

THE CYTOPYGE OF CILIATA

III. MICROPHOTOGRAPHICAL DOCUMENTATION OF THE DEFECACTION IN BLEPHARISMA OVATA

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Abstract

The defecation in *Blepharisma ovata* was investigated in serial photographs. (1) The faecal ball is ellipsoid in shape, 10 to 14 μm in diameter and has a dense consistence. It splits as a rule approximately 10 minutes after having been released to form a finely granulated mass sometimes containing larger inclusions. (2) The defecation lasts about 10 seconds. At the opening where the faecal ball leaves the animal a pointed process is formed, which, however, disappears several minutes after the defecation has been finished. (3) During defecation the faecal ball glides out of the animal relatively slowly while the pellicle (the membrane closing the cytopyge) is tightly adjacent to the ball. Immediately after the function has been finished, the cytopyge appears to be closed again. (4) Presumably, numerous egestion vacuoles coalesce to form a faecal ball.

Introduction

The present work is a member of a series [2, 3] aimed at a photographic registration of the defecation in *Ciliata*. In this way we wish to contribute to the poor knowledge of the mechanism of the cytopyge function.

The morphogenesis and the location of the cytopyge of *Blepharisma undulans* have been investigated by EBERHARDT [1] thoroughly. Accordingly, the cytopyge develops very early from an anlage field and it is capable of functioning long before the end of the cell division. In the full-grown individual it appears at the caudal pole of the cell as an approximately quadrangular distinct area where the striation appears to be interrupted. EBERHARDT [1] did not describe the defecation process.

Material and method

Blepharisma ovata (Fig. 1) was obtained in great number in the alga wadding of the border area of the "Lange Lacke" in Burgenland. An oral membranelle (Fig. 1) covering almost the whole animal is characteristic of this species. This *Blepharisma* is distinguishable by this membranelle even from the species described by STOCKES (cited by KAHL [4]). According to the drawing of this author the body of the latter species (*Blepharisma ovata* STOCKES) is covered by a membranelle but on two-thirds of its length. Otherwise, the two organisms are identical in all essential characteristics, first of all in shape.

Coverslip preparations were examined by phase-contrast microscopy.

Results

The cytopye of *Blepharisma ovata* is situated exactly opposite to the cytostoma, on the site where the ventral and dorsal rows of cilia adjoin each other (Fig. 1, cyt). There is a small space free of cilia here where the content of the cytopye is released. Left to the cytopye there is a contractile vacuole

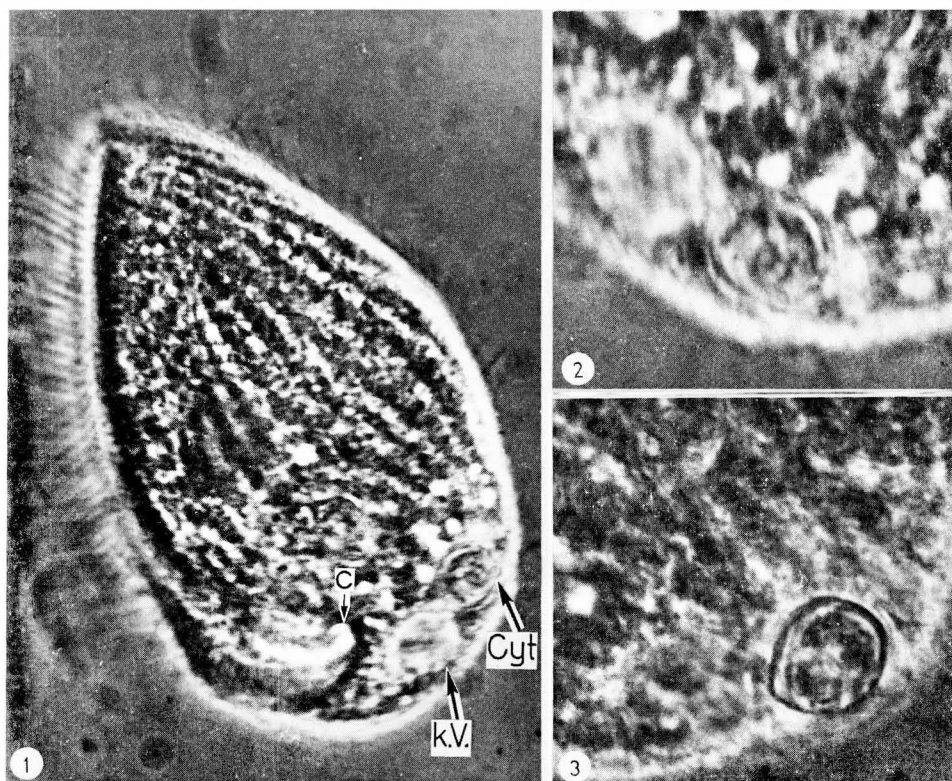
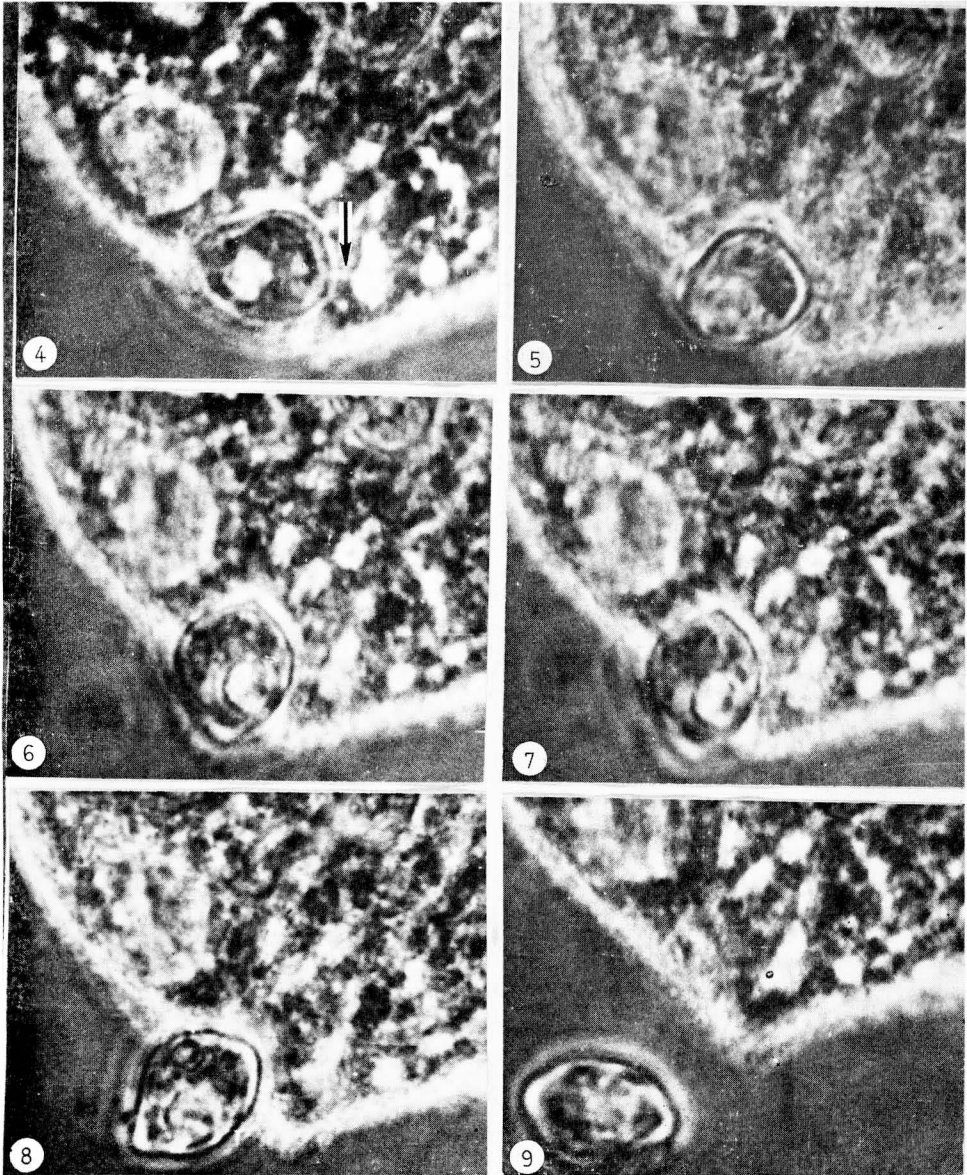


Fig. 1. *Blepharisma ovata*. The whole body anteriorly. C = cytostoma; k.V. = contractile vacuole; Cyt = cytopye. Approx. $\times 900$

the content of which flows out, presumably, on, or immediately beside, the ground of the cytopye (Fig. 1, k. V.). No permanent pore for excretion could be demonstrated.

Figs 2—9 show the consecutive stages of the defecation. The time interval between the stages registered in photographs was about 1 second. The whole process of defecation lasted about 10 seconds. In Fig. 2 the faecal ball already lies on the internal side of the pellicle. Being located deep in the animal and covered by the cytoplasm, it is hardly visible. In Fig. 3 the faecal ball is already shifted to the cytopye. There is a small bulge at the site where it will leave



Figs 2—9. Consecutive stages of the defecation in *Blepharisma ovata*. Photographs taken at 1-second intervals. For detailed information see the text. Approx. $\times 1\,600$

the animal. In the following stage (Fig. 4) one side of the faecal ball has stepped out of the animal. At the same time, the pellicle closing the cytopyge appears to be destroyed. In the further stages (Figs 5—9) the faecal ball glides off the animal. During the period the small bulge (see above) becomes more and more

prominent and at last (Fig. 9) a more or less pointed process is seen at the site of leaving. The end of the defecation is shown in Fig. 9. The faecal ball already lies at a distance from the animal, corresponding to the length of the cilia. The opening becomes invisible immediately after the ball has left the animal.

The faecal ball is ellipsoid in shape and 10–14 μm in diameter. It is apparently enclosed in a sheath and rotates slowly around its longer axis during the defecation process (compare Fig. 4 to Figs 5 and 6). The faecal ball is of dense consistency and somewhat pointed at its two sides (Fig. 6). Some 10 minutes after release it seems to have been split into a finely granulated mass, often containing larger inclusions.

In the immediate vicinity of the cytophyge the cytoplasm is highly vacuolated, being in contact with the cytophyge by fine channels (Fig. 4, arrow). The vacuolization persists after the faecal ball has left the animal and the whole function has reached an end (Fig. 9).

Discussion

In contrast to *Prorodon teres* whose defecation appears like an exocystotic process, it is of gliding type in case of *Blepharisma ovata*: the faecal material migrates slowly out of the animal. Immediately after discharge the opening appears to be closed again. We cannot explain the slow axial turning of the faecal ball during defecation. A similar, at present unexplainable more rapid, rotatory movement of the faecal ball has recently been described for *Amoeba proteus* [5].

The fact that the faecal balls are larger than the more numerous food vacuoles might be explained by a fusion of egestion vacuoles into a faecal ball, a phenomenon observed in connection with the defecation of *Prorodon teres* [3]. The faecal ball in *Blepharisma ovata* being only slightly larger than the food vacuoles each, one must believe that the food vacuole becomes poorer in substance during the digestion process, i.e., in cases when only one food vacuole is defecated it must be either smaller than a faecal ball or, if it is similar or even larger in size, it must be thinner in consistency. However, this is not consistent with our observations.

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