The Morphology of Cyphonautes Larva of *Membranipora serrilamella* Osburn from Hokkaido[1)]

By

Shunsuke F. Mawatari and Tatsunori Itô

Zoological Institute, Hokkaido University

(*With 3 Text-figures*)

Laminaria japonica Areschoug is one of the edible brown algae of economic importance in Japan, and its main distribution range covers nearly the whole shore of Uchiura Bay on the Pacific coast of Hokkaido. Since 1970 the alga has been remarkably fouled with a large amount of bryozoan colonies, all of which are identified with a sole species *Membranipora serrilamella* Osburn, and it has given a heavy damage to the amount of its production. Researches have been carried out by several scientists on this problem from different points of view, and the authors have participated in a study of the life history. The present paper deals with the morphology of the cyphonautes larva as the first report on the biological study of the species.

All the samples of the larvae were collected from several parts off Mori with a Kitahara's surface plankton net. The meshes are in conformity with the Japanese Standard No. NXX 13. About a thousand larvae were obtained in a year since March, 1971, and they were preserved in 2% formalin or 70% alcoholic solutions. The following description is based mostly upon those collected in August, 1971.

Shell size is measured in five dimensions; the linear distance from the anteriormost corner to the posteriormost corner (L), the perpendicular from the anterior apical lobe to the L (Hd), the maximum perpendicular from basal ridge to the L (Hv), the linear distances from the anteriormost corner to the anterior apical lobe (A) and from the posteriormost corner to the posterior apical lobe (P).

Before going further the authors express their sincere thanks to Professor Mayumi Yamada of Hokkaido University for his guidance and reading the manuscript. They are also indebted to the staffs of the Mori Fishermen's Union for their kind help in the field work. The financial support received from the prefectural government of Hokkaido and from the Hokkaido Associated Fishermen's Union is gratefully acknowledged.

1) Contribution No. 933 from the Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan.

Description

Largest specimen (Fig. 1, G): dimensions, L=0.60 mm, Hd=0.40, Hv=0.11, A=0.56 and P=0.42; a pair of shells transparent and colorless except for basal part; apical part distinctly bilobular, each lobule never sharpened but moderately rounded; bottom between both lobules situated right above about a third the length of L from posteriormost corner; nearly whole anterior margin less swollen; posterior margin clearly swelling, remarkably thickened and produced posteriorly at basal one seventh the length; basal ridge rather thickened, yellowish brown in color and ornamented with a series of more than 40 major tubercles arised from

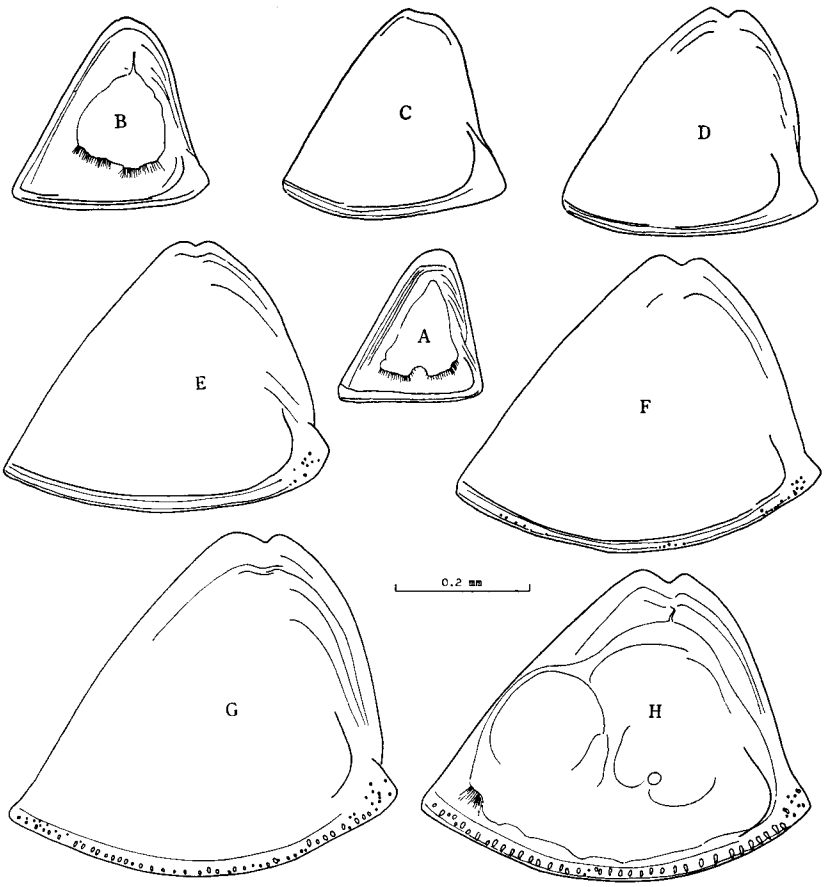

Fig. 1. Various types of cyphonautes larvae of *Membranipora serrilamella* arranged with the increase of their size from A to G. Both G and H are same in length (L) but different in shape.

surface, both posterior and anterior corners also with some scattering minor tubercles, major ones elongate elliptical but minor ones nearly spherical and all of both types dark brown in color; so-called growth lines very clear and dense in posterior part, while those of anterior rather obscure and coarse.

The shell shape varies even in those of identical length of L, and such the example is shown in Fig. 1, H.

Of internal structures the following usual organs differentiate; an apical organ with a ciliary tuft, a pyriform organ, a kidney-shaped adhesive organ, a retractor muscle binding both shells, a stomach just above the adhesive organ, and a pair of ciliary coronae along basal ridge.

Smallest specimen (Fig. 1, A): dimensions, L=0.22 mm, Hd=0.21, Hv=0.02, A=0.26 and P=0.21; a pair of shells entirely transparent and colorless; each margin nearly straight except for each corner which is rather rounded off; apical corner hardly bilobular; posterior basal corner never produced; basal margin thickened, entirely bare and colorless; growth lines clear, but less in number; no organic internal structures recognized except for a pair of ciliary coronae.

The shell size examined in a hundred specimens ranges between 0.22 mm and 0.60 mm in the measure L, 0.20 and 0.40 in Hd, 0.01 and 0.12 in Hv, 0.26 and 0.56 in A, 0.21 and 0.42 in P.

Seven cyphonautes larvae of various types are shown in Fig. 1, A-G arranged in order of the increase of their size. The major characteristics in this series are interpretable as a gradual differentiation of several features. According as they grow, the apical part becomes bilobular, the posterior basal corner more projects and thickens while the anterior basal one hardly changes in shape, the posterior as well as the basal margin is more rounded, the basal ridge becomes gradually yellowish in color, and growth lines increase in number. The basal ornamentation is not differentiated in smaller specimens, but primarily appears as several minor granules scattering at the posterior corner, further they gradually increase the number and extend along the basal margin in almost a single row, and moreover each granule becomes larger in size and elliptical in shape. Although such the ornamentation appears primarily on the posterior corner in the specimens of more than about 0.4 mm in L, there are several specimens without such ornamentation, nevertheless they attain even to 0.5 mm in L.

The relation between both L-A and L-P in all the specimens examined is shown in Fig. 2, from which major morphological variation is interpretable as a serial succession. The L is nearly identical with both the A and the P in smaller specimens, while the former is much longer than the latters in larger ones. The A always exceeds the P of which the ratio of increase lowers apparently with the increase of the L. The shell shape, therefore, seems to vary almost continuously between a slender isosceles triangular shape in the smaller specimens and wider scalene in the larger ones, and further the anterior margin in the latters is remarkably elongated.

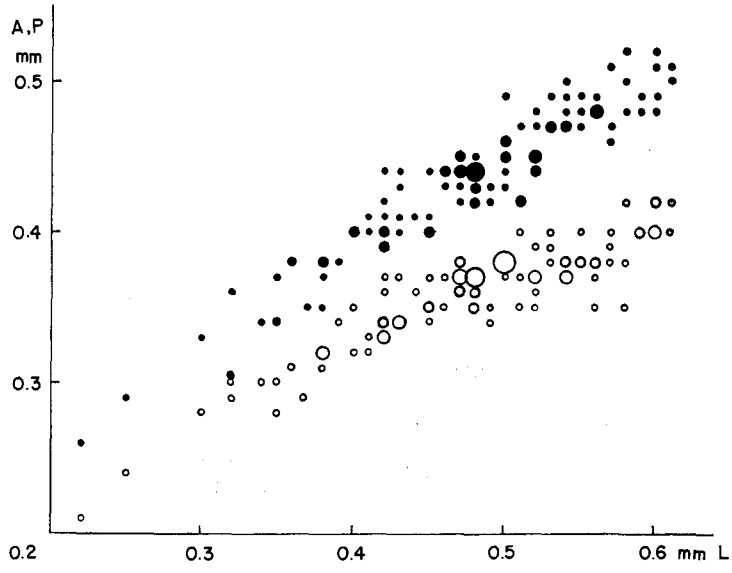

Fig. 2. The variation in shell size L, A and P measured in a hundred specimens collected in August, 1971. White circles and black spheres indicate the relations between L-P and L-A, respectively.

Discussion

The present cyphonautes larvae clearly differ from those of *Electra pilosa* which were reported by Atkins (1955) from Plymouth, England. There are noticeable features in *E. pilosa*, namely their minor size (0.44 mm in length, 0.36 mm in height), no ornamentation on basal margin, opaque and brownish shells, and especially their characteristic shape.

Atkins also reported the cyphonautes larvae of *Membranipora membranacea*, which attained strikingly larger size (0.84 mm in length, 0.64 mm in height). Such larger size (0.77 mm in length) was reported again by Ryland (1964) from the North Sea. According to the descriptions and figures by these authors, the cyphonautes larvae of *M. membranacea* have several certain characteristics as follows; transparent shells furnished with ornamentation and brownish along basal rim, apical lobules much sharpened, and posterior margin rather straight. The present specimens are easily distinguishable from the larva of *M. membranacea* in those differences in the shell shape. Although the present specimens and those of *M. membranacea* are alike in the presence of ornamentation, their arrangement together with the composition of tubercles is quite distinct from each other especially in the larger specimens.

On the other hand O'Donoghue (1926) reported the cyphonautes and their

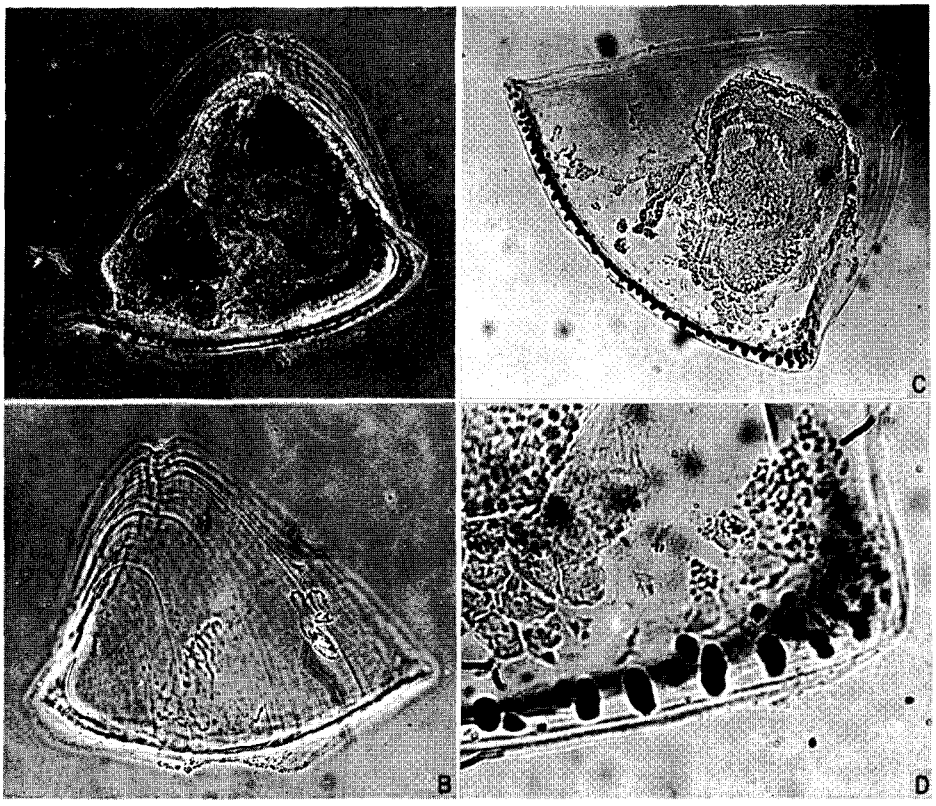

Fig. 3. Cyphonautes larvae of *M. serrilamella*. A, a larva of moderate size, internal organs well-differentiated. ×100 B, a shell with clear growth lines. ×100 C, a larger shell with the basal ornamentation consisting of more than 40 brown tubercles. ×100 D, a posterior basal corner of shell enlarged from C., major elliptical tubercles along base and minor spherical ones scattering on the posterior corner. ×400

succeeding metamorphosis of *Membranipora villosa* from Departure Bay, British Colombia, Canada. His description as well as the figure of the larva well coincides with that of the present specimens particularly in the shell shape and the ornamentation which was interpreted by him as "the rib is furnished with a series of small spine-like denticulations which are arranged in a single row for the most part but at the angles of the shell they are in a double row". The shell length in *M. villosa*, however, is 0.51 mm without great variation, thus, much smaller than the present specimens examined.

References

Atkins, D. 1955. The cyphonautes larvae of the Plymouth area and the metamorphosis of *Membranipora membranacea* (L.). J. mar. biol. Ass. U. K. **34**: 441–449.

O'Donoghue, L. H. 1929. Observation on the early development of *Membranipora villosa* Hincks. Cont. Canad. Biol. Fish. **3** (8): 249–263.

Ryland, J. S. 1964. The identity of some cyphonautes larvae (Polyzoa). J. mar. biol. Ass. U. K. **44**: 645–654.