each ending in about four to six teeth. Occasionally the upper crossbeam is absent. Figures 3*c* and 3*d* show the type of table which crowds the pedicels. Many are less regular than this, being curved in the plane of the disk as well as in that of the spire. End plates of pedicels have a diameter of about 0.24 mm.; perforations numerous, rather larger about periphery than in center.

This species differs from *hawaiiense* in the following respects: Shape of body, thickness of perisome, color, distribution of pedicels and their larger size, presence in pedicels of modified tables, very crowded condition of deposits, character of tables, presence of a few rods in

base of tentacles, form of calcareous ring. *Alexandri* belongs to the same section of the genus as the preceding species and is very distinct from any known form. The distribution of pedicels is unusual for this genus. The specimen is evidently adult, because the gonad is very large.

This species is named for Mr. A. B. Alexander, of the Bureau of Fisheries, fisheries expert during the Hawaiian cruise. To his effective coöperation in that region of difficult dredging much of the success of the undertaking was undoubtedly due.

Subfamily PSOLINÆ R. Perrier.

Psolinæ R. Perrier, Holothuries, Exped. du Travailleur et du Talisman, 1903, pp. 493, 512.

Genus PSOLUS Oken.

Psolus Oken, Lehrbuch der Naturgeschichte, Pt. 3, Zool., 1815, p. 352.

Tentacles, 10; ventral surface flat, with two or three rows of pedicels, the median radius often without them; dorsal surface convex, without ambulacral appendages, usually with large calcareous scales or external plates; mouth and anus sometimes with distinct valvular plates; edge of body sharp.

PSOLUS MACROLEPIS, new species.

Plate LXXIX, figs. 1, 1*a–f*.

Tentacles 10, rather small, arborescent. Body broadly oval, much depressed. Dorsal scales not numerous, but large, only slightly imbricating, the edges, however, very tightly fitted together; lateral scales decreasingly smaller, those surrounding rim rather minute; only two rows of scales between mouth and anus, the middorsal region being occupied by about four scales larger than the rest. Mouth surrounded by five regular triangular valves, the sides of which are subequal, and the bases defining a rude circle; a small triangular scale between adjacent oral valves at their base; this is absent between two scales. Anal aperture surrounded by about twelve scales, five of which are shorter and broader than others (see figure). Surface of all scales except minute ones about rim of body beset with irregularly spaced, small granules, which are rather sparse on mouth and mediodorsal scales, and nearly lacking on anal. Sole flat; median ambulacrum wholly without pedicels; the lateral ambulacra with two series of pedicels, of which the outer are smaller, rather more numerous and situated close to sharp edge of body. Deposits: In ventral perisome perforated plates of irregular shape, either smooth or provided with a few knobs, the perforations from four to twenty in number; in pedicels a terminal plate and numerous elongated, perforated, mostly smooth rod-like plates with undulating,

almost spiny border; in dorsal perisome surrounding base of tentacles, irregular elongated plates with many perforations; in tentacles comparatively very large irregular, curved perforated rods (or sometimes without perforations and spiny or branched); in finer branches of tentacles smaller, very variable rather finely perforated plates. Sole thin and translucent. Color in life: Ground color, very dull light brown, the center of each scale being a darker brown; five oral plates, a pinkish yellow ocher, light carmine at tips, the anal opening salmon pink. Length, slightly curved, 19 mm.; breadth, 16.5 mm.; width of circle of oral valves, 7.5 mm.; distance from edge of oral valves to edge of anal, 6 mm.; from center of oral aperture to center of anal, 11 mm.

Locality.—Station 3863, Pailolo Channel between Maui and Molokai islands, 127 to 154 fathoms, broken coral, coarse gravel, rocks; bottom temperature, 60°. One specimen on a lump of lava.

Type.—Cat. No. 21225, U.S.N.M.

Owing to the fact that the specimen is a trifle bent to conform to the surface of the rock on which it was found, the breadth in the figure is too great in proportion to actual length. The outlines of the scales near margin are very inconspicuous, the plates themselves being very tightly fitted together, although imbricating slightly, as do also the middorsal plates. In addition to the granules the surface of scales is regularly and microscopically roughened, giving under a magnifying glass the appearance of tesselation. The series bordering sharp edge of body is very small and free from granules. When the oral valves are viewed from inner surface a rather narrow oblong scale or plate is seen to be fitted over the radial suture between two oral valves, there being thus five of these secondary oral scales. Their distal tips are pointed, and from the exterior can be indistinctly seen between the tips of the primary oral scales. On the inner surface at tip of each secondary or inner oral valve is a small, pointed deciduous tooth-like ossicle, the five points meeting in center of oral aperture. These can not be seen from exterior at all.

The plates in the sole are well spaced and the largest attain a major diameter of 0.24 mm., although the majority are about 0.135 to 0.15 mm. The central perforations are usually the largest. Edge of plates is undulating or marked by blunt lobes. Knobs are present on most of larger plates, such as fig. 1*b*, but plates of the type of fig. 1*c* (length 0.1 mm.) do not have them as a rule. At edge of sole the plates become considerably larger (0.24 mm.) with relatively smaller holes and more prominent undulations on margin. The plates consequently appear stouter and heavier. They grade into the elongated rod-like perforated plates of pedicles which attain a maximum length of 0.28 mm., decreasing in size toward tip of pedicel. The plates in membrane surrounding base of tentacles are especially distinguished from

those in sole by having many comparatively and actually smaller perforations. They vary from oblong to triangular, oval, or irregular, and some are to be classed as rods. These plates are smooth, but comparatively few of the largest which have the central holes conspicuously larger than the rest have a few knobs on the surface. Plates of this type (fig. 1*f*) attain a major diameter of 0.22 mm., though most of them are shorter than this. The large rods in the stem of the tentacles (1*e*) attain a length of 0.5 mm., but many are considerably smaller. They are usually slenderer than fig. 1*e*, with fewer perforations. In the smaller branches of tentacles are smaller, crowded, irregular, perforated plates, similar to but smaller than the perforated plates in perisome surrounding base of tentacles. They are much more irregular in shape.

The presence of large regular oral valves and of the two rows of pedicels on lateral ambulacra allies this form to *P. antarcticus* (Philippi), *tuberculosus* Théel, *ephippifer* Wyville Thomson, and *diomedeæ* Ludwig, from all of which it is separated by the very narrow region between mouth and anus, there being but two rows of large plates intervening. The dorsal plates, are relatively larger than in *diomedeæ* and the granules smaller and more numerous. There is also a great difference in the size of oral and anal valves in *macrolepis*, while the anal valves are quite different from those of *diomedeæ*, as may be seen by a comparison of figures.[a] In *macrolepis* the oral valves when closed are flush with the general surface of dorsum, but in *diomedeæ*, judging from the figure, are slightly raised. The deposits also present points of difference, especially in the size of the knobs on the plates these being large and conspicuous in *diomedeæ*. The present species may be readily distinguished from the other relatives above mentioned by the two series of dorsal plates between mouth and anus. *Diomedeæ*, from the vicinity of Cocos Island, appears to be the nearest of kin.

Order PARACTINOPODA Ludwig, 1891.

Family SYNAPTIDÆ Burmeister.

Synaptidæ Burmeister, Handbuch der Naturgeschichte, 2. Abth. Zoologie, 1837.

Subfamily SYNAPTINÆ Östergren.

Synaptinæ Östergren, Öfv. Ak. Förh., 1898, p. 111 (Das System der Synaptiden).

Genus SYNAPTULA Örsted.

Synaptula Örsted, Synaptula vivipara, Vid. Meddel. Nat. Foren. Kjøbenhavn for 1849 ad 1850, 1851, p. 7. Type, *Synaptula vivipara* Örsted.

[a] Mem. Mus. Comp. Zool., XVII, No. 3, 1894, pl. vi, figs. 1, 2, 3.

Leptosynapta (part) VERRILL, Trans. Conn. Acad. Sci., I, Pt. 2, 1867–71, p. 325. Type, *L. tenuis* (Ayres) = *Synapta inhærens* (O. F. Müller); not equivalent to *Synaptula*, but some species referred to *Leptosynapta* now referable to *Synaptula*.

Heterosynapta VERRILL, Trans. Conn. Acad. Sci., I, Pt. 2, 1867–71, p. 346. Type, *Holothuria viridis* Lesueur = *Synaptula vivipara* Örstergren.

Chondroclæa (part) ÖSTERGREN, Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 1898, No. 2, p. 113. Type, *Synapta indivisa* Semper.—SLUITER, Siboga Holothurioidea, 1901, p. 125.

Tentacles 10 to 27 pinnate, usually with numerous divisions; retractor muscles present (except in *S. nigra* according to Semper). Cartilaginous ring present between calcareous ring and ring canal; perforations in cartilaginous ring posterior. Anchors with unbranched stock or handle[a] to shaft, flukes smooth, the middle of the arch beset with small granular protuberances. Anchor plates with large central toothed hole surrounded by six other toothed[b] holes, but that nearest handle only partly toothed, or smooth, and its outer end rather acute. This hole is arched over by a curved rod with two (not four) supports—i. e., it is not branched where attached to anchor plates, as in following genus. Madreporic canal single, unbranched.

Synaptula as here used includes the first division of Östergren's *Chondroclæa*; that is, all the species enumerated by him with the exception of *Synapta beselii*.[c] Unfortunately Östergren's appropriate name can not be retained for this group because antedated by *Synaptula* Örsted. Örsted's species (*viripara*) is a fairly typical member of this genus, so that it is not possible to restrict *Synaptula* to a narrower genus and retain *Chondroclæa*.

The still earlier name *Tiedemannia* Leuckart can not be applied with certainty to any species, although it was given ostensibly to

[a] This handle is finely toothed, but not with conspicuous divisions, as in *Euapta* and *Opheodesoma*.

[b] A difference in the serrations of these holes exists between *Euapta* and *Synaptula*. In the former the teeth occupy the whole circumference of the holes (except in handle) on the side directed toward exterior of body wall (or that on which the bridge occurs in the handle). On the inner side of the plate they occupy only half the circumference. In *Synaptula* the teeth occupy only half (but opposite halves) of the circumference on both surfaces of plate. In *Opheodesoma* the teeth are as in *Euapta*.

[c] The type of *Synapta* Eschscholtz (1829) is *Synapta mamillosa*. This is equivalent to the earlier *Holothuria maculata* Chamisso and Eysenhardt, 1821, according to Dr. Hubert Lyman Clark *in litt.* The name therefore stands *Synapta maculata* (Chamisso and Eysenhardt), with *Synapta mamillosa* Eschscholtz, 1829, *S. oceanica* (Lesson, 1830), *?Synapta radiosa* (Lesson, 1830), *?S. punctulata* (Quoy and Gaimard, 1833), *?S. doreyana* (Quoy and Gaimard, 1833), *S. beselii* Jäger, 1833, and possibly others as synonyms. The name *Synapta* can not be used for the *inhærens* group as Östergren proposed. The genera closely allied to *Synapta* in the order of their description stand as follows:

Synapta ESCHSCHOLTZ, 1829. Type, [*S. mamillosa*] *S. maculata* (Chamisso and Eysenhardt) Clark [=*S. beselii* Jäger, and authors]. Synonyms: *Oncinolabes*

Fistularia vittata Forskål.[a] Leuckart says: "Muss offenbar ein eigen Genus bilden, welches ich Herrn Geheimen Rath Tiedemann zu ehren, der sich so gross verdienste um die Anatomie der Echinodermen erworben hat, *Tiedemannia* genannt habe. L." This is in a footnote. In the text above the following occurs: "Er [Prof. Leuckart] zeigte unter anderen, dass *Fistularia* (*Holothuria*) *vittata* keine Athmungswerkzeuge habe wie *Holothuria tubulosa* u. a., dass der Eierstock aus zwei mehrfach verästelten Schläuchen bestehe." Dr. Östergren writes me as follows concerning *vittata:* "'*Chondrodaca vittata* (Forsk.)' werden Sie in meinem Verzeichnis der Synaptiden nicht finden. Unter der Namen *Synapta vittata* (Forsk.) findet man in der Litteratur *verschiedene Arten* der Gattungen *Chondrodaca* und *Euapta*, von denen jedoch keine mit Forskål's *Fistularia vittata* identisch sein dürfte, denn diese besitzt nur 12 Tentakel (die Angabe Forskål's im Texte wird durch die Figur bestätigt). Mir liegen mehrere solchen Arten aus dem Rothen Meere vor jedoch konnte ich kein von diesen sicher mit der Art Forskål's identificieren."

There can be no certainty, therefore, that Leuckart really had Forskål's species, and indeed that this species is a *Synaptula*, as might be surmised from Théel's summary. If *vittata* has only 12 tentacles, naturally both Théel and Lampert are in error in placing the number at 15. The name *Tiedemannia* consequently can not seriously compete with *Synaptula*. It seems questionable if Forskål's species can ever be accurately identified, since so much confusion already exists in regard to it.

SYNAPTULA KEFERSTEINII (Selenka).

Synapta keferstcinii Selenka, Beiträge zur Anatomie und Systematik der Holothurien, Zeitschr. f. wiss. Zool., XVII, 1867, p. 360, pl. xx, figs. 120, 121. (Sandwich Islands.)—Semper, Holothurien, 1868, p. 14, pl. v, fig. 24; pl. xxxix, fig. 11.—Théel, Challenger Holothurioidea, Pt. 2, 1886, p. 19. Authors up to Östergren.

Brandt, 1835; ?*Reynaudia* Brandt, 1835; *Chondrodaca* (part), Östergren, 1898. This is a monotypic genus differing from *Synaptula* in the character of the anchor plates, and branched madreporic canal.

Synaptula Örsted, 1857. Type, *S. viripara* Örsted. Synonyms: *Leptosynapta* (part) Verrill, 1867–1871; *Heterosynapta* Verrill, 1867–1871; *Chondrodaca* (part) Östergren, 1898.

Leptosynapta Verrill, 1867–1871. Type, *L. tenuis* Ayres (not Quoy and Gaimard)=*L. inhærens* (O. F. Müller). Synonyms: *Dactylota* (part) Brandt, 1835; *Synapta* Östergren (not Eschscholtz), 1898.

Euapta Östergren, 1898. Type, *Eu. godeffroyi* (Semper).

Labidoplax Östergren, 1898. Type, *L. buskii* (M'Intosh); *Synapta tenera* Norman is a *nomen nudum*.

Protankyra Östergren, 1898. Type, *P. abyssicola* (Théel).

Ophiodesoma nob. Type, *O. spectabilis*, new species; see below. Near *Euapta*.

[a] Oken's Isis, XXIII, 1835, p. 685.

Chondroclava keferstcini ÖSTERGREN, Das system der Synapteden, Öfversigt, etc., 1898, no. 2, p. 114.

Tentacles 25 to 26, with 30 to 62 (or even 80 according to Semper) digits along either side in a crowded zigzag series, or even two series. Cartilaginous ring 7 mm. wide, with 17 small perforations on posterior border. Polian vesicles 23 in the single specimen available. Single madreporic canal in dorsal mesentery; madreporic body rather elongate. Anchor arms smooth, the stock on handle without processes but very minutely roughened along the edge. Anchor plates symmetrical, with six larger dentate holes, a smaller partially dentate one, together with two large and three or four small smooth ones at the handle. Miliary granules, small irregular rods or incomplete rosettes. Color in life, brownish green; in alcohol, reddish brown.

Localities.—Station 4031, Penguin Bank, south coast of Oahu Island, 27 fathoms, fine coral sand, foraminifera, coral; Station 3876, Auau Channel, between Maui and Lanai islands, 28 to 43 fathoms, sand and gravel; 5 fragments.

The specimen from 4031 consists of a fragment about 250 mm. long (in life) of the anterior portion of an animal, while those from 3876 are fragments of the posterior part of two or three smaller individuals. The former has lost the calcareous deposits through dissolution, but in the latter specimens they are in good condition. The deposits agree fairly well with Selenka's figure. In the handle of the anchor plates, which are 0.24 to 0.25 mm. long, are three small smooth holes and two large. The third large hole, which is smooth in Selenka's figure, is toothed around the posterior border. This hole is considerably smaller than the other two in the handle and is median in position. Of the three small holes the median is the largest. The rod which forms an arch across handle is toothed on posterior border and has one or two teeth on outer border. The teeth in the six serrate holes are very conspicuous. The stock or transverse handle at the end of the shaft of the anchor is without any processes, but it is minutely roughened. There are a few granuliform protuberances on the central portion at the base where the two flukes join each other. Miliary granules are similar to Semper's figures, namely, small irregular rods about 0.01 to 0.0135 mm. long, often expanded into plate-like forms. (Plate LXXX, fig. 2.)

Three fragments of a small individual minus the anterior end were also taken at 3876. The deposits are essentially as in the adult, but the handle of the anchor plates may have as many as five or six small holes. The handle or stock is more frequently absent from the anchor shafts, and the miliary granules are simpler than in the above-described specimen, almost exactly like Semper's figures. Ludwig has noted that the seventh hole in the anchor plate is toothed[a] and Bedford[b] in a specimen from Rotuma found toothed and smooth holes.

[a] Zool. Jahrb. Syst., III, 1888, p. 818. [b] Proc. Zool. Soc., 1898, p. 847.

This species, the type of which came from the Hawaiian Islands, may be readily distinguished from other synaptids of the region by the number of tentacles. Semper records the species from Samoa, and it has been taken also at Amboina, Rotuma, and Kosseir (Red Sea).

Genus EUAPTA Östergren.

Euapta Östergren, Das System der Synaptiden, Öfv. Ak. Forh., No. 2, 1898, p. 112. Type, *Euapta* (olim *Synapta*) *godeffroyi* (Semper).—Sluiter, Siboga Holothurioidea, 1901, p. 123.

Synapta (part) Authors up to Östergren.

Tentacles normally 15 (13 to 17) pinnate, with numerous digits either free or united by web for half their length. Cartilaginous ring absent. Stock of anchors branched, arms smooth, but beset in middle of arch (opposite end of shaft) with numerous small granuliform protuberances. Anchor plates with a large central hole, surrounded by six (or seven) other large holes, all toothed,[a] except that adjacent to handle, which is toothed on inner part of circumference only. Handle of plate arched over by a curved rod with four supports, i. e., it joins the plate in two places, on either side. The handle or attached end of anchor plates with two large and several small smooth holes, one of the large holes situated on each side of the rather acute outer end of the usual large median hole of the handle; the latter, as well as the lateral holes of the handle, is spanned by the arched rod. Calcareous ring without conspicuous anterior projections. Madreporic canal single (or very few and dorsally situated). Retractor muscles present.

This is equivalent to section A of Östergren's *Euapta* and includes *godeffroyi* (Semper), *lappa* (J. Müller), and *polii* (Ludwig).

EUAPTA GODEFFROYI (Semper).

Synapta godeffroyi Semper, Reisen ein Archipel Philippinen, Pt. 2, 1, Holothurien, 1868, p. 231, pl. xxxix, fig. 13 (Samoan Islands).

Euapta godeffroyi Östergren, Das System der Synaptiden, Öfv. Ak. Forh., No. 2, 1898, p. 113.

Tentacles 14 to 16 (14 and 15 in Hawaiian examples) pinnate, with about 56 to 70 digits united for about half their length by a thin web. Deposits: Anchors with smooth arms and about six to eight minutely spiny processes to handle of shaft; anchor plates with seven large dentate holes and two large and three (or more) small smooth holes in handle; the seventh hole acutely ovate and only partially dentate; miliary rosettes subcircular with a hole in center. Anchors not deformed in Hawaiian specimens. Color in alcohol, creamy white with spaced broad bands of olive brown across the back and slightly darker lines than general body tone along dorsal radii. The ground

[a] A difference in the distribution of the serrations of these holes in *Synaptula* and *Euapta* has been mentioned under *Synaptula*.

color of body is really a livid grayish, closely marbled with creamy white representing aggregations of rosettes. The brown bands more or less spotted with whitish. Tentacles grayish green to yellowish gray. Polian vesicles large, about 30 in number. Madreporic body single, in dorsal mesentery. Length of alcoholic specimen, 250 mm.

Localities.—Station 3872, Auau channel between Maui and Lanai islands, 43 to 32 fathoms, yellow sand, pebbles, coral; Station 3876, same locality, 28 to 43 fathoms, sand and gravel; Hilo, Hawaii (H. W. Henshaw, collector, Acc. No. 41822, U.S.N.M.); 4 specimens.

The calcareous ring is slightly different from the figure given by Semper. Thus the radial pieces have an anterior perforation but the posterior border is not so deeply notched, rather less so than the interradial pieces, which are also a trifle less excavated. The Polian vesicles are somewhat unequal in length, the longest being 30 mm. The long rachis of either half of gonad gives off at intervals a slender tubule three or four times dichotomously branched. Retractors well developed. Madreporic body is elongated.

The anchor plates, the exact form of which is best seen from the figure (Plate LXXXI, fig. 3*c*), appear to be rather more regular than in Samoan examples, judging from Semper's figures. The two larger smooth holes of handle are symmetrically placed, the rather acute anterior end of the odd half-serrate hole being between their hinder ends. Usually there are three small perforations on edge of handle, the central one being largest; rarely, however, there is but one, or the three are subequal and less regular than in figure. Plates are about 0.27 mm. long. I find no peculiar anchors with triradiate shafts such as Semper figures. The arms or flukes are occasionally bent off their plane. The stock or handle to shaft has six to eight minutely spiny or rugose processes, and there are a few granuliform protuberances at the opposite end where the two arms join. Anchors are about 0.38 mm. long. Rosettes are about 0.021 to 0.027 mm. in diameter. In perisome surrounding mouth are many rosettes and numerous straight or slightly curved rods thickened or branched, and minutely spiny at tip. The surface of these rods, which are abundant also in digits of tentacles, is thickly covered all over with minute granuliform spines or asperities. Their length in the tentacles is 0.13 to 0.27 mm. and in the oral disk 0.12 to 0.24 mm., usually nearer the former than latter dimensions. (See Plate LXXXI, fig. 3*b*.) These rods are not mentioned by Semper, but they were probably overlooked in the type specimens. Neither does Bedford speak of them. He found no malformations in the deposits in his specimens from Rotuma.[a]

Euapta godeffroyi has been recorded from Mauritius, Pelew, Thursday, Fiji, Samoa, Caroline, and Rotuma. The Hawaiian records thus materially extend its known range.

[a] Proc. Zool. Soc., 1898, p. 847.

OPHEODESOMA, new genus.

Type.—Opheodesoma spectabilis.

Numerous madreporic canals, distributed around the ring canal. Cartilaginous ring sometimes present, when perforations are along anterior border, not along posterior border as in *Synaptula*. The two large lateral holes in handle of anchor plate absent, the central hole larger than in *Euapta*, and rounded, not acute, on the outer edge; plates otherwise as in *Euapta*. Calcareous ring with conspicuous anterior projections. Tentacles and anchors as in *Euapta*. Retractors present.

Some notes on this genus will be found under the following species. The genus includes species mentioned under section B of Östergren's *Euapta—glabra* (Semper), *grisea* (Semper), and *serpentina* (J. Müller).

OPHEODESOMA SPECTABILIS, new species.

Plate LXVI; Plate LXXX, figs. 1, 1*a–d;* Plate LXXXI, fig. 2.

Tentacles 15 (very rarely 16), rather long, pinnate; digits, 30 to 70 (usually 50 to 54), united for half their length by a web. When living the animal is characterized usually by five regular series of numerous large globular protruberances extending from end to end of body; occasionally these are absent. Body wall rough, opaque. Deposits: Symmetrical anchor plates with six large toothed holes, and in the handle one still larger hole (serrate on border toward free or large end of plate and rounded, not acute on opposite border), and in addition four or five small smooth holes bordering free edge of handle. Occasionally one or two small partially serrate holes are present on distal border of plate, causing some asymmetry. Anchors with smooth flukes, and about seven to ten minutely spinous protuberances on the stock or handle to shaft. Miliary granules, tiny rosettes usually with a small hole in center. Cartilaginous ring well developed, with medium-sized holes on anterior border, adjacent to calcareous ring. Polian vesicles many (over 100); madreporic canals small and very numerous, forming a crowded series over the whole extent of ring canal. Color in life, reddish orange spotted with brown, the brown forming transverse more or less interrupted bands; ventral surface posteriorly grayish, spotted with whitish and barred with dark gray. Tentacles dark dull greenish. The protruberances are usually rather dark. Length variable. The largest individuals observed were 600 mm. long (2 feet). Others were 300 to 450 mm. The length depends largely, of course, on the amount of extension of the animal at moment of measurement.

Locality.—Pearl Harbor, near Honolulu, Oahu (Aiea and other portions of harbor). Very common in shallow water on sandy bottom and on submerged coral; 60 specimens.

Type.—Cat. No. 21226, U.S.N.M.

The tentacles appear to be quite constantly 15 except for two specimens which have 16. They are 20 to 25 mm. long when extended. Occasionally one or more tentacles are considerably smaller than the rest, but as there is no constancy in position, I suppose these represent regenerating members. Occasionally individuals are found which have lost a tentacle and possess an incipient "bud" in its place. As noted in the diagnosis, the number of digits varies considerably, but in the large tentacles it is usually over 50. The small number of 30 is found only on small tentacles above alluded to. If one is fortunate in finding a tentacle with the digits extended, the web is seen to extend slightly beyond the middle of the digits. The longest digits are at the middle of the tentacle, and thence they are graduated in size toward either end, the smallest being proximad, where they cease about 6 mm. from base. The surface of body is very rough with the anchors, but the surface of the perisome itself appears to be smooth in decalcified specimens.

The calcareous ring is fairly stout and is composed of 15 pieces, there being two interradials between each radial. Both are slightly excavated on posterior border. The radials have a large perforation on the anterior border and the interradials a simple subspatulate process. The exact form is best appreciated from figures. The cartilaginous ring is about 5 mm. wide and the perforations occur regularly opposite each piece of the calcareous ring, so that the concave posterior border of the piece forms the anterior edge of a perforation. These perforations vary in size, even in the same individual, being from 0.5 to 1.25 mm. long. In the dorsal mesentery is a single slender madreporic canal, and in addition very many (upward of fifty) shorter ones form a crowded series all along the ring canal. The latter are curved or twisted and are about 0.5 to 1 mm. in length, usually less than a millimeter. Polian vesicles are extremely numerous (125 in one specimen), and in preserved specimens are often slender and filamentous, forming a tangled mass of threads all around the ring canal. At their base is the wreath of madreporic canals. Length of Polian vesicles about 10 mm. or less. Gonad in a right and a left tuft. When fully developed it extends nearly to middle of body. The long slender rachis gives off at intervals a slender tuft of tubules, which is really a single tubule three or four times dichotomously branched. Fairly well developed retractor muscles are present. Ciliated urns are abundant on mesentery near attachment to body wall. This portion of mesentery in anterior part of body is finely perforated.

The anchor plates are fairly broad for length, the latter being 0.285 to 0.298 mm. The exact form is best appreciated from figure. Usually there are six toothed holes, but occasionally one or two small perforations occur at broad end. A plate with one such is figured. (Plate

LXXXI, fig. 2.) Besides the four or five smooth holes on border of handle, several very fine perforations are occasionally interpolated irregularly between these and the edge. The anchors are 0.4 to 0.45 mm. long. On the edge at the point where the flukes join are three or more inconspicuous granuliform protuberances. The flukes are sometimes slightly twisted off their proper plane, and are thus asymmetrical. The small rosettes are subcircular and 0.0135 to 0.0189 mm. in diameter. They are more numerous on the lighter portions of the integument (especially ventrad) than on the darker, and are so arranged as to give the effect of marbling under low power of microscope. When they are particularly abundant they leave more or less open circular spaces (where they are only scattered) in which an anchor and its plate occur. In the perisome surrounding the mouth are numerous rods 0.0675 to 0.135 mm. long, smooth except for the tops, which are slightly swollen and bluntly toothed or merely roughened (Plate LXXX, fig. 1*d*). No rods in digits as in *Euapta godeffroyi*, but relatively few rosettes occur there.

This strikingly colored synaptid is abundant in the shallow water of Pearl Harbor, at Aiea, and other localities. From the shore one may see numerous individuals slowly crawling over the soft bottom among the scattered sea weeds. Many specimens were taken with a dip net from the boat landing at Doctor McGrew's place, Aiea. When the animal is moving the tentacles are slowly brought into play. The large globular excrescences, which frequently form five series along the body, may possibly aid in locomotion, although numerous individuals without these were observed creeping about. It will be noted that these protuberances do not form double rows as in *Synapta maculata* [i. e., *beselii*] and *Opheodesoma glabra*.

This species is closely related to *Opheodesoma glabra* (Semper). I have sent specimens to Dr. H. L. Clark, who believes that they are referable to *glabra*, as he is inclined to minimize the importance of the cartilaginous ring. After a thorough reexamination, I am unable to agree with Doctor Clark and have decided to keep the form separate, although in a different genus from that in which I originally placed it (*Synaptula*). Thus, following Doctor Clark, I have considered the form of the calcareous particles as of generic value, rather than the presence of a cartilaginous ring.

The following characters in parallel columns will serve to contrast *spectabilis* and *glabra*. The authorities for the statements concerning *glabra* are in parentheses. Neither Doctor Clark nor I have seen specimens of this species.

Spectabilis.	*Glabra.*
Well-developed cartilaginous ring present.	Cartilaginous ring absent.[a] (Théel.)
Interradial pieces of calcareous ring broadly truncate anteriorly; radial pieces rounded anteriorly with large hole.	Interradial pieces tapering anteriorly and subacute; radial pieces angular anteriorly with small hole. (Semper, Pl. IV, fig. 8*a*.)
Surface of body very rough from the anchors (both in life and when preserved in alcohol). Anchors lie near surface.	Surface of body smooth, not roughened by anchors either in life or when preserved. Anchors deep in the skin. (Semper,[b] Sluiter.)
Characteristic protuberances when present forming five single series along body.	Characteristic protuberances when present forming five double series along body. (Semper, Pl. II.)
Color in life, reddish orange spotted with brown, the brown forming transverse more or less interrupted bands; ventral surface grayish posteriorly, spotted with whitish and barred with dark gray.	Color in life, uniform Van Dyke brown; in alcohol, uniform reddish brown or dark brown. (Semper, Pl. II, Théel.)

[a] Théel states (Challenger Holothurioidea, Pt. 2, p. 20): "Cartilaginous ring absent." Semper does not mention the ring in his original description (Holothurien, p. 12), but as he mentions its presence in all the species of *Synaptula* he described we are led to suppose that the structure is absent in *glabra*. Furthermore, Sluiter, who has described numerous species of *Synaptula* (sub nomine *Chondrodota*), places *glabra* under *Euapta*, which he would not have done without remark if a cartilaginous ring had been present. Östergren, who gives primary importance to the cartilaginous ring, did not find it in *glabra*.

[b] This I consider an important difference. Semper says (Holothurien, p. 11, under *Synapta beselii*): "Bei einer 3 Fuss langen neuen Art, meiner *Synapta glabra*, liegen diese Organe [i. e., the anchors] im Gehen so tief in die Haut eingebettet, dass ich sie wegen ihrer ganz glatten schlüpfrigen Haut für ganz ankerlos hielt, solange ich die Haut nicht microskopisch untersucht hatte." Under the description of *glabra* (p. 12) he says: "Hier liegen die Anker * * * so tief in der Haut, dass man sie erst nach dem Tode leicht erkennt, denn selbst unsanfte Berührung veranlasst das lebenskräftige Thier nicht im Mindesten sie hervorzustrecken, sodass ich langer Zeit das Thier für eine riesige Chirodota hielt."

I handled over a hundred *Opheodesoma spectabilis* in life and can safely affirm that the anchors are in nowise embedded deep in the skin. They are in evidence as soon as one picks up an animal.

There is no *Synaptula* with which the present species can be confused, on account of the fundamental difference in the form of anchor stock and the presence of numerous madreporic bodies in combination with 15 tentacles. Several species have been listed as *Synapta vittata*, these species being either *Synaptula* or *Euapta*. The *Synapta* or *Fistularia vittata* of Forskål is unknown. Théel lists a 15-tentacled "*Synapta vittata*," which has a cartilaginous ring (according to Müller, although Müller probably did not know a *Fistularia vittata*.) Under

his synonymy Théel gives a reference to Herapath.[a] This figure is that of some *Euapta*. Lampert[b] lists *Synapta rittata*, with the same reference to Herapath in synonymy. He, however, examined a specimen at first hand, for he found "*numerous madreporic bodies.*" No known species occurs which has madreporic bodies numerous (*Ophiodesoma*) and at the same time anchors and plates like those figured by Herpath (*Euapta*). Just as Doctor Östergren says, in his letter, different authors are trying to fasten Forskål's name on to several different species of at least two genera. Sluiter has recently[c] listed a specimen of "*Chondrodaa rittata*," basing his identification on Jäger's description,[d] but there is no telling what his 13-tentacled species is. He gives no figures.

Thus it would seem that all the comparisons of *Ophiodesoma spectabilis* must be made within the genus and not with Synaptulas; *Ophiodesoma glabra* is the only species which shows very close resemblances with *spectabilis*.

Perhaps the erection of a new genus requires some defense. The character of the anchor plates, the numerous madreporic canals, the occasional presence of a cartilaginous ring differing in structure from that of *Synaptula*, the presence of anterior projections on calcareous ring divides the group of *spectabilis*, *glabra*, *grisea*, and *serpentina* very sharply from that of *godeffroyi* and *lappa*. In respect to the cartilaginous ring, *spectabilis* bridges the gap to *Synaptula*, but the differences in deposits are sharp, while the ring itself is different in structure.

Genus PROTANKYRA Östergren.

Synapta (part) AUTHORS up to Östergren.

Protankyra ÖSTERGREN, Öfv. Ak. Forh., LV, 1898, p. 116. Type, *Synapta abyssicola* Théel.

Tentacles 10 to 14 digitate with four or five digits. Retractor muscles and cartilaginous ring absent. Anchor arms serrate, the vertex without minute knobs or granules; stock or handle branched occasionally. Anchor plates without abruptly narrowed handle and with numerous irregular holes. Almost always an irregular perforated arch over the attached end of plate, united with latter in several places. Circumference of plate uneven or incomplete.

[a] Quarterly Jour. Mic. Sci., 1865, pl. 1, fig. 6, is exact reference, according to Lampert.

[b] Seewalzen, p. 216.

[c] Siboga Holothurioidea, p. 126.

[d] De Holothuriis, 1833, p. 14.

PROTANKYRA ALBATROSSI, new species.

Plate LXXXI, figs. 1, 1*a*; Plate LXXXII, figs. 4, 4*a–c*.

Tentacles 12 (varying occasionally to 13 or 14), with 4 digits, the 2 terminal being longest, a series of three to six small "sensory cups" on either side of tentacle between proximal digit and base. Two ventral Polian vesicles. Madreporic canal, single, dorsal. Deposits: Anchors with a rather long shaft, spiny handle and upward to nine teeth on either arm. Anchor plates rather large, very variable, with two large central holes and numerous smaller ones; edge uneven: occasionally an incipient handle. Along the radii, in oral disk, and tentacles, many irregular rod-shaped, C-shaped, O-shaped, and variously formed grains. Color in life, translucent white, often with a pale lilac tinge. Length of large specimen, 100 mm., slender.

Localities.—Type (Cat. No. 21227, U.S.N.M.) from Station 3840, south coast of Molokai Island, 266 to 314 fathoms, light-brown mud, sand, rocks; bottom temperature, 46°. Taken also at the following stations:

List of Stations.

Station.	Locality.	Depth.	Nature of bottom.
3835	South coast of Molokai Island	169–182	Fine brown sand, mud.
3836	.....do	238–255	Brownish gray mud, sand.
3839	.....do	259–266	Light-brown mud, sand.
3895	.....do	252–429	Coral, rocks.
3984	Vicinity of Kauai Island	237–164	Fine coral sand.
3998	.....do	235–228	Coarse brown coral sand, shells, rocks.
4043	West coast of Hawaii Island	236–233	Gray sand, broken shells, rocks.
4044	.....do	233–198	Fine gray sand.
4079	North coast of Maui Island	143–178	Gray sand, foraminifera.
4082	.....do	220–238	Gray sand.
4083	.....do	238–253	Do.
4132	Vicinity of Kauai Island	257–312	Fine gray sand, mud.
4139	.....do	512–339	Fine gray sand, rocks.
4140	.....do	339–437	Fine gray sand.
4141	.....do	437–632	Volcanic sand, foraminifera.
4142	.....do	632–881	Coarse manganese sand rocks.

Ninety specimens.

Tentacles are usually 12, but specimens with 13 and 14 are occasionally found, often from the same station as those with 12. The digits are fairly constantly 4; only in a single case out of a number examined did a tentacle have 5. Along either side of the tentacle between the proximal digit and the base is a series of from three to six small pear-shaped bodies attached by the smaller end, about 0.2 to 0.25 mm. in length. They apparently correspond to the "ciliated sucking disks" which Semper figures for *Anapta gracilis*. In the present specimens they appear to be considerably contracted, and it is not certain whether there are cilia present at the tip. The series is not always very regular, the proximal body standing out of line in many cases.

The anchor plates are very variable in shape, and many are in different stages of development. Complete plates range from 0.2 to

0.27 mm. in length. There are two large central holes, but the others vary so much in size that it is futile to attempt a detailed description. The figures will serve to illustrate the usual type. Occasionally there is an incipient handle (Plate LXXXII, fig. 4), such as is well developed in *Labidoplax*, but plates in the same individual vary greatly in this respect. In specimens from a more considerable depth (4141, 4142) the outline of the plates is rather more even, the two central holes are relatively smaller than those from lesser depths, the calcareous framework is somewhat stouter, and the plates average a little larger. The anchors are 0.24 to 0.35 mm. long. Many are represented by simple rods, being in a state of development. The miliary grains vary considerably in number, being scarce in some specimens and abundant in others. When present in normal numbers they are arranged in two series along each radius, with others scattered sparsely on either side of the series. The O- and C-shaped grains are commonest, but other forms are numerous. In some specimens variations of straight or slightly curved rods predominate. In the shaft of the tentacle, C- and O-shaped bodies predominate, but in the digits slightly curved rods. Grains in the body range from about 0.04 to 0.065 mm. in length; those in the tentacles are smaller, and those in oral disk smallest. The figures are drawn to scale.

Although this species is undoubtedly closely related to *Protankyra challengeri* (Théel), there are a number of differences of considerable importance, namely, the presence of two series of little "sensory cups" on tentacles, the variable number of tentacles, arrangement of miliary granules, as well as their somewhat different form, more elaborate anchor plates. Even the calcareous ring presents points of difference.[a] Sluiter[b] has named a variety *sibogæ*[c] of *P. challengeri*, the plates of which are more like those of the present species than are typical *challengeri*. In other points *sibogæ* seems to be very close to *challengeri*, which was taken in 140 fathoms at Fiji Islands.

It may eventually be found that *challengeri* is a very wide ranging and variable species, including possibly apparently separate forms, but it is pure assumption to so regard it at present. It seems far better, in view of the differences pointed out above, to regard the Hawaiian specimens as belonging to a separate species, which may well bear the name of the fisheries steamer *Albatross*.

[a] Compare Plate LXXXII, fig. 4*a*, with Plate I, fig. 4*d*, Challenger Holothurioidea.

[b] Siboga Holothurioidea, p. 131.

[c] This is an unfortunate name, since it invalidates the *sibogæ* given on the following page (132) to a different species of *Protankyra*. Since *P. sibogæ* is now without a name, it may be called *Protankyra sluiteri*, after its discoverer.

Genus ANAPTA Semper.

Anapta SEMPER, Reisen im Archipel Philippinen, Pt. 2, I, Holothurien, 1868, p. 17. Type, *Anapta gracilis* Semper.

Tentacles 12, pinnate. Deposits in form of oval or elongate grains, or entirely absent. General form, synaptoid.

ANAPTA INERMIS, new species.

Plate LXXIII, fig. 2; Plate LXXXII, fig. 1.

Tentacles 12, digitate, each with about 12 to 16 very small, slender digits; end of tentacles rounded without an evident odd terminal digit. Digits increase slightly in size distad. General form of body rather robust, with rounded posterior extremity. Body wall thin, translucent, the five longitudinal muscle bands showing plainly. Deposits entirely wanting. Color in alcohol, bleached grayish, profusely covered with small reddish brown or yellowish brown spots, more abundant in anterior than in posterior part of body. In type these spots are fused on anterior half of body, giving a raw sienna tint with larger grayish spots and smaller dark brown dots. Often the brownish mud in alimentary canal gives the body a brown hue. In some specimens the small brown spots are few in posterior portion of body. Calcareous ring stout, composed of ten and eleven pieces in two specimens dissected. Pieces unequal, both radial and interradial with an anterior tooth and nearly straight posterior border. One large Polian vesicle. (Plate LXXXII, fig. 1.) One very short, rather inconspicuous, madreporic canal at anterior edge of dorsal mesentery. Gonad large, with a central trunk to either tuft, from which spring branches either simple or once dichotomously branched. Alimentary canal very large and usually gorged with mud, giving the animal a plump appearance. Length, about 100 mm.; greatest breadth, about 14 to 20 mm.; in life probably somewhat longer and slenderer.

Localities.—Type (Cat. No. 21228, U.S.N.M.) from Station 3910, south coast of Oahu Island, 311 to 337 fathoms, fine gray sand and mud; bottom temperature 43.7 ; 2 specimens. Taken also from the following stations, in all, 11 specimens.

List of stations.

Station.	Locality.	Depth.	Nature of bottom.
3839	South coast Molokai Island	259–266	Light brown mud, sand.
3916	South coast Oahu Island	299–330	Gray sand, mud.
3919	.....do	294–257	White sand, mud.
3997	Vicinity of Kauai Island	418–429	Fine gray sand, brown mud.
4088	North coast Maui Island	306–297	Fine gray sand.
4089	.....do	297–304	Do.

On account of the absence of deposits in the skin it is rather difficult to assign trenchant characters to this species. Consequently a figure of the external appearance is given. The pieces of the calcareous ring are a trifle variable and the dorsal radial pieces are likely to be a little irregular, as shown in figure. There is constantly but one large Polian vesicle. The shaft of the tentacles is very large and stout in comparison with the small digits which are slightly irregular in length. In life the disparity may not be present.

The absence of deposits is certainly not due to acid, since a *Sigmodota* in perfect condition, so far as deposits are concerned, was taken from the bottle in which specimens were kept for over two years. The only known species with which the present form might be confused is *Anapta subtilis* Sluiter from the Bay of Batavia. *Inermis* differs in having 12 to 16 instead of 4 or 5 digits to tentacles, and in having a stout calcareous ring instead of a rudimentary one; no papillæ on body in *inermis;* one instead of several Polian vesicles. *Inermis* is also longer in proportion to width than *subtilis*. *Subtilis*, like *inermis*, lacks calcareous deposits.

Subfamily CHIRIDOTINÆ Östergren.

Chiridotinæ Östergren, Öfv. Ak. Förh., 1898, p. 117.

Genus CHIRIDOTA Eschscholtz.

Chiridota Eschscholtz, Zoologischer Atlas, Pt. 2, 1829, p. 12. Type, *Chiridota discolor*, Eschscholtz.

Tentacles 10 to 20, peltate, digitate. Deposits: Groups of wheels inclosed within walls of the integument, and, in addition, often more or less curved rods. Wheels with six spokes. Hermaphrodite.

KEY TO HAWAIIAN SPECIES OF CHIRIDOTA.

a. Wheel papillæ numerous, in five longitudinal series on body ..... *hawaiiensis*.
aa. Wheel papillæ few (8 to 50) in a single dorsal series ..... *uniserialis*.

CHIRIDOTA HAWAIIENSIS, new species.

Plate LXXXI, fig. 5; Plate LXXXII, figs. 3, 3*a–c*.

Near *Chiridota rigida* Semper. Tentacles 12; digits 8 to 10, the two terminals being conspicuously larger than laterals, which are graduated in size, the smallest being proximad. Ventral interambulacra with a single rather irregular series of "wheel papillæ," at least in proximal half of body; when present beyond middle, very few and scattered. Three dorsal interambulacra with many more numerous wheel papillæ, which are much more crowded in anterior than poste-

rior half of body. Anteriorly they are scattered, often encroaching upon radii; posteriorly they form a very irregular zigzag series; sometimes very few posteriorly. Papillæ unequal in size. Deposits: Wheels and numerous scattered, small, slightly curved, and C-shaped rods, swollen or knobbed at the tips, together with straight rods forked at one or both ends. In tentacles are numerous larger, more elaborately branched rods. In addition numerous small oval grains, or grains swollen at both ends and constricted in middle, are found in longitudinal muscles. Body wall thin, translucent. Color in life, between burnt carmine and pomegranate purple, translucent. Wheel papillæ light yellowish red. Length, 15 to 45 mm.; breadth, 2 to 7 mm.; usually broadest posteriorly.

Locality.—Reef between Honolulu Harbor and Waikiki, Oahu, in tide pools. The animals live a few inches beneath the surface of the soft, sandy bottom of numerous tide pools and are very common. About 125 specimens.

Type.—Cat. No. 21230, U.S.N.M.

In general form the body is cylindrical, often, but not always, broader posteriorly than anteriorly. Posterior extremity rounded to truncate, depending upon the degree of contraction. Tentacles are about 2.5 mm. long and the two terminal digits about 0.5 to 0.57 mm. The number of digits is constantly 8 to 10, the same individual having tentacles with 8, 9, or 10 digits. In the case of 9 digits there are two enlarged terminal ones, just the same as when an even number is present. The number of tentacles is very rarely 13. In a large number counted only one individual was found which thus departed from the normal number. As noted in the diagnosis, there is a single series of spaced wheel papillæ on each of the two ventral interambulacra, but in posterior half of body these papillæ are very few or are wanting. There are rather more papillæ on middorsal interambulacrum than on the two dorso-laterals, although the difference is not great. In some individuals a rather irregular series is formed along the three interradii, but generally the papillæ are scattered so that no regular serial arrangement is discoverable within each interambulacrum. The wheel areas under the microscope are seen to be circular or elliptical, usually the latter, and range from 0.24 to 0.6 mm. in diameter.

Calcareous ring (Plate LXXXII, fig. 3*d*) does not possess any peculiar characters. Madreporic canal single, in dorsal mesentery. Polian vesicles, 11 or 12, of which 4 are considerably larger than the rest.

The wheels (Plate LXXXII, fig. 3) vary in diameter from 0.045 to 0.1 mm., many sizes being found within a single group, where they are packed several layers deep. The small curved rods vary in length somewhat, the commoner lengths being found between 0.03 and 0.046 mm. The tips and sometimes the middle are slightly swollen, the former being provided with incipient thorns in some cases. The forked

rods are fairly common. All the rods are rather evenly scattered and are found in the tentacles, being there different in shape and more elaborately branched at the tips and subterminally. (Plate LXXXII, figs. 3*b*, *c*.) These rods are also larger, measuring commonly from 0.048 to 0.076 mm. The grains (fig. 3*a*) are very numerous along the longitudinal muscles and are 0.019 to 0.03 mm. in length.

The species to which *hawaiiensis* shows nearest relationship are *rigida* Semper, *liberata* Sluiter, and *amboinensis* Ludwig. From *rigida* the species differs in having constantly 8 to 10 digits to the tentacles instead of 13; in having less numerous wheel papillæ, especially on the ventral interambulacra; in possessing much heavier spokes to the wheels, and probably also in the presence of numerous oval and dumbbell grains along longitudinal muscles. The calcareous ring is nearly identical with that of *liberata*. From *liberata*, *hawaiiensis* differs in distribution of papillæ, in the presence of branched rods in integument, in the greater number of Polian vesicles. *Amboinensis* is very close to *rigida*, according to Ludwig's short description, and differs from *hawaiiensis* in the same respects as *rigida*. It is not possible to tell from any of the descriptions of the above forms whether the much branched rods in the tentacles of *hawaiiensis* are peculiar. If they are, they will afford an additional character of importance.

These little animals were found by the writer in digging for Enteropneusta, *Ptychodera laysanica* Spengel being rather common in the same habitat. The broad, flat reef which extends from Honolulu Harbor toward Waikiki is uncovered by the receding tide for a considerable width. Many little pools are left in the coral, and it is in the sandy bottoms of these that *Chiridota hawaiiensis* is so common a few inches beneath the surface of the sand. The alimentary canal is always gorged with coral sand. *C. liberata* Sluiter lives on live or dead coral over which it creeps.

CHIRIDOTA UNISERIALIS, new species.

Plate LXXX, fig. 4; Plate LXXX, figs. 5, 5*a–c*.

Tentacles 12; digits 10 to 12, the 2 terminal larger than the rest, the subterminal nearly as large, and the rest graduated in size, the proximal digits being very small. Middorsal interambulacrum only with "wheel papillæ," which are scattered very irregularly in a single lineal series the whole length of body, or are confined mostly to posterior half. Papillæ are of conspicuous size and 9 to 50 in number. Surface of body, as in preceding species, is slightly roughened by small, low, flattish, wart-like eminences, which are apparent only when animal is contracted. Deposits: Wheels larger than those of *hawaiiensis*, and smooth straight or curved rods slightly swollen at middle and with two or three blunt incipient spines at tips. In muscle bands are

smooth rods with rounded tips. Color in life, two phases, one dark purple, the other pale lilac; wheel papillæ whitish; tentacles brownish. Length, about 150 mm.; breadth variable, in unconstricted state, 7 to 9 mm.

Locality.—Station 3892, north coast of Molokai Island, 328 to 414 fathoms, fine gray sand; bottom temperature 42.5°; 10 specimens.

Type.—Cat. No. 21229, U.S.N.M.

The present species is much larger than the foregoing and differs in the great reduction in number of wheel papillæ as well as in color. The wheel papillæ vary greatly in number and apparently are more numerous in the light than in the dark individuals, which have in the neighborhood of ten papillæ, mostly in posterior two-thirds of body. In only one case have I found a papilla outside of the middorsal interambulacrum. In one individual a small papilla is situated just at the upper edge of a dorso-lateral interambulacrum and is nearly radial in position. Inasmuch as the body is constricted at intervals it is not possible to tell the exact breadth. Tentacles are much contracted in preserved specimens. The proximal digits are often so small that it is then difficult to tell whether there are 8 or 10 digits. The prevalent number appears to be 12 or 11. The terminal digits are only slightly larger than the subterminal, although in an uncontracted state the difference may be greater.

The calcareous ring is sufficiently shown by the figure (Plate LXXXII, fig. 5*c*). There are five Polian vesicles, of which two are much larger than the other three. Madreporic canal single, in dorsal mesentery. Tubules of gonad unbranched. Retractor muscles rather stout, confluent with longitudinal bands about 15 mm. from anterior extremity of body.

Wheels from same individual do not differ so much in size as in *hawaiiensis*, and are larger than in that species. They vary from about 0.12 to 0.19 mm., the majority being about 0.175 mm., in diameter. The rods are commonly about 0.08 to 0.12 mm. long, while the smooth ones in the muscles vary from 0.041 to 0.08 mm. Most of the rods of outer perisome have one to three shallow notches at tip, and occasionally a short branch in the center. Somewhat deformed grains such as X, fig. 3*a*, are rarely seen, but real C-shaped rods appear to be absent. The deposits are rather evenly scattered, but appear to be lacking in tentacles.

This species differs from the other 12-tentacled forms in the distribution of the wheel papillæ, of which there are a very small number, confined to middorsal interambulacrum. In respect to the small number of wheels, at least, *uniserialis* resembles *Trochodota purpurea*[a]

[a] Not to be confused with *Sigmodota purpurea* Studer (*Chiridota studeri* Théel), which has S-shaped deposits, and which has been considered as a synonym of *Chiridota contorta* Ludwig, a *Taniogyrus*.

(Lesson), but differs in having numerous scattered curved or straight rods with swollen notched tips, in addition to the minute smooth rods in muscle bands. *T. purpurea* has, moreover, sigmoid deposits in the external perisome besides the scattered aggregations of wheels. It is found at the Falkland Islands. *C. pisanii*, from the Chonos Archipelago, coast of Chile, 45° south latitude, also resembles *uniserialis*, having C-shaped deposits in the tentacles and one row of wheel papillæ in each of the three dorsal interambulacra. *Pisanii* is nearer *purpurea* than is *uniserialis*.

Genus TÆNIOGYRUS Semper.

Tæniogyrus SEMPER, Holothurien, 1868, p. 23. Type, *Chirodota australiana* Stimpson.

Tentacles 10 to 12. Deposits, S-shaped rods, and sometimes wheels with six spokes, grouped in papillæ.

Semper's genus *Tæniogyrus*, founded on Stimpson's *Chirodota australiana*, a fairly close relative of Ludwig's *contorta*, is quite distinct from either *Chiridota* or *Trochodota*.

TÆNIOGYRUS, species.

Plate LXXXII, fig. 2.

From Station 3919, south coast of Oahu Island, 257 to 220 fathoms, gray sand, there is a fragment of a *Tæniogyrus* evidently closely related to *T. contorta* (Ludwig). Tentacles 12; digits probably about 11 or 12, but tentacles are too contracted to ascertain accurately. Wheel papillæ are present, but the integument is too much injured to ascertain arrangement. Polian vesicles 10, of unequal size; madreporic canal single. Deposits, wheels, in groups, and very numerous sigmoid rods (Plate LXXXII, fig. 2). The wheels resemble those figured by Théel,[a] and have a diameter of 0.09 to 0.175 mm., while the sigmoid particles are slightly different, as may be seen by comparing figures. The latter are 0.185 to 0.23 mm. long, being thus smaller than in *contorta*.

The color of the specimen is whitish in alcohol, and the length is about 60 mm. The specimen is apparently nearly whole, but has been twisted and rubbed over sand till it resembles a dirty piece of cord. About the only differences which can be determined are in the number of Polian vesicles and size and shape of the sigmoid deposits. The species is evidently close to *contorta*.

[a] Challenger Holothurioidea, Pt. 2, pl. 11, fig. 2*a*.

LIST OF DREDGING STATIONS AND OF SPECIES COLLECTED AT EACH STATION.

Station 3813, south coast Oahu Island. Depth, 264 to 183; bottom, coral sand, lava specks, shells:

Mesothuria murrayi.

Station 3824, south coast Molokai Island. Depth, 222 to 498; bottom, coral rocks, broken shells:

Bathyplotes patagiatus.

Station 3834, south coast Molokai Island. Depth, 8; bottom, coral rocks, sand, shells:

Holothuria impatiens, Holothuria fusco-olivacea.

Station 3835, south coast Molokai Island. Depth, 169 to 182; bottom, fine brown sand, mud:

Protankyra albatrossi.

Station 3836, south coast Molokai Island. Depth, 238 to 255; bottom, brown gray mud, sand:

Orphnurgus insignis, Protankyra albatrossi.

Station 3839, south coast Molokai Island. Depth, 259 to 266; bottom, light brown mud, sand:

Orphnurgus insignis, Protankyra albatrossi.

Station 3840, south coast Molokai Island. Depth, 266 to 314; bottom, light brown mud, sand, rocks:

Protankyra albatrossi.

Station 3847, south coast Molokai Island. Depth, 23 to 24; bottom, sand, stones:

Holothuria paradoxa.

Station 3863, northeast approach to Pailolo Channel, between Molokai and Maui islands. Depth, 127 to 154; bottom, broken coral, coarse gravel, rocks:

Psolus macrolepis.

Station 3866, northeast approach to Pailolo Channel, between Molokai and Maui islands. Depth, 283 to 284; bottom, gray mud, fine sand:

Mesothuria murrayi, Pseudostichopus propinquus.

Station 3872, Auau Channel, between Maui and Lanai islands. Depth, 43 to 32; bottom, yellow sand, pebbles, coral:

Holothuria hawaiiensis, Holothuria anulifera, Euapta godeffroyi.

Station 3876, Auau Channel, between Maui and Lanai islands. Depth, 28 to 43; bottom, sand, gravel:

Holothuria hawaiiensis, Holothuria anulifera, Synaptula kefersteinii, Euapta godeffroyi.

Station 3883, Pailolo Channel, between Maui and Molokai islands. Depth, 277 to 284; bottom, globigerina ooze:

Mesothuria murrayi, Orphnurgus insignis.

Station 3887, north coast Molokai Island. Depth, 552 to 809; bottom, globigerina mud:

Palopatides retifer.

Station 3892, north coast Molokai Island. Depth, 328 to 414; bottom, fine gray sand:

Chiridota uniseriatis.

Station 3895, south of Molokai and west of Lanai islands. Depth, 252 to 429; bottom, coral rocks:

Protankyra albatrossi, Mesothuria parva.

Station 3910, south coast of Oahu Island. Depth, 311 to 337; bottom, fine gray sand, mud:

Anapta inermis.

Station 3916, south coast Oahu Island. Depth, 299 to 330; bottom, gray sand, mud:
Anapta inermis.

Station 3919, south coast Oahu Island. Depth, 257 to 220; bottom, gray sand:
Mesothuria parva, Anapta inermis, Taniogyrus, sp.

Station 3979, vicinity of Bird Island. Depth, 222 to 387; bottom, fine white sand, foraminifera, rocks:
Pælopatides rectifer, Scotodcima vitreum, Orphnurgus insignis.

Station 3984, vicinity of Kauai Island. Depth, 237 to 164; bottom, fine coral sand:
Protankyra albatrossi.

Station 3988, vicinity of Kauai Island. Depth, 469 to 165; bottom, gray foraminiferous sand, pebbles:
Mesothuria carnosa, Bathyplotes patagiatus, Orphnurgus insignis, Latmogone biserialis.

Station 3994, vicinity of Kauai Island. Depth, 330 to 382; bottom, fine gray sand, foraminifera:
Bathyplotes patagiatus, Orphnurgus insignis, Pannychia pallida.

Station 3995, vicinity of Kauai Island. Depth, 427 to 676; bottom, fine gray sand, rocks:
Pælopatides retifer.

Station 3997, vicinity of Kauai Island. Depth, 418 to 429; bottom, fine gray sand, brown mud:
Mesothuria carnosa, Orphnurgus insignis, Anapta inermis.

Station 3998, vicinity of Kauai Island. Depth, 235 to 228; bottom, coarse brown coral sand, shells, rocks:
Mesothuria parva, Protankyra albatrossi.

Station 4015, vicinity of Kauai Island. Depth, 362 to 318; bottom, gray sand, rocks:
Orphnurgus insignis.

Station 4019, vicinity of Kauai Island. Depth, 550 to 409; bottom, gray sand, foraminifera, rocks:
Pælopatides retifer.

Station 4021, vicinity of Kauai Island. Depth, 286 to 399; bottom, coral sand, foraminifera:
Mesothuria carnosa, Bathyplotes patagiatus, Orphnurgus insignis.

Station 4022, vicinity of Kauai Island. Depth, 399 to 374; bottom, coral sand, foraminifera, rocks:
Pælopatides retifer.

Station 4025, vicinity of Kauai Island. Depth, 275 to 368; bottom, fine gray sand, broken shells, foraminifera:
Ophnurgus insignis.

Station 4028, vicinity of Kauai Island. Depth, 444 to 478; bottom, gray sand, globigerina:
Pælopatides retifer.

Station 4031, Penguin Bank, south coast of Oahu Island. Depth, 27 to 28; bottom, fine coral sand, foraminifera, coral:
Synaptula kefersteinii.

Station 4038, west coast of Hawaii Island. Depth, 689 to 670; bottom, gray mud, foraminifera:
Pælopatides retifer.

Station 4039, west coast of Hawaii Island. Depth, 670 to 697; bottom, gray mud, foraminifera:
Pælopatides retifer.

Station 4041, west coast of Hawaii Island. Depth, 382 to 253; bottom, gray mud, foraminifera:
Mesothuria carnosa, Orphnurgus insignis, Bathyplotes patagiatus, Pannychia pallida.

Station 4043, west coast of Hawaii Island. Depth, 236 to 233; bottom, gray sand, broken shells, rocks:

Lætmogone, sp., *Protankyra albatrossi*.

Station 4044, west coast of Hawaii Island. Depth, 233 to 198; bottom, fine gray sand:

Thyonidium alexandri, *Protankyra albatrossi*.

Station 4079, north coast of Maui Island. Depth, 143 to 178; bottom, gray sand, foraminifera:

Protankyra albatrossi.

Station 4081, north coast of Maui Island. Depth, 202 to 220; bottom, gray sand, foraminifera:

Mesothuria parva.

Station 4082, north coast of Maui Island. Depth, 220 to 238; bottom, gray sand:

Protankyra albatrossi.

Station 4083, north coast of Maui Island. Depth, 238 to 253; bottom, gray sand:

Orphnurgus insignis, *Protankyra albatrossi*.

Station 4084, north coast Maui Island. Depth, 253 to 267; bottom, fine gray sand:

Orphnurgus insignis.

Station 4085, north coast Maui Island. Depth, 267 to 283; bottom, sand, shells:

Orphnurgus insignis.

Station 4086, north coast Maui Island. Depth, 283 to 308; bottom, sand, shells:

Orphnurgus insignis.

Station 4088, north coast Maui Island. Depth, 308 to 306; bottom, fine gray sand:

Mesothuria murrayi, *Anapta inermis*.

Station 4089, north coast Maui Island. Depth, 297 to 304; bottom, fine gray sand:

Anapta inermis.

Station 4096, northeast approach of Pailolo Channel. Depth, 272 to 286; bottom, fine gray sand:

Mesothuria murrayi, *Orphnurgus insignis*.

Station 4101, Pailolo Channel, between Maui and Molokai islands. Depth, 143 to 122; bottom, coral sand, shells, foraminifera:

Thyonidium hawaiiense.

Station 4110, Kaiwi Channel, between Molokai and Oahu islands. Depth, 449 to 460; bottom, gray sand:

Pælopatides retifer.

Station 4115, northwest coast of Oahu Island. Depth, 195 to 241; bottom, coral sand, foraminifera:

Mesothuria parva.

Station 4122, southwest coast of Oahu Island. Depth, 192 to 352; bottom, coarse coral, sand, shells:

Mesothuria parva.

Station 4123, southwest coast of Oahu Island. Depth, 352 to 357; bottom, fine gray sand and mud:

Orphnurgus insignis.

Station 4130, vicinity of Kauai Island. Depth, 283 to 309; bottom, fine gray sand:

Mesothuria carnosa.

Station 4131, vicinity of Kauai Island. Depth, 309 to 257; bottom, fine gray sand:

Mesothuria carnosa.

Station 4132, vicinity of Kauai Island. Depth, 257 to 312; bottom, fine gray sand and mud:

Mesothuria carnosa, *Protankyra albatrossi*.

Station 4134, vicinity of Kauai Island. Depth, 324 to 225; bottom, fine coral and volcanic sand:

Mesothuria carnosa, *Bathyplotes patagiatus*, *Orphnurgus insignis*.

Station 4136, vicinity of Kauai Island. Depth, 294 to 352; bottom, fine coral sand:
Mesothuria carnosa.

Station 4139, vicinity of Kauai Island. Depth, 512 to 339; bottom, fine gray sand and rocks:
Mesothuria carnosa, Protankyra albatrossi.

Station 4140, vicinity of Kauai Island. Depth, 339 to 437; bottom, fine gray sand:
Bathyplotes patagiatus, Orphnurgus insignis, Protankyra albatrossi.

Station 4141, vicinity of Kauai Island. Depth, 437 to 632; bottom, volcanic sand, foraminifera:
Pelopatides retifer, Latmogone biserialis, Protankyra albatrossi.

Station 4142, vicinity of Kauai Island. Depth, 632 to 881; bottom, coarse manganese sand, rocks:
Protankyra albatrossi.

Station 4151, vicinity of Bird Island. Depth, 800 to 313; bottom, fine coral sand, foraminifera, stones:
Pelopatides retifer.

Station 4176, vicinity of Niihau Island. Depth, 672 to 537; bottom, gray sand, mud, foraminifera:
Pelopatides retifer.

Station 4187, vicinity of Kauai Island. Depth, 508 to 703; bottom, gray sand, foraminifera:
Pelopatides retifer.

EXPLANATION OF TECHNICAL TERMS.

The calcareous deposits are likely to cause some trouble to the naturalist unacquainted with holothurian anatomy, because they have been given arbitrary technical names. These names are listed below, together with a number of other technical terms which are not self-explanatory.

ambulacra, the five radii.

anal teeth, calcareous teeth, five in number, surrounding anus of *Actinopyga*.

anchor plates, the perforated, often regular plates which accompany anchors. (Plate LXXXI, figs. 1*a*, 2.)

anchors, anchor-shaped deposits of *Synapta* and allied genera. (Plate LXXX, fig. 1*b*.)

buttons, buckle-shaped deposits often accompanying tables. (Plate LXVII, figs. 2*c*, *d*, *e*.)

calcareous ring, a ring, made up of plates of lime, around the œsophagus; generally ten pieces, five of which serve as points of attachment for radial muscles (q. v.) and are called *radial pieces* or *radialia*, while the alternate five are termed *interradial pieces* or *interradialia*. (Plate LXXXII, fig. 1.)

Cuvierian organs, long, slender, often whitish tubes attached to proximal portion of respiratory tree in a tuft or bunch. When ejected violently they serve as organs of defense, being very viscid and extraordinarily extensible; present especially in species of *Holothuria* and *Actinopyga*.

digitate, said of tentacles when the branches are few and arise from tip so as to resemble miniature fingers. (Plate LXXXI, fig. 5.)

disk, perforated plate forming the base of a table. (Plate LXVII, fig. 2*b*.)

gonad, the ovary or testis, as the case may be.

interambulacra, interradii, or the five longitudinal areas between the radii.

interradial pieces, see calcareous ring. (Plate LXVIII, fig. 4*a*, *i r*.)

madreporic canal, the calcareous canal connecting the ring canal of water vascular system with body cavity, or with exterior in many Elpidiidæ. Often numerous in a single individual, frequently single. (Plate LXXX, fig. 1, *m*.)

mesentery, especially the dorsal mesentery, the sheet of transparent tissue joining the œsophagus and intestine to body wall. The anterior portion of alimentary canal is slung by the dorsal mesentery to the middorsal (interradial) line of body wall. (Plate LXXX, fig. 1, *me.*)

miliary granules, simplest form of calcareous deposits, namely, more or less irregular grains.

papillæ, ambulacral appendages in which the sucking disk is absent and the terminal plate absent or rudimentary.

pedicels, tube feet, or locomotor organs, having a terminal sucking disk.

peltate, said of tentacles having a circular, flattish, or convex crown.

pinnate, of tentacles having the branches occurring regularly along the sides in two opposite series and without subdivisions. (Plate LXVI.)

plates, thin, flat, wide, usually perforated deposits. (Plate LXXIX, fig. 1, *b.*)

Polian vesicle, cul-de-sac, or reservoir, connected with ring canal of water vascular system. (Plate LXXX, fig. 1, *p. v.*)

posterior prolongations of calcareous ring. (Plate LXXIX, figs. 2, 3.)

radial muscles, the five, usually double, bands of muscle running from end to end of the animal along the five radii.

radial pieces, see calcareous ring. (Plate LXXXII, fig. 1, *r.*)

respiratory trees, when present, a pair of long, much-branched outgrowths of wall of cloaca, lying in body cavity, usually unequal in length. The left is frequently associated with the *rete mirabile*. (Plate LXXIV, fig. 1, *r.*)

rete mirabile, complex plexus of blood vessels between the dorsal vessel (marginal vessel of the *rete mirabile*) and the lacunar network of the alimentary canal. Some of the numerous small retia mirabilia form webs around the terminal ramifications of the left respiratory tree.

retractor muscles, anterior free portion of radial muscle attached to end of radial piece of calcareous ring and serving to retract tentacles and anterior portion of body into body cavity for protection.

rods, rod-shaped deposits. (Plate LXXV, figs. 1–5.)

rosettes, calcareous deposits in the form of rods more or less irregularly and profusely branched. (Plate LXVII, figs. 1*c*, 4*a*; Plate LXXX, fig. 1*c.*)

spire, upright portion of a table. (Plate LXVII, fig. 2*a*; Plate LXXII, figs. 1*a–e.*)

supporting rods, calcareous rods in walls of tentacles, papillæ, and pedicels. (Plate LXVIII, fig. 4; Plate LXIX, fig. 1*g.*)

table, a perforated plate having a projection, made up of several rods more or less joined together, rising perpendicularly from the middle. (Plate LXVII, fig. 2*a.*)

tentacle ampullæ, vesicles of the ambulacral system connected with the tentacles and lying in the body cavity, around the calcareous ring.

tentacles, modified ambulacral appendages surrounding the mouth, often much branched. (Plate LXVI, *t.*)

wheels, wheel-shaped deposits. (Plate LXXVIII, fig. 1.)

EXPLANATION OF PLATES.

(All figures were drawn by the writer.)

PLATE LXVI.

Fig. 1. *Ophiodesoma spectabilis.* From a colored sketch of a medium-sized living animal. About four-fifths natural size. The present illustration does not truly reproduce the shades. The excrescences, and often a narrow transverse band between them, are much darker than the interspaces; the former are brown, the latter orange, except posteriorly on the ventral surface, which is grayish barred with darker gray, often almost black.

PLATE LXVII.

Fig. 1. *Actinopyga mauritiana.* Rods and grains from ventral perisome, × 200. 1*a*–*d*. Rods from dorsal perisome, × 400.

2. *Actinopyga parvula.* Table viewed from above, showing crown and disk. 2*a*. Slightly larger table from side. 2*b*. Disk of table. 2*c*–*e*. Buttons. 2*f*. Plate and rod from dorsal papilla, × 200. 2*g*. Calcareous ring, mediodorsal piece without anterior tooth, × 3.

3. *Actinopyga obesa.* Rods from perisome, × 400.

4. *Holothuria paradoxa.* Several rods from dorsal perisome, × 200. 4*a*. Same, × 400. 4*b*. Rods from dorsal pedicels, × 200. (See also Plate LXIX, fig. 5.)

5. Same. Various forms of rods from ventral perisome, × 200.

PLATE LXVIII.

Fig. 1. *Holothuria cinerascens.* Crown of table. 1*a*. Smaller table from side. 1*b*. Larger table. 1*c*–1*e*. Various forms of disks of tables. 1*f*. Rough rods from general perisome. All × 200.

2. *Holothuria verricax.* Two views of table. 2*a*. Tables with rudimentary spire. 2*b*. Various forms of rods from general perisome. 2*c*. Larger rod intermediate between supporting rods and the small button-like rods of general perisome, × 200.

3. *Holothuria fuscorubra.* Reduced disk of table. 3*a*–*c*. Various forms of tables. 3*d*. Various forms of buttons. 3*e*. Button from near tip of pedicel, × 200.

4. *Holothuria hawaiiensis.* Supporting rods of pedicels and papillæ, × 200. 4*a*. Two radial and 1 interradial (*ir*) piece of calcareous ring, × 4. 4*b*. Large table from above, showing disk and crown. 4*c*. One type of small table. 4*d*. A large table from side. 4*e*. Disk of smaller table. 4*f*. Another type of small table. 4*g*. Various forms of buttons, some of them incomplete, × 200.

5. *Holothuria arenicola.* Table from above, the crown, and side. 5*a*–5*b*. Two forms of buttons. 5*c*. Supporting rod, dorsal pedicels, × 200.

PLATE LXIX.

Fig. 1. *Holothuria pardalis.* 1, 1*a*–*d*. Various forms of tables; 1*b* crown; 1, 1*a* disk from beneath. 1*e*. Supporting rod from pedicel. 1*f*. Various forms of buttons. 1*g*. Supporting rod from dorsal pedicel, × 200.

2. *Holothuria anulifera.* Disk of table and crown, from above. 2*a*. Table from side. 2*b*. Table from wall of papilla, viewed from one side; this type rather uncommon. 2*c*. A rare form of complete button. 2*d*. Usual form of incomplete knobbed buttons and knobbed rods, × 200.

Fig. 3. *Holothuria fusco-olivacea.* Disk of commonest form of table. 3*a*. Very rare form of large table (tip missing). 3*b*. Small table. 3*c*, 3*d*. Crowns of tables. 3*e*. One of the commoner tables from side. 3*f*. Various forms of buttons; x and x^1 are covered with small knobs, but these have been omitted to show more clearly the perforations, × 200. See also Plate LXX, fig. 3.

4. *Holothuria impatiens.* Disk of a regular table. 4*a*. Crown, from above, and characteristic table from side. 4*b*. Button. 4*c*. Supporting rod from papilla. 4*d*. Less regular table disk, × 200.

5. *Holothuria paradoxa.* A supporting rod from dorsal pedicel, × 200.

Plate LXX.

Fig. 1. *Stichopus tropicalis.* Large table, side view. 1*a*. Disk of large table. 1*b* Crown of smaller table, dorsal perisome. 1*c*. Smaller table, dorsal perisome; disk, side view, and crown. 1*d*. Rods from dorsal perisome. 1*e*. Disk of a table intermediate between the large and small tables. 1*f*. Side view of same. 1*g*. C-shaped rods, × 200. 1*h*. Supporting rod, ventral pedicel, × 140. 1*i*. Spire of ventral table.

2. *Holothuria atra.* Crown and side view of characteristic table. 2*a*. Disk of same. 2*b*. One of the small rods from general perisome, × 200. 2*c*. One of the rods forming a perforated plate, × 665.

3. *Holothuria fusco-olivacea.* Supporting rod of pedicel, × 200.

4. *Mesothuria carnosa.* Disk of one of the larger tables. 4*a*. Side view of characteristic table; only two spire rods shown. 4*b*. Table seen from above, showing disk and crown of spire. 4*c*. Two views of one of the smaller tables. 4*d*. Smaller table with sample crown, viewed from above. 4*e*. Reduced table from wall of pedicel. 4*f*. Medium-sized rod from oral disk. All × 200.

Plate LXXI.

Fig. 1. *Mesothuria murrayi.* Large table viewed from above, showing disk and crown. 1*a* and 1*b*. Two characteristic tables showing variation in spire. 1*c*. Disk of a small table of general perisome. 1*d*–1*g*. Various forms of tables from pedicels. 1*h*. Very characteristic simple disk tables of general perisome. Here the secondary peripheral perforations are lacking. Compare with 1 and 1*c*, × 200.

2. *Mesothuria parva.* Characteristic table, side and top view. 2*a*–2*c*. Various forms of crowns of tables, × 200.

3. *Pseudostichopus propinquus.* Deposits from wall of respiratory tree. 3*a*–*b*. Same, × 400.

4. *Mesothuria carnosa* (young?). Side view of table of a small Mesothuria referred with doubt to *carnosa*. 4*a*. Disk and crown of same, × 200.

Plate LXXII.

Fig. 1. *Bathyplotes patagiatus.* Disks of tables from ventral perisome. 1*a*. Table from dorsal perisome. 1*b*. Disk of table from ventral perisome. 1*c*. Disk of large table from base of the large dorsal papillæ. 1*d*. Side view of table from ventral perisome. 1*e*. Side view of large table from base of dorsal papillæ. 1*f*. Table from dorsal papilla proper. 1*g*. Two arms of a disk of table from perisome at base of a large dorsal papilla. 1*h*. C-shaped rods in subcutaneous layer of body wall. $1h^1$. From wall of gonad (lower figure). 1*i*. Supporting rods from dorsal papillæ. The lower figure shows a tip viewed from a flat side, × 175. 1*j*. Calcareous ring, radial piece directly over figure, × 4. 1*k*. Supporting rod from dorsal papilla, × 175.

Fig. 2. *Pseudostichopus propinquus.* Calcareous ring, one of the dorsal radial and interradial pieces. 2*a*. Ventral radial and interradial pieces.

PLATE LXXIII.

Fig. 1. *Orphnurgus insignis.* Dorsal view of large specimen. Two-thirds natural size.
2. *Anapta inermis.* Ventral view, showing general form. Two-thirds natural size.
3. *Pseudostichopus propinquus.* Ventral view, × 1.

PLATE LXXIV.

Fig. 1. *Pseudostichopus propinquus.* Dissected from above to show alimentary canal, anal aperture (*a*), ring canal (*c*), cloacal cavity (*cl*), gonad (*g*), longitudinal muscle bands (*lm*), dorsal mesentery (*m*), madreporic canal (*mc*), Polian vesicle (*p*), respiratory trees (*r*). × 1⅓.
2. *Scotodeima vitreum.* Ventral view, showing the large semirigid papillæ and two rows of pedicels on either ventrolateral radius. *a*, *b*, *c*, dorsal papillæ. × 1⅓. 2*a*. Calcareous ring, the radial portion with perforation. × 6.

PLATE LXXV.

Fig. 1. *Scotodeima vitreum.* Rods from large lateral or flank papillæ. 1. From middle portion. 1*a*. From distal portion. 1*b*. Irregular rod from basal half. 1*c*, 1*d*. Distal portion. 1*e*. From tip. 1*e*. Characteristic large rod from basal portion. Note that 1*e* is the other half of 1*é*. × 66.
2. Same. Rods from dorsal perisome. 2*a–c*. Other rods from dorsal perisome. × 66. See also Plate XI, fig. 1*a*.
3. Same. Rods from wall of gonad.
4. Same. Rods from ventrolateral pedicels, the larger from near base, the smaller from tip. × 66.
5. *Lætmogone biserialis.* Rod from ventral perisome. 5*a*. Another rod. × 175.

PLATE LXXVI.

Fig. 1. *Scotodeima vitreum.* Characteristic rod from ventral perisome. 1*a*, 1*b*, 1*c*. Rods from ventral perisome. 1*c*. Showing a slightly more complicated form than 1. × 66.
2. Same. Large rod from dorsal perisome. × 66.
3. *Pseudostichopus propinquus.* 3*a–3b*. Rods from wall of gonad. × 400.

PLATE LXXVII.

Fig. 1. *Orphnurgus insignis.* 1, 1*a–e*. Various forms of rods from dorsal perisome. × 66.
2. Same. 2, 2*a–e*. Rods of ventral perisome, anterior two-thirds of body. × 66.
3. Same. Large ellipsoid from ventral perisome in posterior third of body. 3*a*. Rod intermediate between ellipsoid and fig. 2, from posterior region, ventral perisome. 3*c*. Smaller smooth ellipsoid from same region. 3*b*, 3*b*[1], 3*d*, 3*e*. Rods from pedicels. (Fig. 1*c* is the commoner type in the papillæ.) × 200.

PLATE LXXVIII.

Fig. 1. *Lætmogone biserialis.* Wheel from dorsal perisome, viewed from convex side. 1*a*. Edgewise view of same. 1*b*. Wheels from ventral perisome. That on left from convex side, × 175. That on right from concave side, × 350. 1*c*. Small wheel from dorsal papilla, × 175. 1*d*. Rod from ventral perisome, × 175. 1*e*. Rod from pedicel, × 175.

Fig. 2. *Pannychia pallida.* Large wheels from general perisome, viewed from concave side. 2*a*. Another from convex side. 2*b*. Small wheels of general perisome and pedicels. 2*c*. Edgewise view of large wheel. 2*d*. Modified wheel-like plate at end of papillæ. 2*e*. Wheel-like plate from oral disk. 2*f*. Rod from end of tentacle, × 175. 2*g*. Calcareous ring, radial piece perforated, × 4. 2*h*. Rods from oral disk.

PLATE LXXIX.

Fig. 1. *Psolus macrolepis.* Dorsal surface, × 2. 1*a*. Same, ventral, × 2. 1*b*–1*c*. Plates from ventral perisome, × 200. 1*d*. Calcareous ring, three pieces, radial in center, × 6. 1*e*. Rod from tentacle, × 200. 1*f*. Perforated plate from perisome between base of tentacles and oral valves.

2. *Thyonidium hawaiiense.* Three radial (*r*) and two interradial (*ir*) pieces of calcareous ring, × 4⅔. 2*a*. Disk of table from general perisome. 2*b*. Side view of same. 2*c*. Spire of table with four prongs. 2*d*. Disk of table from perisome at base of tentacles. 2*e*. Rod from oral plate, × 200.

3. *Thyonidium alexandri.* Calcareous ring, two radial and three interradial pieces, × 4⅔.

PLATE LXXX.

Fig. 1. *Opheodesoma spectabilis.* Cartilaginous ring, Polian vesicles, etc., viewed from side. *cr.*, cartilaginous ring. *cu.*, ciliated urns. *g.*, gonad. *gd.*, gonoduct. *i.*, intestine. *m.*, madreporic canals. *me.*, dorsal mesentery. *pr.*, Polian vesicles (very numerous), × 2⅔. 1*a*. Calcareous ring (radial pieces, *r*, with perforations), × 3⅓. 1*b*. Anchor, slightly less than × 200. 1*c*. Miliary rosettes, upper, × 330; lower, less than × 200, or same magnification as anchor. 1*d*. Rods from oral disk, × less than 200.

2. *Synaptula kefersteinii.* Miliary grains, × 666.

3. *Thyonidium alexandri.* Characteristic table, side view. 3*a*. One of the regular tables viewed from above. 3*b*. A larger table with more irregular disk, seen from above. 3*c*, 3*d*. Tables from pedicels. 3*e*. Plate from perisome at base of tentacles, × 200.

PLATE LXXXI.

Fig. 1. *Protankyra albatrossi.* An anchor and miliary grains. 1*a*. Anchor plate, × 200.

2. *Opheodesoma spectabilis.* Anchor plate, × somewhat less than 200.

3. *Euapta godeffroyi.* Anchor. 3*a*. Miliary rosettes. 3*b*. Rod from tentacle. 3*c*. Anchor plate, × less than 200.

4. *Chiridota uniserialis.* A tentacle, × 13.

5. *Chiridota hawaiiensis.* A tentacle, × 13.

PLATE LXXXII.

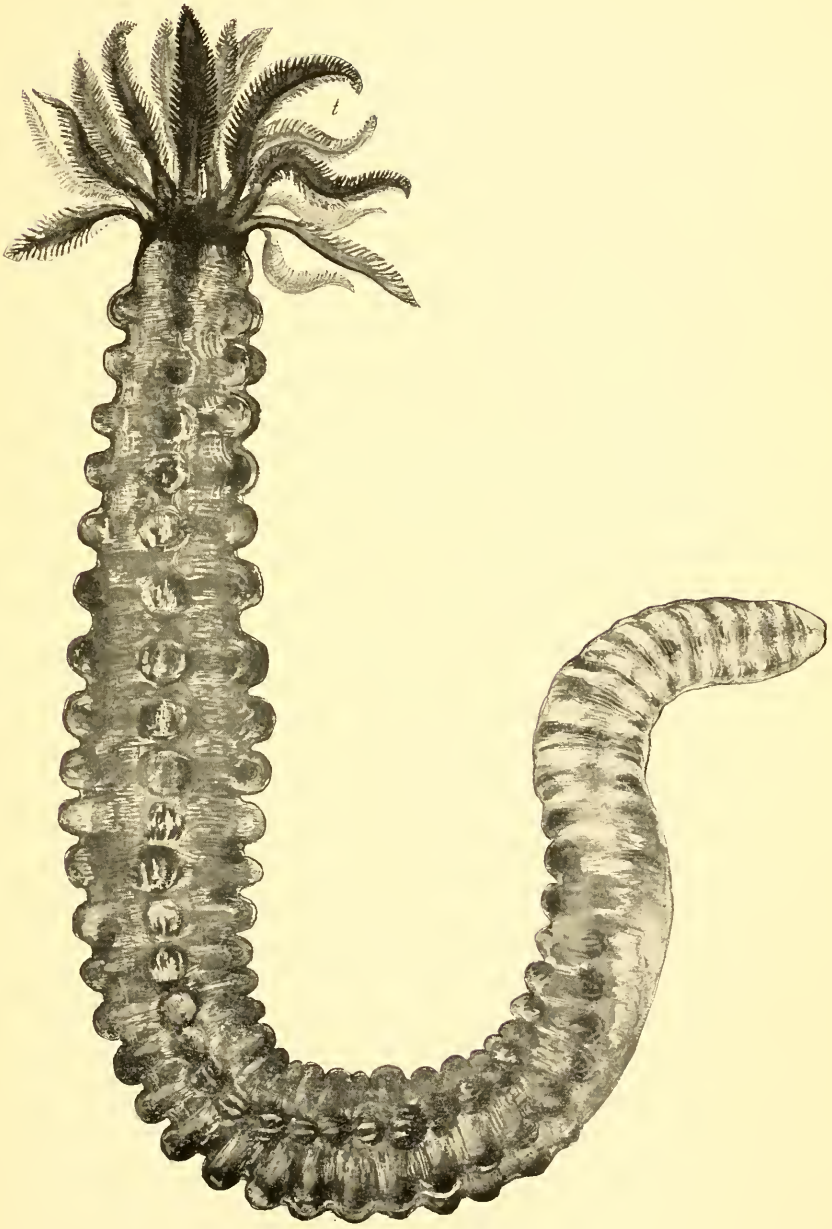
Fig. 1. *Anapta inermis.* Calcareous ring, ring canal, etc.; *al.*, alimentary canal; *gon.*, gonad.; *m.*, madreporic canal; *pr.*, Polian vesicle; *r.*, radial pieces of calcareous ring, × 2.

2. *Taeniogyrus* sp. One of the sigmoid deposits, × 200.

3. *Chiridota hawaiiensis.* A wheel. 3*a*. Grains from subcutaneous layer along radii, × 200. 3*b*. Rods from tentacles, × 400. 3*c*. Same. 3*d*. Calcareous ring, × 13. 3*e*. Rods from general perisome, × 200. 2*e'*. Same, × 400. (Fig. to right.)

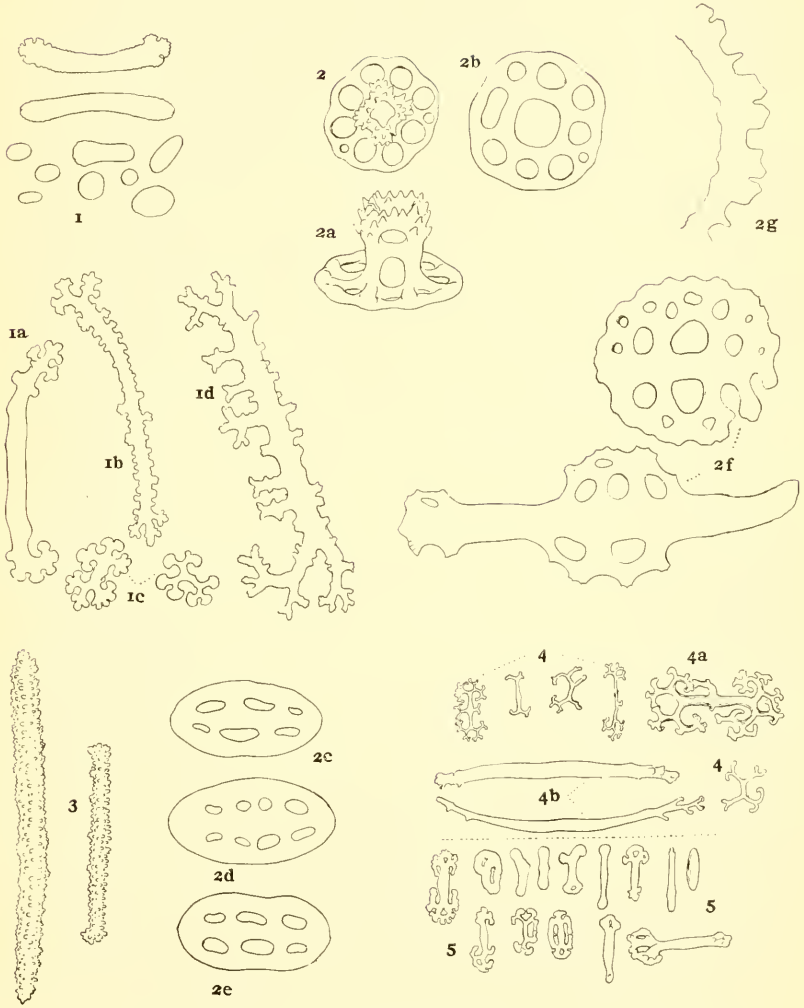
4. *Protankyra albatrossi.* End of anchor plate, showing incipient handle, × 200. 4*a*. Calcareous ring, × 6⅔. 4*b*. Deposits from tentacles. 4*c*. From oral disk, × 200.

5. *Chiridota uniserialis.* Wheel. 5*a*. Rods from general perisome, × 400. 5*b*. From subcutaneous layer, along radii, × 200. 5*c*. Calcareous ring, × 13.



OPHEODESOMA SPECTABILIS.

FOR EXPLANATION OF PLATE SEE PAGE 741.



ACTINOPYGA, HOLOTHURIA.

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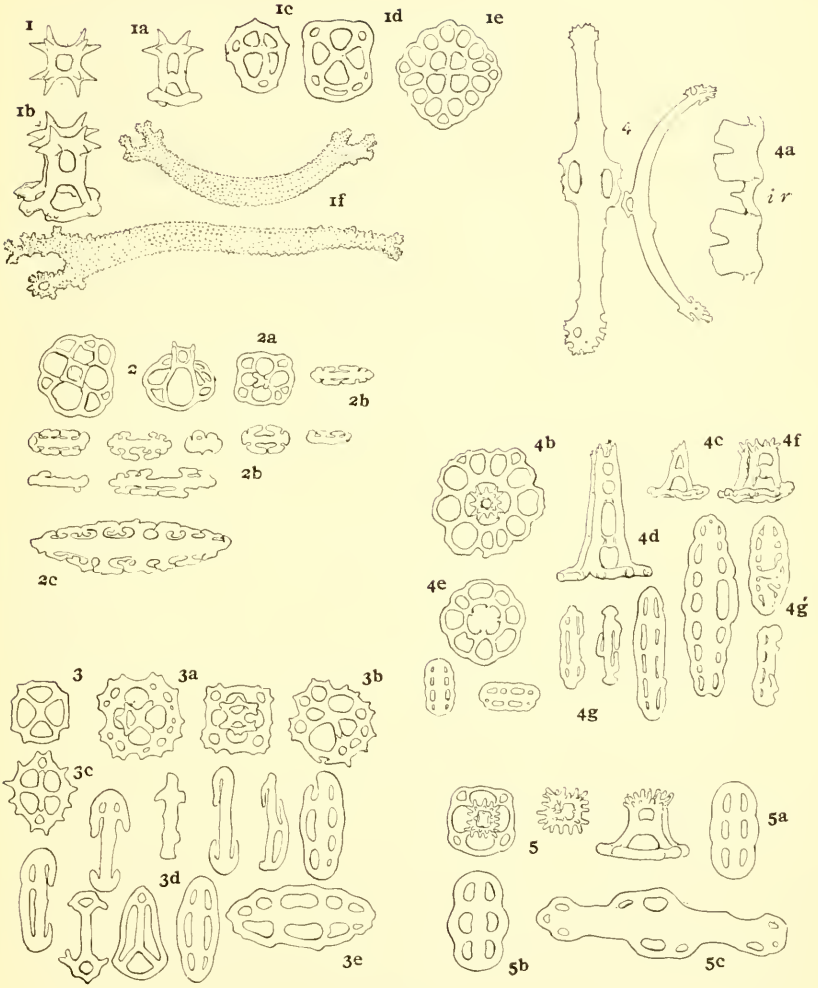

HOLOTHURIA.

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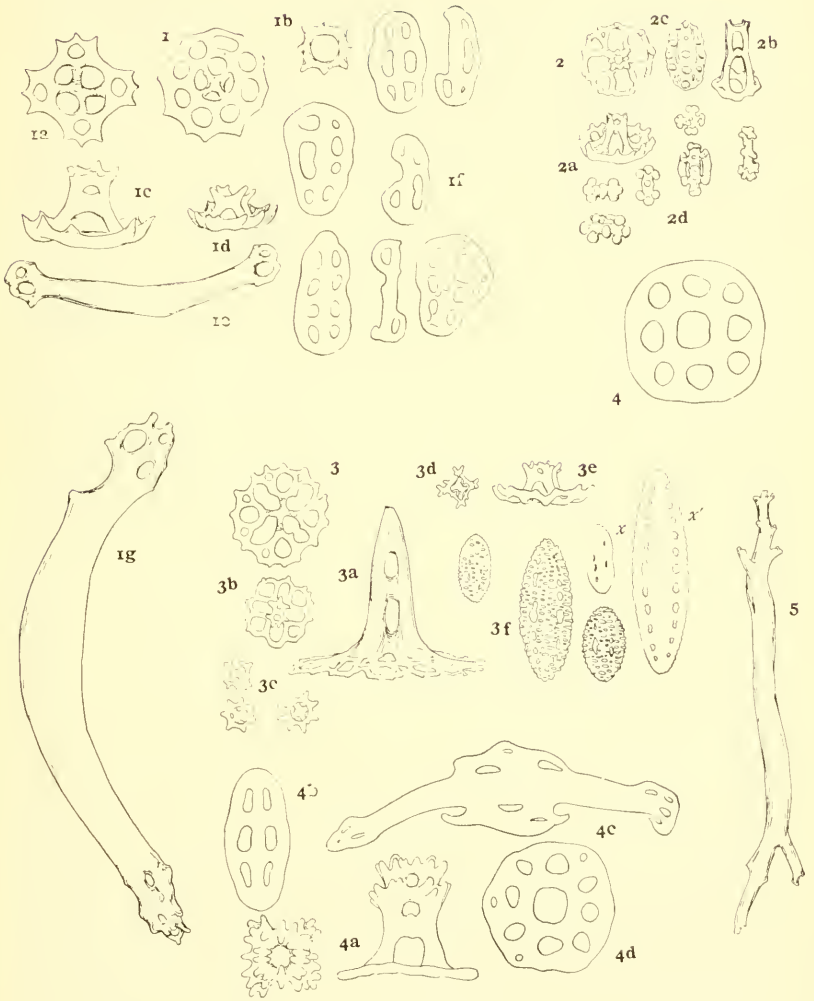

HOLOTHURIA.

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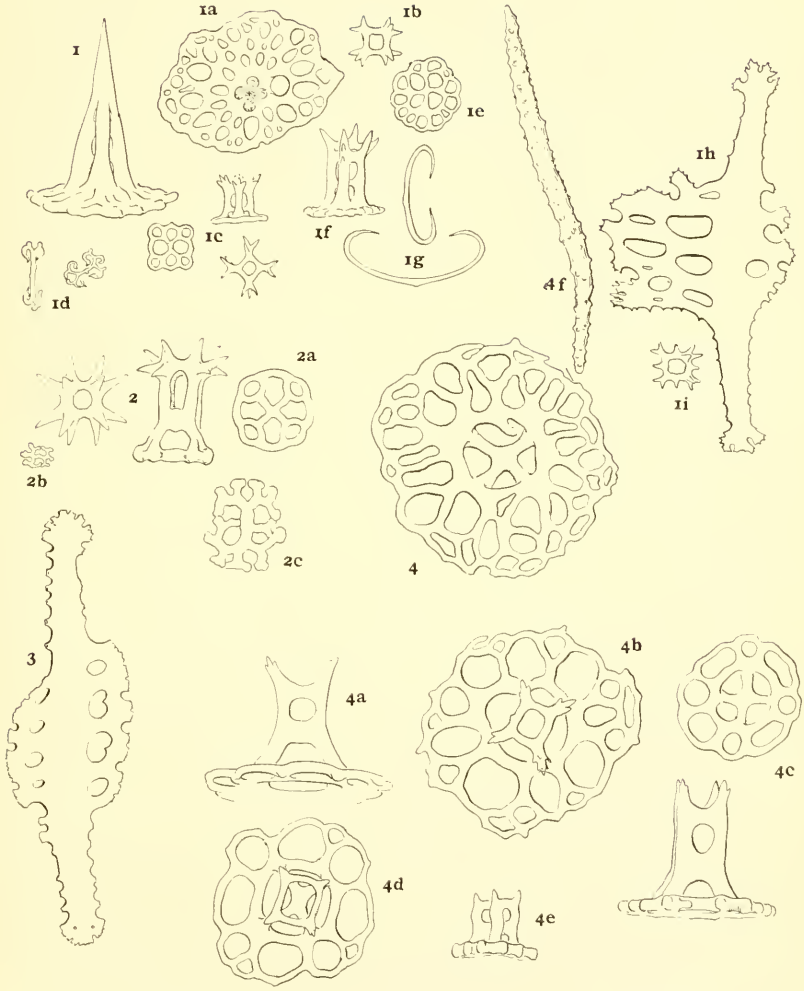

HAWAIIAN HOLOTHURIIDÆ.

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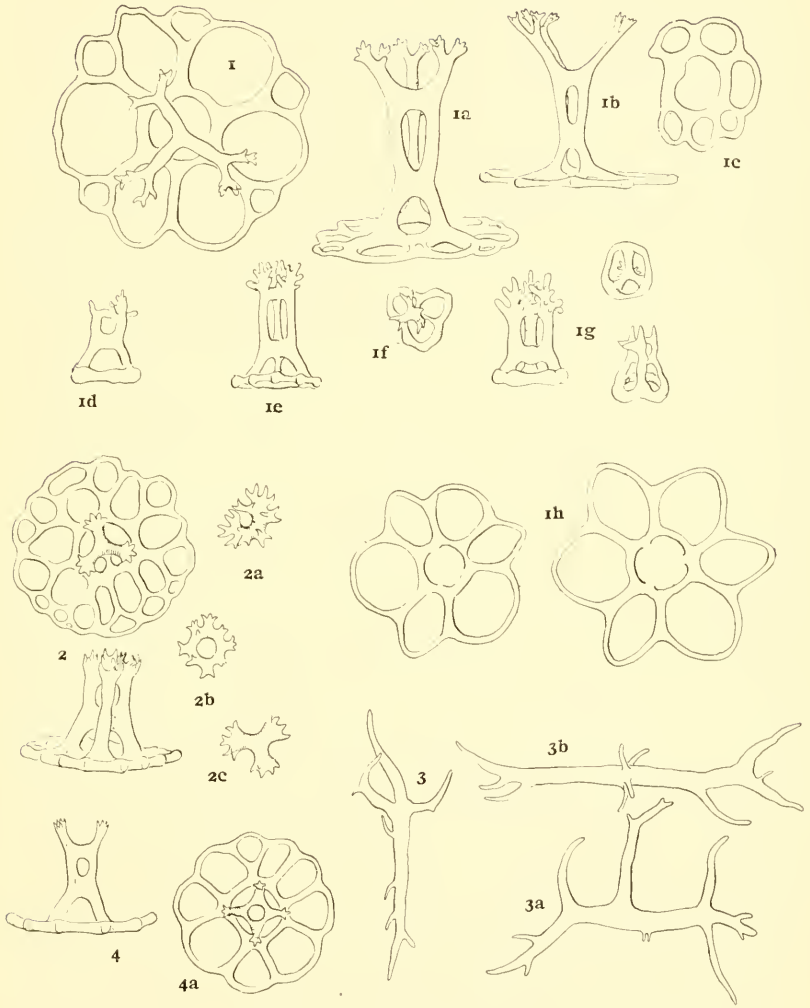

MESOTHURIA, PSEUDOSTICHOPUS.

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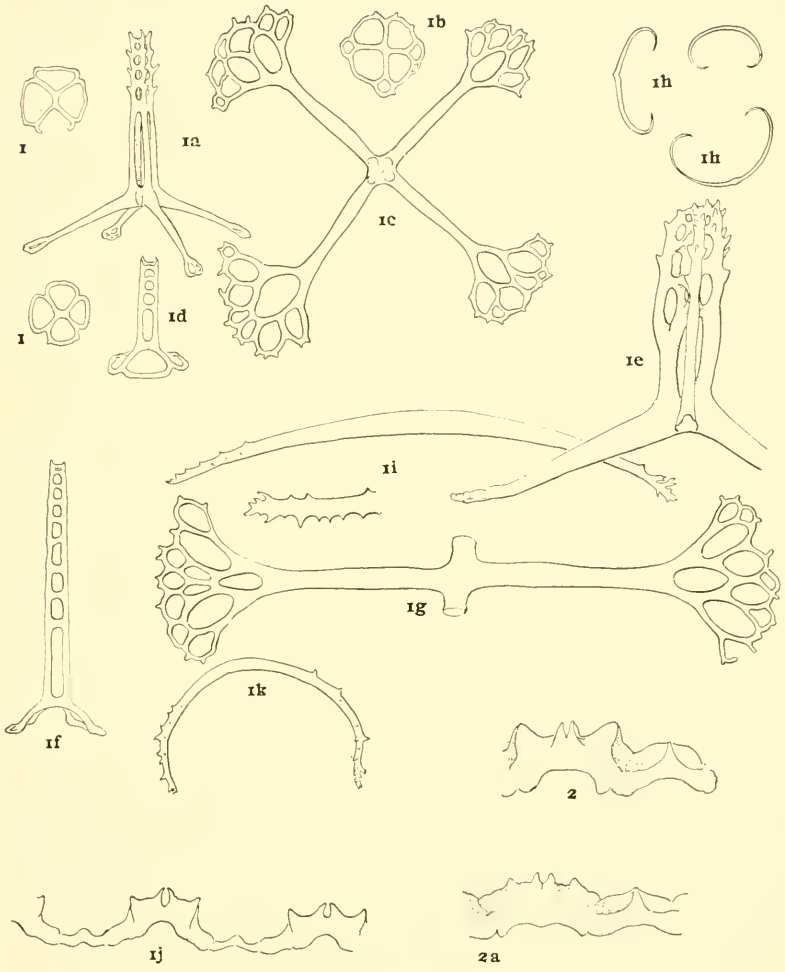
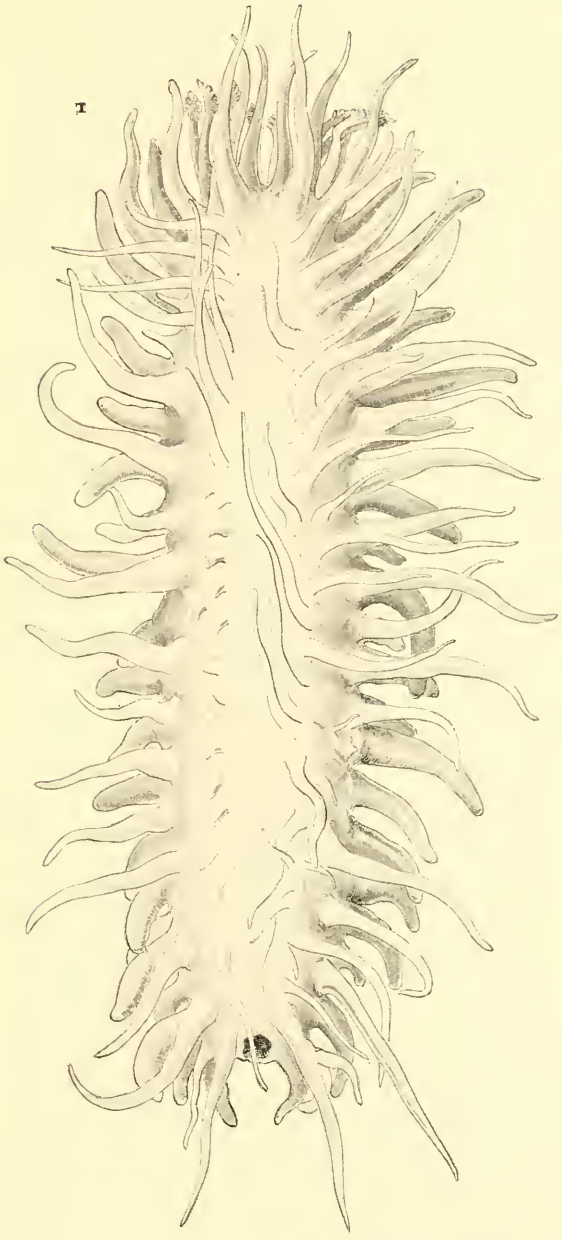
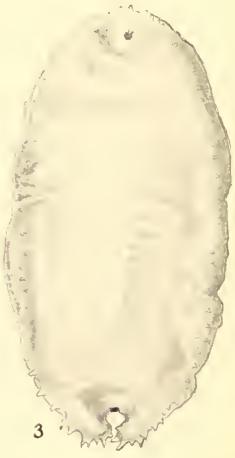


BATHYPLOTES, PSEUDOSTICHOPUS.

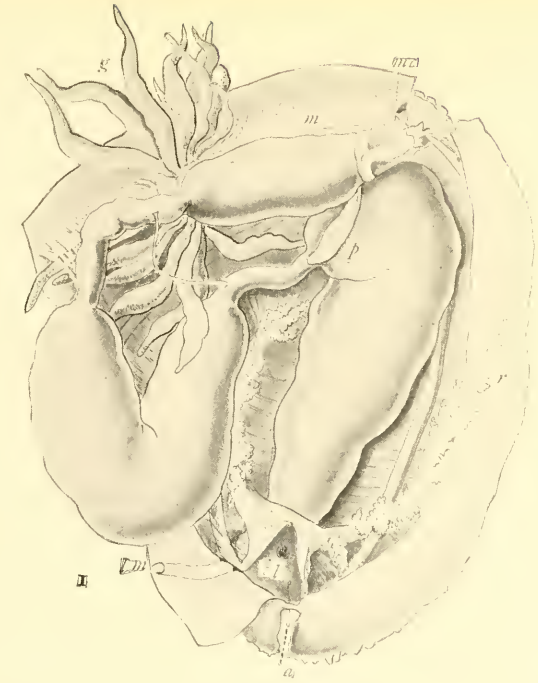
FOR EXPLANATION OF PLATE SEE PAGES 742 AND 743.





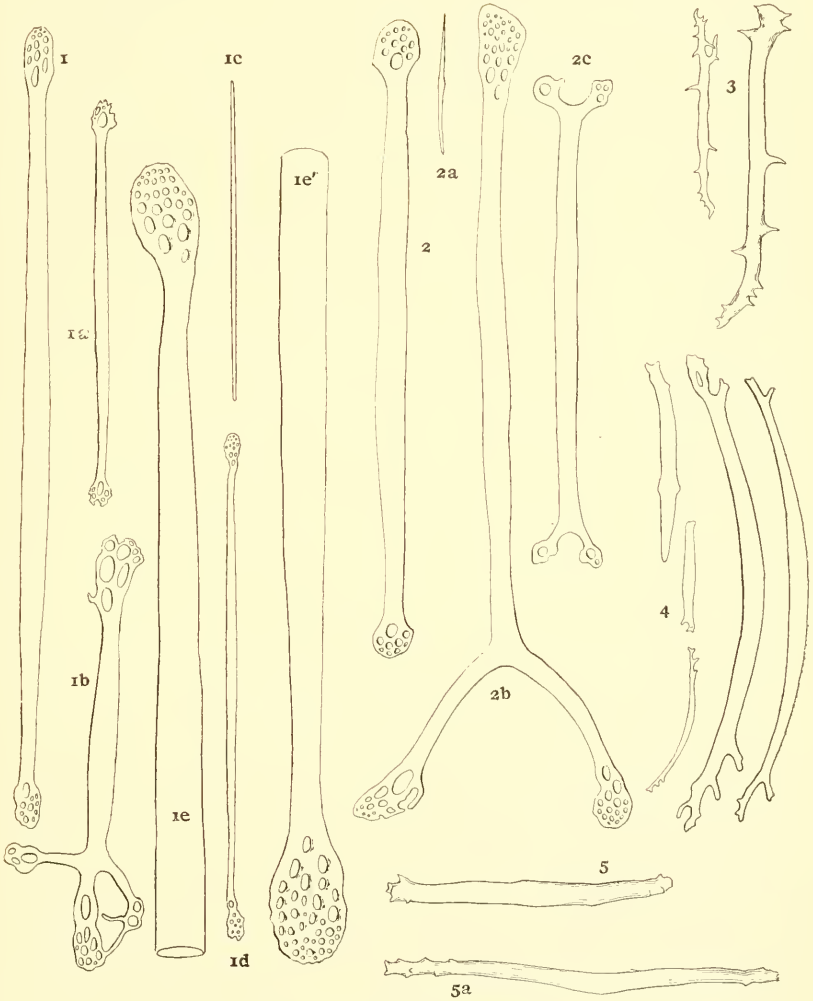
HAWAIIAN HOLOTHURIANS.

FOR EXPLANATION OF PLATE SEE PAGE 743.



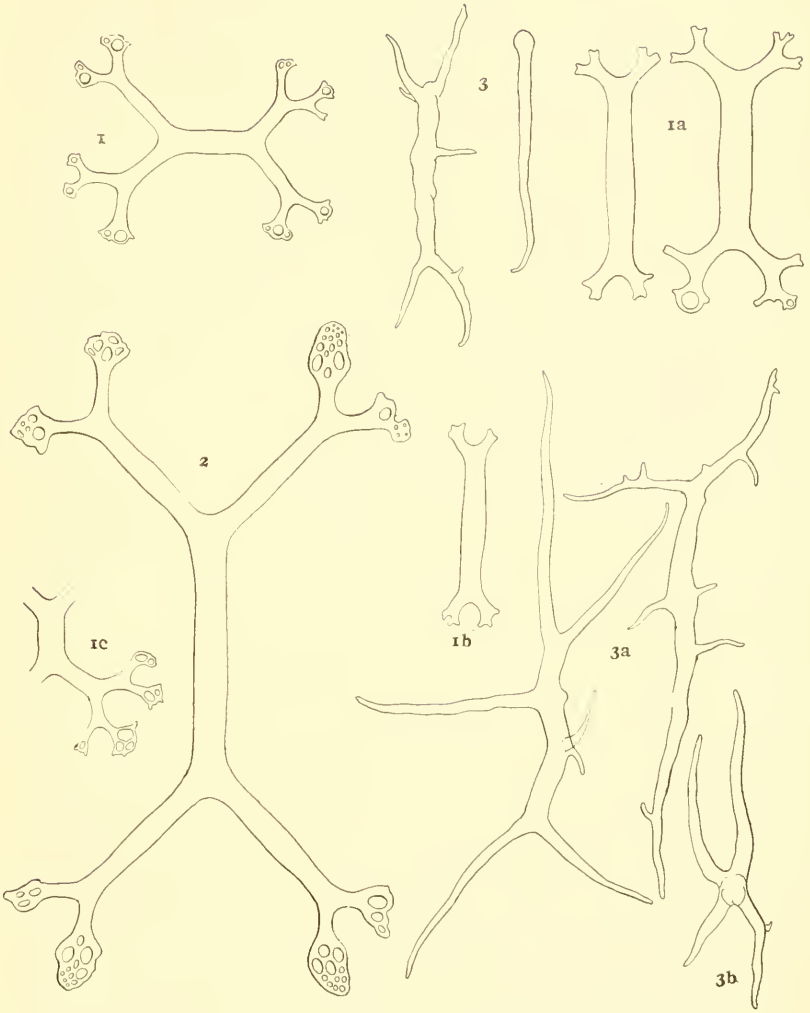
PSEUDOSTICHOPUS, SCOTODEIMA.

FOR EXPLANATION OF PLATE SEE PAGE 743.



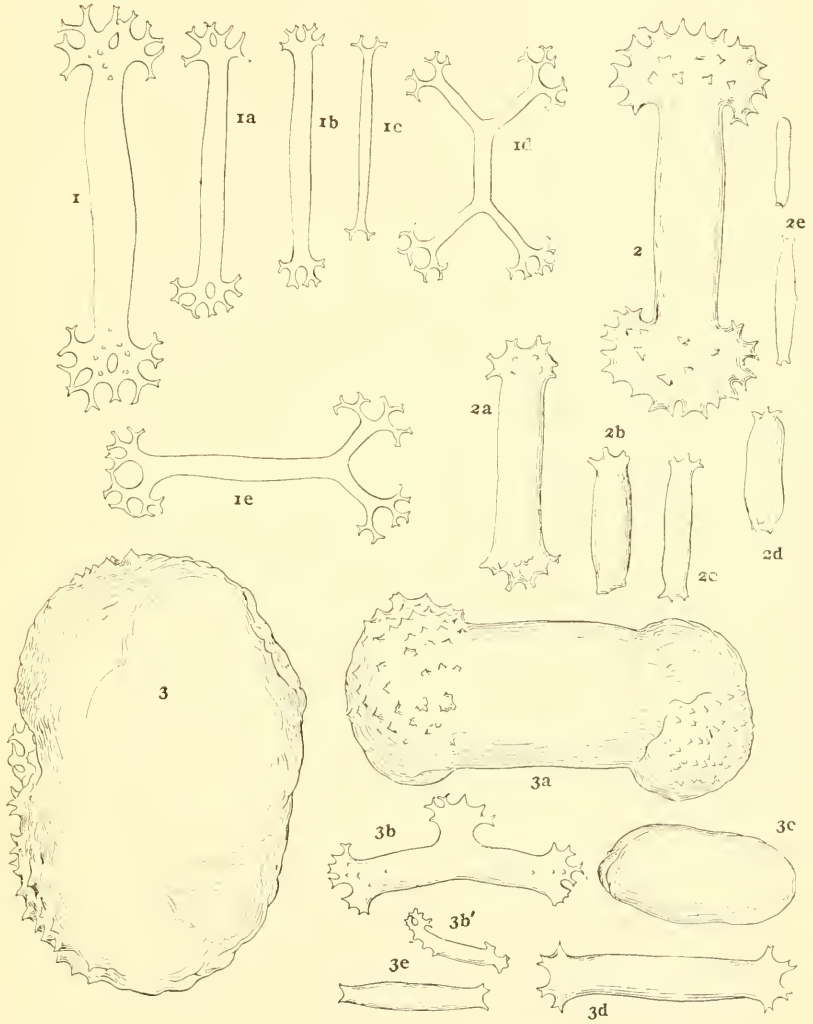
SCOTODEIMA, LÆTMOGONE.

FOR EXPLANATION OF PLATE SEE PAGE 743.



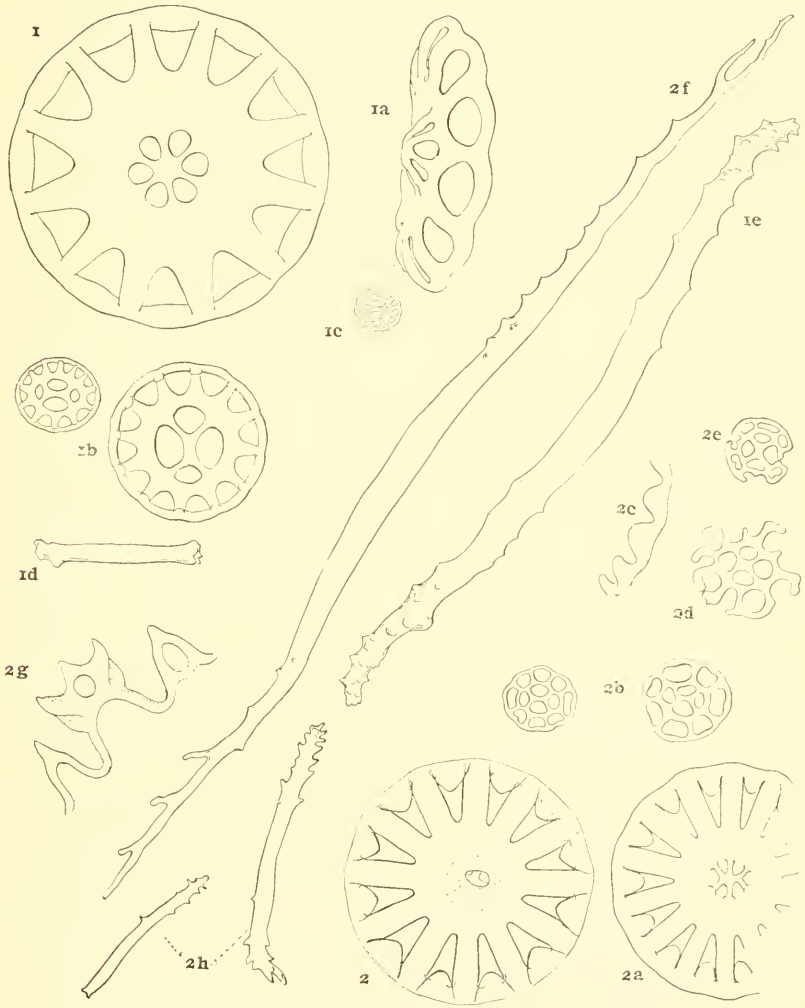
SCOTODEIMA, PSEUDOSTICHOPUS.

FOR EXPLANATION OF PLATE SEE PAGE 743.



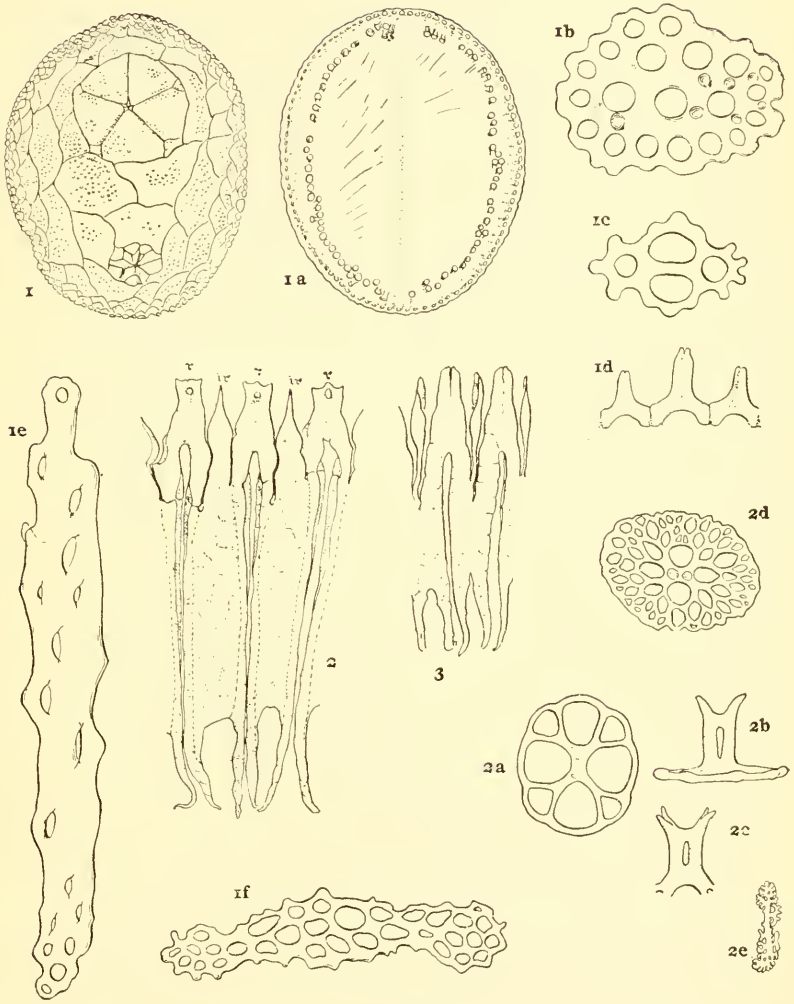
ORPHNURGUS INSIGNIS.

FOR EXPLANATION OF PLATE SEE PAGE 743.



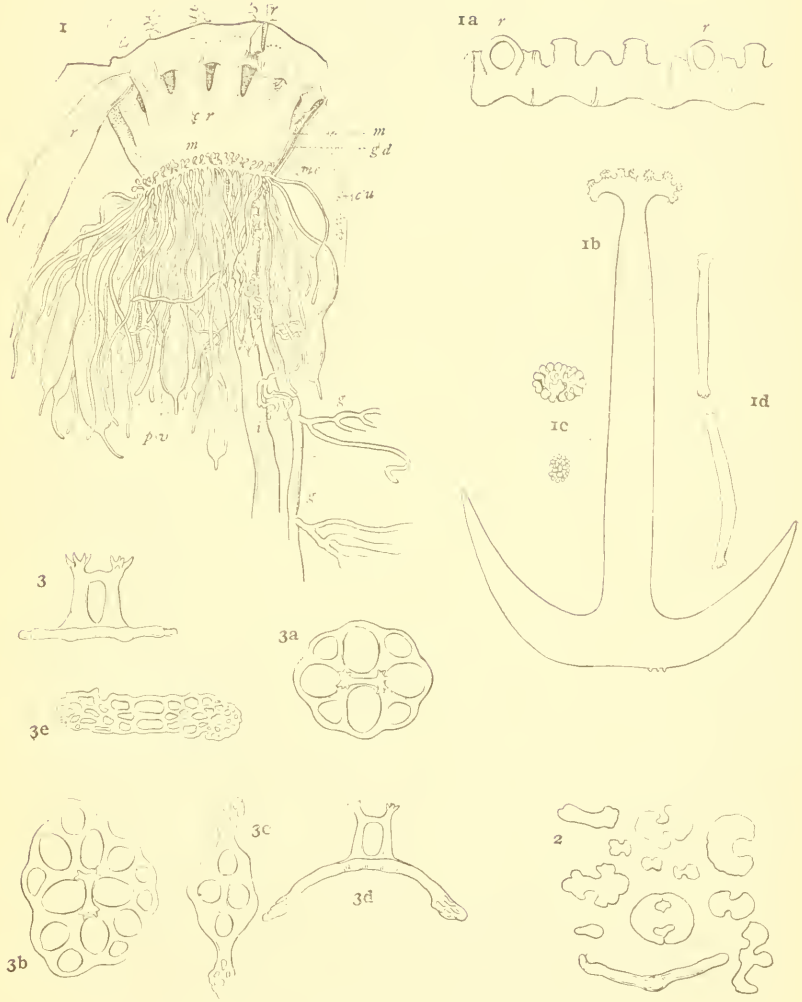
HAWAIIAN ELPIDIIDÆ.

FOR EXPLANATION OF PLATE SEE PAGES 743 AND 744.



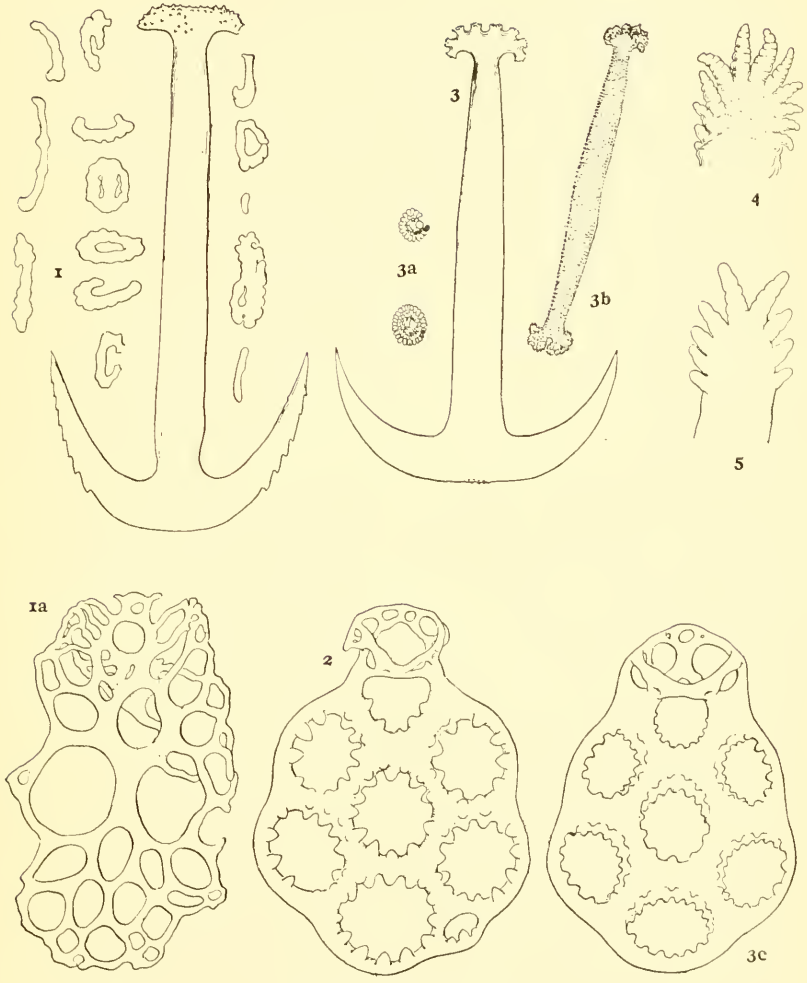
HAWAIIAN CUCUMARIIDÆ.

FOR EXPLANATION OF PLATE SEE PAGE 744.



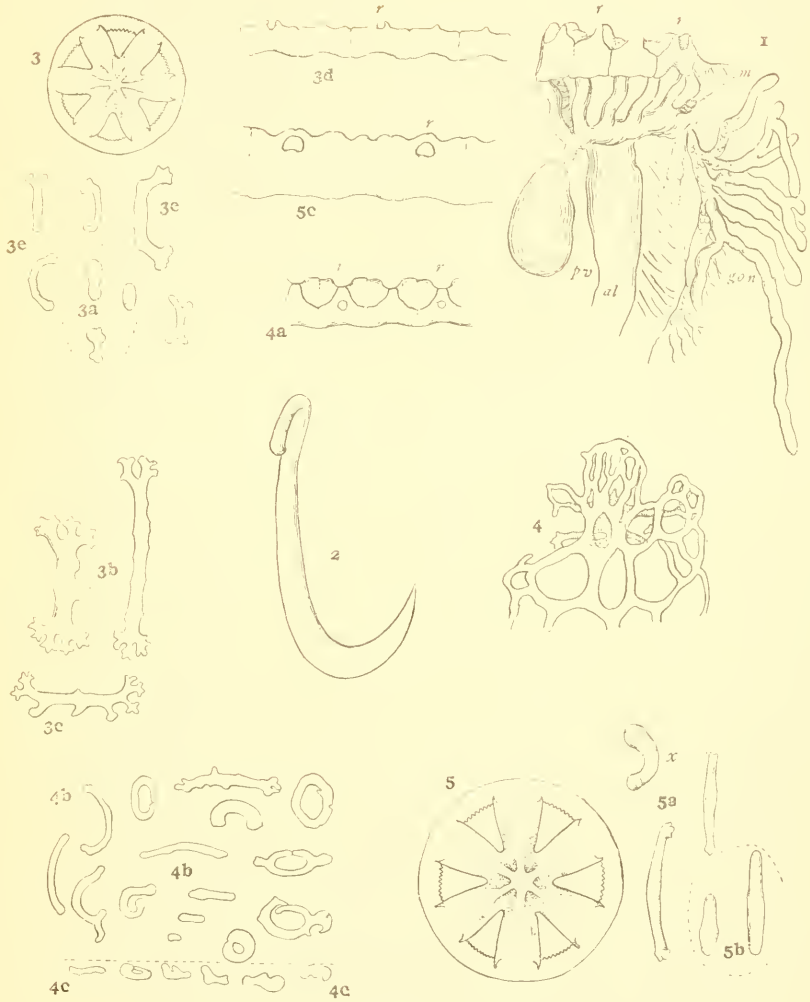
OPHEODESOMA, SYNAPTULA, THYONIDIUM.

FOR EXPLANATION OF PLATE SEE PAGE 744.



HAWAIIAN SYNAPTIDÆ.

FOR EXPLANATION OF PLATE SEE PAGE 744.



HAWAIIAN SYNAPTIDÆ.

FOR EXPLANATION OF PLATE SEE PAGE 74.