Семинар

История систем органического мира

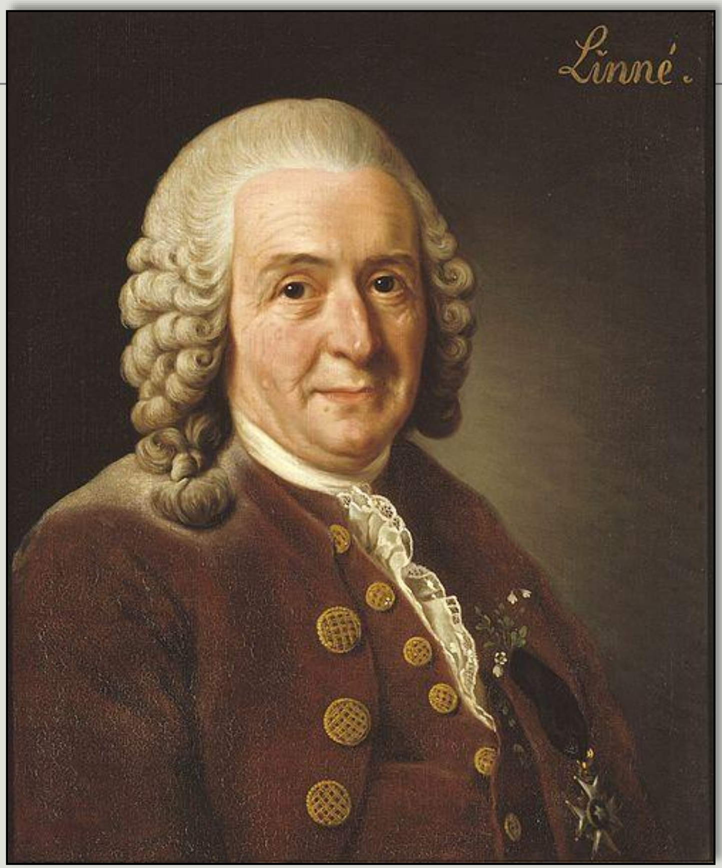
Carolus Linnaeus, 1735, 1758 **2 царства**

Животные (Animalia)

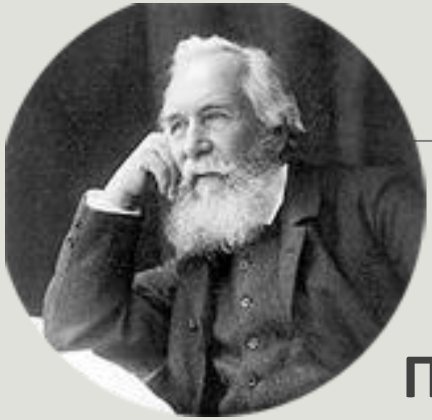
Растения (Vegetabilia), включая водоросли

Systema naturæ sive regna tria naturæ systematice proposita per classes, ordines, genera, & species. Lugduni Batavorum [Leyden]: apud Theodorum Haak. 1735.

Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima, reformata. Holmiæ [Stockholm]: impensis direct. Laurentii Salvii. 1758. [4] Bl., S. 6-823.



История систем органического мира

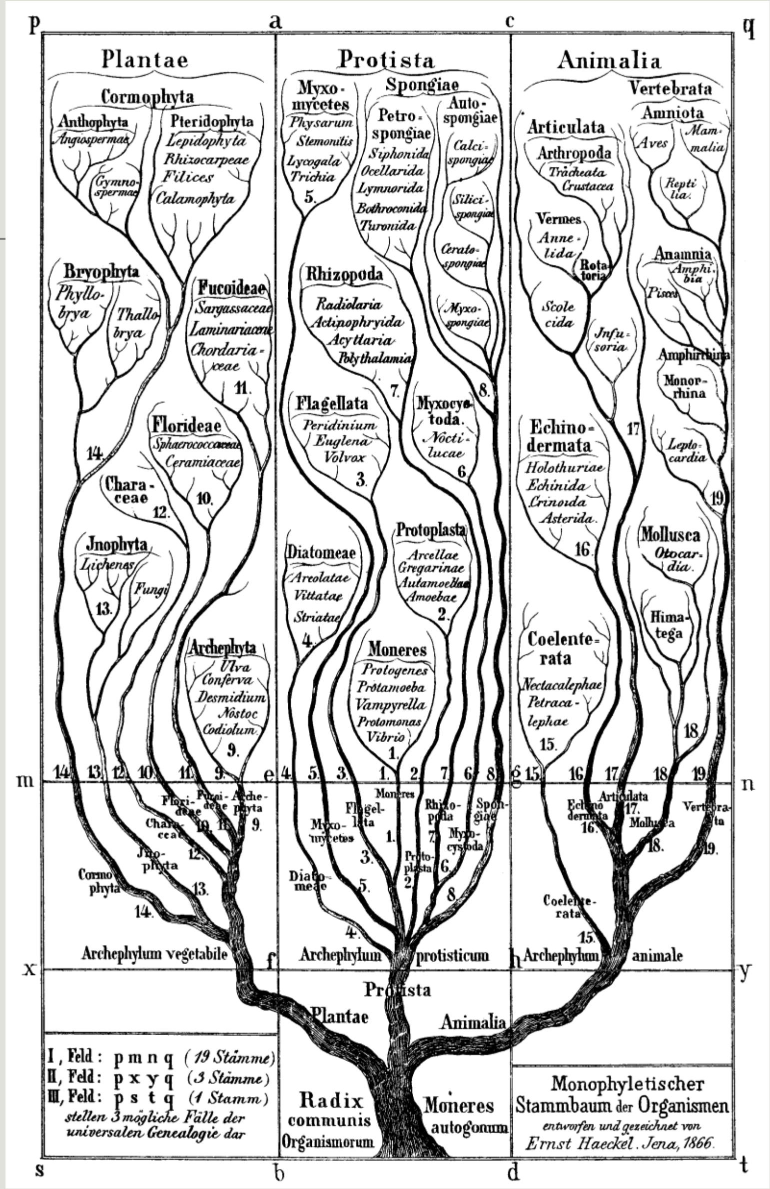


Ernst Haeckel, 1866
3 царства

Простейшие (Protista), включая бактерии, простейшие, некоторые водоросли, грибы

Животные (Animalia)

Растения (Plantae)



«*Generelle Morphologie d. Organismen*» (2 изд., 1866)

История систем органического мира

E.Chatton,1923-1925, 1937

2 империи

Прокариоты (Prokaryota)

Эукариоты (Eukaryota)

Herbert Copeland, 1938, 1956

4 царства

Монера (Monera), включая бактерии и синезеленые водоросли

Простейшие (Protoctista), включая водоросли, грибы, протозоа

Растения (Plantae)

Животные (Animalia)

The kingdoms of organisms", *Quarterly review of biolo* v.13, p. 383-420, 1938.

The classification of lower organisms, Palo Alto, Calif., Pacific Books, 1956

История систем органического мира

Robert Whittaker, 1969

5 царств

1. **Бактерии** (Monera)
2. **Грибы** (Fungi)
3. **Простейшие** (Protista)
4. **Растения** (Plantae)
5. **Животные** (Animalia)

В основу системы положены различия в питании и строении (многоклеточные и одноклеточные)

The kingdoms of the living world. 1957.Ecology, 38:536—38.

New concepts of kingdoms of organisms. 1969.Science, 163:150-60.

История систем органического мира

Woese et al., 1977

6 царств

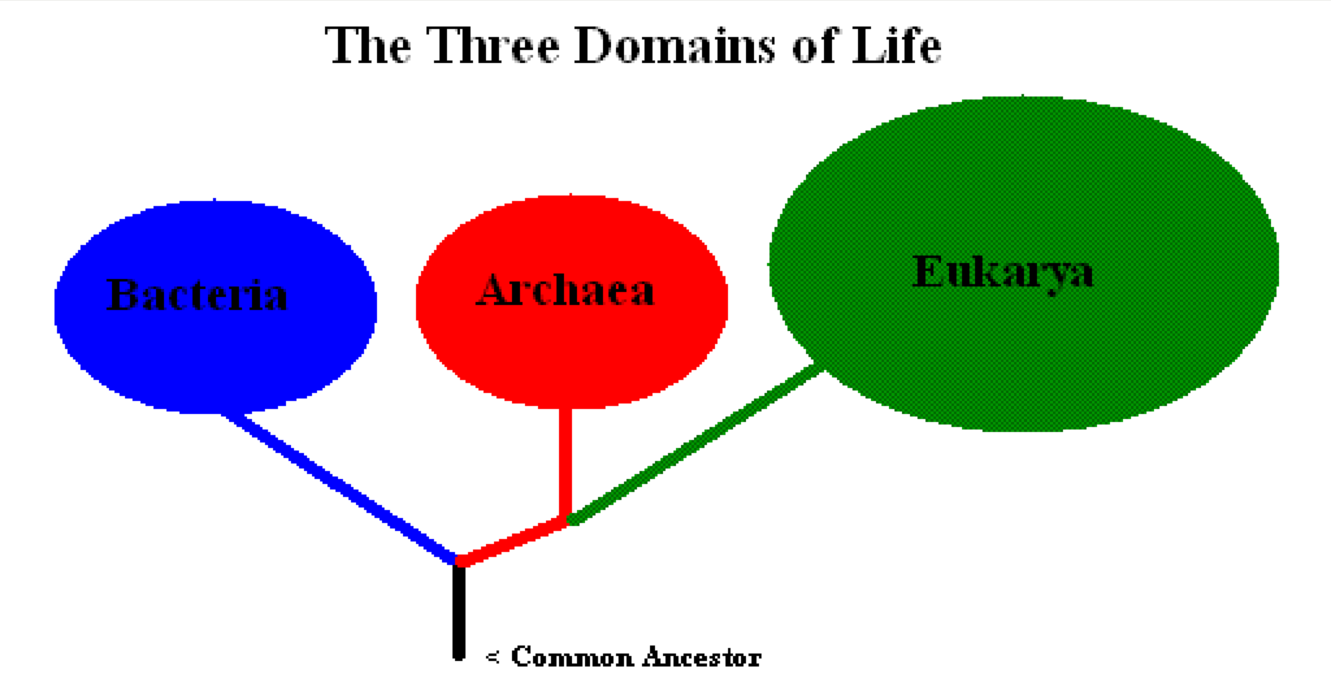
1. **Эубактерии** (Eubacteria)
2. **Археи** (Archaebacteria)
3. **Грибы** (Fungi)
4. **Простейшие** (Protista)
5. **Растения** (Plantae)
6. **Животные** (Animalia)

Phylogenetic structure of the prokaryotic domain: the primary kingdoms. **Woese CR, Fox GE**
Proc Natl Acad Sci U S A. 1977 Nov; 74(11):5088-90.

История систем органического мира

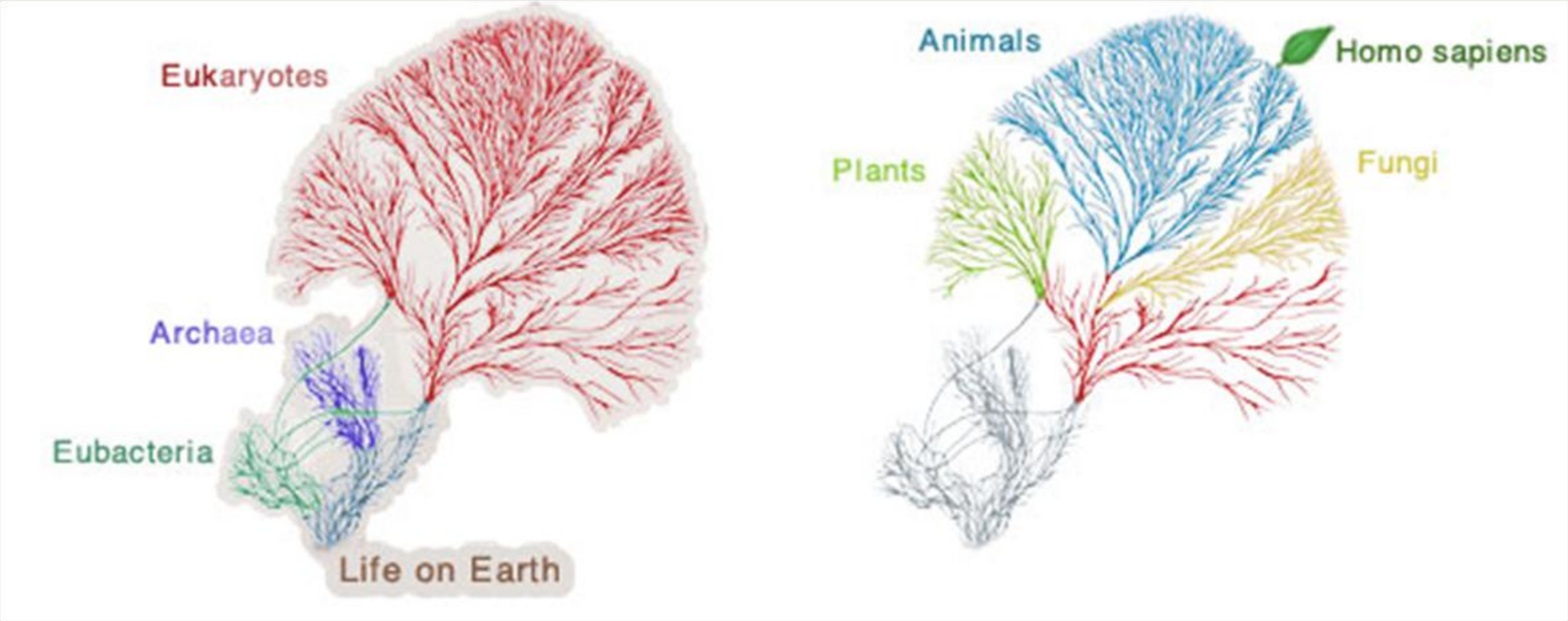
Woese et al. 1990

3 домена



http://commons.wikimedia.org/wiki/File:3_domains_of_life.GIF?uselang=ru

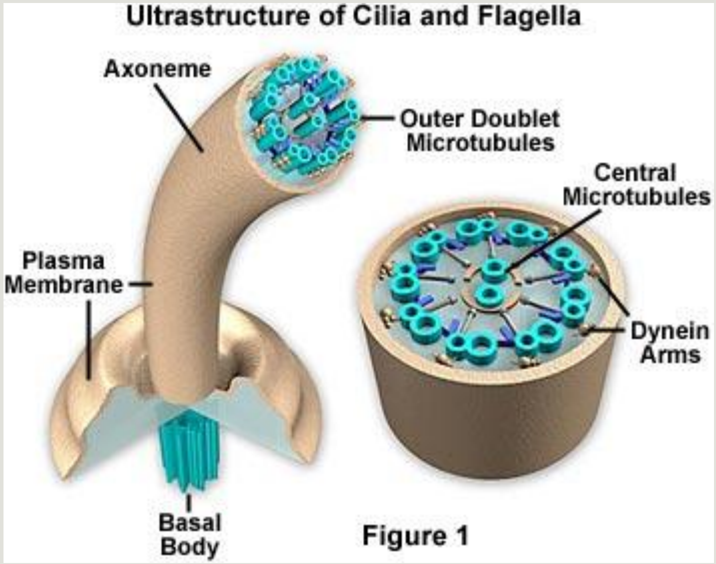
Дерево органического мира

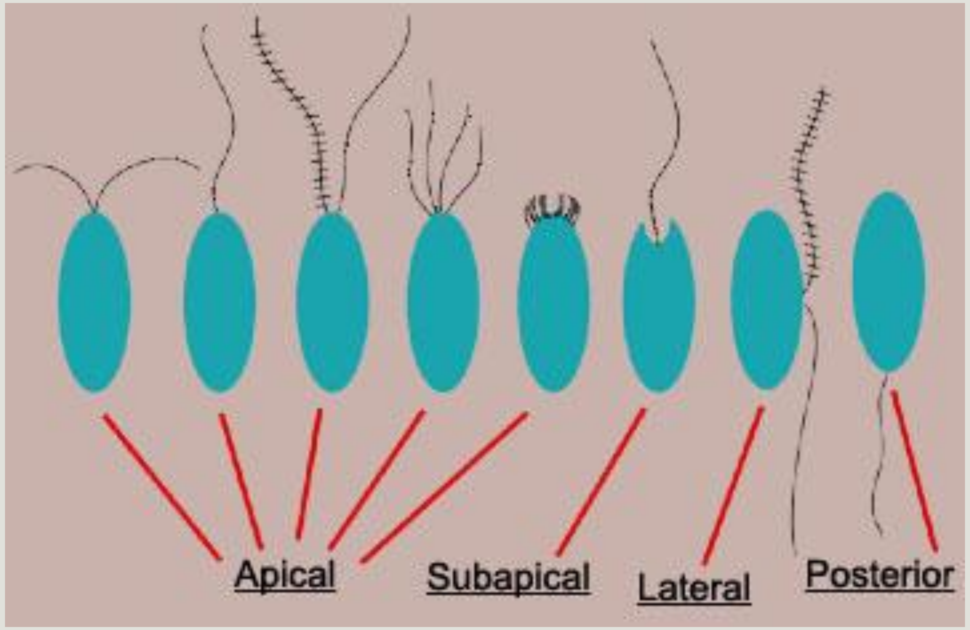


http://commons.wikimedia.org/wiki/File:3_domains_of_life.GIF?uselang=ru

Морфологические признаки, используемые для построения современной системы

1. **Особенности строения жгутикового аппарата**
2. Строение митохондрий
3. Происхождение пластид





http://torresbioclan.pbworks.com/f/1195094236/flagella.jpg

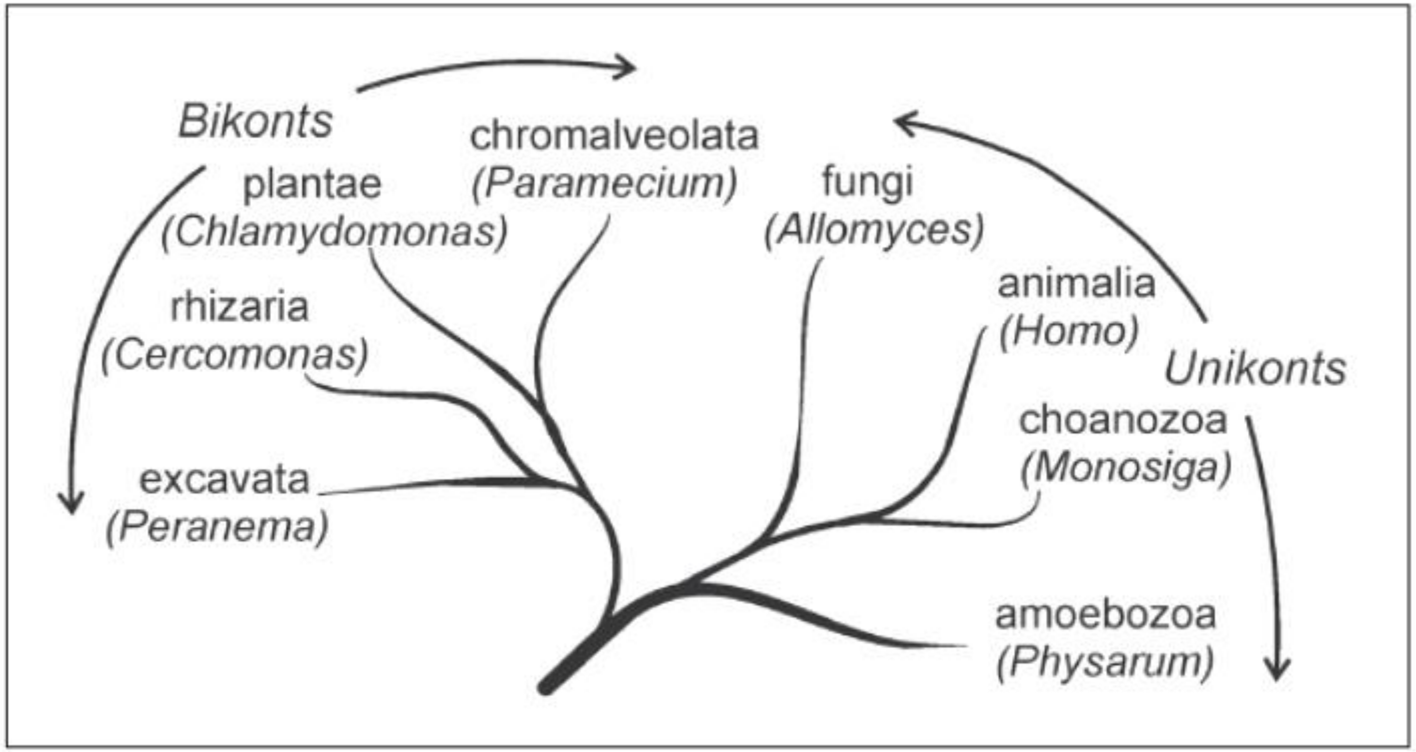
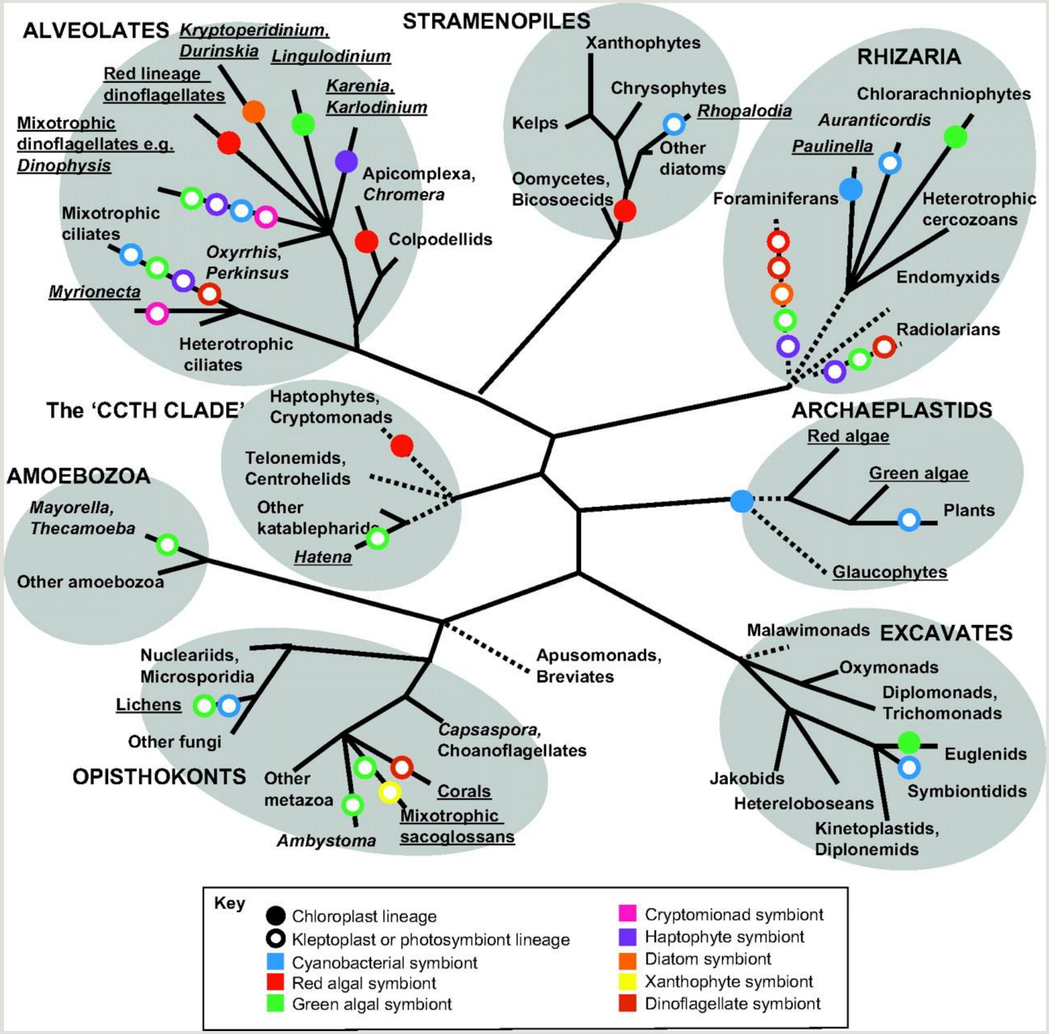


Figure 2. Diagram of probable evolutionary divergence that generated all existing branches of eukaryotic organisms. Under the name of each branch or clade is a the name of a representative genus in that clade that contains species with typical motile 9+2 flagella. Based on recent studies of rare gene fusion events, as well as more traditional sequence comparisons, the entire tree is divided into two superclades, unikonts and bikonts.

Origins and Evolution of Eukaryotic Endomembranes and Cytoskeleton,
edited by Gáspár Jékely. ©2006 Eurekah.com.

David R. Mitchell

The distribution of photosynthesis across the eukaryotes.



Dorrell R G , Howe C J J Cell Sci 2012;125:1865-1875

Морфологические признаки, используемые для построения современной системы

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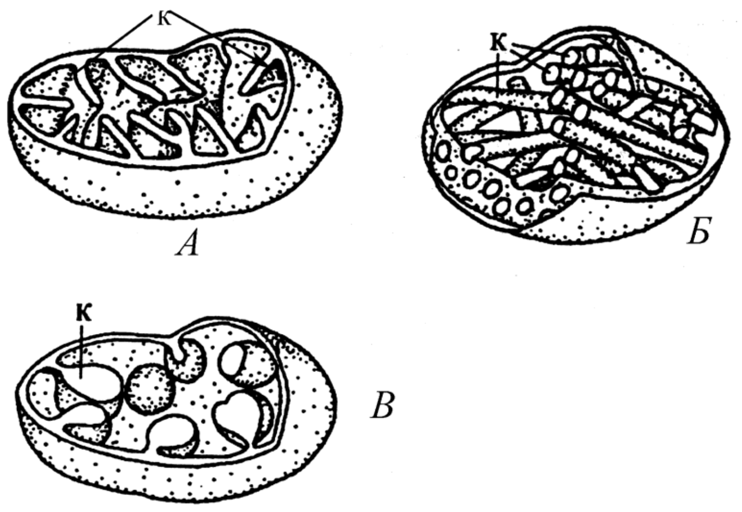
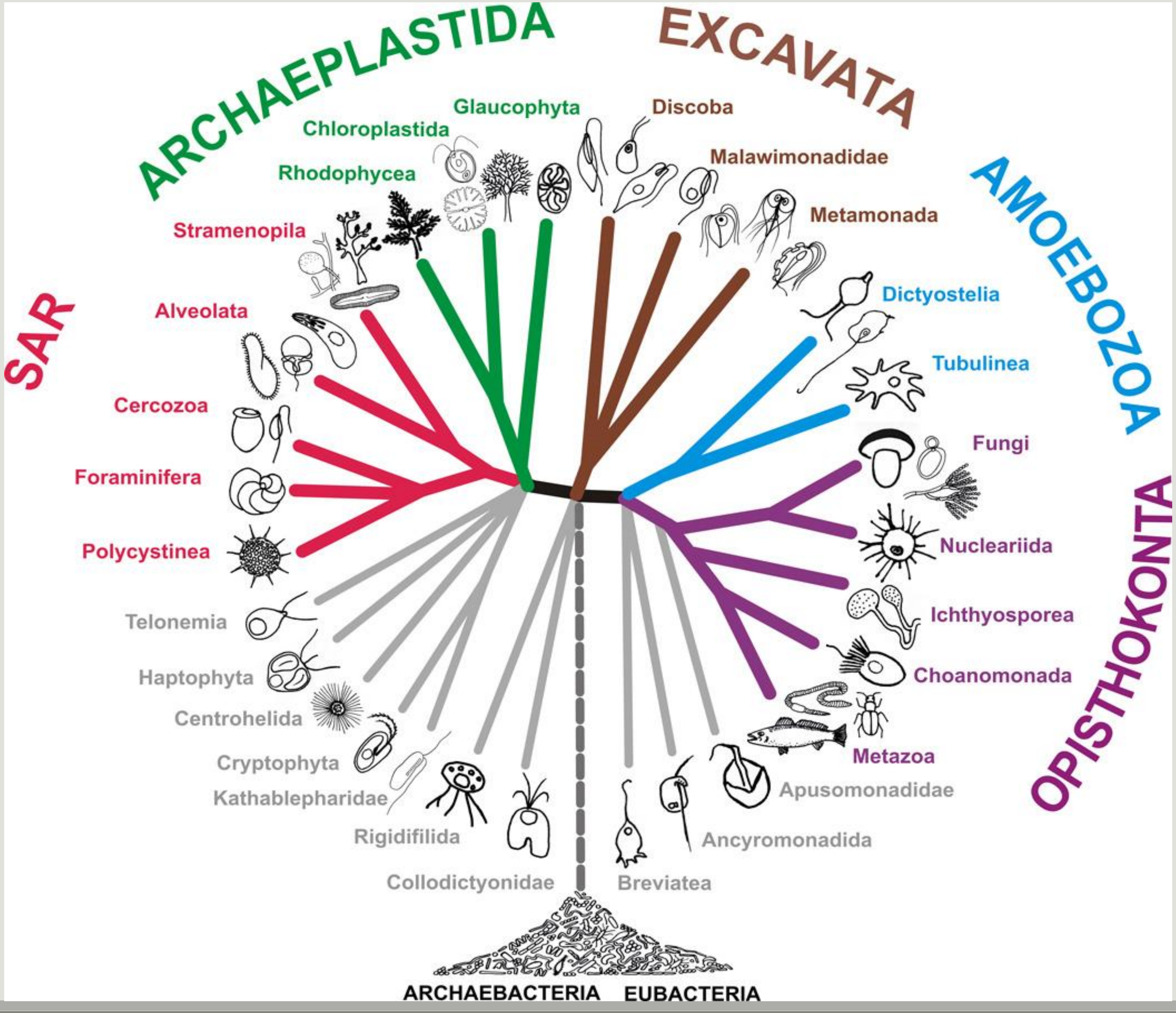


Рис. 22. Различные типы крист (к) митохондрий (по: Кусакин, Дроздов, 1994). *А* - пластинчатые или гребневидные; *Б* - трубчатые; *В* - дисковидные.



J. Eukaryot. Microbiol., 59(5), 2012 pp. 429–493

Морфологические признаки, используемые для построения современной системы

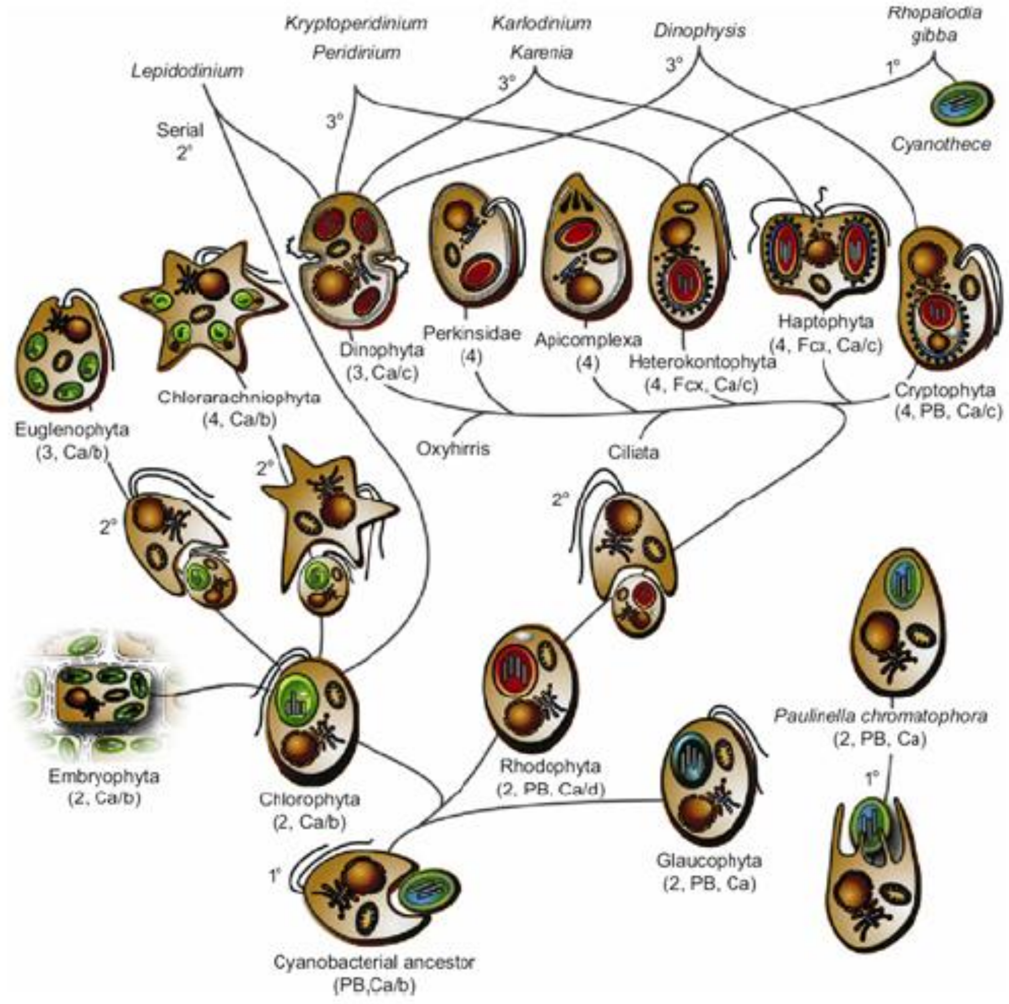


Figure 6. Evolutionary relations of plastids. The main branches diverging from the primary endosymbiotic event are those going to Chlorophyta (the 'green line') and Rhodophyta (the 'red line'), but even before their divergence the Glaucophyta plastids branch-off. For an explanation of other relationships, see text. From Gould *et al.*[59]. Reprinted, with permission, from the *Annual Review of Plant Biology*, vol. 59. © 2008 by Annual Reviews http://www.annualreviews.org/.

CURRENT SCIENCE, VOL. 96, NO. 11, 10 JUNE 2009

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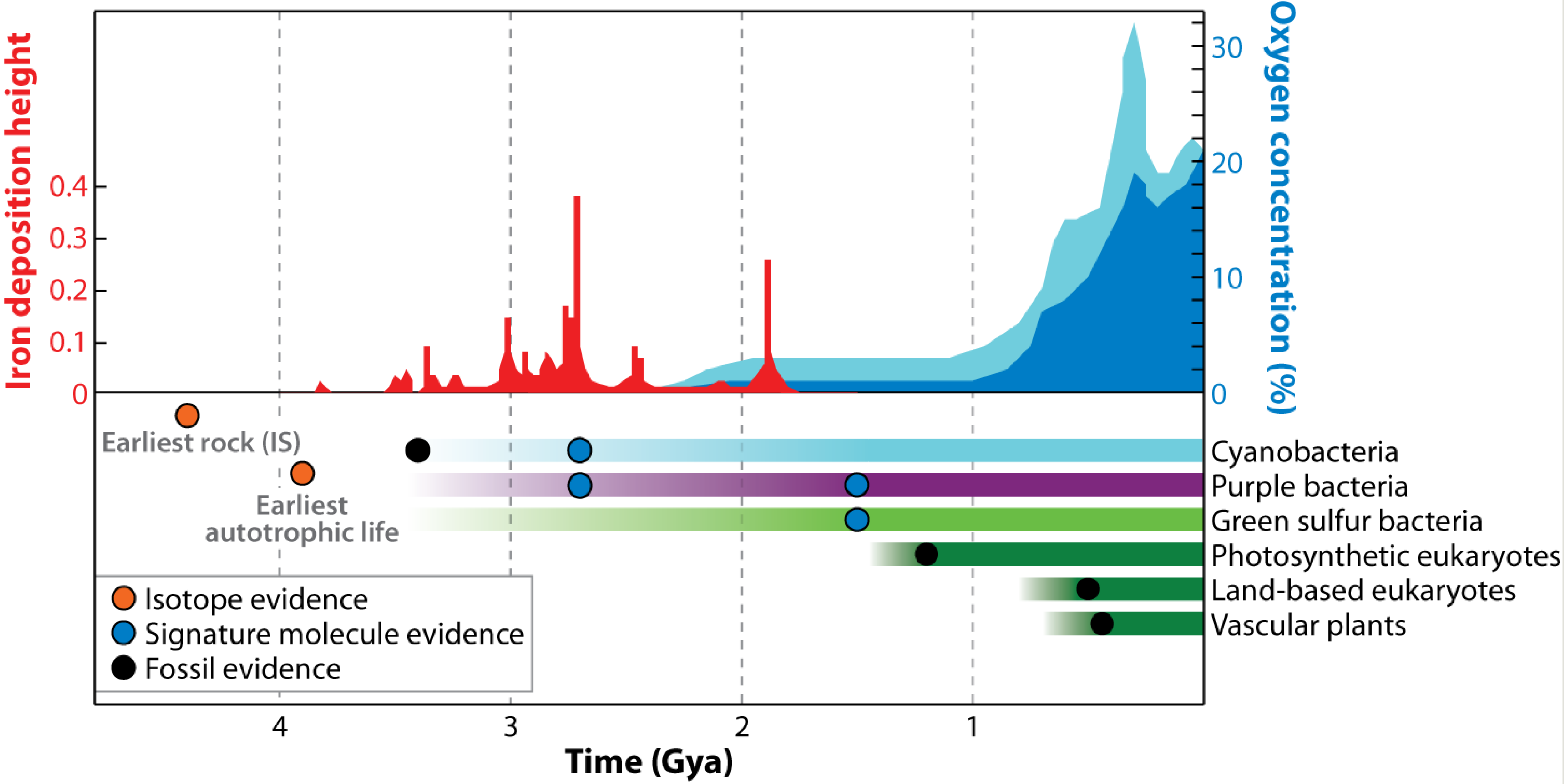
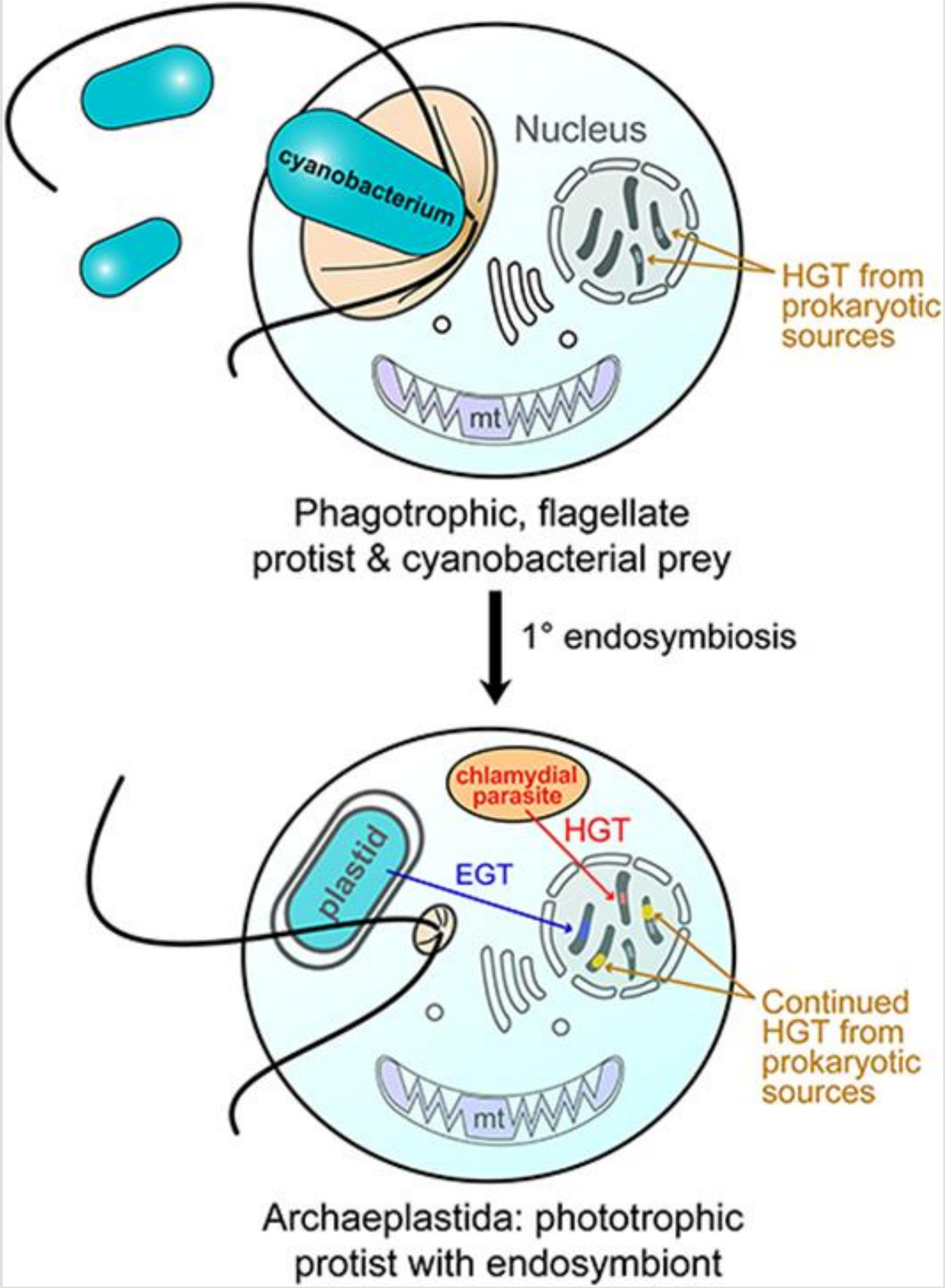
3. **Происхождение пластид**



Hohmann-Marriott MF, Blankenship RE. 2011.
Annu. Rev. Plant Biol. 62:515–48

Происхождение пластид



Front. Ecol. Evol., 17 October 2014 | doi: 10.3389/fevo.2014.00066

Primary endosymbiosis and the evolution of light and oxygen sensing in photosynthetic eukaryotes

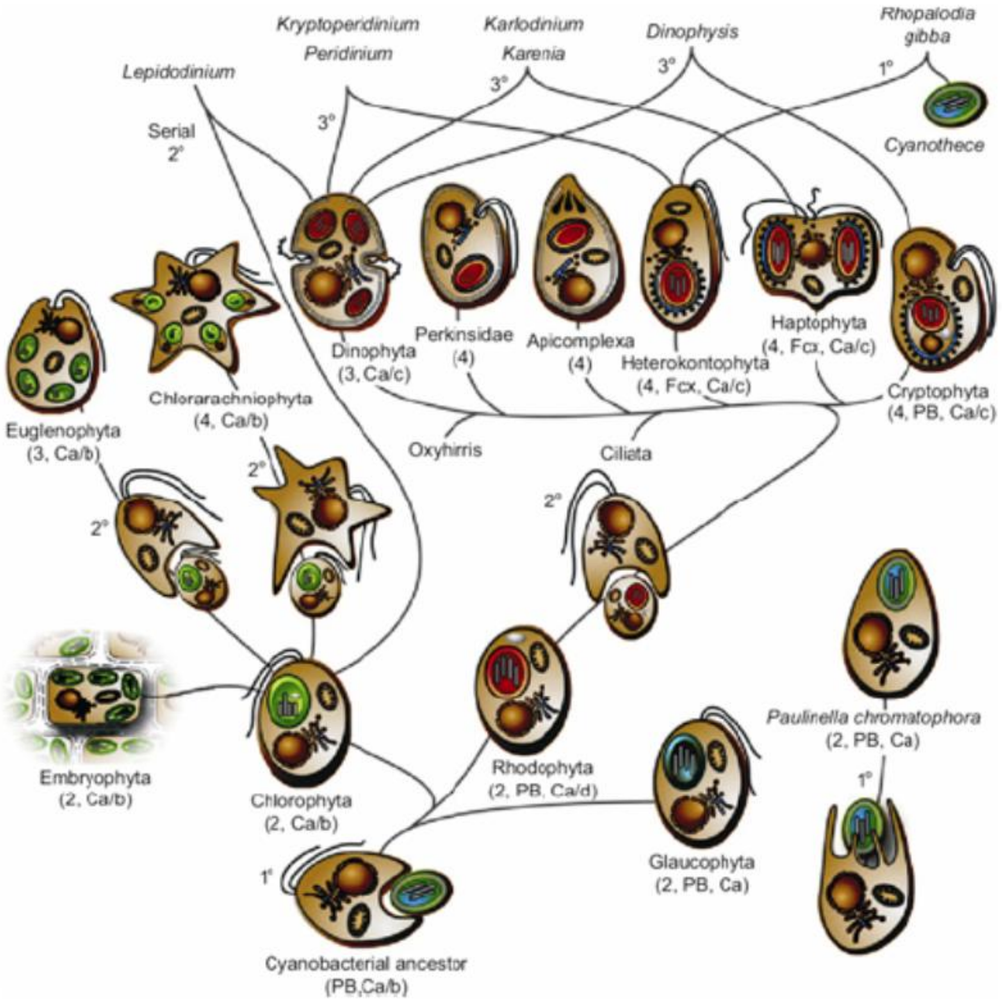
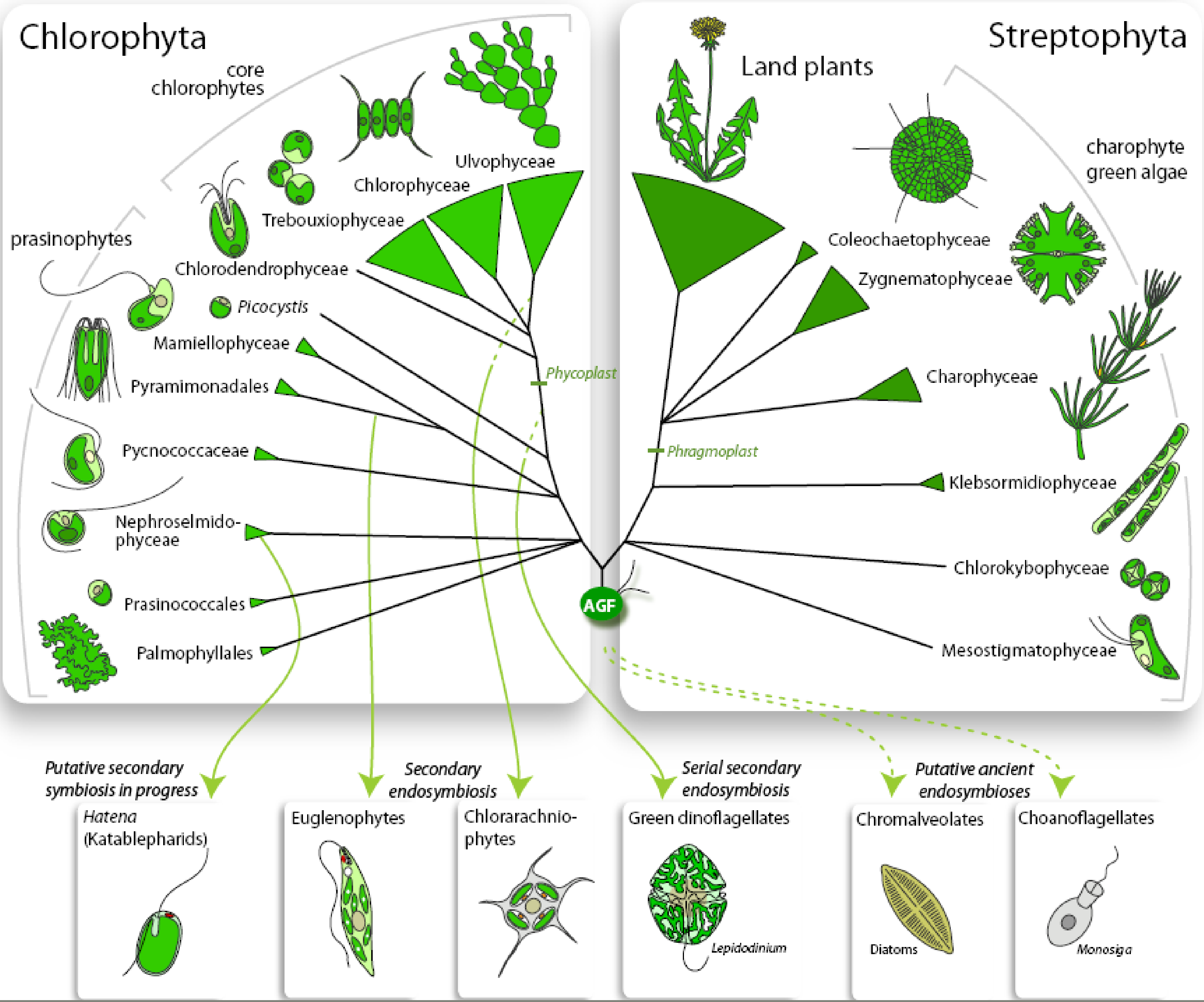


Figure 6. Evolutionary relations of plastids. The main branches diverging from the primary endosymbiotic event are those going to Chlorophyta (the 'green line') and Rhodophyta (the 'red line'), but even before their divergence the Glaucophyta plastids branch-off. For an explanation of other relationships, see text. From Gould *et al.*[59]. Reprinted, with permission, from the *Annual Review of Plant Biology*, vol. 59. © 2008 by Annual Reviews http://www.annualreviews.org/.



Chlorophyta
core chlorophytes
Ulvophyceae
Chlorophyceae
Trebouxiophyceae
prasinophytes
Chlorodendrophyceae
Picocystis
Mamiellophyceae
Pyramimonadales
Pycnococcaceae
Nephroselmido-phyceae
Prasinococcales
Palmophyllales
Phycoplast
AGF
Streptophyta
Land plants
charophyte green algae
Coleochaetophyceae
Zygnematophyceae
Charophyceae
Phragmoplast
Klebsormidiophyceae
Chlorokybophyceae
Mesostigmatophyceae
Putative secondary symbiosis in progress
Secondary endosymbiosis
Serial secondary endosymbiosis
Putative ancient endosymbioses
Hatena (Katablepharids)
Euglenophytes
Chlorarachnio-phytes
Green dinoflagellates
Lepidodinium
Chromalveolates
Diatoms
Choanoflagellates
Monosiga

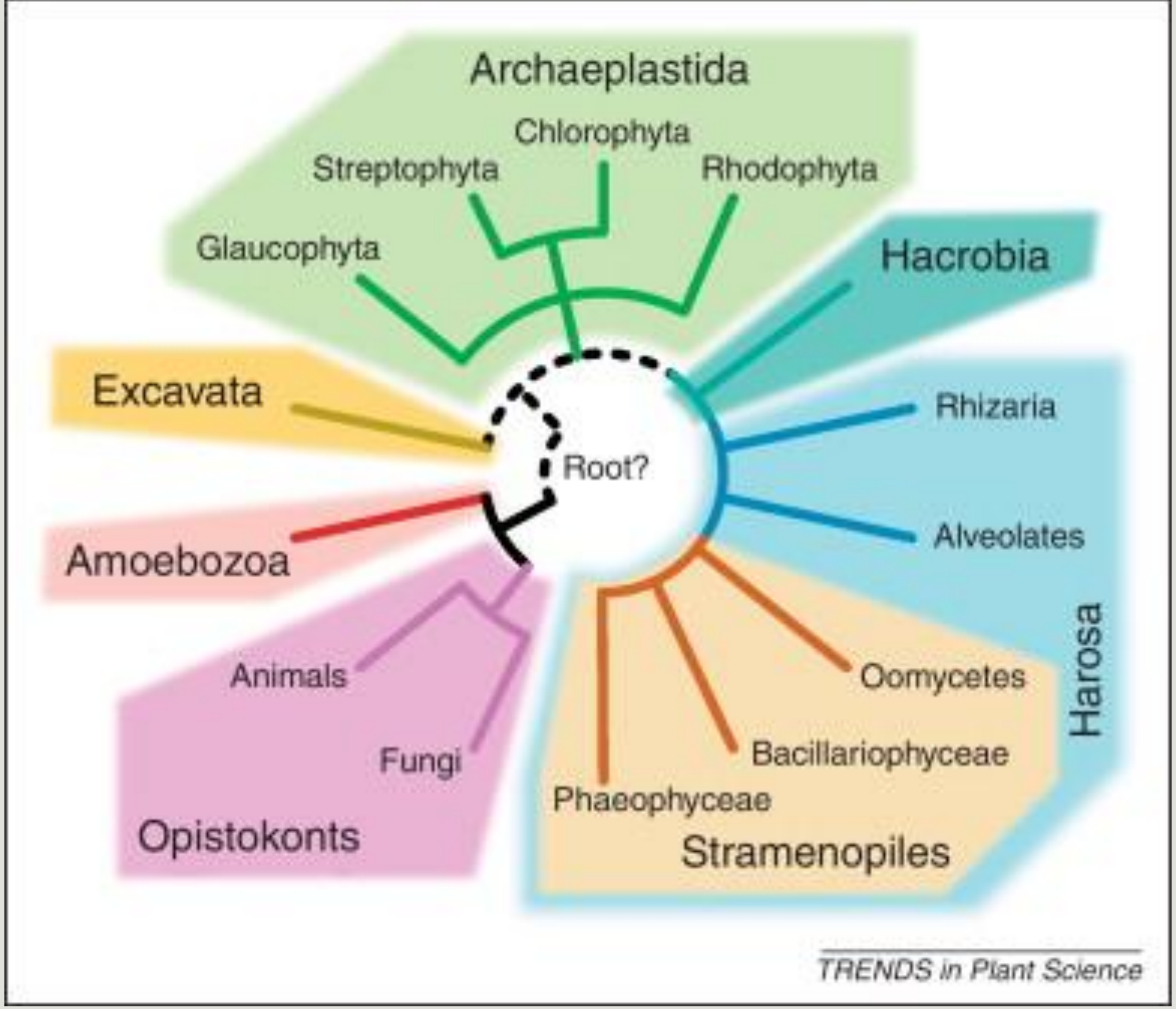


Figure 1 Eukaryotic tree of life. The phylogenetic relationships between Unikonta (including Opisthokonta), Excavata, Archaeplastida, Hacrobia and Harosa (or SAR for Stramenopiles–Alveolates–Rhizaria) are shown (based on, among others, <ce:cross-refs refid…

Bénédicte Charrier , Aude Le Bail , Bruno de Reviers

Plant Proteus: brown algal morphological plasticity and underlying developmental mechanisms

Trends in Plant Science, Volume 17, Issue 8, 2012, 468 - 477
http://dx.doi.org/10.1016/j.tplants.2012.03.003

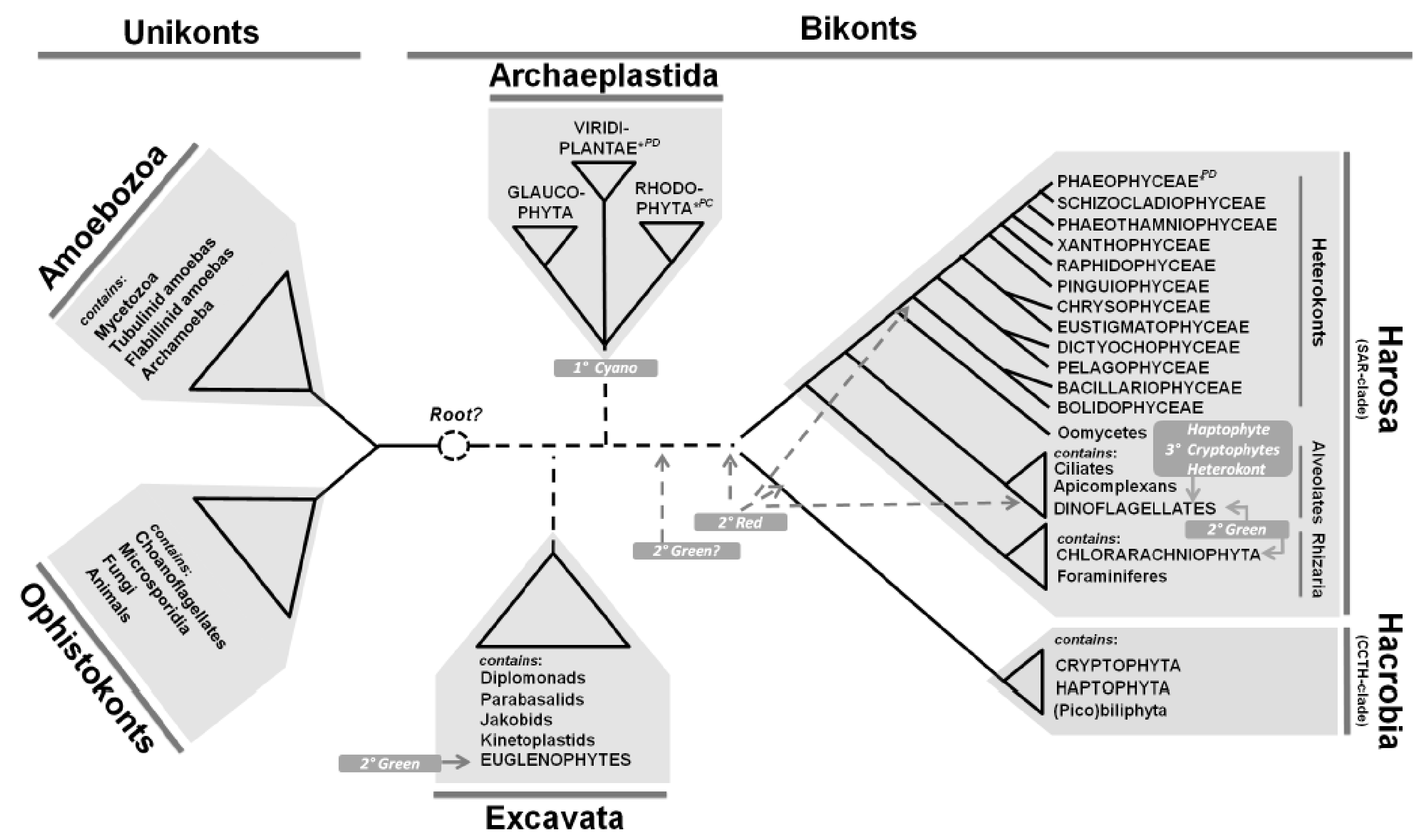
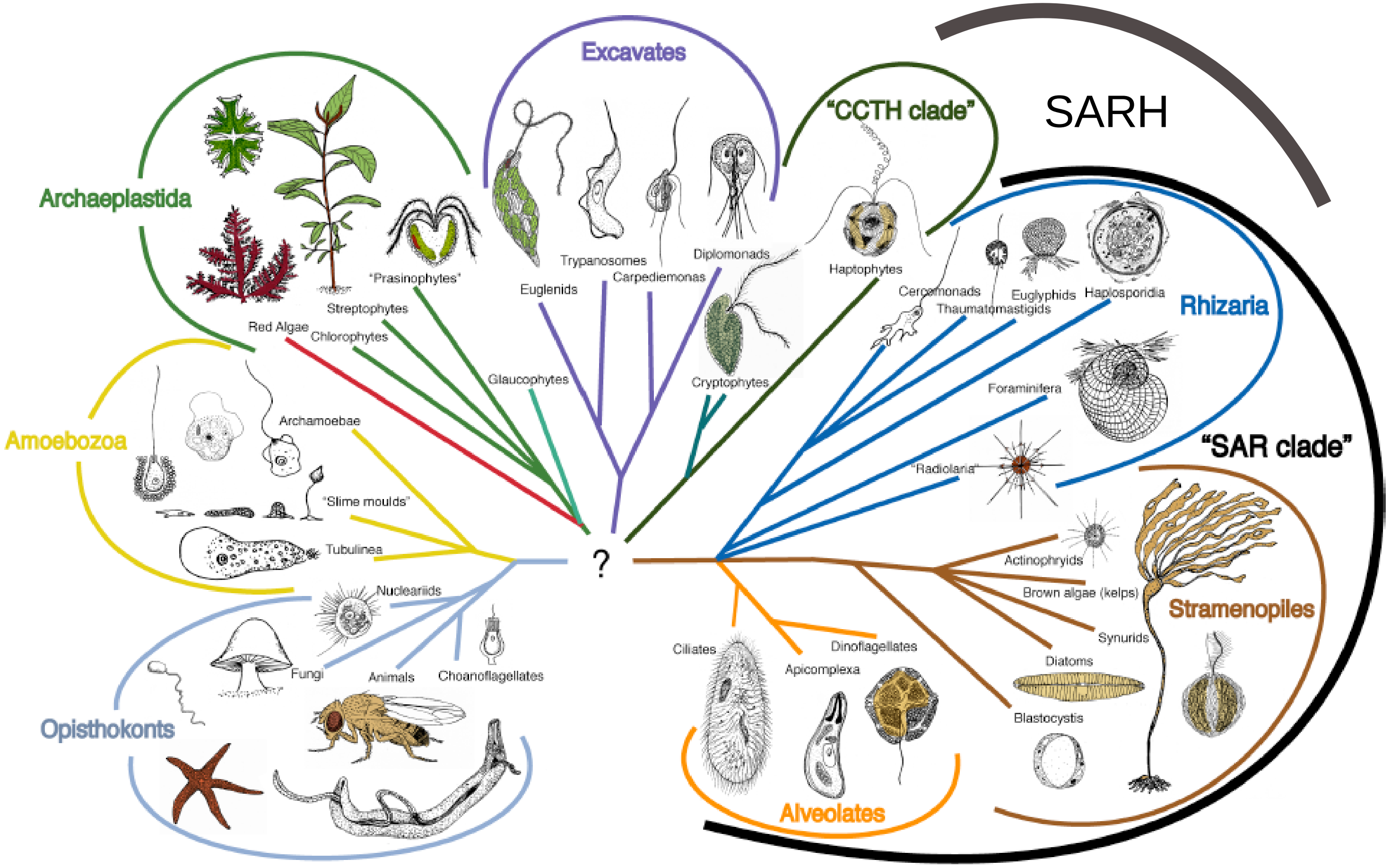


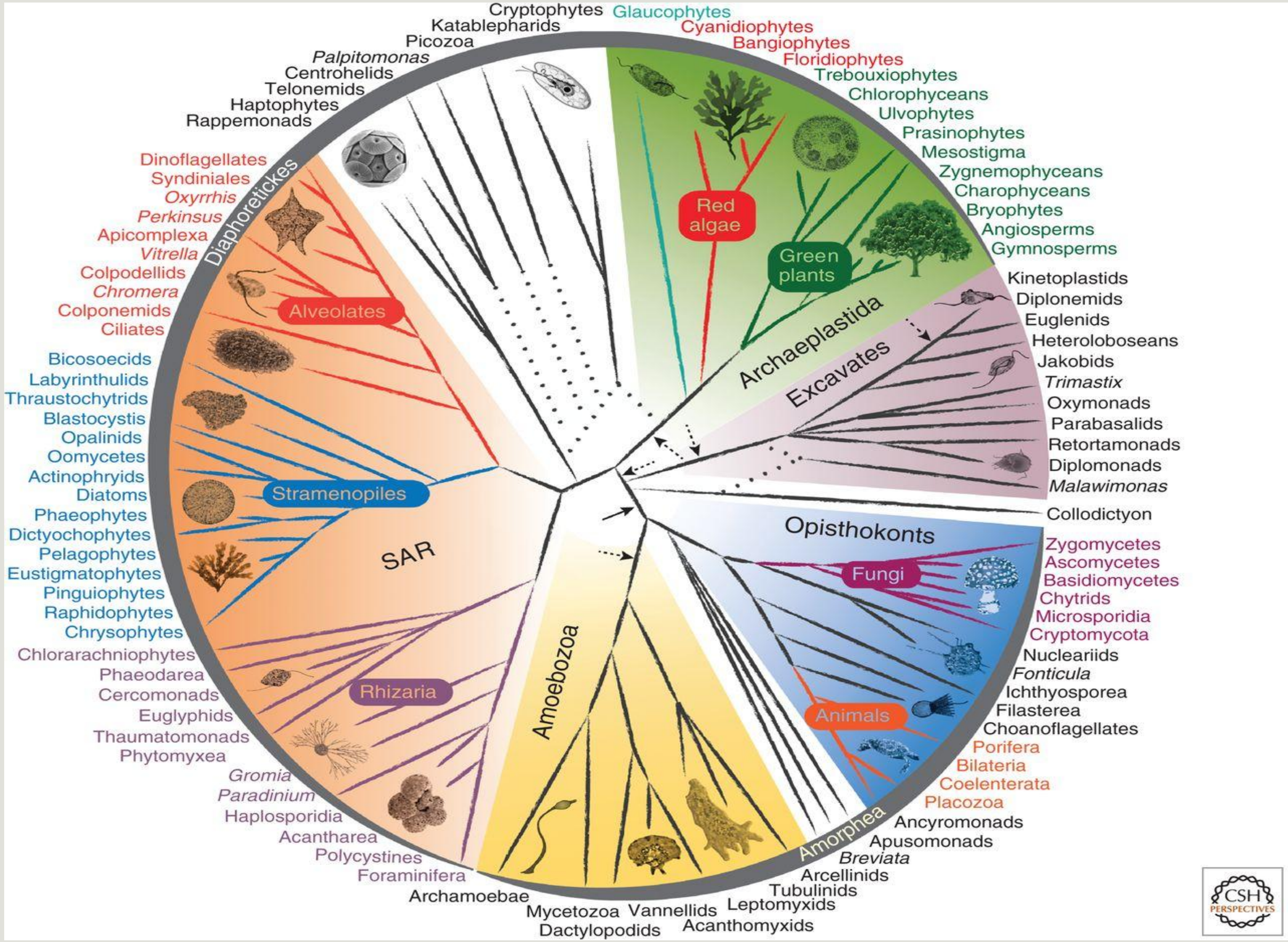
Figure 1. Relationships between major eukaryotic lineages (after (3, 15, 19, 20, 212-217)) indicating photosynthetic lineages and complex multicellularity. Endosymbiotic gene transfer is indicated with gray rectangles specifying the nature of the organelle donor. Dashed lines, and question marks refer to controversial phylogenetic relationships among the hypothesized "supergroups". Unresolved relationships are indicated as polytomies. Clades containing photosynthetic eukaryotes are marked with capitals. Parenchymatous photosynthetic lineages are marked by an asterisk, (1°) Primary endosymbiosis, (2°) secondary endosymbiosis, (3°) tertiary endosymbiosis, (PD) multicellularity by means of plasmodesmata (Phaeophyceae & Viridiplantae), (PC) multicellularity by means of pit connections (Rhodophyta), endosymbiotic relationships are indicated by grey rectangles. Branch lengths are not proportional to time.

Bogaert K.A., Arun A., Coelho S. & De Clerck O. (2012)
Brown algae as a model for plant organogenesis
In: De Smet I. (ed.) *Methods in Molecular Biology - Plant Organogenesis.* Springer Verlag. 97-125



Supplementary online material to:
Walker G., Dorrell R.G., Schlacht A., Dacks J.B. (2011): Eukaryotic systematics: a 2011 user's guide for cell biologists and parasitologists. *Parasitology* **138,** 1-26.

Global tree of eukaryotes from a consensus of phylogenetic evidence (in particular, phylogenomics), rare genomic signatures, and morphological characteristics.



Burki F Cold Spring Harb Perspect Biol 2014;6:a016147

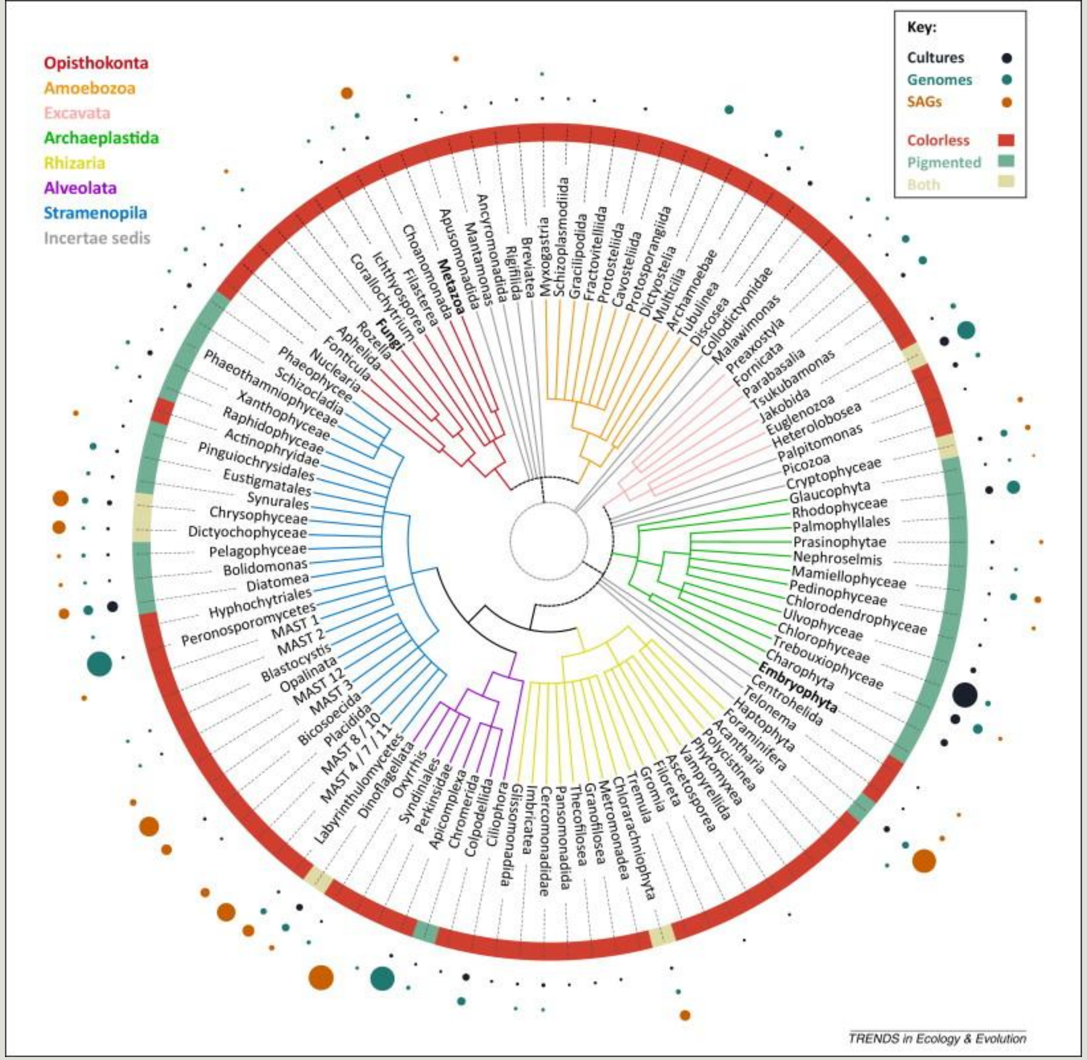


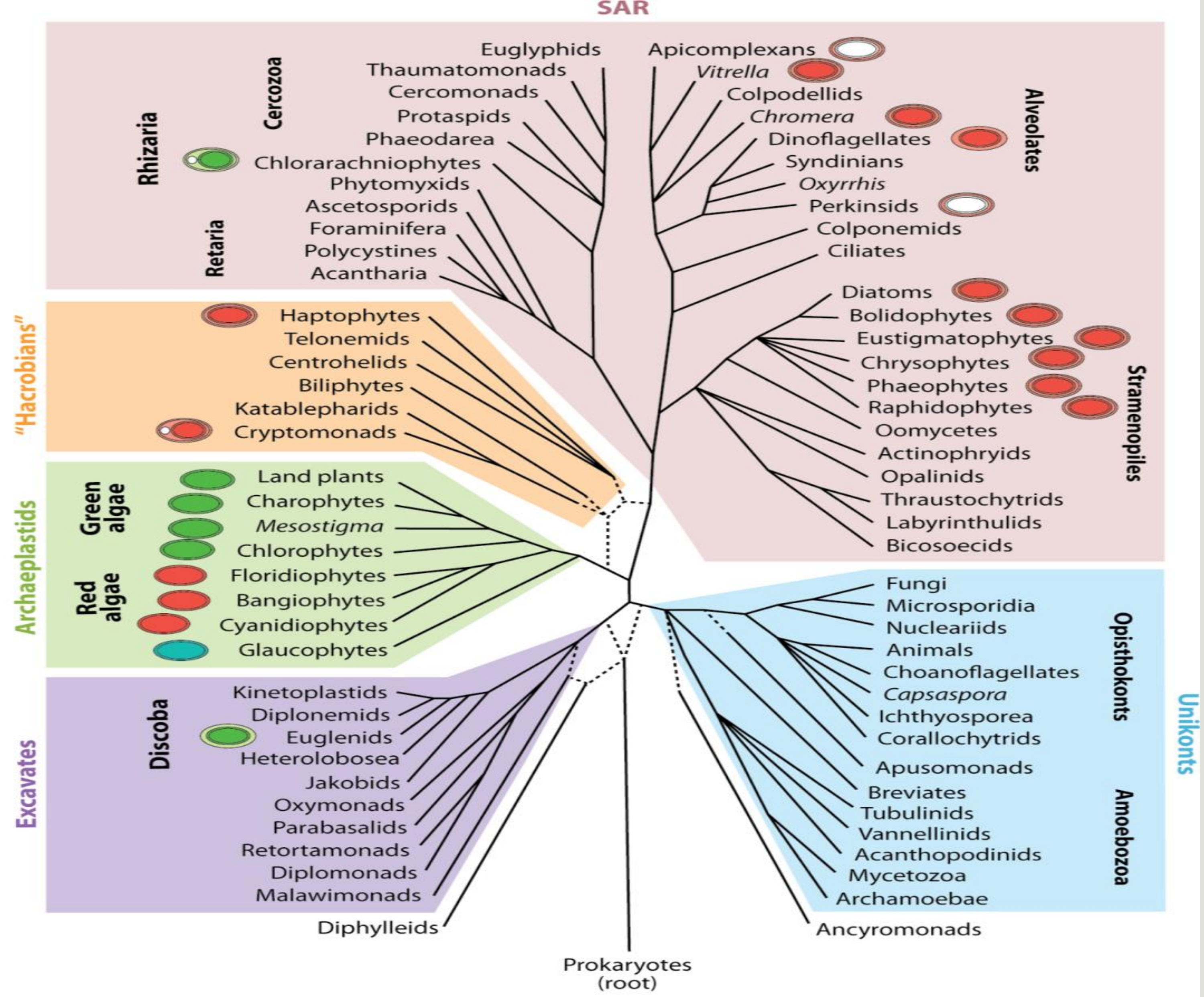
Figure 4 The tree of eukaryotes, showing the distribution of current effort on culturing, genomics, and environmental single amplified genome (SAG) genomics for the main protistan lineages. Eukaryotic schematic tree representing major lineages. Colored bra...

Javier del Campo , Michael E. Sieracki , Robert Molestina , Patrick Keeling , Ramon Massana , Iñaki Ruiz-Trillo

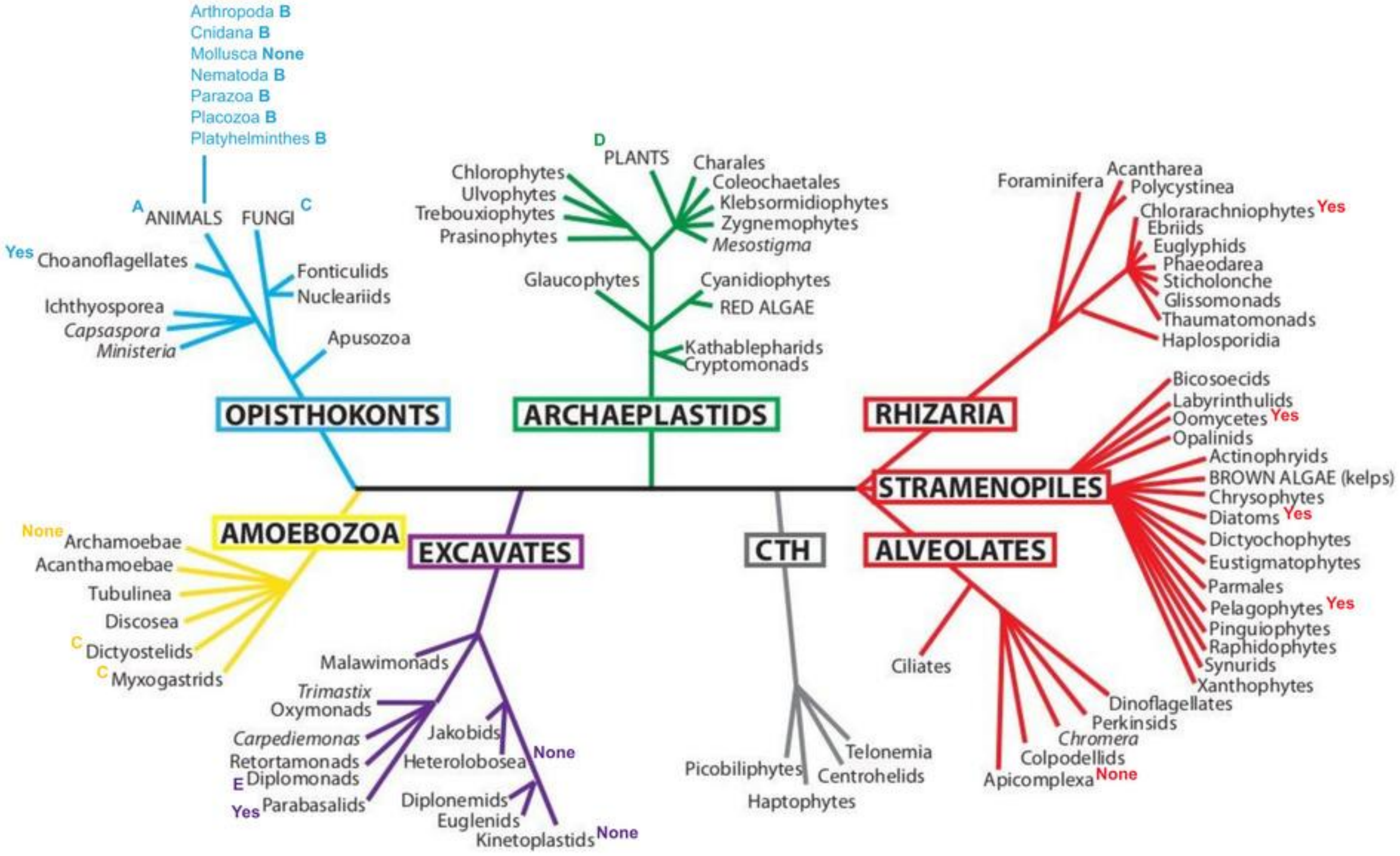
The others: our biased perspective of eukaryotic genomes

Trends in Ecology & Evolution, Volume 29, Issue 5, 2014, 252 - 259

http://dx.doi.org/10.1016/j.tree.2014.03.006



Keeling PJ. 2013.
Annu. Rev. Plant Biol. 64:583–607

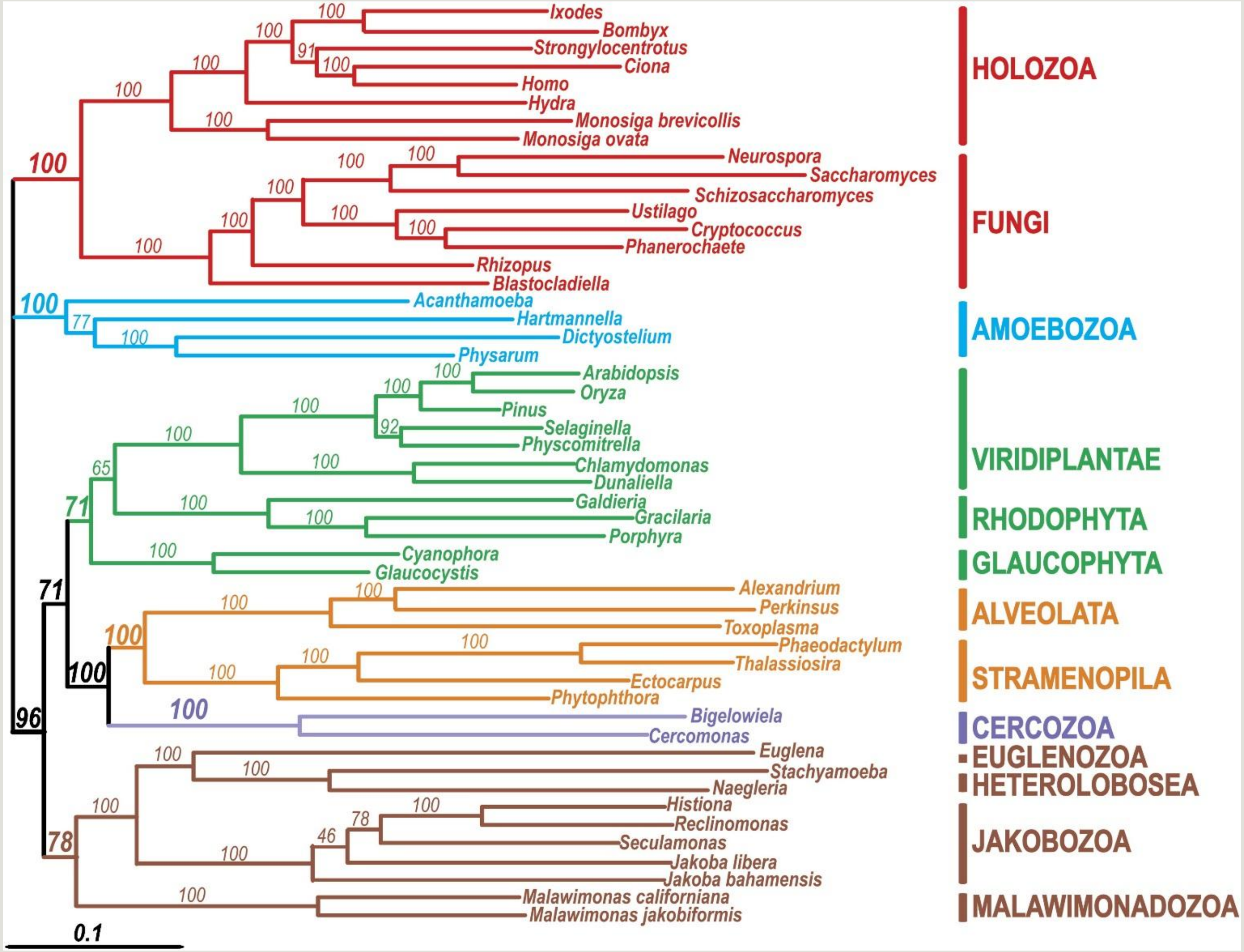


Arthropoda B
Cnidana B
Mollusca None
Nematoda B
Parazoa B
Placozoa B
Platyhelminthes B
A ANIMALS
FUNGI C
Yes Choanoflagellates
Fonticulids
Nucleariids
Ichthyosporea
Capsaspora
Ministeria
Apusozoa
OPISTHOKONTS
D PLANTS
Chlorophytes
Ulvophytes
Trebouxiophytes
Prasinophytes
Charales
Coleochaetales
Klebsormidiophytes
Zygnemophytes
Mesostigma
Glaucophytes
Cyanidiophytes
RED ALGAE
Kathablepharids
Cryptomonads
ARCHAEPLASTIDS
Foraminifera
Acantharea
Polycystinea
Chlorarachniophytes Yes
Ebriids
Euglyphids
Phaeodarea
Sticholonche
Glissomonads
Thaumatomonads
Haplosporidia
RHIZARIA
Bicosoecids
Labyrinthulids
Oomycetes Yes
Opalinids
Actinophryids
BROWN ALGAE (kelps)
Chrysophytes
Diatoms Yes
Dictyochophytes
Eustigmatophytes
Parmales
Pelagophytes Yes
Pinguiophytes
Raphidophytes
Synurids
Xanthophytes
STRAMENOPILES
None Archamoebae
Acanthamoebae
Tubulinea
Discosea
C Dictyostelids
C Myxogastrids
AMOEBOZOA
EXCAVATES
Malawimonads
Trimastix
Oxymonads
Carpediemonas
Retortamonads
E Diplomonads
Yes Parabasalids
Jakobids
Heterolobosea None
Diplonemids
Euglenids
Kinetoplastids None
CTH
Picobiliphytes
Telonemia
Centrohelids
Haptophytes
ALVEOLATES
Ciliates
Dinoflagellates
Perkinsids
Chromera
Colpodellids
Apicomplexa None

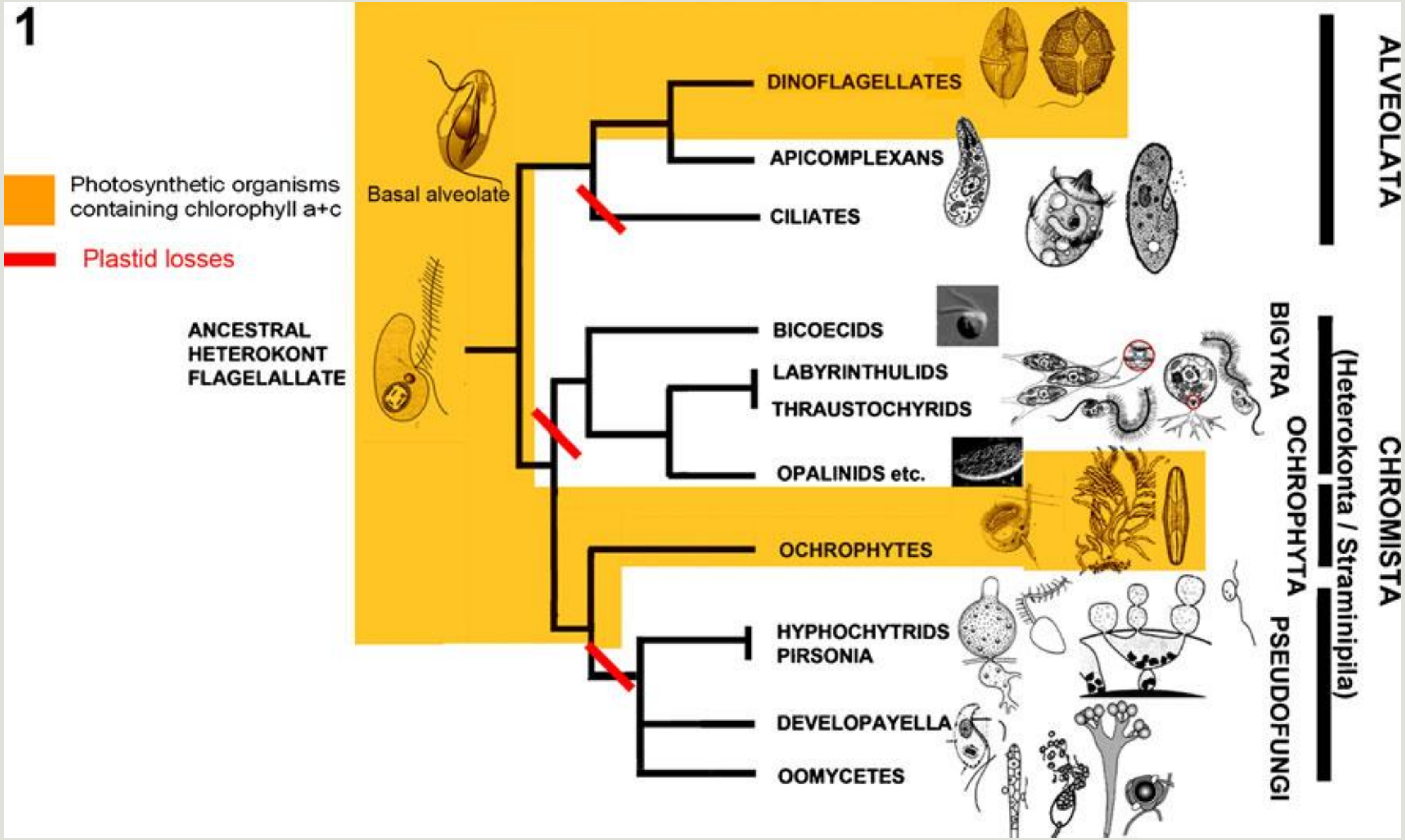
Супергруппа Excavata

Superphylum	Phylum/Class	Representative genera (examples)	Description
Discoba or JEH	Euglenozoa	*Euglena*, *Trypanosoma*	Many important parasites, one large group with plastids (chloroplasts)
	Heterolobosea (Percolozoa)	*Naegleria*, *Acrasis*	Most alternate between flagellate and amoeboid forms
	Jakobea	*Jakoba*, *Reclinomonas*	Free-living, sometimes loricate flagellates, with very gene-rich mitochondrial genomes
Metamonada or POD	Preaxostyla	Oxymonads, *Trimastix*	Amitochondriate flagellates, either free-living (*Trimastix*) or living in the hindguts of insects
	Fornicata	*Giardia*, *Carpediemonas*	Amitochondriate, mostly symbiotes and parasites of animals.
	Parabasalia	*Trichomonas*	Amitochondriate flagellates, generally intestinal commensals of insects. Some human pathogens.

Figure 3



Current Biology 2007 17, 1420-1425DOI: (10.1016/j.cub.2007.07.036)


1
Photosynthetic organisms containing chlorophyll a+c
Plastid losses
Basal alveolate
ANCESTRAL HETEROKONT FLAGELALLATE
DINOFLAGELLATES
APICOMPLEXANS
CILIATES
BICOECIDS
LABYRINTHULIDS
THRAUSTOCHYRIDS
OPALINIDS etc.
OCHROPHYTES
HYPHOCHYTRIDS
PIRSONIA
DEVELOPAYELLA
OOMYCETES
ALVEOLATA
CHROMISTA
(Heterokonta / Straminipila)
BIGYRA
OCHROPHYTA
PSEUDOFUNGI

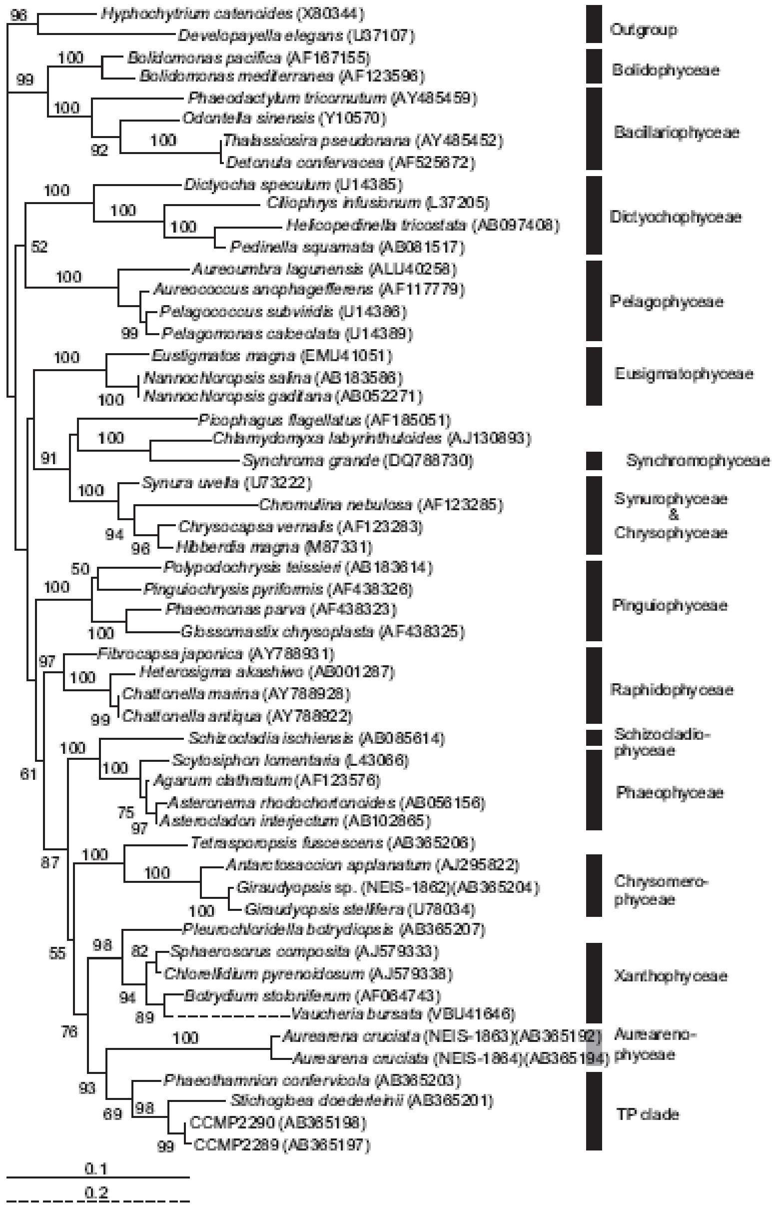


Figure 16. Phylogenetic tree based on 18S rDNA sequences and constructed using maximum likelihood method. Bootstrap values larger than 50% are shown at the internal branches. Unambiguously aligned 1593 nucleotide positions from 54 species were used for the analysis.

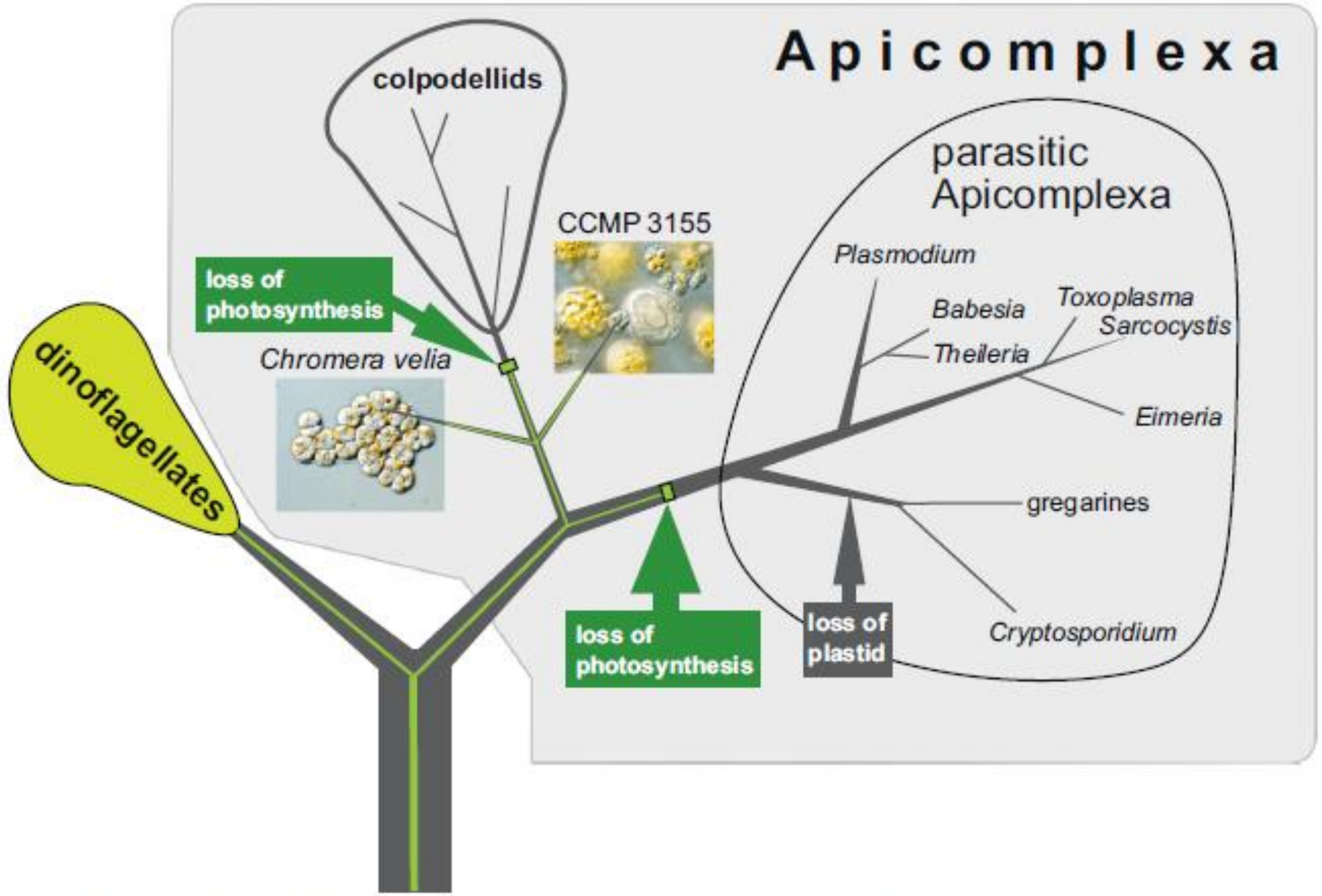
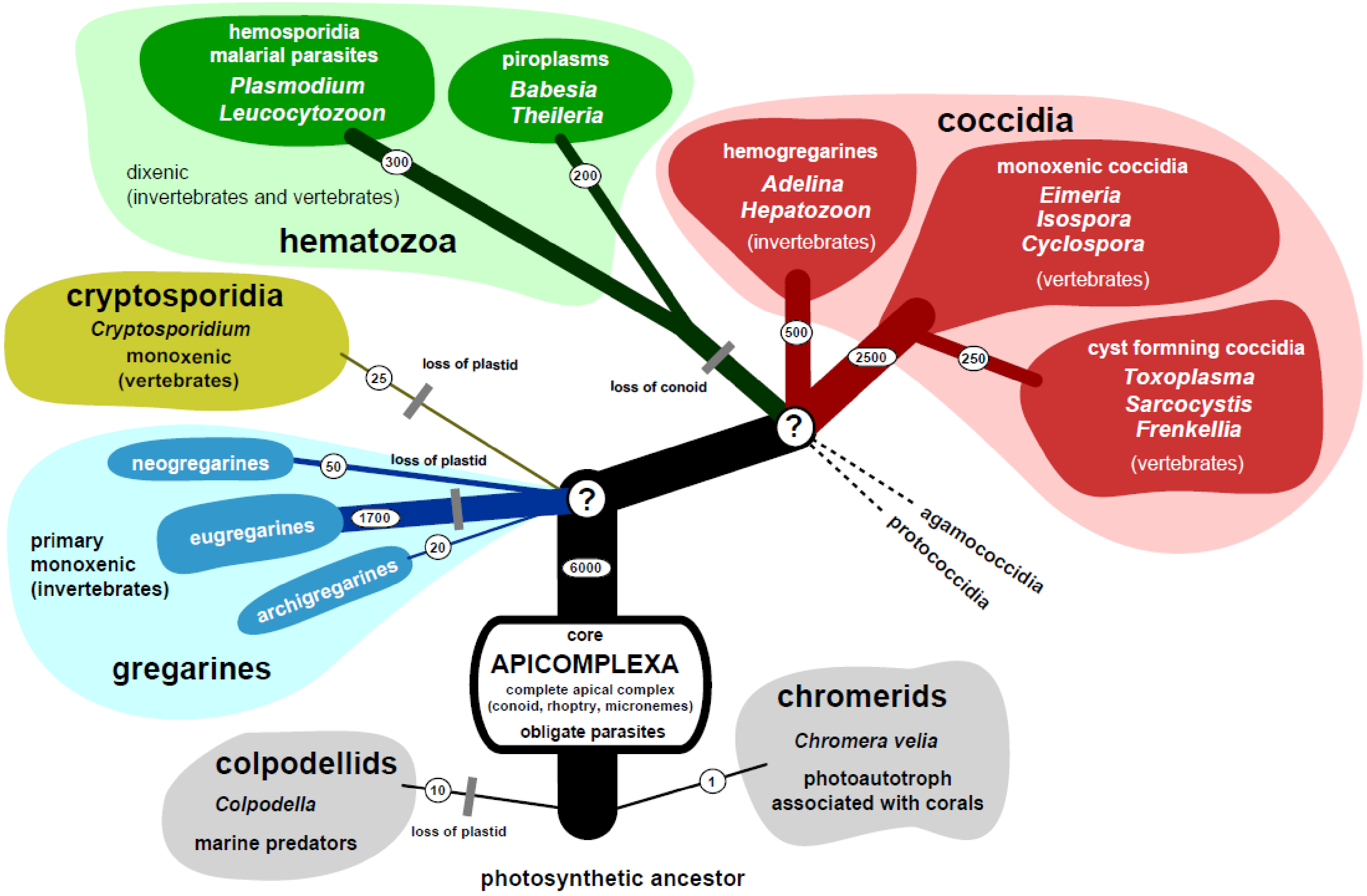


Figure 55. Current view of the evolution of chromerids. A schematic tree shows evolutionary relationships among chromerids and apicomplexans. The green line in the tree indicates photosynthetic organisms. Losses of photosynthesis or plastids are indicated. We propose that photosynthesis was lost once in chromerids with respect to colpodellids and once in the lineage evolving to apicomplexan parasites. We suppose chromerids to form a sister groups, mainly based on their unique pigmentation and molecular phylogeny.

Morphology, Ultrastructure and Life Cycle of *Vitrella brassicaformis* n. sp., n. gen., a Novel Chromerid from the Great Barrier Reef

Protist, Vol. 163, 306–323, March 2012
http://www.elsevier.de/protis



hemosporidia
malarial parasites
Plasmodium
Leucocytozoon
piroplasms
Babesia
Theileria
300
200
dixenic
(invertebrates and vertebrates)
hematozoa
coccidia
hemogregarines
Adelina
Hepatozoon
(invertebrates)
monoxenic coccidia
Eimeria
Isospora
Cyclospora
(vertebrates)
500
2500
250
cyst formning coccidia
Toxoplasma
Sarcocystis
Frenkellia
(vertebrates)
cryptosporidia
Cryptosporidium
monoxenic
(vertebrates)
25
loss of plastid
loss of conoid
neogregarines
50
loss of plastid
eugregarines
1700
20
archigregarines
primary
monoxenic
(invertebrates)
gregarines
6000
agamococcidia
protococcidia
core
APICOMPLEXA
complete apical complex
(conoid, rhoptry, micronemes)
obligate parasites
chromerids
Chromera velia
photoautotroph
associated with corals
1
colpodellids
Colpodella
marine predators
10
loss of plastid
photosynthetic ancestor