REPORT OF THE BIOLOGICAL SURVEY OF MUTSU BAY
33. ACTINIARIA OF MUTSU BAY*

By

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(With Plate XI and thirty figures)

(Received November 7, 1938)

This paper is mainly based on an examination of specimens of actinians collected in connection with the biological survey of Mutsu Bay carried out during the summers of 1926 and 1927, and partly on specimens obtained from time to time by Profs. S. Hôzawa and S. Kokubo, and Messrs. H. Satô and I. Nonaka. Observations of living specimens of some common species were made during the present writer's stay at the Asamushi Marine Biological Station in the summers of 1925, and 1927. These species being common in other localities of Japan, they have together with some from these other localities been subjected to careful comparative investigation during the past ten years. The collection includes 13 species belonging to 10 genera and 7 families. Among them, the large actinians *Anthopleura stella* and *Anthopleura japonica* are commonly found on rocks and between crevices near the tidal lines; *Anthopleura xanthogrammica* occurs frequently in slightly deeper portions, almost buried in mud, while several dozen small red actinians, *Anthopleura pacifica* n. sp. are often arranged in rows between fissures in rocks. *Diadumene Luciae* is in most cases found in great numbers on and beneath the shingle on the sea-shore. Several colour varieties of *Epiactis prolifera* and *Metridium sensile* var. *fimbriatum* usually form coloured sheets in shallow pools and depressions. A single specimen of the swimming actinian, *Boloceroides mc murrichi* was found in this bay. This species occurs very commonly on the southern coasts of Japan among sea-weeds, attached to or swimming about among the plants. The four abasilar species, *Peachia quinquecapitata*, *Eloactis mazelii*, *Harenactis attenuata* and *Andwakia hozawai*, were found buried in sand at levels deeper than the tidal lines, but the larvae of *P. quinquecapitata* are parasitic on several species

* Contribution from the Marine Biological Station, Asamushi, Aomori-ken, No. 159.

of Hydromedusae. Besides the actinians above mentioned, a single specimen of *Neophellia mutsuensis* n. g. et n. sp. was obtained at some depth off Urata. On reviewing the species of this survey, the actinians of the bay are mostly representatives of those of the North Pacific, which have hitherto been recorded as existing in North America, Canada and Alaska, but *Andwakia hozawai*, *Anthopleura pacifica* n. sp. and *Neophellia mutsuensis* n. g. et n. sp. are found only in Japan. The occurrence of *A. hozawai* must be especially noted, because the genus *Andwakia* has hitherto been represented only by a single species, *mirabilis*, found in the Northern parts of Europe. *Neophellia mutsuensis* n. g. et n. sp. is the actinian which has some external resemblances to the Phellidae but from the internal features, must belong to the Paractiidae. *Boloceroides mc murrichi* was found as a tropical immigrant. This species is widely distributed in the distant tropical Pacific and Indian Oceans as far as Zanzibar, Africa and the Suez Canal.

With the publication of this paper the writer wishes to express his cordial thanks to Prof. S. HÔZAWA, Dr. S. KOKUBO and Mr. H. SATÔ for putting specimens at the writer's disposal and for items of important information about some actinian species. For the photomicrographs here given the writer is extremely grateful to Mr. H. YAMAGUCHI of this Institute. A part of the work was carried out through a grant from the Foundation for the Promotion of Scientific and Industrial Research in Japan.

Tribe NYNANTHEAE

Subtribe BOLOCEROIDARIA

Family **BOLOCEROIDIDAE**

1) **Boloceroides mc murrichi** (KWIETNIEWSKI)

Subtribe ATHENARIA (Abasilaria)

Family **HALCAMPOIDAE**

2) **Peachia quinquecapitata** MC MURRICH
3) **Eloactis mazelii** (JOURDAN)
4) **Harenactis attenuata** TORREY

Family **ANDWAKIIDAE**

5) **Andwakia hozawai** UCHIDA

Subtribe ENDOMYARIA

Family **BUNODACTIIDAE**

6) **Anthopleura stella** (VERRILL)
7) **Anthopleura xanthogrammica** BRANDT
8) **Anthopleura japonica** VERRILL
9) **Anthopleura pacifica** n. sp.
10) **Epiactis prolifera** VERRILL

Subtribe INERMIA

Family **PARACTIIDAE**

11) **Neophellia mutsuensis** n. g. et n. sp.

Subtribe ACONTIARIA

Family **DIADUMENIDAE**

12) **Diadumene Luciae** (VERRILL)

Family **METRIDIIDAE**

13) **Metridium sensile** var. **fimbriatum** VERRILL

Subtribe BOLOCEROIDARIA

Family **BOLOCEROIDIDAE**

Boloceroides mc murrichi (KWIETNIEWSKI)

Boloceroides mc murrichi: CARLGREN, 1900, pp. 16–18; —. 1924, p. 16; UCHIDA, 1938, Ann. Zool. Jap., vol. 17, pp. 623–635.
Boloceroides sp.: OKADA, 1930, pp. 708–713; KOMORI, 1931, pp. 55–62, pl. 4; OKADA et KOMORI, 1932, pp. 164–199;
Bolocera mc murrichi: KWIETNIEWSKI, 1898, pp. 394–395.
Gonactinia sp.: OKADA, 1926, pp. 482–486.

A single specimen was obtained by Mr. I. NONAKA in 1925 at Asamushi. This actinian is very well-known in Japan on account of its swimming habit and is quite common along the Pacific coasts of Japan from Misaki southwards, but it is probably rare in Mutsu Bay. The species is widely distributed in the Pacific and Indian Ocean regions, such as the Japanese coasts including the Bonin Islands, Caroline Islands, Thursday Island, Amboyna Island and Zanzibar in East Africa. *Boloceroides hermaphroditica* found in Zanzibar and the Suez Canal seems to be a

hermaphrodite form of this species, because the latter is only different from the type species in sexual conditions.

Subtribe ATHENARIA
Family **HALCAMPOIDAE**

Peachia quinquecapitata Mc MURRICH
(Textfigs. 1–4)

Peachia quinquecapitata: Mc MURRICH, 1913, Proc. Zool. Soc. London, p. 963, pl. 98, figs. 1–4; UCHIDA, 1932, Proc. Imp. Acad., vol. 8, p. 318, fig. 1.
Peachia sp.: UCHIDA, 1928, Proc. Imp. Acad., vol. 4, p. 67, figs. 1–2.
Bicidium aequoreae: Mc MURRICH, 1913, Proc. Zool. Soc. London, p. 967, pl. 98, figs. 5–7.

The adult actinian is commonly found burrowing in sand with no formation of any shell-like substance round it, but the young is ectoparasitic on some Hydromedusae, such as *Aequorea coerulescens* and *Catablema multicirrata*.

Adult. The column is cylindrical terminating in a slightly contracted physa, measuring about 35 mm long and 10 mm wide in the widest portion. The surface is smooth, but when examined under a lens, it is finely granulated. All the examples so far examined have no foreign material adhering to them. The body wall is very thin, and shows clearly 12 opaque lines of insertion of the perfect mesenteries. The tentacles are 12 in number and bilaterally arranged in a single circlet. They are short, thick, tapering at the tip but not capitate. The oral disc is not particularly wide. The actinopharynx is long and provided with a siphonoglyphe. The surface of the stomatodaeum is longitudinally grooved along the lines corresponding to the insertions of the mesenteries. The lips are roundly elevated, representing ten folds, five on each side, which correspond to the intervals between the perfect mesenteries, leaving the conchula on the line of the siphonoglyphe. The conchula is surmounted by five nipple-shaped processes which consist of two pairs lying on either side of the conchula and a larger median one situated between them on the sagittal plane of the body. The scapus is of the same width, becoming slightly narrow towards the physa. The physa is devoid of basal disc but is furnished with a central pore, round which several small papillae are radially arranged.

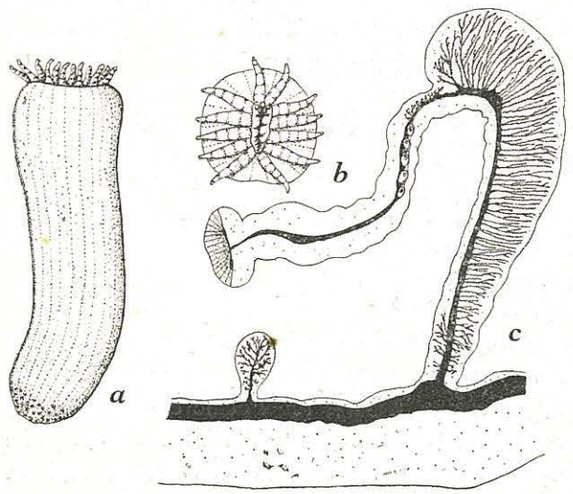

Fig. 1. *Peachia quinquecapitata* Mc MURRICH; a. Side view ×3/2; b. Oral view; c. Transverse section of mesenteries.

Anatomical aspects. The mesenteries are arranged in ten pairs, six of which are perfect, the other four being imperfect. Two of the perfect pairs are directives. Both perfect and imperfect pairs are arranged alternately in position with the exception of the median perfect one which is located between two perfect pairs.

The perfect mesenteries alone are fertile, and each is provided with a mesenterial filament. They are furnished with a well-developed long muscle band composed of numerous narrow laterally arranged branches, which again are repeatedly divided into still smaller ones. The muscle pennons are almost similar in width along the whole length, and are rather diffuse, though the axial portion is a little widened. The longitudinal pennons and the parietal muscles fuse together without distinct limits. The gonads develop in the mesenteries proximal to the muscle bands, eggs and testicular vesicles being arranged in a row in transverse sections. The imperfect mesenteries are small and almost oval in cross-section. They are each provided with an arborescent parietal muscle but destitute of mesenterial filaments. Specimens preserved in formalin generally retain a brown colour in the column and several transverse deep brown bands in each tentacle.

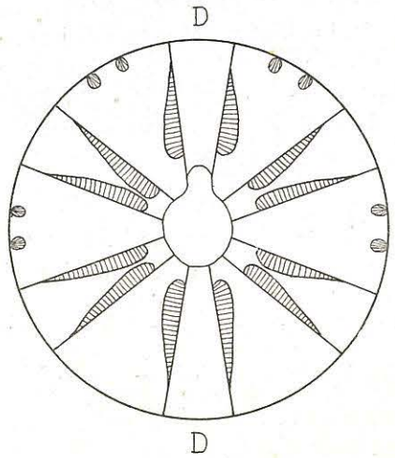

Fig. 2. Diagram of transverse section through the actinopharynx of *Peachia quinquecapitata* Mc MURRICH.

Young forms. The smallest young actinian obtained from the Hydromedusae is slightly larger than 1 mm in diameter. The larvae, 1–2 mm wide, are very flat and slightly convex aborally. The tentacles have not yet appeared but the peripheral margin is more or less undulating. Mouth elliptical, without siphonoglyphe, being situated in the central portion on the oral surface. There is no indication of longitudinal grooves and papillae on the side wall. In sections of these larvae, the mesogloea is thinner than the ectoderm and the endoderm, and devoid of longitudinal muscles and mesenterial filaments. The ectoderm cells are exceedingly high and full of numerous granules intensely stained by haematoxylin in their lower half, the endoderm cells being generally thickly granulated, but a few of them glandular, with a slightly widened head containing well-stained minute granules towards the inner side. Though not easily distinguished externally, eight tentacles are present, each being provided with an axial canal. In larvae, 2.5–3.5 mm in diameter, the upper margin is well-expanded, and is divided into 12 round tentacular lobes of different sizes bilaterally arranged. Along the column run eight longitudinal furrows, these indicating the lines of insertion of the mesenteries. The mouth, situated in the central portion of the oral surface, is provided with a siphonoglyphe but without a conchula. In the sections, the above-mentioned 12 tentacles, with the exception of the two directives, are arranged in five pairs. The lumens of the two tentacles adjacent to the directive tentacle which is opposite to the siphonoglyphe, are each connected with a chamber. The lumens of the two adjacent tentacles of the remaining eight open into a chamber, this resulting in the formation of two pairs of chambers. The four chambers thus formed are each provided with a short imperfect mesentery, which is to develop into a perfect one later. Mesenterial filaments are found in the old mesenteries. Longitudinal muscles are not developed in all the mesenteries. The siphonoglyphe extends deeply into the stomodaeum. The structure of the ectoderm, mesoderm and endoderm is almost similar to that described above. After these stages, the column gradually elongates aborally and becomes cone-

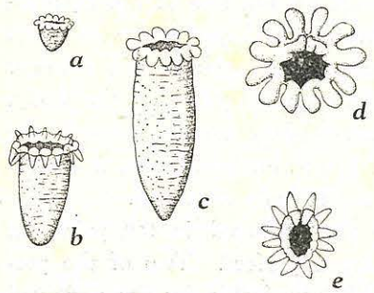

Fig. 3. Larvae of *Peachia quinquecapitata* in the parasitic stages on the hydromedusa *Aequorea coerulescens;* a–c. Side views of actinians ×1½; d and e. Oral views of c and b respectively.

shaped, while the oral disc enlarges very slowly. The tentacles develop as 12 lobed marginal elongations. Along with the external changes, the internal modifications, such as the formation of the mesenteries and the development of the longitudinal pennons occur. The papillae of the conchula do not appear in the parasitic stage. The larvae in this stage exactly agree with *Bicidium aequoreae* reported by Mc Murrich. The largest larva, found parasitic on a hydromedusa, is about 20 mm long but still has short tentacles, and the conchula is still bare. According to Dr. S. Kokubo, the leptomedusa *Aequorea coerulescens* is most abundant in February, and then gradually decreases in number, but becomes larger in size. About 30% of the hydromedusae collected during May were observed to harbour 2–8 actinian larvae. These larvae were of a pale flesh colour in the living state, but some individuals were slightly as bluish as the radial canals and muscles of the hydromedusa. From the similarity of coloration, Dr. Kokubo is of the opinion that the parasites obtain nourishment from the hydromedusa. The actinian larva attaches itself to the subumbrella of the host by the oral surface, and hangs nearly perpendicularly, with the cone-shaped aboral end quite free. After the hydromedusa is destroyed, the actinian seems to assume a sedentary life in muddy sand. There its metamorphosis is completed and it attains sexual maturity. An account of the metamorphosis of the Indian species, *Peachia tropica* has been recently published in detail by Panikkar (1938).

Fig. 4. *Aequorea coerulescens* bearing two larvae of *Peachia quinquecapitata* ×2/5. Photo. by Dr. Kokubo

Remarks. It may be inferred from Verrill's description of them that the specimens, obtained from the east side of Richmond Gulf in 1899 and reported by him to be of *Bicidiopsis arctica*, are identical with the Japanese species in the number, arrangement and structure of the me-

senteries, and in the number of the nipple-like processes on the conchula, but differ in regard to the deep sulcate siphonoglyphe and the fertile imperfect mesenteries. Several adult specimens were dredged up off Yokohama, Ôma, Ôshima, Futago and Kami-itazaki during July-August in 1926–1927.

Eloactis mazelii (JOURDAN)

(Textfigs. 5–6)

Eloactis mazelii: CARLGREN, 1921, pp. 111–115, pl. 1, fig. 1; STEPHENSON, 1935, pp. 91–95, pl. 23, figs. 1 & 2.

A single specimen measuring 24 mm high and 15 mm wide in a preserved state was obtained at a depth of about 10 fathoms off Moura by Prof. S. HÔZAWA. This specimen is not distinctly divided into three sections. The physa, far smaller in diameter than the oral disc, is roundly contracted and marked off from the scapus. The surface of the column, rugosely papillated and wrinkled, is provided with 20 distinct longitudinal furrows, these corresponding to the insertions of the mesenteries. The physa, thinner in the wall than the scapus, is perforated thus having numerous apertures. The oral disc is narrower in diameter than the widest part of the column, smooth and provided with radial folds, which correspond to the insertions of the mesenteries. A well-developed ventral siphonoglyphe is present. There is no conchula near the siphonoglyphe. The actinopharynx is marked with numerous longitudinal furrows, and covers about a quarter of the length of the body. The tentacles are 20 in two circlets, those of the inner circlet being larger than those of the outer one. The outer tentacles correspond to the exocoels, while the inner ones belong to the endocoels. These tentacles are capitate and smoother than the column. According to Mr. H. SATO, the actinian was brownish grey, with slightly bluish tentacles, which were blotched with dark brownish flecks near the rounded apical end.

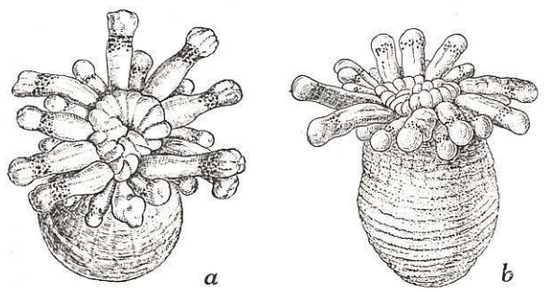

Fig. 5. *Eloactis mazelii* (JOURDAN); a. Oral view; b. Side view. ×3/2.

Anatomical aspects. There are 10 pairs of mesenteries, two of which are directives; the ventral pair is connected with the siphonoglyphe. All the mesenteries are perfect and fertile in the adult, but the 10 pairs of mesenteries, probably corresponding to the outer small tentacles, are perfect only in the distal portion, and fertile only in the proximal portion in small individuals. The longitudinal pennons are strong and markedly circumscribed especially in the fertile region. The parietal muscles are weak. Both marginal and oral stomata are large. There is no marginal sphincter.

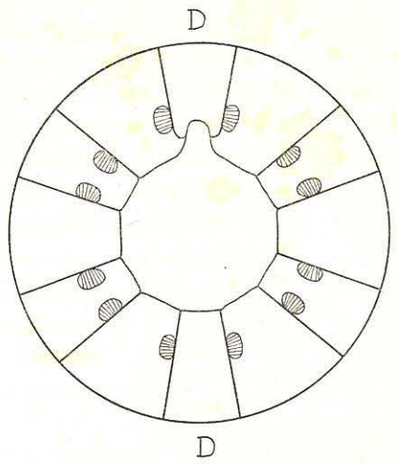

Fig. 6. Diagram of horizontal section through the actinopharynx of young *Eloactis mazelii*.

Remarks. This species seems to be rather common and is known to exist in the northern parts of Europe and the Mediterranean Seas, but its existence has not hitherto been recorded in the Pacific. Several specimens belonging to this species were also found in the collection from Onagawa Bay. The colour seems to be somewhat different from that of specimens found in Europe, but the European specimens are also very variable in coloration.

Harenactis attenuata TORREY

(Textfigs. 7–9)

Harenactis attenuata: TORREY, 1902, Proc. Washington. Acad. Sci., vol. 4, pp. 384–387, pl. 24, figs. 4, 5, textfigs. 16, 17., —; CARLGREN, 1936, ditto, vol. 26, p. 19.

A single specimen was obtained by Prof. HÔZAWA on July 24, 1926 off Kami-itazaki, and three examples by Mr. NONAKA in 1925 from the bay. They all seem to be immature specimens of the American species. The body is changeable, owing to being in a stage of contraction, cylindrical, 21 mm long and 3 mm wide, in a preserved specimen, divided into capitulum, scapus and physa. The wall of the column in the preserved specimens is intricately wrinkled transversely. The oral disc is concealed among the tentacles and long oval in shape, the mouth being situated in the central portion of the disc, with folded lips and a single siphono-

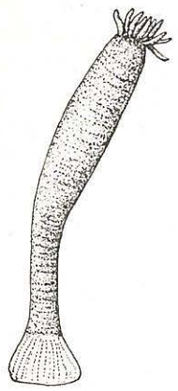

Fig. 7. Side view of *Harenactis attenuata* TORREY. ×2.

glyphe but no conchula. The tentacles, 24 in number, are arranged in two alternative circlets. These tentacles are nearly similar in length, rather broad and each with a bluntly pointed tip, as shown in Fig. 4, Pl. 24 by TORREY (1902). On the surface of the column can be seen the indications of 24 insertions of mesenteries. The column is widest in the middle length and narrows near the physa. The physa, though variable when contracted, is ampullaceous, thin-walled and becomes wide basally. The mesenteries are visible from outside through the wall of the physa. The colour in preserved specimens is dull reddish.

Anatomical aspects. There are 24 pairs of mesenteries grouped in two series; the first series is nearly perfect along the part corresponding to the actinopharynx, while the second is imperfect with the exception of the upper short limited part. The mesenteries of the first series are provided with partial muscles, muscle pennons and mesenterial filaments. The gonads had not yet developed in any of the mesenteries. The parietal

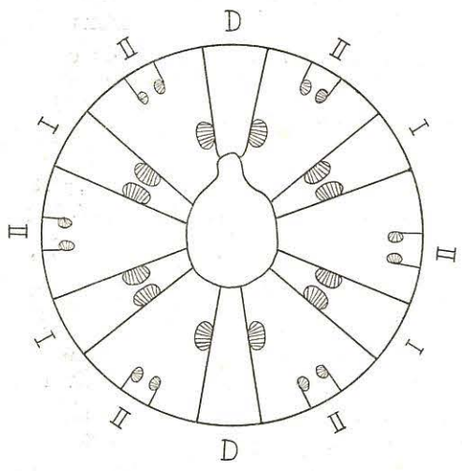

Fig. 8. Diagram of horizontal section through actinopharynx of young *Harenactis attenuata*.

Fig. 9. Section of a directive mesentery of young *Harenactis attenuata*.

muscles and longitudinal muscle pennons are composed of about 15 or more branches, which are again divided into several branchets. The muscle pennons are most complicated in the parts with the mesenterial filaments, but not so much as shown in TORREY's figures, because the Japanese specimens are all in the earlier stage of growth. The muscle pennons are in the intermediate stage between the circumscribed and diffused states. The mesenteries of the second series are provided with parietal muscles only, which are slightly more weakly developed than in the mesenteries of the first series, and have short mesenterial filaments.

Remarks. The species was found in San Pedro and Newport, both in California. The Japanese specimens, which are smaller in size and provided with mesenteries which are less differentiated, are probably immature examples of this species.

Family ANDWAKIIDAE

Andwakia hozawai UCHIDA

(Textfigs. 10–12)

Andwakia hozawai: UCHIDA, 1932, Proc. Imp. Acad., vol. 8, pp. 394–396.

Sixteen specimens were collected by Prof. HÔZAWA on July 1926 at Asadokoro in Asamushi Bay. The actinian occurs buried in sandy bottoms, probably without any covering, being permeated with detritus particles. The surface of the column wall is hard and papillated. The column is thin, hard and leather-like, while the mesogloea is universally thin. The body, though extremely variable in form owing to contraction, is broadly cylindrical and somewhat cornucopia-like. A well-preserved specimen is 55 mm long, and 10 mm wide in the widest distal part and 4 mm in the narrowest proximal part of the scapus. The capitulum is short and liable to be withdrawn into the scapus, which is wider than the former. When slightly contracted, the capitulum is clearly marked off from the scapus by a collar-like fosse. The tentacles are about 60–80 in number, perforated at the tip, tapering, filamentous, and arranged in 5–6 cycles, the outer tentacles being slightly smaller than the inner ones. The oral disc is rather small,

Fig. 10. *Andwakia hozawai* UCHIDA; Side view. ×1.

with a slit-like mouth in the central portion. The siphonoglyphes are two in number, and the lips are somewhat elevated, forming 13–15 foldings. The scapus is elongated, and can be divided into two parts; the comparatively narrow proximal part is about 1/3 the length of the scapus, while the broader distal part is widest in the middle portion. The surface of the scapus is generally smooth, and seems to be devoid of conspicuous papilla-like excrescences. The insertions of the mesenteries in the scapus and in the physa are obvious from the outside. A few acontia are often observed to be emitted from the surface of the body-wall through cinclids distributed in the middle portion of the scapus. The physa is ampullaceous, and very conspicuous in well-preserved specimens, but is often reduced to an enlargement merely, in contracted specimens. The colour of specimens preserved in formalin is bluish grey.

Anatomical aspects. The tentacles consist of a very thick mesogloea furnished with ectodermal ring muscles, which give rise to many centrifugal processes, and of thin endoderm. Around the marginal portion of the capitulum the mesogloeal sphincter feebly develops. The ectoderm of the scapus is generally thicker than the mesogloea and the endoderm, though the latter two become quite thick near the basal portion. The inner layer of the actinopharynx is highly folded and made of high cylindrical ectoderm cells, containing many gland cells. The mesogloea has many centrifugal cores, one in each fold. The mesenteries are arranged in 24 pairs, of which six are perfect and 18 imperfect. Of the six perfect pairs two are the directives. The perfect mesenteries are supplied with a parietal muscle and well-developed longitudinal muscle pennons situated proximally to the actinopharynx, which is connected with the endoderm walls of the coelom by means of two terminal lamellar parts. The cross-section of

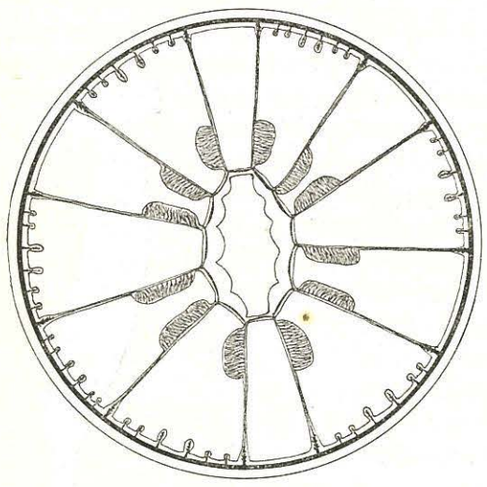

Fig. 11. Diagram of horizontal section through the actinopharynx of *Andwakia hozawai.*

the muscle pennons is generally circumscribed, but circumscribed-diffused below the actinopharynx, and always provided with a number of parallel muscle processes. The mesenterial filaments, generally three-lobed at the tip, are absent in the mesenteries near the basal portion. The imperfect mesenteries are divided into two groups, six pairs of the secondary and 12 pairs of the third cycle. These mesenteries are destitute of mesenterial filaments, and are furnished with a parietal muscle, having several processes on both sides. The gonads develop only in the perfect mesenteries, the ova or testicular vesicles being arranged in a row in the long tract of the mesogloea. The acontia, present in the middle and rather lower portions of the scapus, are few in number.

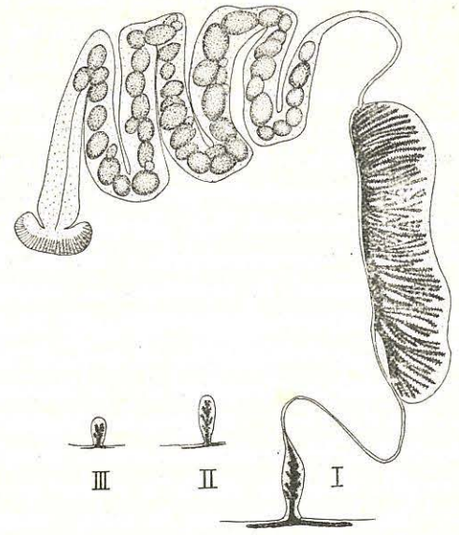

Fig. 12. Sections of mesenteries of the first, second and third series of *Andwakia hozawai.*

Remarks. The genus *Andwakia* has hitherto been represented by the single species, *Andwakia mirabilis* DANIELSSEN, which was found in Husöen, Sognefjord, on the western coast of Norway. On account of the disparity in the number of tentacles, the presence of imperfect mesenteries of the third cycle and the absence of the covering round the column, the Japanese actinian seems to be quite different from the Norwegian species.

Subtribe ENDOMYARIA
Family BUNODACTIIDAE

Anthopleura stella (VERRILL)

(Pl. XI, Fig. 4; textfigs. 13–16)

Bunodes stella: VERRILL, 1864, pp. 16–17, pl. 1, figs. 1–8.
Bunodactis stella: VERRILL, 1899, p. 43.
Cribrina stella: MC MURRICH, 1910, pp. 76–77, pl. 3, figs. 6–7; CARLGREN, 1921, pp. 148–151.

Tealinopsis stella: VERRILL, 1922, pp. 112 G–113 G, pl. 20, figs. 4–12; pl. 26, figs. 1–6 & pl. 31, fig. 3.
Cribrina artemisia: ASANO, 1911, pp. 138–139, pl. 2, fig. 11.
? Cribrina elegantissima: MC MURRICH, 1901, pp. 18–23, pl. 1, fig. 7 & pl. 2, figs. 8–14 (red coloured variety ?)
? Cribrina sp.: WASSILIEFF, 1908, p. 18, Taf. 1, Fig. 1; Taf. 5, Fig. 59 & Taf. 6, Fig. 60.

Since this species has been generally described on the basis of preserved and contracted specimens, the marginal sphaerules have hitherto been overlooked. In VERRILL's previous paper (1864) are given figures of expanded specimens drawn by E. S. MORSE (Pl. 1, figs. 5 & 7). The actinians illustrated there have distinct marginal swellings probably corresponding to marginal sphaerules. In Japan, this actinian has long been wrongly named *C. artemisia*. As to the living state and the coloration of this species VERRILL (1864) gave the best description, and, as regards the internal anatomy, MC MURRICH (1910) went fully into the details.

When fully expanded, the actinian is pillar-shaped with the middle portion narrowest, enlarging more rapidly towards the disc than towards the base. When elongated, the column is long and cylindrical, its height being more than twice the diameter. Ordinarily, the height is only slightly larger than the diameter, measuring generally 20–60 mm high and 15–40 mm wide. When contracted, the column becomes dome-like, the upper part being thickly covered with verruciform suckers, which are sparsely distributed but arranged in regular vertical rows in the lower part. The tentacles are broad and about equal in length to the diameter of disc, being always regularly arranged in the following five cycles, 6, 6, 12, 24, 48. They are each wider near the base, and gradually taper to the obtuse tip. Those of the first two cycles are slightly larger than the rest, forming the inner row of twelve, which are generally held in an upright position during expansion, while the others are mostly curved more or less outwards and, especially those of the fifth cycle, downwards. The tentacles of the first, second and third series may extend beyond the diameter of the expanded oral disc, but the tentacles of the fifth cycle are always shorter than the oral disc. Round the margin of the disc, just below the fifth cycle the tentacles often stand round marginal sphaerules in a sparse row. The mouth slit-like, often with elevated lips on the directive line, is situated in the centre of the oral disc. The column with the exception of the bases, is covered with verruciform suckers which are arranged in about 48 vertical rows, more thickly set in the upper part, but very sparsely near the base. These suckers in the living specimens are papillated but transversely elliptical, with a central cavity and a raised crenulated margin in the preserved specimens. In contracted specimens, the suckers are often so crowded near the marginal portion as to be nearly in contact, being only separated by wrinkles. The suckers situated nearer the margin in a vertical series are generally larger. In its habitat, the actinian has pebbles and fragments of shells adhering to its suckers, but when brought into an aquarium it discards them in a few hours. When the actinian contracts in an aquarium the suckers are observed to eject water.

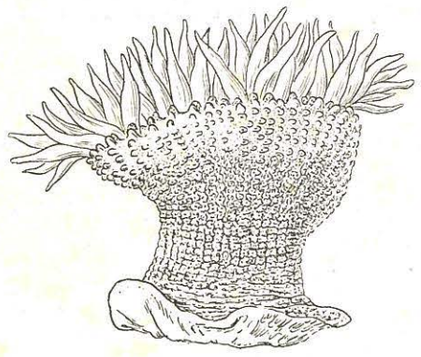

Fig. 13. Side view of a preserved specimen of *Anthopleura stella* (VERRILL). ×1.

The coloration of the oral disc and of the column is variable to some extent, but that of the verruciform suckers is always greenish. The oral disc, varies in colour, being brownish green or greenish brown, generally dark reddish brown near the bases of tentacles and greenish round the mouth. From the bases of the primary tentacles outwards radiate pairs of white bands to the margin of the oral disc, the lips of these disc often being tinted bright green, the stomodaeum white. The tentacles are white, slightly brownish or slightly pinkish (especially in specimens from the warmer parts of Japan). When contracted they are yellow or pink. In large specimens the shaft of the tentacles is mottled with white spots, their bases being generally white on their abaxial side. The marginal sphaerules are whitish brown. The column is generally greenish black, with green verruciform suckers. Near its base the column is often flesh-coloured or yellowish grey. It is noticeable that some specimens collected at Oshoro have a reddish column wall with green verruciform suckers. These specimens resemble in colour *Cribrina elegantissima* reported by MC MURRICH to exist in Puget Sound.

Anatomical aspects. The ectoderm cells are high, cylindrical and vesiculated, the endoderm cells being low cylindrical, laden with black granules in the upper half, and vesiculated in the lower half. The ectoderm cells of the tentacles are very narrow and chain-shaped, and their endoderm cells are mostly granulated and glandular. The muscles of

tentacles are ectodermal and sparsely branched. The outer surface of the marginal sphaerules is largely furnished with long spirocysts. The sphincter is well-developed, nearly kidney-shaped, circumscribed pedunculate,

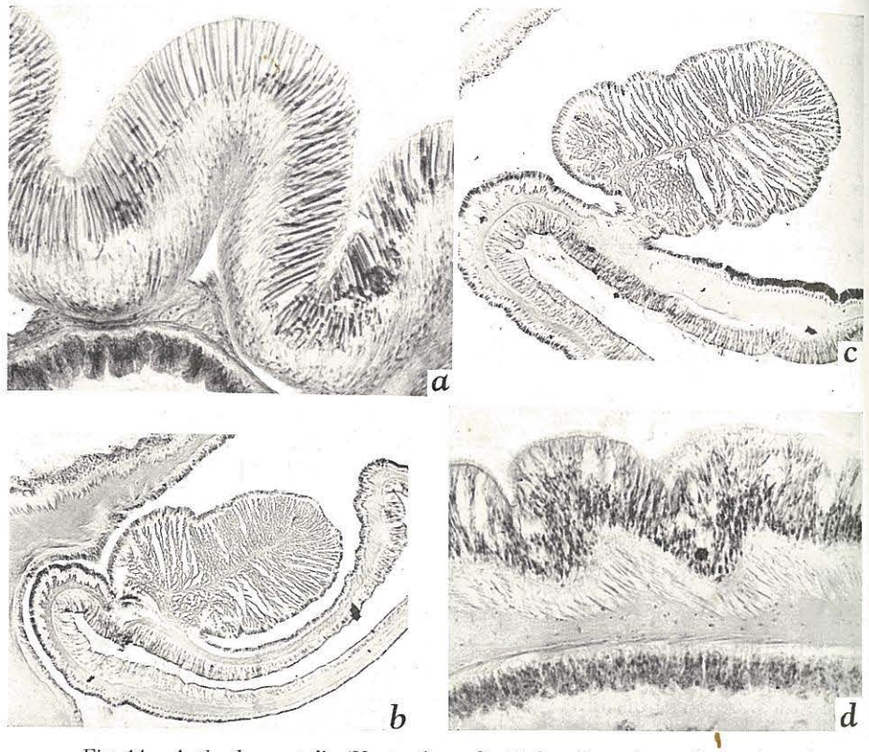

Fig. 14. *Anthopleura stella* (VERRILL); a. Sagittal section of marginal sphaerule. ×180; b–c. Radial sections of a sphincter in two different parts. ×40; d. Transverse section of a part of tentacle. ×180.

with numerous anastomosed foldings. The siphonoglyphes are two in number. The mesenteries are hexamerously arranged; in the four cycles, 6, 6, 12, 24. The first two cycles of the mesenteries are perfect, containing two directives. With the exception of the directives, all the mesenteries are provided with mesenterial filaments and are fertile. The longitudinal muscles of these mesenteries are well-developed, and diffused circumscribed; the muscle pennons of the directives are grouped in several foldings; those of the first and the second mesenteries are narrow in width but extend for a fair length showing shallow foldings; the muscles

of the third mesenteries are rather circumscribed, and those of the fourth mesenteries are often crescent. The parietobasilar and basilar muscles are well developed, especially in the lower part.

Distribution. The actinian is common in Mutsu Bay in shallow pools near low-water mark, buried to the tentacles in sand, occupying the cracks and crevices of ledges covered with algae. This is one of the commonest species on the coasts of Japan from Hokkaido to Kyushu. It is also known on the Atlantic and Pacific coasts of North America and further on the coasts of Northern Europe. The Japanese actinian seems to reach a larger size than that in other localities.

Remarks. The description of the external features of this species in the living state has been based entirely on the field notes of collectors and never been verified by reference to the investigators' observations with the exception of those of ASANO. The colorations hitherto described regarding this species, however, are in general agreement, though

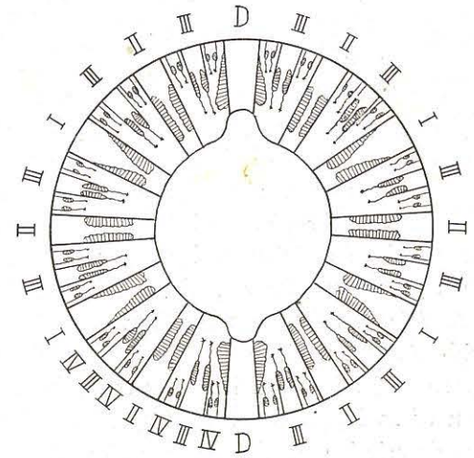

Fig. 15. Diagram of horizontal section through the actinopharynx of *Anthopleura stella*.

Fig. 16. Sections of mesenteries of *Anthopleura stella*.

the descriptions are rather brief and not in detail. The presence of the bright green verruciform suckers seems to be one of the most important characters of this actinian. *Cribrina elegantissima* described by Mc MURRICH corresponds with the present species in the preserved state, in the section of the sphincter etc. and, furthermore, resembles in colour reddish specimens of the same species from Oshoro. But for the present the writer cannot say that they are definitely identified. ASANO who examined specimens from Misaki where this actinian occurs very abundantly, described an actinian under the name of *Cribrina artemisia*. From his description and figures, that actinian is quite different from *Cribrina artemisia*=*Anthopleura xanthogrammica* but is most likely to be identified with *A. stella*. The marginal sphaerules are hardly visible in preserved specimens, and, even in living examples are liable to escape the observation of zoologists other than specialists for the Actiniaria. Therefore, in the description of this species the sphaerules have not been recorded. ASANO reported that his actinian has pseudo-acrorhagi, but as shown in the figure of a section here given, they are true acrorhagi=marginal sphaerules, which are studded with clusters of nematocysts.

Anthopleura xanthogrammica (BRANDT)

(Textfigs. 17-18)

Anthopleura xanthogrammica: Mc MURRICH (probably different species), 1901, pp. 36-39, pl. 2, fig. 14 et pl. 3, figs. 21-24; TORREY, 1906, pp. 41-46, pl. 8; ASANO (probably referable to *Anthopleura japonica*), 1911, pp. 139-140, pl. 2, fig. 13; CARLGREN, 1934, pp. 349-351.

Anthopleura japonica: ASANO, 1911, p. 140, pl. 2, fig. 14.

Bunodes californica: FEWKES, 1889, pp. 28-30, pl. 6, figs. 5, 6.

Cribrina artemisia: Mc MURRICH, 1901, pp. 23-26, pl. 2, figs. 15-16; pl. 3, figs. 18-20; TORREY, 1902, p. 390, pl. 25, figs. 1-3.

Evactis artemisia: VERRILL, 1922, pp. 113 G-114 G; CARLGREN, 1934, pp. 16-17.

Anthopleura xanthogrammica and *Cribrina artemisia* have often been described as two separate species, but the main difference lies in the presence or absence of the marginal sphaerules. These two species have been mostly reported on on the basis of preserved specimens; in the preserved state, the marginal sphaerules are flattened or distorted, and liable to be readily overlooked. In 1906 TORREY having examined many living specimens came to the conclusion that the two species must be conbined in the single species, *A. xanthogrammica*.

The body is very changeable relatively to conditions, very extensile and long cylindrical when buried in sand below sea-water, but when brought into an aquarium, it becomes lower in height. In the elongated state, it reaches 90 mm long, the distal portion being rounded and wide, while the rest is narrow and long cylindrical. When the actinian is preserved in the elongated condition, it often takes the form as illustrated by Mc MURRICH (fig. 15, pl. 2, 1901) for *Cribrina artemisia*=*Anthopleura xanthogrammica*. Expanded specimens in aquaria are generally 30-60 mm in diameter and 30-50 mm high. When contracted, these specimens become cylindrical, nearly equal in width throughout the whole length, with verruciform suckers, which cluster round the oral margin and sparsely distributed lower down. The tentacles, are all shorter than the diameter of the oral disc, slenderer than those of *A. stella*, the oral side of them being in most cases traversed by irregular white flecks, which are generally about ten in number. These flecks are almost always present. The 12 tentacles of the first and the second cycles are directed axially in the well-expanded condition, while the rest are directed outwards and bent downwards. The mouth is slit-like, situated in the centre of the oral disc. The marginal sphaerules, varying in number with individuals, are found above the uppermost verruciform suckers, which are generally two- or three-lobed. The column is set with verruciform suckers which are swelled and cone-shaped in well-expanded specimens but long and papillose in preserved ones. The uppermost verrucae are the largest and alternate in position with the marginal tentacles. The verruciform suckers have each a pit in the centre. They are larger and longer nearer the oral disc, and, especially at a short distance from the oral margin, very crowded, forming "a papillose collar" in contracted specimens, but below the "papillose collar" the suckers become suddenly low and are sparsely distributed. The column holds gravels and fragments of shells attached round the oral margin, but holds none in the lower part. Near the basal portion there are no suckers. The basal disc, firmly adhesive, is smaller in diameter than the oral disc.

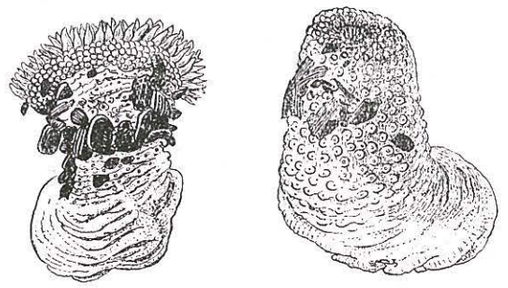

Fig. 17. Preserved specimens of *Anthopleura xanthogrammica* BRANDT. ×1.

The colour is rather variable in the oral disc and tentacles, but nearly

similar in the column. The tentacles are generally brownish grey with flecks, with a whitish shade on the abaxial side. The 12 tentacles of the first and second cycles of large specimens are often slightly pinkish purple on the abaxial side. Specimens having brownish green or green tentacles are still found. In these the abaxial side of the tentacles is greenish white. In one specimen the tentacles were a pinkish purple. The oral disc is nearly the same in colour as the tentacles: the grey tentacled ones are provided with the greyish oral disc, and the green tentacled with the greenish oral disc. From the periphery of the epistoma radially issue white streaks, varying in individuals in broadness and distinctness, which seem to correspond to the number and order of the tentacles, thence forming several radial groups. These white streaks are sometimes slightly pinkish in shade. Both sides of the base of the tentacles of the first and second cycles are prominently marked with the broad white streaks. The verrucae crowded near the upper portion of the column, having sand and gravel attached to them, are always greyish olive green. The marginal sphaerules are brownish yellow. The lower part of the column is yellowish brown or flesh-coloured.

Anatomical aspects. Ectoderm cells generally cylindrical, with a nucleus in the middle portion, the lower part being vesiculate, with the nerve

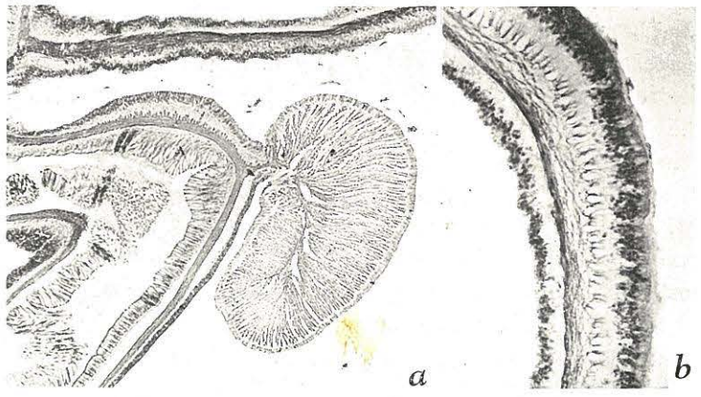

Fig. 18. *Anthopleura xanthogrammica* BRANDT; a. Radial section of sphincter. ×40; b. Transverse section of tentacle. ×180.

net at the base. Those in the column generally filled with small black granules. Ectoderm cells in the actinopharynx, high cylindrical, glandular, vacuolate and with cilia. Endoderm cells rather low, cylindrical, filled with black granules. There are marginal sphaerules, of which the basal

part is vesiculate and glandular, but the larger part is closely set with long spirocysts. Muscles of the tentacles ectodermal, slightly branched. Muscles of the oral disc near the mouth, endodermal, with short arborescent foldings. Sphincter, nearly elliptical in shape, circumscribed asymmetrically pedunculate pinnate, with numerous foldings, as figured by MC MURRICH (1901) in *Cribrina artemisia*. The mesenteries are arranged in 6+6+12+24=48 pairs, 2 of which are directives. In the upper portion of the actinopharynx, 24 pairs are perfect but in the lower part 12. The mesenteries, except the directives, are all fertile in large specimens. The muscle pennons are well-developed. The parietobasilar and basilar muscles are strong.

Distribution. The actinian is known on the Atlantic and Pacific coasts of North America. It is distributed also in the Behring Sea (Kamchatka and Alaska). In Japan it is commonly found on the coasts of Hokkaido and the Northern parts of Honshu. It is found buried in sand, attached to the substratum, just below the tidal lines. In this condition the column is generally very elongate, with gravels and fragments of shells adhering round the oral margin. In the case of contraction after being taken out of the water the actinian spurts water from the upper verruciform suckers.

Remarks. The reason why this species has been binominally described under the name of *Anthopleura xanthogrammica* and *Cribrina artemisia* is that the two forms have been hitherto described mostly from preserved materials. In preserved specimens of this species, especially in those with the contracted oral disc, the marginal sphaerules are hardly distinguishable from contracted tentacles and verruciform suckers. Except for a brief original description, *Cribrina artemisia* has been mainly described only on the basis of preserved specimens. Having examined living and preserved specimens, the present writer is also of the same opinion as TORREY that the two actinians must be combined in the single species, *Anthopleura xanthogrammica*. This actinian is distinctly characterized by the presence of the white spots along the tentacles and of the white radial streaks on the oral disc, and also by the olive verruciform suckers thickly massed in the limited distal portion of the column and by the flesh-coloured column in which low flesh-coloured verruciform suckers are distributed. The features of the column are visible in preserved specimens. This species is easily distinguishable from *Anthopleura stella* by the characteristics above-mentioned. Moreover, this species is characterised by its changeable column, as TORREY states, "The form of the column varies accordingly, very long individuals taken from the sand

becoming much shorter than broad in aquaria." CARLGREN (1934) pointed out that the actinian reported by KOMAI and IKARI (1929) as *Anthopleura xanthogrammica* (the identification is probably due to ASANO's original paper, 1911) may possibly be *Anthopleura japonica* briefly mentioned by VERRILL (1899). The writer, though somewhat doubtful about the identification, distinguished here *A. xanthogrammica* from this actinian which is distributed in the southern parts of Japan, and seems to be identified with VERRILL's *A. japonica.*

Anthopleura japonica VERRILL

(Pl. XI, Fig. 3; textfigs. 19–21)

Anthopleura japonica: VERRILL, 1899, p. 218; ASANO, 1911, 140, pl. 2, fig. 14 (=*A. xanthogrammica*).
Anthopleura xanthogrammica: ASANO, 1911, pp. 139–140, pl. 2, fig. 13.
Anthopleura mc murrichi: WASSILIEFF, 1908, pp. 19–20, Taf. 1, Fig. 14; Taf. 6, Figs. 61–64; Textfig. 6.

This actinian is common on the southern coasts of Honshu and Kyûshu. The separation of this species from *Anthopleura xanthogrammica* remains for future investigation but, following CARLGREN (1934), the actinian is described under the name. Body changeable, sometimes long rather than wide, sometimes wide rather than long, generally 4–7 mm high and 4–6 mm wide in the widest diameter. The oral disc expands more widely than the pedal disc, the middle part of the column being the smallest in diameter. Tentacles rather short, long cone-shaped, arranged in 5 cycles, 6, 6, 12, 24, 48, almost similar in length in large specimens, but in general the 12 tentacles of the first two cycles are slightly larger than the rest and extend upright, with rapidly narrowing prehensile tips. Just outside the tentacles are arranged marginal sphaerules in a row. Column widest in the upper portion and narrowest in the middle length; the upper portion below the oral disc is thickly furnished with many adhesive suckers, which become large and cone-shaped in their expanded condition. The uppermost suckers are more or less lobulated. The adhesive suckers are smaller and more sparsely

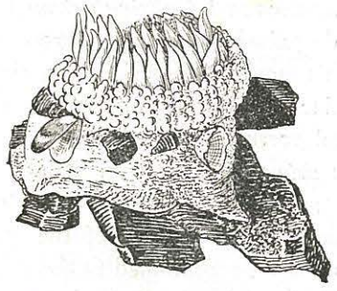

Fig. 19. Preserved specimen of *Anthopleura japonica* VERRILL. ×1.

distributed in the lower half. The actinian has pebbles and shells adhering to the suckers and ejects water from these when it contracts.

Colour not very variable. Oral disc bluish brown or deep brown or sometimes with radial stripes. Epistome brownish purple or deep brown. Lips with a few white flecks. Tentacles dark brown, sometimes reddish brown, especially in the slightly contracted state. Generally no white flecks as in *A. xanthogrammica.* Marginal sphaerules white or yellowish white. Column yellowish brown in young individuals but dark brown in large specimens. Verrucae same in colour as the column. Some individuals dark bluish in the column, and some dark brown in the upper column and dark bluish in the lower part.

Anatomical aspects. Ectoderm high-cylindrical, containing many glandular cells among supporting cells. Endoderm high-cylindrical, glandular, the lower half generally vesiculate and containing *Zooxanthellae,* which

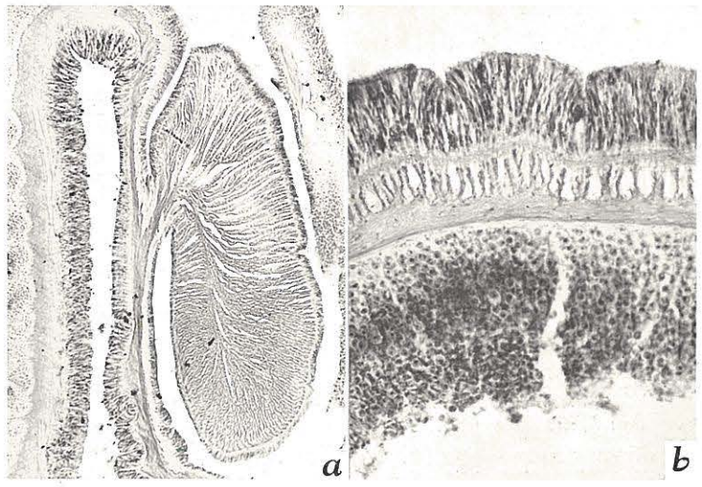

Fig. 20. *Anthopleura japonica* VERRILL; a. Radial section of sphincter. ×40; b. Transverse section of tentacle. ×180. The endoderm of the tentacle contains large number of symbiotic algae.

are especially numerous in the tentacular endoderm. Tentacles with well-developed ectodermal muscles, numerous nematocysts in the ectoderm and many symbiotic algae in the endoderm. Marginal sphaerules thickly studded with nematocysts. Siphonoglyphes two in number. Sphincter, well-developed, elongate elliptical, circumscribed, pedunculate pinnate, with numerous foldings which are complicately anastomosed. Mesenteries

hexamerously arranged, 6+6+12+24=48, including two pairs of directives, those of the first and the second are perfect and large, while those of the third and the fourth are imperfect and small. All the mesenteries are provided with mesenterial filaments and fertile with the exception of the directives. Muscle pennons are well-developed but rather diffused and narrow in width in all these mesenteries. The muscle pennons of the first mesenteries extend farthest along the mesenteries, and those of the second mesenteries are slightly shorter than these. The muscle pennons of the third mesenteries are shorter than the former two, but relatively wider than them. Those of the fourth mesenteries are smallest and often irregularly shaped.

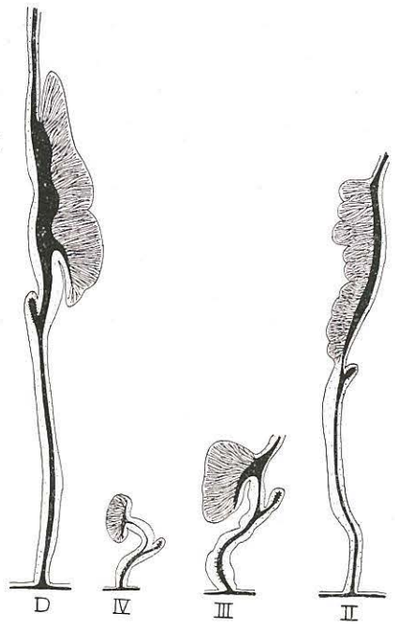

Fig. 21. Sections of mesenteries of *Anthopleura japonica* VERRILL.

Distribution. This actinian is common on the coasts of Honshu and Kyushu. It lives on the tidal line on elevated rocks above the water in ebb-tides and is generally covered with pebbles and shells attached to the verruciform suckers. Actinians probably referable to this species were reported as found in Japan from Shimoda, Izu Prov. by VERRILL and Enoshima by WASSILIEFF.

Remarks. The species is seemingly distinguishable from *A. xanthogrammica* by its non-spotted reddish brown tentacles and by the column, which is brown in colour. The verrucae are distributed in the more lower part and do not present such conspicuous elongations as the latter. The endoderm cells contain numerous symbiotic algae, which have not been found in Japanese specimens of *A. xanthogrammica* living in the same locality as this species. However, it is probable that the difference in the coloration and habitats of the two species are correlated with the presence or absence of the symbiotic algae. On the other hand, TORREY (1906) reported in the case of for *A. xanthogrammica* that "the characteristic green color of the species is found only in individuals exposed to the sun. It is due to the presence of a unicellular alga in the endoderm of the column wall, mesenteries and tentacles. Where sunlight does not penetrate, as under wharves (CALKINS), or in caves, the algae, though present, do not develop so luxuriantly as in more exposed situations, and the polyps are correspondingly pale." Specimens with a green oral disc and tentacles are often observed in Japanese specimens of *A. xanthogrammica*, but in *A. japonica* the oral disc is always bluish brown or brown and the tentacles brown or reddish brown. Moreover, this species does not occur in the northern parts of Hokkaido. To determine the identity of these two species the histological investigation must be further gone into. The actinian described by WASSILIEFF as *A. mc murrichi* n. sp., based on a single specimen obtained at Enoshima, seems to be identical with this species, because the external features in the preserved condition (Taf. 1, Fig. 14) and anatomical characters generally agree with those of the present species, though the figure of the sphincter of WASSILIEFF's specimen is too vaguely drawn. The original description by VERRILL of this species is restricted to the external features of a preserved specimen from Shimoda. In the same locality *A. japonica* occurs in abundance.

Anthopleura pacifica n. sp.

(Pl. XI, Fig. 2; textfigs. 22-23)

Anthopleura xanthogrammica: MC MURRICH, 1901, pp. 36-39, pl. 2, fig. 17; pl. 3, figs. 21-24 (in part).

Among Japanese species belonging to *Anthopleura*, this actinian is characterized by its small size and red coloration. Body generally 15–20 mm high and 12–18 mm wide, but rarely more than 30 mm high and 25 mm wide in large specimens. Body variable in form in aquaria, becoming very elongated, and forming a long cylindrical shape, with the expanded distal part. Tentacles about 60–80 in number, starting generally from near the margin of the oral disc, though somewhat hexamerously, not regularly arranged probably on account of asexual reproduction. The tentacles are thick and firm, rather short, always shorter than the column-height and not filamentous. Oral disc, wider than the column, flat and with a slit-like mouth in the centre. Marginal sphaerules about 20 in number, round and arranged in a circlet. Column with verruciform suckers, which are rather indistinct and arranged in about 48 rows. The suckers

are larger near the marginal portion of the column, and are not found in the basal portion. Being sometimes very small, most of them may, with the exception of the premarginal ones, be overlooked in a careless observation.

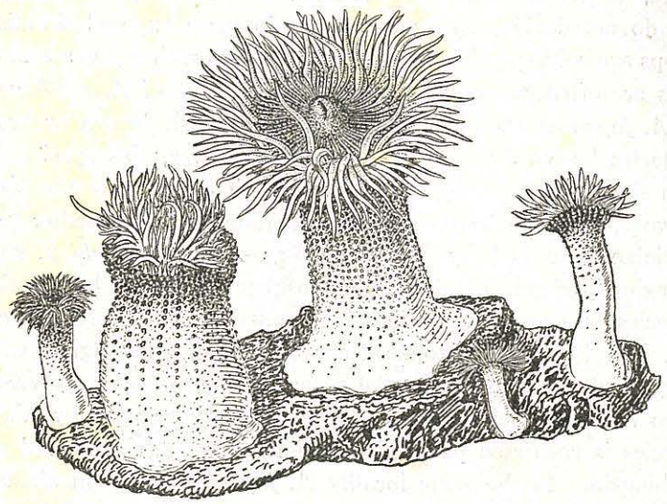

Fig. 22. *Anthopleura pacifica* n. sp. ×1.

Colour almost constant. Column pinkish red in the lower portion, but greenish in the upper, especially near the oral disc. Verrucae green in the central portion. Marginal sphaerules pale pink. Tentacles slightly pinkish on the axial surface and slightly greenish on the abaxial surface. They are spotted with several transversal white patterns. Oral disc mainly dark red with a green nuance, with some radial pinkish red patterns. Lips pinkish.

Anatomical aspects. Ectoderm very high, seemingly composed of two layers of cells; the outer cells being mostly glandular and eosinophile, the inner cells narrow and connected with nerve cells at their bases. Mesogloea thinner than the ectoderm, containing wandering cells sparsely distributed and giving rise to minute processes of the endodermal muscles. Endoderm composed of conical finely granulated glandular cells which are laden with many dark granules only in the upper portion. The ectoderm cells of the basal disc are narrow cylindrical and glandular, the outer surface of the ectoderm being bordered with widened heads of narrow gland cells; the basal portion contains many long eosinophile

glandular parts. The marginal sphaerules with the exception of the basal portion, are covered with slender nematocysts, which are thickly set in a

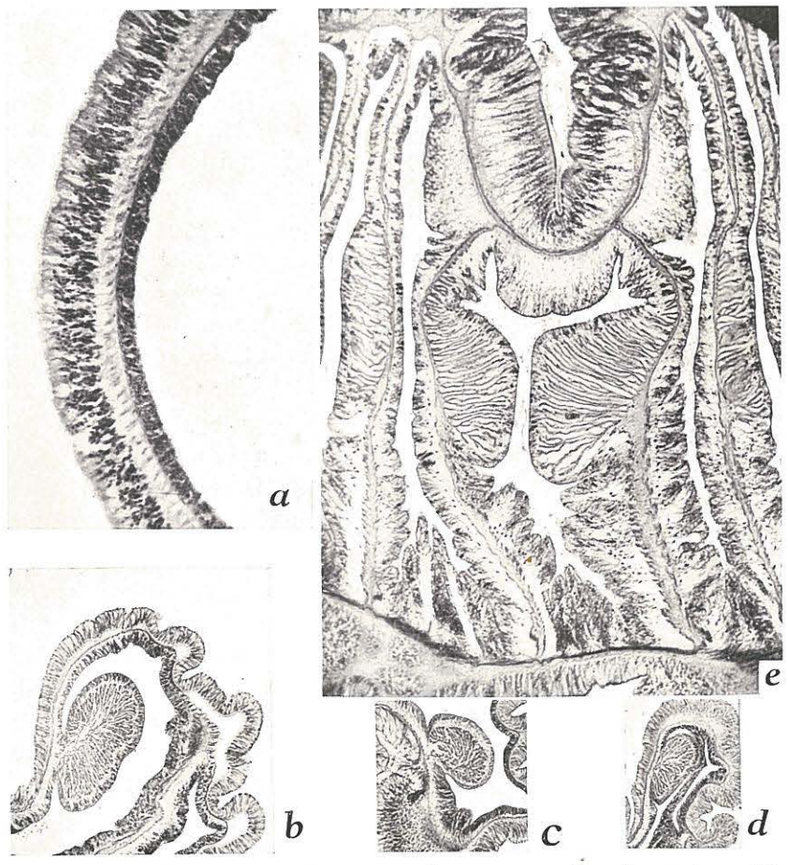

Fig. 23. *Anthopleura pacifica* n. sp. a. Transverse section of tentacle. ×180; b–d. Radial sections of sphincters of different specimens. ×40; e. Siphonoglyphe supported by a pair of non-directive mesenteries as the result of asexual multiplication. ×76.

row. The ectoderm of the tentacles is about four times the height of the endoderm. The ectoderm cells are chain-shaped, covered with long spirocysts and connected with the nerve nets at their bases. The tentacle muscle are ectodermal and slightly folded. The mesogloea of the tentacles is thin. The endoderm of the tentacles contains thick plasm, laden with granules well stained by Haematoxylin and pigmented granules. The

sphincter is generally small, round or elongated, circumscribed pedunculate palmate but pinnate in large specimens. There are more than two siphonoglyphes on account of asexual fission. They are frequently supported by a pair of large mesenteries, which are not directives. These siphonoglyphes are surmised to have secondarily formed in the parts corresponding to the mesenterial parts of the first series after the fission. When the fission is repeated, the actinian comes to have more than two siphonoglyphes. In fact, the histological differentiation of the siphonoglyphes in one actinian is more or less variable. The mesenteries especially in young specimens seem to have the tendency to be arranged as 6+6+12+24, but probably on account of frequency of the fission, the arrangement is generally in disorder. The directive mesenterial pair could not be in most cases observed, and the partner of the mesenteries only stands here and there between the mesenterial pairs. The first two series seem to be perfect, but the third and fourth are imperfect. The mesenteries have well-developed longitudinal muscle pennons, which are diffused-circumscribed in the first mesenteries and long diffused in the other ones. Parietobasilar muscles well-developed in the lower portion. Gonads and mesenterial filaments develop on the first, the second and the third series of mesenteries.

Distribution. The actinian is commonly found in a colony on rocks and between cracks and in shallow pools of sea-water at low tide. The species is at present known to exist in the southern parts of Hokkaido, Mutsu Bay and southern parts of Korea. It is probably distributed on the coast of Puget Sound on the Pacific coast of North America.

Asexual reproduction. While examining the mesenteries of this species it was found that their arrangement generally seemed to be regular, but that in two or more places, especially between the directives, a mesenterial pair lacked a partner, and, therefore, the arrangement was in disorder, often giving rise to a few small mesenterial pairs there. When the actinians were reared in aquaria, some small individuals firmly attached to the substratum, became flattened and elongated in two opposite directions, with the pedal disc being gradually divided into two equal parts.

Remarks. This species resembles *Bunodactis verrucosa* in colour and general apearance, but differs from it in the possession of marginal sphaerules and less distinct verrucae. In the comparatively small size this species is somewhat similar to *Anthopleura thallia*[1], but is different

[1] An actinian probably referable to this European species occurs at Oshoro, Hokkaido.

from it in coloration and in the presence of more indistinct verrucae. Mc MURRICH (1901) described *Anthopleura xanthogrammica* from Puget Sound. With reference to his description CARLGREN (1934) pointed out that "the description of Mc MURRICH (1901) for *Anthopleura xanthogrammica* partially were based on other species." The actinian illustrated by Mc MURRICH in pl. 2, fig. 17 seems to be rather small, having small numbers of tentacles which rise only from the marginal portion of the oral disc, as is a characteristic of *A. pacifica* n. sp. Besides the similarity of Mc MURRICH's actinian to this new species in the small size and the form of the sphincter, the multiplication by fission is rather common in these two actinians. As to the multiplication of Mc MURRICH's specimens, he says "Dr. CALKINS states that evidences of multiplication by fission were not unfrequent among the Port Townsend specimens." On the other hand the multiplication by fission has hitherto never been observed in *Anthopleura xanthogrammica* and *Cribrina artemisia*. Though the coloration may be somewhat different, it is highly probable that Mc MURRICH's specimens belong to the species in question.

Epiactis prolifera VERRILL

(Pl. XI, Figs. 1 & 6; textfig. 24)

Epiactis prolifera: Mc MURRICH, 1901, pp. 39–43; TORREY, 1902, pp. 392–393, pl. 25, figs. 4, 5; UCHIDA, 1934, pp. 17–31, pl. 3.
Epiactis ritteri: TORREY, 1902, pp. 393–394, pl. 25, figs. 6, 7.
Bunodes japonica: VERRILL, 1869, p. 28.

This actinian is very common in Ôshima of Mutsu Bay. As stated in the present writer's previous paper, its coloration is very variable, and the form of the column also varies according to its living conditions. In the well-expanded state many white radial striations are generally observed round the mouth, the number corresponding to that of the tentacles. The column wall of this actinian is sometimes nearly smooth but sometimes prominently papillated. The papillation is different in degree, irregular in arrangement and always occurs only in the middle part of the column. This condition is quite different from the papillation of other actinians belonging to the Bunodactiidae, whose columns have papillae=verrucae arranged in distinct longitudinal rows, with the larger ones near the marginal portion. This species carries

Fig. 24. *Epiactis prolifera* VERRILL; small specimen. ×1.

its embryos and young actinians on the column wall.

Distribution. This species is known to exist on the Pacific coasts of North America, from Alaska to California. In Japan it is found in the Kurile Islands, Hokkaido and the northern parts of Honshu southwards to Misaki.

Subtribe INERMIA
Family **PARACTIIDAE**

Neophellia n. g.

Paractiidae with definite base. Column divided into the short scapulus and the main part; the scapulus free from sand but the main part of the column walled with a thick glandular epithelium to which sand grains adhere. Lower part of column thin-walled and lacking sand grains. Tentacles simple, in more than two cycles, their longitudinal musculature being ectodermal. Oral disc simple. Mesogloeal sphincter well-developed. Mesenteries not divided into macrocnemes and microcnemes. There are twelve pairs of fully developed mesenteries, perfect, having gonads and mesenterial filaments. The mesenteries of the first series are all furnished with diffused-circumscribed retractors. In the mesenteries of the second series inequality always occurs in the same pair; one partner is furnished with the circumscribed retractors but the other is deficient in retractors. There are another twelve pairs which are imperfect, having gonads, mesenterial filaments, but lacking retractors. All the mesenteries are fertile. Acontia are non-existent.

The genus resembles *Phellia*, *Paraphellia* etc. in general external appearance, but differs from them in having 12 perfect mesenteries and lacking acontia. The genus *Flosmaris* which alone forms the separate family Flosmarisidae resembles the new genus in the number of perfect mesenteries and in several external features, but is distinguishable in the possession of acontia and mesenteries, which are sharply divided into macrocnemes and microcnemes. On account of the absence of acontia and the inequality of the second mesenteries the new genus has been classed with the Paractiidae. In the latter the genus coincides with *Hormosa*, *Alloactis* and *Tealidium* in having mesenteries which are all fertile, but differs in the structure of the column and in the inequality of the second set of mesenteries. With regard to the inequality in the number of the mesenteries, the new genus is rather closely related to *Actinostola*.

Neophellia mutsuensis n. g. et n. sp.
(Textfigs. 25–28)

A single specimen was obtained on July 30, 1926 off Urata between Futago and Ôshima. Body in the preserved state rather cone-shaped, with rapidly expanded pedal portion and cylindrical upper portion, with the narrowest part in the middle length. Measurements as follows: pedal disc 12 mm wide, oral disc 6 mm wide, column 16 mm long, scapulus 3 mm long. Tentacles nearly 100 in number, all more or less contracted and bluntly tapering to the tips, the outer tentacles being smaller than the inner ones. The surface of the column is corrugated probably on account of shrinkage, generally permeated with sand, with the exception of the scapulus and the basal part, 3 mm long, near the pedal disc. Here, the surface is rather smooth and thin, showing indications of mesenteries. In the main part of the column are found shallow longitudinal grooves corresponding to the mesenteries obscurely visible on account of the rugose surface and the attached sand.

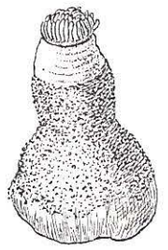

Fig. 25. *Neophellia mutsuensis* n. g. et n. sp. ×2.

Anatomical aspects. Ectoderm cells of the main part of the column, high and glandular, thick with granules and protoplasm, rarely vacuolate. Mesogloea thick, rigid and fibrous. Endoderm cells glandular and vacuolate. The ectoderm of the tentacles is thickly set with nematocysts

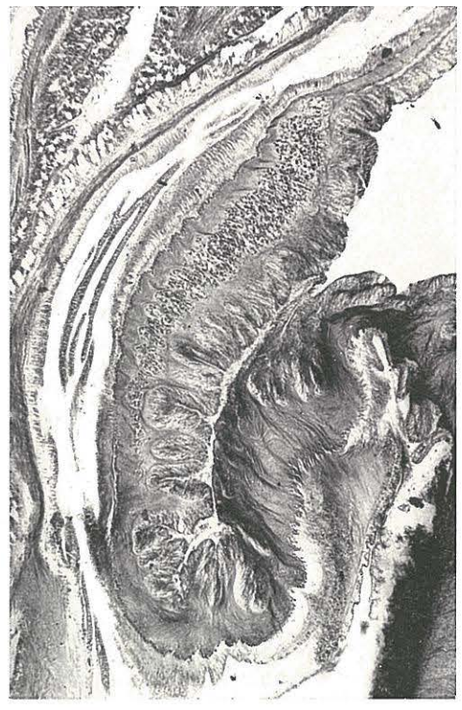

Fig. 26. *Neophellia mutsuensis* n. g. et n. sp.; Radial section of marginal portion containing mesogloeal sphincter. ×60.

on the outer surface and with granulated cells in the inner layer. The endoderm of the tentacles is vacuolate. Muscles, ectodermal, slightly folded. Mesogloeal sphincter well-developed, with many muscular bundles which are distributed in several rows. Mesenteries arranged as $6+6+12=24$. The mesenteries of the first series are always perfect and with longitudinal

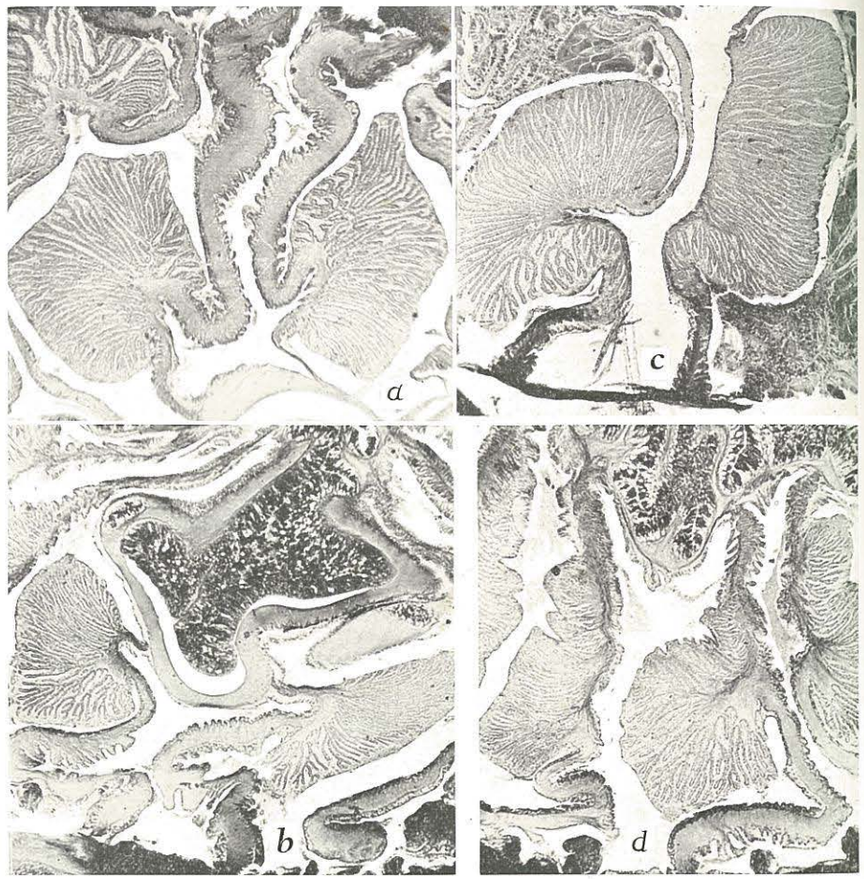

Fig. 27. *Neophellia mutsuensis* n. g. et n. sp.; a. Transverse section of directive mesenteries through the actinopharynx. ×40; b. Transverse section of directive mesenteries through the upper part of actinopharynx. ×40; c. Transverse section of directive mesenteries through the stomach. ×30; d. Transverse section of non-directive mesenteries; the middle right one being a developed partner of the second mesenteries, the rudimental partner being seen at the base to the left side of the developed partner. ×40.

muscle pennons, which are well-developed in the upper part of the stomach. The mesenteries of the second series are perfect in the upper portion but the partner of the single pair always lacks longitudinal muscle pennons. In the lower part of the actinopharynx only the partners without muscle pennons are imperfect. In the stomach the mesenteries of the second series are all deficient in longitudinal muscle pennons but bear well-developed parietobasilar muscles. The mensenteries of the third series are all imperfect, and lack mesenterial filaments. The muscle pennons of the mesenteries of the first and the second series are circumscribed, nearly triangular or round at the level of the actinopharynx but larger and somewhat crescent in cross-section near the basal portion, the mesenteries of the first series being larger than those of the second. Parietobasilar muscles present in all the mesenteries and better developed towards the basal part. Gonads develop on the mesenteries of the first and the second series with the exception of the directives.

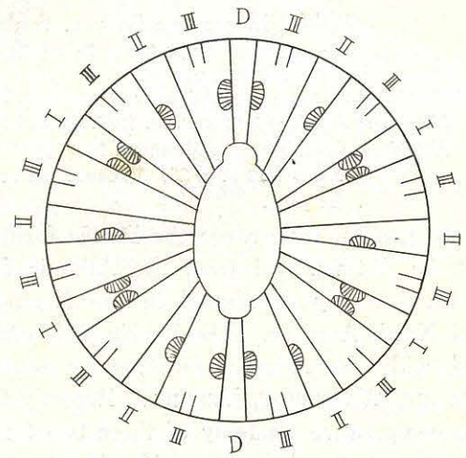

Fig. 28. *Neophellia mutsuensis* n. g. et n. sp.; diagram of horizontal section through the actinopharynx.

Subtribe ACONTIARIA
Family **DIADUMENIDAE**

Diadumene Luciae (VERRILL)

Diadumene Luciae: UCHIDA, 1932, pp. 69–82, pl. 4; —, 1936, pp. 896–906.

This species is widely distributed on the European and North American coasts, and is known as the most interesting actinian on account of the mode of dispersal. Several small specimens were collected by the present writer in Mutsu Bay. In Japan the actinian had long been wrongly named *Sagartia leucolena*.

Distribution. Northern coasts of Europe, the Mediterranean Sea, Atlantic and Pacific coasts of North America. In Japan, common round the coasts of Hokkaido, Honshu, Kyushu, Shikoku (probably) and Corea. This is a shallow water form, and is generally found with pebbles and molluscan shells adhering to it.

Family METRIDIIDAE

Metridium sensile var. fimbriatum VERRILL

(Pl. XI, Fig. 5; textfigs. 29–30)

Metridium sensile var. *fimbriatum:* CARLGREN, 1934, p. 353.
Metridium sensile: STEPHENSON, 1935, pp. 214–232, pls. 15, 16, 25, 26, 27 (in part).
Metridium dianthus: MC MURRICH, 1901, pp. 3–13; TORREY, 1902, pp. 395–406; WASSILIEFF, 1908, p. 35; VERRILL, 1922, pp. 90–92; CARLGREN, 1933, pp. 22–24 (in part).

In general appearance the Pacific form *fimbriatum* of *M. sensile* cannot be distinguished from the Atlantic form *M. sensile* var. *dianthus* which is widely distributed in the Northern Atlantic coasts of Europe and North America. The Pacific *fimbriatum* is therefore generally identified with the Atlantic *dianthus* by several authorities, MC MURRICH, TORREY, WASSILIEFF, VERRILL. Recently CARLGREN (1933, 1934) studying the comparative anatomy of these two forms found that the sizes of the nematocyst capsules are considerably larger in the Pacific form than in the Atlantic, and, thence separated them into two varieties. STEPHENSON (1935), following him, described four varieties of this species. In Mutsu Bay the actinian is common on the shallow water coasts of Ôshima, generally forming colonies between crevices and under rocks. Body variable in shape, sometimes more high than wide, with the voluminous disc and well-expanded base, which is firmly adherent and wider than the column. Column very extensive and variable in form, sometimes long cylindrical and sometimes short dome-shaped, widening below to the base and sharply above to the capitulum, which is marked off from the column by a distinct parapet. The surface of the column is smooth, perforated for emitting acontia. Cinclids

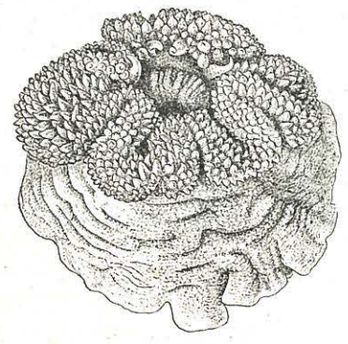

Fig. 29. Preserved specimen of *Metridium sensile* var. *fimbriatum* VERRILL. ×3/2.

inconspicuous to the naked eye, scattered in arrangement. Capitulum, trumpet-shaped, bearing a large disc. The margin of the disc is nearly round in young specimens but generally divided into five lobes in large ones; these lobes being different in size and some of them occasionally showing a tendency to further subdivision in large actinians. Tentacles numerous, growing on the disc, especially thick on the marginal portion, with younger ones outwards, rather short in proportion to the size of the actinian. As regards the coloration of the Japanese specimens, they are grouped in the third series by STEPHENSON (1935). They are all brown, grey fawn brown or dark brown. The column is mostly chestnut brown or dark brown and often blotched with lighter colours especially in young specimens. Tentacles greyish brown or brownish blue, with a few yellow distal bands and a white tip, the base being light brown. Acontia white. As was pointed out by MC MURRICH (1901) the brown actinian seems to be the fundamental type, as in the case of *Diadumene Luciae* the olive form with 12 orange stripes is the fundamental one. On account of the occurrence of the asexual reproduction of this species, the numbers of the siphonoglyphes and mesenteries are reported to be variable.

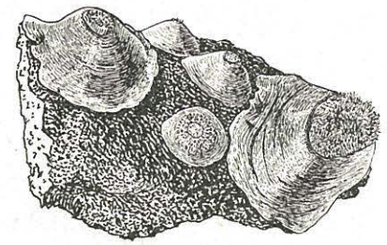

Fig. 30. A part of a colony of *Metridium sensile* var. *fimbriatum* in preserved condition. ×3/2.

Distribution. This variety has been reported to exist on the Pacific coasts of North America (Puget Sound and Nanaimo) through Alaska, Kamchatka and Behring Sea to Hokkaido (Nemuro). It is common on the coasts of the Kurile Islands, Hokkaido and the northern parts of Honshu in Japan.

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B. Sakuma & S. Suzuki del.

T. Uchida: Actiniaria of Mutsu Bay.

EXPLANATION OF PLATE

1. *Epiactis prolifera* VERRILL
2. *Anthopleura pacifica* n. sp.
3. *Anthopleura japonica* VERRILL
4. *Anthopleura stella* (VERRILL)
5. *Metridium sensile* var. *fimbriatum* VERRILL
6. *Epiactis prolifera* VERRILL

(All in natural size)