4. On the Life History of Eutima, and on radial and bilateral symmetry in Hydroids.

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Claus has given an account (Arbeiten IV, 2. 1.) of the mature hydra of a species which is very similar to *Eutima mira* (McCr.) and he has also described the formation of the medusa buds, and the metamorphosis of the young medusa. Although he reared the hydroids from the egg he neglected to study the early stages, and his account, which contains all that has been published on the history of the group, is therefore very incomplete.

I have reared the hydroid of *Eutima mira* from the egg, and am therefore able to supplement Claus' account, by a history of the embryology of the planula, and an account of the young hydroid.

The early stages present many interesting points which have never been described, although more careful observation will undoubtedly result in their discovery in other hydroids.

The pear-shaped planula is so transparent that the internal changes can be studied in the living animal, and it is possible to actually witness the delamination of the entoderm from the inner ends of the ectoderm cells. This takes place most rapidly at the small end, but entoderm cells are formed over the whole inner surface, and they arrange themselves in a single layer one cell thick, around a central digestive cavity, which soon becomes obliterated.

After the entoderm is formed, there is a very interesting change, which has, as far as I am aware, never been described. The small end of the planula becomes elongated and then the entoderm is invaginated, giving to the embryo almost exactly the appearance of an echinoderm gastrula. The resemblance is so complete that, if the formation of the entoderm and digestive cavity had not been witnessed the embryo might easily be mistaken for an invaginate gastrula, but the later history shows that the invagination has nothing to do with the formation of the digestive tract, but is a gland for furnishing the cement by which the planula is to fasten itself.

It is at first at the small end of the body, but as one lip of the orifice grows faster than the other, it is soon pushed into one side, so that the planula is no longer radially but bilaterally symmetrical, with a dorsal and a ventral surface.

The ventral surface of the small end is soon fastened to some solid substance, and the invaginated portion is protruded and pours out its cement. Even in specimens with two or three fully formed hydranths the gland which is thus formed may be seen, as a flat part of ectoderm cells, at the proximal end of the hydrorhiza. After fastening itself the planula elongates, and forms a layer of perisarc, by means of which it is fastened throughout its whole length. It does not become a hydranth but a hydrorhiza, and the first hydranth is formed as a bud, which grows out at right angles to the long axis at the end opposite the adhering gland. As soon as the first hydranth has acquired tentacles and a mouth, a second bud grows out close to the base of the first, and so on; the portion which is formed from the body of the planula persisting as a root without buds.

The formation of the first hydranth from the planula is therefore, in this species at least, a process of metagenesis rather than a metamorphosis, and this is also the case in *Hydractinia*, where the planula becomes a root, and produces the first hydranth by budding.

The planula of *Turritopsis* has an invagination at its small end, and more careful study will undoubtedly show its presence in other species.

The young hydranth of *Eutima* has a tentacular web, and the tentacles are situated in definite radii. There are five equidistant large tentacles, which are the first to appear, and alternating with these, five smaller and younger secondary or interradial tentacles.

The distribution of the tentacles of hydroids with reference to definite radii, does not seem to be at all unusual. Hamann who calls attention to the fact in *Podocoryne Hæckelii* (Jen. Zeit. XV. 1882) says that this is the only instance known, although he suggests that further research may show that it is not unusual.

The tentaculated planulae of *Aegineta* and *Aeginopsis* figured by Metschnikoff (Z. Z. XXIV) must, as I believe, be regarded as hydrae, and in these the four primary tentacles are definitely arranged, just as they are in *Podocoryne Hæckelii*.

In the American *Cunina octonaria* (McCr.) the larva is a true hydra, with mouth and stomach, and with no traces of an umbrella or of some organs. It gives rise to other hydras by budding, and in the egg-embryo, as well as in the buds, there are at first two opposite tentacles; two more soon appear at right angles to the first, as in *Aeginata*, and much later four smaller ones are developed in alternation with the four primary ones.

I believe that the young *Liriope* is essentially a hydra, with ac-

celerated development of the gelatinous umbrella, and here to we have four radially arranged primary tentacles.

The first hydranth of *Hydractinia* is almost exactly like Hamann's *Podocoryne*. It has at first four primary radial tentacles, one at each angle of the mouth: and four smaller inter-radials afterwards make their appearance.

In all these cases there are four radii. But in *Stomatoca* and in *Tubularia cristata* there are five, as in *Eutima*.

In the hydranth (*Perigonimus*) of *Stomatoca apicata* (McCr.) even when fully grown, there are usually five large radials, and five smaller interradials. It is true that the number ten is not universal, but it is constant enough to show that it is the typical number, and this is true also of the actinula of *Tubularia cristata*, in which the lips of the five radials are turned forwards, and the lips of the five smaller interradials are turned backwards or towards the aboral end of the body. In some actinulae there are only eight or nine tentacles, and in others eleven or twelve, but ten is the typical number.

In a Beaufort *Podocoryne* which is probably the larva of *Dysmorphosa fulgurans* the tentacles are usually in fives.

We therefore have radial symmetry with four parameres in

Podocoryne Hæckelii,
Hydractinia (young hydranth),
Cunina octonaria (young larva),
Polyxenia leucostyla (young larva),
Arginopsis Mediterranea (young larva),
Liriope (egg, embryo)

and radial symmetry with five parameres in

Podocoryne (*Dysmorphosa*) (mature hydranth),
Eutima mira (young hydranth),
Perigonimus (*Stomatoca*) *apicata* (mature hydranth),
Tubularia cristata (Actinula).

In a Beaufort *Sertularia*, *Dinamena bilateralis*, the tentacles exhibit marked bilateral symmetry. They are about twenty-two in number, and are arranged in an elipse, with the short axis in the plane of the stem, and the long axis at right angles to the stem. There is a single tentacle, shorter than any of the others, at each end of the long axis, and on each side of this they gradually increase in size towards the poles of the short axis, where they are largest. This bilateral symmetry is undoubtedly induced, like the symmetry of the hydrothecae, by the bilateral arrangement upon the stem, but it is interesting to note that it is not general among the Sertularia.

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