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On the Polyp of the Scyphomedusa, *Sanderia malayensis* and its Reproduction

By

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(*With 14 Text-figures and 1 Plate*)

In 1975 the authors reported the ephyra and postephyra of the medusa, rearing the ephyra nearly to the adult form. Recently in November of 1976 the senior author visited the Yomiuri-Land in Kanagawa prefecture and found there many polyps, some of which were producing ephyra of the species. Through the kindness of the members of the Yomiuri-Land, we could get ample materials of the polyp and used for investigation. So far as we are aware, the Semaeostomae show normally polydiscous, while Rhizostomae, such as *Cassiopea*, *Cephea* and *Mastigias* exhibit all monodiscous strobilation. Therefore, it must be noticeable that this Semaeostome medusa retains monodiscous strobilation and thence it will be concluded that the polydiscous or monodiscous strobilation is nothing to do with the phylogeny of Scyphomedusae.

Polyp: The well developed polyp is cup-shaped and colourless, with the oral disc, 0.8–1.2 mm, and an epistome in the centre, which is encircled by 22–40 tentacles which are filamentous with a minute globe-like end and nearly 6 mm in well-extended condition. Infundibula are generally 4 in number, but out of the polyps examined in some were counted 6, rarely 5 or 7. In the junction-point of the calyx with the stalk the polyp is furnished normally with a polyp-bud and a movable stolon which is long and prehensile, sometimes extends to the substratum and sometimes coiled up (Fig. 1). The polyp agrees with that of *Chrysaora hysoscella* which was described by Chuin (1930) in having the movable stolon.

Budding: In many cases, polyp-bud begins to grow accompanied with the movable stolon which arises on the opposite side at nearly the same level. At first step, it is difficult to distinguish the projection of the polyp from that of the stolon, but sooner or later, the former begins to be characterized by the formation of the slight oral protrusion at the top (Fig. 2) and then the tentacles begin to grow around the perifery of the oral disc. The tentacles arise regularly as is seen in the other scypho-polyps in general. They rapidly increase in number and attain

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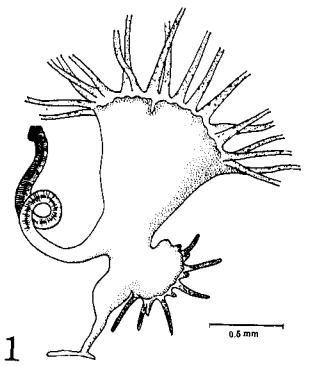
numerous numbers as seen in the mother-polyp. Then, the calyx becomes finally jointed to the stalk of the mother-polyp, excluding the stolon. Concerning this fact, further description will be given afterwards.
The buds are usually 1 but exceptionally 2 in number.



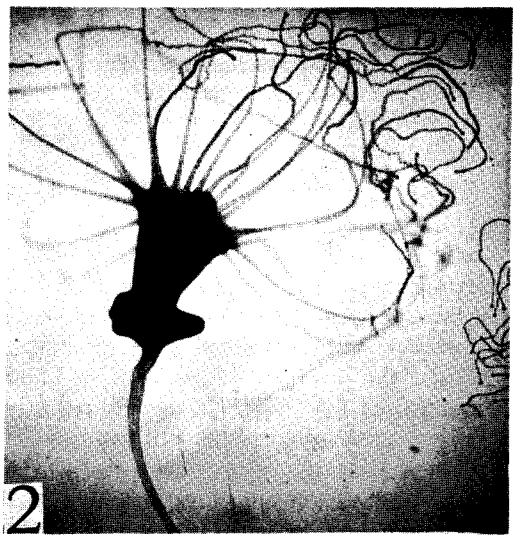
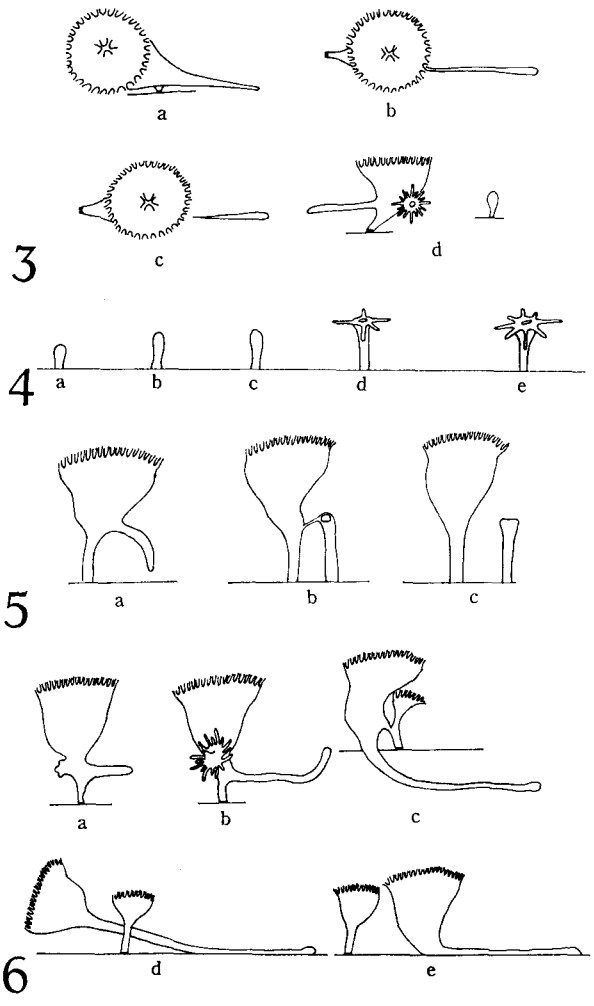


Fig. 1 Complete polyp provided with a young bud and a movable stolon.
Fig. 2 A polyp provided with two protrusions which become later a polyp and a movable stolon respectively (oral disc, 1.0 mm in diameter).

Stolonization: The stolon appears at first as a cone-like body which appears on the side of the junction area of the calyx and the stalk, and then gradually elongated. When the bud and the stolon simultaneously develop, the latter extends in the opposite direction against the former. The development of the stolon is extremely rapid as compared with the other parts of the body of the polyp. The stolon develops to several mm in the maximum length and far broader than tentacles in breadth. It usually takes only 2 or 3 days from the beginning of stolonization to become a full grown stolon, 5–6 mm in length. The stolon is slender, with numerous transverse stripes and slightly tapered to the terminal por-

Fig. 3 Schematic figures showing the formation of polyp from residual stolon: a; Stolon elongated. b; Stolon just attaches itself to substratum. c; Stolon is partially degenerated and only the terminal part survived. d; The residual part has grown to a tiny polyp.
Fig. 4 Schematic figures showing the growth of polyp from an isolated piece of stolon: a; Juvenile polyp, 1st day after attachment, 4th day after isolation. b; 5th day after attachment. c; 10th day after attachment. d; 14th day after attachment, 0.3 mm in



height. e; 15th day after attachment.

Fig. 5 Schematic figures showing the direct formation of daughter-polyp separated from the mother-polyp: a: The stolon-like elongation extends downwards. b; It attaches itself to the bottom. c; It is separated from the mother-polyp and becomes a new polyp afterwards.

Fig. 6 Schematic figures showing the formation of a daughter-polyp from the mother-polyp which is at the same time provided with a polyp-bud and a movable stolon: a; A polyp-bud and a stolon came in view. b; These develop respectively. c; The calyx of the daughter-polyp is connected with the stalk of the mother-polyp, while the movable stolon remains joint with the calyx of the mother-polyp. d; Mother-polyp and daughter-polyp are barely connected. e; These 2 polyps are divided into 2 individuals.

tion which ends as a knob. The knob is used for attachment but not for taking food. The stolon becomes well extended along the bottom of the rearing dish but not yet attaches to the substratum. On the contrary, it slowly, sometimes rapidly moves and winds like a coiled spring. Several days or more afterwards, the stolon

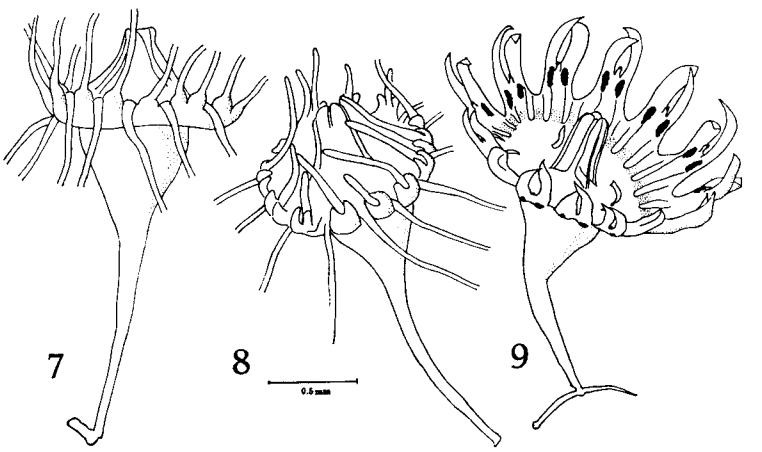


Fig. 7 At the beginning of strobilation.
Fig. 8 Strobilation proceeds gradually.
Fig. 9 Ephyra nearly completed.

attaches itself to the substratum with the terminal knob but sooner or later, the adhesion comes to whole bottom of the stolon and firmly fastened to the bottom. Some of the stolons remain in situ, while some of them are torn off, and the residual part grows to a tiny polyp (Fig. 3). When a free movable stolon was artificially cut off at the middle portion, the proximal half of the stolon rapidly regenerated to a perfect long stolon with a terminal knob at the tip. On the other hand, the isolated part of the stolon at first swam and crawled for a while and then attached to the bottom and formed a new polyp in several days (Fig. 4). It was rarely observed that a stolon-like elongation from the side of mother-polyp extended downwards and attached itself to the bottom by the tip. After that, the stolon-like body becomes separated from the mother-polyp near the proximal end of the stolon, thence the separated stolon becomes a new polyp firmly attached to the substratum (Fig. 5). When the polyp is removed from the substratum and then the isolated polyp is laid on the bottom, it slowly moves by using the terminal knob for adhesion and the stolon for contraction. The polyp has usually 1 but exceptionally 2 stolons. In this species, the relation between the budding and the stolonization is very characteristic of the process of the growth. In many cases, budding and stolonization simultaneously occur at the junction point of the calyx

and the stalk, taking the opposite direction each other. As growth proceeds, the calyx of the bud gradually joins with the stalk of the mother-polyp, while the movable stolon joins with the calyx of the mother-polyp, thus they become to form a cross barely connected to each other by a narrow bridge of tissue. Several days

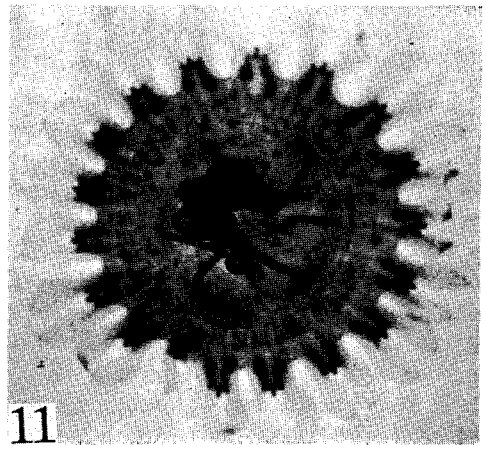


Fig. 10 Two ephyrae derived from the double headed polyp, (larger ephyra being 3.8 mm in diameter).

Fig. 11 Completed ephyra, 3.5 mm in diameter with 6 gastral filaments.

afterwards, they become 2 individual polyps (Fig. 6). The budding and the stolonization did not both occur continuously through the year round but seem to be limited to the particular periods. The polyps had been reared in natural sea water and artificial sea water at the constant temperature 20°C in the laboratory.

Strobilation: The strobilation was more or less continuously seen to occur in the polyps throughout the year when reared at constantly 20°C in water temperature. The sign of the beginning of the strobilation was as follows (Figs. 7, 8, 9): (1) outgrowth of ephyral lappets in the basal part of the alternate tentacles, (2) discoidal elongation of the peristome which forms the upper part of the calyx, (3) colour change in the oral disc from whitish to pale greenish. The morphological changes in the strobilation of this species is not so fundamentally different from these generally seen in other Semaeostomae except the fact that strobilation is monodiscous. It will be summarized as follows: (1) absorption of the rhopalar tentacles and then the interrhopalial ones, (2) formation of ephyral lappets with sensory organs, (3) increase of the pulsatory motion in the ephyral lappets, (4) the colour change of the ephyral part from pale greenish to brownish with the development of the strobilation (Fig. 12, 13). The days required for strobilation were fairly short; it takes about 2–5 days, average 3 days from the beginning of strobilation to the separation of ephyra at the constant 20°C in water temperature.

The residual part left behind after the separation of ephyra again grew to the adult polyp and repeated strobilation until 17 to 30 days at the temperature above mentioned. For example, the first strobilation took place on August 26, the second one on September 17 and the third one on October 6. Ephyrae just before separation are between 2.9 and 4.3 mm in diameter and the ephyral lappets were counted between 12 and 24 pairs, especially 16 pairs were the most abundant. They pulsate all actively in later period of strobilation. As the exceptional case several polyps crowned with 2 ephyrae originated in a double headed polyp were seen in the coase of investigation (Fig. 10).

The interrelationship between the number of infundibula and that of gastral filaments: In this species the infundibula present in the oral disc were not found always 4, but in some individuals were 6, with scanty exception of 5 or 7. The ephyrae just before liberation from the basal polyp were also provided with 4 or 6 gastral filaments (Fig. 11). The polyps with 4 infundibula and gastral filaments against those with 5–7 infundibula and gastral filaments were in the ratio 3 to 2 in number. The infundibula and the gastral filaments are sometimes arranged at irregular intervals and irregular arrangement of the gastral filaments. The irregularity coincides with that of infundibula. On the other hand, the difference between 4 and 6 in number of infundibula or in gastral filaments seems to be not genetically absolute, because two sister ephyrae derived from a two-headed polyp had 4 gastral filaments on one ephyra and 6 ones on the other ephyra respectively.

Acknowledgement

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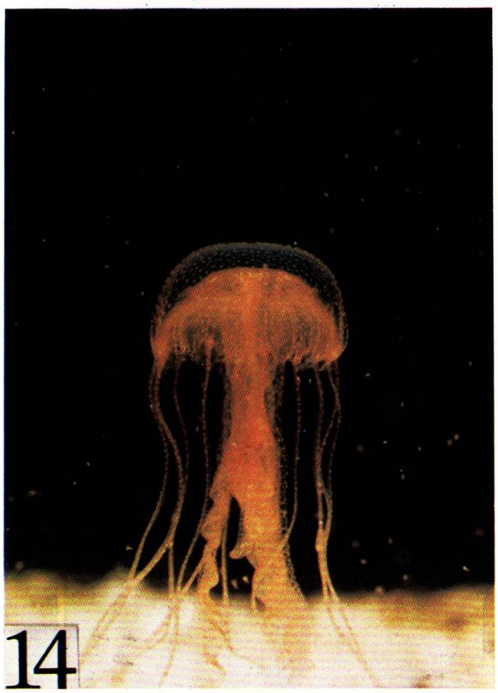
Explanation of Plate VI

Fig. 12 A polyp with a young ephyra and movable stolon, Mr. Katsumi Sakamoto photo.

Fig. 13 A polyp with a newly completed ephyra, Mr. Katsumi Sakamoto photo.

Fig. 14 A medusa about 50 days afterliberation, Mr. Katsumi Sakamoto photo.

Fig. 15 A medusa about 60 days after liberation, Mr. Katsumi Sakamoto photo.



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