ON A *CHARACIUM* GROWING ON *ANOPHELES* LARVAE

By M. O. P. IYENGAR and M. O. T. IYENGAR

(With Plate III and 1 figure in the text)

In connection with malaria research the second author has to examine large numbers of *Anopheles* larvae collected daily from several villages near Sonarpur in Lower Bengal. In the course of this work, many larvae were observed to show a greenish appearance which on microscopic examination proved to be due to a fairly dense growth of a species of *Characium* (Plate III, 2–5), often accompanied by a small number of young plants of an *Oedogonium* in a sterile condition. Several species[1] of *Characium* have been recorded as occurring on *Cyclops* and other minute crustaceans, as well as on Rotifers, but so far none have been reported on living mosquito larvae. *Oedogonium* does not appear to have been so far found growing on any living animal.

The *Characium* occupied practically all parts of the body of the larva except for the ventral surface where it was scanty or absent. There was a fairly rich growth on the back and flanks of the larva and the anal portion was often densely covered. The algae are associated frequently with certain Vorticellae, and the growth of these various epizoic organisms was often so considerable as to render the identification of the larva difficult. The algal growth seemed to hamper to some extent the freedom of movement of the larva, but the latter did not otherwise appear to suffer in any way.

The frequent occurrence of these algae on this particular substratum is not purely accidental, since other suitable substrata (*Pistia*, *Lemna* and other aquatics, as well as objects lying in the water) in the same ponds never bore these forms. The many larvae of the *Culex* mosquito and May-fly larvae present did not show any growth of the two algae, which were in fact restricted to the larvae of *Anopheles*. It is evident that they favoured a moving substratum

[1] J. Brunnthaler in Pascher's *Susswasserflora*, Heft 5, mentions the following six species of *Characium* as occurring on animals: *C. cylindricum* F. D. Lambert and *C. gracilipes* F. D. Lambert on *Branchipus vernalis*, *C. groenlandicum* P. Richter on Phyllopods, *C. Hookeri* (Reinsch) Hansgirg on species of *Cyclops*, *C. Debaryanum* (Reinsch) De Toni on Crustaceans and *C. limneticum* Lemmermann on *Diaphanosoma*. Filarszky (2) records *C. saccatum* Filarszky and *C. setosum* Filarszky as occurring on *Branchipus stagnalis*.

and, among the available aquatic animals, the *Anopheles* larvae in preference to other larvae. By growing on an actively moving larva the algae secure better aeration than is afforded in a stagnant and consequently poorly aerated piece of water. The *Characium* riding on its ever active host is carried into different areas of the pond where fresh supplies of dissolved gases may be available. The cutaneous respiration of the *Anopheles* larva ensures a good supply of carbon dioxide. The frequent dense aggregation of the algae on the anal gills, where cutaneous respiration is greatest, is possibly due to the large supplies of CO_2 available, as well as to the nutriment derived from the excreta of the larva.

When the *Anopheles* larva comes to rest near the water surface, it floats horizontally with the dorsal side upwards and fully exposed to the sky, so that the algae receive plenty of sunlight. The presence of the alga in large numbers on the back and flanks of the larvae and its absence or scarcity on the ventral surface may be the result of the normally greater illumination of the former. The absence of the alga on the larvae of *Culex* and allied genera in the same water is perhaps due to their different habits. The larva of *Culex* does not float horizontally, but hangs downwards from the surface of the water. An alga will therefore not obtain as much sunlight when growing on a *Culex* or similar larva as when growing on an *Anopheles* larva.

The larva moults periodically under normal conditions once in every three or four days and with the old skin all the algae growing on it are shed. The larva, however, very soon becomes covered with a fresh coating of algae, whose growth is remarkably rapid, zoospores apparently being formed at short intervals. Plenty of empty cells of *Characium* from which the contents have already escaped are to be found on the living larvae. The zoospores often settle down on the empty walls and grow direct into new *Characium* plants (Plate III, 3 and Fig. 1, *C*, *D*, *H*), and it is not uncommon to find plants of a third generation growing on these latter (Fig. 1, *J*). This shows clearly that the time taken for the zoospore to settle down on the larva and grow into a new plant forming zoospores in its turn is much shorter than the interval between two moulting periods of the larva.

The larvae of the following six species of *Anopheles* served as hosts for the *Characium*: *A. vagus* Donitz., *A. subpictus* Grassi, *A. pseudojamesi* Strickland and Chawdury, *A. varuna* Iyengar, *A. hyrcanus* Giles and *A. barbirostris* v. d. Wulp.

The cells of the alga are pear-shaped, squat (Plate III, 4) or elongated, broadly rounded at the top and narrowed gradually below into a rounded base. They are attached by a very minute mucilage pad to the body of the larva. This pad is seen only on staining and careful examination under higher powers. The cells have a central nucleus and the chloroplast has a single pyrenoid. Division of the

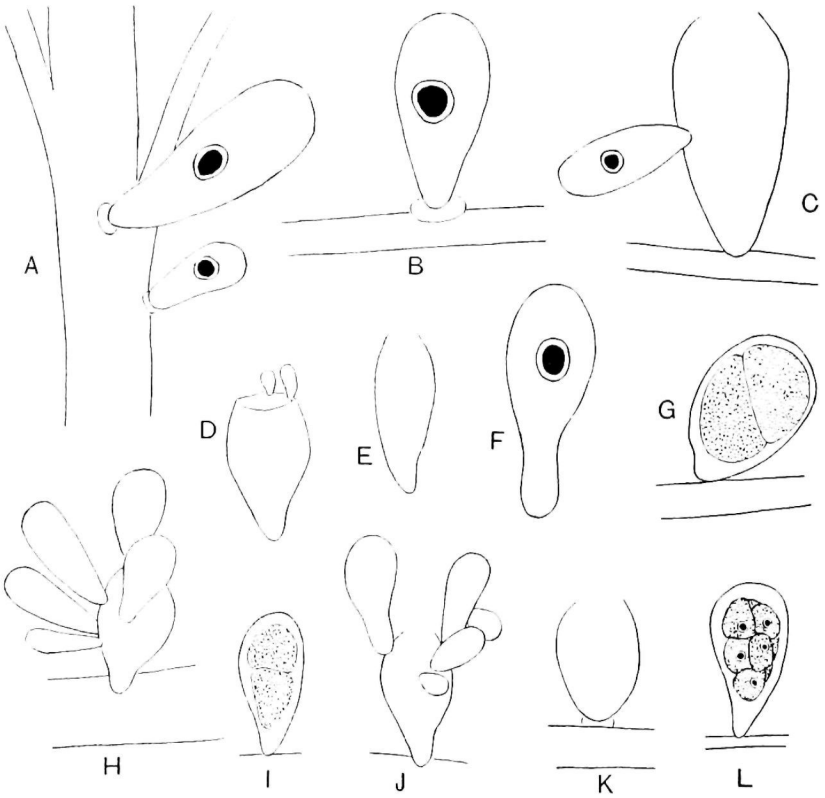

Fig. 1. *Characium anophelesi* sp.nov. *A*, two cells on the hairs of an *Anopheles* larva; *B*, a single cell; *C*, *D*, *H*, daughter-cells growing on empty cells; *E*, *K*, empty cells; *F*, a cell with a very broad base; *G*, *I*, division of cell contents into two; *J*, a colony of three generations; *L*, division of cell contents into eight. Pyrenoids black. *A–C*, *F* × 1000; the rest × 638.

contents is into 2, 4 or 8 parts which presumably escape as zoospores which have, however, not been directly observed. The contents escape by a clean rupture of the cell wall at the top, the empty mother wall appearing urn-shaped (Fig. 1, *C*, *D*, *E*, *J*, *K*). As already mentioned the contents often germinate on the empty walls and form colonies (Fig. 1, *C*, *D*, *H*, *J*). The dimensions of the fully grown

1

2

3

4

5

IYENGAR—ON A *CHARACIUM* GROWING ON *ANOPHELES* LARVAE

cells are 41–48 × 22–30 μ, the smaller dimension being the width of the cell at its broadest portion.

The alga appears to be a new species which we propose to call *Characium anophelesi* sp.nov. with the following diagnosis:

Cells pear-shaped, squat or elongated, broadly rounded at the top and narrowed gradually below into a rounded base, attached to the substratum by a thin round pad of mucilage; contents dividing into 2, 4 or 8 parts which escape by a clean rupture at the top; empty mother wall urn-shaped; small colonies sometimes formed; dimensions of the fully grown cells 41 × 28 μ, 48 × 22 μ, 48 × 30 μ.

Hab. Growing densely on living larvae of several species of *Anopheles* mosquitoes in ponds in Sonarpur, Lower Bengal, India.

This species shows some resemblance to *C. saccatum* Filarszky which the author records as growing on *Branchypus stagnalis* Schaeff., but in *C. saccatum* the basal attaching mucilage is of a different form; in some cells Filarszky (cf. (2), Fig. 2, *C*, *D*) shows it disc-shaped, in others pocket-shaped with the lower end of the cell embedded in it ((2), Fig. 2, *A*, *B*). *C. anophelesi*, on the other hand, is attached by a very minute thin mucilage pad. In *C. saccatum* the cell opens by a vertical rupture ((3), Fig. 10), while in the present species a part of the apical wall of the cell breaks down to form a clear-cut aperture. The cells of *C. anophelesi* are far more variable in form and broader in proportion to their length than those of *C. saccatum*.

C. anophelesi also shows some resemblance to *C. Sieboldii* Braun, but the cells of this latter species commonly have a pointed apex, especially when young((1), Tab. III, A, Figs. 1–17).

In conclusion the authors have much pleasure in thanking Prof. F. E. Fritsch for his kind help.

REFERENCES

(1) Braun, A. *Algarum unicellularum genera nova et minus cognita*. Lipsiae, pp. 32–36. 1855.

(2) Filarszky, F. von. Zwei neue *Characium*-Arten. *Botanikai Kozlemenyek*, Budapest, **13**, 7. 1914.

(3) —— Auf Phyllopoden lebende Characien. *Archivum Balatonicum*, **1**. 1926.

EXPLANATION OF PLATE III

Characium anophelesi sp.nov. 1, a few cells on the body of a larva; the contents of some of the cells have divided into two (× about 90); 2, dense growth of the alga on the abdominal segments of the larva (× about 60); 3, a portion of the head of a larva enlarged to show the algal growth; some of the young *Characium* plants are growing on the empty parent-cells (× about 130); 4, mature cells whose contents are beginning to divide (× about 350); 5, head of a larva with a dense growth of *C. anophelesi* (× 60).