Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

XLVI.

Synaptidæ

by

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With Plates II—III.

The present paper deals with the Synaptids collected by Dr. Th. Mortensen on his different expeditions, except those found at New Zealand and the Auckland-Campbell Islands[1]) which were described by Dr. Mortensen himself (Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16, XXIX. Th. Mortensen: Echinoderms of New Zealand and the Auckland-Campbell Islands, IV). Descriptions of the rather few specimens of tropical and pacific Synaptids from older collections in the Copenhagen Museum are also included. As by far the largest number of specimens mentioned in this paper, were collected by Dr. Mortensen, the collector is only named, when the specimens dealt with are found by others; thus in all places where the collector is not mentioned, the specimens belong to Dr. Mortensen's collections.

The collection includes 92 different forms of Synaptids, three of which are described as new varieties. Of the 89 species described, 47 are new to science, and 10 are old species which were on account of the more or less incomplete previous descriptions, hitherto regarded as synonyms of other species. Of each species a complete description is given, as far as possible, and all characters of systematic value are illustrated. Histological examination on sections of more interesting organs as eye spots, gustatory organs, ciliated funnels, gonads and the different parts of the alimentary canal has not been made. When I began the examination of the collection, Dr. Mortensen called my attention to the variation of the ciliated funnels, as he supposed them to offer rather valuable systematical

[1]) In the paper on the Echinoderms from New Zealand and the Auckland-Campbell Islands Dr. Mortensen describes 8 different Synaptids, 3 of which *Ch. nigra, Ch. carnleyensis* and *Tr. microurna* are new to science.

characters. My studies have shown that Dr. Mortensen was right in presuming so, as the shape of the ciliated funnels without any doubt is of the highest classificatory value in this family. Another character hitherto often overlooked and neglected, but evidently of the greatest value for the specific and often also for the generic diagnosis, is the shape of the "miliary granules".

In genera in which so many species have been described since 1908, that Clark's keys to the species is not satisfactory any longer, new keys have been worked out, but when, as in *Labidoplax* and *Protankyra*, only few new species have been found, the keys in "The apodous Holothurians" are still fully efficient, as are also the keys to the genera given there. For the *Chiridotinae*, Clark has given some excellent keys in his "Echinoderms of the Torres Strait" (Department of Marine Biology of the Carnegie Institution of Washington, Volume X, 1921).

For the opportunity of studying this exceedingly large[1]) and for the larger part nicely preserved collection, I beg to express my best thanks to Dr. Mortensen. I am also deeply obliged to Dr. Mortensen for his valuable help and the never failing interest with which he has always favoured my studies.

In the Archives of the Zoological Museum of Copenhagen, there are some fine drawings of *Synaptula vivipara* Ørsted, made by the Danish zoologist A. S. Ørsted during his stay on Jamaica in the year 1845. The drawings were exhibited at a lecture in the "Dansk Naturhistorisk Forening" in 1849, but never published. Only a summary of the lecture is published in the first Volume of "Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening" and in this the genus *Synaptula* is established. Ørsted's drawings show that he was one of the first or the first to see the development of the eggs as well as several anatomical details. It has therefore been thought desirable to publish his drawings and thus to give him full credit for his excellent observations, cfr. Pl. III. The notes in Ørsted's hand accompanying his drawings are not in a state making it desirable to publish them. Danielssen and Koren ("Observations sur le développement des Holothuries" in "Fauna littoralis

[1]) Clark refers in "The Apodous Holothurians" 88 species in all to this family and since that time only 17 new species have been described.

Norvegiae". 2. livr. Bergen. 1856) are given credit of being the first to have studied the development of Holothurians. The figures here published show that in reality Ørsted was the first to make these observations. But not only the direct development of the young, also the larval glandular organ and the fact that the number of tentacles increases from 5 to 12 during the development of the

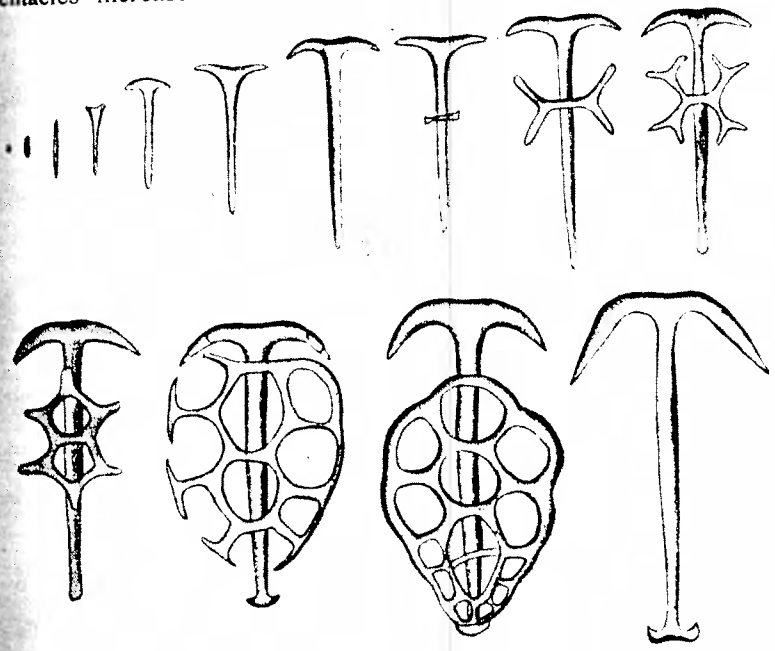


Fig. 1. Developmental stages of anchors and anchor-plates in *Synaptula vivipara* (= *hydriformis*) drawn by A. S. Ørsted in 1845.

specimen were discovered by Ørsted. Even the enervation of the eye-spots, which was denied by Haman, Semon and Ludwig, is dissected out and drawn, and the presence of eyes is furthermore used in the diagnosis of the genus *Synaptula*.

The first discoverer of the ciliated funnels is Mertens who writes: "Kein Respirationsbaum, statt desselben am Gekröse zahlreiche kleine Cylinder, wie wir sie schon ganz ähnlich in der Holothurie Nr. 6 bemerkt haben" (cfr. Ludwig: Revision der Mertens-Brandt'schen Holothurien, pag. 579). These "cylinders" are the large, up to 1 mm long clusters of funnels in *Polycheira rufescens*

Erratum.

p. 107, l. 10 from below
for enervation read innervation.

and in *Chiridota discolor*. Quite independently of Mertens' observations (which remained unknown till published by Ludwig) Ørsted observed these organs and gave excellent drawings of them and their arrangement in the *Synaptula*.

Also the development of the anchors and anchor-plates was seen quite correctly by Ørsted (cfr. Fig. 1). Quatrefages figured in 1842 a few of the later stages found in "*Synapta*" *duvernæa* and only later on, 1854 Ayres states that the first rudiments of the anchors appear before those of the anchor-plates. Ørsted's figure (Fig. 1) which was drawn in 1845, shows all the various developmental stages of the anchors and anchor-plates. Even the arrangement of the anchors at a right angle to the longitudinal axis of the specimen is shown correctly in the figure of the fully developed young (cfr. Pl. III).

As a matter of fact Ørsted's observations were far ahead of his time, and had his figures been published then, in 1849, he would have acquired the honour of being one of the pioneers in the study of the anatomy and development of the Holothurians.

Subfamily I. **Synaptinae.**

Østergren. 1898. Das System der Synaptiden. pag. 111.
Clark. 1908. The Apodous Holothurians. pag. 70.

The subfamily *Synaptinae* was established in 1898 by Østergren for the 6 genera:

Euapta
Chondrocloea
Synapta
Labidoplax
Protankyra
Anapta

It is accepted by Clark in "The Apod. Holoth." but comprises in this work 11 different genera. Østergren's genus *Euapta* was divided into two by Fisher who regards the species with numerous stone-canals as a separate genus, *Opheodesoma*. The genus *Chondrocloea* was again divided by Clark into three different genera. To the first of these the name *Synapta* Eschscholtz is applied, with "*Holothuria*" *maculata* Chamisso & Eysenhardt as the genotype. Østergren's

genus *Synapta* thus had to be changed and got Verrill's name *Leptosynapta*. The second genus, which was represented by "*Synapta*" *kefersteinii* Selenka, was on account of the many tentacles named *Polyplectana*. The third genus has, as proposed by Fisher, got Ørsted's name *Synaptula*. For Koehler and Vaney's species *Anapta? dubiosa* Clark established the genus *Dactylapta*. The last of the genera accepted by Clark is *Rhabdomolgus* Keferstein.

In Dr. Mortensen's collections all the genera exept *Anapta*, *Dactylapta* and *Rhabdomolgus* are represented. Of the genus *Labidoplax* only a single species, *variabilis* Théel is represented, and of the large genus *Protankyra* not more than 8 species are found. The other genera are nearly completely represented, the only species which are wanting being some of the atlantic species of *Leptosynapta*, which according to the area of the Expeditions could not be expected.

The study of these many species has resulted in the division of the subfamily into two different groups:

1. *Micrournae*
2. *Heterourna*e

The first group, the *Micrournae* includes the five genera:

Synapta
Opheodesoma
Euapta
Polyplectana
Synaptula

It is characterized by having only one sort of small ciliated funnels, which are quite alike in all the species referred to the group. Besides, the anchor-arms are quite smooth and on the vertex there are usually minute knobs, which may be placed either on the vertex itself or on the sides of it. The articulation between anchor and anchor-plate is always made over a distinct "bridge" across the "posterior" part of the anchor-plates. Curved rods are never found, but miliary granules, usually in the shape of rosettes. The coloration is usually very different and the size of the specimens may be exceedingly large.

The second group, the *Heterournae*, includes the genera:

Leptosynapta
Epitomapta

Patinapta *Labidoplax*
Eupatinapta *Protankyra*

It is characterized by having ciliated funnels of varying size and shape, and often more than one sort in the single specimen. The shape of the funnels is in this group usually quite distinct for each species, though as far as our present knowledge goes none of the genera are characterized by a peculiar shape of funnels.

The anchors have normally the arms more or less regularly serrate and minute knobs are never found on the vertex. The articulation between anchor and anchor-plate is never made over a bridge, but over some bridge-like irregularities in the surface of the plate. These may be of a very different shape in different genera and species, but they are of a rather constant shape in the single species. Miliary granules of the skin never in the shape of rosettes, but they are usually bent rods or small perforated plates. The colour of the species of this group is usually pale yellow or brown, very seldom dark brown or blackish, and the size of the specimens is never so large as it may be in the *Micrournae*.

The two genera *Dactylapta* and *Anapta* most likely belong to respectively *Heterournae* and *Micrournae*, but our knowledge of them is for the present too insufficient for saying it definitely.

The aberrant genus *Rhabdomolgus* would not seem to be closer related to any of the two groups, and most likely it represents an independent third group.

Synapta Eschscholtz.

Eschscholtz. 1829. Zoologischer Atlas. Heft. II pag. 12.
Clark. 1908. The Apodous Holothurians. pag. 78.

Genotype: *Holothuria maculata* Chamisso & Eysenhardt.

Remarks: In "The Apod. Holoth." Clark writes that the genus *Synapta* is a monotypic one "(with the type species *maculata)*", as he supposes the elder "species" which he mentions to be all only one species. This is not so. The collection at hand shows that we have good reasons for regarding *Hol. oceanica* Lesson as specifically different from *Hol. maculata* Chamisso & Eysenhardt, and that there is nothing that speaks for the identity of *oceanica* with *Synapta mammillosa* Eschscholtz.

When Eschscholtz in 1829 established the genus *Synapta*, he referred the following four species: *Hol. reciprocans* and *vittata* Forskål, *Hol. maculata* Chamisso & Eysenhardt and *Synapta mammillosa* Eschscholtz to the genus, the latter being described as a new species. The description of *mammillosa* is, however, so insufficient and the figure given of it so poor that it is hardly possible to recognize the species, and nobody ever meant to do so. Therefore it will be very unpractical to make this species the genotype. Of the three other species neither *reciprocans* nor *vittata* can come into consideration as genotypes. *Reciprocans* belongs to the later established genus *Synaptula* Ørsted, and *vittata* is so insufficiently described that we must — with Clark — regard it as irrecognizable. The fourth and last of the species mentioned by Eschscholtz, *maculata*, is, though poorly described, so well figured that it is easily recognized in the collection at hand, wherefore I deem it the most reasonable to make *maculata* the genotype for *Synapta* — as done by Clark in "The Apod. Holoth."

To the genus *Synapta* belong for the present only two species: *maculata*, the genotype, and *oceanica* (Lesson). Of the elder species which Clark refers to *maculata* as synomyns *S. beselii* Jäger is not sufficiently described; and it is not possible to see to which genus it really belongs, the characters mentioned, suiting to *Opheodesoma* and *Euapta* as well as to *Synapta*. It is only certain that it is not synonymous with any of the two said species of *Synapta*. The statement "Tentaculorum 7 lineas longorum pinnae in basi membrana iunctae sunt" shows that it cannot be referred to *maculata* which has no membrane between the digits, and the dark rings seen on the figure separate it decidedly from *oceanica*, which is distinctly striped and quite without dark rings. Another thing is that the specimens, which Held, Semper, Théel and other authors have identified as *S. beselii* Jäger, evidently must be referred to the genus *Synapta*, and judging from the figures, to *S. maculata*. The same also holds good of Held's species *astrolabi*. This species is established only on the calcareous deposits, nothing being said about the other characters of the specimen, nor the locality. Held states that *astrolabi* mainly differs from his specimen of *beselii (= maculata)* in the size of the anchors, though the anchor-plates are of equal size. This difference is not larger than it may be

found in one specimen, and as the shape of the anchors is much alike (the width of the arms is in both figured anchors ca. 70 % of the anchor-length) I do not see any reason for separating *astrolabi* from *maculata*. Also Selenka's species *agassizii* must be regarded as synonymous with *maculata*. Selenka's description of the colour (olive-green with olive-brown stripes) agrees rather well with the typical colour of *maculata*, and the figure of the calcareous deposits resembles the deposits of *maculata* so much that the slight differences may well be due to a less accurate drawing.

As, in my opinion, there is no doubt that *agassizii* Selenka is synonymous with *maculata*, the aberrant specimens mentioned by Clark in 1920 may not be referred to this species. Most likely Clark's specimens really belong to an aberrant form, but whether it is a variety of one of the two hitherto known species or it is a new species, it is not possible to say, as Clark has stated nothing more about them, than that they are typically white with brownish stripes.

The genus *Synapta* is in the collection represented by 18 nicely preserved specimens and a single fragment, which are rather easily separated into the following four groups:

1. The specimens from St. Crux Island, off Zamboanga.
2. The specimens from Sebesi (Sunda Strait).
3. The specimens from Mauritius.
4. The specimens from Tahiti.

Of these the specimens from St. Crux Island represent the genotype *maculata*, and those from Tahiti without any doubt *S. oceanica* (Lesson). The other groups very likely represent independent species, but as they are closely related to *maculata* and only represented by three specimens, two from Mauritius and one from Sebesi, I prefer to describe them as varieties of *maculata*, naming them var. *sundaensis* and var. *Andreae*.

A single specimen from Amboina, which I have referred to *S. maculata*, differs in several respects slightly from the specimens from St. Crux Island. Possibly it will ultimately prove to be a separate form, but the question cannot be settled until more material will be available.

Synapta maculata (Chamisso & Eysenhardt).

Holothuria maculata. Chamisso & Eysenhardt. 1821. De animalibus . . . pag. 325 Pl. XXV.
Synapta maculata. Eschscholtz. 1829. Zoologischer Atlas II pag. 12.
„ *astrolabi*. Held. 1857. Ueber die Kalkkörper in der Haut der Synapten.
„ *agassizii*. Selenka. 1867. Beiträge zur Anatomie und Systematik der Holothurien pag. 361 Pl. XX fig. 122.
„ *maculata*. Clark. 1908. The Apodous Holothurians pag. 78.
„ „ (part.) Clark. 1924. The Synaptinae pag. 471.

St. Crux Island, Zamboanga. II. 1914. Among corals. 8 specimens.
Amboina. 12. II. 1922. 1—2 m. Among corals. 1 specimen.

The longest specimen from St. Crux Island measures, though the posterior end is wanting, 138 cm in length by ca. 3 cm in diameter. The colour is olive-green with five olive-brown stripes and numerous white spots. The tentacles are of the same colour as the body, but instead of the white spots there are some fine, white stripes. There are 15 tentacles, and each of them has 30—40 pairs of digits, not united by a membrane. On the oral disk there are no eye-spots, but on the oral side of the tentacle-base there is a large pigment-spot, which may prove to be an eye. The weak calcareous ring (Fig. 2. 10) is almost quite buried in the voluminous cartilaginous ring. The radial pieces are perforated for the nerves. The numerous polian vesicles are exceedingly long and situated all around the circular canal. The bushy-branched, madreporic canal is mostly single, but sometimes there may be two of them. In one of the specimens from St. Crux Island there are beside the dorsal madreporic canal, numerous small unbranched ones placed all around the circular canal. This however must be regarded as an abnormity, and thus of no clasificatory value, for the specimen mentioned does not in other respects differ from the others. The empty gonads are very long and rather like polian vesicles. They are branched and with no distinct main branch. The anterior end of the intestine is thick and glandular and distinctly different from the rest which has a large loop. The ciliated funnels are all of one sort, and as far as seen of the same size and shape as the funnels in *Opheodesoma* (Fig. 5. 10). They are found on the reticulated basal part of the mesenteries, but on account of the preservation of the specimens the real shape of the funnels cannot be exactly seen.

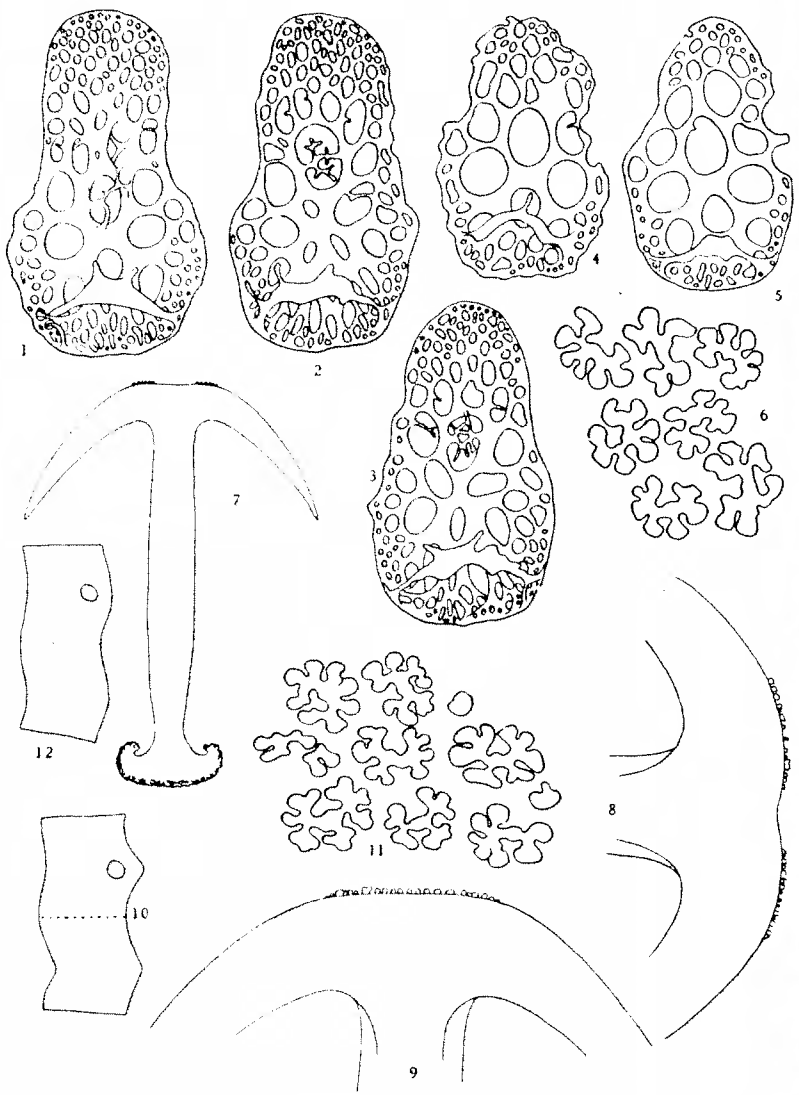


Fig. 2. Calcareous deposits of *Synapta maculata* 1—10 and *Synapta oceanica* 11—12. 1—3 normal plates; 4—5 plates from the abnormal specimen from St. Crux Island; 6 miliary granules; 7 anchor; 8—9 vertex of anchors showing the different arrangement of the minute knobs in the same specimen; 10 pieces of calcareous ring. 1—5 & 7 × 60; 8—9 × 140; 6 & 11 × 750; 10 & 12 × 4.

The anchors (Fig. 2. 7) measure ca. 900 μ in length by ca. 625 μ in width and the width of the arms is ca. 69 % of the anchor length. The stock of the anchor is not branched but finely toothed, and the arms are smooth. On the vertex there are some minute knobs (Fig. 2. 8-9). These are usually found on the vertex itself, but often in a little group on each side of vertex. The two arrangements do not indicate any specific difference as they are found in the same specimen. The anchor-plates (Fig. 2. 1-3) measure ca. 650 μ in length and in their articular end ca. 400 μ in width. The articular end of the plates is typically wider than the anterior end, which does not usually measure more than 225 μ. The bridge is present and supplied with irregularly arranged knobs and spines. Across the central hole in the plates there is usually a fine network, and in the two ends of the plates there are numerous small holes. In spite of the relatively large variation of the plates, they are much alike in shape in the eight specimens. Only a single specimen from St. Crux Island (not the specimen with the abnormal madreporic canals) has somewhat different anchor-plates. The plates are in this specimen smaller and more irregularly formed (Fig. 2. 4-5), but as in all other respects it does not differ from the other specimens, and even the width-index of the anchors is 69, I suppose it to be only an abnormal specimen of *maculata*. Rods are wanting in the oral disk and in the tentacles. The miliary granules in the skin are rosettes (Fig. 2. 6) of somewhat different size and shape. The usual size is 15—25 μ in diameter.

This species is rather distinctly characterized by the shape of the anchor-plates, the width-index of the anchors, the coloration, and in having no membrane between the digits.

Synapta maculata var. *Andreae* n. var.

Mauritius. 1874. Andréa. 2 specimens.

The two specimens at hand are in the exterior very different, as the smaller of them has been on exhibition for many years in the museum, wherefore it has nearly quite lost its colour. The other one is the anterior end of a very large specimen, probably the largest Synaptid ever seen. It measures ca. 30 cm in length by ca. 7 cm in diameter. The colour of this fragment is dark olive-green with faint brownish stripes and white spots. Both specimens

have 15 tentacles, each with ca. 25 pairs of digits, which are not united by a membrane. On the oral side of the tentacle-base there is an eye-spot. The calcareous ring is weak and enclosed in the cartilaginous ring. The polian vesicles are numerous and the madreporic canal is bushy-branched. The anterior end of the intestine is as in *maculata* thick and glandular and the ciliated funnels are as in that species small and placed on the mesenteries.

Although the large specimen is so much bigger than the other Synaptas present, the calcareous deposits are smaller here than in the other forms. The anchors (Fig. 3. 2) measure ca. 750 μ in length by ca. 600 μ in width and the width-index is ca. 80. The stock is not branched, but spiny, the arms are smooth and on the vertex there are minute knobs. The anchor-plates (Fig. 3. 9-11) are oval or rectangular and not wider in the articular than in the anterior end. They measure ca. 600 μ in length by ca. 325 in width. The central holes are large and there are usually few small ones in the ends, but in some few plates there may be, as seen from the figure (Fig. 3. 11) some more holes in the fore-end. The miliary granules are rosettes, quite alike those in *maculata*, and rods are wanting in both the oral disk and in the tentacles.

This form is closely related to *maculata*, but it differs so distinctly from it in the shape of the anchor-plates and in the width-index of the anchors, that it cannot simply be referred to the said species. Whether it must be regarded as a variety of *maculata* or as a separate species it is not possible to say, as our knowledge of the range of variations of the calcareous deposits in this genus is very insufficient.

Synapta maculata var. *sundaensis* n. var.

Sebesi (Sunda Strait). I. VIII. 1922. The shore at low water mark. 1 specimen.

The colour of the single specimen at hand is very near that of *maculata*, except that it is a little more mottled. It has 15 tentacles, each with but 20 pairs of digits, which are not united by a membrane. On the oral side of the tentacle-base there are pigment-spots and the internal anatomy is quite as in *maculata*.

The anchors (Fig. 3. 3) measure ca. 950 μ in length by ca. 700 μ in width and the width-index is ca. 73. The stock of

the anchors is usually unbranched and spiny, but in some of the anchors it is slightly branched, though not so much as in *Opheodesoma*. The arms are smooth and on the vertex there are minute knobs. The anchor-plates (Fig. 3. 4-5) measure ca. 700 μ in length and ca. 350 μ in width. They are more nearly rectangular, but somewhat narrower on the middle than at the two ends. On the middle of the bridge there is a peculiar, large spine. It seems to be rather characteristic as it is present, more or less developed, in nearly all the plates, but its value as specific character cannot be decided by means of a single specimen. Rods are wanting and the miliary granules are rosettes as in *maculata*.

This form is very like *maculata*, but the difference in the shape of the anchor-plates is so great that it will probably prove to be an independent species, but for the present it seems the best to regard it only as a variety of *maculata*.

Synapta oceanica (Lesson).

Holothuria oceanica. Lesson. 1839. Centurie Zoologique. pag. 99, and in Duperry: Voyage autour du monde . . . pag. 9.
Synapta oceanica. Jäger. 1833. De Holothuriis. pag. 14.
" *maculata* part. Clark. 1908. The Apodous Holothurians. pag. 78.
" " " " 1924. The Synaptinae. pag. 471.

Tahiti. The Galathea Expedition. 5 specimens.

The specimens at hand measure from 20—48 cm in length. Their colour is bright yellow with a clear brown stripe in the ambulacra and a dark brown stripe at each side of the ambulacra (Pl. II Fig. 1). They have 15 tentacles, each with 15—20 pairs of digits. The digits are united by a low but distinct web. On the oral side of the tentacle-base there is a distinct pigment-spot. The calcareous ring (Fig. 2. 12) is nearly buried in the voluminous cartilaginous ring, and the radial pieces are perforated for the nerves. The madreporic canal is bushy-branched and the numerous polian vesicles are placed all around the circular canal. The gonads are branched and have a distinct main branch. The intestine has a loop, and the anterior end of it is thick and glandular. The ciliated funnels are, as in *maculata*, placed on the reticulated part of the mesenteries.

The anchors (Fig. 3. 1) measure ca. 1050 μ in length by 750 μ

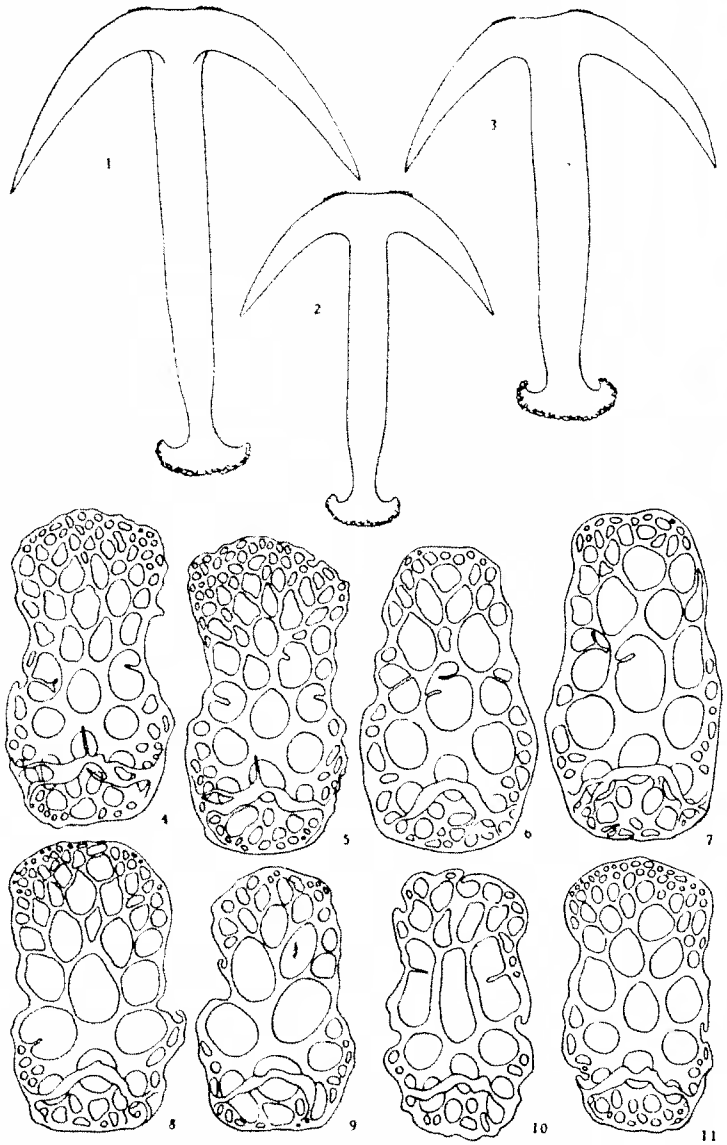


Fig. 3. Calcareous deposits of *Synapta oceanica* 1 & 6–8; *Synapta maculata* var. *Andreae* 2 & 9–11 and *Synapta maculata* var. *sundaensis* 3–5. × 60.

in width, and the width-index is ca. 71. The stock is finely toothed and the arms are smooth. On the vertex there are minute knobs. The anchor-plates (Fig. 3. 6—8) are oval and measure ca. 700 μ in length by 425 μ in width. The central hole is large and without a network as that found in the plates of *maculata*. Around the central hole there are usually seven large holes and in both ends of the plates some additional smaller ones. This shape is the characteristic one, but in one of the specimens there are some plates with somewhat wider ends (Fig. 3. 8) and with a corresponding larger number of the small additional holes. Many of the anchor-plates are not fully developed and then without a bridge and with an incomplete margin. Rods are wanting in the oral disk and in the tentacles, and the miliary granules (Fig. 2. 11) are ca. 15—20 μ large rosettes.

This species differs distinctly from the forms described above, in its peculiar colour and in having a distinct web between the digits. Besides, also the anchor-size and the shape of the anchor-plates afford good characters. The aberrant specimen from Tahiti described by Clark in "The Synaptinae" may be regarded as a specimen of *oceanica*. For the present we do not know other localities for this species than Tahiti, but it will probably be found also in other places of the Indo-Pacific Ocean.

Opheodesoma Fisher.

Fisher. 1907. The Hawaiian Holothurians. pag. 723.
Clark. 1908. The Apodous Holothurians. pag. 73.

Genotype: *Opheodesoma spectabilis* Fisher.

Remarks: The genus *Opheodesoma* is in the collection at hand represented by 29 well preserved specimens, which may be divided into eight different groups. The characters used for the separation of the groups are not well defined and for this reason it is for the present not possible to say definitely whether the mentioned groups really represent different species; but as they are easily separated, I suppose it the better course for the present to regard them as independent species.

The characters which are most usable for the systematic of the genus are: the presence or absence of a web between the digits, the shape of the calcareous ring and the shape of the anchor-plates.

Furthermore the rods from the oral disk and the tentacles are of great systematic value and, together with the numerous madreporic canals, afford the main character for separating this genus from *Euapta*.

Key to the species of *Opheodesoma*.

1. Dorsal side of body distinctly striped (Pl. II Fig. 2-3), ventral side uniformly grey ..... *lineata*
   Dorsal side of body never striped, but either mottled or of uniform colour 2
2. Digits united by a web 3
   Digits not united by a web 5
3. Rods present in both the oral disk and the tentacles. Cartilaginous ring very faint or nearly wanting ..... *clarki*
   Rods present in oral disk but wanting in tentacles 4
4. Cartilaginous ring voluminous and quite enclosing the weak calcareous ring ..... *spectabilis*
   Cartilaginous ring not so voluminous that it encloses the stout calcareous ring ..... *glabra*
5. Rods present in both the oral disk and the tentacles. Calcareous ring green ..... *serpentina*
   Rods wanting in both the oral disk and the tentacles. Calcareous ring green ..... *variabilis*
   Rods wanting in tentacles but present in oral disk. Calcareous ring pure white 6
6. Anterior processes of the radials of nearly the same length as the calcareous ring itself (Fig. 4. 7) ..... *grisea*
   Anterior processes of the radials not more than one third of the length of the calcareous ring itself (Fig. 4. 1) ..... *mauritiae*

Opheodesoma spectabilis Fisher.

Opheodesoma spectabilis. Fisher. 1907. The Hawaiian Holothurians. pag. 723. Pl. 66, Pl. 80 Fig. 1 a–d and Pl. 81 Fig. 2.

Opheodesoma spectabilis. Clark. 1908. The Apodous Holothurians. pag. 75.

Taba Bay, Mindanao. 12. III. 1914. The shore. 1 specimen.

The single specimen at hand measures 113 cm in length. It is uniformly bluish-grey, and the ventral side of body is somewhat lighter than the dorsal. Protuberances are totally wanting. It has 15 tentacles with the digits united by a web. On the oral side of the tentacles there are faint eye-spots. The cartilaginous ring is very voluminous and encloses the weak calcareous ring. All the pieces of the calcareous ring have anteriorly a low process, and the processes are united by a distinct membrane (Fig. 4. 6). The

processes on the radial pieces are ringformed for the passage of the nerves. The polian vesicles as well as the small madreporecanals are numerous. The gonads are branched. The intestine has a loop and on the mesenteries there are small cup-shaped, ciliated funnels.

The anchors (Fig. 5. 15) measure ca. 280 μ in length by ca. 190 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 5. 1) measure from 220 to 250 μ in length by 180—185 μ in width. The articular end

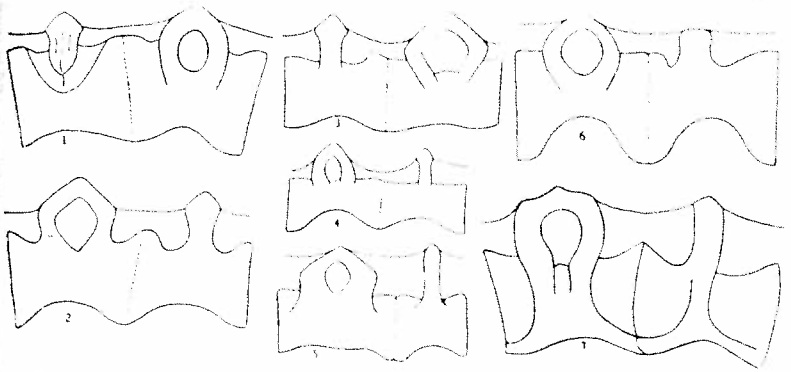


Fig. 4. Pieces of calcareous ring of *Oph. mauritiae* 1, *Oph. serpentina* 2, *Oph. variabilis* 3, *Oph. clarki* 4, *Oph. glabra* 5, *Oph. spectabilis* 6, *Oph. grisea* 7. 1 3 & 5 7 × 6; 4 × 16.

is in this species of a rather constant shape: Across the large hole is a bridge, which is united with the plate in four places, and the holes in the posterior margin are of nearly equal size. The large holes in the plates are distinctly dented with large rounded teeth, which for the most are found in two rows on the exterior surface of the plate.

Miliary granules, in the shape of rosettes, are found all over the body as well as in the tentacles and in the oral disk. In the oral disk there are furthermore small, smooth rods. These are often a little curved and swollen at the ends (Fig. 5. 14). In the specimen at hand such rods are totally wanting in the tentacles.

In general appearance this specimen is very like the following species *glabra*, and the body-wall is, as it is stated to be in the latter species, thick and smooth. But the size and shape of the anchors and anchor-plates as well as the peculiar shape of the

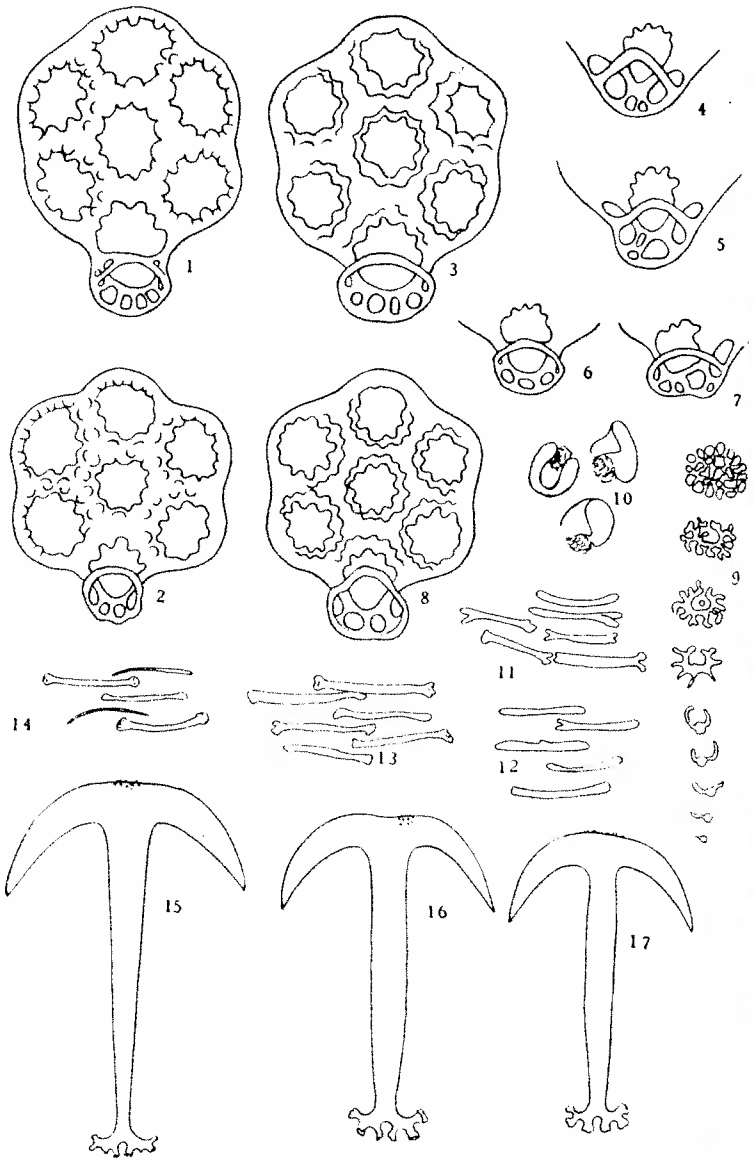


Fig. 5. Calcareous deposits and ciliated funnels of *Oph. spectabilis* 1 & 14-15, *Oph. glabra* 3-8 & 13 & 16. *Oph. clarki* 2 & 9-12 & 17. 3-8 various anchor-plates and articular ends; 9 development of rosettes; 10 ciliated funnels; 11 rods from tentacle; 12-14 rods from oral disk. 1-8 & 15-17 × 170; 9 × 450; 10 × 180; 11-14 × 200.

calcareous ring and the thick cartilaginous ring, make it easily distinguishable from *glabra*, and shows that it may without any doubt be referred to Fisher's species *spectabilis*.

Opheodesoma glabra (Semper).

Synapta glabra. Semper. 1868. Die Holothurien. p. 12, Pl. II & Pl. IV f. 8.
Opheodesoma glabra. Fisher. 1907. The Hawaiian Holothurians. pag. 723.
" " Clark. 1908. The Apodous Holothurians. pag. 74, Pl. V fig. 24.
" " " 1924. The Synaptinae. p. 465, Pl. II f. 4—6.

Amboina. 11. II. 1922. 1—2 m. Corals. 1 specimen.

The specimen at hand measures 45 cm in length and is uniformly grey with white spots due to large heaps of miliary granules. It has 15 tentacles each with ca. 25 pairs of digits united by a web. On the oral disk there are eye-spots. The cartilaginous ring is well developed, but it is not so voluminous that it encloses the thick and solid calcareous ring (Fig. 4. 5). On the anterior margin of each piece of the calcareous ring there is a conspicuous long process, those on the radials being perforated for the nerves. There are numerous polian vesicles and madreporic canals, and the gonads are branched. The intestine has a loop and on the mesenteries there are small cup-shaped ciliated funnels.

The anchors (Fig. 5. 16) measure from 270 to 280 μ in length by 160 to 170 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 5. 3—8) measure from 180—240 μ in length and 140—180 μ in width. The smaller plates have the articular end and especially the bridge somewhat different from those in the larger ones. As in *spectabilis* rosettes are found all over the skin, but in this specimen they are not uniformly spread, but as said, often gathered into large heaps. Rods (Fig. 5. 13) are only found in the oral disk.

The specimen at hand differs distinctly from that of *spectabilis*. Although the calcareous ring is faintly different from that of Semper's type, cf. Die Holothurien Pl. IV fig. 8, I have no doubt in referring it to that species.

Opheodesoma clarki n. sp.

Synapta glabra. Théel. 1885. The Challenger Holothurioidea II, pag. 20.
Opheodesoma glabra. Clark. 1924. The Synaptinae, pag. 465 Pl. II fig. 4—6.

St. Crux Island, Zamboanga. 24.II.1914. The shore. 1 specimen.

The specimen at hand is but a very young one and does for that reason not measure more than 6 cm in length. The colour is pale green with large white spots, due to heaps of miliary granules. It has 15 tentacles each with 9—11 pairs of digits, united by a web. On the oral disk there are eye-spots. The cartilaginous ring (Fig. 4. 4) is rather well developed and the radials are perforated for the nerves. There are 15 polian vesicles and numerous madreporic canals. The gonads are not developed. The intestine has a loop and on the mesenteries there are small cup-shaped ciliated funnels (Fig. 5. 10).

The anchors (Fig. 5. 17) measure ca. 180 μ in length by ca. 100 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 5. 2) measure 150—200 μ in length and 140—180 μ in width. Their shape is very constant and they have large knobs on the exterior surface. The miliary granules are rosettes (Fig. 5. 9). The figure shows some developmental stages of the rosettes, from which it appears that the rosettes which are so characteristic for the two genera *Opheodesoma* and *Euapta*, are but further complicated stages of the rosettes found in *Synapta* and *Synaptula*.

In both the oral disk and the tentacles there are curved rods (Fig. 5. 11-12). These have often branched ends, but they are not swollen and dented as in *spectabilis* and *glabra*.

This species is the most closely related to *glabra*, with which species it has been confounded, but it differs distinctly from it in the shape of the anchors and plates and in having rods in the tentacles. Probably also the wanting or at any rate very incompletely developed cartilaginous ring will prove to be a valid character for separating the two species.

The three species described above, *spectabilis*, *glabra* and *clarki*, differ distinctly from the other species of the genus. They have all of them a distinct web between the digits, and the shape of the

articular end of the anchor-plates is in these species unusually constant. In the other five species of the genus the articular end of the plates is so varying that it is often exceedingly difficult to say which shape is the most characteristic. Furthermore the shape of the plates themselves is so constant that the length-width indices give a rather good character for separating the species from each other. The table below shows how much they differ. The measurements are given in microns.

Species	Anchors			Anchor-plates		
	Length	Width	L : W	Length	Width	L : W
spectabilis . .	150—300	185—200	0,66—0,74	220—250	180—185	0,74—0,81
glabra	270—280	160—170	0,60—0,66	180—240	140—180	0,76—0,81
clarki	150—250	90—150	0,55—0,60	150—200	140—180	0,90—0,93

Opheodesoma serpentina (Johs. Müller).

Synapta serpentina. Johs. Müller. 1850. Anatomische Studien über die Echinodermen, pag. 132. The figures of the calcareous deposits are found in Johs. Müller: Über den Bau der Echinodermen, Pl. IV fig. 17, Pl. IX fig. 5.
Euapta serpentina. Østergren. 1898. Das System der Synaptiden, pag. 113.
Opheodesoma serpentina. 1907. Fisher. The Hawaiian Holothurians, pag. 725.
Opheodesoma serpentina. Clark. 1908. The Apod. Holothurians, p. 76.
Amboina. 10.II.1922. The shore by low-water mark, among *Thalassia*. 5 specimens.

The specimens at hand measure from 30 to 50 cm in length, The colour is bluish-grey with white spots due to large heaps of miliary granules. They have 15 tentacles, each with 20—25 pairs of free digits. On the oral disk there are eye-spots. The cartilaginous ring is well developed and the processes on the anterior margin of the calcareous ring (Fig. 4. 2) are united by a thick menbrane. The calcareous ring itself is distinctly green and the radial processes are perforated for the nerves. On the circular canal there are numerous polian vesicles and madreporic canals. The gonads are long and branched. The intestine has a loop and on the mesenteries there are numerous ciliated funnels of the usual shape.

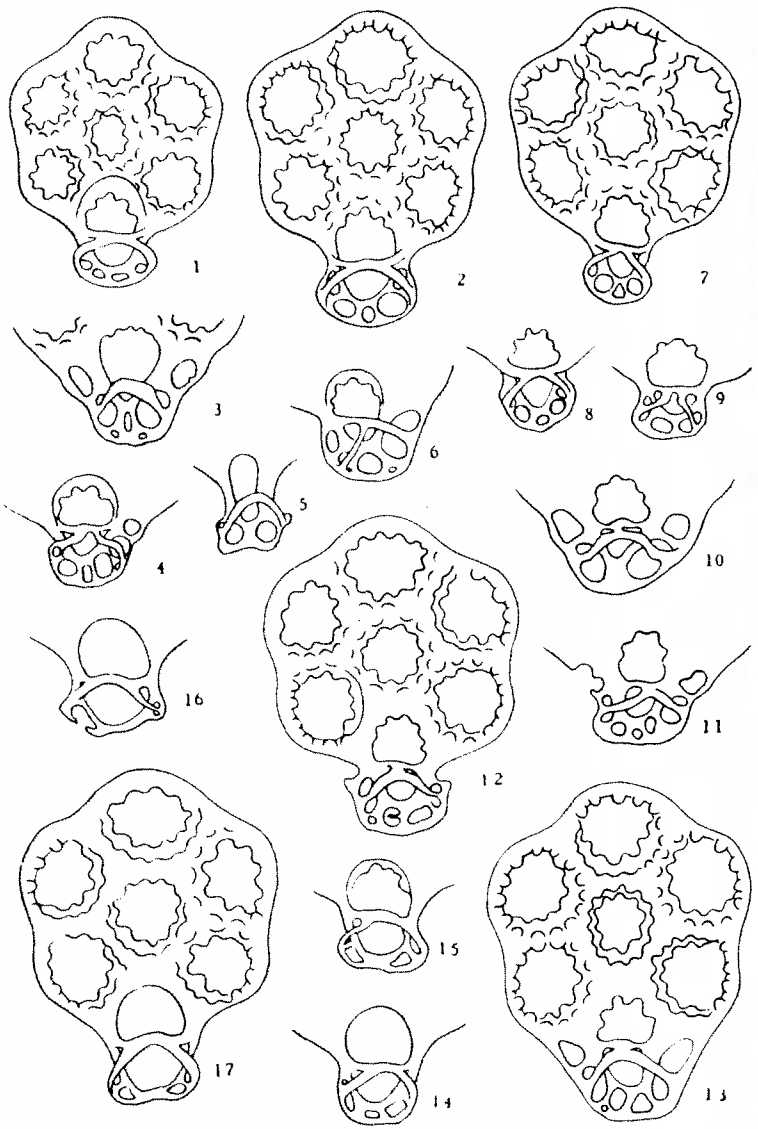


Fig. 6. Anchor-plates of *Oph. serpentina* 1, *Oph variabilis* 2—6. *Oph. grisea* 7—9. *Oph. lineata* 10—13. *Oph. mauritiae* 14—17. × 170.

The anchors (Fig. 7. 1) measure ca. 270 μ in length by ca. 170 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 6. 1) are ca. 200 μ long and ca. 170 μ wide and on the exterior surface there are some large knobs. The plates in *serpentina* are very like those in *spectabilis*, and are as these latter of a relatively constant shape. The miliary granules are rosettes and in the oral disk as well as in the tentacles there are curved rods. The rods from the oral disk (Fig. 7. 8) have the ends a little swollen and branched, which is not the case with those in the tentacles (Fig. 7. 7). The oral rods meassure ca. 80 μ in length and the tentacle rods are a little shorter.

Oph. serpentina is easily recognized by the shape of the pieces of the calcareous ring which, as said, is green, and by having rods in both the oral disk and in tentacles. From *Oph. variabilis*, which also has a green calcareous ring, it differs distinctly in the shape of the anchor-plates and in the presence of rods.

Opheodesoma variabilis n. sp.

North of Oahu. Hawaii. 26.III.1915. Shallow water. 6 specimens.

The specimens at hand measure from 20 to 30 cm in length. They are pale yellow with brown or brownish-green spots. They have 15 tentacles each with 20—25 pairs of digits, not united by a web. On the oral disk there are eye-spots. The cartilaginous ring is less developed than in *serpentina*. The calcareous ring (Fig. 4. 3) is green. The anterior processes on the calcareous ring are united by a membrane and the radial processes are perforated for the nerves.

There are many polian vesicles and madreporic canals. The gonads are much branched. The intestine has a loop and on the base of the mesenteries there are small cup-shaped ciliated funnels.

The anchors (Fig. 7. 2) measure ca. 340 μ in length by ca. 230 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 6. 2) measure ca. 250 μ in length by ca. 190 μ in width. On the exterior surface there are the common two rows of large knobs around the holes. The shape of the articular end is very variable (Fig. 6. 2-6). Some few

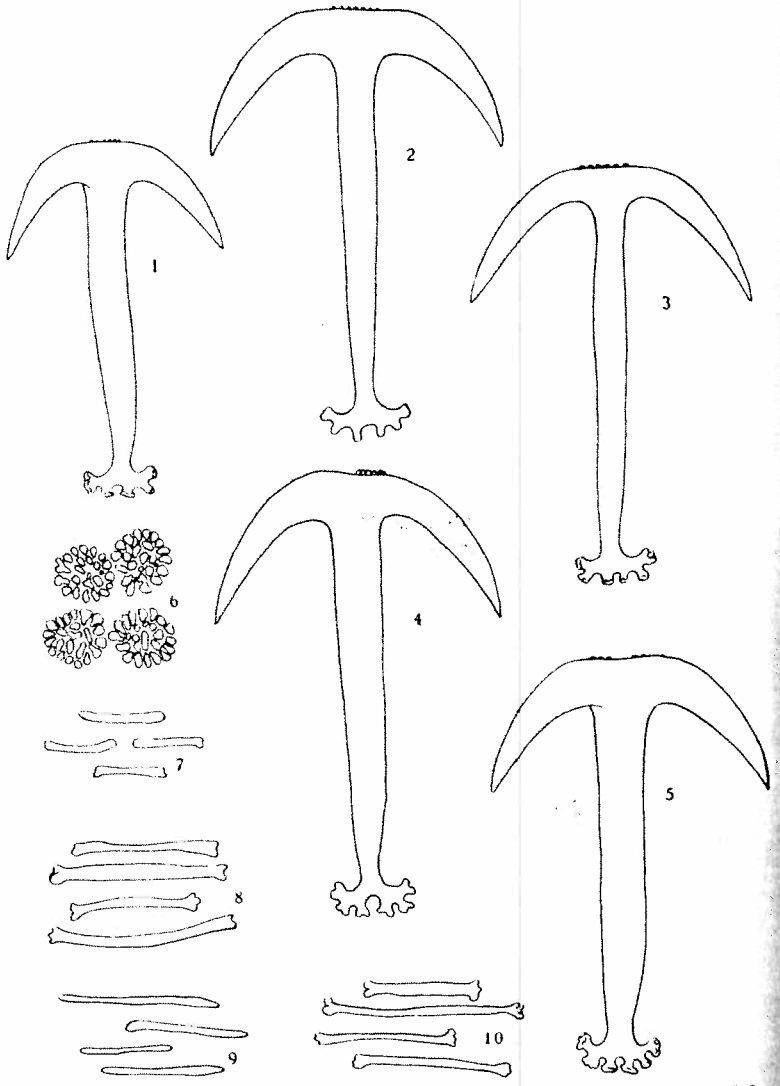


Fig. 7. Calcareous deposits of *Oph. serpentina* 1 & 7–8, *Oph. variabilis* 2 & 6, *Oph. grisea* 3 & 9, *Oph. lineata* 4, *Oph. mauritiae* 4 & 10. 1–5 anchors, 6 miliary granules, 7 tentacle rods, 8–10 oral rods. 1–5 × 170, 6 × 450, 7–10 × 200.

plates are, as the one figured, quite normally formed, and then much like the plates in *serpentina*, but by far the larger part of the plates are very different from that regular form, and some have even large side-holes as the plates in *Euapta* (Fig. 6. 5). Such side-holes are also found in *Oph. lineata*, but as, on the other hand some of the plates in *Euapta tobagoensis* are lacking the side-holes the presence or absence of these holes does not afford a reliable generic character. The miliary granules are rosettes, which are lying so densely all over the skin that, even when cleared in balsam, it is nearly quite intransparent. Rods are totally wanting both in the oral disk and in the tentacles.

This species is the most closely related to *serpentina* Johs. Müller, but differs distinctly from that species in the variable shape of the anchor-plates and in the absence of rods. From the other species without a web between the digits it differs in the shape of the anchor-plates and in the shape and colour of the calcareous ring.

Opheodesoma grisea (Semper).

Synapta grisea. Semper. 1868. Die Holothurien, p. 11 Pl. IV f. 6–7.
Euapta grisea. Østergren. 1898. Das System der Synaptiden, pag. 113.
Opheodesoma grisea Fisher. 1907. The Hawaiian Holothurians, pag. 723.
— — Clark. 1908. The Apodous Holothurians, pag. 75.
— — — 1924. The Synaptinae, p. 466 Pl. II f. 1–3.

Zebu. 20.IV.1900. 1 specimen.
Pearl Harbour, Honolulu. 5.V.1915. 8 specimens.
Saparoea Bay. 10.III.1922. 19 fms. Sand. mud. 1 specimen.
Edam, Java Sea. 5.IX.1922. Coral reef. 1 specimen.

The specimens at hand measure from 15 to 22 cm in length, but the largest specimen is lacking the posterior end, and may have measured ca. 35 cm in length. They are all dark mud-grey, distinctly darker on the dorsal than on the ventral side. They have 15 tentacles and the digits are not united by a web. On the oral disk no eye-spots are seen, but on a more careful preparation they are seen to be quite as well developed as in the other species of *Opheodesoma*. The lacking of eyes in Clark's specimens of *grisea* described in "The Synaptinae" therefore may be due to a less exact examination. The cartilaginous ring is large and the

calcareous ring is rather thick and pure white. The anterior processes on the calcareous ring are in this species unusually long (Fig. 4. 7), a little longer than the ring itself. The radial processes are perforated for the nerves, and between all the processes there is a distinct membrane. There are numerous polian vesicles and madreporic canals. The gonads are branched and the intestine has a loop. On the mesenteries there are numerous cup-shaped ciliated funnels.

The anchors (Fig. 7. 9) are ca. 300 μ long and 240 μ wide. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 6. 7) are ca. 230 μ long and ca. 195 μ wide, and on their exterior surface they have two rows of large knobs around the holes. The articular end with the bridge is somewhat varying in shape (Fig. 6. 7—9). The miliary granules are rosettes, which are found all over the skin, and in the tentacles. In the oral disk there are ca. 80 μ long curved rods (Fig. 7. 9), which differ from the rods found in the other species in not being swollen and branched in the ends.

Oph. grisea is an easily recognized species, which differs distinctly from *serpentina* and *variabilis* by its pure white calcareous ring. In "The Synaptinae" Clark writes that he has some specimens of *grisea* with the calcareous ring slightly tinged with green. As all the specimens at hand as well as the present specimens of *mauritiae* have a pure white calcareous ring, I cannot help supposing that if Clark's specimens really have the calcareous ring green, they may perhaps rather belong to another species. From the following species *mauritiae* the present species differs especially in the shape of the calcareous ring, in the size and shape of anchors and anchor-plates and in the shape of the oral rods.

Opheodesoma mauritiae n. sp.

Mauritius. 1874. Andrea. 3 specimens.

The three specimens at hand measure from 40 to 50 cm in length by 4—5 cm in diameter. The colour is yellowish-brown, and the skin is thick and smooth. They have 15 tentacles, and the digits are not united by a web. On account of the thick skin on the oral disk, the eyes are, as in *grisea*, not visible, but when

the skin is removed it is possible to see the well developed eyes, which are united with the oral ring-nerve by distinct nerves, one for each eye. The cartilaginous ring is large, and the pure white calcareous ring is stouter than in any other species of the *Synaptinae* here examined. The calcareous ring (Fig. 4. 1) is of the same length as in *grisea*, but the anterior processes are shorter, and the thickness of the ring is greater than its length. The radial processes are perforated for the nerves and all the processes are united by a low web. There are numerous polian vesicles and madreporic canals. The gonads are branched. The intestine has a loop and on the base of the mesenteries there are ciliated funnels of the usual shape and size.

The anchors (Fig. 7.5) measure ca. 330 μ in length by ca. 220 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 6. 17) measure ca. 260 μ in length by ca. 200 μ in width and have on the exterior surface the common two rows of large knobs around the holes. The shape of the articular end is very variable (Fig. 6. 14-17). The miliary granules are rosettes, found all over the skin and in the tentacles. In the oral disk there are ca. 80 μ long rods with swollen and slightly branched ends (Fig. 7. 10). Rods are not found in the tentacles.

This species is the most closely related to *grisea*, as the pure white calcareous ring separates it distinctly from the other species of the genus which are wanting the web between the digits. From *grisea* it differs especially in the peculiar shape of the calcareous ring. Furthermore the shape of the anchors and plates as well as that of the oral rods show marked differences.

Opheodesoma lineata n. sp.

West of Koh Kut. Gulf of Siam. 4.III.1900. Ca. 15 fms. Mud. 1 fragment.

The fragment at hand measures 30 cm in length, though both the anterior and the posterior end are wanting. The colour (Pl. II Fig. 2-3) is very characteristic of the specimen. The dorsal side of the body is dark olive-green with white or bright yellow spots and stripes and the ventral side is uniformly grey. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 7. 4) measure ca. 350 μ in length by ca. 210 μ in width. The stock is branched and on the vertex there are minute knobs. There are two typical forms of anchor-plates, one with side-holes and one without, and between these there are many different intermediate stages (Fig. 6. 10-11). Those with side-holes (Fig. 6. 13) measure ca. 270 μ in length by ca. 210 μ in width, those without side-holes (Fig. 6. 12) ca. 240 μ in length by ca. 180 μ in width. Both sorts of plates have the common two rows of large knobs around the holes. The miliary granules are rosettes which are gathered in large heaps.

As this fragment is lacking the madreporic canals and has the two mentioned sorts of anchor-plates the generic determination is not at all certain, but as the general appearance of the anchor-plates is more like that of the plates in *Opheodesoma* than that of the plates in *Euapta*, I have referred it to *Opheodesoma*. That the specimen is at any rate a valid species, different from all the hithertho known species of both *Opheodesoma* and *Euapta* appears from the very characteristic shape of the anchor-plates and the peculiar colour.

Euapta Østergren.

Østergreen. 1898. Das System der Synaptiden, pag. 112.
Sluiter. 1901. „Siboga" Holothurien, pag. 123.
Fisher. 1907. The Hawaiian Holothurians, pag. 721.
Clark. 1908. The Apodous Holothurians, pag. 72.
— 1924. The Synaptinae, pag. 462.

Genotype: *Synapta godeffroyi* Semper.

Remarks: In the description of *Opheodesoma variabilis* it is said that the presence or absence of the side-holes on the anchor-plates may not be a reliable generic character. For this reason the two best characters for separating *Euapta* from *Opheodesoma* are the small number of madreporic canals and the large size of the rods in the oral disk and the tentacles.

In *Opheodesoma* the rods are usually confined to the oral disk, and when tentacle-rods are present they are smaller than the oral-rods. Further the surface of both oral- and tentacle-rods in *Opheodesoma* is always quite smoth. In *Euapta* there are always rods in the tentacles and these are larger than those in the oral

disk. Most of the rods in the tentacles as well as those in the oral disk have a very characteristic rough surface, as mentioned by Fisher. Besides, the rods in *Opheodesoma* are not more than ca. 80 μ long and those in *Euapta* may be ca. 280 μ long.

The geographical distribution of the genus *Euapta* is very interesting as the one group of species is Indo-Pacific and the other West-Indian. Only one specimen is reported from the West African Coast (Théel in the "Challenger" Report) but the specific determination of it (*lappa*) cannot be regarded as quite certain.

The two old-known species *godeffroyi* (Semper) and *lappa* (Johs. Müller) are distinctly different, and easily separated. Furthermore *polii* (Ludwig) is a distinct species, not synonymous with *lappa* as supposed by Clark. One of the best characters separating *polii* from *lappa* is the lacking of the web between the digits, which is present in *lappa*. The specimens described by Clark in „The Synaptinae" as *lappa*, are most likely specimens of *polii*, since Clark states the web between the digits to be wanting, and his measurements agree pretty well with Ludwigs figure of the anchor-plate in *polii*. The specimens at hand of *lappa* and *tobagoensis* Heding have all a distinct web between the digits, and are thereby easily separated from *polii*, which is not represented in the collection.

Of the Indo-Pacific group there are six specimens from Hawaii. Five of these are typical specimens of *godeffroyi* Semper, but one differs distinctly from the others. It is described as a new species and on account of its large size named *magna*.

Key to the species of *Euapta*.

1. West-Indian species 2
   Indo-Pacific species 4
2. Web wanting between the digits ..... *polii*
   Web present between the digits 3
3. Rods in oral disk different from those in tentacles, having the ends unbranched. Articular end of anchor-plates of varying shape and side-holes often wanting ..... *tobagoensis*
   Rods in oral disk as well as those in tentacles with distinctly branched ends. Side-holes large and always present ..... *lappa*
4. Web present between the digits ..... *godeffroyi*
   No web between the digits ..... *magna*

Euapta tobagoensis n. sp.

Tobago, B. W. I. IV.1916. 7 specimens.

The specimens at hand measure 20—50 cm in length, and their colour is brownish-grey with five dark-brown stripes, one in each ambulacrum. The body-wall is thin and dry to the touch, and not thick and slimy as in *lappa*. The specimens have all 15 tentacles, each supplied with 20—25 pairs of digits, united by a web. On the oral disk there are eye-spots. The calcareous ring (Fig. 9. 3) is bright green and there are no processes on its anterior margin. The radial pieces are perforated for the nerves, and on the exterior side of the ring there are distinct muscular impressions. A cartilaginous ring is wanting. There are numerous polian vesicles and one to two large madreporic canals. The gonads are branched and the intestine has a large loop. On the mesenteries there are ciliated funnels of the common size and shape.

The anchors (Fig. 10. 7) measure ca. 380 μ in length by ca. 220 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 10. 8-12) measure ca. 260 μ in length by 170 μ in width. The shape of the anchor-plates is very variable, but the most common is that of the plate figured, with two side-holes of equal size. The side-holes are often wanting and then the bridge (as seen Fig. 10. 10-11) is formed as a ring fastened to the posterior part of the articular end. There are numerous intermediate stages between the plates with the two equally large side-holes and the plates with the ring-shaped bridge and no side-holes. Fig. 10. 9 shows the articular end of a plate (several plates of that shape are found) which differs from the normal plates in having the bridge fastened to the sides of the large hole (the articular hole) in the articular end. The holes in the anterior end of the anchor-plates are dented, and instead of the second row of knobs, which is common in *Opheodesoma*, there is a more or less complete, ring-shaped edge.

The miliary granules are rosettes which are found all over the skin and in the tentacles. In the oral disk and in the tentacles there are curved rods, with a distinctly rough surface. The rods in the tentacles (Fig. 8. 8) measure 130—200 μ in length and have the ends bushy-branched. The rods in the oral disk (Fig. 8. 9)

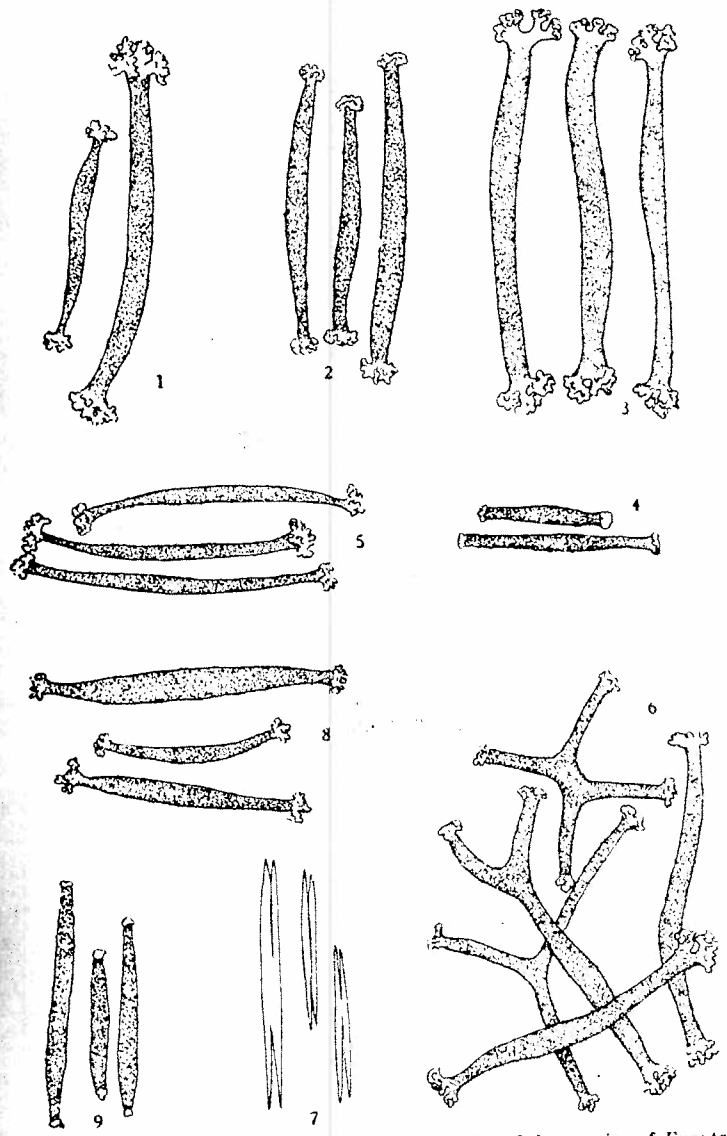


Fig. 8. Rods from the tentacles and the oral disks of the species of *Euapta*. **1—2** *Euapta lappa*, 1 from tentacles, 2 from oral disk; 3—4 *Euapta godeffroyi*, **3** from tentacles, 4 from oral disk; 5—7 *Euapta magna*, 5 from the exterior part of the oral disk, 6 from the tentacles and 7 from the area of the oral disk, which is closest to the mouth; 8—9 *Euapta tobagoensis*, 8 from tentacles, 9 from oral disk. × 200.

are smaller and their ends neither swollen nor branched. They measure 80—160 μ in length.

This species is the nearest related to *lappa* (Johs. Müller) but the differences in the shape of the anchor-plates, the calcareous ring and the oral rods separate it distinctly from that species.

In the tissue around the calcareous ring and the water-vascular system there are in some of the specimens some small cysts, which evidently are of patalogical nature. When these cysts are present in the tissue around the calcareous ring, they often produce so great deformities of the ring, that the characteristic shape is hardly recognizable.

Euapta lappa (Johs. Müller).

Synapta lappa. Johs. Müller. 1850. Müllers Archiv, pag. 134. The figures of the calcareous deposits are found in Johs. Müller: Ueber den Bau der Echinodermen, 1856, Pl. VI fig. 17 and Pl. IX fig. 4.

Euapta lappa. Østergren. 1898. Das System der Synaptiden, pag. 113.

— — Clark. 1908. The Apodous Holothurians, pag. 73 Pl. IV fig. 23—25.

Non: *Euapta lappa*. Clark. 1924. The Synaptinae, pag. 464 Pl. I fig. 5—7

St. Thomas. Krebs. 1 specimen.

St. Croix. Benzon. 2 specimens.

Christianssted. 10.I.1906. 1 specimen.

The largest specimen at hand, that from Christiansted, measures 55 cm in length. The colour is yellowish and the skin is thick and slimy. All the specimens have 15 tentacles each with ca. 20 pairs of digits, which are united by a web. On the oral disk there are eye-spots. The cartilaginous ring is wanting. The calcareous ring (Fig. 9. 4) is green and the radial pieces are perforated for the nerves. There are no processes on the anterior edge of the ring. There are many polian vesicles and a single madreporic canal. The gonads are branched and the intestine has a loop. On the mesenteries there are ciliated funnels of the common size and shape.

The anchors (Fig. 10. 5) measure ca. 350 μ in length by ca. 200 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 10. 6) measure ca. 260 μ

in length by ca. 170 μ in width. Their shape is rather constant and the side-holes are large. The miliary granules are rosettes and in both the oral disk and the tentacles there are curved rods. These have a distinctly rough surface and bushy-branched ends. The tentacle-rods (Fig. 8. 1) are the largest, measuring 150—250 μ

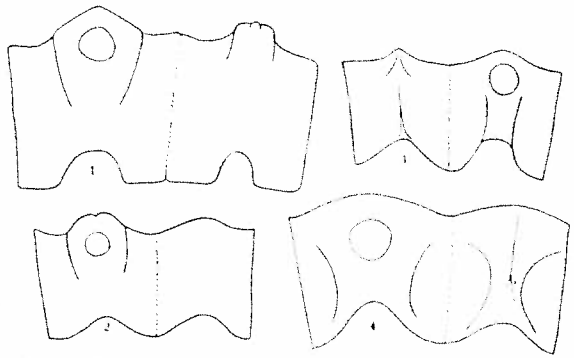


Fig. 9. Pieces of the calcareous ring in *Euapta magna* 1, *Euapta godeffroyi* 2, *Euapta tobagoensis* 3 and *Euapta lappa* 4. × 6.

in length. The oral rods (Fig. 8. 2) do not measure more than 80—150 μ in length.

Euapta lappa is distinctly characterized by the shape of the rods, the calcareous ring and the anchor-plates, and is by these characters easily separated from the four other species of the genus. Whether it occurs in other localities than the West-Indies is not known with certainty.

Euapta godeffroyi (Semper).

Synapta godeffroyi. Semper. 1868. Die Holothurien, p. 231 Pl. 39 f. 13.

Euapta godeffroyi. Østergren. 1898. Das System der Synaptiden, p. 113.

Euapta godeffroyi. Clark. 1908. The Apodous Holothurians, pag. 72.

— — — 1924. The Synaptinae, pag. 462 Pl. I fig. 1—4.

Hilo. Hawaii. IV.1915. 5 specimens.

The specimens at hand measure from 25 cm to 40 cm in length, and their colour is yellow with brown stripes and spots. They have 15 tentacles, and the digits are united by a web. On the oral disk there are eye-spots. The cartilaginous ring is wanting and the calcareous ring is green. The radial pieces (Fig. 9. 2) are perforated

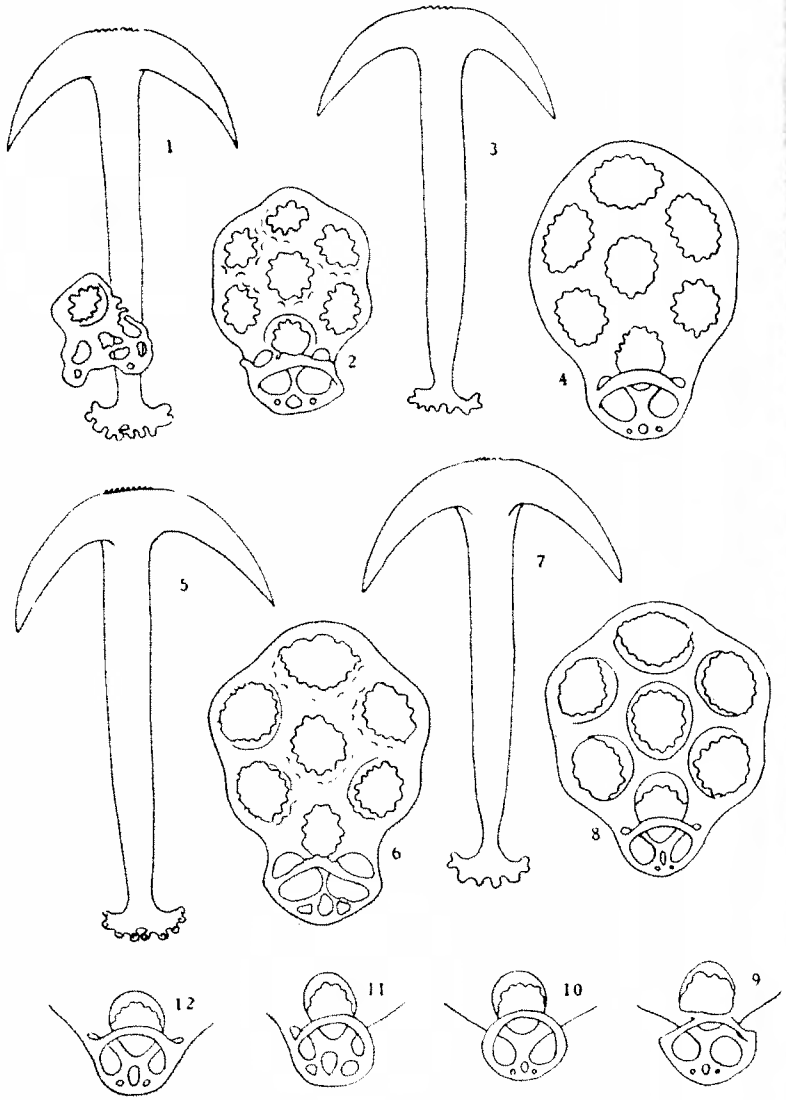


Fig. 10. Anchors and anchor-plates from *Euapta godeffroyi* 1—2, *Euapta magna* 3—4, *Euapta lappa* 5—6 and *Euapta tobagoensis* 7—12. × 170.

for the nerves. There are many polian vesicles and two to three large madreporic canals. The gonads are branched and the intestine has a loop. The mesenteries are finely reticulated close to the body-wall, and on this part the ciliated funnels are placed.

The anchors (Fig. 10. 1) measure ca. 320 μ in length by ca. 190 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates are in this species usually more or less abnormal, but even when the plates are so reduced as the figured one (Fig. 10. 1) the anchors are of quite normal size and shape. The normal plates (Fig. 10. 2) measure ca. 210 μ in length by ca. 150 μ in width and are very like the plates in *lappa*, the side-holes being large. The miliary granules are rosettes which are found all over the skin and in the tentacles. In the oral disk and in the tentacles there are curved rods with bushy branched ends and a rough surface. The rods in the tentacles (Fig. 8. 3) measure up to 280 μ in length and those in the oral disk (Fig. 8. 4) 140—180 μ in length.

This species is easily recognized, as the malformation of the anchor-plates probably is characteristic of it; but even if all the plates may be normally shaped it cannot be confounded with other species, as it is sufficiently characterized by the shape of the calcareous ring and the rods.

Euapta magna n. sp.

Hilo, Hawaii. 18.IV.1915. Rock pools. 1 specimen.

The specimen at hand measures 85 cm in length by ca. 3,5 cm in diameter. The colour is white with black spots on the dorsal side. It has 15 tentacles and the digits are not united by a web. On the oral disk there are eye-spots. The cartilaginous ring is wanting. The calcareous ring (Fig. 9. 1) is green and on the anterior edge there are low processes which are not united by a membrane. All the pieces of the ring are regularly notched in the posterior edge, and the radial ones are perforated for the nerves. There are numerous polian vesicles and one large madreporic canal. The gonads are branched and the intestine has a loop. The mesenteries are as in *godeffroyi* reticulated close to the body-wall and the ciliated funnels are confined to the reticulated part.

The anchors (Fig. 10. 3) measure ca. 330 μ in length by ca.

200 μ in width. The stock is branched and on the vertex there are minute knobs. The anchor-plates (Fig. 10. 4) measure ca. 230 μ in length by 160 μ in width. They are very regularly shaped, and differ from the plates in the other species of *Euapta* in being nearly egg-shaped. The miliary granules are rosettes which are found all over the skin and in the tentacles. In the tentacles and in the oral disk there are rods. The rods in the tentacles (Fig. 8. 6) measure from 100 μ to 280 μ in length, and many of them are more or less branched. Their surface is distinctly rough. In the oral disk there are two different forms of rods. One of them (Fig. 8.5), that which is found closest to the tentacles, has like the tentacle-rods, a rough surface and bushy-branched ends. The other sort (Fig. 8. 7), that which is found closest to the mouth, is quite smooth and does not measure more than 100 to 150 μ in length.

Euapta magna is the most nearly related to *godeffroyi*, but differs distinctly from it in having no web between the digits, and in the shape of the anchor-plates, the curved rods and the calcareous ring.

Polyplectana Clark.

Clark. 1908. The Apodous Holothurians, pag. 76.
— 1924. The Synaptinae, pag. 468.

Genotype: *Synapta Kefersteinii* Selenka.

This genus is closely related to *Synaptula* and it is not quite certain that it really represents a separate generic type. The two genera do not differ in more than two characters, the number of the tentacles and the shape of the miliary granules. The number of the tentacles is in *Synaptula* usually 13, but species are known with 10—12 and 15 tentacles. All the known species of *Polyplectana* have normally 25 tentacles, but this number is not constant as it may vary from 16 to 27. In the collection at hand the number of tentacles in *Polyplectana* varies from 18 to 27 and in "The Synaptinae" Clark mentions a specimen with 16 tentacles, and furthermore writes: "The number of tentacles shows great diversity and is not closely correlated with size". For this reason it is quite impossible to say to which genus a specimen with 15 or 16 tentacles may be referred, when we must rely on the tentacle-number alone as generic character. The other character is seemingly much more reliable. The miliary granules in *Synaptula*, when present, are either rosettes or small circles of minute granules, whereas in *Polyplectana* they are always more or less branched and curved rods. By this character it would be easy to separate the two genera, if there were not an exception, viz. the specimens described as *Synapta nigra* by Semper and as *Synaptula nigra* by Clark. These specimens have 15 tentacles and their miliary granules are said to be branched rods, not rosettes. After the number of tentacles there would be some reason for referring them to *Synaptula*, but after their miliary granules they may quite as well be referred to *Polyplectana*. The large collection of *Synaptula* and *Polyplectana* at hand seems to show that the shape of the miliary granules is the more important character, and that "*nigra*" for this reason must be separated from *Synaptula*. On the other hand, the large number of specimens recorded as *nigra* is contrary to the suggestion that they may be regarded as abnormal specimens of *Polyplectana*. From the descriptions at hand it is impossible to see which is the case, and we must await future examinations of good specimens. If such examinations show that *nigra* is a valid species, different from *Polyplectana*, it without any doubt represents a separate genus, *Tiedemannia* Forskål.

In the collection at hand there are 80 specimens of *Polyplectana*, and though all the 69 specimens from Taboga represent but one species, *oculata* n. sp., the collection includes the following five different species.

kefersteinii Selenka
zamboangae n. sp.
longogranula n. sp.
galatheae n. sp.
oculata n. sp.

From the study of these species it appears that not only "*Synapta*" *kallipeplos* Sluiter must be regarded as an independent species, and not as a synonym of *kefersteinii*, as assumed by Clark, but that many of the specimens referred to *kefersteinii* by Sluiter and Clark, may represent distinct species. The specimens from Amboina described by Sluiter in Semon's "Reisen" differ from all the hitherto known species in having degenerated anchors and anchor-plates. Two of the species at hand, *kefersteinii* and

oculata, are characterized in having degenerated anchor-plates in the anterior end of the body, and the three other species in having the anchor-plates from the anterior end of the body usually normally shaped. This gives reason for regarding Sluiter's specimens, which have all the anchors and plates malshaped, as a valid species, as Sluiter furthermore writes: "Es scheint mir nicht wahrscheinlich, dass hier eine theilweise Lösung der Kalkspicula durch die Conservierungsflüssigkeit vorliegt". Therefore I shall designate the species as *P. sluiteri* n. sp.

The specimens described by Clark in "The Synaptinae", pag. 468 may without any doubt be divided into at least four different species. The two of these are *kefersteinii* and *oculata*, and the two others are represented by the specimens from Samoa and Tahiti. According to the localities I shall name them *Polyplectana samoae* n. sp. and *Polyplectana tahitiensis* n. sp.

The specimens from Samoa differ from all the known species except *oculata*, in having small rods in the tentacles. That it cannot however be referred to *oculata* is evident from the figure of its miliary granules cf. "The Synaptinae" pls. I fig. 11. The specimen from Tahiti may be separated from the other species described in "The Synaptinae" as "The miliary granules are bent, branched and contorted rods, of rather unusual stoutness". This is furthermore a good character for distinguishing it from the other species from Tahiti, *galatheae*, in which species miliary granules are quite or nearly quite wanting.

The genus *Polyplectana* is reported from all over the tropical part of the Pacific- and Indo-Pacific Ocean, and for the present we must distinguish between at least nine different species belonging to it. As to the distribution of the species, hardly anything is known as yet with certainty. The following list gives the known species and their localities.

oculata n. sp. Panama
galatheae n. sp. Tahiti
tahitiensis n. sp. —
samoae n. sp. Samoa
kefersteinii Selenka. Hawaii
kallipeplos Sluiter. Batavia

longogranula n. sp. Hawaii
zamboangae n. sp. Zamboanga
sluiteri n. sp. Amboina

Though some of the species are rather insufficiently described, they may be distinguished by the characters used in the key.

Key to the species of *Polyplectana*.

1. Anchors and anchor-plates all more or less reduced and irregularly formed ..... *sluiteri*
   Anchors and anchor-plates are usually not reduced, at any rate not in the posterior end of the body. Only some of the anchor-plates in the anterior part of the body may be somewhat irregular 2
2. Minute rods present in the tentacles 3
   No minute rods in the tentacles 4
3. American species with but few rods in each tentacle ..... *oculata*
   Samoan species with numerous rods in each tentacle ..... *samoae*
4. Miliary granules unusually stout; (Tahiti) ..... *tahitiensis*
   Miliary granules rather small and thin or quite wanting 5
5. Miliary granules totally wanting; (Tahiti) ..... *galatheae*
   Miliary granules present 6
6. Distinct muscular impressions on the calcareous ring (Fig. 12. 2) 7
   No distinct muscular impressions on the calcareous ring, only seen as dark spots (Fig. 12. 3) 8
7. Miliary granules long and slender rods, which are usually unbranched. The middle of the rods often swollen (Fig. 11. 1—2) ..... *longogranula*
   Miliarly granules irregularly branched bodies ..... *kallipeplos*
8. Miliary granules long and slender, not irregularly branched (Fig. 11. 3—4) ..... *zamboangae*
   Miliary granules not long and slender rods, but short and irregularly shaped bodies (Fig. 11. 9—10) ..... *kefersteinii*

Polyplectana kefersteinii (Selenka).

Synapta kefersteinii. Selenka. 1867. Beiträge zur Anatomie und Systematik der Holothurien, pag. 360, Pl. XX fig. 120—121.

Chondrocloea kefersteinii. Østergren. 1898. Das System der Synaptiden, pag. 114.

Synaptula kefersteinii. Fisher. 1907. The Hawaiian Holothurians, pag. 719, Pl. 80 fig. 2.

Polyplectana kefersteinii. Clark. 1908. The Apodous Holothurians, pag. 16 & 76, Pl. IV fig. 20—22.

Hilo, Hawaii. IV.1915. One specimen (= two fragments)

The specimen at hand measures, though the posterior end is wanting, 7 cm in length by 1,5 cm in diameter. The length of the lacking end may not be rather large, as the posterior end of the loop of the intestine is present. Thus the specimen has probably not been more than ca. 10 cm long. The colour is in alcohol brownish grey, and there is no distinct difference in the colour of the dorsal and ventral side. The tentacles are somewhat darker than the body. There are 24 tentacles, each with 16—18 pairs of digits. As the tentacles are much contracted, it is not possible to see whether the digits are united by a web or not. On the oral disk there are weak eye-spots at the base of the tentacles. The cartilaginous ring is large and has foramina close to the posterior margin. The calcareous ring is unusually stout and consists of 24 pieces, one for each tentacle. The radial pieces are very like the interradial ones, apart from the perforation for the nerves, but are wider than the interradial pieces in their anterior end. Furthermore the outline of the anterior margin of the radial pieces is slightly different from that of the interradial ones (Fig. 12. 3). Selenka's statement that the calcareous ring consists of "25 einander gleichen Stücken" (cf. Selenka's figure Taf. XX fig. 120), therefore is not correct. Further Selenka draws, in the left side of this figure, the tentacles in the prolongation of the pieces of the calcareous ring, whereas in reality the tentacles are placed off the intervals between the pieces of the calcareous ring; their muscles being thus attached with one half to each two adjoining pieces of the ring. On the exterior side of the calcareous ring there are no muscular impressions, but the area to which the tentacle-muscles are fastened is usually a little darker than the rest of the ring. There are many polian vesicles and a single stone-canal. The madreporite is short and thick and therefore different from the madreporites in the other species represented, which are relatively longer and also prolongated along the stone-canal. Whether this has any systematical value in this genus, or not, it is not possible to state from the material at hand. The gonads are long and thin and branched several times. The alimentary canal may be divided into three distinctly different parts. The oesophagus is rather long and narrow with thin walls. The stomach is wide and with thick and glandular walls, and the long intestine is very thin-

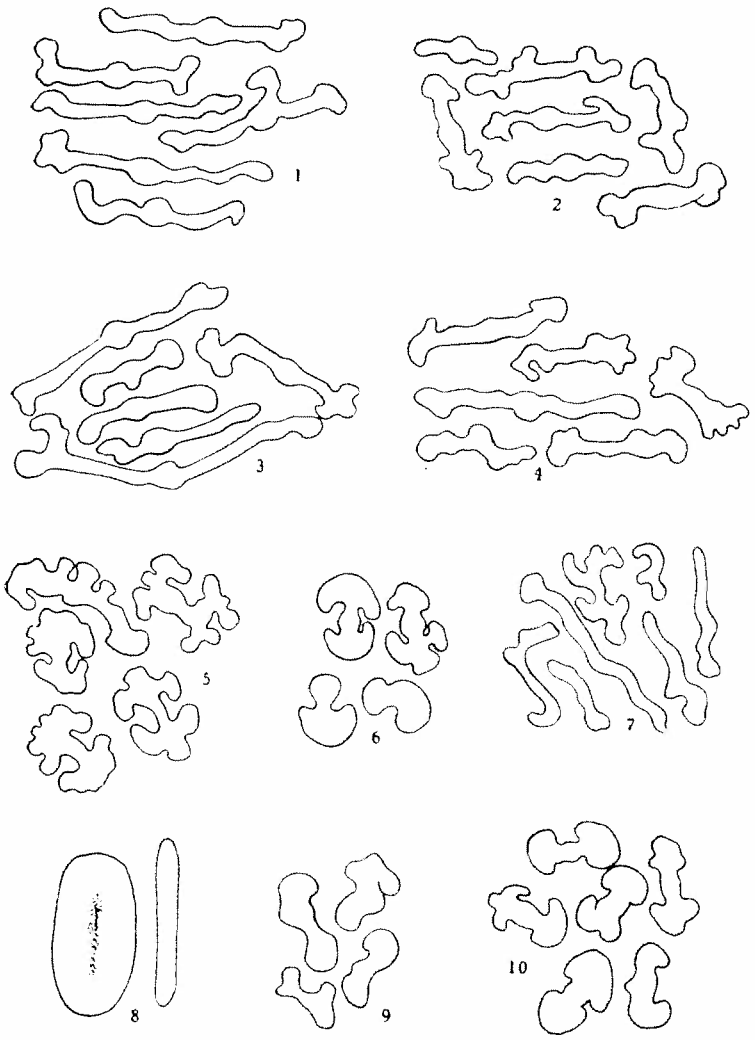


Fig. 11. Miliary granules from the species of *Polyplectana*. 1–2 *Polyplectana longogranula*; 1 from posterior end of body, 2 from anterior end of body. 3–4 & 8 *Polyplectana zamboangae*; 3 from posterior end of body, 4 from anterior end of body, 8 oval bodies from longitudinal muscles. 5–6 *Polyplectana oculata*; 5 from posterior end of body, 6 from anterior end of body. 9–10 *Polyplectana kefersteinii*; 9 from anterior end of body, 10 from posterior end of body. 1–7 & 9–10 × 1100, 8 × 900.

walled. The ciliated funnels are of the usual size and shape, and are placed on the mesenteries close to the body-wall.

The calcareous deposits are in the anterior end of the specimen a little smaller than in the posterior end, and the anterior plates have, as the plates in the anterior end of *oculata*, often the articular ends more or less incompletely developed (cf. fig. 14. 11—13 of *oculata*). It is interesting to see that not few of the anchors from the anterior end have three arms. The third arm is found on the vertex and the knobs are then either wanting or found somewhat to the one side. The normally shaped anchors from the anterior end of body (Fig. 13. 10) measure ca. 260 μ in length by ca. 150 μ in width. The stock is rather irregularly shaped, but never branched, and on the vertex there are some few minute knobs. The anchor-plates from the anterior end (Fig. 14. 8) measure ca. 220 μ in length by ca. 150 μ in width. The six large holes in the anterior end of the plates are distinctly serrate, but the seventh, the "articular hole" is usually smooth, though some few teeth may be found on its anterior margin. The side-holes in the articular end are large and the bridge is uniformly serrate on its anterior side.

The anchors from the posterior end (Fig. 13. 9) measure ca. 280 μ in length by 170 μ in width. Their stock is more regular than in the anchors from the anterior end, and on the vertex there are a few more, minute knobs. The anchor-plates (Fig. 14. 7) measure in this end of the specimen ca. 220 μ in length, but their width is usually a little larger than in the anterior plates, ca. 170 μ. The serration of the holes and the bridge is quite as in the normal plates from the anterior end.

Beside the anchors and anchor-plates there are found miliary granules and oval plates. The miliary granules (Fig. 11. 9-10) are irregularly shaped bodies, which measure from 8 μ to 15 μ in length. They are found as a dense coat all over the posterior end, but very scattered in the anterior end. The oval plates are found in the longitudinal muscles. In the tentacles there are found no calcareous deposits.

P. kefersteinii is characterized especially by the shape of the calcareous ring and the miliary granules, but also in the other characters it differs from the other species of the genus. It is known with certainty only from Hawaii. The many specimens of *Polyplectana* from various other localities are probably referred to this species only because of the insufficiency of Selenka's description.

Polyplectana oculata n. sp.

Taboga, Panama. XI.1915. The shore, between corals. 69 specimens.

The specimens at hand are of very varying size, the largest measuring ca. 15 cm in length and the smallest but 3 cm, but the greater part of them measure 7—9 cm by 1—1,5 cm in diameter. The body-wall is very thin and soft and the specimens are so adherant

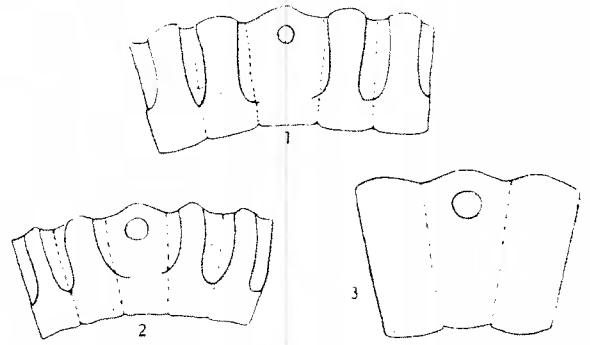


Fig. 12. Pieces of calcareous ring in *Polyplectana oculata* 1, *Polyplectana longogranula* 2 and *Polyplectana kefersteinii*. 3 × 9.

that it is exceedingly difficult to separate them. The colour is dorsally dark grey and ventrally nearly white. The tentacles are in some specimens clear yellow and in others more brownish. The specimens have usually 25 tentacles, but the number is varying from 18—27 and not closely correlated with size. Each tentacle is in the distal two thirds of its length supplied with 9—10 pairs of digits, which are united by a web. On the oral disk there are very distinct eye-spots.

The cartilaginous ring is well developed and encloses the posterior margin of the calcareous ring. The calcareous ring (Fig. 12. 1) consists of 25 pieces, of which the radial ones are perforated for the nerves and somewhat differing in shape from the others. On the external side, there are distinct muscular impressions. There are many polian vesicles and a single stone-canal. The madreporite is elongated along the one side of the stone-canal. The

gonads are weakly developed, but distinctly branched. The alimentary canal is divided into three parts, but they are not so distinctly different as in *kefersteinii*. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The calcareous deposits are, as in *kefersteinii*, different in the two ends of the body. In the anterior end the articular ends of the plates are usually more or less malformed (Fig. 14. 11-13). Also the anchors may be of a rather unusual shape, but while the abnormal shape of the anchor-plates is typical of the species, that of the anchors is rather rare. Also in the posterior end of the specimens malformations are found, but here it is usually anchors and corresponding plates which are doubled in the articular end. In some specimens such malformations are so common that one might suppose them to be typical of the species, but as they are quite or nearly quite wanting in other specimens, they are scarcely of any clasificatory value.

The anchors of *oculata* differ from those of all the other species, especially *kefersteinii* and *galatheae*, in the flukes being unusually short and thick and having typically few, 1—3, minute knobs on the vertex. The anchors from the anterior end of body (Fig. 13. 11) measure ca. 260 μ in length by ca. 130 μ in width, those from the posterior end (Fig. 13. 12) ca. 280 μ in length by ca. 130 μ in width. The anchor-plates from the anterior end (Fig. 14. 9) measure ca. 190 μ length by ca. 140 μ in width. The articular hole is usually smooth and the bridge is serrate on the anterior margin. The anchor-plates of the posterior end (Fig. 14. 10) measure ca. 200 μ in length by ca. 150 μ in width. The serration of the holes and the bridge is as in the plates of the anterior end.

The miliary granules (Fig. 11. 5-6) are distinctly different in the two ends of the specimens. In the posterior end they are 10—20 μ large, irregularly shaped bodies making a dense layer all over the skin. In the anterior end they are but 8—10 μ long and are more scattered. Oval plates are not found. In the oral disk there are no calcareous deposits, but in the tips of the tentacles there are some small irregularly shaped rods (Fig. 11. 7).

P. oculata differs from all the other species of the genus, in the shape of the calcareous deposits as well as in the shape of the body, which is unusual, conical.

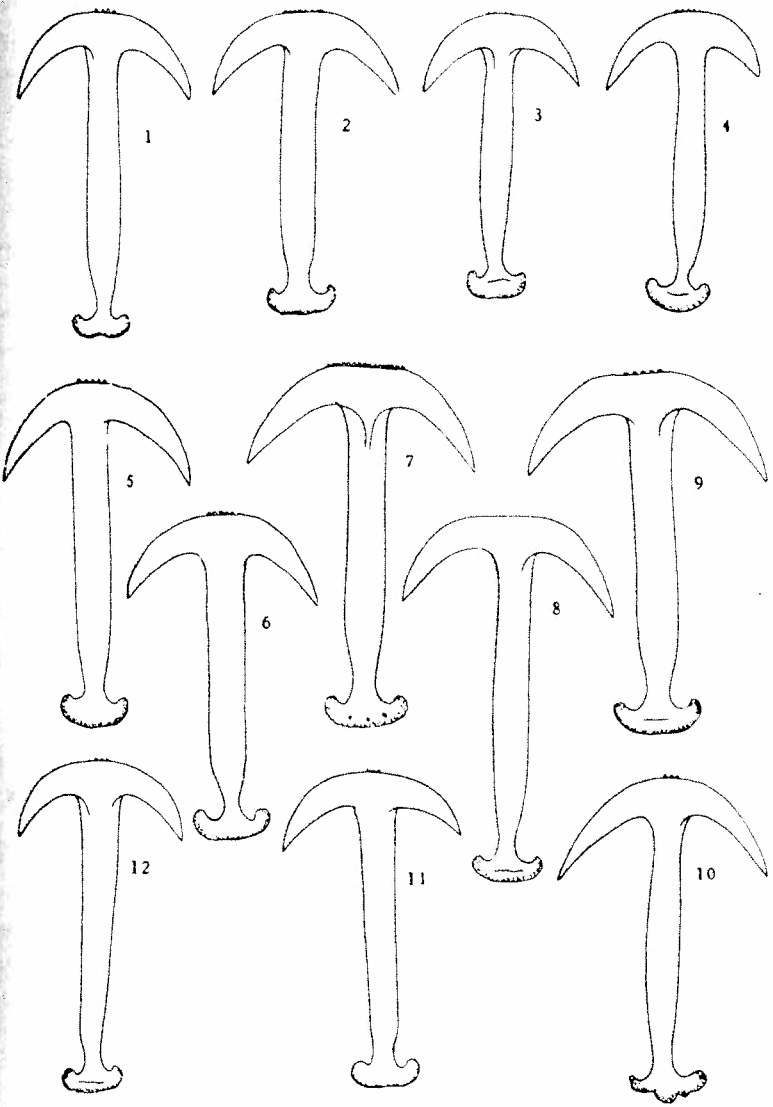


Fig. 13. Anchors from the species of *Polyplectana*. 1–4 *Polyplectana zamboangae*, 1 from posterior end of body, 2–4 from anterior end of body. 5–6 *Polyplectana longogranula*, 5 from posterior end of body, 6 from anterior end of body. 7–8 *Polyplectana galatheae*, 7 from posterior end of body, 8 from anterior end of body. 9–10 *Polyplectana kefersteinii*, 9 from posterior end of body, 10 from anterior end of body. 11–12 *Polyplectana oculata*, 11 from anterior end of body, 12 from posterior end of body. × 170.

Polyplectana galatheae n. sp.

Tahiti. The Galathea Expedition. One specimen.

The single specimen at hand measures ca. 15 cm in length by 1,5 cm in diameter. The colour is uniformly grey. It has 25 tentacles, which are so contracted that neither the number of the digits nor the presence or absence of a web can be ascertained. On the oral disk there are eye-spots, The cartilaginous ring is well developed and almost wholly encloses the weak, calcareous ring, which is quite alike that in *oculata*. There are numerous polian vesicles and a single stone-canal. The madreporite is, as in *oculata*, elongated along the one side of the stone-canal. The gonads are short and thick and not much branched. The alimentary canal is not distinctly divided into oesophagus, stomach and intestine, but it has a large loop. The ciliated funnels are of the usual size and shape. They are found on the mesenteries close to the body-wall.

The anchors from the anterior end of the specimen (Fig. 13. 8) are not different from those more posteriorly (Fig. 13. 7). They measure ca. 300 μ in length by 170 μ in width. The anchor-plates from the anterior end of body (Fig. 14. 3) measure ca. 200 μ in length by 170 μ in width, and those from the posterior end (Fig. 14. 6) measure ca. 230 μ in length by 170 μ in width. The plates from the two ends of the specimen differ in the shape of the articular hole, in the anterior plates being usually smooth, in the posterior plates usually being supplied with some few teeth in the anterior margin.

Rods and miliary granules are wanting in the specimen at hand, but in the longitudinal muscles there are oval plates, measuring ca. 25 μ in length.

This specimen cannot be referred to any of the species hitherto known. The shape of the calcareous ring puts it closest to *oculata*, from which species it differs distinctly in the shape of the anchors and anchor-plates. That it cannot be referred to the same species as Clark's specimen from Tahiti, (*tahitiensis*) characterized by the unusually large miliary granules, is evident as miliary granules are totally wanting in the specimen at hand.

Polyplectana longogranula n. sp.

Hilo, Hawaii. IV.1915. Rocky shore. 5 specimens.

The beautifully preserved specimens at hand are by their general appearance easily separated from the specimen of *kefersteinii* from the same locality. They are long and slender and in contradistinction to the hard and stiff *kefersteinii*, they are very soft. The colour is reddish-brown. The largest specimen measures 14 cm in length by 0,6 cm in diameter and has 27 tentacles. The other specimens are shorter and more slender and have but 25 tentacles. The tentacles are for ca. 2 mm length united at the base, by a membrane, and on the distal two thirds they have ca. 20 pairs of digits. The digits are free and not united by a web. On the oral disk there are eye-spots. The cartilaginous ring is well developed and has foramina close to the circular canal. The calcareous ring (Fig. 12. 2) has distinct muscular-impressions wherefore it is rather like the calcareous ring in *oculata*. There are many polian vesicles and a single stone-canal. The madreporite is unusually long and elongated along the stone-canal. The gonads are short and thick and bushy-branched. The alimentary canal is not differentiated into oesophagus, ventricle and intestine, but it has a large loop. The ciliated funnels are of the usual size and shape and are found on the mesenteries close to the body-wall.

The anchors from the anterior end of body (Fig. 13. 6) measure ca. 240 μ in length by 150 μ in width, and those from the posterior end (Fig. 13. 5) measure ca. 265 μ in length by 160 μ in width. They have the stock finely toothed and on the vertex there are minute knobs. The anchor-plates from the anterior end (Fig. 14. 1) measure nearly the same as those from the posterior end (Fig. 14. 2), ca. 200 μ in length by 150 μ in width. They are very alike, and in both ends some of the articular holes are serrate on the anterior margin and others are smooth.

The miliary granules are, in the anterior end of the body, ca. 25 μ long rods (Fig. 11. 2), irregularly shaped. The rods in the posterior end of the body (Fig. 11. 1), are a little longer and have usually the middle distinctly swollen. Beside the rods there are oval plates. These are in this species rather small, measuring no more than 8—12 μ in length. In the tentacles and in the oral disk no calcareous deposits are found.

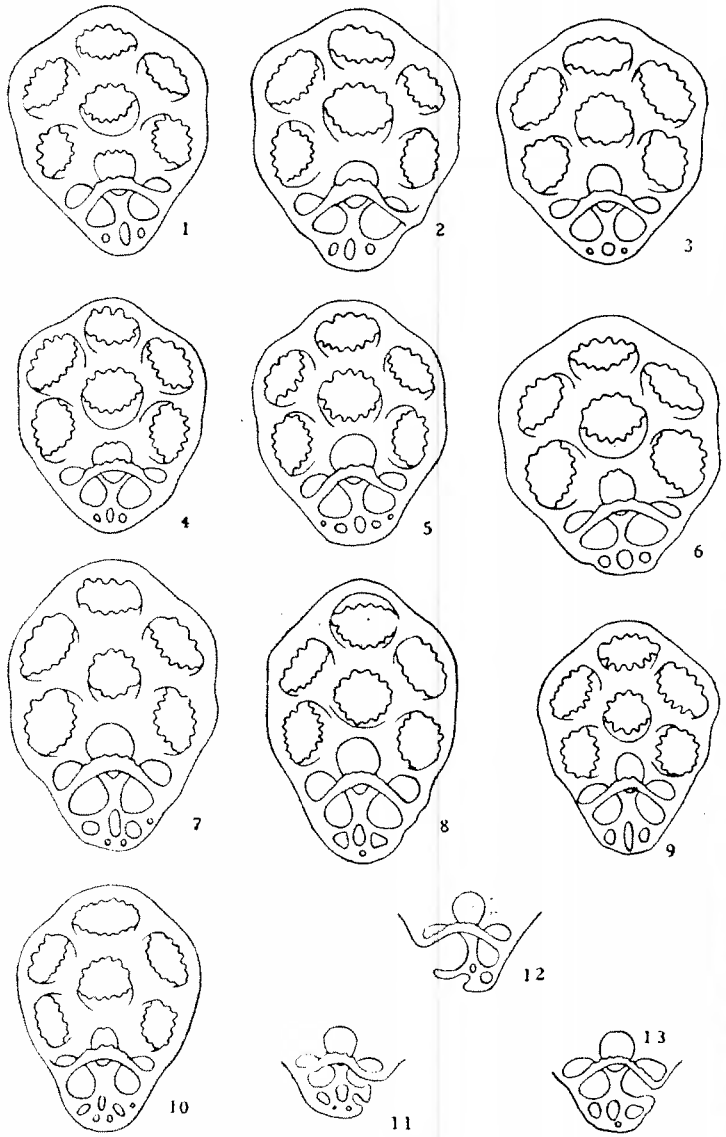


Fig. 14. Anchor-plates from the species of *Polyplectana*. 1–2 *Polyplectana longogranula*, 1 from the anterior end of body, 2 from the posterior end of body. 3 & 6 *Polyplectana galatheae*, 3 from anterior end of body, 6 from posterior end of body. 4–5 *Polyplectana zamboangae*, 4 from anterior end of body, 5 from posterior end of body. 7–8 *Polyplectana kefersteinii*, 7 from posterior end of body, 8 from anterior end of body. 9–13 *Polyplectana oculata*, 9 & 11–13 from anterior end of body, 10 from posterior end of body. × 170.

P. longogranula differs in the shape of the miliary granules distinctly from the three species described above. From *kefersteinii*, which occurs in the same locality, it furthermore differs in the shape of the calcareous ring, of the anchors and anchor-plates, and probably also in the shape of the madreporic body.

Polyplectana zamboangae n. sp.

St. Crux Island, Zamboanga. 25.—28.II.1914. Three fragments.

The fragments at hand are on their dorsal side mud-grey and ventrally pure white. The anterior end has 25 tentacles, which are so contracted that neither the number of the digits nor the presence of a web can be ascertained. The cartilaginous ring is well developed and nearly encloses the calcareous ring, which is quite like that of *kefersteinii* (Fig. 12. 3). There are many polian vesicles and a single stone-canal. The madreporite is longer than in *kefersteinii*. The intestine has a loop, but it is not so well preserved that it is posible to state anything about the oesophagus and the ventricle. The ciliated funnels are of the usual shape and size and found on the mesenteries close to the body-wall.

The anchors are in the anterior end of body ca. 250 μ in length and 150 μ in width. In the posterior end of body they are ca. 170 μ in length and 150 μ in width. Those from the anterior end of body are of very varying shape (Fig. 13. 2-4), some being quite asymmetrical. This is not the case with those more posteriorly (Fig. 13. 1). The anchor-plates measure in the anterior end of body ca. 190 μ in length and 150 μ in width. The articular hole and the bridge (Fig. 14. 4) is distinctly serrate. The plates from the posterior end of the specimen (Fig. 14. 5) measure ca. 210 μ in length by 160 μ in width. Also here the bridges are serrate, but the articular holes are usually smooth. The miliary granules (Fig. 11. 3-4) are very like the granules in *longogranula*, and also here the posterior rods are the longest and have the characteristic swollen middle. Besides the miliary granules there are oval plates in the ambulacra. These (Fig. 11. 8) measure ca. 30 μ in length. In the oral disk and in the tentacles there are no calcareous deposits.

P. zamboangae is in the shape of the calcareous ring very like *kefersteinii* and in that of the miliary granules like *longogranula*, but

in the other characters it differs so much from both these species that it cannot be referred to any of them.

Synaptula Ørsted.

Synaptula. Ørsted. 1849. Videnskabelige Meddelelser fra dansk naturhistorisk Forening, pag. VII.
Heterosynapta. Verrill. 1867. On the geographical distribution of the Echinoderms of the west-coast of America, pag. 346.
Chondrocloea. Østergren. 1898. Das System der Synaptiden, pag. 113.
Synaptula. Fisher. 1907. Hawaiian Holothurians, pag. 117.
— Clark. 1908. The Apodous Holothurians, pag. 80.

This genus was established by A. S. Ørsted for some viviparous West-Indian specimens, which he named *Synaptula vivipara*. The reexamination of the type-specimens of *vivipara* as well as Ørsted's beautiful, but hitherto unpublished, figures of them show that Fisher and Clark are doing right in regarding *Synaptula vivipara* Ørsted as synonymous with *Holothuria hydriformis* Lesueur, which species for that reason must be regarded as the genotype.

In "The Apodous Holothurians", pag. 80, Clark writes that the genus *Synaptula* "contains an unusually large number of poorly described or imperfectly known species". In regarding the four species:

reciprocans (Forskål) *[nigra]*
striata (Sluiter) *[recta]*
aspera (Sluiter) *[virgata]*
var. *maculata* (Sluiter) *[reticulata]*

as synonymous with the species in [], he refers only the following eight species to the genus:

nigra (Semper)
hydriformis (Lesueur)
psara (Sluiter)
indivisa (Semper)
recta (Semper)
virgata (Sluiter)
lactea (Sluiter)
reticulata (Semper)

These twelve species are all except *nigra* and *indivisa*, represented in the collection at hand, and the specimens at hand shows that

they are valid species easily separated. As to *nigra* (Semper) it is shown in the description of *Polyplectana*, pag. 141, that there are reasons for regarding it either as a *Polyplectana*, or if future investigations will show that the number of the tentacles is really 15, as the genotype of another genus. Whether the name *Tiedemannia* really may be used for such genus is not at all certain, but it will in any case be quite wrong to name it *Chondrocloea* as suggested by Clark "The Apod. Holoth.", pag. 81. The genotype of *Chondrocloea* is *Synapta indivisa* Semper, and though I have some doubt as to the validity of this species, I would think it the most reasonable to use this name for the oriental species here described as *Synaptula*, in case *hydriformis* should in the future prove to be generically different from them. *S. indivisa* (Semper) is not represented in the collection, and I have, as said above, some doubt as to the validity of this species. If it really proves to be a valid species, the long tentacles and the unbranched gonads make it easily recognizable.

Besides the 10 mentioned species 17 new species of this genus are found in the material at hand. The larger part of them are good species which are easily separated, but some few ones as *tualensis, rosea, östergreni* and *minima* may ultimately be found to be young specimens of some of the other species. In spite of this, as they differ so much from the other specimens at hand, I suppose it the better course to describe them as independent species. Thus we know for the present, the following 28 species of the genus *Synaptula:*

reciprocans (Forskål)
rosea n. sp.
aspera (Sluiter)
indivisa (Semper)
recta (Semper)
striata (Sluiter)
albolineata n. sp.
alba n. sp.
virgata (Sluiter)
jolensis n. sp.
psara (Sluiter)
denticulata n. sp.
tualensis n. sp.
neirensis n. sp.
östergreni n. sp.
madreporica n. sp.
hydriformis (Lesueur)
rosetta n. sp.
maculata (Sluiter)
reticulata (Semper)
lamperti n. sp.
purpurea n. sp.
bandae n. sp.
menbrana n. sp.

lactea (Sluiter) *ater* n. sp.
minima n. sp. *violacea* n. sp.

The study of these species shows that the genus, though *hydriformis* in several respects differs distinctly from the other species, is one of the most homogeneous genera of the *Synaptinae*, and the examination of the numerous beautifully preserved specimens at hand (ca. 330) throws a desirable light on the range of variation within the species, and on the value of the systematical characters.

The larger part of the specimens have a rather characteristic colour, and even the irregularly mottled species as *recta*, *striata*, *psara* and *denticulata*, may be separated by the coloration.

The number of tentacles is within the species usually very constant, and very rarely it varies with more than a single tentacle. Nearly all the species have 10 or 13 tentacles, and only *hydriformis* and *reciprocans* are known with certainty to have another number 12 and 15. The number of digits varies from 4—ca. 30 pairs. Some species, as *bandae* and *hydriformis*, are characterized in having relatively few digits and others, as *psara*, in having many digits; but as the number of digits is evidently increasing with age, it is not a character of much classificatory value.

The presence or absence of a web between the digits, is, though it may be very difficult to distinguish in preserved specimens, probably one of the most important characters. Internal characters which may be used for classification in this genus are: the shape of the calcareous ring, the cartilaginous ring, the stone-canal and the madreporite. The number of the polian vesicles varies from three to more than fifty, but it is, as the number of the digits, more or less increasing with age. The gonads are in all the species but *hydriformis* and *indivisa*, distinctly branched, and in *hydriformis* where they are club-shaped in all the small specimens at hand (especially in those from Tobago), the larger specimens (especially those from Bermuda and Jamaica) seem to have branched gonads. The ciliated funnels (Fig. 15. 9) are in all the species found on the mesenteries, and are of the same size and shape as in the genera *Synapta*, *Opheodesoma*, *Euapta* and *Polyplectana*.

The calcareous deposits are anchors, anchor-plates and, in all but one species, miliary granules. Rods are wanting in all the oriental species, but present in the tentacles of *hydriformis*. The

size of the anchors and anchor-plates varies from less than 100 μ to more than 350 μ, but the usual size is ca. 250 μ. The anchors and anchor-plates are in the posterior end of body often a little larger and somewhat differing in shape from those more anteriorly. In some species e. g. *alba* there are two distinctly different sizes of anchors and anchor-plates all over the body, and in many species, if not in all, there are some few very small anchors and anchor-plates (these small anchors are often wanting and the anchor-plates are found alone). These minute anchors and plates may (cf. the description of *hydriformis* pag. 185) be the first post-larval or post-embryonal plates. Malformations of anchors and plates are very rare, except in *neirensis* (Fig. 22. 14 & 16). Malformed plates are found in the specimens of *recta* and in a single specimen of *virgata*.

The miliary granules are, when present, usually (always?) rosettes. They are with certainty known to be wanting only in one species, *aspera*. In some species e. g. *psara*, *neirensis* and *madreporica*, there are no rosettes, but circles of "minute granules". Whether these "circles" are really characteristic of the named species, or they are but the result of a partly dissolution of the rosettes, it is not possible to see in preserved specimens. That they may be due to dissolution is certain, for though three years old balsam-preparations of *rosea* show distinct rosettes (Fig. 15. 16), the miliary granules in the specimen from which the preparations were made, are now three years after the nicest "circles" (Fig. 15, 13). The shape of the miliary granules is usually very characteristic of the species and for this reason they often afford an excellent systematical character.

All the known species of *Synaptula* are littoral forms, and none are known to occur in deeper water than ca. 100 m. When in spite of this Herouard refers some fragments of Synaptids from depths of ca. 2000 m in the Atlantic Ocean, to this genus, and moreover to *hydriformis*, one of the most pronounced littoral species (Holothuries provenant des Yachts Princesse Alice etc. 1923) we may safely say that this identification must be erroneous (cf. Th. Mortensen: Handbook of the Echinoderms of the British Isles, pag. 425, Note).

In zoogeographical respect this genus is interesting in *hydri-*

formis being restricted to West-Indian seas, whereas all the other species occur in the Malay Archipelago. Probably it would be the better course to separate *hydriformis* from the other species, which then should be named *Chondrocloea*. The characters which separate *hydriformis* from the other species are the presence of rods in the tentacles and the viviparity, but as it is in all other respects very like the other species, and as our knowledge of the systematical value of the mentioned characters is not sufficient as yet, I prefer for the present to refer all the species to the same genus, *Synaptula* (cf. p. 155).

In the key to the species, some of the species are found in more than one place. This is due to the less satisfactory preservation of some of the species, some of the characters used for separating these species being not discernible with certainty.

Key to the species of *Synaptula*.

1. Colour uniformly purple, neither reticulated nor mottled with white stripes or spots. Diameter up to 2 cm ..... *violacea*
   Colour not uniformly purple. (When purple, always more or less reticulated and the diameter not more than half a cm) 2
2. Colour dark violet with five white stripes (Pl. II fig. 5) ..... *ater*
   Colour different, not dark violet with five white stripes 3
3. Tentacles 15 (14) 4
   Tentacles 13 (14) 5
   Tentacles 12 (10—13?) 18
   Tentacles 10 (9—11) 19
4. Colour dark brown or nearly black, tentacles normally 15, digits not united by a web ..... *reciprocans*
   Colour pale reddish, tentacles probably 14, digits united by a distinct web ..... *rosea*
5. Tentacles nearly one third of body-length, gonads unbranched *indivisa*
   Tentacles shorter, gonads distinctly branched 6
6. Miliary granules entirely wanting ..... *aspera*
   Miliary granules present as rosettes or more or less complete circles of minute granules 7
7. Digits united by a web 8
   Digits not united by a web 15
8. Anchor-plates nearly oval, in posterior end of body often reduced Fig. 22. 14-17 ..... *neirensis*
   Anchor-plates neither oval nor reduced in posterior end of body 9
9. Cartilaginous ring voluminous with small perforations close to the circular canal 10

   Cartilaginous ring developed only around the calcareous ring. Often very faint or nearly wanting. The holes at the circular canal so large that distinct "tentacle-canals" are visible 13
10. In each end of body but one size of anchors and plates 11
    In each end of body two different sizes of anchors and plates *tualensis*
11. Madreporite short, not elongated along the stone-canal. Calcareous ring with distinct projections on anterior margin ..... *denticulata*
    Madreporite elongated along the stone-canal. Calcareous ring without processes on anterior margin 12
12. Muscular impressions on calcareous ring distinct, usually not more than three holes in posterior end of anchor-plates. Stone-canal in mature specimens often curled into a clue ..... *madreporica*
    Muscular impressions on calcareous ring very faint or wanting. Usually five small holes in posterior end of anchor-plates. Stone-canal straight ..... *psara*
13. Only one sort of anchors and plates; bridge thick and usually smooth ..... *jolensis*
    In posterior end of body two different sizes of anchors and plates; the bridge distinctly dented 14
14. Tentacles 13, colour finely striped. 5—7 small holes in posterior end of anchor-plates ..... *virgata*
    Tentacles probably 14; colour uniformly reddish. 1—3 small holes in posterior end of anchor-plates ..... *rosea*
15. Colour greyish-green with white stripes. Pl. II fig. 4 ..... *albolineata*
    Colour varying, not greyish-green with white stripes 16
16. Colour pure white. In anterior end of body two, in posterior end of body three different sizes of anchors and plates (Fig. 19. 6-9). Anterior margin of calcareous ring with distinct projections ..... *alba*
    Colour varying, only one size of anchors and plates. Anterior margin of calcareous ring without distinct projections 17
17. Colour light, posterior margin of calcareous ring nearly straight Fig. 16. 4 ..... *recta*
    Colour dark, posterior margin of calcareous ring distinctly notched *striata*
18. Digits free, not united by a web. West-Indian species ..... *hydriformis*
    Digits united by a web. East Indian species ..... *rosetta*
19. Digits united by a web 20
    Digits free, not united by a web 26
20. Colour pure white, posterior margin of radials different from that of interradials ..... *membrana*
    Colour not pure white, posterior margin of radials not distinctly different from that of interradials 21
21. Colour grey with five purple stripes 22
    Colour different, not grey with five purple stripes 23
22. Radials and interradials not distinctly different. Three holes in posterior end of anchor-plates ..... *bandae*

Radials and interradials distinctly different, ca. 9 holes in posterior end of anchor-plates ..... *lamperti*

23. Cartilaginous ring very faint and translucent (Fig. 27. 10)... *østergreni*
Cartilaginous ring well developed around the calcareous ring, not translucent in its anterior half 24

24. Colour reddish-grey, mottled with brown spots and bands (Pl. II fig. 6—7). Calcareous ring faint with more or less incomplete anterior margin (Fig. 24. 12) ..... *maculata*
Colour more or less dark purple, not mottled, but either finely striped or reticulated..... 25

25. Body reticulated, tentacles purple. Three small holes in posterior end of anchor-plate. Miliary granules irregularly shaped (Fig. 25. 4) *reticulata*
Body finely striped, tentacles yellow. 5—7 small holes in posterior end of anchor-plates. Miliary granules very regularly shaped (Fig. 25. 11) *purpurea*

26. Colour violet ..... *minima*
Colour white 27

27. Muscular impressions on calcareous ring distinct (Fig. 26. 3).. *bandae*
Muscular impressions on calcareous ring wanting (Fig. 26. 12) . *lactea*

Synaptula reciprocans (Forskål).

Synaptula nigra (partim). Clark. 1908. The Apodous Holothurians. pag. 81—82.

Synaptula reciprocans. Th. Mortensen. 1926. Trans. Zool. Soc. Part I pag. 117.

Port Tawfiq. 1924. Dr. M. Fox. 3 specimens.

The specimens at hand measure 12, 10 & 6 cm in length. Their colour is dark brown and the tentacles are a little darker than the body. They have 15 tentacles, which are in the largest specimen ca. 1 cm long. On the distal two thirds there are ca. 15 pairs of digits. The digits are so much contracted that the absence or presence of a web cannot be stated with certainty. Eye-spots are not visible on the oral disk, and the eyes are rudimentary. The cartilaginous ring is well developed and encloses the weak calcareous ring. On the exterior side of the calcareous ring there are distinct muscular impressions, and the radials are perforated for the nerves (Fig. 15. 7). There are several polian vesicles and a single stone-canal. The short and voluminous gonads consist of a thick main branch and many short side-branches. The oesophagus is distinct from the intestine which has a large loop. On the mesenteries there are ciliated funnels, which are placed into small groups (Fig. 15. 9) with 2—5 funnels in each. In the groups the funnels are situated

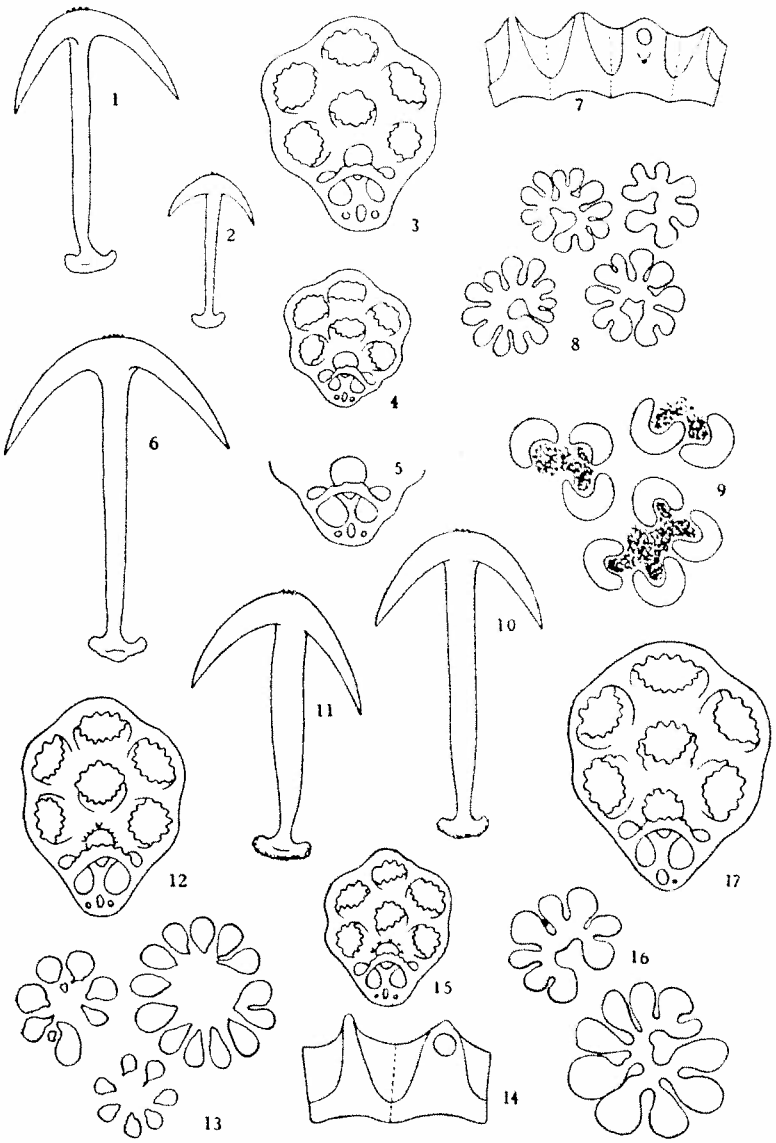


Fig. 15. Calcareous deposits and ciliated funnels of *Synaptula reciprocans* and *Synaptula rosea*. 1-9 *reciprocans*, 10-17 *rosea*. 11-12 from anterior end of body, 10, 15, 17 from posterior end of body. 1-6, 10-12, 15 & 17 × 180; 7 & 14 × 21; 9 × 180; 8. 13 & 16 × 1000.

with the open side against each other, and between the funnels there is a granulated mass.

For the description of the calcareous deposits, only two small pieces of skin imbedded in balsam are present, as the deposits in the specimens themselves have unfortunately been dissolved. There are two different sizes of anchors and plates (Fig. 15. 1-2). The larger anchors measure ca. 220 μ in length and 140 μ in width, and the smaller ones ca. 120 $\mu \times$ 65 μ. The stock is finely tooted and on vertex there are minute knobs, 3—5 in the large anchors and 1—3 in the small ones. The large anchor-plates measure ca. 170 μ in length and ca. 140 μ in width. The shape of the plates is varying. Most of the plates are narrow in the posterior end (Fig. 15. 3), but some few in each preparation are more wide (Fig. 15. 5). The articular hole is smooth and the bridge has some few knobs. In the posterior end of the plates there are three small holes. The small plates (Fig. 15. 4) measure ca. 110 μ in length and 160 μ in width, and their shape is quite as that of the large anchor-plates with the wide posterior end. In the one preparation there are some few anchors of a third size. These anchors (Fig. 15. 6) measure ca. 270 μ in length. The miliary granules (Fig. 15. 8) are rosettes, which are spread all over the skin.

This species is the only species of *Synaptula* which is known with certainty to have 15 tentacles, but it agrees so well with the other oriental species of the genus that there is no doubt that it belongs to it. That it cannot be synonymous with Semper's *Synapta nigra*, as assumed by Clark in "The Apod. Holoth." pag. 81, was pointed out by Th. Mortensen (Op. cit.).

Synaptula rosea n. sp.

Off Jolo. 21. III. 1914. 15 fms. One specimen.

The specimen at hand measures ca. 13 cm in length and 0,5 cm in diameter. The colour is a bright reddish. It has 14 tentacles, but as there is but one specimen present, it is not possible to say whether this number is the normal, or the species has 13 or 15. The tentacles are ca. 1,2 cm long, with ca. 20 pairs of digits united by a web. On the oral disk there are distinct eye-spots. The calcareous ring (Fig. 15. 14) is pure white, without any traces

of green. On the exterior side there are distinct muscle-impressions and the radials are perforated for the nerves. The cartilaginous ring is faint, and only visible around the calcareous ring. There are eight large polian vesicles and 10—12 small ones. The stone-canal is single. The gonads are short and thick and bushy-branched. The intestine has a large loop and on the mesenteries there are ciliated funnels of the common shape.

The anchors and plates in the posterior end of body are a little larger than those more anteriorly. In the posterior end there are some few small anchor-plates (Fig. 15. 15), but the corresponding anchors are wanting. The small plates measure ca. 110 μ in length. The normal anchors from the posterior end of body (Fig. 15. 10) measure ca. 260 μ in length and 150 μ in width. The arms are relatively short and on the vertex there are some few minute knobs. The anchors from the anterior end of body measure ca. 220 μ in length and ca. 130 μ in width. Their arms are relatively longer than the arms in the anchors from the posterior end of body (Fig. 15. 11), and the shape of the vertex is also a little different. The stock is finely dented in both forms of anchors. The anchor-plates from the anterior end (Fig. 15. 12) measure ca. 175 μ in length and 130 μ in width, and those from the posterior end (Fig. 15. 17) measure ca. 200 $\mu \times$ 160 μ. The articular hole as well as the bridge are in all three sizes of plates distinctly serrate. In the posterior end of the plates there are two to three small, smooth holes.

The miliary granules (Fig. 15. 16) are rosettes which measure ca. 25 μ in diameter. As mentioned (pag. 157) the rosettes in this specimen have changed into circles of minute granules (Fig. 15. 13) on account of a slight acidity in the preserving fluid.

This species is in some characters rather like *virgata*, but in others so much like *reciprocans*, that it will not be correct to refer it to any of the two species.

Synaptula aspera (Sluiter).

Chondrocloea aspera. Sluiter. 1901. "Siboga" Holothurians. pag. 128. Pl. X fig. 12.

Synoptula virgata. Clark. 1908. The Apodous Holothurians. pag. 85.

Vatek, opposite Toeal. III. 1922. Rocky shore. 0—2 m. 1 specimen.
Toeal. 25. III. 1922. Rocky wall with sponges. 3 specimens.

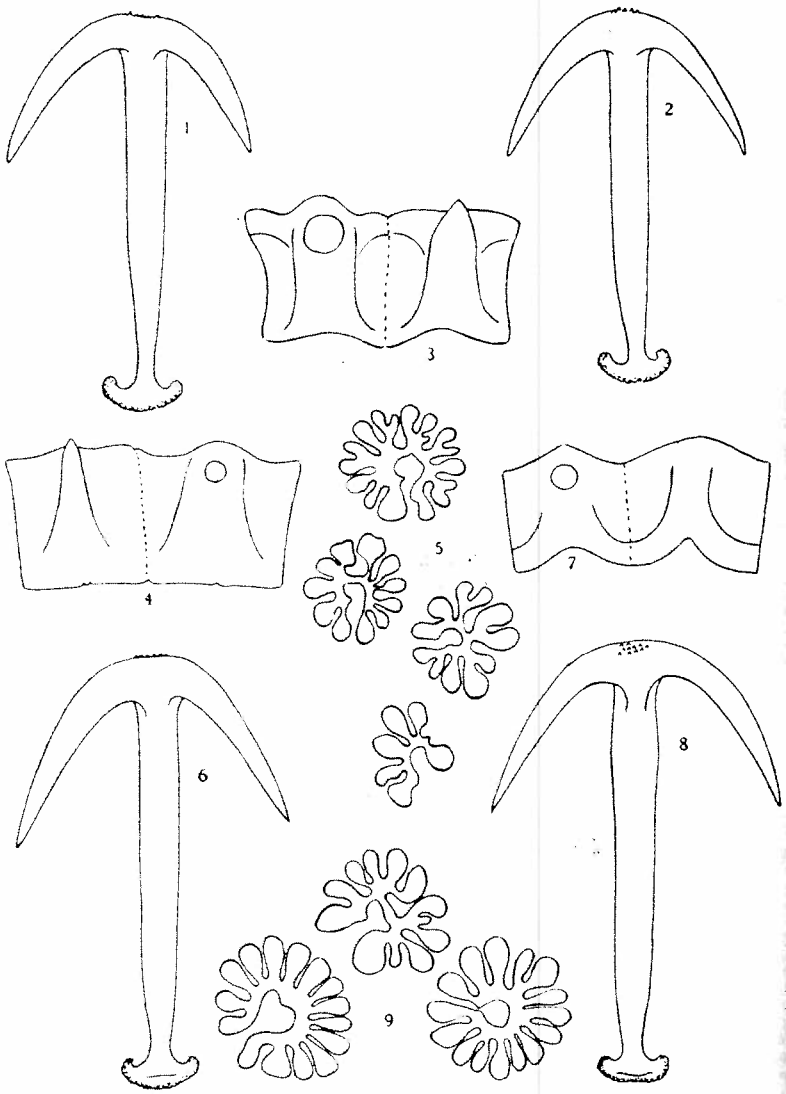


Fig. 16. Calcareous deposits and calcareous ring of *Synaptula aspera* 1-3, *Synaptula recta* 4-6 and *Synaptula striata* 7-9. 1-2, 6 & 8 × 180; 3-4 & 7 × 24; 5 & 9 × 1000.

The specimen from Vatek measures 34 cm in length, and the specimens from Toeal measure 14-21-23 cm in length. The colour is uniformly brownish-grey and the tentacles are a little darker than the body. The three specimens have 13 tentacles and the fourth, one of those from Toeal, but twelve. Each tentacle has ca. 20 pairs of digits united by a web. The eyes are well developed, but eye-spots are not visible on the oral disk. The calcareous ring (Fig. 16. 3) is thick and on the exterior side it has large and distinct muscular impressions. It is pure white and the radial pieces are perforated for the nerves. The cartilaginous ring is stout and nearly quite encloses the calcareous ring. It has small perforations through the posterior margin, close to the circular canal. There are many polian vesicles of different size and a single stone-canal. The gonads are voluminous and branched several times. The intestine has a loop and on the mesenteries there are ciliated funnels of the common size and shape.

The anchors from the anterior end of body (Fig. 16. 2) measure ca. 270 μ in length and 180 μ in width, and those from the posterior end (Fig. 16. 1) measure ca. 330 × 200 μ. They are of very nearly the same shape, with the stock finely dented and with minute knobs on the vertex. The anchor-plates are very different in the two ends of body. Those from the anterior end (Fig. 17. 2) measure ca. 210 μ in length and 150 μ in width. The articular hole is usually smooth and in the posterior end of the plate there are ca. 5 small holes. The plates from the posterior end (Fig. 17. 1) are of the same length, but they are wider, ca. 175 μ, and have but three small holes in the posterior end. The articular hole is in these plates usually serrate on the anterior margin. In both shapes of plates the bridge is distinctly dented.

Miliary granules are totally wanting, and as the anchors and plates show no signs of dissolution, the granules cannot have been dissolved.

The four specimens at hand are very characteristic. They differ from all the species at hand in the shape of both the calcareous ring, the anchors and the plates. Furthermore the lacking of miliary granules gives a very valuable character. Whether they are really the same as Sluiter's *aspera* is not at all certain, but as this is the only species of *Synaptula* described, which is wanting the

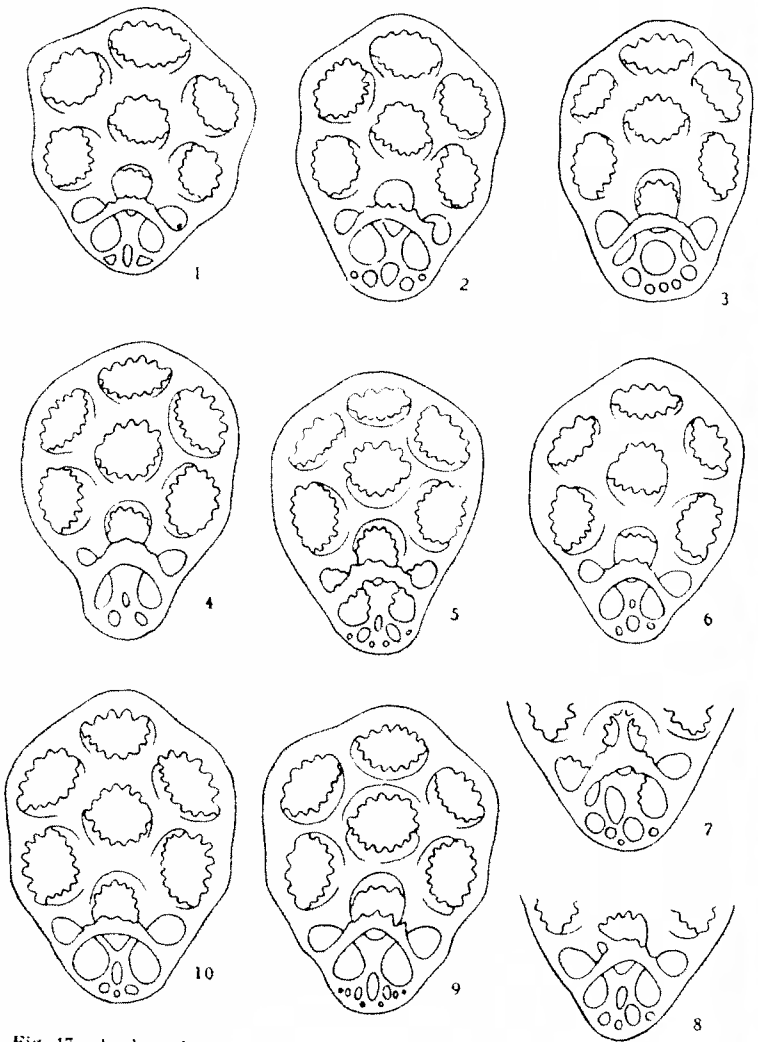


Fig. 17. Anchor-plates from *Synaptula aspera* 1 from posterior end, 2 from anterior end; *Synaptula recta* 3–5 from anterior end, 6–8 from posterior end; *Synaptula striata* 9 from posterior end, 10 from anterior end. × 180.

miliary granules, I suppose it the better course to refer them to this species. The peculiar shape as well as the rough surface of the deposits in Sluiter's specimen is, as Clark writes, evidently due to dissolution.

Synaptula recta (Semper).

Synapta recta. Semper. 1868. Die Holothurien. pag. 14, Pl. IV fig. 2-3.
Chondrocloea recta. Østergren. 1898. Das System der Synaptiden. p.114.
Synaptula recta. Clark. 1908. The Apodous Holothurians. pag. 84.
" " Clark. 1921. The Echinoderms of the Torres Strait. pag. 160.
" " Clark. 1924. The Synaptinae. pag. 475, Pl. I fig. 13, Pl. III fig. 9.

Vatek, opposite Toeal., III. 1922. Rocky shore. 2 specimens.

The specimens at hand measure 31 and 40 cm in length and their tentacles are ca. 1,5 cm long. The colour is bright reddish-grey with white spots, due to large heaps of miliary granules. They have 13 tentacles and ca. 20 pairs of much contracted digits, which are not united by a web. On the oral disk there are faint eye-spots. The cartilaginous ring is large and nearly quite encloses the calcareous ring. Close to its posterior margin there are some small perforations. The calcareous ring (Fig. 16. 4) is pure white and the posterior margin of the pieces is nearly straight. The radials are perforated for the nerves. There are many polian vesicles of different size and a single stone-canal. The gonads are rather voluminous and branched several times. The intestine has in both specimens a large loop, and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and plates are of nearly the same size in both ends of body, but the anchor-plates are very varying in shape (Fig. 17. 3-8). The anchors (Fig. 16.6) measure ca. 330 μ in length and 190 μ in width; and the anchor-plates measure ca. 240 μ in length and 170 μ in width. The anterior margin of the articular hole is always serrate and on the bridge there are numerous knobs, usually rather large but of varying size. Often the bridge is malformed (Fig. 17. 7-8) with large projections, which are usually fastened to the margin of the articular hole. The number of small holes in the posterior end of the anchor-plates is varying. The miliary granules (Fig. 16. 5) are rosettes with a diameter of ca. 20 μ.

Synaptula striata (Sluiter).

Synapta striata. Sluiter. 1888. Die Evertebraten. . . . Batavia. p. 216. Pl. II f. 39-40.

Chondrocloea albo-punctata. Sluiter. 1901. "Siboga" Holothurien. p. 127.

Synaptula recta. Clark. 1908. The Apodous Holothurians. pag. 84.

Toeal. 25. III. 1922. Rocky wall with sponges. 8 specimens.

The specimens at hand measure ca. 30 cm in length. Their colour is bluish-grey with white spots, due to large heaps of miliary granules. They have 13 tentacles, but some of the tentacles are often very small and seemingly regenerating. Each tentacle has ca. 20 pairs of digits, which are not united by a web. On the oral disk no eye-spots are visible, and the eyes are found to be very small. The cartilaginous ring is voluminous and nearly quite encloses the calcareous ring; it is perforated along its posterior margin. The calcareous ring (Fig. 16. 7) is pure white. It differs in shape distinctly from that of *recta*, as the posterior margin of the pieces is distinctly notched. On the exterior side there are muscular impressions and the radials are perforated for the nerves. There are many polian vesicles and a single stone-canal. The gonads are large and branched. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 16. 8) measure ca. 350 μ in length and 220 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 17. 9-10) are less varying than the plates in *recta*, but they are somewhat different in the two ends of the body. They measure ca. 230 μ in length and 170 μ in width. The articular hole as well as the bridge, is distinctly serrate. In the posterior end of the plates there are, in the plates from the anterior end of the body, ca. 4 holes and, in the plates from the posterior end of the body ca. 9 holes, of which the medial one is the largest. The miliary granules (Fig. 16. 9) are rosettes, a little larger than the rosettes in *recta*.

Synaptula striata is the most closely related to *recta*, but differs in the shape of the calcareous ring and the calcareous deposits so much from it that I have no doubt that it is a valid species. The description of *Chondrocloea albo-punctata* agrees so well with the specimens at hand, that I suppose it is synonymous with *striata*.

Synaptula albolineata n. sp.

Banda. 5. V. 1922. The shore at low-water mark. 1 specimen.

The specimen at hand measures ca. 21 cm in length and ca. 1,5 cm in diameter. The colour is exceedingly characteristic (Pl. II fig. 4) as it is greenish-grey with five pure white stripes in the ambulacra, due to abundance of miliary granules. The tentacles are as the body greenish-grey, but instead of the white stripes they have more or less regular white rings. There are 13 ten acles, each with 28—30 pairs of free digits. The eyes are very small and only visible on preparation. The cartilaginous ring is very large and encloses the calcareous ring. Close to the circular canal there are large perforations, but no tentacle canals as in *virgata* cfr. pag. 174.

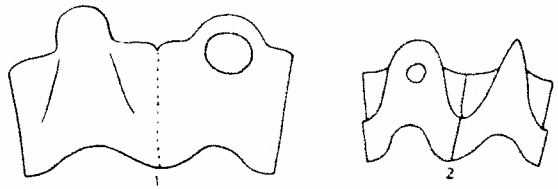


Fig. 18. Pieces of calcareous ring from *Synaptula alba* (1) and *Synaptula albolineata* (2). × 24.

The calcareous ring (Fig. 18. 2) is clear green with a pure white stripe on the limit of each two adjacent pieces. The radials are perforated for the nerves. The muscular impressions on the exterior side of the calcareous ring are distinct. There are 18 polian vesicles, four of which are very large. The single stone-canal has a large madreporite, prolongated along the one side of it. The gonads are very long and several times branched. The three parts of the alimentary canal are distinctly different and the intestine has a large loop. On the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and plates from the posterior end of body are not much different from those more anteriorly, but all over the body there are two different sorts. The large anchors (Fig. 19. 1) measure ca. 320 μ in length by 200 μ in width and the smaller ones (Fig. 19. 2) but ca. 200 μ in length by ca. 120 μ in width. The two sizes of anchors are quite alike, with the stock finely dented and with minute knobs on the vertex. The large anchor-plates (Fig. 19. 3)

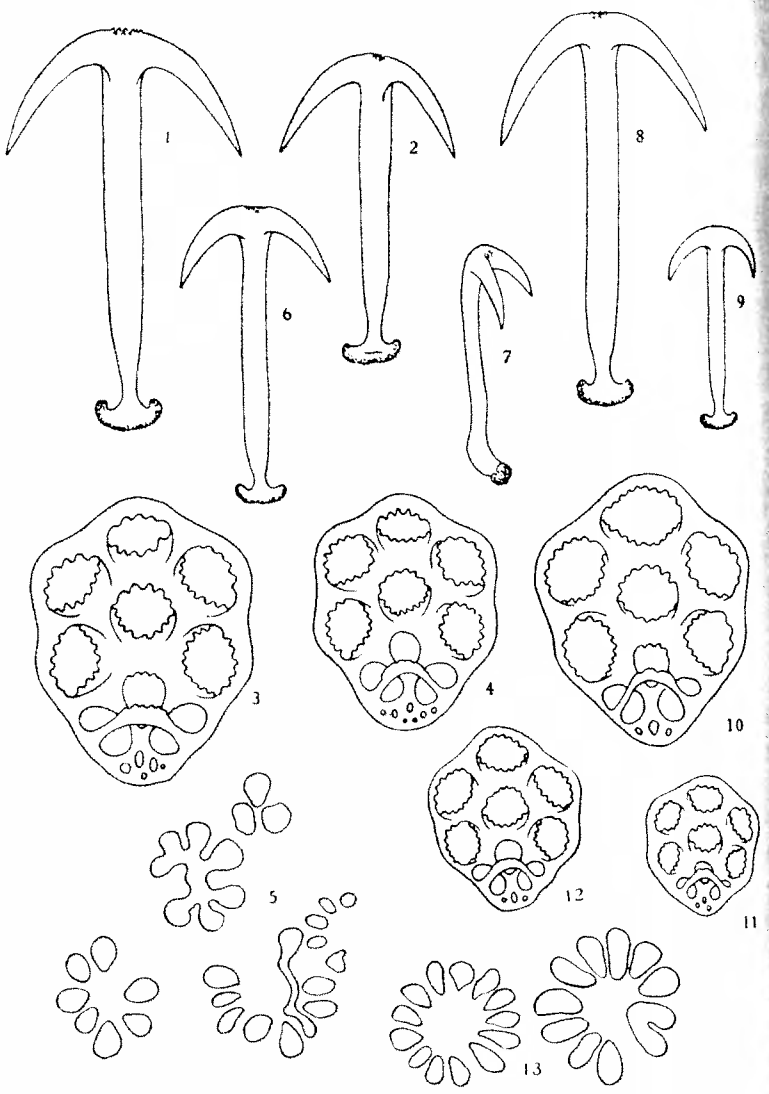


Fig. 19. Calcareous deposits from *Synaptula albolineata* 1-5 and *Synaptula alba* 6-13. 1-4 & 6-12 × 80; 5 & 13 × 1000.

measure ca. 230 μ in length and 170 μ in width. The bridge is distinctly dented and the anterior margin of the articular hole is serrate. In the posterior end of the plate there are 4—6 small holes. The smaller plates (Fig. 19. 4) measure ca. 150 μ in length and 130 μ in width. The articular hole is in these plates usually smooth and the teeth on the bridge are not so distinct as on that of the large plates. In the posterior end of the plates there are some few more small holes. The miliary granules are found only in the white stripes of the ambulacra and in the white rings on the tentacles. They are either irregularly formed rosettes or free minute granules (Fig. 16. 5), arranged in more or less regular circles.

This species is easily recognized by its peculiar colour and by the shape and colour of the calcareous ring. The only other species with five white stripes, known is *ater*, but the dark violet or purple colour of the latter, as well as the shape of the anchor-plates and the miliary granules, distinctly separate the two species.

Synaptula alba n. sp.

Off Neira, Banda. 19. VI. 1922. 13 m. Sand. One specimen.

The specimen at hand measures, without the tentacles, 8 cm in length; the tentacles measure ca. 1 cm. The colour is a pure white, and the tentacles are of the same colour as the body. There are 13 tentacles, each with 16 pairs of digits. The digits are long and slender, placed with small intervals as in *hydriformis* (Fig. 23. 1) and not united by a web. Eye-spots are present on the oral disk. The cartilaginous ring is large and with small perforations at the posterior margin. The calcareous ring (Fig. 18. 1) is pure white. The radial pieces are perforated for the nerves and the interradials have a large projection on the anterior margin. There are eight polian vesicles and a single stone-canal. The gonads are very thin and branched several times. The intestine has a large loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and anchor-plates from the two ends of the body are rather alike, but in the anterior end there are two, and in the posterior end three different sizes. The largest anchors (Fig. 19. 8) measure ca. 300 μ in length and 160 μ in width, those of the second size (Fig. 19. 6) ca. 210 μ in length and 110 μ in width. These

two sizes of anchors are rather alike, only the smaller ones have a little shorter arms. The third size of anchors (Fig. 19. 9) are ca. 150 μ in length and 80 μ in width, and differ from the two others in the shape of the arms and of the vertex. All three sorts of anchors have the stock finely dented and have minute knobs on the vertex. The anchor-plates (Fig. 19. 10-12) measure [1]) 240 $\mu \times$ 180 μ, [2]) 140 $\mu \times$ 120 μ, [3]) 120 $\mu \times$ 100 μ. The articular hole is in the two small plates quite smooth, but in the largest one it has the anterior margin serrate. The bridge has in all three sorts of plates some faint knobs and in the posterior end they have three small holes. The miliary granules (Fig. 19. 13) are circles of minute granules, scattered all over the body and in the tentacles.

This species differs in the shape of the anchors and anchor-plates, as well as in that of the calcareous ring, distinctly from all the other species of the genus, and is seemingly not closely related to any of the species known.

Synaptula virgata (Sluiter).

Chondrocloea virgata. Sluiter. 1901. "Siboga"Holothurien. Pl. 128, p. I f. 5.
Synaptula virgata. Clark. 1908. The Apodous Holothurians. pag. 85.
Amboina, Innerbay. 18. III. 1914. Sand. Coral. 2 specimens.
The Kei Islands. Off Toeal. 14. IV. 1922. Sand, ca. 20 m. 2 specimens.
5° 57 S. 106° 34 E. Java See. 7. VIII. 1922. Sand, shells, 22 m. 1 specimen.

The very characteristic colour of this species, makes it easily recognizable, and there is in my opinion no doubt that the specimens from Amboina Innerbay are the same species as Sluiter's *Chondrocloea virgata*. The specimens from St. 19 and St. 116 differ from the Amboina-specimens in having black pigment arranged in fine stripes in the skin. Also on the calcareous ring there is black pigment, for which reason I suppose that it is of pathological nature. Besides in having black pigment the mentioned specimens differ from the Amboina-specimens in having numerous abnormal anchor-plates (Fig. 20. 5 & 9). Possibly these specimens will ultimately prove to represent a distinct species. For the present however, it would seem the better course to refer them to *S. virgata*, with which species they are at any rate, closely related.

The largest specimen from Amboina measures 23 cm in length

and its colour is quite as the figure in the „Siboga" Holothurians Pl. I fig. 5. It has, like the other specimens, 13 tentacles, each with ca, 20 pairs of digits united by a large web. The eyes are

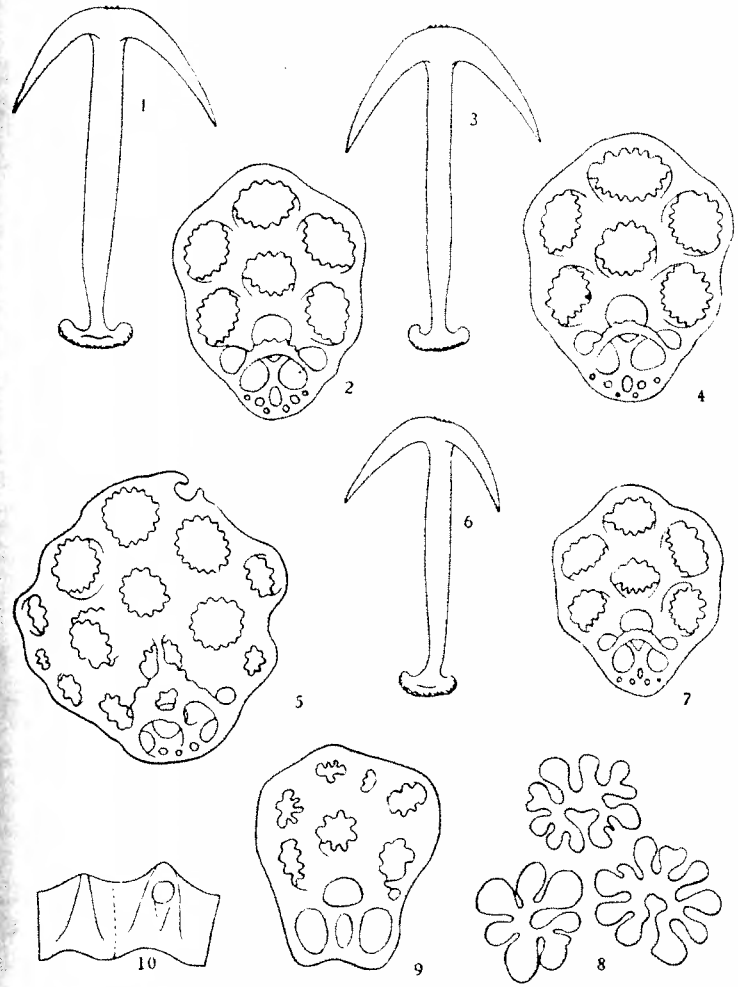


Fig. 20. Calcareous deposits 1-9 and calcareous ring 10 of *Synaptula virgata*. 1-2 from the anterior end, 3-4 & 6-7 from posterior end; 5 & 9 abnormal anchor-plates of the specimen from St. 116. 1-4 & 9 × 180; 8 × 1000; 10 × 24.

small and on preserved specimens not visible on the oral disk. The cartilaginous ring is around the posterior margin of the calcareous ring thick, white and intransparent, but closer to the circular canal

it is thin and translucent. The perforations through its posterior margin are so large that they reach the intransparent part, for which reason the posterior part of the cartilaginous ring is reduced to "tentacle-canals" (cf. the description of *Synapta picta (= Synaptula hydriformis)* by Théel in "the Challenger Holothurians" II pag. 10). The calcareous ring (Fig. 20. 10) is in the specimens from Amboina pure white, and in the other specimens, as said, tinged with black. The radial pieces are perforated for the nerves, and the muscular impressions are faint. There are in all the specimens ca. 15 polian vesicles and a single stone-canal. The gonads are branched and the intestine has a loop. On the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and anchor-plates from the two ends of body are different, and in the posterior end they are of two different sizes. The large anchors in the posterior end (Fig. 20. 3) measure ca. 270 μ in length and 170 μ in width. The small anchors (Fig. 20. 6) measure ca. 210 $\mu \times 140$ μ and those from the anterior end of body (Fig. 20. 1) measure ca. 240 $\mu \times 140$ μ. The anchors are all of the same shape with the stock finely dented and with minute knobs on the vertex.

The anchor-plates from the posterior end of body (Fig. 20. 4 & 7) measure ca. 200 $\mu \times 160$ μ and 140 $\mu \times 120$ μ, and the normal plates from the anterior end (Fig. 20. 2) ca. 160 $\mu \times 130$ μ. In the anterior end there are some few larger plates, which are of the same size as the large plates in the posterior end, ca. 200 $\mu \times$ 160 μ. All the anchor-plates are of the same shape with the articular holes smooth and with the bridges serrate. In the posterior end of the plates there are 5—7 small holes.

The miliary granules (Fig. 20. 8) are ca. 20 μ large rosettes, which are found all over the skin arranged into long heaps or rather stripes, which, as Sluiter writes, lends the purple skin its peculiar colour.

Synaptula jolensis n. sp.

Off Jolo. 19. III. 1914. Ca. 25 fms. Sand, coral. 1 specimen.

The specimen at hand measures 5 cm in length and 0,8 cm in diameter. The colour is pale red with some irregular white stripes. There are 13 tentacles of the same colour as the body,

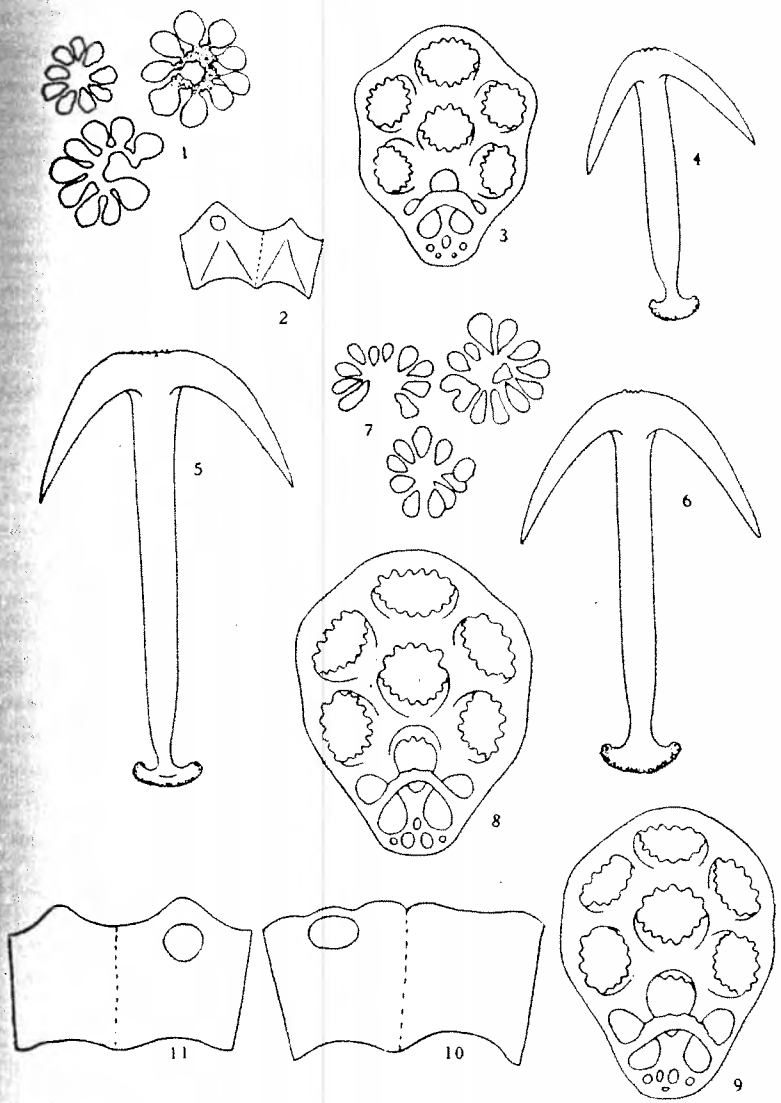


Fig. 21. Calcareous deposits and calcareous ring of *Synaptula jolensis* 1-4 and *Synaptula psara* 4-11. 5 & 8 from posterior end, 6 & 9 from anterior end; 10 calcareous ring of abnormal specimen, 11 of normal.
3-6 & 8-6 × 180; 1 & 7 × 1000; 2, 10-11 × 24.

each with 6—8 pairs of digits united by a web. The eyes are very faint and hardly visible. The cartilaginous ring is, as in *virgata*, well developed only around the calcareous ring and has large perforations. The calcareous ring is pure white and the radial pieces (Fig. 21. 2) are perforated for the nerves. There are 8 polian vesicles of which two are much smaller than the other six. The stone-canal is single. The gonads are well developed and branched. The oesophagus is thick and glandular and the thin intestine has a large loop. On the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and anchor-plates from the two ends of the specimen are not distinctly different in size, and in the posterior end there is but one size of anchors and plates. The anchors (Fig. 21. 4) measure ca. 250 μ in length and 150 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 21. 3) measure ca. 200 μ in length and 150 μ in width. The articular holes as well as the bridges are totally smooth and in the posterior end of the plates there are five small holes. The miliary granules (Fig. 21. 1) are rosettes, which show different stages of dissolution of the medial part.

This species is closely related to *virgata*, and there is much reason for supposing that future investigations will show it to be synonymous with that species. The general appearance, the one size of anchors and plates as well as several small differences make it however unjustifiable for the present to refer it to *virgata*.

Synaptula psara (Sluiter).

Synapta psara. Sluiter. 1888. Die Evertebraten. . . . Batavia. p. 219.
Chondrocloea psara. Østergren. 1898. System der Synaptiden. p. 114.
„ „ Sluiter. 1901. "Siboga" Holothurien. pag. 126.
Synaptula psara. Clark. 1908. The Apodous Holothurians. pag. 84.
„ „ Clark. 1924. The Synaptinae. pag. 475.

Vatek. III. 1922. 4 specimens.

The largest specimen at hand measures ca. 30 cm in length and 1,5 cm in diameter. The colour is pale reddish-grey with some faint white spots due to heaps of miliary granules. There are 13 tentacles, some few, 1—2 of which are shorter and evidently regenerating. Each tentacle has ca. 25 pairs of digits united by a web. The eyes are small and not visible on the oral disk. The cartilaginous ring

is voluminous and the perforations through its posterior margin are small. The calcareous ring (Fig. 21. 11) is in all but one of the present specimens pure white. The large specimen differs in the shape of the calcareous ring from the other three. The faint projection on the anterior margin is, in this specimen, wanting (Fig. 21. 10), but whether this is abnormal, or this specimen ought to be separated from the other specimens, it is not possible to see, but as it agrees pretty well with the other specimens in all the other characters, I do not think it wrong to refer them all four to the same species. There are many polian vesicles and a single stone-canal. The madreporite is long and elongated along the stone-canal. The gonads are long and branched and the intestine has a large loop. On the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and anchor-plates in the posterior end of body are different from those in the anterior end. The posterior anchors (Fig. 21. 5) measure ca. 360 μ in length and 200 μ in width; those more anteriorly (Fig. 21. 6) ca. 320 μ in length and 200 μ in width. The stock is finely dented and on the vertex there are some minute knobs. The posterior plates (Fig. 21. 8) measure ca. 250 μ in length and 200 μ in width. The bridge and the anterior margin of the articular hole is more or less serrate. In the posterior end of the plates there are 4—5 small holes. The plates from the anterior end of body (Fig. 21. 9) are of the same shape as those more posteriorly, but they measure ca. 220 $\mu \times 170$ μ. The miliary granules (Fig. 21. 7) are circles of minute granules.

Synaptula denticulata n. sp.

Toeal. 21. III. 1922. Ca. 2 m. Sand, Eunice-tubes. 7 specimens.
Off Toeal. 21. III. 1922. 1—2 m. Between Hydroids and Alcyonarians. 6 specimens.
? Opposite Toeal. 25. III. 1922. Sand, coral-blocks. 1 specimen.

The largest specimens at hand measure 16—20 cm, but the majority are not longer than 6—8 cm. The small specimens are greyish-green with white spots, the large ones are nearly colourless and mottled with green and white. They have 13 tentacles, each with ca. 25 pairs of digits united by a web. On the oral disk there are distinct eye-spots. The cartilaginous ring is well developed

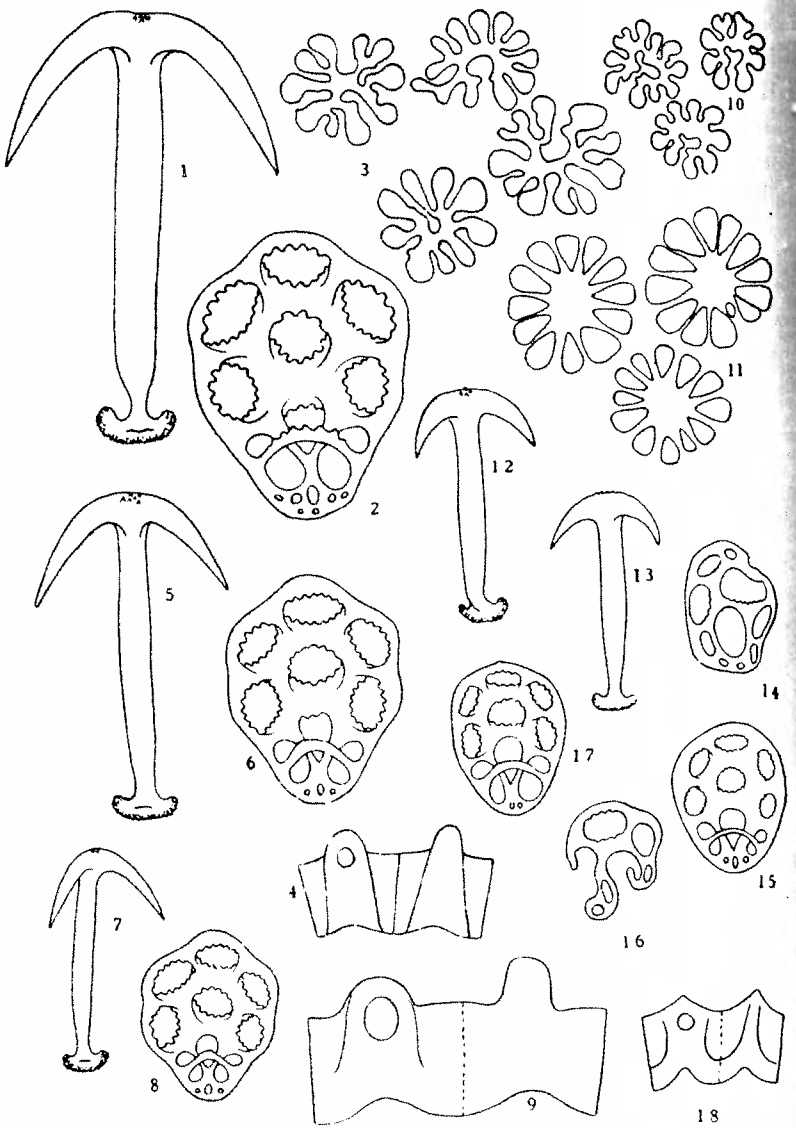


Fig. 22. Calcareous deposits and calcareous rings of *Synaptula denticulata* 1-4, *Synaptula tualensis* 5—10 and *Synaptula neirensis* 11—18. 12 & 17 from anterior end, 13—16 from posterior end. 1—2, 7—8, 12—17 × 180; 13, 10, 11 × 1000; 4 × 24; 9 & 18 × 36.

and has 13 small holes close to the posterior margin. The calcareous ring (Fig. 22. 4) is green with white longitudinal stripes along the sutures of the pieces. The radials are perforated. There are 20 polian vesicles and a single stone-canal. The madreporite is short. The gonads are in the large specimens well developed and distinctly branched. In the small ones they are undeveloped. The intestine has a large loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors and anchor-plates are not different in the two ends of body. The anchors (Fig. 22. 1) measure ca. 320 μ in length and 200 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 22. 2) measure ca. 220 μ in length and 160 μ in width. The anterior margin of the articular hole is, as well as the bridge, distinctly serrate. In the posterior end of the plates there are 7 small holes. The bridge is often malformed with one or two long projections, which are, as the projections in the malformed plates in *recta* and *virgata*, fastened to the anterior margin of the articular hole. The miliary granules (Fig. 22. 3) are rosettes which are gathered into heaps.

This species differs distinctly from *psara* in the shape and the colour of the calcareous ring and in the short madreporite, and from *virgata* in the colour, in the shape and colour of the calcareous ring and in the arrangement of the miliary granules.

Synaptula tualensis n. sp.

Toeal. 21. III. 1922. 2 m. Sand. 3 specimens.

One of the specimens at hand is but a fragment; the two others measure 6,5 cm and 7,5 cm in length. The colour is, as the colour of the small specimens of *denticulata*, greyish-green with white spots. There are 13 tentacles, each with ca. 18 pairs of digits united by a web. The eyes are small and not visible on the oral disk. The cartilaginous ring is well developed and with small perforations close to the posterior margin. The calcareous ring (Fig. 22. 9) is distinctly green and the muscular impressions are faint. The radial pieces are perforated for the nerves, and the interradial pieces have a long projection on the anterior margin. There are 15 polian vesicles and a single stone-canal. The madreporite is large and elongated along the stone-canal. The gonads are well

developed, thin and branched, and the alimentary canal has a large loop. On the mesenteries there are ciliated funnels of the usual shape and size.

The anchors and anchor-plates are not different in the two ends of body, but in each end there are two different sorts. The large anchors (Fig. 22. 5) measure ca. 260 μ in length and 150 μ in width; the small anchors (Fig. 22. 7) measure ca. 140 μ in length and 80 μ in width. The stock is finely dented and on the vertex there are some minute knobs. The large anchor-plates (Fig. 22. 6) measure ca. 180 μ in length and 130 μ in width, the small plates (Fig. 22. 8) ca. 110 μ in length and 100 in width. The plates are much alike, with a nearly smooth bridge and three small holes in the posterior end, but the articular hole has in the large plates the anterior margin serrate; in the small plates it is usually smooth. The miliary granules (Fig. 22. 10) are rosettes which are gathered in the white spots.

This species is the closest related to *denticulata*, from which it differs in having two different sizes of anchors and plates, in the length of the madreporite and in the shape of the calcareous ring.

Synaptula neirensis n. sp.

Off Neira, Banda. 5. VI. 1922. Ca. 10 m. Sand. One specimen.

The specimen at hand measures but 2 cm in length. The colour is uniformly pale violet. It has 13 tentacles, each with 5—6 pairs of digits, which are united by a web. Eye-spots are present on the oral disk. The cartilaginous ring is distinct, close to the calcareous ring, but in its posterior part it is reduced to "tentacle-canals". The calcareous ring (Fig. 22. 18) is pure white and on its exterior side there are distinct muscular impressions. All the pieces are notched in the posterior margin and the radials are perforated for the nerves. There are 5 polian vesicles and a single stone-canal. The gonads are faintly developed, but three times branched. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The calcareous deposits are peculiarly formed and different from the deposits in all other species of *Synaptula*. The anchors from the posterior end of body (Fig. 22. 13) measure ca. 190 μ in length and 110 μ in width, and those from the anterior end (Fig. 22. 12)

ca. 180 μ in length and 110 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates from the anterior end of body (Fig. 22. 17) are nearly oval and measure ca. 110 μ in length and 90 μ in width. In the posterior end of body the anchor-plates are nearly all more or less reduced (Fig. 12. 14 & 16). Those which are not reduced (Fig. 22. 15) measure ca. 110 μ in length and 100 μ in width. The articular hole and the bridge is usually smooth, and in the posterior end of the plates there are three small holes. The miliary granules (Fig. 22. 11) are in spite of the small size of the specimen and the anchors and anchor-plates unusually large. They are ca. 30 μ large circles of minute granules. Whether they have really been rosettes in the living specimen or not, it is not possible to see, but there is nothing to indicate a partly dissolution,

S. neirensis is not closely related to any of the other species of the genus, and it is easily recognized by the shape of the calcareous deposits.

Synaptula madreporica n. sp.

Zamboanga. 2. III. 1914. 6 specimens.

The specimens at hand are varying in size, the largest measuring 31 cm in length and 0,5 cm in diameter. The colour is uniformly dark grey and the dorsal side is a little darker than the ventral side. There are 13 tentacles, which in all the specimens are stretched straight out in the prolongation of the body. The tentacles measure in the largest specimen 1,5 cm in length, and are for ca. 2 mm united. Each tentacle has ca. 20 pairs of very contracted digits, which are united by a web. The eyes are very small and not visible on the oral disk. The calcareous ring (Fig. 24. 3) is pure white and nearly quite buried in the large cartilaginous ring. On the exterior side of the calcareous ring there are distinct muscular impressions, and the radials are perforated for the nerves. The cartilaginous ring is as in *psara* large and with 13 small perforations close to the posterior margin. There are many polian vesicles and a single stone-canal. This is in the mature specimens very peculiarly formed, as the basal part of it is curled up into a large clue, which is partly hidden in one of the holes in the cartilaginous ring (Fig. 24. 5). This is not the case with the small specimens at hand, in which

the stone-canal has but a single curve, and in the smallest specimen at hand the stone-canal is nearly quite straight. As the specimens at hand show different degrees of curled stone-canals, correlated with the size of the specimens, I suppose that it is the normal state that the mature specimens in this species have the peculiar curled stone-canal. The gonads are in the large specimens well developed and branched. The intestine has a large loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The calcareous deposits in the posterior end of body are nearly quite dissolved by acid in the preserving fluid. In the anterior end of body where the dissolution has not been so great, there are anchors, anchor-plates and miliary granules. It is interesting to see that the deposits in the posterior end of body seem to be more dissoluble than those from the anterior end; one might be tempted to suggest that this is not really the case, and that the mentioned deposits are also nearly wanting when the specimen is alive. But in the large collection of Synaptids at hand there are not few specimens with the deposits partly dissolved, and in these specimens the deposits from the posterior end are always the most attacked. This is especially seen in the specimens at hand of *reciprocans*, for in these specimens there were good deposits in both ends of body three years ago, and now the deposits from the posterior end have nearly totally disappeared; those from the anterior end are only half dissolved.

The anchors from the anterior end of the body (Fig. 24. 1) measure ca. 280 μ in length and 200 μ in width. They are of the usual shape with a finely dented stock and with minute knobs on the vertex. The anchor-plates (Fig. 24. 2) measure ca. 200 μ in length and 150 μ in width. The anterior margin of the articular hole as well as the bridge are serrate. In the posterior end of the plates there are three small holes. The miliary granules (Fig. 24. 4) are circles of minute granules. This condition may perhaps be due to a partly dissolution of normal rosettes.

S. madreporica is the most closely related to *psara* and *denticulata*, but it differs in the exterior as well as in the shape of the calcareous deposits so much from these two species that it would be unjustifiable to refer it to them.

Synaptula hydriformis (Lesueur).

Holothuria hydriformis. Lesueur. 1824. Description of several new species of Holothuria, pag. 162.
Holothuria viridis. Lesueur. 1824. Op. cit., pag. 163.
Synaptula vivipara. Ørsted. 1849. Videnskabelige Meddelelser fra dansk naturhistorisk Forening 1849—51, pag. VII.
Synapta viridis. Pourtalès. 1851. On the Holothuridae of the Atlantic coast of the United States, pag. 14.
Synapta pourtalesii. Selenka. 1867. Beiträge zur Anatomie und Systematik der Holothurien, pag. 365.
Leptosynapta hydriformis. Verrill. 1867. On the geographical distribution of the Echinoderms of the West-coast of America.
Leptosynapta pourtalesii. Verrill. 1867. Op. cit.
Heterosynapta viridis. Verrill. 1867. Op. cit.
Synapta vivipara. Ludwig. 1886. Die von G. Chierchia gesammelten Holothurien, p. 28.
Synapta picta. Théel. 1886. "Challenger" Holothurioidea II, p. 10, Pl. I fig. 9—10.
Synapta vivipara. Clark. 1896. The viviparous Synaptas of the West-Indies.
Synapta vivipara. Clark. 1896. Notes on the life history of *Synaptula vivipara*. Ørsted.
Synapta vivipara. Clark. 1898. *Synapta vivipara*.
Chondrocloea vivipara. Østergren. 1898. Das System der Synaptiden, pag. 114.
Synaptula vivipara. Fisher. 1907. The Hawaiian Holothurians, pag. 717.
Synaptula hydriformis. Clark. 1908. The Apodous Holothurians, pag. 23 & 82, Pl. VI fig. 1—22.
Synaptula hydriformis. Clark. 1924. The Synaptinae, pag. 473, Pl. III fig. 5—6. Pl. IV fig. 4.

St. Croix. 1845. A. S. Ørsted. 4 specimens.
Between little Saba and St. Thomas. 7.III.1906. 15 fms. Th. Mortensen. 1 specimen.
Jamaica, Port Royal. 1907. H. L. Clark. 2 specimens.
Tobago, B. W. I. IV.1916. The shore, between *Corallina*. Th. Mortensen. 66 specimens.
Jamaica, Port Royal. 1924. H. L. Clark. 3 specimens.
Jamaica, Montego Bay. 1924. H. L. Clark. 2 specimens.
Bermuda, Hungry Bay. 1924. H. L. Clark. 2 specimens.
Bermuda. 1926. The shore. Th. Mortensen. 71 specimens.

The specimens at hand from the various localities differ so much that the suggestion lies at hand that they may represent different local races or varieties; but as it is not possible to see with any

reasonable certainty on preserved specimens, whether the differences really are of clasificatory value or only due to different age, I prefer to describe all the specimens as the same species, and in the description of the single characters to point out the local differences.

As to the size of *Synaptula hydriformis* Clark writes (The Apod. Holoth. pag. 82) that it is 10—15 cm. None of the specimens at hand are so large. The largest specimen at hand, one of those from Jamaica, measures 7 cm and another measures 6 cm. The other specimens from Jamaica are 3—3 1/8 cm long, while Ørsted's specimens from St. Croix are but 0,8—1,5 cm long. The specimens from Tobago vary from 0,4—1,5 cm and those from Bermuda from 1—3 cm. These differences in size may probably be due to differences in age alone; but as the different groups are from often widely different localities, and the larger part of them have embryos in the body-cavity, it cannot be regarded as certain that age alone accounts for the different sizes. Besides no other *Synaptula* is known where the size of the mature specimens varies to such extent.

The large specimens from Jamaica are pure white, but whether they are really white, or their colour has disappeared in alcohol it is not possible to see. All the other specimens, excepting alone Ørsted's which have lost their colour, are either green or reddish. That the lacking of colour in Ørsteds specimens is due to fading is seen from his figures cfr. Pl. III, which represent them as green and reddish. In balsam preparations it is seen that the green colour is due to green chromatophores, and that the red colour is diffusely spread all over the body. As furthermore the red specimens have also green chromatophores, there is reason for supposing that *hydriformis* is normally green, and that the red colour is due to their eating spores of red algae.

In mature specimens there are always 12 tentacles. They are united at the base, and each has up to 20 pairs of digits. The digits are not united by a web, and are placed at distinct intervals cf. (Fig. 23. 1). On the oral disk there are twelve pairs of large eye-spots. In one of the specimens from Bermuda, there are beside the normal eyes on the oral disk several large eye-spots on the digits.

The calcareous ring (Fig. 23. 6) is weak and nearly quite enclosed in the cartilaginous ring. It is usually pure white and has

very faint or quite indistinct muscular impressions. The radials are perforated for the nerves. The cartilaginous ring is well developed around the calcareous ring, but very faint and translucent in its posterior part. The perforations through the posterior margin are so large, that there are, as said by Théel in the description of *Synapta picta* ("Challenger" Rep. Holoth. II, pag. 10), twelve large "tentacle-canals" which reach from the circular canal to the calcareous ring. The stone-canal is single. In the specimens from Tobago, the small specimens from Bermuda as well as in Ørsted's specimens, there are 2—4 polian vesicles. In the large specimens from Bermuda there are 7—10 polian vesicles, and in Clark's specimens from Jamaica there are twelve.

The alimentary canal has usually a large loop on the intestine, but in a single specimen the loop is wanting. In this specimen the alimentary canal is in its whole length fastened by the mid-dorsal mesentery, and in the posteriormost end also by the faintly developed, right, ventral mesentery. The well developed, left, dorsal mesentery is quite free of the intestine. All the three mesenteries are supplied with ciliated funnels of the usual size and shape.

The gonads are in the specimens from Tobago short and club-shaped and enclose large eggs. The specimens have also embryos in the body-cavity. In most of the other specimens the gonads are long and thin but unbranched, and in the largest specimens there are 1—5 short side-branches.

The shape and size of the calcareous deposits in the specimens from Tobago differ from those of the specimens from Bermuda and Jamaica. In all the specimens at hand the deposits from the anterior end of body are of the same size and shape as the normal ones from the posterior end, but there are here found some anchors and plates which are much smaller than the others. An examination of the embryos in the specimens from Tobago shows that the embryonal anchors measure 80—90 μ and the plates ca. 60 μ in length. This agrees excedingly well with the size of the small anchors and plates in the posterior end of the mature specimens, and I suppose that these small anchors and plates really are the embryonal deposits, which have not disappeared. In the same way the small anchors and plates which are found in the posterior end of many of the other species may probably be regarded as embryonal.

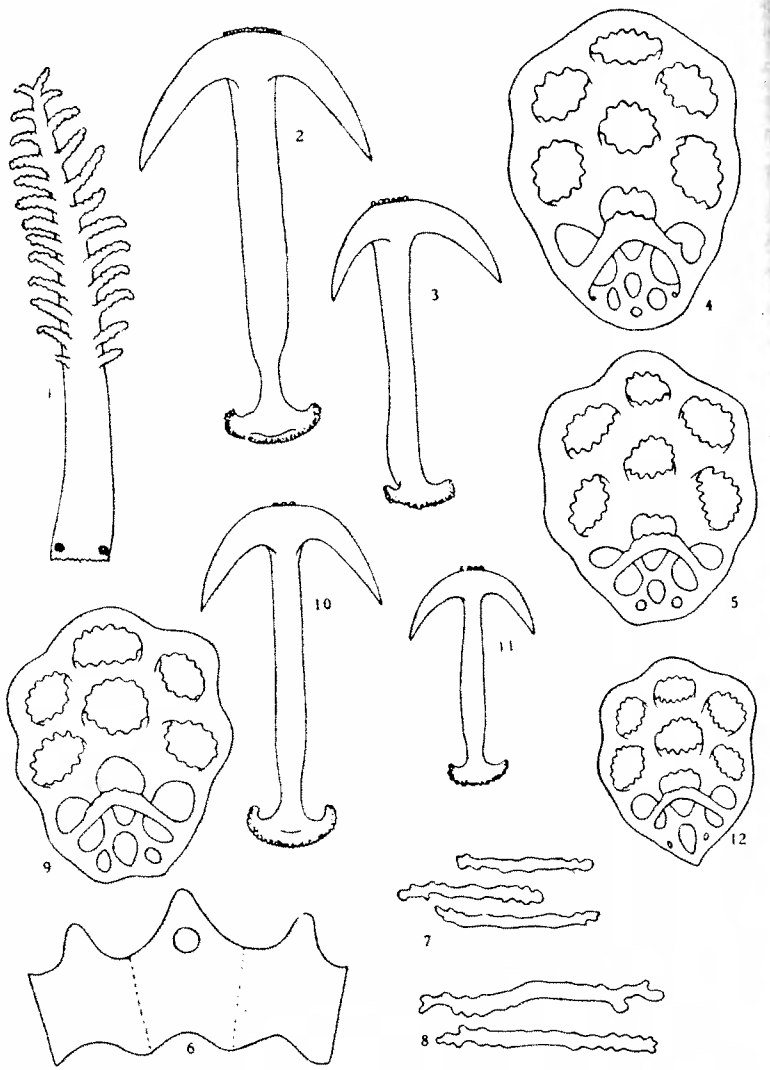


Fig. 23. *Synaptula hydriformis*: 1–6 & 8 from Bermuda. 7 & 9—12 from Tobago. 1 & 6 × 24, 2–5 & 7—12 × 270.

The length of the anchors in the specimens from Bermuda (Fig. 24. 2-3) varies from ca. 145 μ to 220 μ, and may within a single specimen vary up to 35 μ. The width increases with the length and is ca. 60 % of it. The anchor-plates (Fig. 23. 4-5) measure ca. 80 % of the corresponding anchors, and their width is ca. 75 % of their length. The small anchors from the posterior end measure 130—140 μ in length. The anchors and plates in the specimens from Tobago do not vary so much. The anchors (Fig. 23. 10-11) measure ca. 150 μ in length and 80 μ in width, and the plates (Fig. 23. 9 & 12) measure ca. 120 μ in length and 90 μ in width. The small anchors are 90 μ × 50 μ. All the anchors have the stock finely dented and have minute knobs on the vertex. The knobs on the vertex are not as in most of the oriental species arranged into one or two small groups, but in a single row. The anchors of Bermuda specimens have up to 20 knobs, and those from Tobago have not more than 3—6. The anchor-plates in the two groups of specimens differ somewhat in shape (Fig. 23. 4-5, 9 & 12), but the bridge is always more or less uneven and the anterior margin of the articular hole is usually serrate. In the posterior end of the plates there are usually three holes, but the large plates of the Bermuda specimens have four.

The miliary granules (Fig. 24. 10-11) are rosettes. In the specimens from Jamaica the rosettes are more or less irregularly shaped, but as the calcareous deposits in these specimens are distinctly attacked by acid in the preserving fluid, the irregular shape probably is due to dissolution. The rosettes in the specimens from Bermuda are a little larger than those in the specimens from Tobago.

In the tentacles and in the digits rods are often present. These are more or less slender, rather uneven and often a little branched (Fig. 23. 7-8). They measure in the tentacles ca. 100—120 μ and in the digits 50—80 μ. Such rods are not always present, and their number may be exceedingly different, and does not correspond with the size of the specimens. Often rods are wanting in some tentacles, though a rather large number are present in others of the same specimen.

From the above description it appears that though the specimens from Tobago in many characters differ from those from Bermuda,

the characters are so varying and the differences so slight that, for the present at least, it will be the better not to separate them.

Synaptula rosetta n. sp.

Off Jolo. 18.III.1914. 15 fms. Coral-sand. One specimen.

The specimen at hand measures 3 cm in length by 0,3 cm in diameter. The colour is uniformly pale red. It has twelve tentacles, but as only one specimen is present it is not quite certain that this is the normal number of tentacles. Each tentacle has 6—8 pairs of digits which are united by a web. The eyes are small and faintly visible on the oral disk. The calcareous ring is pure white and the radial pieces are perforated for the nerves. The cartilaginous ring is faintly developed and its posterior part is, as in *hydriformis*, "tentacle-canals".

There are four polian vesicles and one stone-canal. The gonads are faintly developed and distinctly branched. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual shape and size.

There is only one sort of anchors (Fig. 24. 6) which measure ca. 200 μ in length and 130 μ in width. The stock is finely dented and on the vertex there are some minute knobs. The normal anchor-plates (Fig. 24. 8) measure ca. 150 μ in length and 120 μ in width. Their shape is rather unusual and characteristic in the posterior end being very narrow. The articular hole is usually smooth, and on the bridge there are some very small teeth. In the posterior end there are three holes. Beside these plates there are some few smaller ones (Fig. 24. 7) which measure ca. 100 μ in length and 90 μ in width. They differ from the normal plates in their posterior end being not so distinct and with only a single hole in it.

The miliary granules (Fig. 24. 9) are large rosettes, which are uniformly spread over the body.

This species is, if the number of the tentacles is really twelve, not closely related to any of the other species of the genus. If on the other hand the number of tentacles is 13, which may very probably prove to be correct, it is the most closely related to *virgata*, from which species it differs both in the general appearance and in the size and shape of the calcareous deposits.

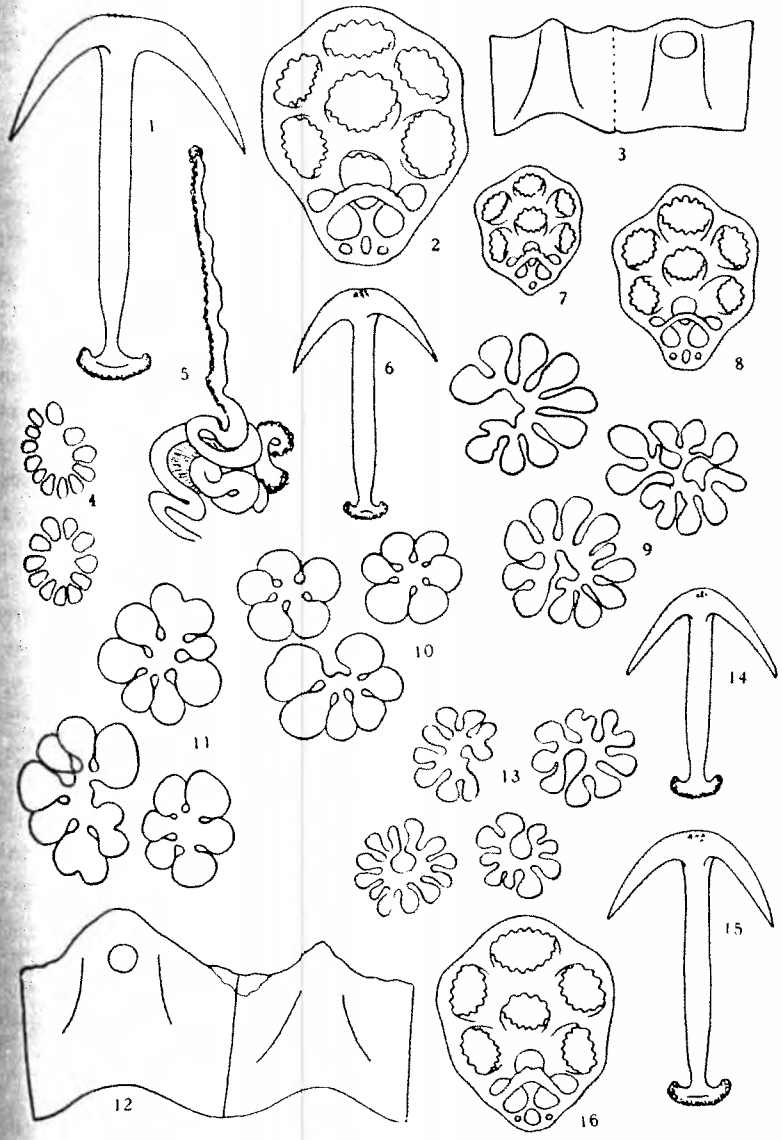


Fig. 24. Calcareous deposits, calcareous ring and stone-canal of *Synaptula madreporica* 1–5; calcareous deposits of *Synaptula rosetta* 6–9; rosettes of *Synaptula hydriformis*, 10 from Tobago, 11 from Bermuda; calcareous deposits and calcareous ring of *Synaptula maculata* 12–16. The anchors and anchor-plates × 180, the rosettes × 1000 the stone-canal fig. 5, × 9 and the calcareous rings fig. 3 & 2, × 24.

Synaptula maculata (Sluiter).

Synapta reticulata var. *maculata*. Sluiter. 1888. Die Evertebraten . . . Batavia, pag. 214.

Synapta reticulata. Clark. 1908. The Apodous Holothurians, p. 86.

Taba Bay, Mindanao. 12.III.1914. Coral-reef. 10 specimens.

The length of the specimens at hand varies from 3 cm to 13 cm. Their colour (Pl. II fig. 6-7) is greyish-red with dark brown spots or rings. The number of the tentacles is normally 10 but two small specimens have 11. Each tentacle has ca. 25 pairs of digits, which are united by a web. On the oral disk there are distinct eye-spots. The cartilaginous ring is well developed around the calcareous ring, where it is dark purple. The posterior part of it is as in *virgata* and *hydriformis* "tentacle-canals". The calcareous ring (Fig. 24. 12) is very faint, and its anterior margin is in all the specimens at hand more or less incomplete. The radial pieces are perforated for the nerves and all the pieces are faintly tinged with green. There are 15 polian vesicles and a single stone-canal. The gonads are in the large specimens well developed, and have an unusually large main-branch. The oesophagus is distinctly different from the rest of the alimentary canal, and the intestine has a large loop. On the mesenteries there are ciliated funnels of the usual shape and size.

The normal anchors (Fig. 24. 15) measure ca. 210 μ in length and 160 μ in width. They have the stock finely dented and on the vertex there are minute knobs. Besides these anchors, and corresponding with anchor-plates of the usual size, there are some smaller ones (Fig. 24. 14) with more slender arms. The anchor-plates (Fig. 24. 16) measure ca. 160 μ in length and 140 μ in width. The articular hole is smooth and on the bridge there are some few large knobs. In the posterior end of the plates there are three small holes, the medial one of which is by far the largest. The miliary granules (Fig. 24. 13) are rosettes. These are found all over the skin, but they are lying densest in the white stripes and spots.

This species differs not only in the size and the general appearance from *reticulata* (Semper), but the weak calcareous ring with the distinct traces of green separates it distinctly from *reticulata*, which species has a rather stout calcareous ring without any traces

of green. Furthermore the size and the shape of the anchors and anchor-plates afford usuable characters for separating the two species.

Synaptula reticulata (Semper).

Synapta reticulata. Semper. 1868. Die Holothurien, pag. 13. Pl. IV fig. 4—5, Pl. V fig. 12 & 23, Pl. VI fig. 9.

Synapta reticulata. Sluiter. 1888. Die Evertebraten . . ., pag. 214.

Chondrocloea reticulata. Østergren. 1898. Das System der Synaptiden.

— — Sluiter. 1901. "Siboga" Holothurien, pag. 127.

Synaptula reticulata. Clark. 1908. The Apodous Holothurians, pag. 86.

— — Clark. 1924. The Synaptinae, pag. 477.

Off Toeal. 21.III.1922. 1—2 m. Between Hydroids and Alcyonarians. 75 specimens.

Toeal. 21.III.1922. 2 m. Sand. Eunice-tubes. 4 specimens.

There is in my opinion no doubt that this is Sempers *Synapta reticulata*, though the present specimens have some more digits and polian vesicles. The specimens at hand measure from 1—4 cm in length. The colour is more or less dark purple and distinctly reticulated. The small specimens are much darker than the larger ones, and the suggestion lies at hand that these specimens represent Bedford's variety var. *nigropurpurea*. This may be right, but as there are no other distinct differences between the small and the large specimens, I do not suppose that there is reason enough for separating them into two groups.

There are usually 10 tentacles. A single one has only 9, but none of the 79 specimens at hand have more than 10. Each tentacle is supplied with 15—17 pairs of digits, which are united by a web. The eyes are small and hardly visible on the oral disk. The cartilaginous ring is very stout, and on its exterior side there are large muscular impressions. The anterior margin is very characteristic. The calcareous ring is a little reddish, but there are no traces of green. The radial pieces (Fig. 25. 1) are perforated. The cartilaginous ring is well developed around the calcareous ring, and its posterior part is distinctly "tentacle-canals". There are 12—14 polian vesicles and a single stone-canal. The madreporite is short and agrees pretty well with Semper's figure. The gonads are thin and several times branched. The oesophagus is distinctly different from the intestine which has a large loop. On the mesenteries there are ciliated funnels of the usual shape and size.

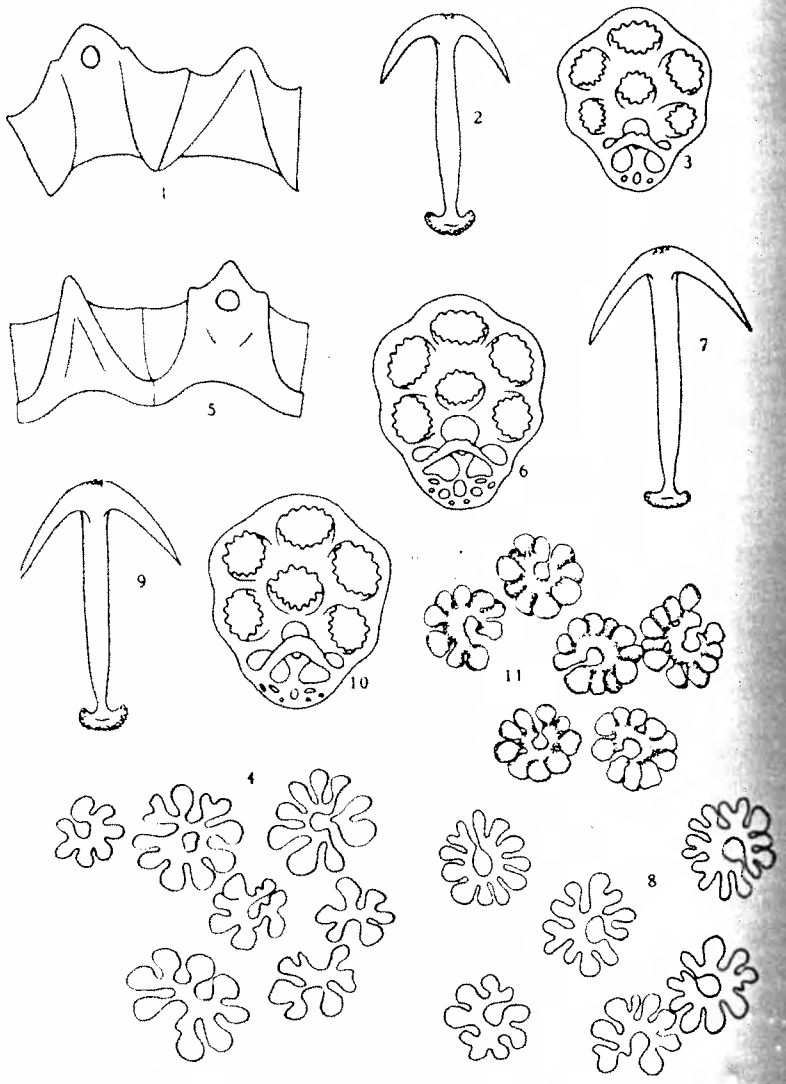


Fig. 25. Calcareous deposits and calcareous rings of *Synaptula reticulata* 1—4; *Synaptula purpurea* 5 & 9-11; *Synaptula lamperti* 6—8. Anchors and plates × 180, rosettes × 1000, calcareous rings × 36.

The calcareous deposits from the two ends of body are not distinctly different. The anchors (Fig. 25. 2) measure ca. 180 μ in length and 100 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 25. 3) measure ca. 150 μ in length and 125 μ in width. The articular hole is smooth and on the bridge there are some few teeth. In the posterior end of the plates there are three small holes. The miliary granules (Fig. 25. 4) are rosettes of irregular size and shape.

I quite agree with Clark that "young individuals (and perhaps adults) of two or more species are confused under the name reticulata". As seen above Sluiter's variety *maculata* may be regarded as a valid species, and the following species *lamperti*, most likely agrees with Lampert's striped specimens of "*reticulata*".

Synaptula lamperti n. sp.

Synaptula reticulata. Lampert. 1889. Die während der Expedition der Gazelle gesammelten Holothurien.

Banda. 5.VI.1922. Ca. 20 m. Sand, Sponges. One specimen.

The specimen at hand measures 5 cm in length by 0,3 cm in diameter. The colour is grey with five purple stripes, one in each ambulacrum. It has 10 tentacles each with ca. 15 pairs of digits, united by a web. Eye-spots are present on the oral disk. The calcareous ring is pure white and in shape quite as the ring of *reticulata*. The cartilaginous ring is well developed and there are no "tentacle-canals", but only large holes through the posterior margin. There are 10 polian vesicles and a single stone-canal. The gonads are branched and the loop on the intestine is wanting. The alimentary canal is in its whole length fastened by the mid-dorsal mesentery. The left dorsal mesentery is very large, as in the specimen of *hydriformis*, which is lacking the loop on the intestine, but not united with the intestine. The right ventral mesentery is very faintly developed, and only fastened to the rectum. On the two large mesenteries there are a great abundance of ciliated funnels.

The anchors (Fig. 25. 7) measure ca. 230 μ in length and ca. 150 μ in width. The stock is finely dented, and on the vertex

there are minute knobs. The anchor-plates (Fig. 25. 6) measure ca. 170 μ in length and 140 μ in width. The articular hole is usually smooth, and on the bridge there are faint knobs. In the posterior end of the plates there are constantly nine holes, the central one of which, is the largest. The miliary granules (Fig. 25. 8) are rosettes.

This species is in several respects very like *reticulata*, but the peculiar colour and the shape of the anchors and anchor-plates (especially that of the articular end) separate it so much from this species that they are easily separated.

Synaptula purpurea n. sp.

Banda. 5.VI.1922. Ca. 20 m. Sand, sponges. 1 specimen.

The specimen at hand measures 3 cm in length. The colour is purplish-brown with faint white stripes due to heaps of miliary granules. The tentacles are bright yellow and for this reason very different from the body. There are 10 tentacles, each with ca. 15 pairs of digits united by a web. On the oral disk there are eye-spots. The cartilaginous ring is as in *lamperti* well developed, with large perforations close to the circular canal. The calcareous ring (Fig. 25. 5) is pure white and has large muscular impressions. The radials are perforated for the nerves. There are eight polian vesicles and a single stone-canal. The gonads are branched and the intestine has a large loop. On the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 25. 9) measure ca. 200 μ in length and 130 μ in width. The stock is finely dented and on the vertex there are minute knohs. The anchor-plates (Fig. 25. 10) measure ca. 150 μ in length and 130 μ in width. The articular hole is smooth and the thick bridge is usually smooth. In the posterior end of the plates there are 6—8 small holes. The miliary granules (Fig. 25. 11) are small rosettes, which are unusually thick.

This species is the most closely related to *reticulata* and *lamperti*, but it differs distinctly from these latter in the tentacles being yellow, in the shape of the calcareous ring, and in that of the calcareous deposits.

Synaptula bandae n. sp.

Zonnegat, Banda. 4.VI.1922. Sand, coral. 1 specimen.
Banda. 5.VI.1922. Ca. 20 m. Sand, sponges. 1 specimen.[1])
Off Waling, Banda. 15.VI.1922. 15 m. Sand. 1 specimen.

The specimens at hand measure ca. 3 cm in length. Their colour is in the two specimens pure white, and in the third, that from Banda 5.VI., there is a faint purple stripe in each ambulacrum, so the colour of this specimen is rather like that of *lamperti*. There are 10 very short tentacles, each with but 4—5 pairs of digits. The tentacles are in the two specimens so contracted that the presence or absence of a web cannot be ascertained, but in the third, the striped specimen, a distinct web is present. On the oral disk there are eye-spots. The cartilaginous ring is very faint and has large perforations through the posterior margin. The calcareous ring (Fig. 26. 3) is very characteristic, as it is short and thick with large muscular impressions. It is pure white and the radials are perforated for the nerves. In the striped specimen there are 10 polian vesicles. The two other specimens are not so well preserved that it is possible to see the number of the polian vesicles. In all the three specimens there is one stone-canal. The gonads are branched and the intestine has a large loop. On the mesenteries there are ciliated funnels of the usual size and shape.

The calcareous deposits, especially the anchor-plates, are in this species lying more densely than in any other species known. Only in the striped specimen, they are somewhat more spread. The anchors (Fig. 26. 1) measure ca. 230 μ in length and 150 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 26. 2) measure ca. 170 μ in length and 140 μ in width. Their shape is very like that of the anchor-plates in *rosetta*, the posterior end being very narrow. The articular hole is usually smooth and on the bridge there are irregular knobs. In the posterior end there are three small holes. The miliary granules (Fig. 26. 4) are rather characteristic. They are ca. 30 μ large rosettes, which are lying in a dense layer all over the body.

The specimen from Banda 5.VI differs in several respects from the two other specimens, of which that from off Waling is the type;

[1]) The identification of this specimen is not beyond doubt.

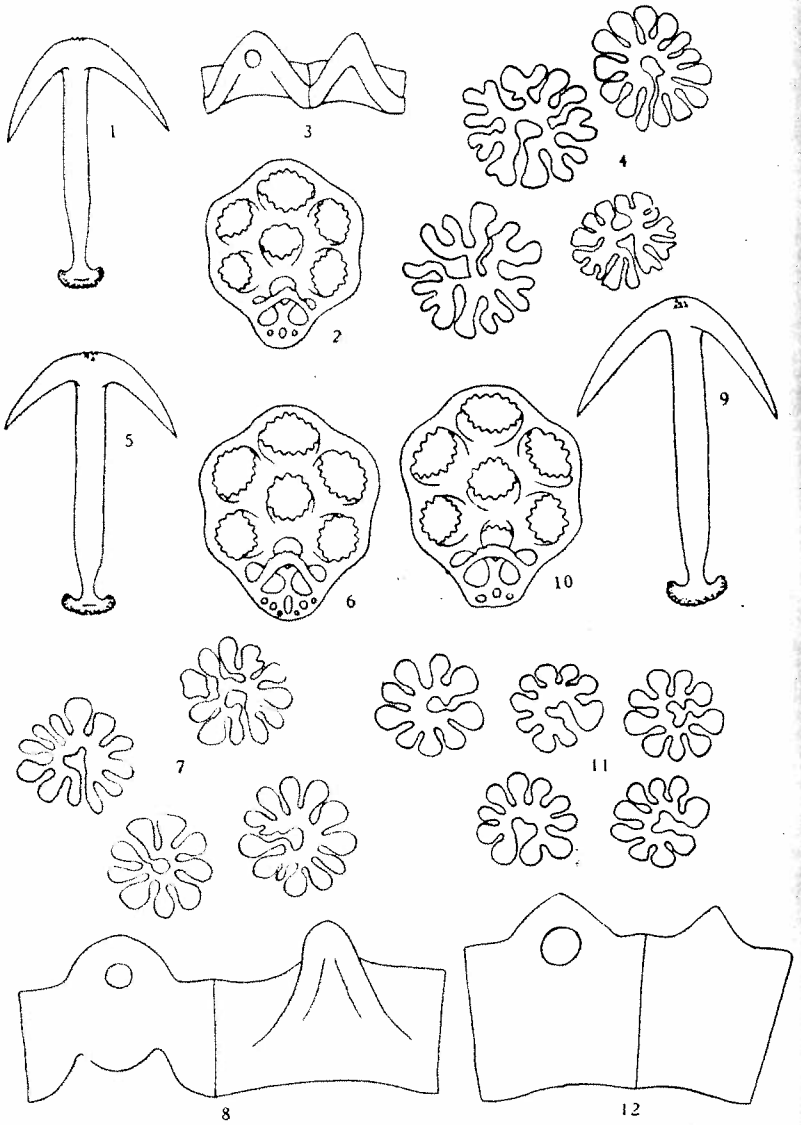


Fig. 26. Calcareous deposits and calcareous rings of *Synaptula bandae* 1–4, *Synaptula membrana* 5–8, *Synaptula lactea* 9–12. Anchors and plates × 180; rosettes × 1000; calcareous rings × 36.

but as the calcareous deposits and the calcareous ring are rather alike, I have referred them to the same species.

Synaptula bandae is not closely related to any other known species.

Synaptula membrana n. sp.

Between Koh Mesan and Koh Chuen. 6.II.1900. 15 fms. Stones. 2 specimens.

Off Neira Banda. 14.VI.1922. 25 m. Sand. 2 fragments.[1])

The specimens from 6. II. 1900 measure 5 cm in length; their colour is pure white. They have ten tentacles. Each tentacle is 0,5 cm long, with 16—20 pairs of long and slender digits, which are united by a web. The eyes are small and not visible on the oral disk. The cartilaginous ring is very faintly developed or quite wanting, and the circular canal is unusually thick. The pure white calcareous ring (Fig. 26. 8) is stout and of a very characteristic shape, different from the calcareous ring in all other known species. The interradials have long anterior processes and their posterior margin is, contrary to that of the radials, only slightly concave. The radials are perforated for the nerves. There are 18 and 29 polian vesicles in the two specimens from Siam and the stone-canal is single. The oesophagus is distinctly different from the rest of the alimentary canal, and on the intestine there is an unusually large loop. The loop measures ca. 4 cm in length and the specimens are as said 5 cm long. On the mesenteries there are ciliated funnels of the usual shape and size.

The anchors (Fig. 26. 5) measure ca. 230 μ in length and 150 μ in width. The stock is finely dented and on the vertex there are minute knobs. The plates (Fig. 26. 6) measure ca. 200 μ in length and 160 μ in width. The articular hole is usually smooth. The bridge is often smooth, though there are usually some small teeth on it. In the posterior end of the plates there are ca. 7 small holes, the medial one of which is distinctly the largest. The miliary granules (Fig. 26. 7) are rosettes, which are lying in so dense a layer that it is nearly impossible to see the anchors and plates.

This species is not closely related to any of the others; it is very distinctly characterized by the long tentacles, the calcareous

[1]) The identification of the two fragments from off Neira is not beyond doubt.

ring and the total or nearly total wanting of a cartilaginous ring. Also the calcareous deposits as well as the colour afford valuable, though not very conspicuous characters.

Synaptula lactea (Sluiter).

Synapta lactea. Sluiter. 1888. Die Evertebraten .... Batavia, p. 216.
Chondrocloea lactea. Østergren. 1898. Das System der Synaptiden.
„ „ Sluiter. 1901. "Siboga" Holothurien. pag. 126.
Synaptula lactea. Clark. 1908. The Apodous Holothurians. pag. 85.

Between Koh Mesan and Cape Liant. 7. II. 1900. 5—8 m. 1 specimen.
Zonnegat, Banda. 4. VI. 1922. Sand, coral. 1 specimen.
The Kei Islands. S. of Doe Roa. 10. IV. 1922. 40 m. Sand. 1 specimen.[1])

The largest specimen at hand measures 10 cm in length; the others no more than 4 cm in length. The colour is in alcohol very pale rose or nearly white. The two specimens have 10 tentacles, but that from Doe Roa has a rudimentary one more. Each tentacle has ca. 12 pairs of free digits which are nearly quite retracted into the tentacle. On the oral disk there are faint eye-spots. The cartilaginous ring is weakly developed, and the pure white calcareous ring (Fig. 26. 12) is unusually stout. The large, nearly square pieces are quite without muscular impressions; the radials are perforated for the nerves. There are 6—7 polian vesicles and a single stone-canal. The gonads are branched, and the intestine has a faint loop. On the mesenteries there are ciliated funnels of the usual shape and size.

The anchors (Fig. 26. 9) measure ca. 240 μ in length by 150 μ in width. The stock is finely dented, and on the vertex there are minute knobs. The anchor-plates (Fig. 26. 10) measure ca. 170 μ in length and 150 μ in width. The articular hole has the anterior margin serrate, and on the bridge there are small knobs. In the posterior end of the plates there are three small holes. The miliary granules (Fig. 26. 11) are rosettes. They are in the two specimens rather equally spread over the body, but in the specimen from Doe Roa they are gathered into small heaps.

This species is not closely related to any of the other known species. It is distinctly characterized by the colour and by the free digits, as well as by the shape of the calcareous ring. Also the

[1]) The identification of the specimen from Doe Roa is not beyond doubt.

shape of the calcareous deposits is rather characteristic of the species. The specimen from Doe Roa is in most characters very like the other two specimens, but there are many but very faint differences indicating that it is probably another species. Still, as the specimen is less well preserved and the differences are so slight, I have referred it to *lactea* and not described it as an independent form.

Synaptula østergreni n. sp.

The China Sea. 20° N, 114° E. On Sea-weed. Koch. 11 specimens.

The specimens at hand measure 1—4 cm in length by 0,3 cm in diameter. They are quite colourless and the body-wall is thin and translucent. They have 10 tentacles, each with 16—20 pairs of digits, united by a web. On the oral disk there are eye-spots. The calcareous ring is pure white, and consists of 10 pieces of nearly equal size and shape. The radials are perforated for the nerves. The cartilaginous ring is faintly developed, quite translucent and has distinct "tentacle-canals" (Fig. 27. 10). There are eight polian vesicles of varying size and a single stone-canal. The gonads are weakly developed, but distinctly branched. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 27. 7) measure ca. 150 μ in length and 100 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 27. 8) measure ca. 130 μ in length and 110 μ in width. The articular hole as well as the bridge are quite smooth, and in the posterior end of the plate there are three small holes. The miliary granules (Fig. 27. 9) are partly dissolved circles of minute granules.

This species is apparently not closely related to any of the other species, but as all the specimens at hand are rather small, juvenile ones, it is not beyond doubt that it will not prove to be closely related to, or even identical with one of the other and better known species. Still as all the specimens are rather alike, and it is not possible to refer them to any known species, I think it the better course for the present to describe them as an independent species.

Synaptula minima n. sp.

The Kei Islands. Off Doe Roa. 18. IV. 1922. Ca. 40 m. Sand. One specimen.

The single specimen at hand does not measure more than 1 cm in length. The colour is grey with 4—5 faint purple stripes in each interambulacrum. The tentacles are brown. There are 10 tentacles, each with 6 pairs of digits. The digits are, as far as can be seen, not united by a web, but as the tentacles are much contracted, this cannot be stated with certainty. On the oral disk there are faint eye-spots. The calcareous ring consist of 10 pieces which, as in *østergreni*, are of nearly equal size and shape. The radials are perforated for the nerves. The cartilaginous ring is very faint (or quite wanting). There are three polian vesicles and a single stone-canal. The gonads are faintly developed, but distinctly branched. The intestine has a large loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 27. 11) are ca. 135 μ long and 75 μ wide. The flukes are rather short and thick, and on the vertex there are some few minute knobs. The stock is, as in the other species, finely dented. The plates (Fig. 27. 12) measure ca. 125 μ in length and 125 μ in width. The articular hole has the anterior margin serrate, and on the bridge there are some few teeth. In the posterior end of the plates there is but a single hole. The miliary granules (Fig. 27. 13) are circles of minute granules.

This species is as *østergreni* based on a very young specimen, and the validity of it is for that reason not beyond doubt. But as it differs so much from all the other species known in the size and shape of the calcareous deposits, I prefer to describe it as an independent species.

Synaptula ater n. sp.

Toeal. 25. III. 1922. 1—2 m. Rocky wall with sponges. 1 fragment.

The fragment in hand is in the exterior so characteristic, that it is easily separated from all other species of *Synaptula*. It measures 16 cm in length, and the colour (Pl. II fig. 5) is dark violet with white stripes, one in each ambulacrum. The anterior end with the tentacles, the calcareous ring and the polian vesicles are wanting. The posterior end of the branched gonads is present. The

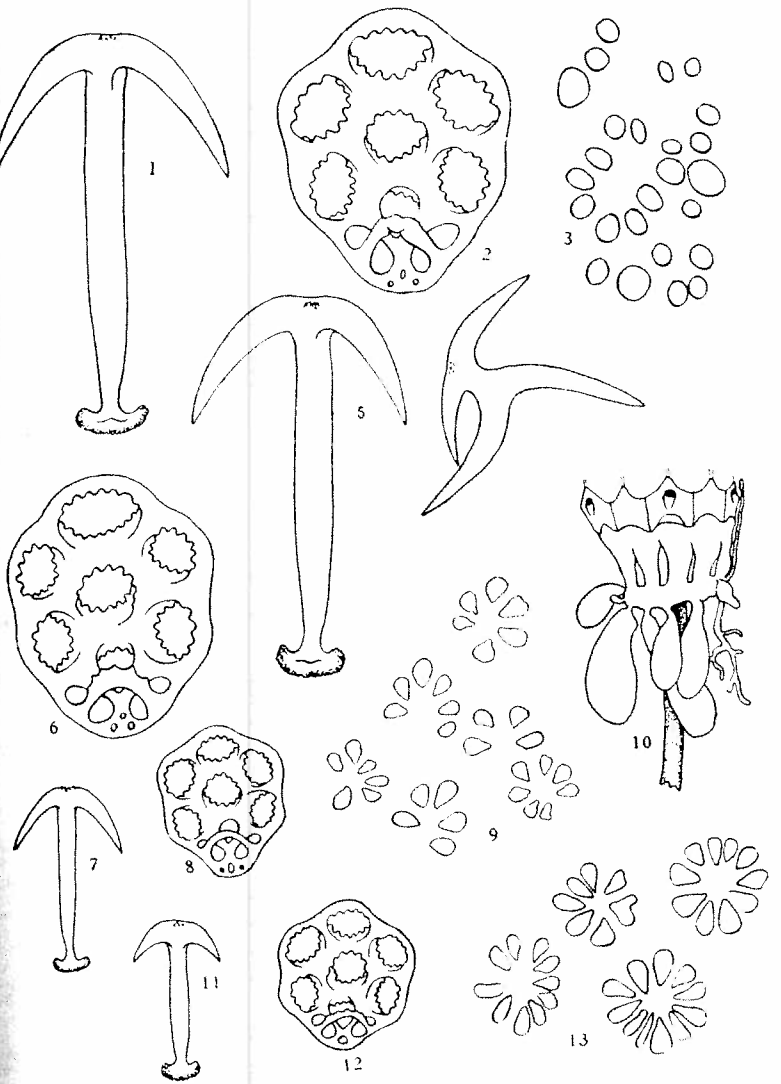


Fig. 27. Calcareous deposits and water-vascular-system of *Synaptula ater* 1—4, *Synaptula violacea* 5—6. *Synaptula østergreni* 7—10. *Synaptula minima* 11—13. Anchors and plates × 180; rosettes × 1000; fig. 10 × 12.

intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 27. 1) measure ca. 330 μ in length and 200 μ in width. The stock is finely dented and on the vertex there are some minute knobs. These latter are usually arranged in a single group placed on the vertex itself, but in many of the anchors they are found on one of the sides of the vertex. The anchors as well as the anchor-plates are in both ends of the fragment of the same size and shape, but abnormal ones may occur (Fig. 27. 4). The anchor-plates (Fig. 27. 2) measure ca. 230 μ in length and 170 μ in width. The articular hole is usually smooth, but the anterior margin of it may have some few large teeth. The bridge is uneven and often united with the sides of the articular hole. In the posterior end of the plates there are three very small holes. The miliary granules (Fig. 27. 3) are only found in the white stripes in the ambulacra. The minute granules are often arranged in more or less complete circles.

This species is distinctly different from all other species of the genus. It is characterized by the dark colour with the five white stripes and by the shape of the calcareous deposits.

Synaptula violacea n. sp.

Koh Sarlak, Gulf of Siam. 16. III. 1909. Coral-blocks. One fragment.

The fragment at hand is in the exterior quite like a fragment of *Chiridota violacea* Johs. Müller, but the presence and the shape of anchors and anchor-plates, proves that it is a *Synaptula*. The peculiar colour and the shape of the anchors and plates separate it from all the known species of the genus, and as these characters may be sufficient for characterizing the species, it will be the better course to describe it as an independent species.

The fragment measures 3 cm in length and 2 cm in diameter. The colour is uniformly brownish-purple. The intestine has a loop and on the mesenteries there are ciliated funnels of the usual size and shape.

The anchors (Fig. 27. 5) measure ca. 320 μ in length and 190 μ in width. The stock is finely dented and on the vertex there are minute knobs. The anchor-plates (Fig. 27. 6) measure ca. 210 μ in length and 180 μ in width. The anterior margin of the articular hole is serrate, and on the thick bridge there are large teeth. In the posterior end of the plates there are three small holes of equal size. The miliary granules are nearly quite dissolved circles of minute granules.

Synaptula violacea is an easily recognizeable species, distinctly separated from the other known species, by its size and colour.

Leptosynapta Verrill.

Leptosynapta Verrill. 1867. On the geographical distribution of the Echinoderms of the west coast of America. pag. 325.
Synapta. Østergren. 1893. Das System der Synaptiden. p. 114.
„ Clark. 1901. The Synaptas of the New England coast. pag. 21.
Leptosynapta. Clark. 1908. The Apodous Holothurians. pag. 86.

Genotype: *Synapta tenuis* Ayres.

This genus was proposed in 1867 by Verrill (Op. cit. pag. 325; the footnote) for "such species as *S. tenuis* Ayres of New England and *S. inhaerens* of Europe" and he furthermore writes that "*S. tenuis* may be regarded as the type". In spite of this the genus *Leptosynapta* was for more than thirty years regarded as invalid, and the two mentioned species for this reason referred to *Synapta*. As Østergren in 1898, divided the old genus *Synapta* into different independent genera, he used the name *Synapta* for that genus of which *inhaerens* was the typical species. In "The Apodous Holothurians", Clark shows that the name *Synapta* must be used for the genus of which *maculata* Chamisso & Eysenhardt is the type, and that Østergren's genus *Synapta* is identical with Verrill's *Leptosynapta*, which name then must be used.

In discussing this question, Clark has no doubt that *inhaerens* O. F. Müller is the genotype for *Leptosynapta*, as he is quite convinced that *inhaerens* is a circumpolar species, common at the American coasts, and that *tenuis* Ayres is synonymous with it. In "The Synaptas of the New England coast" he writes: "The common white *Synapta* of the New England coast is *S. inhaerens* (O. F. Müller)" and "*S. girardii* Pourt. and *S. tenuis* Ayres are synonyms of that species". The examination of the American specimens of *Leptosynapta* in Dr. Mortensen's large collection, shows that *inhaerens* is not represented among them. This does not agree with the fact that *inhaerens* is reported from numerous American localities, and leads to the suggestion that the American specimens do not really belong to *inhaerens*. In order to have this question solved, some

specimens of the supposed *inhaerens* were ordered from Woods Hole, the american type-locality of the species. The examination of these beautifully preserved specimens, shows that they are distinctly different from the European specimens of *inhaerens* from the Norwegian coast (The differences are mentioned below in the description of *Leptosynapta tenuis* (Ayres) pag. 209). I therefore cannot hesitate in supposing that *inhaerens* (O. F. Müller) is totally wanting at the American coasts, where it is represented by *tenuis* (Ayres) in the Atlantic Ocean and by *clarki* Heding in the Pacific Ocean.

The specimens received from Woods Hole agree pretty well with the description of *tenuis* (Ayres) and as they are from the same locality I think it quite justifiable to refer them to that species which must be regarded as a valid species, distinctly different from *inhaerens*. As to the identity of *tenuis* and *girardii* (Pourtalès) I am in very great doubt, but the question cannot be answered definitely on base of the material in hand. Beside *tenuis* and *girardii* Clark has referred Selenka's two species *gracilis* and *albicans* to *inhaerens*. This is, according to what is said above, evidently erroneous; while *gracilis* without any doubt is but a specimen of *tenuis* with the calcareous deposits partly dissolved, *albicans* must be regarded as a valid species from the American coast.

In the description of *albicans* (Beiträge zur Anatomie und Systematik der Holothurien, pag. 363) Selenka does not say anything about rods in the skin. This he may perhaps have forgotten; as he has, however, both described and figured the rods from the tentacles, and in the description of other species for instance that of *Synapta agassizii* Selenka, he has figured the corpuscles from the skin, we may well be right in supposing that *albicans* (like *Leptosynapta lens* Heding and *Leptosynapta circopatina* Clark), is lacking rods in the body-wall. If so, the specimens from Kilizut Harbour, which Clark in the "Puget Sound Echinoderms" has referred to *albicans* with a ?, cannot be referred to this species. In the collection of Dr. Mortensen, there are from the Pacific coast of North America, four different species of *Leptosynapta*, but none of them may be referred to *albicans*. Clark's specimens from Kilizut Harbour are closely related to only one of them, *clarki* Heding, from which species they differ in lacking sensory cups on the tentacles and rods in the interambulacra. But as Clark had only one little specimen and a fragment, we cannot lay too much weight on these characters, and there is in my opinion hardly any doubt, that the specimens from Kilisut Harbour belong to the species *clarki*.

In "The Apod. Holoth." Clark refers nine species to the genus *Leptosynapta*, and since then eight new species, all referred to this genus, have been described. The collection at hand includes, though no European specimens are included, 487 specimens representing 15 different species which all belong to the genus as it is characterized by Clark in "The Apod. Holoth.". The study of these beautifully preserved specimens shows that the genus, as diagnosed by Clark, includes distinctly different groups, and that it will be the most reasonable to separate the six species

Synapta roseola Verrill 1874,
Epitomapta tabogae Heding,
Synapta ooplax v. Marenzeller 1881,
— — var. *lævis* Bedford 1889,
— *acanthia* Clark 1890,
Leptosynapta multipora Clark 1924,

from *Leptosynapta* and establish three new genera or subgenera *Epitomapta*, *Patinapta* and *Eupatinapta* with the species *tabogae*, *ooplax* and *acanthia* as the genotypes. When these species are separated from *Leptosynapta*, the diagnosis of the genus thus restricted must be a follows: Tentacles 10—12, usually pinnate. Digits few, 1—9 on each side of the tentacle (in *minuta* Becher the digits are said to be entirely wanting). Sensory cups are usually present on the tentacles and eye-spots are wanting. The radial pieces of the calcareous ring are perforated for the nerves, and a cartilaginous ring is wanting. Polian vesicles few 1—5, and the stone-canal single and unbranched. Ciliated funnels are always present (in *minuta* there is but a single one), and of very varying shape. The calcareous deposits are often slightly different in the two ends of body, those from the posterior end being the larger. The anchor-plates have normally seven large teethed holes. A well defined bridge is wanting.

To the genus thus characterized twelve of the species at hand must be referred. The study of these shows that the American

species in several respects differ distinctly from those from Australia as well as from *inhaerens* (O. F. Müller) and *chela* Mortensen. All the American species at hand except the ten-tentacled species *transgressor*, are characterized in having the anchors from the posterior end of body longer and more slender than those from the anterior end, and furthermore in having two distinctly different sizes and shapes of ciliated funnels, of which the larger ones are in shape very like the flower of a *Lamium* or an *Antirrhinum*. This is not the case with the Australian species or with *inhaerens* and *chela*, in which species the anchors from the two ends of the specimens are not distinctly different, and the ciliated funnels, though of varying size, are of only one sort being more or less fan-shaped.

The following 25 more or less well known species may be referred to *Leptosynapta*.

1. *Holothuria inhaerens* O. F. Müller 1776. The west coast of Scandinavia.
2. *Synapta tenuis* Ayres 1851. Woods Hole.
3. — *dolabrifera* (Stimpson 1855) Clark 1924. Port Jackson.
4. — *galliennii* Herapath 1865. Guernsey.
5. — *albicans* Selenka 1867. Mendocino, California.
6. — *macrankyra* Ludwig 1887. Naples, Mediterranean.
7. — *bergensis* Østergreen 1905. The west coast of Scandinavia.
8. — *decaria* Østergren 1905. The west coast of Scandinavia.
9. — *minuta* Becher 1906. The North Sea.
10. *Leptosynapta latipatina* Clark 1921. The Torres Strait.
11. — *circopatina* — 1924. Jamaica.
12. — *crassipatina* — Key West, Florida.
13. — *ictinodes* — Western Port, Victoria.
14. — *multigranula* — Tortugas, Florida.
15. — *parvipatina* — Bucco Bay, Tobago.
16. — *chela* Th. Mortensen 1926. The Red Sea.
17. — *micropatina* n. sp. Tobago.
18. — *clarki* n. sp. Nanaimo.
19. — *lens* n. sp. La Jolla, California.
20. — *transgressor* n. sp. Nanoose Bay.

21. *Leptosynapta roxtona* n. sp. Roxton Passage, Vancouver.
22. — *variopatina* n. sp. Long Reef, Australia.
23. — *jacksonia* n. sp. Port Jackson
24. — *reducta* n. sp.
25. — *irregularis* n. sp.

As we do not know the number of the tentacles in *roxtona*, this species is found two times in the key, both in the group with 10 tentacles and in that with 12 tentacles.

Key to the species of *Leptosynapta*.

1. Tentacles ten (9—11) 2
   Tentacles twelve (11—13) 5
2. European species 3
   American species 4
3. Digits wanting, beside anchors and plates small perforated plates with four holes ..... *minuta*
   Digits present, 2—4 on each side of tentacle. No small perforated plates ..... *decaria*
4. Anchors and plates small (up to 150 μ); not different in the two ends of the body. Anchor-plates often more or less reduced in the articular end (Fig. 32. 11) ..... *transgressor*
   Anchors in posterior end of specimen ca. 220 μ long. The plates never reduced or *Labidoplax*-like ..... *roxtona*
5. European species 6
   Australian and Indo-Pacific species 9
   American species 16
6. Anchors not more than 500 μ in length 7
   Anchors 500—800 μ in length ..... *macrankyra*
7. Anchors not more than 300 μ in length. Intestine without a loop *inhaerens*
   Anchors 300—500 μ in length. Intestine with a loop 8
8. Anchor-plates of anterior end of body in the main smooth.. *bergensis*
   Anchor-plates of anterior end of body with serrate edge .... *galliennii*
9. Rods wanting, miliary granules small ca. 7 μ large bodies. Anterior end of specimen nearly black ..... *ictinodes*
   Rods present. Colour not blackish 10
10. Rods in posterior end of body more or less bent, and often "chela-shaped". Their ends not perforated 11
    Rods in posterior end of body irregularly shaped; often with perforated ends ..... *latipatina*
11. Outline of rods in digits usually smooth, very seldom weakly undulating and never with distinct knobs 12

Outline of rods in digits very seldom smooth, usually distinctly undulating or with large knobs 14

12. Rods in digits with enlarged and perforated ends..... *variopatina*
Ends of digital rods not distinctly enlarged and never perforated.... 13

13. Rods in digits curved and branched (Fig. 39. 1) and distinctly different from those in tentacle-stem. Anchor-plates usually irregularly formed with a varying number of additional holes in anterior end . *irregularis*
Rods in digits not so distinctly curved and branched (Fig. 35. 9) and not different from those in tentacle-stem. Anchor-plates often more or less reduced in the articular end; additional holes not found *reducta*

14. Rods in digits distinctly undulating, often with large knobs. Rods in tentacle-stem nearly smooth..... .. *dolabrifera*
Rods in digits and tentacle-stem alike, all with more or less undulating outline 15

15. Outline of rods undulating, often nearly smooth. Ends not perforated. (Red Sea) ..... *che'a*
Outline of rods with large knobs. Ends usually perforated. (Port Jackson)..... *jacksonia*

16. Pacific species 17
Atlantic species..... 20

17. Rods wanting in body-wall, minute granules often present 18
Rods present in body-wall, minute granules wanting..... 19

18. Tentacle-rods wanting, minute granules present..... *lens*
Tentacle-rods present ..... *albicans*

19. Beside the common rods, large curved rods are present in the interambulacra. Anchor-arms short (Fig. 31. 1-5)..... *clarki*
No large curved rods in interambulacra. Anchor-arms long and slender (Fig. 33. 1) ..... *roxtona*

20. Miliary granules wanting. Anchor-plates more or less rounded, with smooth holes..... *circopatina*
Miliary granules present. Anchor-plates more or less oblong with dented holes 21

21. Tentacle-rods wanting ..... *crassipatina*
Tentacle-rods present..... 22

22. Anchors small 80—120 μ, tentacle-rods short and wide, usually irregularly perforated (Fig. 30. 9-10) ..... *micropatina*
Anchors larger 140—200 μ. Tentacle-rods long and slender and not perforated (Fig. 29. 2 & 4)..... *tenuis*

Leptosynapta tenuis (Ayres).

Synapta tenuis. Ayres. 1851. Notices on Holothuridae. Proc. Bost. Soc. Nat. Hist. vol. IV, pag. 11.

— *ayressii*. Selenka. 1867. Beiträge zur Anatomie und Systematik der Holothurien, pag. 362.

— *gracilis*. Selenka. 1867. Op. cit., pag. 363, Pl. XX fig. 123—124.

Leptosynapta tenuis. Verrill. 1867. Notes on Radiata, pag. 325.

Synapta gracilis. Østergren. 1898. Das System der Synaptiden.

— *inhaerens*. Clark. 1899. The Synaptas of the New England coast. Pl. X fig. 3 and Pl. XI fig. 1, 3, 5, 7.

Leptosynapta inhaerens. Clark. 1908. The Apodous Holothurians, pag. 32 & 88.

Leptosynapta inhaerens. Clark. 1908. The Synaptinae, pag. 483 Pl. VII fig. 12—16.

New Haven. 5 specimens.
Woods Hole. 1927. Several specimens.

The specimens from Woods Hole measure up to 30 cm in length by ca. 1 cm in diameter. The colour is pale yellow with numerous white papillae. They have twelve pinnate tentacles, each with 9—11 digits (4—5 on each side) of which the terminal one is the longest. On the oral side of each of the tentacles there are 15—25 sensory cups. Eye-spots are wanting on the oral disk. The calcareous ring (Fig. 28. 2) is well developed. The radials are perforated for the nerves and on the exterior side there are muscular impressions. A cartilaginous ring is quite wanting. There are few, 1—3 polian vesicles, and a single stone-canal. The gonads are long and branched and the genital opening is seen on a little wart between the dorsal tentacles close to their posterior side. The oesophagus is thin and the stomach is different from the intestine which is lacking a loop. The ciliated funnels are numerous and found in the usual three interambulacra. The larger part of the funnels are small and "funnel-shaped" (Fig. 28. 1), but in the posterior end of body there are some very large ones of a quite different shape. The shape of these large funnels is rather like that of the flowers in *Lamium* (Fig. 28. 1), and they are arranged at regular intervals. They are often wanting or nearly wanting in the dorsal interambulacrum.

The common anchors in the posterior end of the specimens (Fig. 28. 4) measure ca. 200 μ in length by 110 μ in width. The arms are slender and irregularly dented. Among these anchors there are often found a few smaller ones (Fig. 28. 3), which measure but ca. 140 μ in length by 60 μ in width. The arms are not so slender as in the large anchors, but as these latter distinctly dented. In the anterior end of the specimens the anchors are of a different shape (Fig. 28. 5) and usually not toothed on the arms. They measure here ca. 140 μ in length by 90 μ in width. The anchor-

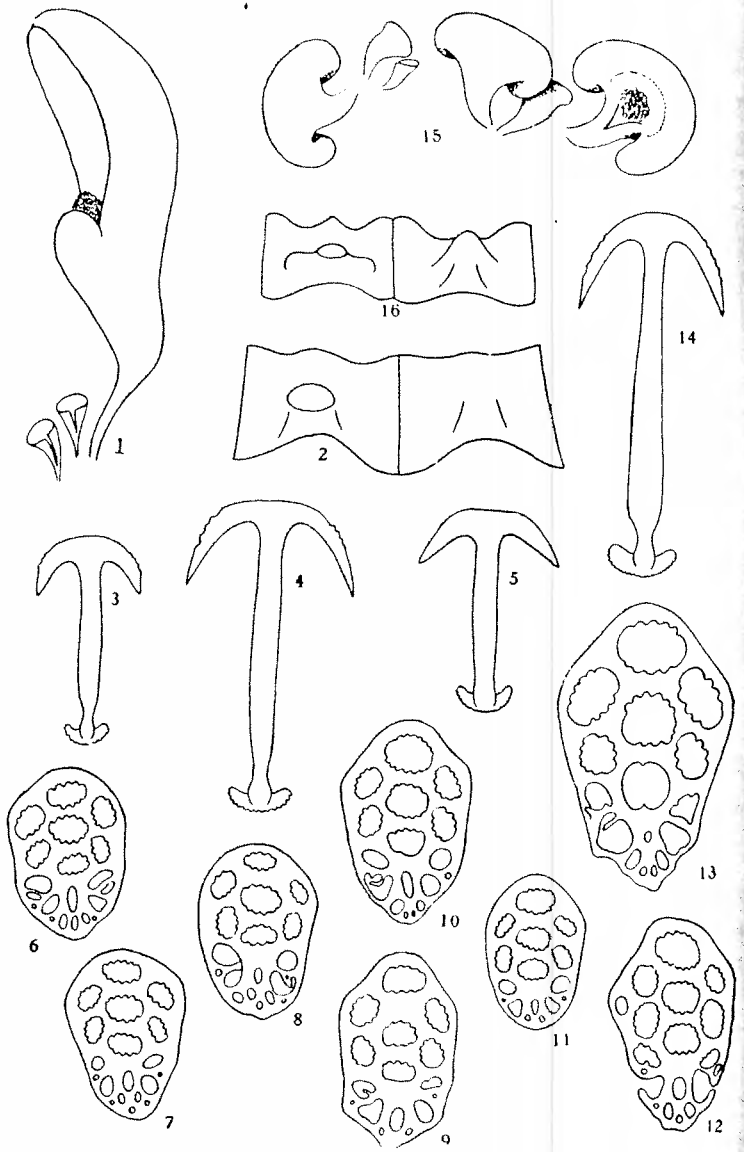


Fig. 28. Ciliated funnels, calcareous ring and calcareous deposits of *Leptosynapta tenuis* 1—12 and *Leptosynapta inhaerens* 13—16. 3—4 & 9—12 from posterior end of body; 5—8 from anterior end of body. Anchors and anchor-plates × 200, ciliated funnels × 36, calcareous ring × 24.

plates corresponding with the large anchors in the posterior end (Fig. 28. 9-10, 12) measure ca. 130 μ in length by 80 μ in width. The large holes in the anterior end of the plates are toothed. In the articular end there are besides the paired side-holes 5—7 small, smooth holes the two of which are usually situated in the "bridges" across the side-holes. Corresponding with the small anchors from the posterior end of the specimens, there are some nearly oval plates (Fig. 28. 11), which measure ca. 100 × 60 μ and are perforated in the same way as the large plates. The plates from the

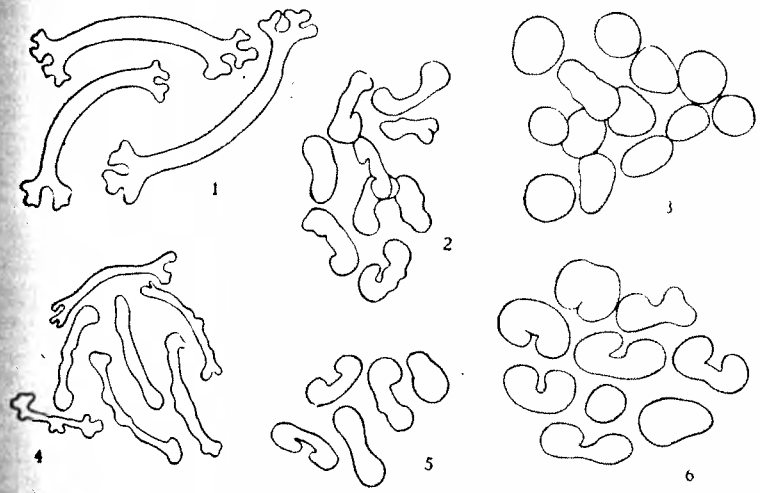


Fig. 29. Rods and miliary granules of *Leptosynapta inhaerens* 1 and *Leptosynapta tenuis* 2—6. 1—6 × 550.

anterior end of the specimens (Fig. 28. 6-8) measure ca. 110 μ in length by 70 μ in width. They are very like the small plates from the posterior end of the specimens, but they have always some more holes through their posterior end.

Miliary granules are found in the ambulacra and in the small white papillae. In most of the specimens examined, the granules in the ambulacra are small, rounded or oval plates (Fig. 29. 3), those in the papillae differing from them in being "chela-shaped" (Fig. 29. 5). In other specimens there is but one sort of miliary granules (Fig. 29. 6) which are then of somewhat varying shape. The rods in the digits (Fig. 29. 4) are irregularly shaped, but di-

stinctly different from the short and thick granules in the tentacle-stem (Fig. 29. 6).

Leptosynapta tenuis (Ayres) was hitherto regarded as synonymous with *inhaerens* (O. F. Müller), and the specimens from Woods Hole regarded as typical American examples of this species. The comparison of the American specimens with good specimens from Bergen, shows that the American specimens are specifically different from *inhaerens*. In order to put it quite clear, it may be practical to give the differing characters in tabular form.

tenuis from Woods Hole	*inhaerens* from Bergen
Skin rather thick, intransparent. All papillae white.	Skin thin and translucent. Anterior part of dorsal papillae mud-grey, the others white.
Number of digits 9—11.	Number of digits 13—17.
Number of sensory cups 15—25.	Number of censory cups 2—8.
Genital porus on a low wart, close behind the tentacles.	Genital porus on a very long papilla which is, for the two thirds of its length, united with the oral side of one of the dorsal tentacles.
Ciliated funnels of two distinctly different sorts (Fig. 28. 1). The large ones labiate.	Ciliated funnels of varying size, but not of two distinctly different sorts. The large ones being fan-shaped (Fig. 28. 15).
The anchors and anchor-plates from the posterior end of the specimens of another size and shape than those from the anterior end (Fig. 28. 3—12).	The anchors and anchor-plates from the two ends of the specimens not distinctly different. Their shape is typically different from that of the anchors and plates in *tenuis* (Fig. 28. 13-14).
Shape of calcareous ring cf. Fig. 28. 2.	Shape of calcareous ring cf. Fig. 28. 16.
Digital rods small and irregularly shaped (Fig. 29. 4). Their ends faintly enlarged and more or less branched.	Digital rods large, slightly curved and with much enlarged and branched ends (Fig. 29. 1).

From the other East American species of *Leptosynapta*, the species *tenuis* is more or less distinctly different, but the real relation between these species cannot be made out until larger collections from Florida, Jamaica and Tobago will be available.

Leptosynapta micropatina n. sp.

Tobago, B. W. I. IV.1916. The lagoon. Sand-bottom. 2 specimens.

The specimens at hand measure ca. 5 cm in length by 0,2 cm in diameter. Their colour is in alcohol pale yellow. They have 12 tentacles, each with five pairs of digits and 4—7 sensory cups. Eye-spots are wanting. The calcareous ring is well developed (Fig. 30. 12). Each piece has an anterior projection and the radials are perforated for the nerves. Muscular impressions are, especially on the radials, distinct. A cartilaginous ring is wanting. Owing to the preservation of the specimens it is not possible to see much of the internal anatomy. The gonads include well developed eggs, and the genital porus is found on a long and thin papilla. This genital papilla is found close to the tentacles; it is ca. one third of the tentacle length and thinner than the digits.

The anchors are in the posterior end of the specimens ca. 120 μ long and 60 μ wide. They are rather slender (Fig. 30. 5 a) and on their arms there are 4—5 teeth. Besides these large anchors, there are some few smaller ones, which do not measure more than ca. 79 μ in length. These anchors (Fig. 30. 5) are of the same shape as the larger, but they have not more than 2—3 teeth on the arms. The anchors in the anterior end of the specimens (Fig. 30. 7-8) measure ca. 80 μ in length. They are not so slender as the anchors in the posterior end, and their arms are usually quite smooth. The anchor-plates corresponding with the large anchors in the posterior end of the specimen (Fig. 30. 1) measure ca. 100 μ in length and 60 μ in width. They are very varying in shape, and there are distinct bridges across the side-holes. Additional holes may be found in the anterior end of the plates. The articulation with the anchors is somewhat varying (Fig. 30. 2-3) but a distinct bridge across the posterior end of the plates is wanting. The anchor-plates are usually hollow in the middle, and the posteriormost part lies somewhat lower than the rest of the plate. The plates corresponding with anchors from the anterior end of the specimens (Fig. 30. 4) measure ca. 80 μ in length and 50 μ in width. Additional holes are rare in these plates, but their articular ends are, as in the more posterior plates, very irregularly shaped.

There are only few miliary granules, which are seemingly con-

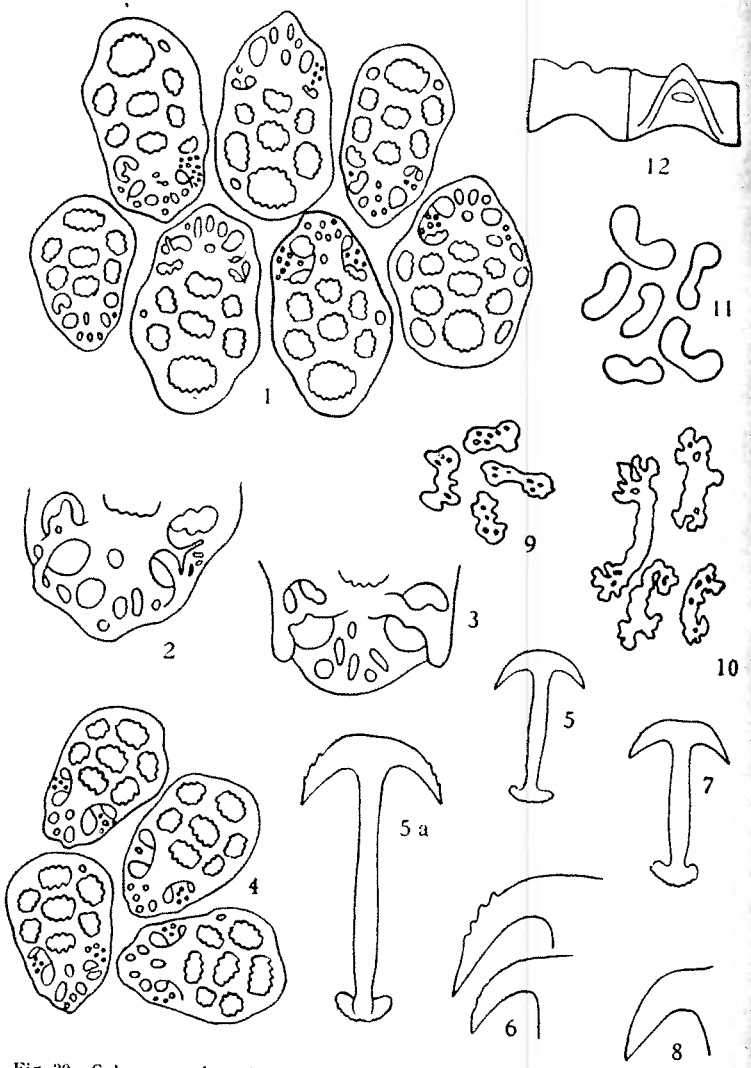


Fig. 30. Calcareous deposits and calcareous ring of *Leptosynapta micropatina*. 1–3 & 5–6 from posterior end of body. 4 & 7–8 from anterior end of body, 9 from tentacle-stem, 10 from digits, 11 from body-wall. 1 & 4–8 × 270, 2–3 & 9–11 × 450, 12 × 24.

fined to the ambulacras. They are small, rounded, more or less bent rods (Fig. 30. 11). The rods in the digits (Fig. 30. 10) as well as those in the tentacle-stem (Fig. 30. 9) are irregularly shaped and characteristic in being perforated.

Lept. micropatina appears to be most closely related to *tenuis*, from which species it differs on the other hand distinctly in the shape of the calcareous deposits. Besides, also the size of the anchors and plates afford a valid character for separating the two species, but because of the large difference in the size of the specimens in hand of the two species, this character is not for the present to be relied upon.

Leptosynapta clarki n. sp.

Roxton Passage. 9.VI.1915. 15—25 fms. Mud and stones. 2 specimens.
Nanaimo. 26.VI.1915. In the lagoon. 96 specimens.

The specimens from Nanaimo measure up to 25 cm in length by 0,5 cm in diameter. Their colour is bright yellow, the numerous small papillae on the body being of the same colour as the skin. They have twelve tentacles, each with four pairs of digits. The terminal digits are by far the longer. On the oral side of the tentacles there are usuallly 3—4 sensory cups, but there may be up to seven. Eye-spots are wanting. The radial pieces of the calcareous ring (Fig. 31. 15) are perforated for the nerves and the muscular impressions are visible. A cartilaginous ring is wanting. There are few, 1—3 polian vesicles, and a single stone-canal. The alimentary canal is straight and consists of a long and thin oesophagus, a thick and glandular, stomach-like intestine and a short rectum. The ciliated funnels (Fig. 31. 18) are found in the usual three interambulacra. There are, as in *tenuis*, two different sorts, the small ones being funnel-shaped and the larger ones labiate. The gonads are well developed and contain eggs with a diameter of ca. 240 μ. They are much branched and open on a very small papilla between the dorsal tentacles.

The anchors in the posterior end of body are rather varying in size and shape (Fig. 31. 1-3). They measure ca. 190—210 μ in length and 70—80 μ in width. The arms are rather short and distinctly serrate. The anchors from the anterior end of body are more varying than those from the posterior end (Fig. 31. 4-6).

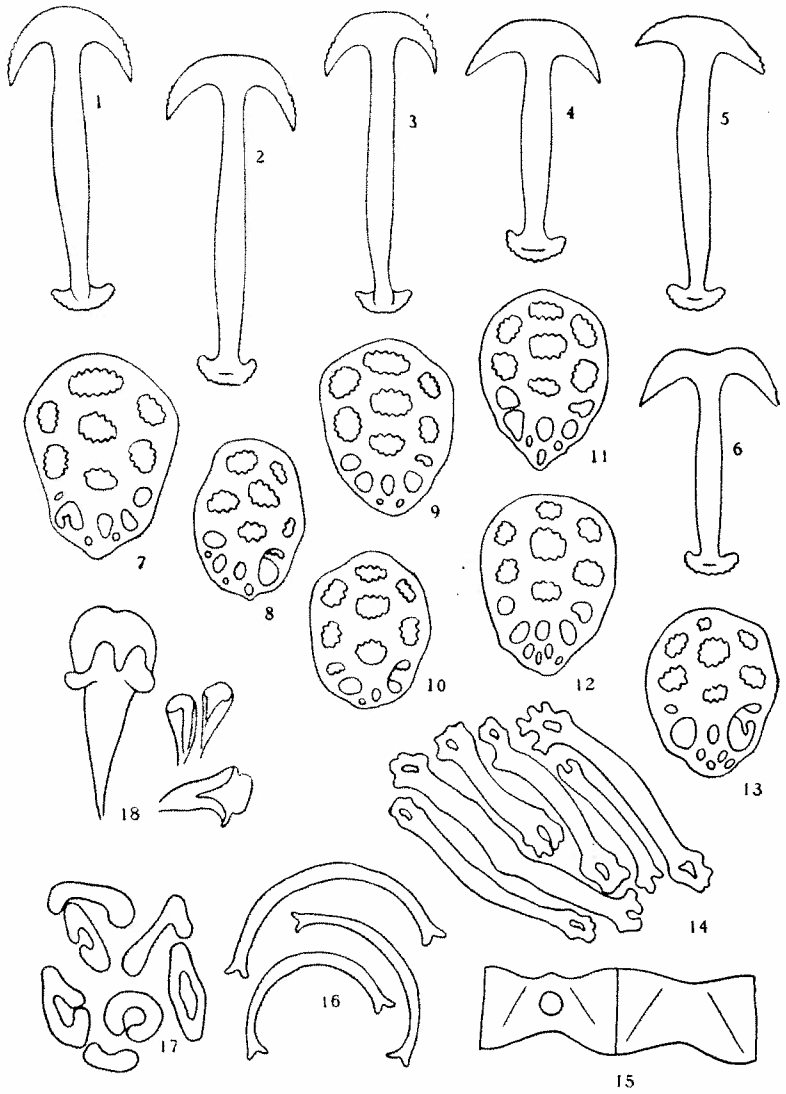


Fig. 31. Calcareous deposits, calcareous ring and ciliated funnels of *Leptosynapta clarki*. 1—3 & 7—10 from the posterior end of body, 4—6 & 11—13 from anterior end of body, 14 from tentacles, 16 from posterior interambulacra, 17 from ambulacra. 1—13 × 200, 14 & 16—17 × 450, 15 × 24, 16 × 36.

They measure 140—190 μ in length by ca. 90 μ in width. Their arms are short and thick and usually quite smooth. The anchor-plates (Fig. 31. 7-13) are of varying size and shape, but not distinctly different in the two ends of body. They measure 100—130 μ in length by 70—100 μ in width. They have usually seven large toothed holes in the anterior end, and rather few smooth holes in the articular end.

The rods in the ambulacra (Fig. 31. 17) are of varying shape, bent rods, chela-shaped bodies or rings. In the posterior end of the interambulacra there are some few large semicircular spicules with forked ends (Fig. 31. 16). The rods in the digits and in the tentacle-stem (Fig. 31. 14) are alike. They are large, nearly straight rods with enlarged, weakly branched and usually perforated ends.

This species, the West American representative of *inhaerens*, is easily distinguished from both *tenuis* and *inhaerens*, from which two species it differs in nearly all characters. I dedicate this well marked species to the eminent author of the "Apodous Holothurians".

Leptosynapta lens n. sp.

Bird Rock, La Jolla. 27. VIII. 1915. Rocky shore. 1 specimen.
False Bay, La Jolla. 12.IX.1915. Shallow water. Mud—sand. 25 specimens.

The largest specimen at hand measures ca. 3 cm in length. The skin is yellow, but the numerous brownish warts make the colour of the specimens in alcohol brownish-grey. There are twelve tentacles each of which has five pairs of digits and 6—9 sensory-cups. Eye-spots are wanting. The calcareous ring (Fig. 32. 7) is very characteristic as all the pieces have a large nearly square notch in their posterior margin. The radials are perforated for the nerves, and muscular impressions are visible. A cartilaginous ring is wanting. There is one polian vesicle and a single unbranched stone-canal. The alimentary canal is straight and the oesophagus is long and thin, and distinctly different from the stomach which, as in *clarki*, seemingly reaches to the short rectum. The gonads are branched and the genital duct opens on a long papilla. This papilla is ca. one third of the tentacle-length and is placed in the dorsal interambulacrum, its own length posterior of the tentacles. The ciliated funnels are, as in *clarki*, of two different sizes and shapes, the larger ones being labiate (Fig. 32. 6).

The anchors from the posterior end of body (Fig. 32. 1) are ca. 150 μ long and 70 μ wide. They are very slender and the arms are distinctly serrate. The anchors from the anterior end of body (Fig. 32. 2) are shorter and their arms are thicker, with but 1—3 small teeth. They measure ca. 110 μ in length and 70 μ in width. The anchor-plates from the posterior end of body (Fig. 32. 3) measure ca. 120 μ in length and 100 μ in width. They have seven large, toothed holes in the anterior end, and besides the paired side-holes, three small holes in the articular end. The plates from the anterior end of body measure ca. 190 μ in length and ca. 80 μ in width. They are rather varying in shape (Fig. 32. 4-5) and have usually in the articular end a single smooth hole more than the posterior plates. Rods are entirely wanting, both in the anterior and in the posterior end of body, but in the interambulacra there are found some very small rounded calcareous bodies (Fig. 32. 8).

Leptosynapta lens is the most closely related to *albicans* Selenka, and may ultimately prove to be identical with it. But for the present I think it is preferable to keep the form here described as a separate species.

Leptosynapta transgressor n. sp.

Roxton Passage. 9. VI. 1915. 15—25 fms. Mud and stones. 2 specimens.
Nanoose Bay. 15. VI. 1915. Ca. 25 fms. Mud and stones. 5 specimens.

The specimens at hand are very small being not more than 1 cm in length. The number of tentacles is varying; one of the specimens from Nanoose Bay has but 9, three have 10 and one has 11. The number evidently does not depend on size, as the specimen with eleven tentacles is but 0,6 cm long. The specimens from Roxton Passage are lacking the tentacles. Each tentacle has 4—5 pairs of digits and 2—3 sensory cups. The calcareous ring (Fig. 32. 10) is well developed and muscular impressions are visible. The radials are perforated for the nerves. There are 2—3 polian vesicles and a single unbranched stone-canal. In the polian vesicles there are numerous large rods (Fig. 32. 14) usually with an undulating outline. The gonads are, in the specimens at hand, unbranched, but as they are not fully developed, they may be branched in mature specimens. The opening of the genital duct is (probably due to the young age of the specimens at hand) not

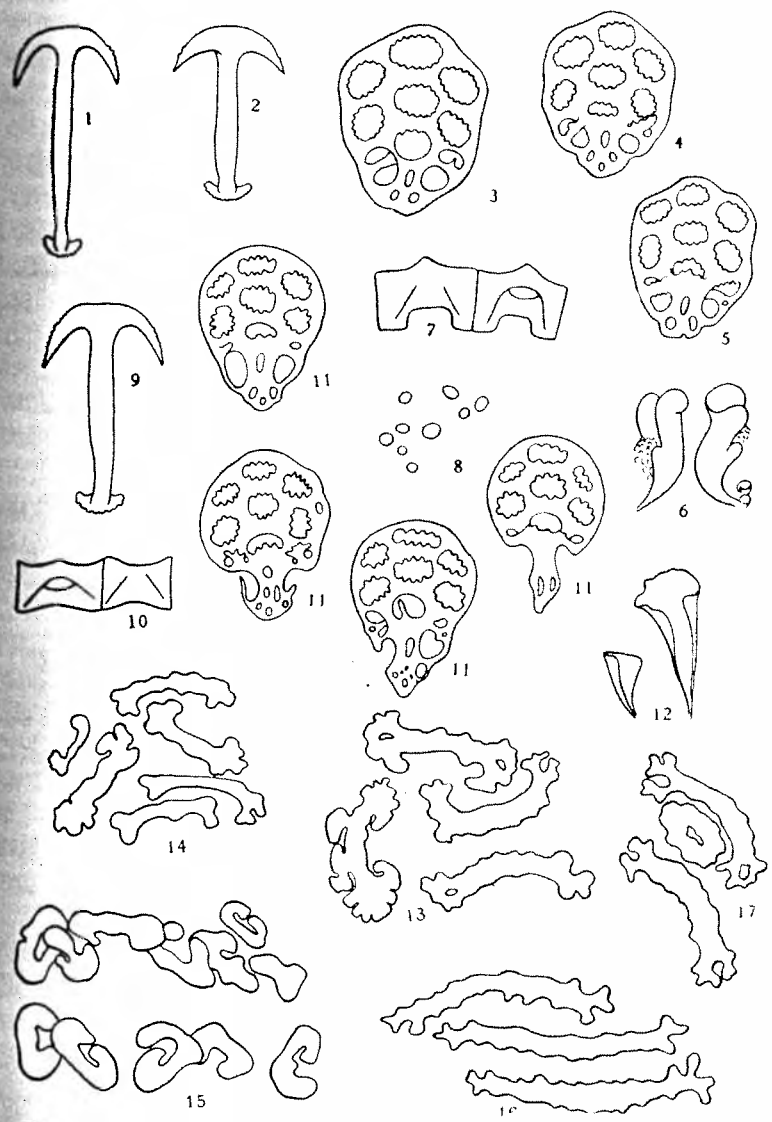


Fig. 32. Calcareous deposits, calcareous rings and ciliated funnels of *Leptosynapta lens* 1—8 and *Leptosynapta transgressor* 9—17. 1 & 3 from posterior end of body, 2 & 4—5 from anterior end of body. 13 rods from interambulacra, 14 from polian vesicle, 15 from ambulacra, 16 from digits. 17 from tentacle-base. Anchors and anchor-plates × 200, calcareous rings × 24, ciliated funnels × 36, rods × 450.

visible on the body surface. The ciliated funnels are, as in the other species, found on the body-wall in the usual interambulacra, but there is found only one sort (Fig. 32. 12) though of different sizes. They are funnel-shaped and opened in the side. There is only one sort of anchors. They measure ca. 130 μ in length and 80 μ in width, and are rather slender (Fig. 32. 9), with the arms distinctly toothed. The anchor-plates (Fig. 32. 11) are of very varying shape, and usually they are more or less reduced in the articular end, being then rather like the plates in *Labidoplax*. They measure ca. 110 μ in length and 80 μ in width. In the body there are two different sorts of rods, one in the ambulacra and one in the interambulacra. Those in the ambulacra (Fig. 32. 15) are bent or chela-shaped rods of the usual size. They are lying very densely and are arranged in two distinct rows. The rods in the interambulacra (Fig. 32. 13) are lying more scattered and never in rows, nor are they confined to the papillae. They are larger than the rods in the ambulacra and their outline is distinctly undulating. Their ends are often enlarged, faintly branched and perforated. The rods in the digits (Fig. 32. 16) are long and slender and distinctly different from the shorter and thicker ones in the tentacle-stem (Fig. 32. 17). All the rods in the tentacles and the digits are of the same size as the large rods in the interambulacra, and have as these the outline undulating.

Leptosynapta transgressor differs, besides in the number of the tentacles, distinctly from all the hitherto known species, in the shape of the calcareous deposits.

Leptosynapta roxtona n. sp.

Roston Passage. 9. VI. 1915. 15—25 fms. Mud and stones. 3 fragments.

These three fragments differ in the shape of the anchors and anchor-plates so much from all the hitherto known species, that I have no doubt in describing them as a new species. They measure 0,5—1,5—3 cm in length, and their colour is pale yellowish-grey. In the longest fragment there is a little piece of gonad present. It contains only sperma, but whether eggs are really wanting or not, cannot be ascertained as the rest of the gonad is lacking. On the body-wall there are some few ciliated funnels. There is only one sort very like the funnels in *transgressor* (Fig. 33. 5).

There is only one sort of anchors and anchor-plates present. The anchors (Fig. 33. 1) measure ca. 220 μ In length and 120 μ in width. They are rather beautiful, and regularly shaped. The stock is finely dented and the long and slender arms are distinctly serrate. The anchor-plates (Fig. 33. 2-3) measure ca. 180 μ in length and 140 μ in width. The seven large holes as well as the two anterior side-holes are distinctly dented. In the posterior end there are usually besides the two posterior side-holes, five small, rounded and smooth holes. The shape of the bridges across the side-holes is somewhat varying and they are often perforated. The posterior end

Fig. 33. Calcareous deposits and ciliated funnels of *Leptosynapta roxtona* 1—3 × 200, 4 × 450, 5 × 100.

of the plates is usually distinctly pointed. In the ambulacra there are some few more or less bent rods (Fig. 33. 4).

This species is distinctly characterized and easily recognized by the shape of the calcareous deposits, and it is evidently not closely related to any of the other known American species of the genus.

Leptosynapta dolabrifera (Stimpson) Clark (1924).

Synapta dolabrifera. Stimpson. 1856. Descriptions of some new marine Invertebrata. pag. 386.

Leptosynapta dolabrifera. Clark. 1908. The Apodous Holothurians. pag. 89.

" " Clark. 1924. The Synaptinae. pag. 484. Pl. 7 fig. 1—6.

Port Jackson. 7. IX. 1914. Shark island. 3 specimens.
Port Jackson. 20. X. 1914. Rocky shore. 1 specimen.

The three specimens from Shark Island are only some very contracted fragments, but they agree, in the shape of the calcareous deposits, rather well with the specimen from 20. X. 1914.

This specimen, which is nicely preserved, measures 7,5 cm in length, and its colour is pale yellowish-white, seemingly quite without reddish pigment. It has twelve tentacles, and each tentacle has 6—7 pairs of digits and 15—20 sensory cups. The calcareous ring (Fig. 35. 4) is well developed, and of a very characteristic shape. The radials are perforated for the nerves. A cartilaginous ring is wanting. There are four vesicles and a single unbranched stone-canal. Oesophagus is long and thin and distinctly different from the voluminous folded intestine. The ciliated funnels are found on the body-wall, and are as the funnels in *inhaerens* fan-shaped. The gonads are branched and the genital opening is on a low wart-like papilla in the dorsal interambulacra, a little behind the tentacles.

The anchors in the posterior end of the specimen (Fig. 34. 1) are ca. 250 μ long and 110 μ wide. The arms are long and slender and serrated with 4—6 large and regular teeth. The anchors from the anterior end (Fig. 34. 2) are shorter and thicker and the serration on the arms is not so regular as it is on the large anchors. They measure ca. 180 μ in length and 100 μ in width. The anchor-plates (Fig. 34. 3-4) are in the two ends of the specimen of very nearly the same size. They measure ca. 150 μ in length and 100 μ in width. The seven large holes in the anterior end are always toothed. In the articular end there are besides the side-holes three small rounded holes as well as a long and narrow medial one. In the bridges across the side-holes there is often a single, little, rounded or triangular hole. The rods in the body-wall are somewhat different in the two ends of the specimens. Those in the posterior end (Fig. 35. 3) are more scattered and not so distinctly bent as those in the anterior end (Fig. 35. 5). The rods in the digits are different from those in the tentacle-stem. They are large and nearly straight (Fig. 35. 1). Their ends are enlarged and either perforated or slightly branched, and their outline is either undulating or supplied with large knobs. The rods in the tentacle-stem (Fig. 35. 2) are more slender and nearly smooth. Their ends are enlarged, and as those of the digital rods either perforated or branched.

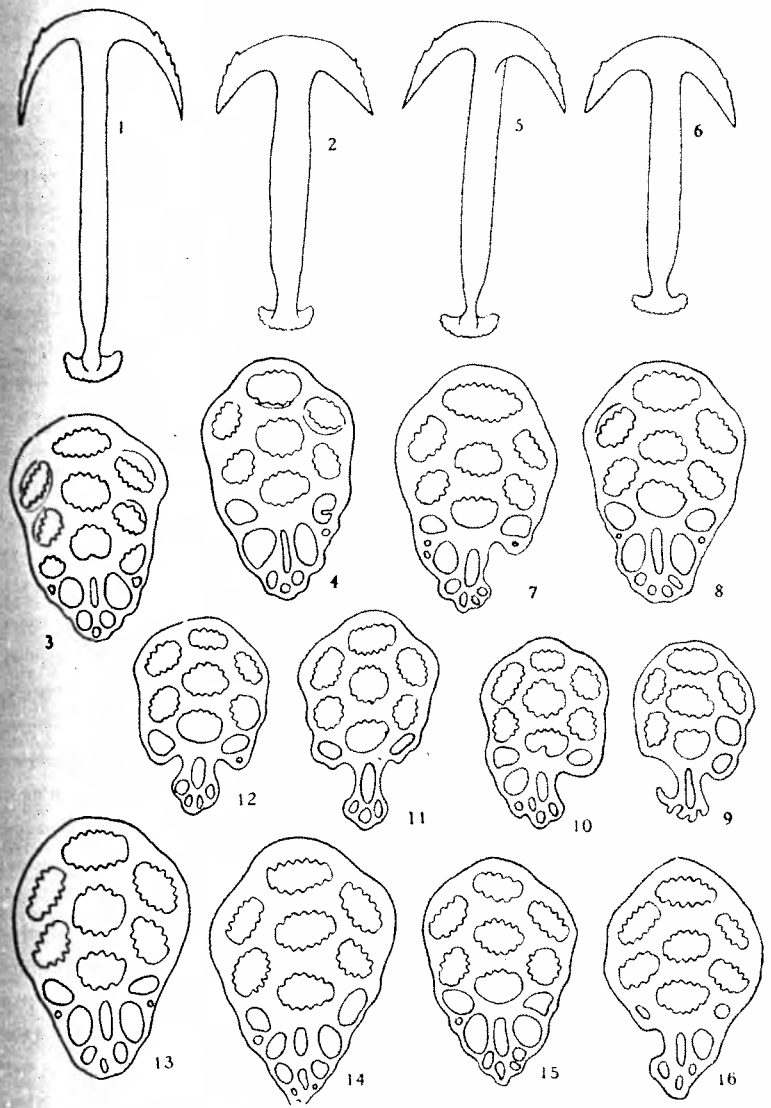


Fig. 34. Anchors and anchor-plates of *Leptosynapta dolabrifera* 1—4 and *Leptosynapta reducta* 5—16. 1, 3, 5, 7—9 & 15—16 from posterior end of bodies; 2, 4, 6, 10—12 & 13—14 from anterior end of bodies. 13—16 from aberrant specimen of *reducta*. × 200.

Stimpson's description of *dolabrifera* is rather poor and so unsatisfactory that according to it each of the present five species from the neighbourhood of Port Jackson may be named dolabrifera. For this reason I think it the better course to regard the specimen described by Clark in 1924 (The Synaptinae pag. 484 Pl. 7 fig. 1—6) as the type and use Clark's excellent description of *dolabrifera* as basis for any systematical discussion of the Australian *Leptosynaptids*.

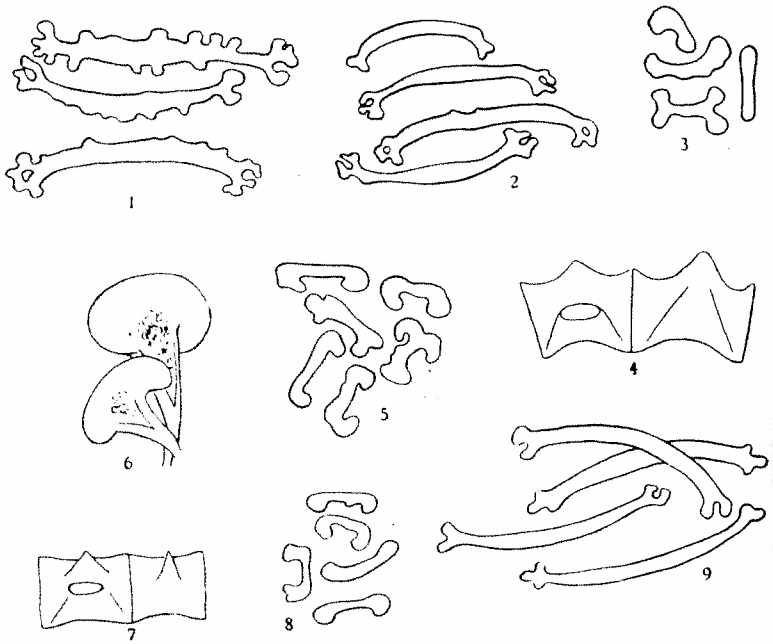


Fig. 35. Calcareous rings, ciliated funnels and rods of *Leptosynapta dolabrifera* 1–5 and *Leptosynapta reducta* 6–9. 1 from digits, 2 from tentacle stem, 3 from posterior end of body, 5 from anterior end of body, 8 from body, 9 from tentacles. Rods × 450; calcareous rings × 24; ciliated funnels × 36.

The single specimen from Port Jackson 20. X. 1914 agrees so closely with Clark's description, that there can, in my opinion, be no doubt that it is that species. The differences between Clark's and my descriptions may be due to individual variation. Only, as Clark's figure of the "supporting rods from tentacles" Pl. 7 fig. 4 agrees so well with the rods in the tentacle-stem of the specimen at hand, I suppose that Clark has overlooked the peculiar rods in the digits.

Leptosynapta reducta n. sp.

Port Jackson. 4. III. 1915. 2 fms. Sand. 49 specimens.

The specimens at hand measure up to four cm in length. They are as *dolabrifera* pale yellowish-white, and have twelve tentacles. Each tentacle has 7 pairs of digits and 15—20 sensory cups. Eye-spots are wanting. All the pieces of the calcareous ring (Fig. 35. 7) are faintly biconcave with a little triangular projection on the anterior margin. The radials are perforated for the nerves. Cartilaginous ring is wanting. There are 3—4 polian vesicles and a single unbranched stone-canal. The oesophagus is distinctly different from the voluminous, folded intestine. The ciliated funnels (Fig. 35. 6) are of one sort only, fanshaped and found on the body-wall. The gonads are branched and the genital duct is not visible on the exterior surface of the body.

The anchors from the posterior end of body (Fig. 34. 5) measure ca. 200 μ in length and 110 μ in width, and those from the anterior end (Fig. 34. 6) measure ca. 180 μ in length and 100 μ in width. The anchors are all rather alike, only the posterior ones have some few more teeth on the arms. The anchor-plates are very varying in shape, and somewhat different in the two ends of body. The plates from the anterior end measure usually ca. 130 μ in length and 80 μ in width. They are very characteristic, being more or less reduced in their articular end (Fig. 34. 10-12). The normal anchor-plates from the posterior end (Fig. 34. 7-8) of the specimens measure ca. 160 μ in length and 100 μ in width. They are usually not reduced in the articular end, where they have 4—6 small round holes besides the side-holes and a long and narrow medial one. Besides these large plates, there are often found some smaller more or less reduced ones (Fig. 34. 9), no longer than ca. 110 μ in length. Some of the specimens differ in having larger and lesser reduced anchor-plates (Fig. 34. 13-16).

In the body-wall there is but one sort of miliary granules. These (Fig. 35. 8) are small, more or less bent rods. The rods in the digits are not different from those in the tentacle-stem. They are long and slender (Fig. 35. 9) and quite smooth. Their ends are but faintly enlarged and often a little branched or forked.

This species is characterized especially by the shape of the calcareous ring and the tentacle-rods; furthermore the general

appearance of the specimens as well as the shape of the anchors and plates afford good characters. It is closely related to the other Australian species of the genus, but is easily distinguished by the reduced anchor-plates and the slender tentacle-rods.

Leptosynapta variopatina n. sp.

Long Reef, Port Jackson Head. 29.X.1914. Under stones at low water mark. 5 specimens.

Only one of the specimens at hand is complete, the others being fragments of various sizes. The complete specimen measures 7 cm in length and 0,3 cm in diameter. The colour is greyish-brown. It has twelve tentacles, each with 7 pairs of digits and 6—8 sensory cups. The calcareous ring (Fig. 37. 1) is very stout, with distinct muscular impressions. The radial pieces are perforated for the nerves. The cartilaginous ring is wanting. There are 5 polian vesicles and a single unbranched stone-canal. The oesophagus is long and thin and distinctly different from the thick and folded intestine. The ciliated funnels are fan-shaped as in *dolabrifera* and as in that species found only on the body-wall. The gonads are bushy branched and the genital porus is found a little behind the tentacles. A genital papilla is wanting

The anchors from the posterior end of body measure ca. 250 μ in length and 120 μ in width. They are rather stout and their arms are serrate (Fig. 36. 1). The anchors from the anterior end of body are not so long and their arms are short and thick, with only few teeth (Fig. 36. 2). They measure ca. 180 μ in length and 100 μ in width. The anchor-plates from the posterior end of body (Fig. 36. 5-7) measure ca. 170 μ in length and 120 μ in width. They are rather varying in shape. The side-holes are divided into two and the anterior ones are as the seven large holes distinctly serrate. In the articular ends of the plates there are besides the side-holes usually five rounded or oval holes. In the bridges across the side-holes there are usually small round holes. These holes may be wanting, and then the articular end of the plates is distinctly narrower than that of the normal plates. The plates from the anterior end of body are only little smaller than those from the posterior end. They measure ca. 150—160 μ in length by 100—110 μ in width. Also in these plates the small holes in the "bridges" may be wanting, and the articular end is then as mentioned in the plates from the

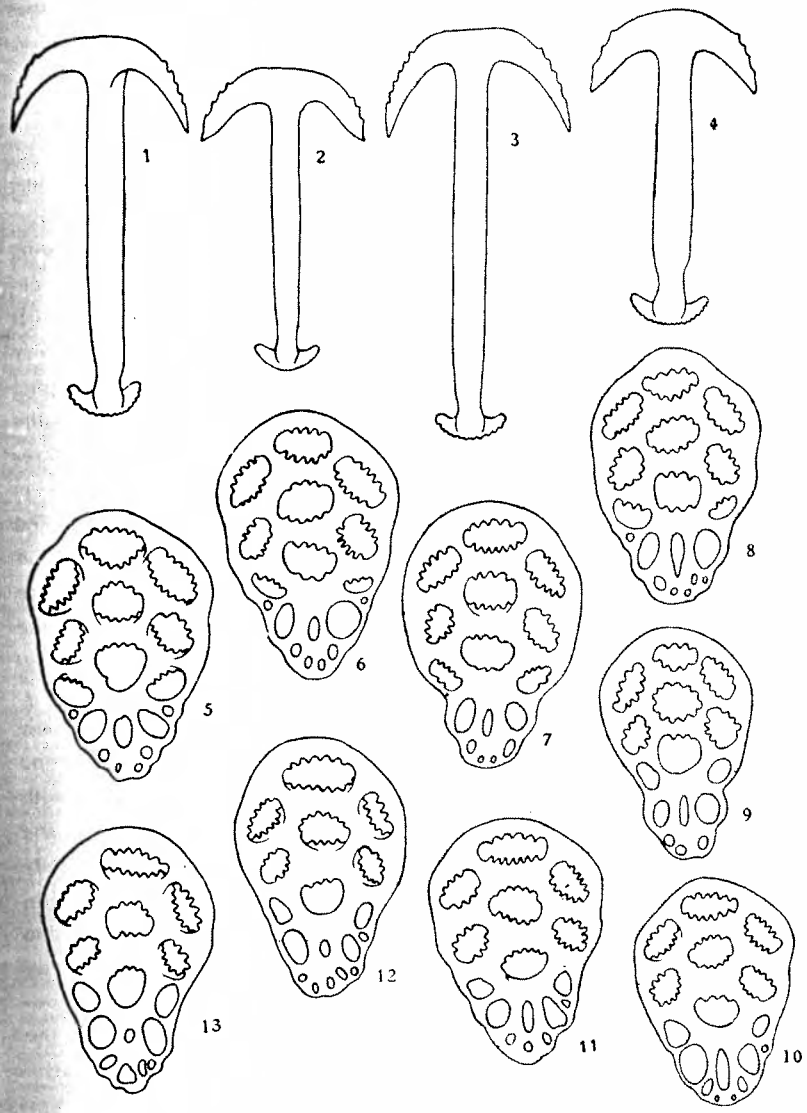


Fig. 36. Anchors and anchor.plates of *Leptosynapta variopatina* 1—2 & 5—9 and *Leptosynapta jacksonia* 3—4 & 10—13. 1, 3, 5—7 & 12—13 from posterior end of body; 2, 4 & 8—11 from anterior end of body. × 200.

posterior end of body, distinctly narrowed. There is only one sort of rods in the body-wall (Fig. 37. 3). They are irregularly shaped, usually curved and C-shaped. The rods in the digits (Fig. 37. 2) are not different from those in the tentacle-stem. They are rather large and straight or slightly bent. Their outline is usually quite smooth, and their ends are enlarged and perforated.

This species is characterized by the shape of the calcareous ring, the anchor-plates and the tentacle-rods; and it may by these characters be easily distinguished from the other Australian species of the genus.

Leptosynapta jacksonia n. sp.

Port Jackson. 3. X. 1914. Sand and gravel. 3—5 fms. 4 specimens.
Port Jackson. 3. III. 1915. 13 fragments.

The fragments from 3. III. 1915 are in a very poor condition, and they are only with some hesitation referred to this species,

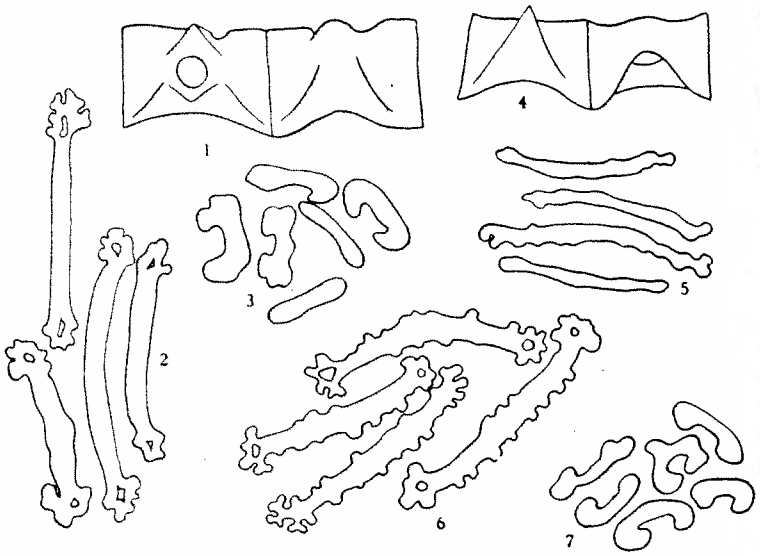


Fig. 37. Miliary granules and calcareous ring of *Leptosynapta variopa\ina* 1—3 and *Leptosynapta jacksonia* 4—7. 1 & 6 from tentacles, 3 & 7 from posterior end of body, 5 from anterior end of body. 1 & 4 × 24; 2—3 & 5—7 × 550.

from which they differ somewhat in the colour. The specimens from 8. X. 1914 measure up to 7 cm in length. Their colour is bright yellow. They have twelve tentacles, each with 6—7 pairs

of digits and 6—8 sensory cups. Eye-spots are wanting. The interradial pieces of the calcareous ring (Fig. 37. 4) have a low triangular projection on the exterior side. The radial pieces are perforated for the nerves. A cartilaginous ring is wanting. There are three polian vesicles and a single unbranched stone-canal. The oesophagus is thin and different from the intestine. Ciliated funnels are fan-shaped and placed on the body-wall. The gonads are branched and in the specimens from 3. III. filled with eggs. The genital porus is not visible on the exterior side of the body-wall.

The anchors from the posterior end of body measure ca. 270 μ in length and 120 μ in width. They are rather slender (Fig. 36. 3) and on the arms there are ca. 6 low teeth. The anchors from the anterior end of body (Fig. 36. 4) measure ca. 200 μ in length and 110 μ in width. Their arms are short and thick and with but 2—4 teeth. The anchor-plates from the two ends of body (Fig. 36. 10-13) are rather alike. The seven large holes are toothed and in the articular end there are besides the side-holes, 3—6 small, smooth holes of varying size. The plates are of very nearly the same size and measure ca. 170 μ in length and 110 μ in width. There are two different sorts of rods in the body-wall. The first (fig. 37. 7) is very common in both ends of the body. They are always more or less curved and often C-shaped. The second sort is only found in the anterior end of body, where they are lying very scattered. They are slightly bent (Fig. 37. 5) but never C-shaped and their ends are neither enlarged nor branched or perforated. Their outline is often faintly undulating. The rods in the digits (Fig. 37. 6) are not different from those in the tentacle-stem. They are rather large and their ends are usually enlarged and perforated. Their outline is supplied with large knobs, which may be arranged very regularly, especially on the convex side.

This species is in several characters, for instance the shape of the anchors and anchor-plates, and the rods in the digits, very like *dolabrifera*, from which species it differs in the shape of the calcareous ring and in having knobbed rods in the tentacle-stem. The presence of long and slender rods in the anterior end of body may also be a useful character for distingushing it from *dolabrifera*. From the other species of the genus it differs in having knobbed tentacle-rods, in the shape of the calcareous ring, and in the shape of the anchors and plates.

Leptosynapta irregularis n. sp.

Port Jackson. 20. X. 1914. Rocky shore. 11 specimens.

The specimens at hand are rather large. They measure up to 17 cm in length. Their colour is pale brownish and darkest close to the tentacles. The brown colour is due to small brown warts which are densest (probably not only due to contraction) in the anterior end of body. There are twelve tentacles which measure up to 0,8 cm in length. Each tentacle has 7—8 pairs of digits and 8—14 sensory cups. Eye-spots are wanting. The calcareous ring (Fig. 39. 5) is well developed and the radials are perforated for the nerves. A cartilaginous ring is wanting. There are three polian vesicles and a single unbranched stone-canal. The alimentary canal is straight and the oesophagus is different from the intestine. The ciliated funnels are fan-shaped and found on the body-wall. The gonads are branched and the genital duct opens on a low wart, close behind the dorsal tentacles.

The anchors and anchor-plates are very varying in shape and usually irregularly formed. The anchors from the posterior end of body (Fig. 38. 1-2) measure ca. 250 μ in length and 130 μ in width. The arms are rather long and distinctly serrate. Some of the anchors differ from the normal ones in having the arms bent outwards. The anchors in the anterior end of body (Fig. 38. 3-4) measure ca. 200 μ in length and 100 μ in width. The arms are also here serrate, but there are seldom more than 3—4 teeth. Also in this end of body the anchors may have the arms bent outwards. The anchor-plates (Fig. 38. 5-6) measure ca. 150 μ in length. Their outline is very irregular and in the anterior end of the plates there are usually several additional holes which are more or less toothed. The plates from the posterior end of body have usually more additional holes than the plates in the anterior end. One of the specimens examined differs from the others in having the outline of the anchor-plates more regular, and in having fewer, very rarely none, additional holes in the anterior end of the plates (Fig. 38. 7-9). The miliary granules are in the posterior end of body more or less C-shaped (Fig. 39. 3) and in the anterior end of body often ring-shaped (Fig. 39. 4). The rods in the tentacles (Fig. 39. 2) are rather like those in the body, only they are somewhat larger and their shape more irregular. The rods in the digits

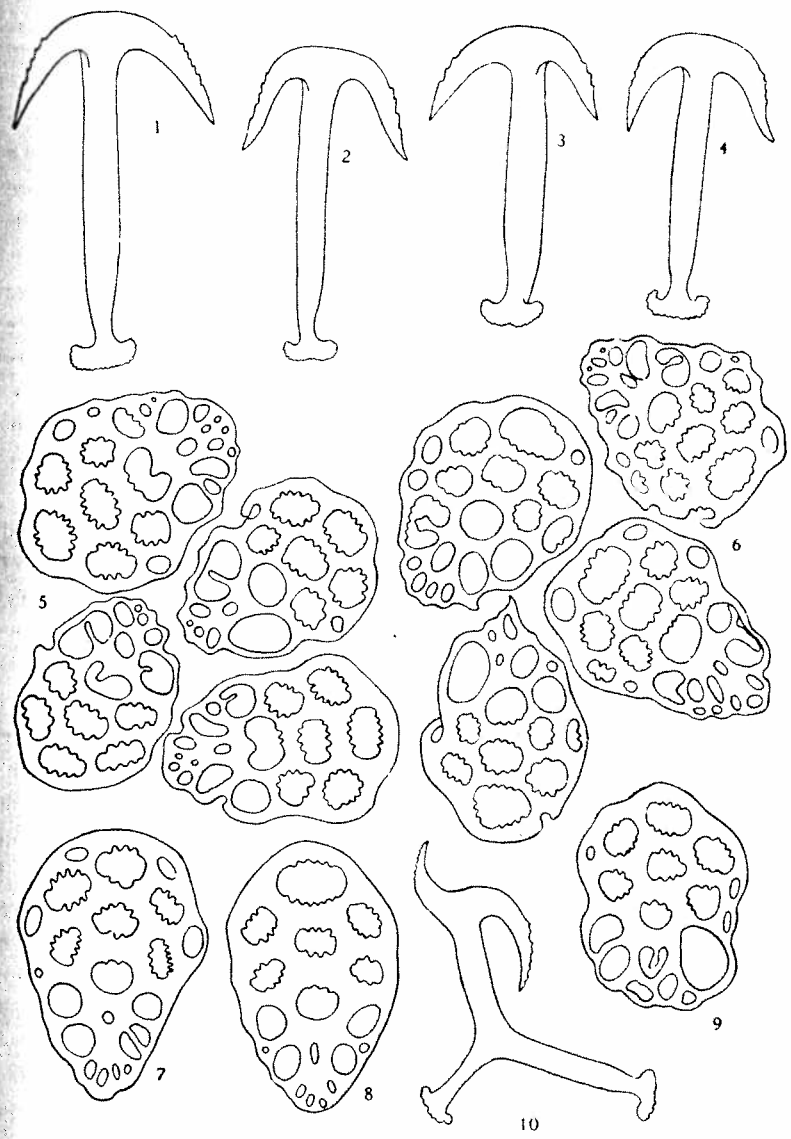


Fig. 38. Anchors and anchor-plates of *Leptosynapta irregularis*. 1—6 from the type. 7—10 from aberrant specimen. 1—2 & 6 from posterior end of body, 3—4 & 5 from anterior end of body. × 200.

are slender and distinctly bent (Fig. 39. 1). Their ends are faintly enlarged and branched, but never perforated.

Leptosynapta irregularis is characterized by the brown warts on

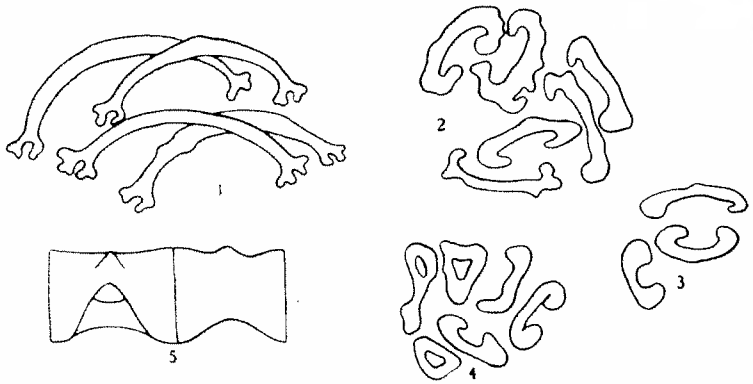


Fig. 39. Miliary granules and calcareous ring of *Leptosynapta irregularis*. 1 from digits, 2 from tentacle-stem, 3 from posterior end of body-wall, 4 from anterior end of body-wall. 1—4 × 550; 5 × 24.

the body, by the irregular shape of the anchor-plates and by the smooth and slender rods in the digits, and it may by these characters be easily distinguished from the other species of the genus.

Epitomapta n. g.

Genotype: *Epitomapta tabogae* n. sp.

Diagnosis: Tentacles pinnate, usually twelve. Sense organs never in the form of pigment-eyes, but occur as sensory cups on the oral side of the tentacles. Calcareous ring well developed. The radial pieces are not perforated for the nerves, but with a notch in the anterior margin. Cartilaginous ring wanting. Polian vesicle and stone-canal single. Stone-canal unbranched. Ciliated funnels are of different shape and only found on the body-wall, not on the mesenteries.

The calcareous deposits in the body-wall are anchors, anchor-plates and miliary granules, in the tentacles rather large rods. The stock of the anchors is finely toothed and the vertex is smooth. The anchor-arms are in the posterior end of body distinctly serrate, in the anterior end of body usually smooth. The anchor-plates have seven large holes in the anterior end and a varying number of

smooth holes in the articular end. The articular end is faintly hollowed, but a distinct bridge is wanting.

To the genus thus characterized belong for the present two different species: *Synapta roseola* Verrill 1874 and *Epitomapta tabogae* Heding. *Roseola* is reported several times from Massachusetts and Bermuda, and *tabogae* is common at Taboga and Taboguilla, Panama.

Epitomapta tabogae n. sp.

Taboga, Panama.	2.II.1916.	Sandy shore, at low water mark.	1	specimen.
„	3.II.1916.	„ „	13	„
„	4.II.1916.	„ „	2	„
Taboguilla.	10.II.1916.	Under stones, by low water.	1	„

The specimens at hand measure up to 9 cm in length by ca. 0,5 cm in diameter. Their colour is in alcohol bright yellow. They have twelve tentacles, each with 5—6 pairs of digits and 8—14 sensory cups. The length of the digits is increasing outwards, the terminal one being the longest. Eye-spots are wanting on the oral disk. The radial pieces of the calcareous ring (Fig. 40. 7) are not perforated for the nerves, but notched in their anterior margin. A cartilaginous ring is wanting. There is only a single polian vesicle and one unbranched stone-canal. The oesophagus is thin and different from the folded intestine. The gonads are voluminous and bushy-branched. They enclose eggs with a diameter of 150 μ. The genital duct opens on the end of a very long papilla (measuring two thirds of the tentacle-length) which is found between the dorsal tentacles. The ciliated funnels (Fig. 40. 8) are found on the body-wall, where they appear to be united by a fine string.

The anchors from the posterior end of body (Fig. 40. 1) measure ca. 200 μ in length and 100 μ in width. They are rather slender and their arms are distinctly serrate. The anchors from the anterior end of body (Fig. 40. 2) measure ca. 170 μ in length and 100 μ in width, and differ from those more posteriorly in having the arms smooth or nearly quite smooth. The anchor-plates (Fig. 40. 3-6) measure ca. 150 μ in length and 100—110 μ in width. The seven large holes in the anterior end are toothed. The plates from the posterior end of body have usually four holes in the articular end and those from the anterior end have from 5—10 holes in the articular end. The articular end is hollowed and a distinct bridge is

wanting. The "bridges" across the side-holes are often perforated. The miliary granules (Fig. 40. 9) are either C-shaped bodies or oval rings. In some specimens nearly all the granules are rings and in others the majority are C-shaped. In most of the specimens there are more rings than C-shaped bodies. The miliary granules are found in the ambulacra, where they are often lying in rows. They are not different in the two ends of the body. Besides in the ambulacra miliary granules are also found in the small, white papillae which are found all over the body. There are usually 2—8 granules in each papilla (Fig. 40. 11). The rods in the digits are of the same shape as those in the tentacle-stem. They are rather short and thick and their ends are enlarged and perforated (Fig. 40. 10).

This species is characterized by the shape of the calcareous ring, the anchors and anchor-plates, and the ciliated funnels, and in having the genital papilla between the dorsal tentacles. It is closely related only to *roseola* (Verrill), from which species it differs distinctly in the shape of the ciliated funnels, the size and shape of the anchors and anchor-plates, and in the arrangement of the genital papilla.

Epitomapta roseola (Verrill).

Leptosynapta roseola. Verrill. 1874. Report upon the invertebrate animals of Vineyard Sound. pag. 422.

Synapta roseola. Théel. 1886. The Challenger Holothurioidea. pag. 25.

" " Clark. 1899. The Synaptas of the New England coast. pag. 24. Pl. X fig. 1—2, Pl. XI fig. 2—4—6—8.

Leptosynapta roseola. Clark. 1908. The Apodous Holothurians. pag. 93.

" " Clark. 1924. The Synaptinae. pag. 491. Pl. 7 fig. 25—28.

Woods Hole. 21. III. 1907. H. L. Clark. 3 specimens.

" 1928. Deichmann. 2 "

Bermuda. 14. VII. 1926. Th. Mortensen. 79 complete specimens.[1]

The name *Leptosynapta roseola* was proposed by Verrill for the little red Synaptid, found at the Atlantic coast of the United

[1] Of the 79 specimens from Bermuda at hand, the 52 are distinctly red and the 27 pure white. Besides the 79 complete specimens there are many fragments, which are all either pure white or distinctly red, and for that reason easily separated into the two groups, the typical *roseola* and the variety *alba*.

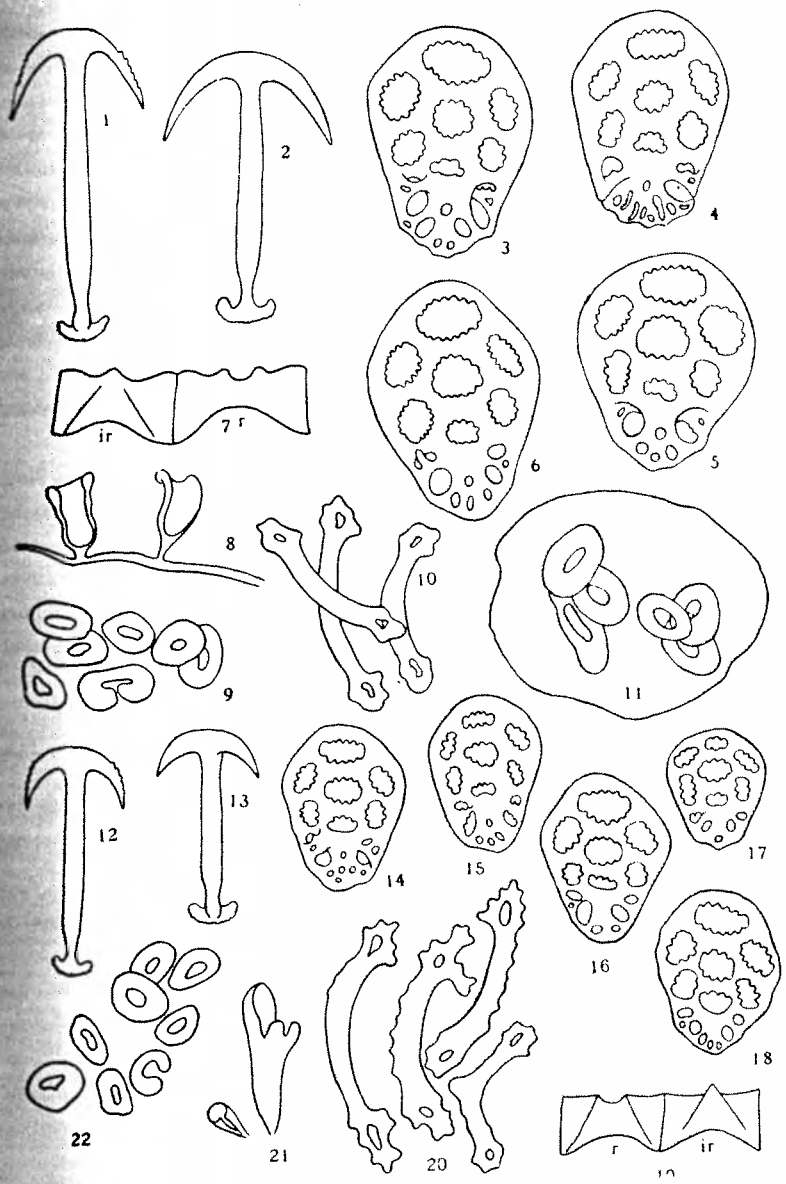


Fig. 40. Calcareous deposits, calcareous rings and ciliated funnels of *Epitomapta tabogae* 1—11 and *Epitomapta roseola* 12—22. 1, 5—6, 12, 16—18 deposits from the posterior end of the specimens; 2—4, 13—15 from the anterior end of the specimens; 9 & 22 miliary granules from the radii; 11 from the warts in interradii; 10 & 20 rods from tentacles. Anchors and anchor-plates × 200; miliary granules and rods × 450; calcareous rings × 24; Fig. 8 × 100 & Fig. 21 × 36.

States. Though this species is distinctly different both from *Leptosynapta tenuis* and *girardii*, it was not regarded as a valid species until Clark's excellent description of it in 1899.

The specimens from Bermuda (those from Woods Hole are badly preserved and nearly quite decalcified) are very interesting as they may, by their size and colour, be separated into two different groups. The specimens of the one group are rather small, measuring no more than 3—5 cm in length. Their colour is as in the typical specimens of the species distinctly reddish brown. The other specimens are larger, up to 12 cm in length, and their colour is, though they are from the same locality and preserved in the same jar, pure white. The two groups are in the exterior so different that one may suppose them to represent distinctly different species; this may be, but as they are rather alike in the calcareous deposits, I prefer for the present to regard the white specimens only as a variety of *roseola* naming it *alba* n. var.

As the white specimens are in the exterior very like *Leptosynapta tenuis*, and may when not carefully examined be mistaken for it, I suppose that the record of *Leptosynapta inhaerens (= tenuis)* from Bermuda may be due to such a mistake.

The description below of *roseola* is based upon the typical red specimens, and as I do not find any distinct differences in the calcareous deposits and the internal anatomy between the red and the white specimens at hand, I do not think it necessary to give a detailed description of the variety.

There are usually twelve tentacles in this species, each with seven digits, the terminal one being ca. three times as long as the others. On the oral side of the tentacles there are 2—5 sensory cups. Eye-spots are wanting. The radial pieces of the calcareous ring (Fig. 40. 19) are not perforated for the nerves, but notched in their anterior margin. The interradials have a large triangular projection on the exterior side. A cartilaginous ring is wanting. There is one polian vesicle and a single unbranched stone-canal. The intestine is straight and fastened by the dorsal and the left ventral mesenteries. The oesophagus is rather short and the stomach is not different from the intestine. The gonads are well developed and have several long and thin branches. The genital duct opens with a rather large papilla. This papilla is not placed on the body-

wall, but ca. one third of the tentacle-length out on the tentacle-stem, and is indifferently found on the tentacle at the right or the left side of the mid-dorsal interambulacrum. The ciliated funnels (Fig. 40. 21) are, as described by Clark, of two different sorts, the larger being labiate.

The anchors from the posterior end of body measure ca. 150 μ in length and 70 μ in width. They are rather slender (Fig. 40. 12), their arms being serrate. The anchors from the anterior end of body (Fig. 40. 13) measure ca. 120 μ in length and 70 μ in width. Their arms are rather short and thick and usually smooth or nearly smooth. The anchor-plates (Fig. 40. 14-18) measure ca. 110 μ in length and 80 μ in width. They are not much different in the two ends of body, but in the posterior end there are some smaller ones (Fig. 40.17), which do not measure more than ca. 70 μ in length. The miliary granules (Fig. 40. 22) are either C-shaped rods or small rings, and they are not different in the two ends of body. The rods in the digits (Fig. 40. 20) are not different from those in the tentacle-stem. They are rather large and usually slightly bent. Their outline is often undulating and their ends are faintly enlarged and perforated.

The specimens here described are in several characters slightly different from those described by Clark in 1899. Clark does not say from where his specimens came, but they were probably found at Woods Hole. Possibly future investigations will show that the specimens from Woods Hole are specifically different from those from Bermuda, but for the present we do not know more than one species of *Epitomapta* from the Atlantic coast of America, though we may distinguish between the typically red form and the white variety.

Patinapta n. g.

Genotype: *Synapta ooplax* v. Marenzeller.

Diagnosis: Tentacles pinnate, usually twelve. Sense organs never in the form of pigment-eyes, but occur as sensory cups on the oral side of the tentacles. Radial pieces of calcareous ring perforated for the nerves. Cartilaginous ring wanting. Polian vesicles few, 1—8. Stone-canal single, unbranched. Shape of ciliated funnels varying. Ciliated funnels being only found on the inner side of body-wall. Calcareous deposits in body-wall: anchors, anchor-

plates and miliary granules, in tentacles rather large rods. Shape of anchors from posterior end of body rather peculiar (Fig. 42. 1 & 5) and typical of the genus. Anchors from anterior end of body always different from those more posterior, and always much shorter, with short and thick arms. Shape of anchor-plates is as that of anchors very characteristic of the genus, those in the anterior end being usually much larger and never smaller than those posteriorly situated. Anterior end of the anchor-plates from the anterior end of body perforated by a varying number of holes, the larger of which are often somewhat dented. A bridge is wanting and the articulation with the anchors often very faint or quite wanting. The anchor-plates from posterior end of body cannot be divided into an anterior part and a distinct articular end. All articulation with the anchors may be wanting, and the plates may be highly reduced.

This genus is in several characters closely related to *Leptosynapta*, but the peculiar shape of the anchors and anchor-plates separates it distinctly from that genus. For the present we do not know more than two species which may be referred to *Patinapta*. Clark assumes that Bedford's variety *laevis* is not different from v. Marenzeller's species, but the specimens at hand show that *laevis* is specifically different from it, und must be regarded as a valid species. Both these species are from the Indo-Pacific ocean. The specimens of a "*Synapta*" found by Voeltzkow at Zanzibar may ultimately prove to be a separate species of this genus, and the same species as Lampert has described as *Synapta ooplax* (cfr. Lampert. Ostafrikanische Holothurien. pag. 66).

Patinapta ooplax (v. Marenzeller).

Synapta ooplax. v. Marenzeller. 1881. Neue Holothurien von Japan und China. pag. 122. Pl. IV fig. 1 a—d.
» » Lampert. 1885. Die Seewalzen. pag. 222.
» » Britten. 1906. Holothurien aus dem Japanischen und Ochotskischen Meere. pag. 150.
Leptosynapta ooplax. Clark. 1608. The Apodous Holothurians. pag. 24 & 90.
» » Ohshima. 1913. Synaptiden von Misaki. pag. 254. Pl. VI fig. 5.
» » Ohshima. 1914. The Synaptidae of Japan. pag. 464.

? *Leptosynapta ooplax*. Clark. 1924. The Synaptinae. pag. 489. Pl. 7 fig. 20—24.

Samalona, Makasser. 28. VI. 1922. Sandy shore. 82 specimens.

The specimens at hand measure up to 20 cm in length by ca. 0,5 cm in diameter. The colour is pure white and the skin is thin and translucent. There are twelve tentacles, each with 4—5 pairs of digits and two irregular rows of sensory cups. Eye-spots are wanting. The calcareous ring (Fig. 41. 5) is rather stout and the radial pieces are perforated for the nerves. A cartilaginous ring is wanting. There are 2—8 polian vesicles and a single unbranched stone-canal. The intestine is straight and the oesophagus not distinct. The ciliated funnels (Fig. 41. 11) are found on the body-wall. The gonads are long and thin and but a few times branched. The genital duct opens on a distinct papilla between the dorsal tentacles.

The anchors from the posterior end of body (Fig. 41. 1) measure from 150 μ to 190 μ in length. The stock is unbranched, but distinctly toothed. The arms are short and curved, being usually quite smooth. The anchors from the anterior end (Fig. 42. 3) measure ca. 160 μ in length by 110 μ in width. The stock is toothed and on the stout and nearly triangular arms there are some few irregular teeth. The anchor-plates from the anterior end of body (Fig. 42. 4) measure ca. 130 μ in length and 100 μ in width. They have 15—25 holes in the anterior end, and the central holes, which are the largest, are usually toothed. The articular end may be hollowed and often perforated with a varying number of small rounded holes. A well defined bridge is wanting. The anchor-plates in the posterior end of body (Fig. 42. 2) measure ca. 80 μ in length. They are irregularly shaped and usually much reduced. The miliary granules are found in both the radii and the interradii. Those from the interradii (Fig. 41. 9) are irregular rings or curved rods. In the radii there are two different sorts, one in the skin (Fig. 41. 8) being regular rings, and one in the longitudinal muscles (Fig. 41. 10) being curved rods with perforated ends. The rods in the tentacle-stem (Fig. 41. 7) are rather large and slightly curved. Their outline is smooth and their ends are perforated. Those in the digits (Fig. 41. 6) are larger, and often branched. Their ends are perforated, and often with more than one hole.

This species is especially characterized by the shape of the calcareous ring, the anchor-plates and the rods from the skin and the tentacles.

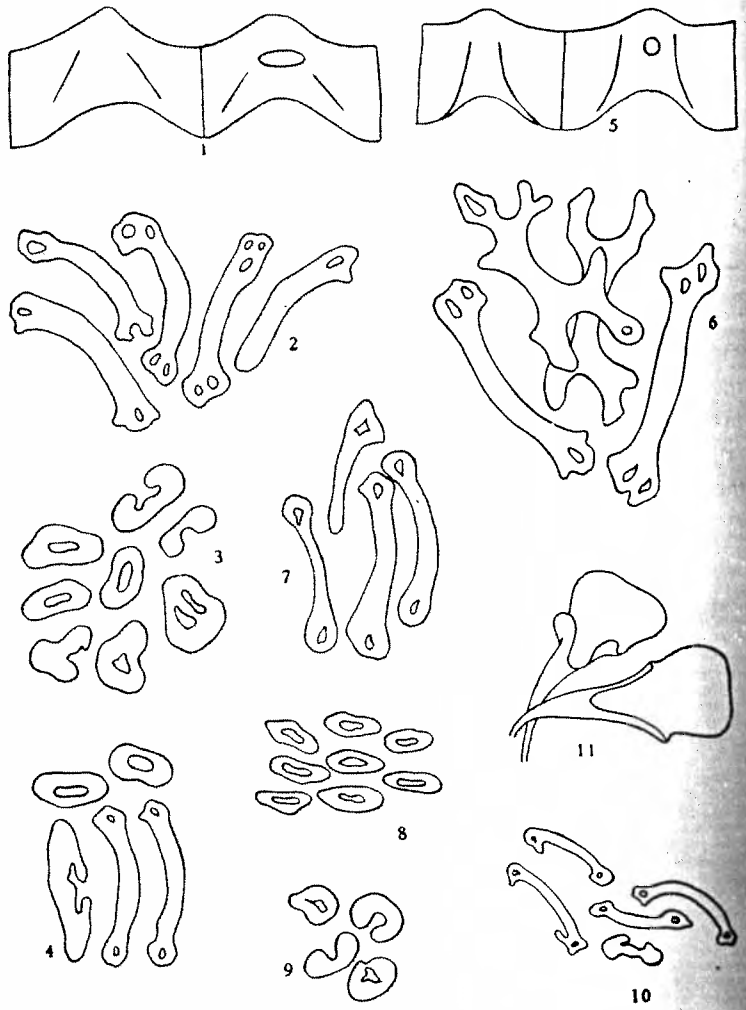


Fig. 41. Calcareous rings, rods and ciliated funnels of *Patinapta laevis* 1—4 and *Patinapta ooplax* 5—11. 2 & 6 rods from digits, 4 & 7 from tentacle-stem, 8 & 10 from the ambulacra. 1 & 5 × 24; 2—4 & 6—10 × 450; 11 × 100.

The measurements of the anchors and plates found in the literature are so deviating that it may be the better course to collect them in a table. My own results are found by measuring ca. 200 anchors and plates from each end of ten different specimens, five of *ooplax* and five of *laevis*.

Observator	Locality	Anterior		Posterior	
		Anchors	Plates	Anchors	Plates
v. Marenzeller	Japan	119	109	200	109
Lampert	Kokotoni	124—140	110—115	120—140	60—90
Britten	Misaki	130	122	170	94
Clark	Funafuti	157	114	157	86
Heding (*ooplax*)	Samalona	145—165	110—135	150—190	30—80
„ (*laevis*)	Saparoea	140—155	90—120	125—155	30—70

Besides the measurements in the table Ohshima writes in 1914 (The Synaptidae of Japan): "In all the specimens before me, the anchors measure 115—195 μ and the anchor-plates 57—135 μ in length". As all the measurements but v. Marenzeller's agree so well, we may suggest that these latter are erroneous. As regards the biology of this species, cf. Note, p. 322.

Patinapta laevis (Bedford).

Synapta ooplax var. ***laevis***. Bedford. 1899. Holothurians in "Willey's Zoological Results". p. 141. Pl. XVII fig. 3a—c.

Synapta ooplax. Britten. 1906. Holothurien aus dem Japanischen und Ochotskischen Meere. pag. 150.

Leptosynapta ooplax. Clark. 1908. The Apodous Holothurians. pag. 90.

„ „ Clark. 1924. The Synaptinae. p. 489. Pl. 7 f. 20—24.

Saparoea Bay. 11. III. 1922. The shore by low water mark. 14 specimens.

The specimens at hand measure up to 16 cm in length. The colour is pure white and the skin is so thin that the coral sand in the intestine as well as some small parasitic bivalves which are found in the oesophagus of some of the specimens may be seen through it. There are twelve tentacles each with 4—5 pairs of digits and 6—12 sensory cups. Eye-spots are wanting. The calcareous ring is rather stout (Fig. 41. 1) and the radials are perforated for the nerves. A cartilaginous ring is wanting. The alimentary canal is straight and the oesophagus is not distinctly different from the intestine. The bivalves found in the oesophagus are rather like *Entovalva mirabilis* Voeltzkow, but at any rate

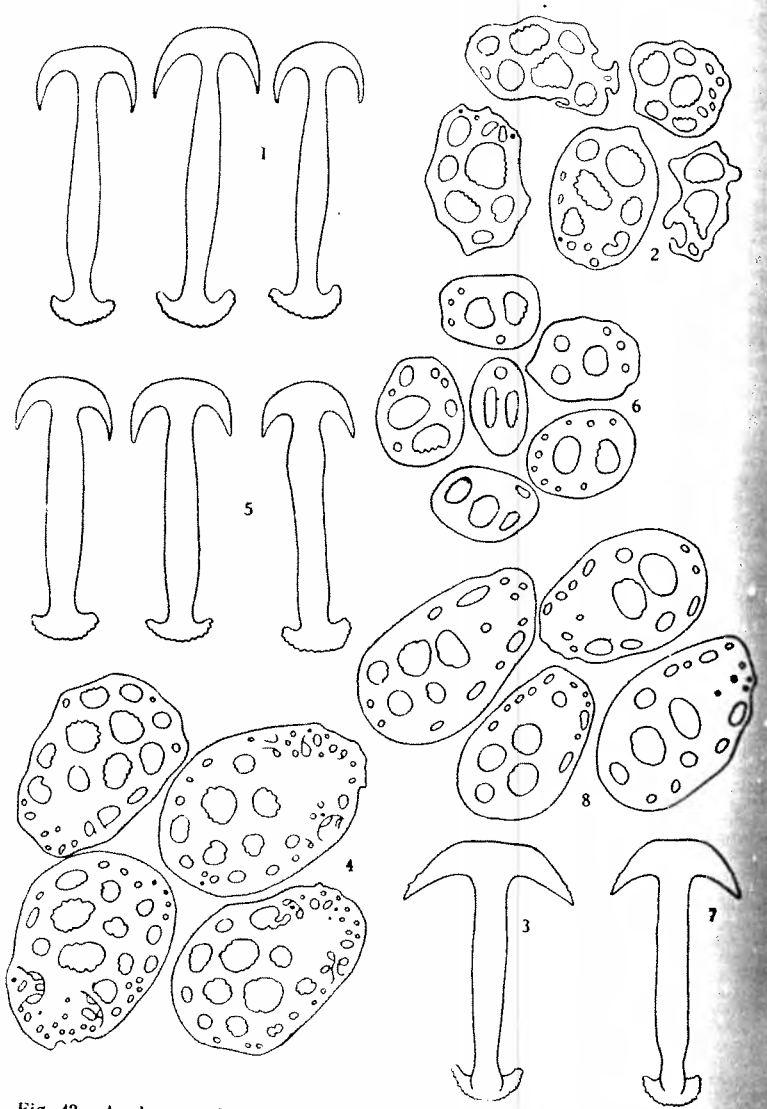


Fig. 42. Anchors and anchor-plates of *Patinapta ooplax* 1—4 and *Patinapta laevis* 5—8. 1—2 & 5—6 from the posterior end of body, 3—4 & 7—8 from the anterior end of body. × 200.

specifically different from it. The ciliated funnels are found on the body-wall. They are of very nearly the same shape as the funnels in *ooplax*. The gonads are voluminous and several times branched. The genital duct opens on a rather long papilla between the dorsal tentacles.

The anchors from the posterior end of body are very like those from the posterior end of *ooplax* only they are a little shorter and thicker. They measure ca. 145 μ in length and 60 μ in width. The anchors from the anterior end of body (Fig. 42. 7) measure ca. 145 μ in length and 80 μ in width. They are usually a little asymmetrical, as the arms may be of different length. The anchor-plates from the anterior end of body (Fig. 42. 8) differ from the corresponding plates in *ooplax*, in being not hollowed in the articular end and in having but 7—9 holes through their anterior end. The holes of these plates are usually quite smooth, but some few and faint teeth may occur. The anchor-plates from the posterior end of body (Fig. 42. 6) are more regularly rounded than in *ooplax*. The larger part of the holes are smooth, but a single one may be more or less toothed.

There is but one sort of miliary granules in the body (Fig. 41. 3). They are of varying shape and usually confined to the ambulacra. The rods in the digits (Fig. 41. 2) are different from those in the tentacle-base (Fig. 41. 4). They are not branched but they have very often two holes in the enlarged ends.

This species is closely related to *ooplax* v. Marenzeller, but it differs in the shape of the calcareous deposits so much from that species, that I have no doubt in regarding it as a valid species.

Eupatinapta n. g.

Genotype: *Synapta acanthia* Clark.

Diagnosis: Tentacle pinnate, usually twelve. Sense organs never in the form of pigment-eyes, but occur as sensory cups on the oral side of the tentacles. Calcareous ring well developed and the radial pieces perforated for the nerves. Cartilaginous ring wanting. Polian vesicles few; stone-canal single and unbranched. Stock of anchors not branched but finely toothed. Anchor-arms more or less serrate and vertex smooth. The anchors from posterior end of body are of different size and shape, the larger ones being distinctly different from those in the anterior end of body. The

anchor-plates are as the anchors of varying size and shape. The small plates have, in both ends of body, seven large holes in the anterior end, and no bridge or other distinct articulation for the anchors. The large plates are elongate and rather like the anchor-plates in *Synapta*. In the anterior end of the plates there are always more than seven large toothed holes (usually 13—16) and the articulation with the anchors is well developed and rather like that of the plates in *Protankyra*, a well defined bridge being wanting. The ciliated funnels in *acanthia* are of two different sizes and shapes, but as the funnels in *multipora* Clark are not known, it is only possible to say that the funnels in this genus may be rather large and of varying shape.

Eupatinapta is in several characters very like *Leptosynapta*, but the presence of large anchor-plates with many holes separates it distinctly from that genus. For the present we do not know more than two species belonging to this genus: *Synapta acanthia* Clark and *Leptosynapta multipora* Clark. Both these species are from the Atlantic coast of America.

Eupatinapta acanthia (Clark).

Synapta acanthia. Clark. 1899. Notes on the Echinoderms of Bermuda. pag. 126. Pl. IV.

Leptosynapta acanthia. Clark. 1908. The Apodous Holothurians. pag. 92. Pl. V fig. 1—13 & 22.

" " Clark. 1924. The Synaptinae. pag. 477. Pl. 6 fig. 12—16.

Bermuda. 14. VII. 1926. Sandy shore at low water. 40 specimens.

The specimens at hand measure up to 14 cm in length. They are yellowish-white with brown warts, which are densest on the anterior end of body. There are 12 tentacles, each with 7—8 pairs of digits and on their oral side there are 4—20 dark brown sensory cups. The calcareous ring (Fig. 44. 11) is distinctly different from Clark's figures as all the pieces have a low projection on the anterior margin. Muscular impressions are distinct and the radial pieces are perforated for the nerves. There are three polian vesicles and a single unbranched stone-canal. The alimentary canal has no loop. It consists in all the specimens dissected of three parts. Oesophagus is long and thin and distinctly different from the long and folded, stomach-shaped intestine (Fig. 43). The third part of the intestine is the short and wide rectum. Thus the alimentary canal apparently differs distinctly from that of Clark's specimens, as there is no distinct stomach (cf. Apod. Holoth. Pl. V fig. 13); but the examination of several more or less contracted specimens, leads to the suggestion that Clark's statements are due to contraction on the preservation of his specimens. The alimentary canal is, in the specimens at hand, for the anterior three fourth of its length fastened by the dorsal mesentery, in the posterior end by the right ventral mesentery.

The ciliated funnels are found in the mid-dorsal, the left dorsal and the right ventral interambulacrum. In the anterior end of body there is but one sort of funnels, which are small and funnel-shaped, and rather like the funnels on the mesenteries in the *Micrournae*. In the posterior end of body there is besides the mentioned small funnels, a second sort (Fig. 44. 8) which is much larger. These large funnels may be ca. 1 mm long, and arranged with rather regular intervals, but in some specimens they are a little wider than the figure shows, and then they may be rather crowded on the body-wall. The shape of these wider funnels is not figured, the two specimens in which they are found being so contracted that the exact shape of the funnels is not to be made out. But in any case I have never seen anything resembling the figure of the funnels given by Clark (cf. Apod. Holoth. Pl. V fig. 12). The funnels drawn (Fig. 44. 8) are from the noncontracted specimen figured (Fig. 43). The gonads are large and branched several times, and the genital duct opens in the dorsal interambulacrum a little behind the tentacles. A genital papilla is wanting.

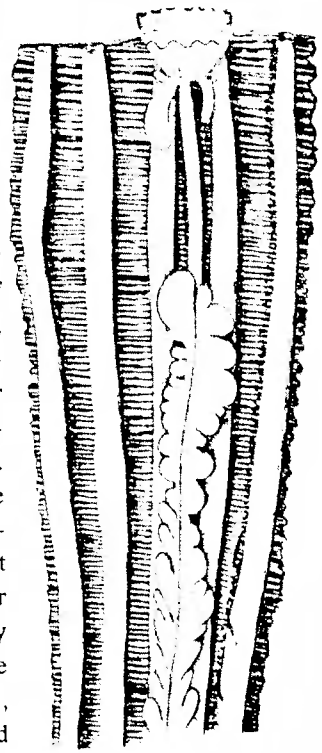


Fig. 43. *Eupatinapta acanthia* Oesophagus and anterior half of intestine. × ca. 3.

In the posterior end of body there are, though with some

variation, three different sizes of anchors and anchor-plates. In the anterior end there is but one size. The largest anchors in the posterior end (Fig. 44. 5-6) measure ca. 700 μ in length and 350 μ in width. They are rather slender and have the arms serrate. The second size of anchors measure ca. 350 μ in length and 200 μ in width. They are very like the large ones, but have not so many teeth on the arms. The third sort of anchors do not measure more than ca. 200 μ in length and 100 μ in width. They are as the two larger ones, rather slender, but they have no more than 1—2 teeth on the arms. The anchors from the anterior end of body (Fig. 44. 7) measure ca. 250 μ in length and 175 μ in width. They are rather stout and have some few teeth on the arms. The plates corresponding with the large anchors from the posterior end of body (Fig. 44. 1) measure ca. 450 μ in length and 250 μ in width. They have ca. 15 large holes in the anterior end, and all the holes except the articular hole are toothed. In the articular end there are 12—14 irregularly shaped smooth holes. Across the articular end there is no well defined bridge, but the articulation with the anchors is well developed and very like that of the plates in *Protankyra*. The second sort of anchor-plates in the posterior end of body (Fig. 44. 2) measure ca. 280 μ in length and 180 μ in width. They have ca. 9—12 toothed holes in the anterior end, and as the large plates a well developed articulation. The third sort of anchor-plates from this end of body (Fig. 44. 3) is very like the plates in some of the Australian species of *Leptosynapta*. They measure ca. 160 μ in length and 110 μ in width. They have usually seven large holes in the anterior end, but there may often be some few small additional ones. The articulation with the anchors is very faint or quite undeveloped. The plates corresponding with the anchors from the anterior end of body (Fig. 44. 4) measure ca. 200 μ in length and 150 μ in width. They have normally 7—8 large toothed holes in the anterior end, and 7—8 small smooth ones in the articular end.

The large deposits are, as said, confined to the posterior end of body, but it is very interesting to see that on the ventral side of body, they are not found much more anteriorly than the posterior fourth of the specimen, while on the dorsal side they are found a little anterior to the middle.

The miliary granules (Fig. 44. 10) are found all over the body,

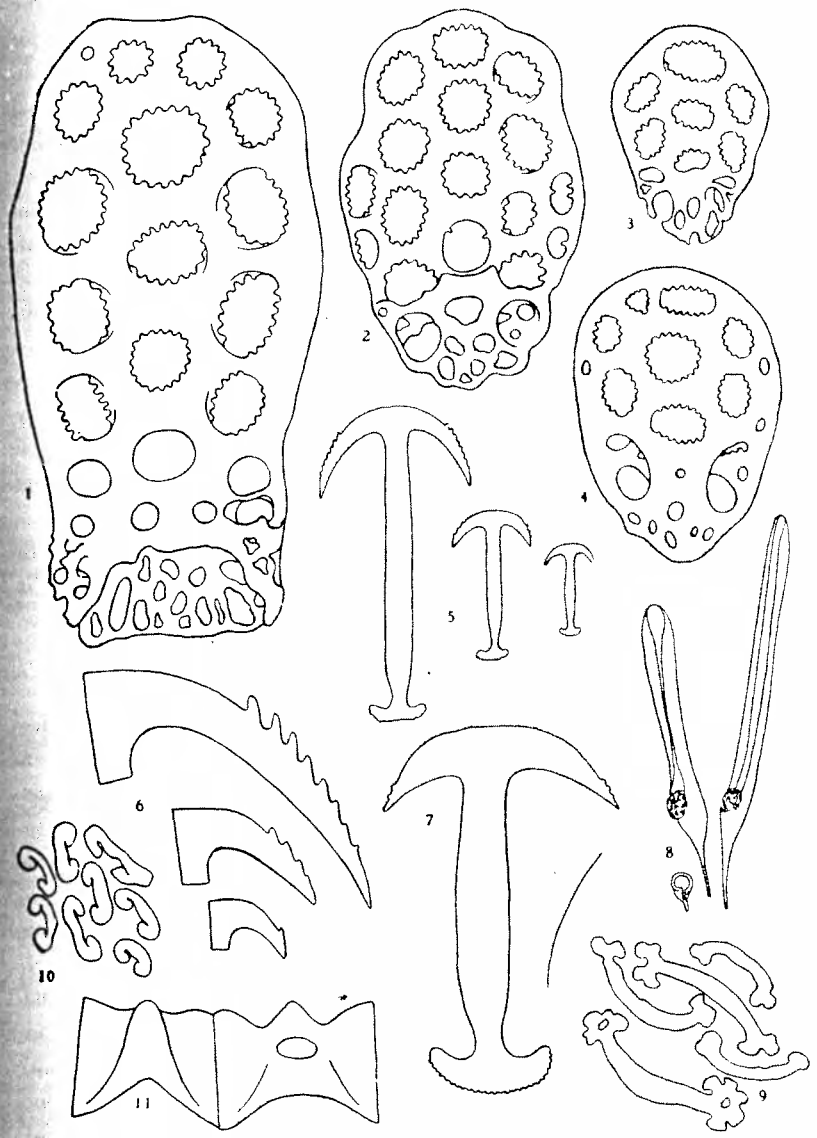


Fig. 44. *Eupatinapta acanthia.* 1—3 & 5—6 anchors and plates from posterior end of body. 4 & 7 anchors and plates from anterior end of body. 8 ciliated funnels from posterior end of body. 9 rods from tentacles, 10 from body-wall. 11 calcareous ring. 1—4 & 6—7 × 200; 5 × 65; 8 × 36; 9—10 × 450; 11 × 24.

where they lie in a dense layer. The rods in the tentacles (Fig. 44. 9) are more or less curved, their ends being usually enlarged and often perforated.

Eupatinapta acanthia is easily separated from *multipora*, as this species is said to be wanting miliary granules in the body-wall.

Labidoplax Østergren 1898.

This genus is only represented in the collection at hand by two small specimens from the Kei Islands. They are nicely preserved, and the examination shows them to be exceedingly interesting and probably distinctly different from all the other species of the genus.

I have no doubt in referring them to Théels variety of *incerta*, and in regarding this form as a valid species; but as there is only the two specimens of the genus in this collection it is not the place here to discuss the systematics of this interesting genus.

Labidoplax variabilis (Théel).

Synapta incerta var. *variabilis*. Théel. 1886. "Challenger" Holothurioidea II. pag. 14. Pl. I fig. 5.

Labidoplax dubia partim. Clark. 1908. The Apodous Holothurians. pag. 96.

The Kei Islands. 5° 31' S.—131° 26' E. 3. IV. 1922. 250 m. Sand. 2 specimens.

The two specimens at hand measure 4,8 cm and 4,6 cm in length by 0,2 cm in diameter. Their colour is white and the skin is so thin and transparent that the longitudinal muscles and the intestine may be seen through it. The one specimen is lacking the anterior end. The other has twelve tentacles (Fig. 45. 1), each supplied with four digits and 12—14 sensory cups, arranged in two longitudinal rows. Only one of the tentacles has, as seen on the figure, the "cups" more equally spread on the oral side of it. A terminal digit as well as eye-spots are totally wanting. The calcareous ring (Fig. 45. 12-13) is very interesting in being symmetrical and in having only the three ventral radials perforated for the nerves. Muscular impressions are very distinct, and the calcareous ring itself is thick and pure white. A cartilaginous ring is totally wanting. There is only one polian vesicle. The stone-canal can, due to contraction of the specimen, not be made out.

The alimentary canal has no loop. Oesophagus is long and thin

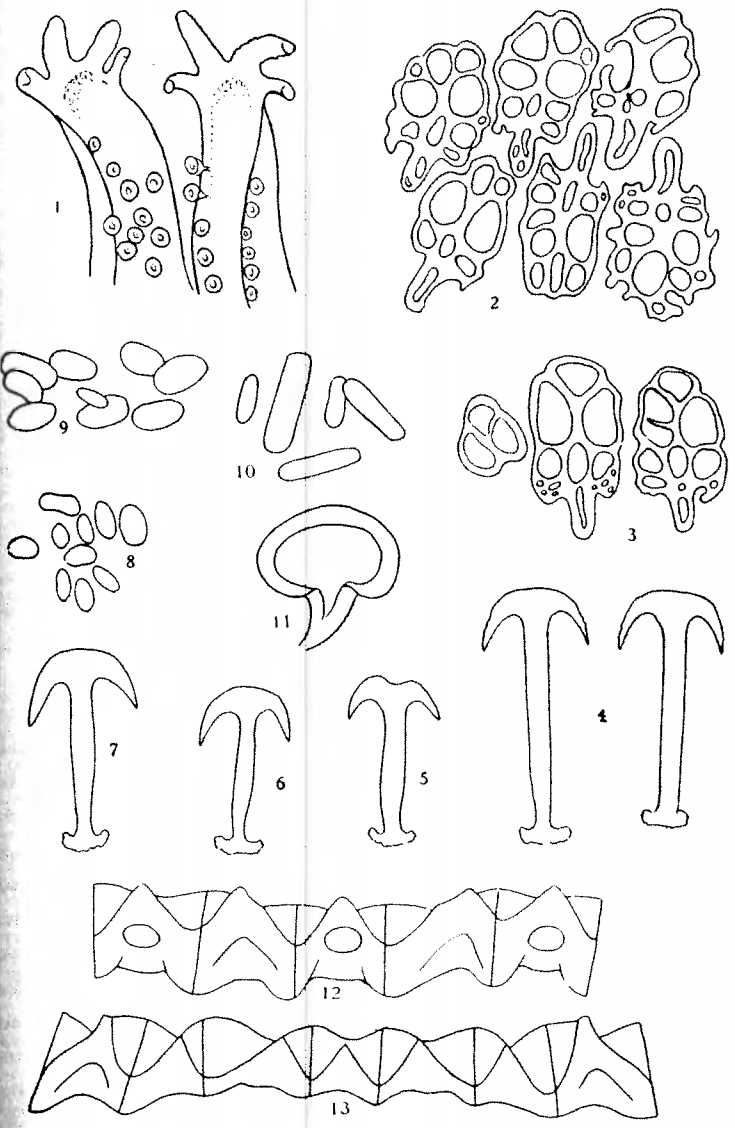


Fig. 45. *Labidoplax variabilis*. 1 Tentacles. 2 Anchor-plates from anterior end of body, 3 from posterior end. 4 Anchors from posterior end, 5—7 from anterior end. 8 oval bodies from interradii, 9 from radii, 10 from tentacles. 11 Ciliated funnel. 12 ventral side of Calcareous ring, 13 dorsal side. 1 & 12-13 × 21; 2-11 × 210.

and different from the folded intestine, The alimentary canal is in its whole length fastened to the body-wall by the dorsal mesentery. The gonads are well developed and one to two times branched. They enclose both eggs and sperma; the eggs are ca. 165 μ in diameter.

The ciliated funnels (Fig. 45. 11) are found on the body-wall. In the body-cavity there are found several nematods, most of which are partly buried in the longitudinal muscles.

The anchors from the posterior end of body (Fig. 45. 4) measure 155 μ in length and 70 μ in width. They are rather slender and their arms are either smooth or faintly dented. The anchors from the anterior end of body (Fig. 45. 5-7) are of varying shape and have always the arms quite smooth. They measure ca. 105 μ in length and 55 μ in width.

The shape of the anchor-plates is very varying. The plates from the posterior end of body (Fig. 45. 3) measure usually ca. 105 μ in length and 55 μ in width, but some of them may be exceedingly reduced. These reduced plates are distinctly different from the various developmental stages found, and may be regarded as fully developed. The plates from the anterior end of body are slightly larger than those from the posterior end, measuring ca. 110 μ—120 μ in length and 50 μ—65 μ in width. They are more varying in shape (Fig. 45. 2), but so reduced plates as in the posterior end are not found.

The miliary granules are small oval bodies, of which those from the radii (Fig. 46. 9) are slightly larger than those in the interradii (Fig. 45. 8). Rods are totally wanting in the tentacles, where there are some rather large and oblong oval bodies (Fig. 45. 10).

Labidoplax variabilis is distinctly characterized by the shape of the calcareous ring and of the oval bodies. Probably also the shape of the ciliated funnels as well as that of the anchors and plates afford good characters for distinguishing it from the other species of the genus.

Protankyra Østergren.

Østergren. 1898. Das System der Synaptiden. pag. 116.
H. L. Clark. 1908. The Apodous Holothurians. pag. 97.

The collection at hand includes only 69 specimens, representing 8 different species, of *Protankyra*, the four of which are new to science.

Though they do not throw much light on the systematics of this large and perplexing genus, the specimens at hand afford a desirable opportunity for studying more in details the four species:

Synapta bidentata, Woodward & Barrett.
Synapta pseudo-digitata Semper.
Synapta autopista v. Marenzeller.
Synapta asymmetrica Ludwig.

These studies show that *bidentata* is a well characterized species, and that it has, as well as *pseudo-digitata*, two different sorts of anchors and anchor-plates in the posterior end of body. Furthermore there can be no doubt that *Synapta distincta* v. Marenzeller is synonymous with it.

In *asymmetrica* there are found branched, ciliated funnels, and the comparison of the funnels in these four species with those found in the four new species, indicates that the ciliated funnels are of the greatest value as specific characters in *Protankyra*.

In "The Apod. Holoth." Clark refers 25 different species to this genus, saying that: "Scepticism as to the validity of some of these species is bound to arise", and since that time six new species have been described. In "Echinoderms from New Zealand and the Auckland-Campbell Islands" Dr. Mortensen has described some specimens of *uncinata* Hutton, which according to Dr. Mortensen may be regarded as a valid species. Thus we may for the present distinguish the following 32 species:

1858. ***bidentata***. Woodward & Barrett: On the genus Synapta. pag. 365, Pl. XIV fig. 23—25.
1868. ***pseudo-digitata***. Semper: Die Holothurien. pag. 9, Pl. IV fig. 12.
similis „ „ pag. 10, Pl. III fig. 2, Pl. IV fig. 14.
petersi „ „ pag. 230, Pl. XXXIX f. 12.
1874. ***asymmetrica***. Ludwig: Beiträge zur Kenntniss der Holothurien. pag. 78, Pl. VI fig. 2.
bankensis. Ludwig: Beiträge zur Kenntniss der Holothurien. pag. 78, Pl. VI fig. 1.
1881. ***autopista***. v. Marenzeller: Neue Holothurien aus Japan und China. pag. 123, Pl. IV fig. 3.
benedeni. Ludwig: Ueber eine lebendiggebärende Synaptide. pag. 55, Pl. III fig. 19—20.
1885. ***brychia***. Verrill: Results of the Expeditions made by the steamer "Albatross". pag. 539.

1886. *verrillii*. Théel: The Challenger Holothurioidea II. pag. 12, Pl. I fig. 1.
insolens. „ „ „ pag. 13. Pl. I fig. 3.
aculeata. „ „ „ pag. 13, Pl. I fig. 2.
challengeri „ „ „ pag. 14, Pl. I fig. 4.
abyssicola „ „ „ pag. 14, Pl. I fig.11.
1889. *rodea*. Sluiter: Nachträgliches über die Echinoderm Fauna. pag. 108, fig. 11-14.
ludwigi. „ „ „ „ pag. 108, fig. 4-9.
1894. *pacifica*. Ludwig: The Holothurioidea. pag. 174, Pl. 18, fig. 13—19.
1901. *bicornis*. Sluiter: Die "Siboga" Holothurien. pag. 131, Pl. X fig. 15.
suspecta. „ „ „ pag. 132, Pl. X fig. 14.
1905. *denticulata*. Koehler & Vaney: Investigator. pag. 105, Pl. 15 fig. 36-39.
conferta „ „ pag. 105, Pl. 15 fig. 26-29.
errata „ „ pag. 106, Pl. 15 fig. 14-16.
tristis „ „ pag. 107, Pl. 15 fig. 17-18.
1908. *duodactyla*. Clark: The Apodous Holothurians. pag. 26 & 101. Pl. IV fig. 1—7.
1915. *kagoshimensis* Ohshima: Rep. on the Holoth. coll. by "Albatross". pag. 283, Pl. 11 fig. 34 a—e.
1924. *bipedata*. Clark: The Synaptinae. pag. 497, Pl. 8 fig. 1—2 & Pl. 10 fig. 7.
1925. *uncinata* (Hutton). Th. Mortensen: Echinoderms from New Zealand. pag. 367, fig. 48—52.
1928. *suensoni* n. sp.
javaensis „
magnihamula „
ramiurna „

That these species may be regarded as valid I quite agree with Clark, but for which reason he has not accepted the two species *inflexa* and *timida* Koehler & Vaney, I do not see. Koehler & Vaney have not described more than one sort of anchors and anchor-plates in *errata*, though they had complete specimens; therefore we are hardly entitled to suppose that anchors, anchor-plates and rods as figured from *inflexa* may be found in specimens of *errata*. I for my part am convinced that *inflexa* is a valid species, and I do no not se why *timida* should be synonymous with *challengeri*. However, as these species are not represented in the collection at hand these questions cannot be solved here.

Protankyra bidentata (Woodward & Barrett).

Synapta bidentata. Woodward & Barrett. 1858. On the genus Synapta. pag. 365, Pl. XIV fig. 23—25.

Synapta distincta v. Marenzeller. 1881. Neue Holothurien von Japan und China. pag. 123, Pl. IV fig. 2.
„ „ Théel. 1886. The "Challenger" Holothurians II. pag. 11. Pl. I fig. 8.
Protankyra bidentata. Östergren. 1898. Das System der Synaptiden. pag. 117.
Protankyra distincta. Östergren. 1898. Op. cit. pag. 117.
Protankyra bidentata. Clark. 1908. The Apodous Holothurians. pag. 102, Pl. V fig. 30.
„ „ Ohshima. 1913. Synaptiden von Misaki. pag. 256—58 & 261, Pl. VI fig. 7—8.
„ „ Ohshima. 1914. The Synaptidæ of Japan. pag. 471.
Misaki. 29. IV. 1914. The shore. 35 specimens.

The specimens at hand measure up to 15 cm in length by 1—1,5 cm in diameter. Their colour is in alcohol pale yellow. The body-wall is rather thin and semitransparent, but so stiff that the specimens may stand on their end in the jar. There are twelve ca. 2 mm long tentacles, each with four digits and 1—2 sensory cups. The digits are of equal length, measuring ca. 1 mm. On the oral disk there are 12 eye-spots. The radial pieces of the calcareous ring are perforated for the nerves and the muscular impressions are distinct. A cartilaginous ring is wanting. There are 2—5 polian vesicles and a single stone-canal. The gonads are several times branched and rather voluminous. They measure ca. 10 cm in length. The oesophagus is distinctly different from the folded intestine, being straight and very muscular. It measures ca. 5 cm. The intestine has a large loop. The ciliated funnels (Fig. 46. 11) are stalked and fan-shaped. They are found on and at the base of the mesenteries, and are not united into clusters. Their length is ca. 150 μ.

The calcareous deposits are distinctly different in the two ends of the body, and in the posterior end there are two different sorts of anchors and plates. The largest anchors (Fig. 46. 1-3) and their corresponding plates are only found in the interambulacra. They measure ca. 450 μ in length and 260 μ in width. Their arms are distinctly serrate and the vertex is smooth and convex. The arms are usually of equal length, but may vary somewhat, the anchors then being asymmetrical (Fig. 46. 3). The large anchor-plates (Fig. 47. 1) are of very nearly the same width, but they vary from 300—400 μ in length, the anterior end being more or less reduced. The holes are all smooth, but the exterior surface of the plates

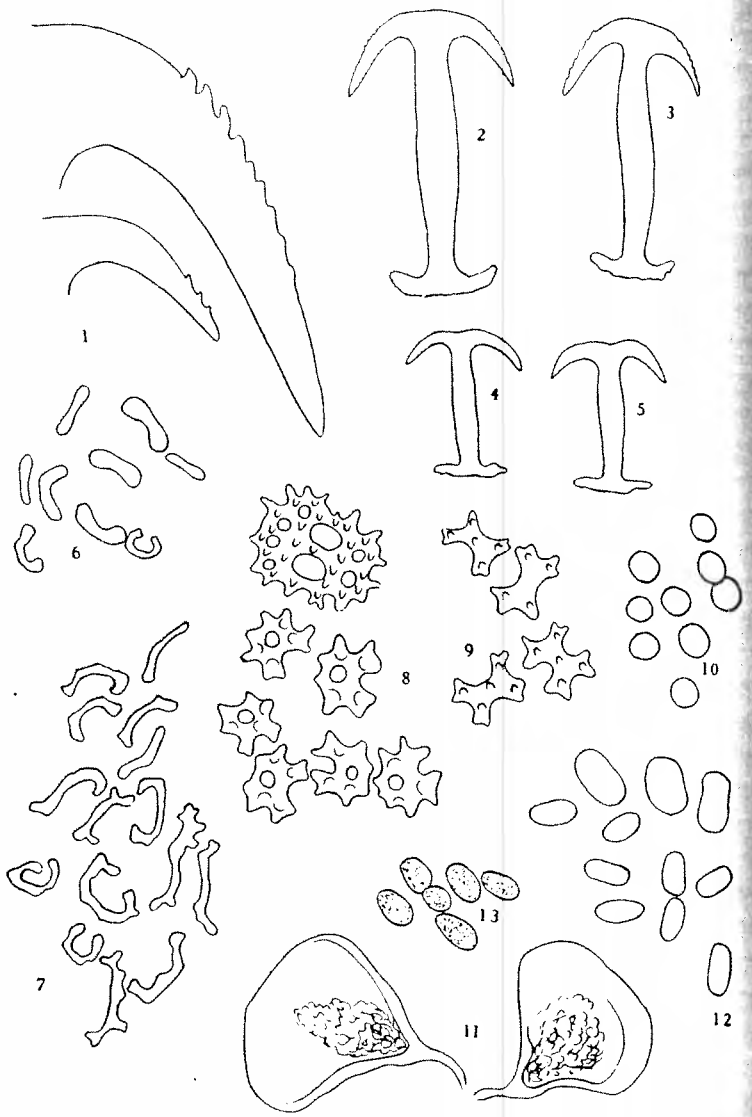


Fig. 46. *Protankyra bidentata*. 1 Anchor-arms. × 165. 2—3 & 5 from posterior end of body, 4 from anterior end of body; 2—5 × 85. 6 granules from tentacle-base. 7 from digits. 8 from anterior end of body, 9 from posterior end of body. 10 from interambulacra in posterior end of body, 12 from anterior end of body, 11 ciliated funnels. 6–10 & 12–13 × 300; 11 × 200.

may be set with small teeth. The small anchors (Fig. 46. 5) differ from the large ones in being hollowed on the vertex and in having only 2—3 teeth on the arms. They measure ca. 225 μ in length and 175 μ in width. The corresponding plates (Flg. 47. 2) are very like the large plates, but they do not measure more than ca. 180 μ in diameter. In the anterior end of body there is not more than one sort of anchors and plates, though the shape of the plates may be rather varying. They are equally found in both the ambulacra and the interambulacra. The anchors (Fig. 46. 4) are rather like the small anchors in the posterior end of body, but they are usually quite smooth on the arms. The anchor-plates are in this end of body much more spiny than in the posterior end (Fig. 47. 3-4) and they may often have a more or less developed network on the middle, being thus rather thick.

There are two sorts of miliary granules; oval bodies and cross-shaped or "stellate" bodies. The miliary granules are as the anchors and anchor-plates different in the two ends of body, and their surface is in the anterior end of body usually more spiny than it is in the posterior end. In the same way the degree of spination may vary from specimen to specimen. The stellate bodies from the posterior end of body (Fig. 46. 9) are rather slender, with long arms and with 4—5 small teeth on the exterior surface. These teeth may in some specimens be nearly wanting. Closer to the tentacles the stellate plates are thicker and the two arms are here usually united, the plate thus being perforate. The teeth are here only low knobs. Such small plates (Fig. 46. 8) may be exceedingly crowded closest to the tentacles, and often united into larger plates with 6—8 holes. The rounded bodies are in the anterior end of the specimens only found in the ambulacra. They are usually elongated (Fig. 46. 12) and consist of two different sorts, the one measuring 20 μ and the other 30 μ in length. In the posterior end of the specimens such bodies are also found in the interambulacra. They are here nearly circular (Fig. 46. 10) and do not measure more than ca. 20 μ in diameter.

In the tentacles there are three different sorts of rods. The rods in the digits (Fig. 46. 7) are very irregularly shaped. They are usually bent and measure 30—50 μ in length. The rods in the tentacle-stem are distinctly different from those in the digits.

They are more regularly shaped (Fig. 46. 6) and measure ca. 30—40 μ in length. In the exterior side of the tentacles there are some small oval, usually brownish bodies (Fig. 46. 13).

Protankyra bidentata is a well marked species, easily recognized. The type of it was a two inches long fore-end, and as seen in the description above one could not expect that Woodward & Barrett should be able to find more than one size of anchors and anchor-plates in it. For this reason Clark in "The Apod. Holoth." has placed *bidentata* among the species with but one size of anchors and plates in the skin. The first to observe more than one sort of anchors and anchor-plates in this species is Théel. He writes in the description of *Synapta distincta* (= *bidentata*) that "most of the anchors have a length of 0,23 mm, but there are some scattered ones to be seen, which measure about 0,4 mm", but as his specimens were only fragments he has not been able to make a closer examination of this feature. In "Synaptiden von Misaki" Ohshima further writes that "Bei *Protankyra bidentata* kommen Anker und Ankerplatten von stark verschiedener Grösse vor . . . . . und die grösseren liegen ausschliesslich in den Interradien, während die kleineren sich immer nur auf die Radien beschränken". Thus there can be no doubt that *Protankyra bidentata* (Woodward & Barrett) belongs to the species with more than one sort of anchors and plates in the skin. From the two other species of this group, *pseudo-digitata* Semper and *bankensis* Ludwig, *bidentata* is distinguished especially by the shape of the ciliated funnels, of the deposits in the tentacles and the anchors and plates.

There is in my mind no doubt that *Synapta distincta* v. Marenzeller is synonymous with *bidentata*, but I do not suppose that *molesta* Semper can be referred to this species. *Synapta molesta* Semper seems to be closer related to *pseudo-digitata* Semper, and most likely it will turn out to be identical with that species.

Protankyra pseudo-digitata (Semper).

Synapta pseudo-digitata. Semper. 1868. Die Holothurien. pag. 9, Pl. IV fig. 12.

? *Synapta molesta.* Semper. 1868. Op. cit. pag. 9, Pl. IV fig. 13, Pl. V fig. 22. Pl. VI fig. 8, Pl. VIII fig. 3.

Synapta innominata. Ludwig. 1875. Beiträge zur Kenntniss der Holothurien. pag. 79, Pl. VI fig. 4.

Protankyra innominata. Østergren. 1898. Das System der Synaptiden. pag. 117.

Protankyra molesta. Østergren. 1898. Op. cit. pag. 117.

Protankyra pseudo-digitata. Østergren. 1898. Op. cit. pag. 217.

Protankyra innominata. Sluiter. 1901. "Siboga" Holothurien. pag. 129.

Protankyra pseudo-digitata. Clark. The Apodous Holothurians. pag. 108.

Protankyra innominata. Koehler & Vaney. 1908. The littoral Holothurioidea collected by the Investigator. pag. 46, Pl. III fig. 17—20.

North of Koh Kong. 23. I. 1900. 8 fms. 6 specimens.
Off Koh Kut. 26. I. 1900. 5 fms. 2 specimens.
Koh Chuen. 23. II. 1900. 30 fms. 1 specimen.
West of Koh Kut. 4. III. 1900. 15 fms. 2 specimens.
Off Samalona, Makasser. 18. VI. 1922. 35 fms. 1 specimen.

The largest specimen at hand measures 7,5 cm in length by 1,5 cm in diameter, thus being much larger than the specimens described as *innominata*, which did not measure more than 1 cm and 3,8 cm in length. The colour is pale white and the body-wall is nearly quite translucent. There are 12 tentacles, each with four digits. Sensory cups are wanting on the specimens at hand. On the oral disk there are twelve eye-spots, but they are so faint, as to be nearly invisible. There are 6 polian vesicles and a single stone-canal. The radial pieces of the calcareous ring are perforated, and a cartilaginous ring is wanting. The gonads are branched. The oesophagus is distinctly different from the intestine, but it is by far not so muscular as in *bidentata*. Ciliated funnels are found at the base of the mesenteries and often also on the body-wall, close to the mesenteries. They measure 40—70 μ in length and are distinctly different from the funnels in *bidentata* (Fig. 48. 7). The intestine has a large loop.

As in *bidentata* the calcareous deposits from the two ends of body are different, and in the posterior end there are more than one sort. The large anchors (Fig. 48. 1) are found only in the posterior half of the interambulacra. They measure 620—650 μ in length and 410—430 μ in width. While the large anchors in the interambulacra of *bidentata* are found alone, the large anchors in the present species are surrounded by three different sorts, which are distinctly smaller. The most common of these (Fig. 48. 3) measure ca. 225 μ in length and 170 μ in width. They differ from the large anchors in being distinctly hollowed on the vertex and in having only 2—3

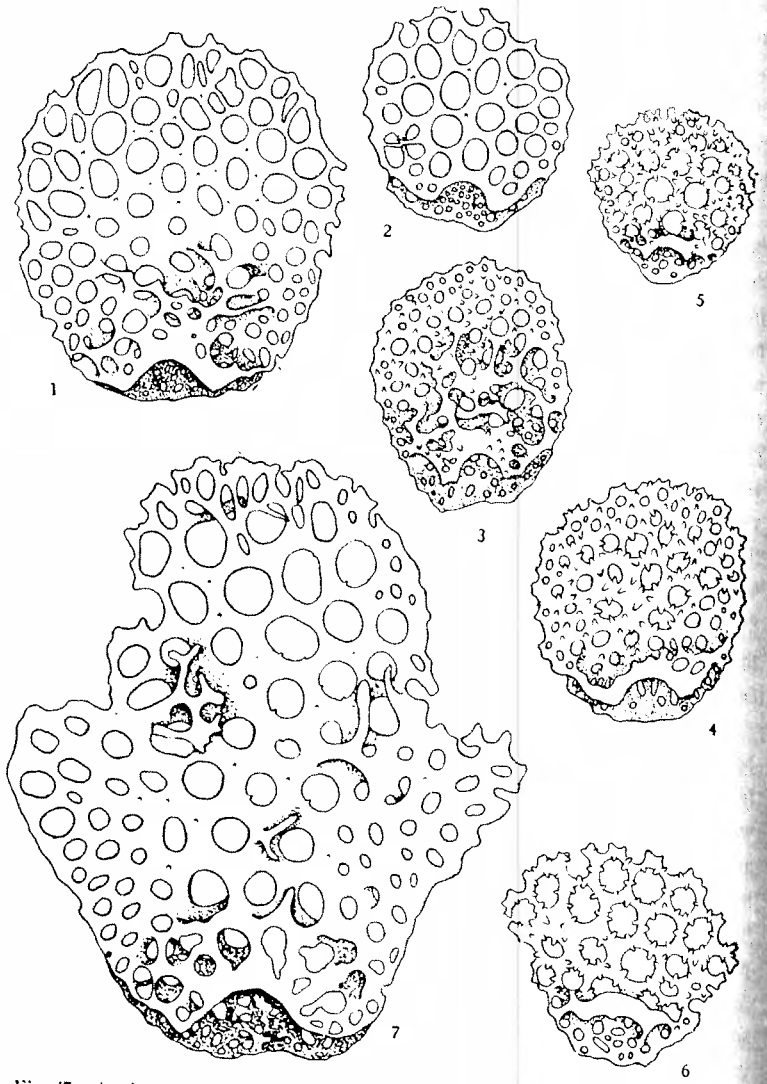


Fig. 47. Anchor-plates of *Protankyra bidentata* 1—4 and *Protankyra pseudodigitata* 5—7. 1 from posterior end of interambulacra, 2 from posterior end of ambulacra, 3 & 4 from anterior end, 5 from anterior end, 6—7 from posterior end. × 165.

teeth on the arms. Among these anchors there is a third much smaller sort (Fig. 48. 4) (150 μ × 115 μ), and a fourth sort (Fig. 48. 2), not hollowed on the vertex and measuring 270—290 μ in length and ca. 180 μ in width. The anchors from the anterior end of body (Fig. 48. 5) are very like the smallest anchors from the posterior end. They measure ca. 150 μ in length, but usually not more than ca. 90 μ in width.

The plates corresponding with the large anchors are very varying in size and shape, as their anterior end may be more or less well developed. They measure up to ca. 500 μ in length by ca. 400 μ in width. The central holes are the largest, and usually they are faintly toothed (Fig. 47. 7). The surface of the plate may be set with faint teeth, and there are often some irregular, branched protuberances. The articulation with the anchors is well developed. The plates corresponding with the small plates in the posterior end are all of very nearly the same shape (Fig. 47. 6), but their size is varying with the size of the anchors. The plates corresponding with the common anchors measure ca. 180 μ in length and 210 μ in width, being thus a little wider than long. The anchor-plates from the anterior end of body (Fig. 47. 5) are, as the small plates from the posterior end, distinctly dented on the surface. They measure ca. 150 μ in diameter and are more or less rounded.

In the posterior end of body there are numerous cross-shaped bodies (Fig. 48. 10) in the interambulacra (in the ambulacra some few ones may be found); they are rather thick, with short arms and with four large teeth, one on each arm. More anteriorly these bodies are slender (Fig. 48. 9) and their arms are relatively longer. On the anteriormost end of body, close to the tentacles, cross-shaped bodies are wanting and represented by numerous, stellate, perforated plates (Fig. 48. 8). The distribution and the number of these three sorts of miliary granules may vary from specimen to specimen, the stellate bodies being always wanting when only few granules are present. Besides the bodies described above, there are oval bodies in both ends of the specimens. In the posterior end of body there are two sorts, one in the ambulacra (Fig. 48. 12) measuring 25—30 μ and one in the interambulacra (Fig. 48. 11) measuring 10—15 μ. In the anterior end of body the small ones from the interambulacra are wanting.

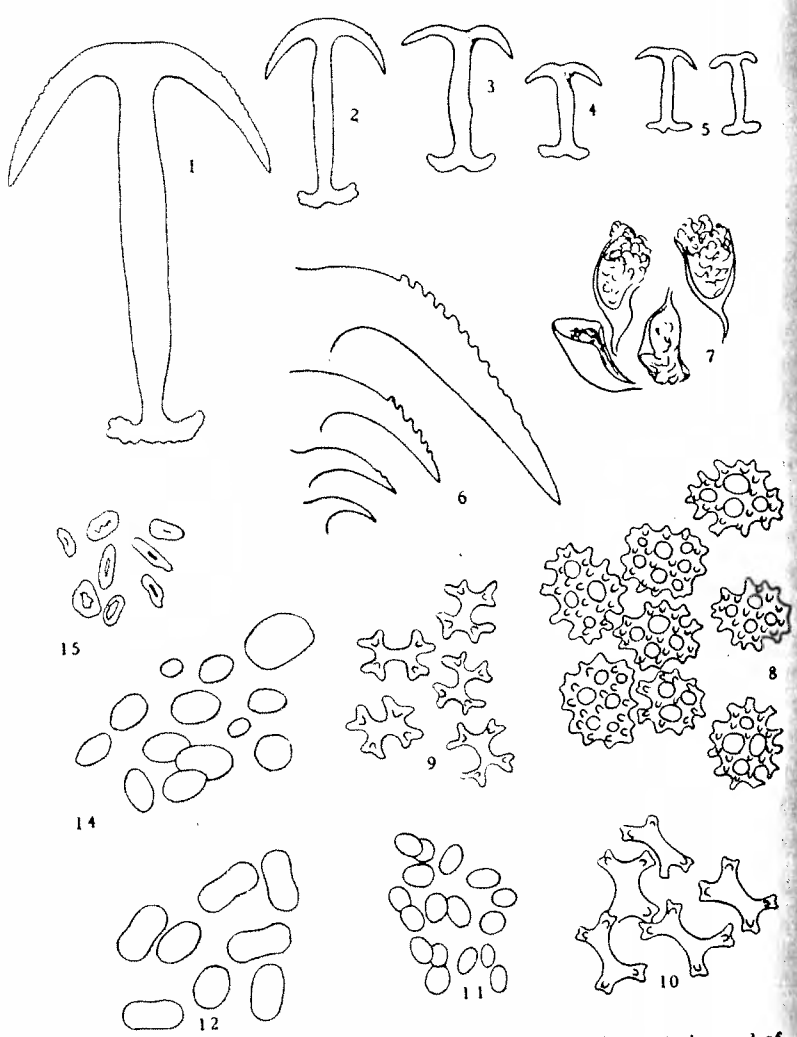


Fig. 48. *Protankyra pseudo-digitata*. 1—4 Anchors from the posterior end of body, 5 from anterior end of body. Anchor-arms from posterior end of body, 7 ciliated funnels. 8 stellate plates from anteriormost end of body. 9 cross-shaped bodies from anterior end of body. 10 from posterior end of body, 11 from interambulacra in posterior end of body. 12 from ambulacra. 14 from tentacle-base. 15 from digits. 1—5 × 85; 6 × 164; 7 × 200; 8—15 × 300.

In the tentacles there are no rods, but only oval bodies. These in the tentacle-base (Fig. 48. 14) vary in size from 10 to 40 μ in diameter. The calcareous deposits in the digits are nearly ring-shaped, the central part being more or less dissolved (Fig. 48. 15).

Protankyra pseudo-digitata Semper is the most closely related to *bidentata* Woodward & Barrett and to *bankensis* Ludwig, but it differs distinctly from both species. In the description of *digitata* it is said that the best characters for distinguishing it and *pseudo-digitata* are the shape of the ciliated funnels, the deposits in the tentacles and the large anchor-plates, and the two species cannot be confounded when these organs are present. According to Ludwig (Beiträge zur Kenntniss der Holothurien pag. 78) *bankensis* differs from *pseudo-digitata* in having dented holes in the anchor-plates and in having serrate arms on the small anchors. These characters do not separate the two species distinctly, as some of the small anchors in *pseudo-digitata* may have serrate ams and the holes in the plates are usually toothed; but that the two species are distinctly different, appears from the shape of the anchor-plates in *bankensis*. Furthermore Ludwig states that cross-shaped and stellate bodies are wanting in the skin of *bankensis*. If this is really the fact, it will be a valuable character for separating the two species. Although I consider *bankensis* as a valid species, I have no doubt that *innominata* Ludwig is synonymous with *pseudo-digitata*. In the description of *innominata* Ludwig writes: "Die grossen Anker kommen nur in den fünf Radien des Körpers vor." This does not agree with the specimens at hand, and as it is also contrary to Ohshima's remarks of *bidentata* in "Die Synaptiden von Misaki", I suppose that it may be a mistake.

That *molesta* Semper may rather be referred to *pseudo-digitata* than to *bidentata* is probable from the shape of the anchor-plates, which quite agree with the small plates in *pseudo-digitata*. Furthermore the size of the ciliated funnels in *molesta* agree much better with that of the funnels in *pseudo-digitata*, than with that of the funnels in *bidentata*.

In the report on the Echinoderms from the Suez Canal, collected in 1924 by the Cambridge Expedition, Dr. Mortensen describes some few specimens of a *Protankyra;* he has not identified the specimens, but supposes that they are identical with or at any rate closely

related to *pseudo-digitata*. Judging from Dr. Mortensen's preparations, I have no doubt in identifying the Suez-specimens as *pseudo-digitata*. The fact that the specimen with tentacles has only ten, may be due to an anomaly, as all the complete specimens at hand have 12 tentacles.

Protankyra pseudo-digitata was previously reported only from Bohol and Makasser. The collection at hand shows that it is more widely distributed, occurring also in the Gulf of Siam and in the Red Sea. On the other hand I do not suppose that it occurs at Japan, where it is represented by *bidentata*.

Protankyra petersi (Semper).

Synapta petersi Semper. 1868. Die Holothurien. pag. 230, Pl. 39 fig. 12.
Protankyra petersi. Østergren. 1898. Das System der Synaptiden. p. 117.
" " Clark. 1908. The Apodous Holothurians. pag. 108. Pl. IV fig. 15—16.

In the collections of the Copenhagen Museum there are some preparations made by C. Semper, containing spicules of some of his more interesting Holothurians. Among these preparations there is one labelled: *Synapta Petersi* S. Amboina, including some few anchors and plates of this species, which must belong to the type-specimen, the only one known till now.

Semper has not given any figure of the anchor-plates in *petersi*, and he only writes: "Die Anker . . . . . sie sind sehr eigenthümlich gebildet, asymmetrisch; der eine kurze und sich bis auf den Stiel niederbeugende Ast trägt 3—4 kleine Zähne, der andre lange vom Stiel abtredende ist ganz glatt. Ausserdem kleine kreuzförmige Körperchen. Die Ankerplatten sind denen von *Synapta pseudo-digitata* ähnlich". Semper is not quite right in saying that the plates in *petersi* are like the plates in *pseudo-digitata*. The outline of the plates in *petersi* is rather like that of the small plates in *pseudo-digitata*, but the plates differ distinctly, those in *petersi* being thick, and consisting of several layers of spiny network, which is densest close to the articular end of the plate (Fig. 51. 1). Thus it is quite erroneous when Clark writes that "The curious grotesque anchors are accompanied by normal plates perforated with numerous smooth holes". The anchor-plates in the preparation at hand measure ca. 300 μ in length.

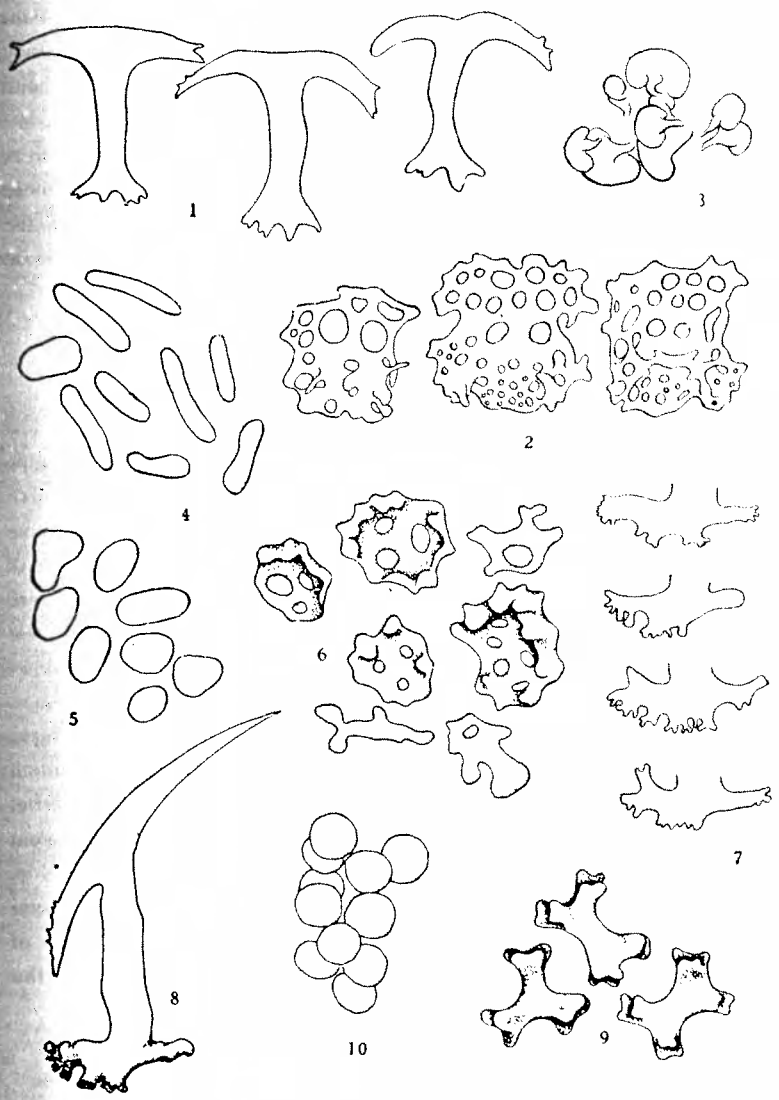


Fig. 49. Calcareous deposits and ciliated funnels of *Protankyra antopista* 1–6 and *Protankyra petersi* 7–10. 1 Anchors. 2 Anchor-plates. 3 Ciliated funnels. 4 Rods from interambulacra. 5 Oval bodies from ambulacra. 6 Miliary granules. 1–2 & 7–8 × 160; 3 × 35; 4–6 & 9–10 × 300.

The anchors (Fig. 49. 8) measure from the point of the long arm to the handle ca. 390 μ. The long arm is as Semper writes usually quite smooth, but a single little tooth may occur. On the short arm there are some few (5—8), very irregular teeth. Also the handles are asymmetrical (Fig. 49. 7), their larger part being always on the same side of the stock as the short arm.

There are two different sorts of miliary granules in the preparation at hand. The one (Fig. 49. 9) is rather thick cross-shaped bodies. The knobs on the ends of their arms are so large that the arms are semingly branched in the ends. The size of these bodies is ca. 25 μ. The other sort is nearly circular granules (Fig. 49. 10) measuring 10—12 μ in diameter.

This species is known only from Amboina, and nobody since Semper has met with it. That it is a valid species seems rather certain, but since the type is still unique, it is posible that this curious species may ultimately prove to be an abnormal specimen of another species.

Protankyra autopista (v. Marenzeller).

Synapta autopista v. Marenzeller. 1881. Neue Holothurien von Japan und China. pag. 223, Pl. IV fig. 3.
„ „ Lampert. 1885. Die Seewalzen. pag. 222.
„ „ Théel. 1886. The "Challenger" Holothurioidea. p. 32.
„ „ Mitsukuri. 1896. A list of Holothurians.
Protankyra autopista. Østergren. 1898. Das System der Synaptiden. pag. 117.
Synapta autopista. Britten. 1907. Holothurien aus dem japanischen und ochotskischen Meere. pag. 149.
Protankyra autopista. Clark. 1908. The Apodous Holothurians. pag. 103, Pl. V fig. 31.
„ „ Ohshima. 1913. Synaptiden von Misaki. pag. 505, fig. 6.
„ „ Ohshima. 1914. The Synaptidae of Japan. p. 472.

Misaki. 28. IV. 1814. The shore. 7 specimens.

The specimens are in the exterior rather like *bidentata*, only they are a little reddish, and, as the specimens at hand of *bidentata*, they are rather stiff, though the body-wall is so thin that the intestine is seen through it. The specimens at hand measure 14—17 cm in length, though they are all lacking the "head" with calcareous ring and polian vesicles. *Pr. autopista* is said to have twelve

tentacles, each with four digits. The tentacles measure ca. 3 mm in length. Sensory cups are never mentioned. Britten writes that the calcareous ring consists of "12 fast gleichförmigen Stücken" with the posterior margin waved, but whether the radials are perforated or not is not mentioned. There is one polian vesicle and a short and twined stone-canal. The intestine has no loop, and in the specimens at hand it is very folded. The gonads are long, thin and branched. The ciliated funnels (Fig. 49. 3) are found on the body-wall. They are rather like the funnels in *Leptosynapta inhaerens* (O. F. Müller) and measure 150—200 μ in length.

The anchors (Fig. 49. 1) are rather small and very irregular in shape. They measure 86—140 μ in length and may often be wider than long. They are usually faintly hollowed or flat on the vertex, and on the arms there may be one to two large teeth. The anchor-plates (Fig. 49. 2) are as the anchors of very varying shape, but they are usually square or quadrangular. They measure 70—120 μ in length and usually very nearly the same in width. They are irregularly perforated with smooth holes and the articulation with the anchors may be nearly wanting.

There are three different sorts of miliary granules in the specimens at hand. The first, the most characteristic, was discovered by v. Marenzeller. It is small, perforated plates, more or less developed. When fully developed (Fig. 49. 6) they are rather bowel-shaped with an undulating edge. The second (Fig. 49. 5) was found by Ohshima, who in "The Synaptidae of Japan" mentions some "smooth, oval granules, 20 μ in diameter" found deeply imbedded in the radii. The third sort found in the specimens at hand (Fig. 49. 4) are rounded or oval rods, measuring 30—35 μ in length. They are found scattered among the small perforated plates in the interambulacra.

Protankyra autopista is, though it is easily distinguishable from all the other species of the genus, a much discussed species. Théel suggests that it may be referred to *molesta* Semper, and Clark writes in "The Apod. Holoth." that "it may be that the type and only known specimen is simply the anterior part of the body of a peculiar individual of the preceding species" (i. e. *bidentata* Woodward & Barrett). That these suggestions are erroneous, and that *autopista* is a valid species distinctly different from *bidentata*, was shown by Ohshima in "The Synaptidae of Japan".

Protankyra suensoni n. sp.

22° 10' N. 114° 30' E. 18 fms. Suenson. 1882. 2 specimens.
40° 23' N. 129° 33' E. 140 fms. Suenson. 1882. 1 specimen.

None of the specimens at hand are complete and only one (from 22° 10' N., 114° 30' E.) is a fore-end. The species must be a relatively large one, as the type-fragment, though exceedingly contracted, measures 2,5 cm in diameter (uncontracted it may be ca. 4 cm in diameter). The body-wall is, perhaps due to contraction, very thick and stiff. The colour is in alcohol pale yellow. Each of the radial muscles is by a deep furrow divided into two nearly triangular parts, the sides of which measure ca. 5 mm. There are twelve tentacles, each with four digits and a very large number of diminutive, sensory cups, spread over the whole oral side. They are so small that they are hardly seen by the unarmed eye. The tentacle-muscles are as in *magnihamula* (cf. p. 271) fastened to both the inner and the outer side of the calcareous ring. There are 15 large polian vesicles of very nearly the same size, and a single, twined stone-canal with a thin and weak madreporite. The gonads (Fig. 50. 5) are, although empty, very voluminous. They consist, on each side, of a large and wide uterus, with 5—8 branches, all on the same side of it. The oesophagus is very thin and for that reason most likely different from the intestine. But as the intestine is lacking, this cannot be ascertained. The ciliated funnels (Fig. 50. 3) are long and slender, and usually united into stalked clusters.

There is found only one sort of anchors (Fig. 50. 1-2). They measure, in the type-specimen, 850 μ in length and 500 μ in width, but in the fragment from 40° 23' N., 129° 33' Ø., they are conspicuously longer, measuring 1000—1150 μ in length and ca. 650 μ in width. As the two fragments agree pretty well in all other respects, the suggestion lies at hand that the large difference in the size of the anchors may be due to the fact that they belong to different parts of the body. The stock of the anchors is finely dented and the arms are serrate. The serration is unusually faint and regular (Fig. 50. 2).

The anchor-plates (Fig. 51. 2) measure in the type ca. 700 μ in length and 550 μ in width. In the other fragment they measure 800 μ in length and 650 μ in width. The shape of the plates is rather characteristic, the articular end being square. The anterior

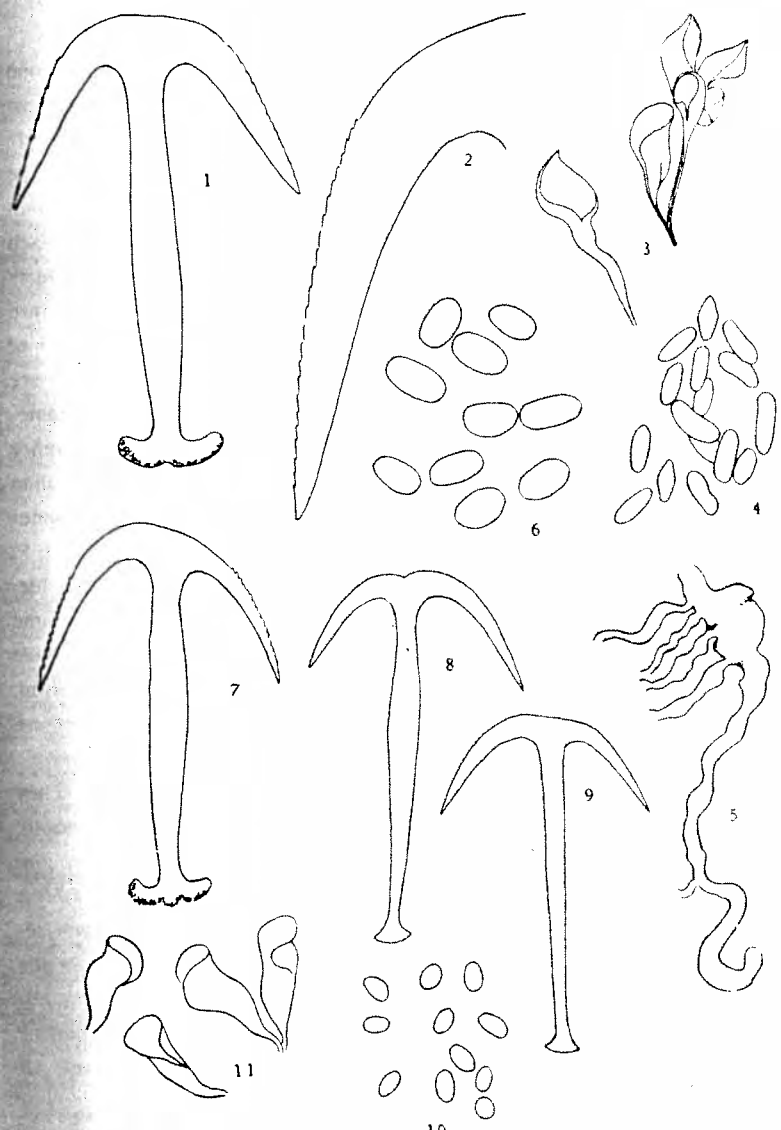


Fig. 50. Calcareous deposits, ciliated funnels and gonad of *Protankyra suensoni* **1–5 and** *Protankyra javaensis* 6–11. 1 & 7–9 × 70; 2 × 160; 3 & 11 × 200; 4, 6 & 10 × 300; 5 × 9.

end of the plates is irregular, but usually nearly oval. The holes are distinctly toothed and in the middle of the plates, as well as in the articular end, there is a rather thick network.

There is only found one sort of miliary granules (Fig. 50. 4). They are 10—20 μ long, smooth, oval bodies, equally destributed all over the body-wall.

Protankyra suensoni is not more closely related to any of the other species. It is distinctly characterized by the shape of the calcareous deposits, especially of the anchor-arms and of the anchor-plates and the ciliated funnels.

Protankyra javaensis n. sp.

The Java Sea, 5° 51' S., 106° 27' E. 7. VIII. 1922. Mud. 60 m. 1 specimen.

The single specimen at hand is but a "head"-less fragment, measuring 6,5 cm in length and 0,8 cm in diameter. As the anterior loop of the intestine is present, the comple e specimen can not have been more than 8—10 cm in length. The colour is in alcohol very pale reddish, for which reason the specimen in the exterior may resemble *rodea* (Sluiter). The mesenteries are close to the body-wall net-formed and supplied with ciliated funnels (Fig. 50. 11). The funnels are placed singly and as far as can be seen not united into clusters.

The calcareous deposits are in this species exceedingly interesting, the anterior ones being the larger. In most Synaptids it is a rule that the anchor-plates from the posterior end of body are the larger, and only the genus *Patinapta* is characterized in having the larger plates in the anterior end of body, but even in this genus the posterior anchors are the largest. Quite contrary to this, the single fragment of *javaensis* has the largest deposits in the anterior end. The suggestion lies at hand that the two ends of the specimen are confounded, but the well preserved rectum, anus and posteriormost part of body-wall, show that this cannot be the fact. The not fully developed stage of the anterior deposits indicates that the specimen is regenerating the anterior end, but even in this case I cannot see any reason for the anterior deposits to be the larger.

The largest anchor-plates (Fig. 51. 4) measure ca. 900 μ in length and 650 μ in width. They are never fully developed, and

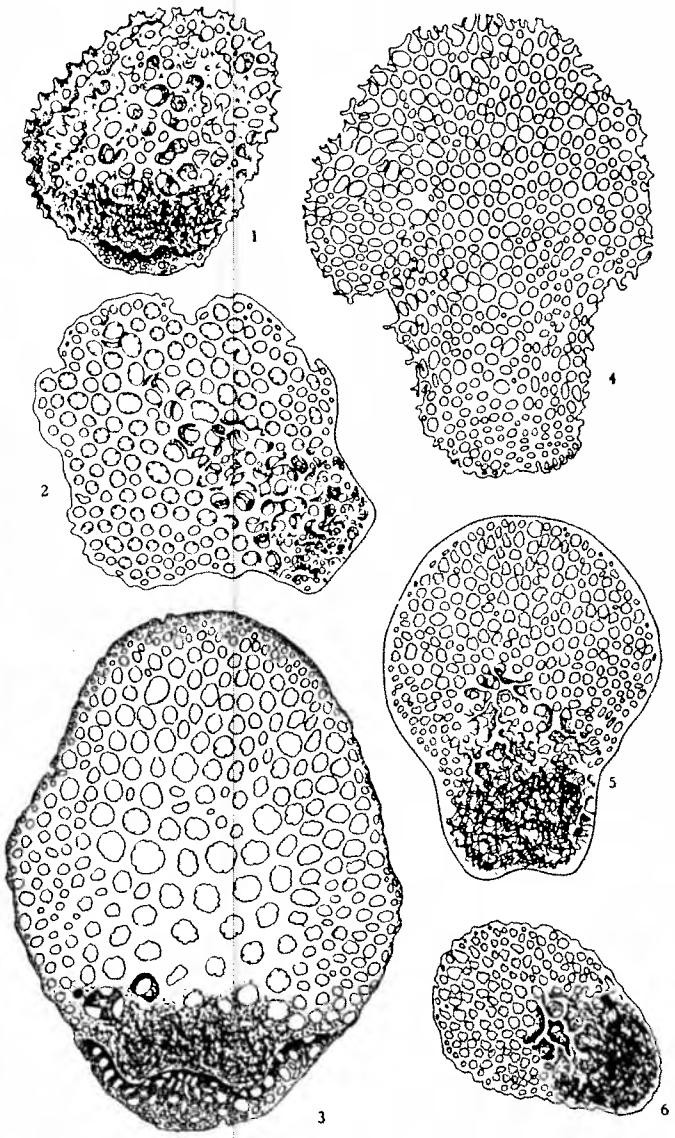


Fig. 51. Anchor-plates of 1 *Protankyra petersi*, 2 *Protankyra suensoni*, 3 *Protankyra magnihamula*, 4—6 *Protankyra javaensis*. × 75.

different developmental stages are present. The numerous round holes in the plates are all smooth, and there is no articulation developed in the posterior end of the plates. The shape of these plates when fully developed seems to be quite as that of the smaller plates found more posteriorly in the specimen (Fig. 51. 5). These plates are fully developed, and they have a distinct margin. The holes are irregularly dented and in the middle as well as in the articular end of the plates a thick network is developed. The length of these plates is ca. 750 μ by 600 μ in width. In the posteriormost end of the specimen there are found some relatively small oval plates, measuring only 550 μ in length and 375 μ in width. Their outline is not smooth and the holes are dented. In the middle and in the anterior end there is a network.

Fully developed anchors are rare, and only found corresponding with the large anchor-plates in the posterior end. They measure ca. 1100 μ in length and 700 μ in width. The anchors are usually faintly asymmetrical. Their arms are distinctly serrate, the vertex is smooth and the stock is finely dented. The anchors corresponding with the large plates in the anterior end of the fragment are, as the plates, not fully developed, and for that reason their arms as well as their stock is smooth.

All over the body there are two different sorts of rods. The smaller are found in the skin, where they lie in a dense layer. They are regularly oval (Fig. 50. 10) and measure only 8—10 μ. The other sort is found in large quantities in the longitudinal muscles, but also in the circular muscles they may be found. They are as the smaller ones regularly oval (Fig. 50. 6) but measure 15—20 μ in length.

Protankyra javaensis is characterized by the shape of the ciliated funnels and by the size and shape of the calcareous bodies. It is not closely related to any of the at present known species of *Protankyra*, except *rodea* Sluiter. This latter species is on the other hand so insufficiently described, that the real relation between it and *javaensis* cannot be ascertained. The two species are seemingly easily separated by the shape of the anchors and plates, but as Sluiter's figures are rather poor, the two species may ultimately prove to be identical. For the present I think it the most reasonable to regard them as different species.

Protankyra magnihamula n. sp.

Hongkong. 1882. Suenson. 1 fragment.

22° 10' N., 114° 30' E. 18 fms. 1882. Suenson. 2 fragments.

There can be no doubt that the two fragments from 22° 10' N., 114° 30' E. belong to the same specimen, which then may be more than 28 cm in length, as the two fragments measure 20 and 8 cm in length. All the three fragments at hand are of the same width, ca. 1 cm, and of the same brown colour.

The fragment from Hongkong, the type, is a well preserved fore-end, which measures ca. 5 cm in length. It has 12 tentacles, each with four digits. Sensory cups are totally wanting. The radial pieces of the calcareous ring are perforated for the nerves, and the muscular impressions are very distinct. The tentacle-muscles are tube-formed (Fig. 52. 6) with a narrow slit in the inner edge. They are not fastened to the walls of the tentacles, but, by four small projections, to the digits. Their proximal part is fastened to the two sides of the anterior margin of the calcareous ring, the muscles being astride on it (Fig. 52. 7). There are three very large and 20 small polian vesicles and a rather long stone-canal with a well developed, hard madreporite. The gonads are voluminous and dichotomously branched. Oesophagus is rather thin and the intestine is lacking. Ciliated funnels are found singly on the body-wall. They are rather slender (Fig. 57. 8) and not united into clusters.

The anchors are of different size. The smallest anchors measure 1100—1200 μ in length, the greater number of them measure 1300—1500 μ and the largest anchor found measures ca. 1750 μ. The anchors (Fig. 52. 2) are usually quite symmetrical, but some few may be more or less asymmetrical (Fig. 52. 1). The arms are regularly serrate (Fig. 52. 3) and the handle is finely branched (Fig. 52. 4-5).

The anchor-plates (Fig. 51. 3) are very regular in shape, being nearly oval. The articulation with the anchors is developed as a fine network, and the holes are distinctly toothed.

The miliary granules (Fig. 52. 10) are found all over the skin; they are very varying and measure from 10—25 μ in length. In the tentacles there are found no rods but oval plates (Fig. 52. 9) measuring ca. 20 μ in length.

Protankyra magnihamula is a well characterized species, easily

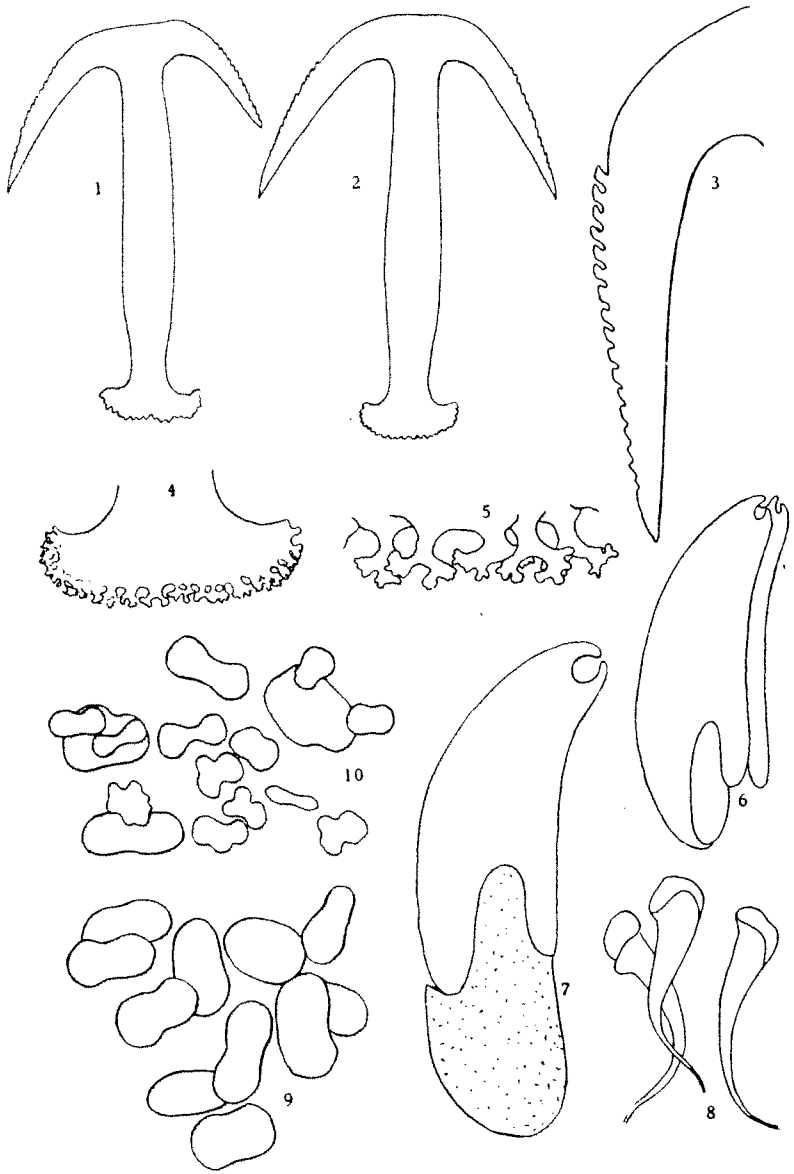


Fig. 52. *Protankyra magnihamula*. 1—2 Anchors. × 40. 3—4 × 80. 5 × 500. 6 Tentacle-muscle dissected out ot tentacle. 7 Tentacle-muscle astride on calcareous ring (the latter shaded . 6—7. × 15. 8 Ciliated funnels. × 200, 9 Oval plates from tentacles. 10 Miliary grannles from body-wall. 9—10. × 500.

separated from all the hitherto known species by the shape of the ciliated funnels, the miliary granules and the anchor-plates. Besides, the unusual size of the anchors affords a good character for recognizing this species.

Protankyra asymmetrica (Ludwig).

Synapta asymmetrica. Ludwig. 1875. Beitrage zur Kenntniss der Holothurien. pag. 88, Pl. VI fig. 2.
" " Théel. 1886. "Challenger" Holoth. II, p. 28.
Protankyra asymmetrica. Østergren. 1898. Das System der Synaptiden. pag. 117, fig. 8.
" " Sluiter. 1901. "Siboga" Holothurien. pag. 129, Pl. X fig. 13.
" " Clark. 1908. The Apodous Holothurians. pag. 107, Pl. V fig. 35—36.

31° N., 124° E. 22 fms. Suenson. 1882. 8 specimens.
31° N., 125° E. 25 fms. Suenson. 1882. 1 specimen.

Only two of the specimens at hand are complete. They measure 10 and 14,5 cm in length and are in alcohol nearly colour-less. The body-wall is thin and, in the posterior end, quite translucent. There are 12 tentacles, each with four digits. Sensory cups are wanting. The radial pieces of the calcareous ring are perforated for the nerves. There are 3—4 polian vesicles, the two of which are, as Ludwig writes, distinctly larger than the others. The stone-canal is single. The gonads are rather long, being nearly three fourths of the body-length; they are dichotomously branched. The intestine is long and thin and with a large loop. The ciliated funnels (Fig. 53. 8) are found on, and at, the base of the mesenteries. They are usually united into clusters, and each funnel is, as in the species *ramiurna*, dichotomously branched, the branches having the shape of a cork-screw.

The anchors are distinctly asymmetrical, and quite agree with Ludwig's figures, except for the fact that anchors with smooth arms are not found. The anchor-plates (Fig. 53. 1-2) are different in the two ends of body. Those from the posterior end (Fig. 53. 1) are oblong with a smooth surface and with smooth holes, and those from the anterior end wider and their surface as well as their holes (Fig. 53. 2) set with distinct teeth.

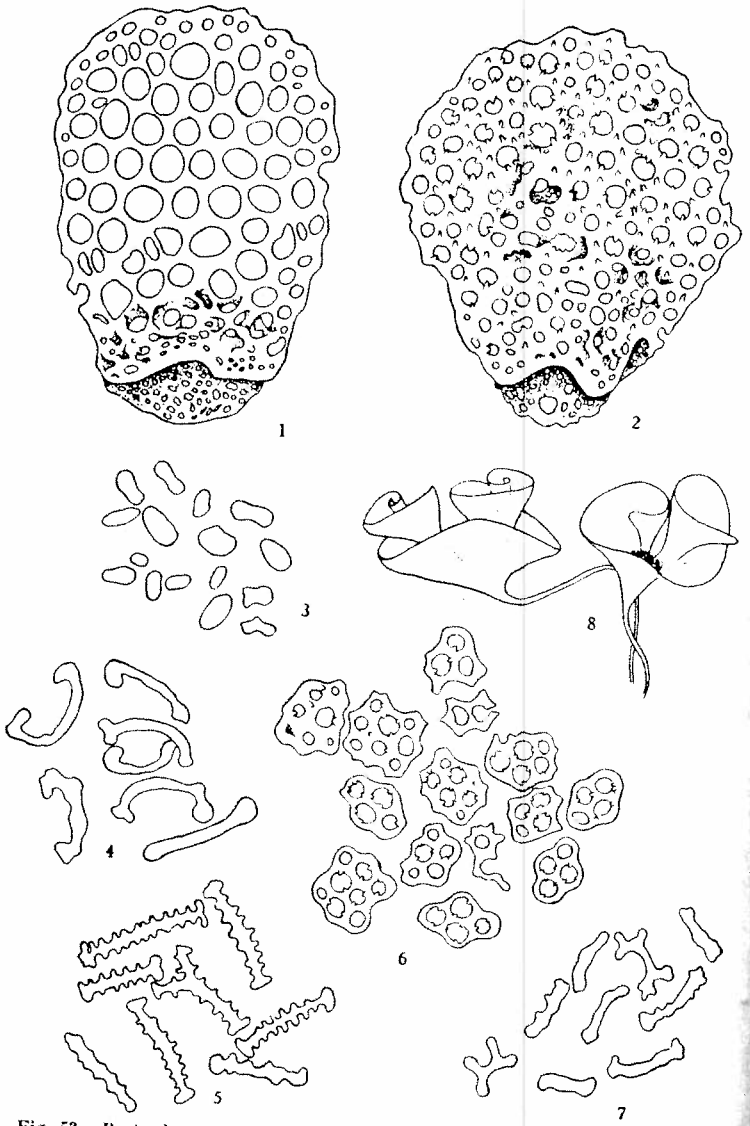


Fig. 52. *Protankyra asymmetrica*. 1 Anchor-plate from posterior end of body, 2 from anterior end of body. 3 Miliary granules from ambulacra. 4 Rods from tentacle, 5 from the tissue around the anchors, 6 from the body-wall, 7 miliary granules from interambulacra. 8 Ciliated funnels. 1—2 × 160; 3—7 × 300; 8 × 90.

The common miliary granules (Fig. 53. 6) are small, perforate plates. They are usually of a rather constant shape, but sometimes they may be very varying (Fig. 53. 6). Among these plates there are found many curved rods (Fig. 53. 7) and in the ambulacra there are oval bodies (Fig. 53. 3). In the tentacle-base there are some few, perforated plates, but the larger part of the deposits here, as well as in the digits, are rather large, curved rods (Fig. 53. 4). In the tissue around the anchors there are the "sehr eigentümliche Stützstäbchen" observed by Sluiter (Fig. 53. 5).

As to the identification of the specimens at hand I have no doubt that they are the same species as the specimens described by Sluiter ("Siboga" Holothurien. pag. 129, Pl. X fig. 13) and I do not think it wrong to refer them to Ludwig's species. In the "Apod. Holoth." Clark writes: "It is virtually certain that neither Ludwig nor Théel would have overlooked such calcareous bodies (i. e. Sluiter's Stützstäbchen), so we are safe in assuming that they were not present in the specimens from Banka. The question naturally arises whether their presence in Sluiter's specimens would not indicate an important specific difference." I do not think so. The specimens at hand show that the number of the "Stützstäbchen" may vary very much, and in some specimens they may be nearly quite wanting, and though they may be present around some of the anchors, they may be totally wanting around others. For this reason both Ludwig and Théel may have made preparations without including a single "Stützstäbchen" though such bodies do occur in the examined specimen. Thus we have no reason for regarding neither Sluiter's specimens nor those at hand as specifically different from the Banka-specimens.

Protankyra ramiurna n. sp.

The West-Indies. Ravn. 1 specimen.

The specimen at hand is lacking the anterior end. It measures 9 cm in length and 1,5 cm in diameter. The intestine has a loop, the anterior curve of which is present.

The ciliated funnels are only found on the body-wall in the interambulacra and seem to be totally wanting on the mesenteries. They are as in *asymmetrica* dichotomously branched (Fig. 54. 1) and the

branches are twined. Some few of the funnels have more than two branches.

The calcareous deposits are all distinctly attacked by acidity in the preserving fluid, and the total wanting of miliary granules may be due to dissolution. The anchors (Fig. 54. 2) measure 350—400 μ in length and 200—250 μ in width. They are rather regular. The

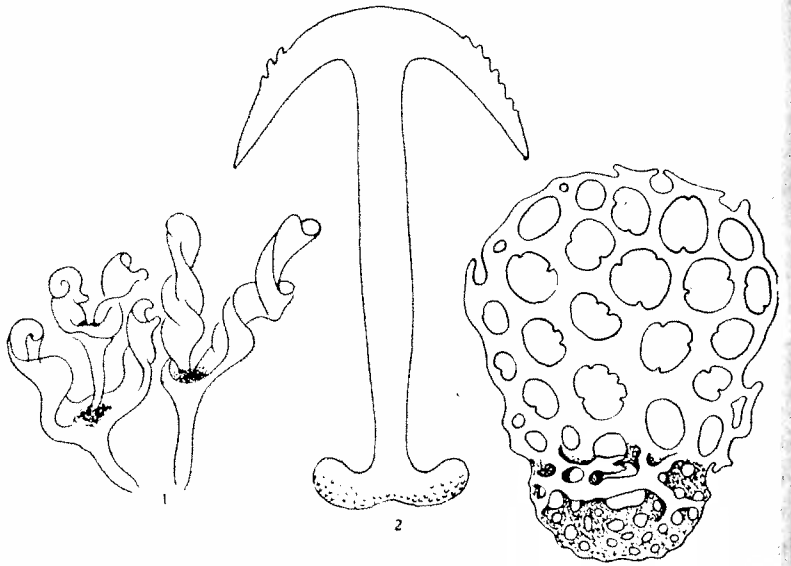


Fig. 54. *Protankyra ramiurna*. 1 Ciliated funnels × 90. 2—3 anchor and plate × 160.

arms are serrate, and the rather large handle is spiny. The anchor-plates (Fig. 54. 3) measure 270—300 μ in length and 200—250 μ in width. There are only few, large holes, the margin of which is distinctly dented, and the outline of the plates is rather incomplete. The articulation with the anchors is well developed, but a real bridge does not occur.

Pr. ramiurna must, in spite of the rather unsatisfactory material at hand, be regarded as a well characterized species, easily recognized by the shape of the anchors, the anchor-plates and the ciliated funnels. In the shape of the ciliated funnels it faintly resembles *Pr. asymmetrica*, but judging from the shape of the calcareous deposits, the two species cannot be regarded as more nearly related.

Subfamily II. Chiridotinae.

Østergren. 1898. Das System der Synaptiden. pag. 117.
Clark. 1908. The Apodous Holothurians. pag. 112.
Clark. 1921. The Echinoderms of the Torres Strait. pag. 163.

The subfamily *Chiridotinae* was established in 1898 by Østergren for the two genera *Sigmodota* Studer and *Chiridota* Eschscholtz, and it is maintained by Clark in "The Apod. Holoth." 1908. In this work Clark totally abandons the genus *Sigmodota* and only maintains the name *Chiridota* for the 12-tentacled species. For the 18-tentacled species he establishes the new genus *Polycheira*. The group "Sigmodota" is divided into four different genera: *Tœniogyrus* Semper, *Trochodota* Ludwig, *Scoliodota* Clark and *Toxodora* Verrill. For Fisher's species *Anapta inermis*, which may be regarded as a Chiridotid, Clark furthermore establishes a separate genus *Achiridota*. These five genera are based only on differences in the calcareous deposits and in the number of the tentacles, and appear to be rather well defined.

In spite of this Dendy, who by his studies of the New Zealand species of the *Chiridotinae* came to the conclusion that differences in the shape of the calcareous deposits are not usable as generic characters, in 1909 rejects all the genera and refers all the species to *Chiridota*. Besides *Chiridota* he has only one genus *Rhabdomolgus* Keferstein, which he regards as a *Chiridotid*, concluding from his new species *Rhabdomolgus novae-zealandiae*. As *Rhabdomolgus* cannot be regarded as a Chiridotid, Becher in 1909 proposes the name *Kolostoneura* for Dendy's species, which may without any doubt be regarded as a Chiridotid. There is, as far as I can see, no reason for following Dendy in rejecting the different genera of the *Chiridotinae*, and I therefore fully agree with Clark in maintaining them. In the report on the Echinoderms from the Torres Strait, Clark discusses in an excellent way these questions, and gives good reasons for maintaining the different genera. Only *Scoliodota* is here abandoned by Clark. The type of that genus was *Chiridota japonica* v. Marenzeller, which, according to v. Marenzeller and Théel, has no wheels among the sigmoid bodies. Now Ohshima in 1912 has shown that in the Japanese specimens some few wheels may be found, for which reason they are better referred to the genus *Trochodota*, and as to *geminifera* Dendy, Clark sup-

poses that the absence of wheels in this species may be due to the preserving fluid.

That this is really the fact, is shown by Dr. Mortensen in 1925 (Echinoderms of New Zealand and the Auckland-Campbell Islands. pag. 378—379), who furthermore shows that *geminifera* must be referred to *Trochodota dunedinensis* (Parker). Thus we might abandon the genus *Scoliodota*, if we had not Théel's Australian specimens of "*Chirodota*" *japonica*, which must be regarded as specifically different from v. Marenzeller's Japanese specimens. This appears from the collection at hand, which includes some specimens from Port Jackson which are without any doubt the same species as Théel's specimens. The examination of these specimens shows that they are lacking wheels in the skin, and as furthermore they differ from *Trochodota* in several other characters, especially in the shape of the calcareous ring, I have no doubt that they represent a separate genus, which must keep the name *Scoliodota*.

Thus we know for the present, eight different genera of the *Chiridotinae*. Six of these are represented in Dr. Mortensen's collections, but as Dr. Mortensen has himself dealt with the two genera *Trochodota* and *Kolostoneura* in the quoted paper, these are not further mentioned here. I may only recall that Dr. Mortensen has described two new *Trochodotas*, *Trochodota dendyi* and *Trochodota dunedinensis* var. *microurna*, the latter of which will most likely prove to be an independent species, easily recognized by the size and shape of the ciliated funnels.

In the work on the Echinoderms of the Torres Strait, Clark gives some excellent keys to the genera of the *Chiridotinae*, and to the species of *Trochodota*, which will be of the greatest value for students of this group of the *Synaptidae*.

Chiridota Eschscholtz.

Eschscholtz. 1829. Zoologischer Atlas II. pag. 12.
Østergren. 1898. Das System der Synaptiden. p. 118.
Clark. 1908. The Apodous Holothurians. pag. 113.
Clark. 1921. The Echinoderms of the Torres Strait. pag. 163.

The genus *Chiridota*, as it is characterized by Clark in "The Apodous Holothurians", is evidently a well defined genus, easily

distinguished from the other genera of the *Chiridotinae*. In "The Apod. Holoth." Clark refers 13 species to it, and since that time five new species of *Chiridota* have been described. In the collection at hand there are 11 different species, two of which, *nanaimensis* and *pacifica*, are new to science. The specimens from Hawaii are without any doubt the same species as Fisher's *hawaiiensis*, and as they differ in several characters from *rigida* Semper, I cannot follow Clark in regarding these two species as synonyms. As to the other species, *liberata* Sluiter and *amboinensis* Ludwig, which Clark refers to *rigida*, I am convinced that they also are specifically different from it. Both the two species are poorly described and the description of *liberata* is furthermore obviously erroneous. However, for the present I think it the better course to regard them as independent species. Thus at present we must distinguish between the following 23 species of *Chiridota*:

1780.	*lævis* Fabricius.	1904.	*marenzelleri* Perrier.
1829.	*discolor* Eschscholtz.	1907.	*hawaiiensis* Fisher.
1849.	*violacea* Johs. Müller.	„	*uniserialis* Fisher.
1851.	*rotifera* Pourtalés.	„	*albatrossii* Edwards.
1868.	*rigida* Semper.	„	*gigas* Dendy & Hindle.
1880.	*eximia* Haacke.	1908.	*regalis* Clark.
1886.	*pisanii* Ludwig.	1920.	*aponocrita* Clark.
1888.	*liberata* Sluiter.	1925.	*nigra* Mortensen.
„	*amboinensis* Ludwig.	„	*carnleyensis* Mortensen.
1896.	*stuhlmanni* Lampert.	1928.	*pacifica* n. sp.
1898.	*fernandensis* Ludwig.	„	*nanaimensis* n. sp.
1899.	*intermedia* Bedford.		

Of these species 14 are represented in the collections of the zoological museum of Copenhagen, and from the study of them it appears that many of the characters hitherto used for separating the species e. g. the arrangement of the wheel-papillae and the number of digits and polian vesicles may vary highly within the single species, for which reason these characters cannot be relied upon. By far the best characters for separating the species seems to be the shape of the ciliated funnels, the shape and arrangement of the miliary granules and the shape of the pieces of the calcareous

ring. As these characters are often poorly described or overlooked it may be desirable to give a more detailed description of them.

The ciliated funnels are, as far as known, found in all the species. According to Johs. Müller they are wanting in *violacea*, but the specimen at hand shows that funnels are really present. The funnels are usually found on the mesenteries, close to the body-wall, and only in *violacea*, where the mesenteries are nearly totally reduced, the funnels are found on the body-wall proper. The arrangement of the funnels on the mesenteries is very different, but within the single species rather constant. They may be either uniformly scattered, arranged into small groups or united into stalked clusters[1]). The real arrangement of the funnels is usually exceedingly difficult to decide, and only careful dissection, besides coloured balsam-preparations may show the real case. The funnels are, as far as can be seen, irregularly scattered on the mesentery in *aponocrita* Clark, and in *lævis* Fabricius they are usually arranged into small groups (Fig. 55. 4). In "Über eine lebendig-gebärende Synaptide" pag. 45 Ludwig states that the funnels in *rotifera* and *discolor* are arranged singly on the mesentery, and in Bronn's "Klassen" pag. 225 he writes that the funnels in *discolor* are "fast immer in Gruppen", but not united into clusters. The examination of the specimens at hand, shows that Ludwig's statements are erroneous, as the funnels in *discolor* are usually (always?) united into stalked clusters (Fig. 55. 5), and that some of the funnels in *rotifera* are free, as Ludwig writes, while others are united into clusters (Fig. 59. 1). In some of the species with the funnels normally free some few (2—3) funnels may be united at the base, without making "stalked clusters" (Fig. 62. 13). In most species there is, in spite of some variation in shape and size, only one sort of funnels, but in *stuhlmanni* there are two different sorts (Fig. 64. 2). Lampert states that in this species the small funnels are confined to the dorsal and

[1]) In 1921 Clark writes in the key to the genera of the *Chiridotinae*, and in the footnote on the same side, that the two genera *Chiridota* and *Polycheira* are separated from each other, the funnels in *Chiridota* being placed singly on the mesenteries, and those in *Polycheira* being always united into clusters. Though the shape of the clusters in the two genera is distinctly different, and most likely indicates a generic difference, we do not as yet sufficiently know the variation of these organs, for being justified in using them as generic characters.

left lateral mesenteries, and the large funnels to the right ventral mesentery. This may be the common case, but the single specimen at hand has large and small funnels among each others. The specimens at hand of *pisanii* Ludwig have, besides the normal funnels, some small long-stalked funnel-like bodies (Fig. 62. 2). Whether these latter are real funnels, and whether they are constantly found, it is not possible to decide from the few specimens available.

Only few species are entirely without miliary granules in the body-wall, as there are usually minute oval bodies in the longitudinal muscles, whereas rods are wanting in the skin. When rods are present attention must be paid, not only to their shape, but also to their arrangement, both whether they are confined to the radii or not, and whether they are equally found on the ventral and dorsal side of body. The rods in *albatrossii* and *pacifica* are usually totally confined to the anterior end of the dorsal side. If in these species pieces for examination are taken from the ventral side or from the posterior end of the body, the specimens might be referred to *lævis* Fabricius.

The calcareous ring consists in all species examined of twelve pieces. In the literature only Sluiter has mentioned a 12-tentacled *Chiridota* with more than 12 pieces in the calcareous ring (*Chiridota liberata* is said to have 15). But as at any rate the statement in the description of *liberata* that it has three ventral interradials may be erroneous, we may well suppose that the same is the case with that of the 15 pieces in the calcareous ring. The two extra interradials are, in all species known, found in the lateral interradii, one in each. The radial pieces of the calcareous ring have usually a passage for the nerve and only *gigas* has, according to Dendy the radials neither notched nor perforated.

The passage for the nerves is in most species a hole through the anterior part of the radials, and only *liberata* and *hawaiiensis* are said to have the radials notched. The examination of the specimens of *hawaiiensis* at hand shows that we have here a much more interesting case. In all the specimens examined the three ventral radials are notched in the margin, and thus they agree with Fisher's figure Pl. 82 fig. 3d, but the two dorsal radials are quite different, being perforated as in most other species. Furthermore I find that

also *rotifera* and *pisanii* have the three ventral radials different from the two dorsal ones, and at any rate the mid-ventral one is distinctly notched in the margin. Of Sluiter's figure (Die Evertebraten .... Batavia. Pl. II fig. 45) it is seen that *liberata* had at any case some of the radials notched, and if the number of interradials be normal, the figure furthermore shows that all five radials were notched. At any rate the notched margin may be a valid character

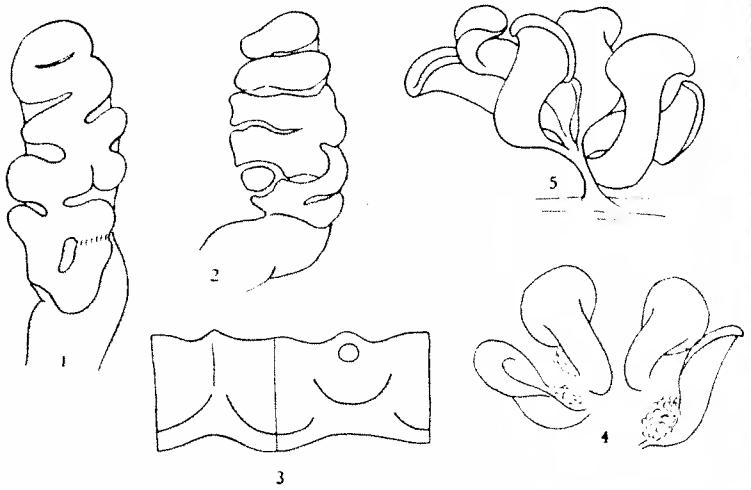


Fig. 55. Ciliated funnels, calcareous ring and madreporite of *Chiridota lævis* 1—4 and *Chiridota discolor* 5. 1-2 & 6—5 × 36; 3 × 36.

for separating both *liberata* and *hawaiiensis* from *rigida* Semper, which latter species, according to Semper's figure Pl. V fig. 13, has the ventral radials perforated.

Other characters which in some cases are of the greatest value for the identification of the species, are: the shape of the intestine, the shape of the gonads and the viviparity or oviparity.

In "The Echinoderms from the Torres Strait" Clark writes that the genus *Chiridota* is a "perplexing genus". This only applies to the older descriptions, which, for the larger part, are rather unsatisfactory. The genus itself is not at all more perplexing than any other genus of the *Synaptidae*, and as the ciliated funnels are so characteristic of the species, we may hope that a reexamination of the type-specimens within this genus will give better results

than in genera, where the main characters are the easily dissolved, calcareous deposits from the skin. Thus it is also erroneous when Théel writes that "The one form passes imperceptibly into the other in such a manner that no special specific characteristics can be drawn up."

As to the geographical distribution of the genus, we may say that *Chiridota* is the widest distributed genus of the *Synaptidae*, though the single species are rather local. Clark states *Ch. lævis* (Fabricius) to be a circumpolar species; but on the other hand he says (Apod. Holoth. pag. 29) about the large collection of this species in the United States National Museum, that "the specimens are in a very poor condition", and that "it seems almost certain that there are at least three species included in this mass of material". From what is said above, it seems rather evident that these three species are *lævis*, *albatrossii* and *pacifica*.

The hitherto known species of *Chiridota* may be distinguished as follows:

1. Miliary granules entirely wanting in the skin, though oval bodies are often present in the longitudinal muscles 2
   Miliary granules present in the skin, though in few cases confined to the anterior end of the dorsal side 7
2. Wheel-papillae numerous, more or less uniformly scattered all over the body, not distinctly arranged in longitudinal series... *fernandensis*
   Wheel-papillae rather few, usually confined to the dorsal side of body, where they are arranged in more or less irregular rows, one in each interambulacrum 3
3. Ciliated funnels usually united into stalked clusters, colour greyish, size up to 30 cm, boreal ..... *discolor*
   Ciliated funnels not united into stalked clusters 4
4. Mid-ventral radial not perforated for the nerve, but notched in the anterior margin. Colour reddish ..... *pisanii*
   Mid-ventral radial perforated for the nerve; colour not reddish, but white, brown or dark purple 5
5. Colour dark violet or black, size large (ca. 20 cm), ciliated funnels small (ca. 0,1 mm), distinctly stalked "cups" ..... *nigra*
   Colour not dark violet. Ciliated funnels large (up to 1 mm) and not stalked "cups" 6
6. Ciliated funnels of different shape and size, the largest ca. 1 mm, and "french-horn"-shaped ..... *carnleyensis*
   Ciliated funnels of nearly the same size and shape, not "french-horn"-shaped ..... *lævis*
7. Miliary granules stellate plates ..... *marenzelleri*

Miliary granules not stellate plates 8
8. Miliary granules "buttons" ..... *eximia*
Miliary granules not "buttons", but rods of different shape 9
9. Radial pieces of calcareous ring ovoid bodies without any passage for the nerves ..... *gigas*
Radial pieces of calcareous ring not ovoid bodies. Passage for nerves present as holes or notches in anterior margin 10
10. Rods confined to ambulacra 11
Rods not confined to ambulacra 12
11. Rods larger than wheel-diameter and nearly straight. Ciliated funnels of two different sorts ..... *stuhlmanni*
Rods smaller than wheel-diameter, usually distinctly curved. Ciliated funnels of only one sort ..... *regalis*
12. Wheel-papillae irregularly scattered all over interradii 13
Wheel-papillae more or less regularly arranged in a single row in the middle of the interradii, often nearly quite wanting ventrally ... 17
13. Mid-ventral radial perforated for the nerve 14
Mid-ventral radial notched in anterior margin for the passage of the nerve 16
14. Colour yellow, miliary granules all more or less C-shaped with rounded ends. The smaller ones make a dense layer in the skin, and the larger ones are arranged into groups in posterior end of body ... *aponocrita*
Colour red or reddish. Rods not all C-shaped and not in a dense layer in the skin 15
15. Rods not distinctly C-shaped. Their ends are not spiny but weakly branched ..... *rigida*
Rods of two sorts: C-shaped and nearly straight with spiny ends *amboinensis*
16. Colour yellow or whitish, viviparous, West-Indian ..... *rotifera*
Colour reddish or brownish, as far as known not viviparous; Hawaiian species ..... *hawaiiensis*
17. Some of, or all the radials notched in the anterior margin ... *liberata*
Radials perforated for the passage of the nerve 18
18. Colour dark purple or brownish 19
Colour yellow 22
19. Rods small, usually crescent-shaped and forming a dense layer in the skin 20
Rods larger, not distinctly crescent-shaped and not forming a dense layer in the skin. Ciliated funnels small and scattered on the mesentery 21
20. Rods of very nearly the same shape and size, the ends irregularly branched. Size small ..... *nanaimensis*
Rods of varying size and shape, the largest crescent-shaped with three or four dentate ends, the smaller more oval bodies. Size large. Ciliated funnels united into stalked clusters placed on the body-wall *violacea*
21. Rods in tentacles very large, those of body nearly totally confined to the dorsal side of anterior end of body ..... *pacifica*

Rods in tentacles small or wanting, those of body uniformly spread over the skin ..... *uniserialis*
22. Size under 10 cm; occurs in Mangrove-svamps ..... *intermedia*
Size usually more than 10 cm, not in Mangrove-svamps ... *albatrossii*

Chiridota albatrossii Edwards.

Chiridota albatrossii Edwards. 1907. The Holothurians of the North Pacific coast of North-America. pag. 50 fig. 1—3.
" " Ohshima. 1915. Report on the Holothurians collected by the United States Fisheries Steamer "Albatross". pag. 284.

Roxton Passage. 9. VI. 1915. 15—25 fms. Mud, stones. 4 specimens.
Nanoose Bay, Nanaimo. 15. VI. 1915. ca. 25 fms. Mud, stones. 1 specimen.
Nanaimo. 16. VI. 1915. ca. 70 fms. Mud. 34 specimens.
Str. of Georgia. 21. VI. 1915. ca. 200 fms. Mud. 21 specimens.
" 7. VII. 1915. ca. 50 fms. Mud. 4 specimens.
" 19. VII. 1915. ca. 200 fms. Mud. 4 specimens.

Edwards writes that this species is difficult to preserve, and in accordance therewith the larger part of Ohshima's specimens were more or less fragmentary. It is therefore noteworthy that all the specimens from Nanaimo 16. VI. are complete. All the other specimens at hand are but fragments. All of them are rather small, those from Nanaimo do not measure more than up to twelve cm in length. They are in alcohol pale yellow with pure white wheel-papillae and minute orange spots, irregularly scattered all over the body and the tentacles. The wheel-papillae are found in a single, rather regular row in each of the three dorsal interradii. On the ventral side of body there are but a few wheel-papillae which are only found at the anterior end. The body-wall is in uncontracted specimens rather thin and so translucent that the intestine as well as the cillated funnels may be seen through it. All the specimens have 12 tentacles, specimens with 10 tentacles as mentioned by Ohshima are not found. The calcareous ring consists of 12 pieces and all the radials are perforated for the nerves. The shape of the calcareous ring in the specimens from the Str. of Georgia (Fig. 56. 7) is slightly different from that of the ring in the specimens from Nanaimo 16. VI. (Fig. 56. 8). A cartilaginous ring is wanting. There are 10—12 polian vesicles and a single stone-canal. The shape of the madreporite is rather varying, but in all

examined specimens distinctly different from Edward's figure Fig. 3, cf. Fig. 56. 2-6. The alimentary canal has a large loop,

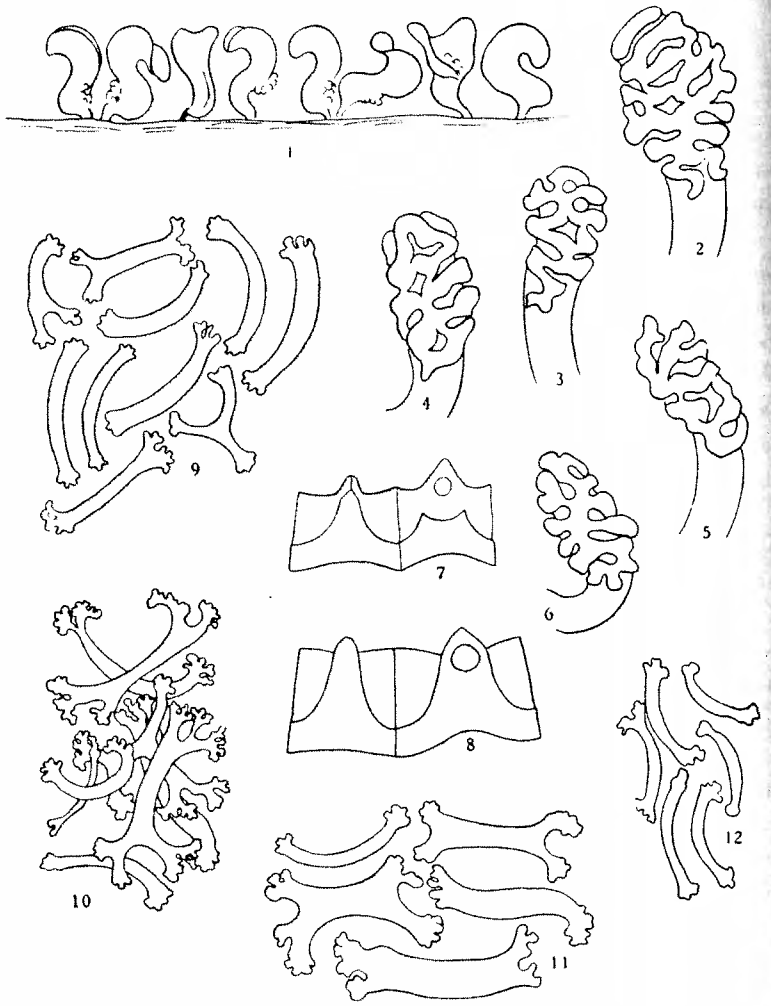


Fig. 56. *Chiridota albatrossii*. 1 Ciliated funnels of specimen from Nanaimo. 2–4 Madreporites of specimen from Nanaimo. 5–6 from Strait of Georgia. 7 Pieces of calcareous ring of specimen from Strait of Georgia. 8 from Nanaimo. 9–12 Rods of specimen from Strait of Georgia. 9 from body-wall. 10 from papilla. 11 from tentacle-base. 12 from digits. 1–6 × 36; 7–8 × 24; 9–12 × 200.

and the ciliated funnels are placed singly on the mesenteries (Fig. 56. 1). They are usually found on all three mesenteries, but

in some of the specimens they are seemingly wanting on the mid-dorsal mesentery, though they are abundant on the two other mesenteries. The gonads are branched several times. The genital porus is found on a little papilla close behind the dorsal tentacles. The sexes are separate. The calcareous deposits in the complete specimens from Nanaimo are nearly quite dissolved by acidity of the preserving-fluid, and only their size can be ascertained. The diameter of the nearly dissolved wheels is 60—120 μ. All the other specimens have nicely preserved deposits. The wheels measure also here 60—120 μ in diameter. There are only few rods in the skin, and in the larger part of the specimens they are almost confined to the dorsal side, where they are often found in small groups. The ends of the rods (Fig. 56. 9) are usually branched and often bifid. Those in the papillae (Fig. 56. 10) are more branched than those scattered in the skin. The rods in the digits (Fig. 56. 12) are distinctly different from those in the tentacle-stem (Fig. 56. 11) being smaller and thinner.

Ch. albatrossii is recorded from numerous of the Albatross's stations, and appears to be widely distributed in the northern part of the Pacific Ocean, where it occurs in depths from 25—400 fms. It is in several characters rather like *lævis* (Fabricius) and may be regarded as the pacific representative of this species. It is as a rule distinctly different from it in having rods in the skin, but as the rods in some of the specimens at hand are very scarce, and Ohshima even states that rods may be entirely wanting, the two species may then be confounded. Still it is seen in the figures that the shape of the calcareous ring, the madreporite and the ciliated funnels afford so valuable characters for separating the two species, that they may be easily distinguished from each other.

Chiridota pacifica n. sp.

La Jolla. 22. VIII. 1915. Soft bottom. 90—100 fms. 55 fragments.

The real length of the species cannot be ascertained, as only fragments are at hand, but as the longest anal-end measures ca. 15 cm and the shortest fore-end measures ca. 3 cm, the length of the species may be ca. 20 cm. The colour is in alcohol pale brown, but different in the two ends of the specimen, as the fore-ends are densely mottled with minute black spots. Such black spots are

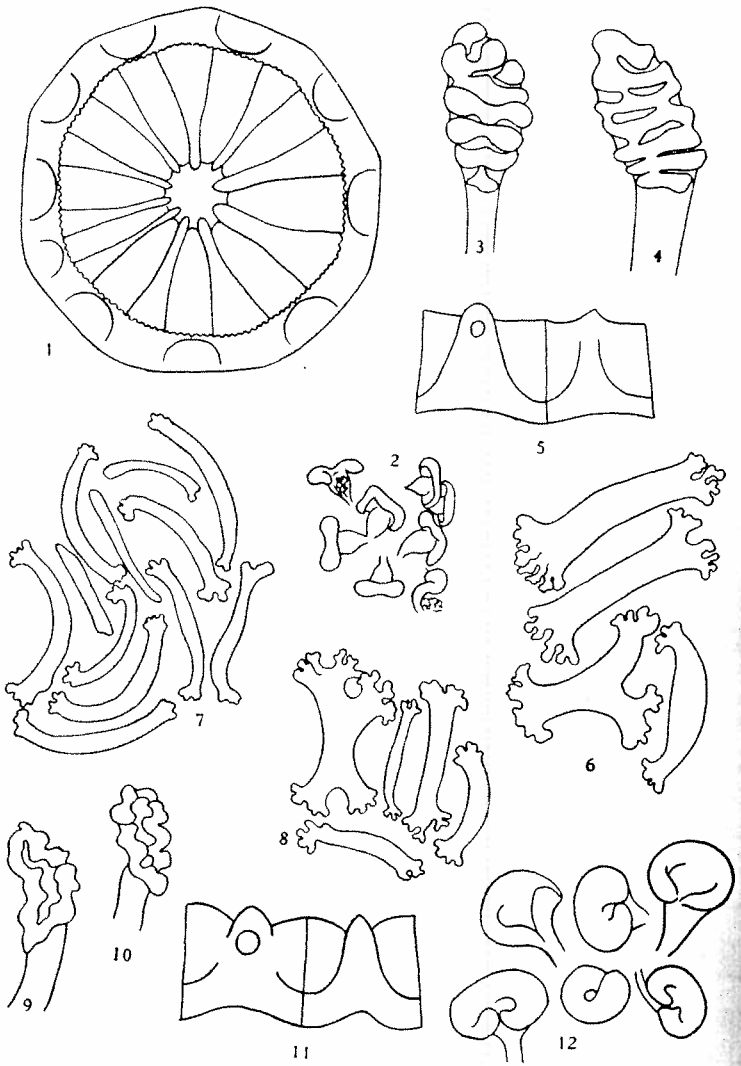


Fig. 57. *Chiridota pacifica* 1—8 and *Chiridota nanaimensis* 9—12. 1 Ten-spoked wheel. 2 Ciliated funnels. 3—4 Madreporites. 5 Pieces of calcareous ring. 6—8 Rods, 6 from tentacle-base, 7 from body-wall, 8 from digits. 9—10 Madreporites. 11 Pieces of calcareous ring. 12 Ciliated funnels.
1 & 6 8 × 209; 2—4 & 9—10 × 36; 5 & 11 × 24; 12 × 120.

totally wanting in the posterior ends of the specimens at hand. The tentacles are bright yellow. There are only few wheel-papillae, which in the three dorsal interambulacra make a single line. In the ventral interambulacra wheels are nearly totally wanting, only in the anteriormost end a few wheel-papillae may be found. The body-wall is rather thin and in the "head"-less fragments quite transparent.

There are twelve tentacles each with six pairs of digits, and at the base of the tentacles there are some few orange spots resembling eyes. The calcareous ring (Fig. 57. 5) consists of 12 pieces of which all the radials are perforated for the nerves. A cartilaginous ring is wanting. There are ca. 15 polian vesicles and a single stone-canal. The madreporite (Fig. 57. 3-4) is of somewhat varying shape, distinctly different from that in *albatrossii*. The retractor-muscles are well developed, but united with the body-wall by a mesentery-like tissue. The alimentary-canal has a large loop and on the mesenteries there are ciliated funnels. These are distinctly smaller than the funnels in *albatrossii*, measuring not more than ca. 150 μ (Fig. 57. 2). In balsam-preparations the shape of the funnels in *pacifica* and *albatrossii* is rather difficult to ascertain, for which reason they may seem alike, but a dissection under a rather high magnification clearly shows the differences.

The wheels measure 50—80 μ in diameter. They have normally six spokes, but wheels with a varying number of spokes are found (Fig. 57. 1). A varying number of spokes in *Chiridota*-wheels was found by Ohshima in *albatrossii* and by Dendy in *Ch. gigas*. Rods are often nearly quite wanting and usually present only in the anteriormost end of the dorsal side. They are rather varying in shape (Fig. 57. 7), usually being bent, with enlarged ends. The rods in the digits (Fig. 57. 8) are not so much different from those in the tentacle-base (Fig. 6) as in *albatrossii*. Neither in the longitudinal muscles nor in the polian vesicles or in the gonads any calcareous deposits are found.

The sexes appear to be separate. The gonads are branched and the genital-duct opens on a little wart-like papilla closely behind the dorsal tentacles.

Chiridota pacifica is nearly related to *albatrossii* and *lævis*. From *lævis* it differs distinctly in having rods in the anterior end of body, in the shape of the madreporite and in that of the ciliated funnels.

From *albatrossii* it differs only in the colour, in the shape and size of the ciliated funnels and in slight differences in the shape of the calcareous deposits.

Chiridota nanaimensis n. sp.

Nanoose Bay. Nanaimo. 15.VI.1915. Mud, stones. ca. 25 fms. 6 specimens.

The specimens at hand are but fore-ends, which do not measure more than ca. 1 cm in length and 0,3 cm in diameter. The colour of the body is in alcohol greyish-purple, and that of the tentacles bright yellow. The body-wall is rather thick and quite intransparent. There are 2—3 wheel-papillae in each interradius, and the papillae are arranged in a single row in the middle of the interradii. There are twelve tentacles, each with five pairs of digits. The calcareous ring (Fig. 57. 11) is unusually stout, with deep muscular impressions. The retractor-muscles are distinct and united to the body-wall by a connective tissue. There are ca. 10 polian vesicles and a single stone-canal. The madreporite (Fig. 57. 9-10) is characterized by the irregular ring-shaped calcification. As the larger part of the alimentary canal is wanting, the presence or absence of a loop on the intestine cannot be ascertained. The mesenteries are well developed and supplied with ciliated funnels measuring ca. 150 μ in length (Fig. 57. 12). The funnels are not united into clusters, but they are situated singly on the mesenteries, where they are irregularly arranged. The wheels are of the common shape and measure 50—70 μ in diameter. The miliary granules (Fig. 58. 1) are exceedingly characteristic and are lying in a dense layer all over the body. They are usually crescent-shaped and of very nearly the same size. The rods in the tentacles (Fig. 58. 2) are larger. They are not so distinctly curved and often bifid in the one or in both ends. The deposits in the digits (Fig. 56. 3) are more or less irregularly shaped bodies.

The gonads are weakly developed, but distinctly branched, and the genital duct opens on a little wart-like papilla close behind the dorsal tentacles.

Chiridota nanaimensis is very characteristic and not more closely related to any hitherto known species of the genus. The dense layer of crescent-shaped rods recalls *violacea* Johs. Müller, but the well developed mesenteries and the small ciliated funnels separate it distinctly from that species.

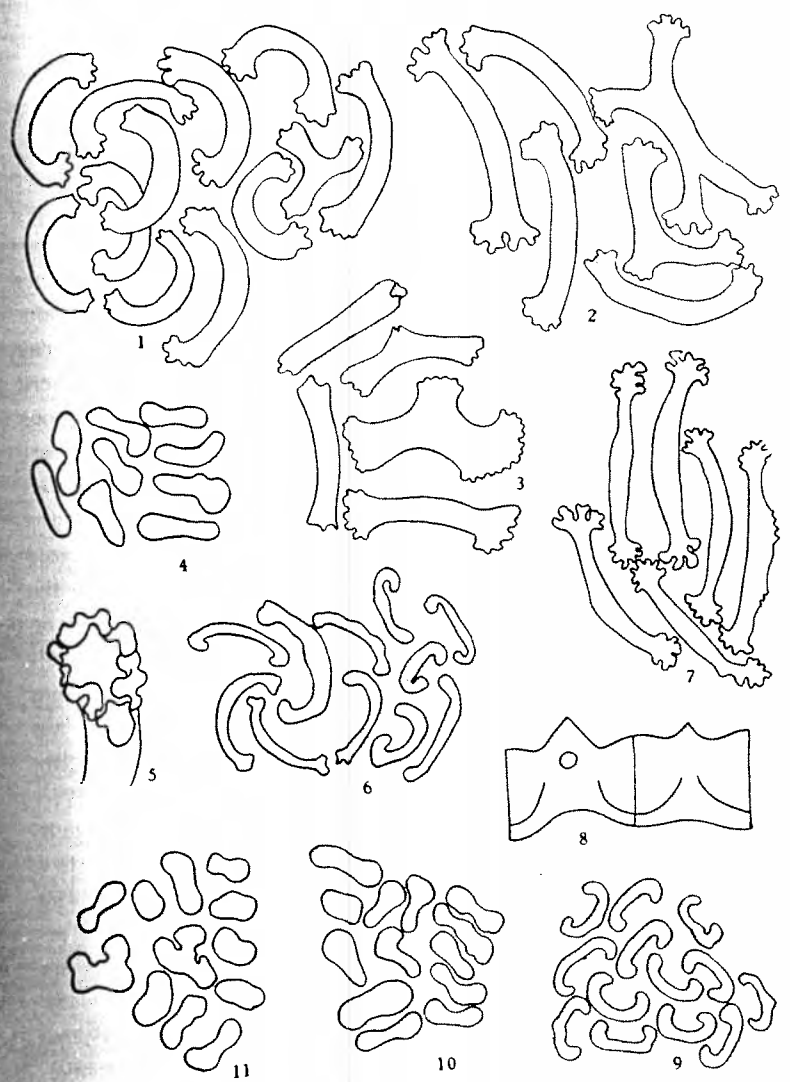


Fig. 58. *Chiridota nanaimensis* 1—3 and *Chiridota aponocrita* 4—11. 1 Rods from body-wall, 2 from tentacle base, 3 from digits, 4 from polian vesicles, 6 from papilla in posterior end of body, 7 from digits, 9 from body-wall, 10 from tentacle base, 11 from longitudinal muscle, 5 madreporite, 8 calcareous ring. The rods × 400; the madreporite × 36 and the pieces of calcareous ring × 24.

Chiridota aponocrita Clark.

Chiridota aponocrita Clark. 1920. Tropical Pacific Holothurians. pag. 125, Pl. 4 fig. 1—2.

Taboga, Panama. 7. XI. 1915. The shore, under stones. 1 specimen.
" " 20. I. 1916. " " 1 "
" " 4. III. 1916. Sandy shore. 2 specimens.

There can be no doubt that these four specimens are Clark's *aponocrita*. Both the locality and the dense layer of "dough-nut-shaped" particles leave no room for doubt. Only the one specimen is complete, but it gives thus an opportunity for a closer description of the species which, because of the fragmentary condition of Clark's specimens, has not been satisfactorily described.

The complete specimen at hand measures 8,5 cm in length by 0,7 cm in diameter. The colour is in alcohol yellowish-white and semitransparent. The wheel-papillae are nearly equally spread all over the body, though densest on the dorsal side of the anterior end. There are twelve tentacles, each with seven pairs of digits. The calcareous ring (Fig. 58. 8) consists of 12 pieces, of which the radials are perforated for the nerves. The calcareous ring according to Clark has "no conspicious projections on either margin", but as seen from the figure all the pieces in the specimen described (as well as the others) have a distinct projection on the anterior margin. A cartilaginous ring is wanting. There are 12 polian vesicles, six of which are much larger than the others. The stone-canal is single and the calcification of the madreporite (Fig. 58. 5) is irregularly ring-shaped. The oesophagus is rather long and thin and different from the intestine which has a large loop. The ciliated funnels (Fig. 59. 2) measure ca. 130 μ in length. They are rather long-stalked and not united into clusters. Where the funnels are exceedingly dense, two to three may be united at the base. The gonads are branched and open on a little papilla close behind the dorsal tentacles.

The wheel-diameter varies from 50—120 μ. Besides the wheels there are found three different sorts of calcareous deposits in the skin. The species is, as said, characterized by the dense layer of "dough-nut-shaped" rods which, as Clark writes, are found even in the skin covering the wheel-papillae. Besides these rods (Fig. 58. 9) there is found a second sort. These are larger and not so

curved (Fig. 58. 6) and are only found in the posteriormost end of the specimen, where they are lying in small groups, covered by the "dough-nut-shaped" rods. As to the deposits in the longitudinal muscles Clark states that they are wanting. Seemingly they are so, but a closer examination shows that they are really present (Fig. 58. 11), only covered by the dense layer of "dough-nut-shaped" spicules. The deposits in the tentacle-base (Fig. 58. 10) are very like the deposits in the longitudinal muscles, and distinctly different from the large rods in the digits (Fig. 58. 7). In the polian vesicles

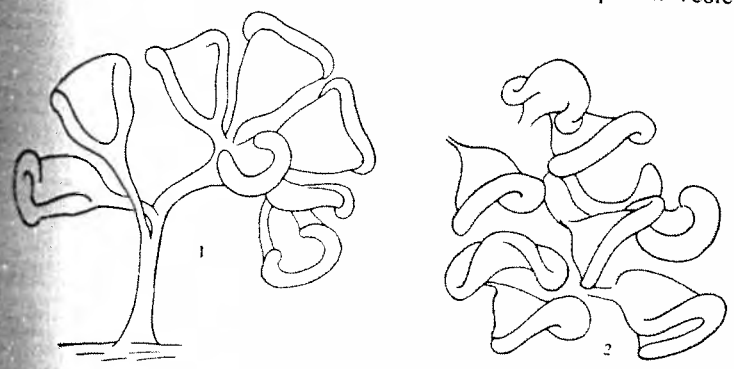


Fig. 59. Ciliated funnels of *Chiridota rotifera* (1) and *Chiridota aponocrita* (2). × 180.

there are deposits of very nearly the same shape as those in the tentacle-base.

Chiridota aponocrita is a very characteristic species, which, as Clark states, differs distinctly from all the other species of the genus.

Chiridota rotifera (Pourtalès).

Synapta rotifera. Pourtalès. 1851. On the Holothurians of the Atlantic coast of the United States. pag. 15.
Chiridota rotifera. Ludwig. 1892. Über eine lebendig-gebärende Synaptide. pag. 42—54, Pl. III fig. 1—5.
" " Clark. 1908. The Apodous Holothurians. pag. 115.
" " Clark. 1910. Development of an Apodous Holothurian. pag. 497—516, Pl. I—II.

St. Jan. 31. III. 1906. Rocky pools. 32 specimens.
Loango. 18. III. 1906. 4 specimens.
Tobago, B. W. I. IV. 1916. Between corals. 30 specimens.
St. Thomas. 4 specimens.

The specimens at hand measure up to 3 cm in length, a single one is 4,5 cm. The colour is in alcohol yellowish-white with pure white wheel-papillae. These are found in both radii and interradii, without any arrangement in longitudinal rows. They are densest close behind the dorsal tentacles, and nearly wanting on the ventral side of the posterior end. There are twelve tentacles, each with 7 pairs of digits. The calcareous ring consists of twelve pieces, of which the seven interradials are rather alike. The two dorsal radials (Fig. 60. 7) are perforated for the nerves and thus different from the three ventral ones (Fig. 60. 8) which are only notched in the anterior margin. The posterior margin of the ventral radials is usually as that of the dorsal ones, slightly concave, but in some specimens the mid-ventral radial differs from that of the two lateral ones (Fig. 60. 11). A cartilaginous ring is wanting. There are 10—12 polian vesicles of different size and a single stone-canal. The madreporite (Fig. 60. 9-10) is much folded. The alimentary canal has a large loop and on the mesenteries there are numerous ciliated funnels. Ludwig states that the ciliated funnels in *rotifera* are found singly on the mesenteries. This is also the fact with the larger part of the funnels, but close to the body-wall where they are exceedingly dense, they may be united into rather longstalked clusters (Fig. 59. 1).

The rods in the skin are, as the rods in *aponocrita*, uniformly scattered all over the body but not so densely. The shape of the rods (Fig. 60. 6) is rather varying, but they are usually slightly curved and often enlarged on the middle and at the ends. In the longitudinal muscles there are oblong bodies (Fig. 60. 12). These are usually smooth, with enlarged ends, their outline being often a little undulating. The deposits in the tentacle-base are as in *aponocrita* very like those in the longitudinal muscles (Fig. 60. 5), and those in the digits (Fig. 60. 4) are large curved rods with branched ends. The deposits in the polian vesicles (Fig. 60. 3) are nearly straight rods with an often undulating outline. The gonads are stated by Ludwig to be hermaphroditic, with which fact the viviparity of the species seems to be in good accordance. The larger part of the specimens examined have eggs in the gonads, but the presence of sperma cannot be ascertained. Only a single specimen seems to have merely sperma in the gonads, but whether

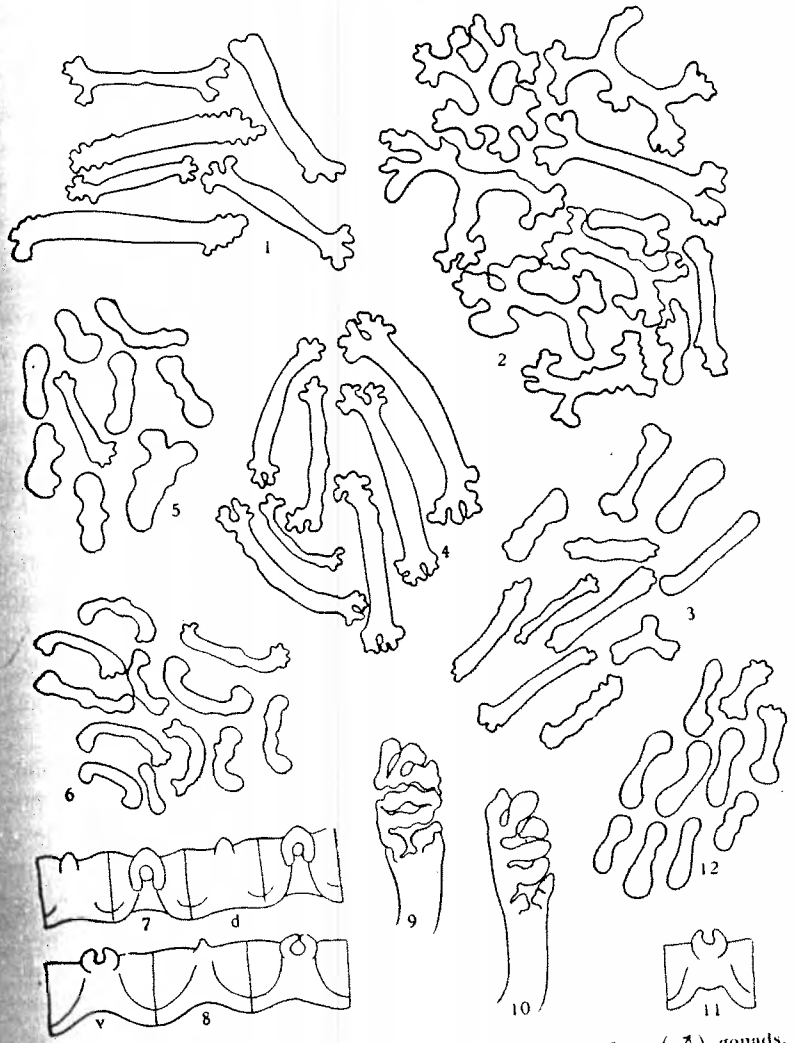


Fig 60. *Chiridota rotifera*. 1 Rods from (♀) gonads, 2 from (♂) gonads, 3 from polian vesicles, 4 from digits, 5 from tentacle-base, 6 from body-wall, 7 dorsal, 8 ventral part of calcareous ring. 9 Madreporite seen from the flat, 10 seen from the side. 11 aberrant ventral piece of calcareous ring. 12 Rods from longitudinal muscles. 1—6 & 12 × 400; 7—8 & 11 × 24; 9—10 × 36.

the sexes are separate, as it is the normal case in the genus, or not, cannot be decided here. It is a very interesting fact that the rods in the gonads with eggs are nearly straight and unbranched (Fig. 60. 1) while in the gonads with merely sperma they are irregularly branched bodies (Fig. 60. 2).

In the body-cavity of some of the specimens from 1906 there are found embryos, but they are without greater interest as, due to the acidity of the preserving fluid, they are quite decalcified.

? *Chiridota violacea* Johs. Müller.

Chiridota violacea Johs. Müller. 1850. Anatomische Studien über die Echinodermen. pag. 137.
" " Clark. 1908. The Apodous Holothurians. pag. 116.

Lontor, Banda. 7. VI. 1902. Sandy shore, at low-water mark. 1 fragment.

There is little room for doubt that the fragment at hand is Johs. Müller's *violacea*, but as the anterior end of it is wanting

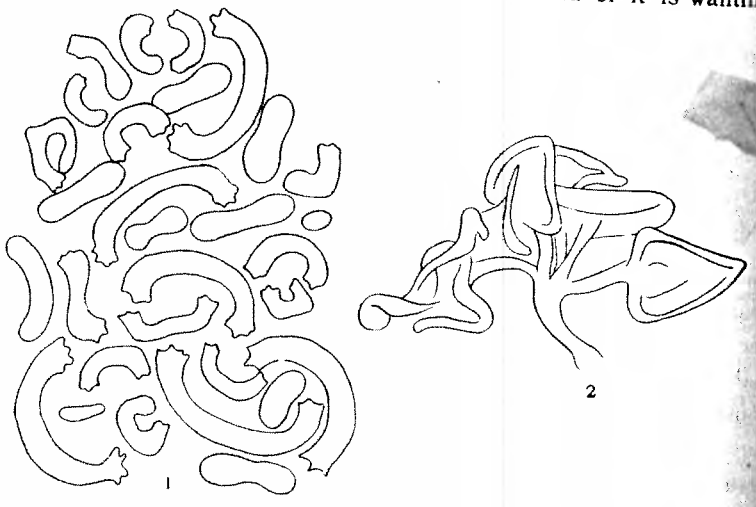


Fig. 61. *Chiridota violacea*. 1 Miliary granules from body-wall. × 400. 2 Ciliated funnels. × 50.

and Johs. Müller has not figured the calcareous deposits nor the peculiar ciliated funnels (which he has not seen), the identification of it is not certain.

The fragment at hand measures without the anterior end 30 cm in length. Its colour is dark purple. The wheel-papillae are large

and occur in a single row in each dorsal interambulacrum. In the papillae there are "Schnüre mit Kalkrädchen". The calcareous deposits make a dense coat all over the skin. They are of very varying size and shape (Fig. 61. 1), the larger ones being crescent-shaped with trispinous ends. There is no loop on the alimentary canal in the fragment, but, though all the three mesenteries are present and united with the intestine, a loop may be present in this species. The mesenteries are very interesting, in being reduced to fine and short threads. For this reason the ciliated funnels are found on the body-wall. They are rather large and always united into long-stalked clusters (Fig. 61. 2). *Chiridota violacea* was previously reported from Ibo, Mosambique and from the Amirante Island.

Chiridota pisanii Ludwig.

Chiridota pisanii Ludwig. 1886. Die vom G. Chierchia gesammelten Holothurien. pag. 29—31, Pl. 2 fig. 14.
" " Ludwig. 1898. Holothurien der Hamburger Magelhaensischen Sammelreize. pag. 71.
" " Ludwig. 1898. Die Holothurien der Sammlung Plate. pag. 445.
" " Clark. 1908. The Apodous Holothurians. pag. 118.

Calbuco Straet, Chile, 2 specimens identified by H. Ludwig.

Chiridota pisanii was rather well described by Ludwig in 1886 and 1898, but neither the peculiar shape of the calcareous ring nor that of the ciliated funnels are mentioned. Therefore it was possible for Clark to write (Apod. Holoth.) that *pisanii* is "strikingly similar to the widely distributed northern species, *Ch. lævis*" and: "Curiously enough, Ludwig does not in any of his several papers make any reference to this similarity, and yet it is quite noticeable. Indeed it is hard to draw any sharp line between the two species."

The examination of the two specimens at hand shows that Clark's supposition is erroneous and that *pisanii* is by no means closely related to *lævis*, from which species it differs distinctly in the shape of the calcareous ring, the ciliated funnels and the tentacle-rods.

The specimens at hand measure 6 cm in length. Their colour is, probably due to the long remaining in alcohol, pure white, without any traces of red. They have 12 tentacles, each with 5 pairs

of digits. The wheel-papillae, which are said to be unusually large in this species, are in the specimens at hand of very varying size. While the smallest papillae are invisible to the unarmed eye and do not enclose more than 4—6 wheels, the largest papillae measure up to 2,3 mm in diameter and include more than 300 wheels. The wheels measure 70—130 μ in diameter. The wheel-papillae are arranged in a single row in each interradius, and densest in the three dorsal ones.

The calcareous ring (Fig. 62. 1) consists of 12 pieces, the four of which are perforated for the passage of the nerves. The midventral radial differs from the others in being notched in the anterior margin. A cartilaginous ring is wanting. There are seven polian vesicles and a single stone-canal. The madreporite (Fig. 62. 6-7) is rather short and has some few large folds. It differs from the madreporite in the other species examined in the calcification being not confined to the exterior side of it, but equally developed around the end of the stone-canal. The sexes are separate and the gonads are much branched. The genital duct opens on a little papilla close behind the dorsal tentacles. The alimentary canal has a large loop and the ciliated funnels are found at the base of the mesenteries. Ludwig writes that "das Mesenterium des absteigenden Darmabschnittes trägt keine Wimperbecker". This does not agree with the specimens at hand, which have ciliated funnels on all three mesenteries. The ciliated funnels (Fig. 62. 2) measure from 150 μ to 350 μ and are more or less regularly funnel-shaped. They have a short stalk, but are not united into clusters. Among the funnels there are found some 50—70 μ large, long-stalked bodies, which are very like small ciliated funnels. Whether they really are ciliated funnels or not, it is not possible to decide on the material at hand.

Besides the wheels there are no calcareous deposits in the skin, but in the longitudinal muscles there are, as mentioned by Ludwig in 1898, numerous oblong bodies. These latter are in the posterior end of body very regular (Fig. 62. 3), but in the anterior end of body they are of a somewhat varying shape (Fig. 62. 4) with a more or less undulating outline. The rods in the digits (Fig. 62. 8) are exceedingly characteristic, the one end being as a rule more sharply curved than the other. These rods differ from those in the tentacle-stem (Fig. 62. 9), which are more or less irregularly shaped.

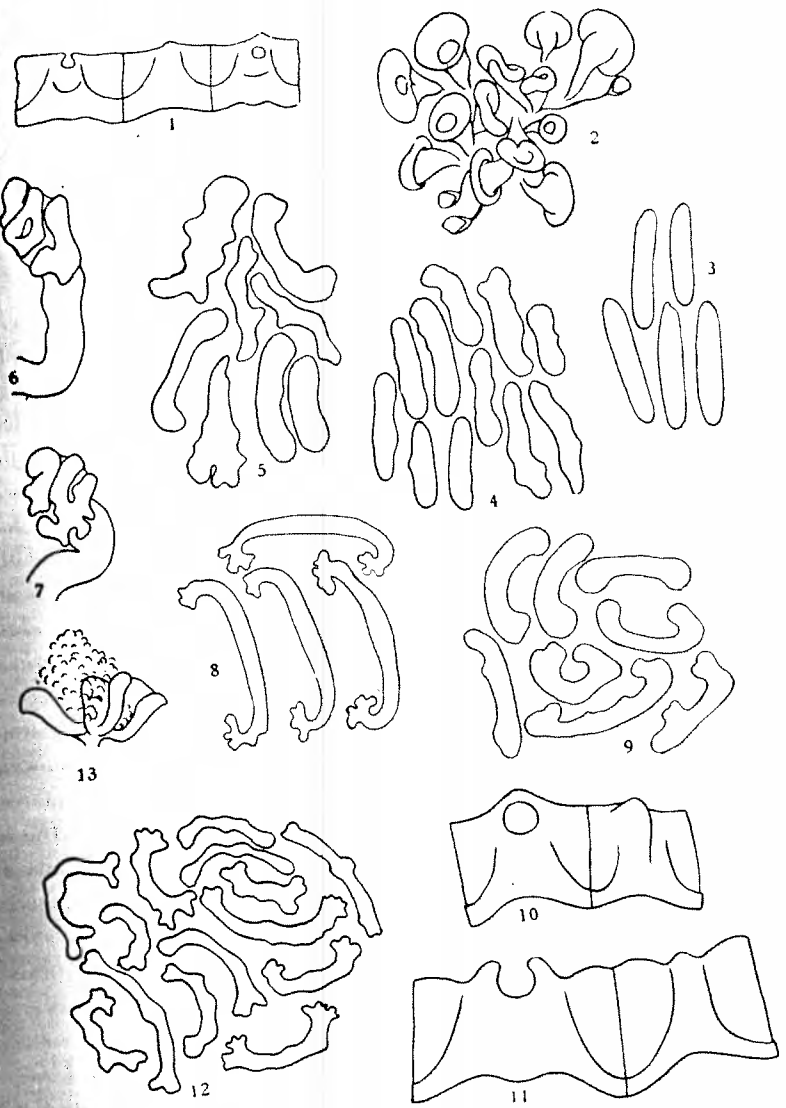


Fig. 62. *Chiridota pisanii* 1—9 and *Chiridota hawaiiensis* 10—13. 1 Ventral pieces of calcareous ring. 2 Ciliated funnels. 3 Rods from posterior end of longitudinal muscles, 4 from anterior end, 5 from polian vesicles. 6 Madreporite seen from the exterior side, 7 from the left side. 8 Rods from digits, 9 from tentacle-base. 10 Dorsal pieces of calcareous ring. 11 Ventral pieces. 12 Rods from the body-wall. 13 Ciliated funnels. Calcareous rings 1 × 24; 10—11 × 36; Ciliated funnels 2 × 36; 13 × 50; Madreporite × 36; Rods × 400.

In the polian vesicles there are numerous calcareous deposits (Fig. 62. 5) of varying shape.

Chiridota pisanii Ludwig differs, as seen from the description, not only distinctly from *Ch. lævis*, but it is not more closely related to any of the species hitherto known.

Chiridota hawaiiensis Fisher.

Chiridota hawaiiensis. Fisher. 1907. Hawaiian Holothurians. pag. 731, Pl. 81 fig. 5, Pl. 82 fig. 3a—c.
Chiridota rigida partim. Clark. 1908. The Apodous Holothurians. p. 117.
Hilo, Hawaii. IV. 1915. 14 specimens.
Honolulu. 1. V. 1915. 18 specimens.

There can in my opinion be no doubt that the specimens at hand are identical with Fisher's species *Chiridota hawaiiensis*. Clark unites in "The Apod. Holoth." this species with Semper's *rigida*, but the examination of the specimens at hand shows that they are evidently specifically different from that species.

The specimens at hand are rather small, not measuring more than 3—3,5 cm in length. They are in alcohol pale reddish-brown or nearly colourless, and the colour of the tentacles is not as in *rigida* different from that of the body. The body-wall is very thin and nearly quite translucent. The wheel-papillae are of varying size and not equally distributed. They are very crowded on the anterior end of the dorsal side and nearly wanting in the posterior end. There are twelve tentacles, each with 3—5 pairs of digits. The two terminal digits are by far the longest, and in some of the specimens they may be united unto their end.

The calcareous ring consists of twelve pieces of which the two extra interradials are found in the dorso-lateral interradii, one in each. The two dorsal radials (Fig. 62. 10) are perforated for the nerves and distinctly different from the three ventral radials, which are but notched in the anterior margin. Also in the shape of the posterior margin the radials may be different, that of the mid-ventral and usually, but not constantly, also that of the two latero-ventral radials having a double notch (Fig. 62. 11). The mid-dorsal interradial differs from the others, especially from the two ventral ones in having a conspicuous projection on the exterior side. A cartilaginous ring is wanting. There are 9—11 polian vesicles, the

four of which are much larger than the others. The stone-canal is single, and the madreporite has a folded calcification on its exterior side (Fig. 63. 2). The intestine has a large loop and on the mesenteries there are ciliated funnels. The funnels (Fig. 62. 13) are rather small and usually arranged into small groups. Often the funnels of a group may be united on a very short stalk. This is

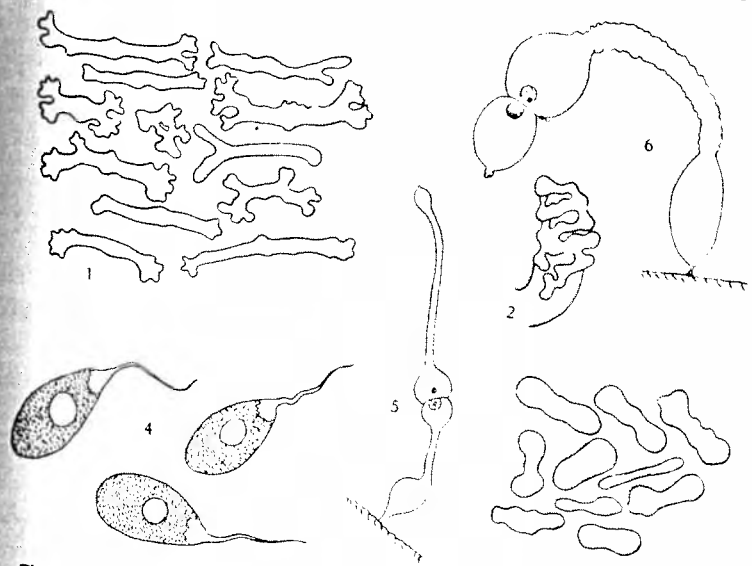


Fig. 63. *Chiridota hawaiiensis*. 1 rods from tentacles × 400. 2 madreporite × 36. 3 rods from longitudinal muscles × 400. 4 parasitic protozoan × 900. 5-6 gregarinian-like parasites × 35.

exceedingly difficult to ascertain, and only further examinations on specimens preserved for cytological studies may show the real state. At any rate, whether the funnels are united on a common stalk or not, the funnel-stalk is very short and yields for that reason a valid character for separating *hawaiiensis* from *rigida*, in which species the funnels are long-stalked, cf. Semper's figure Pl. VI fig. 4. As to *rigida* I suppose that some of the funnels are free and others united into stalked clusters, which would agree with the contradictory statements (pag. 19 and pag. 35) in "Die Holothurien" (cf. Ludwig: Holothurioidea pag. 235. and Lampert: Ostafrikanische Holothurien pag. 70). The gonads are branched and in some of the specimens very voluminous. Fisher writes in the "Hawaiian Holo-

thurians" that the genus *Chiridota* is hermaphroditic; which may indicate that his two species *hawaiiensis* and *uniserialis* are hermaphroditic, but, as far as I can see without sections, the specimens at hand of *hawaiiensis* are of separate sexes. The genital duct opens on a little papilla close behind the dorsal tentacles.

The rods in the body-wall (Fig. 62. 12) are very varying in size and shape. They are usually curved and faintly swollen on the middle. The ends are often irregularly branched or spiny. In the longitudinal muscles there are numerous oblong bodies (Fig. 63. 3), but neither in the polian vesicles nor in the gonads there are found any calcareous deposits. The rods in the tentacles (Fig. 63. 1) are irregularly shaped and of very varying size.

Chiridota hawaiiensis may be regarded as a valid species, distinctly different from *rigida*. On the other hand it is not quite certain whether it may not ultimately prove to be synonymous with Sluiter's *liberata*. Still, as this species is so unsatisfactorily and partly erroneously described, there is in my mind no reason for referring the easily recognizeable and as well described specimens from Hawaii to that species.

In the body-cavity of one of the specimens at hand there are found some interesting parasites. There are seemingly two sorts. The one, of which there are two specimens, is a gregarinian-like organism (Fig. 63. 5-6) which is fastened to the side of the intestine. It consists of two to three large cells of somewhat varying shape. The other sort are small cells with a single, rather short cilium (Fig. 63. 4). They are united into small lumps, being free-swimming in in the body-fluid. Whether it is two different stages of the same species, or two different sorts of Protozoans, cannot be ascertained on the specimens at hand.

? *Chiridota stuhlmanni* Lampert.

Chiridota stuhlmanni Lampert. 1868. Ostatrikanische Holothurien. p. 67.
" " Clark. 1908. The Apodous Holothurians. p. 115.

Fiji. 1 specimen.

The single specimen at hand measures ca. 5 cm in length by ca. 0,75 cm in diameter. The colour is in alcohol reddish-brown with numerous white wheel-papillae in the interambulacra. These

papillae are entirely wanting in the ambulacra, for which reason the specimen at hand has five dark stripes, one in each ambulacrum. It has 12 tentacles of the same colour as the body. On each tentacle there are 7 pairs of digits. The calcareous ring consists of twelve pieces, of which the five radials all have a very large perforation for the passage of the nerves (Fig. 64. 1). All the pieces

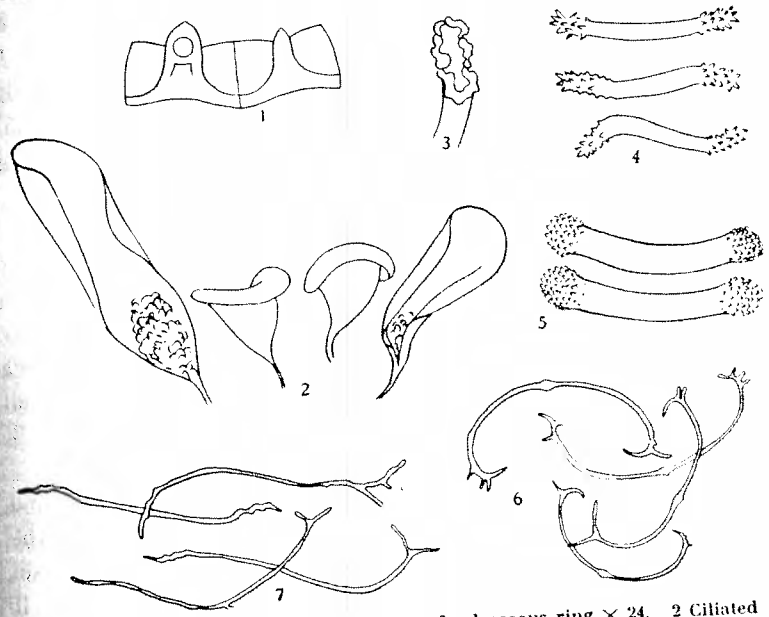


Fig. 64. *Chiridota stuhlmanni.* 1 pieces of calcareous ring × 24. 2 Ciliated funnels × 90. 3 madreporite × 36. 4 rods from digits × 225. 5 rods from body-wall × 210. 6 spicules from posterior end of interambulacra × 225. 7 spicules from gonad × 225.

of the calcareous ring have a distinct projection on the anterior margin, and the muscular impressions are deep. There are twelve polian vesicles and a single curled stone-canal. The polian vesicles are of different size and the calcification of the madreporite is ring-shaped (Fig. 64. 3). The gonads are branched, rather voluminous and enclose nearly ripe eggs, measuring ca. 120 μ in diameter. The genital duct opens on a little papilla close behind the dorsal tentacles. The alimentary canal has a large loop, and on the mesenteries there are, as mentioned by Lampert, two different sorts of ciliated funnels (Fig. 64. 2). The large funnels are only found

at the base of the mesenteries, and the small ones are scattered all over the basal part of them.

The wheels measure 40—120 μ in diameter. Besides the wheels there are some large, bent rods in the skin. They are interesting in being longer than the largest wheel-diameter and are arranged into ten rather regular rows, one on each side of the ambulacra. In the rows all the rods are parallel and in right angles to the longitudinal axis of the specimen. The rods themselves measure ca. 250—270 μ in length, are very slightly curved and have the ends distinctly spinous (Fig. 64. 5) with numerous, small spines. These large rods are also found in the tentacle-stem, but the rods in the digits (Fig. 64. 4) are smaller, ca. 100 μ, and have fewer and larger spines. Besides these large and thick rods, there are some very thin C-shaped rods in the interambulacra (Fig. 64. 6) and in the oral disk. In the gonads there are some few thin rods of the same sort, but they are here not C-shaped (Fig. 64. 7).

Chiridota stuhlmanni is a very characteristic species, which by the shape and size of the rods and the ciliated funnels is easily separated from all the other hitherto known species. The specimen at hand differs from Lampert's description of *Chiridota stuhlmanni* in some few characters, for which reason the identification of it is not quite certain. Lampert states that *stuhlmanni* differs from *rigida* and similiar species in having the wheel-papillae "völlig gleichmässig über den ganzen Körper verteilt". This is, as seen from the description, not the case with the specimen at hand. Furthermore Lampert writes about the radial pieces of the calcareous ring: "Nur konnte ich keine Durchbohrungen finden", a marked difference from what is the case with the radials of the present specimen. Also the presence of the thin C-shaped rods in the interambulacra seems to indicate a specific difference. But in spite of this I do not find it reasonable to separate this single specimen from Lampert's species, with which it quite agrees in the shape and size of the ciliated funnels and the large rods in the skin. Until a reexamination of either Lampert's type-specimen or of specimens from the type-locality Timbatu is made, I do not think it desirable to separate the Fiji-specimen from the species *stuhlmanni*.

Polycheira Clark.

Clark. 1908. The Apodous Holothurians. pag. 129.

Genotype: *Chiridota rufescens* Brandt (= *Ch. variabilis* Semper).

The genus *Polycheira* was established in 1908 by Clark for the 18-tentacled species, hitherto referred to *Chiridota*. That the number of tentacles really indicates a generic difference is supported by the character of the ciliated funnels. These are in *Polycheira* always united into stalked clusters, which may be rather large, ca. 1 mm, though the funnels themselves are small. The new species *P. echinata* differs in the shape of the clusters somewhat from the other species, as the clusters in this species are unusually small and very like those of the funnels in *Ch. hawaiiensis* Fisher, but they differ from *hawaiiensis* in their arrangement. In *hawaiiensis* the ciliated funnels are united into clusters only close to the base of the mesenteries, and single funnels are always found. In *P. echinata* the clusters of funnels are more equally spread over the mesenteries, and all the funnels are united into clusters. Clark has established the genus as a monotypic one, as he supposes that all the different species described with 16—19 tentacles are really the same species, *rufescens* Brandt. With this I cannot agree, and at any rate I think that Semper's two species *variabilis* and *vitiensis* are different. The differences in the calcareous deposits are according to Semper rather slight, and at any rate not very reliable, as the deposits in *variabilis* are so variable; but the figure of the ciliated funnels makes it clear that the two species are not synonymous. The funnels are in *variabilis* ca. 100 μ long and in *vitiensis* ca. 350 μ long. The large collection of *variabilis* at hand shows no distinct variation in the size of the funnels, though the size of the clusters may be much varying, which indicates that it must be erronous to refer *vitiensis* to *variabilis*.

Besides the specimens of *variabilis*, Dr. Mortensen's collection includes a single specimen of another species of *Polycheira*. It is described below under the name *echinata*, in reference to the peculiar spinous rods, which distinguish it from *variabilis*. This single specimen is obviously a very young one and for that reason it does not contribute much to the classification of the genus. Only it may be said that it is almost certain that the species and specimens which are referred to *rufescens* Brandt by Clark and Ohshima will prove

to represent several different valid species. Even the specimens here referred to *Ch. variabilis* Semper, as well as Semper's different specimens of this species, probably represent different forms, which may be characterized and separated by the shape of the calcareous ring and the serration of the ends of the curved rods in the skin.

The genus *Polycheira* is at any rate one of the least known genera of the *Synaptidae*, and without any doubt the classificatory problems connected with it are very interesting and might well deserve being taken up for a closer investigation on a better material. The present collection, does not allow a detailed study neither of the calcareous deposits nor of the finer, anatomical details. For the present we may distinguish between the following three species: *variabilis* Semper, *vitiensis* Semper and *echinata* Heding. According to Ludwig's Revision der Mertens-Brandt'schen Holothurien pag. 573—579, Brandt's species *Chirodota rufescens* is the same as Semper's *variabilis*, for which reason we may use the eldest name, though only Semper's description is tolerably usable.

Key to the species of *Polycheira*.

1. Ciliated funnels ca. 100 μ in length 2
   Ciliated funnels ca. 350 μ in length..... *vitiensis*
2. Miliary granules 60—100 μ long, more or less irregularly C-shaped. Oval bodies present in the longitudinal muscles. Rods in tentacles usually more than 150 μ and often with branched ends. Ciliated funnels in large distinctly stalked clusters with more than 15 funnels *rufescens*
   Miliary granules 120—160 μ long, slightly bent rods with spiny ends. Oval bodies in longitudinal muscles wanting. Rods in tentacles not more than 110 μ long, usually unbranched. Ciliated funnels in small short-stalked clusters with only 3—5 funnels in each ..... *echinata*

Polycheira rufescens (Brandt).

Chiridota rufescens. Brandt. 1835. Prodromus. . . . pag. 59.
" *variabilis*. Semper. 1858. Die Holothurien. pag. 20, 231 & 267. Pl. V fig. 6, 7, 9, 11, 19, Pl. VIII fig. 5—6 and Pl. XXXIX fig. 15.
" *rufescens*. Ludwig. 1881. Revision der Mertens-Brandt'schen Holothurien. pag. 579.
Polycheira rufescens. Clark. 1908. The Apodous Holothurians. pag. 120.
" " Ohshima. 1813. Synaptiden von Misaki. p. 258 fig. 9.
" " Ohshima. 1914. The Synaptidae of Japan. pag. 475.

Koh Lom, Gulf of Siam. 9. III. 1900. 72 specimens.
Saparoea Bay. 10. III. 1922. Rocky shore, at low water. 4 specimens.
Sebesi. Sunda Strait. 13. III. 1922. The shore, at low water. 2 specimens.

As to the biology of this species cf. Note pag. 322.

As said in the above remarks about this genus the collection at hand includes several closely related forms, but as the preservation does not allow any closer study of the finer characters, I must refer all the specimens to Semper's *variabilis* (= *rufescens* Brandt), which is however most likely a collective name for several related species.

The specimens from Koh Lom are pale greyish and those from Saparoea and Sebesi are nearly blackish-purple. All the specimens have 18 tentacles each with 5—7 pairs of digits. The calcareous ring consists of 18 pieces and all the five radials are perforated for the passage of the nerves. The shape of the calcareous ring (Fig. 65. 8) is not much varying, but a single large specimen from Koh Lom differs somewhat in the shape of the ring (Fig. 65. 7) from the other specimens. There are 10—12 polian vesicles and a single stone-canal. The madreporite is rather long (Fig. 65. 6) and the calcification of it is very folded. The alimentary canal has a large loop and on the mesenteries there are large clusters of ciliated funnels (Fig. 65. 1-2). The clusters are of very varying shape, but usually there are two sorts in each specimen, a large and a smaller one. Whether the smaller ones are younger stages of the large clusters, it is not possible to decide from the collection at hand, but intermediate stages have not been found, and as they are furthermore found in different places I suppose that also the smaller ones may be regarded as fully formed. The funnels themselves are all of one shape (Fig. 65. 5) and measure ca. 100 μ in length. The large specimen with the peculiar calcareous ring has the clusters slightly different from those in the other specimens examined, the funnels being arranged in two rows on the stem. The length of the large clusters is in this specimen ca. 1 mm, and in the other specimens 0,7—1 mm. The small clusters measure ca. 0,3 mm in length. The gonads are in many of the specimens rather faintly developed, but they are distinctly branched and the genital duct opens on a little papilla close behind the dorsal tentacles.

The wheels are in uncontracted specimens very regularly arranged

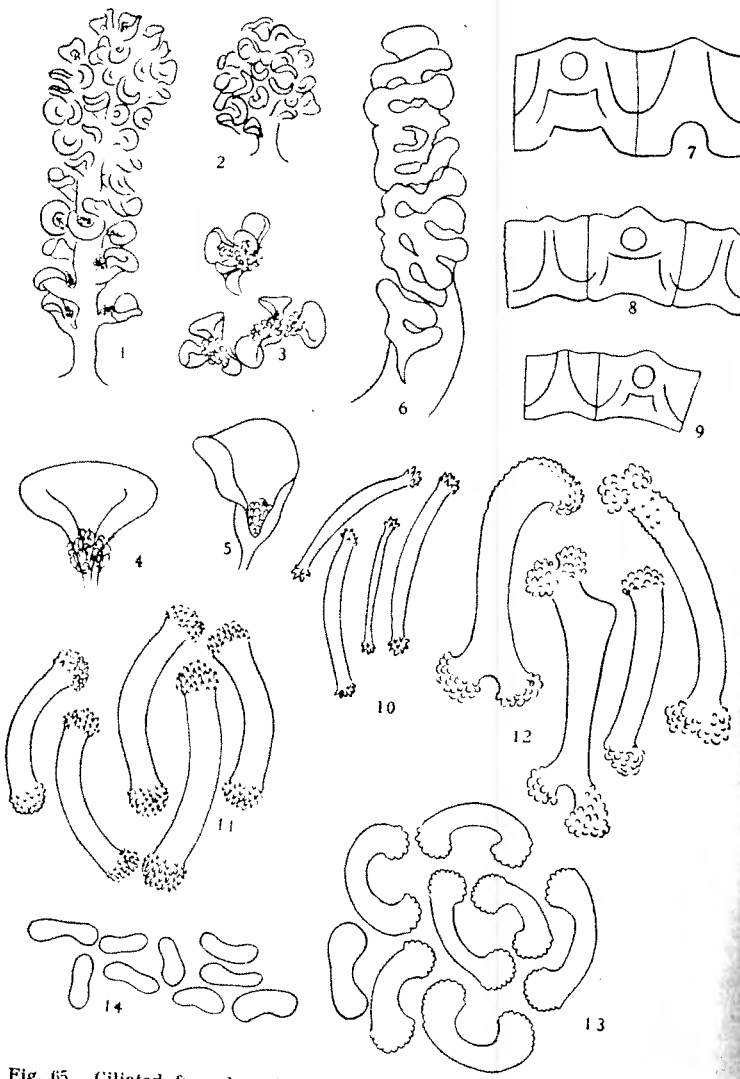


Fig. 65. Ciliated funnels and calcareous deposits af *Polycheira rufescens* and *Polycheira echinata*. 1—2 clusters from *rufescens*, 3 from *echinata* × 36. 4 a single funnel from *echinata*, 5 from *rufescens* × 225. 6 Madreporite of *rufescens* × 36. 7 pieces of calcareous ring from abnormal specimen of *rufescens*, 8 from normal specimen, 9 from *echinata* × 15. 10 Rods from tentacle of *echinata* × 225. 11 Rods from body of *echinata* × 225. 12 Rods from tentacle of *rufescens* × 225. 13 Rods from body-wall of *rufescens* × 225. 14 Miliary granules from radius of *rufescens* × 225.

in groups in a single layer, with the smallest in the middle. They measure ca. 80—140 μ in diameter. The rods in the skin are more or less regularly C-shaped bodies with enlarged ends. The rods may be either folded-serrate or spiny in the ends, and probably this may prove to be a usable character for separating different forms form each other, but then we must be sure that the rods are not attacked by the preserving fluid. Fig. 65. 13 shows the rods from the skin of the large specimen with the peculiar calcareous ring. In this specimen the ends of the rods are not spiny, the small knobs on their ends, when seen from the end of the rod, showing as distinct transversal folds. In others of the specimens the rods are irregularly spiny, but these specimens appear to be faintly attacked by the preserving fluid. The rods in the tentacles are large and usually slightly bent. Their ends are distinctly swollen and full of blunt spines. The figure (Fig. 65. 12) shows tentacle-rods from the same specimen, from which the figure of the rods from the skin is taken. In other specimens the tentacle-rods are often unbranched, though they are of the same size and shape. In the longitudinal muscles, but not in the polian vesicles and the gonads of the specimens examined, there are small oval calcareous bodies (Fig. 65. 14).

Probably the large specimen will prove to represent a distinct species, but for the present it will be preferable only to mention its differences from the other species.

Polycheira echinata n. sp.

Koh Lom. 9. III. 1900. 1 specimen.

The single specimen at hand is a very young one. It is quite colourless and does not measure more than 1,5 cm in length. It has 17 tentacles each with three pairs of digits. The calcareous ring consists of 18 pieces and all the five radials are perforated (Fig. 65. 9). There are four polian vesicles and a single stone-canal. The madreporite is quite like the madreporite in *rufescens*, only, in accordance with the minute size of the specimen, much smaller. The gonads are undeveloped vesicles, but distinctly branched, and the genital duct opens a little behind the dorsal tentacles. The alimentary canal has a loop and on the mesenteries there are ciliated funnels. These are always united into small clusters (Fig. 65. 3)

with but 3—5 funnels in each. The funnels themselves (Fig. 65. 4) are fan-shaped and slightly different from the funnels of *rufescens*, though they are of the same size. The arrangement of the wheels is as in *rufescens*, but the wheels are smaller, measuring only 40—90 μ in diameter.

In spite of the minute size of the specimen, the rods in the skin are distinctly larger than the corresponding rods in the large specimens of *rufescens*. Furthermore they are of quite another shape with distinctly spiny ends (Fig. 65. 11). The rods in the tentacles (Fig. 65. 10) are distinctly different from the rods in the skin as well as from the tentacle-rods in the specimens of *rufescens*. They are thin and slightly bent, with spiny ends.

Polycheira echinata differs in the characteristic size and shape of the rods markedly from *P. rufescens*. Probably also the shape of the clusters of ciliated funnels will prove to be a usable character, but as the specimen at hand is so young, it is not quite certain that the clusters will not grow and in adult specimens be larger. Furthermore the wanting of oval bodies in the longitudinal muscles may be of some value as a specific character, but as long as we do not know whether they are always present in *rufescens*, too much weight should not be laid on this character.

Tæniogyrus Semper.

Semper. 1868. Die Holothurien. pag. 23.
Fisher. 1907. The Hawaiian Holothurians. pag. 735, Pl. 82 fig. 2.
Clark. 1908. The Apodous Holothurians. pag. 121.
Ohshima. 1915. Holothurians from North West Pacific. pag. 286.
Clark. 1921. The Echinoderms from Torres Strait. pag. 165.

Genotype: *Chiridota australianus* Stimpson.

The genus *Tæniogyrus* was established by Semper in 1868 for Stimpson's species *Ch. australiana*, but was not recognized as valid until 1908 in Clark's "Apod. Holothurians". Clark refers two different species to it, *australianus* and *contortus*. In 1915 Ohshima describes a new interesting species which lives commensally with some Cidarids, naming it *T. cidaridis*. In 1921 Clark distinguishes between four species, as he regards the specimen mentioned by Fisher in 1907 as a valid species. The collection at hand includes five different species of *Tæniogyrus*,

two of which are new to sience. Thus we know for the present six different species of this genus:

1856. *australianus* (Stimpson).
1874. *contortus* (Ludwig).
1915. *cidaridis* Ohshima.
1921. *dubius* Clark.
1928. *keiensis* n. sp.
1928. *clavus* n. sp.

These species are in several characters rather alike, but they may be separated as follows:

1. Tentacles 12 2
   Tentacles 10 3
2. Polian vesicles 6 or 7. Wheels 42—130 μ in diameter. Inrolled end of sigmoid bodies divided into a few short, pointed branches .. *contortus*
   Polian vesicles 10. Wheels 90—195 μ in diameter. Inrolled end of sigmoid bodies unbranched ..... *dubius*
   ..... *keiensis*
3. Polian vesicles 12 4
   Polian vesicle single ..... *australianus*
4. Sigmoid bodies in groups 5
   Sigmoid bodies not in groups .....
5. Radials faintly furrowed on exterior side. No conspicuous projection on the anterior margin. Tentacle-rods small. Gonads 2—3 times branched ..... *cidaridis*
   Radials not furrowed on exterior side. A large square projection on the anterior margin. Tentacle-rods large. Gonads unbranched .... *clavus*

Tæniogyrus contortus (Ludwig).

Chirodota contorta. Ludwig. 1874. Beiträge zur Kenntniss der Holothurien. pag. 80, Pl. VI fig. 6.
Chirodota contorta. Ludwig. 1898. Holothurien der Hamburger-Magelhaensischen Sammelreise. pag. 73, Pl. III fig. 37—42.
Tæniogyrus contortus. Clark. 1908. The Apodous Holothurians. pag. 122. Pl. VII fig. 8—13.
" " Clark. 1921. The Echinoderms from the Torres Strait. pag. 165.

Kerguelen. 20—60 fms. Prof. Thompson.

The single specimen available is ca. 3 cm long and its colour is in spirit pale brown. It has 12 much contracted tentacles, but the number of digits cannot be ascertained. The calcareous ring consists of twelve pieces, which are, as far as seen on the poorly preserved specimen, of quite the same shape (Fig. 66. 2), the radials

not being perforated for the passage of the nerves. There are seven polian vesicles and a single stone-canal. The madreporite (Fig. 66. 3) is irregularly ring-shaped. The intestine has a large loop and the ciliated funnels (Fig. 66. 1) are placed on the mesenteries. They are irregularly funnel-shaped, with a rather thick collar, and in a

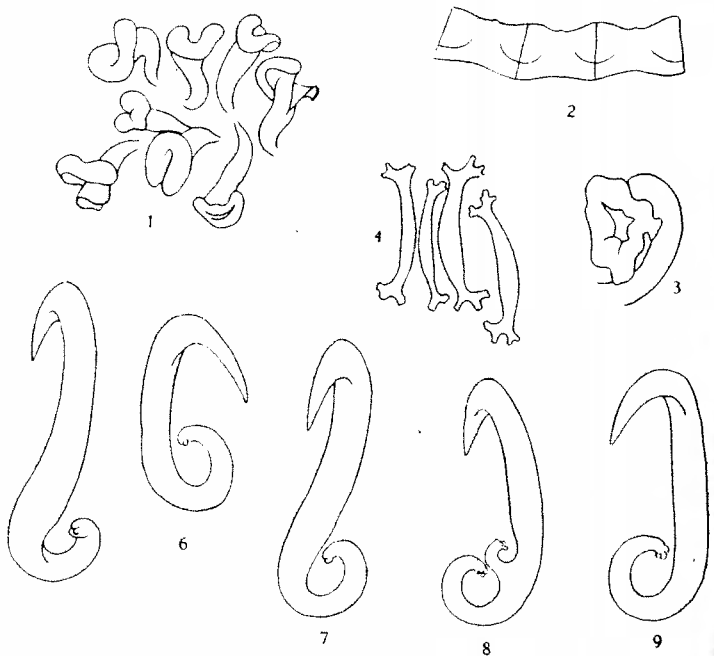


Fig. 66. *Tæniogyrus contortus*. 1 ciliated funnels × 36. 2 pieces of calcareous ring × 24. 3 madreporite × 36. 4 tentacle-rods × 160. 5—9 sigmoid bodies × 160.

few cases they are double. The gonads are branched and apparently hermaphroditic.

The wheels are nearly dissolved, but the sigmoid bodies and the tentacle-rods are present. The sigmoid bodies (Fig. 66. 5-9) quite agree with Ludwig's figures, and even abnormal bodies are found. The tentacle-rods (Fig. 66. 4) are slightly bent and have branched ends.

Clark writes in 1921 that "specimens from Kerguelen need a critical reexamination". Though the poorly preserved specimen at hand does not allow a closer and more critical examination, it

seemingly quite agrees with Ludwig's description of *contortus*, and I for my part have no doubt in referring it to the same species as the S. American specimens.

Tæniogyrus keiensis n. sp.

The Kei Islands, St. 28. 5°37'S., 132°34'E. 17.IV.1922. 400 m. 2 specim.

The specimens at hand measure ca. 3 cm in length and 0,3 cm in diameter. Their colour is in alcohol yellowish grey. There are 10 tentacles each with seven digits. The calcareous ring consists of ten pieces of which the radials are distinctly notched in the anterior margin (Fig. 67. 2). The muscular impressions are deep and a cartilaginous ring is wanting. There are two large and ten smaller polian vesicles and a single stone-canal. The madreporite is lacking in the one specimen, evidently lost by the rough handling[1]). In the other specimen it is unusually large (Fig. 67. 1). Whether the large size is really normal it is not possible to decide from a single specimen, but it differs so much from the madreporite in the other species of *Tæniogyrus*, that the suggestion lies at hand that it is abnormal. If it will really prove to have the large size, it is not only exceedingly interesting, but it will also be a valid character for separating this species from the other species of the genus. Each of the gonads are branched into three equal branches. The sexes are separate and the genital duct opens on a very little papilla close behind the dorsal tentacles. The intestine has a large loop and at the base of the mesenteries there are ciliated funnels. The funnels are usually united into stalked clusters (Fig. 67. 3), but single funnels may also be found. The shape of the funnels is very variable, and they may, as in *contortus*, sometimes be double.

The calcareous deposits in the skin are wheels and sigmoid bodies. The wheels are of the shape common in this genus, and their diameter is varying from 30—120 μ. The sigmoid bodies (Fig. 67. 5-8) are not arranged into groups. They are quite wanting on the dorsal side of the specimen, but very abundant on the ventral side. They measure 180—220 μ in length. In the tentacles there are rather large rods which measure from 210 to 250 μ

1) It was taken by means of a tangle.

in length. Those in the digits are of the same shape (Fig. 67. 4), but they are much smaller, not measuring more than 80—100 μ.

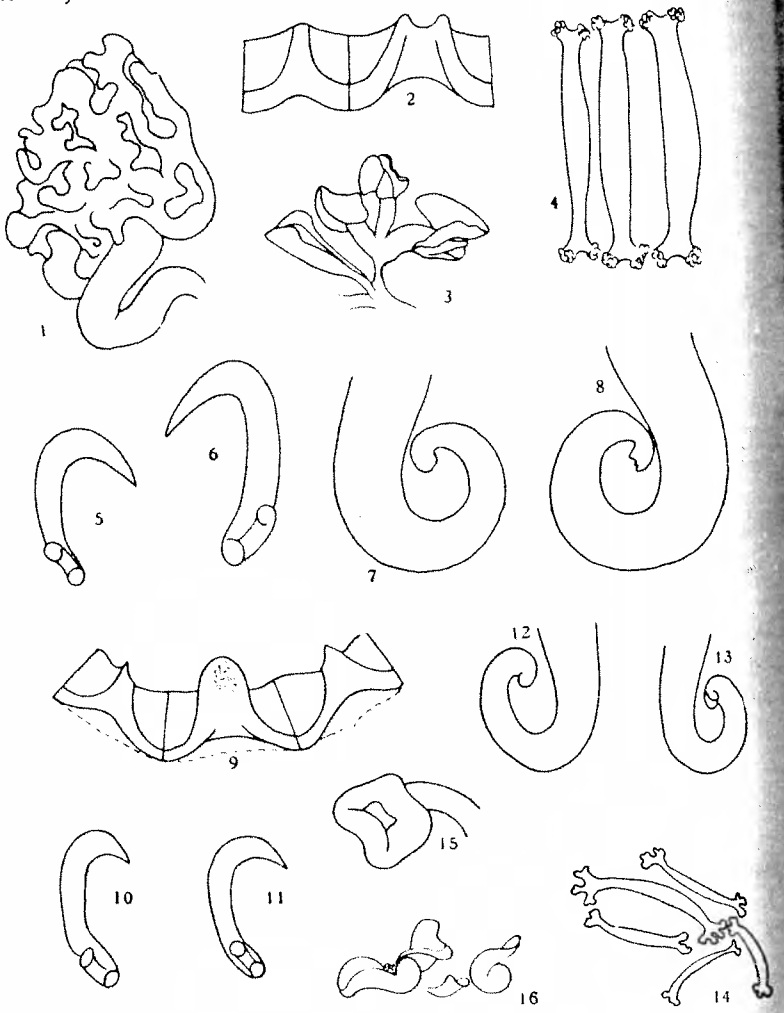


Fig. 67. 1—8 *Tæniogyrus keiensis*, 9—16 *Tæniogyrus australianus*. 1 madreporite × 36. 2 pieces of calcareous ring × 24. 3 ciliated funnels × 55. 4 tentacle-rods × 160. 5—6 sigmoid bodies × 160. 7—8 inrolled ends of sigmoid bodies × 550. 9 pieces of calcareous ring × 24. 10—11 sigmoid bodies × 160. 12—13 inrolled end of sigmoid bodies × 550. 14 tentacle-rods × 160. 15 madreporite × 36. 16 ciliated funnels × 36.

Tæniogyrus keiensis is an easily recognizable species, which is the most closely related to *T. cidaridis* Ohshima. It is characterized

by the number of the tentacles and the polian vesicles, by the shape of the calcareous ring, the gonads and the ciliated funnels. Judging from the contorted shape of the specimens and the arrangement of the sigmoid bodies, there is reason for supposing that this species like *cidaridis* and *clavus* is living commensally with Cidarids, but as to that nothing is remarked on the label.

Tæniogyrus australianus (Stimpson).

Chiridota australiana. Stimpson. 1856. Description of some new marine Invertebrata. pag. 386.

Tæniogyrus australianus. Clark. 1908. The Apod. Holothurians. p. 122.
" " Clark. 1921. The Torres Strait Echinoderms. pag. 166.

Port Jackson, Shark Island. 7. IX. 1911. Australian Museum. 1 specimen.
" 8. X. 1914. 3—5 fms. Sand, gravel. 9 specimens.
" 9. X. 1914. 2—3 fms. Sand, mud. 4 specimens.
" 4. III. 1915. 2 fms. Sand. 4 specimens.

The specimens at hand measure up to 6 cm in length. Their colour is in spirit pale yellow, tinged with red. They have ten tentacles, each with 5 pairs of digits. The calcareous ring consists of ten pieces, the radials being distinctly different from the interradials (Fig. 67. 9). The interradials are somewhat varying in shape, but there is no distinct difference between the ventral and the dorsal pieces. The calcareous ring is interesting in having, in all the specimens examined, a faint cartilaginous margin. As the calcareous ring is rather stout and has a well marked posterior margin, the cartilaginous ring cannot be part of it, but must be regarded as a real cartilaginous ring, though distinctly different from that found in the *Synaptinae*. There is one polian vesicle and a single stone-canal. The madreporite (Fig. 67. 15) is irregularly ring-shaped. The alimentary canal is not well preserved, but as far as seen it has a loop. The ciliated funnels (Fig. 67. 16) are found only on the body-wall. They are rather difficult to examine, but as far as can be seen, they are of varying size and shape and not united into clusters.

The wheels are gathered into rather large papillae. They are of the common shape and measure from 70—100 μ in diameter. The sigmoid bodies are always confined to small papillae, and usually arranged into groups, but in some of the specimens there are very few (1—2) in each papilla. They are rather small, not measuring

more than ca. 110 μ. The hook is short and the inrolled end unbranched, but often with a few rounded knobs (Fig. 67. 10-13). The spicules in the tentacles (Fig. 67. 14) are slightly curved, with enlarged ends. They measure ca. 110 μ in length.

T. australianus is an easily recognized species, distinctly different from the other species of the genus, in the arrangement of the sigmoid bodies, and in the shape of the calcareous deposits. The shape of the ciliated funnels is seemingly rather characteristic, and in any case distinctly different from that of the funnels in *T. keiensis*.

Tæniogyrus cidaridis Ohshima.

Tæniogyrus cidaridis. Ohshima. 1914. The Synaptidae of Japan. p. 477.
" " Ohshima. 1915. Holothurians from the North West Pacific. pag. 286.
" " Clark. 1928. The Echinoderms of the Torres Strait. pag. 166.

Misaki. 19. IV. 1914. 80—100 fms. 1 specimen.
Okinose. Sagami Bay. 23. VI. 1914. 100 fms. 1 specimen.
" 1. VII. 1914. 200 fms. 2 specimens.
Sagami Bay. 2. VII. 1914. 400 fms. 1 specimen.

All the five specimens at hand are attached to spines of Cidarids by their coiled posterior end. Their colour is in alcohol pale yellow, with large white wheel-papillae. The wheel-papillae are quite wanting on the posterior end of the ventral side (i. e. that part of the specimen which is turned against the Cidarid-spine) but exceedingly abundant on the dorsal side. There are ten very contracted tentacles, with but few digits. The calcareous ring is rather stout. It consists of ten pieces, the radials being different from the interradials. The radials (Fig. 68. 8) have a distinct slit in the exterior side, and all the calcareous pieces have distinct muscular impressions. There is one polian vesicle and a single stone-canal. The madreporite (Fig. 68. 3) has a very characteristic shape, being a square, bent ring. On account of the contraction of the body, the shape of the alimentary canal cannot be made out. On the body-wall there are some few ciliated funnels (Fig. 63. 2). The gonads are branched and the sexes seem to be separate.

The wheels are of the usual size and shape, and only a few abnormal ones (Fig. 68. 1) are found. The sigmoid bodies are nearly totally confined to the wheel-less part of the ventral side,

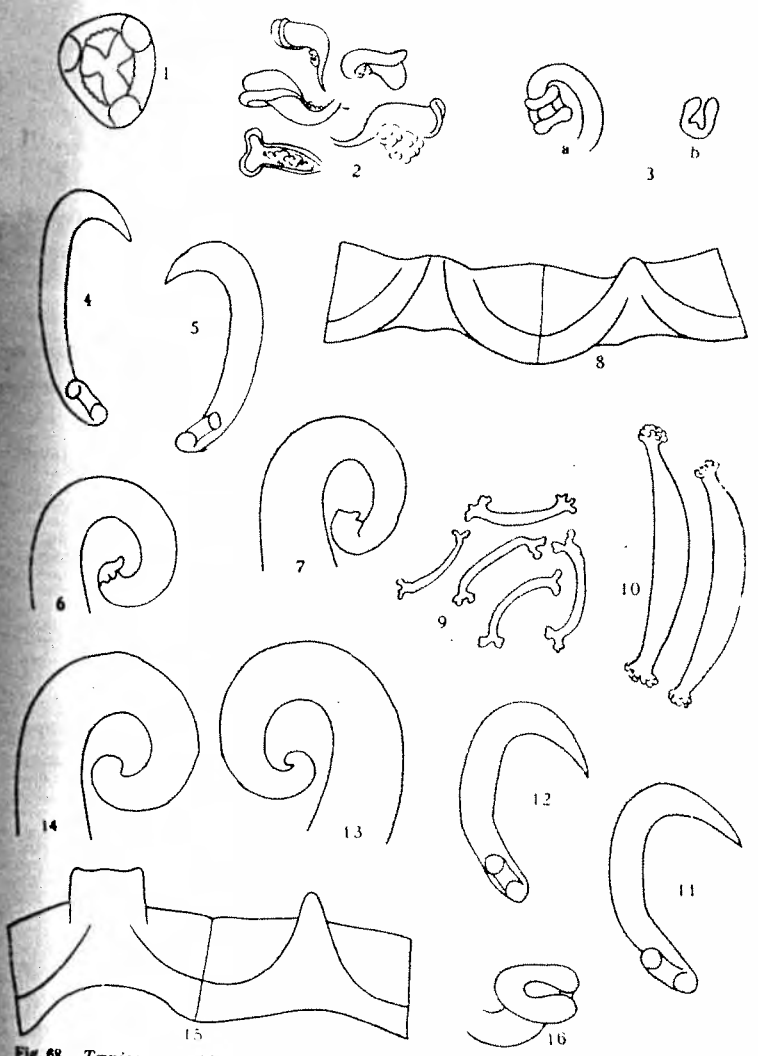


Fig. 68. *Tæniogyrus cidaridis* 1—9 and *Tæniogyrus clavus* 10—16. 1 abnormal wheel × 550. 2 ciliated funnels × 36. 3 madreporite × 36. 4—5 sigmoid bodies × 160. 6—7 inrolled ends of sigmoid bodies × 550. 8 pieces of calcareous ring × 24. 9 tentacle-rods × 160. 10 tentacle-rods × 160. 11—12 sigmoid bodies × 160. 13—14 inrolled ends of sigmoid bodies × 550. 15 pieces of calcareous ring × 24. 16 madreporite × 36.

which is, as said, turned against the Cidarid-spine. They measure ca. 200 μ in length. The hook is rather short (Fig. 68. 4-5) and the inrolled end is usually irregularly branched like that of the hooks in *contortus* (Fig. 68. 6-7). The spicules from the tentacles (Fig. 68. 9) measure ca. 100 μ, and their ends are distinctly branched.

Tœniogyrus cidaridis is a rather interesting species which is easily recognized by the shape of the calcareous ring, the hooks and the tentacle-rods. From the two other species, found commensally with Cidarids, *keiensis* and *clavus*, it differs distinctly in the shape of the hooks and the tentacle-spicules.

Tæniogyrus clavus n. sp.

The Kei Islands. St. 41, 5°28' 40" S., 132°28' E. 245 m. Mud. 25.IV.1922. 1 specimen.
„ St. 46, 5°47' 20" S., 132°13' E. 300 m. Mud. 2.V.1922. 4 specimens.
„ St. 50, 5° 34' S., 132° 25' E. 233 m. Sand. 4.V.1922. 9[1]) specimens.

The specimens at hand are very like *keiensis* and *cidaridis*, and like these specimens they are confined to Cidarid-spines. They are in alcohol white with yellowish tentacles. The arrangement of the wheel-papillae is quite as in *cidaridis*, with numerous papillae on the dorsal side, and hooks on the ventral side. There are ten tentacles each with 5 pairs of digits. The calcareous ring (Fig. 68. 15) consists of ten pieces, the radials being characterized by a large, square projection on the anterior margin. There is one polian vesicle and a single stone-canal. The madreporite (Fig. 68. 16) is irregularly ring-shaped. The alimentary canal has a large loop, and the gonads are very voluminous and unbranched. The sexes are separate. Ciliated funnels could not be made out.

The wheels are of the usual shape and measure 35—140 μ in diameter. The sigmoid bodies (Fig. 68. 11-12) measure ca. 175 μ in length. The hook is rather large and the inrolled end is not branched (Fig. 68. 13-14). In the tentacles there are rather large and very characteristic spicules (Fig. 68. 10). They measure ca. 120—150 μ in length and their ends are unbranched and spiny.

[1]) From this locality there are some more specimens, but they are still remaining on the corresponding Cidarids.

Tœniogyrus clavus is, although nearly related to *keiensis* and *cidaridis*, easily recognized by the shape of the calcareous ring, the hooks and the tentacle-spicules. Furthermore the unbranched gonads may be a valid character for separating this species from the others.

Scoliodota Clark.

Scoliodota Clark. 1908. The Apodous Holothurians. pag. 125.
Trochodota Clark. 1921. The Echinoderms from Torres Strait. pag. 164.

Genotype: *Scoliodota théelii* Heding.

Diagnosis: Tentacles ten, peltated, digitate. Wheels wanting; calcareous deposits in the skin sigmoid bodies only. In the tentacles rods may occur. Calcareous ring bilaterally symmetrical. Polian vesicle and stone-canal single.

Remarks: The genus *Scoliodota* was established by Clark in 1908 with the species *Chiridota japonica* v. Marenzeller as the genotype. This species is rather unsatisfactorily described, and the real genotype may for this reason be the specimens which Théel in 1886 referred to v. Marenzeller's species. In 1913 Ohshima showed that v. Marenzeller's species is a *Trochodota*, for which reason Clark in 1921 abandoned the genus, without taking into consideration the Australian specimens, described by Théel. The specimens from Port Jackson at hand leave no doubt that they represent the same species as the specimens described by Théel in 1886, and as they are generically different from *Trochodota*, I have no doubt in referring them to Clark's genus *Scoliodota*. *Scoliodota* is then a monotypic genus, for the present only known from Australia.

Scoliodota théelii n. sp.

Chiridota japonica. Théel. 1886. "Challenger" Holothurioidea II. pag. 17, Pl. II fig. 3.
Scoliodota japonica. Clark. 1908. The Apodous Holothurians. pag. 125, Pl. VII fig. 5.

Port Jackson. 8. X. 14. 3—5 fms. 2 specimens (+ several fragments).

The real length of this species cannot be ascertained, as none of the specimens at hand are complete, but it may prove to be ca. 10—15 cm. The colour of the skin is, in alcohol, pale grey, but the specimens are, especially in the anterior end, covered by a dense

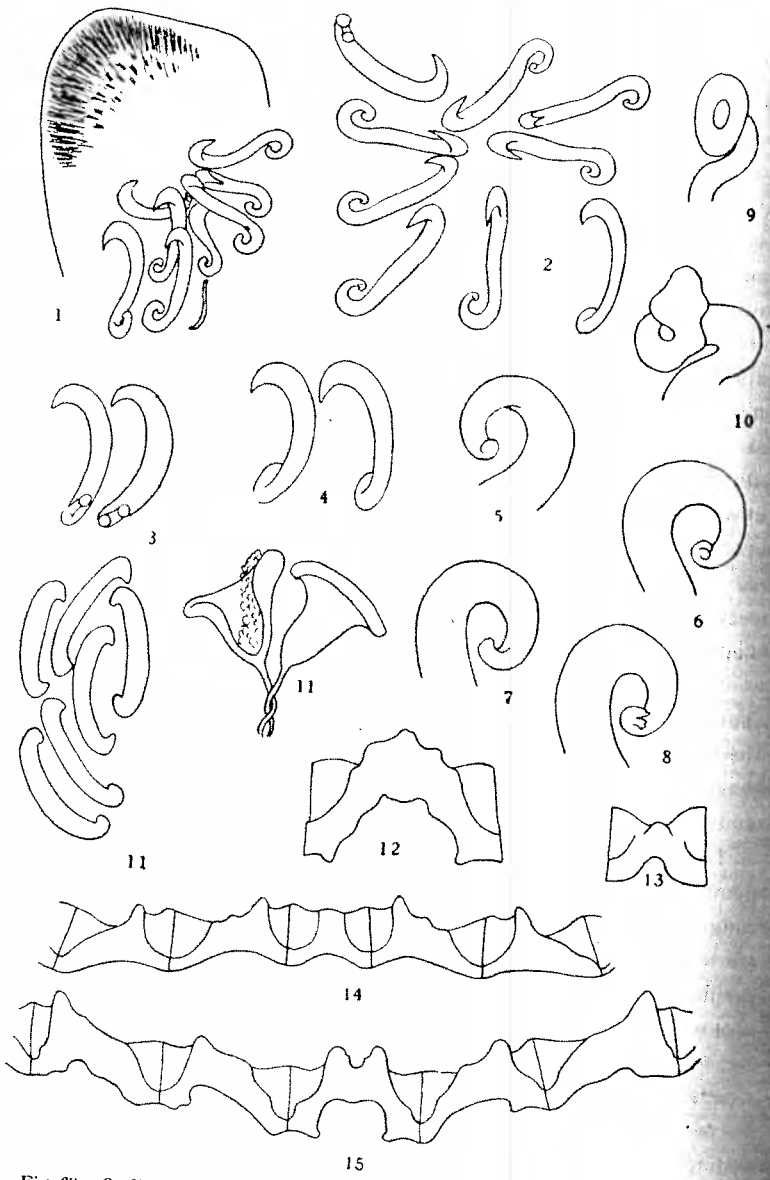


Fig. 69. *Scoliodota théelii*. 1—9, 11 & 14—15 from ♂. 10 & 12—13 from ♀. 1 Papilla with hooks × 130. 2 Group of hooks from posterior end of specimen × 160. 3 hooks from anterior end, 4 from posterior end × 160. 5—8 inrolled ends of hooks × 450. 9—10 madreporites × 36. 11 rods from tentacles × 160. 12—13 ventral and dorsal piece of calcareous ring from the female specimen × 36. 14—15 calcareous ring from the male specimen × 36. 16 ciliated funnels × 160.

coat of dark brown or purple papillae, which lend to the anterior end of the specimens a dark brown colour. The posteriormost end is lacking the coloured papillae, for which reason it is grey. There are ten tentacles, each of which has 7 pairs of digits. Sense-organs are not found, neither on the tentacles nor on the oral disk. The calcareous ring (Fig. 69. 14-15) is rather interesting as it is, like the ring of *Labidoplax variabilis* Théel, bilaterally symmetrical. The radials are not distinctly different from the interradials, not being perforated for the nerves. The calcareous ring is somewhat differing in the two specimens at hand. The lateral pieces agree quite well, but the mid-dorsal and the mid-ventral pieces are distinctly different (Fig. 69. 12-13). The two specimens are of different sex, but whether the differences in the calcareous rings correspond with the sexes cannot be ascertained from only two specimens. The retractor-muscles are large, but united with the body-wall by a mesentery-like tissue. There is a single large polian vesicle and one stone-canal. The madreporite is of different shape in the two specimens (Fig. 69. 9-10). The alimentary canal is straight and so filled with sand that it nearly quite fills out the body-cavity.

The ciliated funnels are found at the base of the mesenteries. They are long-stalked and not united into clusters (Fig. 69. 11). The sexes are, as said, separate and the gonads are branched. The genital duct opens on a very long papilla found in the dorsal interradius, somewhat behind the tentacles.

In the body-wall no other calcareous deposits are found than sigmoid-shaped bodies. These are gathered into groups, which are lying beneath the coloured papillae (Fig. 69. 1). The sigmoid bodies are not lying in the papillae as in *Trochodota dendyi*, and the whole papilla may be removed without disturbing the arrangement of the hooks. In the posterior end of the specimens the arrangement of the hooks (Fig. 69. 2) quite agrees with Théel's figure in the Challenger Holothurioidea II, Pl. II fig. III, and leaves no doubt as to the identification of the specimens at hand. The sigmoid bodies are of somewhat varying shape (Fig, 69. 3-9) and have often the inrolled ends divided into a few short, pointed branches, quite as in *Tæniogyrus contortus*. The sigmoid bodies measure in the posterior end of the specimens ca. 139—140 μ and in the anterior end of the specimens 100—120 μ. In the tentacles there are some

rather peculiar rods (Fig. 69. 11). They are of the same size as the sigmoid bodies and are all of very nearly the same size.

Scoliodota théelii is in several respects rather like *Trochodota dendyi*, but it differs distinctly from that species in the shape of the calcareous ring, the tentacle-rods and the ciliated funnels.

Note. It may be desirable to add this little note, containing some biological observations made by Dr. Mortensen on various of the Synaptids collected during his voyages.

Opheodesoma grisea (Semper). This species was found in considerable numbers thrown up on the beach in Pearl Harbour, near Honolulu. Although almost completely dried up they were still alive, and it was very remarkable to see the dry skin, which had almost the appearance of a piece of black paper, gradually assuming its normal appearance and consistence as the rising water reached them. It is evident that this Synaptid can stand a fairly long exposure to the direct radiation of the sun, apparently more so than any other Holothurian. However, those specimens which were thrown higher up on the beach and had been completely dried up, were definitely dead. Direct experiments as to the resistance of this species aginst exsiccation might well lead to interesting results.

Patinapta ooplax (v. Marenzeller). On the little island of Samalona, off Makassar, this species was found in good numbers in the coarse coral sand of the beach, in a place rather exposed to the surf. The animals were living entirely buried in sand, digging like earthworms and eating their way through the sand, their alimentary canal being completely filled therewith. They seem thus to feed on the detritus and the microorganisms which may be living in the sand — a rather meagre diet, anyhow. They were rather tough in spite of the skin being quite thin and transparent, so that they would not break when being grasped by one end and hauled out of the sand.

Polycheira rufescens (Brandt). On the little island of Koh Lom, off the W.coast of Koh Chang, in the Gulf of Siam, this nearly black Synaptid was found in considerable numbers under stones on a sandy beach; about a score of specimens would be found

together in a bunch. When the stone was thrown over they would squirt out the water from their bodies and then try to bore themselves down into the sand. The tentacles were strongly agglutinating. When placed in a dish some of the specimens would rise the foreend above the water and cling by means of the tentacles to the sides of the dish.

Explanation of Plates.

Plate II.

This plate shows the very characteristic colour of some Synaptids. Figs. 1—5 are painted after specimens in alcohol, figs. 6—7 after living specimens. As the colour is the same in the whole length of the body, only a small part is shown of each species.

Oph. lineata is the only one of the species here figured of which the colour of the dorsal side differs from that of the ventral side.

Fig. 1. *Synapta oceanica* (Lesson). Nat. size.
Figs. 2—3. *Opheodesoma lineata* n. sp. Nat. size. — 2. The body seen from the right side. 3. The body seen from the dorsal side.
Fig. 4. *Synaptula albolineata* n. sp. Nat. size.
Fig. 5. — *ater* n. sp. Nat. size.
Fig. 6—7. — *maculata* (Sluiter). — 6. A complete specimen. Nat. size. 7. A fragment of the body × 5.

Plate III.

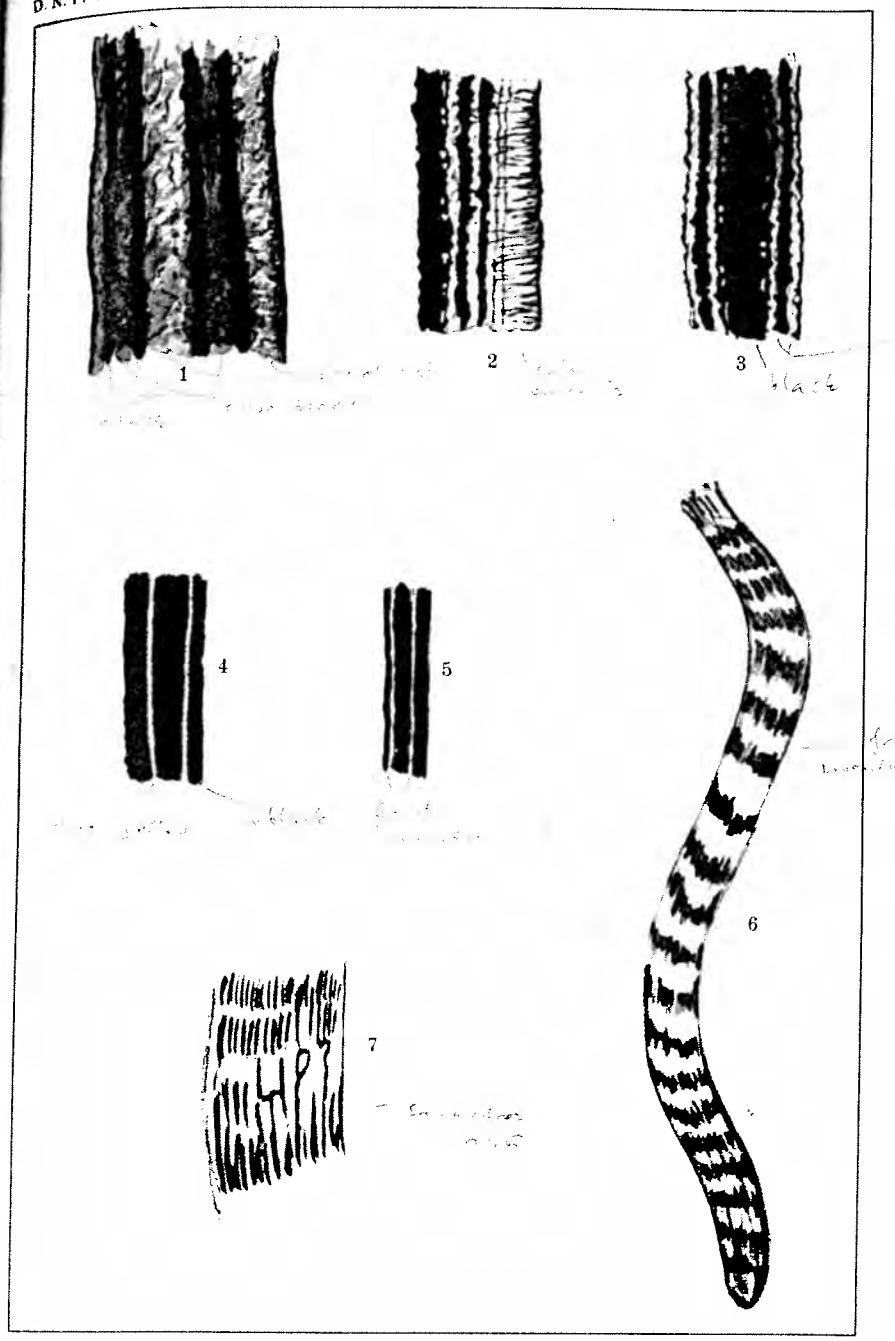
Synaptula vivipara Ørsted (= *hydriformis* (Lesueur)).

All the figures were drawn by A. S. Ørsted during his stay on Jamaica in the year 1845; the name below is in Ørsted's handwriting. The enlargement of the figures is not stated, but it may vary from × ca. 5 (the two coloured drawings) to × ca. 200 (the figure of the ciliated funnels).

The lowermost figure to the left of the plate represents some eyes and their innervation. The figure above this represents a tentacle, situated off the interstice between two adjacent pieces of the calcareous ring.

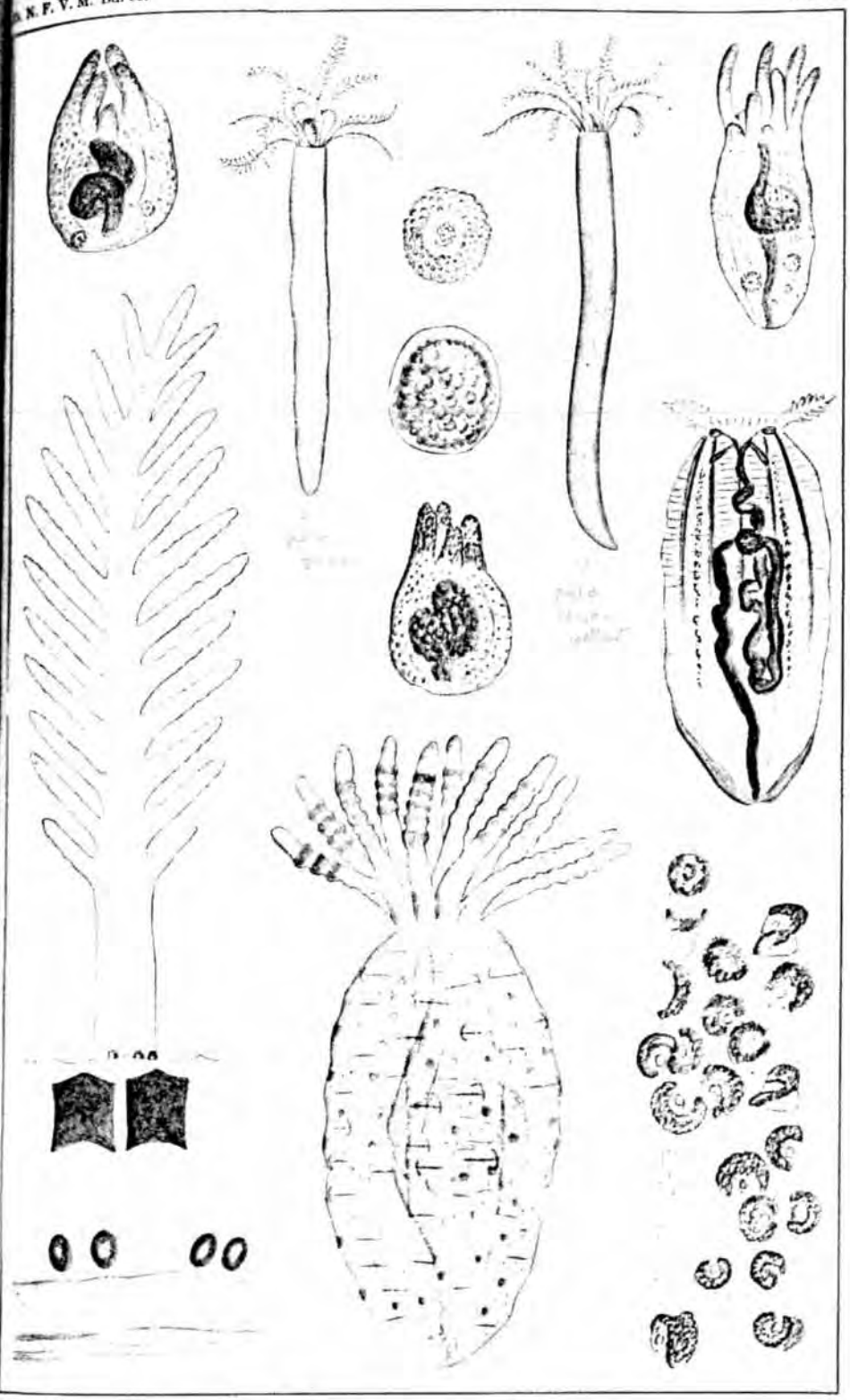
The figures in the midline of the plate and the uppermost figure to the left and right sides represent a series of developmental stages. In the two latter figures are seen the larval organs (the punctured circles).

The figure in the middle of the right side of the plate shows an opened specimen with two rows of ciliated funnels and two club-shaped gonads. The intestine is long and folded and has a large loop. Below, in the right side of the plate, is a figure of the ciliated funnels and their arrangement on the mesentery.



1-5 S. HEDING pinx.

1. Synapta oceanica (Lesson). — 2-3. Opheodesoma lineata n. sp. — 4. Synaptula albolineata n. sp. — 5. Synaptula ater n. sp. — 6-7. Synaptula maculata (Sluiter).



A. S. ØRSTED del.

Synaptula viridis Ørst.