

БОТАНИЧЕСКАЯ НОМЕНКЛАТУРА

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Елена Юрьевна Воронина

Мария Александровна Гололобова

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М.А. Гололобова (ком. 412)

Курс включает:

10 лекций

Форма отчетности:

зачет

ЛЕКЦИЯ 1.

- Краткая характеристика “низших растений” и их место в системе органического мира

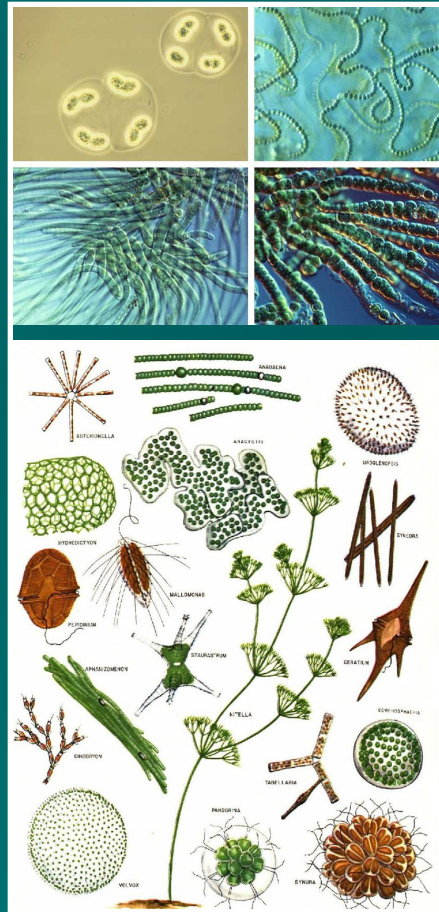
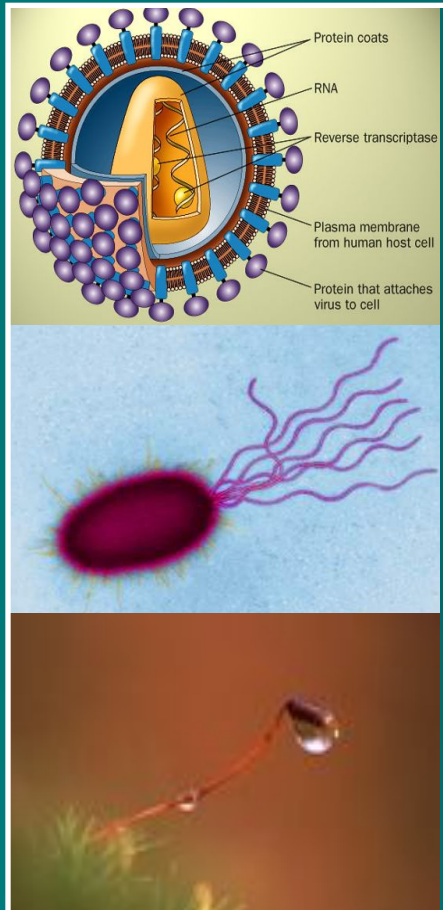


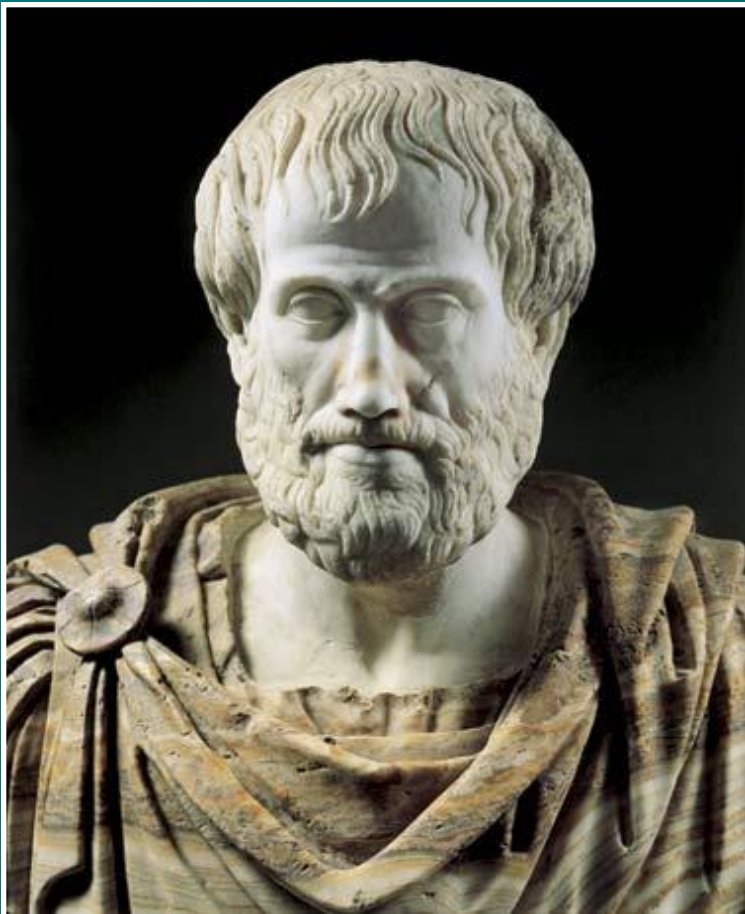
- Разделил все растения на *Thallobionta* (низшие растения) и *Embryobionta* (высшие растения)
- Выдвинул идею подчинения групп
- Ввел в ботанику понятие «семейство»

Антуан Лоран де Жюссьё
(1748–1836)

КТО ТАКИЕ НИЗШИЕ РАСТЕНИЯ?

- **НИЗШИЕ РАСТЕНИЯ** - растительноподобные организмы, тело которых не дифференцировано на отдельные органы (листья, стебли, корни). Такое вегетативное тело называется **таллом** (= слоевище)



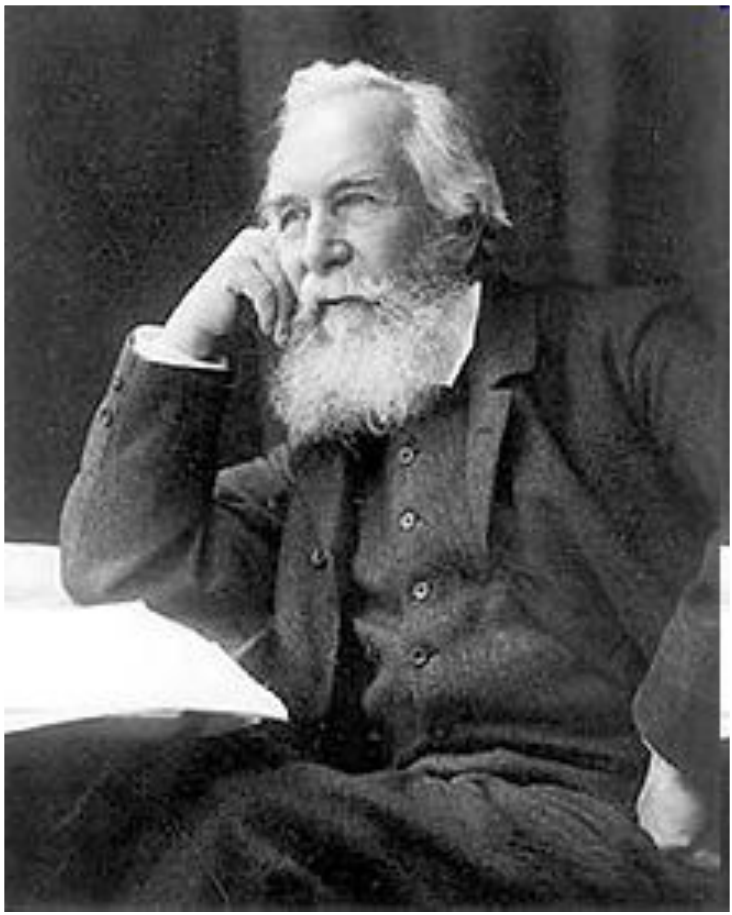


- Предложил первую классификацию органического мира
- Разделил все живые организмы на два царства: *Animalia* (Животные) и *Plantae*, или *Vegetabilia* (Растения)

Аристотель
(384 до н.э. – 322 до н.э.)

Некоторые системы классификации органического мира (по: Маргелис, 1983) (цифра в верхней строке указывает число царств)

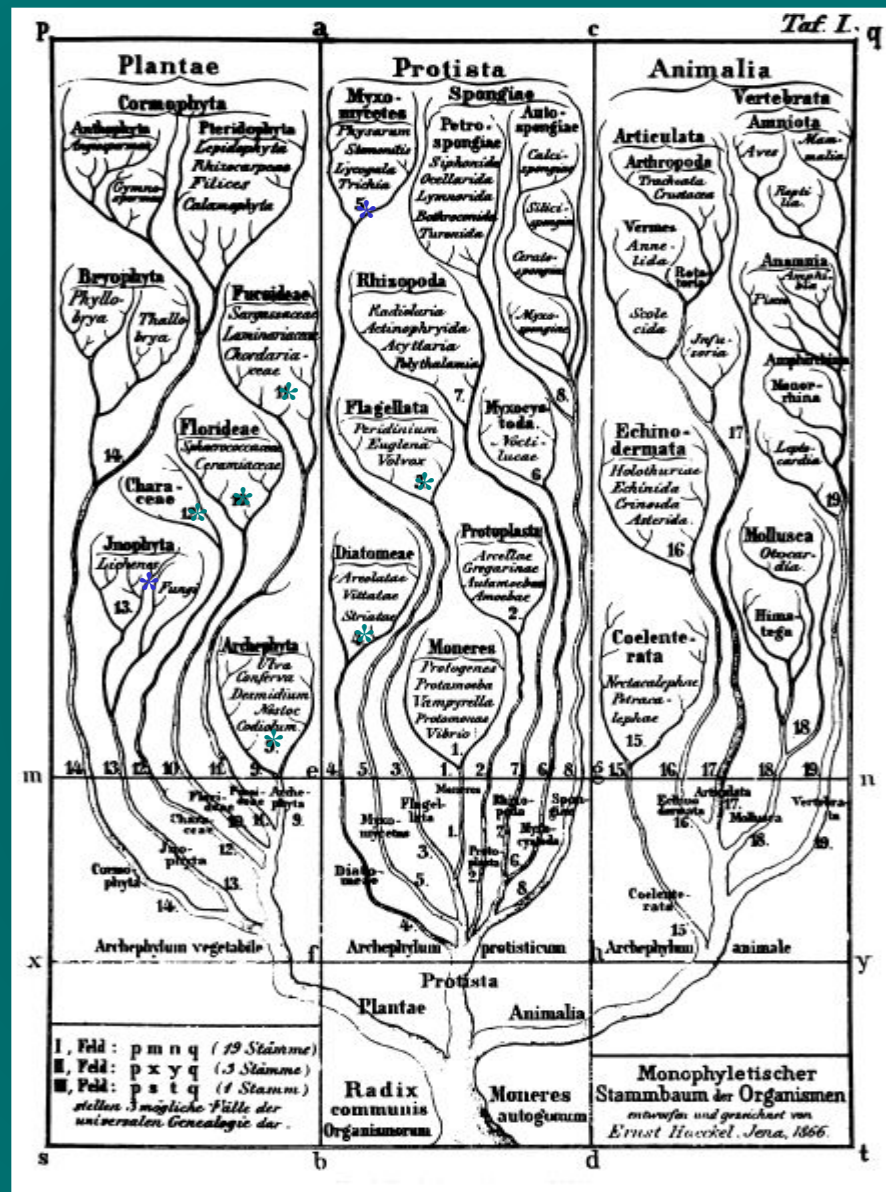
Традиционная	По Кертису (1968)	По Стейниеру с соавт. (1977)	По Коупленду (1956)	По Уиттэйкеру (1969)
2	3	3	4	5
Растения	Протисты	Протисты	Монеры	Монеры
бактерии	бактерии	бактерии	бактерии	бактерии
синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли
зеленые водоросли	простейшие	простейшие	Протоктисты	Протисты
хризифиты	слизевики	зеленые водоросли хризифиты	простейшие	простейшие
бурые водоросли	Растения	зеленые водоросли хризифиты	зеленые водоросли хризифиты	хризифиты
красные водоросли	зеленые водоросли	бурые водоросли	бурые водоросли	автотрофные
слизевики	хризифиты	красные водоросли	красные водоросли	гипохитриды
настоящие грибы	бурые водоросли	слизевики	слизевики	плазмодиофоры
мхи	красные водоросли	настоящие грибы	настоящие грибы	Растения
сосудистые растения	настоящие грибы	Растения	слизевики	зеленые водоросли
Животные	мхи	мхи	Растения	бурые водоросли
простейшие	сосудистые растения	сосудистые растения	мхи	красные водоросли
многоклеточные	Животные	Животные	сосудистые растения	водоросли
	многоклеточные	многоклеточные	Животные	мхи
			многоклеточные	сосудистые растения
				Грибы
				слизевики
				оомицеты
				хитриды
				настоящие грибы
				Животные
				многоклеточные



- Разделил все живые организмы на три царства: *Animalia* (Животные), *Plantae* (Растения) и *Protista* (Протисты)*

*от греческого «*proto*» - первичный

Эрнст Генрих Филипп Август Геккель
(1834–1919)



Древо жизни по Геккелю

из: Haeckel, 1866

Некоторые системы классификации органического мира (по: Маргелис, 1983)

(цифра в верхней строке указывает число царств)

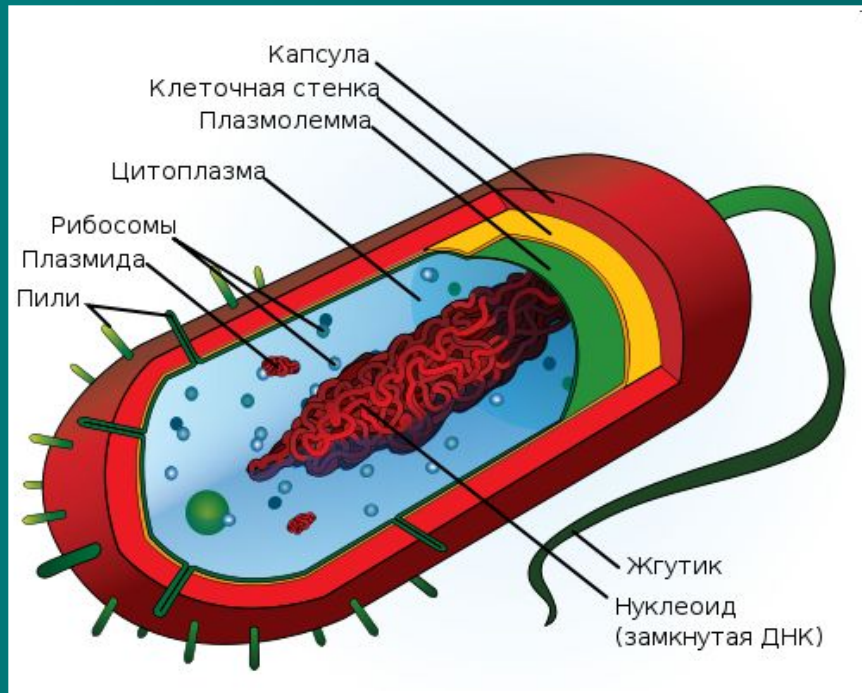
Традиционная	По Кертису (1968)	По Стейниеру с соавт. (1977)	По Коупленду (1956)	По Уиттэйкеру (1969)
2	3	3	4	5
Растения	Протисты	Протисты	Монеры	Монеры
бактерии	бактерии	бактерии	бактерии	бактерии
синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли
зеленые водоросли	простейшие	простейшие	Протоктисты	Протисты
хризифиты	слизевики	зеленые водоросли	простейшие	простейшие
бурые водоросли	Растения	хризифиты	зеленые водоросли	хризифиты
красные водоросли	зеленые водоросли	бурые водоросли	хризифиты	выпленовые
слизевики	хризифиты	красные водоросли	бурые водоросли	типо хитриды
настоящие грибы	бурые водоросли	слизевики	красные водоросли	плазмодиоформы
мхи	красные водоросли	настоящие грибы	слизевики	Растения
сосудистые растения	настоящие грибы	Растения	настоящие грибы	зеленые водоросли
Животные	мхи	мхи	Растения	бурые водоросли
простейшие	сосудистые растения	сосудистые растения	мхи	красные водоросли
многоклеточные	Животные	Животные	сосудистые растения	мхи
	многоклеточные	многоклеточные	Животные	сосудистые растения
			многоклеточные	Грибы
				слизевики
				оомицеты
				хитриды
				настоящие грибы
				Животные
				многоклеточные



Эдвард Шаттон
(1883–1947)

- ✓ Ввел в биологию термины «прокариоты» и «эукариоты» (Chatton, 1925)
- ✓ Первым высказал идею о разделении организмов на два царства:
Prokaryota (Прокариоты) и *Eukaryota* (Эукариоты)

Прокариотная (слева) и эукариотная (справа) клетки

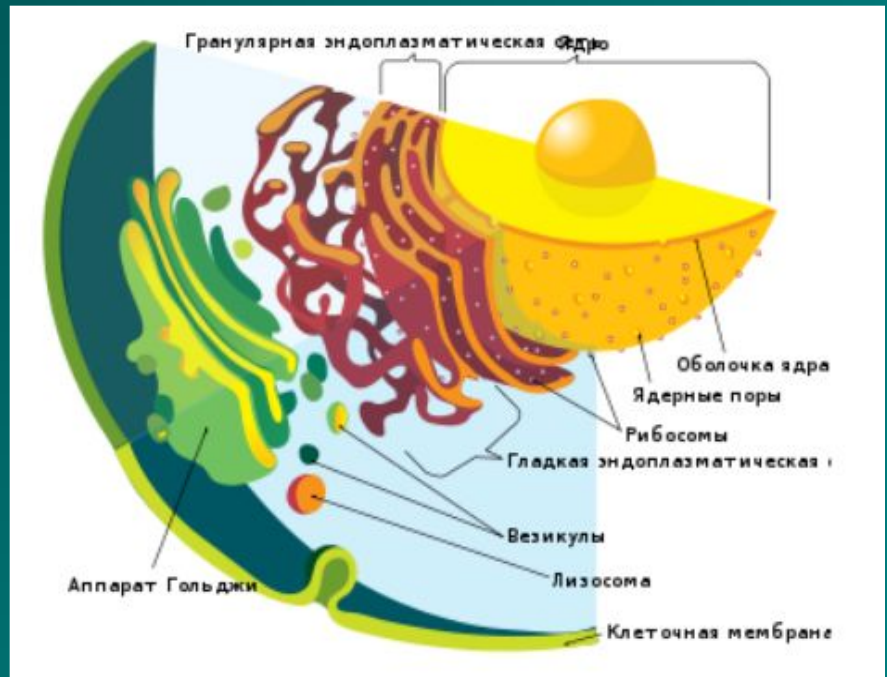


Прокариотная клетка*

*от греческого «pro» - до и «karyon» - ядро

Эв(у)кариотная клетка*

*от греческого «eu» - хорошо и «karyon» - ядро



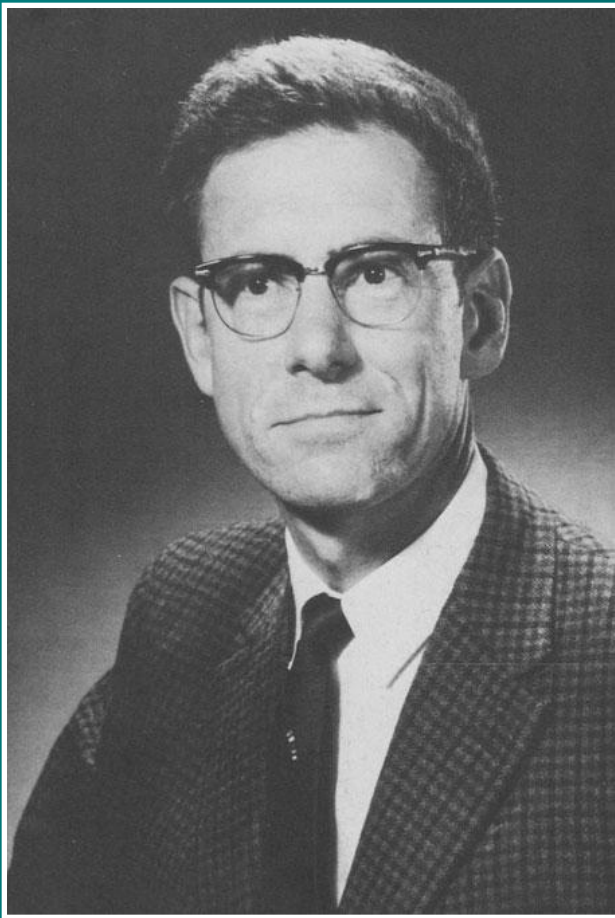
Сравнение основных характеристик прокариотной и эукариотной клеток

Признак	Прокариотная клетка	Эукариотная клетка
Организация генетического материала	ядро отсутствует, ДНК кольцевая	ядро имеется; ДНК организована в хромосомы
Локализация ДНК	в нуклеоиде и плазмидах, не ограниченных элементарной мембраной	в ядре и некоторых органеллах
Клеточное деление	митоз отсутствует	деление путем митоза
Мембранные органеллы	отсутствуют	имеются
Рибосомы в цитоплазме	70S-типа	80S-типа
Движение цитоплазмы	отсутствует	часто обнаруживается
Клеточная стенка (там, где она имеется)	в большинстве случаев содержит пептидогликан	пептидогликан отсутствует
Жгутики	нить жгутика построена из белковых субъединиц, образующих спираль	каждый жгутик содержит набор микротрубочек, собранных в группы: 2·9·2

Некоторые системы классификации органического мира (по: Маргелис, 1983)

(цифра в верхней строке указывает число царств)

Традиционная	По Кертису (1968)	По Стейниеру с соавт. (1977)	По Коупленду (1956)	По Уиттэйкеру (1969)
2	3	3	4	5
Растения	Протисты	Протисты	Монеры	Монеры
бактерии	бактерии	бактерии	бактерии	бактерии
синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли
зеленые водоросли	простейшие	простейшие	Протоктисты	Протисты
хризифиты	слизевики	зеленые водоросли	простейшие	простейшие
бурые водоросли	Растения	хризифиты	зеленые водоросли	хризифиты
красные водоросли	зеленые водоросли	бурые водоросли	хризифиты	выпленовые
слизевики	хризифиты	красные водоросли	бурые водоросли	гипохитриды
настоящие грибы	бурые водоросли	слизевики	красные водоросли	плазмодиоформы
мхи	красные водоросли	настоящие грибы	слизевики	Растения
сосудистые растения	настоящие грибы	Растения	настоящие грибы	зеленые водоросли
Животные	мхи	мхи	Растения	бурые водоросли
простейшие	сосудистые растения	сосудистые растения	мхи	красные водоросли
многоклеточные	Животные	Животные	сосудистые растения	мхи
	многоклеточные	многоклеточные	Животные	сосудистые растения
			многоклеточные	Грибы
				слизевики
				оомицеты
				хитриды
				настоящие грибы
				Животные
				многоклеточные



Роберт Хардинг Уиттакер
(1920–1980)

✓ Первым обосновал разделение организмов на пять царств (Whittaker, 1969): *Monera**, или *Prokaryota* (Прокариоты, Монеры), *Protista* (Протисты), *Plantae* (Растения), *Animalia* (Животные) и *Fungi* (Грибы)

*от греческого «μονο» – один

New Concepts of Kingdoms of Organisms

Evolutionary relations are better represented by new classifications than by the traditional two kingdoms.

R. H. Whittaker

There are those who consider questions in science which have no unqualified, experimentally determined answer scarcely worth discussing. Such feeling, along with conservatism, may have been responsible for the long and almost unchallenged dominance of the system of two kingdoms—plants and animals—in the broad classification of organisms. The unchallenged position of these kingdoms has ended, however; alternative systems are being widely considered (1–16) and are appearing in many introductory biology texts (17–24). My purpose in this article is to discuss the merits of new classifications which depart from the traditional two kingdoms, the systems of Copeland (2–7) and Whittaker (4, 5).

Two-Kingdom System

Man is terrestrial, and he sees around him two major groups of organisms of very different adaptation to existence on land—the photosynthetic, rooted, higher plants, and the food-ingesting, mobile, higher animals. So distinct is way of life, direction of evolution, and kind of body organization in these groups that a concept of dichotomy—plants versus animals—is almost inescapable if they are considered by themselves. The two groups became the nuclei around which concepts of the plant and animal kingdoms were developed by early naturalists. The kingdoms have been part of the formal classification of living things since Linnaeus (27).

Monera, liverworts, and microscopic algae are chiefly plants in their photosynthetic and sessile way of life, and though the photosynthetic process itself was not understood by early naturalists these forms were grouped

with the higher land plants. The higher fungi on land are sessile, and their apparently "rooted" manner of growth suggested the plants. It thus seemed reasonable to assign fungi to the plant kingdom, and some students believed that they had evolved from algae. The wealth of unicellular life discovered by microscopists offered greater difficulty. Some forms were motile and ingested food, however, and were naturally regarded as one-celled animals or protozoans. Others were sessile and photosynthetic, hence one-celled plants. There remained a wide range of unicellular forms in which sessility and flagellate or pseudopodial motility, and ingressive, photosynthetic, and absorptive nutrition, were combined in various ways which were neither clearly plant-like nor animal-like. In a number of cases plant-like and animal-like motifs were connected by a series of closely related intergrading forms within the same major taxon. There remained also the bacteria which, though few are photosynthetic and many are motile, seemed better treated as plants because of their walled cells. The plant and animal kingdoms are products of a process of conceiving, by which groups of organisms which were aquatic, or fungal, or microscopic, or more than one of these, were added around the nuclear concepts of plant and animal derived from higher land organisms.

It was recognized that the two-kingdom system came into difficulties in treatment of the unicellular organisms, since some groups of these were claimed both for the plant kingdom by botanists and for the animal kingdom by zoologists. The system seemed, however, a reasonable treatment of the living world in terms of two kingdoms and evolu-

tionary directions (Fig. 1). In time the system seemed not reasonable but axiomatic; suggestions of other kingdoms were regarded as the idiosyncrasies of individuals. There were such suggestions, however, as the limitations of the two-kingdom system became more evident. I have reviewed proposals for other kingdoms in more detail elsewhere (5).

Limitations of the Two-Kingdom System

The difficulties of the two-kingdom system may be summarized in relation to four points.

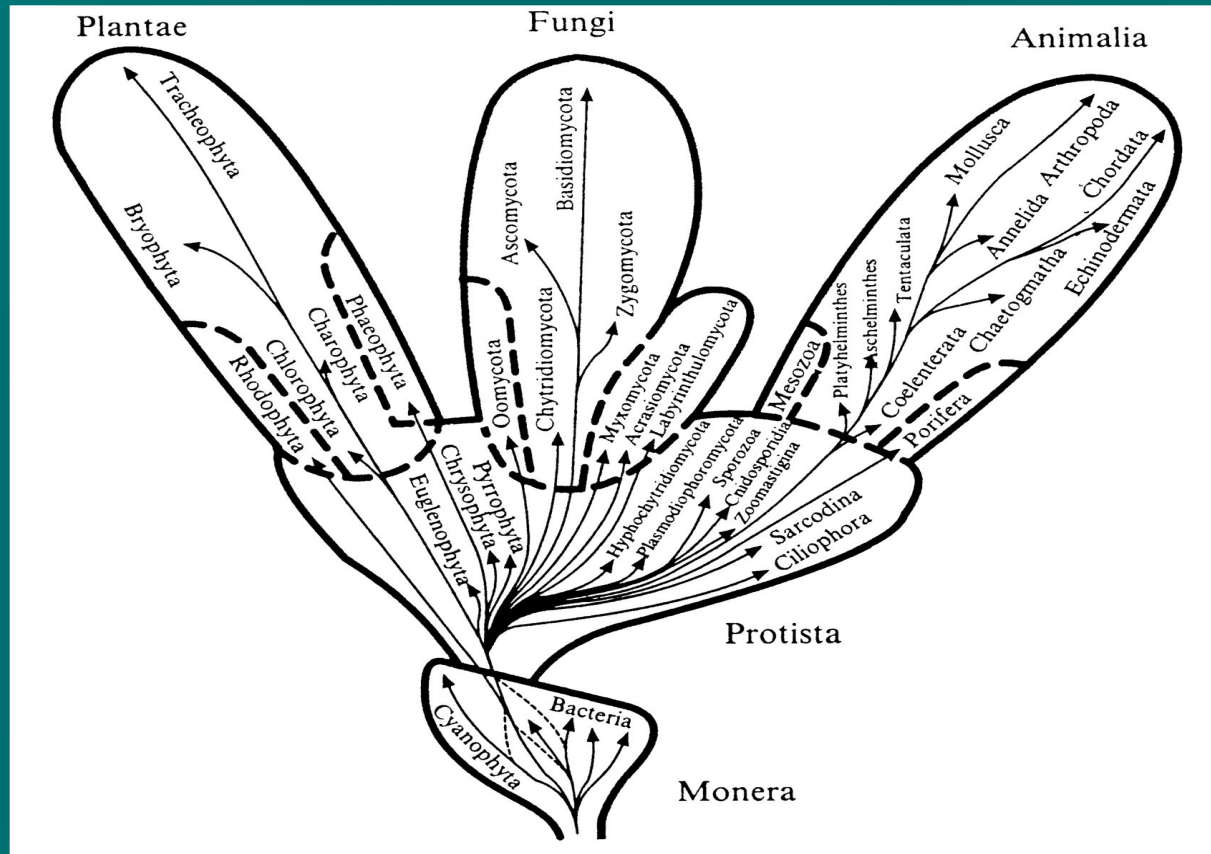
1) *The position.* The most obvious difficulty is that for which we use *Euglena* and its relatives as the exemplar for students—the intergrading combinations of plant and animal characters, the fusion of the kingdom, among unicellular organisms. Because of the impossibility of clear division of the unicells into plants and animals, a number of authors suggested third kingdoms of lower organisms (28–32). Hogg (28) observed the intergradation of plants and animals among lower forms and proposed for them the *Regnum Plantigenum* and the term "Protoctista." Haeckel (29) proposed separating the lower organisms as the kingdom "Protista." Haeckel included the spores in this kingdom in one treatment (30), and the fungi in another (30), but the kingdom comprised primarily, and in later treatments (31, 32) only, the unicellular organisms.

Although constant of the third kingdom of lower organisms and use of "Protoctista" and "Protista" have varied, two principal possibilities may be distinguished. The lower kingdom may either comprise only unicellular organisms (including those forming colonies of unicells), the kingdom *Protista* of Haeckel (29–32) and others (33, 20, 27, 7, 16), or the lower kingdom may comprise the unicells plus other organisms which lack the kind and degree of tissue differentiation characteristic of higher plants and animals, thus including fungi and more or all algae, the kingdom *Protoctista* of Hogg (30) and Copeland (3), (in either of these concepts bacteria and blue-green algae may be excluded as indicated below.)

Some authors (33, 32, 15, 19, 22) prefer the more familiar term "Protista" for the second concept. Different inter-

The author is professor of biology in the Institute of Biology, University of Illinois, Urbana, Illinois, U.S.A.

Филогенетические взаимоотношения между основными группами организмов (по: Whittaker, 1969)



Monera - включает прокариотные организмы

Protista - преимущественно одноклеточные эукариоты

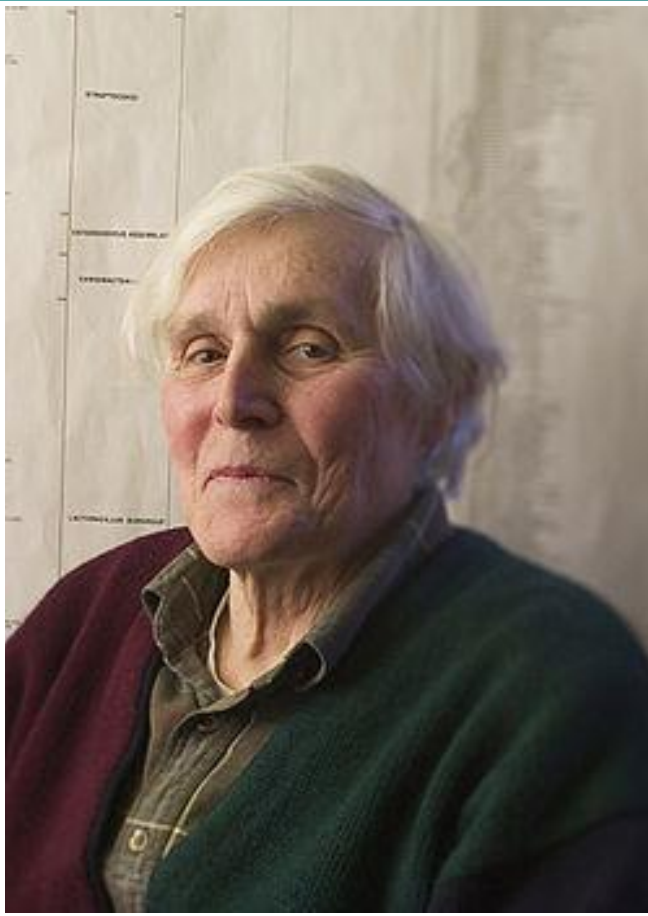
Многоклеточные эукариоты представлены 3 царствами, различающимися по способу питания:

Plantae - автотрофы, **Fungi** - осмотротрофы, **Animalia** - фаготрофы

Некоторые системы классификации органического мира (по: Маргелис, 1983)

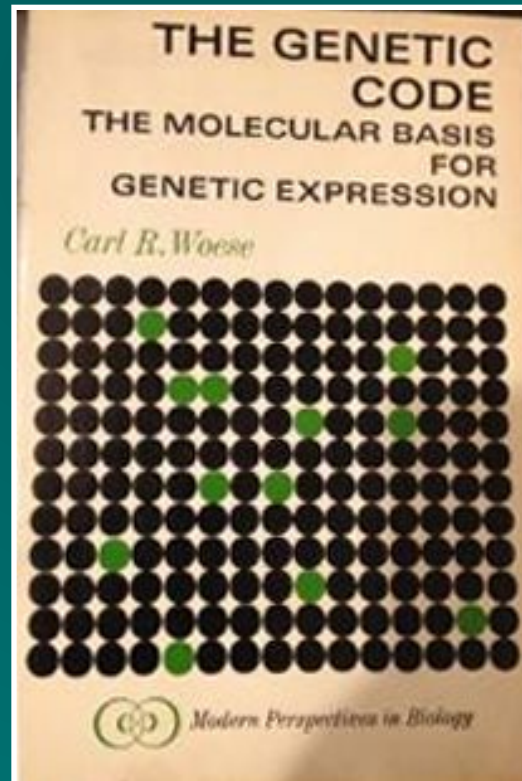
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2	3	3	4	5
Растения	Протисты	Протисты	Монеры	Монеры
бактерии	бактерии	бактерии	бактерии	бактерии
синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли	синезеленые водоросли
зеленые водоросли	простейшие	простейшие	Протоктисты	Протисты
хризифиты	слизевики	зеленые водоросли	простейшие	простейшие
бурые водоросли	Растения	хризифиты	зеленые водоросли	хризифиты
красные водоросли	зеленые водоросли	бурые водоросли	хризифиты	выпленовые
слизевики	хризифиты	красные водоросли	бурые водоросли	гипохитриды
настоящие грибы	бурые водоросли	слизевики	красные водоросли	плазмодиоформы
мхи	красные водоросли	настоящие грибы	слизевики	Растения
сосудистые растения	настоящие грибы	Растения	настоящие грибы	зеленые водоросли
Животные	мхи	мхи	Растения	бурые водоросли
простейшие	сосудистые растения	сосудистые растения	мхи	красные водоросли
многоклеточные	Животные	Животные	сосудистые растения	мхи
	многоклеточные	многоклеточные	Животные	сосудистые растения
			многоклеточные	Грибы
				слизевики
				оомицеты
				хитриды
				настоящие грибы
				Животные
				многоклеточные



Карл Ричард Вёзе (1928-2012)

- ✓ Обосновал применение в филогении последовательности рРНК
- ✓ Выделил домен Archaeobacteria (Археобактерии, Археи) (Woese, Fox, 1977)



Proc. Natl. Acad. Sci. USA
Vol. 74, No. 11, pp. 5088-5090, November 1977
Evolution

Phylogenetic structure of the prokaryotic domain: The primary kingdoms

(archaeobacteria/eubacteria/urkaryote/16S ribosomal RNA/molecular phylogeny)

CARL R. WOESE AND GEORGE E. FOX*

Department of Genetics and Development, University of Illinois, Urbana, Illinois 61801

Communicated by T. M. Sonneborn, August 18, 1977

ABSTRACT A phylogenetic analysis based upon ribosomal RNA sequence characterization reveals that living systems represent one of three aboriginal lines of descent: (i) the eubacteria, comprising all typical bacteria; (ii) the archaeobacteria, containing methanogenic bacteria; and (iii) the urkaryotes, now represented in the cytoplasmic component of eukaryotic cells.

The biologist has customarily structured his world in terms of certain basic dichotomies. Classically, what was not plant was animal. The discovery that bacteria, which initially had been considered plants, resembled both plants and animals less than plants and animals resembled one another led to a reformulation of the issue in terms of a yet more basic dichotomy, that of eukaryote versus prokaryote. The striking differences between eukaryotic and prokaryotic cells have now been documented in endless molecular detail. As a result, it is generally taken for granted that all extant life must be of these two basic types.

Thus, it appears that the biologist has solved the problem of the primary phylogenetic groupings. However, this is not the case. Dividing the living world into *Prokaryotae* and *Eukaryotae* has served, if anything, to obscure the problem of what extant groupings represent the various primeval branches from the "big bang" line of descent. The distinction between *prokaryote* and *eukaryote* is not primarily a phylogenetic distinction, although it is generally treated so. The eukaryotic cell is organized in a different and more complex way than is the prokaryote; this probably reflects the former's composite origin as a symbiotic collection of various simpler organisms (1-5). However striking, these organizational dissimilarities do not guarantee that eukaryote and prokaryote represent phylogenetic extremes.

The eukaryotic cell *per se* cannot be directly compared to the prokaryote. The composite nature of the eukaryotic cell makes it necessary that it first be conceptually reduced to its phylogenetically separate components, which arose from ancestors that were noncomposite and so individually are comparable to prokaryotes. In other words, the question of the primary phylogenetic groupings must be formulated solely in terms of relationships among 'prokaryotes'—i.e., noncomposite entities. (Note that in this context there is no suggestion *a priori* that the living world is structured in a dichotomous way.)

The organizational differences between prokaryote and eukaryote and the composite nature of the latter indicate an important property of the evolutionary process: Evolution seems to progress in a "quantized" fashion. One level or domain of organization gives rise ultimately to a higher (more complex) one. What "prokaryote" and "eukaryote" actually represent are two such domains. Thus, although it is useful to define phylogenetic patterns within each domain, it is not meaningful

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to construct phylogenetic classifications between domains. Prokaryotic kingdoms are not comparable to eukaryotic ones. This should be recognized by an appropriate terminology. The highest phylogenetic unit in the prokaryotic domain we think should be called an "urkingdom"—or perhaps "primary kingdom." This would recognize the qualitative distinction between prokaryotic and eukaryotic kingdoms and emphasize that the former have primary evolutionary status.

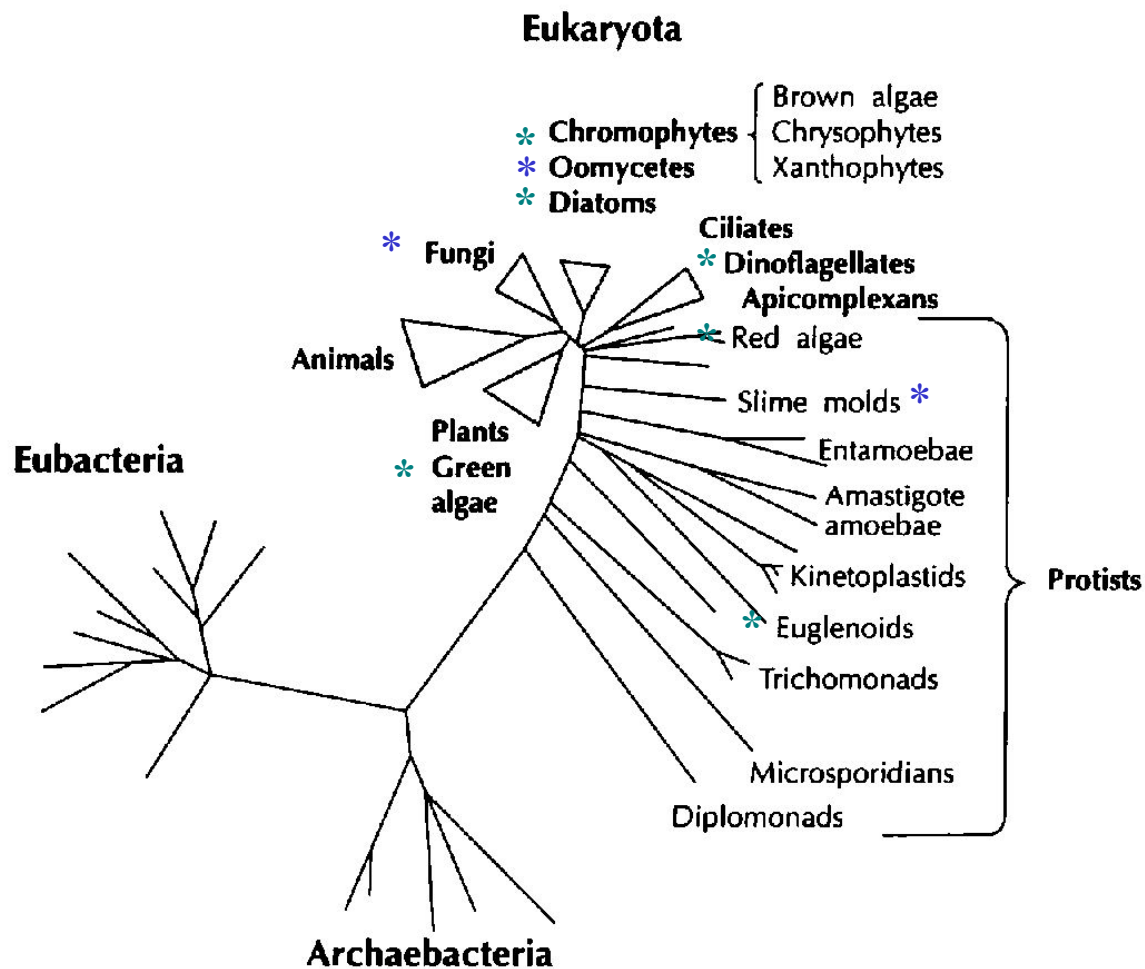
The passage from one domain to a higher one then becomes a central problem. Initially one would like to know whether this is a frequent or a rare (unique) evolutionary event. It is traditionally assumed—without evidence—that the eukaryotic domain has arisen but not, as all extant eukaryotes stem from a common ancestor, itself eukaryotic (2). A similar prejudice holds for the prokaryotic domain (3). [We elsewhere argue (6) that a hypothetical domain of lower complexity, that of “progenotes,” may have preceded and given rise to the prokaryotes.] The present communication is a discussion of recent findings that relate to the unkingdom structure of the prokaryotic domain and the question of its unique as opposed to multiple origin.

Phylogenetic relationships cannot be reliably established in terms of noncomparable properties (7). A comparative approach that can measure degree of difference in comparable structures is required. An organism's genome seems to be the ultimate record of its evolutionary history (8). Thus, comparative analysis of molecular sequences has become a powerful approach to determining evolutionary relationships (9, 10).

To determine relationships covering the entire spectrum of extant living systems, one optimally needs a molecule of appropriately broad distribution. None of the readily characterized proteins fits this requirement. However, ribosomal RNA does. It is a component of all self-replicating systems; it is readily isolated, and its sequence changes but slowly with time—permitting the detection of relatedness among very distant species (11–13). To date, the primary structure of the 16S (ribosomal) RNA has been characterized in a moderately large and varied collection of organisms and organelles, and the general phylogenetic structure of the prokaryotic domain is beginning

A comparative analysis of these data, summarized in Table 1, shows that the organisms clearly cluster into several primary kingdoms. The first of these contains all of the typical bacteria so far characterized, including the genera *Acetobacterium*, *Acinetobacter*, *Acholeplasma*, *Aeromonas*, *Alcaligenes*, *Anaerostipes*, *Aphanoplasma*, *Bacillus*, *Bdellovibrio*, *Chlorobium*, *Chromatium*, *Clostridium*, *Corynebacterium*, *Escherichia*, *Eubacterium*, *Lactobacillus*, *Leptospira*, *Micrococcus*, *Mycoplasma*, *Paracoccus*, *Photobacterium*, *Propionibacterium*,

* Present address: Department of Biophysical Sciences, University of Houston, Houston, TX 77004.



«Неукорененное» дерево, отражающее три царства, построенное на анализе сходства последовательностей генов рРНК

Система прокариот и простейших (по: Кусакин, Дроздов, 1998)

[illegible]

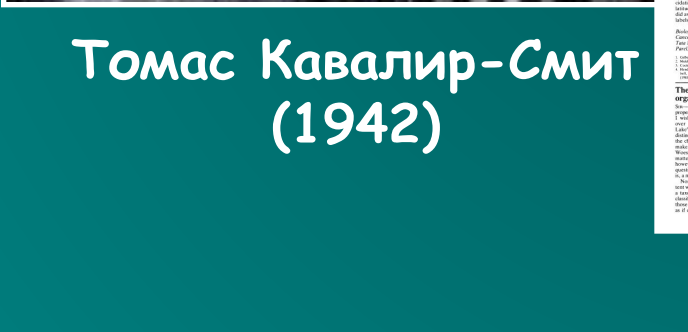
Система
включает
19 царств!

О. Г. Кусакин, А. Л. Дроздов

ФИЛЕМА ОРГАНИЧЕСКОГО МИРА

2

ПРОКАРИОТЫ И НИЗШИЕ ЕВКАРИОТЫ



*от латинского «*unus*» - один
**от латинского «*bi*» - два

****от дотинското «b» — бас**

SCIENTIFIC CORRESPONDENCE

The 'central dogma' asserting the one-way transfer of information from DNA-to-RNA to proteins has been challenged. The discovery of reverse transcriptase, the proposition of reverse translation [1] and impetive evidence exists that aminoacyl-tRNA synthetases may be able to perform gross structural shifts (see ref. 4). These findings deserve to be kept in view as an alternative to the long-held view that it is conceivable that amino acid arrangements around a geographically-formatted substrate may be incorporated in a stepwise manner in the self-assembled lipid bilayer became linked to form a monomer. But the misreading had catalytic activity for the transfer of amino acids to tRNA, and be converted to a new molecule, setting in motion the formation of a pathway. Striking evidence for the existence of a distinct type of arrangement of amino acids around a molecule, generating two different types of aminoacyl-tRNA synthetases could be accumulated and reversed-transcribed to monomers. Their integration would form the basis of a new model for the origin of the structure of functionally related genes in bacteria.

100%

[illegible][illegible]

in any 1000 species kingdom: Protodon, anguilla, salmonella, etc to avoid splitting the two 'zoological' (=Nonacellaria) and the three 'botanical' (later, Circumprotista-100). The kingdom here antebiochemical sided into four phyla: severely revised. The name that Myxozoa (tooth, Amoeba) are ephoria). Myxozoa, origin: sea made in halos, gastrotrich, phlores and fertilis. Metacommunity and, not as a separate unit. Repellants and (fish) is called of a Cereus within the traditional semi-archaeobacteria are currently recognized later in modified in its. Pseudomonas and, here, here defined as principles also make a separate kingdom, gdon, Uchacoria, Nephelaria, with generic, which lack Diphtheria, with a lower level. This tier of cell envelope moiety, definition of

[illegible]

their classification of the kingdom Protista, a fundamental bifurcation among six major eukaryotic kingdoms and the analysis concerning a younger ancestor classically associated with protistan phylogeny and the origin of other eukaryotes and of six lineages. Therein, controversy and uncertainty continue and include some features (e.g. *Leishmania* and *Haemaphysalis*, *Euglenozoa*, *Phaeobacterales*, *Isosporales*), the controversial classification of the green algae (*Chlorophyta*) in stragglers from *Alveolates* (*Chlorista*) diverged from a common ancestor with *Leishmania* was the most likely (3). The taxonomic order of the five lineages and the quality of relationships currently is probably still under discussion. The five lineages are: *Leishmania*, *Chlorista*, *Haemaphysalis*, *Euglenozoa* and *Phaeobacterales* (4).

[illegible][illegible]

zoans, photosynthetic diatoms (e.g. *Thalassiosira weissflogii*), but were originally excluded from C₃ because their silicate lates and members are simpler, their closest evolutionary relatives *Chlorella* and *Agrostophyllum*, grow as free-living, unicellular organisms. The resulting panmixis provides a range of habitats to enhance chromism and albedo, and that both (collectively) 'chromoblasts' are the same secondary structure (recently of a red sign, *Chlorococcoides* 1997, now freely identified (Kott 2000), that may have been a common ancestor of the algal group suggested to have formed the cyanobacteria (Mora et al. 2000) perhaps due to secondary symbiosis that implies chromism and chloroplasts into cyanobacteria.

Proc. R. Soc. Lond. B (2006) 273, 1251–1262
DOI 10.1098/rspb.2004.2505

Системы органического мира (по: Cavalier-Smith, 1998, 2002, 2003 и т.д.)

empire PROKARYOTA (Cavalier-Smith 2002b)

kingdom Bacteria

subkingdom Negibacteria (phyla Eobacteria, Sphingobacteria, Spirochaetae, Proteobacteria, Planctobacteria, Cyanobacteria)

subkingdom Unibacteria (phyla Posibacteria, Archaeobacteria)

empire EUKARYOTA (Cavalier-Smith 1998)

kingdom Protozoa (Cavalier-Smith 2002a, 2003a)

subkingdom Sarcomastigota (phyla Amoebozoa, Choanozoa)

subkingdom Biciliata

infrakingdom Rhizaria (phyla Cercozoa, Foraminifera, Radiolaria)

infrakingdom Excavata (phyla Loukozoa, Percolozoa, Euglenozoa,

Metamonada; the latter now includes Parabasalia and Anaeromonadea; Cavalier-Smith 2003a,b)

infrakingdom Alveolata (phyla Myxozoa (Cavalier-Smith & Chao 2004),

Ciliophora)

Biciliata incertae sedis: phylum Apusozoa (may be sister to Excavata); phylum Heliozoa

kingdom Animalia (Myxozoa and 21 othera phyla) (Cavalier-Smith 1998; Cavalier-Smith & Chao 2003c)

kingdom Fungi (phyla Archemycota, Microsporidia, Ascomycota, Basidiomycota) (Cavalier-Smith 2000b)

kingdom Plantae

subkingdom Biliphyta (phyla Glaucophyta, Rhodophyta)

subkingdom Viridaplantae (Chlorophyta, Bryophyta, Tracheophyta)

kingdom Chromista

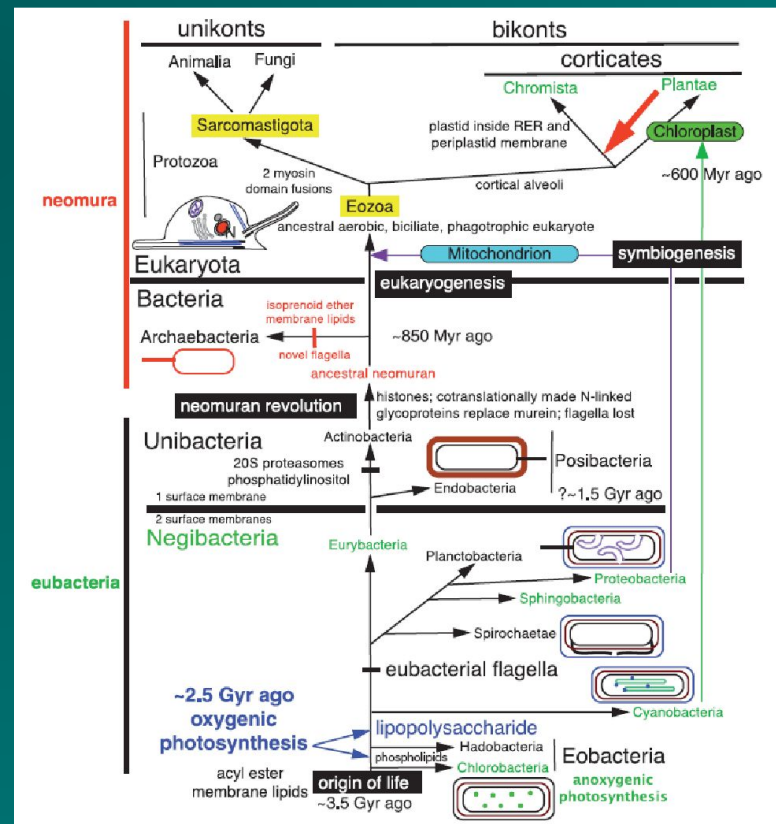
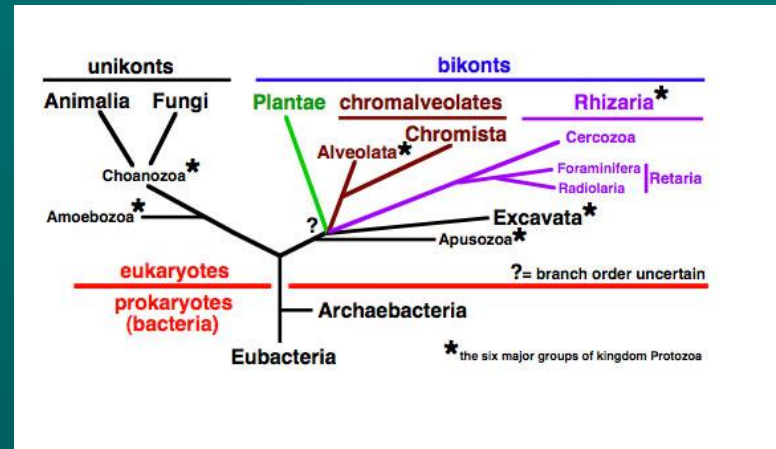
subkingdom Cryptista (phylum Cryptista: cryptophytes, goniomonads, katablepharids)

subkingdom Chromobiota

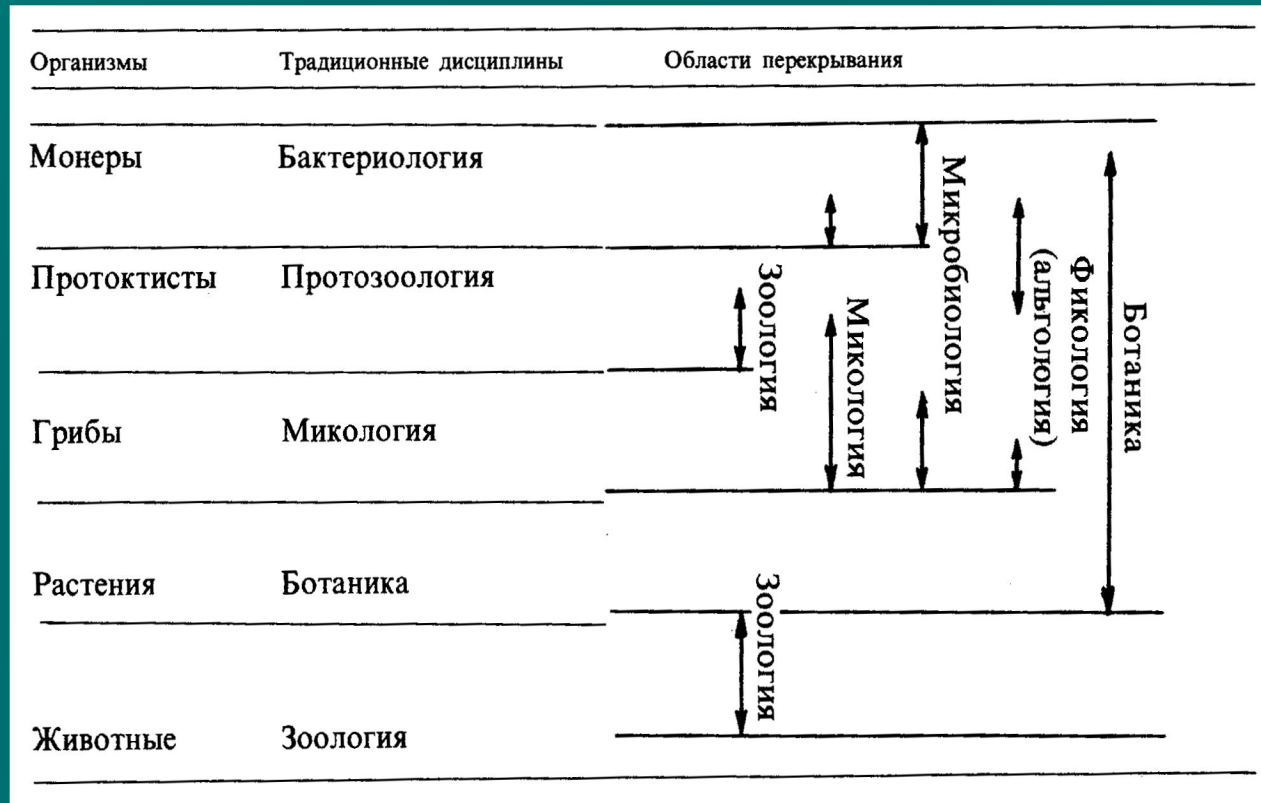
infrakingdom Heterokonta (phyla Ochrophyta, Pseudofungi, Opalozoa

(comprising subphyla Opalinata, Sagenista)

infrakingdom Haptista (phylum Haptophyta)



Организмы и традиционные дисциплины, их изучающие (по: Маргелис, 1983)



«[...] систематика так называемых «низших» организмов (бактерий, протистов и грибов) находится в брожении. Противоречия возникают отчасти из-за профессиональной организации микробиологов и ботаников. Их традиции плохо отражают взаимосвязи между организмами, которые они изучают» (Маргелис, 1983: 29).

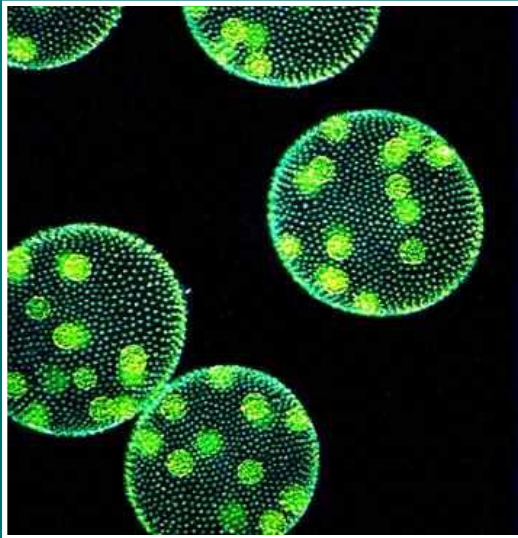
Расхождения в классификации ботаников и зоологов



Ботаники			Зоологи	
Таксономический уровень	Таксон	Критерий	Таксон	Критерий
Царство	Plantae	Фотосинтез	Animalia	Подвижность
Тип	Chrysophyta	Золотисто-желтая пигментация	Protozoa	Одноклеточное животное
Класс	Chrysophyceae		Phytomastigophorea	Пластиды
Порядок	Chrysamoebida	Амебофлагеллятные подвижные стадии	Chrysomonadina	Золотисто-желтый цвет пластид
Род и вид	<i>Ochromonas danica</i>		<i>Ochromonas danica</i>	

Какие организмы традиционно рассматривает курс?

ВОДОРОСЛИ



ЛИШАЙНИКИ



ГРИБЫ



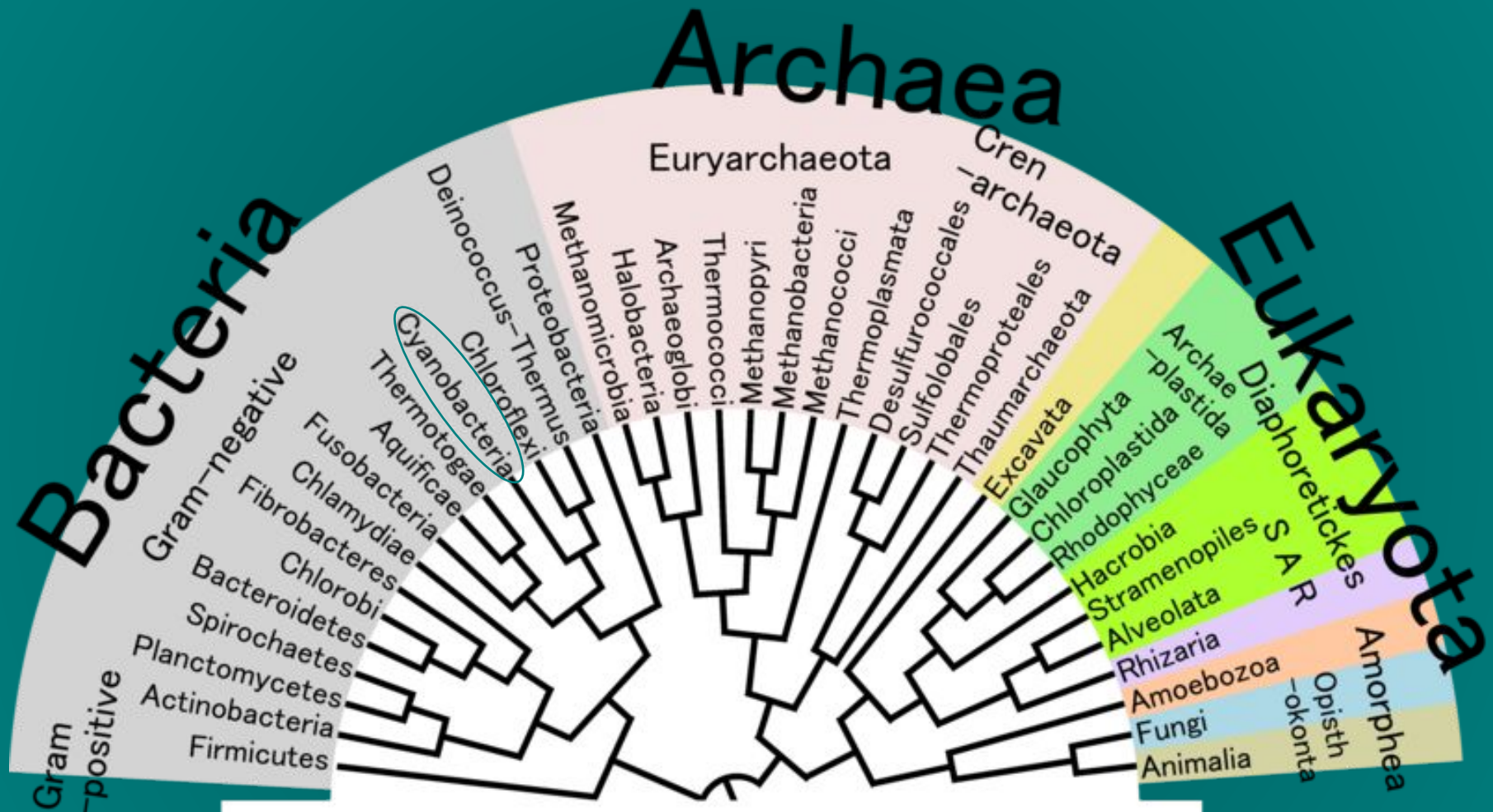
ПСЕВДОГРИБЫ



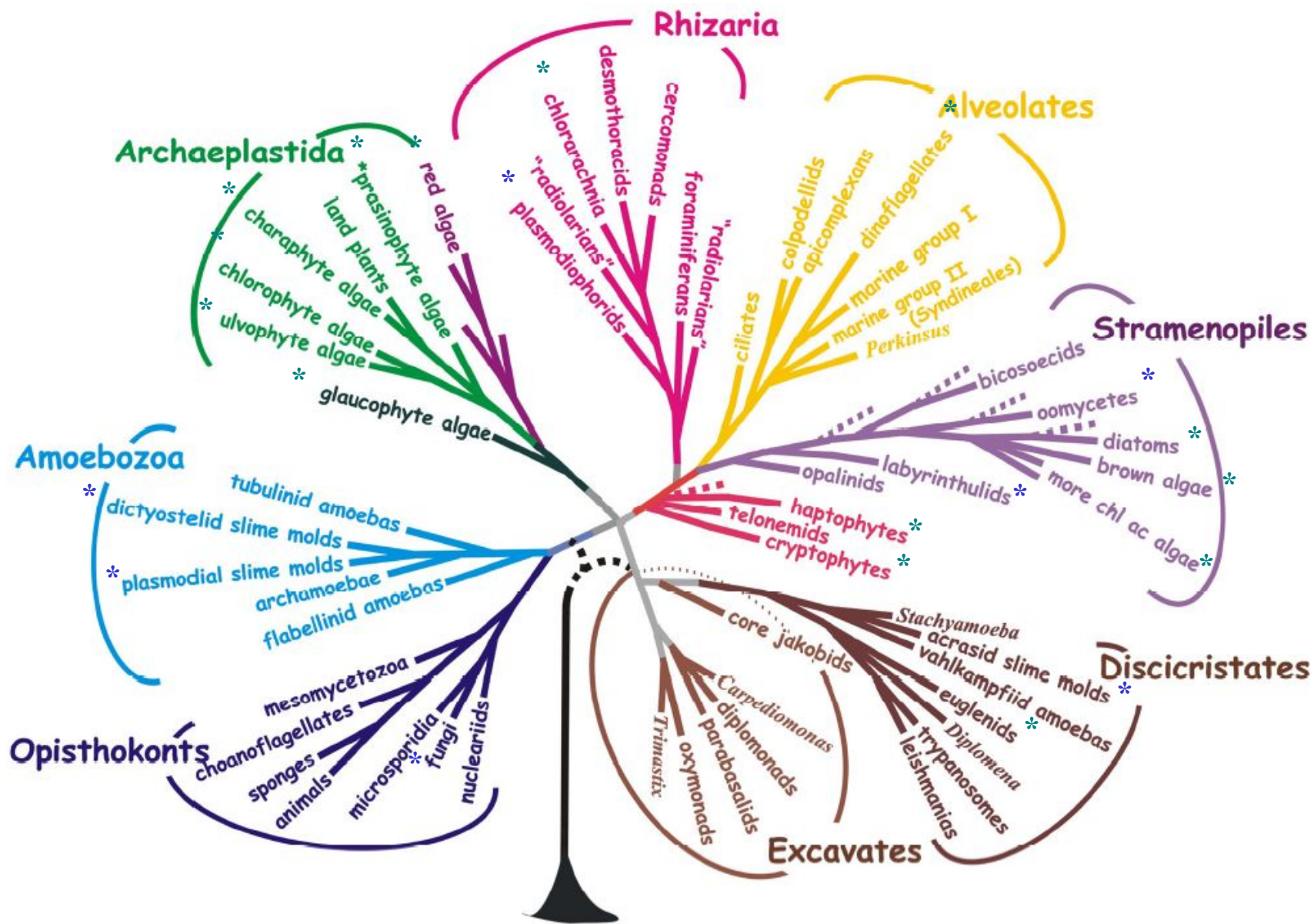
СЛИЗЕВИКИ



Связи между макротаксонами органического мира



Связи между макротаксонами эукариот



Tree of Life Web Project (ToL) <http://tolweb.org/tree/phylogeny.html>

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TREE OF LIFE web project

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The Tree of Life Web Project (ToL) is a collaborative effort of [biologists](#) and [nature enthusiasts](#) from around the world. On more than 10,000 World Wide Web pages, the project provides information about biodiversity, the characteristics of different groups of organisms, and their evolutionary history ([phylogeny](#)).

Each page contains information about a particular group, e.g., [salamanders](#), [segmented worms](#), [phlox flowers](#), [tyrannosaurs](#), [euglenids](#), [Heliconius butterflies](#), [club fungi](#), or the [vampire squid](#). ToL pages are linked one to another hierarchically, in the form of the evolutionary tree of life. Starting with the [root of all Life on Earth](#) and moving out along diverging branches to individual species, the [structure of the ToL project](#) thus illustrates the genetic connections between all living things.

[read more about the Tree of Life Web Project...](#)



"The affinities of all the beings of the same class have sometimes been represented by a great tree... As buds give rise by growth to fresh buds, and these if vigorous, branch out and overtop on all

UNIKONTA

Империя Unikonta (Одножгутиковые) – большинство представителей имеют один жгутик

Царство Opisthokonta (Заднежгутиковые) – жгутиковые клетки (сперматозоиды, зооспоры) имеют один задний жгутик; клетки имеют митохондрии с плоскими кристами
Группа монофилетичная



Fig. 11. Some examples of opisthokonts. From left to right: the choanoflagellate *Salpingoeca* (© William Bourland), the animals *Saimiri sciureus* (squirrel monkey, © Luc Viatour) and *Cyanea capillata* (lion's mane sea jelly, © Patrick Keeling), the fungus *Morchella* (© Patrick Keeling), and the microsporidian *Fibrillanosema crangonycis* (© Leon White).

Мусота (Грибы) *

Отделы: Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota, формальный отдел Deuteromycota

Лихенизированные грибы (лишайники) рассматривают в соответствующих группах грибов

UNIKONTA

Империя Unikonta (Одножгутиковые) – большинство представителей имеют один жгутик

Царство Amoebozoa (Амебозоа) – в жизненном цикле присутствуют амебоидные стадии; псевдоподии лобозные; клетки имеют митохондрии с трубчатыми кристами
Группа монофилетичная (?)

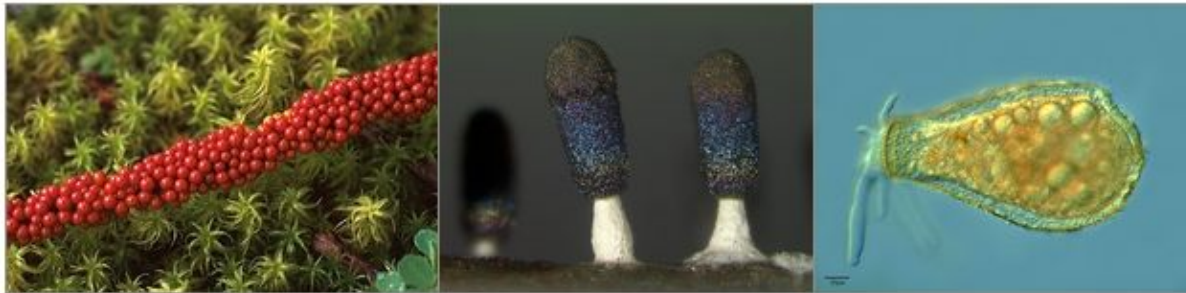


Fig. 12. Some examples of amoebozoans. From left to right: the slime mold *Leocarpus fragilis* (© 2008 Mavi Rodriguez Garcia), the slime mold *Diachea leucopodia* (© 2006 Randy Darrah, The Eumycetozoon Project, University of Arkansas), and a lobosean testate amoeba, likely *Nebela tubulosa* (© 2009 Antonio Guillén, identified by Ralf Meisterfeld).

Слизевики

Отделы: Mucromycota, Dictyosteliomycota

□ **ЛОБОЗНЫЕ ПСЕВДОПОДИИ (ЛОБОПОДИИ)**– широкие лопастевидные выросты, содержащие экто- и эндоплазму

ARCHAEPLASTIDA (PLANTAE)

Империя Plantae (Растения) – включает представителей, у которых хлоропласт возник в результате первичного эндосимбиоза; клетки имеют митохондрии с плоскими кристами

Группа монофилетичная

Царство Glaucophyta (Глаукофиты) – одноклеточные и колониальные формы; клетки содержат уникальный хлоропласт (цианелла); хл. а

Царство Rhodophyta (Багрянки) – одноклеточные, колониальные и многоклеточные формы; хл. а

Царство Chloroplastida, Viridiplantae (Зеленые растения) – одноклеточные, колониальные и многоклеточные формы; хл. а, b



Fig. 7. Some examples of Archaeplastida. From left to right, the red alga *Chondracanthus* (© Patrick Keeling), the green alga *Cosmarium* (© Patrick Keeling) and the land plants *Typha latifolia* (© Patrick Keeling) and *Calocedrus decurrens* (© 2008 Fort Photo).

Водоросли

Отделы: Glaucophyta, Rhodophyta, Chlorophyta, Charophyta

RHIZARIA

Империя Rhizaria (Ризария) – одноклеточные организмы; клетки имеют филозные псевдоподии или аксоподии

Группа монофилетичная

Царство Cercozoa (Церкозоа) – клетки имеют митохондрии с трубчатыми кристами; филоподии образуют сеть (анастомозы)

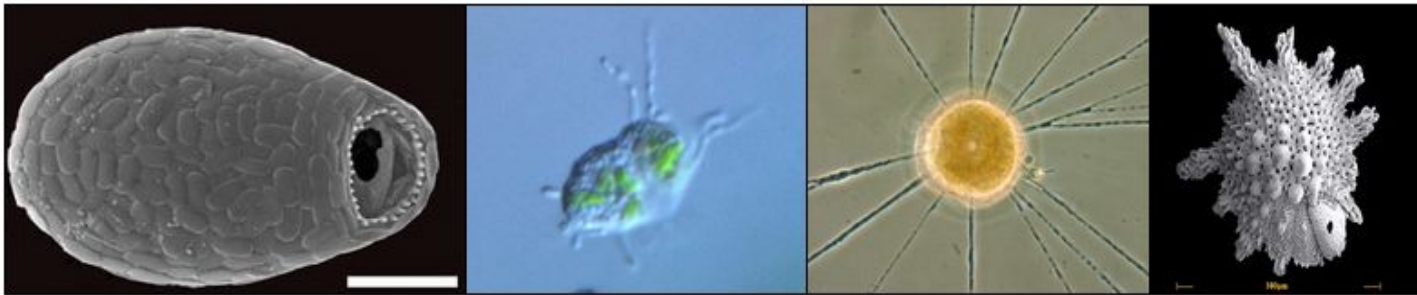


Fig. 10. Some examples of Rhizaria. From left to right: the euglyphid amoeba *Corythion dubium* (© Edward Mitchell), the chlorarachniophyte *Gymnochlora* (© Patrick Keeling), the foraminiferans *Allogromia* (© Jan Pawlowski and José Fahrni) and *Calcarina spengleri* (© 2008 Michael).

Слизевики

Отделы: Plasmodiophoromycota

Водоросли

Отделы: Chlorarachniophyta

- ❑ **ФИЛОЗНЫЕ ПСЕВДОПОДИИ (ФИЛОПОДИИ)**- длинные нитевидные выросты, содержащие эктоплазму и актиновые микрофиламенты
- ❑ **АКСОПОДИИ**- конусовидные выросты, содержащие микротрубочки, окруженные цитоплазмой

CHROMALVEOLATA

Империя Chromalveolata (Хромальвеолята) – включает представителей, у которых хлоропласт возник в результате вторичного (третичного) эндосимбиоза (у некоторых – вторично утрачен)

Группа монофилетичная

Царство Stramenopiles (Страминопилы) – зоиды имеют трехчастные мастигонемы на жгутиках; клетки имеют митохондрии с трубчатыми кристами

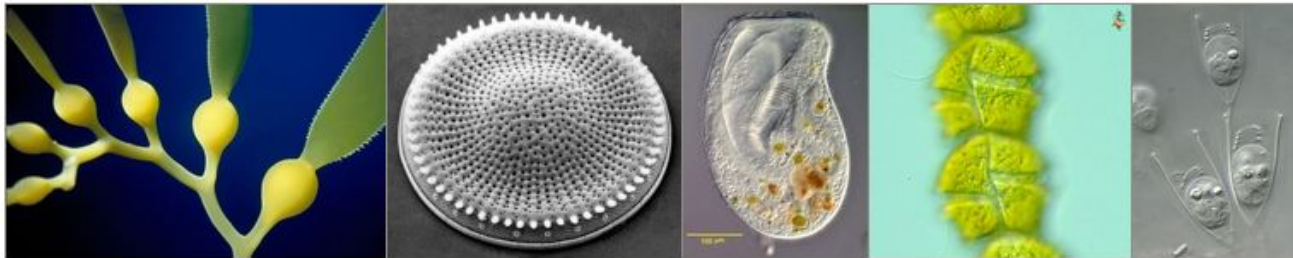


Fig. 9. Some examples of chromalveolates. From left to right: the multicellular brown alga *Macrocystis* (© Tom Gruber), the diatom *Stephanodiscus* (© David G. Mann; this image is derived from the Professor Frank Round Image Archive at the Royal Botanic Garden Edinburgh), the ciliate *Bursaria truncatella* (© William Bourland, Freshwater and terrestrial microbes of Idaho), the filamentous dinoflagellate *Gymnodinium catenatum* (© Bob Andersen and D. J. Patterson; this image is of material from Provasoli-Guillard National Center for Culture of Marine Phytoplankton), and the bicosoecid *Bicosoeca petiolata* (© William Bourland, Freshwater and terrestrial microbes of Idaho).

Псевдогрибы

Отделы: Oomycota, Hyphochytridiomycota, Labyrinthulomycota

Водоросли

Отделы: Ochrophyta

CHROMALVEOLATA

Империя Chromalveolata (Хромальвеолята) – включает представителей, у которых хлоропласт возник в результате вторичного (третичного) эндосимбиоза (у некоторых – вторично утрачен)

Группа монофилетичная

Царство Alveolates (Альвеоляты) – у большинства представителей клеточные покровы имеют альвеолы (кортикальные везикулы); митохондрии с трубчатыми кристами

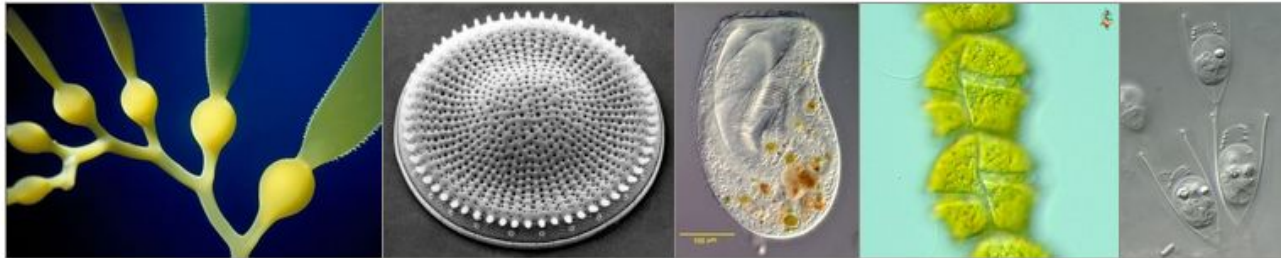


Fig. 9. Some examples of chromalveolates. From left to right: the multicellular brown alga *Macrocystis* (© Tom Gruber), the diatom *Stephanodiscus* (© David G. Mann; this image is derived from the Professor Frank Round Image Archive at the Royal Botanic Garden Edinburgh), the ciliate *Bursaria truncatella* (© William Bourland, Freshwater and terrestrial microbes of Idaho), the filamentous dinoflagellate *Gymnodinium catenatum* (© Bob Andersen and D. J. Patterson; this image is of material from Provasoli-Guillard National Center for Culture of Marine Phytoplankton), and the bicosoecid *Bicosoeca petiolata* (© William Bourland, Freshwater and terrestrial microbes of Idaho).

Водоросли

Отделы: Dinophyta

CHROMALVEOLATA

Империя Chromalveolata (Хромальвеолята) – включает представителей, у которых хлоропласт возник в результате вторичного (третичного) эндосимбиоза (у некоторых – вторично утрачен)

Царство Cryptophyta (Криптофиты) – большинство представителей – одноклеточные монадные формы с дорсовентральным строением клетки; клетки содержат ядро эндосимбионта (нуклеоморфу)

Царство Harpophyta (Гаптофиты) – большинство представителей – одноклеточные монадные формы; клетки имеют между жгутиками вырост – гаптонему

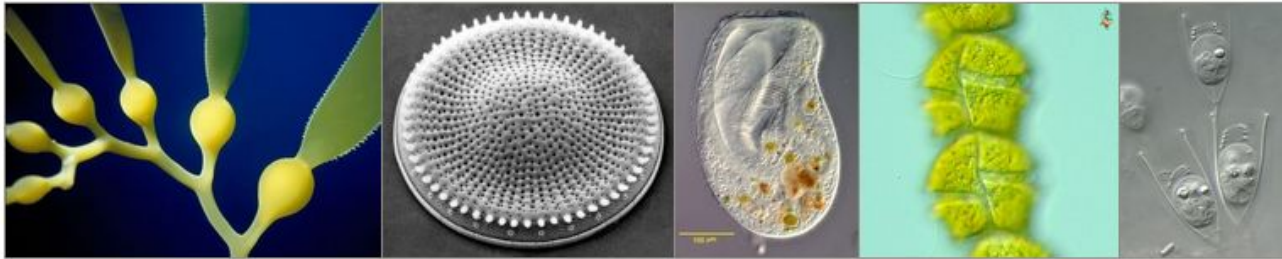


Fig. 9. Some examples of chromalveolates. From left to right: the multicellular brown alga *Macrocystis* (© Tom Gruber), the diatom *Stephanodiscus* (© David G. Mann; this image is derived from the Professor Frank Round Image Archive at the Royal Botanic Garden Edinburgh), the ciliate *Bursaria truncatella* (© William Bourland, Freshwater and terrestrial microbes of Idaho), the filamentous dinoflagellate *Gymnodinium catenatum* (© Bob Andersen and D. J. Patterson; this image is of material from Provasoli-Guillard National Center for Culture of Marine Phytoplankton), and the bicosoecid *Bicosoeca petiolata* (© William Bourland, Freshwater and terrestrial microbes of Idaho).

Водоросли

Отделы: Cryptophyta, Harpophyta (Prymnesiophyta)

EXCAVATA

Империя Excavata (Экскавата) – одноклеточные организмы; многие представители имеют цитостом и пищевую борозду

Группа не монофилетичная

Царство Discicristates (Дисцикристата) – клетки имеют митохондрии с дисковидными кристами

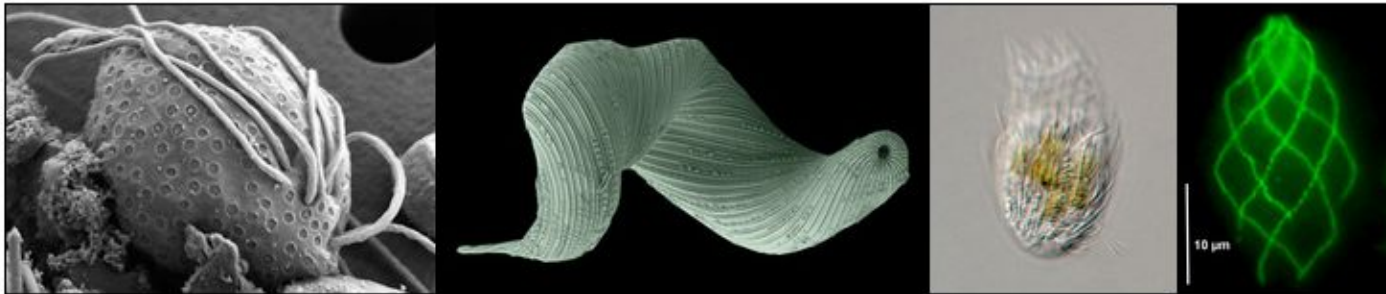


Fig. 8. Some examples of Excavata. From left to right: an SEM of the oxymonad *Saccinobaculus minor* (© Kevin Carpenter and Patrick Keeling), an SEM of the photosynthetic euglenid *Lepocinclis spirogyra* (© 2003 Brian S. Leander), a DIC light micrograph of the heterolobosean *Stephanopogon minuta* (© Naoji Yubuki and Brian S. Leander) and a fluorescence micrograph of the parabasalid *Holomastigotes elongatum* (© Guy Brugerolle).

Слизевики

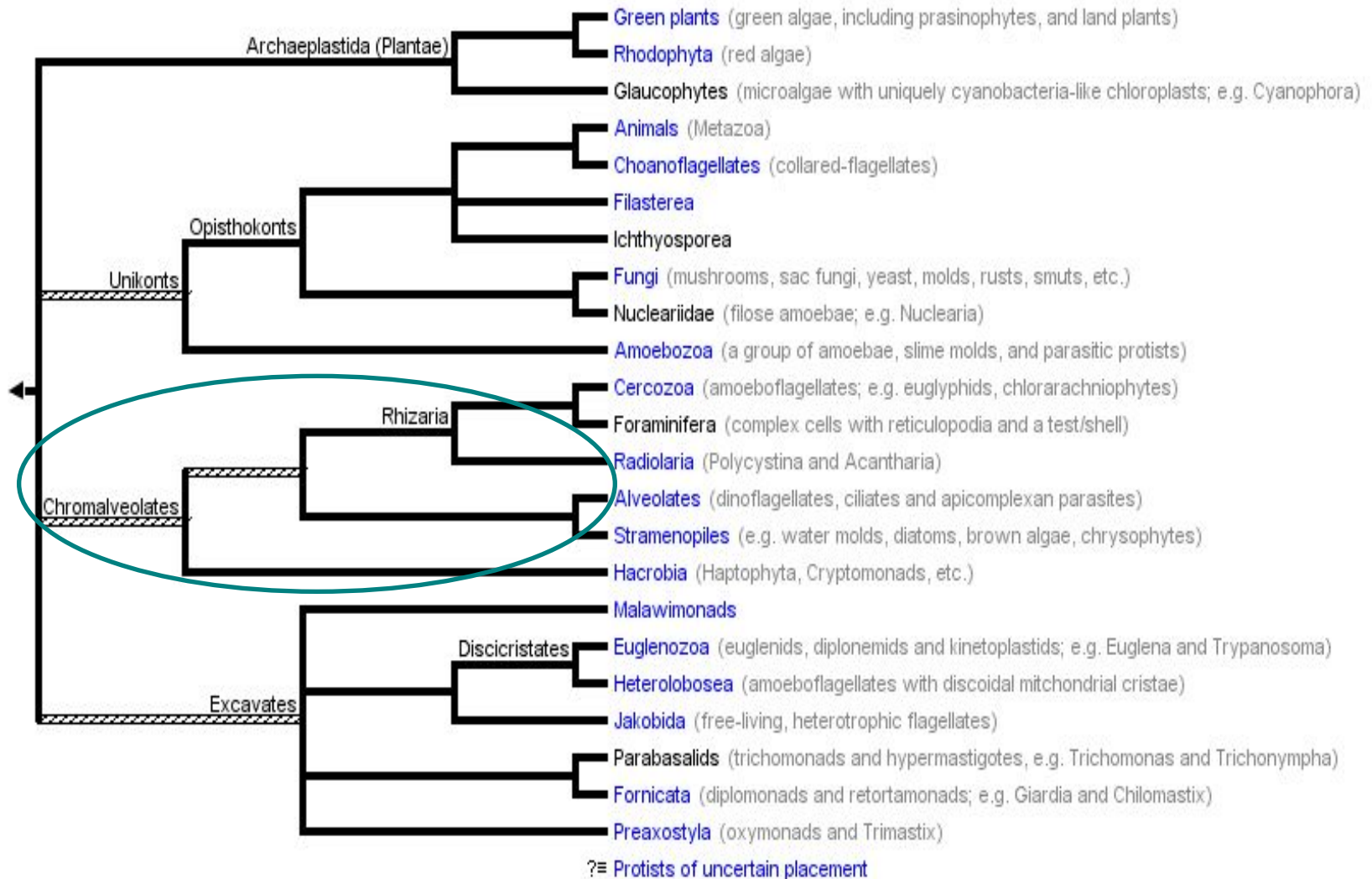
Отделы: Acrasiomycota

Водоросли

Отделы: Euglenophyta

❑ **ЦИТОСТОМ**– участок тела, предназначенный для эндоцитоза

Связи между макротаксонами эукариот



Связи между макротаксонами эукариот

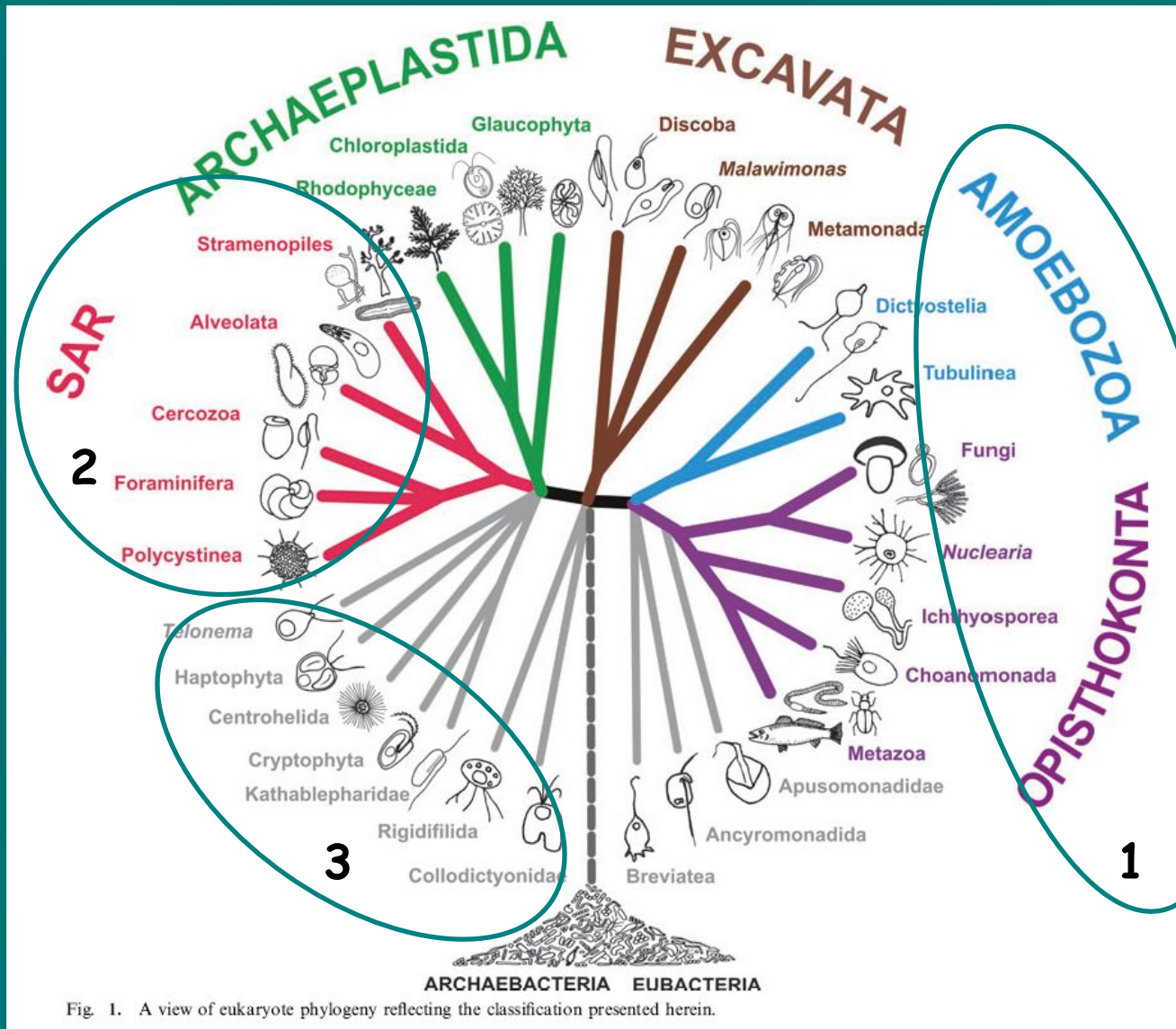
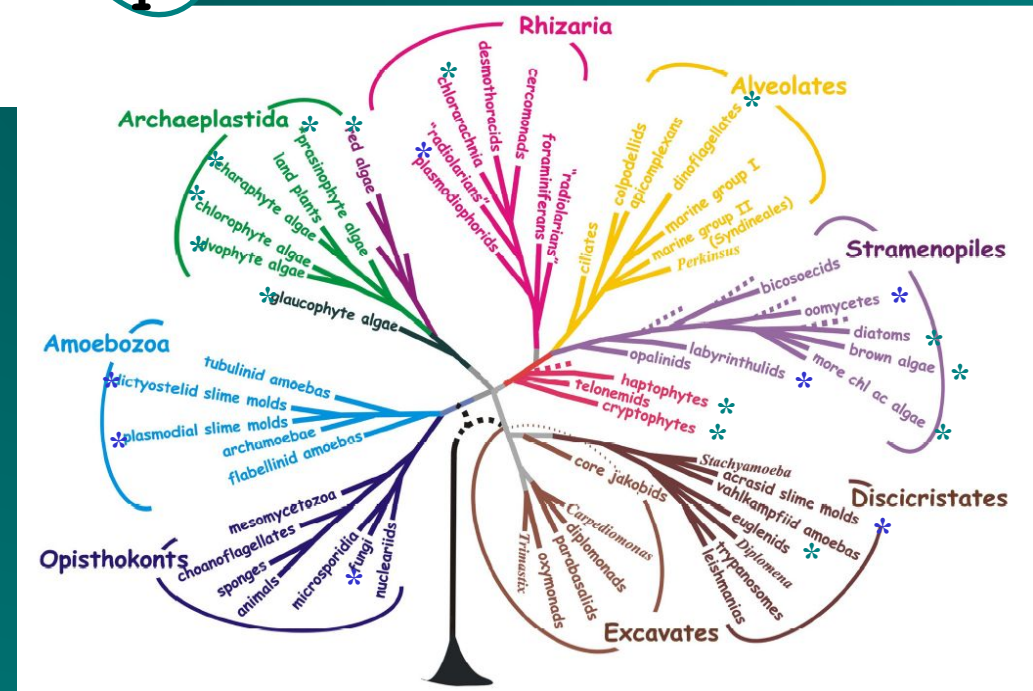
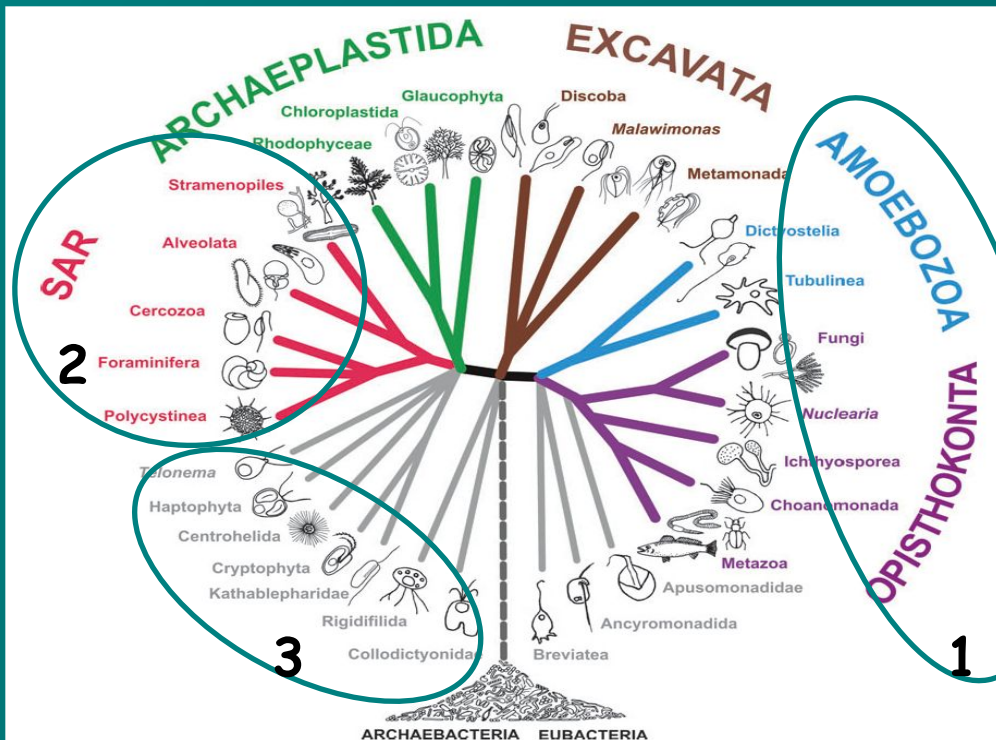


Fig. 1. A view of eukaryote phylogeny reflecting the classification presented herein.

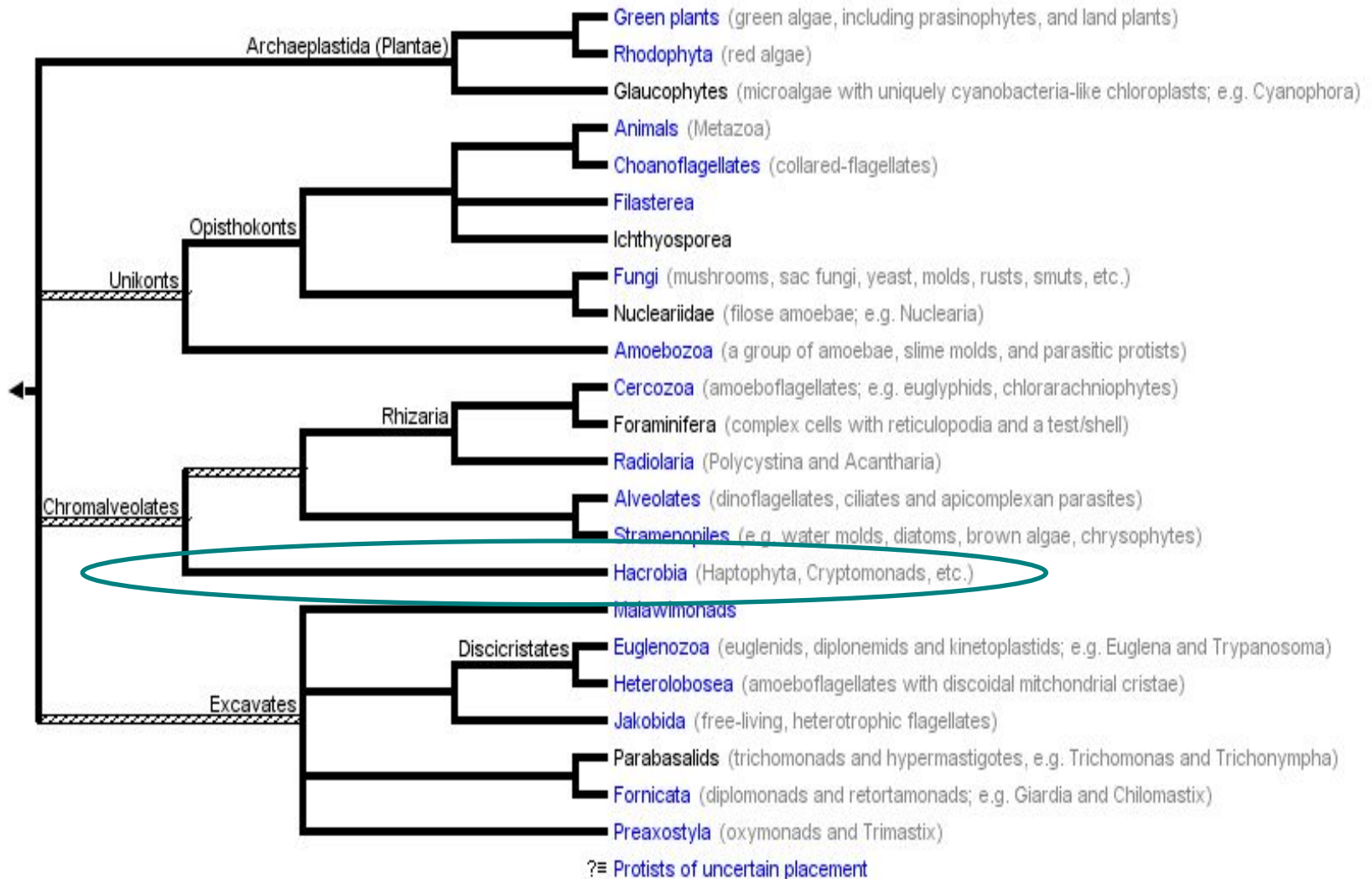
Примечание. 1- Unikonta; 2- SAR (Stramenopiles, Alveolates, Rhizaria);
3- Группы *incertae sedis*

из: Adl et al., 2012

Связи между макротаксонами эукариот



Связи между макротаксонами эукариот



Molecular Phylogeny and Description of the Novel Katablepharid *Roombia truncata* gen. et sp. nov., and Establishment of the Hacrobia Taxon nov

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Abstract

Background: Photosynthetic eukaryotes with a secondary plastid of red algal origin (cryptophytes, haptophytes, stramenopiles, dinoflagellates, and apicomplexans) are hypothesized to share a single origin of plastid acquisition according to Chromalveolate hypothesis. Recent phylogenomic analyses suggest that photosynthetic "chromalveolates" form a large clade with inclusion of several non-photosynthetic protist lineages. Katablepharids are one such non-photosynthetic lineage closely related to cryptophytes. Despite their evolutionary and ecological importance, katablepharids are poorly investigated.

Methodology/Principal Findings: Here, we report a newly discovered flagellate, *Roombia truncata* gen. et sp. nov., that is related to katablepharids, but is morphologically distinct from other members of the group in the following ways: (1) two flagella emerge from a papilla-like subapical protrusion, (2) conspicuous ejectosomes are aligned in multiple (5–11) rows, (3) each ejectosome increases in size towards the posterior end of the rows, and (4) upon feeding, a part of cytoplasm elastically stretch to engulf whole prey cell. Molecular phylogenies inferred from Hsp90, SSU rDNA, and LSU rDNA sequences consistently and strongly show *R. truncata* as the sister lineage to all other katablepharids, including lineages known only from environmental sequence surveys. A close association between katablepharids and cryptophytes was also recovered in most analyses. Katablepharids and cryptophytes are together part of a larger, more inclusive, group that also contains haptophytes, telonemids, centrohelids, and perhaps biliphytes. The monophyly of this group is supported by several different molecular phylogenetic datasets and one shared lateral gene transfer; therefore, we formally establish this diverse clade as the "Hacrobia."

Conclusions/Significance: Our discovery of *R. truncata* not only expands our knowledge in the less studied flagellate group, but provide a better understanding of phylogenetic relationship and evolutionary view of plastid acquisition/losses of Hacrobia. Being an ancestral to all katablepharids, and readily cultivable, *R. truncata* is a good candidate for multiple gene analyses that will contribute to future phylogenetic studies of Hacrobia.

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Introduction

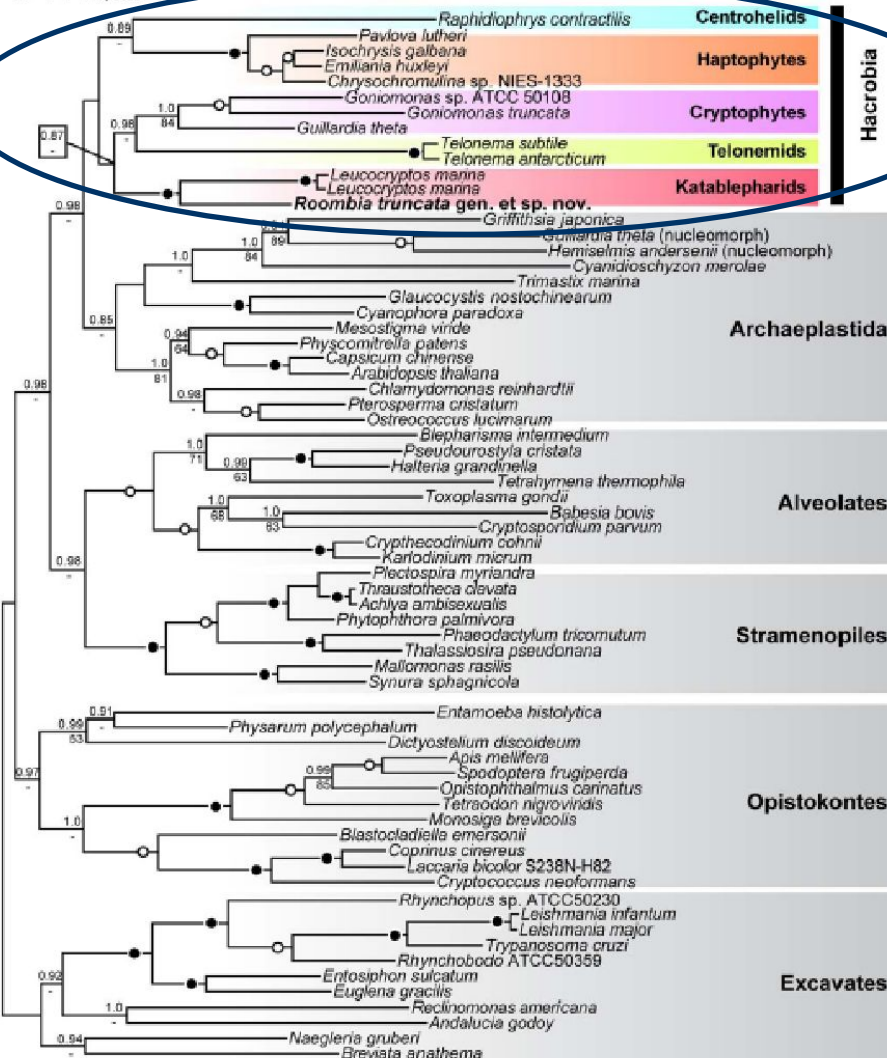
Katablepharids are cosmopolitan colorless flagellates that play an important role as predators in both marine and freshwater microbial ecosystems [1–6]. Katablepharids were originally described by Skj  r [7] based on the cloning to ovate cell shape with one anterior and one posterior flagellum emerging from a subapical region. These flagellates had been classified as a subgroup of cryptophytes based on similarities observed in light microscopy, then later re-classified as *toxostax* spp. based on ultrastructural studies [1]. Recent molecular phylogenetic analyses inferred from small and large subunit (SSU and LSU, respectively)

rDNA sequences suggest that katablepharids are indeed a sister group of cryptophytes [9–11].

Although a close relationship between katablepharids and cryptophytes is clear, whether or not they are one another's closest relatives remains open to debate; several other lineages previously classified as *toxostax* spp. have been shown to branch in this part of the eukaryotic tree in molecular phylogenetic analyses, such as telonemids [12,13] and (picoph)phytes, known only from environmental sequences and fluorescence in situ hybridization (FISH) images [14–17].

Their close association to cryptophytes makes katablepharids an interesting group from the perspective of the chromalveolate

- PP 1.0, BS 100
-    PP 1.0, BS > 85



The evolutionary history of haptophytes and cryptophytes: phylogenomic evidence for separate origins

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An important missing piece in the puzzle of how plastids spread across the eukaryotic tree of life is a robust evolutionary framework for the host lineages. Four assemblages are known to harbour plastids derived from red algae and, according to the controversial chromalveolate hypothesis, these all share a common ancestry. Phylogenomic analyses have consistently shown that stramenopiles and alveolates are closely related, but haptophytes and cryptophytes remain contentious; they have been proposed to branch together with several heterotrophic groups in the newly erected Hacrobia. Here, we tested this question by producing a large expressed sequence tag dataset for the katablepharid *Rombia truncata*, one of the last hacrobian lineages for which genome-level data are unavailable, and combined this dataset with the recently completed genome of the cryptophyte *Guillardia theta* to build an alignment composed of 288 genes. Our analyses strongly support haptophytes as sister to the SAR group, possibly together with telonemids and centrochids. We also confirmed the common origin of katablepharids and cryptophytes, but these lineages were not related to other hacrobian; instead, they branch with plants. Our study resolves the evolutionary position of haptophytes, an ecologically critical component of the oceans, and proposes a new hypothesis for the origin of cryptophytes.

Keywords: phylogenomics; plastid; haptophyte; cryptophyte; katablepharid; tree of life

1. INTRODUCTION

Eukaryotes first acquired photosynthesis through endosymbiosis, where a heterotrophic cell engulfed and retained a photosynthetic prokaryote related to modern-day Cyanobacteria, ultimately integrating it to form the highly specialized plastid organelles we see today [1–3]. This crucial event in eukaryote evolution is generally seen as unique: primary plastids probably evolved only once in the common ancestor of glaucophytes, red algae and green plants (green algae + land plants), together making the Plantae supergroup [4] (but see [5]). A much more recent case of cyanobacterium to eukaryote endosymbiosis has been reported in the rhizarian *Paulinella chromatophora* [6], but this event appears to have had less impact on the diversification of plastids. Photosynthesis spread further to other eukaryotic lineages by means of secondary endosymbioses, when other eukaryotes subsequently engulfed green or red algae, and, in dinoflagellates, tertiary endosymbioses [7]. On the green side, two independent cases of secondary endosymbioses are known, leading to chlorarachniophyte and euglenid algae, respectively [8]. On the red side, the situation is much more contentious.

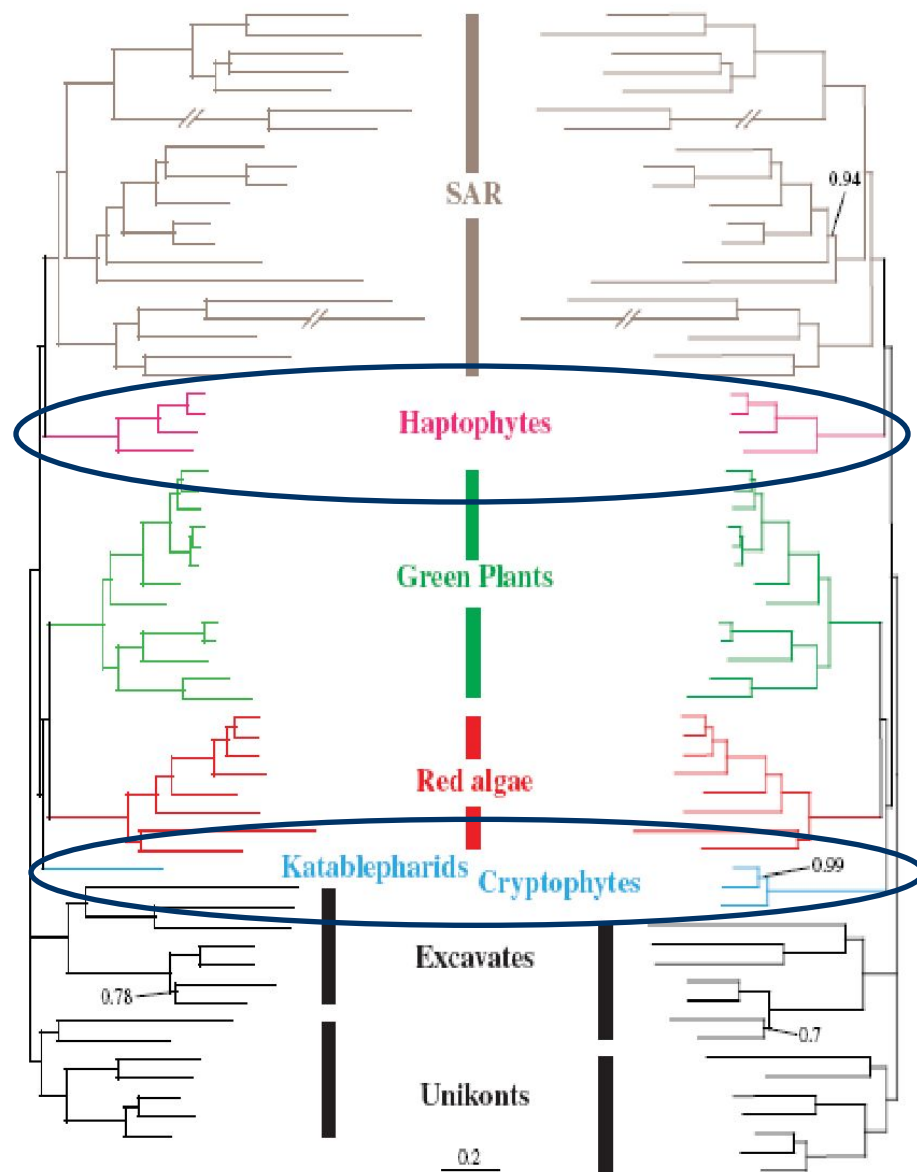
The chromalveolate hypothesis has been regarded as a likely evolutionary framework for explaining the origin and distribution of red secondary plastids [9,10]. It posits that a single secondary endosymbiosis with a red alga gave rise to plastids in stramenopiles (or heterokonts), alveolates,

haptophytes and cryptophytes, altogether forming the Chromalveolata supergroup [11]. This hypothesis is based on the fact that complex events are necessary to establish a plastid, so it is more parsimonious to limit the number of plastid origins, regardless of the number of plastid losses this implies [12]. Thus far, plastid data have generally supported the monophyly of some or all of the chromalveolate lineages where plastids are known. Molecular evidence for this includes multi-gene phylogenies [13,14], shared evolutionary history of several nucleus-encoded plastid-targeted genes [15–18], and a rare lateral gene transfer in the plastids of haptophytes and cryptophytes [19].

The chromalveolate hypothesis also predicts that the host nuclear lineages are monophyletic; so far, however, this has proven impossible to verify despite the use of substantial alignments (in the range of 30 000 amino acids). Nuclear-based phylogenomics have consistently shown that stramenopiles and alveolates are closely related, and that they form a strongly supported group with Rhizaria, altogether making the so-called SAR group [20,21]. At the same time, haptophytes and cryptophytes generally appeared together, albeit with less support and only when relatively large alignments are used [21–24]. Based on congruent plastid and nuclear data, these were proposed to be a second chromalveolate lineage, Hacrobia [25]. Other lineages that were not originally included in the chromalveolate hypothesis have since been suggested to be members of Hacrobia (namely telonemids, centrochids, katablepharids, picobiliphytes, *Rapheomonas* and rappemonads), but the support for these is variable, and typically few data are available, from only a single representative of these lineages [22,25–32].

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Группы, которые традиционно изучают альгологи

Империя	Отделы водорослей
Eubacteria	Cyanophyta
Archaeplastida	Glaucophyta
	Rhodophyta
	Chlorophyta
	Charophyta
SAR (Stramenopiles + Alveolates + Rhizaria)	Ochromophyta
	Dinophyta
	Chlorarachniophyta
Excavata	Euglenophyta
Incertae sedis	Cryptophyta
	Haptophyta

Группы, которые традиционно изучают микологи

Империя	Отделы грибов	Отделы слизевиков	Отделы псевдогрибов
Unikonta	Chytridiomycota	Мухомycota	
	Zygomycota	Dictyosteliomycota	
	Glomeromycota		
	Ascomycota		
	Basidiomycota		
	"Deuteromycota"		
Excavata		Acrasiomycota	
SAR (Stramenopiles + Alveolates + Rhizaria)		Plasmodiophoromycota	
			Oomycota
			Hyphochytridiomycota
			Labyrinthulomycota

Международный Кодекс Номенклатуры водорослей, грибов и растений

International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011

CHAPTER III. Nomenclature of taxa according to their rank

SECTION 1. Names of taxa above the rank of family

Article 16

16.1. The name of a taxon above the rank of family is treated as a noun in the plural and is written with an initial capital letter. Such names may be either (a) automatically typified names (Art. 10.7), formed from the name of an included genus in the same way as family names (Art. 18.1; but see Art. 16.4) by adding the appropriate rank-denoting termination (Art. 16.3 and 17.1), preceded by the connecting vowel -o- if the termination begins with a consonant; or (b) descriptive names, not so formed, which may be used unchanged at different ranks.

Ex.1. Automatically typified names above the rank of family: *Lycopodiophyta*, based on *Lycopodium*; *Magnoliophyta*, based on *Magnolia*; *Gnetophytina*, based on *Gnetum*; *Pinopsida*, based on *Pinus*; *Marattiidae*, based on *Marattia*; *Caryophyllidae* and *Caryophyllales*, based on *Caryophyllus*; *Fucales*, based on *Fucus*; *Bromeliineae*, based on *Bromelia*.

Ex.2. Descriptive names above the rank of family: *Anthophyta*, *Chlorophyta*, *Lycophyta*, *Parietales*; *Ascomycota*, *Ascomycotina*, *Ascomycetes*; *Angiospermae*, *Centrospermae*, *Coniferae*, *Enantioblastae*, *Gymnospermae*.

16.2. For automatically typified names, the name of the subdivision or subphylum that includes the type of the adopted name of a division or phylum, the name of the subclass that includes the type of the adopted name of a class, and the name of the suborder that includes the type of the adopted name of an order are to be based on the same generic name (see also Art. 16.4) as the corresponding higher-ranked name.

Ex.3. *Pteridophyta* Bergen & B. M. Davis (1906) and *Pteridophytina* B. Boivin (1956); *Gnetopsida* Engl. (1898) and *Gnetidae* Cronquist & al. (1966); *Liliales* Perleb (1826) and *Liliineae* Rchb. (1841).

16.3. Automatically typified names end as follows: the name of a division or phylum ends in *-phyta*, unless it is referable to the algae or fungi in which case it ends in *-phycota* or *-mycota*, respectively; the name of a subdivision or subphylum ends in *-phytina*, unless it is referable to the algae or fungi in which case it ends in *-phycotina* or *-mycotina*, respectively; the name of a class in the algae ends in *-phyceae*, and of a subclass in *-phycidae*; the name of a class in the fungi ends in *-mycetes*, and of a subclass in *-mycetidae*; the name of a class in the plants ends in *-opsida*, and of a subclass in *-idae* (but not *-viridae*). Automatically typified names not in accordance with these terminations or those in Art. 17.1 are to be

16.3. Automatically typified names end as follows: the name of a division or phylum ends in *-phyta*, unless it is referable to the algae or fungi in which case it ends in *-phycota* or *-mycota*, respectively; the name of a subdivision or subphylum ends in *-phytina*, unless it is referable to the algae or fungi in which case it ends in *-phycotina* or *-mycotina*, respectively; the name of a class in the algae ends in *-phyceae*, and of a subclass in *-phycidae*; the name of a class in the fungi ends in *-mycetes*, and of a subclass in *-mycetidae*; the name of a class in the plants ends in *-opsida*, and of a subclass in *-idae* (but not *-viridae*). Automatically typified names not in accordance with these terminations or those in Art. 17.1 are to be corrected, without change of the author citation or date of publication (see Art. 32.2). However, if such names are published with a non-Latin termination they are not validly published.

отдел/phylum	- phyta	- phycota
подотдел/subphylum	- phytina	- phycotina
класс/class	- phyceae	- phyceae
подкласс/subclass	- phycidae	- phycidae

Положение эукариотных "низших растений" в макросистеме органического мира (по: Adl et al., 2012)

супер-группы	группы	группы и отделы "низших растений"
Opisthokonta		грибы (Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota)
Amoebozoa		слизевики (Mycetozoa, Dictyosteliomycota)
Archaeplastida		водоросли (Glaucophyta, Rhodophyta, Chlorophyta, Charophyta)
SAR	Stramenopiles	водоросли (Ochromyces); псевдомицеты (Oomycota, Hyphochytridiomycota и Labyrinthulomycota)
	Alveolates	водоросли (Dinophyta)
	Rhizaria	водоросли (Chlorarachniophyta); слизевики (Plasmodiophoromycota)
Excavata	Discicristates	водоросли (Euglenophyta); слизевики (Acrasiomycota)
Insertae sedis		водоросли (Cryptophyta, Haptophyta)

СПАСИБО ЗА
ВНИМАНИЕ!