

Report of the Biological Survey of Mutsu Bay.
15. Sipunculoidea.¹⁾

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(With Pls. I-IV and 15 text-figures.)

INTRODUCTION.

The Sipunculoidea collected by the Biological Survey of Mutsu Bay are represented by nine species belonging to six genera. Of the nine species four may be regarded new to science.

The following is the list of the species.

- (1) *Sipunculus nudus* LINNAEUS.
- (2) *Siphonosoma mourense*, n. sp.
- (3) *Physcosoma japonicum* (GRUBE).
- (4) *Physcosoma scolops* (SELENKA et DE MAN).
- (5) *Physcosoma glaucum*, n. sp.
- (6) *Phascolosoma zenibakense* IKEDA.
- (7) *Phascolion ikedai*, n. sp.
- (8) *Dendrostoma blandum* SELENKA et DE MAN.
- (9) *Dendrostoma hexadactylum*, n. sp.

Here I express my deep gratitude to Professor Dr. S. HÔZAWA for his help rendered me during the course of the present work. I also express my hearty thanks to Professor Dr. S. HATAI, Professor Dr. W. FISCHER, Professor Dr. VAN DER HORST, Professor Dr. L. CUÉNOT, Professor Dr. R. V. CHAMBERLIN, Dr. A. TEN BROEKE, Professor Dr. T. KAWAMURA, Professor Dr. T. KOMAI, Professor Dr. T. UCHIDA, Mr. Y. OZAKI, Mr. M. UÉNO and Mr. S. TAKATSUKI, for their acts of kindness in various ways.

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DESCRIPTION OF THE SPECIES.

Key to the genera of Sipunculoidea found in Mutsu Bay.

- I. Longitudinal muscle layer separated into bundles.
 - A. Hooks absent.
 1. Tentacles leaf-like. Body surface divided into small rectangular areas. Introvert with tall, triangular scale-like papillae posteriorly directed. Genus *Sipunculus*.
 2. Tentacles filamentous. Body surface shows no rectangular areas. No prominent scale-like papillae on the introvert. Genus *Siphonosoma*.
 - B. Hooks present on the introvert. Filamentous tentacles arranged in a single semicircle above the mouth. . . Genus *Physcosoma*.
- II. Longitudinal muscle layer continuous.
 - A. Two segmental organs.
 1. Hooks absent. Numerous tentacles arranged in one or many rows around the mouth. Genus *Phascolosoma*.
 2. Large hooks scattered on the introvert. Tentacles dendritic. Genus *Dendrostoma*.
 - B. One segmental organ. The worms generally inhabit the Molluscan shells. Genus *Phascolion*.

Genus SIPUNCULUS LINNAEUS.

Each of the longitudinal and circular muscle layer is separated into bundles. Leaf-like tentacles present around the mouth. Hooks absent. Four retractor muscles present. Intestinal convolution coils spirally around the spindle-muscle terminating free from the body-wall, and is fastened to the body-wall by means of numerous fixing-muscles arising from the latter. Two segmental organs exist. The Polian canals run along the oesophagus. Integumental canal runs along each of the longitudinal muscle-bands. Triangular scale-like papillae are distributed on the introvert.

1. *Sipunculus nudus* LINNAEUS.

(Pl. I, Fig. 1; Text-fig. 1)

Sipunculus nudus, LINNAEUS, 1766, Syst. Nat. 12th edit. p. 1078; W. KEFERSTEIN, 1860, p. 1; 1865, p. 418-419; 1867, p. 44-45; W. BAIRD, 1868, p. 77; J. ANDREAE,

1881, p. 477-481; 1882, p. 201-258, Pls. XII-XIII; E. SELENKA, 1883-1884, p. 92; 1885, p. 22; H. WARD, 1891, p. 143-182, Pls. I-III; A. SHIPLEY, 1893, p. 327; 1899 (2), p. 158; W. FISCHER, 1895, p. 9; 1914 (2), p. 1-28; 1922 (2), p. 5, Pl. XXVI, Figs. 5-6; S. METALNIKOFF, 1900, p. 261-322, Pls. XVII-XXII; C. SLUITER, 1902, p. 5; H. AUGENER, 1903, p. 297-371; I. IKEDA, 1904, p. 31; 1905, p. 169; R. SOUTHERN, 1913 (1), p. 1-46; J. GEROULD, 1913, p. 428; R. CHAMBERLIN, 1920 (2), p. 30; L. CUÉNOT, 1922, p. 14; 1927, p. 249; A. TEN BROEKE, 1925, p. 2.

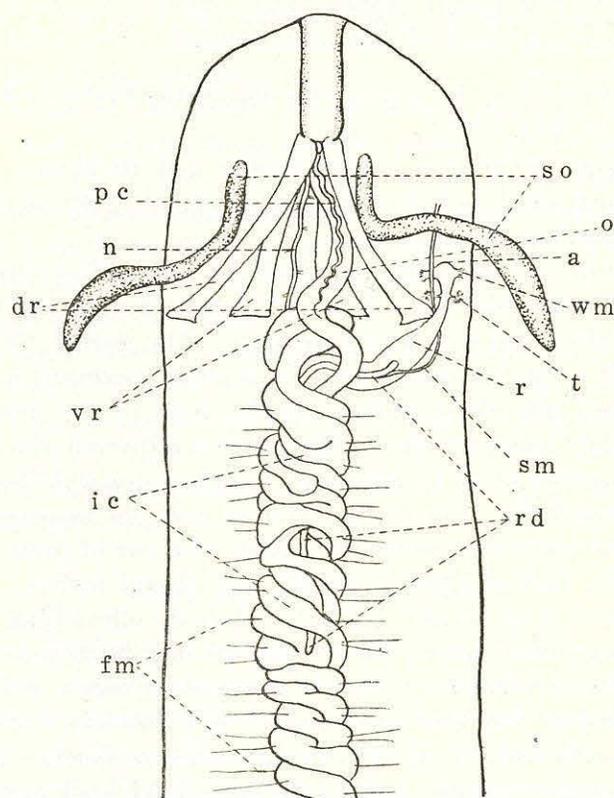
Two specimens of this species were obtained by Professor S. HÔZAWA at Moura in July, 1926.

They are 140-200 mm. in total length, and 10-13 mm. in width. The introvert which is half withdrawn, is about 20-30 mm. long, and is much narrower than the trunk.

The surface of the trunk excluding the introvert is closely beset with small rectangular areas which are formed by the intersection of the longitudinal and circular muscle-bands. The skin of the body is thin and is somewhat translucent. In alcoholic specimens it is nearly white, tinged with slight yellow. At the base of the introvert the skin is slightly brown in colour. The introvert is covered with numerous scale-like papillae which are triangular in surface view with their vertices directed posteriorly. Hooks are absent on both the introvert and the trunk. The tentacular membrane consists of a pair of (right and left) broad lobes, each of which is divided into several leaflets. Of these leaflets, those lying dorsally are larger than the others lying ventrally.

The longitudinal muscle layer is divided into 29-30 separate bands which do not anastomose except in the anterior region of the trunk. In the introvert they fuse together forming a continuous sheet. The circular muscle layer is also divided into numerous bands. Two pairs of short retractor muscles arise at the same level from the inside of the body-wall. The ventral pair (Text-fig. 1, vr) is attached to the 2nd-5th longitudinal muscle-bands, while the dorsal pair (Text-fig. 1, dr) is connected to the 9th-12th of the same. A spindle-muscle (Text-fig. 1, sm) which springs from the 15th longitudinal muscle-band in front of the anus (Text-fig. 1, a), is not fixed posteriorly to the body-wall. Numerous fixing-muscles (Text-fig. 1, fm) which arise from the body-wall and the retractor muscles, are attached to the intestinal convolution (Text-fig. 1, ic). The intestinal convolution (Text-fig. 1, ic) consists of about 20 spirals and its anterior half shows double spirals. The

Polian canals (Text-fig. 1, pc) pass along the dorsal and the ventral sides of the oesophagus (Text-fig. 1, o). They are simple and have not any villus arising from them. The rectal diverticulum (Text-fig. 1, rd) is not a globular sac but is an extraordinarily long tube attaining



Text-fig. 1. *Sipunculus nudus* LINNAEUS. Specimen dissected showing the anterior part of the body. a, anus; dr, dorsal retractor muscles; fm, fixing-muscles; ic, intestinal convolution; n, ventral nerve-cord; o, oesophagus; pc, Polian canal; r, rectum; rd, rectal diverticulum; sm, spindle-muscle; so, segmental organ; t, tuft-like organ; vr, ventral retractor muscles; wm, wing-muscles. $\times \frac{5}{4}$.

the length of about 40 mm. It arises from the rectum (Text-fig. 1, r) near the point where the intestine begins to coil, and runs posteriorly along the spindle-muscle ending blindly at the middle of the intestinal

convolution. A pair of tuft-like organs (Text-fig. 1, t) exists near the anus arising from both sides of the rectum and are fastened to the body-wall by means of the mesenteries. The segmental organ (Text-fig. 1, so) consists of a pair of long tubes of about 25 mm. length and of a yellowish-gray colour. The anterior one-fifth of their length is fixed to the body-wall by means of the mesenteries. Their external openings lie between the 4th and 5th longitudinal muscle-bands at the level far distant from the anus. The ventral nerve-cord (Text-fig. 1, n) does not closely attach to the skin in the anterior region of the body. It is accompanied by two narrow muscles which run along both its sides and which are given off from the first longitudinal muscle-bands at the level of the apertures of the segmental organs. At the level of the introvert-base these two muscles are fused together into a broader muscle which terminates anteriorly in the same point where the nerve-cord also terminates. There is no eye-spot.

Localities.—This species is cosmopolitan and occurs in the Mediterranean Sea, North Sea, Red Sea, Indian Ocean, Adriatic Sea, along the southern coast of the United States of America, Panama, Spain, France, Malaca, the Philippine Islands, Italy, the Bismarck Archipelago, Istria, China, South Australia, etc. In Japan, IKEDA reported this species from Misaki, Tateyama and the Inland Sea. In Mutsu Bay, it was obtained at Moura.

Remarks.—Of the present species I should like to remark on the following points: (1) According to the following authors we learn that the longitudinal muscle layer is separated into 23-34 bands: KEFERSTEIN (1865, p. 419), 30-32; METALNIKOFF (1900, p. 278), 32; IKEDA (1904, p. 32), 30; GEROULD (1913, p. 428), 31-32; CUÉNOT (1922, p. 14), 28-34; TEN BROEKE (1925, p. 2) 30-33. In the specimens from Mutsu Bay, however, they are 29-30 in number. (2) Dealing with a specimen from Key West, GEROULD (1913, p. 428) reported on the segmental organs that nearly half their length is fastened to the body-wall by means of mesentery. In the specimens from Mutsu Bay, it is only the anterior one-fifth of each segmental organ that is fixed to the body-wall, as in the cases reported by other authors.

Genus SIPHONOSOMA SPENGLER.

The longitudinal muscle layer is separated into bands. The circular

muscle layer is usually continuous. Filamentous tentacles encircle the mouth as in the case of the genus *Phascolosoma*. Four retractor muscles are present. The intestinal convolution is fastened to the body-wall at both ends of the trunk. At the anterior part of the intestinal convolution, there occur a small number of fixing-muscles. There are two segmental organs. The Polian canal usually gives off numerous Polian tubules. The integumental canals are cut into many isolated closed sacs, branched very irregularly. No triangular scale-like papillae are present on the introvert.

2. *Siphonosoma mourense*, n. sp.

(Pl. I, Fig. 2-4)

Many specimens were collected by Professor S. HATAI and Professor S. HÔZAWA at Moura on the 24th of August, 1926, by means of the "ebi-ami-dredge."

In the type specimen (Pl. I, Fig. 2), the body measures about 350 mm. in total length and 10 mm. in thickness. The length of the introvert is almost one-fifth of the trunk.

The surface of the body has a light yellowish-brown colour when preserved in alcohol, and is beset with flat, elliptical papillae measuring about 0.06-0.25 mm. in major axis and 0.04-0.15 mm. in minor axis. They are entirely transparent, and are glandular in structure. Neither hooks nor spines are present on the whole body surface. Numerous finger-shaped tentacles are present around the mouth. They are arranged in twelve regular radial rows, and each row bears about 20 tentacles. The tentacles are arranged in a manner as shown in Pl. I, Fig. 4.

The longitudinal muscle layer is divided into 22 bands. In the anterior region of the trunk they anastomose with each other and they fuse to form a continuous sheet in the region of the introvert. The circular muscle layer is continuous. Of the two pairs of slender retractor muscles, the ventral pair (Pl. I, Fig. 3, vr) is larger and springs from the 3rd-4th longitudinal muscle-bands at the middle of the trunk, while the dorsal pair (Pl. I, Fig. 3, dr) arises from the 8th-10th longitudinal muscle-bands at the level more anteriorly located. The spindle-muscle (Pl. I, Fig. 3, sm) is fixed to the body-wall at both its ends and gives off two lateral branches at the level where

the intestine begins to coil. Each of these branches is attached to the 8th longitudinal muscle-band at the point about 5 mm. distant anteriorly from the root of the dorsal retractor muscle. The posterior end of the spindle-muscle is divided into several long branches which are fastened separately to the skin at the posterior end of the body. A fixing-muscle (Pl. I, Fig. 3, fm) which springs from the rectum (Pl. I, Fig. 3, r) close to the intestinal convolution (Pl. I, Fig. 3, ic) is attached to the first longitudinal muscle-band on each side by means of its two roots. Broad wing-muscles (Pl. I, Fig. 3, wm) are attached to the rectum near the anus (Pl. I, Fig. 3, a). The crescent-shaped dissepiments are entirely absent on the inner surface of the body-wall. The integumental canals are cut into numerous pieces and form isolated sacs which branch irregularly. Along the longitudinal muscle-bands there occur many KEFERSTEIN'S bodies (Pl. I, Fig. 3, kb). They are arranged in several regular longitudinal rows and all lie in front of the apertures of the segmental organs. They are small elongate blind tubules, and are soft to the touch. The long oesophagus (Pl. I, Fig. 3, o) is accompanied by a Polian canal (Pl. I, Fig. 3, pc) from which numerous short Polian tubules arise. The intestinal convolution (Pl. I, Fig. 3, ic) consists of about 30 spirals and these are fixed posteriorly to the body-wall by means of the spindle-muscle. The rectum bears no diverticulum. The anus (Pl. I, Fig. 3, a) is situated between the 10th-11th longitudinal muscle-bands on the dorsal side of the body. Two segmental organs (Pl. I, Fig. 3, so), forming a pair of slender and tolerably long tubes of a reddish-brown colour, measure about 30 mm. in length and are entirely free from the body-wall. Their external apertures lie between the 3rd and 4th longitudinal muscle-bands almost at the same level as the anus. None of the eye-spots can be detected on the ganglion.

Locality. — Moura.

Remarks. — This new species seems to be closely allied to *Siphonosoma cumanense* (KEFERSTEIN), *Siphonosoma edule* (SLUITER), *Siphonosoma billitonense* (SLUITER), *Siphonosoma carolinense* SPENGLER and *Siphonosoma novae-pommeraniae* FISCHER. The main characteristics by which these species may be distinguished from each other are shown in the following table:

- I. Hooks absent.
- II. Apertures of the segmental organs not behind the anus.
- III. Papillae on the introvert not exceedingly tall.
- IV. 20-30 longitudinal muscle-bands (exceptionally 18-21 in *Siphonosoma carolinense* SPENGLER).
- V₁. Crescent-shaped dissepiments present.
 -*Siph. cumanense* (KEFERSTEIN).
 -*Siph. edule* (SLUITER).
 -*Siph. billitonense* (SLUITER).
 -*Siph. carolinense* SPENGLER.
- V₂. Crescent-shaped dissepiments absent.
 - VI₁. Each of the retractor muscles arises from nearly the same level.*Siph. novae-pommeraniae* FISCHER.
 - VI₂. Each of the retractor muscles arises from different levels.*Siph. mourense*, n. sp.

AUGENER (1903) reported that, (1) the KEFERSTEIN's bodies are found only in *Siphonosoma cumanense* (KEFERSTEIN); (2) in the Indian specimens they were mostly present on the anterior region of the body-wall, while in the American specimens they were found both on the anterior and the posterior regions of the body-wall; (3) they were not always closely attached to the body-wall as mentioned in the description given by KEFERSTEIN; (4) the bodies are regular or irregular in arrangement. IKEDA (1904, p. 34) reported on these bodies of the Japanese specimens that: these structures, "Ovale Gebilde", are seen as small oblong bodies closely adhering to the inner surface of the body-wall in *Siphonosoma cumanense* (KEFERSTEIN), while they are not found at all in *Siphonosoma amamiense* (IKEDA). SPENGLER (1912, p. 271-272), however, pointed out that the bodies are the characteristic of the genus *Siphonosoma*. Lately, FISCHER (1926, p. 105) recorded these bodies under the term of "Zottenartige Anhänge" in the case of *Siphonosoma novae-pommeraniae*. In the specimens from Mutsu Bay the KEFERSTEIN's bodies are observed as rather elongate sacs which are arranged in several regular rows.

Genus PHYSCOSOMA SELENKA.

The longitudinal muscle layer is separated into bands. Finger-shaped tentacles are arranged in a semicircle above the mouth.

[Hooks are usually present. There are two or four retractor muscles. A spindle-muscle around which the intestine coils spirally is fixed to the body-wall at both ends. One or more fixing-muscles are present. There are two segmental organs. The dermal papillae are remarkably large. The dorsal vessel is generally simple.

Key to the species of *Physcosoma* found in Mutsu Bay.

- I. Hooks strongly curved at apex. Body shows a yellowish-brown colour.
 - A. The canal-like space in the hook is simple. No pigmented transverse markings on the dorsal side of the introvert.*Physcosoma japonicum* (GRUBE).
 - B. The canal-like space in the hook is forked. Several pigmented transverse markings exist on the dorsal side of the introvert.*Physcosoma scolops* (SELENKA et DE MAN).
- II. Hooks not strongly curved at apex. Body shows a greenish-blue colour. *Physcosoma glaucum*, n. sp.

3. *Physcosoma japonicum* (GRUBE).

(Pl. I, Fig. 5; Text-fig. 2)

Phascolosoma japonicum, GRUBE, 1877, Vierundfünfzigster Jahresbericht der Schles. Gesellschaft für vaterländische Cultur, Breslau, p. 73.

Phymosoma japonicum (GRUBE), E. SELENKA, 1883, p. 220-222; 1883-1884, p. 76, Pl. II, Figs. 18-19; Pl. X, Figs. 145-146; 1885, p. 21; W. FISCHER, 1895, p. 12; I. IKEDA, 1904, p. 22.

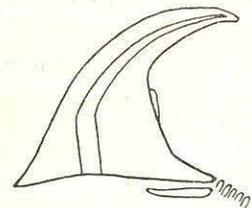
Physcosoma japonicum (GRUBE), A. OSTROUMOV, 1909, p. 319-324; W. FISCHER, 1914 (2), p. 1-28; 1922 (2), p. 13; R. CHAMBERLIN, 1920 (1), p. 5.

Several specimens of this species were taken off Tairadate, off Umayajiri and off Ozawa.

The body (Pl. I, Fig. 5) has a total length of 30-57 mm., and a thickness of 2-7 mm. The introvert is about one-third of the total body-length, and much narrower than the trunk.

The skin is opaque, yellowish-brown in colour, and covered with numerous large papillae of a deep brown colour. They are more crowded in the region of the introvert-base and the posterior end of the body. These papillae are somewhat elliptical in the surface view, and each is provided with a small aperture in the center. Each papilla is thickly covered with numerous polygonal chitinous plates. At the introvert-base and at the posterior end of the body, these papillae are

extremely tall, measuring 0.095–0.19 mm. in height, while in the middle region of the trunk they are small and low measuring only 0.07–0.105 mm. in height. At the anterior end of the introvert, behind the tentacular crown, there are 27–70 rows of hooks. The hooks are about 0.024–0.066 mm. high and are of a deep reddish-brown colour.



Text-fig. 2. *Physcosoma japonicum* (GRUBE). Side view of a hook on the introvert. $\times 400$.

Each hook (Text-fig. 2) has a strongly curved apical tooth accompanied by a small blunt accessory tooth in the middle of its concave edge. In side view, the hook shows a canal-like transparent streak which bends sharply in the middle region of the hook. A short transverse bar is present at the base of each hook. Close to the posterior end of the bar, there occur a number of minute warts arranged in one row. Between every two rows of the hooks there are small perforated papillae arranged in a circular row, each of these

papillae measuring about 0.01 mm. both in height and width. The finger-shaped tentacles, 14–24 in number, present above the mouth, are arranged in a single semicircle.

The longitudinal muscle layer is separated into 22–26 bands. They are anastomosed here and there with each other, and in the region of the introvert they are fused into a continuous sheet. The circular muscle layer is continuous. Of two pairs of retractor muscles, the ventral pair arises from the 3rd–9th longitudinal muscle-bands in the posterior region of the trunk, while the dorsal pair arises far anteriorly from the 6th–8th longitudinal muscle-bands. A spindle-muscle arises from the body-wall in front of the anus and is fixed to the posterior end of the body. A fixing-muscle springs from the left side of the nerve-cord in close approximation to it, and terminates in the first whorl of the intestinal convolution. A pair of stout wing-muscles is attached to both sides of the rectum. The intestinal convolution has 8–14 spirals. No Polian tubules are found on the Polian canal which runs along the dorsal side of the oesophagus. The rectal diverticulum is absent. The anus is situated almost at the same level with the external apertures of the segmental organs. The segmental organs are brown in colour, and the anterior half of their length is connected

with the body-wall by means of mesentery. A pair of eye-spots are visible on the ganglion. There is a pair of gonads along the base of the ventral retractor muscles.

Localities.—Port Jackson; Port Natal; De Castries Bay; Sidney; New Britain and British Columbia. In Japan this species was obtained from Hokkaido, Misaki, Enoura, Enoshima, Satsura and Nokabuta. In Mutsu Bay it occurs at Tairadate, Umayajiri and Ozawa.

Remarks.—The hooks are exceedingly small in size comparing with those of the specimens collected from the other localities. It is reported by SELENKA (1883–1884, p. 76) in his monograph that the tentacles are 28 in his specimen, while we found 14–24 tentacles in the specimens from Mutsu Bay. SELENKA (1883–1884, p. 76) also reported that the fixing-muscle of the species is simple and not forked as in the case of *Physcosoma scolops* (SELENKA et DE MAN), while in the specimens from Mutsu Bay there is not a simple fixing-muscle but a forked one.

4. *Physcosoma scolops* (SELENKA et DE MAN).

(Pl. II, Figs. 9–10; Text-fig. 3)

- Physcosoma scolops*, SELENKA et DE MAN, 1883–1884, p. 75, Pl. II, Fig. 17; Pl. X, Figs. 138–144; 1885, p. 21; C. SLUITER, 1890, p. 119; W. FISCHER, 1892, p. 86; A. COLLIN, 1901, p. 304; H. AUGENER, 1903, p. 297–371; I. IKEDA, 1904, p. 20; M. A. HÉRUBEL, 1904, p. 476–480, Text-fig. 1; 1907, p. 221.
- Physcosoma scolops* (SELENKA et DE MAN), A. SHIPLEY, 1898, p. 56; 1899 (1), p. 470; 1899 (2), p. 156; 1899 (3), p. 1899; 1902, p. 135; 1903, p. 174; C. SLUITER, 1898, p. 443; 1902, p. 12; W. F. LANCHESTER, 1905 (1), p. 28; 1905 (2), p. 30; 1905 (3), p. 36; W. FISCHER, 1913, p. 98; 1914 (1), p. 59–84, Pl. XI, Figs. 6–8; 1914 (2), p. 1–28; 1922 (2), p. 15; 1926 (1), p. 108; I. IKEDA, 1924, p. 31; A. TEN BROEKE, 1925, p. 6.

Many specimens were collected from Futagojima, Asamushi, Tsuchiya, Sai, off Kanita and off Tairadate.

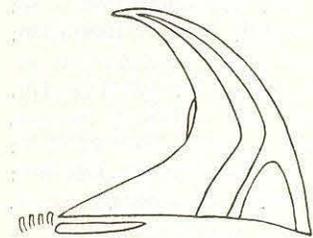
The whole body measures about 25–50 mm. in length and 1.5–4 mm. in thickness in a fully extended state. The introvert is about one-third of the entire body length, and is much narrower than the trunk.

The yellowish-brown coloured body-wall is thin and is covered with numerous large papillae of a deep brown colour. Each papilla is cylindrical in form with a conically pointed tip and is thickly beset with numerous polygonal chitinous plates leaving a small aperture in

the centre. These papillae found at the introvert-base and at the posterior end of the body, are extremely tall. The measurements of the height and the width of the papillae are shown in the following table:

	Specimen A		Specimen B		Specimen C	
	Height	Width	Height	Width	Height	Width
Papilla from introvert			0.11 mm.	0.08 mm.	0.08 mm.	0.13 mm.
Papilla from introvert-base	0.23 mm.	0.23 mm.	0.35 mm.	0.22 mm.	0.32 mm.	0.17 mm.
Papilla from the middle region of trunk	0.12 mm.	0.16 mm.	0.14 mm.	0.15 mm.	0.15 mm.	0.17 mm.
Papilla from the posterior region of trunk	0.29 mm.	0.28 mm.	0.23 mm.	0.31 mm.	0.23 mm.	0.27 mm.

On the dorsal surface of the introvert there are usually numerous pigmented bands of a dark brown colour. Hooks are arranged in 15-25 circular rows at the anterior end of the introvert. Each hook is about 0.036-0.07 mm. both in height and width, and is deep reddish-



Text-fig. 3. *Physcosoma scolops* (SELENKA et DE MAN). Side view of a hook on the introvert. $\times 400$.

brown in colour. It has a strongly curved apical tooth and a very small accessory tooth. In a side view of the hook, we notice a canal-like transparent streak as shown in text-fig. 3. A short transverse bar, having several minute warts close to its posterior end, is present at the base of the hook. Between every two rows of the hooks there exist small perforated papillae about 0.01 mm. in height and width arranged in circular rows.

The tentacles are 16-24 in number and are arranged in a semicircle above the mouth.

The longitudinal muscle layer of the body-wall is divided into 20-29 bands. They are usually separated from each other but are often anastomosed. In the region of the introvert they are perfectly fused into a continuous sheet. The circular muscle layer is continuous.

Two pairs of slender retractor muscles are present. The ventral pair (Pl. II, Fig. 10, vr) of the muscles arises from the 2nd-7th longitudinal muscle-bands at the level of one-fourth of the body-length from the posterior end of the body. The dorsal pair (Pl. II, Fig. 10, dr) is narrower than the ventral, and arises from the 5th-9th longitudinal muscle-bands at a level placed more anteriorly than that of the latter. A spindle-muscle (Pl. II, Fig. 10, sm) arises from the body-wall in front of the anus, and is fixed to the posterior end of the trunk. A fixing-muscle (Pl. II, Fig. 10, fm) arises from the body-wall at the left side of the nerve-cord (Pl. II, Fig. 10, n) in close approximation and insert to the first whorl of the intestinal coil. Wing-muscles (Pl. II, Fig. 10, wm) are attached to the rectum (Pl. II, Fig. 10, r) near the anus. The intestinal convolution (Pl. II, Fig. 10, ic) consists of about 5-15 spirals which coil around the spindle-muscle. A simple Polian canal is found only on the dorsal side of the oesophagus (Pl. II, Fig. 10, o). There is no diverticulum upon the rectum. The anus (Pl. II, Fig. 10, a) is situated almost at the same level with the external apertures of the segmental organs (Pl. II, Fig. 10, so). The segmental organs are long tubes of a reddish-brown colour, and their anterior half is fixed to the body-wall by means of the mesenteries. Two eye-spots (Pl. II, Fig. 10, es) are found on the ganglion.

Localities.—This cosmopolitan species has been obtained from the Philippine Islands, Singapore, the Red Sea, Batavia, Zanzibar, West Africa, Funafuti, the Loyalty Islands, the Indian Ocean, Germany, the Maldive and Laccadive Islands, New Zealand, Tasmania, Ceylon, France, British East Africa, Penang of the Malay Peninsula, the Gulf of Suez, Java, Port Natal and New-Britain. In Japan, according to IKEDA (1904, p. 21; 1924, p. 31) it was previously collected from the Hokkaidô in the north and from the Riukiu Islands in the south. In Mutsu Bay the species was found at Futagojima, Tsuchiya, Sai, Asamushi, off Kanita and off Tairadate.

Remarks.—Three varieties of this species have been reported by E. SELENKA, M. A. HERUBEL and W. FISCHER: They are *Physcosoma scolops* (SELENKA et DE MAN) var. *mossambicense* SELENKA et DE MAN (1883-1884, p. 76, Pl. X, Fig. 144), *Physcosoma scolops* (SELENKA et DE MAN) var. *adenticulatum* HERUBEL (1904, p. 476-480) and *Physcosoma scolops* (SELENKA et DE MAN) var. *tasmaniense* FISCHER

(1914 [2] p. 1-28). The specimens before me differ from the second variety in possessing the warts at the base of the hooks, and from the third variety in the shape of chitinous plates covering the papillae as well as in the absence of the sharp accessory tooth on the hook. The first variety, *Physcosoma scolops* (SELENKA et DE MAN) var. *mossambicense* SELENKA et DE MAN, according to SELENKA, differs from the present species in the colouration of the body, in the opaque skin, in the number of rows of hooks, in the shape of the transparent parts of the hooks and in the absence of the accessory tooth. In the specimens from Mutsu Bay, however, those characters above mentioned seem not to be constant but are rather variable, and thus I am inclined to consider that *Physcosoma scolops* (SELENKA et DE MAN) and *Physcosoma scolops* (SELENKA et DE MAN) var. *mossambicense* SELENKA et DE MAN are such closely allied forms that it seems to be rather preferable not to separate them. In several specimens collected from Tsuchiya and Futagojima, the characteristic pigmented marking on the dorsal side of the introvert is absent. Referring to this marking, IKEDA (1904, p. 22) also states:—"The specimens I collected on the shore of the Aomori Bay, are entirely devoid of the characteristic markings on the introvert". By SELENKA (1883-1884, p. 75) it is reported that the number of rows of hooks is 15-17, but in the specimens from Mutsu Bay they are 15-25. The shape of the transparent canal-like streak of the hook is rather variable and does not show any constant feature as represented in the figures of SELENKA's monograph. The accessory tooth is distinctly visible in some of our specimens, while the others are entirely devoid of it as in the case of FISCHER's specimens from WAHRBERG (1922 [2], p. 15). According to SELENKA (1883-1884, p. 75), the height of the hook is 0.07 mm. while in the specimens from Mutsu Bay it is 0.036-0.07 mm. By SELENKA (1883-1884, p. 75) and the other authors it is reported that the number of the tentacles is 12, while in the specimens from Mutsu Bay it is 16-24. According to SELENKA (1883-1884, p. 75), FISCHER (1926 [1], p. 108) and LANCHESTER (1905 [1], p. 28), the number of the longitudinal muscle-bands is 20-21, 22 and 17-19 respectively, while in the specimens from Mutsu Bay it is 20-29. SELENKA (1883-1884, p. 75) and IKEDA (1904, p. 20) reported that the fixing-muscle of this species is forked at the point of attachment to the intestinal

convolution, while in the specimens from Mutsu Bay the fixing-muscle is not always forked, the majority being simple. In one of the specimens from Mutsu Bay there is a globular body attached to the dorsal side of the oesophagus. The body seems to be quite similar to the body reported by IKEDA (1904, p. 23) in the case of *Physcosoma japonicum* (GRUBE).

5. *Physcosoma glaucum*, n. sp.

(Pl. I, Fig. 6; Pl. II, Figs. 7-8; Text-fig. 4)

Two specimens were collected at Urata on the 13th of July, 1926, by Mr. S. TAKATSUKI.

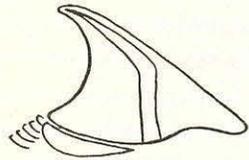
The type specimen (Pl. II, Fig. 7) is small and is about 30 mm. long and 5 mm. wide. The introvert measures about 8 mm. in an almost contracted state.

Both on the anterior and the posterior regions of the trunk the skin shows a light greenish-blue colour, and in the middle it has a greenish tint. Near the anus the skin shows a deeper brown colour. The skin is thin and more or less translucent. The whole surface of the body is covered with numerous papillae which are of a deep brown colour. Those placed in the region of the introvert-base are the largest and those on the introvert are the smallest, as the following table shows.

	Height	Width
Papillae on the introvert	0.06-0.08 mm.	0.055-0.11 mm.
Papillae at the introvert-base	0.12-0.21 mm.	0.14-0.21 mm.
Papillae in the middle region of body	0.05-0.085 mm.	0.065-0.13 mm.
Papillae in the posterior region of body	0.10-0.185 mm.	0.12-0.18 mm.

About 50 rows of hooks are present behind the tentacles on the introvert. Each hook (Text-fig. 4) is small in size, measuring about 0.04 mm. in height and 0.056 mm. in breadth and is deep brown in colour. The apical tooth of the hook is not so strongly curved as in the case of *Physcosoma japonicum* (GRUBE). A transparent canal-like streak which runs inside of the hook, is sharply bent at the middle.

A short transverse bar and several minute warts arranged in one row are found at the base of the hook. The perforated papillae are scattered sparsely among the hooks. They are about 0.01–0.02 mm. in the diameter of the base. Nine filamentous tentacles are arranged in a semicircle above the mouth.



Text-fig. 4. *Physcosoma glaucum*, n. sp. Side view of a hook on the introvert. $\times 400$.

The longitudinal muscle layer is divided into many separate bands, several of which are anastomosed. They are 28 in number at the middle of the body, while they are 24 at the posterior region. In the region of the introvert these bands are entirely fused into a continuous sheet. The circular muscle layer is continuous. Of the four retractor muscles, the ventral pair (Pl. II, Fig. 8, vr) is larger than the dorsal and springs from the 2nd–8th longitudinal muscle-bands at the middle region of the trunk, while the dorsal pair (Pl. II, Fig. 8, dr) arises far anteriorly from the 4th–5th longitudinal muscle-bands. A simple stout spindle-muscle (Pl. II, Fig. 8, sm) which arises in front of the anus is fixed to the posterior end of the body at its extremity. One fixing-muscle (Pl. II, Fig. 8, fm) arises from the first longitudinal muscle-band on the left side of the trunk, and each of its two roots is attached respectively to the oesophagus (Pl. II, Fig. 8, o) and rectum (Pl. II, Fig. 8, r) at the region where the intestine begins to coil into a spiral. A pair of wing-muscles (Pl. II, Fig. 8, wm) are attached to the lateral sides of the rectum near the anus. The intestinal convolution (Pl. II, Fig. 8, ic) consists of 13–14 spirals and its posterior end is fixed to the trunk by means of the spindle-muscle. No diverticulum is present upon the rectum. The anus (Pl. II, Fig. 8, a) is situated slightly behind the external apertures of the segmental organs. A Polian canal (Pl. II, Fig. 8, pc), without tubules upon it, is found running along the dorsal side of the oesophagus. The segmental organ (Pl. II, Fig. 8, so) consists of two large sacs of a yellowish-gray colour and each is furnished with a protuberance in the middle. Their external apertures lie between the 2nd and 3rd longitudinal muscle-bands. The anterior one-third of each segmental organ is fixed to the body-wall by mesentery. A pair of eye-spots (Pl. II, Fig. 8, es) is seen on the ganglion. On the internal surface

of the body-wall, behind the ganglion, there is a narrow transverse marking of a deep green colour.

Locality.—Urata.

Remarks.—This new species may be distinguished from the other members of the genus by the shape of the hooks and by the characteristic greenish-blue colour of the skin.

Genus PHASCOLOSOMA F. S. LEUKART.

The longitudinal muscle layer is continuous. Tentacles are finger-shaped or leaf-shaped, and encircle the mouth in one or many rows or groups. Hooks may or may not be present on the introvert. Two or four retractor muscles are present. Generally a spindle-muscle is also present. The anterior portion of the intestinal convolution is fixed to the body-wall by one or more fixing-muscles, while its posterior end is usually free from the body-wall. There are two segmental organs. The dermal papillae are small in most species.

6. *Phascolosoma zenibakense* IKEDA.

(Pl. III, Figs. 11–12; Text-fig. 5)

Phascolosoma zenibakense, IKEDA, 1924, p. 29, Pl. 1, Fig. 1.

Only one specimen was collected by Professor S. HÔZAWA and Mr. S. TAKATSUKI on the 23rd of July, 1926, off the Asamushi Marine Biological Station by means of a dredge. The specimen was so well preserved in alcohol that the introvert entirely protruded from the trunk.

The animal (Pl. III, Fig. 11) is tolerably large. The whole body measures about 100 mm. in length and 6–14 mm. in thickness, while the introvert is about 40 mm. long and has a uniform width of about 3.5 mm. The posterior end of the trunk is more or less conically pointed.

The ground colour of the skin is a light yellowish-gray, but at the anal region it shows a deep brown colour. The skin appears nearly smooth to the naked eye, but there can be detected sparsely dispersed small papillae when observed under high magnification. The papillae found on the trunk, excepting the posterior region, are cylindrical in form and are of nearly equal height. Those on the posterior

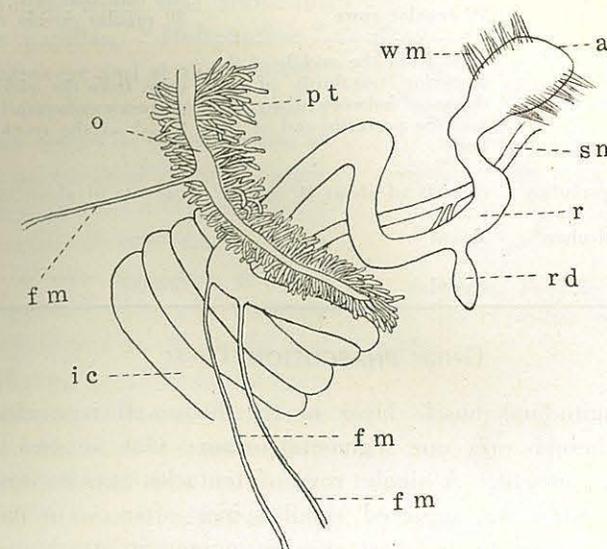
region of the trunk are inferior in height to those above mentioned. The width of the papillae is variable in accordance with the region of the body where they occur, as shown in the following table.

	Height	Width
Papillae on the introvert	About 0.0425 mm.	About 0.0175 mm.
Papillae at the introvert-base	„ 0.0425 mm.	„ 0.0262 mm.
Papillae in the middle region of body	„ 0.0425 mm.	„ 0.0325 mm.
Papillae in the posterior end of body	„ 0.0300 mm.	„ 0.0275 mm.

Neither hooks nor spines are found on the introvert. The tentacles are filamentous and are very numerous, estimating over four hundred. They are arranged in 20 radial double rows, each of which bears 10-16 tentacles.

The longitudinal muscle layer is continuous. The inner surface of the body-wall shows a pearly luster. Two slender retractor muscles (Pl. III, Fig. 12, rm) arise from the middle of the posterior one-third of the trunk and fuse together into one at the anterior portion of the introvert and cover the oesophagus (Pl. III, Fig. 12, o). A single stout spindle-muscle (Pl. III, Fig. 12, sm) arises behind the anus (Pl. III, Fig. 12, a) and its posterior extremity is set free from the body-wall. There are three slender fixing-muscles (Pl. III, Fig. 12, fm), of which two arise from the dorsal wall of the trunk and attach themselves to the first whorl of the intestinal convolution, while the remaining arises also from the dorsal wall, far distant anteriorly from the former, and is attached to the oesophagus. Well developed wing-muscles (Pl. III, Fig. 12, wm) are found upon both lateral sides of the rectum near the anus. The intestinal convolution (Pl. III, Fig. 12, ic), which coils around the spindle-muscle, consists of about 25 double spirals. It is posteriorly free from the body-wall. Numerous and sometimes branched Polian tubules (Text-fig. 5, pt) are present upon the Polian canal (Pl. III, Fig. 12, pc) which passes along the dorsal side of the oesophagus. The segmental organs (Pl. III, Fig. 12, so) which consist of two small sacs of a deep reddish-brown colour, hang free into the body cavity, and their external apertures lie slightly distant from and in front of the anus. A pair of gonads (Pl. III, Fig. 12, g) is found

lying along the base of each retractor muscle. There are two eye-spots on the ganglion, and there is a large diverticulum (Pl. III, Fig. 12, rd



Text-fig. 5. *Phascolosoma zenibakense* IKEDA. Magnified view of a portion of the digestive canal. a, anus; fm, fixing-muscles; ic, intestinal convolution; o, oesophagus; pt, Polian tubules; r, rectum; rd, rectal diverticulum; sm, spindle-muscle; wm; wing-muscles. $\times 7$.

and Text-fig. 5, rd) upon the rectum.

Localities.—Hokkaidô, Japan (1924, IKEDA); Off the coast of Asamushi Marine Biological Station.

Remarks.—The specimen here dealt with seems to agree fairly well with the description and figures given by IKEDA (1924, p. 29), but shows some differences indicated in the following table.

	IKEDA'S description	The specimen from Mutsu Bay
Trunk	85 mm. in length 10 mm. in thickness	60 mm. in length 10 mm. in thickness
Introvert	much narrower than, but nearly as long as, the trunk	40 mm. in length 3.5 mm. in thickness
Papillae	about 0.05 mm. high about 0.025 mm. wide	about 0.04 mm. high about 0.03 mm. wide

	IKEDA's description	The specimen from Mutsu Bay
Tentacles	not less than 200, in about 20 regular rows	not less than 400, in about 20 regular double rows
Retractor muscles	arise from the middle of the posterior two-thirds of the distance between the anus and the posterior end of the body	arise from the middle of the posterior one-third of the length of the trunk
Intestinal convolution	consists of about 30 spirals	consists of about 25 spirals
Rectal diverticulum	absent	present
Eye-spots	absent	present

Genus PHASCOLION THEEL.

The longitudinal muscle layer of the body-wall is perfectly continuous. There is only one segmental organ. One or two retractor muscles are present. A single row of tentacles appears around the mouth, and numerous, recurved small spines often occur in a zone behind the tentacles. In most species, numerous attaching papillae, each of which is capped with one or more spines, are arranged in a broad band encircling the body. The body is generally twisted into spirals. The worms usually inhabit the shells of Gastropods or Scaphopods, but sometimes they also live in the tubes of Annelids or in those constructed by themselves.

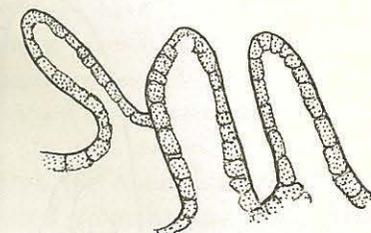
7. *Phascolion ikedai*, n. sp. (Pl. III, Figs. 13-17; Text-figs. 6-9)

Many specimens were obtained by Professor S. HÔZAWA and Mr. S. TAKATSUKI from the muddy-bottom of Mutsu Bay at a depth of about 30 fathoms by means of a scrape-dredge. The worm lives in a state of commensalism with a Madreporarian coral, *Stephanocoris carthausi* FELIX (Pl. III, Figs. 13-14). This worm was first found by Dr. UCHIDA in the coral above mentioned which was sent to him by Professor HOZAWA for identification.

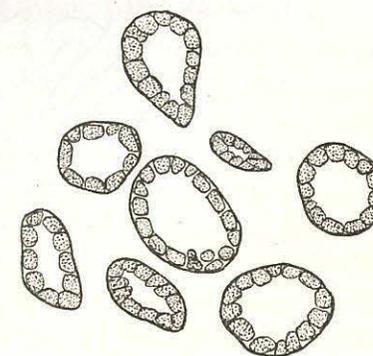
In the specimen (Pl. III, Fig. 15) selected as the type, the length of the trunk is about 7 mm., and the introvert is about two-thirds of the length of the trunk. The trunk is covered with a great number

of large and flat papillae. Those distributed on the anterior one-third of the trunk are exceedingly large, being 0.05-0.1 mm. high and 0.09-0.35 mm. wide, and form the attaching papillae, "Haftpapillen". On the introvert and at the introvert-base, the papillae are much smaller than those found in other regions of the trunk and each of them is closely beset with numerous polygonal plates. At the introvert-base the papillae (Text-fig. 7) are arranged in more or less regular rows and measure about 0.035-0.02 mm. in height and 0.08-0.015 mm. in width at the base. On the introvert the papillae (Text-fig. 6) are cylindrical in form measuring about 0.07-0.05 mm. in height and 0.027-0.012 mm. in width. About 40-80 attaching papillae are scattered on the surface of the trunk. Each of the papillae distributed on the convex surface of the trunk bears a large spine (Pl. III, Fig. 17) while that disposed on the concave surface is furnished with a small one (Pl. III, Fig. 16). The papillae which are placed near the mid-ventral line are entirely devoid of spines. Near the anterior end of the introvert, immediately behind the mouth, there is a group of small spines, one of which is indicated in Text-fig. 8. No tentacles can be detected on the introvert.

The longitudinal muscles of the body-wall form a continuous layer. Only one retractor muscle (Text-fig. 9, rm) with two short roots arises from near the posterior end of the body. The intestinal con-



Text-fig. 6. *Phascolion ikedai*, n. sp.
Side view of papillae on the introvert.
×360.

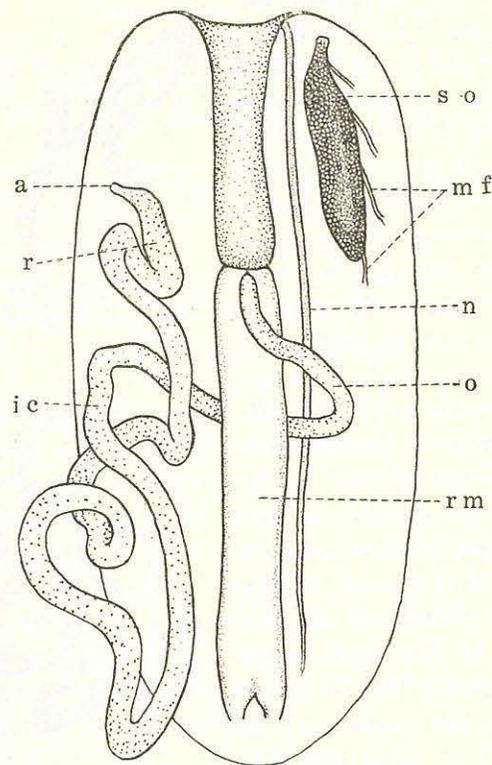


Text-fig. 7. *Phascolion ikedai*, n. sp.
Surface view of papillae at the introvert-base.
×360.



Text-fig. 8. *Phascolion ikedai*, n. sp. A beak-shaped spine on the anterior end of the introvert.
×360.

volution (Text-fig. 9, ic) consists of a few irregular spirals. A large single segmental organ (Text-fig. 9, so) is found on the right side of the



Text-fig. 9. *Phascolion ikedai*, n. sp. Specimen dissected. a, anus; ic, intestinal convoluted; mf, muscle fibers; n, ventral nerve-cord; o, oesophagus; r, rectum; rm, retractor muscle. $\times 14$.

nerve-cord, and is fixed to the body-wall by the several stout muscle fibers (Text-fig. 9, mf). The aperture of the segmental organ is situated far anteriorly from the anus (Text-fig. 9, a).

Remarks.—This new species closely resembles *Phascolion collare* SELENKA et DE MAN in general features. But, however, it differs from the latter in the following points:—(1) The arrangement and form of the spines set on the attaching papillae on the concave surface of the trunk. (2) The situation of the aperture of the segmental organ. (3) The size of the body.

The most interesting point in regard to this new species is the fact that it lives in a state of commensalism with a Madreporarian coral, *Stephanocoris carthausi* FELIX. In regard to the commensalism between the Sipunculoid and the coral there have been reported by SEMPER (1872), MOSELY (1881), ALCOCK (1893), BOUVIER (1895), SLUITER (1902) and IKEDA (1922), cases in several species of the genus *Aspidosiphon*. But there is no record in the case of the genus *Phascolion* except for IKEDA's paper. In that report, he has dealt chiefly with the ecological observations on the commensalism between these two animals (the specimens obtained from Sagami Sea). Concerning the identification of the species of the worm, he only suggested that it is undoubtedly a new species belonging to the genus *Phascolion*, concluding from the presence of a single segmental organ, the presence of the attaching papillae capped with large spines and the presence of other features characteristic to that genus. But the specific name was left undetermined.

In the specimen from Mutsu Bay, there is inserted a Molluscan shell between the worm and the coral as IKEDA (1922) has observed in the specimen taken from Sagami Sea. The greater part of the shell is dissolved and it seems to be difficult to determine the species, but judging from features of the remaining part of the shell there is no doubt that it is of a Gastropod species.

In most cases this worm lives in *Stephanocoris carthausi* FELIX together with a Polychaeta errantia belonging to the genus *Syllis*, more than 40 mm. long and 1 mm. broad. These facts were also observed by IKEDA (1922) in the specimens taken from Sagami Sea.

Genus DENDROSTOMA GRUBE.

The longitudinal muscle layer of the body-wall is continuous. 4-6 dendritic tentacular stems surround the mouth. Large hooks are scattered on the introvert. Two or four retractor muscles, and one spindle-muscle are present. There are two segmental organs, free from the body-wall excepting for the attachment base. The dermal papillae are small.

Key to the species of *Dendrostoma* found in Mutsu Bay.

I. Tentacles arise from four main stems. The papillae in the hooked

region on the introvert are equally short.

- *Dendrostoma blandum* SELENKA et DE MAN.
 II. Tentacles arise from six main stems. The papillae in the hooked region on the introvert are found tall and short mixed.
 *Dendrostoma hexadactylum*, n. sp.

8. *Dendrostoma blandum* SELENKA et DE MAN.

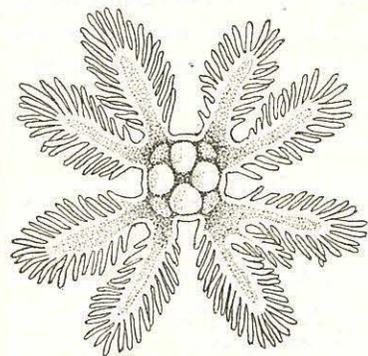
(Pl. IV, Figs. 18-19; Text-figs. 10-12)

Dendrostoma blandum, SELENKA et DE MAN, 1883-1884, p. 85, Pl. I, Fig. 9; Pl. XI, Figs. 159-162; 1885, p. 14; I. IKEDA, 1904, p. 53, Pl. I, Fig. 14; Pl. IV, Figs. 90-91; 1924, p. 30, Pl. I, Fig. 2; A. OSTROUMOV, 1909, p. 319-324; W. FISCHER, 1922 (2), p. 18.

I obtained a single specimen (Pl. IV, Fig. 18) at Tsuchiya on a rock covered by seaweeds (*Sargassum* sp.) on August 29, 1927.

The trunk measures about 7 mm. in length and 3 mm. in thickness. The introvert is nearly as long as, but much narrower than, the trunk.

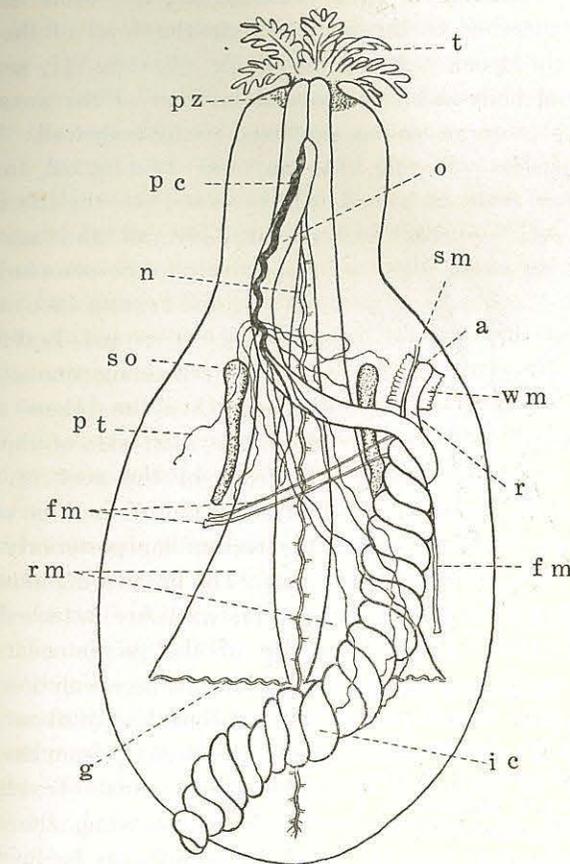
The skin of the trunk is thick and brownish-yellow in colour, while that of the introvert is thin and somewhat translucent, appearing grayish-white. A smooth pigmented zone (Text-fig. 11, pz) lies in the anterior end of the introvert behind the tentacular crown. The whole surface of the skin is covered with small papillae, and in the centre of each papilla there is a clear area surrounded by small granules.



Text-fig. 10. *Dendrostoma blandum* SELENKA et DE MAN. Frontal view of the tentacular crown. $\times 20$.

The papillae in the middle region of the trunk are flat and elliptical in the surface view. They are about 0.05 mm. in major axis and 0.035 mm. in minor axis in the larger ones, while in the smaller the major and minor axes are about 0.04 mm. and 0.025 mm. respectively. In the posterior region of the trunk they become large and more or less roundish in the surface view. On the introvert just behind the hooked region, the papillae are most prominent measure about 0.09 mm. in height and 0.05 mm. in width. In

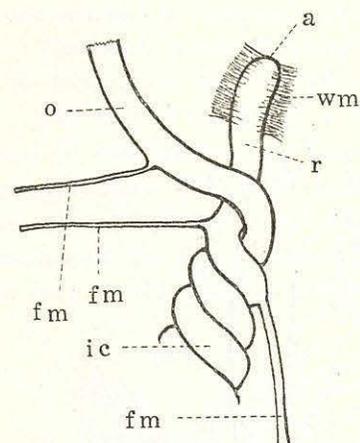
the hooked region (Pl. IV, Fig. 19) of the introvert there are small pear-shaped papillae about 0.03-0.04 mm. high and wide. The hooks (Pl. IV, Fig. 19) on the introvert are numerous, being 103 in all. They are 0.1-0.2 mm. high and are of a blackish-brown colour. The tentacular crown (Text-fig. 10) consists of four main tentacular stems which are divided into eight tentacular arms. The tentacles spring



Text-fig. 11. *Dendrostoma blandum* SELENKA et DE MAN. Specimen dissected. a, anus; fm, fixing-muscles; g, gonad; ic, intestinal convolution; n, ventral nerve-cord; o, oesophagus; pc, Polian canal; pt, Polian tubule; pz, pigmented zone; r, rectum; rm, retractor muscles; sm, spindle-muscle; so, segmental organ; t, tentacles; wm, wing-muscles. $\times 8$.

from both sides of each tentacular arm, and the number of the tentacles on each side is from ten to sixteen. The colour of the tentacles is grayish-white when preserved in alcohol.

The longitudinal muscles are continuous and the inner surface of the body-wall is shiny, but in the region of the roots of the retractor muscles the peritoneum shows some shallow and narrow longitudinal grooves. The retractor muscles (Text-fig. 11, rm) occur in a single pair, and are attached to the body-wall at the level of the posterior one-third of the trunk. A spindle-muscle (Text-fig. 11, sm) springs from the dorsal body-wall close to and in front of the anus (Text-fig. 11, a), and its posterior end is not fixed to the body-wall. There are three fixing-muscles (Text-fig. 11, fm, and Text-fig. 12, fm), two of



Text-fig. 12. *Dendrostoma blandum* SELENKA et DE MAN. Magnified view of a portion of the digestive canal. a, anus; fm, fixing-muscles; ic, intestinal convolution; o, oesophagus; r, rectum; wm, wing-muscles. $\times 12$.

which arise from the left side of the dorsal body-wall and are attached respectively to the oesophagus (Text-fig. 11, o and Text-fig. 12, o) and rectum (Text-fig. 11, r and Text-fig. 12, r), and the remaining one of which is broader than the others and starts from the right side of the body-wall in front of the root of the right retractor muscle and is attached to the rectum far posteriorly from the anus. The broad wing-muscles (Text-fig. 11, wm) are attached on both sides of the rectum near the anus. The intestinal convolution (Text-fig. 11, ic), consisting of about 20 spirals, is free posteriorly from the body-wall. The Polian canal (Text-fig. 11, pc) which passes along the dorsal side of the oesophagus is divided into a

tuft of long tubes near its posterior extremity. These tubes (Text-fig. 11, pt) entangle to a great degree with the intestinal spirals, retractor muscles and other internal organs. The short segmental organs (Text-fig. 11, so), of about one-third of the trunk length, are grayish-yellow in colour. Their external apertures are situated almost at the same

level as the anus. A pair of gonads (Text-fig. 11, g) is found along the base of the retractor muscles. The rectal diverticulum is absent. Eye-spots are seen on the ganglion as a pair of small pigmented spots.

Localities. — California; Enoshima and Hokkaidô, Japan. In Mutsu Bay it was formerly reported from Aomori by IKEDA (1904, p. 55), and this time it was obtained at Tsuchiya.

Remarks. — The specimen seems to be identical with *Dendrostoma blandum* which was first described by SELENKA et DE MAN in 1883–1884 dealing with the specimens from Enoshima, Japan. In dissecting the specimen from Mutsu Bay, however, several differences were revealed which exist between the said specimen and those reported by SELENKA, FISCHER and IKEDA. viz. SELENKA and DE MAN (1883–1884, p. 86) reported that the tentacles arise from five or six main tentacular stems. But afterwards, IKEDA (1904, p. 55) stated that: — “The tentacles are given off from the free margins of the eight arms produced by the dichotomous branching of each of the four main stems.” And FISCHER (1922, p. 18) states referring to this point that: — “IKEDA (1904, p. 53) lieferte Ergänzungen resp. Berichtigungen zu der Beschreibung SELENKA’s. Dieser gibt nämlich an, die Tentakel entspringen aus 5–6 Hauptstämmen. IKEDA sah nur 4, die sich in je 2 Arme teilten. Ich konstatierte ebenfalls 4 Hauptstämme, die aber in je zwei grössere und zwei kleinen Arme teilten so dass 16 Arme sichtbar waren. Die kleinen Arme zweigten sich nur von einem der grösseren Tentakel ab. Die Arme waren, wie IKEDA angibt, in ihren ganzen Verlaufe mit kurzen Tentakeln bedeckt. 16 Arme teilten sich weiter in je 4–5 Zweige, die mit vielen Tentakeln bedeckt waren.” IKEDA (1924, p. 31) again reported on the same subject, basing his argument upon the specimens obtained abundantly from Hokkaidô, Japan, that: — “There are four short tentacular stems, each of which divides into two longer branches. This confirms my former statement on this same point for the specimens from Aomori and Wakkanai. It must, however, be mentioned that the two branches of a tentacular stem are often remarkably different in size, consequently casual observers may fall into error concerning the true manner of branching, or even the number of the tentacular stems. According to SELENKA, there are present 5 or 6 main tentacular stems; but these may be rather anomalous cases of the branching of the stems.” While in the specimen from Mutsu Bay, as already

mentioned above, the main tentacular stems are distinctly four in number, and the each is divided into only two arms in the same manner as in the case of IKEDA's specimens from Aomori and Wakkanai. On the fixing-muscles it was reported by IKEDA (1904, p. 55) and FISCHER (1922, p. 18) that one of them is divided into two branches, while in the specimen from Mutsu Bay it is simple, not being branched. IKEDA (1904, p. 55) and FISCHER (1922, p. 18) noted the existence of a diverticulum upon the rectum, but such a structure was not found in the specimen from Mutsu Bay. Concerning the length of the trunk and introvert, the specimen from Mutsu Bay shows smaller dimensions than those reported by SELENKA and IKEDA as shown in the following table.

	Sp. from Mutsu Bay.	SELENKA's sp. (1883-4, p. 86)	IKEDA's sp. (1904, p. 54)	IKEDA's sp. (1924, p. 30)
Length of the trunk.	About 7 mm.	Less than 25 mm.	2.5 mm. (25 mm?)	40-45 mm.
Length of the introvert.	About 7 mm.	One-third of the body length.		

9. *Dendrostoma hexadactylum*, n. sp.

(Pl. IV, Figs. 20-24; Text-figs. 13-15)

Three specimens were collected from the different localities in Mutsu Bay. The first specimen (Pl. IV, Fig. 20) was taken by myself off the coast of Tsuchiya on September 16, 1927, by means of a dredge; the second (Pl. IV, Fig. 21) was collected at the coast of Tsuchiya from a rock covered by seaweeds by Mr. T. IMAI, in August, 1927; and the third was obtained at Urata by Mr. S. TAKATSUKI, in June, 1927, from a certain fissure of rocks near the tide-marks where a large number of oysters (*Ostrea circumpicta* PILSBRY) were found attached to the surface of these rocks.

The first specimen which was selected as the type of the new species is 55 mm. in length and is 10 mm. thick in a fully expanded state, the introvert being about one-third of the total body length. The second and the third specimens are some what smaller in size than the type specimen.

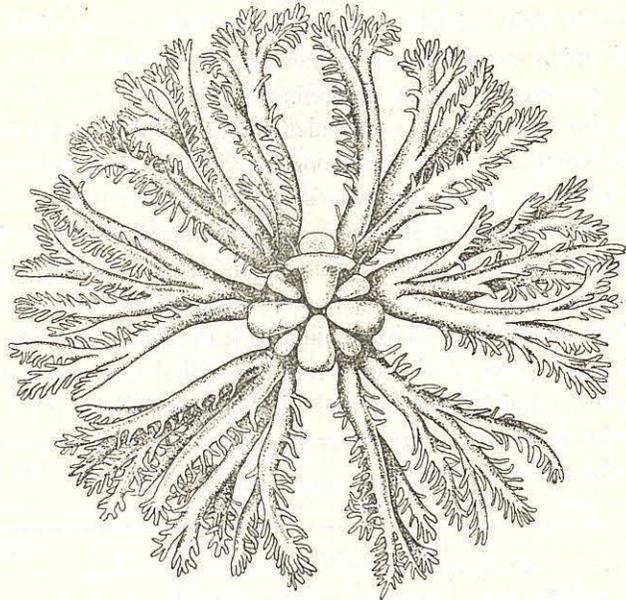
The animal in life is of a yellowish-brown colour on the general

body surface excepting for the introvert-base and the posterior end of the trunk which are of a little darker brown colour. At the anterior end of the introvert, immediately behind the tentacular crown, there is a ring (Text-fig. 14, pz) which is perfectly smooth and is irregularly coloured with light violet. The surface of the trunk when observed under the microscope, shows numerous transverse furrows forming numerous transverse bands encircling the trunk. In the posterior region of the trunk there occur also longitudinal furrows in addition to the transverse furrows above mentioned, and thus numerous small areas are formed. Each of these small areas is provided with a small papilla in the centre and the latter are circular in surface view. The papillae found in the middle region of the trunk (Pl. IV, Fig. 22) and in the region just behind the hooked region of the introvert, are elliptical in surface view. The papillae (Pl. IV, Fig. 23 and 24) situated in the hooked region of the introvert are cylindrical and not uniform in height, some being shorter and the others taller. The measurements of the papillae on the different regions of the body-surface are shown in the following table.

	Type (1st) sp.	2nd sp.	3rd sp.
Height of papillae in hooked region.	0.07-0.163 mm.	0.055-0.095 mm.	0.05-0.145 mm.
Diameter of the base of the same.	0.06-0.085 mm.	0.055-0.057 mm.	0.045-0.07 mm.
Length of major and minor axes of papillae in the middle region of the body.	Major	0.075-0.1 mm.	0.06-0.08 mm.
	Minor	0.05-0.075 mm.	0.05-0.065 mm.
Length of major and minor axes of papillae in the posterior region of the body.	Major	0.08-0.107 mm.	0.075-0.1 mm.
	Minor	0.07-0.105 mm.	0.065-0.1 mm.

The hooks (Pl. IV, Fig. 23) on the introvert are very numerous, numbering over 260, and they measure 0.2-0.36 mm. in height. The tentacles (Text-fig. 13) are light reddish-brown in colour. There are six main stems of the tentacles, and the each is divided into 1-4 stems.

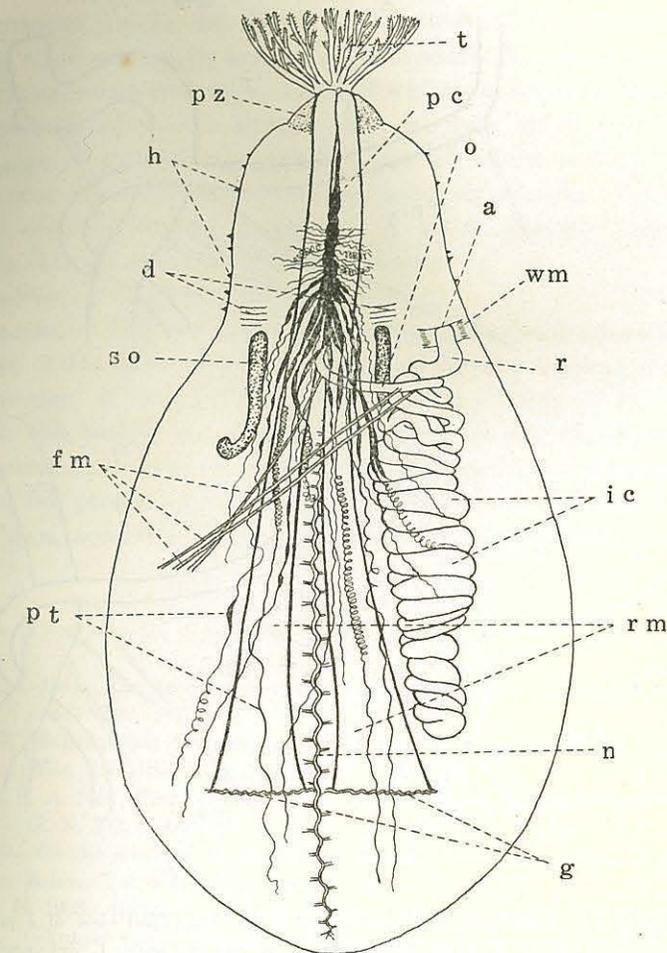
Each of these stems is again divided into branches in an irregular manner. The finger-shaped tentacles are arranged chiefly on the branches above mentioned.



Text-fig. 13. *Dendrostoma hexadactylum*, n. sp. Frontal view of the tentacular crown. $\times 5$.

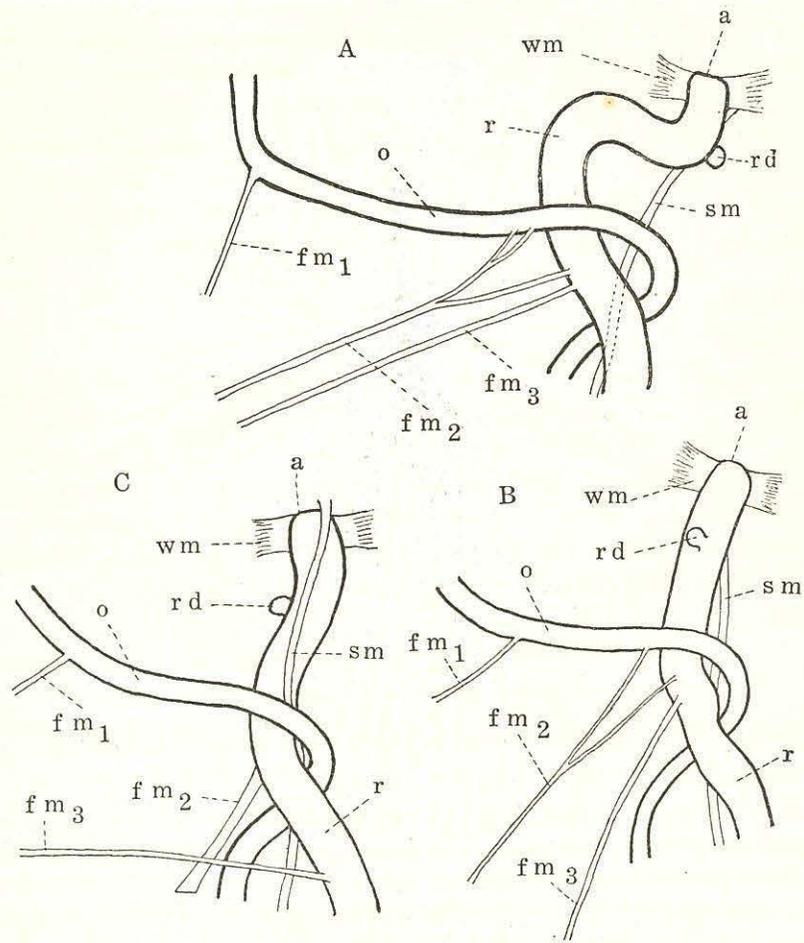
The longitudinal muscle layer is perfectly continuous and the inner surface of the body-wall is remarkably smooth and shows a pearly luster. Two broad retractor muscles (Text-fig. 14, rm) spring from the body-wall at the level of the posterior one-third of the trunk. A spindle-muscle (Text-fig. 14, sm) arises from the body-wall in front of the anus (Text-fig. 14, a), and posteriorly ends free from the latter. The fixing-muscles (Text-fig. 14, fm) are three in number. They arise from the dorsal body-wall of the middle portion of the trunk and at a point far distant from the nerve-cord (Text-fig. 14, n). Two of these muscles are attached respectively to the oesophagus (Text-fig. 14, o) and the rectum (Text-fig. 14, r), while the remaining is attached to both the oesophagus and the rectum by means of its two rootlets. These features concerning the fixing-muscles seem to vary to some

extent in different specimens. The text-fig. 15 (A, B and C) indicates the variations found in the fixing-muscles in the specimens taken from Mutsu Bay. A pair of broad wing-muscles (Text-fig. 14, wm) is



Text-fig. 14. *Dendrostoma hexadactylum*, n. sp. The type specimen dissected. a, anus; d, short dissepiments; fm, fixing-muscles; g, gonads; h, hooks; ic, intestinal convolutions; n, ventral nerve-cord; o, oesophagus; pc, Polian canal; pt, Polian tubules; pz, pigmented zone; r, rectum; rm, retractor muscles; so, segmental organ; t, tentacles; wm, wing-muscles. $\times 2$.

attached to the lateral sides of the rectum near the anus. The Polian canal (Text-fig. 14, pc) passes along the dorsal surface of the oesophagus



Text-fig. 15. *Dendrostoma hexadactylum*, n. sp. Magnified view of a portion of the digestive canal. A, Type (1st) specimen; B, 2nd specimen; C, 3rd specimen; a, anus; fm₁, fm₂, fm₃, fixing-muscles; o, oesophagus; r, rectum; rd, rectal diverticulum; sm, spindle-muscle; wm, wing-muscles. $\times 6$.

and gives off a great number of long blind tubules (Text-fig. 14, pt) on its way. These tubules are often spirally twisted and are greatly entangled with the intestinal convolution and with other internal organs.

The segmental organs (Text-fig. 14, so), consisting of two short tubes of a grayish-yellow colour, are entirely free from the body-wall except for the anterior ends which are fastened to the latter. Their external apertures exist almost at the same level as the anus. Several narrow dissepiments (Text-fig. 14, d) are seen in front of the attachment base of each segmental organ, arranged transversally in a longitudinal line. These dissepiments seem to be identical with those found in *Siphonosoma cumanense* (KEFERSTEIN), though they are very broad and numerous in the case of the latter species. A pair of sexual organs (Text-fig. 14, g) occur along the base of the two retractor muscles. No eye-spot can be detected on the ganglion. A small globular diverticulum (Text-fig. 14, rd) is found upon the rectum.

Localities. — Tsuchiya and Urata.

Remarks. — This new species closely resembles *Dendrostoma blandum* SELENKA et DE MAN in size of body and in the internal structures, but, however, it differs from the latter in the height of the papillae found in the hooked region of the introvert, as well as in the features of the tentacular crown, viz., the number of the main tentacular stems is six in the present species, while in *Dendrostoma blandum* SELENKA et DE MAN, according to FISCHER and IKEDA, it is usually four.

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EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. *Sipunculus nudus* LINNAEUS. Natural size.
- Fig. 2. *Siphonosoma mourense*, n. sp. The type specimen. Natural size.
- Fig. 3. The same, dissected to show the anterior region of the trunk. a, anus; dr, dorsal retractor muscles; fm, fixing-muscles; ic, intestinal convolution; in, infundibulums of the segmental organs; kb, KEFERSTEIN's body; o, oesophagus; pc, Polian canal; r, rectum; sm, spindle-muscle; so, segmental organs; n, ventral nerve-cord; vr, ventral retractor muscles; wm, wing-muscles. $\times 2.5$.
- Fig. 4. The same. A part of a row of the tentacles. Greatly magnified.
- Fig. 5. *Physcosoma japonicum* (GRUBE). Natural size.
- Fig. 6. *Physcosoma glaucum*, n. sp. Surface view of a papilla in the middle region of the trunk. $\times 500$.

PLATE II.

- Fig. 7. *Physcosoma glaucum*, n. sp. The type specimen. Natural size.
- Fig. 8. The same dissected. a, anus; dr, dorsal retractor muscles; es, eye-spot; fm, fixing-muscle; ic, intestinal convolution; n, ventral nerve-cord; o, oesophagus; pc, Polian canal; r, rectum; sm, spindle-muscle; so, segmental organs; vr, ventral retractor muscles; wm, wing-muscles. $\times 4$.
- Fig. 9. *Physcosoma scolops* (SELENKA et DE MAN). Natural size.
- Fig. 10. The same dissected. a, anus; dr, dorsal retractor muscles; es, eye-spot; fm, fixing-muscle; ic, intestinal convolution; n, ventral nerve-cord; o, oesophagus; r, rectum; sm, spindle-muscle; so, segmental organs; vr, ventral retractor muscles; wm, wing-muscles. $\times 4$.

PLATE III.

- Fig. 11. *Phascolosoma zenibakense* IKEDA. Natural size.
- Fig. 12. The same dissected. a, anus; fm, fixing-muscles; g, gonad; ic, intestinal convolution; n, ventral nerve-cord; o, oesophagus; pc, Polian canal with Polian tubules; r, rectum; rd, rectal diverticulum; rm, retractor muscles; sm, spindle-muscle; so, segmental organs; t, tentacles; wm, wing-muscles. $\times 1.5$.
- Fig. 13. and Fig. 14. *Stephanocaris carthausi* FELIX. $\times 2$.
- Fig. 15. *Phascolion ikedai*, n. sp. The type specimen. $\times 6$.
- Fig. 16. The same. Spines on the concave surface of the trunk. $\times 90$.
- Fig. 17. The same. Spines on the convex surface of the trunk. $\times 90$.

PLATE IV.

- Fig. 18. *Dendrostoma blandum* SELENKA et DE MAN. $\times 2$.
 Fig. 19. The same. Hooks and papillae on the introvert. $\times 90$.
 Fig. 20. *Dendrostoma hexadactylum*, n. sp. The type specimen. Natural size.
 Fig. 21. The same. The second specimen. Natural size.
 Fig. 22. The same. Surface view of a papilla from the middle region of the body-wall. $\times 360$.
 Fig. 23. The same. Hooks and papillae on the introvert. $\times 70$.
 Fig. 24. The same. Cross section of the skin together with a papilla in the hooked region of the introvert. $\times 250$.
 c, cuticle; cm, circular muscle layer; dg, duct of the subdermal gland;
 e, epidermis; lm, longitudinal muscle layer; pa, papilla; pe, peritoneum;
 sg, subdermal gland; ss, subepidermic space.



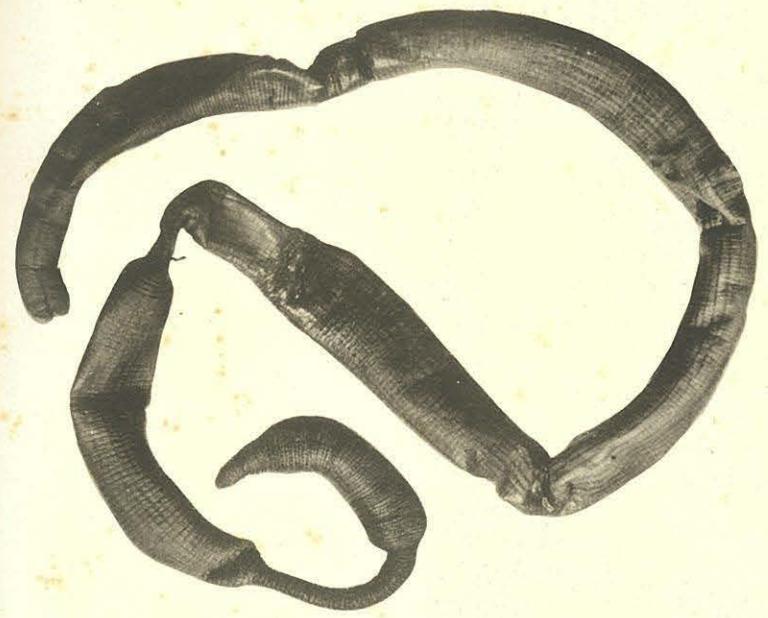


Fig. 2.

Fig. 5.



Fig. 3.

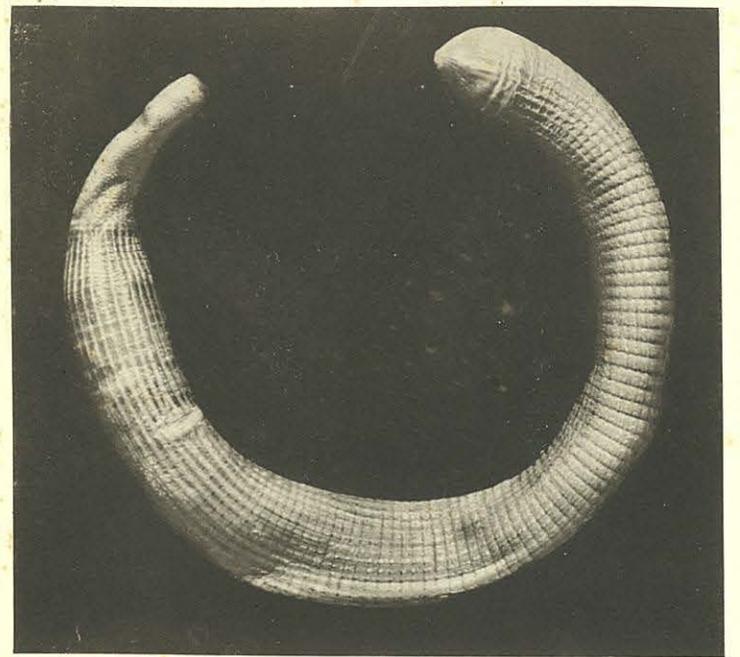


Fig. 1.

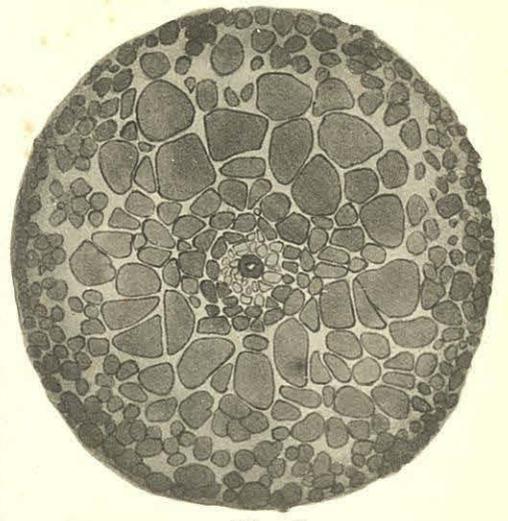


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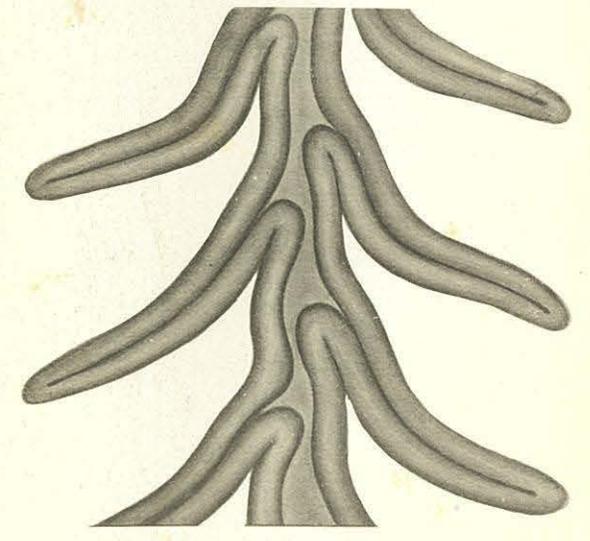
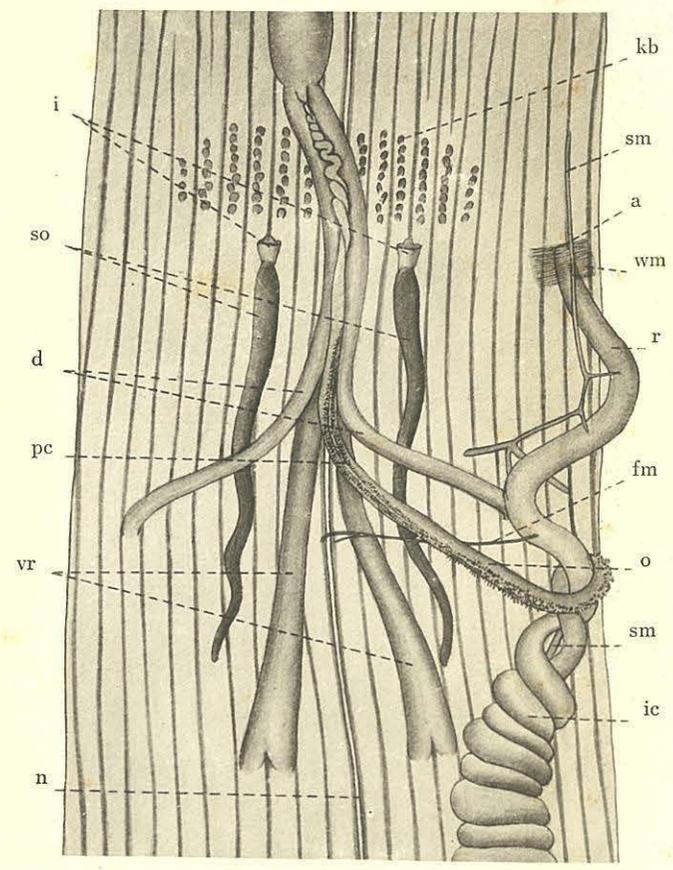
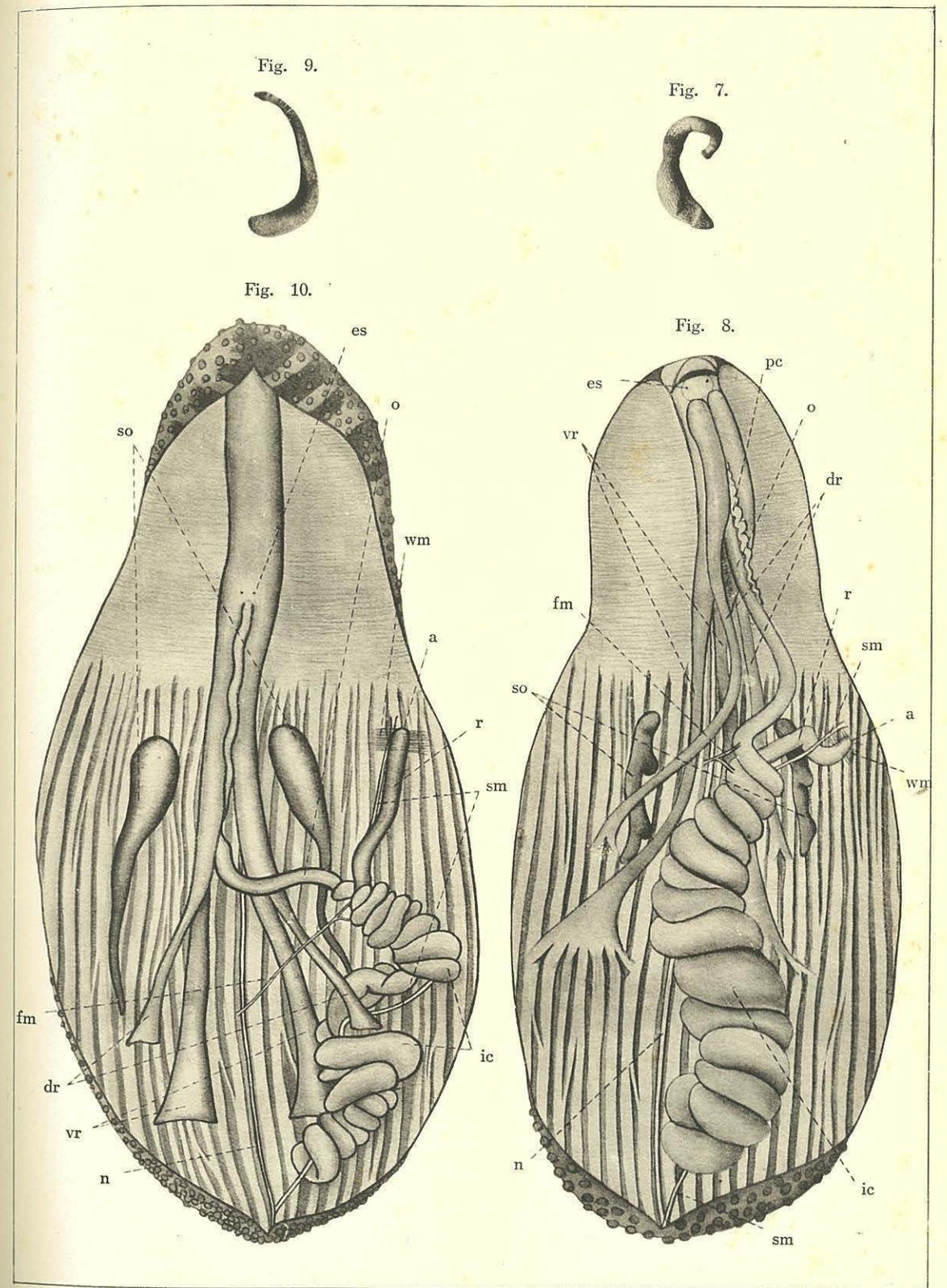


Fig. 4.

2.
t. × 90.
specimen. Natural size.
middle region of the
t. × 70.
with a papilla in the
of the subdermal gland;
papilla; pe, peritoneum;



H. SATÔ del. and K. AOYAMA photo.

H. SATÔ: Sipunculoidea of Mutsu Bay.

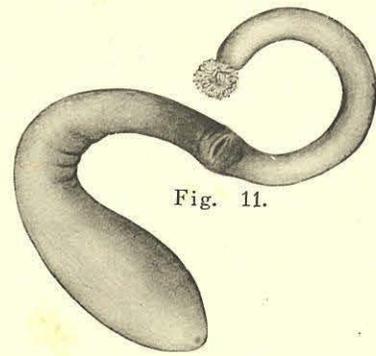


Fig. 11.



Fig. 14.

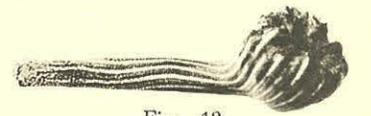


Fig. 13.

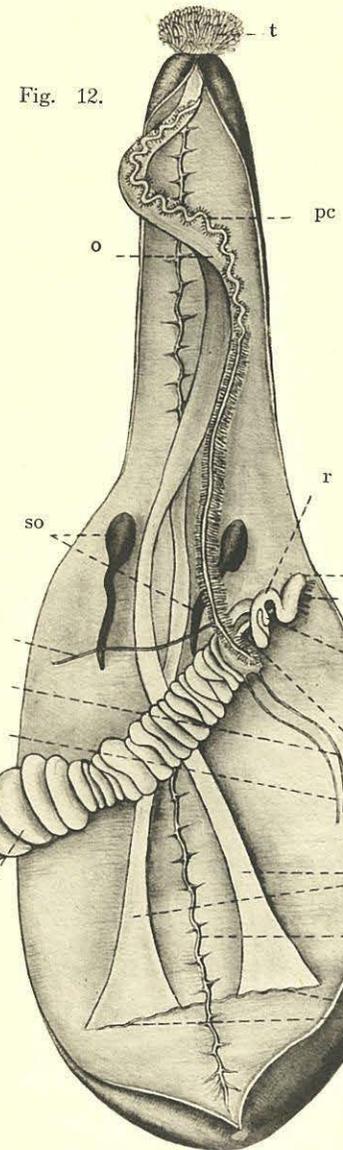


Fig. 12.

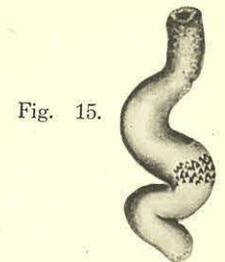


Fig. 15.

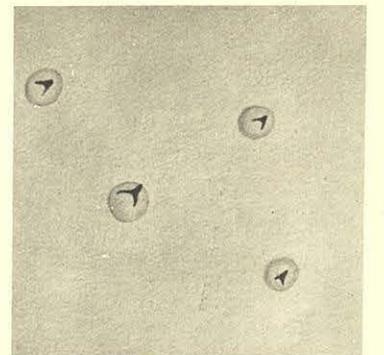


Fig. 16.

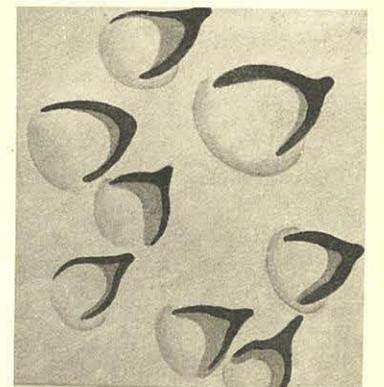


Fig. 17.

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H. SATÔ: Sipunculoidea of Mutsu Bay.



Fig. 20.



Fig. 21.



Fig. 18.

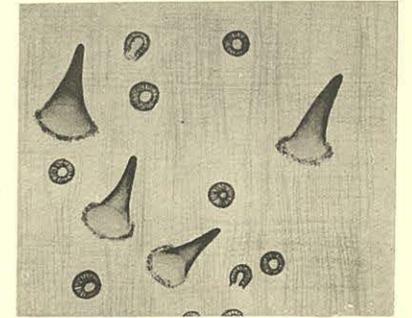


Fig. 19.

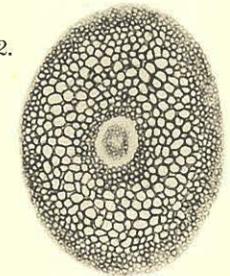


Fig. 22.

Fig. 23.

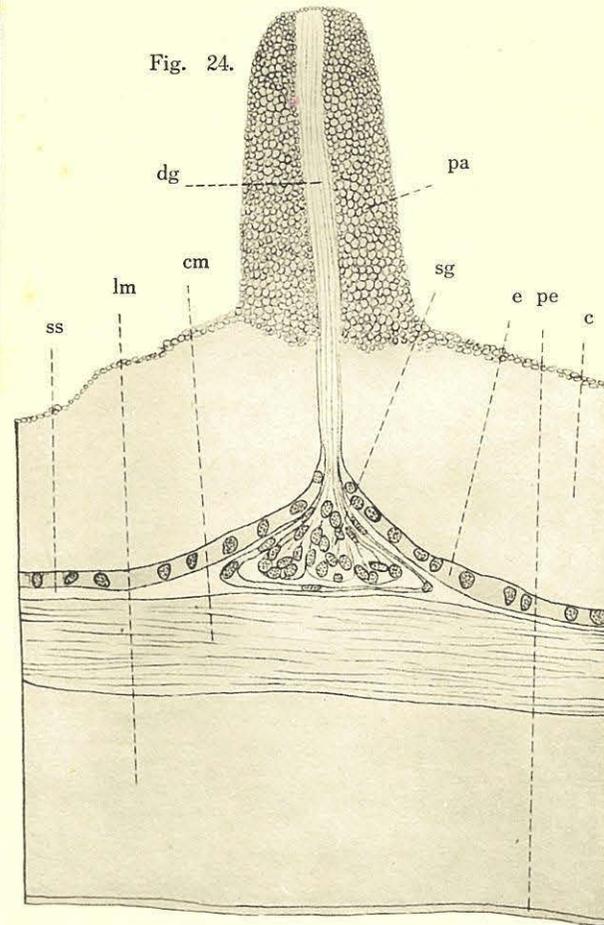
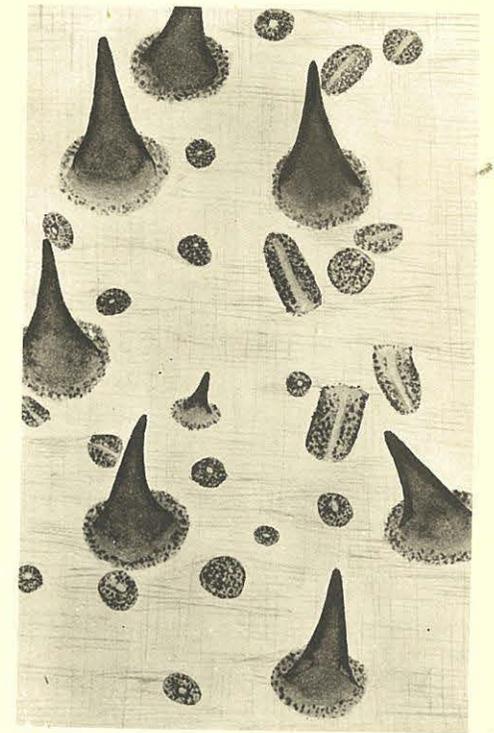


Fig. 24.

H. SATÔ del. and K. AOYAMA photo.

H. SATÔ: Sipunculoidea of Mutsu Bay.