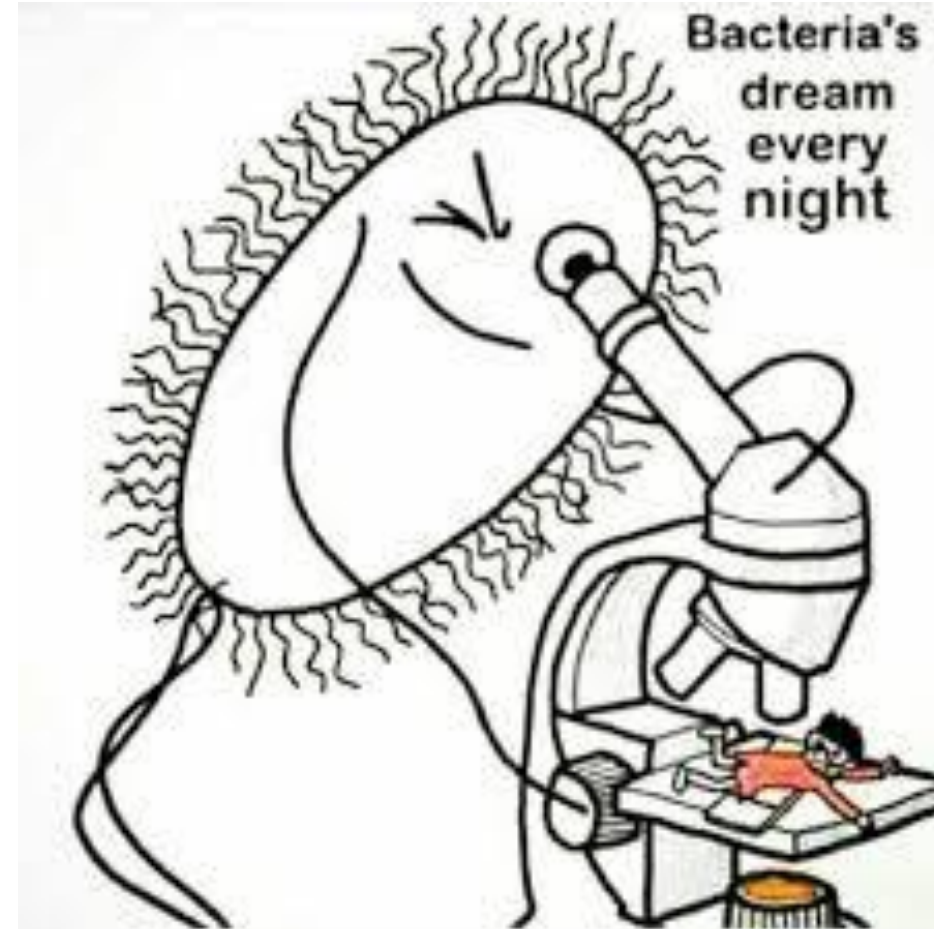


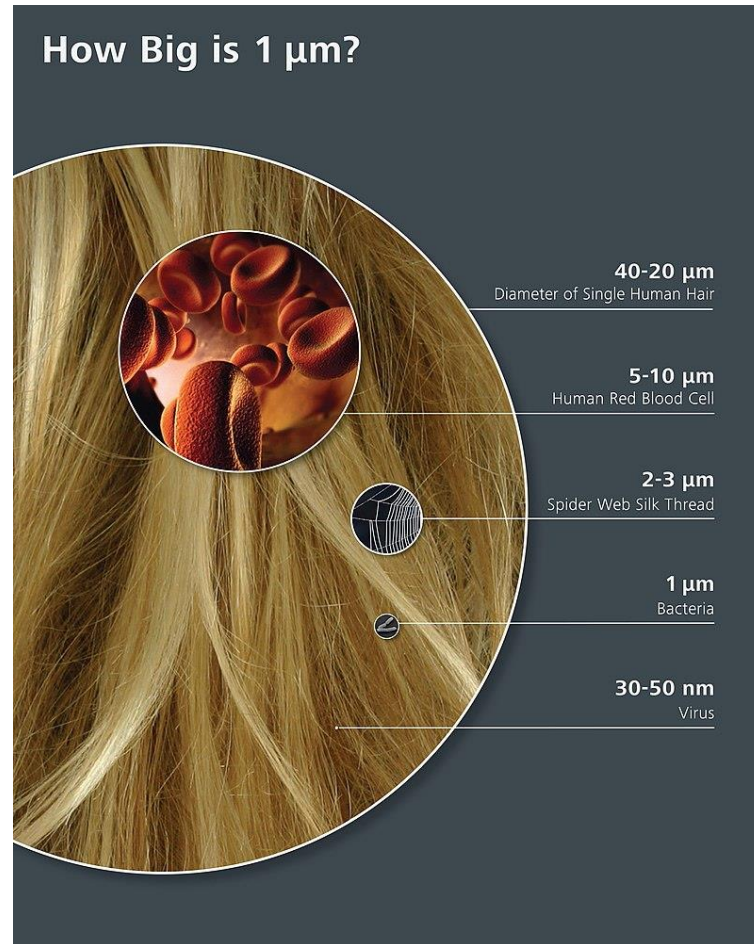
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# Introduction to microbiology

PharmDr. Jakub Treml, Ph.D.



# What is microbiology?



μῖκρος = small

βίος = life

λογία = science

= science about microorganisms

# Types of microorganisms

## Parasites:

basic parasitology;  
ecto- endo-; eucaryots

## Fungi:

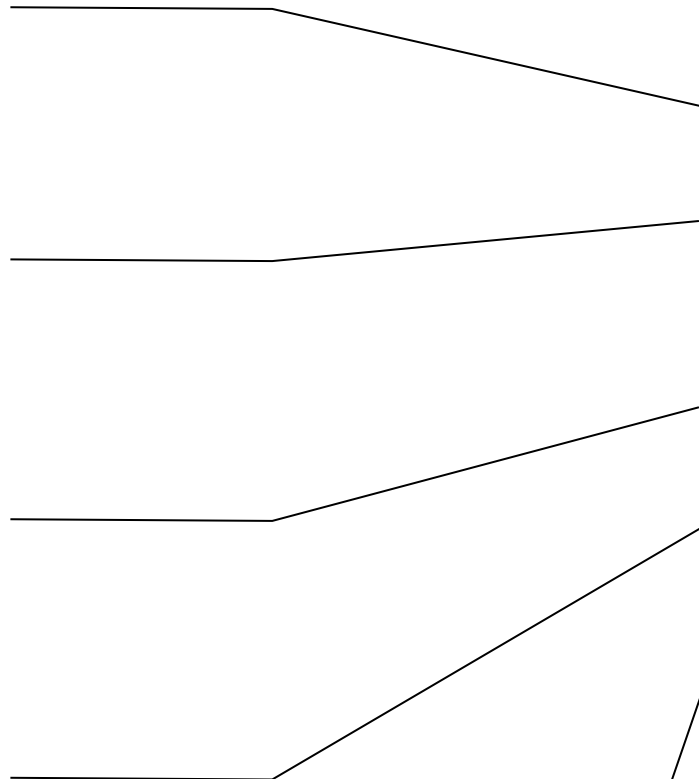
basic mycology;  
yeasts; moulds; eucaryots

## Bacteria:

basic bacteriology;  
procaryotss (+ archea)

## Viruses:

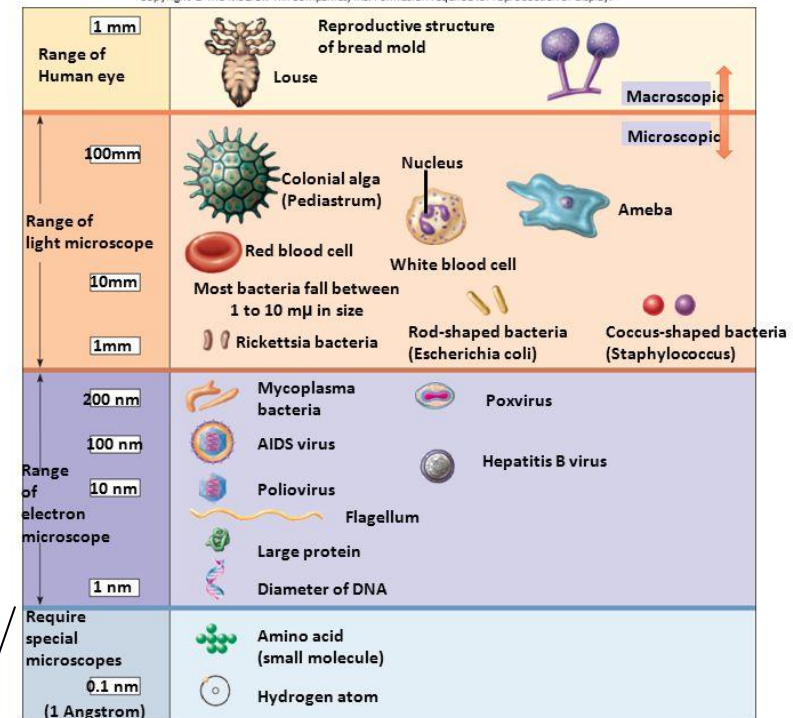
basic virology;  
subcellular



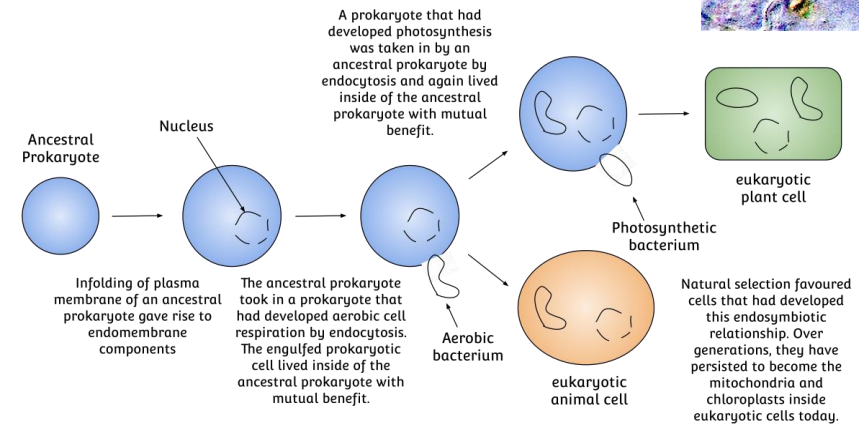
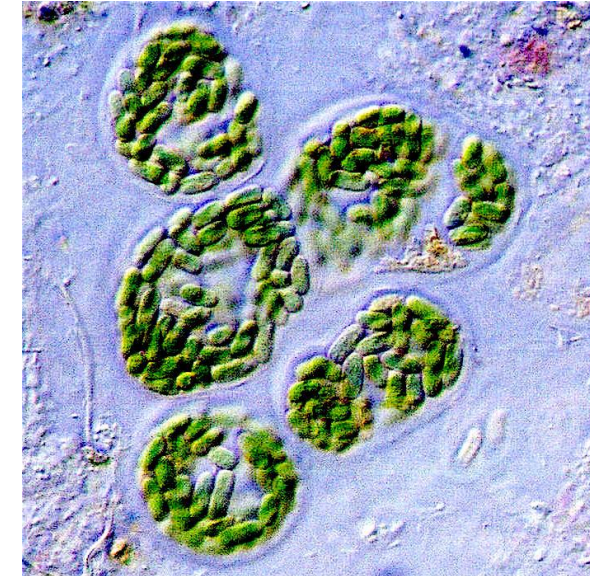
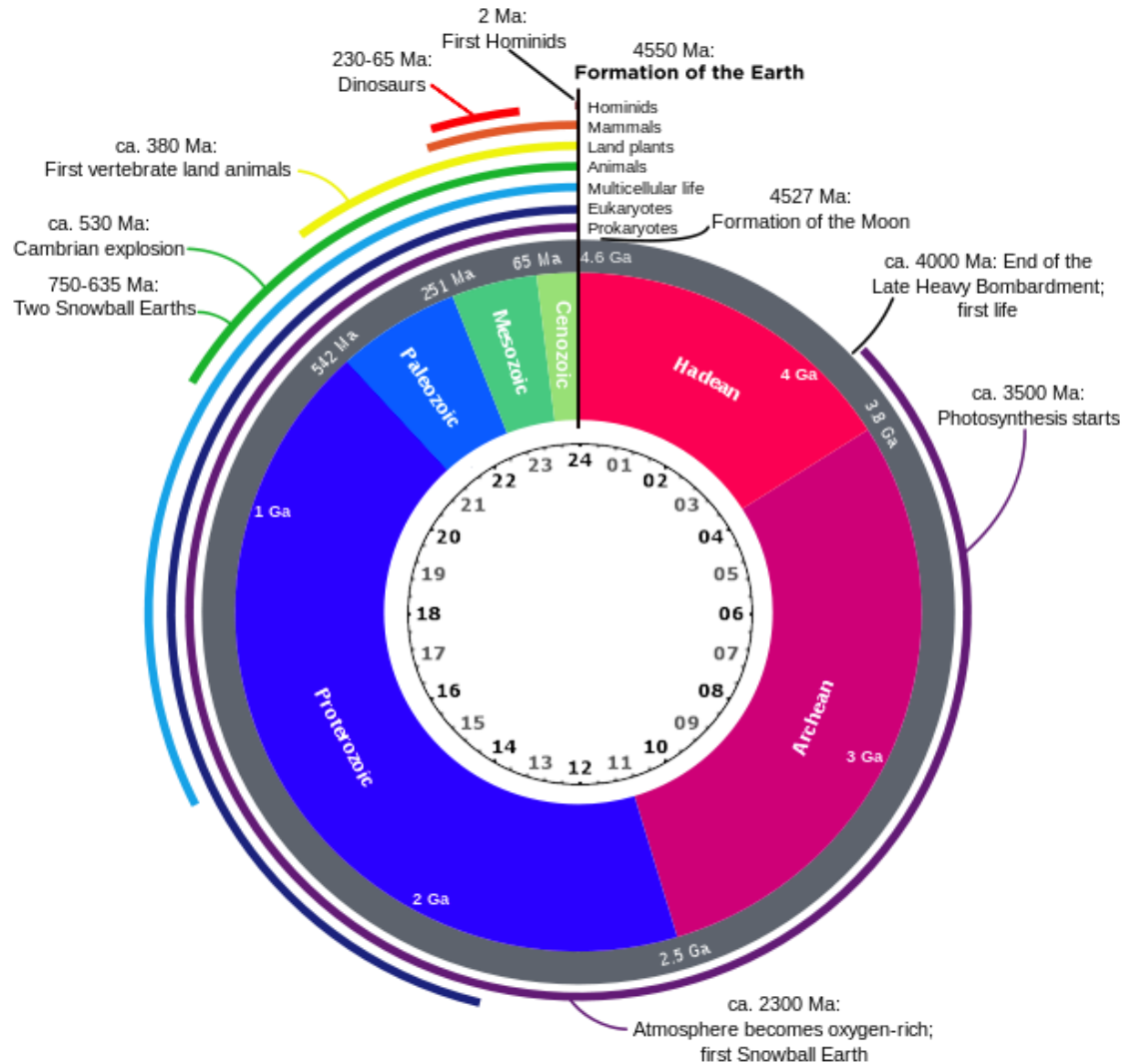
**Prions:**  
protein infection

## Size Range of Microbes

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# Microbiology – history of interaction...



## Chloroplast and Mitochondrial Evidence

- They have double membranes
- They can only be produced by division of pre-existing mitochondria and chloroplasts
- They have their own DNA which is naked and circular
- They have ribosomes which are 70S in size

# Microbiology – history of interaction...

## 'World's oldest brewery' found in cave in Israel, say researchers

15 September 2018



DANI NADEL/AFP/GETTY

Archaeologists were looking for evidence of plant foods when they discovered the alcohol traces

Researchers say they have found the world's oldest brewery, with residue of 13,000-year-old beer, in a prehistoric cave near Haifa in Israel.

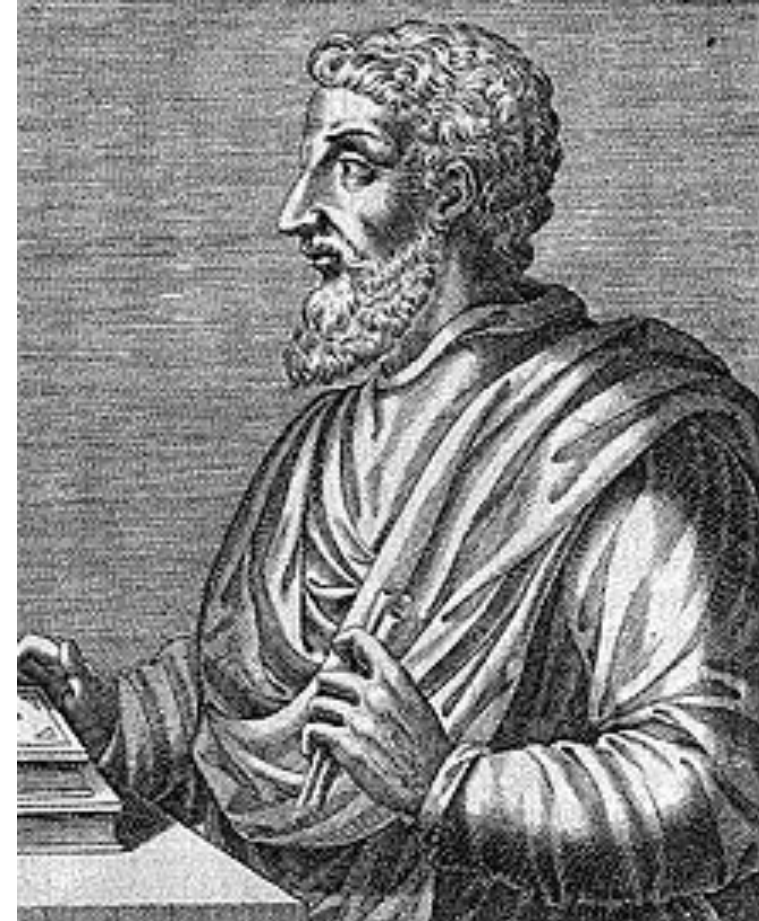


# Proto-microbiology (before 17th cent.)

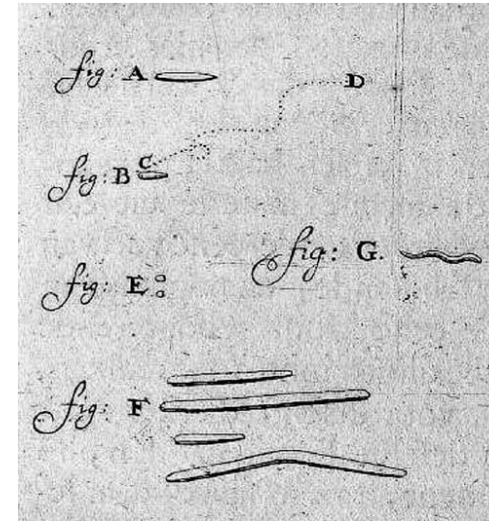
Ibn Síná (Avicenna) (980 – 1037 CE)



Marcus Terentius Varro (116 – 27 BCE)



# Antonie van Leeuwenhoek (1632 - 1723)



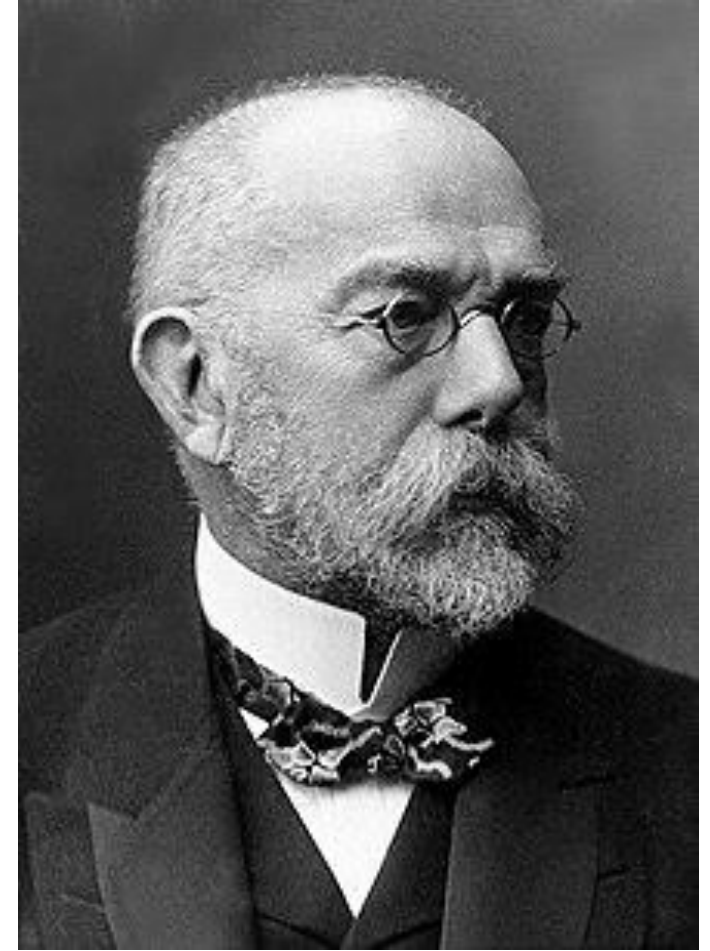
# Germ theory of disease



**Louis Pasteur** (1822-1895)  
- fermentation (wine)  
- pasteurisation  
- vaccination (1885 – rabies -  
Meister)

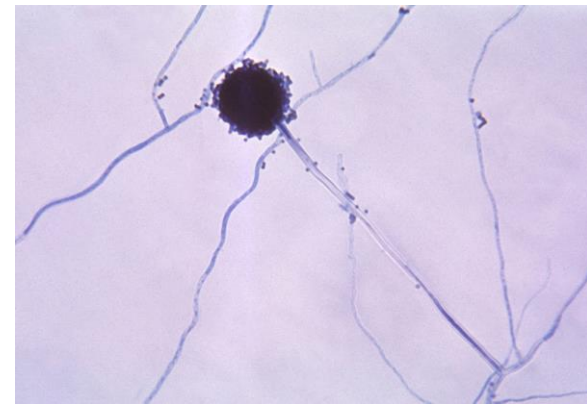


**Robert Koch** (1843-1910)  
- mycobacteria - tuberculin  
- anthrax  
- 4 postulates





# Mycology - beginnings



Pier Antonio MICHELI  
(1679 - 1737)

**Pier Antonio Micheli** (17./18. stol.)

- prof. botanics – discovered fungal spores
- mould *Aspergillus* (aspergillum = sprinkler)
- used to be "plants" - since sixties "fifth kingdom"  
*Fungi* (Robert Whittaker) - nemotile, ergosterol, no chlorophyl

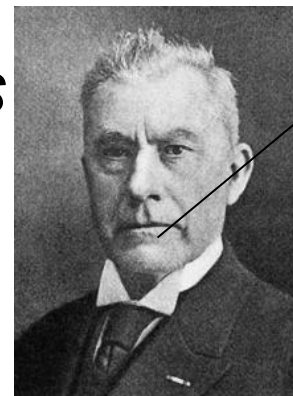


*Claviceps purp.*  
intoxication;  
kykeon;  
Fr. revolution;  
LSD

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# Virology - beginnings

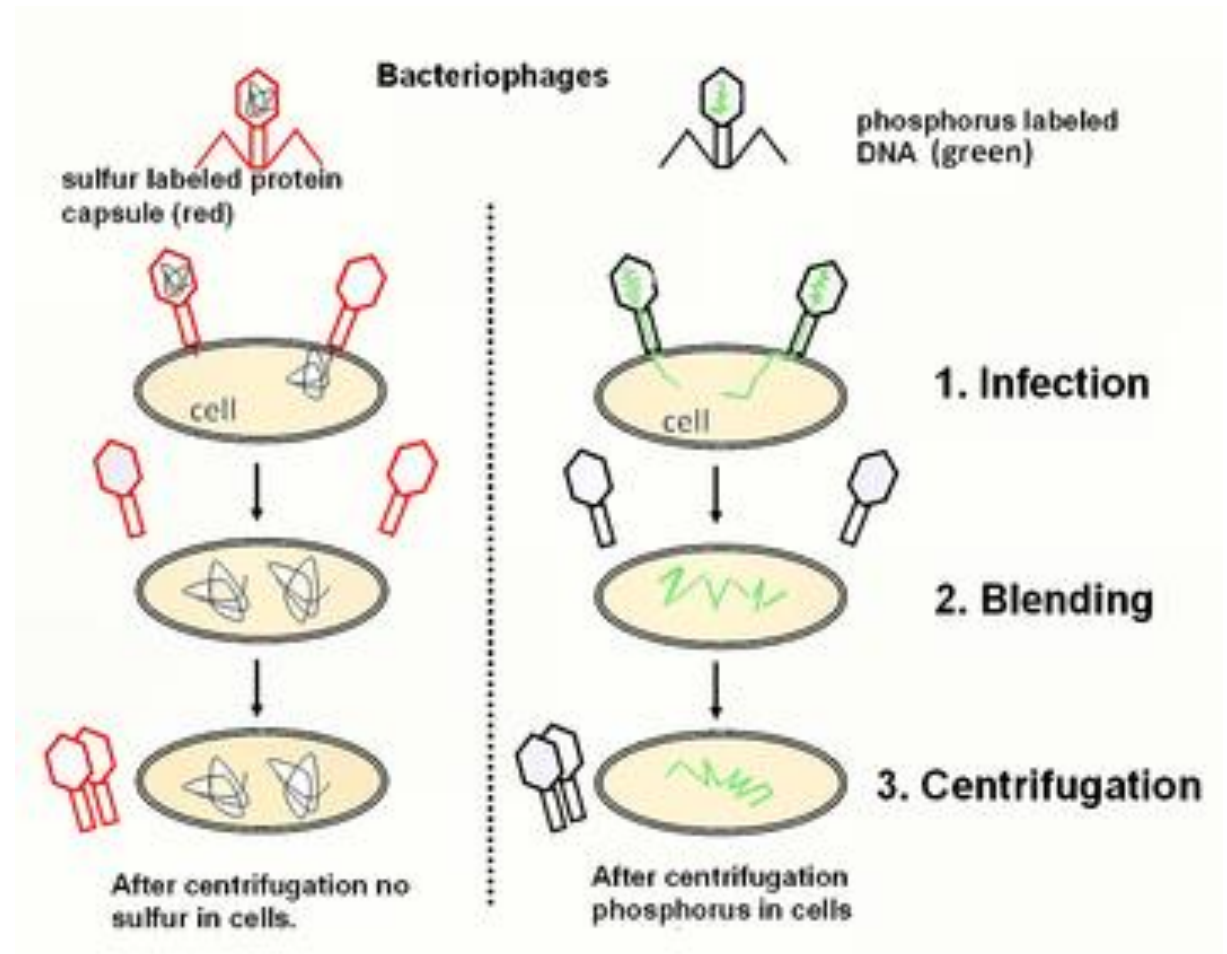
- 1886: Adolf Mayer – tobacco mosaic (filtration of sap; light microscope)
- 1892: Dimitri Ivanovsky – small than bacteria, no cultivation
- 1898: Martinus Beijerinck – *virus* (*contagium vivum fluidum*)
- 1935: crystallization of TMV



fixation of  $N_2$  - *Fabaceae*  
*Desulfovibrio*

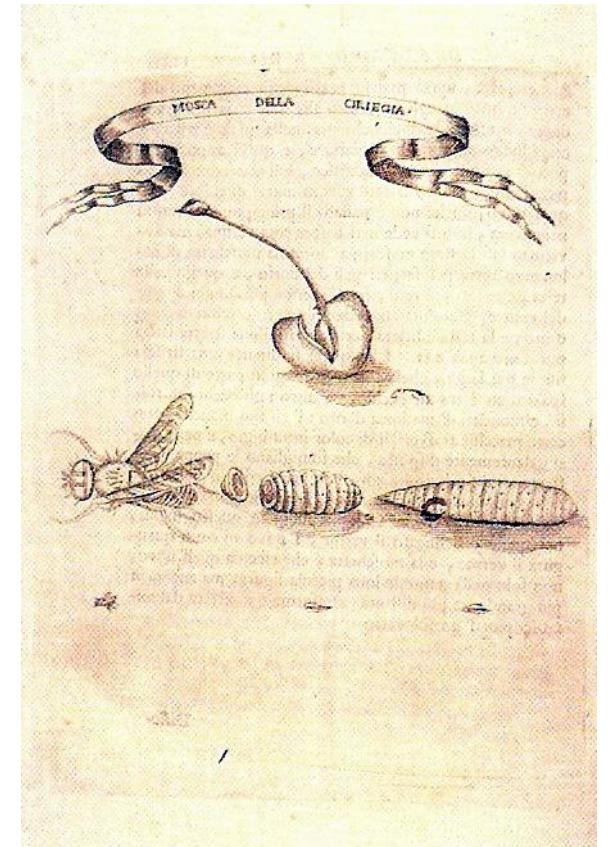
# Virology – what is the cause?

- 1952: Hershey-Chase experiment
- DNA – hereditary information (bourgeois pseudoscience = genetics and molecular biology)



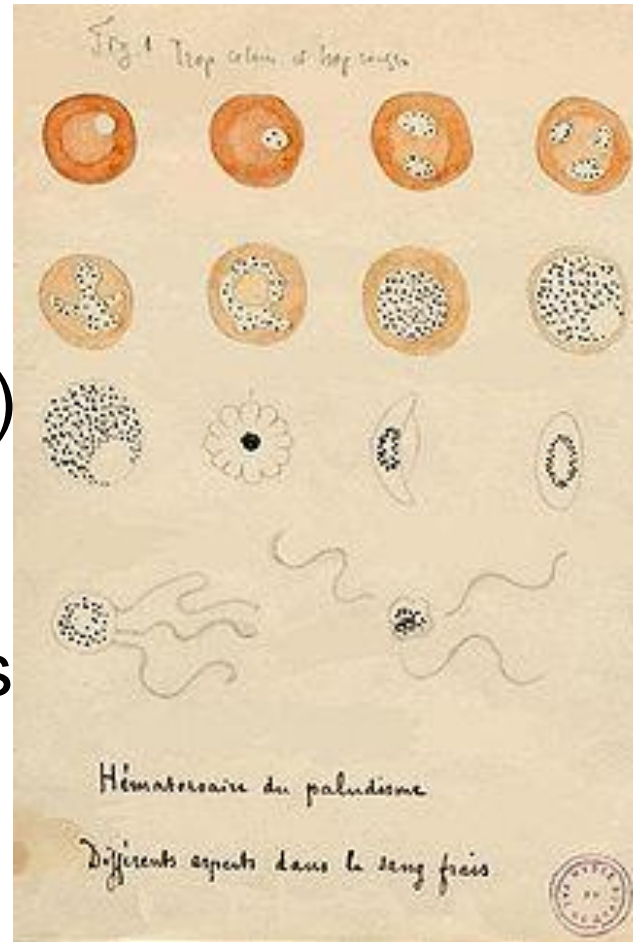
# "Father of parasitology" - Francesco Redi

- Italy; 17th century
- refuted spontaneous abiog.
- ectoparasited (tick)
- development stages - larvae
- liver fluke, roundworm



# Mala aira = *Plasmodium*

- Charles Laveran – 1880 –  
army hospital Algiers  
(blood smear of dead patient)
- 1897 – Ronald Ross –  
India – developmental stages  
of mosquito stomach



20<sup>e</sup> August 1897

36) Aug 18<sup>th</sup> (14<sup>th</sup> day) dead. Blood with white corpuscles.  
No malarial parasites seen with yellowish film present. (Q 10)

37) Aug 19<sup>th</sup> (15<sup>th</sup> day) dead. Same, malarial, blood  
parasites.

38) Aug 20<sup>th</sup> (16<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

39) Aug 21<sup>st</sup> (17<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites. The malarial parasites are in the stomach  
and in the blood. The malarial parasites are in the  
stomach and in the blood.

40) Aug 22<sup>nd</sup> (18<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

41) Aug 23<sup>rd</sup> (19<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

42) Aug 24<sup>th</sup> (20<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

43) Aug 25<sup>th</sup> (21<sup>st</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

44) Aug 26<sup>th</sup> (22<sup>nd</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

45) Aug 27<sup>th</sup> (23<sup>rd</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

46) Aug 28<sup>th</sup> (24<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

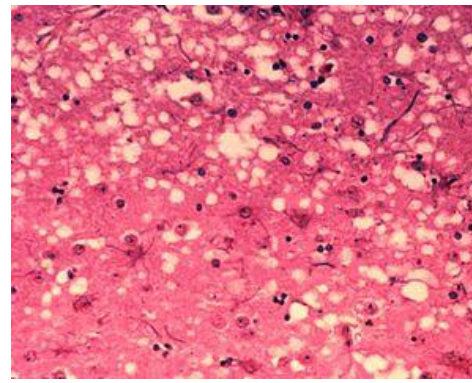
47) Aug 29<sup>th</sup> (25<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

48) Aug 30<sup>th</sup> (26<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

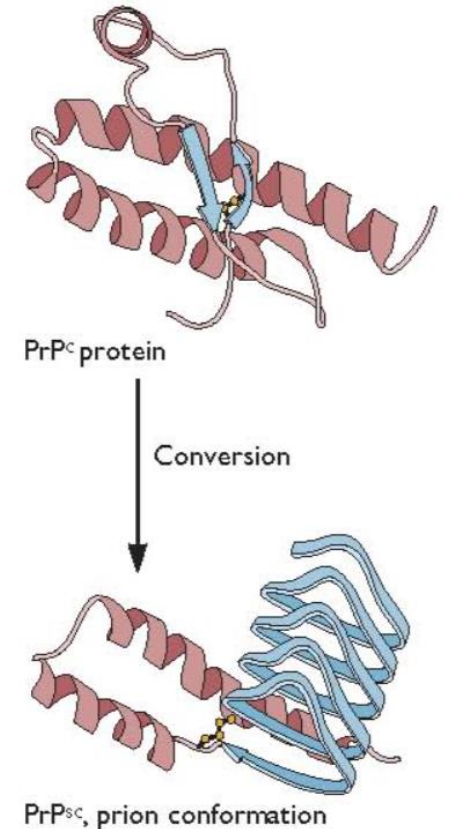
49) Aug 31<sup>st</sup> (27<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

50) Aug 31<sup>st</sup> (27<sup>th</sup> day) living. Blood with white corpuscles.  
The stomach just inside of the surface contains  
two large cells with pigment & numerous malarial  
parasites.

# Protein infection



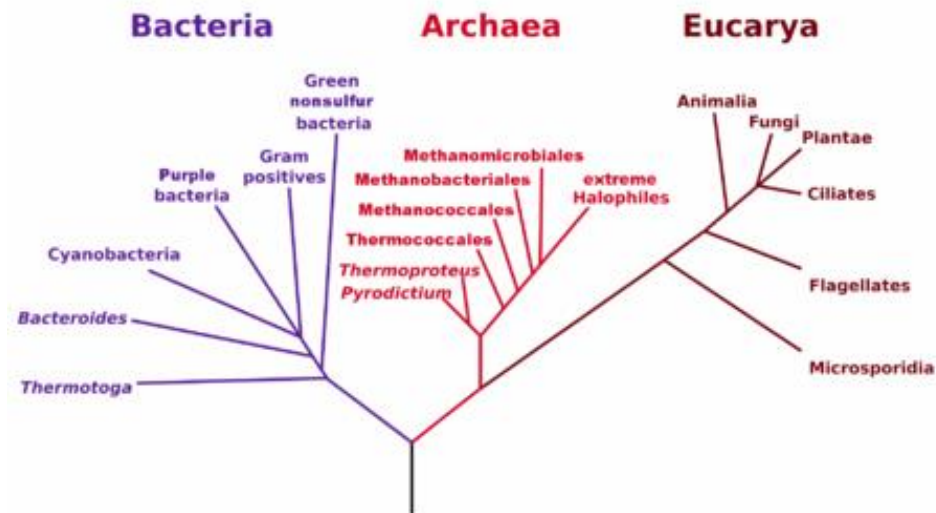
- sixties: Alpert and Griffith: transmissible spongiform encephalopathy: scrapie, Creutzfeldt-Jakob d.
- cause? resists radiation = protein?  
(gene suppression; conversion to abnormal p.; antibody)
- 1982: Stanley Prusiner – isolation of first prion protein (PrP)



# Carl Woese & George Fox - Archea

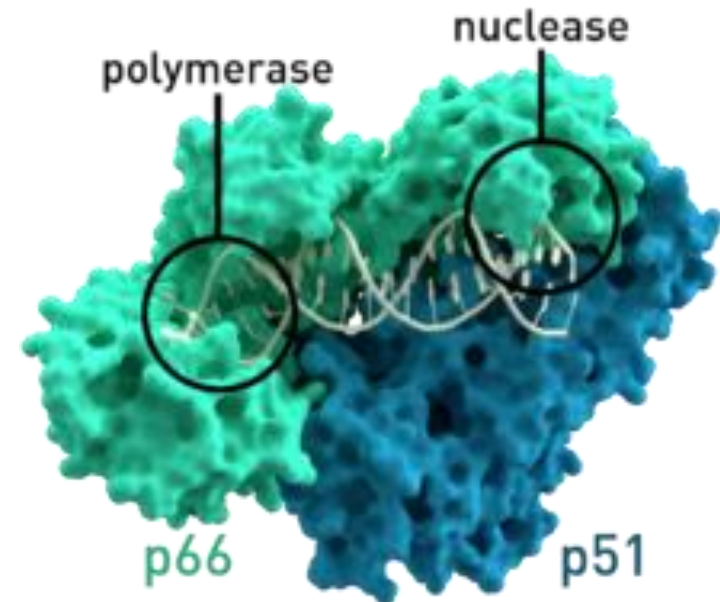
- fast expansion of sequencing methods (most of the bacteria from environment is not suitable for cultivation) - analysis of phylogenetic relations of bact. rRNA - 1977: metanogens are separate domain of life

## Phylogenetic Tree of Life



# Reverse transcription – punch to the standard model

- 1970: Howard Temin isolated enzyme reverse transcriptase from virions of Rous sarcoma + indep. David Baltimore from mouse leukemia virus
- RNA dependent DNA polymerase
- retrovirus; later discovery of HIV





# Medical microbiology – fight with illnesses

- 1923: Alexander Fleming – evolutionary paradigm (survival of the fittest; Darwin's theory of natural selection)
- where are we 100 yrs later?
- post-antibiotic era



This is genius and incredibly depressing at the same time [#10yrchallenge](#) [#useantibioticswisely](#) [#FOAMed](#) [#intensivecare](#)



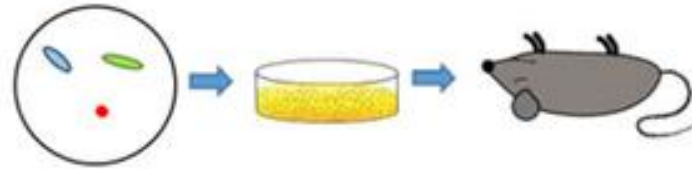
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# Microbial ecologists - "good microbes"

- M. Beijerinck – Sergey Vinogradsky: symbiosis of bacteria and plants, fixation of nitrogen; chemolithotrophy
- Arthur Isaac Kendall: pioneer in gut bacteria discoveries
- beg. of 20th cent.: Elia Mechnikoff – bulgarian countryside, ageing
  - fermented diary products (*Lactobacillus delbrueckii* subsp. *bulgaricus*)



# Change of paradigm - microbiome



single-acting, unsocial organisms causing diseases



strongly interacting microbes that built up stable network structures & interact with host/environment in a variety of ways



advances in microbiome research leading to the **One Health** concept that implies interconnection of all areas of life through their respective microbiota

1988 - Whipps *et al.*

*microbiome* = a characteristic microbial community occupying a reasonably well-defined habitat which has distinct physio-chemical properties

- human body; plants;  
environment (soil, sea, etc.)

# Human Microbiome project - 2007



*microbiota* = collection of microorganisms in certain place (procaryots + eucaryots)

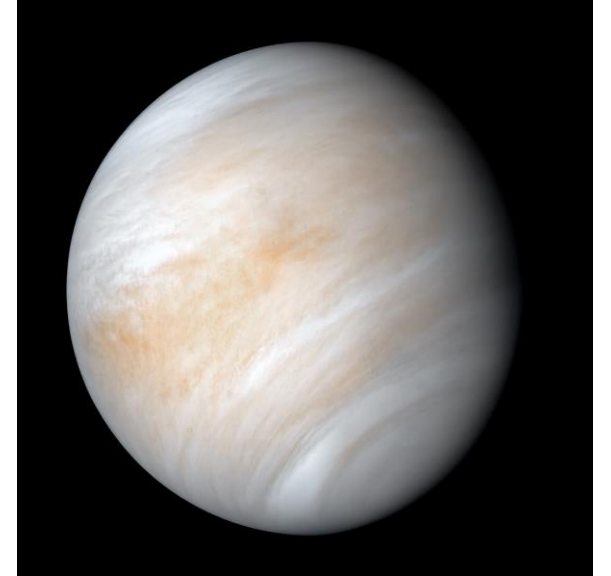
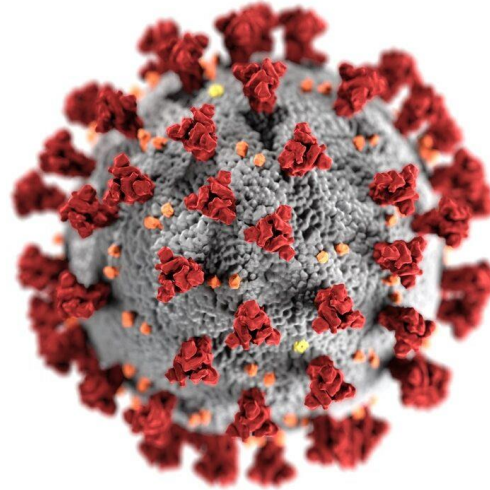
- humans: number of somatic cells = number of microbiota (macroorganisms)

- NOT ~~10x~~ more

- Ed Yong: "*When Neil Armstrong and Buzz Aldrin landed on Moon, they made giant leap for humanity as well as for microbiota*"

- NOT "microflora"

# Is microbiology important?



# Thanks for your attention!

