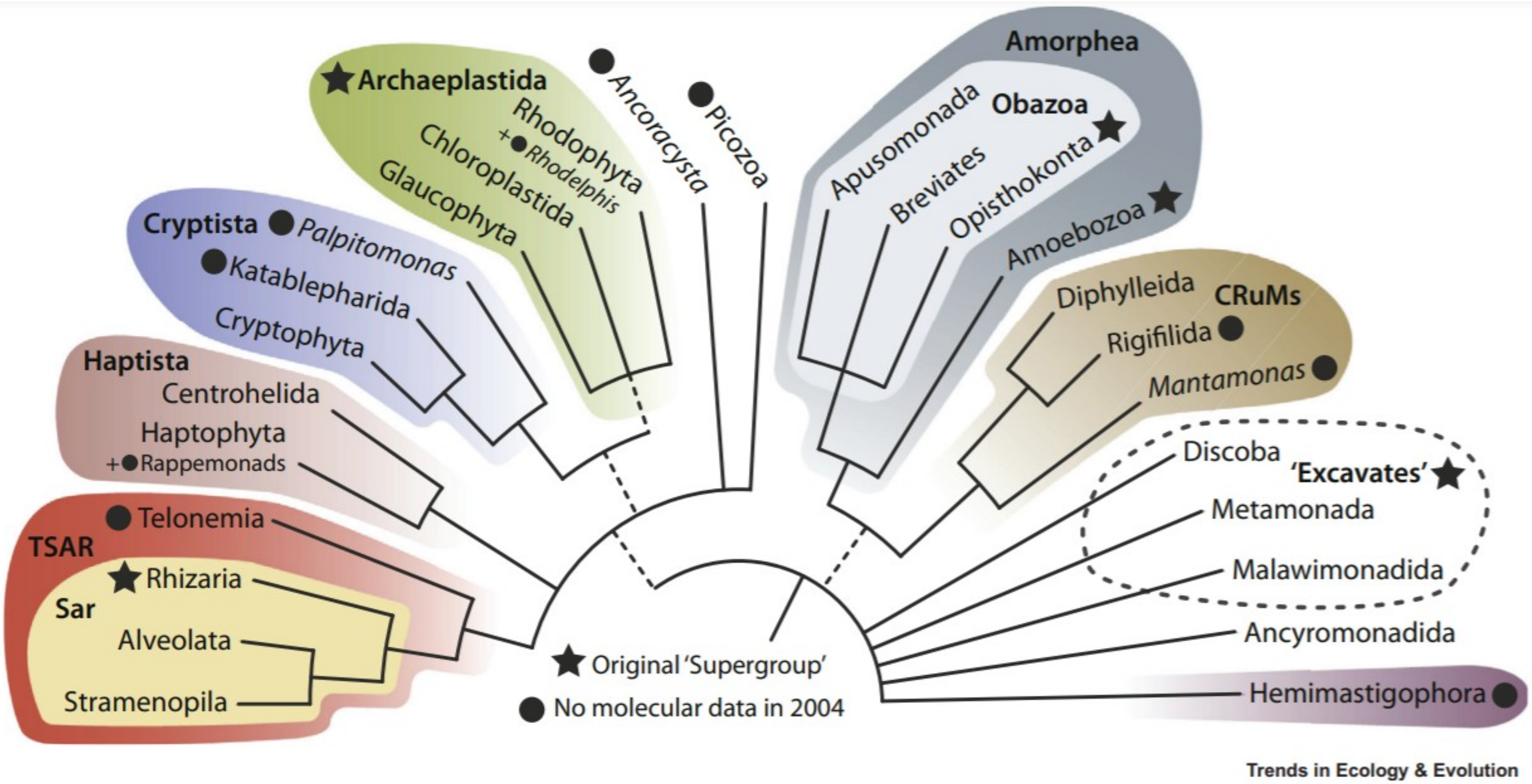


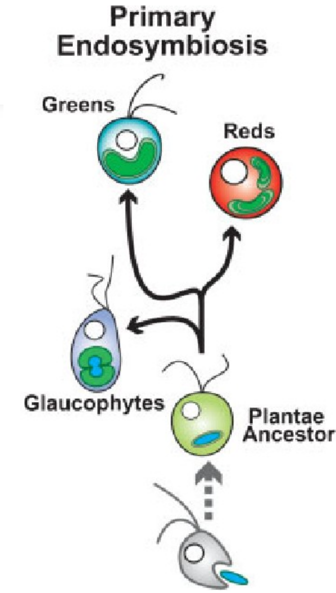
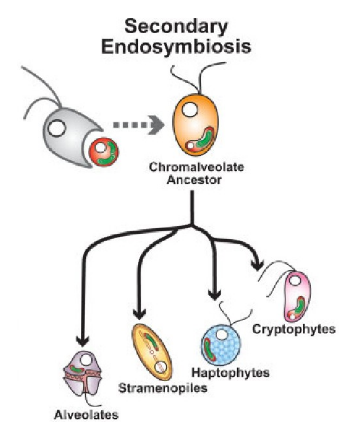


Figure 1. The New Tree of Eukaryotes.

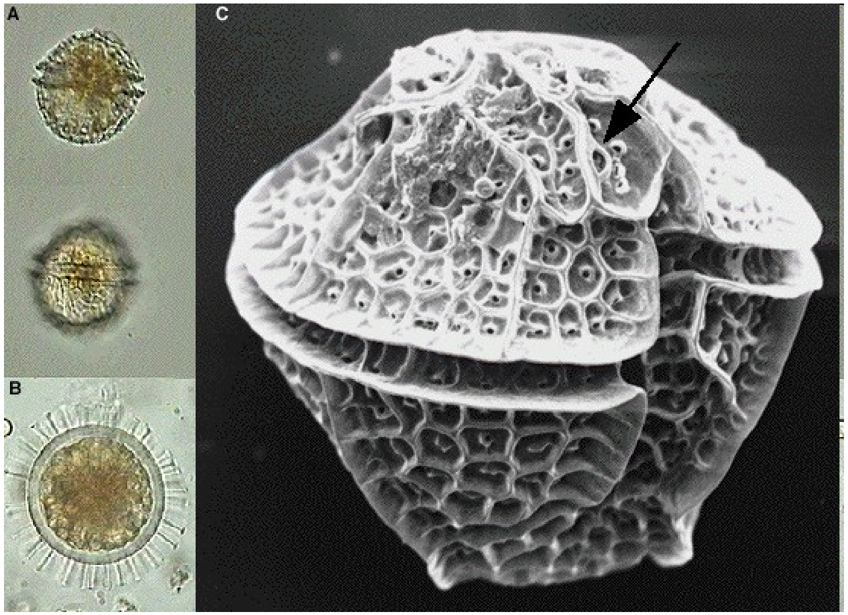
This summary is based on a consensus of recent phylogenomic studies. The colored groupings correspond to the current 'supergroups'. Unresolved branching orders among lineages are shown as multifurcations. Broken lines reflect lesser uncertainties about the monophyly of certain groups. Star symbols denote taxa that were considered as supergroups in early versions of the supergroup model; thus, all original supergroups except Archaeplastida have either disappeared or been subsumed into new taxa. The circles show major lineages that had no molecular data when the supergroup model emerged, most often because they had not yet been discovered. Rappemonads (in parentheses) are placed on the basis of plastid rRNA data only. The putative new major lineages *Microheliella* and *Anaeramoeba* are not shown due to the limited evidence that they belong outside all existing groups shown here (Table 1).

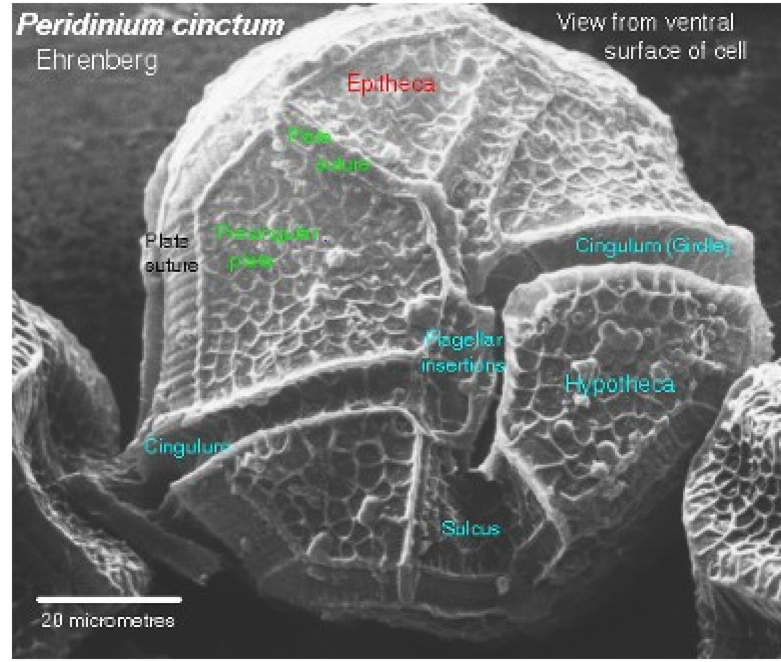


Burki et al., 2020, Trend Ecol Evol

Dinophyta (= *Dinozoa, Dinoflagellata*)

mostly phototrophic group belonging to ***Alveolata***, traditionally considered as algae, especially from an ecological point of view





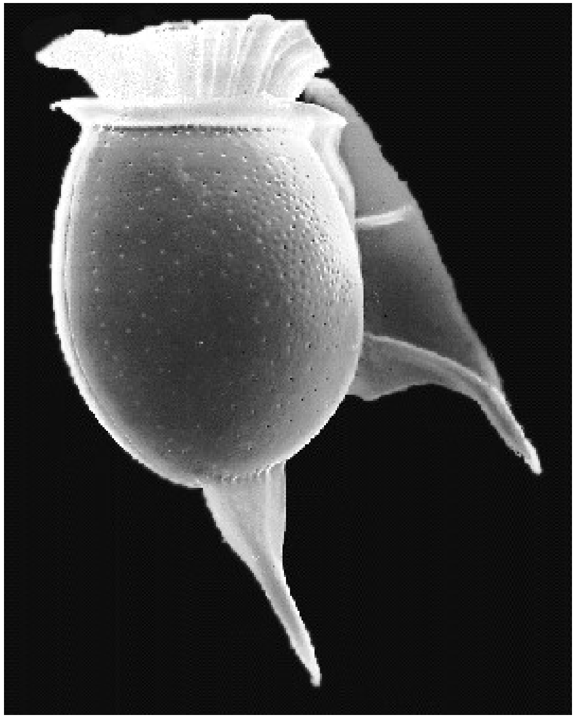
dinokaryon – nucleus lacking any histons, i.e. permanently condensed DNA

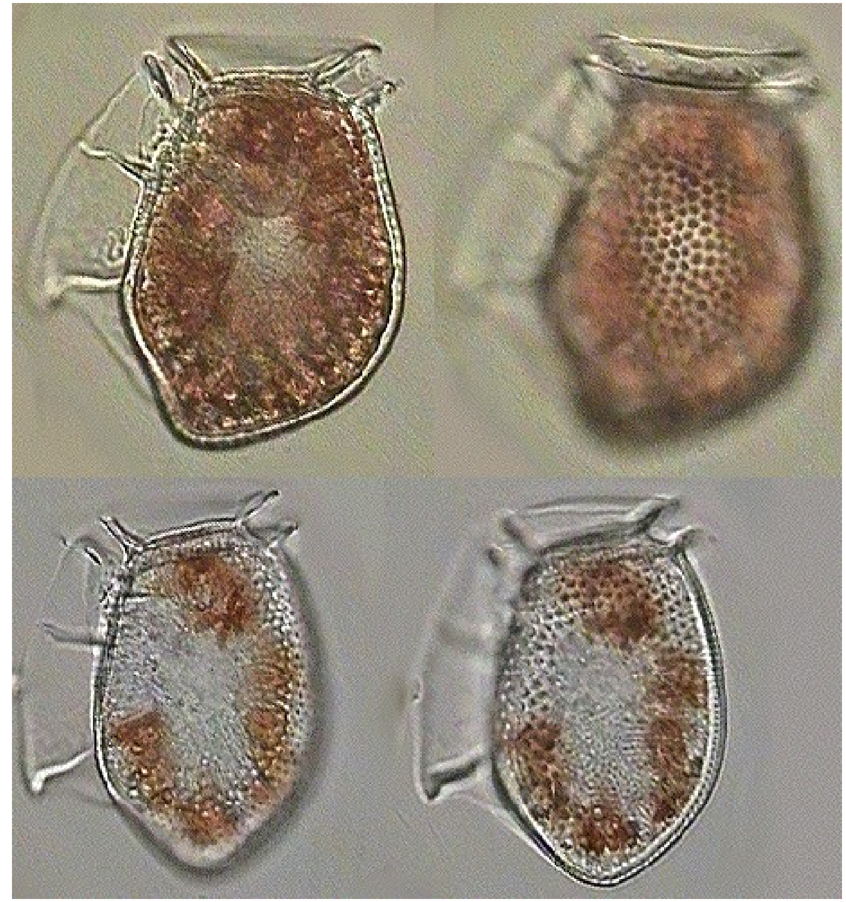
oldest fossils - 600 mil. let – late Precambrium
(the morphotypes are more or less identical with some recent cold-water cysts of dinoflagellates)

about 2000 species, mostly in marine plankton, about 10% in freshwater, often as parasites

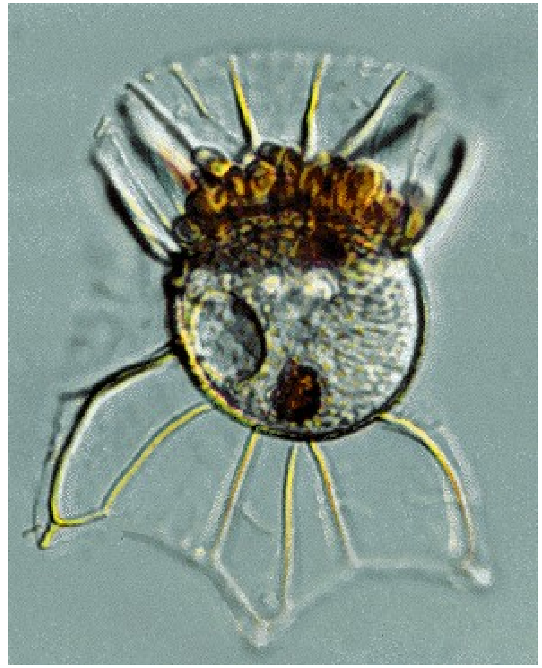
about half of species heterotrophic, lacking plastids; often phagotrophic
secondary plastids from red or green lineage; tertiary plastids from multiple hosts
in general – many symbiotic events in evolution (including kleptoplastids)

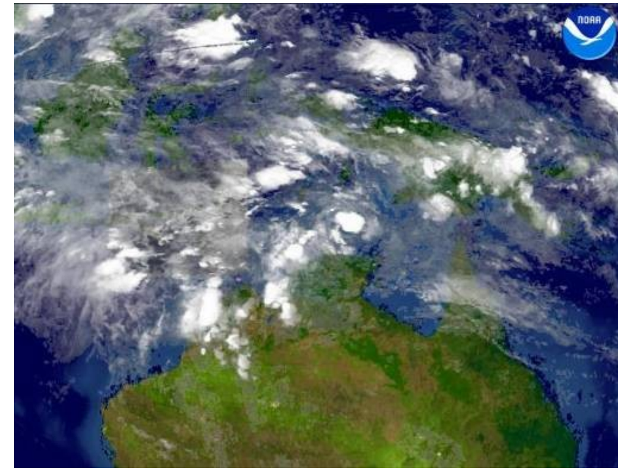
Dinophysis - red tides, toxins in marine habitats

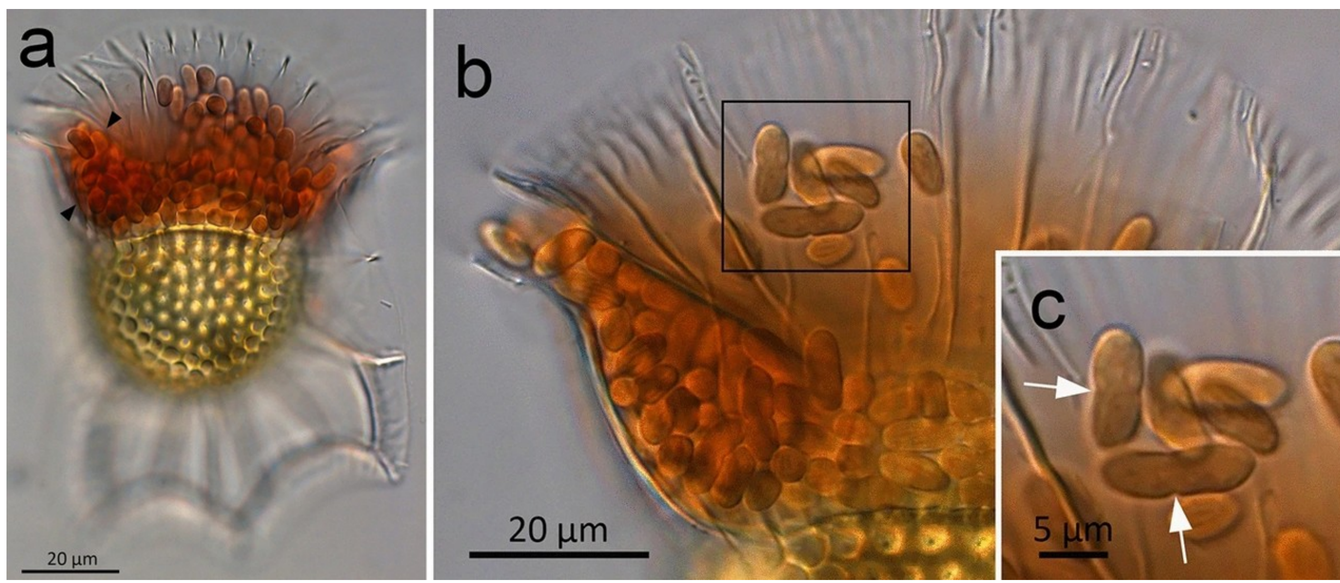




Ornithocercus



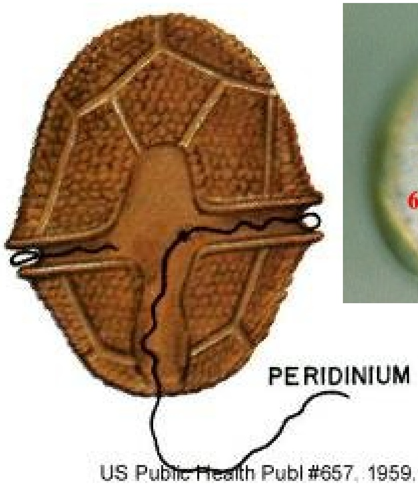


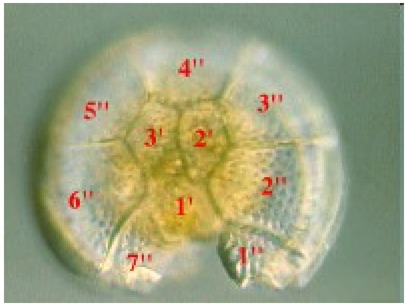


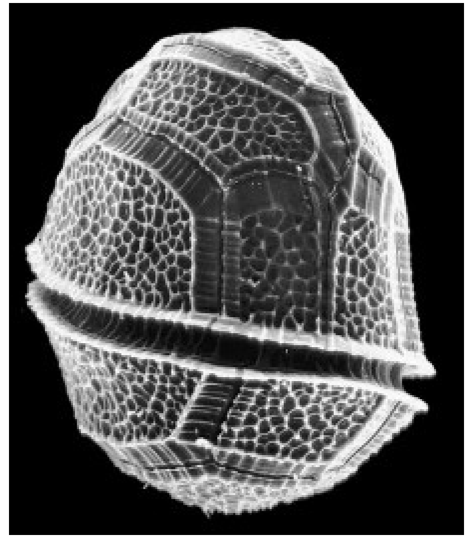
symbiotic, heterocytous cyanobacteria (nitrogen-fixing), otherwise heterotrophic
(sub-)tropical marine plankton

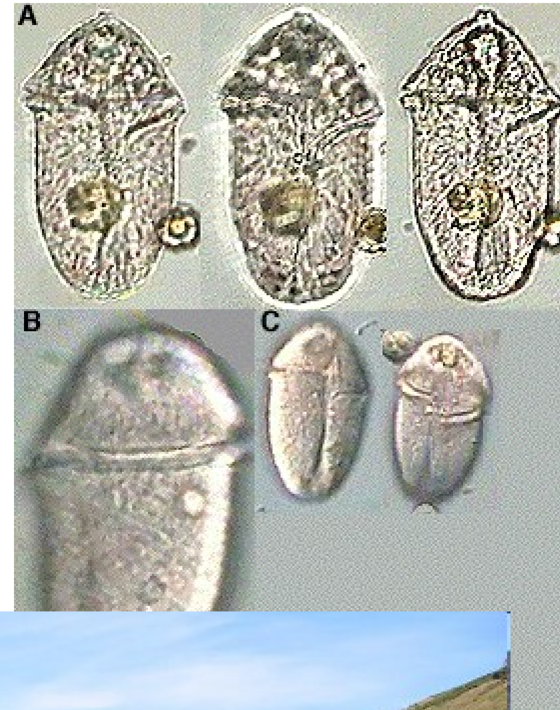
Peridinium

Gymnodinium

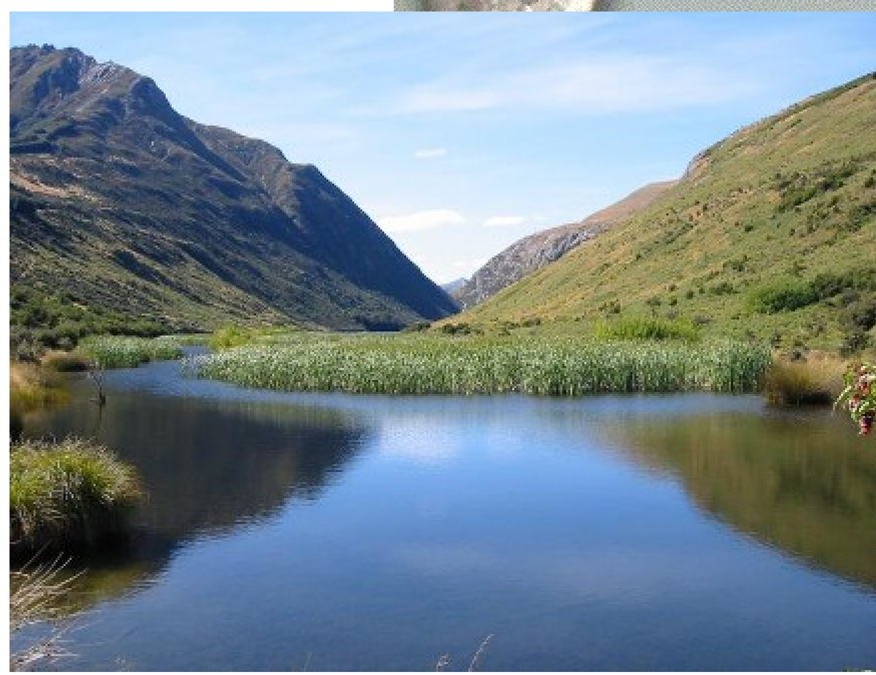




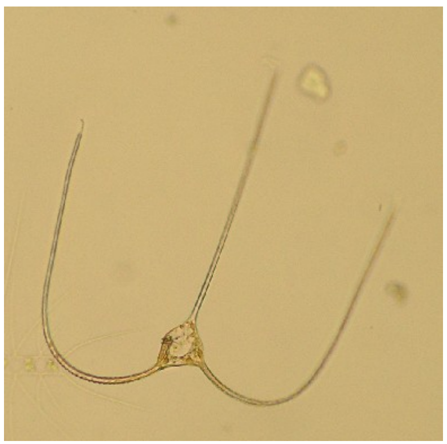


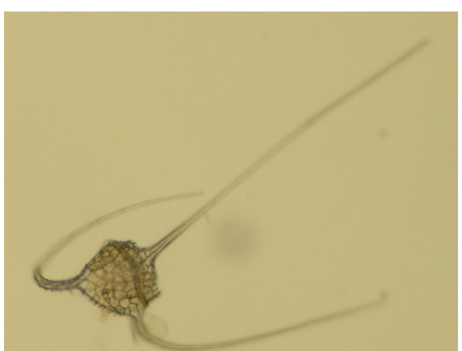


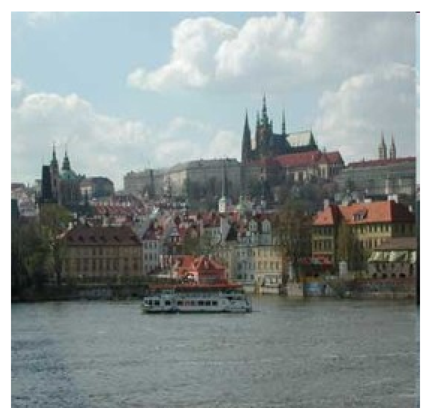
freshwater planktonic dinoflagellates



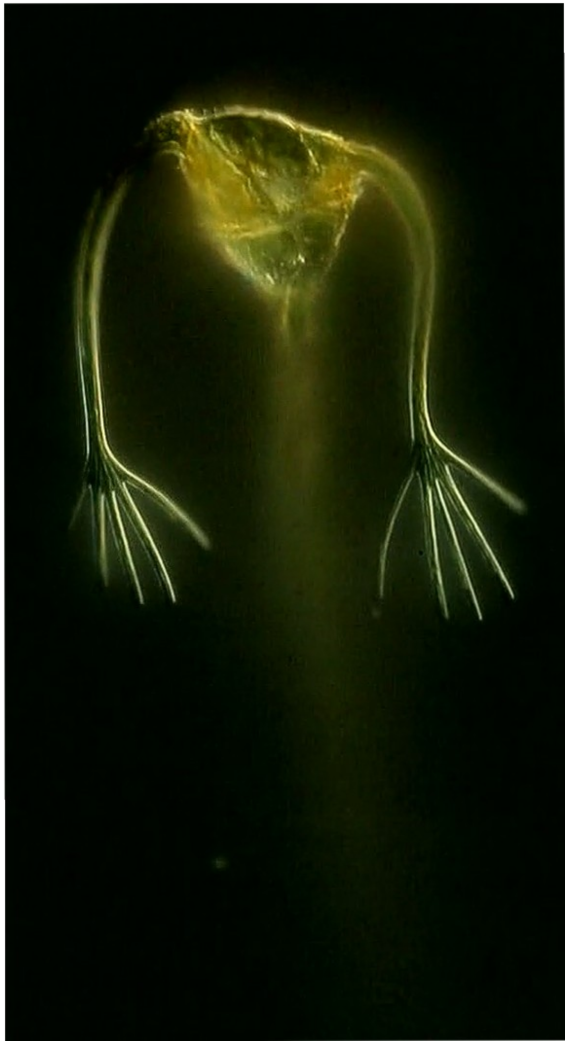
Ceratium complex – one of the most important dinoflagellate taxa from the ecological point of view; individual species/genera occurs both in marine and freshwater phytoplankton







diurnal production of pseudopodes in ***Tripos ranipes***



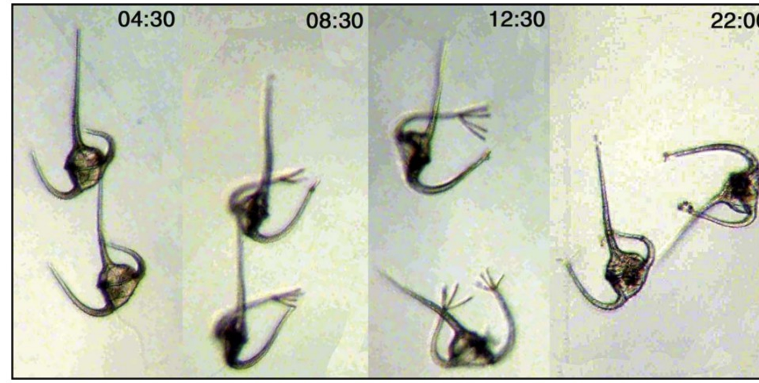
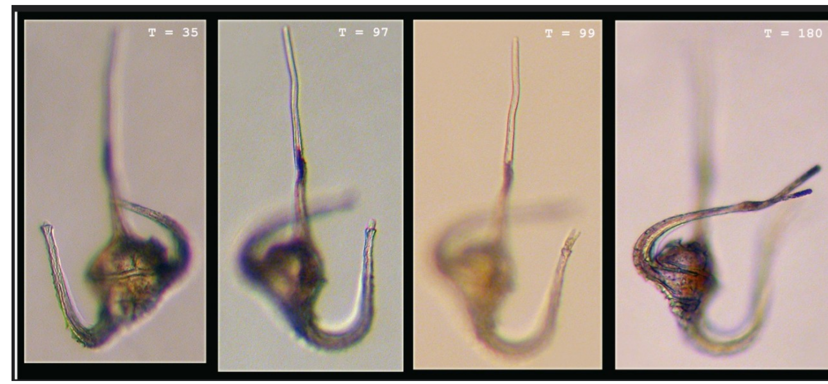
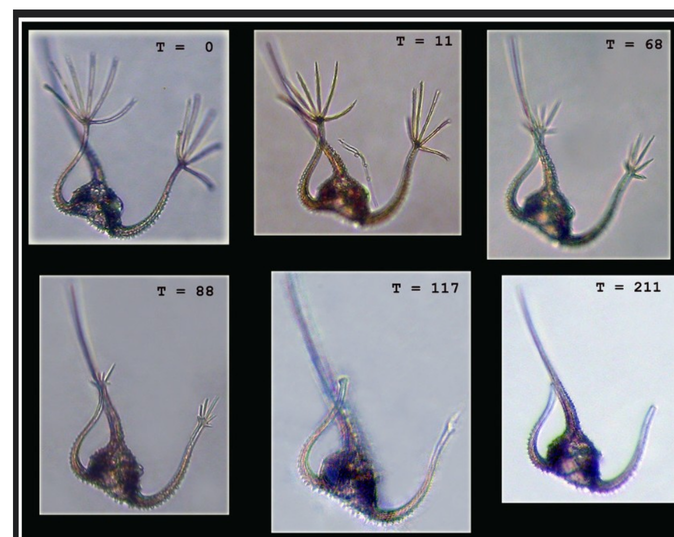


Figure 2. Images of a single pair of *Ceratium ranipes* after 10.5 h in darkness (04:30), 2.5 h of illumination (08:30), 6.5 h of illumination (12:30) and after 6 h of darkness (22:00).





no. minutes from dawn - production of fingers
no. minutes after sunset - retraction

Pizay et al., 2009, Protist
https://planktonchronicles.org/en/portfolio/ceratium-grow-fingers-to-catch-more-light/
https://www.flickr.com/photos/98842375@N03/

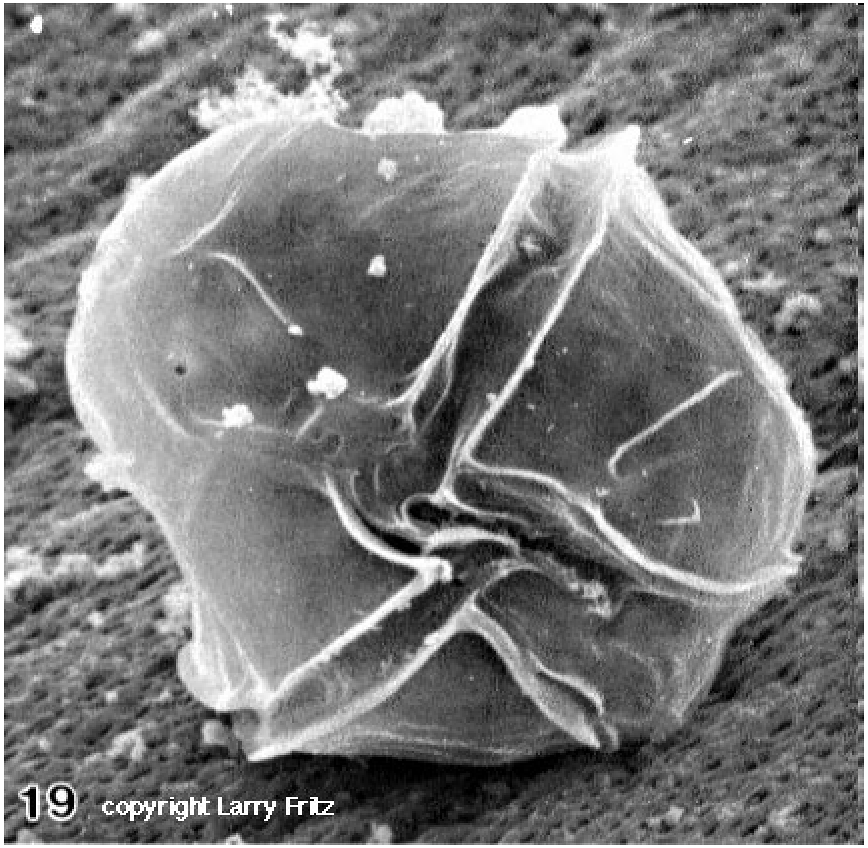
Noctiluca scintilans (seasparkle, svítilka)

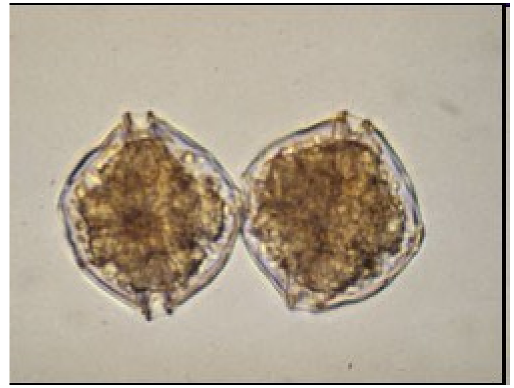
cells up to 2 mm, heterotrophic or
with symbiotic green algae

bioluminiscence
scintilons - specialized organells

https://www.youtube.com/watch?v=7kyP0XsF0zM

Alexandrium





toxic water blooms
in shelf seas - saxitoxin

red tide water blooms

Symbiodinium („zooxanthella“)

probably a monophyletic lineage; obligate endosymbionts of eukaryotes
mostly as intracellular symbionts

hosts: Cnidaria (incl. corals), platyhelminths, Porifera, bivalvs, foraminifers, ciliates

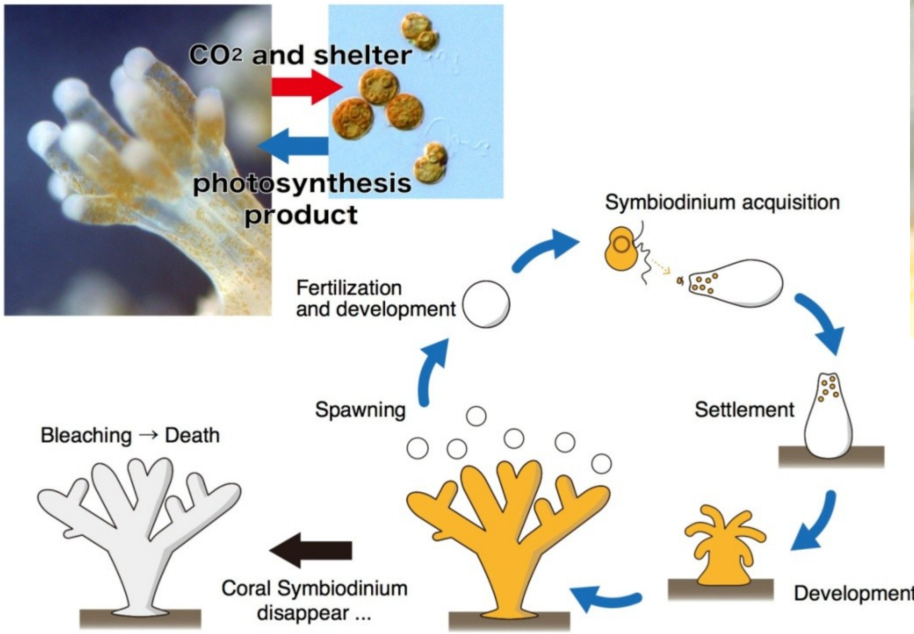
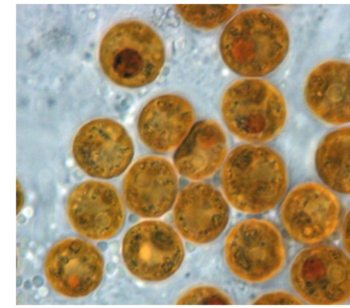
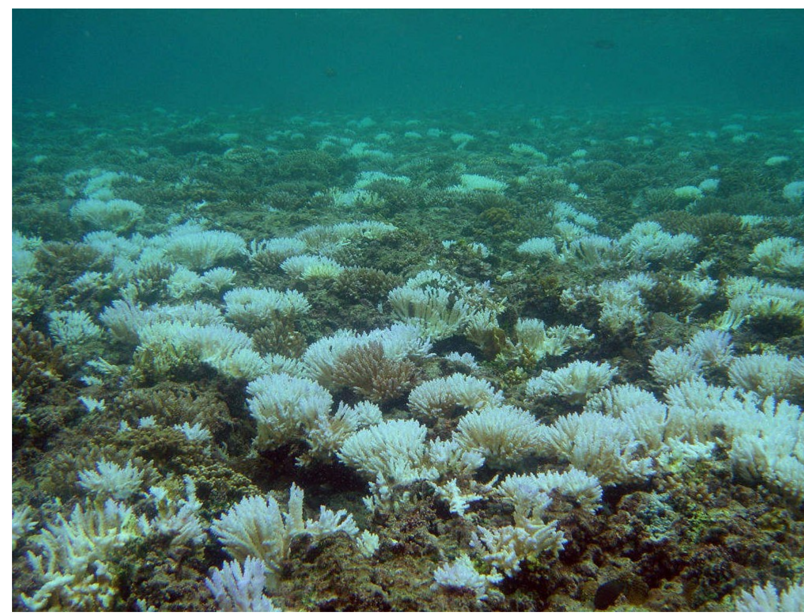


Figure 2. A symbiotic relationship between corals and Symbiodinium

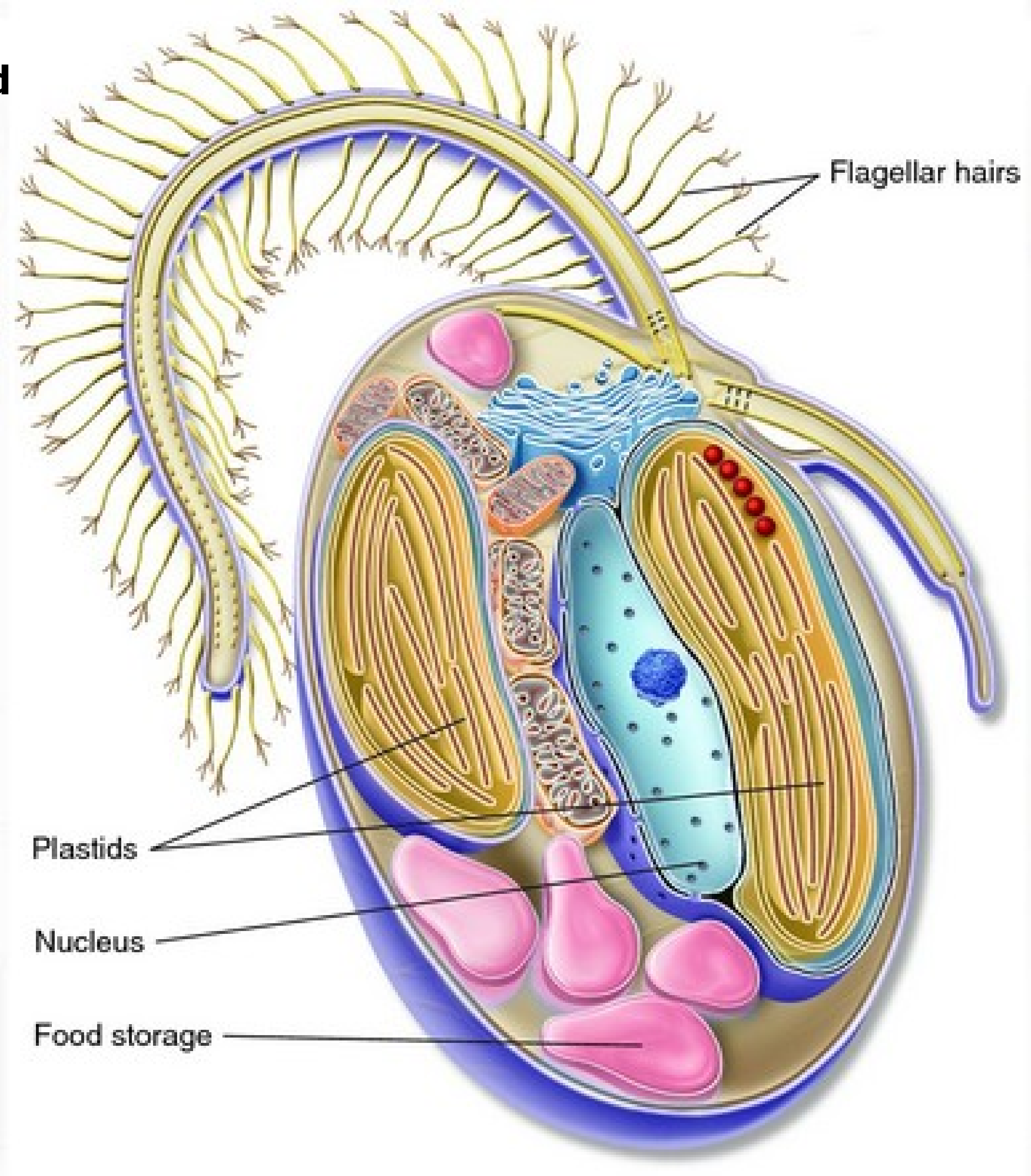
http://mucholderthen.tumblr.com

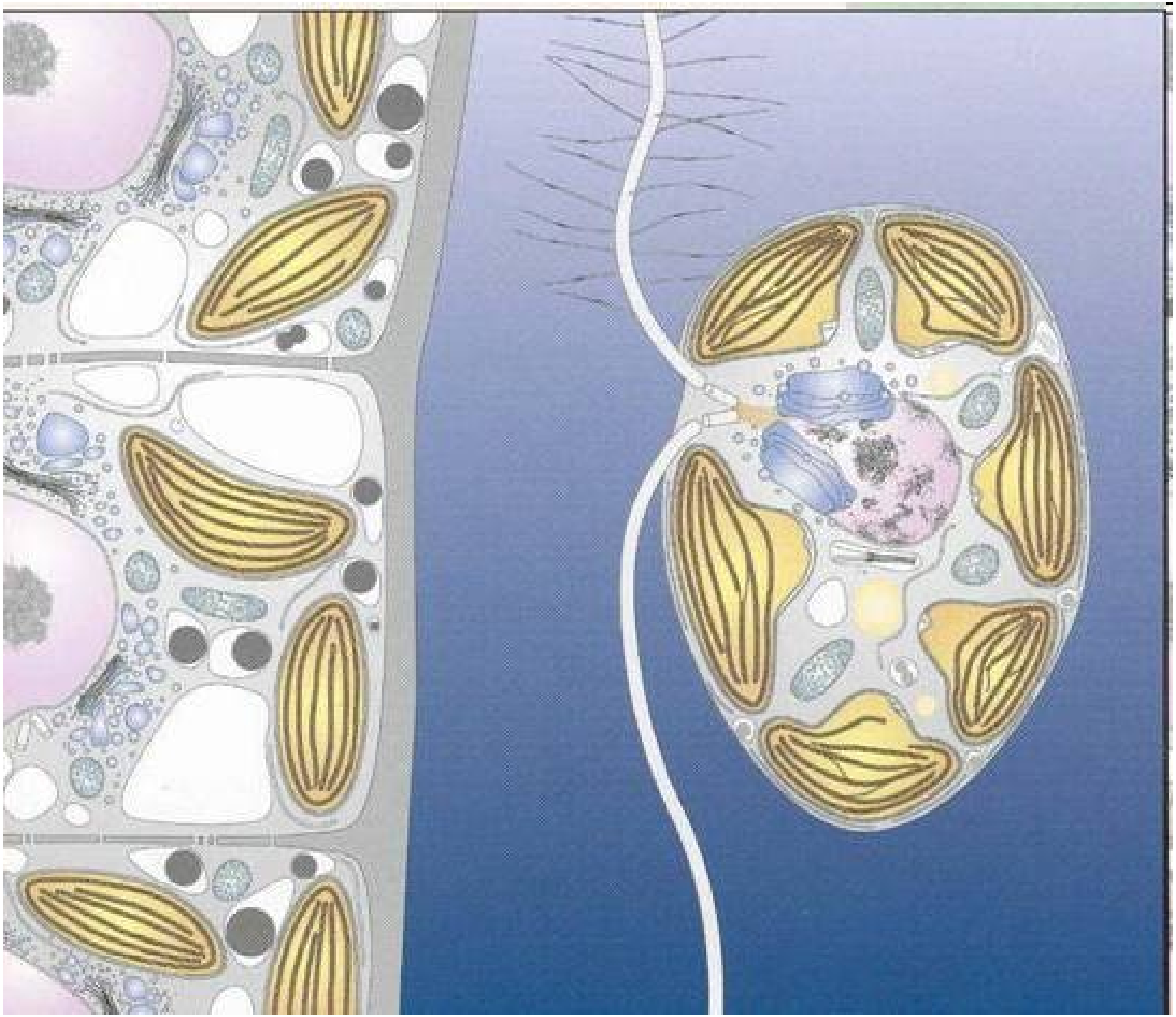

Symbiodinum


marinesciencetoday.org

coral bleaching

basic structural features of stramenopile flagellated cells





seaweed raphidophyte flagellate

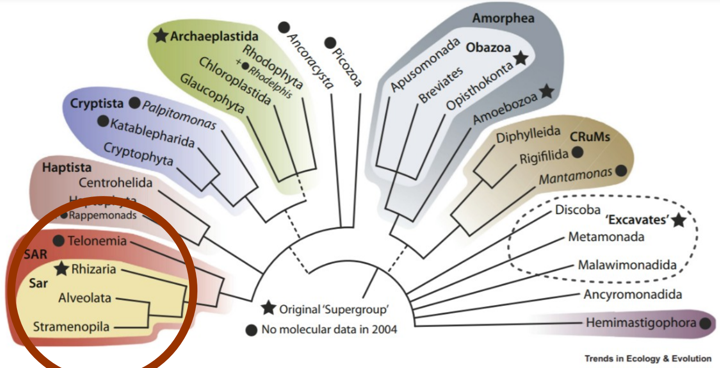


Figure 1. The New Tree of Eukaryotes.

This summary is based on a consensus of recent phylogenomic studies. The colored groupings correspond to the current 'supergroups'. Unresolved branching orders among lineages are shown as multifurcations. Broken lines reflect lesser uncertainties about the monophyly of certain groups. Star symbols denote taxa that were considered as supergroups in early versions of the supergroup model; thus, all original supergroups except Archaeplastida have either disappeared or been subsumed into new taxa. The circles show major lineages that had no molecular data when the supergroup model emerged, most often because they had not yet been discovered. Rappemonads (in parentheses) are placed on the basis of plastid rRNA data only. The putative new major lineages *Microheliella* and *Anaeramoeba* are not shown due to the limited evidence that they belong outside all existing groups shown here (Table 1).

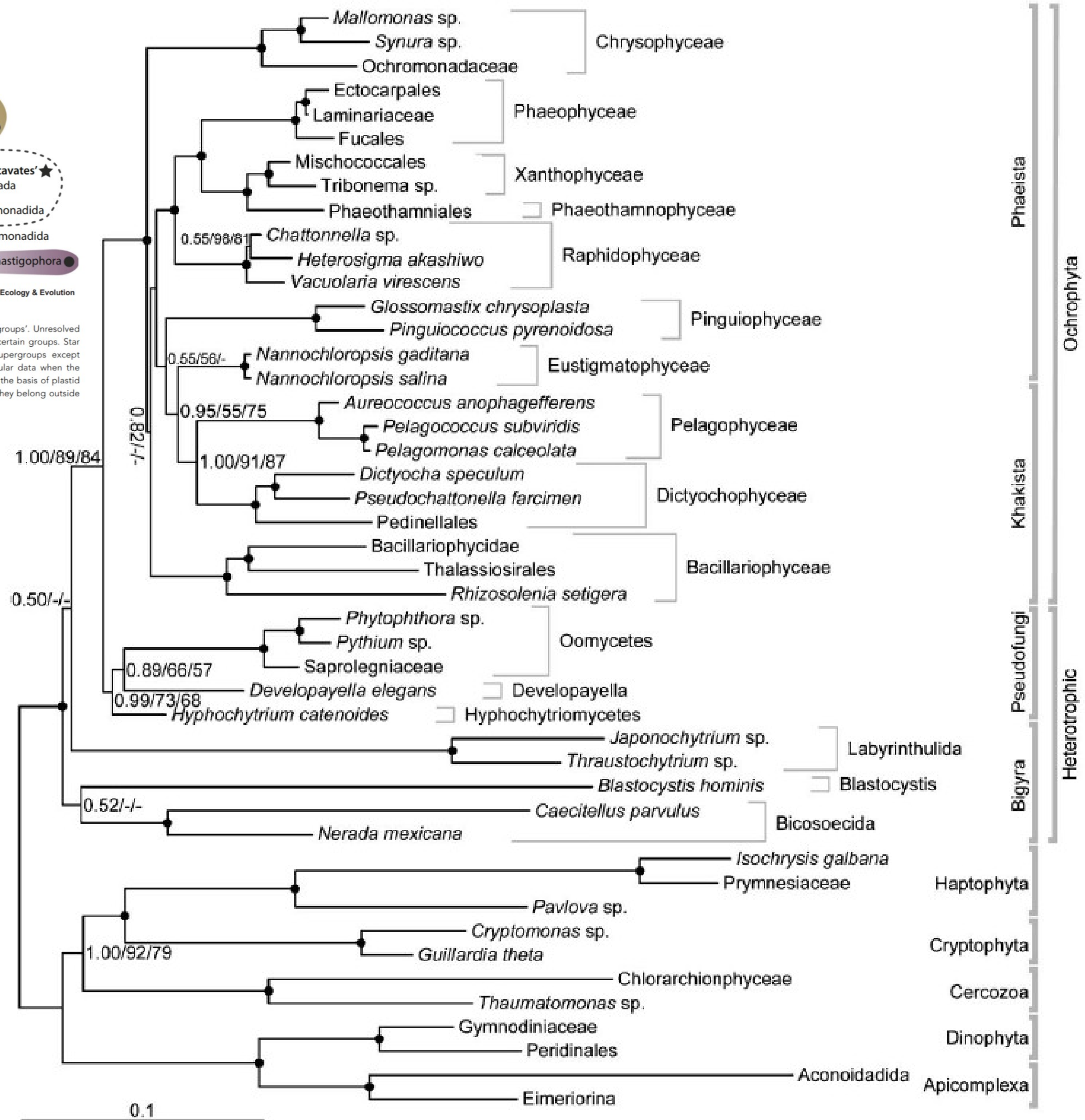
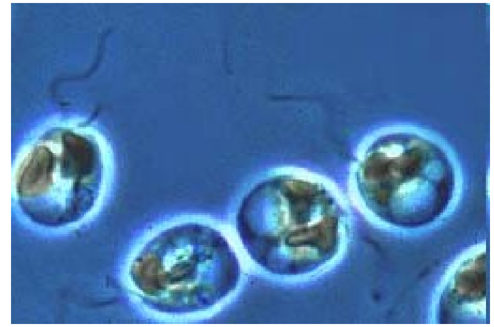


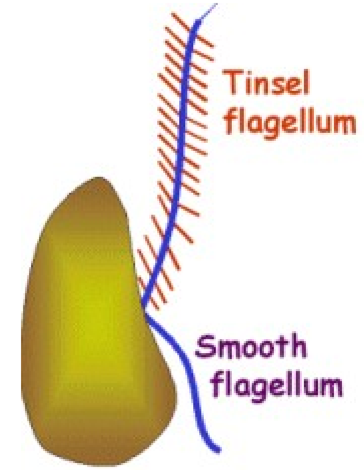
Figure 2. Protein and rDNA phylogeny of heterokonts. Combined lsu, ssu, actin, β-tubulin, *cox1* and *hsp90* phylogeny of Ochrophyta, Bigyra and Pseudofungi. PAML fast-evolving site category 8 for both rDNA and proteins has been removed (Yang 1997, 2007; Kumar et al. unpublished) (4632 characters). For further information, see legend for Figure 1.

Riisberg et al., 2009, Protist

Chrysophyceae (incl. *Synurophyceae*)

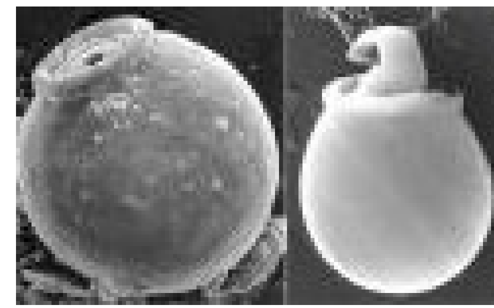
mostly freshwater flagellate and mucilaginous organisms; about 700 species

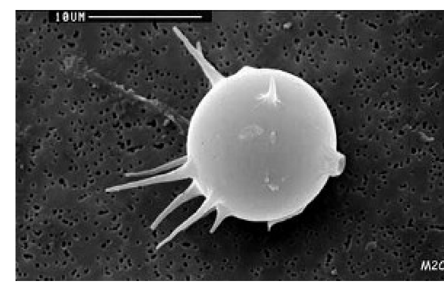




Dinobryon – flagellates in vase-shaped chitinous shells

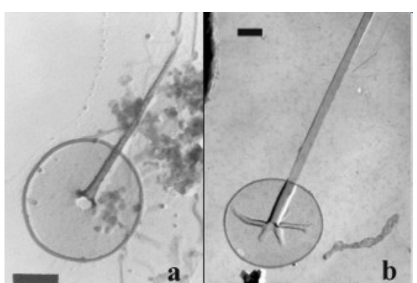
mesotrophic and oligotrophic plankton

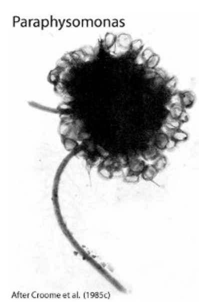


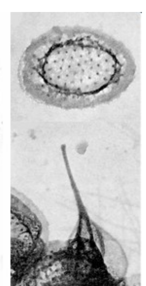


endogenous silicate stomatocysts

Paraphysomonas – genus with rudimentary plastid and silicate scales

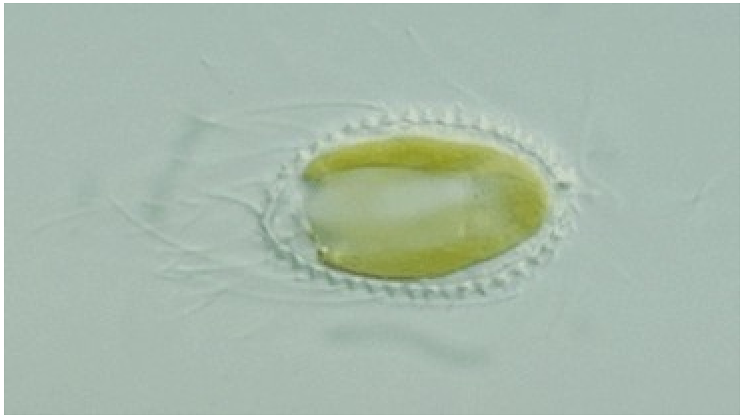


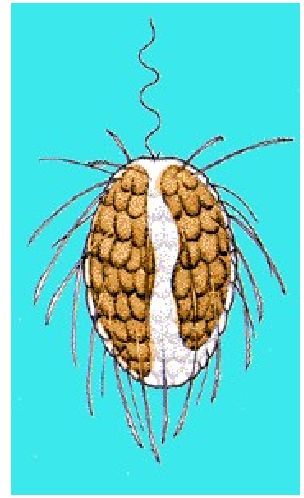


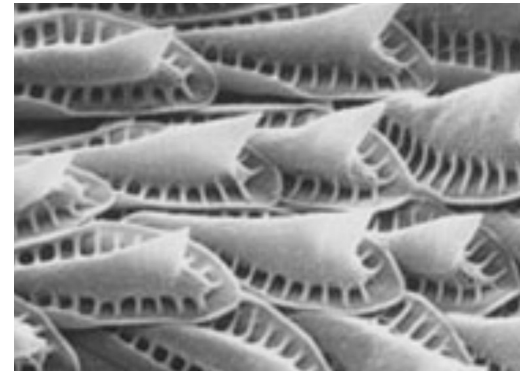


both marine and freshwater species

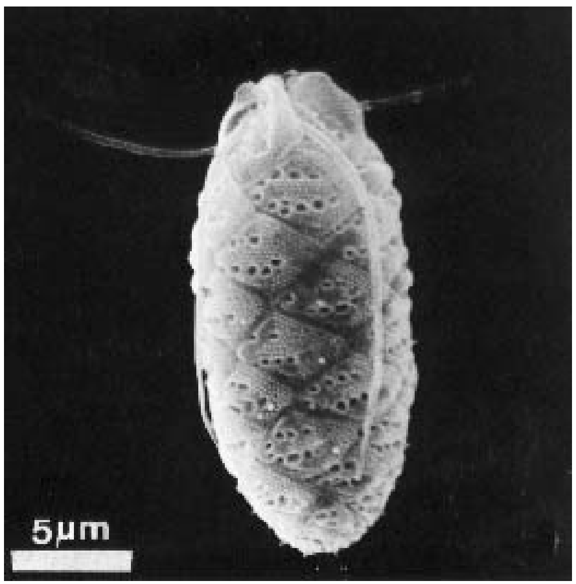
„*Synurophyceae*"
mainly genera *Mallomonas* a *Synura*

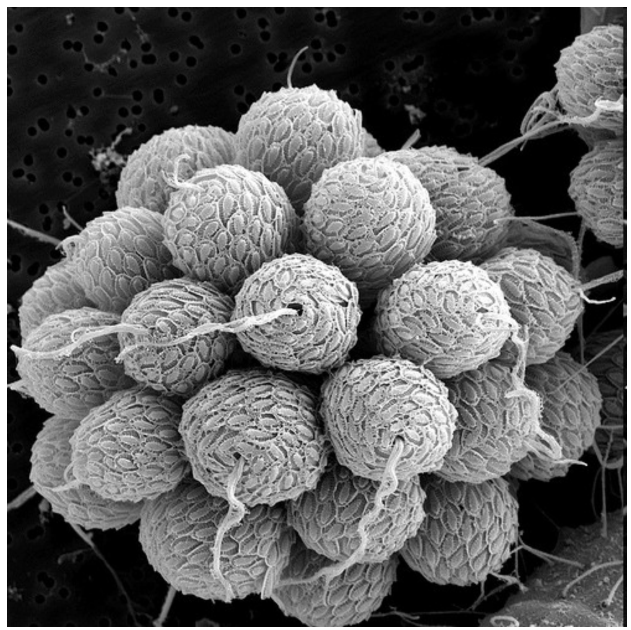


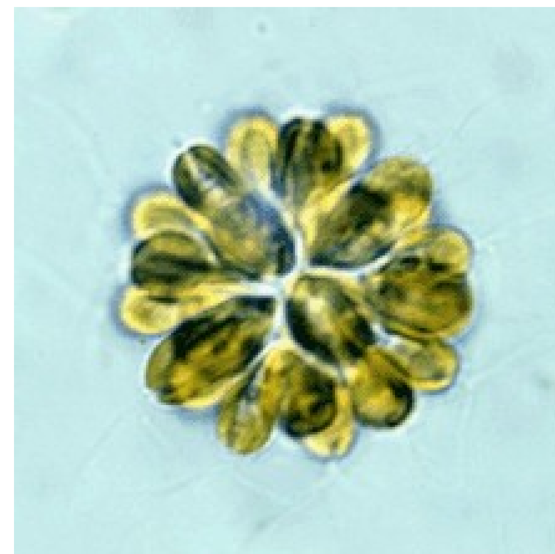




freshwater flagellates with silica scales; about 250 species







http://www.flickr.com/photos/joelmancuso/110623789/

bioindication of environmental dynamics; palaeoecological studies, "blooms" especially in boreal ecosystems

biogenesis of silicate scales

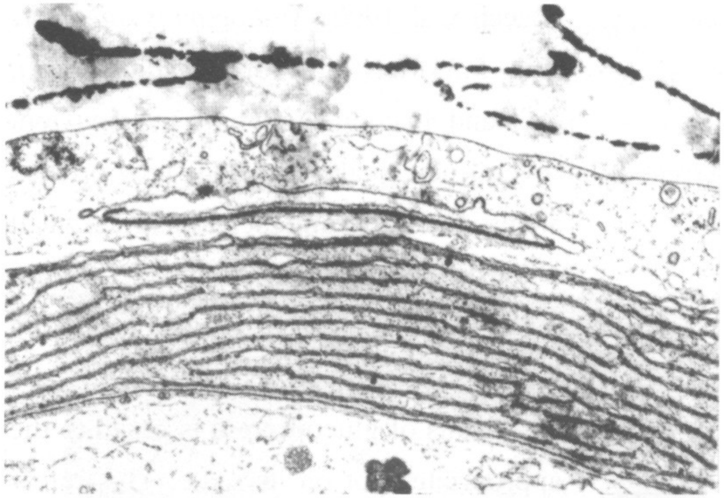


Fig. 5.32. Scale formation in M. caudata. (Wujek & Kristiansen 1978).

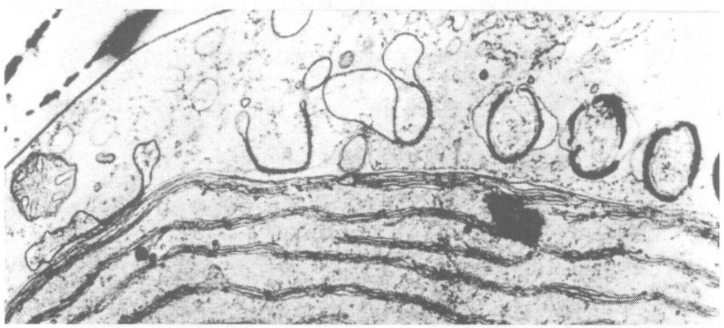
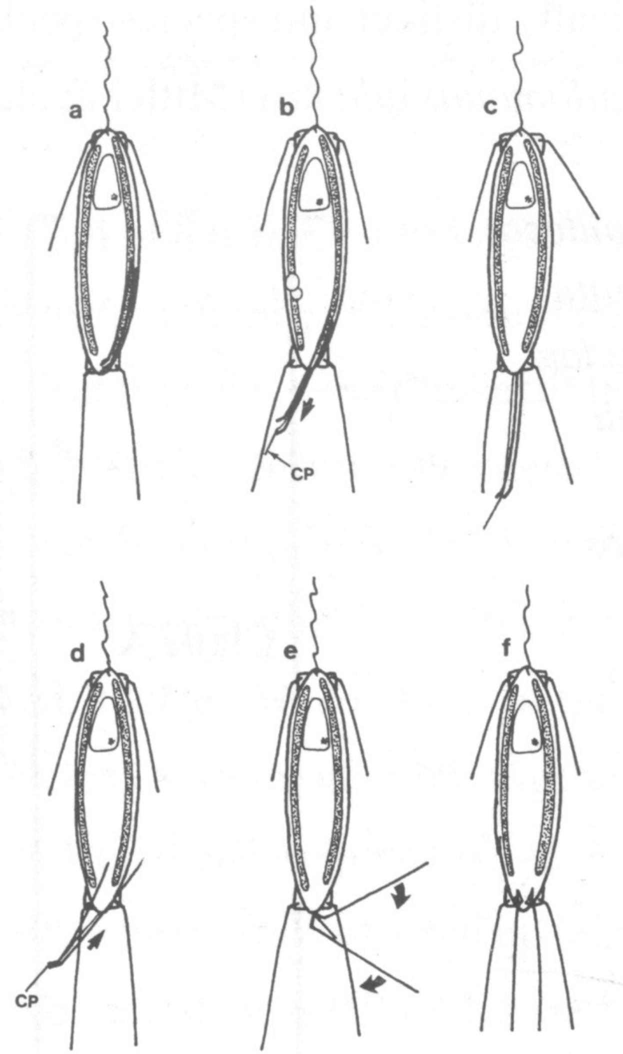
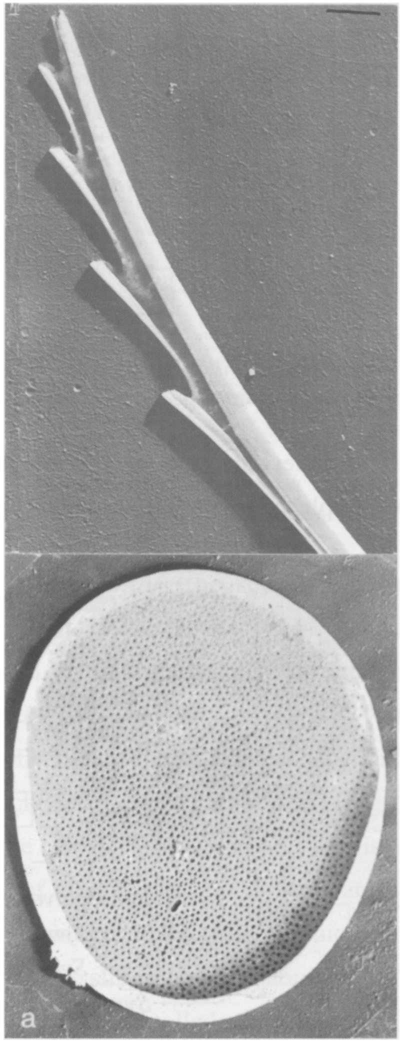


Fig. 5.33. Bristle formation in M. caudata, transverse sections of successive stages. (Wujek & Kristiansen 1978).

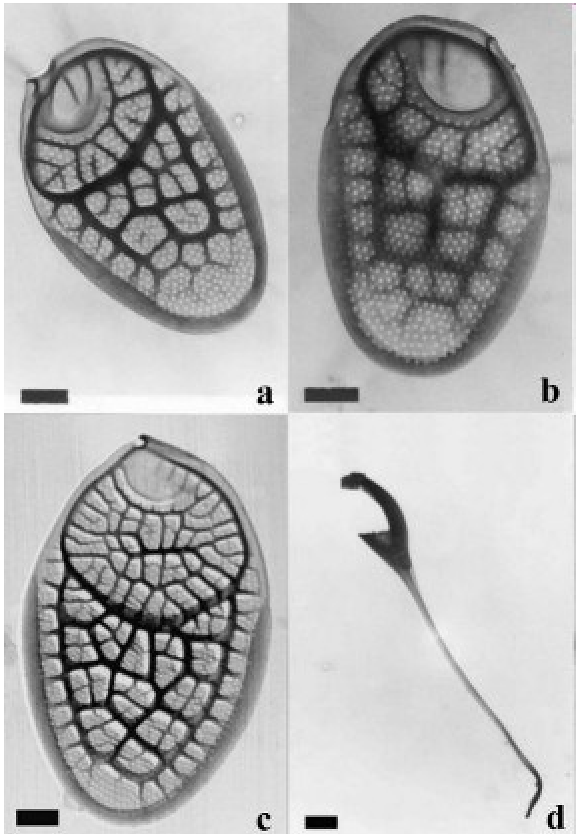
silica deposition vesicles

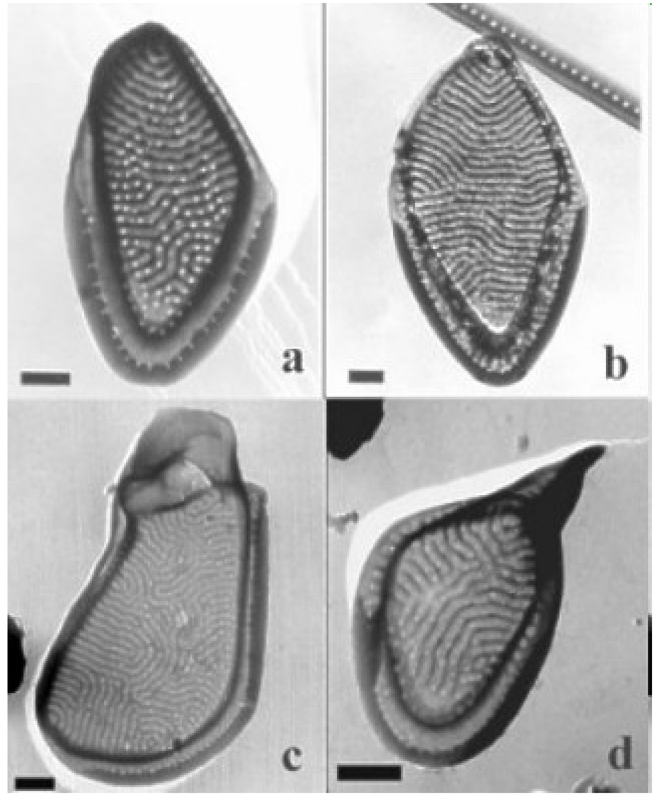


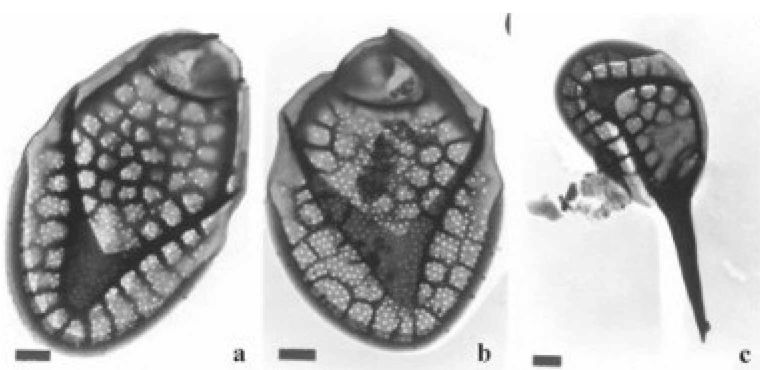
development of posterior bristles in *Mallomonas splendens*

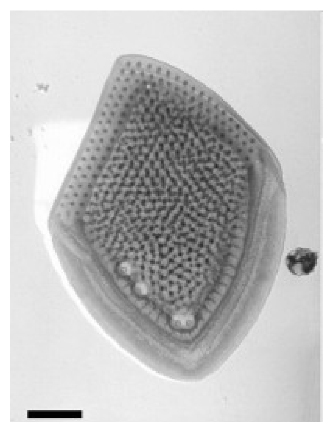


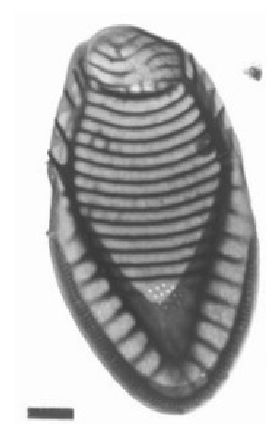
Mallomonas





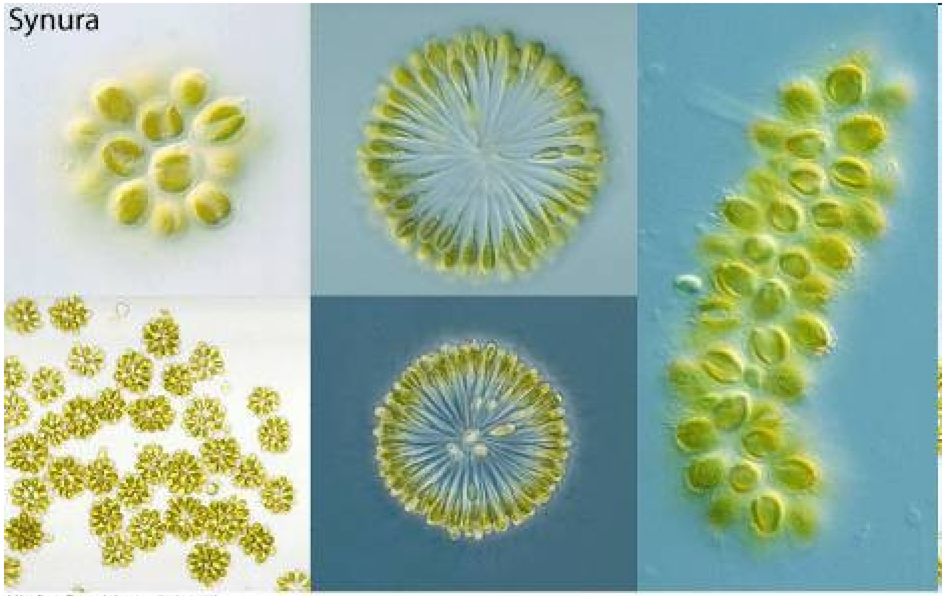




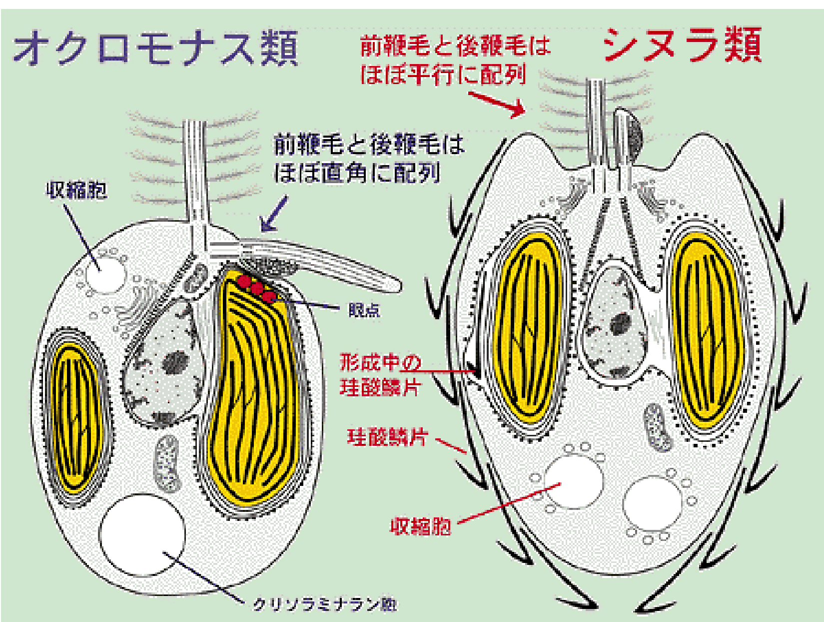


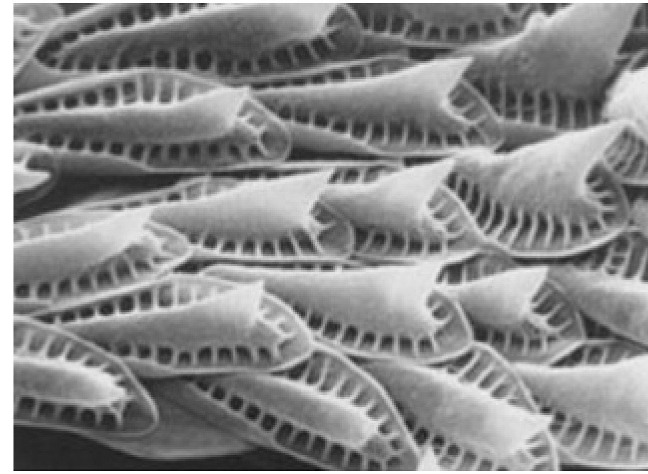
Synura

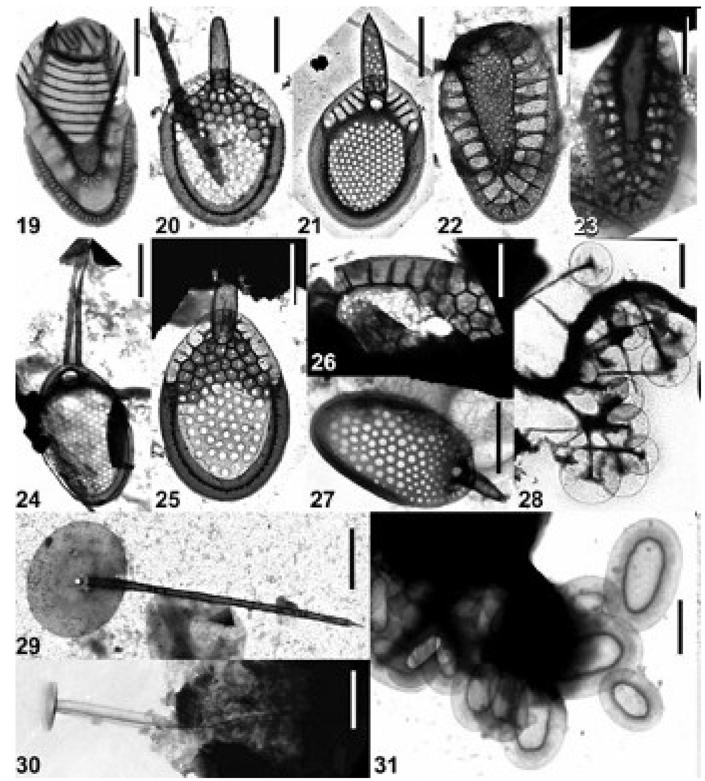
colonial relatives of mallomonads



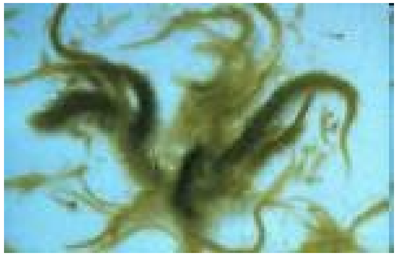
All after Entwisle et al. (1997)

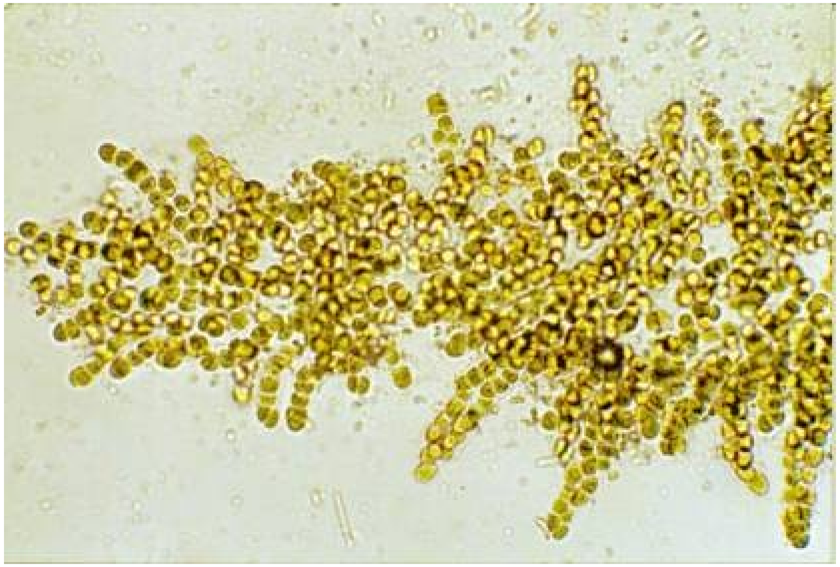






Hydrurus (foetidus)

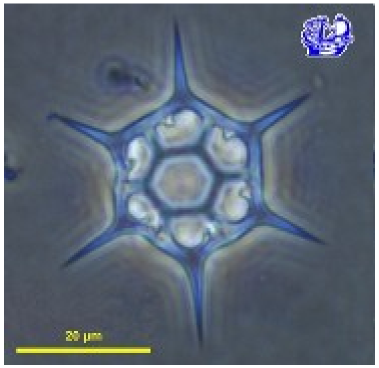




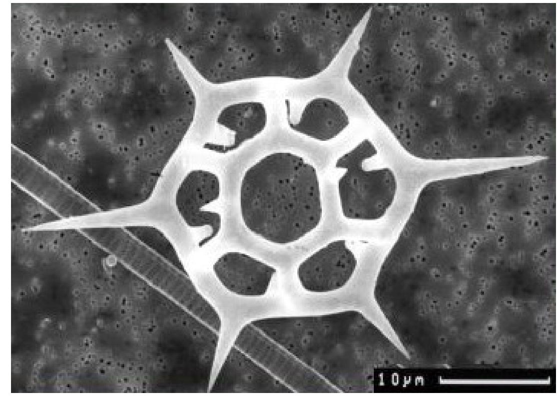
mucilaginous thallus adapted to living in fast flowing water

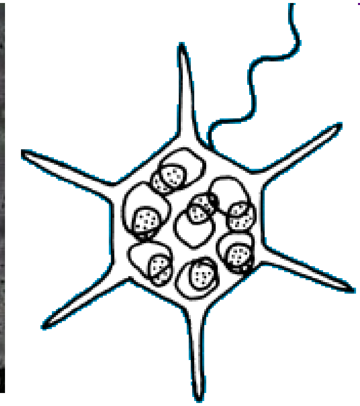
Dictyochophyceae

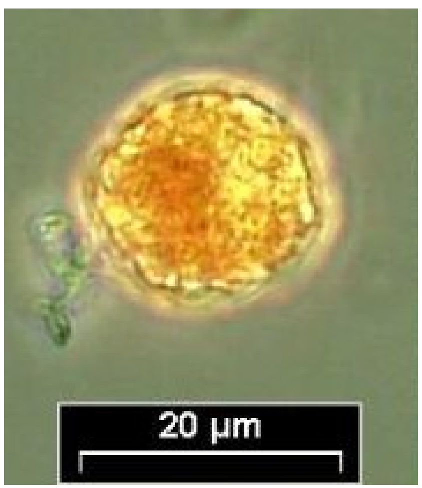
small but ecologically important group of phototrophic marine flagellates

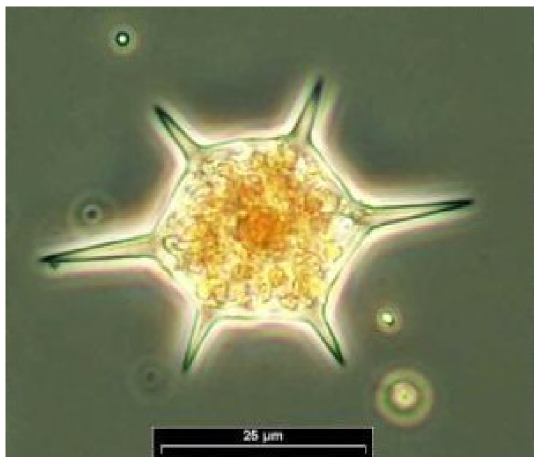


silico-flagellates
Dictyocha
cold oceans, phytoplankton









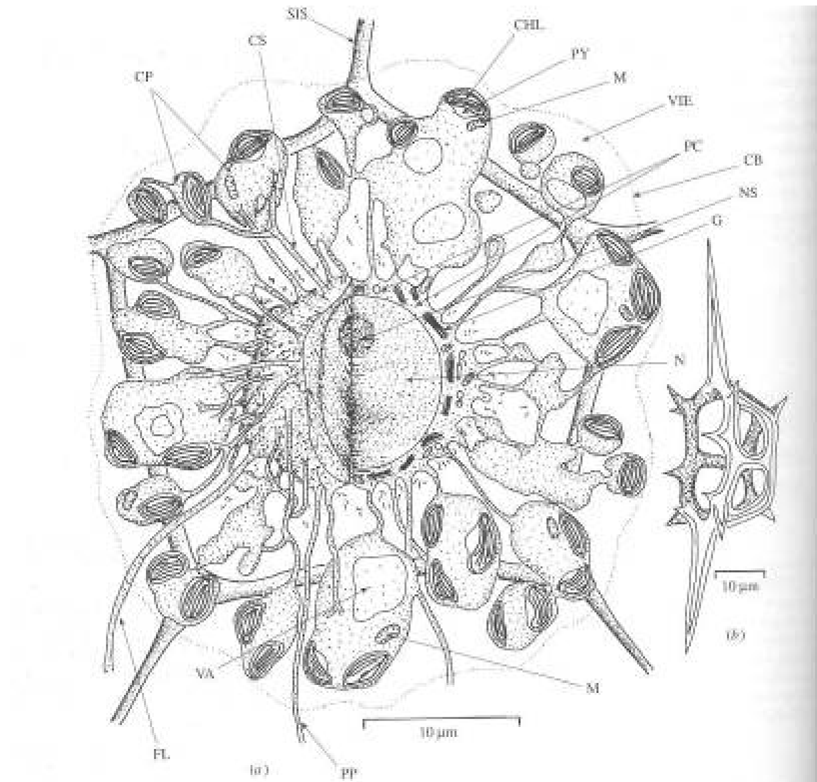
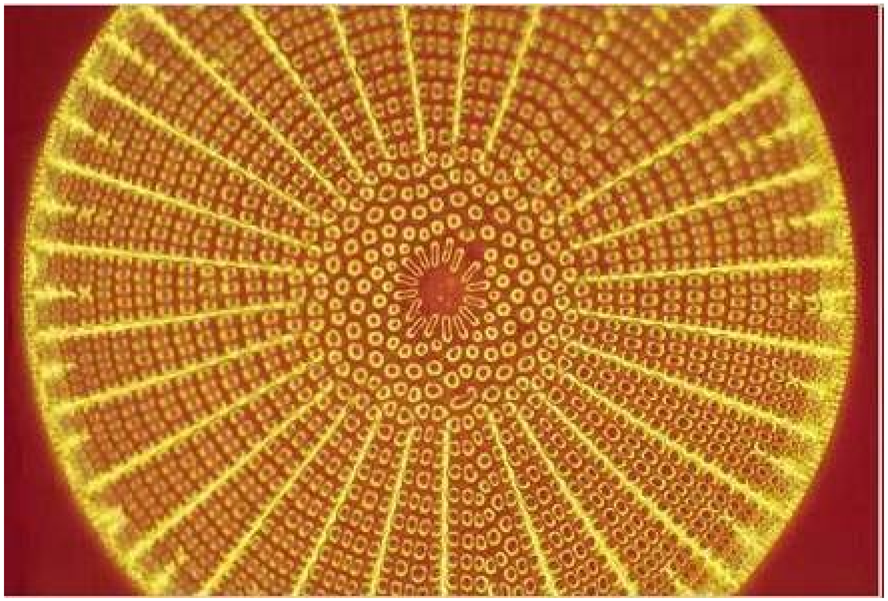
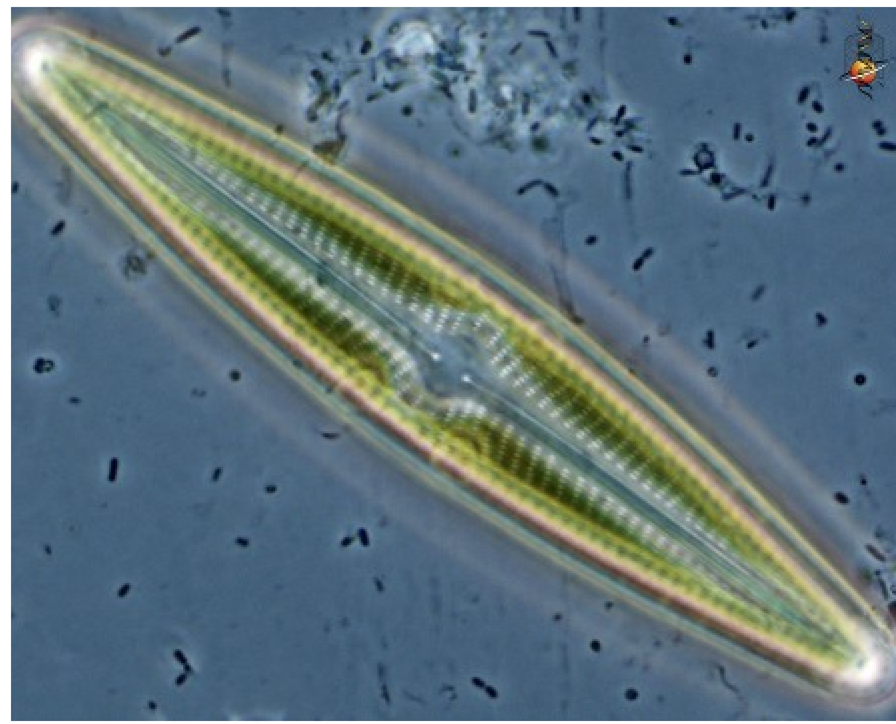


Figure 11.1. *Dictyocha.* (*a*) The radially organized living cell. (*b*) Siliceous skeleton. CB = boundary of cell envelope; CHL = chloroplast; CP = cytoplasmic process; CS = connecting strand; FL = flagellum; G = golgi body; M = mitochondrion; N = nucleus; NS = nucleolus; PC = perinuclear cytoplasm (= peri- karyon); PP = pseudopodium; PY = pyrenoid; SI siliceous skeleton; VA = vacuole; VIE = the ex sive viscous envelope around the cell, withou ous structure. (*a* based on [1812, 1813]; *b* on [300])

since Mesozoic - 120 mya; bioindication of cold periods in the geologial past

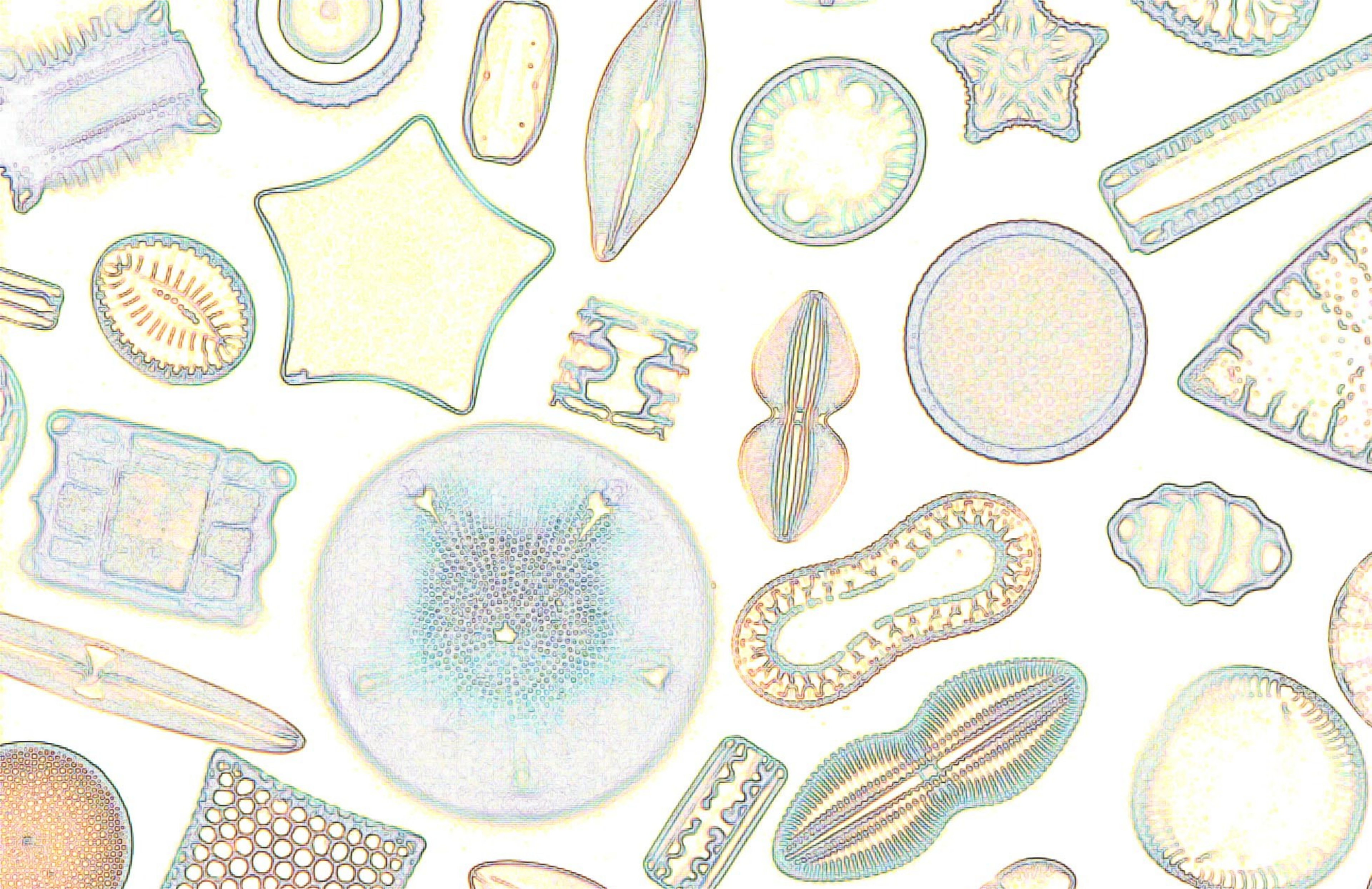
Diatoms – Bacillariophyceae (rozsivky)



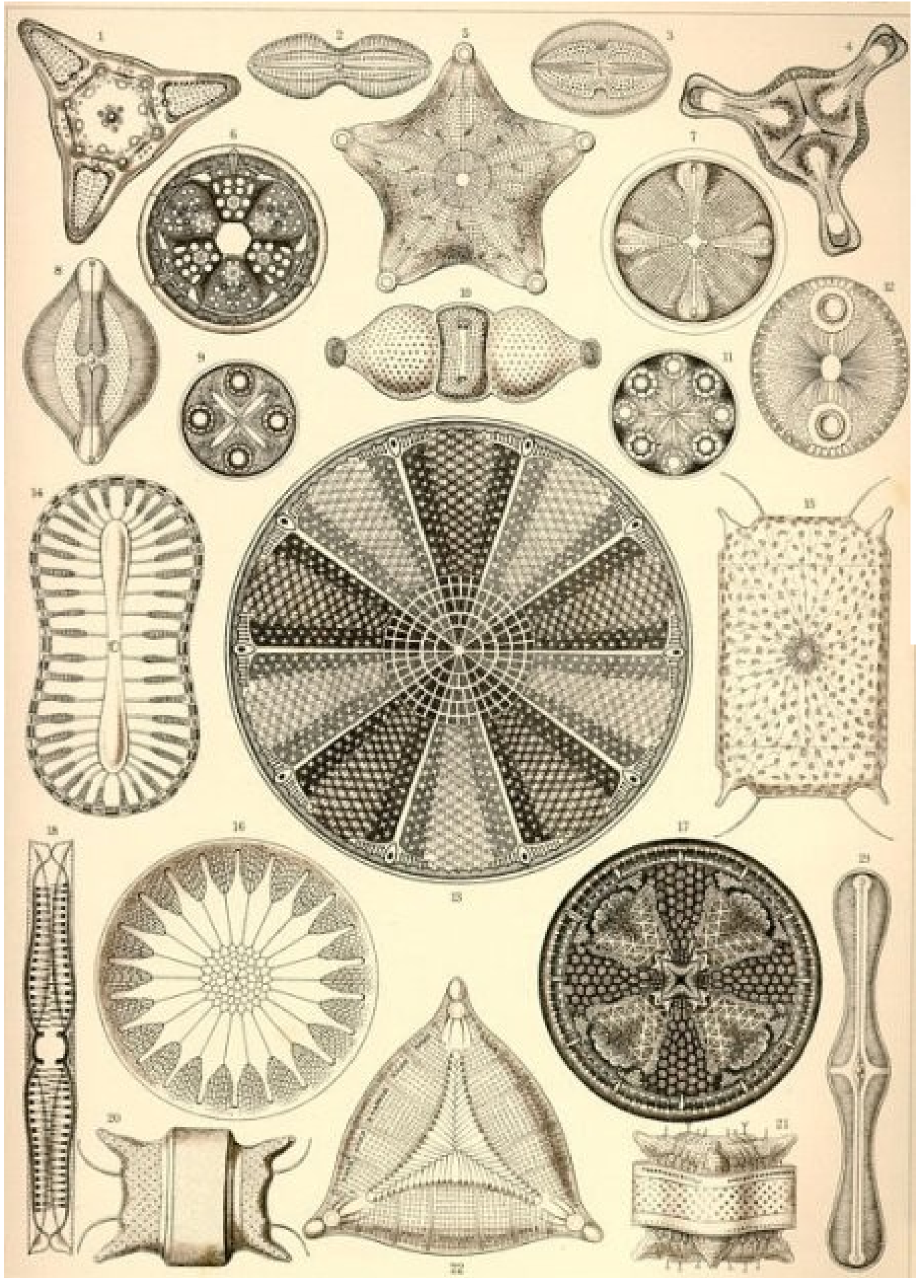


centric and pennate morphological types

silicate shell (frustule) made of two parts



Frazer, 2010, Diatoms or The Trouble With Life in Glass Houses



E. Haeckel: Kunstformen der Natur

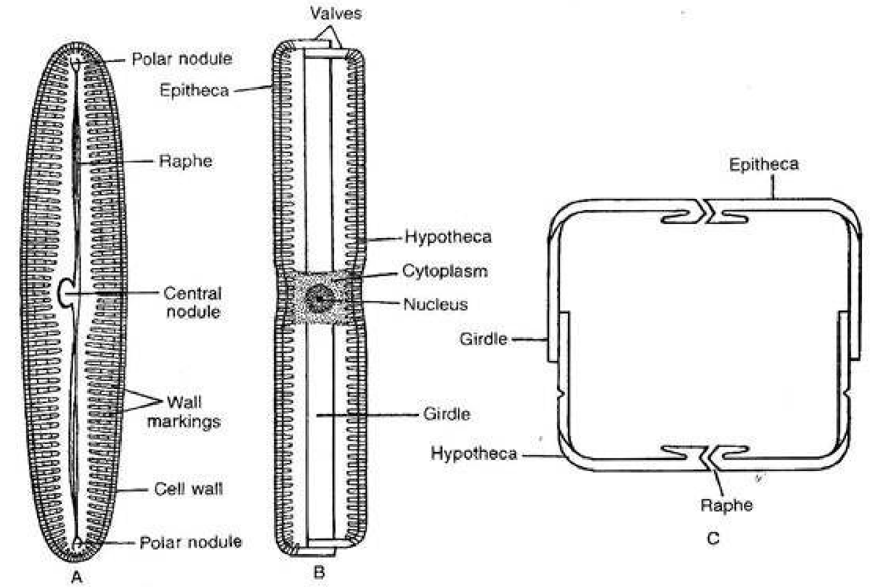
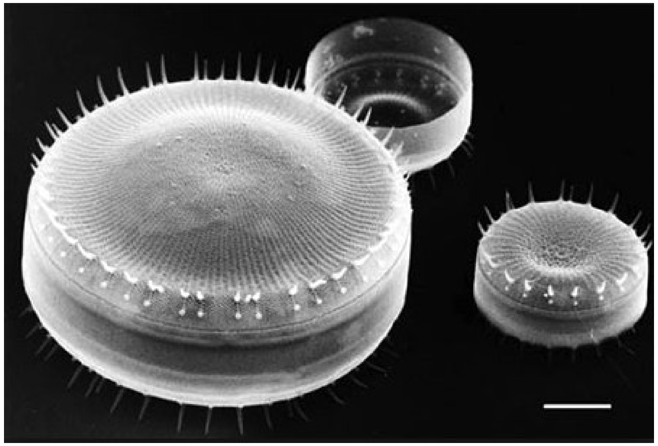
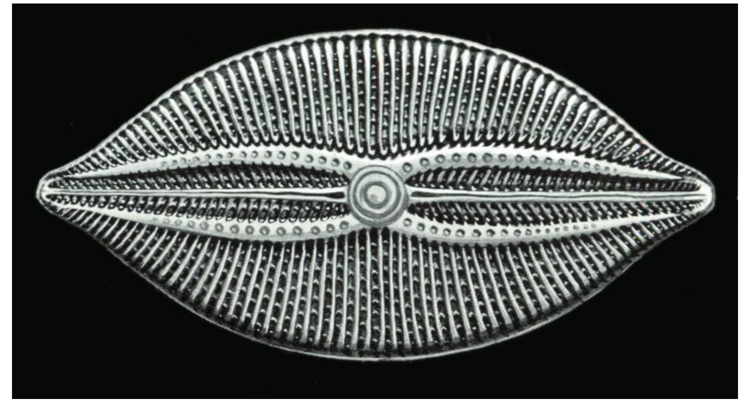
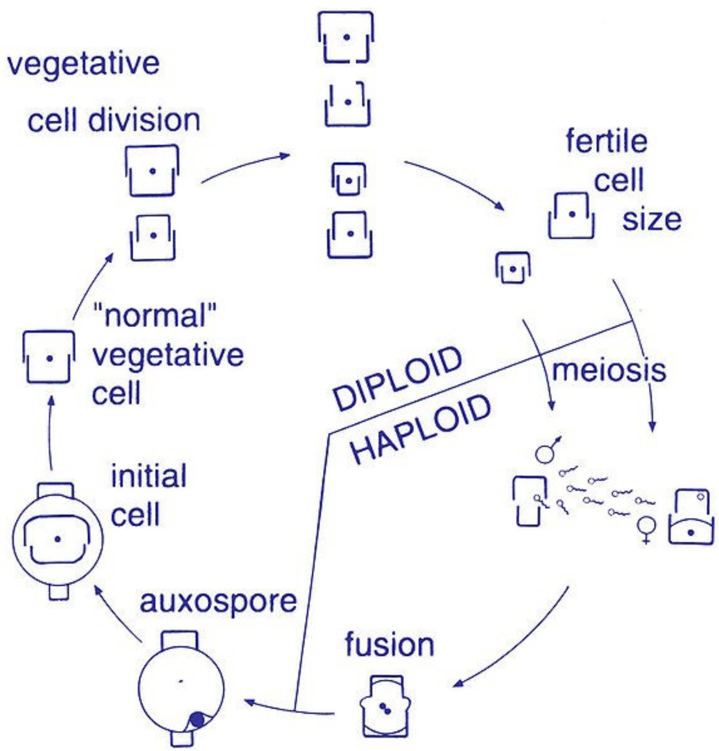


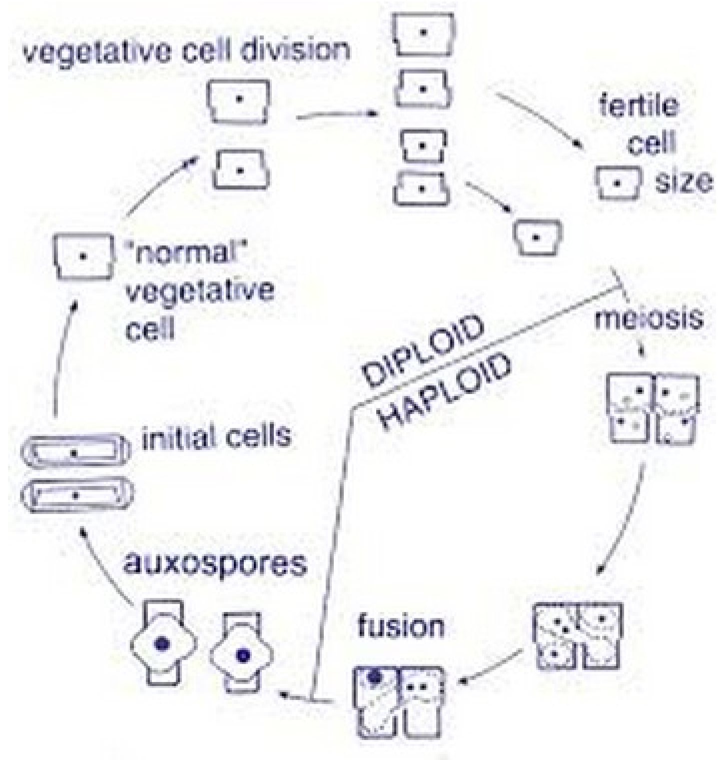
Fig. 3.101 : Cell structure of *Pinnularia viridis* (Pennales) : A. Frustule in valve view, B. Frustule in girdle view, and C. Frustule in transverse section

two basic types of sexual reproduction in diatoms

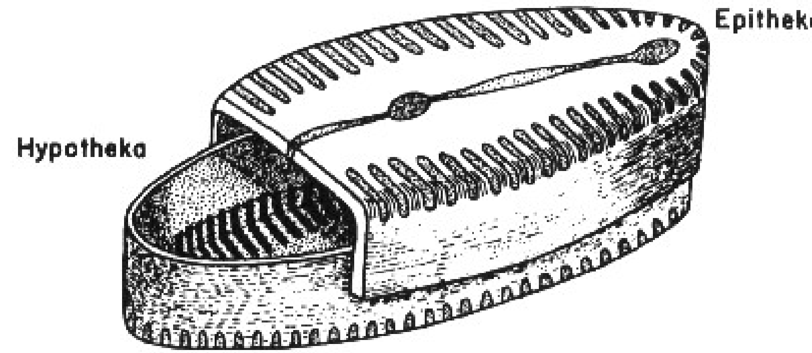


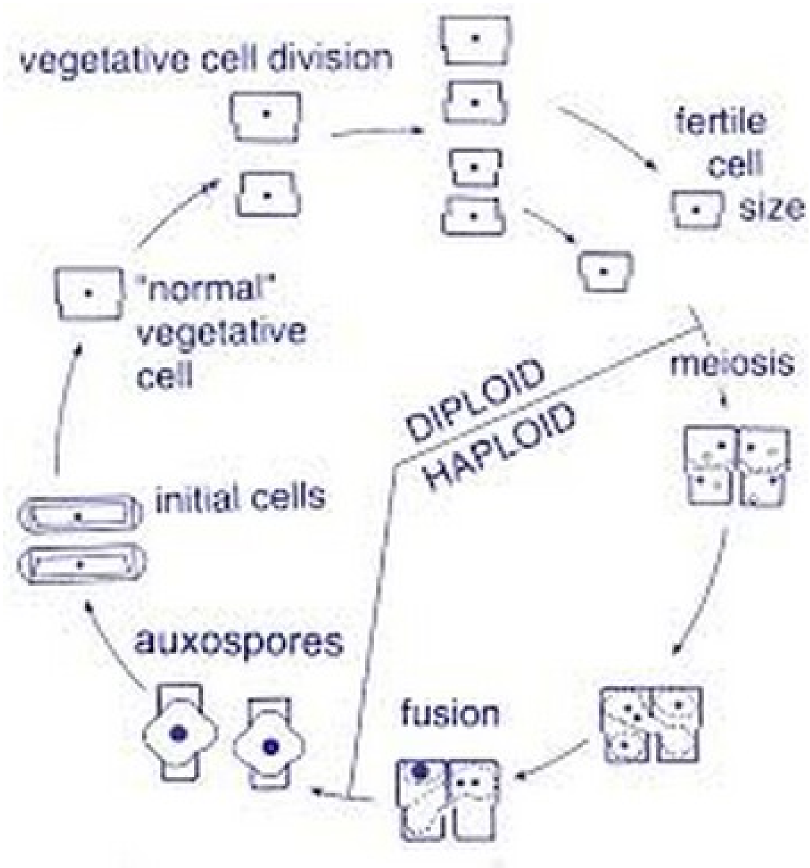


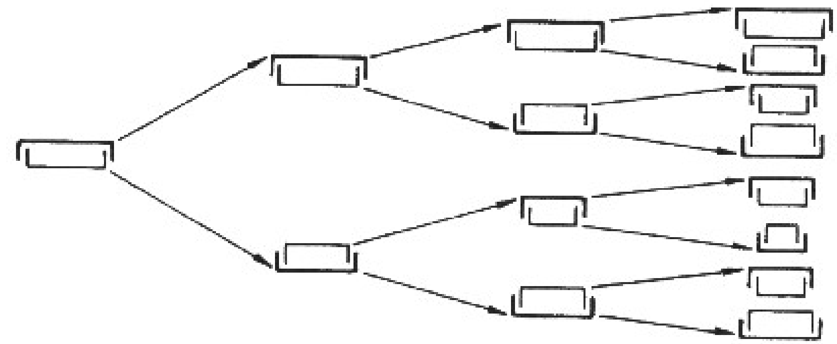


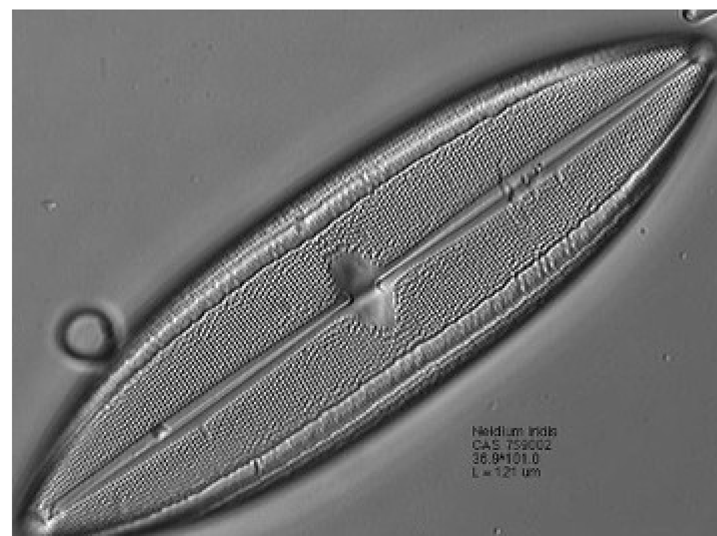


life cycle, frustule structure

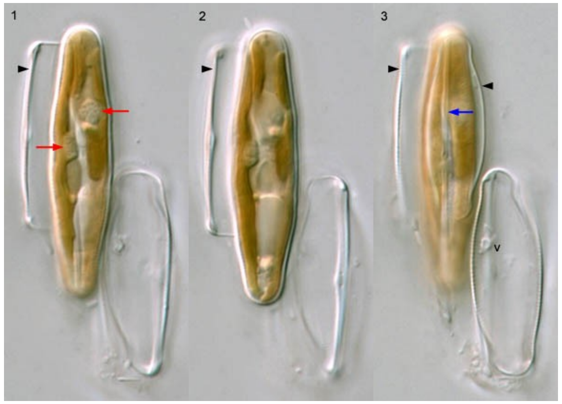


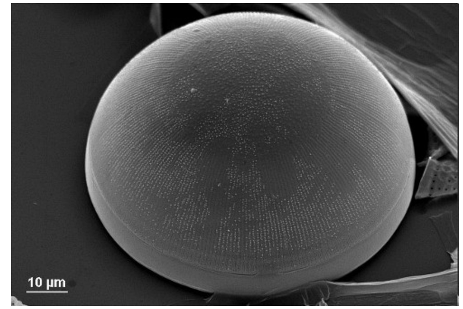






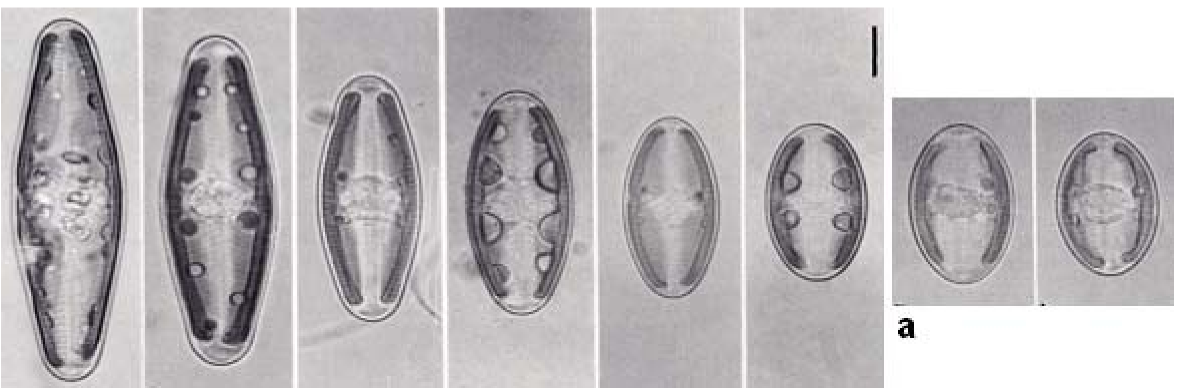
zygote, auxospore, initial cell





rbg-web2.rbge.org.uk/algae/sellaphora

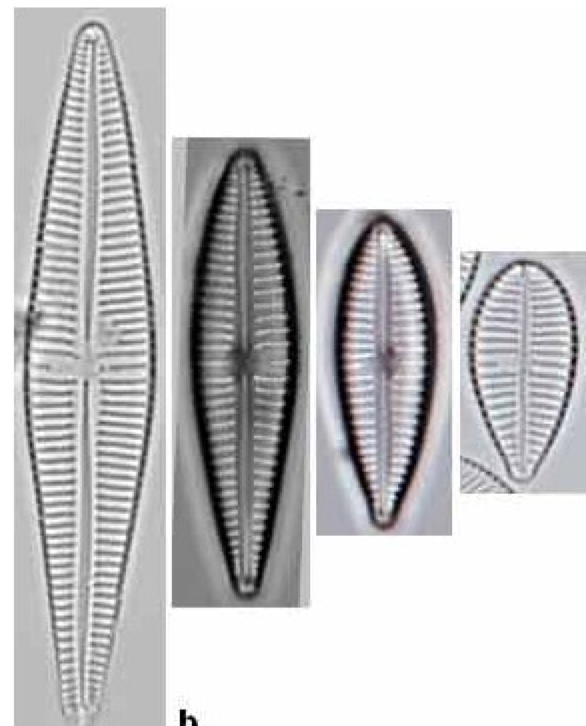
vegetative size diminution cycle (cell shape allometry)



Navicula

http://craticula.ncl.ac.uk/

Gomphonema



diatom phylogeny

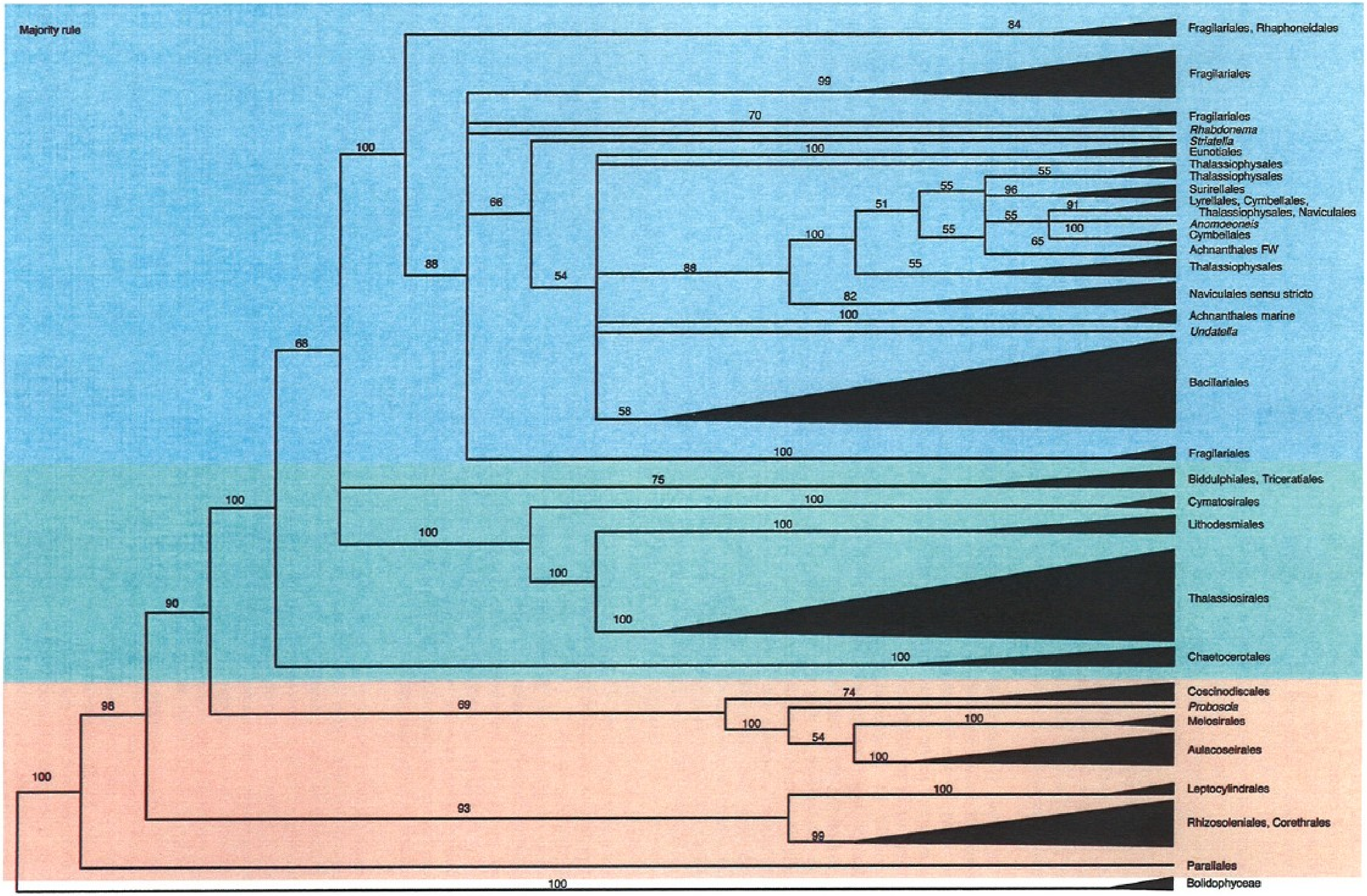
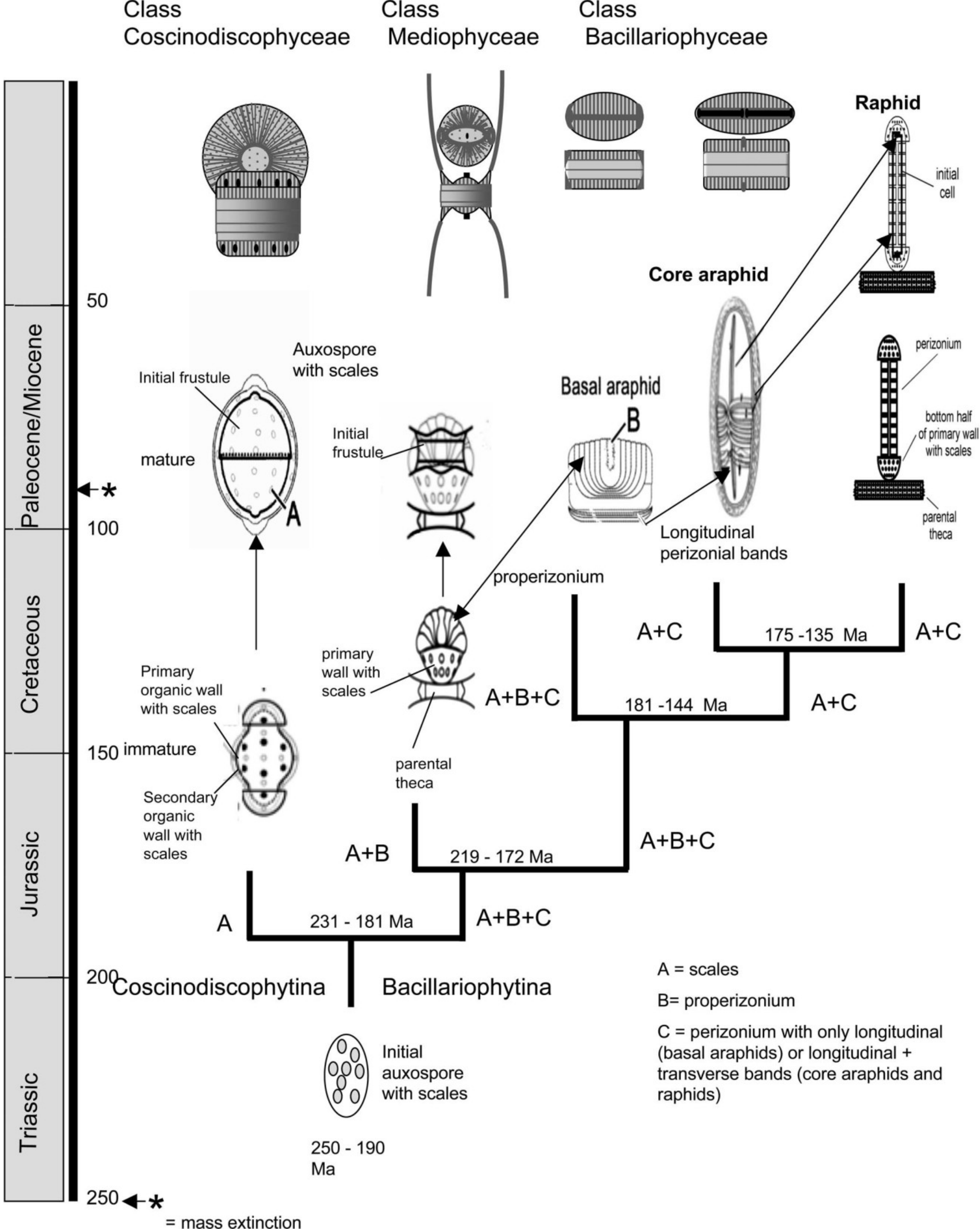


Fig. 2. Phylogeny inferred with the Bayesian analysis. Major clades are collapsed into triangles for clarity. PP > 50% are placed at each node. Pink, clade 1; green, clade 2a; blue, clade 2b.

Medlin & Kaczmarska, 2004, Phycologia



Current taxonomic structure of diatoms ("Bacillariophyta")

Bacillariophytina

Bacillariophyceae (13673)

Mediophyceae (1645)

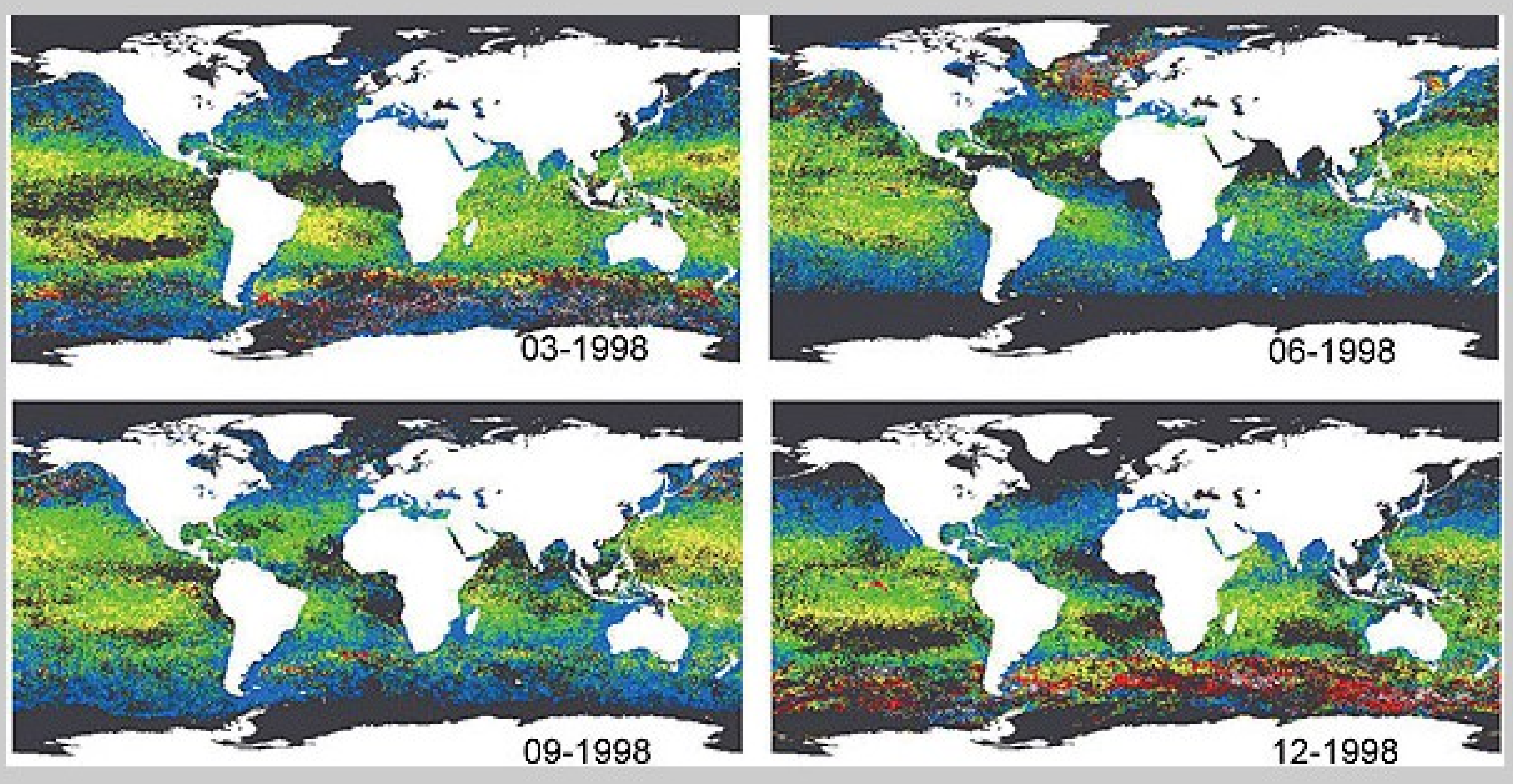
Coscinodiscophytina

Coscinodiscophyceae (1321)

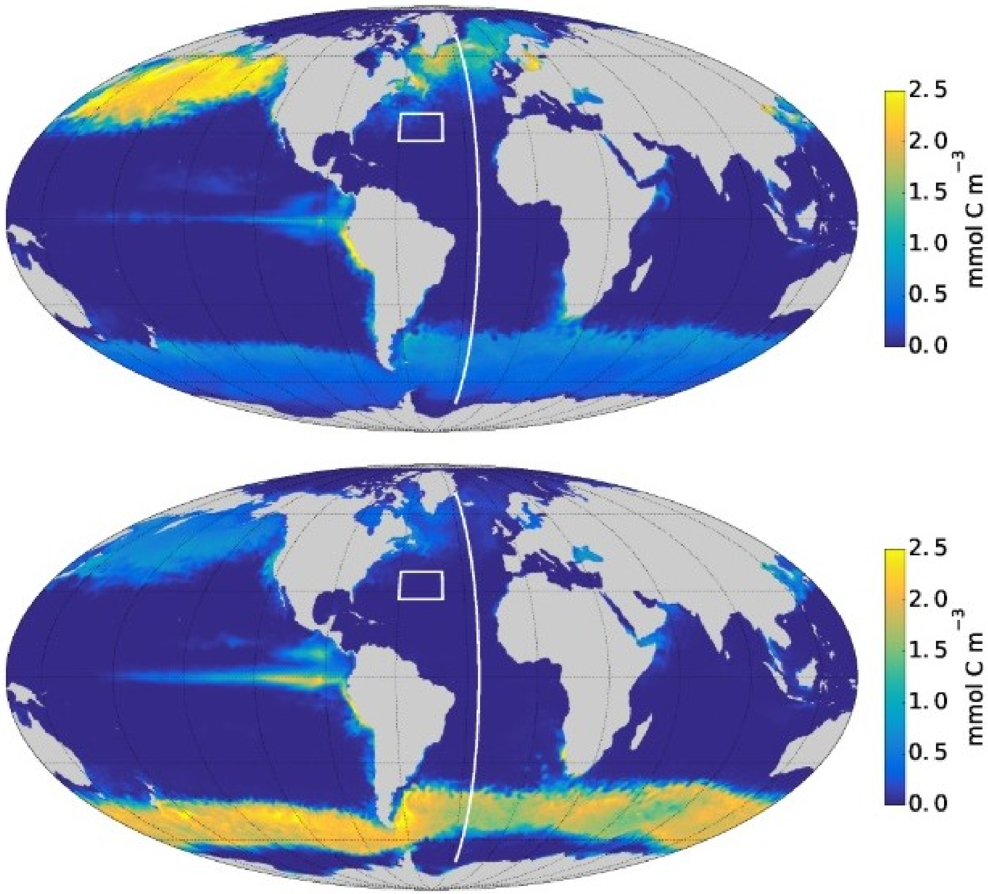
Medlin, 2016, Phycologia
algaebase.org

oceanický fytoplankton – „základní obrázek“

Figure 3 - Variations saisonnières des peuplements de phytoplancton (en bleu : haptophytes; en vert : Prochlorococcus; en jaune : Synechococcus; en rouge : diatomées). Les diatomées abondent au printemps aux hautes latitudes, où les haptophytes dominent le reste de l'année. Prochlorococcus et Synechococcus dominent en permanence dans les régions tropicales.



global diatom productivity

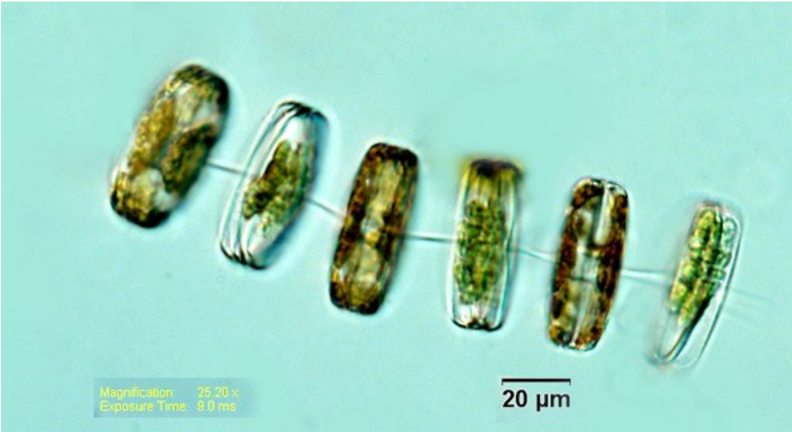


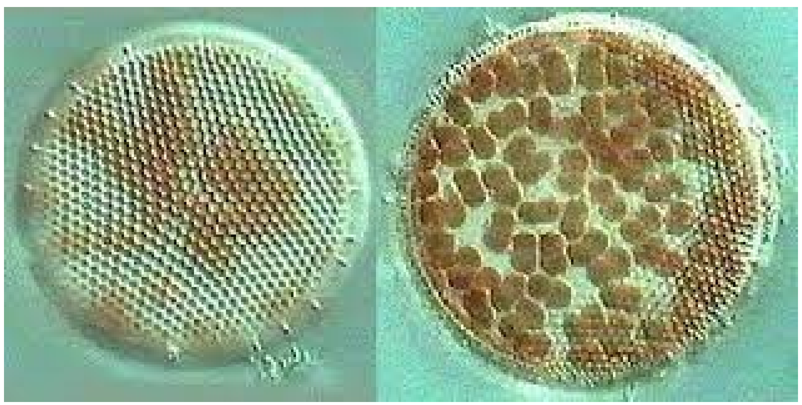
Diatom abundance in the world oceans (moles of carbon per cubic meter) during boreal spring (left) and autumn (right) as simulated by the DARWIN MIT model (Tréguer et al. 2017), 18 km resolution (ECCO2 physical model) © MIT

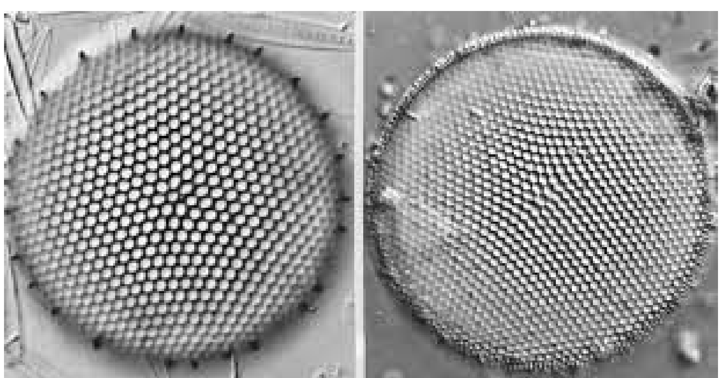
diatoms contribute around 20% of global primary productivity diatoms of marine phytoplankton

wikipedia

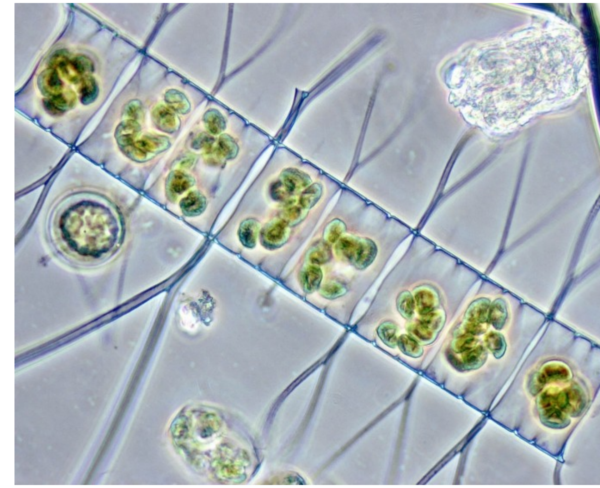
Thalassiosira

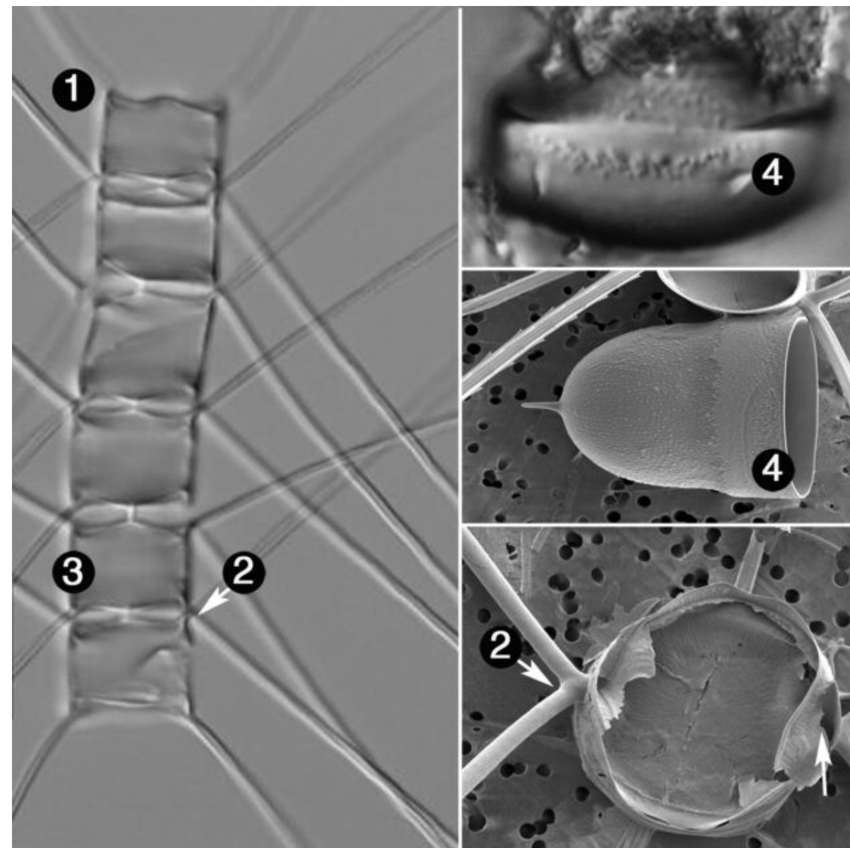






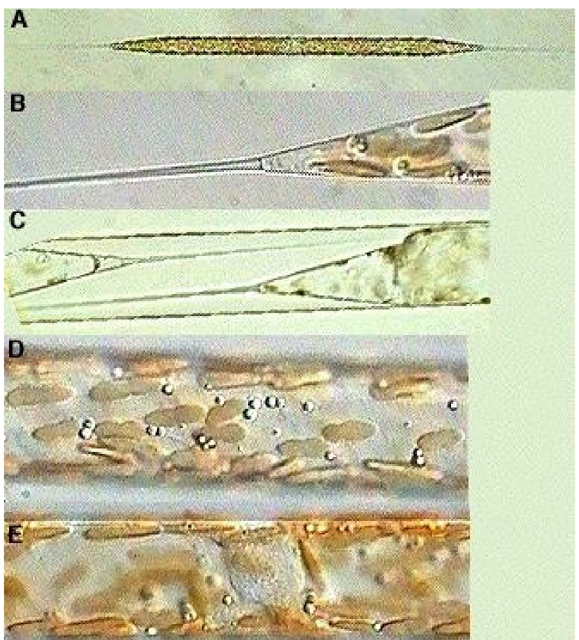
Chaetoceros

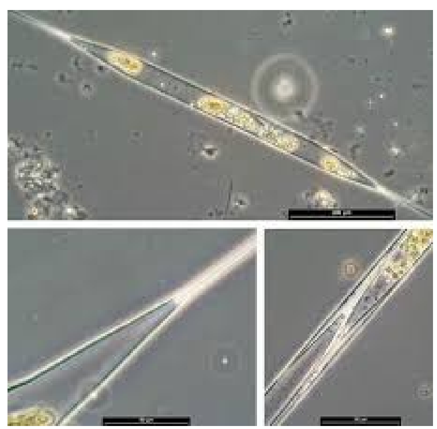




diatoms.org

Rhizosolenia



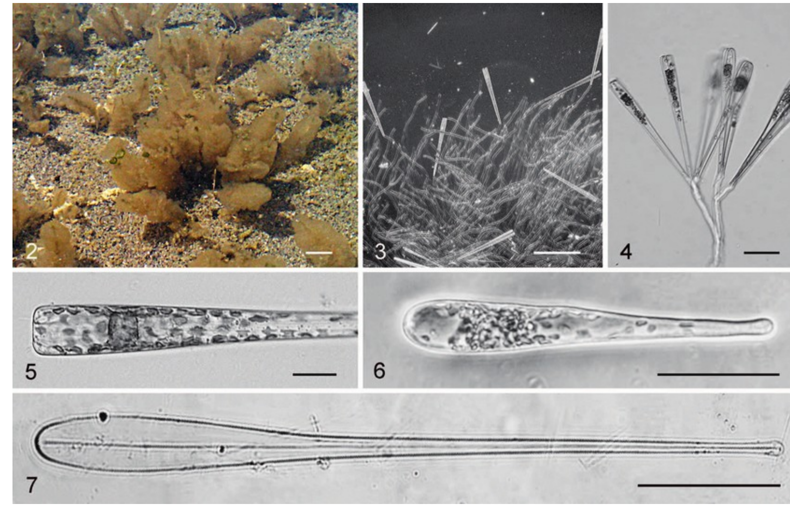


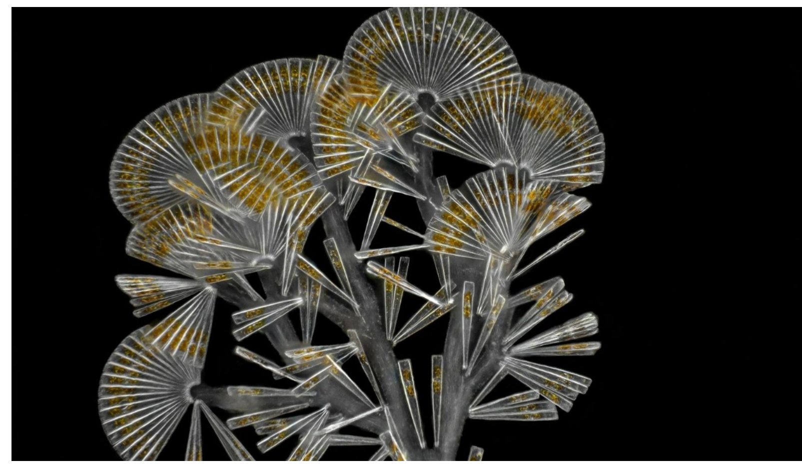
Proboscia

inaturalist.org

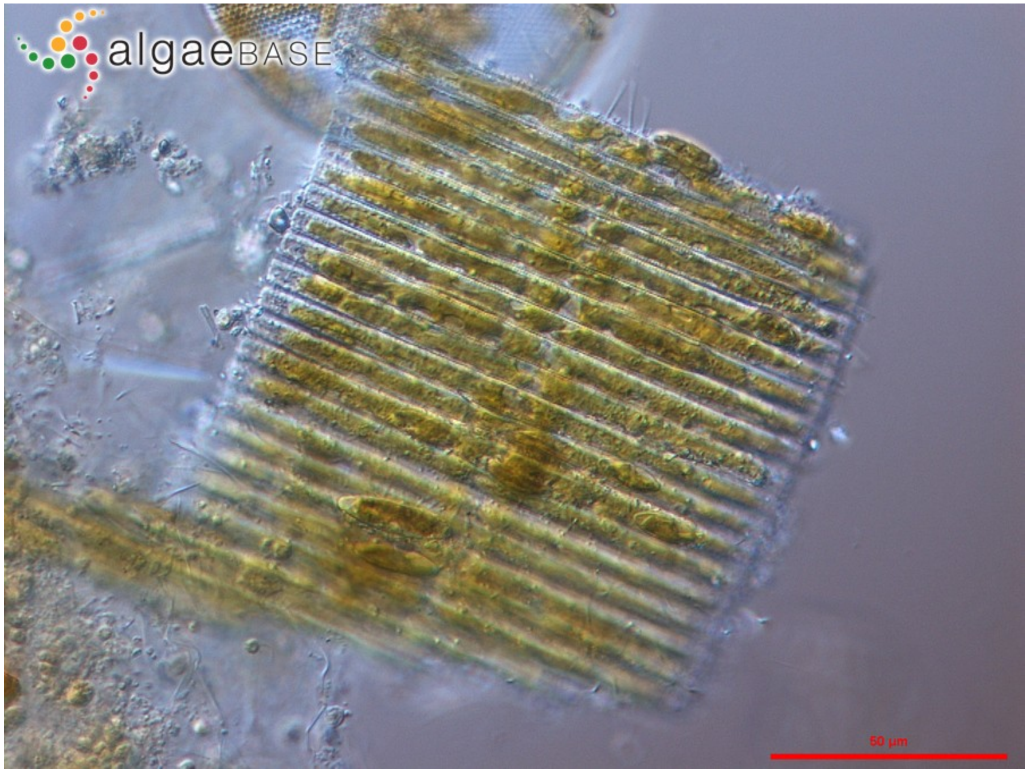
diatoms of marine phytobenthos

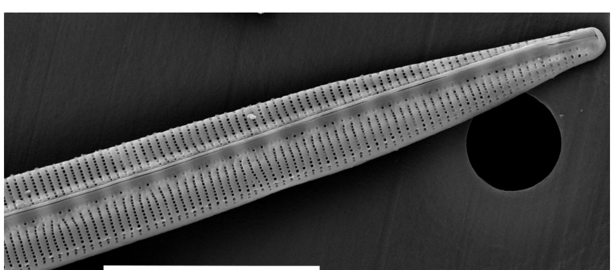
Licmophora





Bacillaria

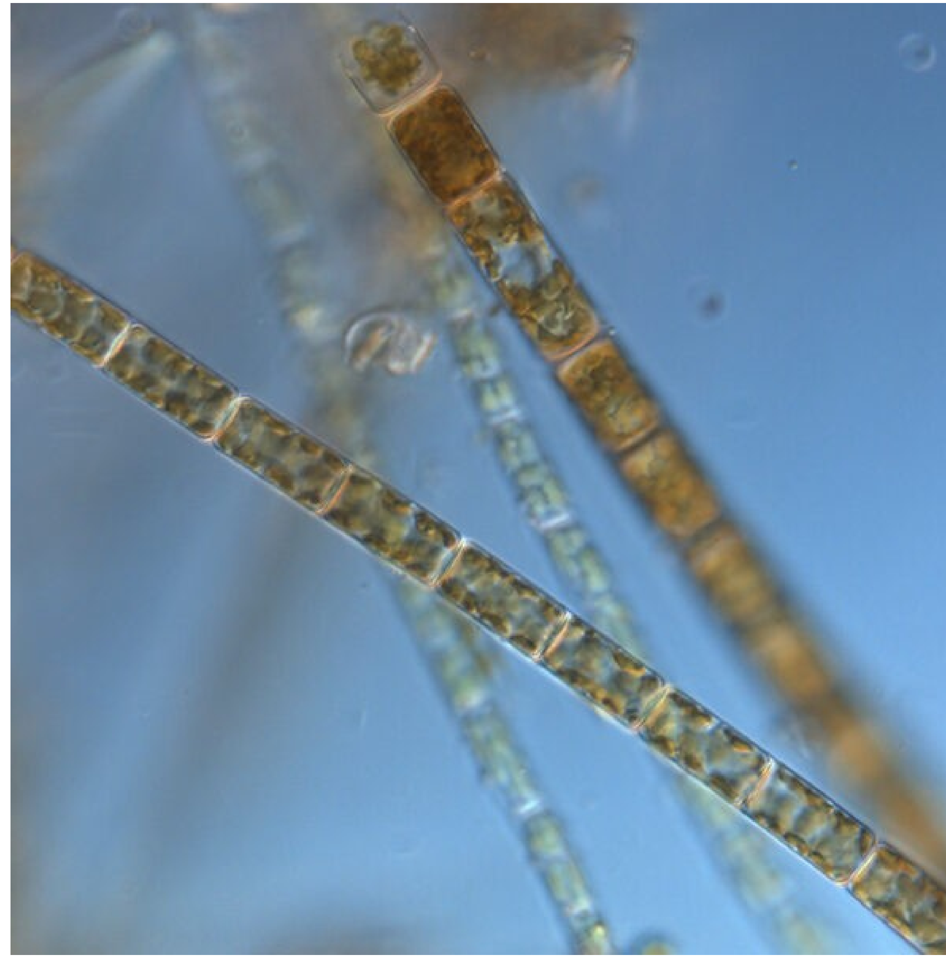


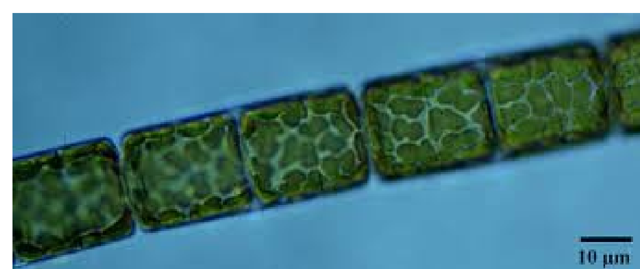


photos: National Geographic; Torrentes et al., 2016, Phycologia

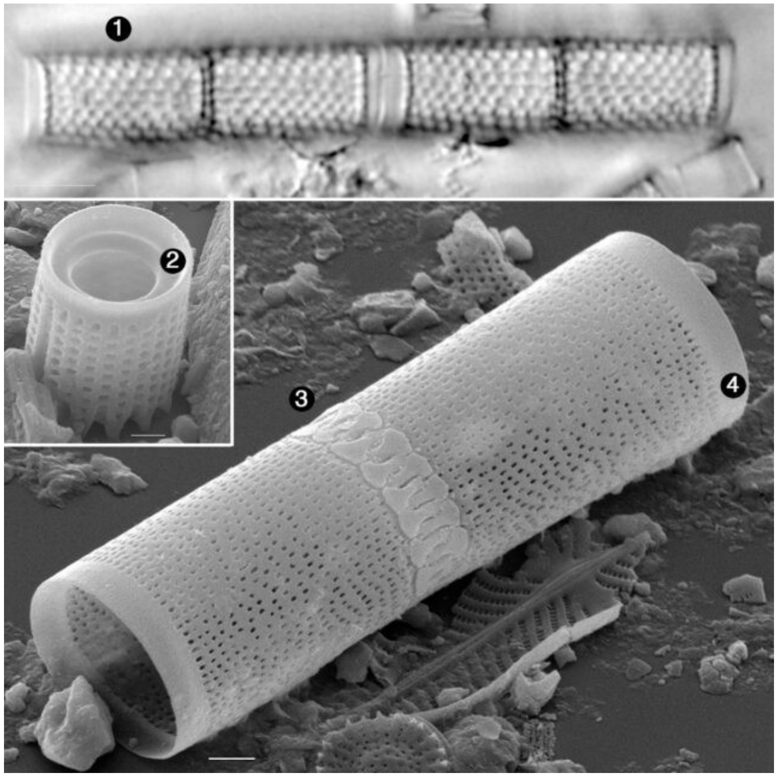
diatoms of freshwater phytoplankton

Melosira



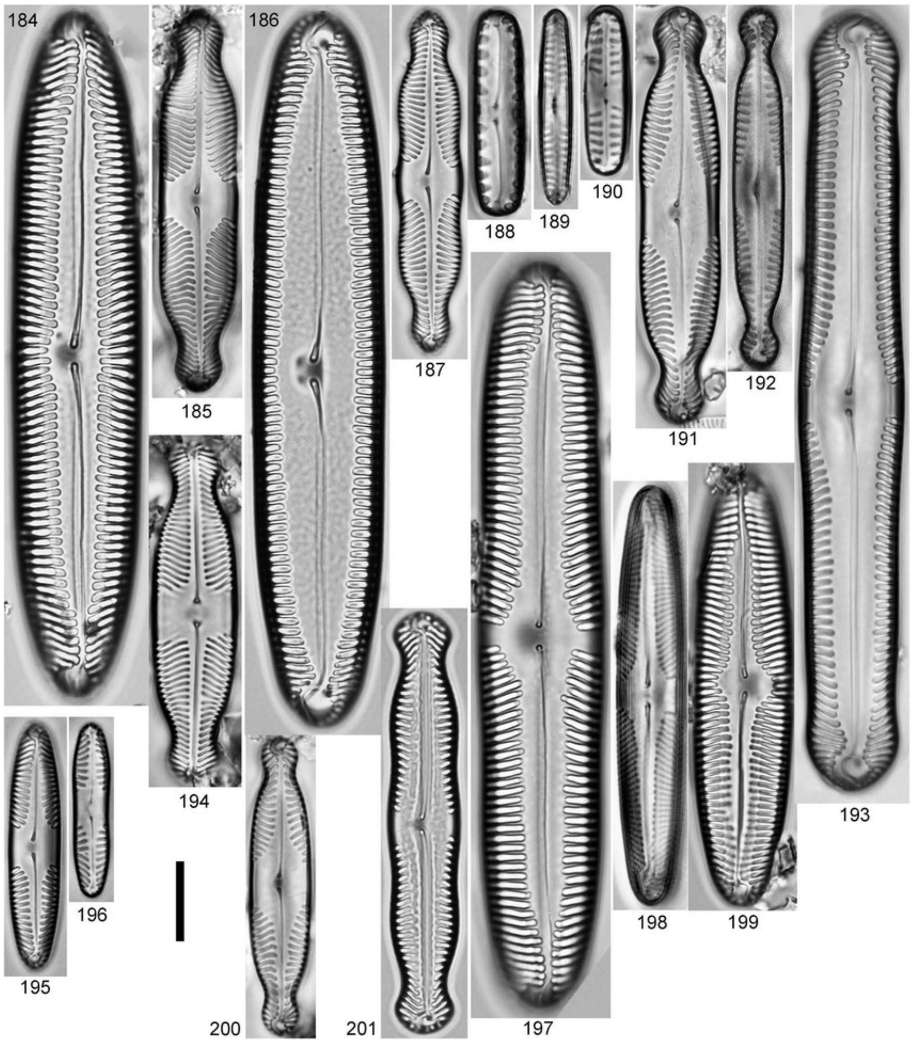


Aulacoseira

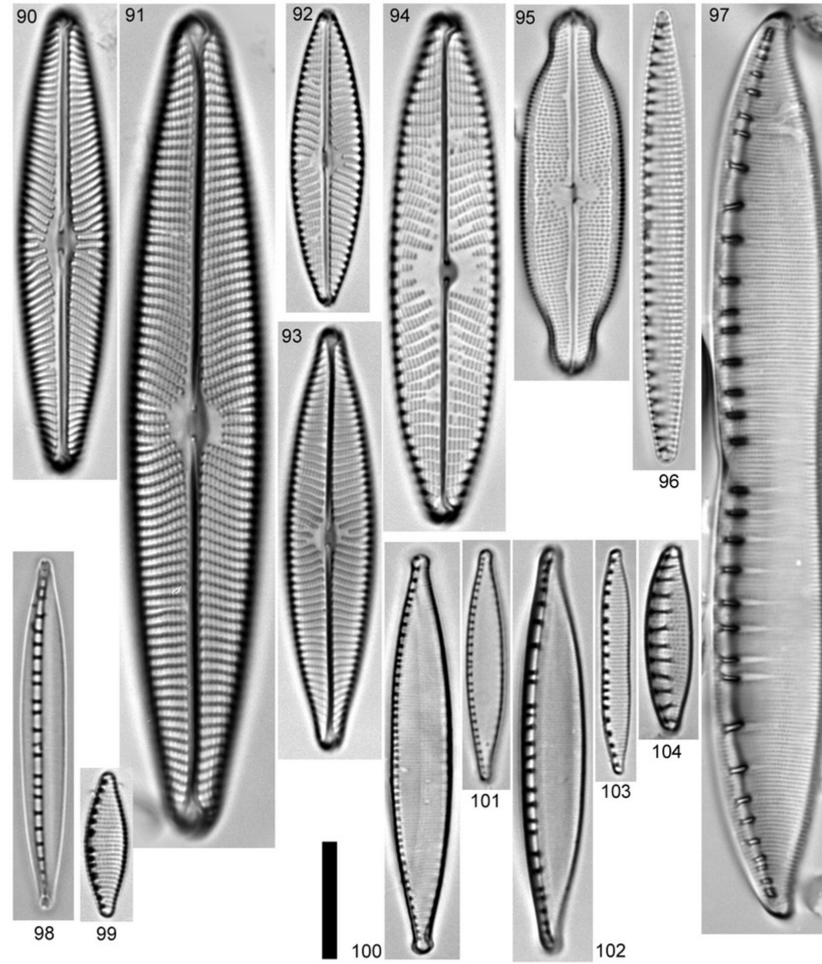


diatoms of freshwater phytobenthos

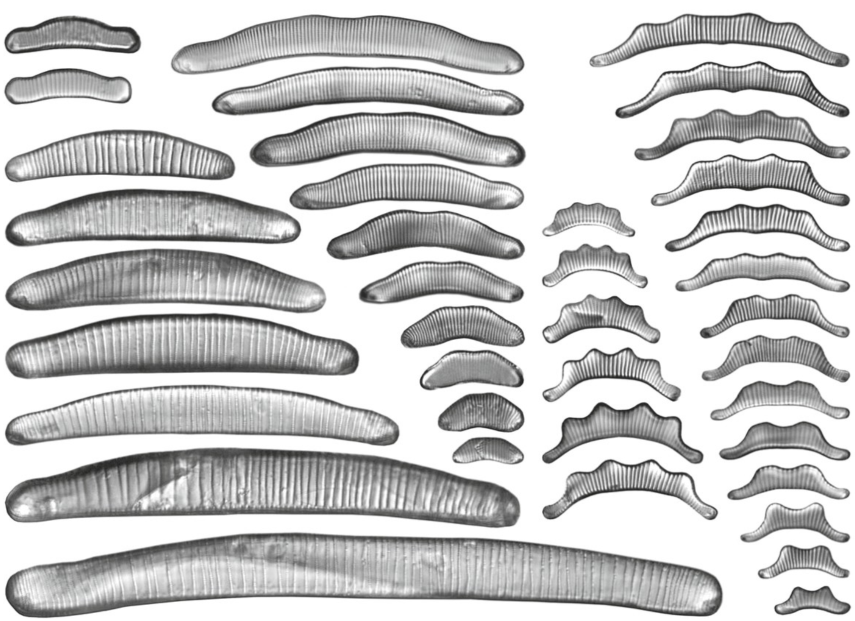
Pinnularia



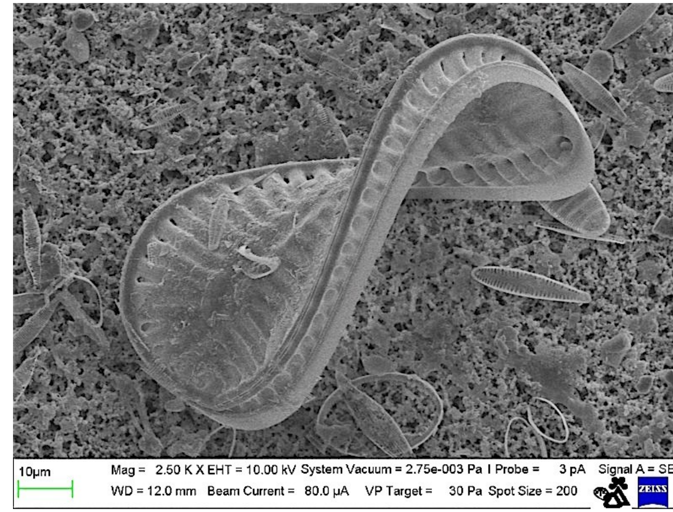
Navicula

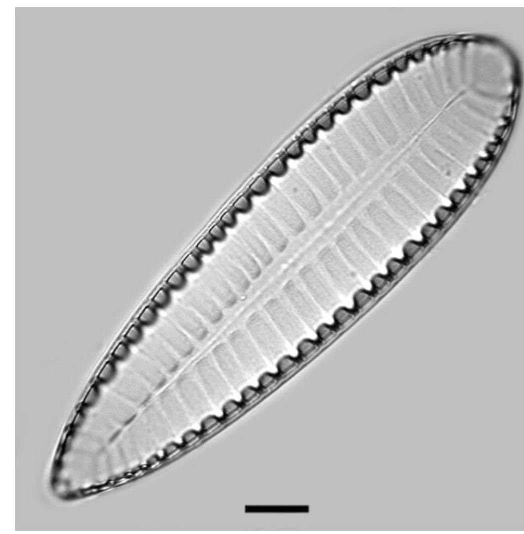


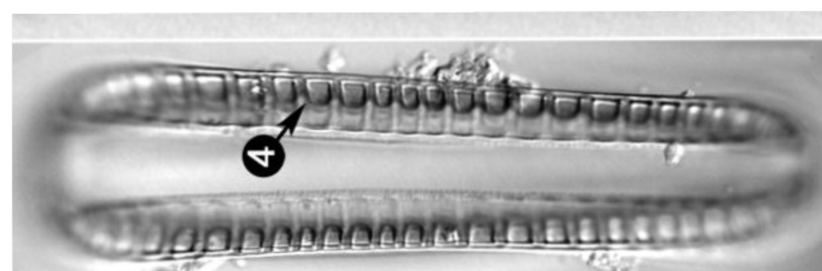
Eunotia



Surirella

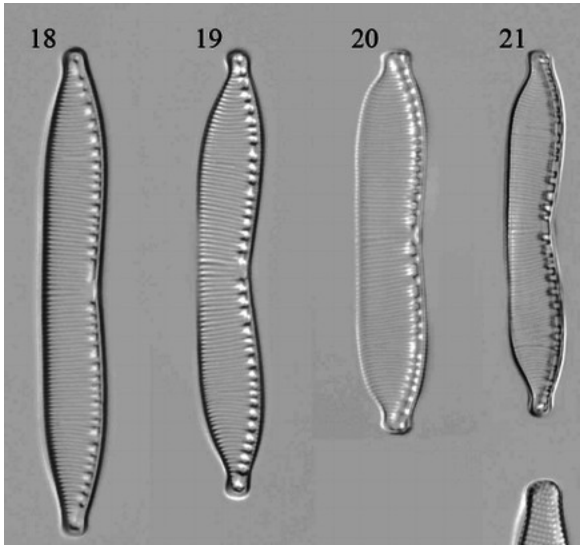


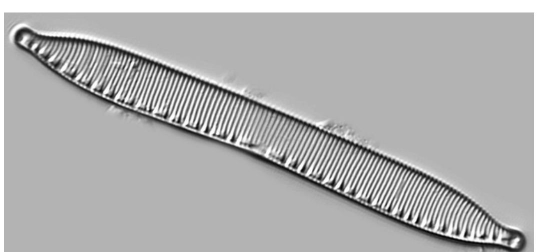




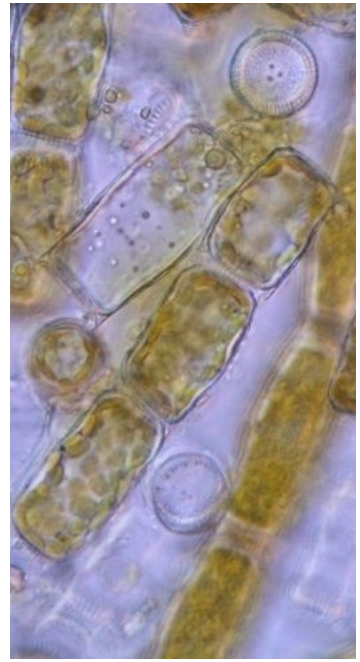
diatoms of subaerial habitats

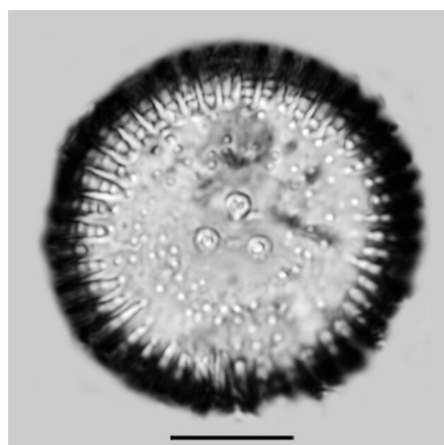
Hantzschia

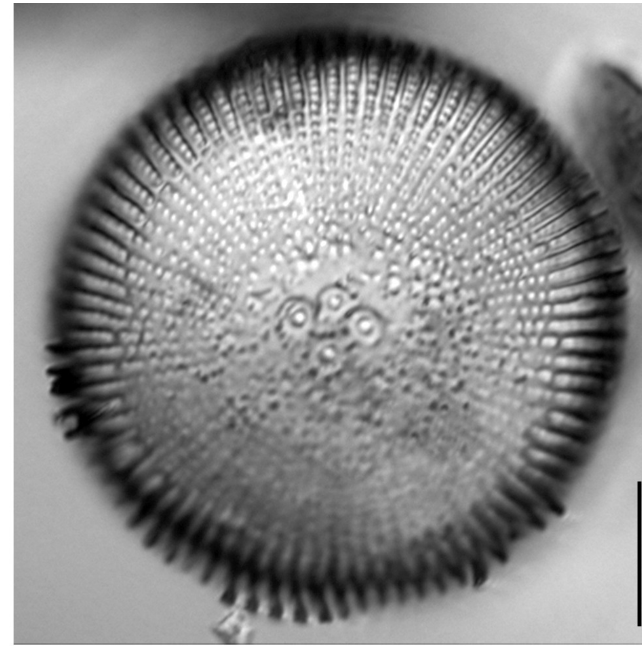


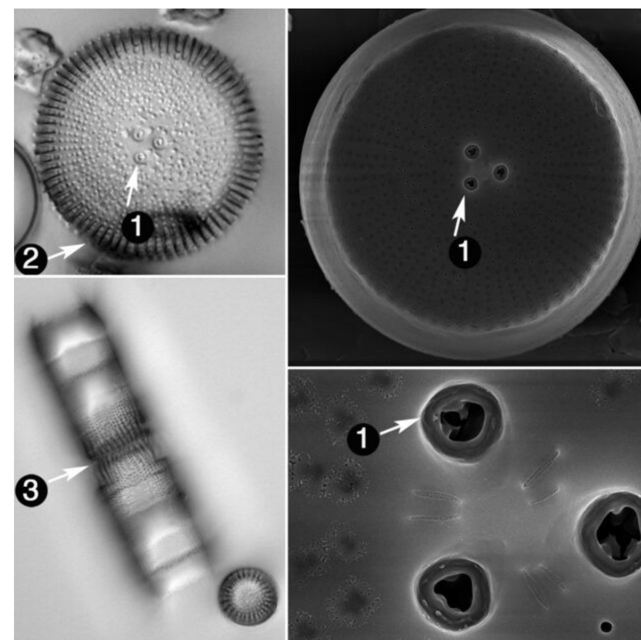


Orthoseira

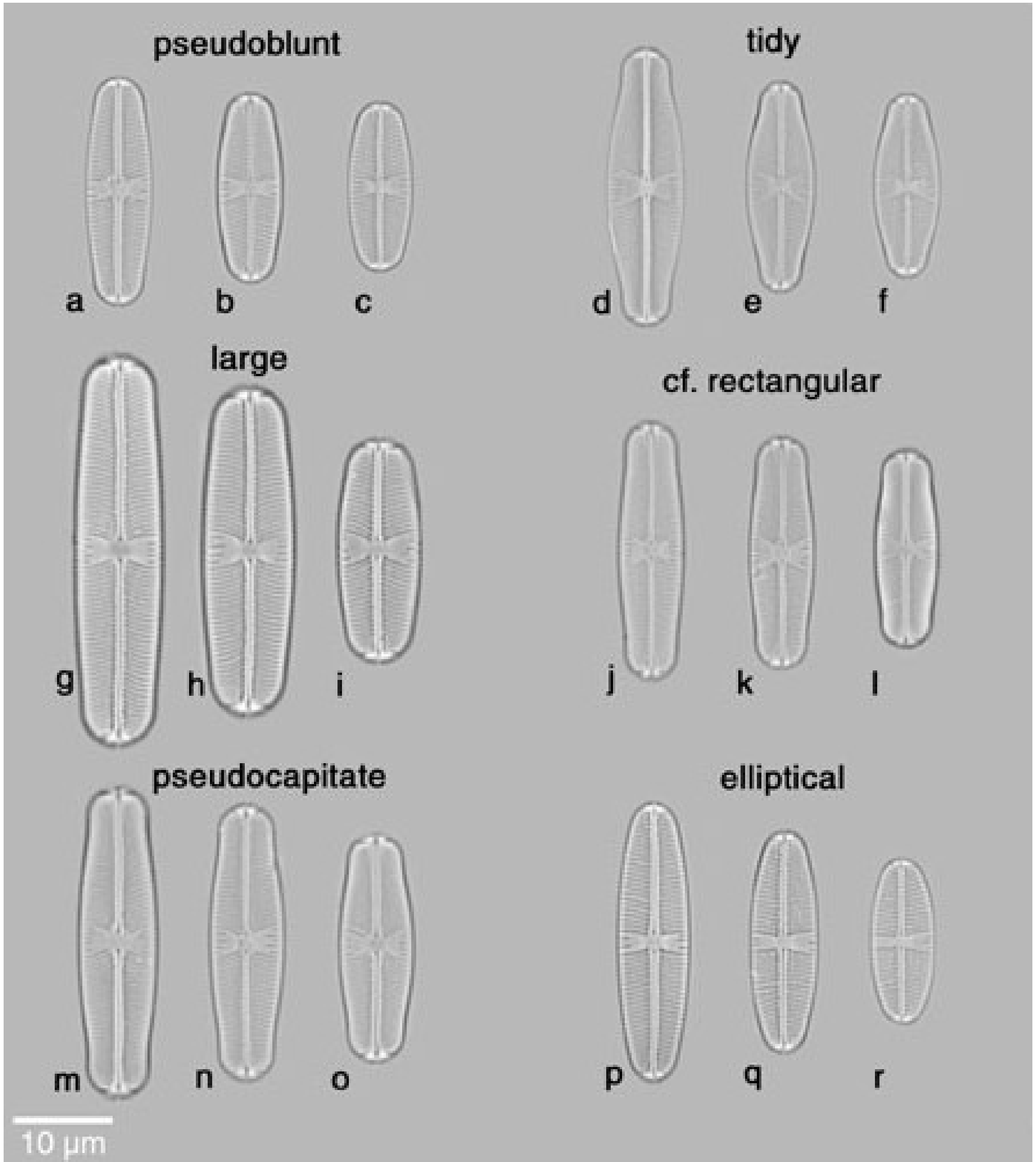


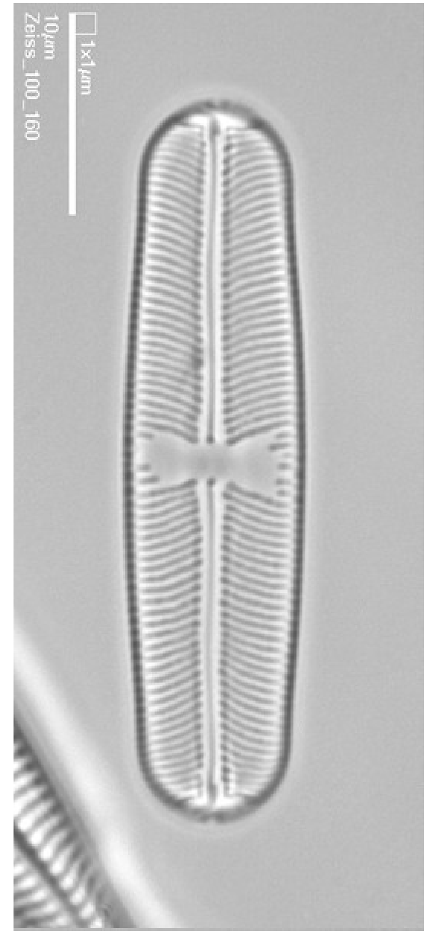


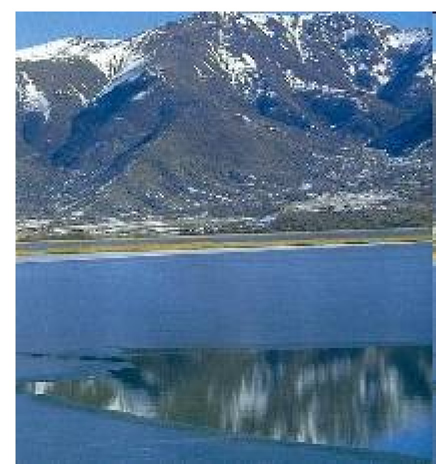


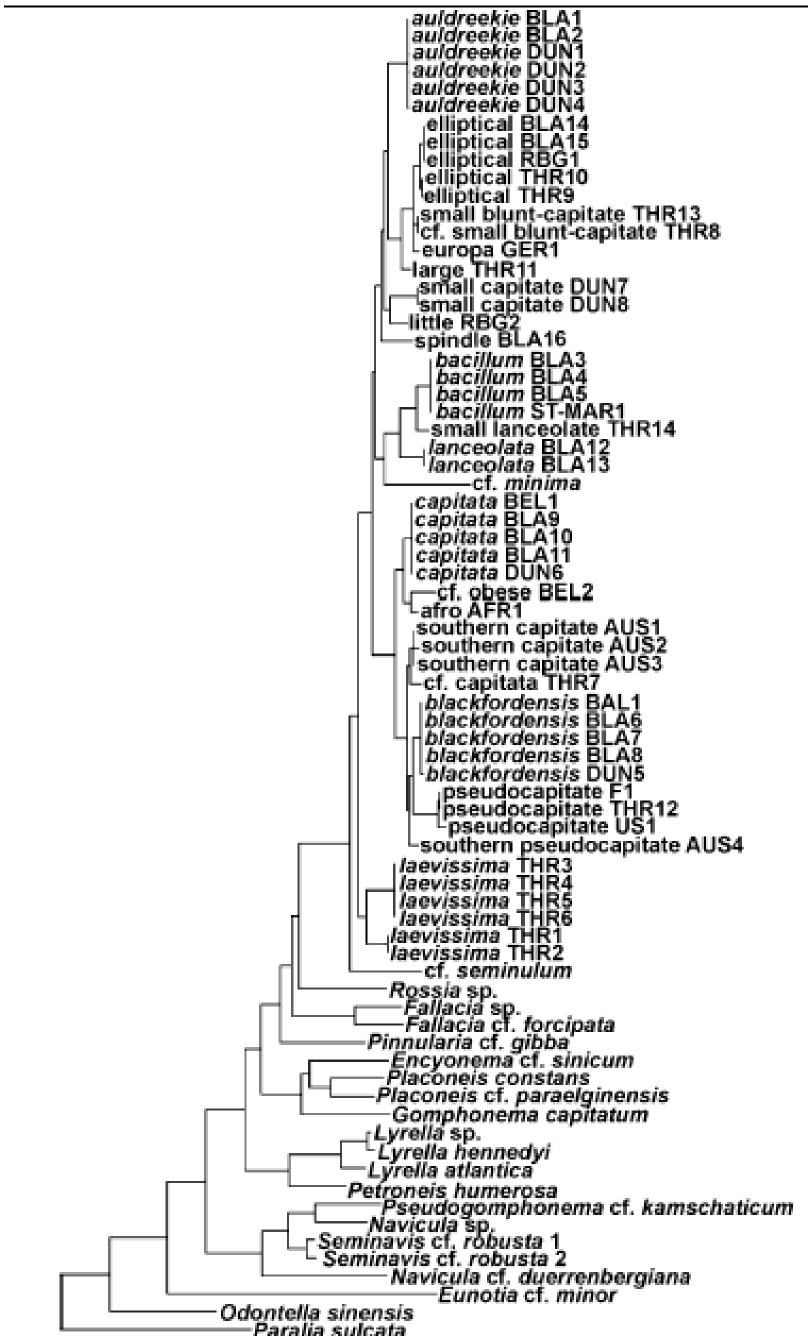


the case for hidden diversity of (benthic) diatoms
Sellaphora pupula









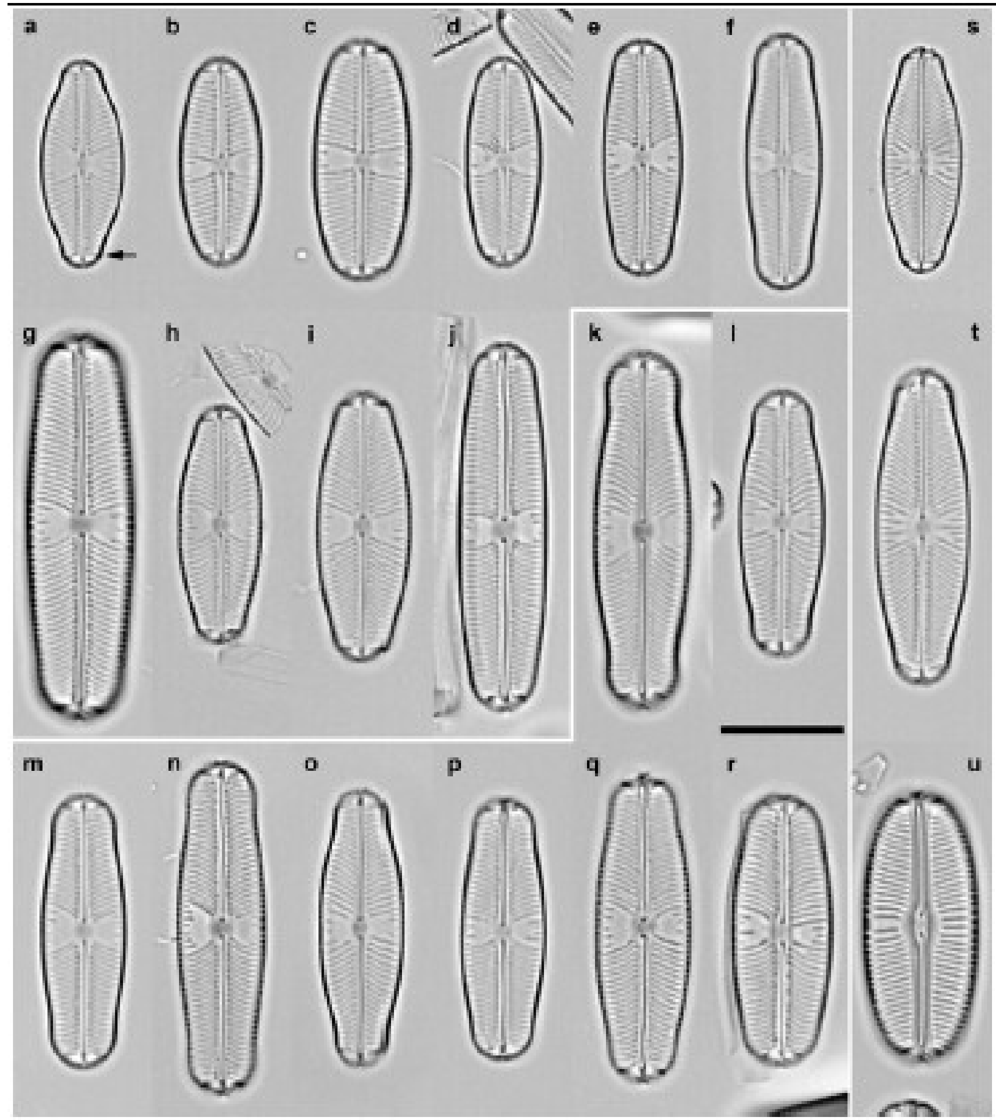


FIG. 7. Representative valves for each of the terminal clades belonging to the *Sellaphora pupula* complex and to *S. bacillum*, all possessing polar bars [e.g., arrow in (a)], grouped according to the results of DNA sequence-based phylogenetic analyses. Scale bar, 10 μm. (a–j) DNA clade 1. (a) *S. auldreekie*, clone BLA2. (b) "elliptical," THR10. (c) "elliptical," BLA14. (d) "small blunt-capitate," THR13. (e) "europa," GER1. (f) "small capitate," DUN7. (g) "large," THR11. (h) "little," RBG2. (i) "spindle," BLA16. (j) "cf. small blunt-capitate," THR8. (k–r) DNA clade 3. (k) *S. capitata*, BLA11. (l) "afro," AFR1. (m) "southern capitate," AUS1. (n) "cf. capitata," THR7. (o) "cf. obese," BEL2. (p) "southern pseudocapitate," AUS4. (q) "pseudocapitate," US1. (r) *S. blackfordensis*, DUN5. (s–u) DNA clade 2. (s) "small lanceolate," THR14. (t) *S. lanceolata*, BLA13. (u) *S. bacillum*, BLA3. Abbreviations are as in Figure 1.

rbcL–based phylogeny of Sellaphora…; how many species?

Evans et al. 2008, J. Phycol.