

Some Observations on the Fertilization and the Early Development of *Phoronis australis*

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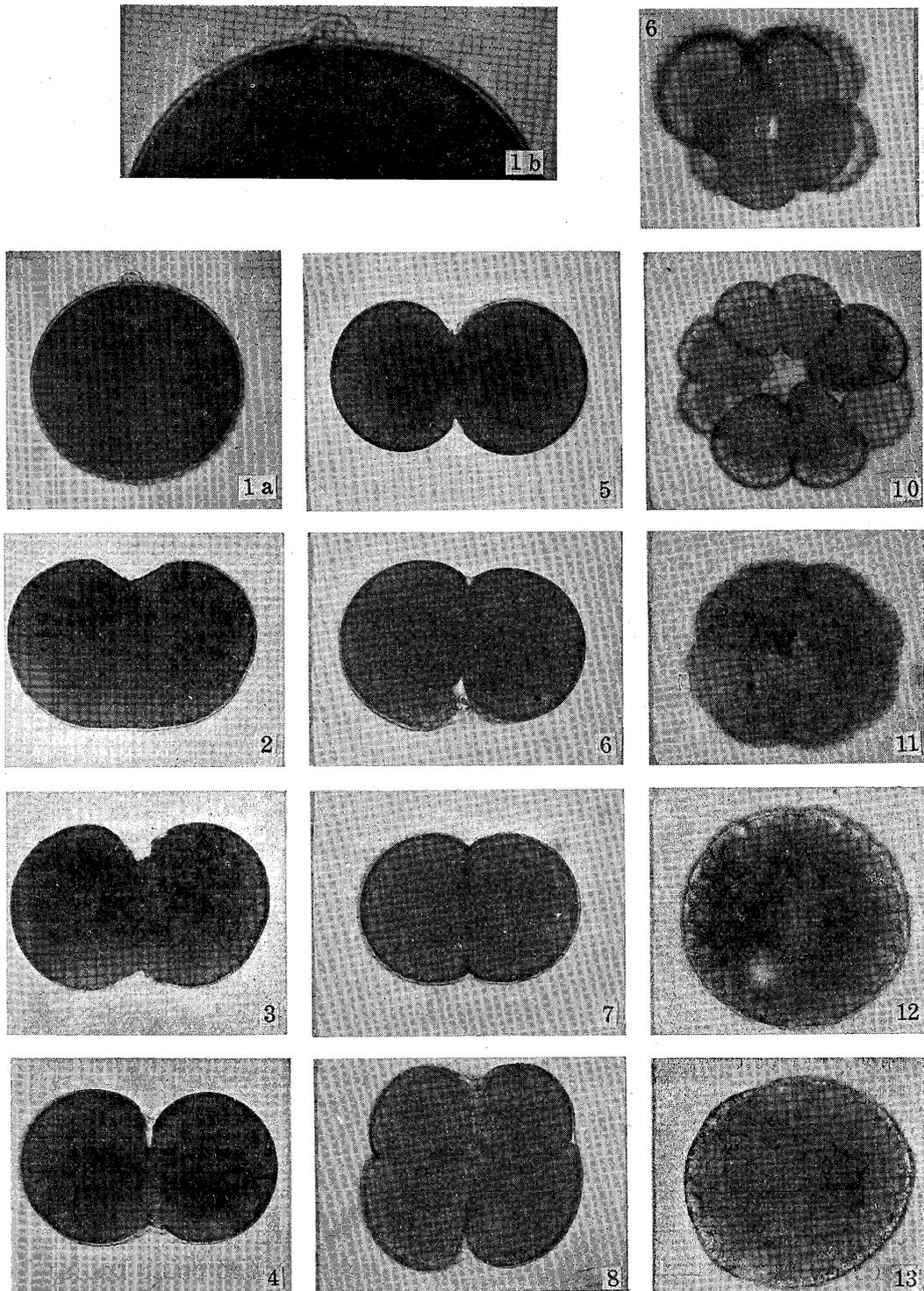
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The following observations on the early development of *Phoronis australis* were carried out at the Misaki Marine Biological Station in the summer of 1953. The observations are still incomplete. But as they contain some facts worthy to be described, this report is presented as a preliminary. The accompanying photographs were taken by Mr. Y. Endo and prepared by Miss C. Takada, to whom and to the staff of the Station my hearty thanks are due.

Fertilization. During the summer season the tentacular crown of *Phoronis australis* is crowded with its larvae of various stages, and through its transparent trunk skin are seen a number of eggs floating freely in the body cavity. By simply pricking with a needle the posterior end of the trunk wall, the eggs, 40~250 in number, mostly 100 from one individual, are easily shed out of body cavity into the sea water, where they can develop without further help of artificial insemination. This is the same with the case of the eggs which are obtained from individuals whose bodies were immersed in the freshwater for 3~5 minutes and whose lophophores were carefully washed by pipetting. This fact, though a further cytological study is needed, seems to suggest that the fertilization of this species has already taken place in the body cavity as has been recently confirmed by Rattenbury (1953) in *Phoronopsis viridis*.

Early Development. Eggs liberated into the sea water are measured 0.13 mm in diameter and are whitish in color. The first polar body is formed about 20 minutes after liberation (room temp. 30C), and the second one appears 30 minutes after this, while the first one usually divides again. The most peculiar phenomenon of the eggs in these stages, which was first noticed by Mr. Endo when photographing, is a presence of bundles of cilium-like protrusions near the polar bodies (Figs. 1a, 1b). These protrusions are constantly flickering and probably form a ring around the bodies. We can not tell at present anything definite about their origin and duration. They, however, seem to be formations of the sort of the polar rings in the egg of *Clepsine* which are said to appear during maturation divisions (Whitman, '87 and others).

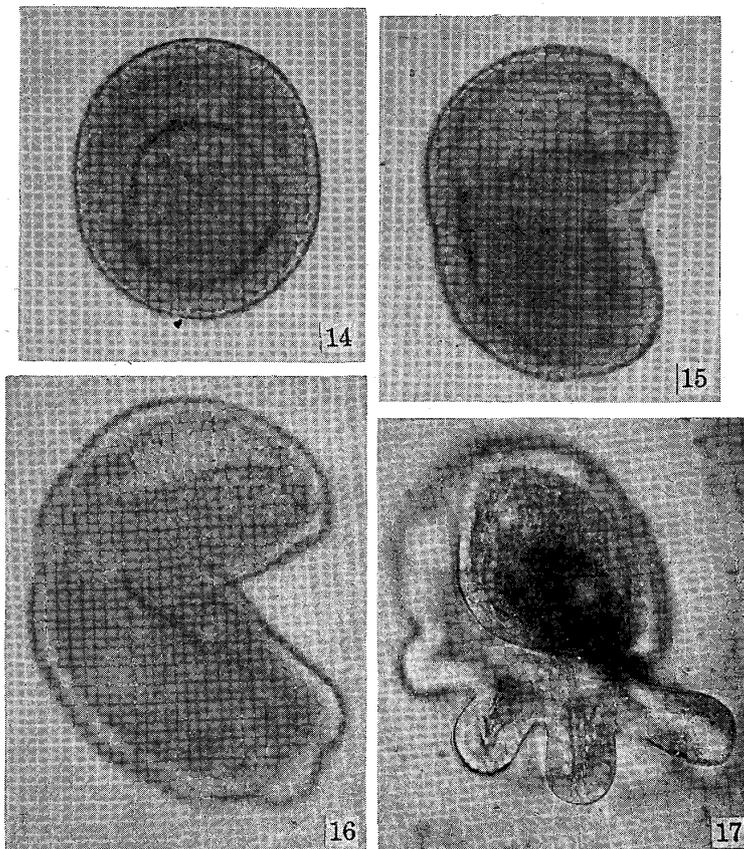
30 minutes after the formation of the second polar body, segmentation begins. Its fashion follows that of the ctenophore or the medusa



Figs. 1-13. Early stages in the development of the egg of *Phoronis australis* ($\times 200$ except Fig. 1b).

Fig. 1a The egg during polar body formation. Fig. 1b Enlarged photograph of the animal portion of the egg shown in Fig. 1a. Notice the cilium-like protrusions on both sides of the polar bodies. Figs. 2-7 Successive stages of the first cleavage. Fig. 8 4-cell stage. Fig. 9 8-cell stage. Fig. 10 16-cell stage viewed from vegetal side. Fig. 11 32-cell stage viewed from vegetal side. Fig. 12 64-cell stage. Fig. 13 Blastula stage.

with the egg nucleus eccentric in position. The cleaving lasts 11 minutes and the egg divides into two blastomeres of equal size. According to Ikeda (1901), who worked on the egg of *Ph. ijimai*, subsequent segmentations proceed asynchronously, hence the 3, 5, 7 cell stages are said to be of constant occurrence. In the present species, this does not to be the case and the segmentations after 2-cell stage proceed rather regularly, the meridional and the equatorial cleavages coming alternately with an interval of about 30 minutes. However, size differences among the resultant blastomeres are rather common and the first noticeable differences come at the 8-cell stage, where the four animal cells are formed far smaller than the four vegetative ones.



Figs. 14-17. Later stages in the development of the egg of *Phoronis australis* ($\times 200$).

Fig. 14 Gastrula stage. Fig. 15 A larva 2 days old. Fig. 16 A larva about 3 days old, in which three pairs of rudimentary tentacles begin to appear. Fig. 17 An Actinotrocha larva about 4 days old with four pairs of tentacles.

In 17 hours a blastula is reached and at the end of the first day that is converted into a gastrula, which begins to rotate slightly. In the 2nd day, preoral lobe is protruded and the whole form of the larva becomes convex. In the 3rd day, appear the three pairs of rudimentary tentacles which grow longer in the 4th day and the larva becomes an

Actinotrocha with four pairs of tentacles, corresponding to the oldest one which is found attached to the lophophore.

Summary

1. In *Phoronis australis*, the eggs liberated out of the body cavity into the sea water have the capacity to develop without further artificial insemination.

2. At the stage of maturation divisions, the egg has bundles of cilium-like protrusions near the polar bodies. These protrusions are constantly flickering and probably form a ring around the bodies.

3. Cleavages proceed rather regularly, and in the 4th day, the egg develops into an Actinotrocha with four pairs of tentacles which corresponds to the oldest one found attached to the lophophore.

Literature

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