THE INTERRELATIONSHIPS OF SCYPHOZOAN CLASS

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In regard to the evolution of Scyphozoa H. Thiel (1966) published a detailed review with which the present writer agrees in general. I will give here some complementary notes to the review.

In 1963 Uchida (p. 9) pointed out that "The three classes of the Coelenterata being so divergently differentiated from each other that any one of them could be the ancestor of the others, it may be said that the primitive form of the phylum probably originated before the Paleozoic and from that protoform the three classes decended". H. Thiel (1966, p. 113–4) expressed the similar opinion that "Without expressing any phylogenetic tendency I would say that the relationships of Anthozoa and Hydrozoa to Scyphozoa reaches back to or beyond a phylogenetic stage of a polyp with four tentacles and four septa. These relationships allow us to think of a common basis for Cnidaria from which the three classes originated independently. Thus the Anthozoa, the Hydrozoa and the Scyphozoa developed simultaneously, none is the primitive class."

It is of my opinion that the primitive form of the Scyphozoa was probably a solitary scyphopolyp with 4 or 8 tentacles and 4 septa, and 4 groups of gastral filaments. The medusan forms followed after the polyp. The Coronatae seem to be akin to the fossil Conulata and are the most primitive forms of the Discomedusae (Ephyridae), but, differing from the conclusion of Naumov (1961) and Werner (1966), the Coronatae do not possibly represent the most primitive form of all the Scyphozoa. It seems to me that the Cubomedusae are the most primitive group, because they have tetramerous structure in symmetry and probably have no stage of ordinary ephyrae.

As is generally known, the scyphostoma is tetramerous, but most of scyphomedusae have the tendency of octomerous symmetry. Among the Scyphozoa, the Cubomedusae stand in special position in the possession of tetramerous

1) Contributions from the Marine Biological Station of Asamushi, Aomori Ken, No. 374.

structure: 4 marginal tentacles or 4 groups of marginal tentacles, 4 sensory organs, 4 radial pockets, 4 groups of gastral filaments and 4 pairs of gonads. Their life-history has not yet been completely revealed but they have the ciliated planula which metamorphoses into the scyphopolyp. The youngest pelagic medusa of *Charybdea rastonii*, 1,2 mm in diameter, which was described by the writer[1] (1926 and 1929), has only one gastral filament in each interradial part of the stomach and naked sensory organs, one in each perradial part just near the bell margin and no velar canals in the velarium. The metamorphosis of the young medusa into the adult was described at the same time (1929). Here remains still unknown how the young medusa was liberated from the sessile scyphopolyp. There may be possible 4 probable cases: budding from the polyp, budding from stolon, direct metamorphosis and strobilation. Among the cases, strobilation is generally seen in the Scyphozoa. It was discussed already that the strobilation might be possible in the fossil Conulata (Kiderlen, 1937). The youngest medusa of Cubomedusae has no sign of apical depression which is often seen in young hydromedusae just budded off. I am of opinion that the young cubomedusa is possibly reproduced by strobilation from the scyphopolyp. The strobilation is possibly different from that of the Discomedusae, because it does not take part in ephyra-formation. It is surmised that the upper part of a scyphopolyp with 8 tentacles metamorphoses into a cubomedusa with 4 tentacles and 4 sensory organs. Though simple in general structure, the Cubomedusae are well differentiated and adapted to the tropical life, in having well-developed marginal tentacles and sensory organs.

As was pointed out by Wietrzykowski (1912), the Stauromedusae have the structure of combination of a scyphomedusa and a scyphopolyp. His idea was adopted by Krumbach (1925) and Uchida (1929). The upper part of them is octomerous; 8 groups of tentacles and generally 8 sensory organs (anchors), while the lower part is tetramerous; 4 radial pockets, 4 groups of gastral filaments and 4 pairs of gonads. The scyphistoma of the Stauromedusae is in their main part morphologically similar to that of the Discomedusae and metamorphosis mainly occurs only in the upper part. The Stauromedusae have planula which is peculiar in devoid of cilia and does not swim. This Scyphozoan group is distributed mostly in circumboreal and also in circumaustral regions and surmised to be adapted to cold waters in lacking the pelagic planula and the strobilation. The Stauromedusae are possibly a side-branch of the Discomedusae (Ephyridae). Judging from their littoral distribution, they might have by chance migrated after the glacial epoch and might assumed the special life.

Thanks to the works on *Stephanoscyphus* of Komai (1935) and Werner (1966),

1) Not Komai (1935) as stated by H. Thiel (1966, p. 87)

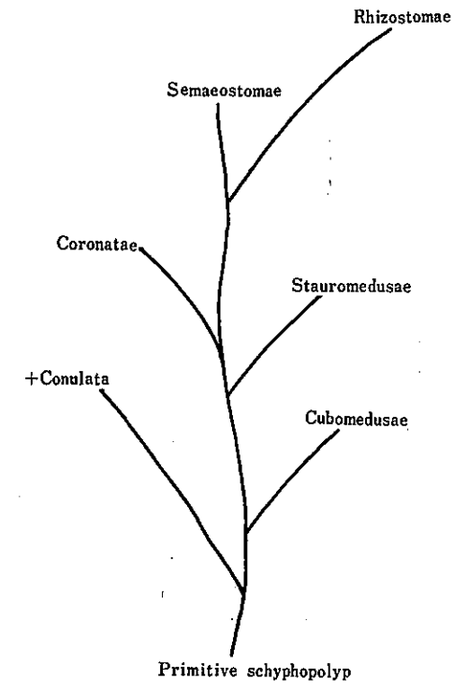

Fig. 1. Dendrogram of scyphozoan relationships.

it was clear that the Coronate go through the strobilation and produce the ephyra which is in general octomerous in structure. The scyphistoma of these Coronatae has the chitinous perisarc and quite similar to those of fossil Conulata. Therefore, the Coronatae seem to be the stem-form of the Discomedusae as was pointed out by Naumov (1961), Werner (1966) and Chapman (1966).

The Semaeostomae are more differentiated in structure than the Coronatae and are provided with more marginal lappets, more tentacles and many radial canals which sometimes anastomose each other. The strobilation is polydiscous as like as that of the Coronatae. This group is the most common and widely distributed especially in temperate regions.

As to the interrelationships between the Semaeostomae and the Rhizostomae the writer (1960, p. 185–187) described in detail and the idea was cited by H. Thiel (1966). The Rhizostomae are of course the most differentiated group in the the Scyphozoa. It must be here further noted that the strobilation of this group is always, so far as studied, monodiscous. The fact was sparely observed in the former time and recently confirmed by Sugiura (1963 and 1966) in several species of rhizostome medusae belonging to the Cassiopeidae, Cepheidae and Mastigiadidae.

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