Part 1-1. The Deepest Evolutionary Chasm: The origin of eukaryotes

Bacterial colonies to true multicellular organisms
Lack of time or opportunity?

Two hypothesis
1. Bottleneck thesis: Christian de Duve
    populations of proto-eukaryotes
    adaptation & expansion of the fittest under the selection pressure

However, competition (bottleneck) does not mean complete disappearance of the others
    there always a niche to survive
    example: birds & bats
        methanogen & sulphate reducing bacteria, both competing for scarce H2

2. A hopeful monster: Goldschmidt
    micromutations
    macromutations: not a succession of micromutations
        speciation (?) to a hopeful monster through fusion of two whole genomes

Differences between bacteria & eukaryotes (pp 30-35)

Evolutionary root of eukaryotic cell structures

- in 4 billion yrs bacteria barely changed,
  - while eukaryotic cells showed complicated evolution
- two hypothesis
  - mergers between a variety of bacterial cells: Lynn Margulis
  - features from within the group

Two theories of eukaryotic cell evolution

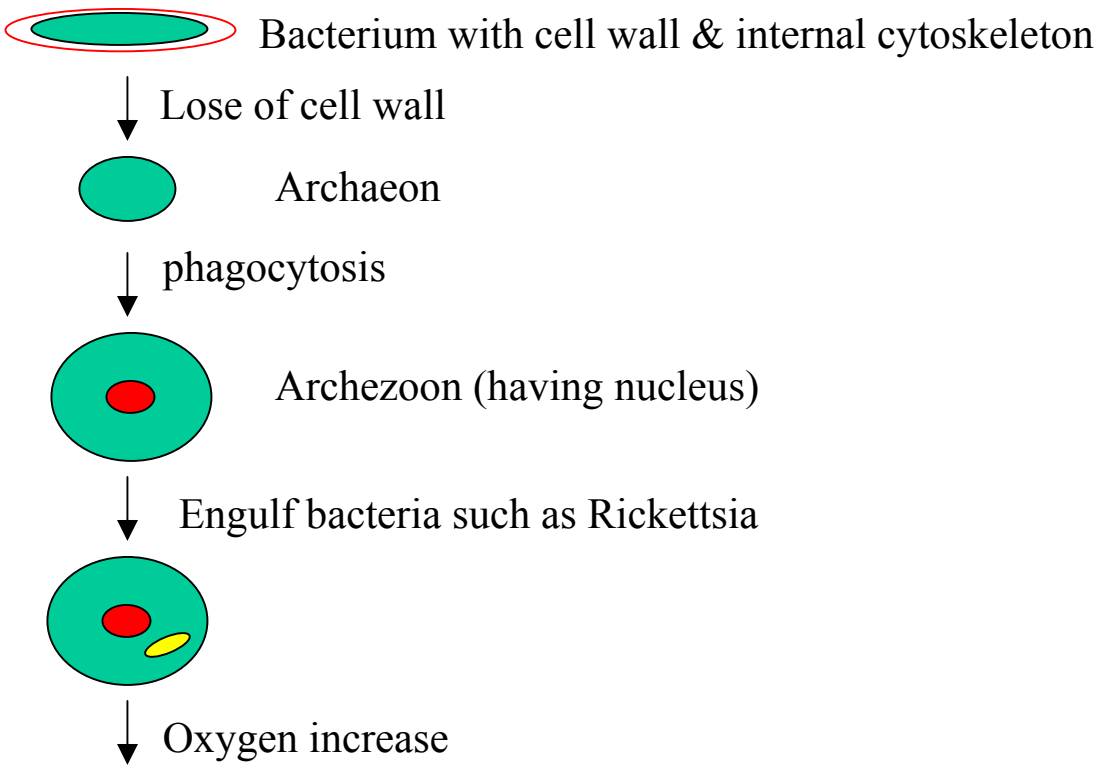
- Mainstream view: Tom cavalier-Smith
- Hydrogen hypothesis: Bill Martin

Part 1-2. Quest for a progenitor (pp 38-50)

Mainstream view

a bacteria gradually transformed into a primitive eukaryotic cell

A scenario



Evidences

1. Catastrophic loss of the cell wall: a possible event & advantage

Survival & subversion of the order of things

Some bacteria having a cytoskeleton as well as a cell wall
Some groups of archaebacteria don't have cell wall
All eukaryotes don't have cell wall

cocci (spherical): default bacterial shape

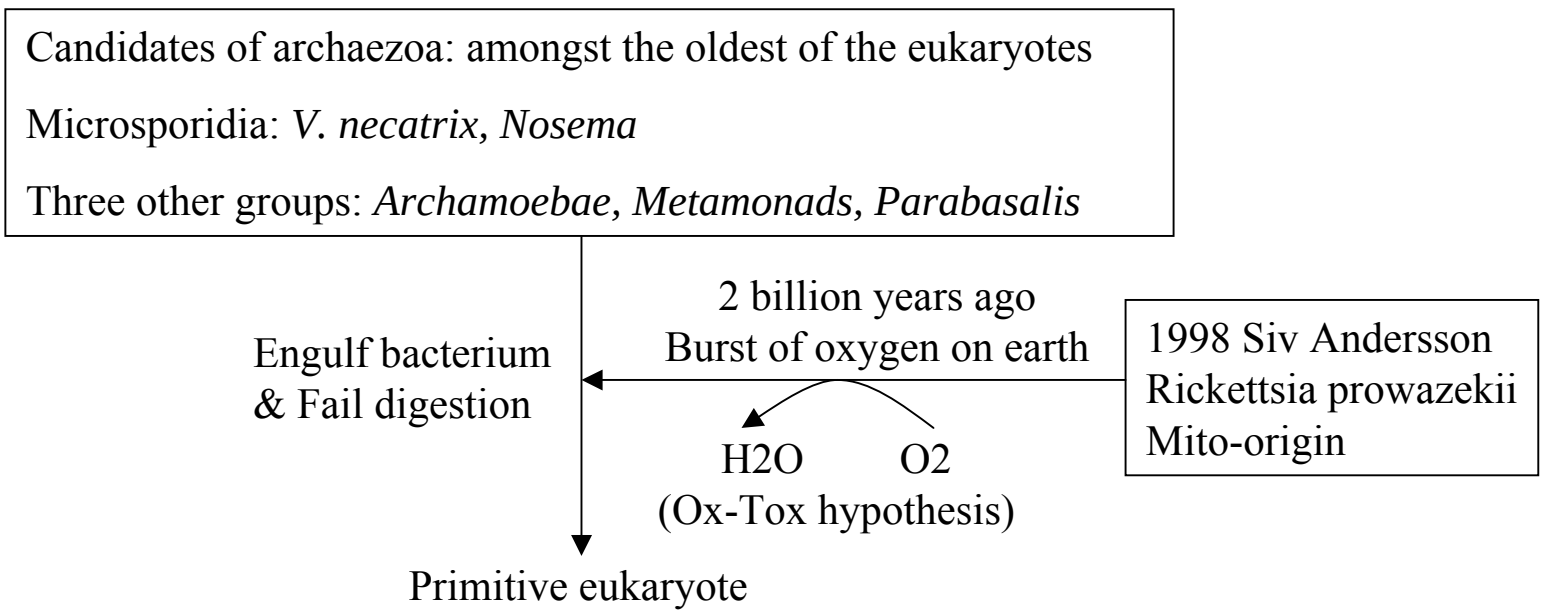
Delete the encoding gene

bacilli (rod): require internal support (actin filament)

2. The archezoa: eukaryotes without mito

Some of the single celled eukaryotes resemble the earliest eukaryotes
>1000 species of the primitive eukaryotes have no mito
A few of them are primitive amitochondriate
thriving today by fermentation in low or absence of oxygen

Postulation of archaezoa, which never had mito
nucleus, dynamic cytoskeleton, phagocytosis



Reversal of a paradigm to “Mainstream view”

1. Genome sequence of archezoa
    - Entamoeba histolytica (a postulated progenitor of eukaryotic cells)
    - Less older than other which has mito

2. Evidence of mito trace in Entamoeba
    - mito gene transfer to nuclear genome
    - some oval organelle (might be remains of mito)
    - more evidence in other archezoa (Giardia)

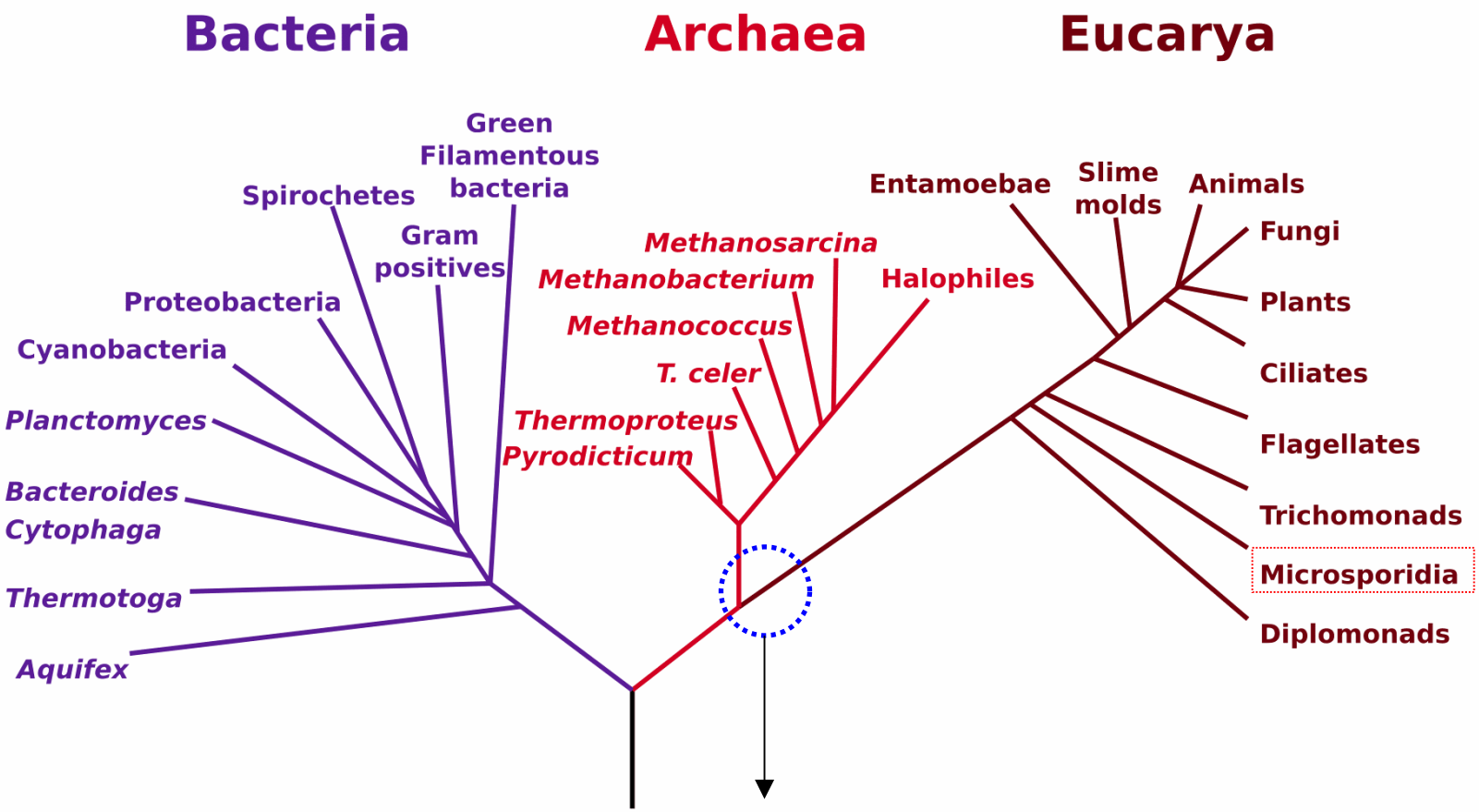
3. Microsporidia
    - more close to the higher fungi

Any remaining possibility to find real archaezoa?

4. Bioinformatics analysis of eukaryotic genes

Phylogenetic Tree of Life

(based on rRNA data: http://en.wikipedia.org/wiki/Archaea)



The common ancestor (lack of cell wall)

Methanogens as mito origin

1. Maria Rivera in 1998 & 2004

   Comparative genome analysis of the organisms from the three domains of life

   Two distinct classses of genes in eukaryotes

   informational: from methanogens

   operational: from α-proteobacteria

2. John Reeve

   the structure of eukaryotic histones is related to methanogen histones

   the 3D structure of DNA-protein package is also similar

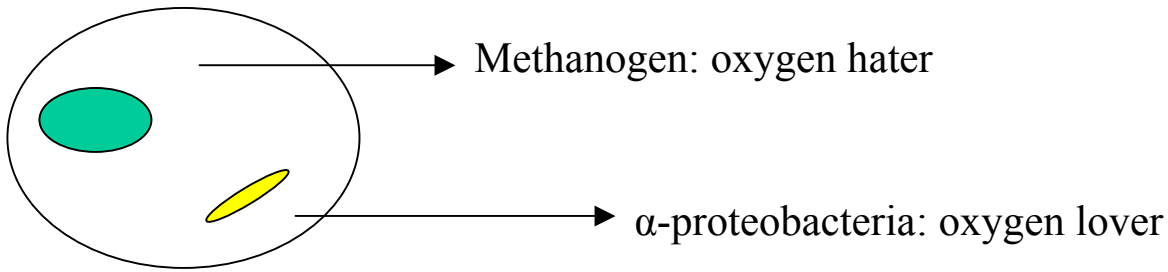
A hopeful monster (the first eukaryotic cell)

a merger between a methanogen and an α-proteobacteria

A symbiosis between

Methanogen and α-proteobacteria (ex. a parasite like Rickettsia)

Methanogen can tolerate the presence of oxygen
but can't generate any energy in its presence
because they depend on hydrogen for fuel



A paradox
How to jump the deep chasm?