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reporting on:

# PI COPLANKTON NOVELTIES

Morphological features of some  
recently described picoplankton



Higher taxa with new  
"picoplankton" representatives

Division Heterokontophyta

Division Dinophyta

Division Chlorophyta



# Heterokontophyta

[Bolidophyceae]

Pinguiophyceae

Eustigmatophyceae

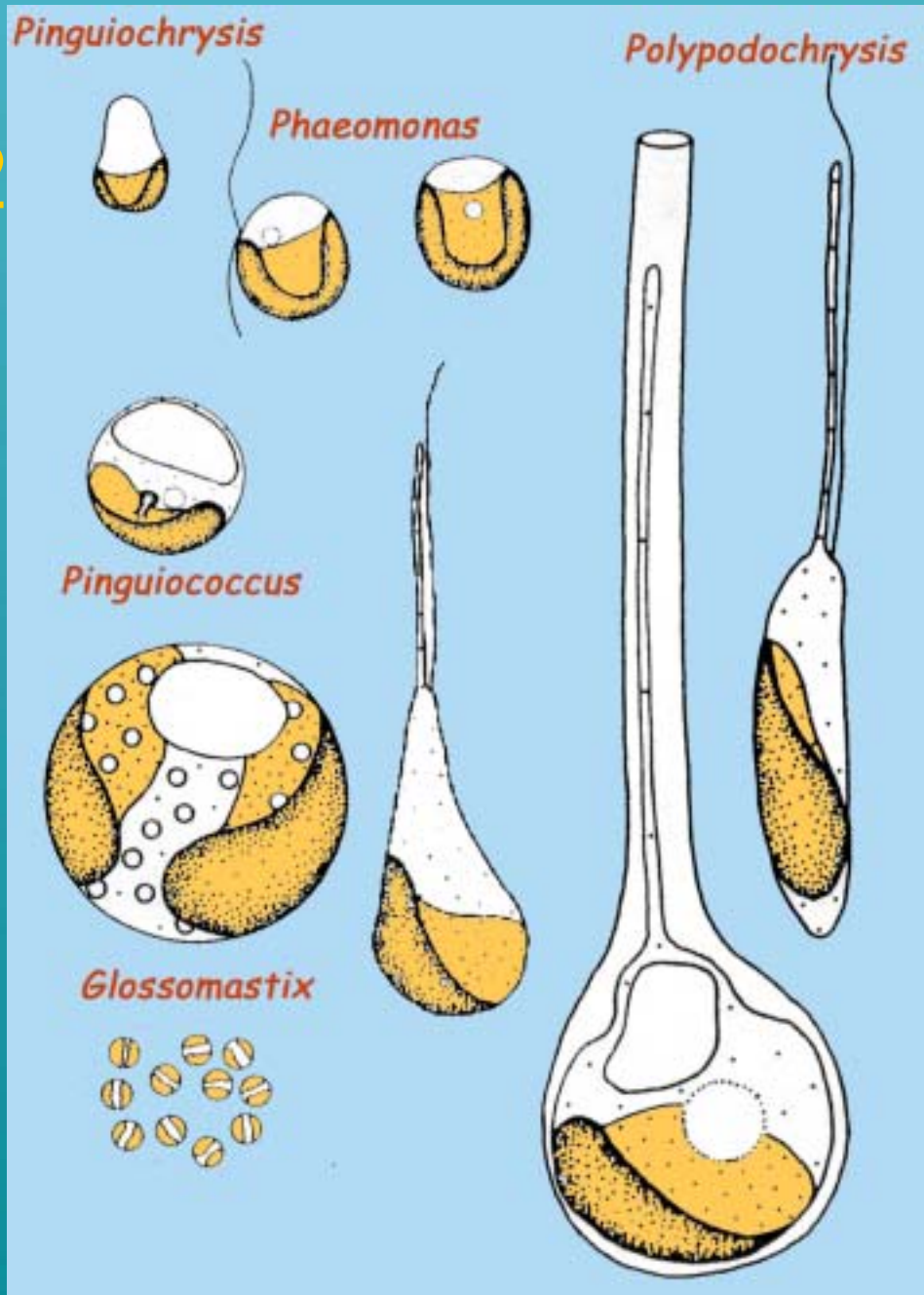
[Pelagophyceae]



# Pinguiophyceae

Kawachi *et al.* 2002

Phycological  
Research 50 p. 35



# Pinguiophyceae *classis nova* Kawachi *et al.* 2002

Based on:

- Ultrastructure
- Pigments
- Molecular data
- Biochemical (fatty acids)  
data



# Pinguiophyceae Kawachi *et al.* 2002

Algae with chlorophylls *a* and *c*, fucoxanthin, violaxanthin, antheraxanthin, zeaxanthin,  $\beta$ -carotene; chloroplasts surrounded by chloroplast endoplasmic reticulum; chloroplast lamellae consisting of three adpressed thylakoids; girdle lamella present; immature flagellum (when present) bearing tripartite tubular hairs without lateral filaments; mature flagellum sometimes the only flagellum present, and lacking tripartite tubular hairs; 2–3 gyred transitional helix located beneath the major transitional plate; eicosapentaenoic acid the dominant fatty acid; 18S rRNA and *rbcL* gene sequences distinct.





Class Pinguiphyceae  
order Pinguiochrysidales  
family Pinguiochrysidaceae

type genus: *Pinguiochrysis*  
Kawachi in Kawachi *et al.*  
2002



# Genus *Pinguiochrysis*

Kawachi 2002

Unicellular, naked without flagellum.  
Single brown chloroplast with  
immersed pyrenoid.  
EPA dominant fatty acid.

(EPA = eicosapentaenoic acid)



Phycological Research 50 p. 50

# Ethymology

*L. pinguis, pingue* = fat, grease

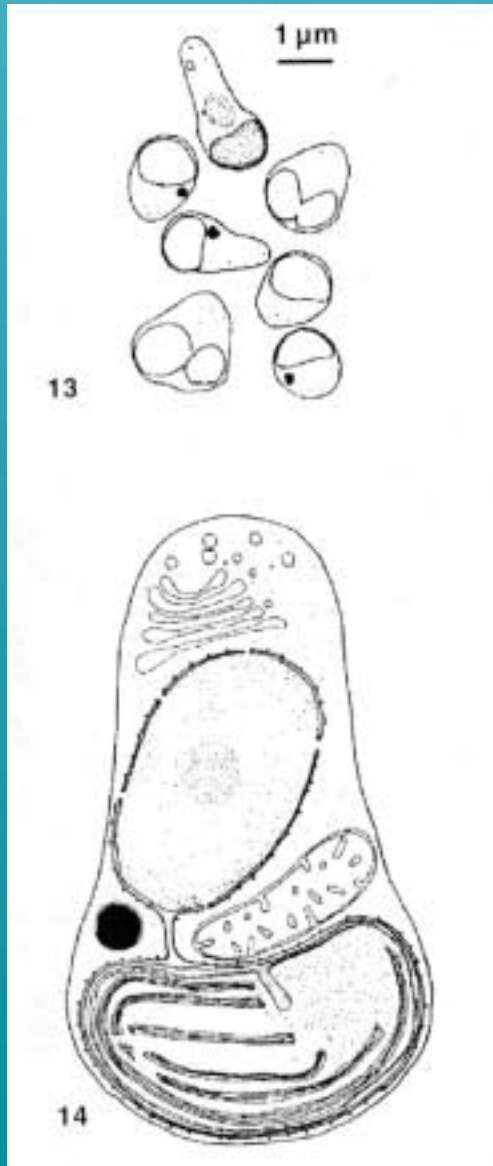
Referring to the large amount of omega-3 fatty acids produced in this species



# *Pinguiochrysis pyriformis*

Kawachi 2002

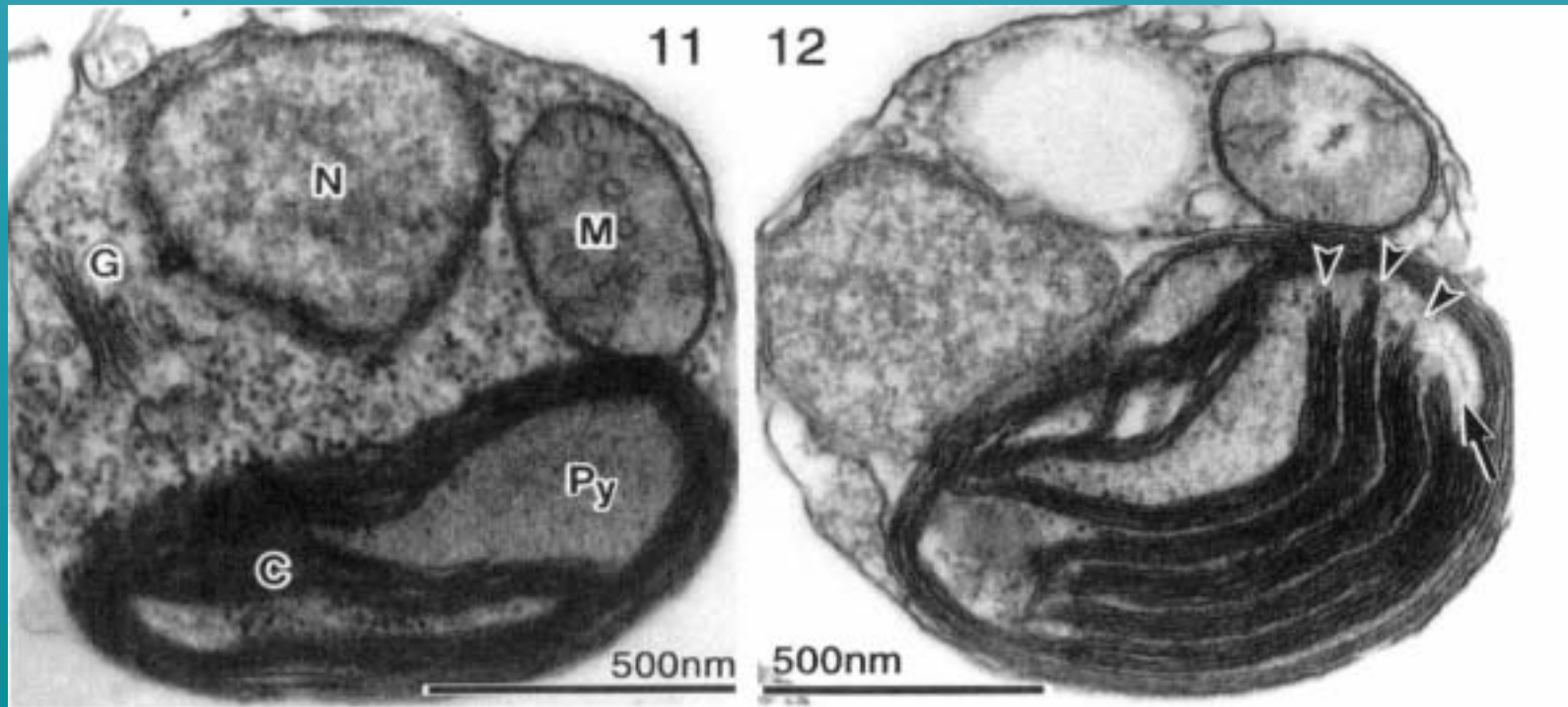
Phycological  
Research 50 p. 50



# *Pinguiochrysis pyriformis*

Dimensions:

1.5-3  $\mu\text{m}$  x 1.0-1.5  $\mu\text{m}$  (elongated)  
or 1.0-2.0  $\mu\text{m}$  (spherical)



# Genus *Pinguicoccus*

Andersen, Potter et Bailey  
2002

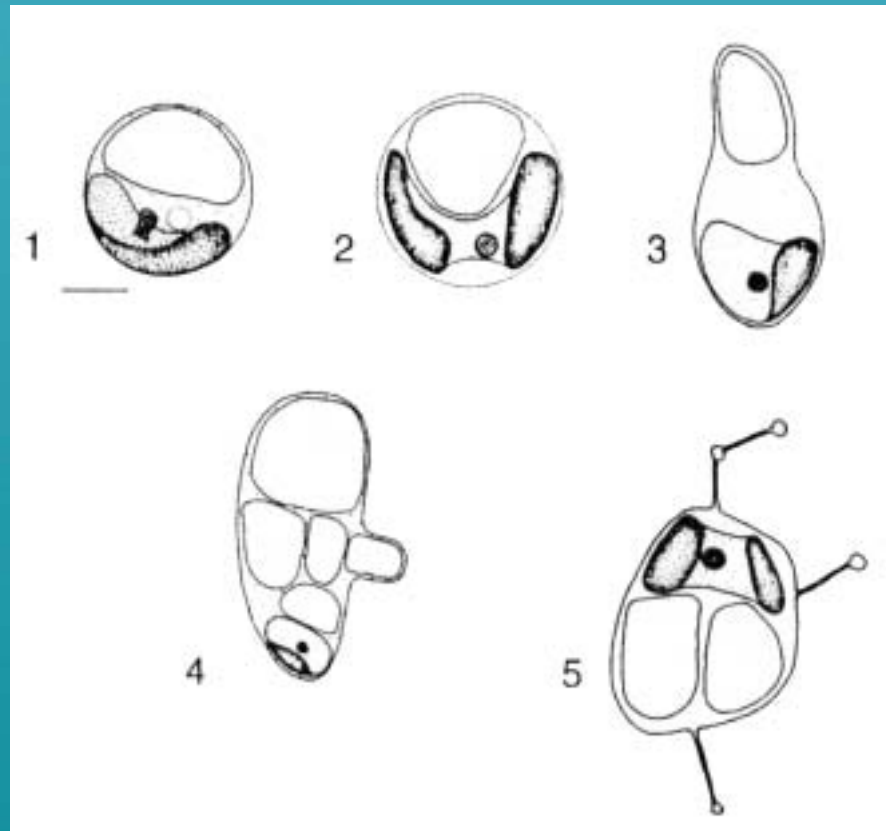
Unicellular, naked cells  
rounded or irregular,  
"nucleotide sequences  
for the 18S rRNA  
and *rbcL* distinct"

Phycological  
Research 50 p. 58



# *Pinguicococcus pyrenoidosus*

Andersen, Potter et Bailey 2002

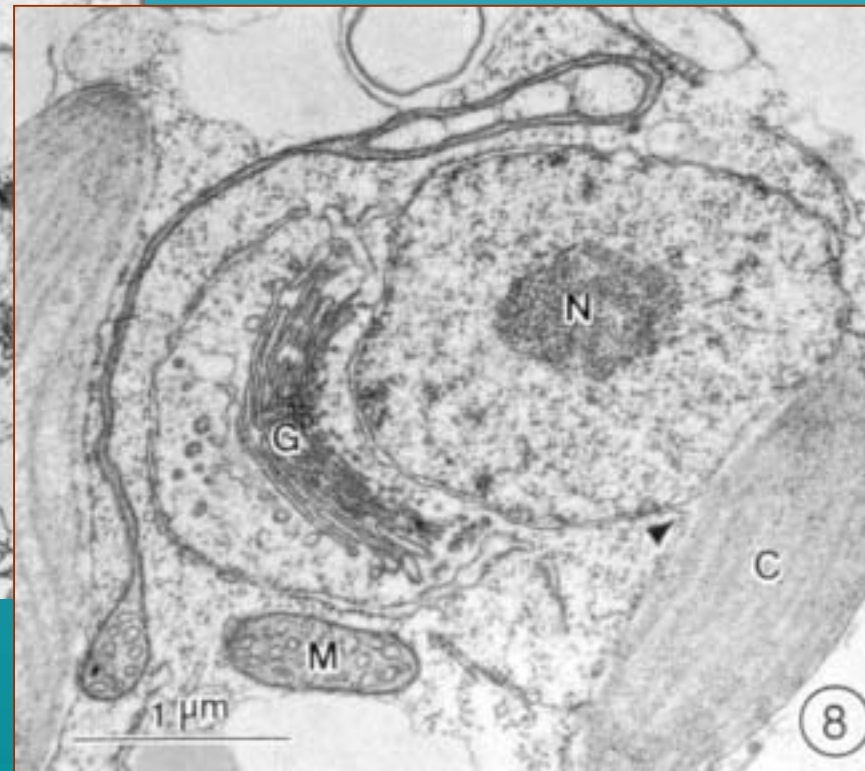
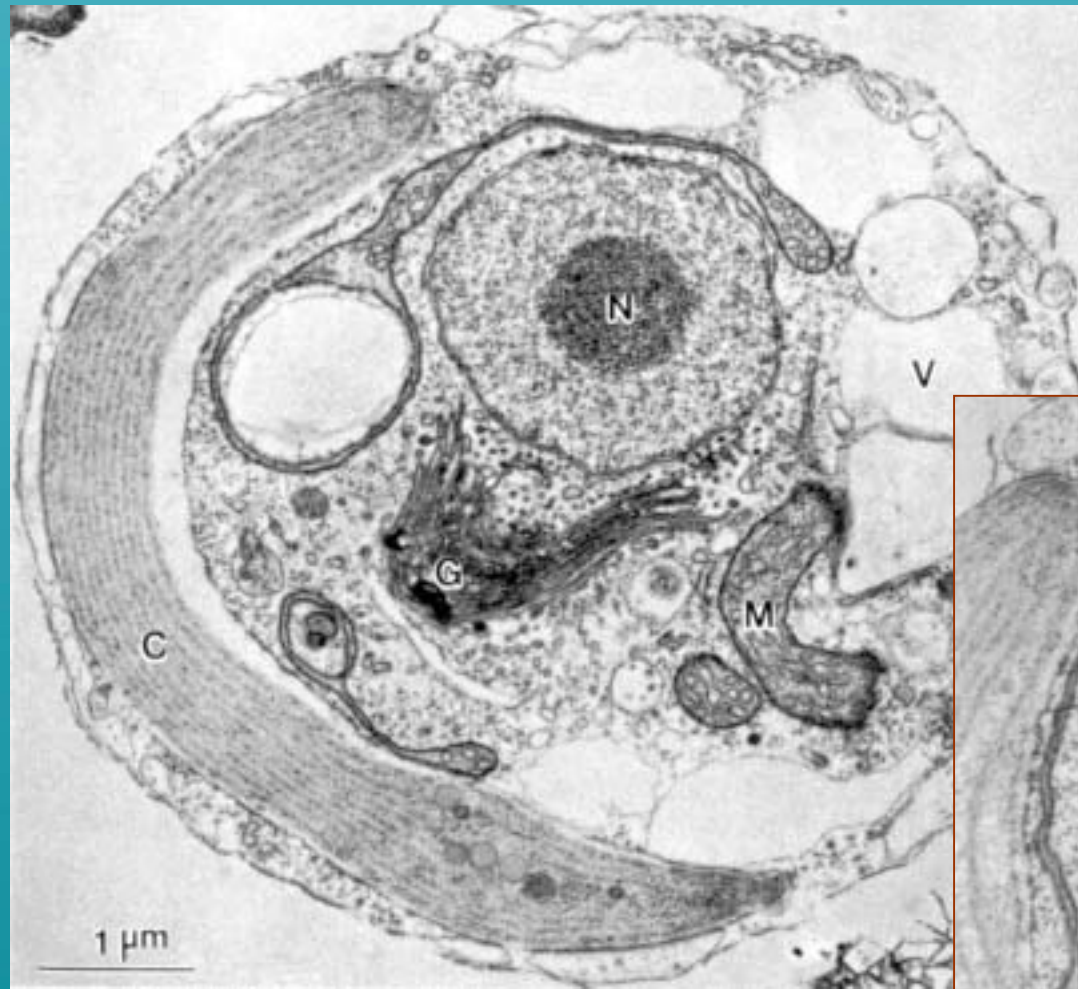


Dimensions: 3-8  $\mu\text{m}$

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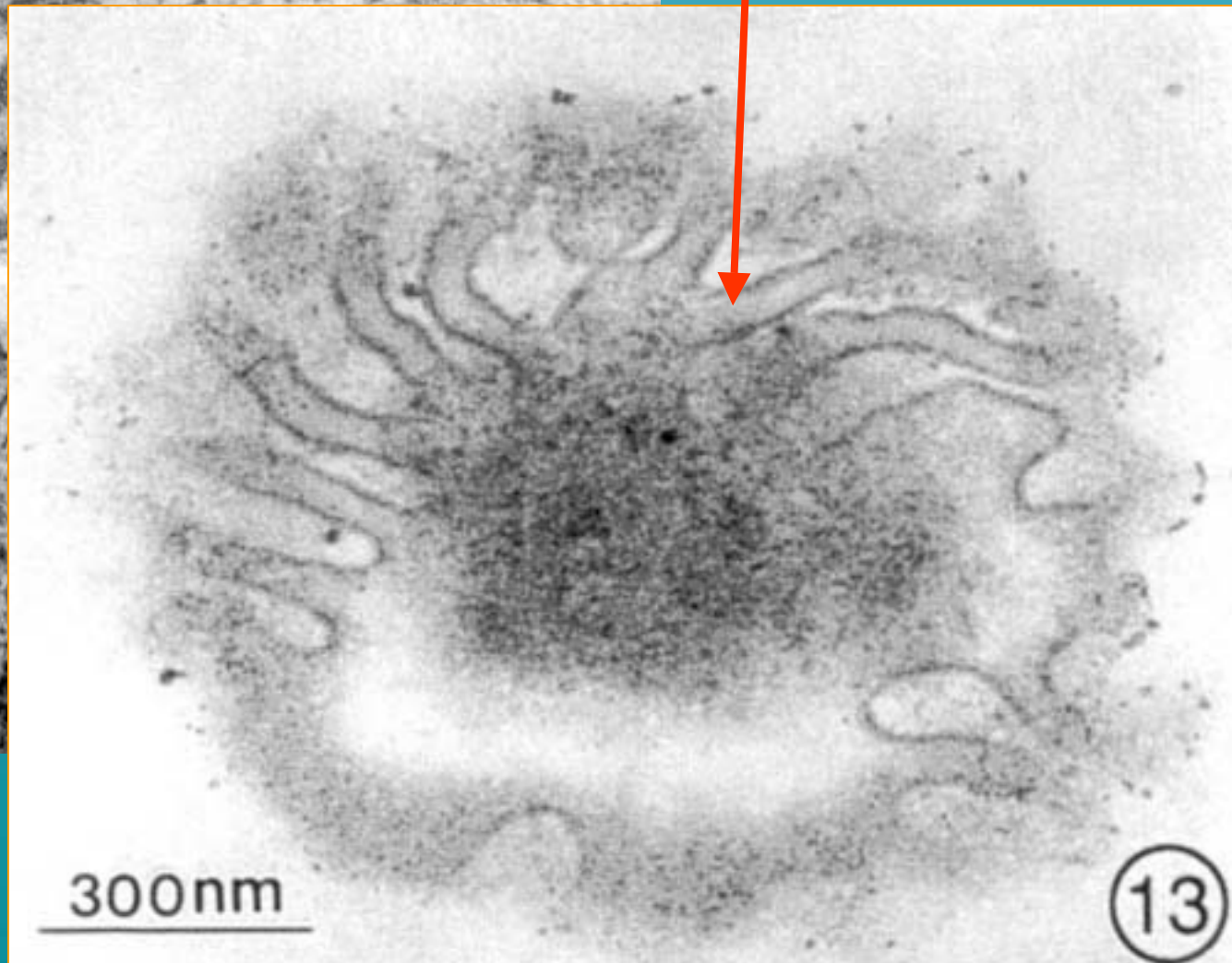
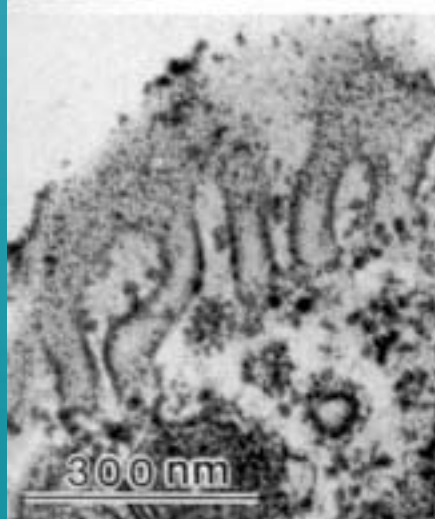
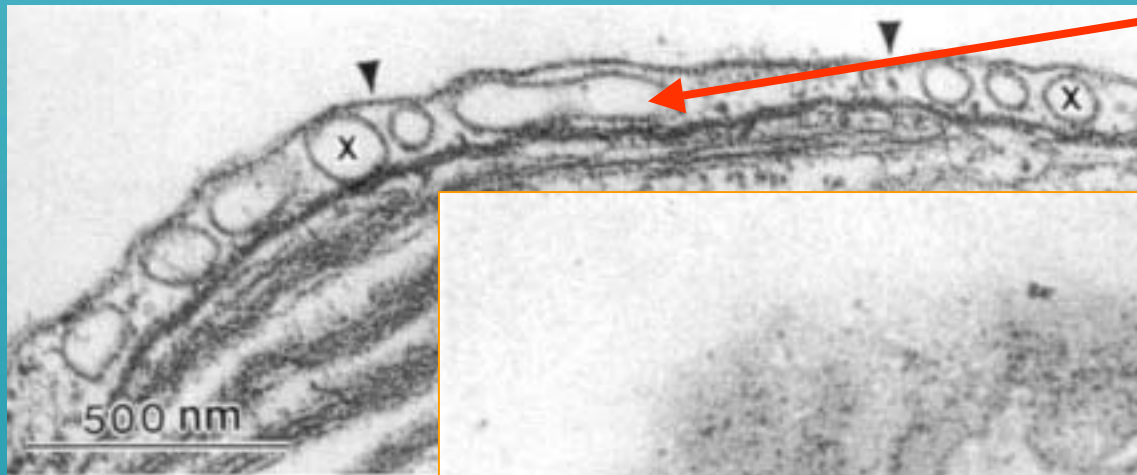


# *Pinguicococcus pyrenoidosus*

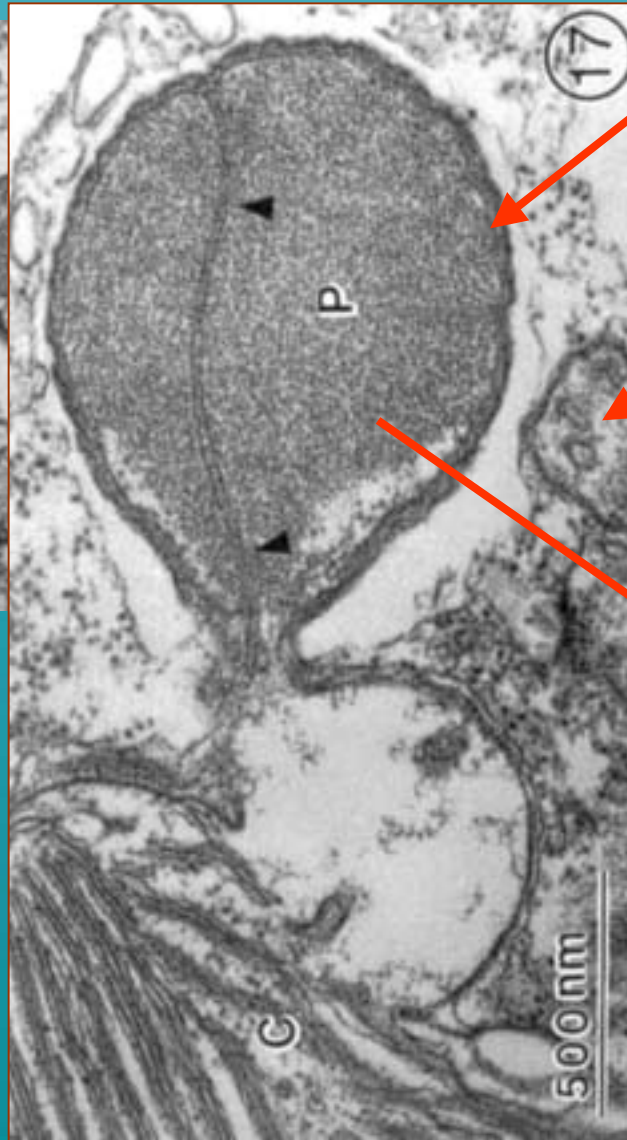
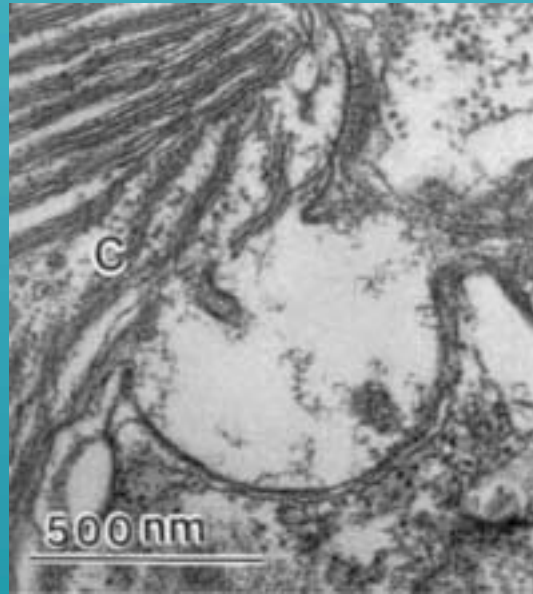


# *Pinguicococcus pyrenoidosus*

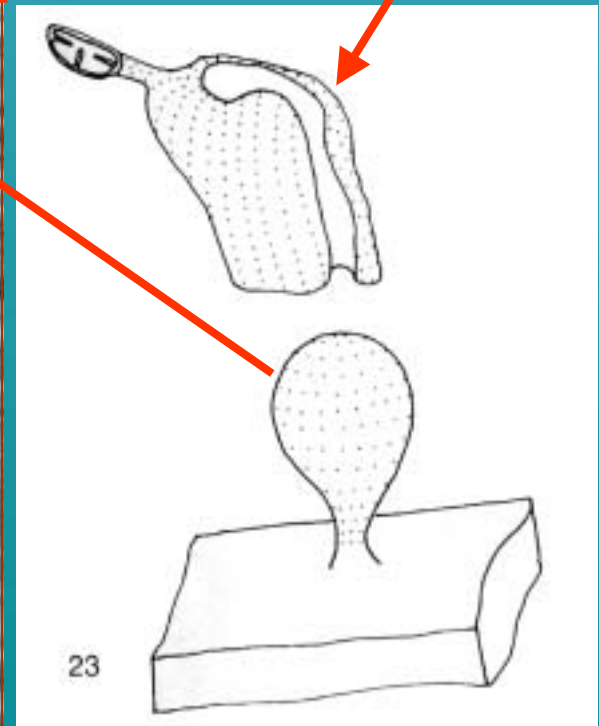
Anastomosing vesicles



# *Pinguicococcus pyrenoidosus*



Pyrenoid with mitochondrial cap



# Genus *Phaeomonas*

## Honda et Inouye 2002

Unicellular, spherical – ovoid

Flagella two, unequal, laterally inserted

Chloroplast single, yellowish-brown

Stigma absent

18S rRNA and *rbcL* genes distinctive



Phycological Research  
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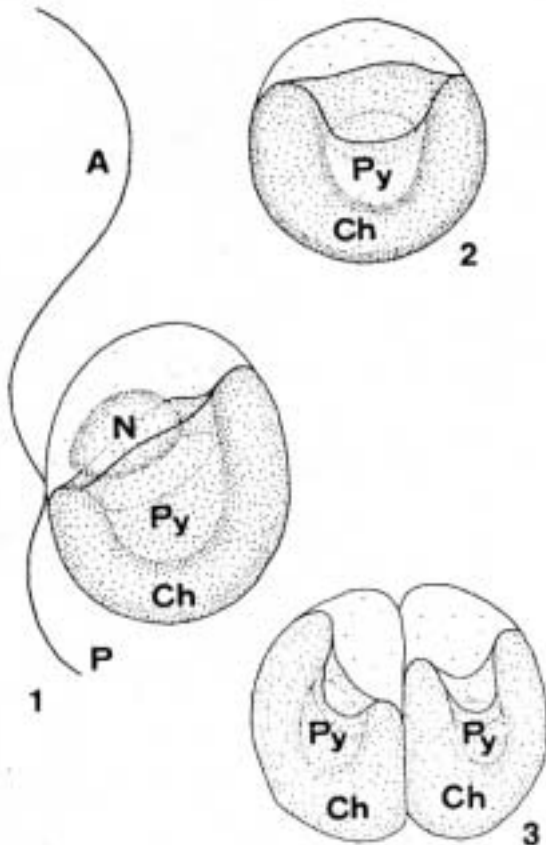
# *Phaeomonas parva* Honda et Inouye 2002

Cell dimensions:

4.0-4.6  $\mu\text{m}$  x 3.2-4.0  $\mu\text{m}$

Flagella: 8.0-11.5  $\mu\text{m}$  and  
5.5-6.0  $\mu\text{m}$

Cup-shaped chloroplast  
with pyrenoid filling the  
cavity



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# *Phaeomonas parva*

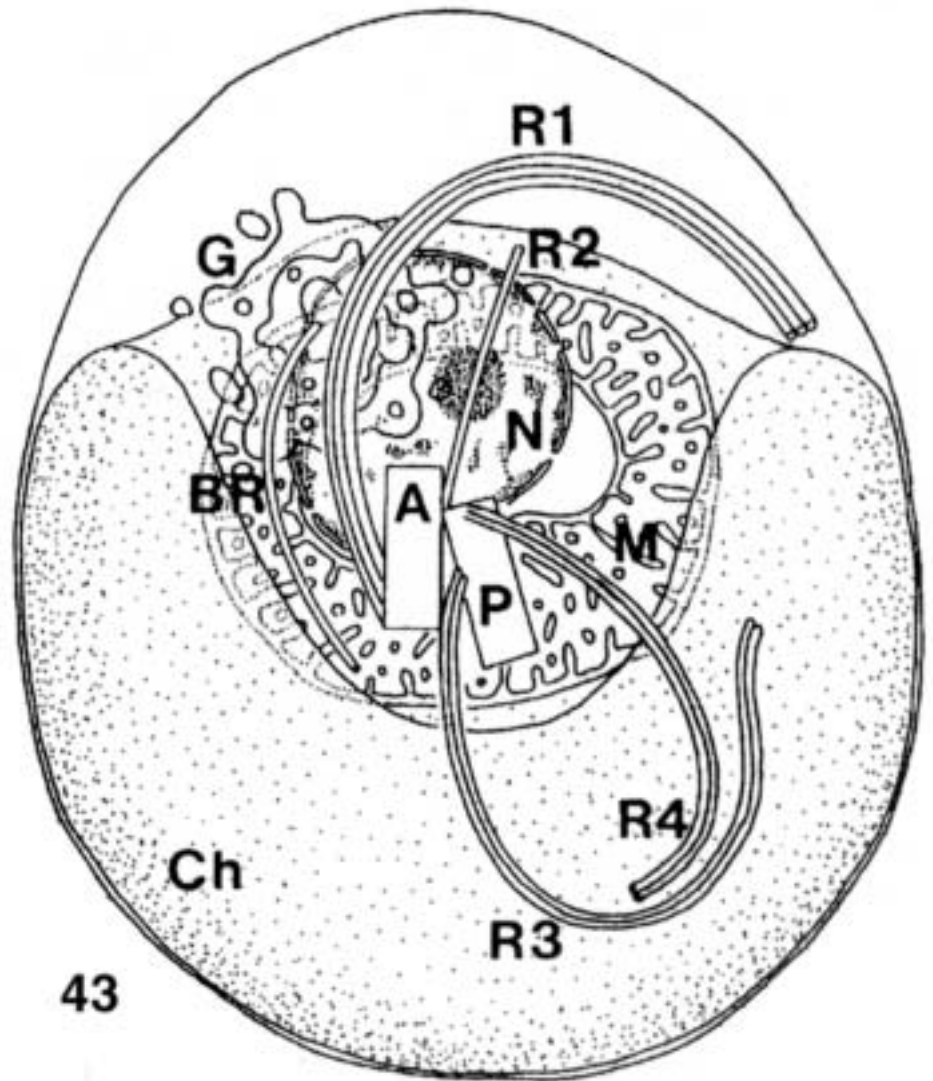
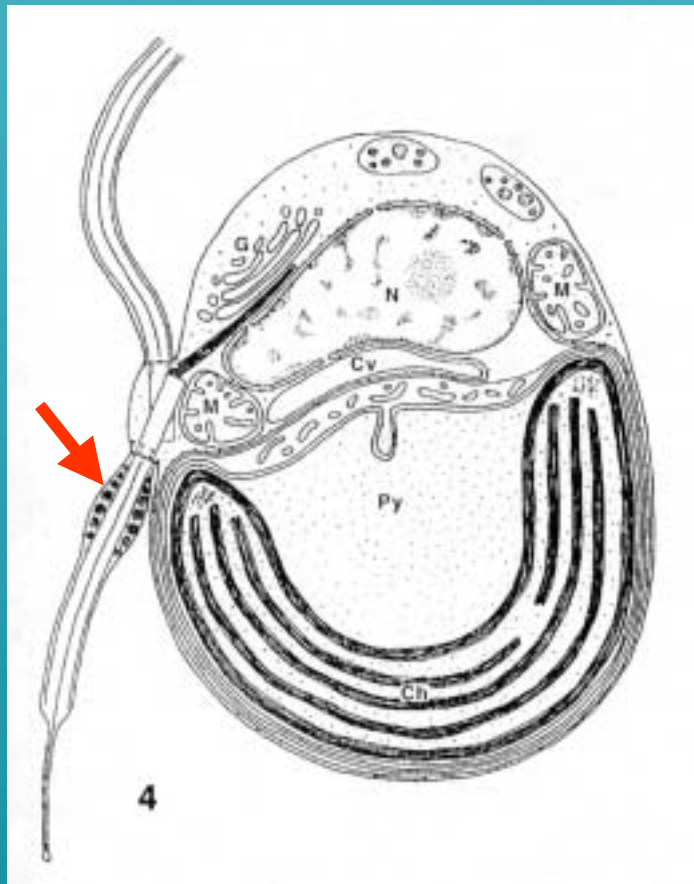
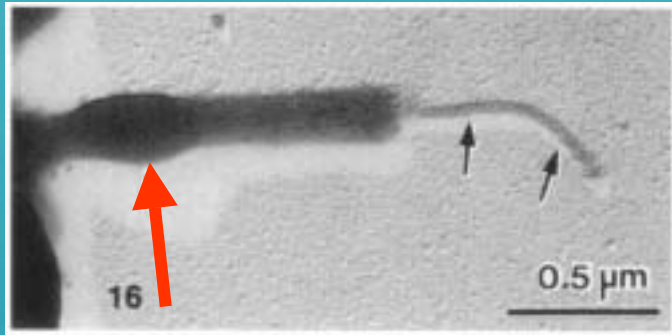


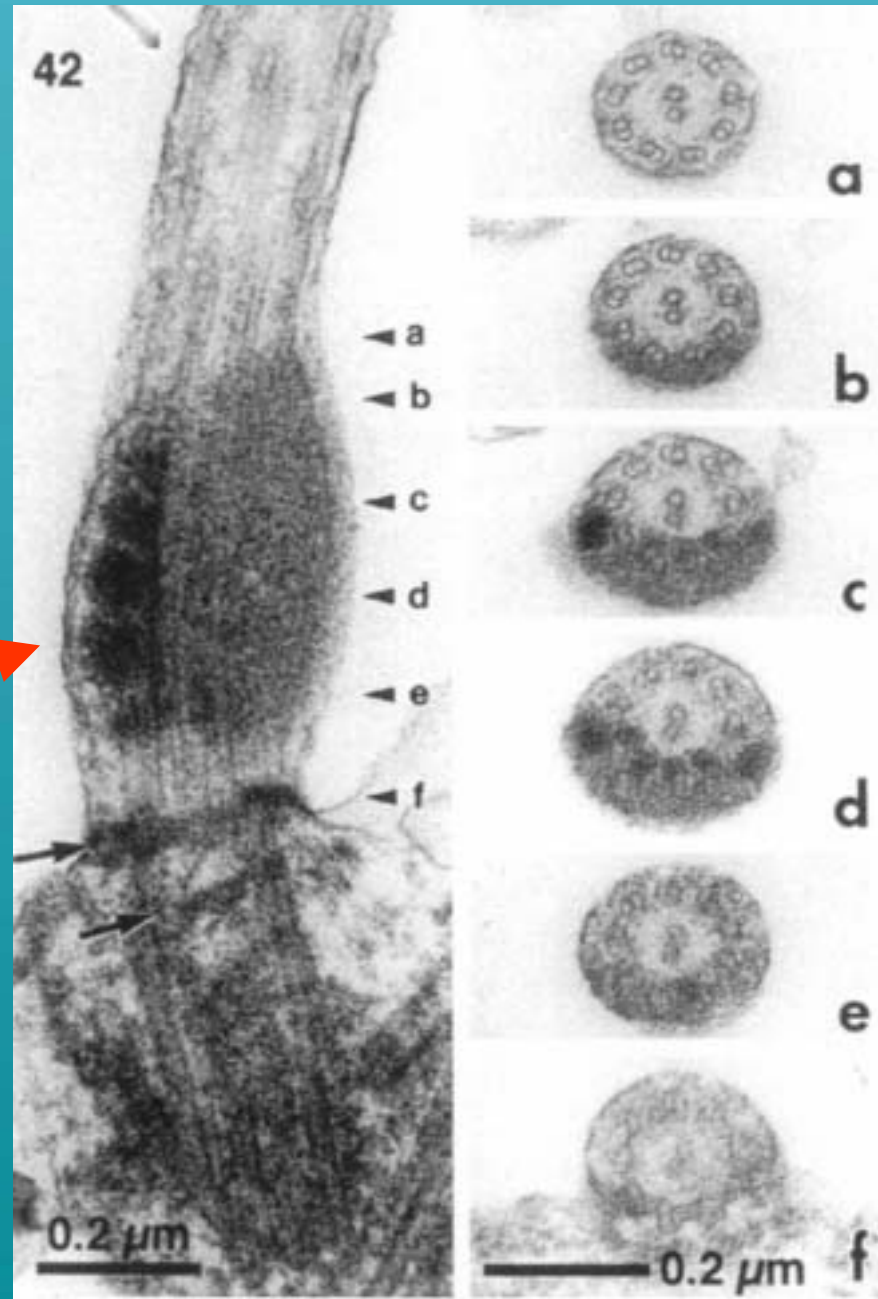
Fig. 43. Diagram of the flagellar apparatus of *Phaeomonas parva*. Cell showing the configuration of microtubular flagellar roots (not to scale).



# *Phaeomonas parva*

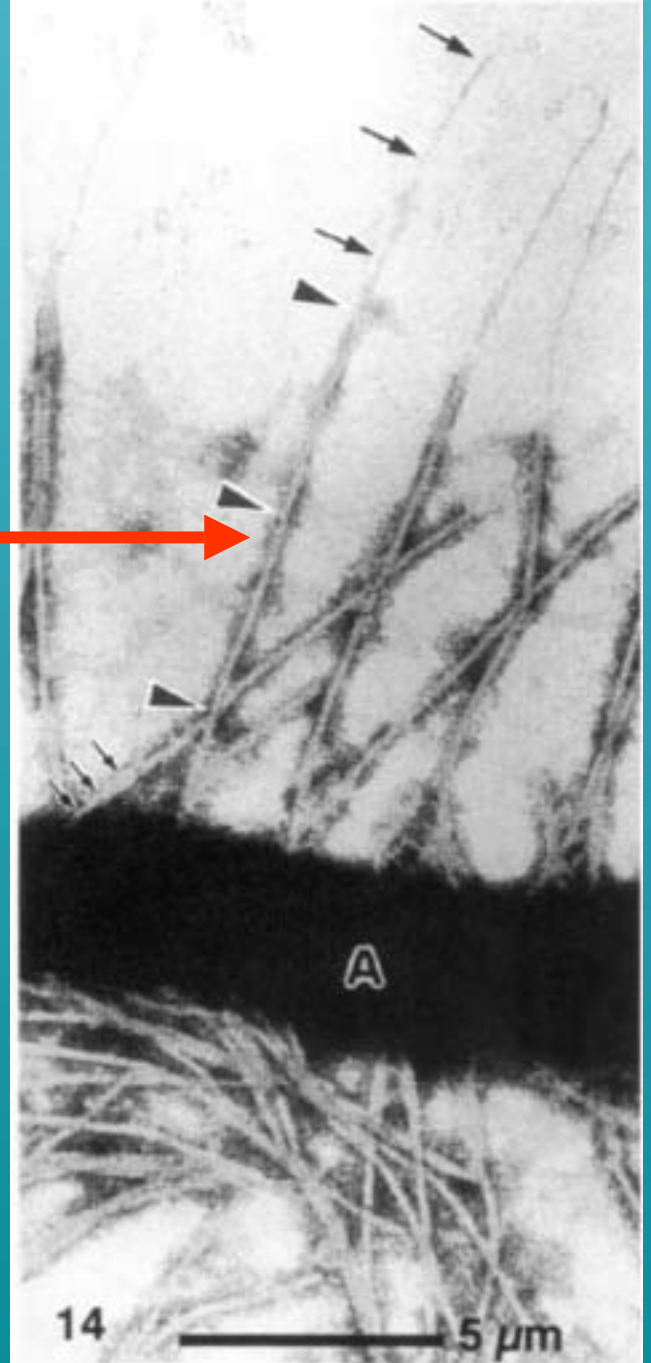


The flagellar swelling



# *Phaeomonas parva*

Tubular hairs of the  
anterior flagellum



# Eustigmatophyceae

Unicellular  
Chlorophyll *a*  
Violaxanthin  
 $\beta$ -carotene  
- girdle lamella



# *Nannochloropsis oceanica*

Suda et Miyashita

Eustigmatophyceae, Heterokontophyta

Cell spherical, oval or pyriform

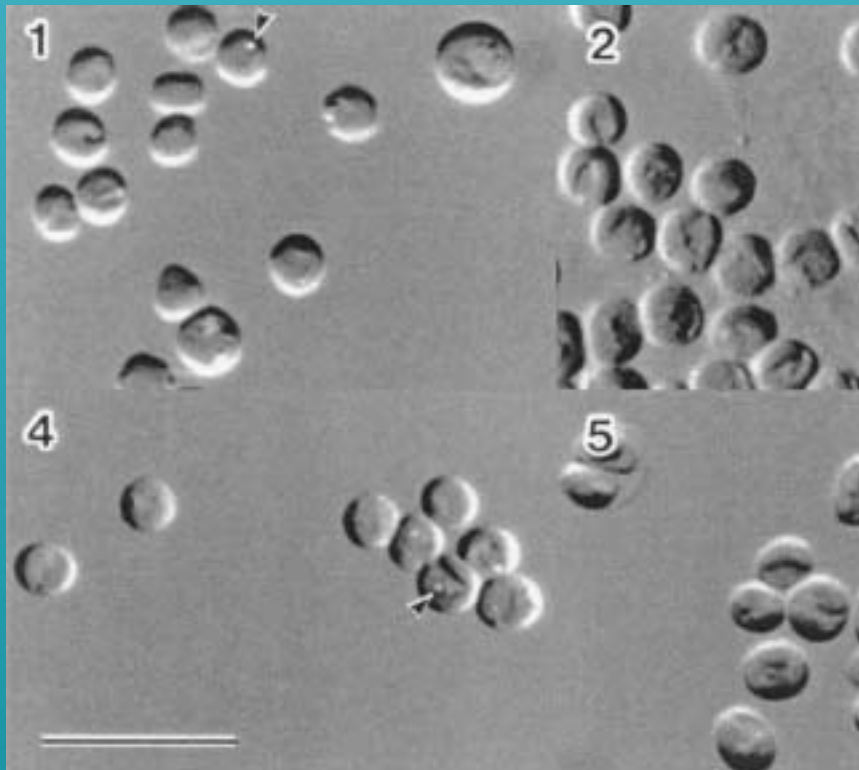
Chloroplast parietal yellow-green

Cell size: 2-4 x 3-5  $\mu\text{m}$

Characterized by 18S rRNA and *rbcL* gene sequences



# *Nannochloropsis oceanica*



MBI C strain 10090



# *Nannochloropsis* Hibberd

## Marine species:

*N. oculata* (Droop) Hibberd

*N. salina* Hibberd

*N. gaditana* Lubian

*N. granulata* Karlson et Potter

*N. oceanica* Suda et Miyashita



# DINOPHYTA

Class Dinophyceae

Order Prorocentrales

*Prorocentrum nux*

Puigserver *et* Zingone 2002

Phycologia 41 p. 30

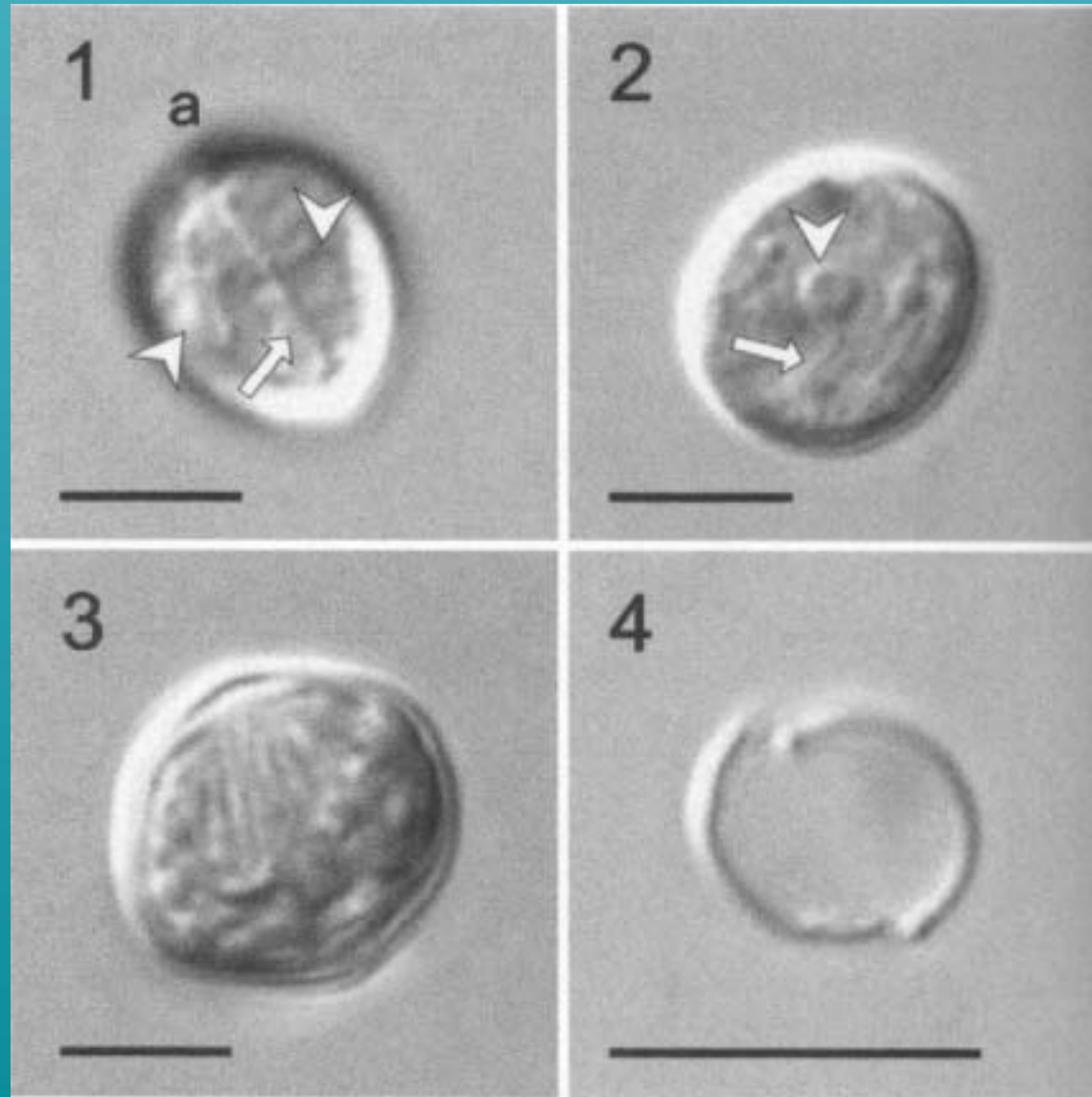


# *Prorocentrum nux*

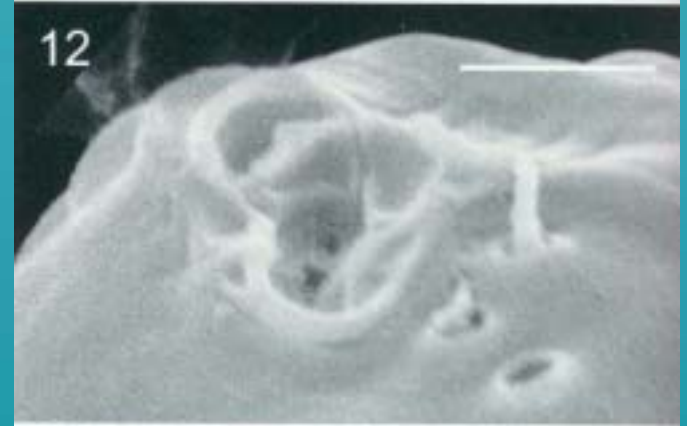
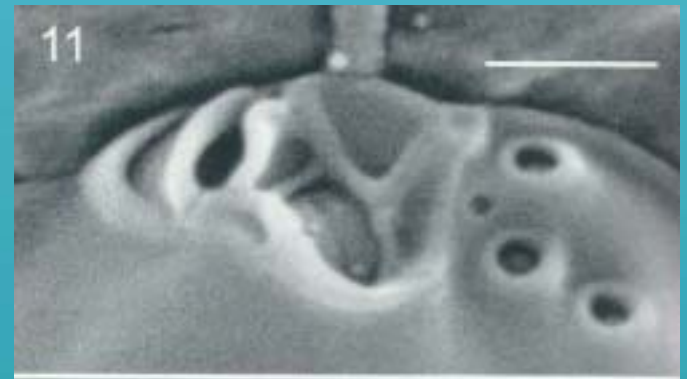
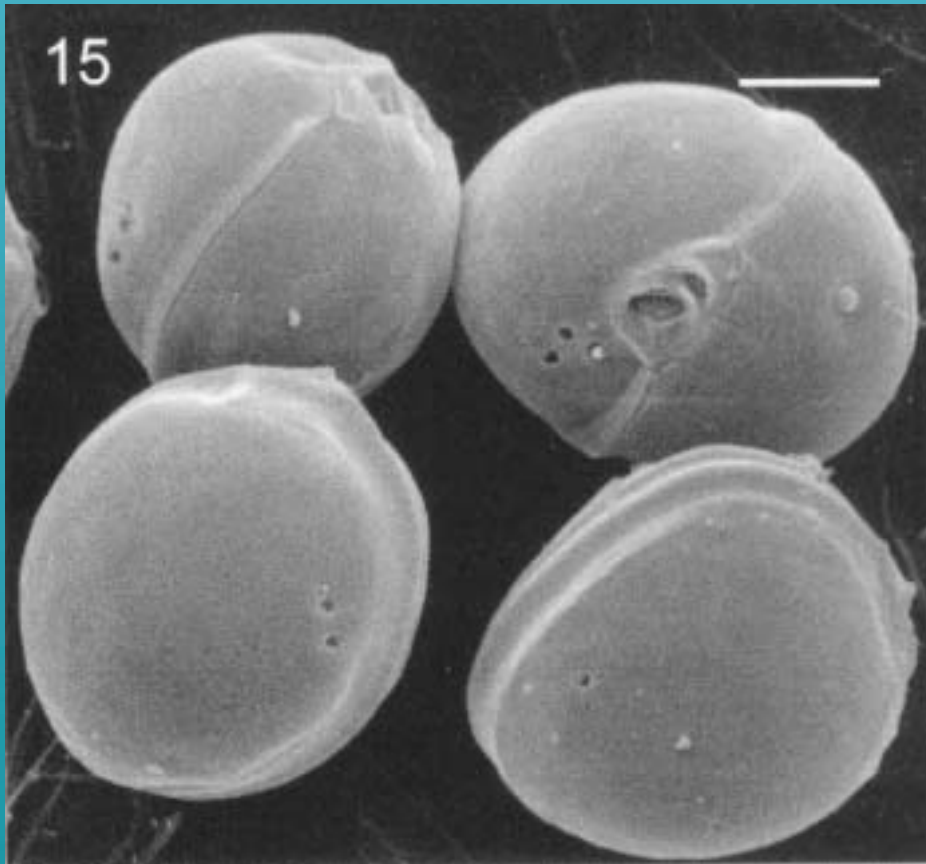
pyrenoids ►

sutur →

Scale bars 5  $\mu$ m



# *Prorocentrum nux*



19

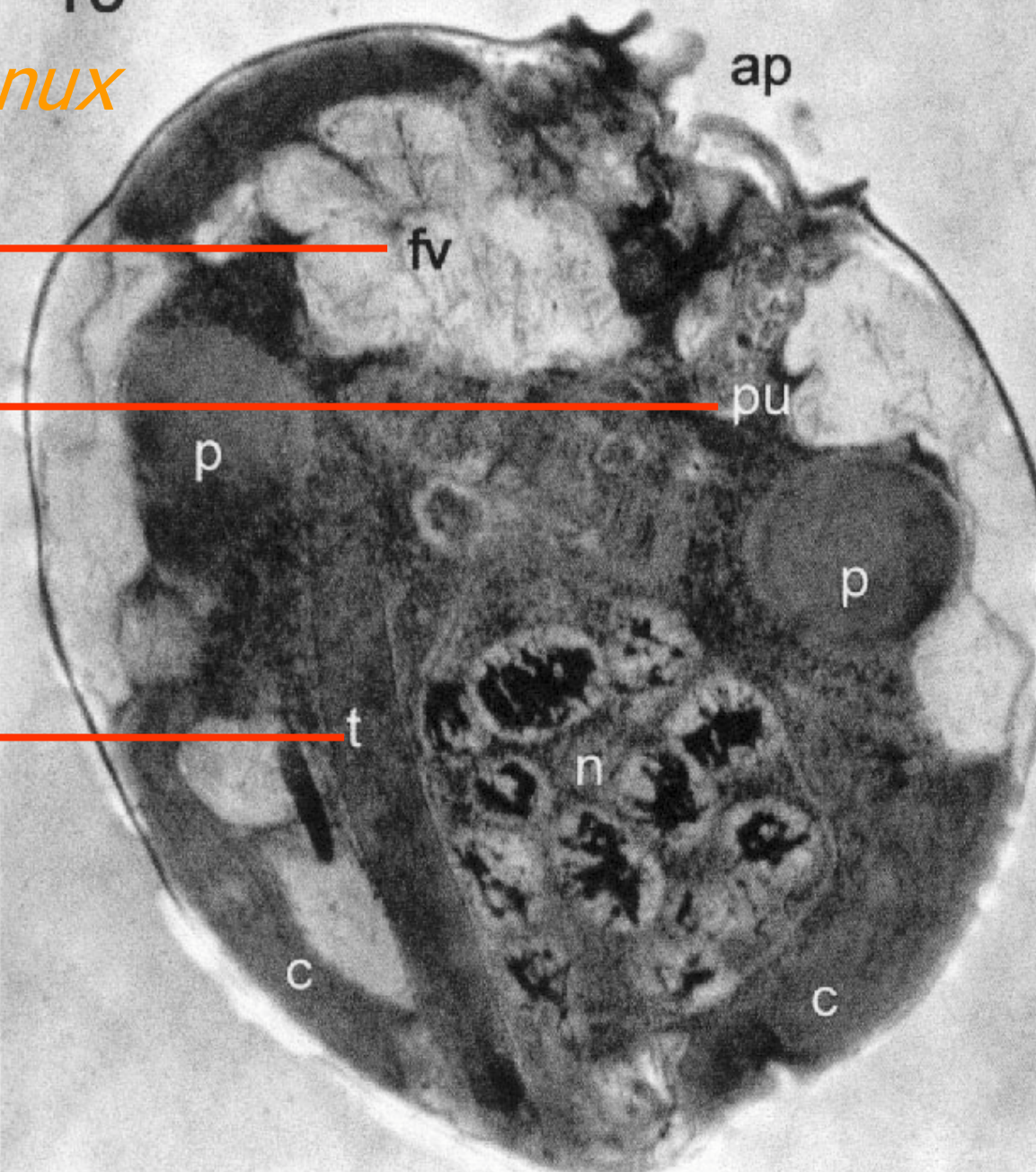
1  $\mu$ m

*Prorocentrum nux*

Fibrous vacuoles

pusule

trichocyst



# *Prorocentrum nux*

Dimensions:

6.3-9  $\mu\text{m}$  x 5.3-10  $\mu\text{m}$

Aff. or = RCC 303?



# Chlorophyta, Prasinophyceae

*Crustomastix didyma* and  
a possible new species

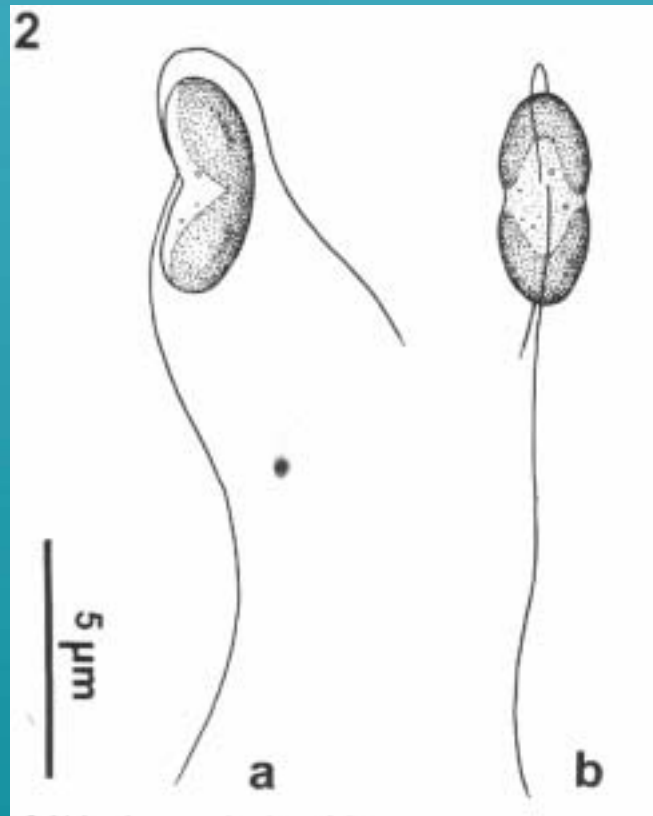


# Genus *Crustomastix* Nakayama, Kawachi et Inouye 2000

Cell bean-shaped with a thin crust  
Chloroplast bilobed pale yellow-green  
Without pyrenoid  
With two flagella



# *Crustomastix didyma* Nakayama, Kawachi et Inouye 2000



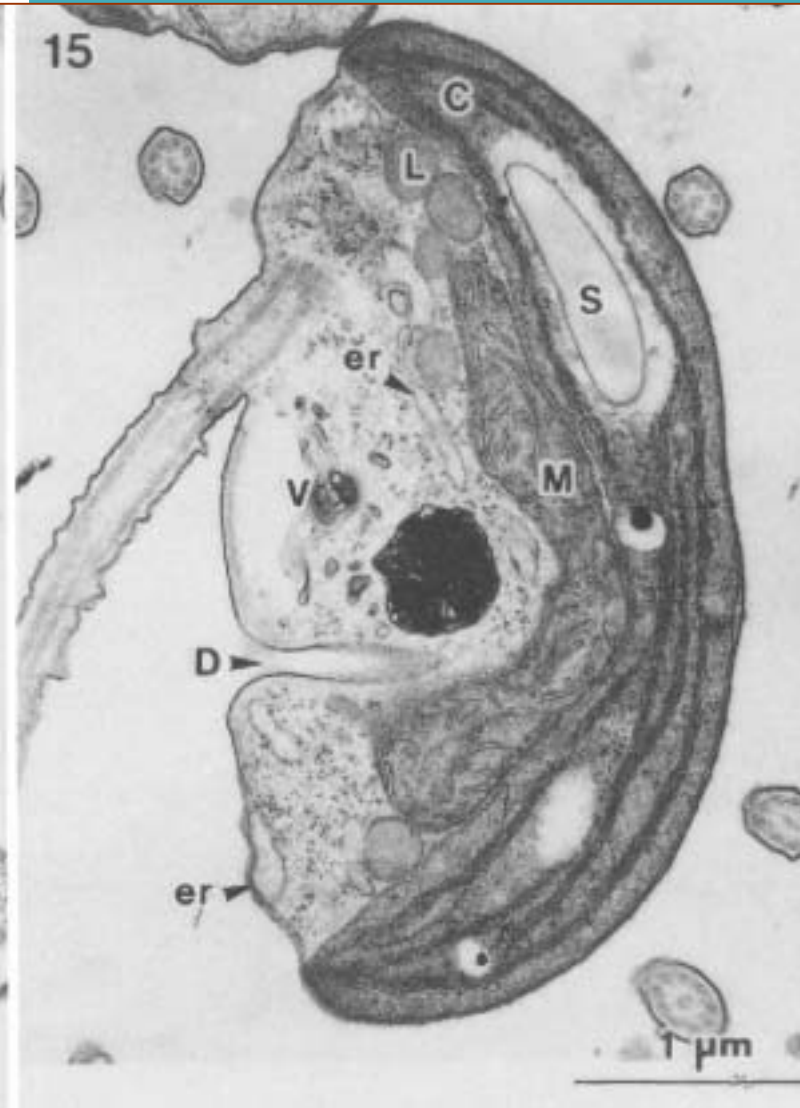
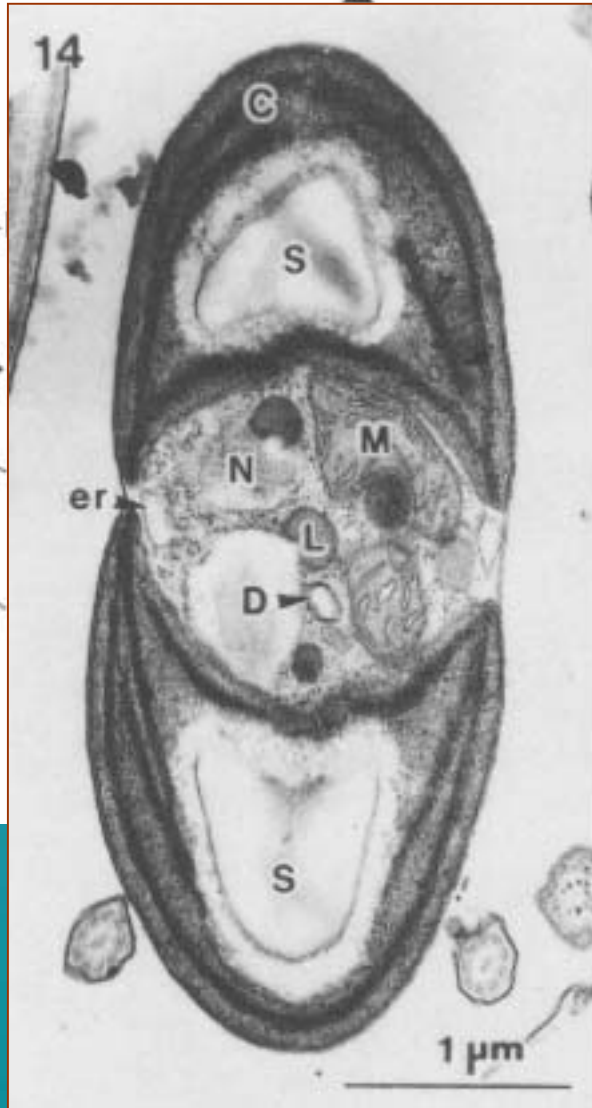
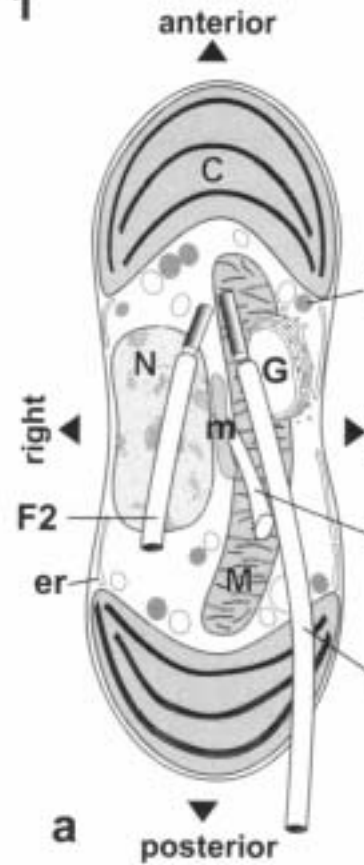
Cell bean-shaped  
Pale yellow-green chloroplast  
Eyespot not observed  
Cell size: 4-6  $\mu\text{m}$  x 2-3  $\mu\text{m}$

Northwestern Pacific



# *Crustomastix didyma*

1



# *Crustomastix "stigmatica"*

A. Zingone, M. Borra, C. Brunet, G. Forlani, W. Kooistra e G. Procaccini

Pale yellow-green chloroplast

Eyespot present

Cell size: 3.5-5.3  $\mu\text{m}$  x 1.5-2.4  $\mu\text{m}$

Distinguished from *C. didyma* by differences in pigments, details in fine structure and genetics



surprises to come from the  
oceans



*Thank you for your*

*attention*







# Why picoplankton?



# Picoplankton etymology

Prefix *pico-* from  
Spanish *pico*  
derived from  
Celtic *pecus* = small



# Picoplankton definition

Sieburth, Smetacek et Lenz 1978

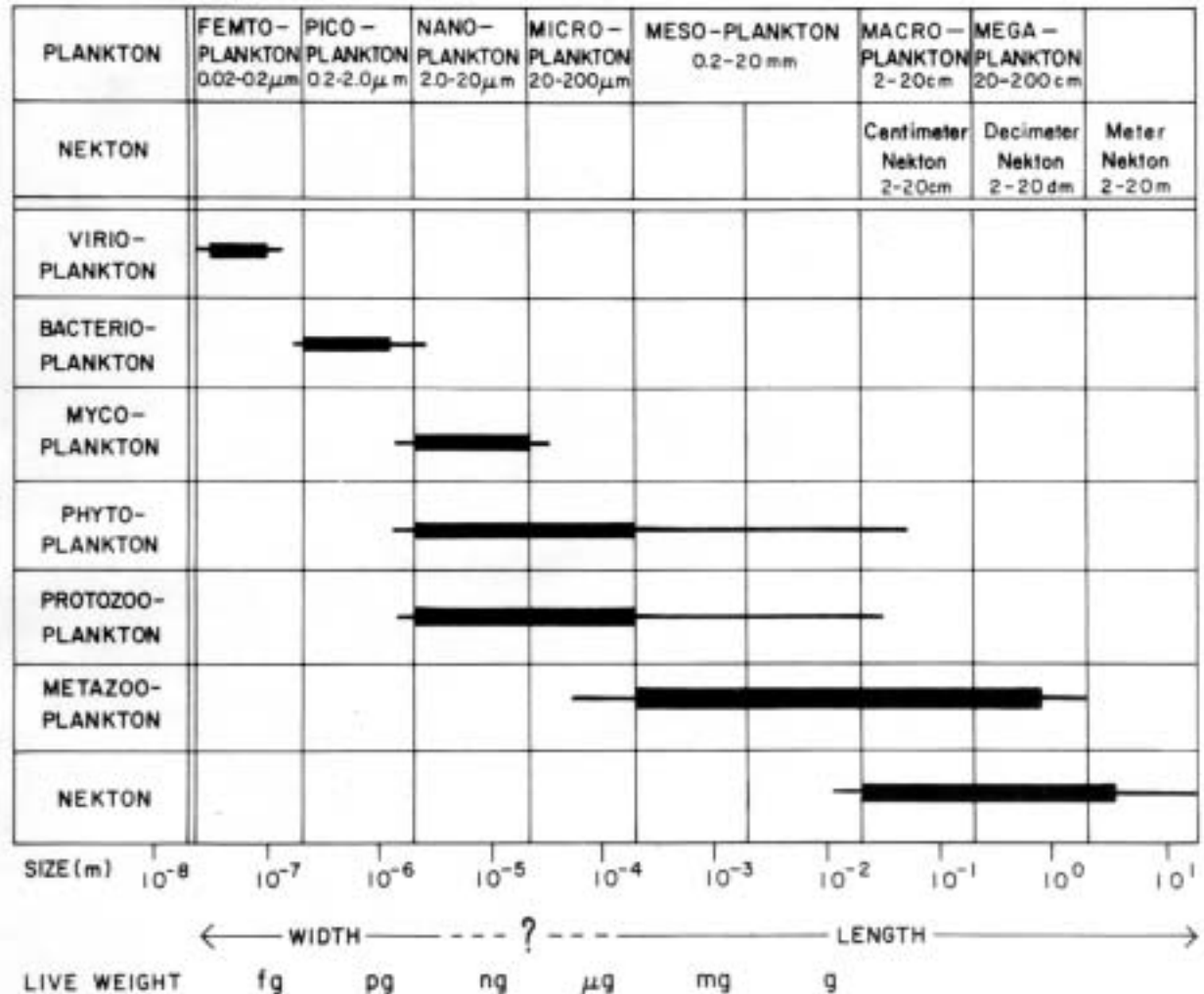
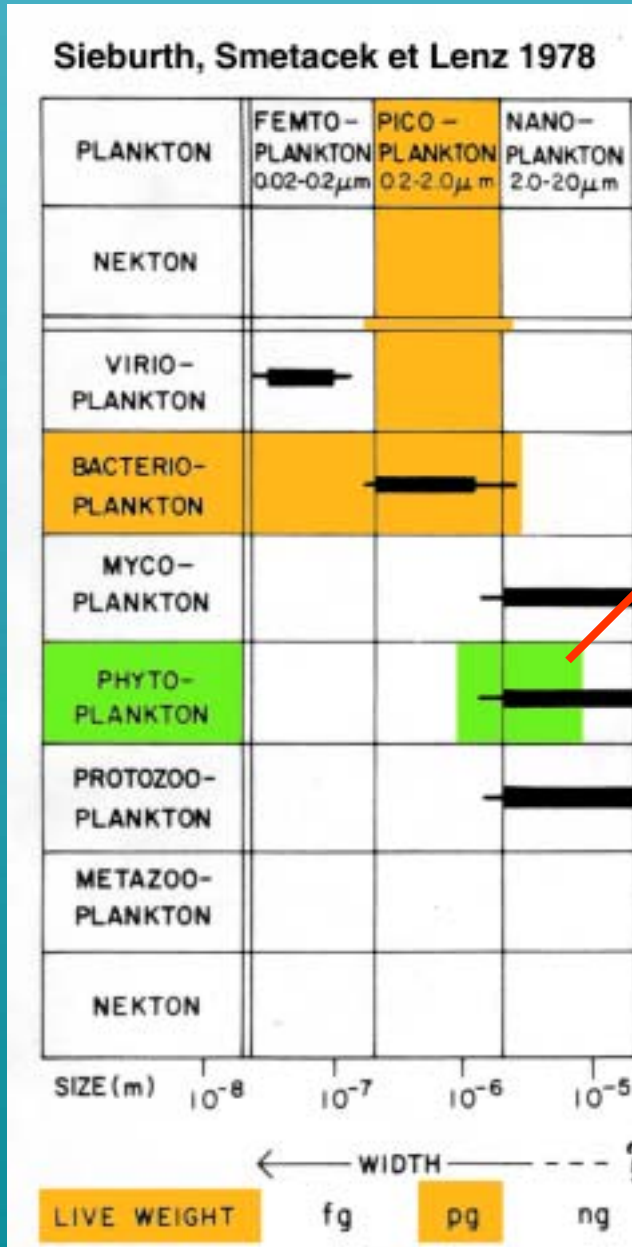


Fig. 1. Distribution of different taxonomic-trophic compartments of plankton in a spectrum of size fractions, with a comparison of size range of nekton.



# Picoplankton versus ultraplankton



PICODIV  
reality



## Ultraplankton:

< 5  $\mu\text{m}$ , e.g., in Drebes (1974)

- < 10  $\mu\text{m}$  Strickland (1960)
- Christensen (1982, 1988);  
ultraplankton = picoplankton = < 2  $\mu\text{m}$

## Ultraphytoplankton:

< 5  $\mu\text{m}$ , e.g., in Beckermann (1996)





*Thank you for your  
attention*

