CHLOROPHYCOTA

This division includes all algae possessing chlorophylls ‘a’ and ‘b’ . Cells of these members contain chloroplasts that are enclosed by a double membrane and lack an additional membrane of chloroplast endoplasmic reticulum. Thylakoids are in stacks of 2-6 or more. Pyrenoids when present are contained within the chloroplast. They are often penetrated by thylakoids and are surrounded by starch deposits. The latter is the most important storage product. The eyespot, when present, is normally positioned within the chloroplast. Flagella are equal or unequal in length, usually inserted in the apical region, and they are mostly two in number. Cell walls are composed of cellulose, except in siphonous members which have xylan and mannan. In Prasinophyceae the cell walls have galacton and uronic acid residues. Many are calcified, especially the siphonous form and members of the Charophyceae.

Asexual reproduction is by fragmentation, or by formation of zoospores, aplanospores or autospores. Sexual reproduction may be isogamous, anisogamous or oogamous. A wide range of reproductive patterns and life histories occurs. The Chlorophycota exhibit all morphological types found within algae except rhizoidal unicells and complex Multicellular thalli.

Parker (1982) included only three classes under Chlorophycota. Of these the Prasinophyceae are very distinct in having a scaly wall ornamentation. The Charophyceae occupy an isolated position between the green algae and the mosses and liverworts.

The majority of Chlorophycota are freshwater forms (90 per cent) and the remainder marine.

Chlorophyceae:

Chloroplast characteristics: Cells of the members of this class contain chlorophyll ‘a’ and ‘b’ in their chloroplasts which may also contain various xanthophylls, including violaxanthin, zeaxanthin, antheraxanthin and neoxanthin. Members of the Bryopsidales contain Siphonein and Siphonoxanthin. These pigments are contained in the chloroplasts that lack associated endoplasmic reticulum, (thus they resemble Rhodophycota). They store starch within the chloroplast stroma and often as a sheath around the pyrenoids.

Eyespots: These are found in motile structures of chlorophycean members. It consists essentially of osmiophilic, carotenoid lipid globules (plastoglobules). The latter are associated with a photoreceptive, rod-shaped or crystalline area near the flagellar axoneme. The photoreceptor is responsible for phototaxy. According to Dodge (1973) the chlorophycean eyespot is part of a chloroplast but not obviously associated with flagella.

Nucleus: As in other eukaryotic algae, here also the DNA is found in the chromosomes. The chromosomes are contained within the nucleus by a double membrane envelope which is continuous with the cell endoplasmic reticulum. The membranes of nuclear envelope are 7-8 nm thick, and are separated by a perinuclear cavity. The nuclear envelope is perforated by numerous pores. In addition to the chromosomes, the nucleus contains the ground substance, or nucleoplasm and one or more nucleoli, which are

densely staining concentrations of basophilic material rich in ribonucleoprotein. They are intimately associated with the specific region of the chromosomal DNA that codes for ribosomal RNA The transcription of ribosomal RNA is possible through a specific kind of RNA polymerase found only in the nucleolus.

Many of the chlorophyceans are uninucleate, but multinucleate cells occur in the siphonous members.

Nuclear division:

During mitosis the nuclear envelope may remain entire, intact with polar fenestrations, or may break down at prophase (eg. Desmids). The spindle is both nuclear and cytoplasmic, although in ***Oedogonium*** is entirely intra-nuclear. ***Oedogonium*** is also distinctive in its possession of complex kinetochores.

The behavior of the mitotic spindle in relation to cytokinesis varies in two ways. In one group the spindle disperses, the new nuclei remain close together and a new set of microtubules perpendicular to the former spindle act as organizers for the new wall. The new microtubules are called as phycoplast. This type of cell division occurs in the members of Volvocales, Chlorococcales, Sphaeropleales, Chlorosarcinales, Chaetophorales and Oedogoniales.

In another way, the spindle persists, the daughter nuclei are held far apart and the new wall is formed by a phragmoplast. Phragmoplast may be defined as the coalescence of dictyosome vesicles containing wall components between the spindle microtubules. This type of cell division occurs in the members of Charophyceae including Chlorokybales, Klebsormidiales and Coleochaetales.

In yet another way cytokinesis occur by a combination of a phragmoplast and furrowing of the cell plasmalemma. This type of cell division occurs in the Ulotrichales, Ulvales, Siphonocladales, Dasycladales and Caulerpales. It should also be noted here that the phragmoplast type of cytokinesis is characteristic for the higher plants.

Flagellar characteristics of Chlorophyceae:

Flagella are the locomotory structures and are of fundamental phyletic importance. Algal flagella is reviewed by Moestrup (1982). Flagella number, insertion and organization are characteristic for division. Motile green algal cells are biflagellated or quadric-flagellated. Rarely they are tri-flagellate as in the zoospores of ***Entocladia wittrockii***. In ***Oedogonium***, the motile cells are of multi-flagellate types-Stephanokont where numerous flagella are inserted in a sub apical ring.

In the Chlorophyceae majority of the members are having isokont flagella, where they are of equal length and appearance. They may be homodynamic in which their movements are coordinated or hetero-dynamic in which they are independent on the same cell. Majority of the members of Chlorophyceae possess true flagella. They are absent in some coccoid members of Chlorococcales, amoeboid gametes of Zygnematales and pseudo-flagella bearing tetrasporales.

True flagellum:

A true flagellum consists of an external axoneme contained within the plasmalemma and comprising nine doublet microtubules surrounding two central microtubules. In ***Golenkinia minutissima*** one of the two central microtubules is not

present. The members of Tetrasporales have only pseudo flagella in which both the central microtubules are not present. Hair points are present in the chlorophycean flagella. These are the extensions of one or both of the central microtubules beyond the tips of the peripheral doublets. The hair point of male gamete serves as a mating structure and in zoospores they act as the first contact point with the substratum.

The external axoneme grows through elongation. New material is added distally to the nine peripheral pairs of microtubules and the central ones are extended by the proximal addition of new units.

Normally flagellar hairs are absent in the Chlorophyceae. However, they are reported to occur on the zoospores and spermatozoids of ***Coleochaete scutata***.

Cell wall characteristics:

In many the cell wall is two layered with a firmer inner layer and an outer mucilaginous layer. According to Dodge (1973) there are three forms. Viz., (i) members with wall containing mainly of cellulosic micro fibrils (some Cladophorales, Siphonocladales); (ii) with less distinct organization of cellulosic micro fibrils and proportionately much more amorphous material (some Ulvales, Oedogoniales, many desmids and coccoid species); (iii) with walls not based on cellulosic micro fibrils (many siphonous species and some Volvocales).

In the siphonous forms walls are composed of polymers of xylose (***Caulerpa***), or mannose (***Acetabularia, Codium***) micro fibrils embedded in a matrix which may consist principally of hemicelluloses. Many siphonous marine species have calcified walls e.g. ***Halimeda***, where aragonite, a form of $CaCO_3$, is deposited extra cellularly. Presence of chitin has been confirmed in ***Pithophora*** (Cladophorales). The walls of members of Oedogoniales are unique in that they break in the upper region during cell division, leaving scars (apical caps). The wall may consist of up to six or seven layers (eg. ***Chlamydomonas reinhardtii***). In ***Valonia*** the micro fibrils are arranged at right angles to one another making the cell wall strong.

Some green algae show a biochemical alternation of generations with respect to cell wall composition. For example, in ***Bryopsis*** the walls of the gametophytes are composed of xylan and glucan and those of the sporophytes are composed of mannan.