The Excretory organs of Opalina.

Part I.

By

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(From the Zoological Institute, Würzburg.)

(With plate IV.)

During the past winter in Würzburg, while engaged in a general study of *Opalina*, suggested by Professor Boveri, I have found excretory organs in three species of the genus — *obtrigona*, *caudata* and *intestinalis*.

Excretory organs have not heretofore been described in *Opalina*, unless, as seems probable, Zeller's [1]) brief description of certain structures in an undetermined species may be so taken. Along with *Opalina dimidiata* he found in the rectum of *Rana esculenta* some *Opalinae* of broader form, apparently not *O. dimidiata*, in which were discernable structures probably to be regarded as excretory, though he did not so describe them. I quote so much of his reference to these animals as is apposite.

„Mitunter findet man Tiere von auffallend plumpem Aussehen (Fig. 38 [2]), welche bei ihrer Länge ganz unverhältnismäßig dick, wie gedunsen sind, und indem sie nach hinten nicht oder nur unbe-

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[1]) Zeller, E. (1877): Untersuchungen über die Fortpflanzung und die Entwicklung der in unseren Batrachiern schmarotzenden Opalinen. Zeitschr. f. wiss. Zool. Bd. XXIX.

[2]) My Fig. 19.

deutend sich verschmächtigen, nicht spindel-, sondern walzenförmig erscheinen. Dabei zeigen sie eine recht eigentümliche, in Falten gelegte Einziehung des hinteren Körperendes. — Solche Tiere können, besonders wenn sie mit einem Deckgläschen belastet nnd dadurch breitgedrückt werden, eine gewisse Ähnlichkeit mit *Opalina ranarum* bekommen nnd mögen so schon manchmal mit dieser verwechselt worden sein. Es ist möglich, sogar wahrscheinlich, daß wir eine bloße Varietät von *Opalina dimidiata* vor uns haben."

Then follows a brief reference to the processes of reprodnction, which are like those in *Opalina dimidiata*. Zeller's only fignre showing the organs in question is copied in my Fig. 19.

Beyond this very brief description and a reference in Delage and Herouard's Traite de Zoologie concréte, assuming the structures described by Zeller to be excretory organs, I know of no reference to any excretory organs in the genus.

In the living *Opalina caudata* it is not very difficnlt to observe the presence of posterior tubules more or less similar to those described by Zeller, bnt after treatiug the living animals with acetic carmine the tubules are mnch clearer. Reference to Figs. 1—8 will show that the organ in question consists of from one to three, generally two, irregularly swollen tnbules opening to the exterior by a short common dnct and a single pore at the posterior end of the body. Between the tubnles, and nsually also around the common excretory dnct, are numerous minnte spheroidal grannles very slightly larger than the general cytomicrosome grannles. These stain more deeply than the ordiuary cytomicrosome grannles with acetic carmine, borax carmine, Mayer's haemalnm, Delafield's haematoxylin, Biondi-Ehrlich-Haidenhain mixture, lichtgrün and some other stains.

In many individuals of this species no excretory tubnles or pore can be seen (Fig. 9). In other cases one sees the external pore and the common dnct but not the inner tubnlar branches (Figs. 1 and 6). Occasionally one sees the outer pore and the inner tubules but canuot make out the connecting dnct (Figs. 4 and 5). I believe these variations to be due to different conditions of contraction.

Often one sees the living animal swimming abont, dragging behind it a spheroidal or elongated mass of granules exactly similar to those between the tnbules and aronnd the dnct (Fig. 8). This condition is especially common in animals that have been removed from the rectum of the host and have been kept for a day or more in 0,6 percent sodium chloride solution. Freqnently also one sees protruded from the posterior end of the body a fan-shaped mass of

clear protoplasm (Figs. 10 and 11). This seems to be a phenomenon of incipient degeneration. Under pressure from a coverglass, in gradnally drying preparations, oil globules are generally protruded from the body at different points on the periphery. The largest of these oil globules is generally fonnd at the posterior end of the body and it is nsnally the first to appear in spite of the fact that the posterior end of the body is the most slender part and mnst be the last to feel the pressnre. These three sorts of posterior protrusions (granules, clear protoplasm, and oil) seem to be connected with the excretory pore.

In *Opalina intestinalis* somewhat similar conditions were found (Figs. 12—14). The excretory pore and the dnct closely resemble those of *O. caudata*, but the inner structnres are not in the form of tnbnles, but rather resemble a cnp-shaped vacnole nearly enclosing a central mass of granules (Fig. 13). It is as if several tubules side by side had fused to form a common cup-shaped vacnole. That this has been the actnal history I wonld not claim, for there is no evidence to support snch a view. More internal still is generally a second vacnole and sometimes a third still further forward, and occasionally there are slight indications of other irregular spaces.

All these structures appear in the living animal, in stained total preparations, and in sections. In the living animal, unstained, the granular mass within the cnp of the posterior vacuole and between it and the second vacnole is sometimes easily observed. The grannles immediately around the vacnoles are slightly larger than the ordinary cytomicrosomes, grading off ontward into these by imperceptable transitions. The difference in size at most is not marked. The staining relations are similar, the granules in and near the vacnoles staining noticeably darker than the ordinary cytomicrosomes (Fig. 14). The membrane surronnding the excretory vacuoles is very delicate in *Opalina*, being searcely more evident than the ordinary cytoplasmic reticnlnm. In *Hoplitophrya uncinata* a repnted near relative of *Opalina*, it is much more marked.

The protoplasmic protrusions from the posterior end of the body, and also the relations of the large oil drop in squeezed specimens, are similar in this species to those described for *O. caudata* (Fig. 12); also, as in *O. caudata*, the vacuoles, grannles and posterior protrnsious are more common and more evident in individuals kept for a time in salt solntion, thongh the vacuoles and granules, and rarely the clear protoplasmic protrusions are readily seen in freshly taken animals.

In *Opalina obtrigona* the excretory organ is relatirely much smaller and is simpler (Figs. 15—18). It consists of a posterior pore (Fig. 17), a short duct and a single hemispherical or lenticular vacnole. No special mass of larger or more deeply staining granules is distinguishable aronnd or near the vacnole. The size of the vacnole varies, as the figures show. Many individuals show no posterior vacnole. Occasionally one finds an individnal with a posterior contour which snggests that the vacnole has just collapsed and that the body, in conseqnence, has shrunken (Fig. 18).

Opalina obtrigona shows another featnre of interest. Among the spherules which crowd the axis of the body, there are posteriorly many small irregular crystalline masses of a brownish yellow color (Fig. 18). This color is a darker shade of the color that is often seen in the whole body of *O. obtrigona*. As to the nature of these crystalline bodies I hope to write more in a future commnnication. They are not fonnd in all individuals and are not eqnally numerous in all the individuals which contain them. Their presence and nnmber seems to have no relation to the presence or size of the excretory vacnole.

No excretory organs have been found in *Opalina ranarum*, though I have stndies this species by all the methods which were snccessful in demonstrating the structures in other species.

May 1st 1907.

Explanation of Plate.

All figures are of optical sections except Fig. 14 which shows a cnt section. All drawings except Fig. 13 were made with a camera lncida.

Plate IV.

Opalina caudata.

Fig. 1. Posterior end of the living animal, showing the excretory pore and dnct. Only one cilium is drawn. 1080 diameters.

Fig. 2. Posterior end of the living animal, showing excretory pore and vacuole hnt no duct connecting them. No cilia are drawn. 930 diameters.

Figs. 3—9. Posterior ends of animals treated with acetic-carmine. One, two, or three tnbules are seen, also the grannles near the tnbules. In Fig. 8 is shown a spheroidal extruded mass of these granules. 930 diameters.

Figs. 10 and 11. Two views of the posterior end of the same living animal showing a lobnlated, fan-shaped protrusion of clear protoplasm. In Fig. 10 two small oil drops are seen at the distal end of the protoplasmic protrusion. 930 diameters.

Opalina intestinalis.

Fig. 12. The posterior end of a living animal, showing a protoplasmic protrusion with an oil drop at its apex. 930 diameters.

Fig. 13. The posterior end of a living animal, showing three excretory vacuoles, the excretory duct and pore, and numerous granules crowded between and around the vacuoles. As the animal revolved upon its long axis, essentially the same appearance was presented from all points of view. The figure is a free-hand drawing of about the some magnification as Fig. 12.

Fig. 14. On obliqne section through the excretory vacuoles. The pore is not shown. 1325 diameters.

Opalina obtrigona.

Figs. 15—18. Posterior ends of different animals which were killed in consive-sublimate-acetic acid mixture and were stained with MAYER's Haemalum. Figs. 15 and 16 show full sized excretory vacuoles, but no pore or duct. Fig. 17 shows a small lenticular vacnole and the excretory pore, but no duct connecting the two. Fig. 18, in which the cilia are not drawn, shows the posterior end of the body shrunken after the contraction of the vacuole. The heavily shaded structures in Fig. 18, except the four chromosome masses in one of the nuclei, represent inaccurately the crystalline masses. They are not dark but are yellow (unstained) and are highly refractive. 1325 diameters.

Fig. 19. ZELLER's figure of the „posterior folds" (probably excretory tubules) in an undetermined species of *Opalina*. „About 200 diameters."

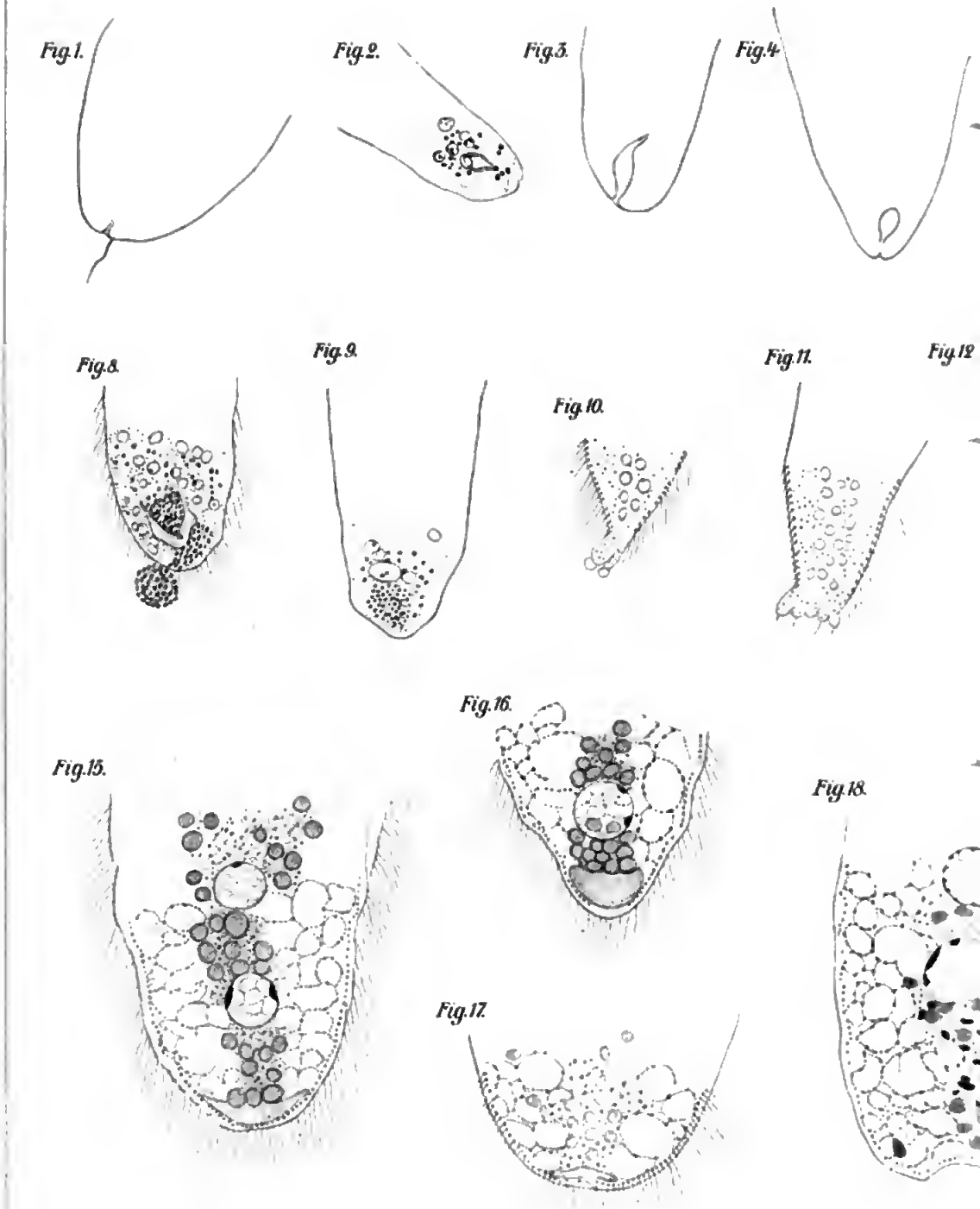

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Fig. 5.

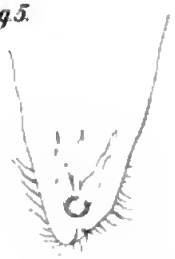


Fig. 6.

Fig. 7.

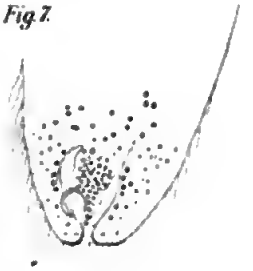


Fig. 13.

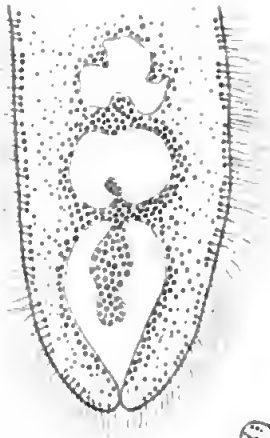


Fig. 14.

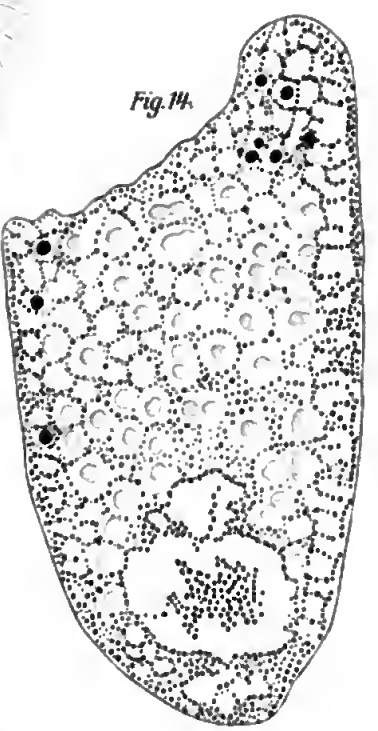
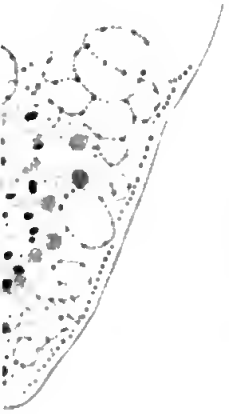


Fig. 19.



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