CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA

XIII. SPORADIC MEMORANDA (4)[1]

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With Plates XIII–XVIII and 1 Text-figure

In this paper are presented the results of the examination on two materials of ascidians. One is a small collection made by Mr. E. HARADA of our laboratory on Nov. 28, 1957 on a trawler working in the area about 20 km off Tanabe Bay and the other is a bigger one collected by Mr. S. KOBAYASI of the Hukui Local Museum of Natural History in 1954–1958 along the coast of Wakasa Bay situated approximately at the middle of the Japan Sea side of the main island of Japan or on trawlers of Kuriya Base working chiefly in Wakasa Bay.

I. Material dredged off Tanabe Bay

This comprises two kinds of pyrosomas and two compound ascidians, of which one form belonging to the genus *Homoeodistoma* seems to represent a new species.

1) *Pyrosoma atlanticum atlanticum* PÉRON, 1804. The largest colony is 97 mm long, 26 mm wide and 10 mm thick; and faintly pinkish in colour. The surface is wholly covered with conspicuous spiny protuberances.

2) *Pyrosoma spinosum* HERDMAN, 1888. Elongate, 165 mm in length and 16 mm in diameter. The test is quite transparent and very fragile; the surface is provided sparsely with spiny protuberances. Zooids reddish.

3) *Syndiazona grandis* OKA. Two olive brown and roundish gelatinous colonies, respectively 30 mm in diameter and 24 mm high and 29 mm in diameter and 27 mm high; both being devoid of peduncular portion. The test is soft and translucent, the yellowish zooids being seen through. Zooids up to 11 mm, of which 4 mm is occupied by thorax; the stomach is smoothly surfaced and situated in the posterior 3–4 mm of the abdomen. Stigmatal rows about 25; about 15 transverse muscles on each side of thorax, of which several anterior ones are slightly oblique. Gonad immature. These specimens are apparently young colonies of *Syndiazona grandis*.

1) Contributions from the Seto Marine Biological Laboratory, No. 324.

4) *Homoeodistoma longigona* n. sp.

(Pl. XIII, figs. 1–5)

A single colony was dredged from the sandy bottom about 120 m deep and about 23 km off Sirahama. Examining the colony closely, it was found that the specimen represents a new member of the genus *Homoeodistoma* hitherto known in the Japanese waters by only a single species *H. michaelseni* REDIKORZEV from the Okhotsk Sea. The colony is a mass measuring 33 mm in length and 17 mm in diameter and consists of three cormidia which are less than 12 mm in diameter on the elliptical coronal surface and very shortly pedunculated. Only the coronal portions of cormidia are projected out of the surface of the colonial mass which is hard gelatinous in consistency, but whitish and translucent allowing to see zooids faintly through the test. The test is rather soft on the upper surface of corona; the basal portion of colony is yellowish brown in colour and covered with fine sand grains and shell fragments.

Zooids: Zooids are 15–20 mm in length. Both branchial and atrial apertures open directly to the exterior. The abdomen is about two-thirds as long as the thorax. The postabdomen is very slender, attaining to four times the length (3–4 mm) of thorax and abdomen measured together.

Thorax: Both apertures 6-lobed. The branchial aperture is usually withdrawn to the level posterior to the atrial by contraction of thoracic muscles. There are 6 orange ocelli around the atrial aperture, and the basal portion of the branchial aperture is encircled on each side by a very distinct yellowish pigment band along the peripharyngeal band, besides a small pigment spot of the same colour is found at the ventral base of the dorsal ganglion. Fifteen to seventeen thoracic muscles on each side; they are roughly running obliquely, starting from the ventral side and converging to the branchial aperture; several posterior muscles are rather delicate. About twenty stigmatal rows are present; the number of stigmata in each row is obscured by contraction. Tentacles ca. 8. The anus is bilobed, and there are about six stigmatal rows in front of the level where the anus is attached.

Abdomen: Oesophagus short. The pyloric end of the stomach is located at the middle of the abdomen. The stomach wall is smooth, except for the distinct mark made by a very stout typhlosole. The hind-stomach and the mid-intestine are separated from each other by a slight constriction. The proximal end of the rectum is strongly constricted from the foregoing part, but no coecum is formed there.

Postabdomen: The vas deferens is very long reaching posteriorly near the rear end of the postabdomen and very thick being fully filled with sperms. Many eggs (25 in an examined zooid) are arranged along the whole dorsal side of the vas deferens; they seem all to be enveloped in the fertillization membrane. Thus it is possible that the dorsal half of the postabdomen is a long ovary and at the same time it works as a long incubatory pouch as PÉRÈS describes such a structure in *Pseudodistoma cyrnusense*.

Remarks: (1) Both branchial and atrial apertures opening directly to the exterior, (2) the existence of postabdomen, (3) the stomach smoothly surfaced, and (4) the ovary and testis being arranged side by side in the postabdomen, these four points are the characteristics assigning the present form to the genus *Homoeodistoma* REDIKORZEV 1927. *H. michaelseni* REDIKORZEV from the Okhotsk Sea and the coasts along Kamtchatka Peninsula resembles the present form in the appearance of the colony. In the former, however, the stigmatal rows are much fewer (12) than in the latter and the postabdomen is much shorter, being only slightly longer than the abdomen. For these reasons, the present form is treated here as a new species and named "*longigona*" after its long postabdmen containing long gonads running throughout it.

II. Material from Wakasa Bay

Besides twenty-one species of ascidians, two pyrosomas from other locality are included in the collection of the Hukui Museum. They are:

1. *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN)
2. *Ciona intestinalis* (LINNAEUS)
3. *Ascidia zara* OKA
4. *Ascidia sydneiensis samea* (OKA)
5. *Botrylloides violaceum* OKA
6. *Symplegma reptans* (OKA)
7. *Polycarpa granosa* TOKIOKA
8. *Polycarpa maculata* (HARTMEYER)
9. *Polycarpa cryptocarpa* var. *kroboja* (OKA)
10. *Cnemidocarpa areolata* (HELLER)
11. *Cnemidocarpa fertilis* f. *minor* TOKIOKA
12. *Cnemidocarpa macrogastra* (OKA)
13. *Styela esther* HARTMEYER
14. *Styela clava* HERDMAN
15. *Pyura lepidoderma* TOKIOKA
16. *Pyura mirabilis* (V. DRASCHE)
17. *Herdmania momus* (SAVIGNY)
18. *Boltenia echinata* (LINNAEUS)
19. *Halocynthia hilgendorfi* (TRAUSTEDT)
20. *Microcosmus hartmeyeri* OKA
21. *Microcosmus multitentaculatus* TOKIOKA

PYROSOMATA

1. *Pyrosoma atlanticum atlanticum* PÉRON
2. *Pyrosoma operculatum* NEUMANN

No new species is presented in this material. Of these species, however, *Polycarpa granosa* and *Cnemidocarpa fertilis* f. *minor* are described respectively merely on a single specimen and *Polycarpa maculata* and *Microcosmus multitentaculatus* are reported only twice by this day. So the descriptions on specimens of these species found in the present material seem to be very useful for ascertaining their validity. Moreover, as the ascidian fauna in the Japan Sea has been known only a

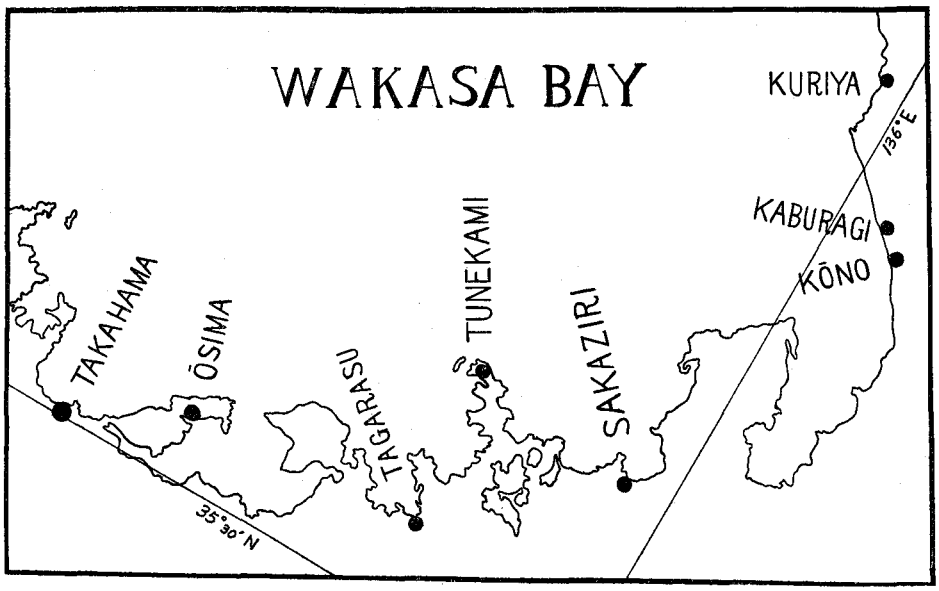


Fig. 1. Map showing localities along the coast of Wakasa Bay, where the present material was collected.

little, it seems to be significant to give here exact localities and some morphological notes for each species in a hope that those might be useful for the affirmation of regional variations found in some species.

1) *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN). Four small white colonies, up to 10 mm×5 mm in extent, found on the test of *Microcosmus hartmeyeri* collected by a trawler of Kuriya Base. They are very thin, ca. 0.5 mm in thickness. Calcareous spicules are distributed densely throughout the colony and rather large, most frequently 30–40μ in diameter, though fluctuating between 28μ and 52μ in examined pieces; the number of rays on the equatoriai plane vary from 10 to 12.

2) *Ciona intestinalis* (LINNAEUS). Seven individuals from Sakaziri, collected on Aug. 8, 1958.

3) *Ascidia zara* OKA (Pl. XIV, fig. 6). A small 8 mm long (in mantle body) specimen found attached on the 90 mm long *Polycarpa cryptocarpa* var. *kroboja* collected by a trawler of Kuriya Base. The test is gelatinous, transparent and armed with a number of spinule-like protuberances over the surface. The musculature on the right side of the mantle body consists chiefly of transverse muscle bands. The branchial aperture 8-lobed and the atrial 6-lobed. The anterior end of the intestinal loop reaches far beyond the base of the atrial siphon. A small amount of mature eggs found in the oviduct.

4) *Ascidia sydneiensis samea* OKA (Pl. XIV, figs. 7–8). A single 29 mm long specimen from Tagarasu, collected on Aug. 11, 1957. The body is elliptical and

attached to the substratum by the whole left side. The test is soft cartilaginous, translucent and faintly grayish purple in colour; the peripheral portion is provided with a number of finger-shaped protuberances up to 3.5 mm in length and bifid at the tip in some ones, while the central area is slightly depressed and nearly smooth. The branchial siphon terminal and the atrial situated approximately at the middle of the dorsal side of the body; the former has 7- and the latter with 6-ridges on the surface, each ridge carries a few spiny protuberances. The mantle musculature reddish brown, widely interrupted. The ciliated groove simply U-shaped. The anterior end of the intestinal loop does not extend beyond the anterior base of the atrial siphon. Apparently this is a young individual of a spinose form of *A. sydneiensis samea.*

5) *Botrylloides violaceum* OKA. Four colonies encrusting sargassums and other objects. Zooids are brownish violet in two colonies, while they are nearly pigmentless in other two. Stigmatal rows 8-11, stomach with 8 longitudinal plications besides typhlosole. Loc.: Three colonies from Sakaziri, collected on Aug. 8, 1958 and one colony from Kôno, collected on Aug. 1, 1957.

6) *Symplegma reptans* (OKA). Two colonies encrusting sargassums, collected at Takahama on Aug. 13, 1955. About eight stigmatal rows are present. The anterior end of the intestinal loop reaches the middle of the fourth stigmatal row. The pyloric coecum is very prominent and issues from its distal end a vessel which bridges between the coecum and the rectum.

7) *Polycarpa granosa* TOKIOKA, 1953

(Pl. XIV, figs. 9-14)

A single specimen found in the trawled material examined at Kuriya. The animal is 72 mm long and 39 mm high, but only 15 mm wide, being strongly depressed laterally. The whole body is covered densely with gravels; both apertures are sessile and quite invisible from the surface. The test itself is rather thin, soft and transparent, but it holds many fine sand grains within it, besides coarse ones. The mantle is very thin and delicate. The branchial aperture terminal and the atrial is situated at one-third of the body length from the posterior end of the body; both siphons are very short and coloured reddish-brown near their bases. Atrial tentacles are long, but very thin. No endocarps are found on the inner surface of the mantle.

Branchial sac: Four folds on each side. The inner longitudinal vessels are arranged in the middle portion as follows:

Right	D	7	(16)	10	(20)	9	(17)	8	(17)	9	V
Left	D	7	(16)	9	(21)	9	(21)	8	(14)	7	V

Transverse vessels are arranged in the order of 1 3 2 3 1 or 1 2 1, where numerals indicate the order of thickness. Parastigmatic vessels absent. Six to eight stigmata in a mesh in intermediate areas. Tentacles 36, larger and smaller ones alternate

rather regularly, being intervened by minute one at each interval. The ciliated groove is simply U-shaped.

Alimentary system: The intestinal loop is confined to the posterior half of the body and very wide. The second loop is extremely shallow, with the axis passing through near the middle of the ventral branch of the loop excluding the stomach. The stomach is elongate and occupies nearly one-third of the whole ventral branch of the loop; there are several longitudinal plications on each surface, but no pyloric coecum is seen. The anal margin is cut into 13 lobules. The oesophagus is very short. A number of minute endocarps are found on the intestinal wall.

Gonad: Eighty one gonads on the left and 132 on the right side. They are elongate elliptical in shape, up to 3.5 mm in length, and attached to the inner surface of the mantle by only a small part of the capsule surface. Testicular follicles are arranged roughly in two rows on the attachment side.

Remarks: Some slight differences are found in features of various organs between the present specimen and the type specimen from Sagami Bay. In the type specimen, the alimentary organ occupies wider area than in the present specimen and a pad-like structure is found in front of the dorsal tubercle. The most striking difference is, however, the existence of an accessory fold at each of the second to fourth branchial folds in the type specimen. The numbers of inner longitudinal vessels on the second to fourth branchial folds in the type specimen agree well with those in the present specimen, if the vessels on both proper and accessory folds are counted together in the type specimen. Probably all these above-mentioned differences are attributable to the degree of contraction or to some environmental conditions, but insignificant as characteristics differentiating these two specimens from each other. And, at present, it is quite impossible to decide definitely which of the type and present specimens represents the regular feature of *P. granosa*.

8) *Polycarpa maculata* (HARTMEYER), 1906

(Pl. XV, figs. 15–20)

A 30 mm long oval individual was dredged by a trawler of Kuriya Base. The posterior half of the body is encrusted with coarse and fine sand grains, while the distal half is nearly exposed, wrinkled irregularly and carries some hydrozoan colonies on the surface. The branchial aperture is terminal and the atrial is situated approximately at one-third of the body length from the anterior end of the body; both apertures are sessile and hardly visible from the surface. The test is soft cartilaginous, translucent and yellowish brown in colour and up to 2 mm in thickness. The mantle is of a moderate thickness, dark brownish in colour and devoid of endocarps on the inner surface. Fine tentacles are found set densely along the margin of the atrial velum.

Branchial sac: Inner longitudinal vessels are arranged as follows:

Right	D	0	(14)	2	(13)	2	(13)	2	(9)	1	V
Left	D	0	(10)	3	(13)	2	(14)	2	(11)	2	V

Transverse vessels are arranged in the following order: 1 4 3 4 2 4 3 4 1, where the numerals represent the order of thickness. Parastigmatic vessels absent. Ten to twelve stigmata in a mesh in intermediate areas. Tentacles 45 including both large and small ones, but excluding a small number of minute ones. The ciliated groove S-shaped.

Alimentary system: The intestinal loop is rather narrow; the second loop is very shallow, with the axis passing through near the middle of the stomach which is elongate and with seven longitudinal plications on the free surface and a small pyloric coecum. The oesophagus short, the rectum is long and the anus is surrounded with six lobules on one side and with three on the other side. All these organs are also coloured dark brownish as the mantle is. A large endocarp is present in the first intestinal loop.

Gonad: Twenty-six gonads on the right and 21 on the left side. They are elliptical in shape, up to 3 mm in length, and attached to the inner surface of the mantle by only a small part near the proximal portion. Many testicular follicles arranged on the attachment side.

Remarks: This is the third record of the species in the Japanese waters.

9) *Polycarpa cryptocarpa* var. *kroboja* (OKA) (Pl. XV, figs. 21-22). Two individuals found in the material dredged by a trawler of Kuriya Base. They are respectively 70 mm and 90 mm in length, the former is heavily infested by two kinds of parasitic copepods in the mantle and branchial sac, and the latter carries many small simple ascidians and hydrozoan colonies on the test surface and also infested by parasitic copepods in the branchial sac. A pontiniid shrimp was found in each specimen. The ciliated groove is simple in both specimens. Four branchial folds on the left and five on the right side; the first (dorsal-most) rudimentary fold on the right side is formed only in the posterior half of the sac. The inner longitudinal vessels are arranged as follows in the 70 mm long individual:

Right	D	0	(7)	2	(10)	6	(17)	5	(15)	4	(18)	3	V
Left	D		4	(12)	7	(16)	6	(16)	6	(13)	6		V

Eighteen tentacles are found in the 70 mm long individual, larger and smaller ones are differentiated. Both specimens are immature.

Remarks: This is the first record of the occurrence of this species in the Sea of Japan.

10) *Cnemidocarpa areolata* (HELLER) (Pl. XV, figs. 23-24). Three specimens collected by a trawler of Kuriya Base. They are respectively 29, 36 and 47 mm in length and all fully mature. The external appearance resembles very closely that of *Styela plicata* (LES.) and the basal portion is encrusted with gravels. Some gonads may be divided into three branches in the proximal half as is shown in fig. 23.

Besides the above-mentioned specimen, a minute 2.5 mm long specimen was found on the surface of a specimen of *Polycarpa cryptocarpa* var. *kroboja*. It is roughly spherical in shape, with both siphons situated on the dorsal side. The test thin, leathery and pale yellowish brown in colour, being tinted red on siphons and around their bases. The mantle is thin and pale pinkish brown in colour. Distinct endocarps are found on the inner surface of the mantle. There are only three branchial folds on each side, of which the third (ventral-most) one is lower than others. Tentacles ca. 15, larger and smaller ones alternate regularly, the cilliated groove is an elongate oval slit. Eight plications are found on the free surface of the oval stomach which occupies the most part of the ventral branch of the intestinal loop. The axis of the second loop passes through the oesophageal region. The anus 6-lobed. No trace of gonads can be seen. It is very difficult to identify exactly this very young immature specimen, but the existence of a number of endocarps, the situation of the second intestinal loop with the axis passing through the oesophageal region and the oval stomach occupying the larger part of the ventral branch of the intestinal loop seem to allude the possibility that this specimen might belong to *Cn. areolata*.

11) *Cnemidocarpa fertilis* f. *minor* TOKIOKA, 1954

(Pl. XVI, figs. 26-29)

Two specimens found attached to a large specimen of "*ritteri*"- form of *Halocynthia hilgendorfi* dredged in Wakasa Bay. They are oval in outline, respectively 8 and 10 mm in length and attached by the ventral side, where the test is very thin. On the dorsal side, the test is leathery, marked with irregular grooves and furrows and dark purplish in colour. The inner surface of the test is bright purplish on the dorsal side. Both apertures are 4-lobed and sessile. The mantle is of a moderate thickness, especially thicker and sprinkled with greenish yellow pigment flecks on the dorsal side. A few endocarps are seen on the inner surface. Atrial tentacles are very fine.

Branchial sac: The inner longitudinal vessels are arranged as follows:

Right	D	0	(11)	1	(8)	1	(11)	1	(7)	1	V
Left	D	1	(11)	1	(9)	2	(9)	1	(7)	1	V

Transverse and parastigmatic vessels alternate regularly. Up to eight stigmata in a mesh. Tentacles ca. 15 including larger and smaller ones, alternating regularly and being intervened by minute ones at intervals. The ciliated groove is simply U-shaped. Tentacles and some vessels of the branchial sac are partly filled with yellowish corpuscles.

Alimentary system: The stomach is small, elliptical in outline and marked with nine longitudinal plications on the free surface. The second intestinal loop is very deep, its axis is passing through the middle of the ventral branch of the intestinal loop. The free margin of the anus is cut into four lobules. In the 10 mm long individual, three gonads on the left and four on the right side.

Remarks: This is the second record of the species and thus the occurrence is significant to ascertain the existence of such a minor form in *Cn. fertilis*. It is, however, very difficult, at present, to judge whether the present form represents merely an ecological form of *Cn. fertilis* or it is deserved to be ranked as a variety.

12) *Cnemidocarpa macrogastra* (OKA) (Pl. XVI, fig. 25). Two specimens, respectively 15 mm and 26 mm in length, dredged in Wakasa Bay and other two, respectively 21 mm and 26 mm long, collected at Kuriya on Feb. 15, 1958. Dredged specimens are attached to gravels and their shape is rather irregular; the larger specimen is contracted so strongly that the test is irregularly wrinkled and grooved and shows somewhat a dark yellowish leathery appearance. The stomach occupies one half of the ventral branch of the intestinal loop and the axis of the second intestinal loop passes through the middle of the stomach in the above-mentioned specimen. Contrarily, specimens from Kuriya are rather spherical in shape and nearly smoothly surfaced. The test is pale yellowish brown or pale pinkish brown with a greenish tint at some parts of the surface. In the larger specimen, the intestinal loop is rather small as shown in fig. 25. The stomach has a minute pyloric coecum, the anal margin is cut into 17 lobules. Six gonads on each side. The arrangement of the inner longitudinal vessels of the branchial sac is as follows:

Right	D	5	(30)	9	(28)	8	(27)	11	(21)	8	V
Left	D	5	(33)	10	(27)	8	(24)	10	(18)	7	V

Probably this specimen represents a short-side extremity of the variation found in the length of the intestinal loop.

13) *Styela esther* HARTMEYER (Pl. XVI, figs. 30–31). A 27 mm long individual from Tunegami, collected on Aug. 5, 1954. The animal seems to be attached on gravels. About ten longitudinal plications on the free surface of the oval stomach and the anal margin is nearly plain except for a few slight incisions. The ciliated groove is U-shaped.

14) *Styela clava* HERDMAN. A single specimen collected at Kuriya in June 1958. The body proper is 30 mm and the peduncle attains to 35 mm in length. Two gonads on the left and four on the right side, where the gonads are arranged in two pairs.

15) *Pyura lepidoderma* TOKIOKA. Two 22 mm long individuals from Kuriya, collected on July 28, 1957, two mature specimens attached to the surface of a "*ritteri*"-form of *Halocynthia hilgendorfi*; eleven small, less than 6.5 mm long, specimens found on the surface of the 90 mm long specimen of *Polycarpa cryptocarpa* var. *kroboja*, and a single 8 mm long specimen attached to the surface of a specimen of *Microcosmus hartmeyeri*. The 22 mm long specimens are pale grayish yellow in colour, while the smaller ones less than 8 mm long, are coloured dark red on the dorsal side. Probably this colouration may fade with growth. In the 6.5 mm long individual, gonads are still immature, although the genital capsules are formed dis-

tinctly, and only six branchial folds are observed on each side, of which the second and the sixth are lower than others.

16) *Pyura mirabilis* (v. DRASCHE). A single 30 mm long specimen collected at Kaburagi on Aug. 4, 1957.

17) *Herdmania momus* (SAVIGNY). A 19 mm long mature specimen collected at Sakaziri on Aug. 8, 1958, 25 and 34 mm long mature individuals from Takahama, collected on Aug. 13, 1956 and two, 16 and 19 mm long, mature specimens collected at Ôsima on Aug. 12, 1955.

18) *Boltenia echinata* (LINNAEUS), 1767

(Pl. XVI, figs. 32–37)

A single 17 mm long specimen attached to the surface of the 90 mm long specimen of *Polycarpa cryptocarpa* var. *kroboja*. The body is roughly oval in outline and slightly depressed dorso-ventrally. The test is leathery, irregularly grooved and provided with a number of protuberances of various length scattered sparsely on the surface. Three of these protuberances are especially long and arranged side by side near the posterior end of the body. All these protuberances and the basal portion of the body near the attachment surface are armed with short spinules less than 1 mm in length. Both apertures are 4-lobed, but quite sessile and hardly detectable. The test is dark red in colour, about 0.5 mm in thickness and the inner surface is deeply reddish purple on the dorsal side. The branchial aperture is subterminal and the atrial aperture is situated slightly posterior to the middle of the body. The mantle is of a moderate thickness and pale yellowish brown in colour. No endocarps are seen on the inner surface.

Branchial sac: Seven folds on the right and eight on the left side. The inner longitudinal vessels are arranged as follows:

Right	D 2 (18) 1 (13) 1 (17) 1 (22) 3 (20) 2 (16) 3 (7) 1	V
Left	D 1 (20) 1 (12) 1 (18) 1 (19) 3 (15) 3 (11) 3 (6) 1 (3) 0	V

The eighth one on the left side is formed only in the anterior portion of the sac. From fifteen to twenty-two stigmata between each pair of transverse vessels in the middle portion. Tentacles ca. 15 excluding minute ones; larger and smaller ones are differentiated; branches in two orders. The ciliated groove is U-shaped.

Alimentary system: The intestinal loop is very elongate. The anal margin is nearly plain and the opening itself is roughly U-shaped.

Gonad: An elongate gonad on each side, undulating somewhat in a zigzag course.

Remarks: The complete absence of characteristic spines on the body surface is very strange. However, I am inclined to identify the present specimen as a peculiar ecological form of *B. echinata*, living in somewhat warmer water, because there remain

still a number of minute spinules and some protuberances on the test surface as mentioned above. Probably these may represent the vestigeal or rudimental stage of spines of typical *B. echinata*. And then, it is not impossible that this specimen might show an intermediate state between *B. echinata* and *B. isibasii* TOKIOKA which is known from Ôsaka Bay and quite devoid of any spine or spinule. Anyhow, it is very interesting that this cold-water species was found attached to the surface of a warm-water form, *Polycarpa cryptocarpa* var. *kroboja*.

19) *Halocynthia hilgendorfi* (TRAUSTEDT), 1885

(Pls. XVII–XVIII, figs. 38–47)

There are three specimens in the material dredged in Wakasa Bay, two of which are armed with branched spines over the whole surface of the body and apparently represent the external appearance of "*Halocynthia igaboja* (OKA)", while in the other one such spines are confined to only the areas surrounding the apertures and a small part of the body posterior to the atrial aperture and evidently shows the appearance of "*Halocynthia ritteri* (OKA)".

"*Igaboja*"-form (figs. 38–42) : 18 mm and 20 mm long specimens. The body is roughly oval in outline, attached to the substratum by the posterior end. Both apertures are sessile, but their situations are easily detectable by thickets of spines so densely set. The spines attain to 5–7 mm in length, with many lateral spinules, and yellowish brown in colour, The test is soft leathery, 0.5 mm–2 mm in thickness and grayish brown or yellowish brown in colour, with somewhat pinkish tint in the smaller specimen. The inner surface and the section are grayish. The mantle is rather thick and pale yellowish in colour. Many endocarps are seen on the inner surface. Eight branchial folds on each side of the branchial sac in the smaller specimen, the eighth (ventral-most) is formed only in the anterior portion of the sac. Inner longitudinal vessels are arranged on the left side as follows (18 mm long individual) :

D 1 (16) 1 (18) 1 (18) 1 (16) 1 (16) 1 (14) 1 (14) 1 (8) 1 V

Transverse vessels are arranged in the order of 1 3 3 3 2 3 3 3 1, where the numerals indicate the order of thickness. Parastigmatic vessels present. About five stigmata in usual meshes, but up to ten in wider meshes along the endostyle. Large tentacles ca. 15, being intervened by small ones at intervals ; branches in 2 orders. The ciliated groove U-shaped, with both horns strongly curled in. The axis of the second intestinal loop passes through the oesophageal region. The oesophagus is long ; the liver consists of two portions, the anterior part consisting of linear hepatic plications and the posterior area consisting of somewhat follicular hepatic lobules.

Anus plainly margined. Four mature gonads on each side in both specimens ; they are united one another at the proximal end.

"*Ritteri*"-form (figs. 43–47) : A 50 mm long individual attached to a large cluster of empty oyster shells by the ventral side. The animal seems to be contracted

strongly, the whole body being somewhat ovoid in outline. Both apertures quite sessile. The test is hard leathery and dark reddish in colour; the surface is nearly smooth except for several irregularly formed grooves and a few short spines found very sparsely. The test attains to 6 mm in thickness on the ventral side, the inner surface is reddish. The spines are less than 5 mm in length and usually yellowish brown in colour; its core is slightly reddish near the basal portion. The mantle is pale yellowish and very thick, many endocarps are found on the inner surface. There are eight branchial folds in the posterior part of the sac, but two more folds are formed in the anterior portion. Inner longitudinal vessels are arranged as follows:

(In the posterior part on the left side)
D - (30) 2 (28) 3 (30) 4 (28) 3 (25) 4 (24) 2 (23) 2 (13) 1 V
(In the anterior part on the right side)
D - (29) 2 (27) 3 (30) 2 (28) 3 (28) 2 (24) 2 (23) 3 (20) 2 (17) 1 (9) 2 V

There is an intermediate transverse vessel between each pair of thicker ones, and then about fifteen small vessels at each interval between thicker and intermediate vessels. Parastigmatic vessels are seen in most meshes. Four to five stgmata in a mesh. Large tentacles 14, being intervened by small ones at intervals; branches in 2 orders. The ciliated groove is rosette-formed. The alimentary system is quite the same as that in the "*igaboja*"-form. Ten gonads on each side.

Remarks: Probably these three specimens belong to the "Formenkreis" represented by *Halocynthia hilgendorfi*, although it is still quite unknown about what causes such striking differences found in the external appearance. As to the relationship between the present third specimen and *Hal. pachyderma* (OKA), more crucial examinations on much more specimens should be necessary. *Hal. cactus* (OKA) and the present first two specimens of "*igaboja*"-form resemble each other very closely in the internal structure and also in the external appearance, but the structure of the spines seems to differ distinctly. However, if spines of these different appearances are proved to be continuous by the existence of some intermediate forms, then *Hal. cactus* might be included in the "Formenkreis" dealt with here.

20) *Microcosmus hartmeyeri* OKA. An 85 mm long specimen collected by a trawler of Kuriya Base. Large tentacles 17, small and minute ones ca. 13. The ciliated groove is C-shaped with both terminals strongly incurled. On the inner surface of the mantle on the right side, several large endocarps are arranged in a series.

21) *Microcosmus multitentaculatus* TOKIOKA, 1953

(Pl. XVIII, figs. 48-49).

A 40 mm long individual dredged in Wakasa Bay. The body is roughly ovoid and fastened to a large mass of gravels by the ventral side. Both siphons are short and situated on the dorsal side set side by side by contraction. The test is hard

leathery and yellowish brown in colour, being sprinkled with reddish patches. Seven folds on each side of the branchial sac. Inner longitudinal vessels are arranged as follows;

Right D 2 (23) 1 (21) 1 (23) 2 (21) 3 (19) 2 (18) 3 (14) 1 V

Large tentacles 17, the ciliated groove U-shaped slightly inclined to the right side and both horns curled in. The gonad on the right side is an oval mass, distinctly outlined and fully mature. The arrangement of endocarps differs quite from that found in *M. hartmeyeri*. This is the third specimen of this species. In spite of the specific name "*multitentaculatus*", the number of tentacles seems to be insignificant as a specific characteristic; rather the shape of the gonad, the arrangement of endocarps and probably the appearance of the ciliated groove seem to be significant as clues differentiating the present species from *M. hartmeyeri*.

PYROSOMATA

1) *Pyrosoma atlanticum atlanticum* PÉRON, 1804. A 51 mm long and 14 mm wide (at the aperture) colony from Sagami Bay. Spiny protuberances on the surface are very distinct. Fifteen inner longitudinal bars on each side and 4 dorsal languets were observed on dissected zooids.

2) *Pyrosoma operculatum* NEUMANN, 1908. A 50 mm long and 29 mm wide, somewhat flattened colony from Sagami Bay. The surface of the colony is quite smooth. Nineteen inner longitudinal bars on each side and fourteen dorsal languets were observed on dissected zooids. These features seem to support the identity of this specimen with *P. operculatum*, although the existence of the characteristic operculum-shaped atrial protuberance could not be ascertained on account of the imperfect condition of preservation.

EXPLANATION OF PLATES XIII-XVIII

PLATE XIII

Figs. 1-5. *Homoeodistoma longigona* n. sp. 1—Colony, enlarged; 2—Right side of a zooid excluding postabdomen, magnified; 3—Junction between middle intestine and rectum, 4—Abdmen and postabdomen, magnified; 5—Arrangement of pigment spots and bands at the anterior end of thorax, magnified. at.—atrial aperture, br.—branchial aperture, d.g.—dorsal ganglion, ed.—endostyle.

PLATE XIV

Fig. 6. *Ascidia zara* OKA. A part of test surface, showing three spiny protuberances, magnified.

Figs. 7-8. *Ascidia sydneiensis samea* (OKA). 7—29 mm long animal, 8—Branchial siphon, enlarged.

Figs. 9–14. *Polycarpa granosa* TOKIOKA. 9—72 mm long animal, 10–Right half of mantle body, from outside; 11—Left half of mantle body, inside; 12—Stomach, enlarged; 13—Ciliated groove, magnified; 14—Attachment surface of gonad, enlarged.

PLATE XV

Figs. 15–20. *Polycarpa maculata* (HARTMEYER). 15—30 mm long animal, 16—Left half of mantle body, inside; 17—Right half of mantle body, inside; 18—Ciliated groove, magnified; 19—Anus, enlarged; 20—Attachment surface of gonad, enlarged.

Figs. 21–22. *Polycarpa cryptocarpa* var. *kroboja* (OKA). Ciliated grooves, magnified. 21—70 mm long individual, 22—90 mm long individual.

Fig. 23. *Cnemidocarpa areolata* (HELLER). Right half of mantle body of 47 mm long individual, inside.

Fig. 24. ? *Cnemidocarpa areolata* (HELLER) juv. Left half of mantle body of 2.5 mm long individual, inside.

Fig. 25. *Cnemidocarpa macrogastra* (OKA). Left half of mantle body of 26 mm long individual, inside.

PLATE XVI

Figs. 26–29. *Cnemidocarpa fertilis* f. *minor* TOKIOKA. 26—Dorsal side of 10 mm long specimen, 27—Right half of mantle body, inside; 28–Left half of mantle body, inside; 29–Ciliated groove, magnified.

Figs. 30–31. *Styela esther* HARTMEYER. 30—Ciliated groove, magnified; 31—Anus, enlarged.

Figs. 32–37. *Boltenia echinata* (LINNAEUS). 32—Dorsal side of 17 mm long individual, 33—Spinules from the basal portion of body, magnified; 34—Left half of mantle body, inside; 35—Right half of mantle body, inside; 36—Ciliated groove, magnified; 37—Anal opening, enlarged.

PLATE XVII

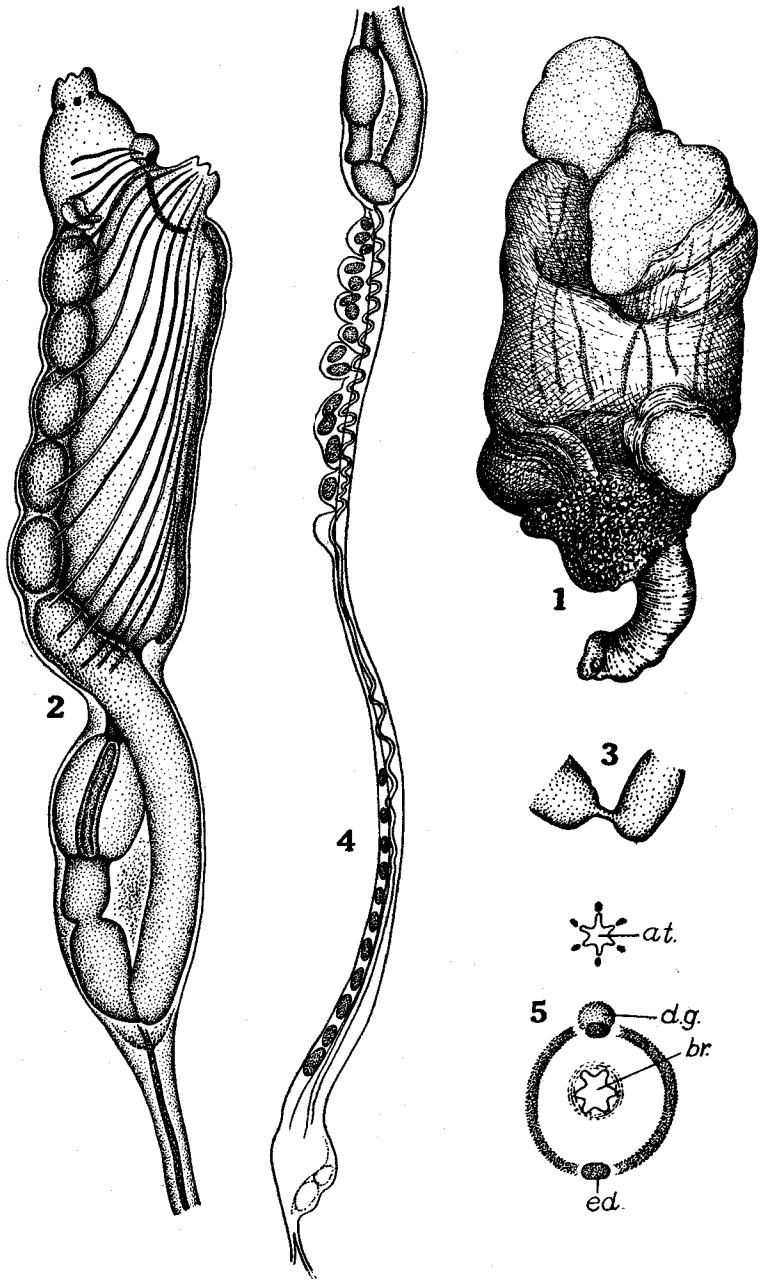
Figs. 38–42. *Halocynthia hilgendorfi* (TRAUSTEDT). "*igaboja*"-form 38—18 mm long animal, 39—Right half of mantle body (25 mm long individual), inside; 40–Left half of mantle body (18 mm long individual), inside; 41—Ciliated groove of 18 mm long individual, enlarged; 42—Ciliated groove of 25 mm long individual, enlarged.

Fig. 43. *Halocynthia hilgendorfi* (TRAUSTEDT). "*ritteri*"-form. One of spines around the branchial aperture, enlarged.

PLATE XVIII

Figs. 44–47. *Halocynthia hilgendorfi* (TRAUSTEDT). "*ritteri*"-form. 44—50 mm long animal, 45—Left side of mantle body, inside; 46—Right side of mantle body, inside; 47—Ciliated groove, magnified.

Figs. 48–49. *Microcosmus multitentaculatus* TOKIOKA. 48—Right half of mantle body, inside; 49—Ciliated groove, magnified.



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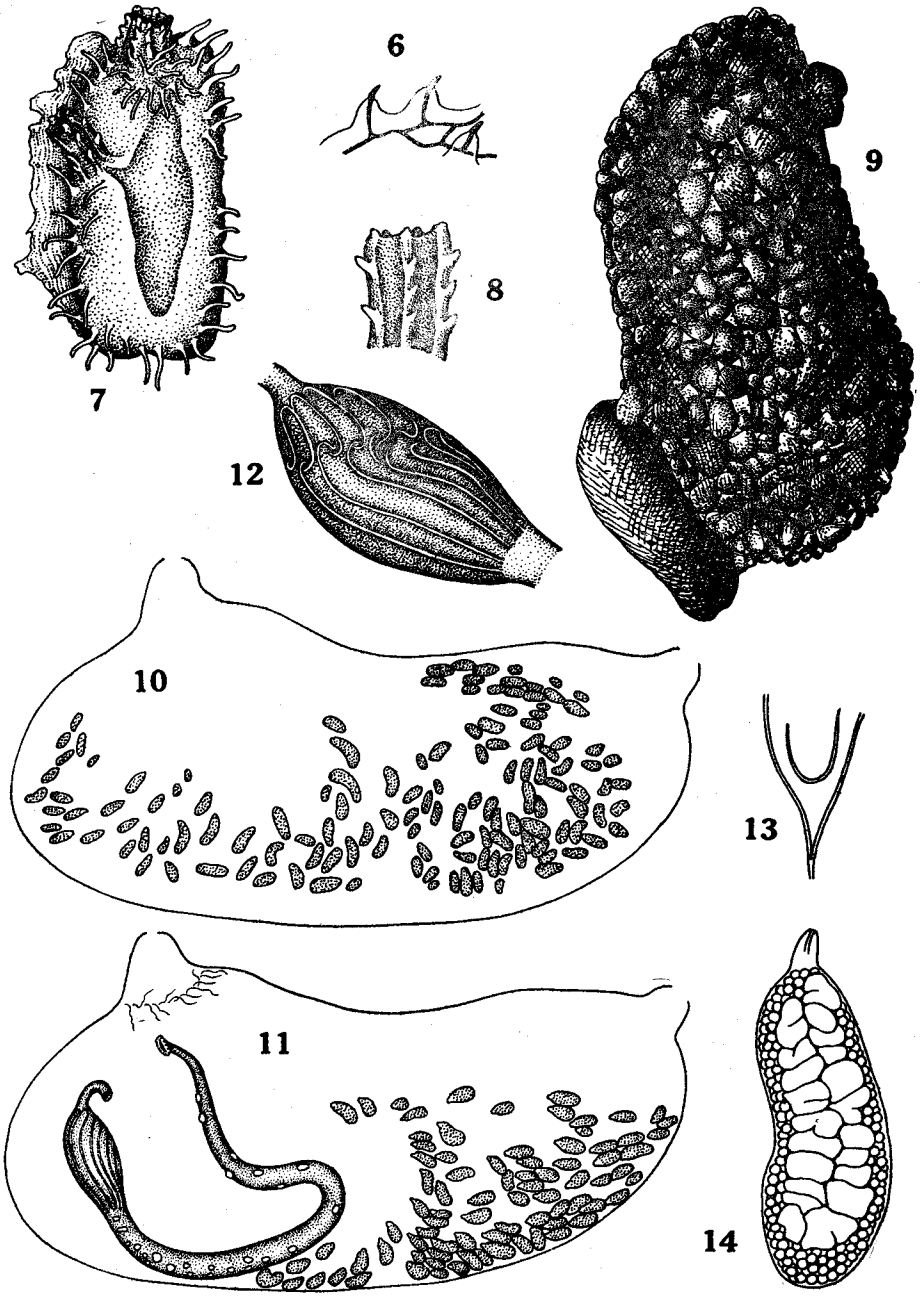

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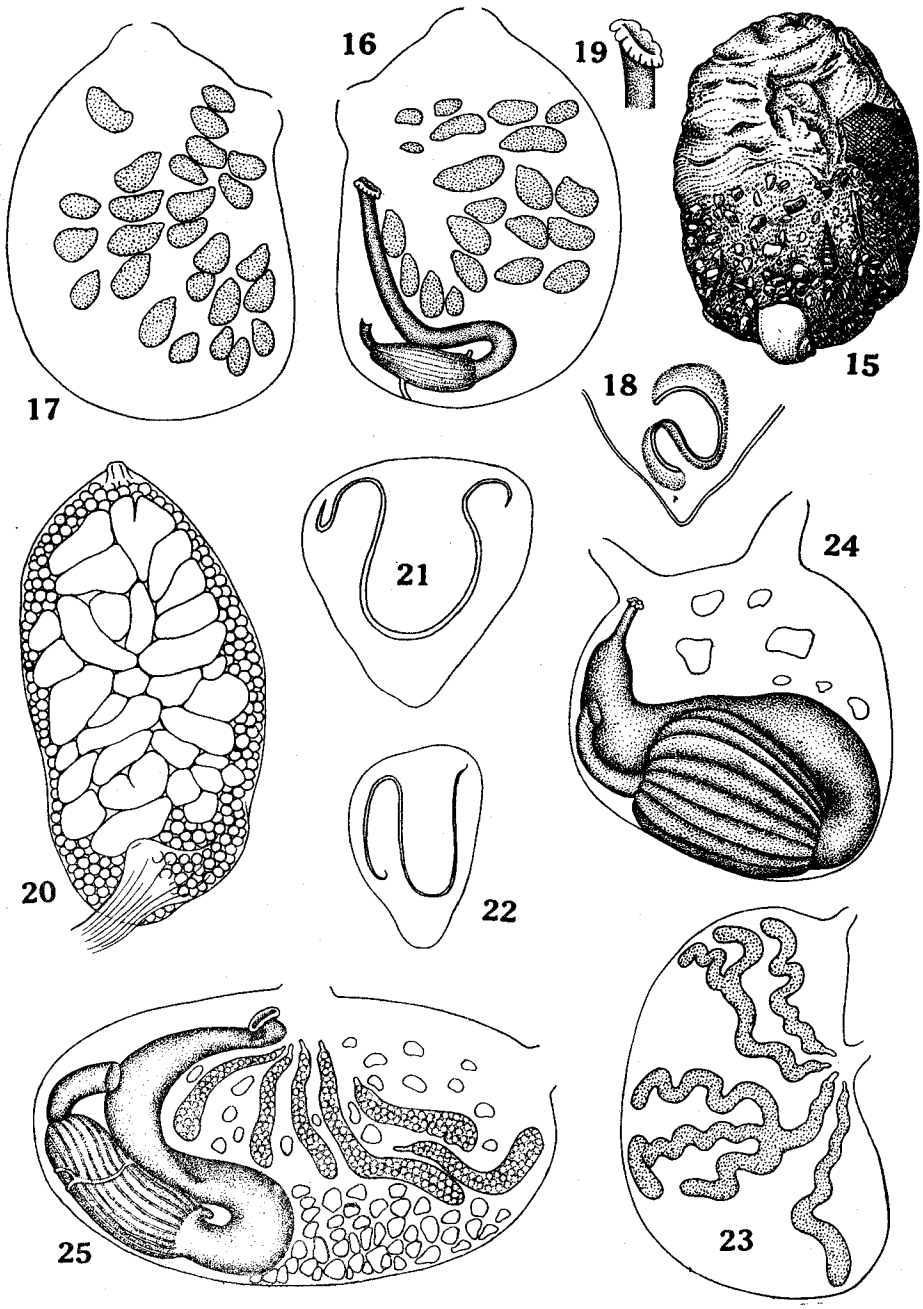

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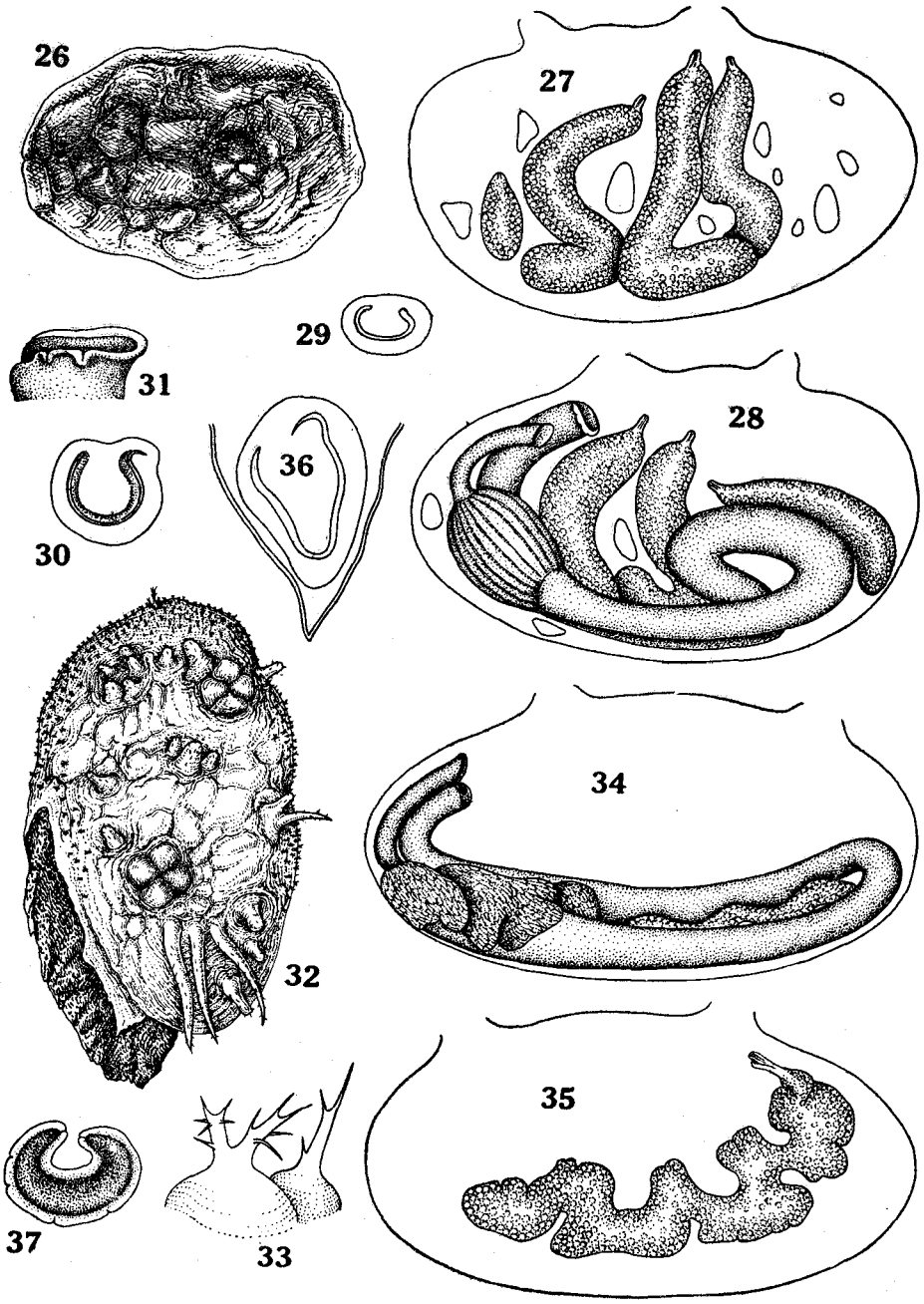

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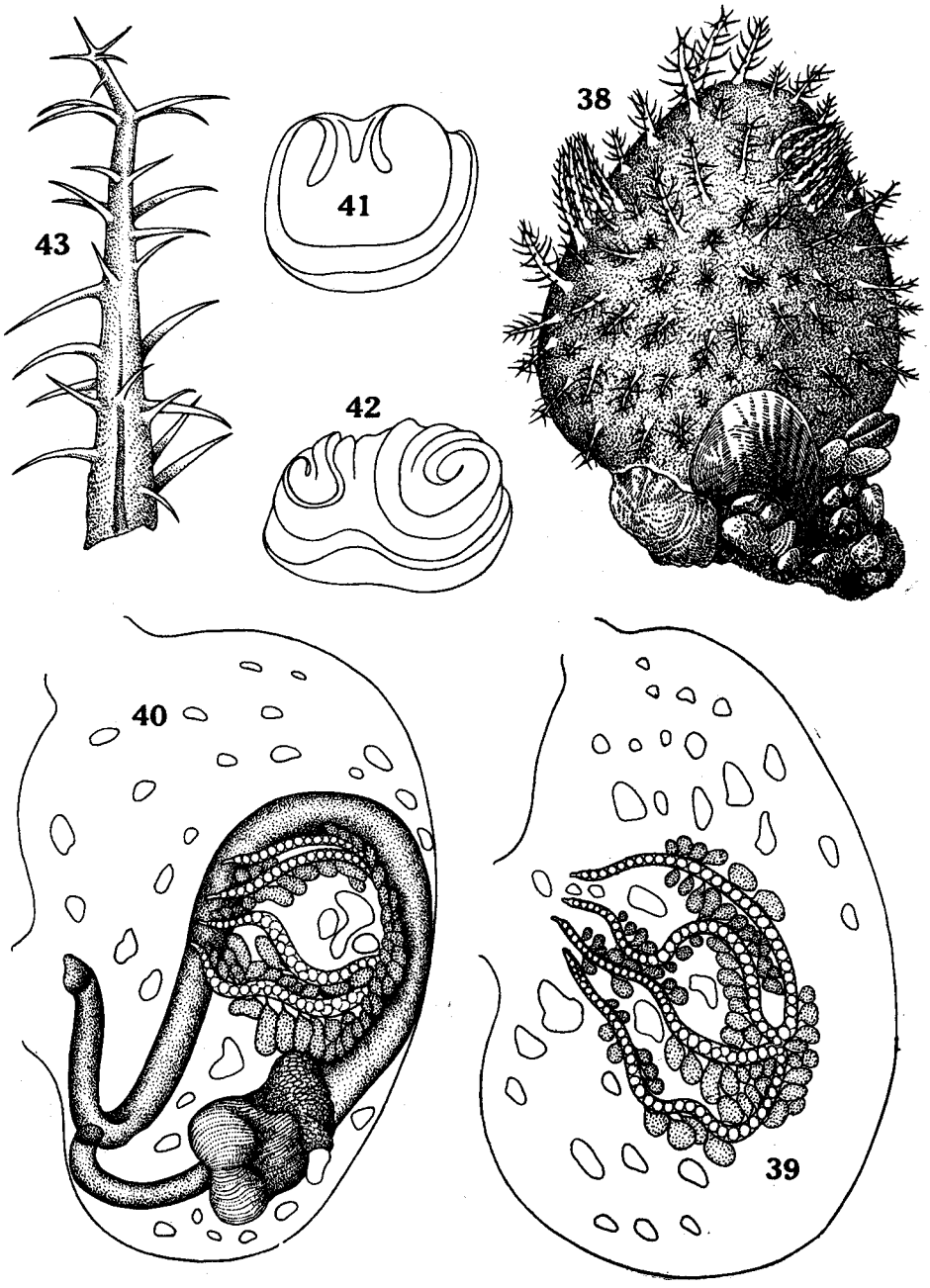

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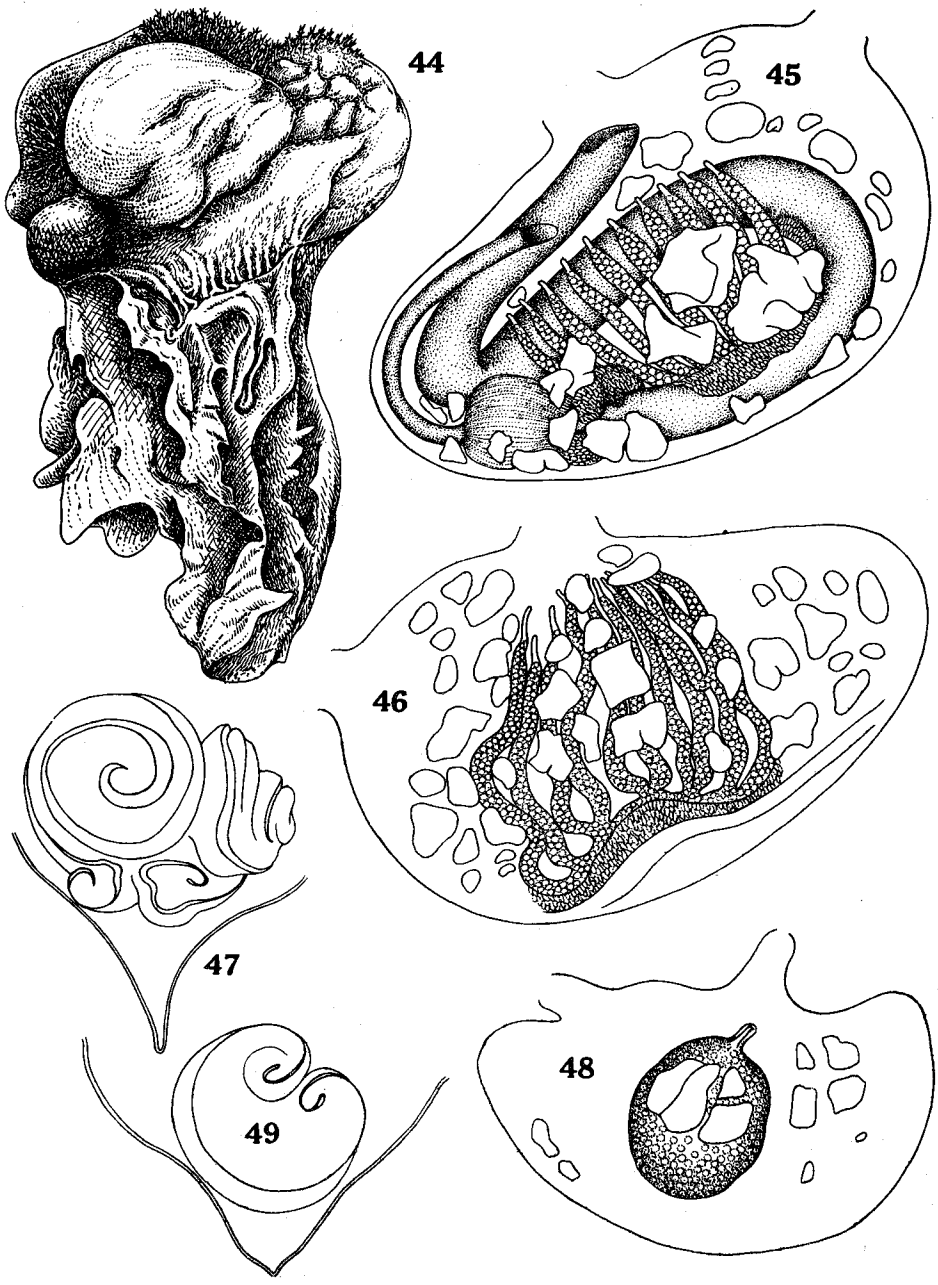

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