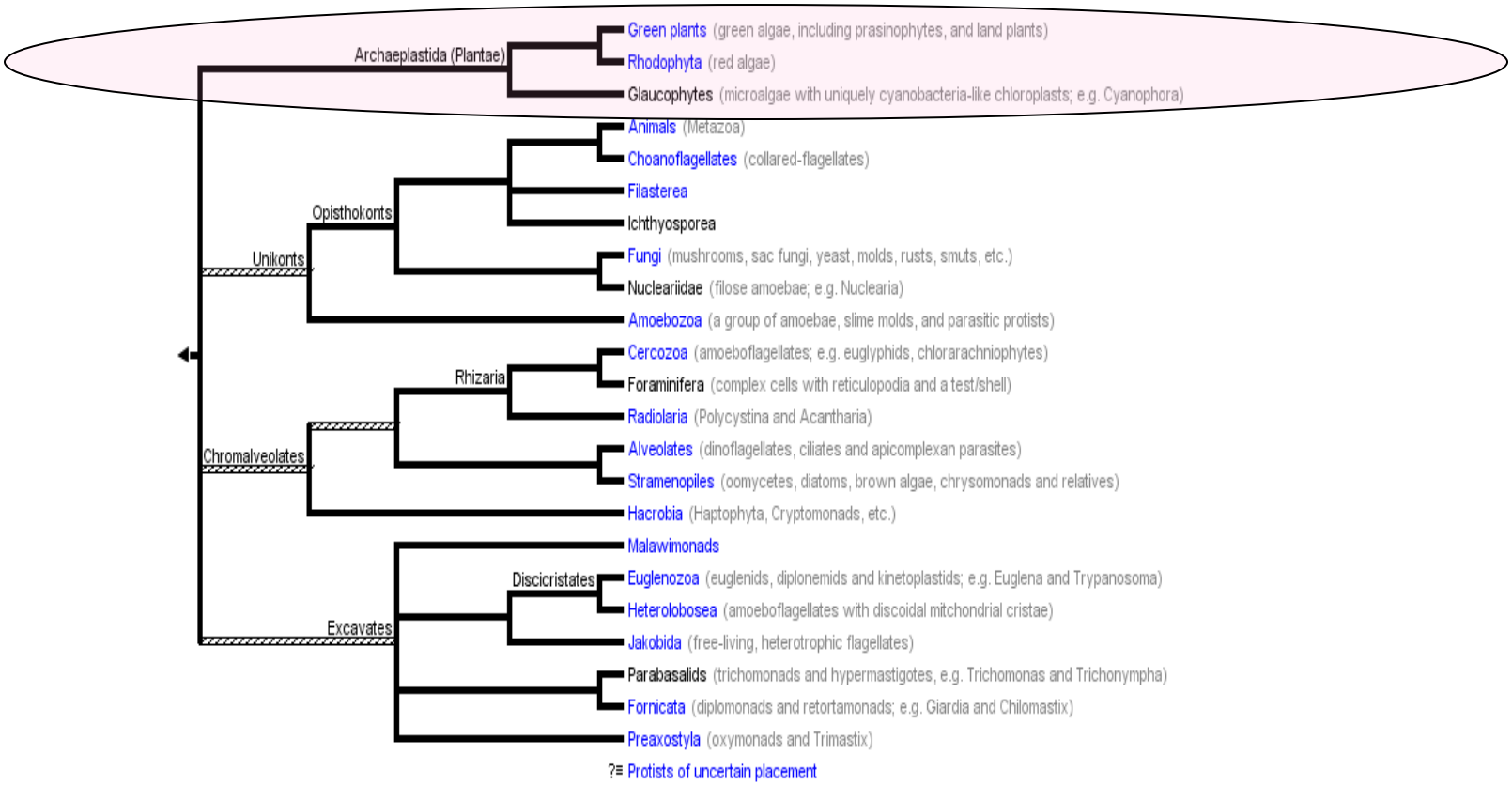
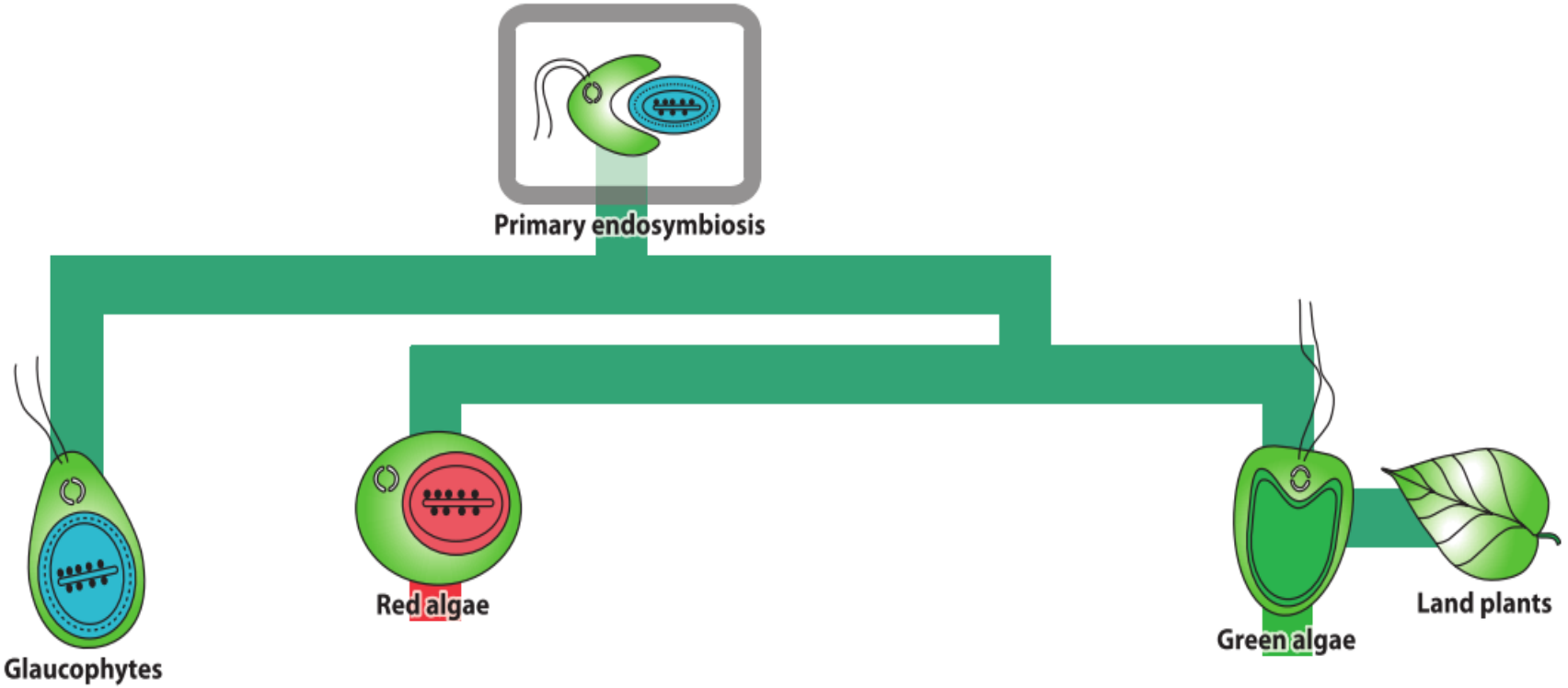
Lineage Archaeplastida

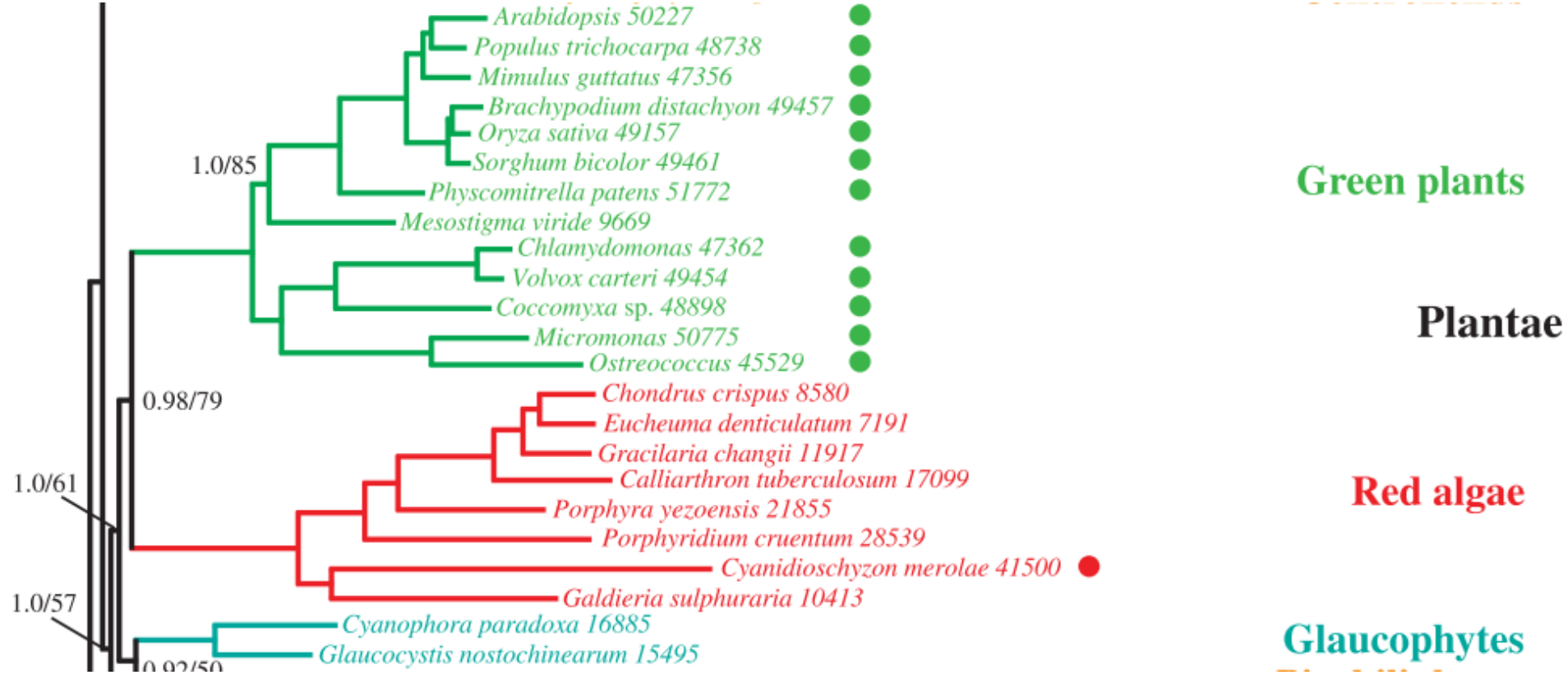


Lineage Archaeplastida



Keeling (2013)

Lineage Archaeplastida



Burki *et al.* (2012)

Lineage Glaucophyta

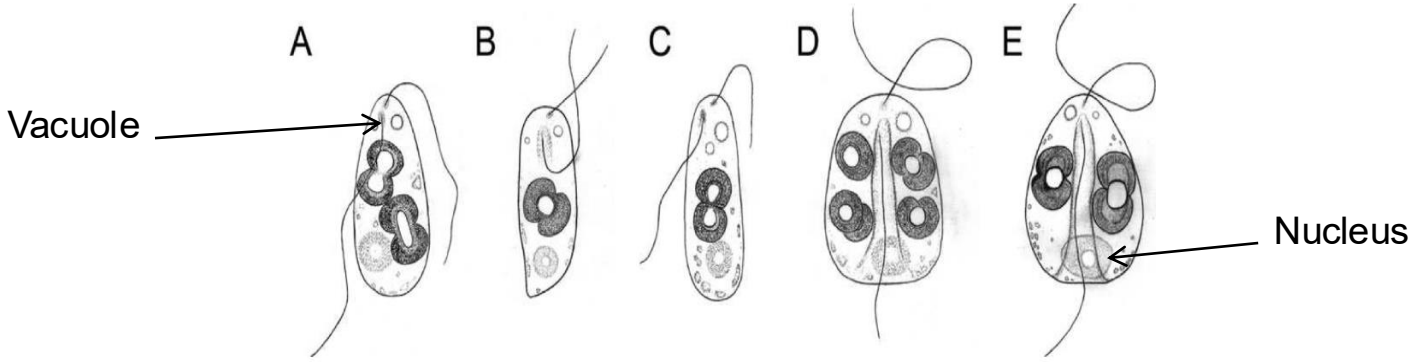
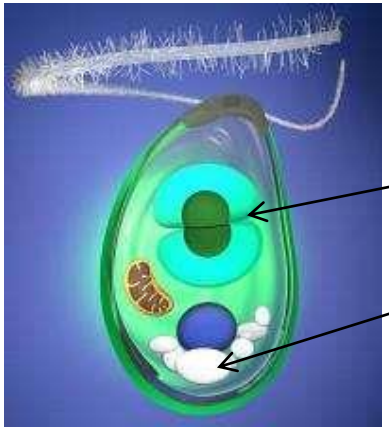
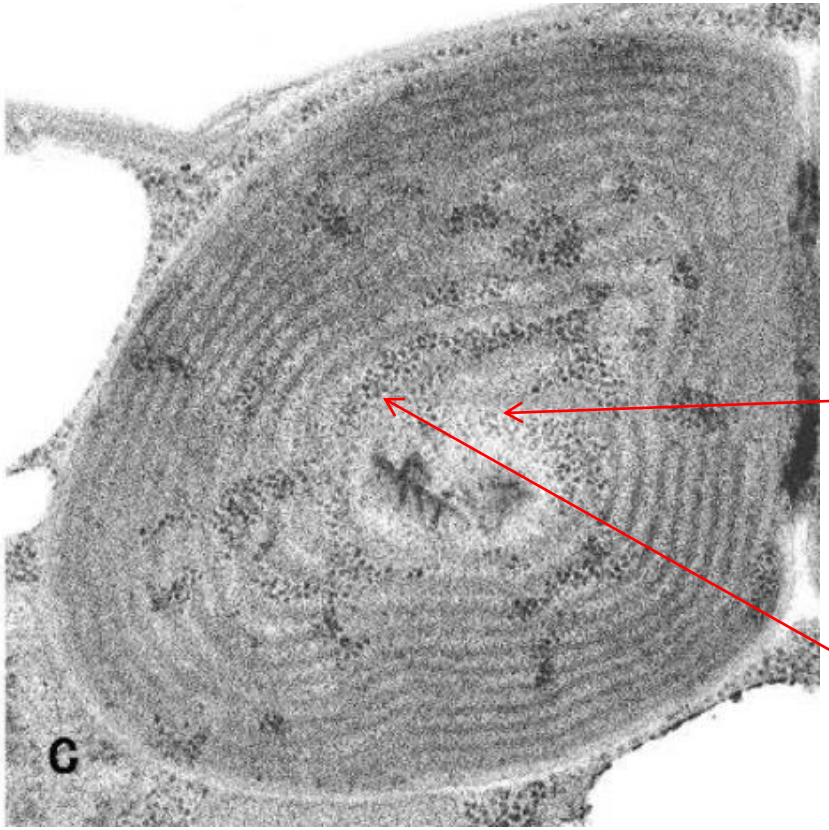


FIG. 1. Light microscope drawings of the vegetative cells of five *Cyanophora* species. (A) *C. paradoxa* Korshikov. (B) *C. cuspidata* Tos. Takah. & Nozaki sp. nov. (C) *C. kugrensii* Tos.Takah. & Nozaki sp. nov. (D) *C. sudae* Tos.Takah. & Nozaki sp. nov. (E) *C. biloba* Kugrens, B.L.Clay, C.J.Mey. & R.E.Lee. Drawings are not to scale.



Linhagem Glaucophyta

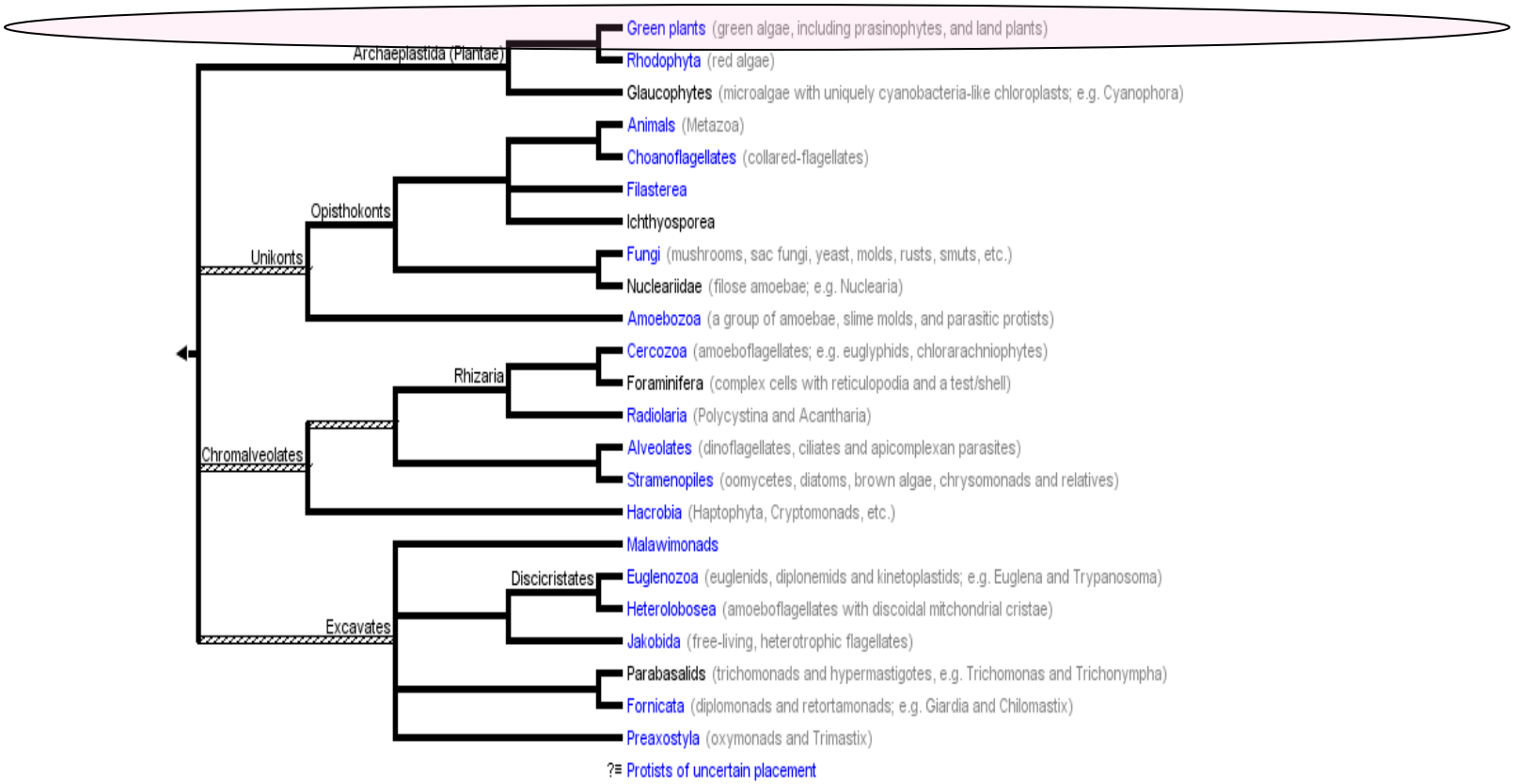


Cyanelle contains peptidoglycan and undergoes division that is intermediate between that of a chloroplast and of a cyanobacterium

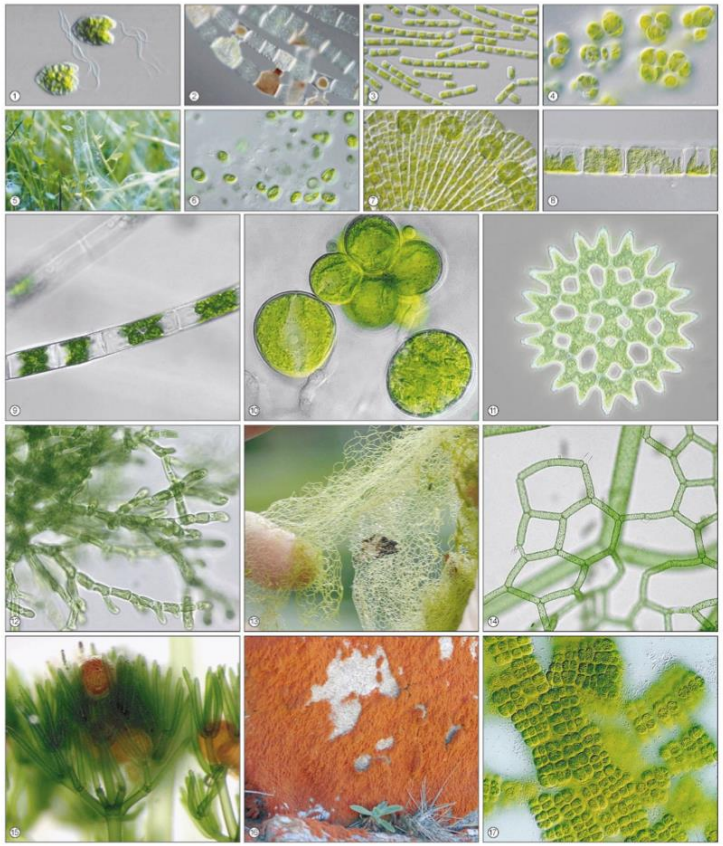
Central Body (a carboxysome?)

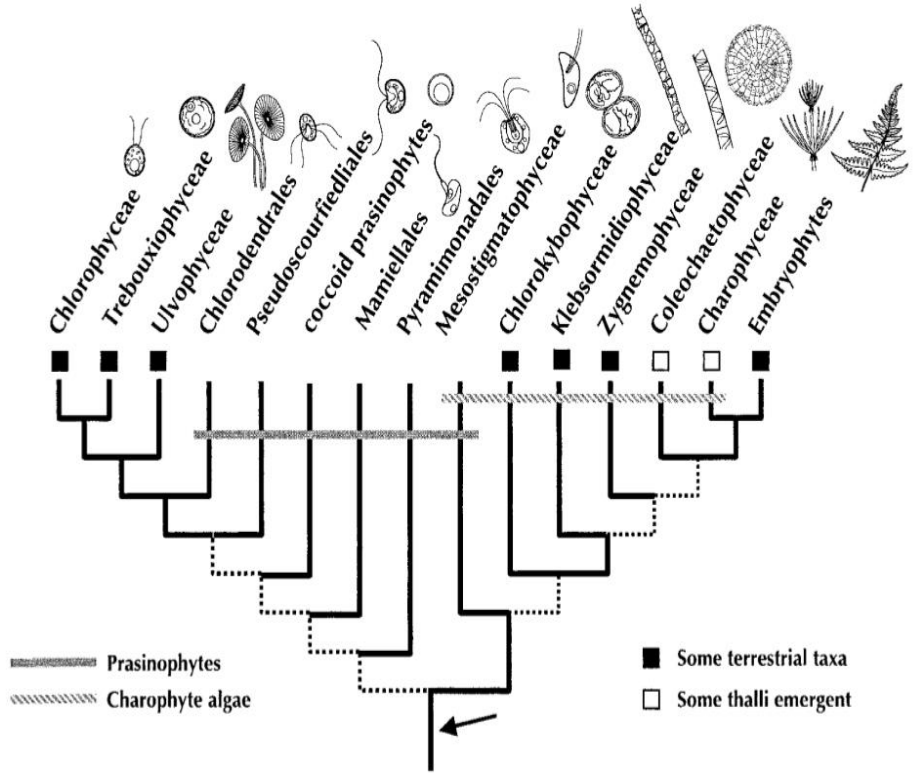
Phycobilisomes

Phylum *Chlorophyta*



Phylum *Chlorophyta*





Lewis & McCourt (2004)

Phylum *Chlorophyta*

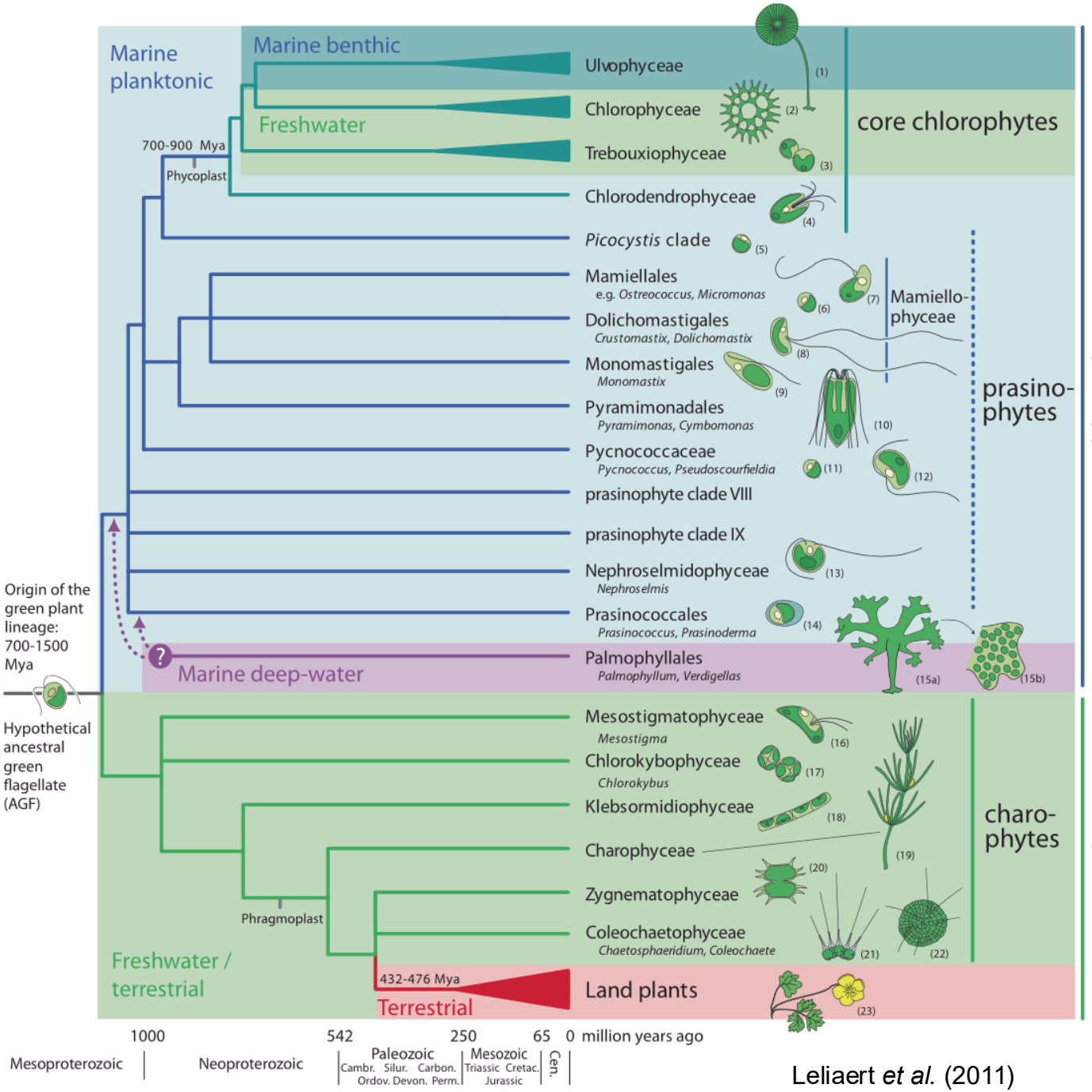
Suffixes:

Phylum: -phyta (Ex. *Chlorophyta*)
Class: -phyceae (Ex: *Chlorophyceae*)
Order: -ales (Ex: *Chlorodendrales*)
Family: -aceae (Ex: *Dunaliellaceae*)

Phylum *Chlorophyta*

- Photosynthetic sub-lineages with chloroplasts (some with leucoplasts, being unable to photosynthesize)
- Chloroplast with 2 membranes
- Chlorophyll *a* and chlorophyll *b*, but without phycobilins
- High biodiversity with unicellular, colonial, multicellular filamentous, branched organisms and polynuclear macrophytes
- Geographical distribution on all continents (including the Arctic and Antartida and aquatic habitats)
- (Endos-) symbiosis in lichens, foraminifera (cleptoplastidia), cercozoa, euglenids, cnidarians, molluscs and vertebrates.

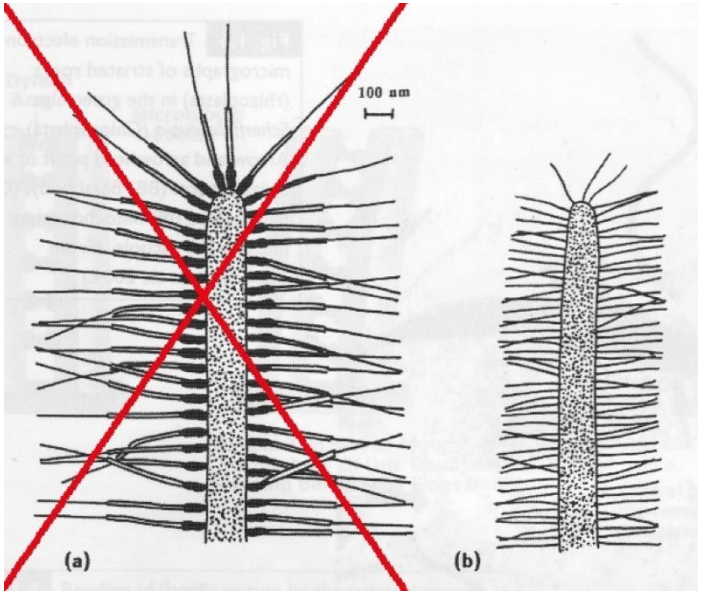
Phylum *Chlorophyta*



Leliaert *et al.* (2011)

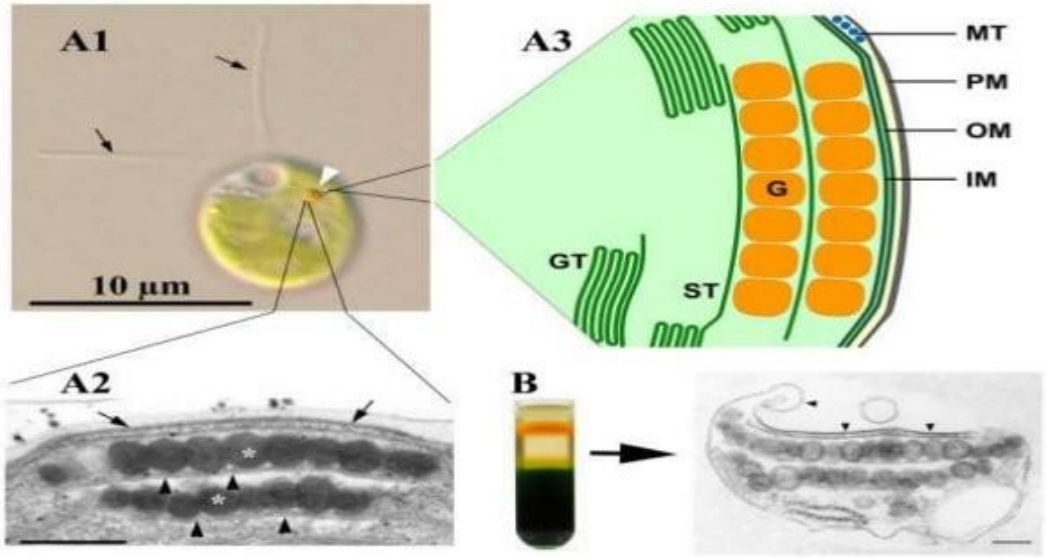
Phylum *Chlorophyta*

- 1-16 flagella
- Flagella without mastigonems, but sometimes with hairs
- Thylakoids can form grana
- Pyrenoids and stigmata are intraplastidial
- Starch is the major reserve polysaccharide

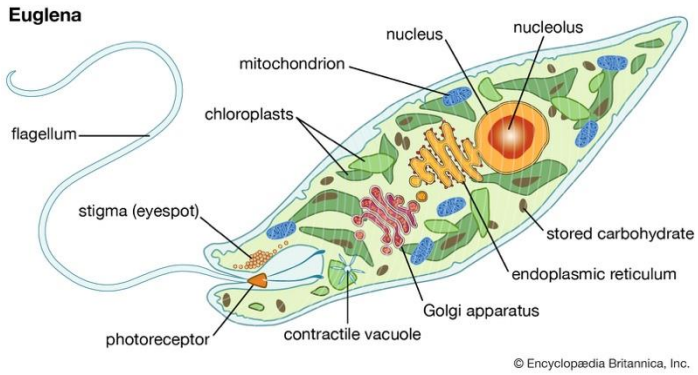


mastigonems vs. hairs

Eyespot / Stigma



The eyespot apparatus of *Chlamydomonas reinhardtii* in the light microscope (A1, white arrow-head), in the transmission electron microscope (A2) and as a schematic drawing (A3). Structural intact eyespot apparatuses can be isolated by sucrose density gradient centrifugation (B).



Euglena has an extraplastidial eyespot

Phylum *Chlorophyta*

Classification according to morphology:

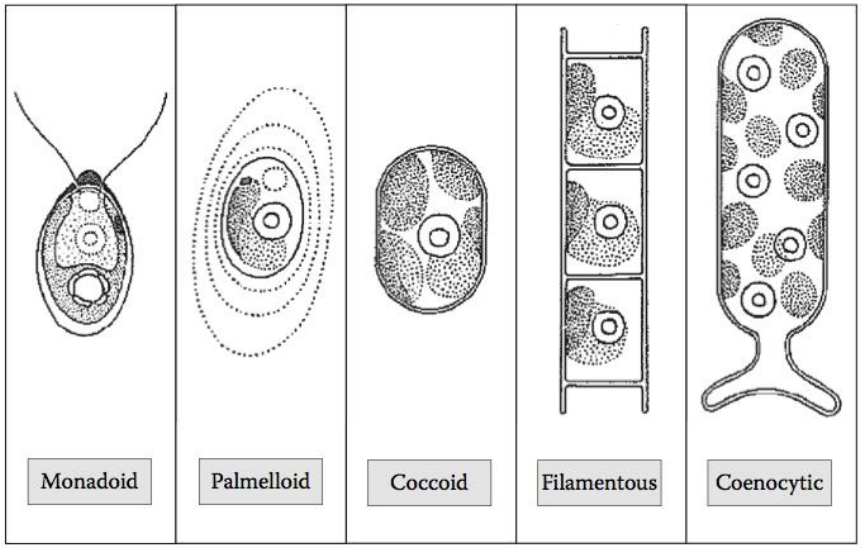


FIGURE 7.1 Different morphological organization in green algae (modified after Ettl, H. and Gärtner, G., *Syllabus der Boden-, Luft- und Flechtenalgen*. Gustav Fischer, Stuttgart, 1995). Parenchymatous and siphonocladous organization are not illustrated.

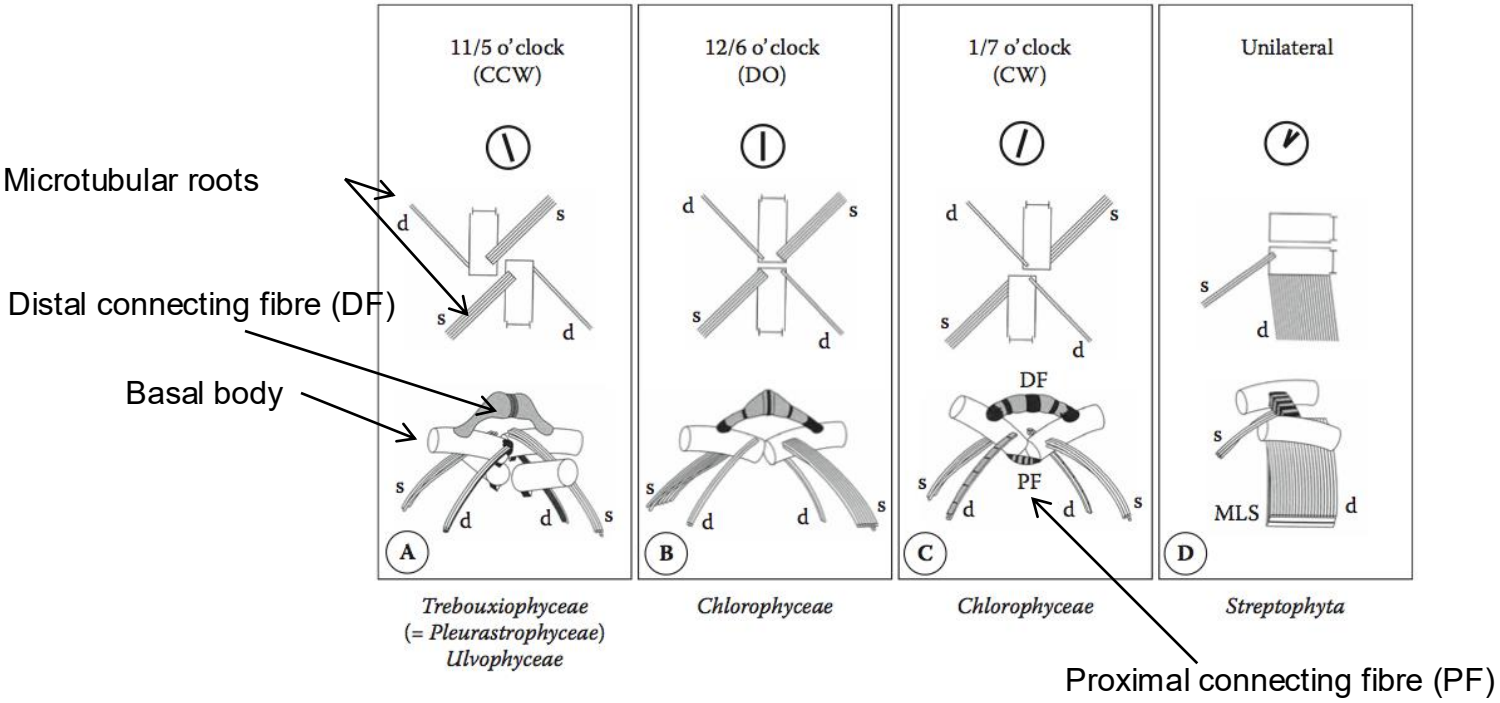
Assumes an evolution from unicellular organisms to more complex multicellular organisms

Pröschold & Leliaert (2007)

Phylum *Chlorophyta*

Classification according to the ultrastructure :

It assumes that the radiation of the various subgroups (classes, orders) occurred from flagellated cells

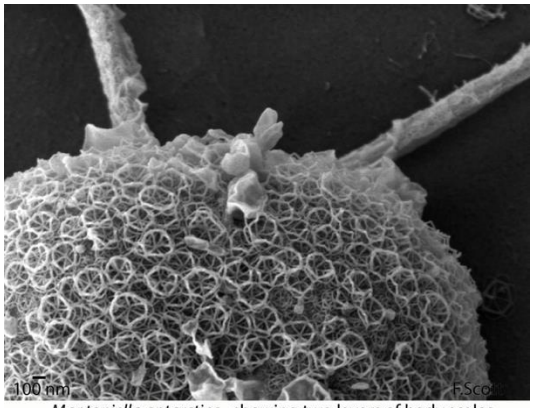


Pröschold & Leliaert (2007)

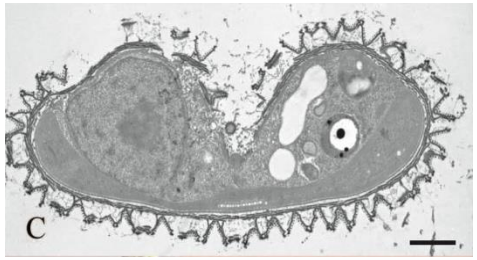
Phylum *Chlorophyta*

Classification according to the type of covering structures

:Scales (“Prasinophytes”)



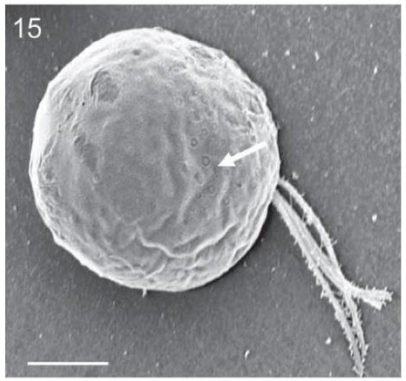
Mantoniella antarctica, showing two layers of body scales, smaller scales, overlain with larger scales.



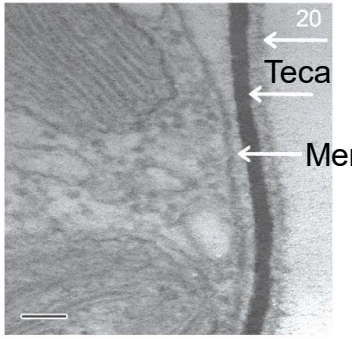
taxonomic.aad.gov.au

Ulvskov *et al*. (2013) *PLOS One* **8**, e76511

Theca – fused scales (*Chlorodendrophyceae*)

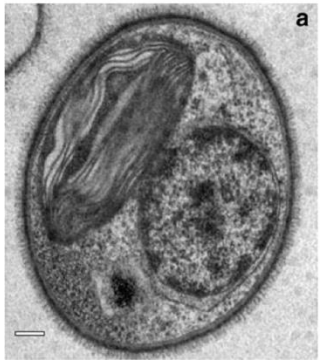


Tetraselmis

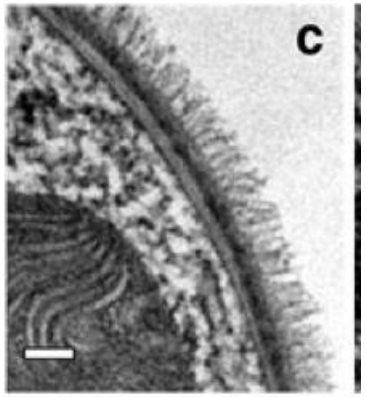


Arora *et al*. (2013) *Eur. J. Phycol*. **48**, 61

Cell wall (*Trebouxiophyceae*)



Chlorella



Gerken *et al*. (2013) *Planta* **237**, 239

Phylum *Chlorophyta*

Composition of cell coverings

Table 2 | Summary of the composition of extracellular coverings in green algae.

Taxon	Covering type	Biochemical composition
Prasinophyceae	"Scales," coatings	2-Keto sugars (e.g., DHA), mannans, glycoproteins
Chlorodendrophyceae	Wall of fused scales	2-Keto sugars (e.g., DHA), proteins
Trebouxiophyceae	Cell walls	Cellulose, algaenan, β-galactofuranan
Chlorophyceae	Crystalline glycoprotein walls; fibrillar cell walls	Hyp-rich glycoproteins, cellulose pectins, AGP, extensin
Ulvophyceae	Cell walls	Cellulose, β-mannans, β-xylans, sulfated (sometimes pyruvylated) polysaccharides or sulfated rhamnogalacturonans, AGP, extensin
Charophyceae-early divergent clades	Scales, cell walls	2-Keto sugars, cellulose, homogalacturonans, 1,3 β-glucans, AGP
Charophyceae-late divergent clades	Cell walls	Cellulose, homogalacturonans, RG-I xyloglucans, mannans, xylans, mixed linkage glucans, 1,3 β-glucans, AGP, extensin, lignin

For further detailed information, key references are provided. AGP, arabinogalactan proteins; Hyp, hydroxyproline.

Domozych *et al*. (2012)