Chrysophyta

26.2 GENERAL CHARACTERISTICS

1. Predominace of an accessory pigment *fucoxanthin*, gives the cells of the members of this class their golden-brown colour, and hence the name "*golden-brown algae*" is given to Chrysophyceae.
2. Starch is absent, but naked pyrenoid-like bodies are occasionally present.
3. Fat and a compound leucosin are the customary forms of food storage. Recent studies, however, suggest that the storage product of these algae is chrysolaminarin.
4. Morphology of the chrysophycean algae ranges from unicellular flagellates to coccoid, rhizopodial, filamentous and rarely parenchymatous forms. Majority of them are, however, unicellular flagellates.
5. The motile cells possess one or two flagella, of which the second flagellum is simple and shorter. In some members (e.g. *Mallomonas*), the shorter flagellum is greatly reduced, and is regarded as photoreceptor. The hairy flagellum bears tripartite hairs.

6. The chrysophycean cells are usually naked, or provided with a cell envelope or *lorica* (South and Whittick, 1987). They are uninucleate and contain one or a few parietal chloroplasts.
7. An eyespot is present usually associated with chloroplast.
8. Characteristic feature of these algae is the presence of *statospores* (or *stomatocysts*), each of which remains enclosed by a silicified wall with a terminal pore (Kristiansen, 1982).
9. Reproduction is mainly asexual, although several species show isogamous type of sexual reproduction. Cyst formation commonly follows sexual fusion.
10. Majority of these algae are freshwater planktonic or epiphytic forms occurring in temperate or cold waters. Many chrysophycean members form a major component of the *nannoplankton* ranging from 10–50 µm in diameter, and can be collected only "if water samples are filtered or centrifuged" (Chapman and Chapman, 1973). Some of these algae are also marine.

Synura, *Ochromonas*, *Paraphysomonas* (Plates III F, X), *Mallomonas*, *Chromulina* and *Phaeothamnion* are some of the common genera of Chrysophyceae.

26.3 CLASSIFICATION

Details of the classification of Chrysophyceae proposed by Fritsch (1935) and followed in this text are mentioned in Chapter 3 (Article No. 3.11; Table 3.1).

Bold and Wynne (1978), however, divided Chrysophyceae into three series and twelve orders as under:

1. *Biflagellate series*, including motile stage bearing two flagella:

Orders

i. Ochromonadales
ii. Chrysapiales
iii. Phaeothamniales

2. *Uniflagellate series*, including motile stage bearing a single pleuronematic flagellum:

Orders

i. Chromulinales
ii. Craspedomonadales
iii. Dictyochales
iv. Chrysosphaerales
v. Thallochrysidales

3. *Aflagellate series*, including members bearing no motile cells:

Orders

i. Chrysococcales
ii. Rhizochrysidales
iii. Stichogloeales
iv. Phaeoplacales

South and Whittick (1987) divided class Chrysophyceae into two subclasses and seven orders:

1. *Chrysophycidae*: Ochromonadales, Chrysoamoebidales, Chrysocapsales, Chrysosphaerales, Phaeothamniales, Sarcinochrysidales.
2. *Dictyochophycidae*: Dictyochales.

Some details of *Ochromonas*, *Mallomonas*, *Synura* and *Phaeothamnion* are discussed in this text.

26.4 OCHROMONAS

Ochromonas (Gr. *Ochros*, orange yellow; *monas*, single organism or cell) is a naked biflagellated monad of family Ochromonadaceae of order Ochromonadales. Its each cell possesses one or two brownish-yellow chloroplasts, a single red eyespot or stigma and a contractile vacuole. Most of its species are planktonic or attached, freshwater organisms, but marine types are also known. Two flagella are laterally attached and unequal in size (Fig. 26.1). Both the flagella seem to extend in a forward direction. The cell, however, essentially pulls itself forward by the activity of long flagellum (Jahn *et al.*, 1964). Nutrition in different species (Aaronson, 1973; Doubourskv, 1974) varies from phototrophic to phagotrophic to saprotrophic. *Ochromonas danica* requires thiamine and biotin whereas *O.malhamensis* also requires cyanocobalamin (Vitamin B_{12}) along with thiamine and biotin.

In *Ochromonas danica*, each cell contains a single, lobed chloroplast at the anterior end and this chloroplast is enclosed by a membranous sac called *chloroplast endoplasmic reticulum (CER)*. According to Gibbs (1962), CER is in continuity with the outer membrane of the nuclear envelope. The chloroplast of *O.danica* shows the presence

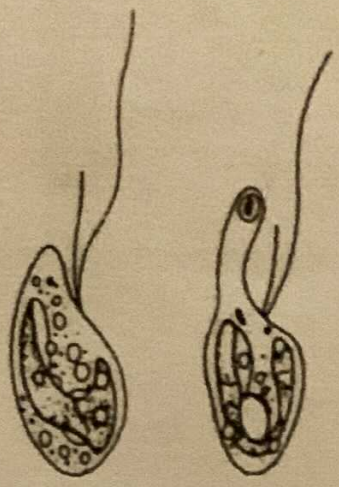

Fig. 26.1 Two biflagellate cells of *Ochromonas* sp. (after Fott)

by chloroplast DNA arranged in a ring-like structure, lying just inside the girdle thylakoid (Gibbs *et al.*, 1974).

Ochromonas reproduces by simple fission. Formation of siliceous cysts have also been observed. Some species also show palmelloid stages.

26.5 MALLOMONAS

Mallomonas (Gr. *mallos*, lock of wool; *monas*, single organism or cell) is also a member of order Ochromonadales. More than 80 species of this genus have been reported from freshwater habitats. Its cells are free floating and have a cell membrane covered by fine delicately sculptured siliceous scales. Usually, the posterior end of scales bear long needle-like projections. Each cell usually posseses one or two golden–yellow chloroplasts. The cells are biflagellate. One of the flagellum reduces (Fig. 26.2) to a short peduncle and shows a photoreceptor role. *Mallomonas* shows isogamous type of sexual reproduction. Cells in different species fuse through hair anterior or posterior ends.

26.6 SYNURA

Synura (Gr. *syn*, jointed; *ura*, tail) is a free-swimming colonial genus of family Synuraceae of order Ochromonadales. The colonies are spherical to ellipsoidal (Fig. 26.3) in shape and composed of a few to numerous cells held together by their elongated posterior ends. The sheaths of the cells are united by a pectinaceous material. Individual cells keep on dividing resulting in an increase in the size of the colony. Each cell is biflagellate, and the two flagella of each cell are unequal in

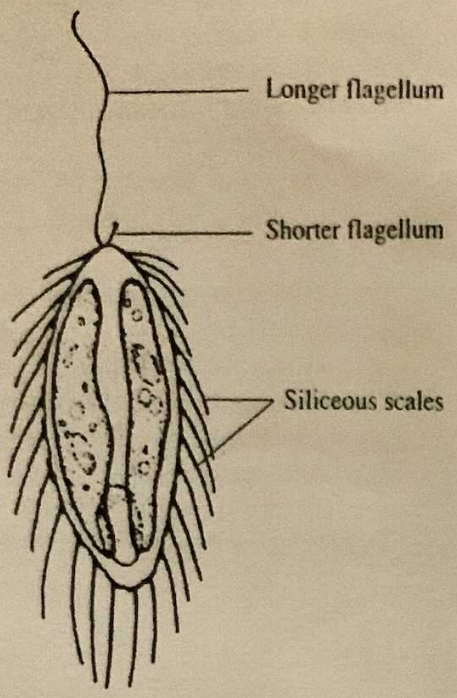

Fig. 26.2 A single cell of *Mallomonas*.

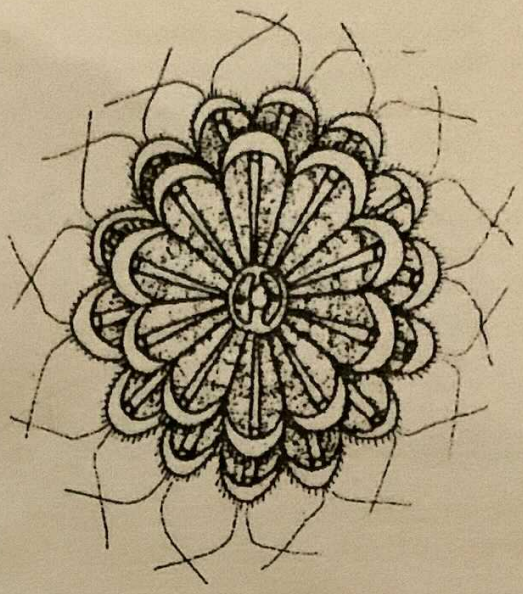

Fig. 26.3 A colony of *Synura uvella*. (after Stein)

size. Flagella bear tiny scales of varied shapes. The scales may be clavate, semicircular, annular or linear in shape (Hibberd, 1973). Siliceous scales that cover the cells have proved to be of great taxonomic significance (Takahashi, 1975). Each cell contains two chloroplasts and a number of contractile vacuoles.

Occasionally, groups of cells of a colony pinch off to form new colonies. Wawrik (1970) described isogamous sexual reproduction in *Synura petersonii*.

26.7 PHAEOTHAMNION

Phaeothamnion (Gr. *phaios*, brown or dusky; *thamnion*, shrub or bush) is a well–branched, erect, filamentous alga (Fig. 26.4) of family Phaeothamniaceae of order Phaeothamniales. Its branched filaments arise from a hemispherical basal cell, which keeps the alga attached as an epiphyte on other algae in freshwater habitats. All cells, except the basal cell, contain one to a few chloroplasts. They are rounded and are surrounded by a thick mucilage. The basal cell generally represents the remains of a typical cyst.

Individual cells of *Phaeothamnion* may produce four to eight zoospores. According to Bourrelly (1968), the zoospores of *Phaeothamnion* resemble with that of *Ochromonas*. Siliceous cysts are also produced. Sometimes, few cells of the filament may dissociate in the form of a palmelloid stage.

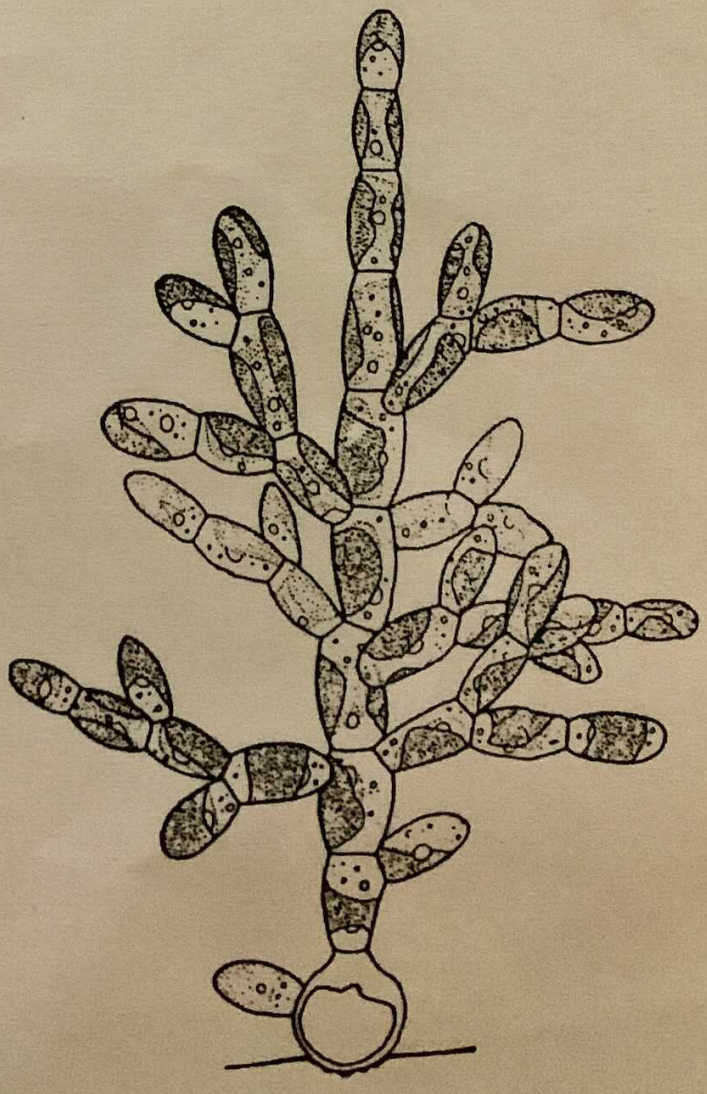

Fig. 26.4 *Phaeothamnion confervicola*. (after Pascher)