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# REPORT ON THE HOLOTHURIANS

Collected by the Barbados-Antigua Expedition from the  
University of Iowa<sup>1</sup>

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The collection of holothurians contains about 400 specimens divided among 18 species. All the West Indian species are represented except forms typical of the Florida Keys and the Greater Antilles. Sluiter's species are recorded for the first time since the types were secured. The apparently new species is a redescription, with a new name, of Selenka's well-known old species, *Stichopus rigidus*.

## KEY TO WEST INDIAN HOLOTHURIANS

- a<sup>1</sup> Appendages present Actinopoda.  
b<sup>1</sup> 20-25 peltate tentacles. Respiratory trees present; no retractor musculature. Holothuriidæ.  
c<sup>1</sup> Tentacle ampullæ present, rete mirabile. Holothurinæ.  
d<sup>1</sup> Genital organs in one tuft. Appendages scattered and not in distinct rows. Actinopygæ.  
Anal teeth present. Holothuria.  
No anal teeth present. Stichopus.  
d<sup>2</sup> Genital organs in two tufts; flattened forms with warts on the dorsal side. Usually C-shaped bodies among the deposits. Synallactinæ.  
c<sup>2</sup> Tentacle ampullæ not present. Usually no rete mirabile. Mesothuria.  
Genital organs in single tuft. Cucumaridæ.  
b<sup>2</sup> 10-20 dendroid tentacles present. No tentacle ampullæ. Retractor musculature present, respiratory trees present

<sup>1</sup> Most of the specimens upon which this report is based were collected by the undersigned while a member of the Barbados-Antigua Expedition and are now in the collections of the State University of Iowa, Stanford University, and the California Academy of Sciences. I had originally intended, at Professor Nutting's request, to write the account of the Holothurians, and prepared the specimens with this end in view. Recently, however, Miss Deichmann has completed much preliminary (unpublished) work on the holothurians of the West Indies and has the group well in hand. It seems appropriate therefore that the report should embody the latest results. Miss Deichmann has, accordingly, relieved me of a rather difficult task. This paper is a contribution from the Hopkins Marine Station of Stanford University.

Certain ecological or field notes are interpolated in brackets and signed with my initials. W. K. Fisher.

- c<sup>1</sup> Appendages scattered over the surface of the body, very indistinctly in rows on the ambulacra.  
 10 tentacles *Thyone*.  
 16-20 tentacles *Phyllophorus*.
- a<sup>2</sup> No appendages, no respiratory trees  
 b<sup>1</sup> Deposits: Anchor and anchor plates. Tentacles pinnate. *Paractinopoda*.  
*Synaptinae*.
- c<sup>1</sup> Anchors with smooth arms, vertex usually with knoblike projections.  
 d<sup>1</sup> Stock of anchors branched irregularly. Calcareous ring without noticeable posterior prolongations. Stone canals not numerous. *Euapta*.  
 Anchor longer than anchor plate; complicated rosettes are found scattered. *Euapta lappa* (J. Müller).  
 d<sup>2</sup> Stock of anchor not branched. Tentacles 15 or fewer. Anchor plates rounded in front, narrow behind, with few holes, the largest dentate and regularly arranged. *Synaptula*.  
 Normally 12 tentacles with 10-20 digits. Viviparous. Anchor as long as anchor plate. Small curved rods are found scattered. *Synaptula hydriformis* (Lesueur).
- b<sup>2</sup> Deposits: No anchors and no anchor plates. Tentacles peltato-digitate.  
 Deposits: Six-spoked wheels. *Chiridotinae*.  
 10-14 tentacles. Wheels collected in small papilla *Chiridota*.  
 Numerous curved rods, with branched ends, scattered in the interambulacra. *Chiridota rotifera* Pourtales.

## KEY TO THE SPECIES OF HOLOTHURIA

- a<sup>1</sup> Slender forms, without pronounced difference between dorsal and ventral side; tentacles small.  
 b<sup>1</sup> Deposits: Tables and regular 6-holed buttons.  
 c<sup>1</sup> Pedicels on distinct warts; skin rough to the touch. Genital organs fastened near the middle of the body. Cuvierian organs very large, transversely finely striated. Vascular ring near the calcareous ring. Tables regular, with 6 large holes in the brim, buttons with 6 large holes. *impatiens* (Forskaal).  
 c<sup>2</sup> Pedicels not on distinct warts; skin smooth. Genital organs fastened near the vascular ring, which is unusually distant from the calcareous ring, (about 2 cm. in specimens 10-15 cm. long). Cuvierian organs small. Tables with 4 small holes in the corners of the disk or a complete ring of small holes; buttons with 6 holes varying from large to very small; buttons with numerous holes are often found. *arenicola* (Brandt).  
 b<sup>2</sup> Deposits: Tables (usually with completely reduced disk) and den-

tate rods. Color dark reddish brown or more faded, usually two rows of dark spots on the dorsal side. Tentacles and pedicels yellow.

- surinamensis* Ludwig.
- a<sup>2</sup> Flattened forms, with fewer appendages on the dorsal side, often on warts, and numerous soft pedicels on the ventral.
- b<sup>1</sup> Deposits: No tables, only scattered rods, with branched ends (never spinous). Uniform dark brown or pale brown; tentacles very large and bushy. *glaberrima* Selenka.
- b<sup>2</sup> Deposits: Tables, together with plates or buttons.
- c<sup>1</sup> Tables high, simple, with small to rudimentary disk. Skin not stiff with spicules.
- d<sup>1</sup> Perforated plates, biscuit-like with many small holes; some have larger holes, often only four, and they are more irregular. 20 tentacles; dorsal warts often indistinct. Color uniform dark with paler—reddish or pink—underside; space around base of pedicels dark (very small specimens 6 cm. long may be sand-colored). Stone canals numerous, in two tufts. Skin thick. *mexicana* Ludwig.
- d<sup>2</sup> Perforated plates with usually four larger central holes and often accessory holes in the brim; edge dentate. 20-25 tentacles. Dorsal warts generally very distinct, in longitudinal rows. Color in alcohol dark brownish and grey, sprinkled with small white dots, arranged in circles around the bases of the dorsal appendages. Color in life, Indian and ocher red above, with two rows of dark reddish brown spots and very numerous small dull green spots, sometimes forming a net design; ventral pedicels greenish yellow against dull Indian red. Stone canal single, well developed. *grisea* Selenka.
- c<sup>2</sup> Tables low, with large disk with knobbed brim and secondary rods, which unite with the spire so that the tables look as if they had numerous rods in the spire. Buttons strongly knobbed, with 6 holes in the dorsal buttons, 10 in the ventral; some few are flat. Supporting rods short and broad, with few holes. Skin stiff from spicules. Color in spirit dirty white. In life, sand color with two rows of dull brown mottlings above and often a rusty stain on ventral surface. Tentacles whitish, very small, and ventrally placed. *fossor* n.sp.

*Holothuria impatiens* (Forskaal)

*Fistularia impatiens* Forskaal, 1775, p. 121, pl. XXXIX, fig. B.

*Holothuria botellus* Selenka, 1867, p. 335.

*Holothuria impatiens* Lampert, 1885, p. 65 (complete list of references).—Theel, 1886, p. 233.—Fisher, 1907, p. 666, pl. LXIX fig. 4a.—Clark, 1901 b, p. 259; 1901, p. 494; 1919, p. 63.—Sluiter, 1910, p. 333.

The single specimen is typical and well developed in every respect.

This form seems never to be abundant; perhaps it lives below tide mark. Very few specimens are known from the West Indies and we know very little about its distribution. It has been taken from Tortugas, Porto Rico, and Tobago; not at Bermuda.

This species can not, for the present, be separated from the form which occurs in the Pacific Ocean, as Selenka already has pointed out.

1 specimen, English Harbor Point, Antigua, among small rocks.

*Holothuria surinamensis* Ludwig

*Holothuria surinamensis* Ludwig, 1874, p. 111, fig. 27.—Theel, 1886 a, p. 210; 1886 b, p. 7.—Heilprin, 1889, p. 136.—Clark, 1899, p. 133; 1901, p. 259; 1919, p. 63.—Verrill, 1907, p. 322.—Sluiter, 1910, p. 332.—Crozier, 1914, pp. 233-297; 1917, p. 560-566.

This form, (Plate 1, fig. 1,) which is known only from the West Indies, is very nearly related to *H. imitans* from Panama and Ludwig has regarded them as identical, while Theel keeps them separate. The tables are about twice as large as in *H. imitans*, which seems to be a rarer form, since few specimens are reported in any collection.

The shape of this species is very variable, ranging from strongly contracted, short specimens to completely extended forms. Further this form is able to multiply by fission (Crozier) and peculiar short forms with incomplete tentacle crown frequently occur. The color varies in alcohol from pale brownish to very dark and nearly all specimens have a double row of dark spots on their back. The deposits are so characteristic that no confusion is possible with other species known at present. An interesting fact is that in a very small specimen the tables have a well developed disk, which is very fragile and easily broken; the teeth on the top of the spire are also better developed in this young specimen and the rods with dentate edge are mostly developed with a series of holes along the edge.

The internal anatomy shows nothing peculiar and in most cases is difficult to study, as the animals often eviscerate themselves, or they are found in regenerating stages.

Ranges from Surinam, the type locality, to Bermuda.

130 specimens from Falmouth and English Harbor, Antigua; 2 from Barbados.

[This very abundant species at Antigua has two color phases which, so far as our observations extended, are characteristic of different habitats. A darker, more reddish or chocolate brown variety with pale brownish or brownish-pink, somewhat flesh-colored,

tentacles occurred at English Harbor, under rocks on the sheltered side of the Point, where a mauve-tinted, branching *Porites* was common.

The animals were sluggish and were living in such a way that the body was surrounded by stones, or stones and sand. At low tide they were always covered by a few inches of water, which on still days became very warm. In the laboratory two species of *Pierasfer* were recovered from the cloaca of some specimens being narcotized.

The other form, somewhat slenderer in habit and of a yellowish brown color, with yellow tentacles, was exceedingly common in Falmouth Harbor, in shallow water where it fairly swarms among coral-lines and under stones in the eel-grass area. It is found where the water has receded at low tide, and hence is very tolerant to heat and exposure. The shallow water in which they occur becomes very warm at mid-day and the animals are sometimes washed up on the beach or rolled around the edge, kept in motion by a ripple. They are always alive. They like very much an erect tufted or branched coralline, but are even commoner under rocks.

Owing perhaps to its tough constitution it is more difficult to kill with narcotizing reagents than other species of *Holothuria*. In life the animals are usually stained with a coating of fine silt or mud which adheres to their skin and partly obscures the rich brown coloring, upon which are marbling and spots of dark brown. The papillæ are rather prominent, unequal and pointed.

In aquaria they become restless, like the other variety.

—W. K. F.]

#### *Holothuria arenicola* Semper

*Holothuria maculata* Brandt, 1835, p. 46-47, (*Sporadipus*, subgenus *Acolhos*).—Ludwig, 1881, p. 595; 1883, p. 156-157; 167-168.—Lampert, 1885, p. 73.—Sluiter, 1910, p. 332.

*Holothuria arenicola* Semper, 1868, p. 61. pls. XX, XXX, fig. 13, XXXV, fig. 4.—Theel, 1886 a, p. 222.

*Holothuria rathbuni* Lampert, 1885, p. 73.—Theel, 1886 a, p. 268.—Clark, 1901 a, p. 343; 1901 b, p. 259, pl. XVII, fig. 7-10; 1919, p. 63.—Verrill, 1901, p. 37, fig. 6a-b, 7; 1907, p. 145, fig. 37.—Sluiter, 1910, p. 332.

This species is one of the commonest in the West Indies and cannot be confused with any other, as its outer appearance is so very characteristic, a long slender body, tapering toward both ends and small terminal tentacles. In the internal anatomy the unusually long distance of the vascular ring from the calcareous ring is the most remarkable feature.

The deposits are of the very common type, tables and 6-holed buttons. There is a very wide range of variation, in individual specimens as well as in the specimens from the same locality.

The tables have from 4 holes to a complete ring of holes in the disk; apparently the tables with only 4 holes are commonest in the larger specimens and they have a low spire, with single cross-beam, ending in few (8-12) teeth. Tables with higher spire are common in the small specimens and also found in the pedicels of the larger.

The 6-holed buttons have large or small holes; in the small specimens, where the buttons form only a thin layer, they are in nearly equal numbers; in the large specimens, where the buttons form the dominating layer, the small-holed are most numerous, but here also is variation; in some preparations not a single large-holed button can be found; in others it is difficult to say which kind is the commoner.

The supporting rods vary from simple ones, with few terminal holes and two larger on the middle (where they are broadest), to buttons with two rows of many small holes. The end plate seems to be the most constant deposit, with 6-10 larger holes in the middle, and a variable large number of smaller holes in the outer part.

This common form is known in two variations, one with small spots irregularly dotted over the body and one with two rows of large dark spots on the back. For the present these forms can be separated only by their coloration, but as they seem to occur in absolutely different localities, it will be natural to keep them separate, at least as varieties.

An interesting fact, which has long been known, is that these two forms occur in both the Pacific and the Atlantic Ocean. At least we are unable to find any differences, and the two varieties seem also to be restricted to different localities in the Pacific.

The type locality was the Bonin Islands where Brandt found the small spotted form (*H. maculata* Brandt). The same is common in the gulf of Panama and can not be distinguished from the specimens from the Atlantic side of Panama, or the specimens from Barbados.

Brandt's species was united with Semper's *H. arenicola* and as the name *maculata* is preoccupied by a *Synapta*, the name *arenicola* should be preferred; but both names have been used, without rule.

The name *rathbuni* was introduced by Lampert (1885) who named a species from Bahia secured by Rathbun. From the description given by Rathbun it is quite evident that it is *H. arenicola*, which

is known from this locality, the only difference being that Rathbun mentions a knobbed body, which doubtless originated from one of the species of *Thyone* which he examined from the same locality.

The name *rathbuni* was later applied to this species, first to the small spotted form, by Clark, 1901, who described and figured the spicules; and later also to the large spotted form by Verrill, 1904-07, who figured specimens from Bermuda. Sluiter, 1910, seems to use the name *rathbuni* only for the small spotted form, and says of *H. maculata*, which he also found, that he is unable to separate the West Indian from the Pacific specimens.

36 specimens from Pelican Isl. Barbados. 1 specimen from The Crane, E. Pt. Barbados. 17 specimens from English Harbor, Antigua. Common under rocks, entirely uncovered by low tide at Pelican Island, sluggish.

*Holothuria grisea* Selenka

*Holothuria grisea* Selenka, 1867, p. 328, pl. 18, fig. 251.—Semper, 1868, p. 92.  
—Greef, 1882, p. 158.—Ludwig, 1882, p. 26.—Lampert, 1885, p. 85.—Theel, 1886, p. 214.—Clark, 1901, p. 258; 1919, p. 63.

Type locality, Haiti. This form, which seems never to be abundant, has a very wide range, nearly the same as that of *H. mexicana*, and is said to occur also on the west coast of Africa (Rolas, Greef, Z. Anz. Vol. V, No. 105, 1882). It is on the Atlantic side of Panama, along with *floridana* on the same coral rocks. At Florida it just touches the limit of *floridana*, but can hardly be said to belong to the fauna of Florida. It ranges as far south as Sao Paulo and Rio Janeiro.

The coloration of preserved specimens is very constant, being dark grey or brown, with small white spots arranged in rings around the bases of the dorsal appendages. These spots are the plates, which are accumulated in heaps in the skin. The dorsal warts are prominent and increase in number with advancing age. It has been supposed to be the young of *floridana* but can very easily be distinguished. The spicules are quite different and there is never, even in the largest specimen, more than one, free, well developed stone canal.

The present material indicates that the number of tentacles is not always 20, as Selenka observed, but varies to 23-25.

4 specimens from Falmouth Harbor, 2 from English Harbor, Antigua.

[The name *grisea* is a misnomer for this Harlequin of West Indian holothurians. All the specimens which I have seen are red in life with two rows of dark reddish brown spots along the back, which is peppered with dull green spots of small size, often in a reticulate design. The prominent lateral papillæ are usually lighter and brighter than the ground color of the back which is not uniform but is a marbling of Indian and ocher red, verging in places on dull orange vermilion. The ventral pedicels are greenish yellow against dull Indian red. Tentacles yellow with brown ends.

This form is found under rocks just below high tide, and is apparently nocturnal. It is usually soiled by mud so that it must be scrubbed to reveal the true colors. It was taken in eel-grass, at the surface of the sand and mud, English Harbor. It is very sluggish in the day time, especially when the tide is out, but at night, in aquaria, is active for a genus the members of which are not given to roving.—W. K. F.]

*Holothuria mexicana* Ludwig

*Holothuria mexicana* Ludwig, 1874, p. 101, fig. 47.—Lampert, 1885, p. 85.—Theel, 1886, p. 215.—Clark, 1901 b, p. 258; 1919, p. 63.

*Holothuria africana* Theel, 1886, p. 174, pl. VIII, fig. 7.

*Holothuria floridana* Edwards, 1905, p. 383-384; 1908, p. 236-301.—Clark, 1919, p. 63.

The type locality is not known; the label was marked Mexico. It is the largest of the two West Indian holothurians, which are characterized by their numerous stone canals and deposits in form of tables and small plates or rosettes and it has been suggested that *mexicana* was the full grown form of *floridana* (Edwards, 1905, Science XXI, p. 383-384; and 1908, Biometrika, p. 236-301). The two forms are different. *H. floridana* has exclusively rosettes, while some few may have their branches united to form perforated plates resembling those of *mexicana*. *H. mexicana* has two kinds of plates, biscuit-formed with small holes and some with fewer, larger holes. In external appearance the two forms are quite different; *floridana* is variable in color, spotted or uniformly colored and is not thick-skinned. With the exception of very small specimens, *mexicana* is always uniform dark colored with paler ventral side. In a single specimen in the present collection large dark spots also are found on the ventral side. The skin in young specimens is thick and leathery. Their distribution is different. In some localities in Cuba and at a single point in Florida the areas of distribution overlap,

but elsewhere *mexicana* is found only in the eastern part of the West Indian waters, to Curacao, while *floridana* ranges from the Keys of Florida to Colon, Panama. *Mexicana* is undoubtedly identical with *H. africana* Theel from West Africa.

Falmouth Harbor, Antigua.

[*Holothuria mexicana* was common in Falmouth Harbor, in eel-grass, along with *Diadema* (*Centrechinus*), *Toxopneustes variegatus* and *Triopneustes esculentus*. In the shallow water which became quite warm at noon, were quantities of *Manicina* corals, and *Millepora alcicornis* of the most branched form. The animals rest motionless upon a bottom of very fine sand or mud, often slimy with organic matter, and the fine particles adhere to the skin of the holothurians. In aquaria at night the animals were more active than in the same situation during day.

The color is some shade of brown, often nearly black, with pale yellowish, pale brownish or pink ventral surface. Rarely the ventral side has large dark brown spots.—W. K. F.]

*Holothuria glaberrima* Selenka

*Holothuria glaberrima* Selenka, 1867, p. 328, pl. XVIII, fig. 57-58.—Semper, 1868, p. 92.—Lampert, 1885, p. 65; 1896, p. 56-59.—Theel, 1886, p. 33.—Clark, 1901, p. 259; 1919, p. 63.—Sluiter, 1910, p. 333.

*Holothuria lubrica* var. *glaberrima* Mitsukuri, 1912, p. 96.

This form seems to occur all over the West Indies; it is not found at Bermuda. It is known from Honduras and many localities on the north coast of South America. Without doubt Selenka is in error in recording it from the Gulf of Panama. Lampert has clearly pointed out the differences between this form and the nearly related *H. lubrica*, with which it has been confused. The color is uniformly brown with paler, more greyish ventral side; sometimes a single pale brown specimen occurs among numerous typical.

52 specimens from English Harbor, Antigua. 2 specimens from Bathsheba, Barbados.

[The habitat of this species is entirely different from that of any other holothurian encountered by the expedition. It is found only on rocky shores, exposed to the buffeting surges of the open sea, where it dwells in miniature basins of the rocks associated with *Echinometra lucunter*. These little hollows are the forms once occupied by *Echinometra*. When the tide is out, the hollows retain usually a little water, which is replenished with air-charged, foamy brine each time a breaker cascades back into the sea. I noticed that

the tentacles are kept expanded in such little pools. In hollows of sufficient size, several animals are wedged tightly together. They are difficult to dislodge, and it is easy to see how the unusual number of tube-feet aid the animal in clinging where the clawing waves are seldom at rest. There is usually a plentiful growth of short, tough kelp where the holothurians live. This kelp overhangs the edges of the little basins in which two or three of the animals are domiciled in such a way as practically to hide them.

The species is easily recognized by its very dark brown color, large, practically dendritic, tentacles and very crowded ventral pedicels.—W. K. F.]

*Holothuria fossor* n. sp.

*Stichopus rigidus* Selenka, (partly), 1867, p. 317, pl. XVIII, fig. 30-31.

*Holothuria rigida* Semper, 1868, p. 79.—Theel, 1886, p. 231.

*Holothuria pleuripus* Sluiter, 1910, p. 333.

*Holothuria hypamma* ? Clark, 1921, p. 178.

*Holothuria hypamma* Clark, 1922, p. 231.

Length 85 mm. Ventral side flattened, dorsal somewhat arched; skin very stiff and rigid, but thin; mouth ventral, the crown of very small and pale tentacles surrounded by a collar of papillæ; anus terminal.

Color, on dorsal side greyish, with about 12 pairs of indistinct spots; ventral surface white, rusty on the middle; and also a ring of rusty red pigment is found around the end of the pedicels. The appendages are small and inconspicuous. On the dorsal side, small wart-like papillæ of different sizes; they are numerous along the edge; ventrally, small retracted pedicels are found, not crowded; they are mostly retracted in the odd ambulacrum, laterally they are more conspicuous on account of the pigmentation.

A small and delicate calcareous ring is present; the posterior edge is undulated; the radialia are broad, squared, with a deep anterior notch; the interradialia are small, with the usual anterior tooth. Tentacle ampullæ small and slender. The vascular ring is about 10 mm. distant from the calcareous ring; one slender Polian vesicle is present and a small stone canal, with small head, free on the right, partly attached to the mesentery. The genital tuft contains numerous long and dichotomously branched tubes, some of which, in the present specimen, are longer than the animal. Two respiratory trees, as usual the left is entangled in the well-developed

rete mirabile. The muscle bands are broad and thick; the circular musculature, very feeble. Plate II.

According to Selenka the Cuvierian organs are branched. There was found a brown mass near the base of the right respiratory tree, but it was impossible to trace any structure in it.

Deposits: In the body wall is found a layer of densely placed large tables, underneath a thick layer of strongly knobbed buttons.

The tables have a knobbed margin, the disk (.059 mm. diam.) has a large central hole and several marginal, but often the primary disk is covered by a secondary network, which hides the original structure; the spire has numerous blunt teeth, which unite and form a network. From the edge of the disk arise rods which unite with projections from the spire. The tables are larger and more complicated dorsally; ventrally they are smaller (.044 mm.) and represent different stages of development. The buttons are smallest and most knobbed dorsally, where they have six holes and are about half as long as the diameter of the tables (.039 mm.); ventrally they have ten to twelve holes and they are twice as long and often nearly flat (.0604 mm.).

In the dorsal papillæ are numerous curved supporting rods (.0832 mm.) but no end plate; in the pedicels the supporting rods (.0858 mm.) are nearly straight; they are broad, with few holes in the ends and on the middle; often they have a low longitudinal ridge; a small end plate is present.

In the pedicels the tables are especially small and of very variable development; Selenka most probably described these simple tables as those with eight rods in the spire. His spinous ellipses are without doubt, the dorsal tables, seen in oblique position.

Clark first noted that the *rigida* from Florida was different from the species of the Society Islands, which is regarded as the type (1921, p. 178). He regards the West Indian species as identical with his *H. hypamma* from Murray Islands (1922). The undeveloped tables in the pedicels of the West Indian species resemble the average tables of *H. hypamma* (.054 mm.); but those found in the body wall of *H. fossor* are large and much more complicated. The buttons are entirely different; they are much more knobbed in the West Indian species, the holes are smaller and they never have the middle bar projecting over the ends of the buttons, as in *H. hypamma*.

Sluiter has recorded a specimen of *H. pleuripus* (Haaeke) from Kingston, which he states agrees with the description given by Theel

of some specimens, in the Godeffroy Collection, from Fiji and Tahiti. Undoubtedly Sluiter is dealing with an example of *H. fossor*, which may be inferred from Theel's description of *H. pleuripus*, more easily than from Selenka's description of *H. rigida*. It has been possible to make sure of the identification by comparing spicules of *H. fossor* with those of Selenka's type of *H. rigida* in the Museum of Comparative Zoology.

Inasmuch as the species from the Society Islands is the genuine *Holothuria rigida* (Selenka) and that from the West Indies is different from Clark's *H. hypamma* (Murray Islands), it becomes necessary to name the West Indian form. Dr. Fisher has proposed the name *H. fossor*, on account of its burrowing habit.

1 specimen, Falmouth Harbor, Antigua.

[This species has less "behavior" than a sluggish chiton. It was found under rocks, which rested on sand, Falmouth Harbor, and was never uncovered by tide. It was deeply buried, after the manner of *Brissus brissus*, and probably does not come to the surface, unless at night. In the aquarium it was very sluggish both by night and by day. In life it is covered with fine sand grains.—W. K. F.]

#### ACTINOPYGA

Anal teeth very small, dorsally warts, ventrally pedicels.

Color uniform brown, with a greenish shade, (the green pigment is extracted in alcohol). Deposits: Tables with numerous holes in the brim and medium sized spire ending in numerous teeth, buttons with 6 holes, elliptical and often curved and irregular. Cuvierian organs present. 20 tentacles. Small form (4.5 cm.). *Actinopyga parvula* (Selenka).

#### *Actinopyga parvula* (Selenka)

*Mulleria parvula* Selenka, 1867, p. 314, pl. XVIII, fig. 17-18.—Semper, 1868, p. 77.—Lampert, 1885, p. 76.—Theel, 1886, p. 199.—Sluiter, 1910, p. 333.  
*Holothuria captiva* Ludwig, 1874, p. 32.—Lampert, 1885, p. 68.—Theel, 1886, p. 220.—Verrill, 1907, p. 321.—Crozier, 1917, p. 560.—Clark, 1919, p. 63, 64.  
*Actinopyga parvula* Clark, 1919, p. 63.—Deichmann, 1921, p. 199-215, text fig. 1-3, 5-7.

As usual this form is abundant. All kinds of animals are present, from complete, normal ones to small balls of skin, lacking either oral or anal end, representing regenerating stages. The anal teeth are very small and usually this species has been recorded as *H. captiva* Ludwig. Even when the anal teeth are not found, in regenerating stages, this species is easily recognized by its comparatively small size, its uniform brown color, and the peculiar green pig-

ment which the body-wall contains. None of the West Indian holothurians with dorsal warts and ventral crowded pedicels, has spicules developed as tables and buttons. The type was described from Florida. It is known from the West Indies to Bermuda.

93 specimens from English Harbor, Antigua. 5 from Barbados.

[This species, the *Holothuria captiva* of the "Narrative," was abundant under stones at Harbor Point, English Harbor, in the same locality as *H. surinamensis*, and was found sparingly under stones at Falmouth Harbor. It is very warty, rich bright brown, with yellow tentacles and not over two and a half inches long. It shoots out its delicate viscid Cuvierian organs with great freedom and precision. A small spider crab which was bombarded with the Cuvierian filaments was visibly embarrassed as the threads stretched out at each movement of his legs. He solved the difficulty by eating the threads.—W. K. F.]

#### STICHOPUS

Deposits: Tables and small C-shaped bodies, 1-2 times as large as the height of the tables. Strongly developed warts on back and side. Color very variable, often greyish brown with darker spots or patches.

*Stichopus badionotus* Selenka.

Deposits: Tables and C-shaped bodies, 3-4 times as large as height of tables; only small warts on back and side. Color yellow with brown, dotted irregularly; tip of papillæ pale. *Stichopus macroparentheses* Clark.

#### *Stichopus badionotus* Selenka

*Stichopus badionotus* Selenka, 1867, p. 316, pl. 18, fig. 26.—Clark, 1922, p. 55, pl. 2, fig. 11-15, (complete list of references).

The specimens show the usual variation in color and pattern. This species ranges from the Atlantic coast of Panama to Bermuda; according to Clark, 1919, it does not occur south of Antigua. Clark has compared specimens from the West Indies with *Stichopus* from the West Coast of Mexico and believes that the two species are identical. He also places Greef's *Stichopus maculatus*, from Rolas, West Africa, as a probable synonym of *badionotus*.

8 specimens, English Harbor, Antigua.

[This conspicuous species was abundant in English and Falmouth Harbors among eel-grass, on a soft, sandy bottom.—W. K. F.]

#### *Stichopus macroparentheses* Clark

*Stichopus macroparentheses* Clark, 1922, p. 61, pl. I, fig. 1-7.

The two specimens are larger than those which Clark found at Jamaica and Birds Key. Both specimens agree with the description

of the type, in the shape of the calcareous ring and the deposits. They are not very well suited to complete description as one specimen is flattened and formless and the other blown up to a thin-walled sac. It is apparent that the pedicels are in three rows and the warts are small and inconspicuous. The genital organs are totally absent in the first specimen and small in the other. The color is yellow or pale brown with darker brown spots, and the ends of the papillæ are pale. They are said in a younger stage to resemble young *S. badionotus*.

2 specimens from English Harbor, on sand among eel-grass.

#### MESOTHURIA

Skin semitransparent. Deposits: Tables alone, with large central hole, surrounded by smaller; spire high and slender with up to 3-4 cross beams ending in four blunt teeth. Few pedicels, dorsally papillæ. Small form (1-2 cm.). *Mesothuria verrilli* Theel.

#### *Mesothuria verrilli* (Theel)

*Holothuria verrilli* Theel, 1886 b, p. 6.—Marenzeller, 1893, p. 79, pl. I, fig. 2, pl. II, fig. 2.

*Holothuria intestinalis* Koehler, 1895, p. 482; 1896, p. 106.—Ludwig, 1900, p. 138.

*Holothuria intestinalis* var. *verrilli* Herouard, 1896, p. 163.

*Holothuria magellani* ? Sluiter, 1910, p. 332.

*Mesothuria verrilli* Oestergren, 1896, p. 347.—Perrier, 1902, p. 357, pl. XVI, fig. 22-31.

The single specimen (Plate I, fig. 2,) is less than 10 mm. long, whitish gray and rough from the numerous deposits. The dorsal appendages are scattered and without end-plate; ventrally they are indistinctly placed in three more or less double rows, and the end plate is well developed. The tables have a central large hole and a different number of marginal holes; the spire is very variable in height and upward of four cross beams have been found. It usually ends in four teeth.

Sluiter has found a specimen from nearly the same locality which he refers to *M. magellani* (Ludwig) and says it is very near to the European *M. intestinalis* (Asc. and Ratke). If the character "no pedicels in the midventral radially" is constant, the present specimen can not be *magellani*. It may possibly be *M. verrilli* Theel, which has been recorded from Barbados, but in a depth of 399 fathoms. The only difference is that Theel speaks of pedicels all over the body. He also describes the tables with one to two cross

beams, but mentions that there is a very wide range of variation in the tables. He does not figure the spicules. The present specimen seems just as likely to be referable to *verrilli*, normally occurring at a great depth as it is to *magellani*, from the Straits of Magellan.

Both forms are nearly related to *M. intestinalis* to which Koehler and Ludwig unite them; Oestergren, however, has compared *M. verrilli* with numerous specimens of the European *intestinalis*, and says that they are different.

1 specimen from Falmouth Harbor, Antigua.

KEY TO THE SPECIES OF THYONE

a<sup>1</sup> Calcareous ring simple; small anal teeth present; tentacles of equal size; end-plate and supporting rods present in the pedicels. Deposits: Four-holed buttons and four-spoked cups with 8-12 teeth in the margin. Perforated plates and rods numerous near the anal end. Color greyish-brown, mottled with darker brown.

b<sup>1</sup> Numerous strongly knobbed buttons with small holes, some few with knobs on the margin and larger holes. Skin stiff with spicules.

*Thyone surinamensis* Semper.

b<sup>2</sup> Few buttons with large holes and knobs on the margin. Skin soft, with few spicules.

*Thyone suspecta* Ludwig.

a<sup>2</sup> Calcareous ring with short posterior prolongations; no anal teeth; tentacles of unequal size, the two ventral being smaller. Deposits: Tables with reduced spire and few rosettes. Well developed end-plate but no supporting rods in the numerous soft pedicels.

b<sup>1</sup> Deposits: Tables with spire reduced to 2 knobs and 4 holes in the oval disk. No separate posterior pieces on the interradialia of the calcareous ring. Color violet.

*Thyone trita* Sluiter.

b<sup>2</sup> Deposits: Tables with spire reduced and regular disk with 8 holes and 8 marginal teeth. Separate posterior pieces on the interradialia, sometimes forming short tails. Color uniform brown.

*Thyone constituta* Sluiter.

*Thyone suspecta* Ludwig

*Thyone suspecta* Ludwig, 1874, p. 16, pl. 6, fig. 19.—Lampert, 1885, p. 157.—

Theel, 1886 a, p. 133.—Sluiter, 1910, p. 333.—Clark, 1919, p. 63.

*Thyone brasiliensis* Verrill, 1868, p. 370.—Rathbun, 1879, p. 141.

The single specimen (Plate III, fig. 2,) is from the same locality as the type. It agrees in every respect with the description of the type and with some specimens from Savanilla, Colombia, except that the end-plate is either small or composed of a central larger part and several smaller peripheral pieces. Many of the cups are poorly developed. This might seem to be caused by the formalin in which the specimen has been preserved, but in the anal region

as well as in the extended introvert the cups are very well developed.

The skin is thick and soft and the pedicels are uniformly spread over the entire body. The anal teeth are present but not very prominent. The spicules are most numerous in the anal part, where large perforated plates are accumulated in addition to the ordinary buttons which have large holes and small isolated knobs on the rim. All stages are found from complete bodies to dichotomously branched ones with the ends of the branches united. The layer of buttons is very scattered.

The cups are not numerous, they are four-spoked with 12 spines on the edge. In the pedicels are simple supporting rods, nearly straight, with large holes and narrowest on the middle. In the introvert, besides numerous cups, are found heaps of rosettes. The rods in the tentacles are of the same type as the supporting rods in the feet, but they are more irregular and branched.

The internal anatomy is normal for the genus; the calcareous ring is simple, deeply incised posteriorly, and anteriorly with large teeth of nearly equal size. One Polian vesicle is present; one dorsally embedded stone canal; the muscular stomach is short; the long and unbranched tubes of the genital organs are filled with eggs and fastened near the middle of the body wall, where the retractors arise; the longitudinal musculature is well developed.

Distribution: Colombia to Barbados; not common.

1 specimen from Barbados.

#### *Thyone trita* Sluiter

*Thyone trita* Sluiter, 1910.

This species has only been recorded from Barbados and only the type specimens are existing. The two present specimens agree well with Sluiter's description. The smallest is very dark, with a shade of violet.

2 specimens from English Harbor, Antigua.

#### *Thyone constituta* Sluiter

*Thyone constituta* Sluiter, 1910.

The single specimen is better developed than the type, which was found at Barbados. The calcareous ring has the same narrow long radialia with short posterior prolongations and the interradiania are broad and overlap the middle of the radialia; but the separate posterior pieces form real short prolongations. As in *T. trita* the pedicels are numerous, small, and soft, with well developed end

plate. The very characteristic tables are, near the oral end, more irregular, with numerous teeth and holes, instead of the ordinary eight teeth and eight holes. The rosette shaped bodies are most numerous in the introvert and more scattered in other parts of the body wall, but they are not very common.

1 specimen from English Harbor, Antigua.

*Thyone surinamensis* Semper

*Thyone surinamensis* Semper, 1868, p. 65, pl. XV, fig. 15.—Lampert, 1885, p. 158.—Theel, 1886, p. 133.

*Cucumaria punctata* Ludwig, 1874, p. 82.—Sluiter, 1910, p. 335.—Clark, 1919, p. 63.

*Semperia punctata* Lampert, 1885, p. 152.

The specimens (Plate III, fig. 1,) except in minor details agree with the description given by Semper. The genital organs are unbranched, but so numerous and twisted around each other, that they appear to be divided. The pedicels are, in some specimens, not uniformly distributed, but absent from a narrow strip on each interradial area. These animals could therefore be referred to *Cucumaria punctata* (Ludwig), which was described from Barbados. The only anatomical difference is that the type of *C. punctata* had 5 Polian vesicles, while the present animals have only one or two. The deposits are of the same type—four-holed knobbed buttons, and cups. A preparation of spicules of a *C. punctata* from Bermuda shows that the cups have, besides about 12 marginal teeth, a variable number of teeth projecting outward. The same is the case of the cups from the present animals. The spicules from the animals with uniformly distributed pedicels can not be separated from those with naked strips on the interradialia; it seems therefore very probable that Ludwig's *C. punctata* is a younger stage of *Thyone surinamensis*.

In coloration and size the present species is similar to *T. suspecta* and the internal anatomy is almost identical. In *T. surinamensis* there are two kinds of buttons: strongly knobbed, with small holes, present in large number, and some few with larger holes and isolated knobs on the margin. These are perhaps stages of the strongly knobbed buttons. In *suspecta* there is only one kind of button, with large holes and isolated knobs; usually they are larger than the average button in *surinamensis*. The cups, supporting rods and rosettes are of exactly the same type. It might be inferred from a mere description, that the two species are the same and that

*suspecta* is only a form in which the large layer of strongly knobbed buttons has not been developed. The figures of the spicules show the actual differences, which are found in the two species. Most of the buttons are smaller in *surinamensis*; the cups are larger in absolute size and in proportion to the buttons. They seem to have more accessory teeth in *surinamensis*, but that may be accidental. The supporting rods are slightly longer in *surinamensis* and often have a nearly straight edge. The holes are small, while *suspecta* has very large holes in the supporting rods and a very undulated margin. The rosettes are much larger in *surinamensis* than in *suspecta*.

Distribution: From northern coast of South America to Barbados (and if identical with *Cucumaria punctata* also from Bermuda.) Pelican Island, Barbados.

*Phyllophorus parvum* (Ludwig)

*Thyonidium parvum* Ludwig, 1881, p. 54-55, pl. III, fig. 16-18.---Lampert, 1885, p. 169.

Eighteen to twenty tentacles in two circles and of different length; skin leathery; the pedicels are not crowded and only indistinctly placed in rows. Deposits: Tables with large rounded or squared disk with two small central holes and 8-10 larger in the margin; spire built up of two rods and ending in few teeth; no supporting rods; small end-plate. Calcareous ring with long posterior prolongations. Color pale reddish brown with violet tentacles.

The single specimen agrees with Ludwig's description. The tentacles are deep violet and of varying size. According to Lampert, this species is common along the coast of Brazil down to Rio Janeiro. It seems never to have been taken in the West Indies.

One specimen from English Harbor, Antigua.

*Euapta lappa* (J. Müller)

*Synapta lappa* J. Müller, 1850, p. 134.

*Euapta lappa* Clark, 1907, p. 73, pl. IV, fig. 23-25. (Complete literature list). 1924, p. 464, pl. I, fig. 5-7.

The present specimens are all large and typical in color and spicules. This species which is the largest apodous form in the West Indies, is, according to Clark, known from Florida to Tobago and also from Teneriffe (Theel).

2 specimens from Falmouth Harbor; 2 from entrance of English Harbor, Antigua.

[This large, showy, and active synaptid was found among stones

at English Harbor (Harbor Point), and at Falmouth Harbor. Professor Nutting, in the narrative of the Barbados-Antigua Expedition, p. 194, writes of it as follows:

"A fully extended specimen sometimes reaches the length of two feet and looks more like an enormous worm than like anything else. It is quite translucent, being thinner walled than most species, and the body is longitudinally striped with reddish brown bands and bears numerous rounded nodules arranged in annular series; but these disappear completely when the animal is entirely extended, or in parts of its length which are extended, only to reappear instantly upon contraction. Waves of such contraction pass rhythmically along its length. It is the most active holothurian by far that I have ever seen and is really a beautiful object when in the aquaria and in vigorous motion. The feathery tentacles are in constant activity, waving this way and that, lengthening and shortening, bending gracefully, their frilled edges a constant play of activity; while the whole body is in rhythmical movement, bending, twisting, elongating, retracting, and at the same time pulsating with the waves of retraction already referred to, during which the hemispherical nodules appear and disappear as if by magic along its whole length. The transparency of the body walls gives a peculiar delicacy that we do not usually associate with the ordinary unattractive 'sea cucumbers'.

"Its footless condition is compensated for by the possession of several peculiar features. Doubtless the hemispherical and temporary nodules already referred to give it a hold on the stones between which it worms its way, and its extreme distensibility enables it to go through quite narrow holes and cracks, while the waves of contraction serve to push it rapidly along either the surface of the sand bottom or over and between rocks. It can also swim to a limited extent and will frequently raise itself on end in the aquaria so as to assume a vertical position with the tentacles exploring the surface while the aboral end rests on the bottom."—W.K.F.]

### *Synaptula hydriformis* (Lesueur)

*Holothuria hydriformis* Lesueur, 1824, p. 162.

*Synaptula hydriformis* Clark, 1907, p. 82, pl. VI. (Complete literature). 1924, p. 473, pl. III, fig. 5, pl. IV, fig. 4.

A single small specimen about 20 mm. long, nearly colorless, with typical spicules. This form is common from Brazil to Florida and is also found at Bermuda (Clark).

One specimen from Antigua.

### *Chiridota rotifera* Pourtales

*Chiridota rotifera* Pourtales, 1851.—Clark, 1907, p. 115, (complete list of references); 1919 p. 63.—Sluiter, 1910, p. 341.

This species seems not to have been taken at Antigua before, but it is a common form which according to Clark has the same distribution as *S. hydriformis*.

2 specimens from Antigua.

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## EXPLANATION OF PLATES

## PLATE I

*Holothuria surinamensis* Ludwig, x670

- 1a Disk of table from very young specimen
- 1b Lateral view of table from very young specimen
- 1c Top of spire seen from above, of old specimen
- 1d-e Tables with completely absorbed disk, lateral view
- 1f Half of rod from skin of old specimen
- 1g Rod from near the end of pedicel of old animal

*Mesothuria verrilli* Theel

- 2a Lateral view of table
- 2b Disk of table from above

## PLATE II

*Holothuria fossor* n.sp., x670

- 1a-b Supporting rods from pedicel
- 1c Flattened button from ventral side
- 1d Knobbed button from ventral side
- 1e Small, relatively simple table from pedicel
- 1f Disk of very simple small table from pedicel
- 1g-h Buttons from dorsal side
- 1i-j Supporting rods from papilla

## PLATE III

*Thyone surinamensis* Semper, x670 (except 1c and 2a)

- 1a Knobbed button
- 1b-c Baskets, seen from above
- 1d Baskets, lateral view
- 1e Supporting rods from pedicel, x270

*Thyone suspecta* Ludwig

- 2a Supporting rods from pedicel, x270
- 2b-c Baskets, lateral view
- 2d-e Buttons

PLATE I

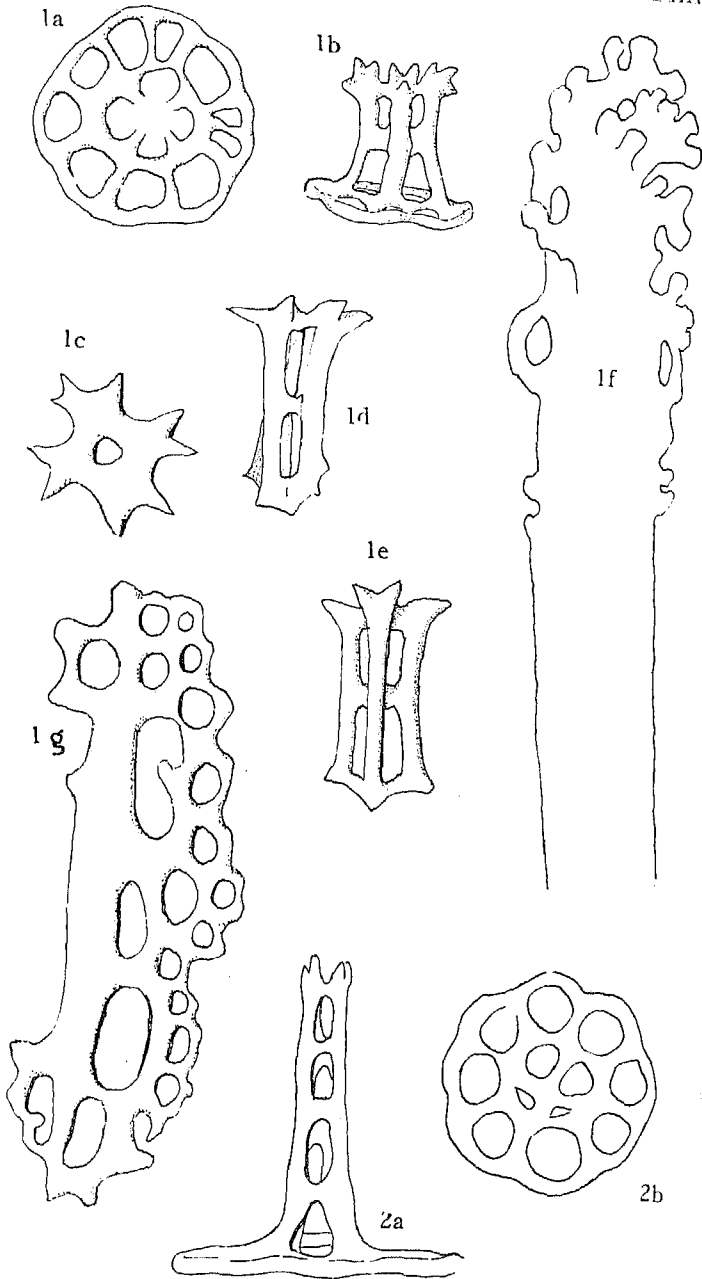


PLATE II

