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A Symbiotic Blepharisma

LELAND P. JOHNSON

During the summer of 1946, while studying material taken from Marble Lake in Dickinson County in Northwest Iowa, a Blepharisma, apparently containing zoochlorellae, was observed. Kahl (1932) lists no symbiotic Blepharisma, but describes *Blepharisma coeruleum* which apparently eats only the alga Tetraspora. Kahl also cites *Blepharisma tardum* and *Blepharisma dileptus* as having a diet composed primarily of red bacteria. It was thought an interesting problem would be to determine the relationship between the Blepharisma and green alga thought to be zoochlorella.

METHODS

The procedures followed for studying the Blepharisma in question were microscopical observations, using 16 mm., 4 mm., and oil immersion apochromatic 1.8 mm. objectives and a 10x ocular. In addition, the organisms were maintained in the laboratory in darkness and in daylight for a period of several weeks. The formation of food vacuoles was observed closely, single organisms were observed for periods of several hours and food intake was determined. Organisms were also broken by pressure and the alga was observed freed from the host Blepharisma. Drawings were made with the aid of a camera lucida and all measurements were made with the aid of a calibrated ocular micrometer.

OBSERVATIONS

The characteristics of the organism most nearly resemble *Blepharisma lateritium*, Ehrb., 1831, as described by Kahl (1932). Body ovoid (Figs. 1, 2), rounded or flattened posteriorly, may be slightly pointed at time when contractile vacuole is evacuated, anterior end considerably flattened. Size, 112 μ -200 μ long by 75 μ -160 μ wide. Nucleus, single, elongate. 20 μ -40 μ long. Gullet, extends posteriorly, curves anteriorly at point where food vacuole is produced. Undulating membrane, short and delicate. Food vacuoles, few to numerous. Food composed of bacteria, flagellates, ciliates, and algae. Contractile vacuole, located posteriorly, usually a single major vacuole surrounded by series of secondary vacuoles which coalesce to form a new major vacuole at time of or following evacuation, sometimes two major vacuoles present (fig. 3). Pellicle, dark pink to light pink in color, few observed colorless, longitudinally striated as ridges 1 μ to 3.5 μ apart. Cirri, 15 μ long, about 1.7 μ apart. Cilia, between ridges.

The alga observed in the cytoplasm of *Blepharisma lateritium* appears to be *Chlorella conductrix*. Size, 3 μ -5 μ in diameter. Body, spherical to broadly ellipsoidal. Chloroplast, single, parietal in position, cup or bowl shaped. Chlorellae, loosely or tightly packed in Blepharisma (figs. 1, 2, 3). Bright green color lost in chlorellae kept in darkness for two weeks, regained following exposure to light. Chlorellae observed daily in *Blepharisma lateritium* for 24 consecutive days

and intermittently for nearly four months, at which time observations were ceased.

In twenty organisms checked at random, the number of food vacuoles varied inversely to number of chlorellae present in cytoplasm.

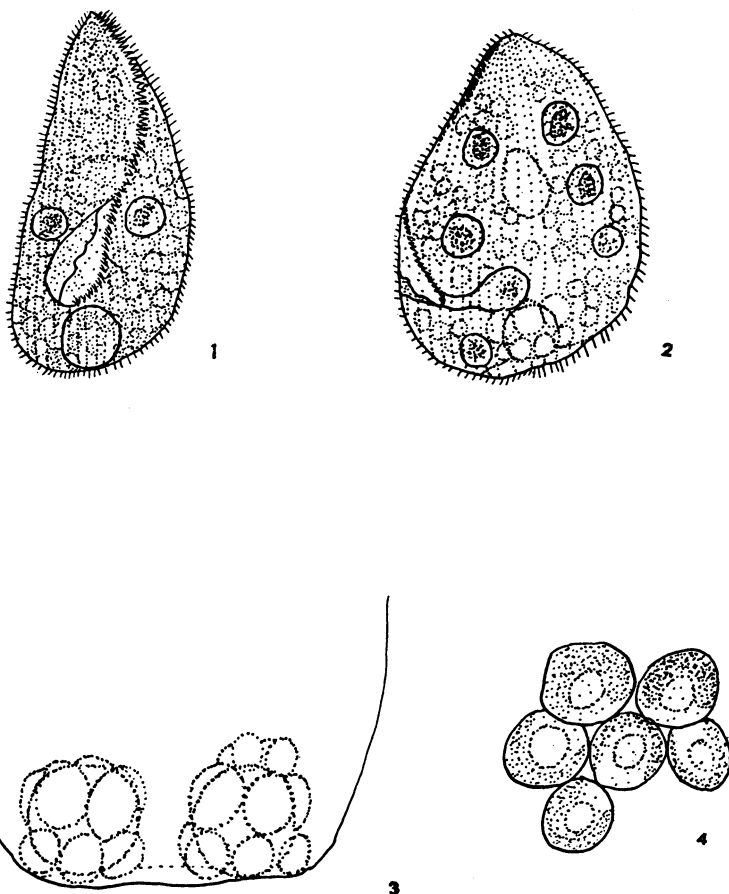


Fig. 1. *Blepharisma* with many symbiotic chlorellae.

Fig. 2. *Blepharisma* with few symbiotic chlorellae.

Fig. 3. Posterior end of *Blepharisma* with two major contractile vacuoles.

Fig. 4. Group of chlorellae after freed from cytoplasm of *Blepharisma*.

DISCUSSION

Many organisms are known to harbor zoochlorellae so it is not surprising that *Blepharisma* was found to harbor the alga also. Goetsch and Scheuring (1926) discuss the parasitic and symbiotic relationship of *Chlorella* to various organisms. They consider *Chlorella* a parasite in pelecypods and brown hydra, in which muscle action

is inhibited and death may occur respectively. In higher turbellarians *Chlorella* may live in intercellular spaces up to two weeks before disappearing. Goetsch and Scheuring (1926) also suggest that an accidental commensalism exists between *Chlorella* and protozoans due possibly to the physiological state of the host. The present observations would substantiate this assumption in that organisms kept in darkness not only survived but maintained themselves well. The *chlorellae* also were maintained and regained their food making power when exposed to light as evidenced by the return of chlorophyll and the bright green color.

The term facultative symbiosis is suggested as the term expressing the existing relationship. The *Chlorellae* were maintained in the *Blepharisma* for two weeks in darkness and for approximately four months in daylight. The food intake of the *Blepharisma* is least in organisms containing most *chlorellae*. Before a final pronouncement concerning the present relationship can be made, population studies are in order. Until population studies are undertaken, evidence points to a mutual benefit to both the *Blepharisma* and *Chlorella*.

SUMMARY

1. A *Blepharisma* identified as *B. lateritium* is described.
2. *Chlorella conductrix*, a cytoplasmic alga found in *B. lateritium* is described.
3. It is suggested that the two organisms may be facultative symbionts.

CITATIONS

1. Goetsch, W., and L. Scheuring (1926). Parasitismus and Symbiosis der algengattung der *Chlorella*. *Zeitschr. morph. u. Okol. Tiere.* 7 ($\frac{1}{2}$):220-253.
2. Kahl, A. (1932), Wimpertiere oder ciliata. In die Tierwelt Deutschlands. Ed. by Fr. Dahl. Jena.

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