

Some Ascidians Dredged around the Oki Islands, the Japan Sea

By

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西川輝昭*: 隠岐諸島周辺でドレッジにより採集されたホヤ類

Participating in the survey programme "Natural History Researches of the Hokuriku and San-in Districts" of the National Science Museum, Tokyo, the author was fortunately given a chance to examine a number of ascidians dredged at 30–55 m deep off Dôgo Island, the Oki Islands in the Japan Sea.

Material

The material consists of the specimens dredged by the research vessel "Galathea" of the Oki Marine Biological Station of Shimane University on September 9–12, 1985 at the following 6 stations off SW coast of Dôgo Island:

- St. 1 – Off Tsuma to Ombejima Islet, 36°10.17'N and 133°13'E, 47–55 m deep, Sept. 9, 1985, 5 hauls,
- St. 2 – Off Tsuma to Uzuhana Point, 36°10.20'N and 133°14–15'E, 55–40 m deep, Sept. 10, 1985, 5 hauls,
- St. 3 – E off Kamishima Islet to off Nukaya, 36°09'N and 133°16'E, 30–45 m deep, Sept. 11, 1985, 2 hauls,
- St. 4 – Off Kamio, 36°09.66'N and 133°17.22'E, 30–35 m deep, Sept. 11, 1985, 2 hauls,
- St. 5 – W off Tsuma, 36°10.29'N and 133°13.52'E, 35–45 m deep, Sept. 12, 1985, 3 hauls,
- St. 6 – SSE off Shijikijima Islet, 36°08.53'N and 133°14.36'E, 35–45 m deep, Sept. 12, 1985, 1 haul.

After careful examinations, the material was classified into the following 24 species; 7 of which with asterisk(s) are recorded for the first time from the Japan Sea area inclusive of the Korea- and Tsushima Straits, and contain 3 species (with a single asterisk) new to Japan; the number of individuals collected at respective stations is given in parentheses.

List of Species Identified

Family Polycitoridae

1. *Sycozoa kanzasi* (OKA): Stn. 6 (one).

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Family Cionidae

2. *Rhopalaea crassa* (HERDMAN): Stn. 1 (several).

Family Ascidiidae

3. *Ascidia sydneiensis samea* OKA: Stn. 1 (one).
 *4. *Ascidia austera* SLUITER: Stn. 1 (one).
 **5. *Ascidia matoya* TOKIOKA: Stn. 1 (one).
 6. *Ascidia* (?) *aenigmatica* n. sp.: Stn. 2 (three).

Family Corellidae

7. *Rhodossoma turcicum* (SAVIGNY): Stn. 2 (two).
 8. *Corella japonica* HERDMAN: Stn. 5 (one).

Family Styelidae

9. *Polycarpa cryptocarpa kroboja* OKA: Stns. 2, 4, 5 and 6 (one on each).
 10. *Polycarpa doederleini* var. *siranuhi* TOKIOKA: Stns. 2 and 3 (two on each).
 *11. *Polycarpa aurita* (SLUITER): Stn. 2 (two).
 12. *Polycarpa maculata* HARTMEYER: Stns. 2 (four) and 5 (one).
 13. *Cnemidocarpa areolata* (HELLER): Stns. 1 (ten), 2 (twenty-one), 3 (three) and 5 (seven).
 14. *Cnemidocarpa fertilis* f. *minor* TOKIOKA: Stn. 3 (eight).
 *15. *Cnemidocarpa* sp. cf. *javensis* MILLAR: Stn. 4 (one).
 16. *Styela coriacea* (ALDER et HANCOCK): Stns. 1 (one), 2 (four) and 5 (two).

Family Pyuridae

17. *Pyura vittata* (STIMPSON): Stn. 1 (one).
 18. *Pyura lignosa* MICHAELSEN: Stn. 2 (five).
 19. *Herdmania momus* (SAVIGNY): Stns. 1 (twenty), 2 (eight), 3 (one), 4 (two), 5 (fourteen) and 6 (one).
 **20. *Boltenia transversaria* (SLUITER): Stn. 3 (one).
 21. *Halocynthia roretzi* (DRASCHE): Stn. 2 (one juvenile).
 **22. *Halocynthia igaguri* TOKIOKA: Stns. 2 and 5 (two on each).
 23. *Microcosmus hartmeyeri* OKA: Stn. 2 (two).

Family Molgulidae

- **24. *Molgula hartmeyeri* OKA: St. 4 (one).

Ascidia (?) *aenigmatica* n. sp., once recorded from Hakodate under the name of *Ascidia granosa*, is so far limited to the Japan Sea. Of the species recorded for the first time from this sea area, *Ascidia austera* and *Polycarpa aurita* have ever been recorded exclusively from the tropical region of the West Pacific, and *Boltenia transversaria* also from that region as well as from the Ariake Sea, west of Kyushu, Japan. On the other hand, *Ascidia matoya*, *Halocynthia igaguri* and *Molgula hartmeyeri* have been so far recorded from the coast of the Kii Peninsula, the Inland Sea of Seto and near the Gotô Islands, west of Kyushu, and were rediscovered after a lapse of 37, 33 and 72 years respectively. The specimen referred in the present study to *Cnemidocarpa* sp. cf. *javensis* is of a tentative taxonomic assignment at present, and therefore is fully described for future studies, as well as the new species. All the specimens examined are to be deposited in the National Science Museum (Natural His-

tory), Tokyo, excepting the holotype of *A. (?) aenigmatica* n. sp. that is kept at the Seto Marine Biological Laboratory of Kyoto University.

Before going into descriptions, the author would like to express his sincere thanks to Dr. Minoru IMAJIMA of the National Science Museum, Tokyo who gave him a chance to examine the present material, and to Prof. Masami OOUJI and other members of the Oki Marine Biological Station for every facility during his stay, especially to Mr. Hiroshi SAITO for his skillful dredging. Thanks are also due to Drs. D.H.H. KÜHLMANN of the Museum für Naturkunde der Humboldt-Universität zu Berlin (MNB) and A.C. PIERROT-BULTS of the Zoölogisch Museum, Universiteit van Amsterdam (ZMA) for the loan of type or other specimens. Dr. Takasi TOKIOKA so kindly read the manuscript critically, to whom the author's very hearty gratitude is expressed here.

Descriptions of a New Species and a Rare Form

Ascidia (?) aenigmatica n. sp.

(Fig. 1)

Ascidia granosa: HARTMEYER, 1906, p. 21 (part?, at least the specimens from Hakodate).
Nec *Ascidia granosa*: SLUITER, 1904, pp. 36-37, pl. 5, fig. 11-14; HASTINGS, 1931, p. 80.

Type series. The holotype, 44 mm long and up to 25 mm wide, was dredged at St. 2 and deposited at the Seto Marine Biological Laboratory, Kyoto University (SMBL Type No. 339). Other two specimens, 47 mm long \times up to 27 mm and 56 mm \times to 30 mm respectively and dredged at the same station mentioned above, designated as the paratypes and deposited in the National Science Museum (Natural History), Tokyo (NSMT-Pc 683).

Description. Body roughly elongated oval in outline and much compressed; the surface covered wholly and densely with sand grains, shell debris and coral(?) fragments. Manner of attachment to the substratum unknown. Both siphons indistinct; branchial aperture terminal, while the atrial slightly anterior to the middle of body. Test tough, transparent and colourless, impregnated densely with the similar foreign matters as those carried on the surface, 2 mm thick or more; without any projections or filaments to gather those matters; test vessels branched very frequently, containing pale brownish pigments. Mantle very thin, fragile, usually furnished with reticulated vessels marked with or containing brownish pigments. It is attached so firmly to test, but leaving the right ventral side furnished with muscles, that it was impossible to take the mantle body out of the test without a heavy injury on the left dorsal side; this might cause some injuries at the time when the specimens are collected (Fig. 1, B). Mantle musculature consists of thick or thin transverse bundles densely arranged in a vertical array along the right side of endostyle, but leaving a considerably wide space free from any muscles to both the dorsomedian and endostyle (Fig. 1, A-B). In the 47 mm long paratype, several muscle fibres are branched off from a few thick bundles in the anterior one-third of the row and extending anteriorly over the transverse musculature. Siphonal musculature composed of fine circular fibres just around each aperture and short radial ones seemingly limited to the distal half of each siphon. Tentacles

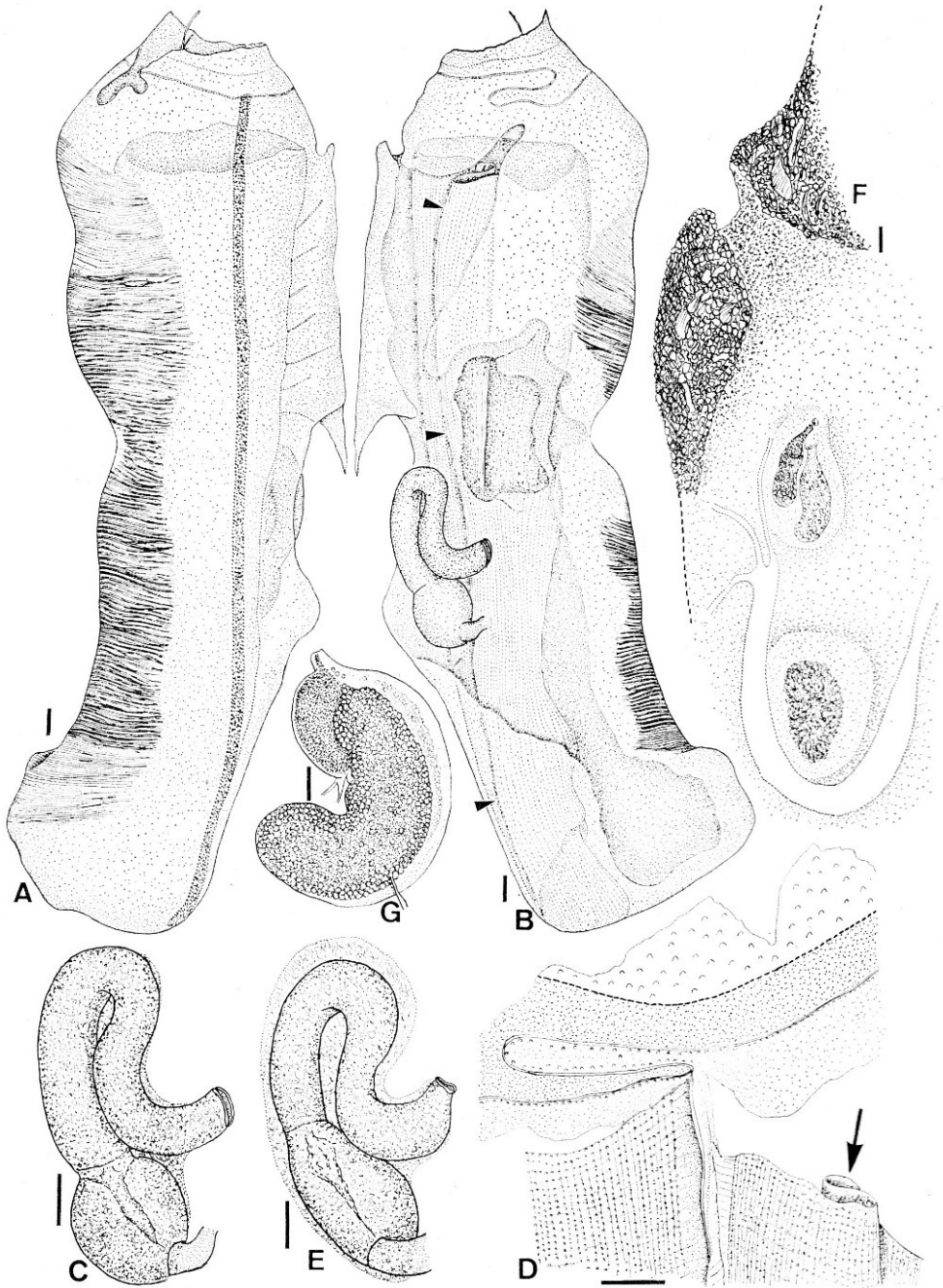


Fig. 1. *Ascidia(?) aenigmatica* n. sp., dredged around Oki Islands. A–C: Holotype (SMBL Type No. 339). D–F: 56 mm long paratype (NSMT-Pc 683). G: 47 mm long paratype (NSMT-Pc 683). A: Right ventrolateral side of mantle body. B: Left dorsolateral side of mantle body, arrowheads showing the position of dorsal lamina. C and E: Alimentary systems covered with mesenchymal tissue. D: Inner view of the anterodorsal part of branchial sac, reconstructed from several fragments; arrow indicating the branchial fold on the left side; tentacles removed to show the curved peripharyngeal band clearly. F: Gonad-like structure embedded in test near the posterior base of atrial siphon, for details see the text. G: Ovary of the gonad-like structure. Scales indicate 1 mm.

well developed: about 50 or more and of various sizes. Prebranchial zone densely papillate. The left peripharyngeal band is curved in deeply onto the right side just before it reaches the dorsomedian (Fig. 1, D), though in the 47 mm long specimen only a small part of this incurve is remained. Neither ciliated groove, dorsal ganglion, neural gland nor neural duct detected. The anterior-most part of branchial sac missing in the holotype and 47 mm long paratype, but seemingly remaining in the 56 mm long paratype; there, a narrow, 3.0 mm long groove occupies the anterior end of dorsal lamina (Fig. 1, D). The lamina always weakly ribbed but smoothly-edged. A large branchial fold is formed exclusively on the left side along the dorsal lamina, anteriorly keeping a considerable distance but posteriorly very close to the lamina, then the lamina approaches to the denostyle posteriorly till these two organs are located very close to each other in the rear end of mantle body (Fig. 1, B). The mentioned structure seems obviously to represent a natural one, for it is supported by many mesenterial strands. About 80 inner longitudinal vessels on the left and 83 ones on the right in the holotype, and 76 and 79 on respective sides in the 56 mm long specimen; more than 150 and 180 transverse vessels in respective specimens; in the 47 mm long one any vessel number could not be read for heavy injury. Branchial papillae conspicuous, but without intermediate papillae; 2 to 3 stigmata, elongated longitudinally, in each mesh. Visceral mass very small, occupying roughly middle one-fifth of mantle body, and sited quite on the ventral side opposite the atrial siphon (Fig. 1, B). The mass is covered nearly completely, though not so thickly, with mesenchymal tissue; the first intestinal loop deep and narrow, while the second rather wide; rectum short; the axis of second loop passing through the pyloric end of stomach (Fig. 1, E) or the starting portion of intestine (Fig. 1, C). No gonads found in visceral mass. Instead, a gonad-like structure is always found embedded completely in the thin inner layer of test, devoid of foreign matters, in a small area just posterior to the posterior base of atrial siphon, though somewhat injured and become obscure in the holotype. The structure seemingly consists of one or two small ovaries, and a small mass of testicular follicles (?) situated somewhat posteriorly to ovaries (Fig. 1, F); aperture(s) are recognizable on the inner surface of test near the ovaries. The structure seems matured only in the 47 mm long specimen; the ovaries stout sausage-shaped and full of eggs, about 250 μ m in diameter; and their anterior part is accompanied each with the distal portion of vas deferens, full of sperms in the case of one ovary (Fig. 1, G). Unfortunately, however, any structural connection cannot be confirmed between these distal parts of vas deferens and the mass of testicular follicles(?) in the present material. Further, it remains questionable whether those gonad-like structures open really into the peribranchial cavity, for instance through the aperture(s) mentioned above.

Remarks. The features that the body is covered with foreign matters, the mantle musculature is limited to the right side and consisting of only transverse fibres, and that the small visceral mass is sited around the level of the middle of body in the present specimens are reminiscent of *Ascidia granosa* SLUITER. So far as the original description is concerned, however, the holotype of this species must be different from the present specimens, as in the former the dorsal lamina and visceral mass are sited in their usual position and never ventrally displaced, the peripharyngeal band is never curved in deeply around the dorsomedian, the

“klein und hufeisenförmig” ciliated groove is found clearly, no branchial fold is formed and the gonad occurs within the first intestinal loop. In order to confirm these features in the original description, the holotype collected from the Flores Sea, 73 m deep and deposited at ZMA (TU 267.8; see SPOEL, 1969, p. 161) was reexamined. Unfortunately, in the holotype, the test has been largely injured, the mantle body is cut into many small pieces and the visceral mass is missing completely, but only it was barely detectable on the basis of several fragments, that the mantle musculature consists really of transverse fibres. Thus at present, the figure of *A. granosa* can be made up only of the features in its original description and then its holotype should be regarded as distinct from the present specimens from Oki. Later, with a very insufficient description, HARTMEYER (1906) recorded *Ascidia granosa* SLUITER from Sagami Bay, 180 m deep, on the Pacific side of Japan, and Hakodate on the Japan Sea coast of Hokkaido. The author was given a chance to examine HARTMEYER's material from Hakodate deposited at MNB. It consists of four specimens, 57–87 mm long. The larger two are devoid of mantle body, while in the rest the mantle body is badly preserved, missing its dorsal half or more and the whole visceral mass. So far as the features confirmable in them are concerned, these specimens may be quite similar to the present specimens from Oki as follows. In the specimens from Hakodate, the test is wholly and densely impregnated with foreign matters, the mantle musculature on the right side consists only of transverse bundles arranged in a rather extensive longitudinal row, tentacles about 60 or 80, dorsal lamina smoothly-edged, and above all the gonad-like structure occurs, though more or less injured, in quite similar features as in the present specimens from Oki. Thus, HARTMEYER's specimens from Hakodate may safely be regarded here as conspecific with those from Oki. As the author has not yet given any chance to examine HARTMEYER's specimens from Sagami Bay mentioned above, as well as the specimens collected from Australia and referred to *A. granosa* by HASTINGS (1931), these two materials may better be treated at present as not conspecific with the specimens from Oki.

The gonad-like structure found embedded completely in the test in the present specimens from Oki and those from Hokkaido is quite unique, but never unnatural, among the whole simple ascidians of Enterogona and Pleurogona, though this is a usual feature in some compound ascidians. So these specimens cannot be assigned to any hitherto known families, if, of course, this structure can be proved inherent in them and the gonadal feature can be accepted taxonomically so significantly. Although the present author is inclined to believe this, the possibility cannot be still ruled out that the structure might represent a part of another (parasitic?) animal. Very unfortunately, however, the present specimens are rather scarce and preserved rather poorly to examine more crucially the nature of their gonad-like structure and the details of some significant organs such as the ciliated groove, dorsal ganglion and the neural duct. Disappearance of these neural structures must be of much more significance than the move of gonads into the test, though such a regressive phenomenon, if this is proved true, will be of a great interest from the ecological and physiological view points, this might afford some clue for the explanation of some aberrant simple ascidians. Under these circumstances, the author wishes at present to avoid to establish a new family or a new genus for these specimens from the Japan Sea, that are then assigned here only

tentatively to the genus *Ascidia*, for their main features, excepting those of the gonads, are well consistent with those in the definition of this genus. And further discussions regarding the systematic position of the present specimens in question may better be left pending here, until some well-preserved specimens are obtained in future.

Among numerous species of *Ascidia* and related genera, there are found some ones in which the gonad is sited more or less apart from the visceral mass as seen in *Ascidia lapidosa* SLUITER so far recorded from Siboga area by SLUITER (1904, pp. 32–34) and *Plurella elongata* KOTT from South Australia by KOTT (1973). In these two species, however, the gonads are attached to or embedded in the mantle wall, but never in the test as seen in the present specimens from the Japan Sea.

Putting aside the gonadal features noted above, the present specimens from Oki are similar to *Ascidia aclara* KOTT hitherto recorded from Australia by KOTT (1952, pp. 309–310; 1972a, pp. 27–28; 1972b, pp. 236–237; 1975, p. 11) and MILLAR (1963, pp. 721–722) in the feature of test encrusted with foreign matters, the existence of an intrinsic branchial fold developed very well on the left side and the peripharyngeal band deeply curved in around the dorsomedian. The former may, however, be easily distinguishable from the latter mainly by the body shape, compressed rather laterally, instead of depressed dorsoventrally in the latter, the mantle musculature consisting of transverse fibres densely arranged in an extensive longitudinal row only on the right side, instead of comprising fibres rather sparsely running across the dorsal part or consisting of 3 narrow bundles of transverse fibres on each side in the latter, the dorsal lamina posteriorly markedly displaced ventrally, instead of situated roughly on the dorsomedian along the whole length in the latter and the visceral mass occupying only the middle one-fifth of the ventral part of mantle body, instead of occupying about two-thirds or more of the dorsal part in the latter. Further, in *A. aclara*, “the gut and gonads all form a tight visceral mass embedded in the thickened body wall” (KOTT, 1972b, p. 236). Thus, the present specimens from Oki are evidently regarded to represent a new species, to which the specific name *aenigmatica* is proposed after its enigmatic features seen in the structure of gonads, branchial sac and visceral mass.

Cnemidocarpa sp. cf. *javensis* MILLAR, 1975

(Fig. 2)

Description. A 6 mm long specimen in the material. Body nearly round in outline and much depressed; attached to a shell fragment by several rooty tufts arranged along the periphery of the attachment side; each tuft composed of 2–10 fine but tough projections issuing from the short stem. Test surface coated wholly and densely with sand grains; test itself very thin, but rather tough, transparent and colourless. Both siphons indiscernible; branchial aperture located roughly at the anterior one-fourth of body, while the atrial at the posterior one-fourth; both on the dorsomedian. Mantle thin but rather tough, transparent to translucent and furnished densely and evenly with very fine muscle fibres. Both vela less developed. Tentacles about 20; larger and smaller ones alternating almost regularly; ciliated groove as a longitudinal slit curved slightly (Fig. 2, C). Nine stigmatal rows

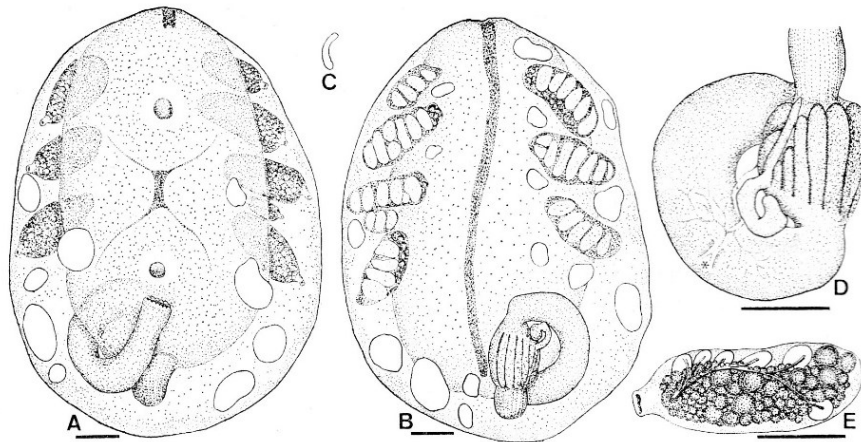


Fig. 2. *Cnemidocarpa* sp. cf. *javensis* MILLAR, 6 mm long specimen from the Oki Islands. A: Dorsal half of mantle body. B: Ventral half of mantle body. C: Ciliated groove. D: Ventral side of alimentary system, vessel with an asterisk leading to mantle. E: A gonad, free surface. Scales indicate 0.5 mm.

on the left, while 10 on the right; 3 and 4 rudimentary branchial folds on the left and right sides respectively; the formula is:

L.D. 0 (6) 0 (5) 0 (3) 0 V.

R.D. 0 (7) 0 (3) 0 (7) 0 (3) 0 V.

Parastigmatic vessels present. Dorsal lamina as a low membrane with smooth edge. Atrial tentacles well developed in a single ring. A moderate number of endocarps over the inner surface of mantle. Visceral mass occupies roughly posterior one-third of mantle body, with the anterior margin reaching at the level between 2nd and 3rd stigmatal row counted from posterior; alimentary canal depressed and deformed as usually seen in *Symplegma* (Fig. 2, A-B). Stomach globular, provided with about a dozen longitudinal plications, of which one or two on either sides of typhlosole converging anteriorly to the latter; pyloric coecum very conspicuous and curved markedly in C shape with the widened distal portion, connected by mesenteric membrane wrapping the proximal half of coecum to the intestine around the bottom of the first loop (Fig. 2, D). Both intestinal loops deep. Three and 5 gonads on the left and right sides respectively, arranged along, but somewhat apart from the endostyle; attached firmly to the mantle wall by wide surface. Each gonad more or less elongated, situated roughly perpendicularly to endostyle with the aperture to dorsal, all fully matured; up to 8 testicular follicles arranged usually in a single row on the whole attachment side; oviduct opening terminally, the aperture of vas deferens close to it (Fig. 2, E).

Remarks. The present specimen resembles *C. rhizopus* (REDIKORZEV) ever recorded from the Arctic and Subarctic waters (see VAN NAME, 1945, p. 266) in the body appearance, encrusted with sand grains and furnished with several attachment tufts, more or less rudimentary branchial folds and in having markedly curved pyloric coecum. However, the two forms differs distinctly from each other mainly in that the body is never depressed and the alimentary system is very extensive in the latter. The deformation of alimentary system

like *Symplegma* in the present specimen may be reminiscent of *Cnemidocarpa lemchei* MILLAR so far recorded from East Pacific, 3570 m deep by MILLAR (1978) and *C. rectofissura* MILLAR from near Macquarie Is., New Zealand, 174 m deep by MILLAR (1982, p. 74). The former is, however, distinguishable clearly from the latter two mainly by gonadal feature (with only a single, longitudinally elongated gonad on each side in the latter two).

The present specimen from Oki may agree well with *C. javensis* MILLAR recorded from Bali Strait, Indonesia, 50–150 m deep by MILLAR (1975, pp. 299–301) in having the test sand-encrusted and furnished with rooty processes on the attachment side, the size and arrangement of alimentary system including conspicuous pyloric coecum, and in the distribution and structure of gonads. On the other hand, in the latter, the test consists of inner and outer layers, both impregnated densely with sand, but readily separable from each other; no atrial tentacles are found; and the branchial sac is furnished with 4 low folds on each side and 3–5 longitudinal vessels in respective interspaces. Although the formation of soft collagenous inner layer or separable tough parchment-like layer is met with in some species and the details of the branchial formula may be variable to some extent, the above-mentioned differences might possibly be of some taxonomic significance. Therefore, the specimen in question may better be regarded as not definitely conspecific with *C. javensis*. At present, the former is recorded here as *C. sp. cf. javensis* and further discussions regarding its taxonomic affiliation is left pending for future studies, until more materials are obtained from various localities.

摘 要

1985年9月に隠岐諸島の島後南西沖深さ 30~55 m からドレッジされたホヤ類は7科24種に分類された。このうち新種としてここに記載した *Ascidia* (?) *aenigmatica* はすでに HARTMEYER (1906) により函館から *Ascidia granosa* として記録されたものと同一種とみなしてよいことが、彼の標本との比較検討により判明した。また **Ascidia austera*, *A. matoya*, **Polycarpa aurita*, **Cnemidocarpa sp. cf. javensis*, *Boltenia transversaria*, *Halocynthia igaguri* および **Molgula hartmeyeri* の7種は日本海新記録。うち*印で示した3種は日本新記録であった。新種 *A. (?) aenigmatica* は生殖腺が筋膜体から一見完全に独立して被嚢に埋まりこむ点で単体ボヤとしては極めてユニークであり、これに基づいて新科新属をたてることも可能に思われる。さらに脳神経複合体を欠くらしい点でも他に類をみない。しかし標本が不完全であるため、これらのユニークな特徴が本種に本来そなわったものであるかどうかについて疑問の余地が全くないわけではない。これらの特徴を別にすれば本種は全体として *Ascidia* 属によく似ているので、ここでは仮にこの属に位置づけた。分類学的位置の厳密な検討は完全な標本の入手をまちたい。本種は鰓嚢左側によく発達したひとつの褶をもつ点でも特異であり、この点ではオーストラリア産の *A. aclara* と類似するが、いくつかの重要な差違により両者は明瞭に区別される。あわせて、インドネシア産の *Cnemidocarpa javensis* と類似するが同一種と断定しかねる標本を *C. sp. cf. javensis* として詳しく記載した。

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