

## ON THE PROPAGATION OF HALOBATES.

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In the "Cambridge Natural History" Vol. VI, 1909, we read concerning the propagation of *Halobates*:

"The young are frequently met with, and there can be no doubt that the whole life-cycle may be passed through by the Insect far away from land. The Italian ship Vettor Pisani met with a bird's feather floating on the ocean off the Galapagos Islands, covered with eggs which proved to be those of *Halobates* in an advanced stage of development. It was formerly believed that the female carries the eggs for some time after their exclusion, and although this has since been denied, it is nevertheless an undoubted fact, for it was observed by Mr. J. J. WALKER, to whom we are indebted for a specimen having the eggs still attached to the body, as shown in fig. 265. Mr. WALKER believes the bugs shelter themselves when the sea is at all rough by keeping at a sufficient distance below the surface; they can dive with facility, and are gregarious."

During my cruises with the investigation-steamer "Brak" over the Java Sea and along the East coast of Sumatra I regularly had opportunities to make observations on the life and also on the propagation of *Halobates*. And these observations lead me in the first place to state as my conviction that *Halobates* cannot dive and that no attempt to frighten it can induce it to dive. When frightened it always takes recourse to rapid flight. If, by some accident, — as happened regularly in our plankton-catches, — the animals get under the surface of the water, they indeed make swimming movements with their legs, but they cannot emerge again to the surface and evidently have to die.

In 1914 WILLIAM LUNDBECK made "Some Remarks on the Eggs and Egg-deposition of *Halobates*" (in "Mindeskript for Japetus Steenstrup", Copenhagen). In this paper he deals with a fairly extensive collection of *Halobates*-eggs left by STEENSTRUP to the Zoological Museum of Copenhagen. It had been brought together for STEENSTRUP by quite a staff of collectors, especially sea-captains, whom he had managed to interest in collecting work, from the Atlantic as well as from the Indo-Pacific region.

Among this material five different sorts of eggs could be distinguished, all oblong with a length of 1—1,2 mm. and a breadth of about 0,4 mm., some with a smooth egg membrane, others with a more or less sculptured one. All were attached to floating objects, such as seaweed, *Spirula*- and *Sepia*-shells,

bird's feathers, coal slag, a piece of timber and a cork, often in groups of several hundreds or even thousands. As in one female no more than 25 ovarial eggs have been found, the number one female lays must be supposed to be near this and it is evident, that several animals have been depositing their eggs on the objects mentioned above. The eggs are attached with a transparent glue-like substance which often surrounds the egg entirely.

As mentioned above, WALKER observed a few females carrying 1—3 eggs fixed to the end of the abdomen, and HILDEMAN (Proc. Wash. Acad. Sc. III, 1901) mentions a similar observation. Evidently, as LUNDBECK suggests, these authors had to deal with females bearing the eggs for a short time, till a suitable place for deposition had been found.

In the Java Sea I never saw such egg-bearing individuals, but more than once did I find the eggs fastened to small floating objects such as branchlets or pieces of pumice stone. In fig. 1, e.g., a small piece of wood is shown with a number of eggs attached to it. They are all placed in the same direction, with the head ends all pointing to the same side. The egg-membrane is smooth and transparent, the length is 1,1 mm. the breadth 0,42 mm. These measures agree perfectly well with those of the different kinds of eggs described by LUNDBECK.

I cannot tell as yet to which species of *Halobates* these eggs belong. I probably should be able to do so, if I knew which species is or are the common one(s) in the Java Sea. Having no time myself to indulge into systematic studies, we will have to wait for the appearance of Vol. XLI of the Monographies of the Siboga-expedition, which will deal with the genus *Halobates*. As was the case with the eggs described by LUNDBECK, I found the eggs attached to the substratum by a transparent glue-like substance.

Through the transparent egg membrane the embryo can be distinguished



Fig. 1. Floating branchlet covered with *Halobates*-eggs,  $\times 3$ .

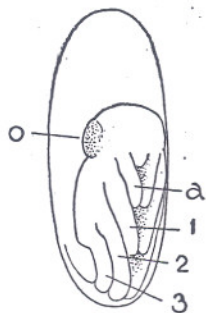


Fig. 2. Egg showing the eversion, *a* antenna, *o*, eye, 1, 2, 3 legs.

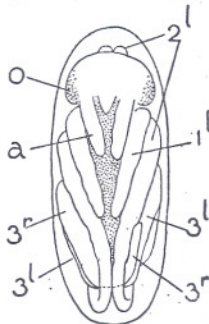


Fig. 3. Slightly older egg, 1<sup>l</sup> left first leg, 1<sup>r</sup> right first leg, etc.

perfectly, especially in the later stages of development, as has been observed by WITLACZIL, while examining the collections of the "Vettor Pisani" (1882-1885), and confirmed by LUNDBECK. In the younger stages the rudiment of the embryo cannot be seen which is evidently due to its immersion in the yolk and its being closed over by the amnion folds. In fig. 2, however, we see the embryo emerging to the surface, a process which has been completed in fig. 3. Simultaneously the colour of the egg-contents, formerly pale, now changes into light orange, whereas the rudiment of the eyes are dark orange.

The embryos are now all situated with their dorsal side directed to the substratum and with their ventral side up. They are performing, especially in somewhat further advanced stages, a slow rotatory movement round their long axis from the left to the right and from the right to the left again. I could not make out what causes this slow but regular movement within the egg membrane but it can hardly be explained unless by the assumption that there are cilia developed somewhere. This movement allows us to study the living embryo not only from the ventral but also from the lateral side.

The rudiment of the proboscis, of the antennae and of the three pairs of legs may be clearly distinguished. The last two pairs of legs already attain a considerable length within the eggs and must therefore bend down round the end of the abdomen and then upwards again. In doing so the 2nd and the 3rd pair show the following difference. The second pair of legs, which are the longest, bend down round the end of the abdomen and then upwards again along the dorsal side to the top of the head, so that their ends may be seen reaching to just above the head if we look at the embryo from the ventral side, as shown in fig. 3.

The last pair of legs, which are shorter, bend down round the abdomen in the same way, but in this case from the left to the right side and from the right to the left, so that the extremity of the left leg comes to lie along the proximal part of the right one and the extremity of the latter along the proximal part of the former. And now it is curious to state, that the extremity of the left leg always lies behind the proximal part of right one, and that the extremity of the right leg always lies in front of the proximal part of

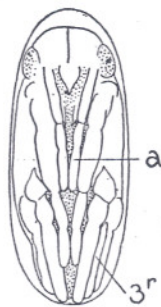


Fig. 4. Still further advanced egg.

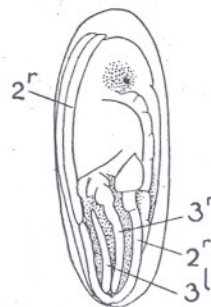


Fig. 5. The same from the side.

the left one. In some 20 eggs examined by me for this purpose I never found the reverse condition.

Figs. 4 and 5 show somewhat further advanced embryos, in which the segmentation of the antennae and of the legs has become evident. Also the abdomen is segmented and more or less movable.

The eggs described here have been fished May 8th, 1922, at 5° 21' S 107° 16' E. They were not all in the same stage of development, some of them being somewhat further developed, others somewhat less, but on the whole the differences were not great.

The next day the embryos began to get visible in a few of them, as a consequence of the inversion (opening of the amnion and emerging of the embryonic rudiment to the surface). Their number increased during the following days, so that on May 12th all the eggs contained inverted embryos. On May 15th one of them hatched and the others followed during the next days. The egg membrane springs open with a fissure reaching from the head end to half of the length of the egg, as has also been noted by LUNDBECK. I can also confirm his conclusion that the larvae moult at once after hatching, so that the cast skin remains attached to the fissure of the egg-membrane.

A newly hatched „larva” — if we may use the word here! — is shown in figs. 6 and 7. It adopts at once the mode of life of the adult *Halobates*, moving over the surface

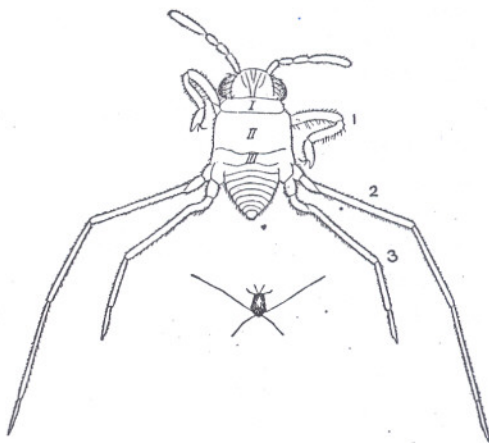


Fig. 6. Newly hatched *Halobates*, from the dorsal side. I, II, III, the three thorax-segments; below: figure showing the natural attitude of the animal when resting on the water surface.

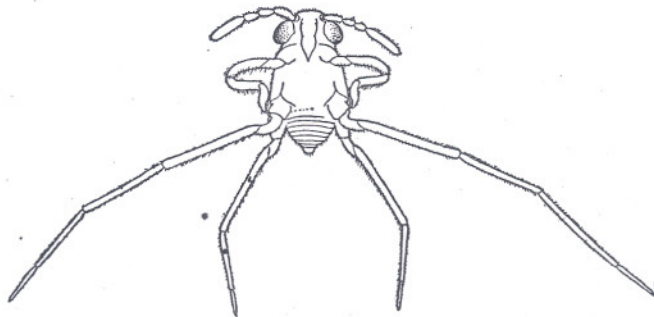


Fig. 7. The same from the ventral side.

of the water with rapid strokes of the second and the last pair of legs. During a few days I thus found every morning a considerable number of them in

the glass of water in which I had kept the eggs, all in vivid action. Evidently then *Halobates* is during its whole life a true surface-dweller which can dive into the water neither in the adult state nor in its youth.

If we now examine the newly hatched *Halobates*, we find that its structure hardly differs from that of the adult. The only differences, indeed, are found in the relative dimensions of the body segments and the relative length of the legs. The lengthening of the thorax and the lengthening of the legs, both so characteristic of the Hydrometridae, is less pronounced, although very evident, in the newly hatched *Halobates*. Thus we see, that neither in external structure nor in mode of life is there any essential difference between the new-born and the adult *Halobates*.

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