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A Symbiotic Blepharisma

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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 vacoules 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.

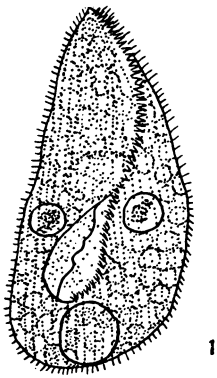
OBSERVATIONS

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 vacoule is evacuated, anterior end considerably flattened. Size, 112μ-200μ long by 75μ-160μ wide. Nucleus, single, elongate, 20μ-40μ long. Gullet, extends posteriorly, curves anteriorly at point where food vacuole is produced. Undulating membrane, short and delicate. Food vacoules, 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 1μ to 3.5μ apart. Cirri, 15μ long, about 1.7μ apart. Cilia, between ridges.

The alga observed in the cytoplasm of *Blepharisma lateritium* appears to be *Chlorella conductrix.* Size, 3μ-5μ 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.



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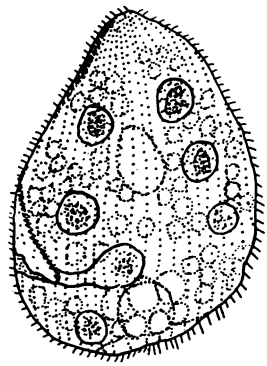

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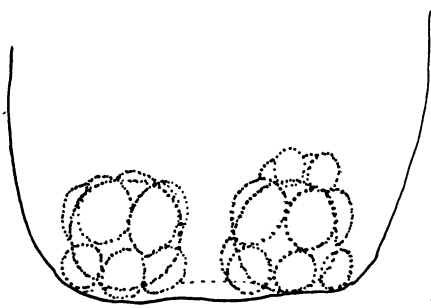

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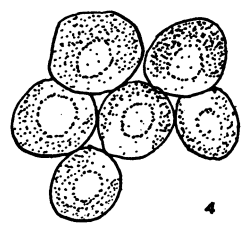

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Fig. 1. Blepmarisma with many symbiotic chlorellae.
Fig. 2. Blepharisma with few symbiotic chlorellae.
Fig. 3. Posterior end of Blepharisma with two major contractile vacuoles.
Fig. 4. Group of chlorellae after freed from cytoplasm of Blepharisma.

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. Zeischr. morph. u. Okol. Tiere. 7 (½):220-253.
2. Kahl, A. (1932), Wimpertiere oder ciliata. In die Tierwelt Deutschlands. Ed. by Fr. Dahl. Jena.

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