1929

(Særtryk af Vidensk. Medd. fra Dansk naturh. Foren. Bd. 88.)

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Contributions to the Knowledge of the Synaptidae. I.

By
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In the summer of 1928 the Zoological Museum of Copenhagen received a small collection of synaptids, collected by Dr. Cyrill Crossland at Zanzibar and Tahiti. It included 43 specimens, representing the following five species:

1. *Synapta oceanica* (Lesson)
2. *Synaptula mortensenii* n. sp.
3. *Patinapta crosslandii* n. sp.
4. *Chiridota rigida* Semper
5. *Polycheira rufescens* (Brandt).

Owing to the careful preservation of the specimens, these few species make a very valuable addition to our knowledge of the synaptids. The African species of *Synaptula* is interesting in being more closely related to the West Indian species *hydriformis* (Lesueur) than to the East Indian species, and the specimens of *Patinapta* have shown, as was to be expected, that the African specimens of this Genus are specifically different from the specimens from the Sunda Islands and Japan.

In contradistinction to this, the nicely preserved specimen of *Polycheira rufescens* is a proof that this species has its distribution from Zanzibar to Japan, and that there are no distinct differences between specimens from different localities. The single specimen of *Chiridota* from Tahiti most likely represents Semper's species *rigida*, and thus, though it is exceedingly contracted, it gives a desirable opportunity for a closer examination of this interesting species.

By far the most interesting of the species represented is *Synapta*

oceanica (Lesson). From the 4 specimens at hand it appears that the colour of this species is exceedingly characteristic and unusually constant, and that neither the size of the spicules nor the presence or absence of a web between the digits may be considered to be of much classificatory value. Furthermore these specimens are provided with some very interesting and hitherto unknown forms of anchors and anchor-plates, which may certainly help to clear up the relation between this Genus and the other Genera of the *Micrournae*.

1. *Synapta oceanica* (Lesson).

Holothuria oceanica Lesson 1830 Centurie zoologique pag. 99, and in Duperry: Voyage autour du Monde Ch. XIV pag. 9.
Synapta oceanica Jäger 1833 De Holothuriis pag. 14.
Synapta maculata Clark 1908 The Apodous Holothurians pag. 78.
Synapta oceanica Heding 1928 "Synaptidae"; Papers from Dr. Th. Mortensen's Pacific Expedition XLVI, in Vid. Med. Dansk Naturh. Forening Bd. 85 pag. 117.

Tahiti 21-II-1925, 4 specimens.

The specimens at hand are nicely preserved and measure 23—36—37 and 43 cm in length. They are yellow in alcohol and in the ambulacra they have the dark stripes which are so characteristic of this Tahitian species (cf. "Synaptidae" Pl. II fig. 1). The tentacles as well as the digits are not contracted, and the web between the digits is either wanting or extremely faintly developed, for which reason this feature cannot be used for separating *oceanica* from *maculata* (Chamisso & Eysenhardt) as supposed in the "Synaptidae". The measurements of the calcareous deposits also seem to be unusable for separating the different forms of Synapta.

After having finished my examination of Dr. Mortensen's collections, I have got the opportunity of examining a large number of synaptas from varying localities. The different and often very characteristic colours of the specimens from different localities indicate different local forms (species, subspecies or races). In order to solve this problem I have begun a statistic examination of the size and shape (the length-width-index) of the anchors and anchor-plates, as well as of the corellation between the size and the shape. These studies are far from ended, but it may be said now that the variation in size of the deposits within a single specimen is so great that some

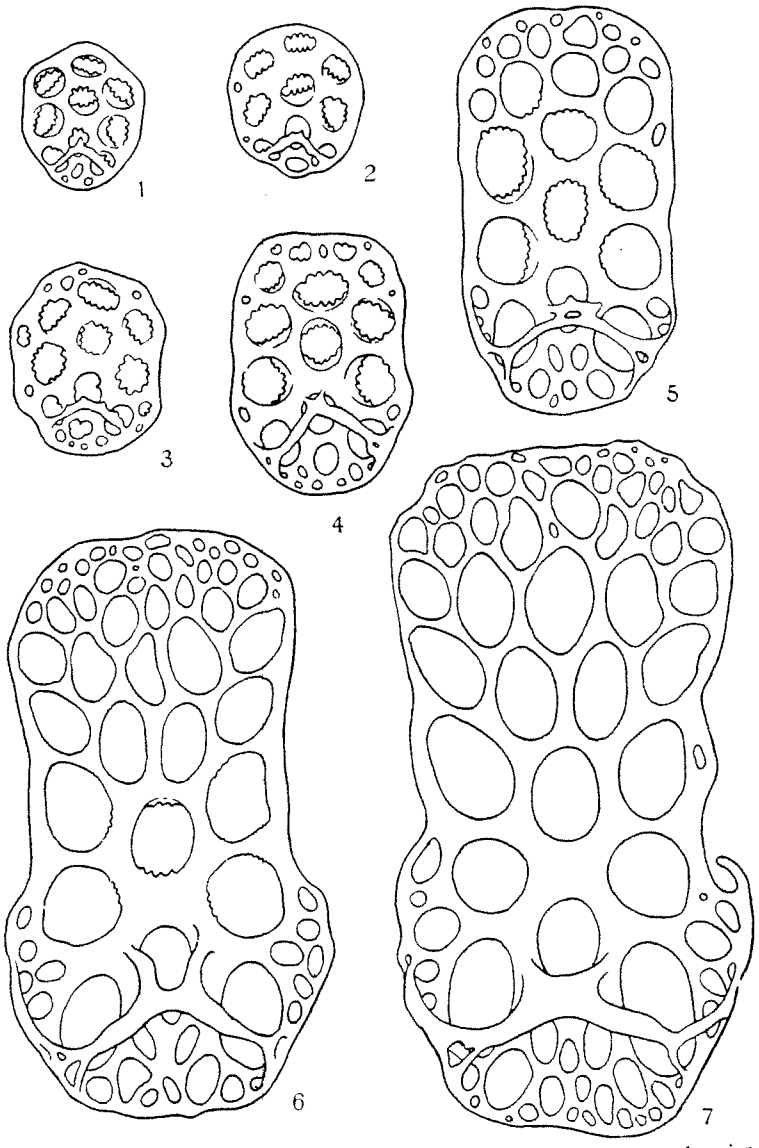

Fig. I. *Synapta oceanica* (Lesson). Different anchor-plates found in the anal region of the specimens from Tahiti. (All the figured plates are from the same specimen.) $^{110}/_{1}$.

few measurements, for instance 20—30, do not give any certainty as to the normal size of the deposits. The measuring of a large number of anchors, i. e. of more than 500, from the same part of the body,

gives a rather regular biologic curve of variation, of which the arithmetic middle represents the normal anchor-size in that part of the body. In this way it is seen that the anchors are distinctly larger in the posterior end of the body than in the anterior end. For instance in some mottled specimens from Samoa, perhaps referable to *S. mammillosa* Eschscholtz, the normal size of the anchors from the anterior end is about 850 μ and from the posterior end about 1030 μ. The absolute size of the anchors varies in the anterior end from 700 μ to 990 μ, and in the posterior end from 800 μ to 1150 μ.

During these examinations by which several thousands of anchors were cleaned (the dense layer of rosettes does not allow any closer study of the spicules in cleared skin) I found some very interesting anchor-plates in the anal region of the present specimens of *oceanica*. In all the other features, the Genus *Synapta* is a pronounced representative of the *Micrournae*, only the large polypore anchor-plates separate it somewhat from the other Genera. It was therefore very surprising to find several small anchor-plates of quite the same shape as is the typical in the Genera *Synaptula* and *Polyplectana* (Fig. I. 1) and at first I also supposed that they were loose plates from a specimen belonging to one of the two above-mentioned Genera, which had clung to the exterior of the specimen at hand. A closer examination of cleared skin-preparations, however, showed that this was not the case, and that the small plates were lying in the skin itself. Furthermore, among the cleaned spicules there were also numerous stages intermediate between the small plates named and the normal, large polypore plates with smooth holes. It is a fact that all the different forms of anchor-plates, seen on fig. I, as well as more intermediate stages exist and may be found in the anal region of the specimens at hand, and the question is now, how their presence may be explained.

In the description of *Synaptula hydriformis* (Lesueur), cf. "Synaptidae" pag. 183—188, I have mentioned the presence of some few abnormally small anchors and plates in the anal region of the specimens, and have shown that they might be supposed to be the first postembryonal or even the embryonal plates, which were not resorbed during the development of the specimen. In the same way we may regard these small plates as some of the larval or the first postlarval plates developed. Whether this is really the case and for what reason they are only found in the posteriormost end of the specimens, and not all over the body, are questions which can only be answered by biological studies, but they seem to be so interesting

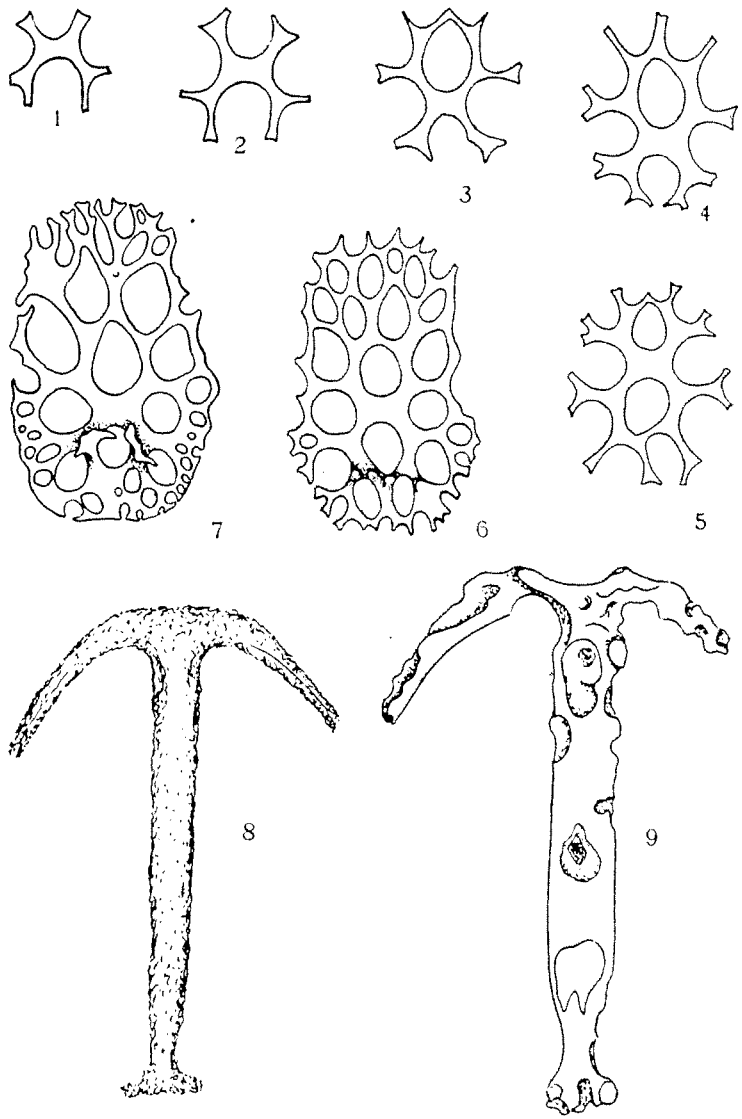

Fig. II. 1—7 Developmental stages of normal anchor-plates from *Synapta oceanica* (Lesson). $^{65}/_{1}$. 8 Anchor of *S. maculata* var. *Andreae* Heding partly dissolved by acid in the preserving fluid. $^{65}/_{1}$. 9 Anchor of *S. oceanica* (Lesson) eroded by unknown factors (not by acid in the preserving fluid). $^{110}/_{1}$.

that they might fairly well deserve to be taken up for a closer examination.

A fact that must not be overlooked is that, though developmental stages of anchors and plates, as well as of wheels and hooks, in the *Chiridotinae*, are rather common, it is very rarely that we find deposits which are being resorbed. As far as I am concerned I have never seen it until now in the present specimens of *oceanica* (Fig. II. 9).

It is very common for students of synaptids to see deposits partly dissolved by acid in the preserving fluid, and the appearance of such deposits is very characteristic as they are more or less equally eroded all over the surface, cf. the figures by Selenka[1]) of "*Synapta*" *gracilis* and by Sluiter[2]) of *Chondrocloea aspera* as well as the present figure (Fig. II. 8) of a partly dissolved anchor of *Synapta maculata* var. *Andreae* Heding. Such deposits are easily recognized and are distinctly different from the anchors in *oceanica* which I suppose are being resorbed. In this species all the other spicules are quite unattacked, and in the attacked anchors there are often large parts which are quite smooth cf. the left side of the shaft of the figured anchor.

For a comparison with the supposed ontogenetic developmental stages of the large poly-pore plates (Fig. I. 1—7), I have figured how the plates are developed in the mature specimen (Fig. II. 1—7).

On Fig. II. 6—7 it is seen that the bridge arises from the sides of the articular hole, and in the fully developed plate it is also united with the articular hole (Fig. I. 6—7). In this character the plates in *Synapta* are more closely related to the plates in *Opheodesoma* and *Euapta* than to the plates in *Synaptula* and *Polyplectana*, a feature that may perhaps be used when the relation of the Genera of *Micrournae* is to be made out.

2. *Synaptula mortensenii* n. sp.[3])

Zanzibar 1901, 33 specimens.

The specimens at hand measure about 5 cm. in length, and are reddish-brown in alcohol. The number of tentacles is varying, but

[1]) Selenka: Beiträge zur Anatomie und Systematik der Holothurien Pl. XX fig. 123—24.

[2]) Sluiter: Siboga-Holothurien Pl. X fig. 12.

[3]) I have dedicated this interesting species to Dr. Mortensen, who is by far the greatest collector of synaptids.

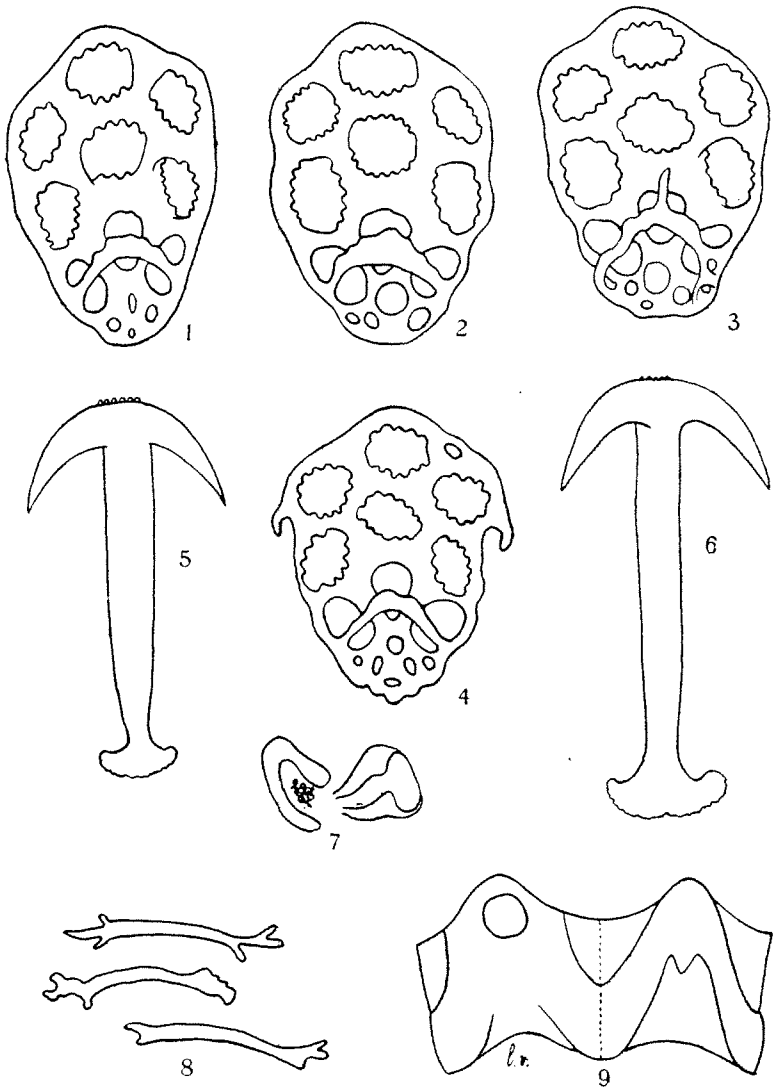

Fig III. *Synaptula mortensenii* n. sp. 1—4 Anchor-plates from anterior end of specimen. $^{250}/_{1}$. 5—6 Anchors from anterior end of specimen. $^{250}/_{1}$. 7 Ciliated funnels. $^{150}/_{1}$. 8 Tentaclerods. $^{250}/_{1}$. 9 calcareous ring $^{42}/_{1}$.

not in correspondance with the size of the specimens. There are 10 in 3 specimens, 11 in 5 specimens, 12 in 23 specimens, and 13 in 2 specimens, but according to the large number of specimens with 12 ten-

tacles, we may suppose that 12 is the normal number. There are 10—12 pairs of free digits on each tentacle, arranged as in *hydriformis* (Lesueur) with distinct intervals. Eye-spots are faint and hardly seen on the oral disk.

The calcareous ring is not enclosed in the well developed cartilaginous ring. It is equally developed on the ventral and the dorsal side, and all the five radials are perforated for the nerves (Fig. III. 9). The muscular impressions on the calcareous ring are very distinct. There are about 5 polian vesicles and a single curled stone-canal. The madreporite is short and not elongated along the stone-canal. The alimentary canal has a large loop and on the mesenteries there are ciliated funnels of the usual size and shape (Fig. III. 7). The large and voluminous gonads are in all dissected specimens unbranched and hermaphroditic, with the very few eggs imbedded in sperma. Both eggs and sperma seem to be ripe.

The anchors measure from 200—230 μ in length and about 110 μ in width. The vertex is distinctly convex and set with a few small knobs in a single row. The stock is unbranched and irregularly dented. The anchor-plates (Fig. III. 1—4) measure about 160 μ in length and 115 μ in width. Their shape is very irregular and there may often be a few extra holes in their anterior end. The bridge is well developed and irregularly knobby. Often it may be set with a large projection on the anterior margin.

Miliary granules are totally wanting, and as neither the anchors and plates, nor the fine spicules in the tentacles are attacked by acid, the granules are certainly not dissolved. In the tentacles there are some rods ca. 100 μ long (Fig. III. 8), with irregularly branched ends.

Synaptula mortensenii is a very conspicuous species, which is easily separated from the other species of the genus, by the shape of the anchors and plates and the tentacle-rods.

3. *Patinapta crosslandii* n. sp.[1])

Zanzibar 1901, 4 specimens.

The specimens at hand measure up to 10 cm. in length and are in alcohol of a pale greyish-yellow or quite white colour. They have 12 tentacles, each with 7 pairs of digits and 0—14 sensory-cups. Eye-spots are wanting.

[1]) I have dedicated this species to the collector of it Dr. C. Crossland.

The calcareous ring consists of 12 pieces of which all the five radials are perforated for the nerves. The ventral and the dorsal pieces are not distinctly different, but the posterior margin of the ring is faintly bilaterally symmetrical (Fig. IV. 5).

A cartilaginous ring is wanting. There are in all four specimens, only one large polian vesicle, and no small ones. The two other species of the genus, *ooplax* (v. Marenzeller) and *laevis* (Bedford) have 2—8

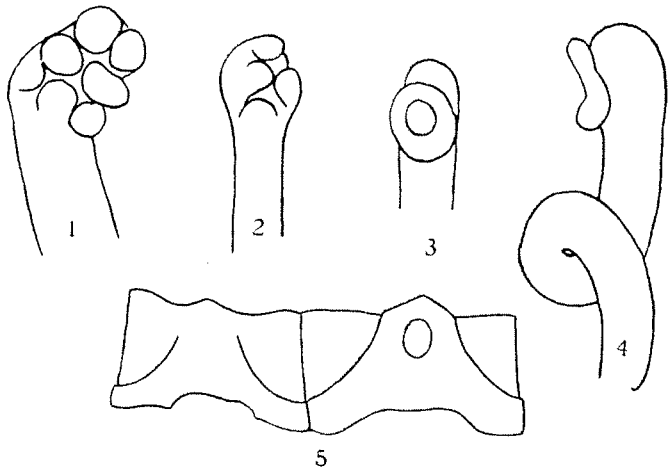

Fig. IV. 1 Madreporite of *Patinapta laevis* (Bedford), 2 of *P. ooplax* (v. Marenzeller), 3—4 of *P. crosslandii* n. sp., 5 Calcareous ring of *P. crosslandii* n. sp. 1—4 $^{70}/_{1}$, 5 $^{42}/_{1}$.

polian vesicles, and thus the single one in *crosslandii* seems to separate this species from the two others, but as only 4 specimens are at hand, further collections may ultimately show that the number of polian vesicles is varying also in this species. There is only one stone-canal. The madreporite is ring-shaped in all the specimens at hand (Fig. IV. 3—4), and thus distinctly different from the madreporites in the two other species (Fig. IV. 1—2).

The oesophagus is not much different from the intestine, and in all the specimens at hand it encloses a few nicely preserved specimens of *Entovalva mirabilis* Voeltzkow. There is no real loop on the intestine, which is in its anterior half fastened by the dorsal mesentery and in its posterior half by the right ventral mesentery. In the middle of the specimen the intestine passes from the dorsal interambulacrum to the right ventral one, across the left dorsal interambulacrum, where

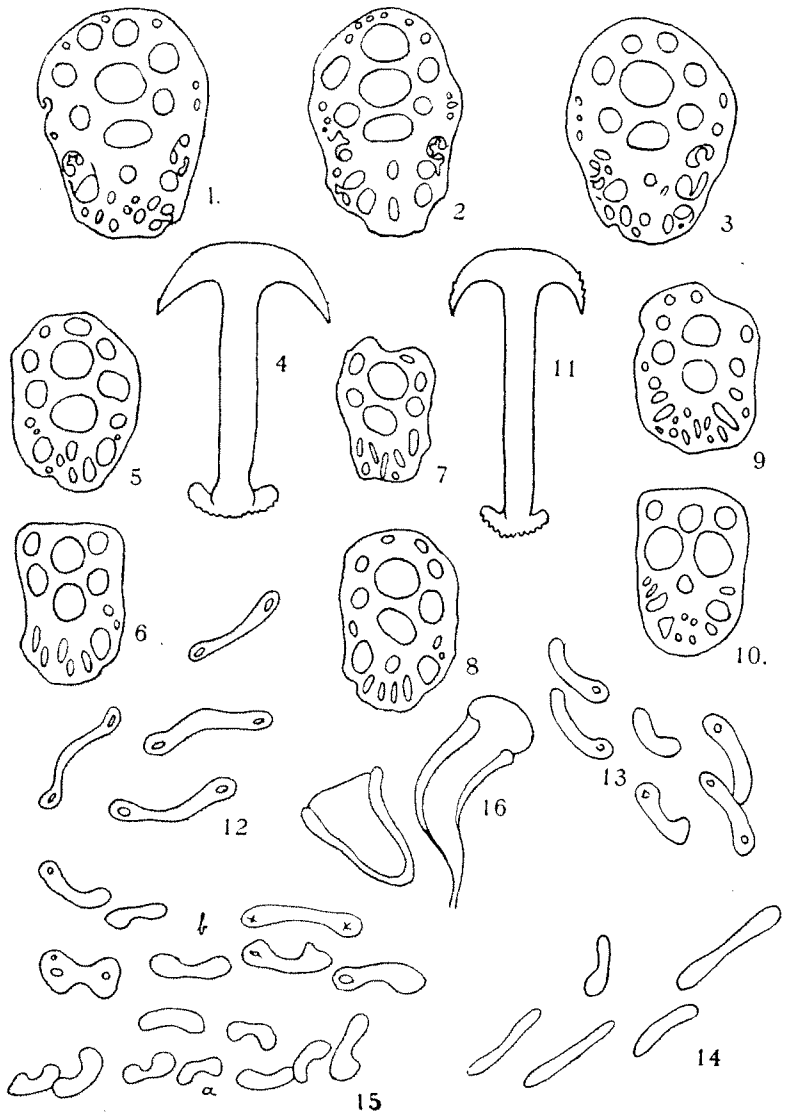

Fig. V. *Patinapta crosslandii* n. sp. 1—4 Anchor and plates from anterior end of specimen. 5—11 Anchor and plates from posterior end of specimen. 12 Rods from digits. 13 Rods from tentacle-base. 14 Rods from posterior end of specimen. 15 Rods from anterior end of specimen, a. from longitudinal muscles, b. from the more exterior part of body-wall.[8] 16 Ciliated funnels. 1—15 $^{250}/_{1}$, 16 $^{150}/_{1}$.

it is attached to the body-wall by a very small mesentery. There is only one kind of ciliated funnels (Fig. V. 16) which are slightly different from the funnels in the two other species. The gonads are faintly developed and distinctly branched. The anchors from the two ends of the specimen are of very nearly the same length, about 135 μ, but their shape is distinctly different (Fig. V. 4 & 11). The anterior anchors have rather stout and smooth arms, often with a very little tooth near the point, and the posterior anchors have more slender and distinctly serrate arms.

The anchor-plates from the anterior and the posterior end of the specimen (Fig. V. 1—3 & 5—10) are not so different as in the two other species, and the large holes are usually smooth. The anterior plates measure about 115 μ in length, and the posterior ones measure without much variation about 80 μ.

The rods from the posterior end of the specimen (Fig. V. 14) are rather long, bent staves, and are usually found in the ambulacra. In the anterior end there are two different kinds of rods. Those from the ambulacra (Fig. V. 15a) are small, bent bodies, and the others (Fig. V. 15b) which may be found both in the ambulacra and in the interambulacra are larger and usually with perforated ends. In the tentacles and in the digits there are bent rods with perforate ends (Fig. V. 12—13).

Patinapta crosslandii is a well characterized species easily separated from both *ooplax* (v. Marenzeller) and *laevis* (Bedford) by the shape of the calcareous ring, the madreporite, the anchor-plates, and the rods.

The measurements of the anchors and plates agree so well with those given by Lampert for *ooplax*, and differ in the same way from the measurements of the deposits in the specimens of *ooplax* and *laevis* examined by me (cf. The "Synaptidae" pag. 241), that there can be no doubt that Lampert's specimens from Kokotoni must be referred to *crosslandii*.

4. *Chiridota rigida* Semper.

Chirodota rigida Semper 1868 Die Holothurien pag. 18, Pl. III fig. 3, Pl. V fig. 3 & 13, Pl. VI fig. 4 and Pl. VIII fig. 11.
Chiridota rigida Clark 1908 The Apodous Holothurians pag. 117.

Faaa Channel, Tahiti, 23-I-1926, 2 fms., 1 specimen.

According to a note sent by Dr. Crossland, the specimen at

hand measured 55 × 4 mm. alive, and its colour was a bright pink with whitish tentacles and mamillae (these latter are due to heaps of wheels).

It has 12 tentacles, which are in the preserved specimen exceedingly contracted (Fig. VI. 1). Each tentacle has 7 pairs of digits of which the two terminal ones are somewhat longer than the others. From Dr. Crossland's sketch (Fig. IV. 2) it is seen that when the tentacles are stretched out, the digits are not placed as the fingers of a hand, but the basal digits on each side are sitting in a bunch close to the middle of the tentacle, and the two terminal ones are situated on the very tip of the tentacle.

There are numerous wheel-papillae scattered all over the dorsal interambulacra, but only some few ones arranged in a single row in each of the ventral interambulacra. The calcareous ring is rather thick and consists of 12 pieces. All the interradials are very much alike, but the mid-ventral radial differs from the other four in not being perforate[1]) but only notched in the anterior margin (Fig. VI. 8—9). The muscular impressions are very distinct. There are four large polian vesicles and ca. 12 small ones (because of the contraction of the specimen the exact number cannot be made out). The stone-canal is short and straight, and the madreporite is very characteristic (Fig. VI. 10) (the shaded part in the figure is cut away by the dissection). Owing to the contraction neither the shape of the intestine nor that of the ciliated funnels could be made out.

All the calcareous deposits are more or less attacked by acid in the preserving fluid, but in spite of the nearly total dissolution of the wheels, the rods are rather well preserved.

Those in the body-wall (Fig. VI. 6) are scattered all over the skin. They are more or less C-shaped and are usually swollen on the middle. It is very characteristic that the two angles between the arms and the "body" of the rods are of different size, quite in the same way as in the rods in the tentacles of *Ch. pisanii* Ludwig. The rods in the digits (Fig. VI. 3) are somewhat larger than the rods in the body-

[1]) The single specimen at hand is exceedingly contracted, and a little attacked by acid in the preserving fluid. For this reason I could not detach the notch from the tissue, without disturbing one of the projections (the shaded one). Therefore, though I am quite convinced that the mid-ventral radial is notched and not perforated, this statement cannot be regarded as quite certain.

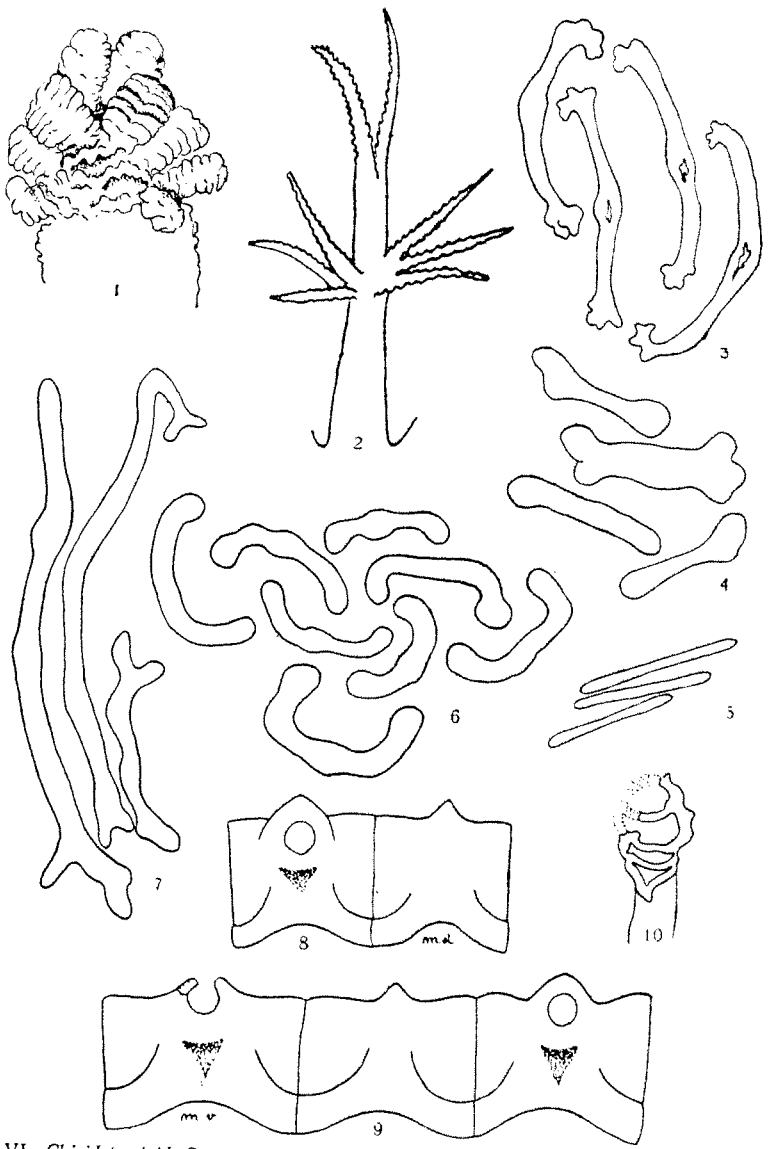

Fig. VI. *Chiridota rigida* Semper. 1 Contracted tentacle. 2 Uncontracted tentacle (sketch by Dr. Crossland). 3 Rods from digits. 4 Rods from polian vesicles. 5 The same seen from the side. 6 Curved rods from the skin. 7 Rods from the oral disk. 8 Dorsal part of calcareous ring. 9 Ventral part of calcareous ring. 10 Madreporite. 1 $^{32}/_{1}$, 3—7 $^{660}/_{1}$, 8—9 $^{32}/_{1}$, and 10 $^{52}/_{1}$.

wall, and their ends are faintly branched. They are often perforated through the middle, but this may be due to the acid in the preserving fluid. In the polian vesicles there is a dense layer of rather large plates of somewhat varying shape (Fig. VI. 4—5). In the oral disk there are some few very large, irregularly branched rods (Fig. VI. 7).

The specimen at hand differs from Semper's specimen of *rigida* in the shape of the rods from the skin and in that of the calcareous ring. Thus there is some reason for regarding them as belonging to two different forms, but as they agree so completely in the arrangement of the wheel-papillae, in the colour of both the body and the tentacles, and in the number of the polian vesicles, I do not suppose it quite correct for the present to separate them.

From *Ch. hawaiiensis* Fisher, which species Clark has supposed to be synonymous with *rigida*, the specimen at hand differs so distinctly that one cannot suppose the two species to be closely related.

As to the biology of this specimen, Dr. Crossland has sent the following short but interesting note: The specimen was brought up with sand sample from the edge of a submerged flat. The tentacles are shaped as the sketch (Fig. VI. 2) which is somewhat rough. They are used actively for crawling, almost like legs; alternate tentacles bending over and kicking backwards, those above and those in contact with the glass the same.

5. *Polycheira rufescens* (Brandt).

Chiridota rufescens Brandt 1835 Prodromus .... pag. 59.
Polycheira rufescens Clark 1908 The Apodous Holothurians pag. 120.
Polycheira rufescens Heding 1928 The "Synaptidae" pag. 306.

Zanzibar 1901, the shore. 1 specimen.

The single specimen at hand is nicely preserved, and gives for that reason a desirable opportunity for a closer examination of the calcareous deposits in correspondance with the other characters. In my paper upon the synaptids from Dr. Mortensen's collections I have supposed that a closer examination of the calcareous deposits of this species would result in a division into different forms or subspecies. One of the reasons why I supposed this was that I had observed that the shape of the ends of the curved rods from the skin

was different in different preparations. But as all the specimens at hand were slightly attacked by acid, it was not possible to ascertain anything with certainty. The specimen at hand has shown that different sorts of rods really exist (Fig. VII. 1—3) but that they cannot have any classificatory value as they are found in the same place of the skin in a single specimen. Seen from the side the rods figured are quite alike the rods in the specimens from Siam (cf. "Synaptidae" Fig. 65. 13). For this reason and as all the other characters are rather constant, I do not hesitate in supposing that there is but one form

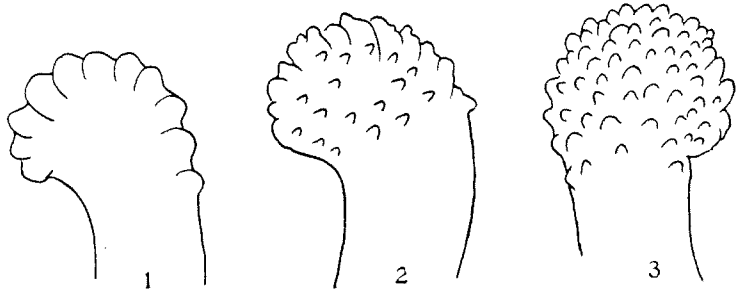

Fig. VII. *Polycheira rufescens* (Brandt). 1—3 Different forms of curved rods from the skin of a single specimen. $^{1200}/_{1}$.

of *rufescens*, which is distributed from Zanzibar to Japan, where it is, according to Ohshima[1]), very common. This is very interesting as the greater part of the synaptids from Japan do not occur in other localities, and the few other species recorded by Ohshima as *Leptosynapta inhaerens* (O. F. Müller) and *Myriotrochus rinkii* Steenstrup may be due to a mistake, on account of the rather poor older descriptions.

At last it may be practical to give a short diagnosis of the present specimen from Zanzibar. It measures 6 cm. in length by 1.2 cm. in diameter. The colour is in alcohol pale grey, dorsally a little darker than ventrally. The tentacles are yellowish. It has 18 tentacles each with about 9 digits. The calcareous ring consists of 18 pieces, the shape of which quite agrees with the figure in the "Synaptidae"

[1]) Ohshima has recorded *P. rufescens* from Japan in 1913, Synaptiden von Misaki pag. 258, Pl. VI, fig. 9, and in 1914, The Synaptidae of Japan pag. 475. In 1916, in the description of "A new case of brood-caring in Holothurians" he writes that *rufescens* occurs at Ushibuka among clusters of *Mytilus*.

(Fig. 65. 8). The radials are perforated and there are three interradials in each of the dorsal interambulacra and two in each of the ventral ones. There are 9 polian vesicles of varying size, the longest being 5 mm. The madreporite is quite as Fig. 65. 6 in the "Synaptidae". The gonads are well developed and much branched. The ciliated funnels are arranged in clusters of varying size and their shape is quite as in the specimens from Siam. The wheels measure 50—100 μ in diameter and are arranged in rounded heaps with the largest wheels closest to the periphery. The rods in the tentacles and in the longitudinal muscles are like those figured in the "Synaptidae" (Fig. 65. 12 & 14).

17.—5.—1929.

TYP. BIANCO LUNO. KBHVN.