

EGU General Assembly 2020

Online | 7 May 2020

“Methanogenesis 2020 – An update”

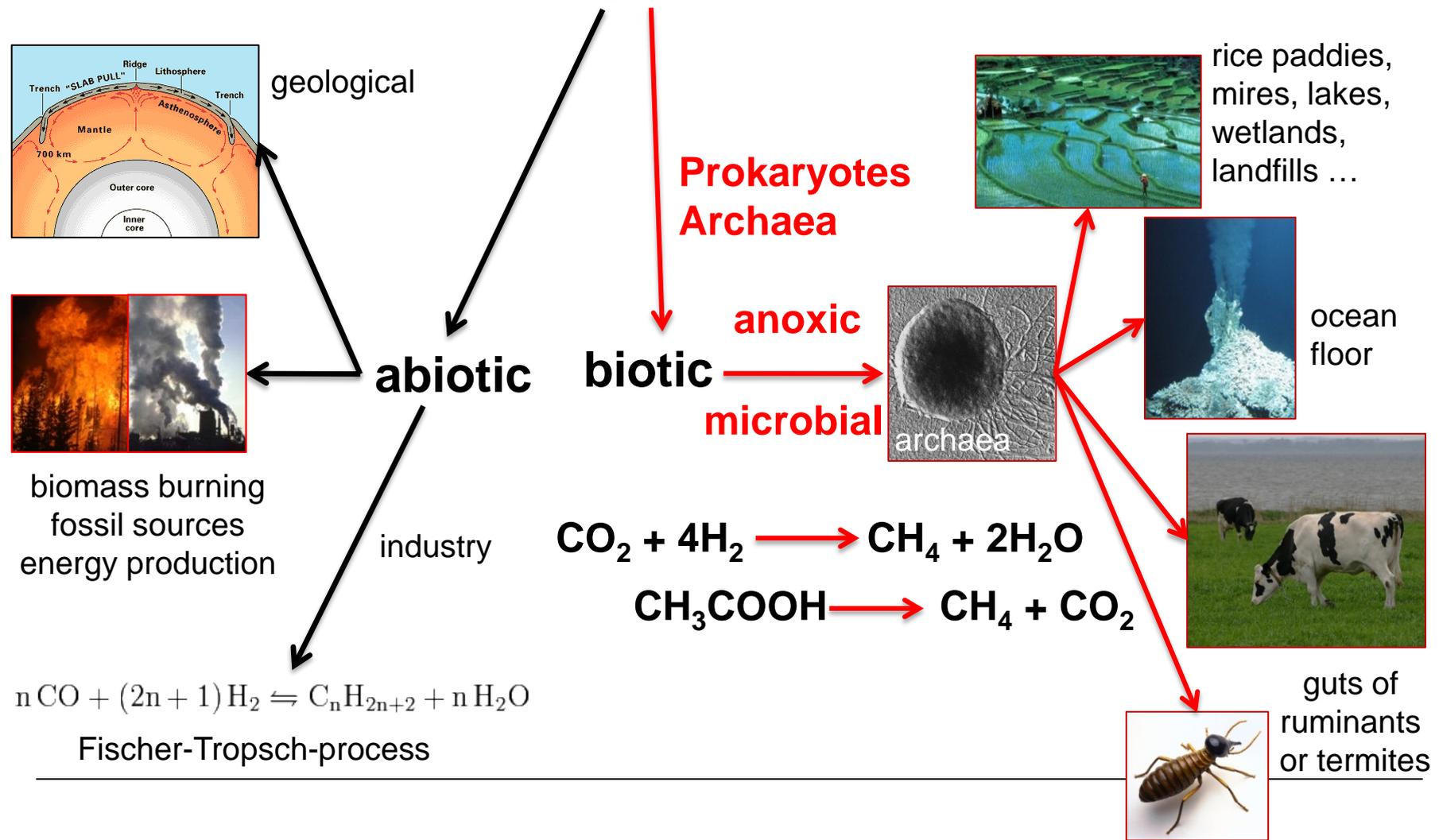
Frank Keppler

*Institute of Earth Sciences
Heidelberg University
Germany*

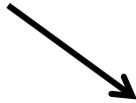
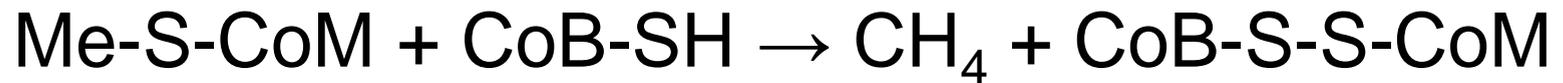
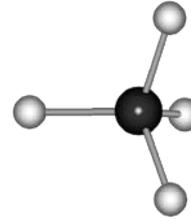


Well known processes of methane formation on Earth

Methanogenesis – traditional view



The final step of methanogenesis by archaea



The enzyme **Methyl-coenzyme M reductase** (MCR) catalyzes the final step in **CH₄** formation...a phylogenetic marker

Ellermann et al., Eur. J. Biochem, 1988

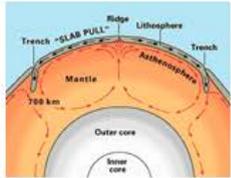
Novel eukaryotic sources recently discovered...

Methanogenesis updated

Abiotic

*chemical
aerobic/anaerobic*

temperature – pressure – UV irradiation



geologic



fossil fuel burning



soils



vegetation fires



senescent vegetation

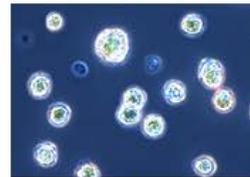
Eukaryotes

*non-archaeal
aerobic*



plants

fungi



algae



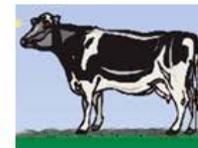
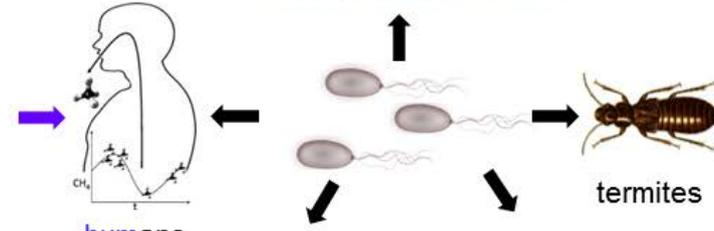
lichens

Archaea

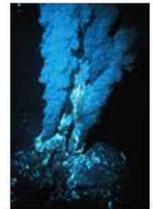
*microbial
anaerobic*



wetlands



ruminants

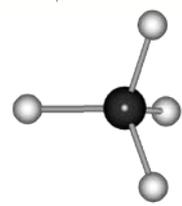
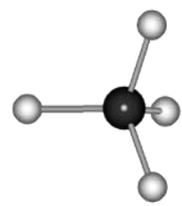


hydrothermal vents

Phylogenetic Tree of Life

Three domain system

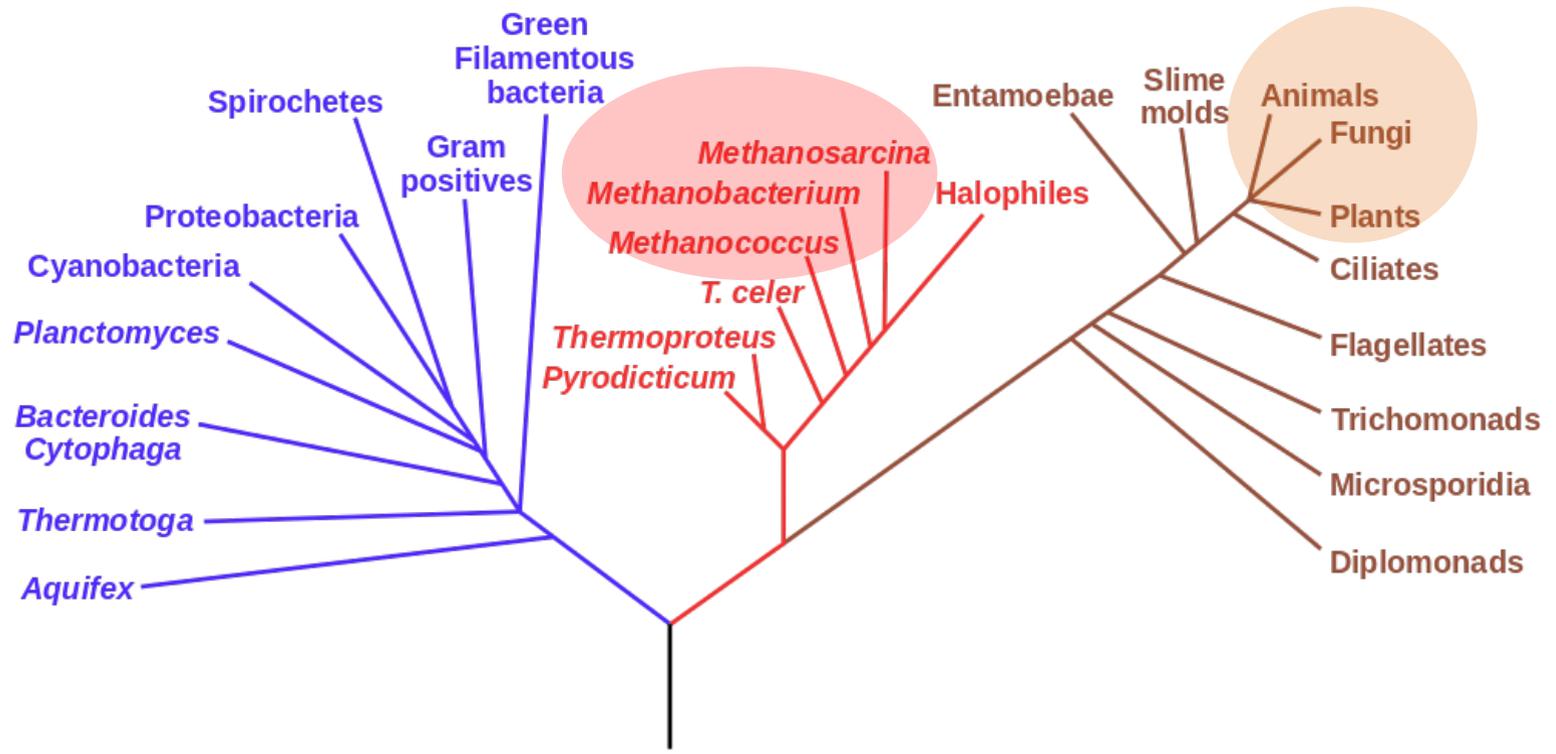
?



Bacteria

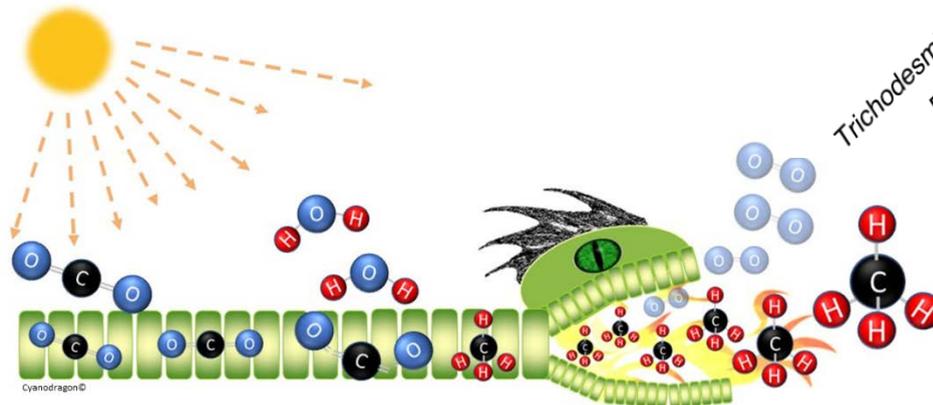
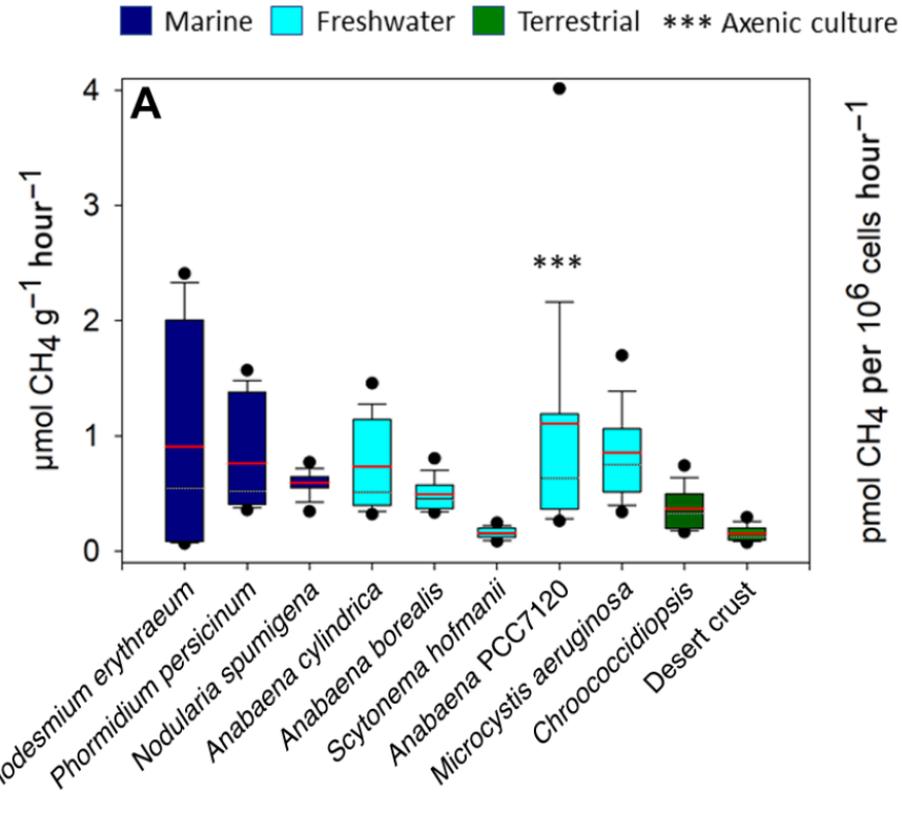
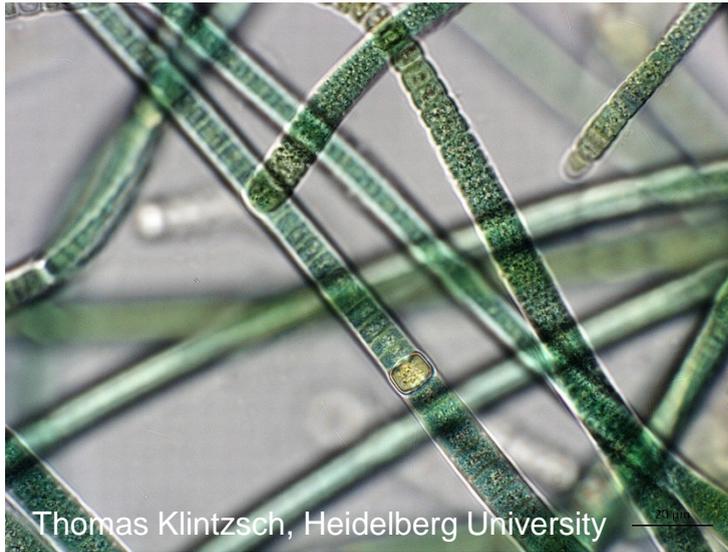
Archaea

Eukaryota



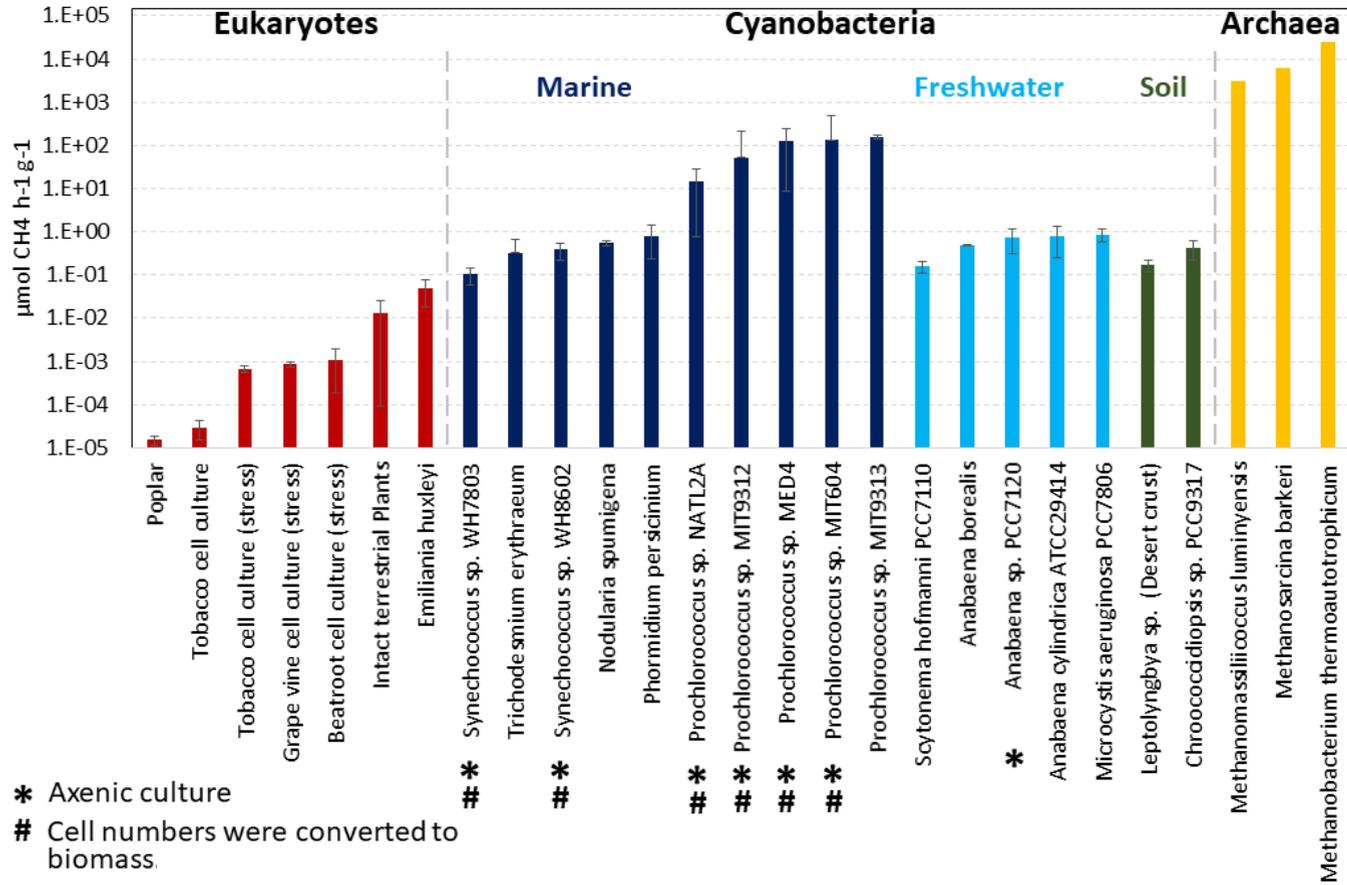
[Phylogenetic Tree of Life taken from Wikimedia Commons]

Widespread formation of methane by *Cyanobacteria* in aquatic and terrestrial environments



Bižić et al., Science Advances, 2020

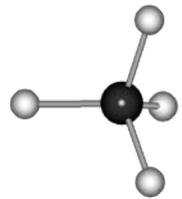
Reported formation rates - from culture experiments:



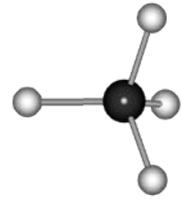
* Axenic culture
Cell numbers were converted to biomass.

Bižić et al., Science Advances, 2020

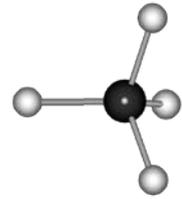
Methanogenesis 2020



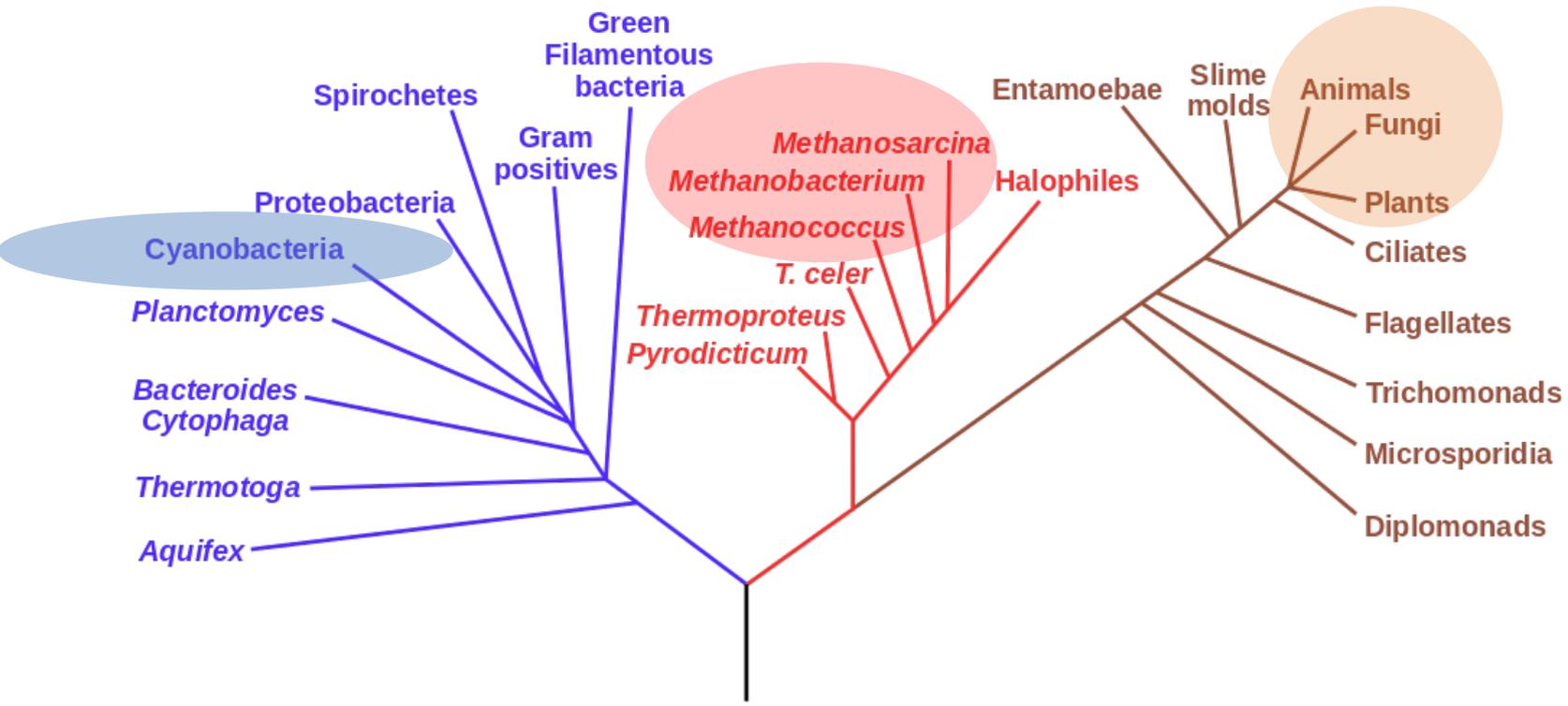
Bacteria



Archaea



Eukaryota



Detailed pathways of non-archaeal methane formation have yet to be discovered...

