

type — but I think it preferable to put off a detailed discussion of this problem till the postembryonal development of more species of *Holothuria* (sensu lat.) has been studied.

14. *Holothuria pardalis* Selenka.

Pl. IX. Figs. 5—6.

A number of specimens of this beautiful species, which occurs — rather sparingly — on the reefs at Ghardaqa, particularly Abu Sadaf, were kept in the tanks of the station for quite a long time for eventual spawning. But no spawning took place, and the only hope of studying its development was then to try artificial fertilization, which was done on August the 26th — rather late in the afternoon. Although a good number of the eggs were ready for fertilization, showing no nucleus, it seemed at first that no fertilization had taken place. However, after about 20 hours there were a fair number of free-swimming gastrulæ, so that a small percentage of the eggs had actually been fertilized, the reason why it could not be ascertained at once being that the fertilization membrane lies very close to the egg-surface; and on account of the late hour when the fertilization was undertaken the cleavage did not begin till it was dark. But here, anyhow, was a case, where artificial fertilization of a Holothurian had succeeded.

At the age of two days the embryos were beginning to assume the Auricularia-shape, and on the third day a small ball had appeared in the posterior end of the body (Pl. IX. Fig. 5). At the age of two weeks the larva had reached its full shape, showing the signs of beginning metamorphosis, viz. the elongation of the enterocoel and hydrocoel vesicles, and the formation of the elastic balls. No lobes were visible as yet on the hydrocoel, but the madreporite spicule had already begun to form. The shape of the larva is quite as usual, as is also the colour (Pl. IX. Fig. 6), the only character by which this larva can be distinguished being the calcareous ball in the posterior end of the body, which is spherical, or somewhat angular, quite smooth, only with a couple of more or less irregular furrows (fig. 29. c).

As the larva only reached its full shape at the time when I had to leave the station, there was no possibility of having it reared through metamorphosis, the more so as only very few of the larvæ were then still in good condition.

15. *Holothuria papillifera* Heding (n. sp.)¹.

Pl. XI. Figs. 1—3.

Of this new species, so highly characteristic by its numerous long, soft, backward directed papillæ, only a few specimens were found on Abu Sadaf and Abu

¹ According to information from Mr. S. G. HEDING, who has kindly undertaken to identify my Ghardaqa-Holothurians, this new species recalls by its calcareous deposits *H. vagabunda* Selenka, but differs strikingly from that species by its peculiar long, soft dorsal papillæ, and by lacking the Cuvierian organs. The colour is a uniform grayish-brown. The tables are c. 45 μ , with one cross-bar and c. 8 spines in the crown, disk usually well developed, with 10 large holes. Buttons very regular, 50 μ long, with 6 angular holes. In the longitudinal muscles 30—40 μ large oblong rings.

Fanadir. On the 19th of August two specimens, which I had in the tank, spawned — but both were males. On the 21st I got two more specimens, which spawned when put into the tank, and this time, fortunately, one of them was a female.

The eggs are 0.1 mm in diameter, of a very faint reddish colour. The fertilization membrane lies quite close to the egg-surface. About 12 hours old the embryos were in the blastula stage, but still lying within the membrane; also the gastrula stage begins within the membrane. At the age of about 22 hours the gastrulæ were free-swimming. Four days old the young *Auriculariæ*, which are unusually broad at the anterior end (Pl. XI. Fig. 1), have formed the spicule in the posterior end. At the age of two weeks the larvæ showed the first sign of the formation of the elastic balls, and at the time when I had to leave the station, the now nearly three weeks old larvæ were in beginning metamorphosis, the elastic balls having formed, and the enterocoel and hydrocoel vesicles being elongated, though lobes had not yet begun to appear on the hydrocoel.

The fully formed larva (Pl. XI. Fig. 3) is scarcely to be distinguished with certainty from the other *Holothuria* larvæ by its shape alone. Also its colour is as usual. But the larval spicule is highly characteristic (fig. 29 a; p. 53), a rather thick-lobed star, and distinguishes it at once from the other larvæ thus far known.

These larvæ were rather unusual in swimming so close to the surface that many of them were caught by the surface-film and thus killed. This was probably the main reason, why the few larvæ still alive when I left the station, disappeared without metamorphosing.

16. *Holothuria (Microthele) difficilis* Semper.

Pl. XI. Figs. 4—5.

Most of the specimens of this species, which is rather common on the reefs at Ghardaqa, were small and showed more or less evident signs of regeneration after autotomy. But in the beginning of August the sailors brought home a number of specimens, which were evidently adult (some 10 centimetres long, when fully extended). They were put into a separate dish under a faint current from the tap, and on the 10th of August I had the great pleasure of finding that they had spawned during the night. The embryos were free-swimming gastrulæ in the morning, so I have no observations on the earliest stages. Judging from the size of the gastrulæ the eggs must be of the usual size, c. 0.1 mm in diameter. Next day the embryos were young *Auriculariæ*, and two days old they had formed the calcareous spicule in the posterior end of the body.

At the age of 10 days the larvæ showed the first signs of metamorphosis, viz. the presence of elastic balls and the elongation of the enterocoel and hydrocoel vesicles. Two weeks old several of the larvæ had metamorphosed. After another two weeks the young *Holothurians* had developed the first tubefoot — while several of the larvæ still remained unmetamorphosed, but evidently normal. No doubt it would have been possible to induce these belated larvæ to metamorphose, as was

- Fig. 1. Young Auricularia of *Holothuria papillifera* Heding. 4 days old. $\times 150$.
- 2. Nearly fully formed Auricularia of *Holothuria papillifera* Heding. 2 weeks old. $\times 115$.
- 3. Fully formed Auricularia of *Holothuria papillifera* Heding. 18 days old. $\times 100$.
- 4. Young Auricularia of *Holothuria difficilis* Semper. 5 days old. $\times 125$.
- 5. Fully formed Auricularia of *Holothuria difficilis* Semper. 16 days old. $\times 100$.
- 6. Young Auricularia of *Holothuria (Microthele) nobilis* Selenka. 7 days old. $\times 150$.

All from the oral side.

