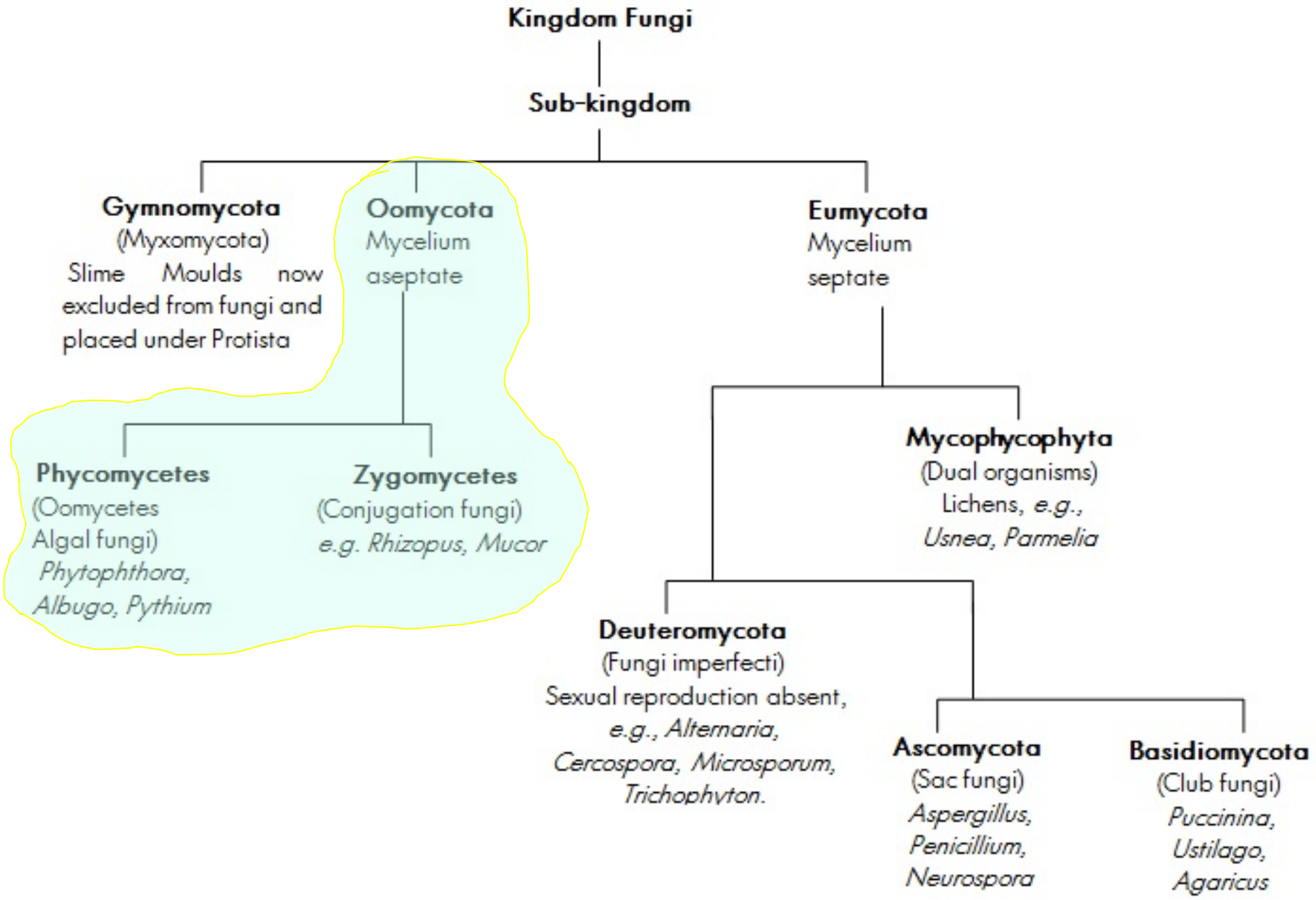
CORSO DI BOTANICA SISTEMATICA

LEZIONE 50

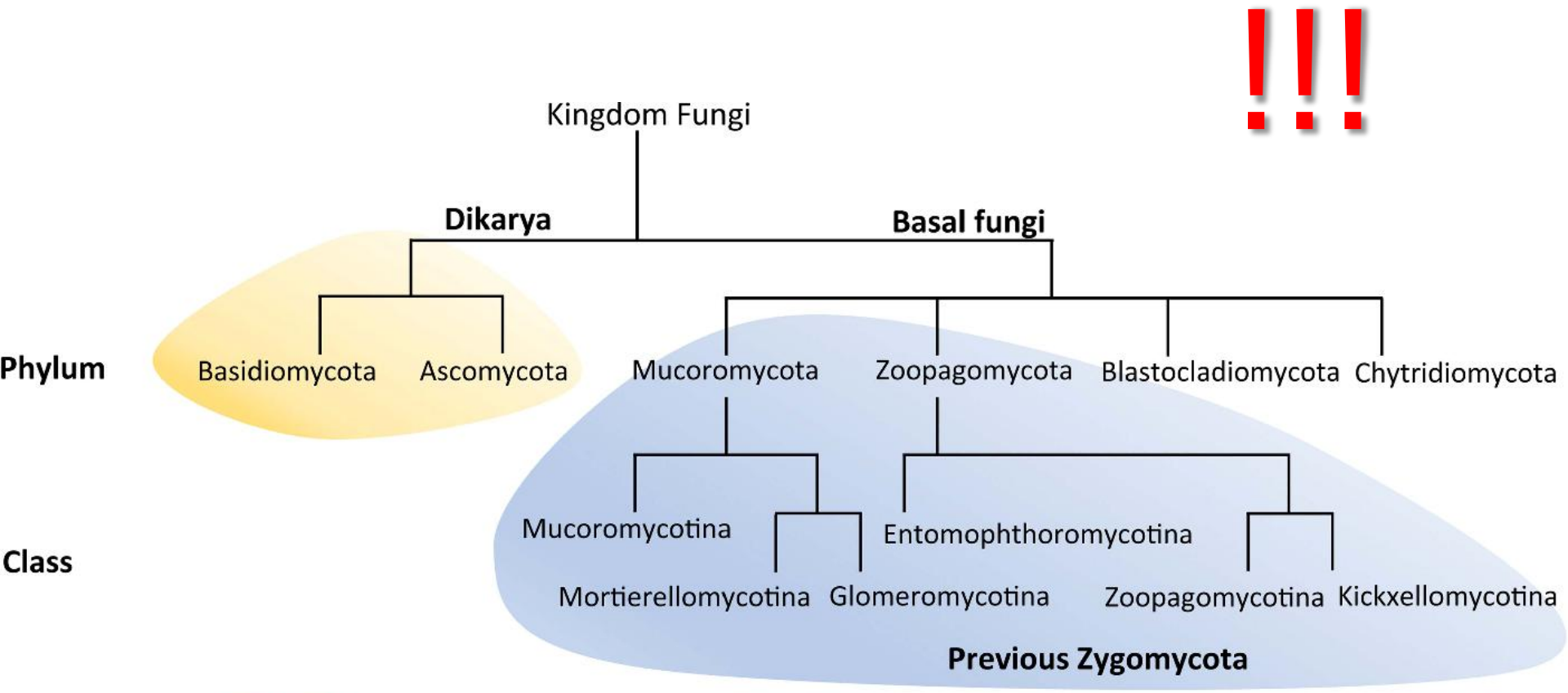
Oomiceti
Myxomiceti


Kingdom Fungi
Sub-kingdom
Gymnomycota
(Myxomycota)
Slime Moulds now excluded from fungi and placed under Protista
Oomycota
Mycelium aseptate
Eumycota
Mycelium septate
Phycomycetes
(Oomycetes Algal fungi)
Phytophthora, Albugo, Pythium
Zygomycetes
(Conjugation fungi)
e.g. Rhizopus, Mucor
Mycophycophyta
(Dual organisms)
Lichens, e.g., Usnea, Parmelia
Deuteromycota
(Fungi imperfecti)
Sexual reproduction absent, e.g., Alternaria, Cercospora, Microsporum, Trichophyton.
Ascomycota
(Sac fungi)
Aspergillus, Penicillium, Neurospora
Basidiomycota
(Club fungi)
Puccinina, Ustilago, Agaricus

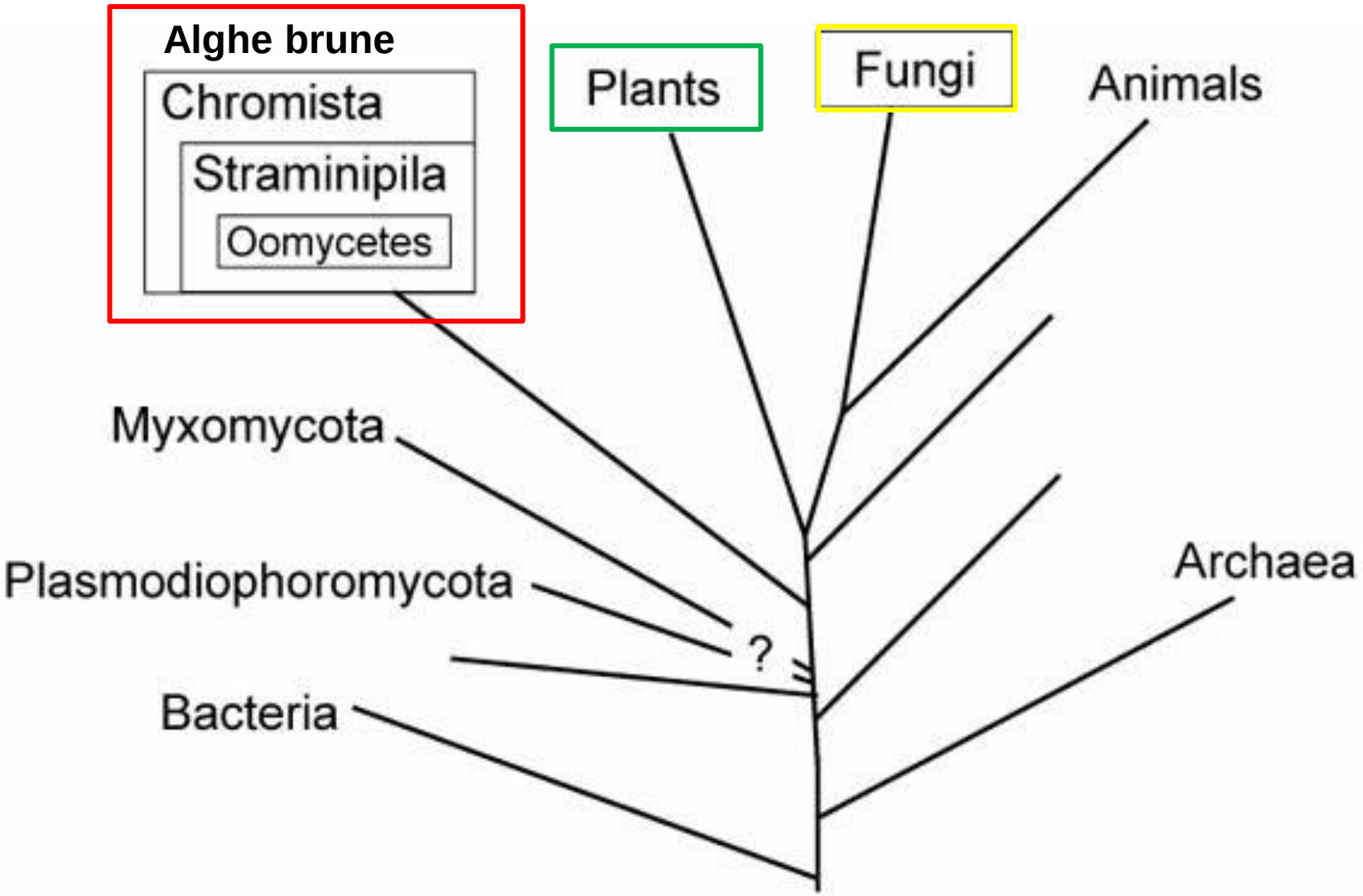
The **Kingdom FUNGI**:

Systematic organization based on genome sequencing into **6 phyla** (James et al., 2020):

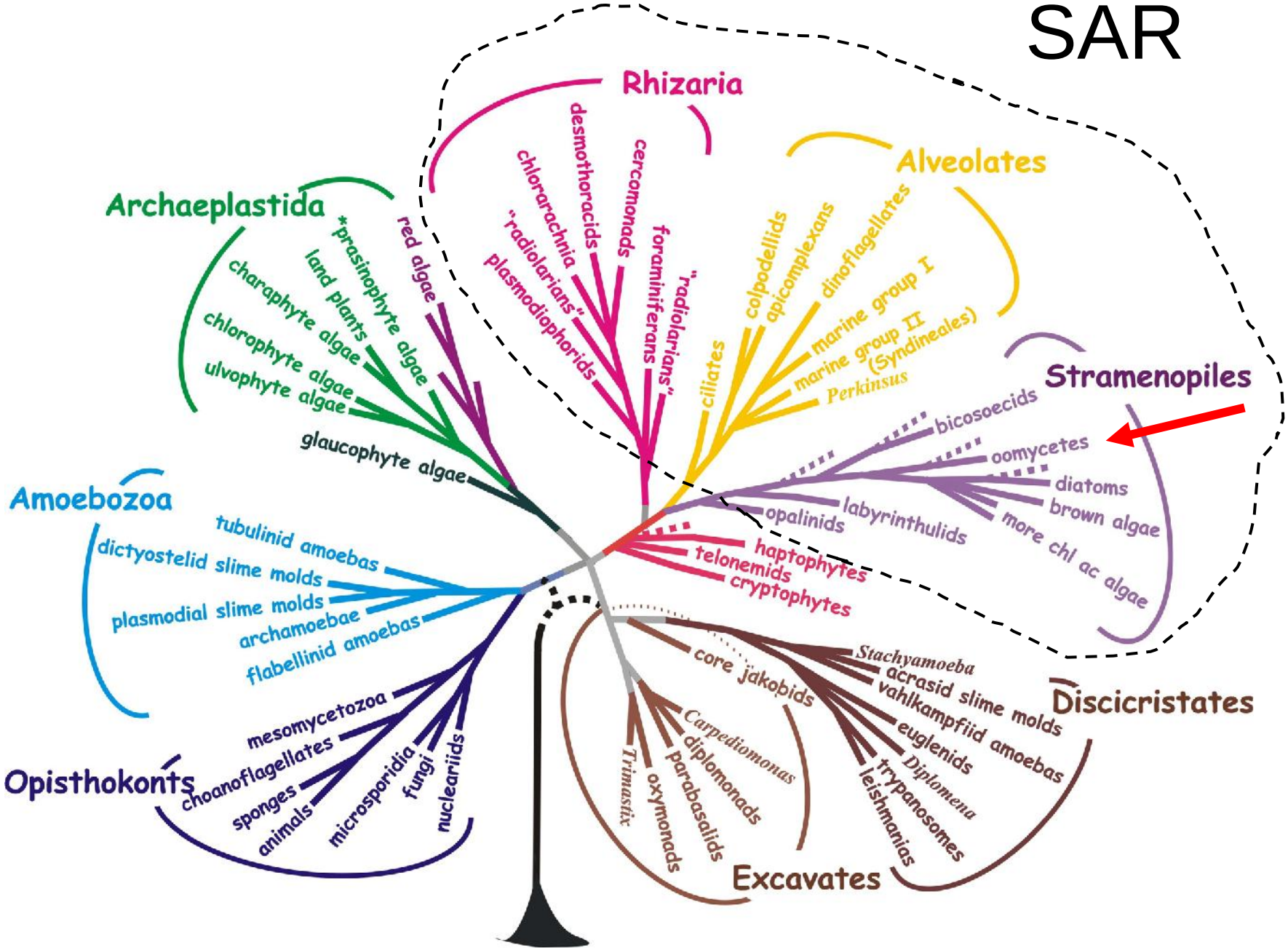
- **Ascomycota, Basidiomycota** (Dikarya)
- **Zygomycota, Glomeromycota, Blastocladiomycota, Chytridiomycota**

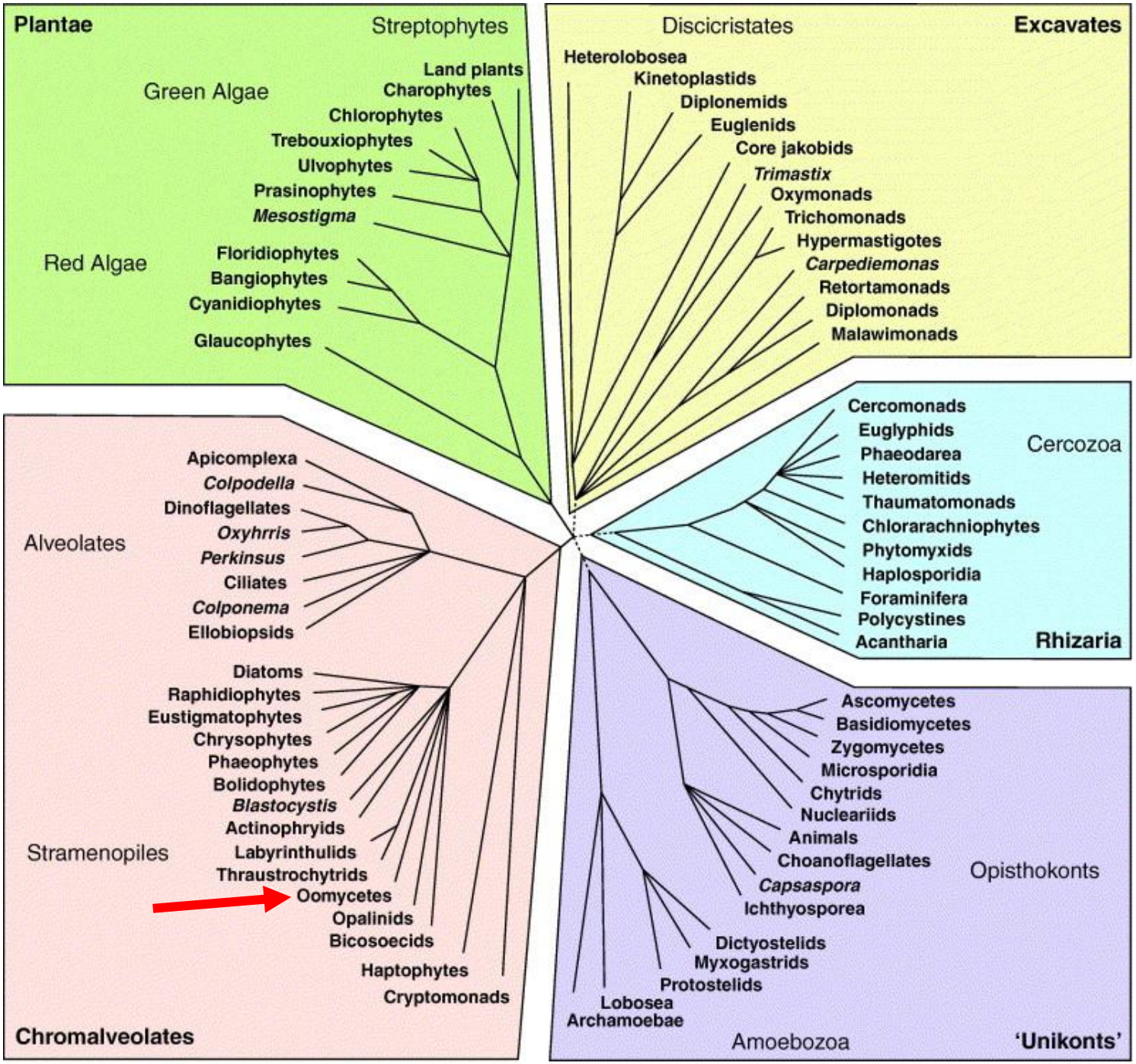


Stramenopiles (Heteroconta; stiff tripartite external hairs on cell or flagella)



SAR


Rhizaria
desmothoracids
cercomonads
chlorarachnia
"radiolarians"
plasmodiophorids
foraminiferans
"radiolarians"
Alveolates
ciliates
colpodellids
apicomplexans
dinoflagellates
marine group I
marine group II
(Syndineales)
Perkinsus
Archaeplastida
red algae
*prasinophyte algae
land plants
charaphyte algae
chlorophyte algae
ulvophyte algae
glaucophyte algae
Stramenopiles
bicosoecids
oomycetes
diatoms
brown algae
more chl ac algae
labyrinthulids
opalinids
haptophytes
telonemids
cryptophytes
Amoebozoa
tubulinid amoebas
dictyostelid slime molds
plasmodial slime molds
archamoebae
flabellinid amoebas
Discicristates
Stachyamoeba
acrasid slime molds
vahlkampfiid amoebas
euglenids
Diplomena
trypanosomes
leishmanias
core jakobids
Carpediomonas
diplomonads
parabasalids
oxymonads
Trimastix
Excavates
Opisthokonts
mesomycetozoa
choanoflagellates
sponges
animals
microsporidia
fungi
nucleariids

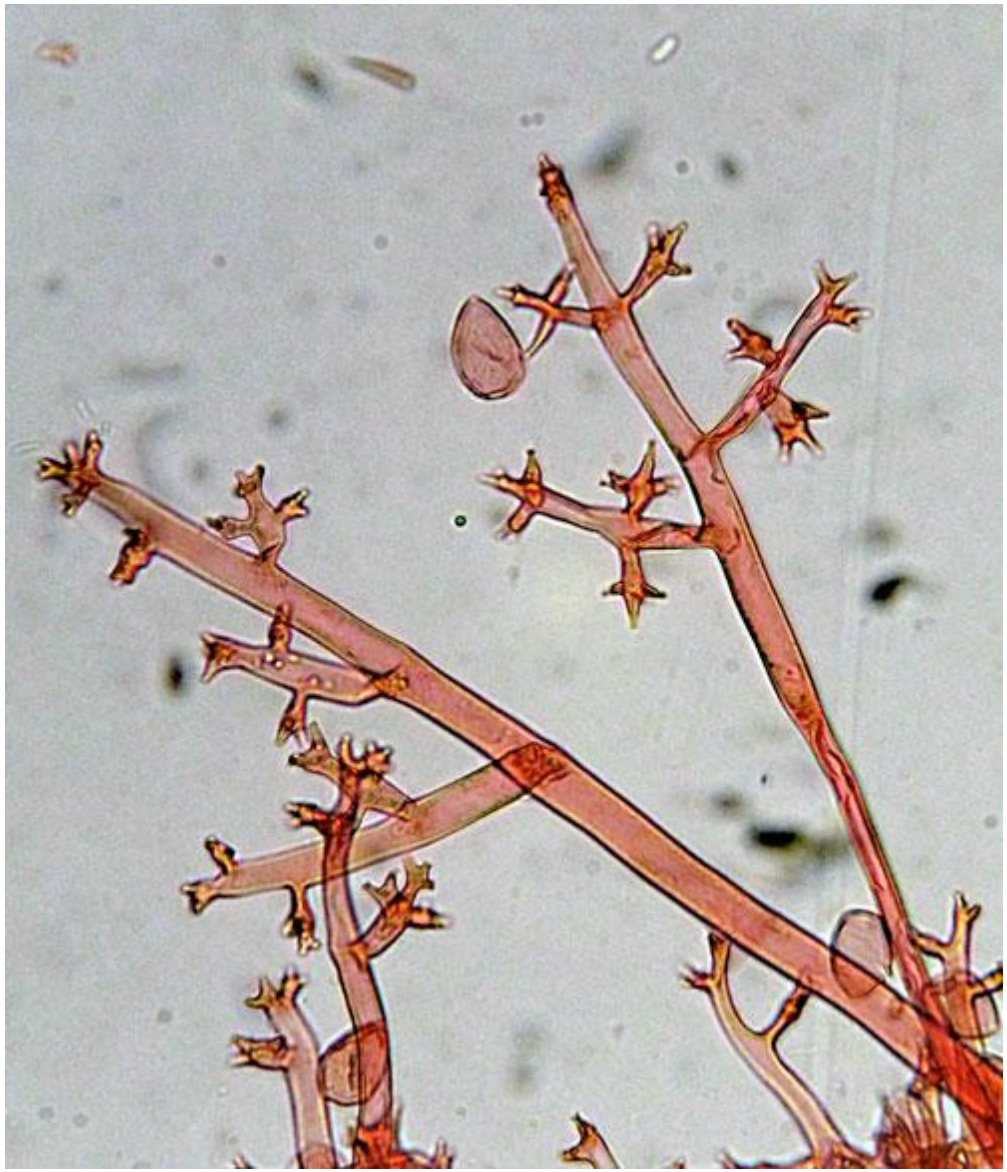


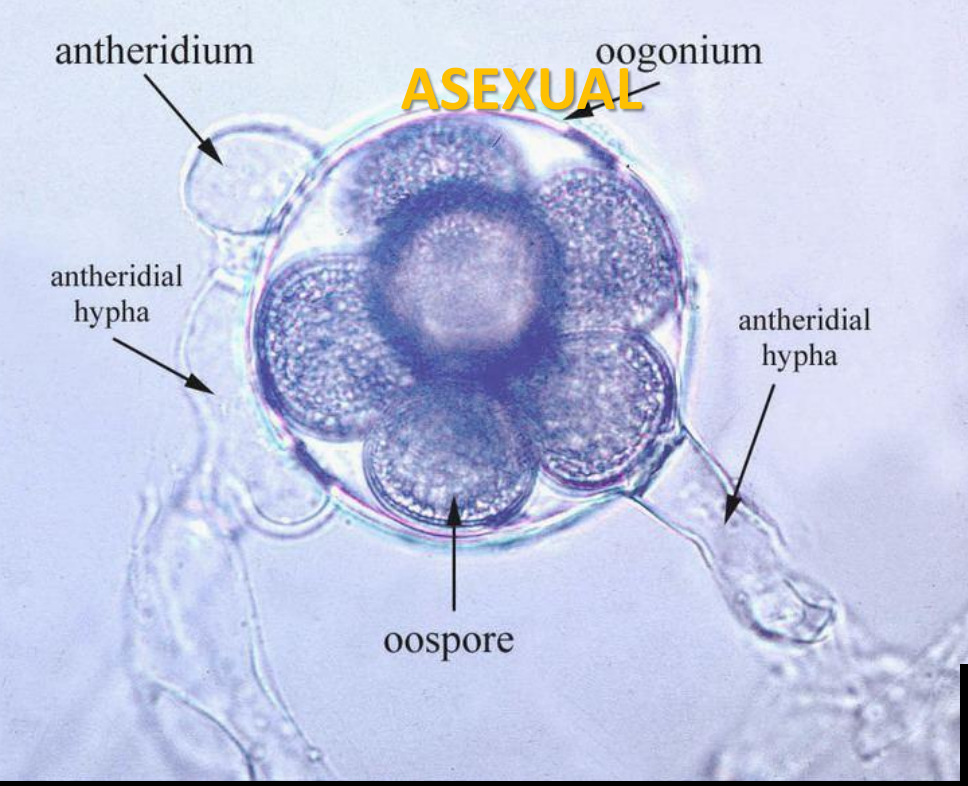
TRENDS in Ecology & Evolution

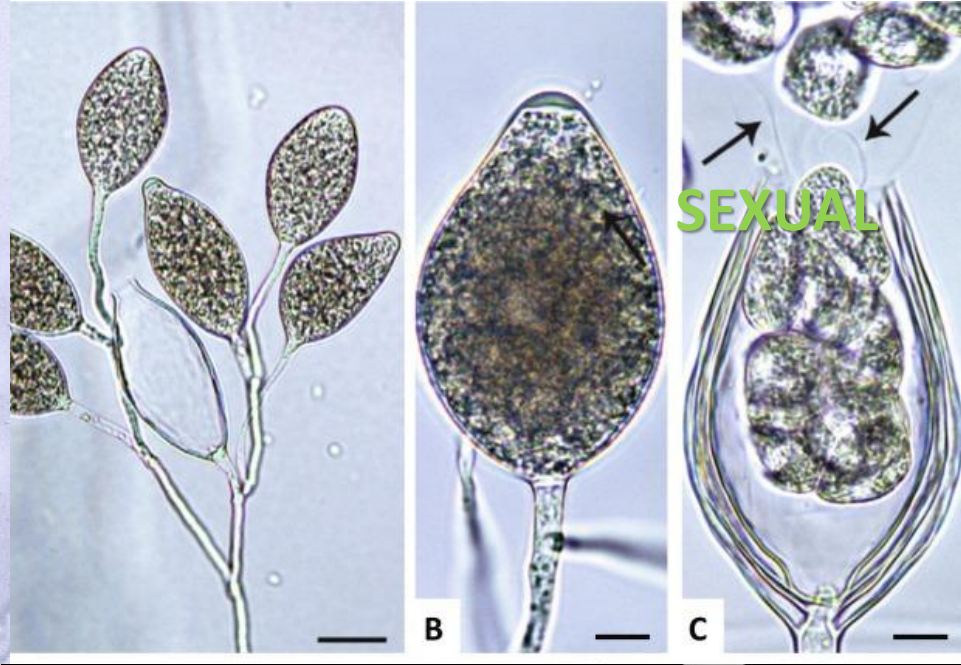
OOMYCOTA (Heterokonta)

- *oo* (grrek) = egg, *mykita* = fungus → large **round oogonia** containing female gametes
- "**water mold**" → earlier classification as fungi preferring conditions of high humidity and running surface water (characteristic for the basal taxa of the oomycetes).

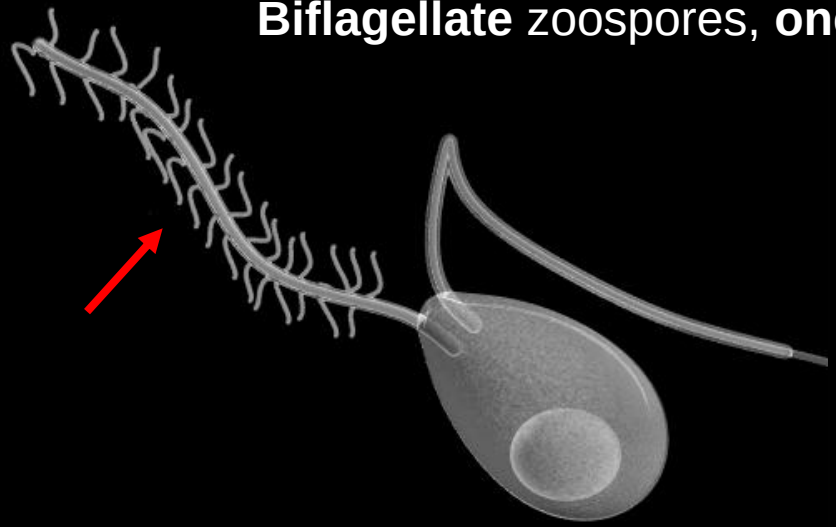
OOMYCOTA: affini alle **alghe brune** (non ai funghi!)
ife non settate con **pareti cellulosiche**

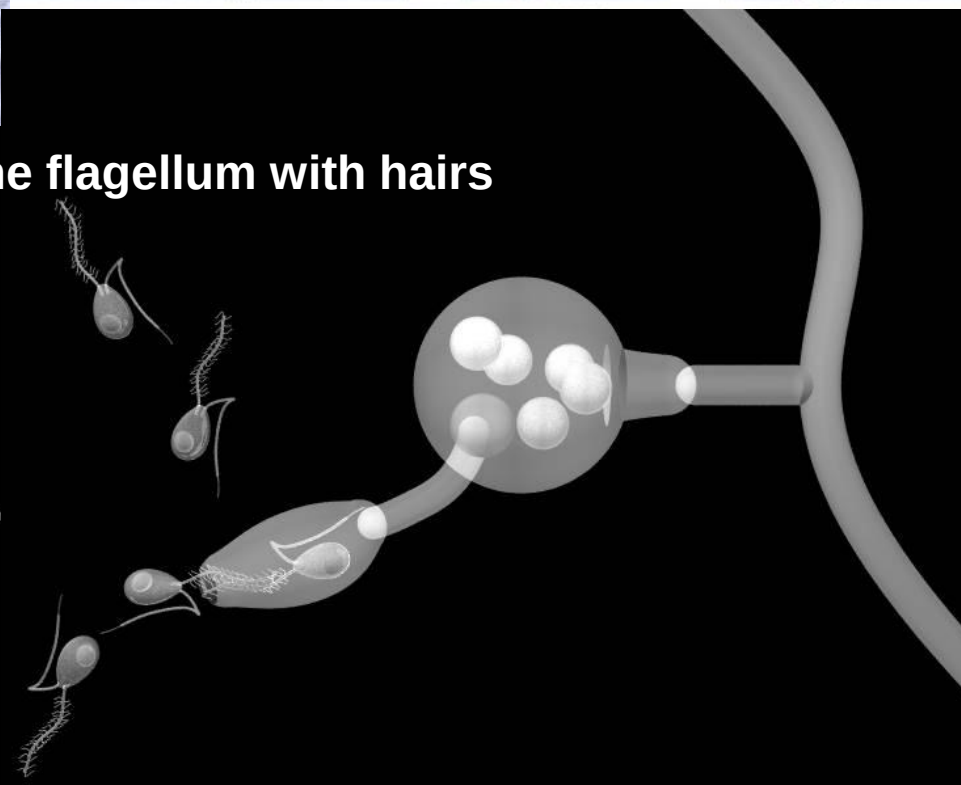






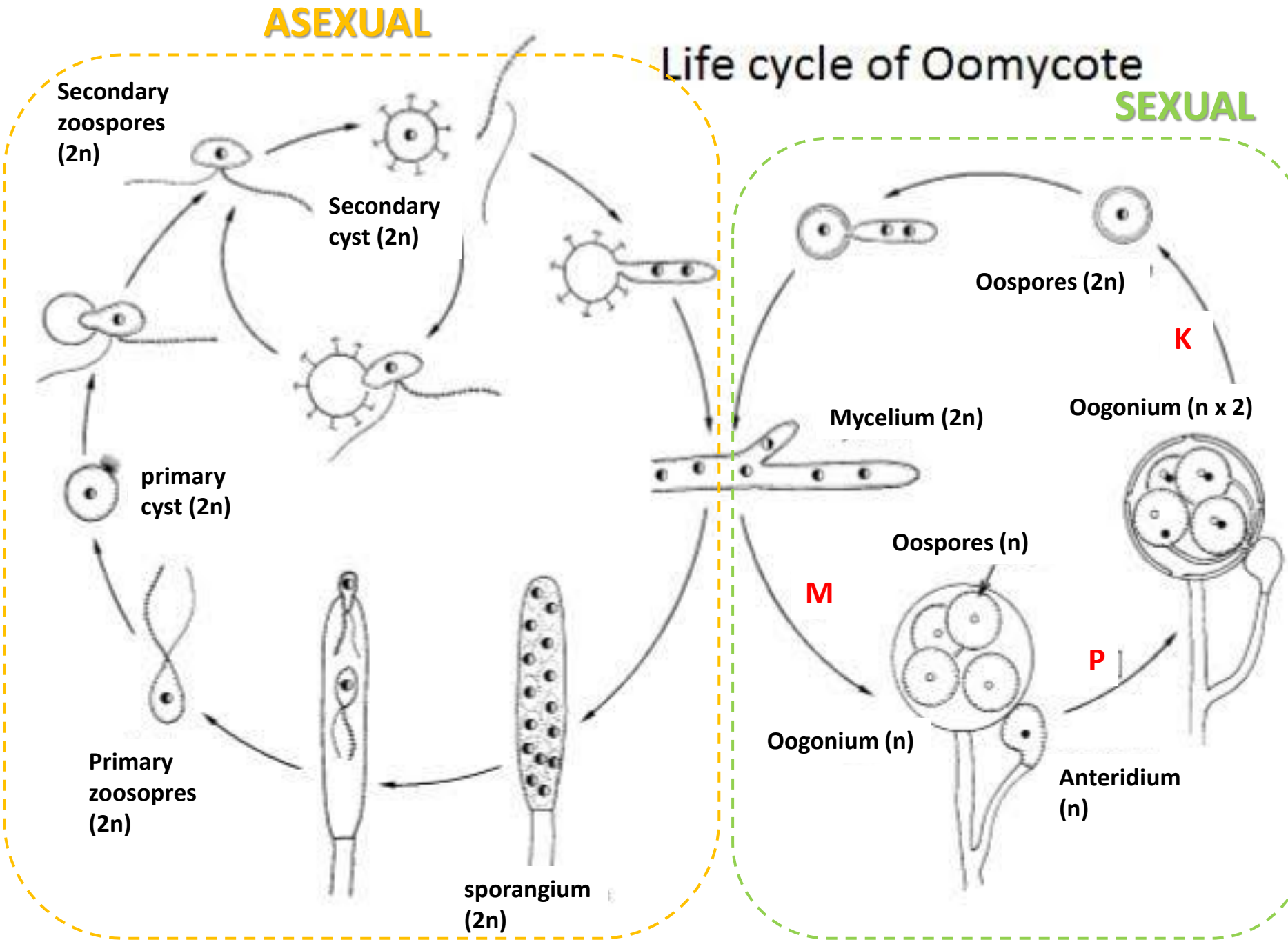
Biflagellate zoospores, **one flagellum with hairs**

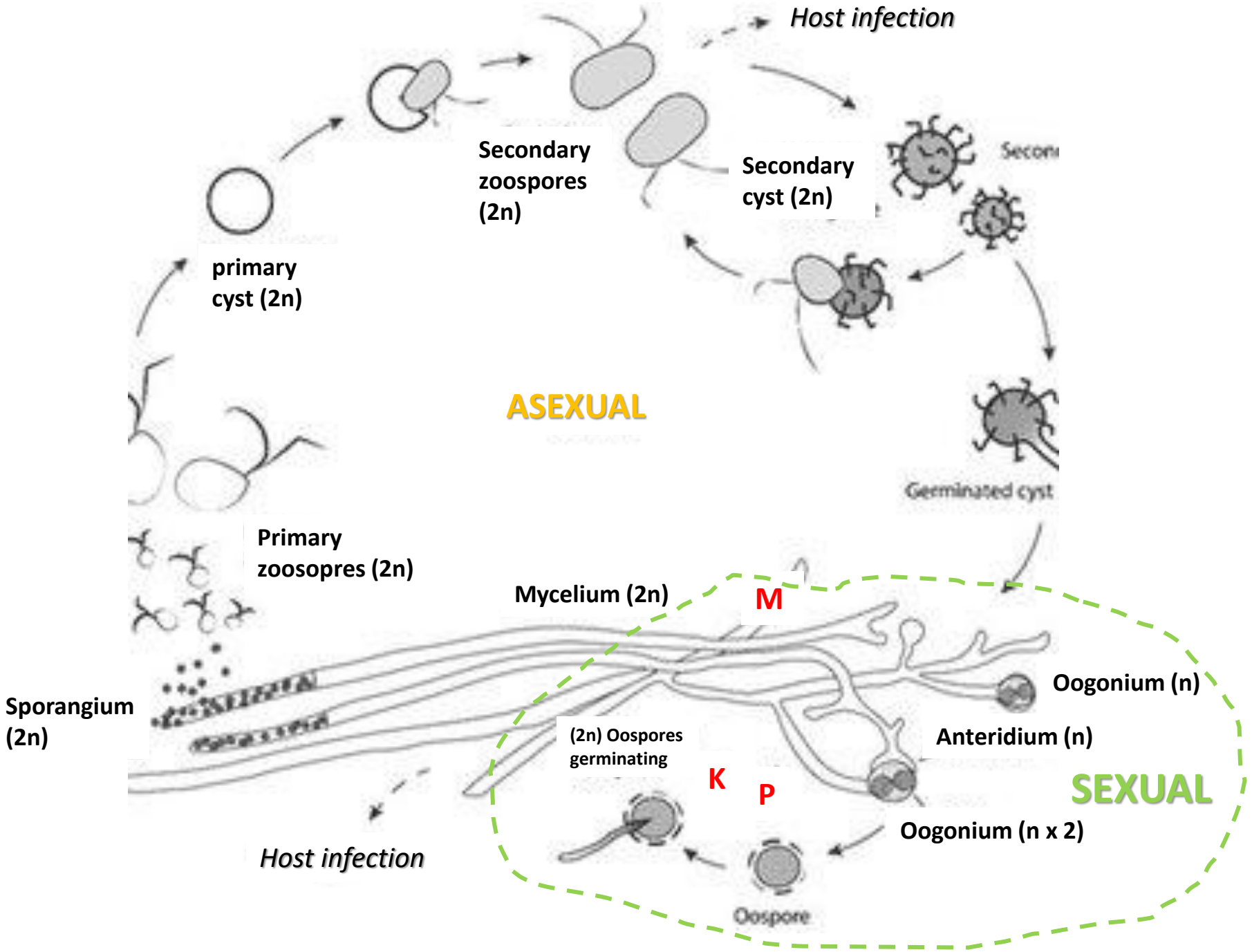




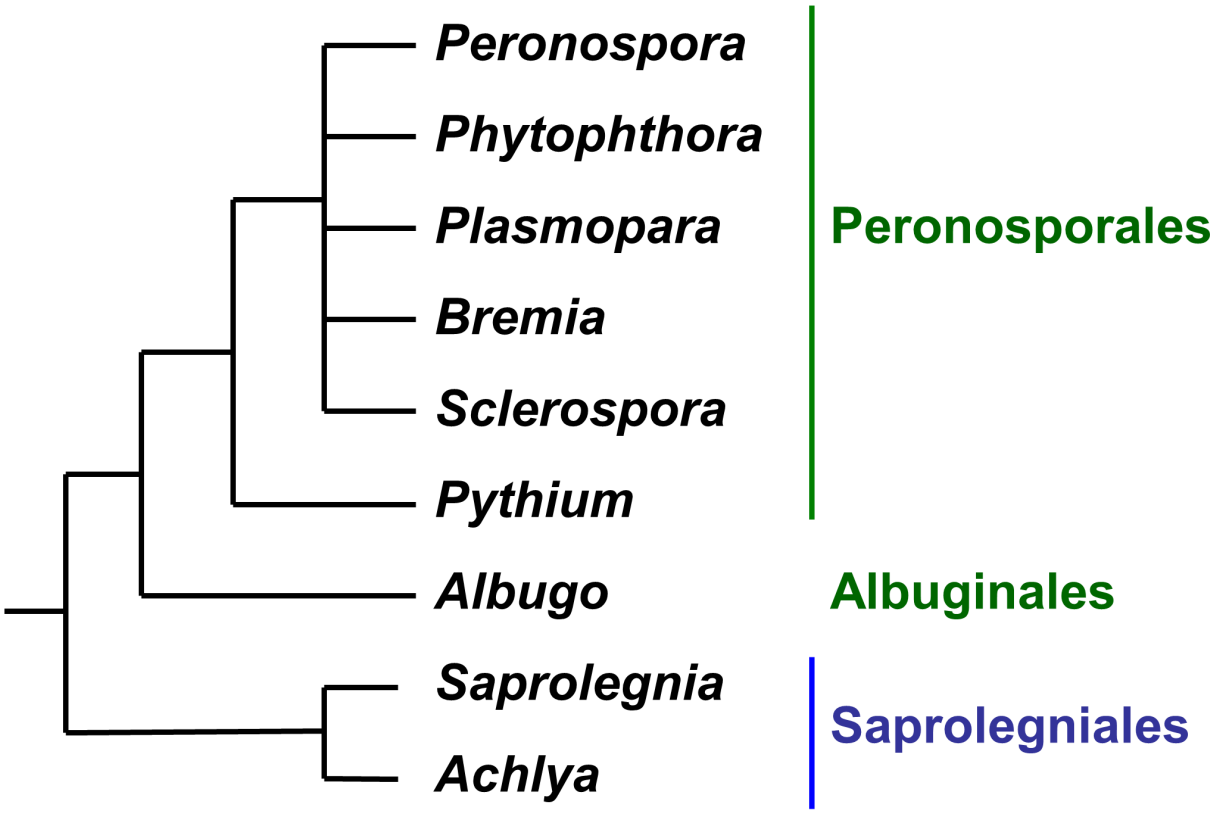
Simile alle alghe brune!!

Life cycle of Oomycote



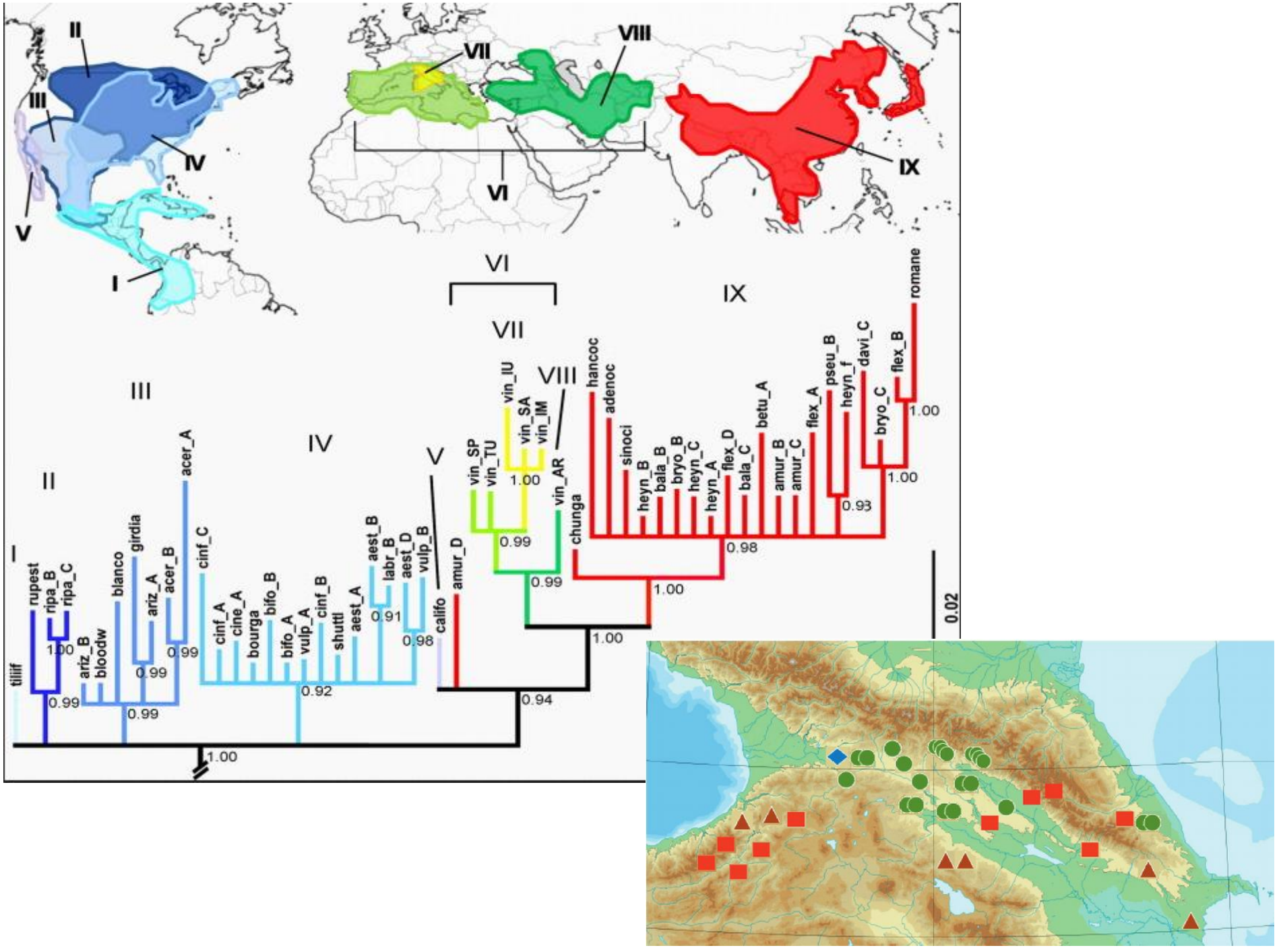

Host infection
Secondary zoospores (2n)
Secondary cyst (2n)
primary cyst (2n)
ASEXUAL
Germinated cyst
Primary zoosopres (2n)
Mycelium (2n)
M
Sporangium (2n)
Oogonium (n)
(2n) Oospores germinating
Anteridium (n)
K
P
SEXUAL
Oogonium (n x 2)
Host infection
Oospore

OOMYCOTA (Heterokonta)



1) Peronospora della vite - *Plasmopara viticola*

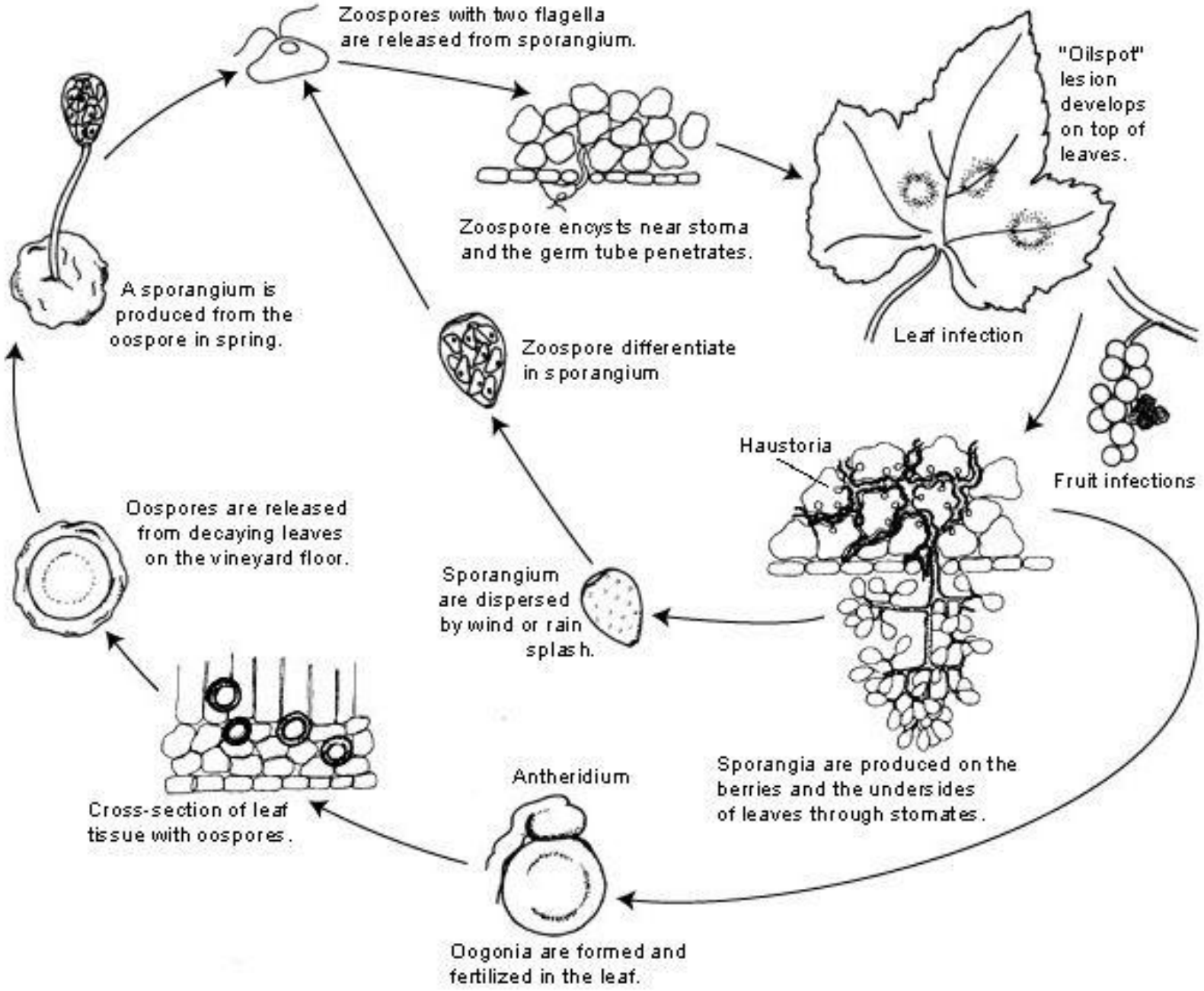
2) Peronospora della patata - *Phytophthora infestans*

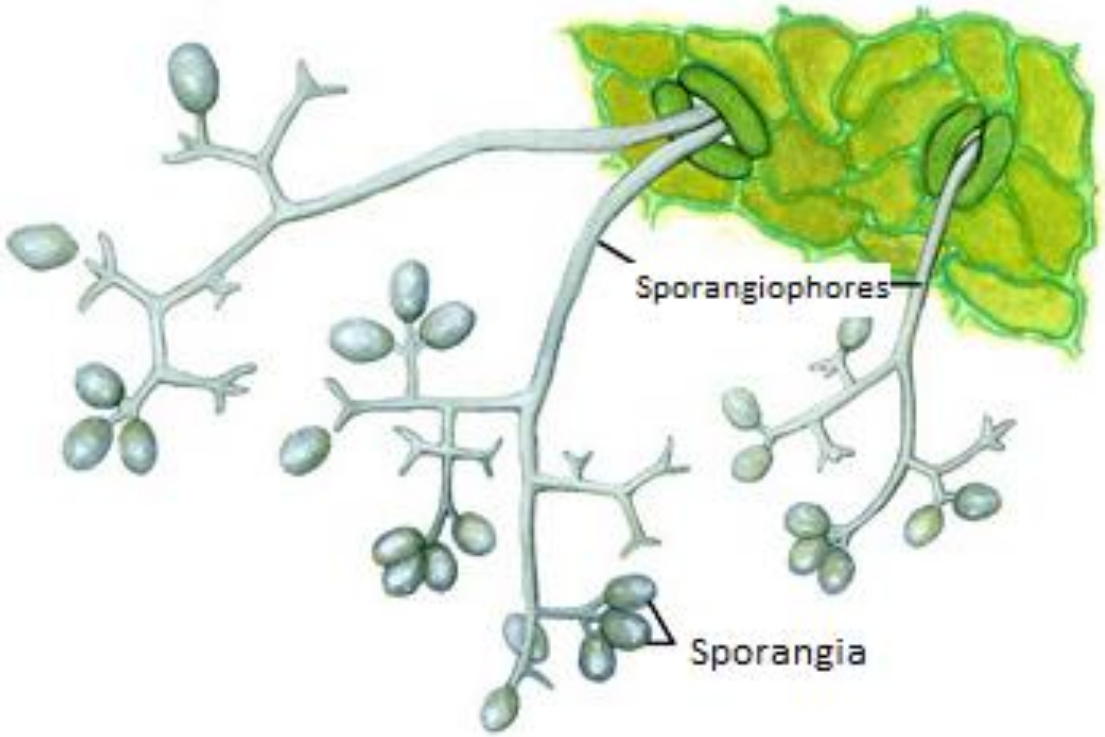

II
III
IV
V
I
VII
VIII
VI
IX
tilliif
rupest
ripa_B
ripa_C
ariz_B
bloodw
blanco
girdia
ariz_A
acer_B
acer_A
cinf_C
cinf_A
cine_A
bourga
bifo_B
bifo_A
vulp_A
cinf_B
shuttl
aest_A
aest_B
labr_B
aest_D
vulp_B
califo
amur_D
vin_SP
vin_TU
vin_IU
vin_SA
vin_IM
vin_AR
chunga
hancoc
adenoc
sinoci
heyn_B
bala_B
bryo_B
heyn_C
heyn_A
flex_D
bala_C
betu_A
amur_B
amur_C
flex_A
pseu_B
heyn_f
davi_C
bryo_C
flex_B
romane
1.00
0.99
0.99
0.99
0.92
0.91
0.98
0.94
1.00
1.00
0.99
1.00
0.98
1.00
0.93
1.00
0.02

Plasmopara viticola

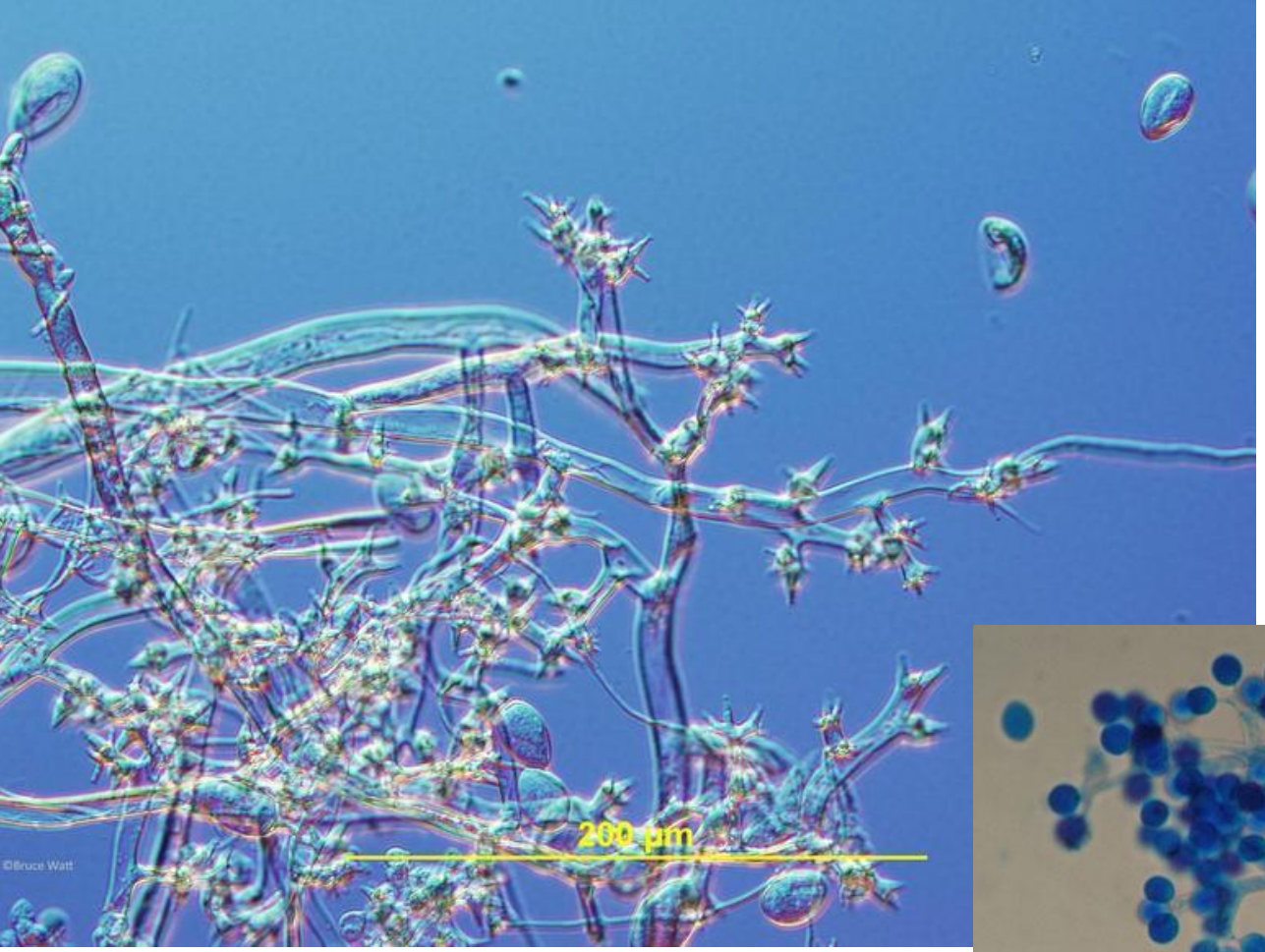
Peronospora della vite- grapewine downy mildew

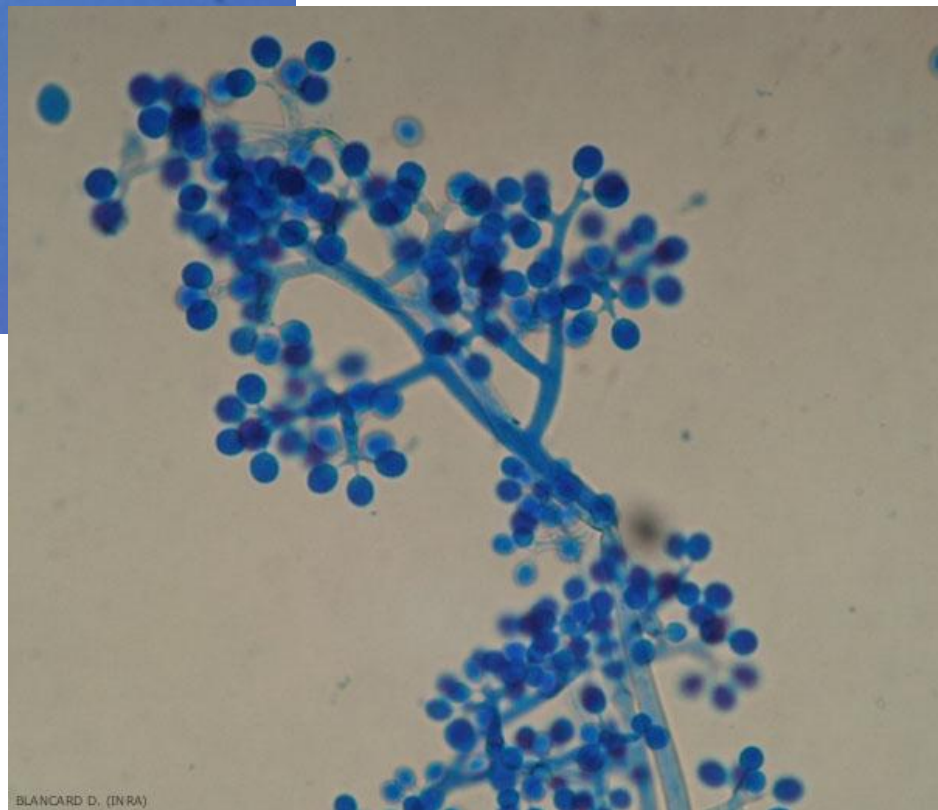
Plasmopara viticola – Peronospora della vite – **life cycle**




Sporangiophores
Sporangia


INRA A. (INRA)


200 µm
©Bruce Watt

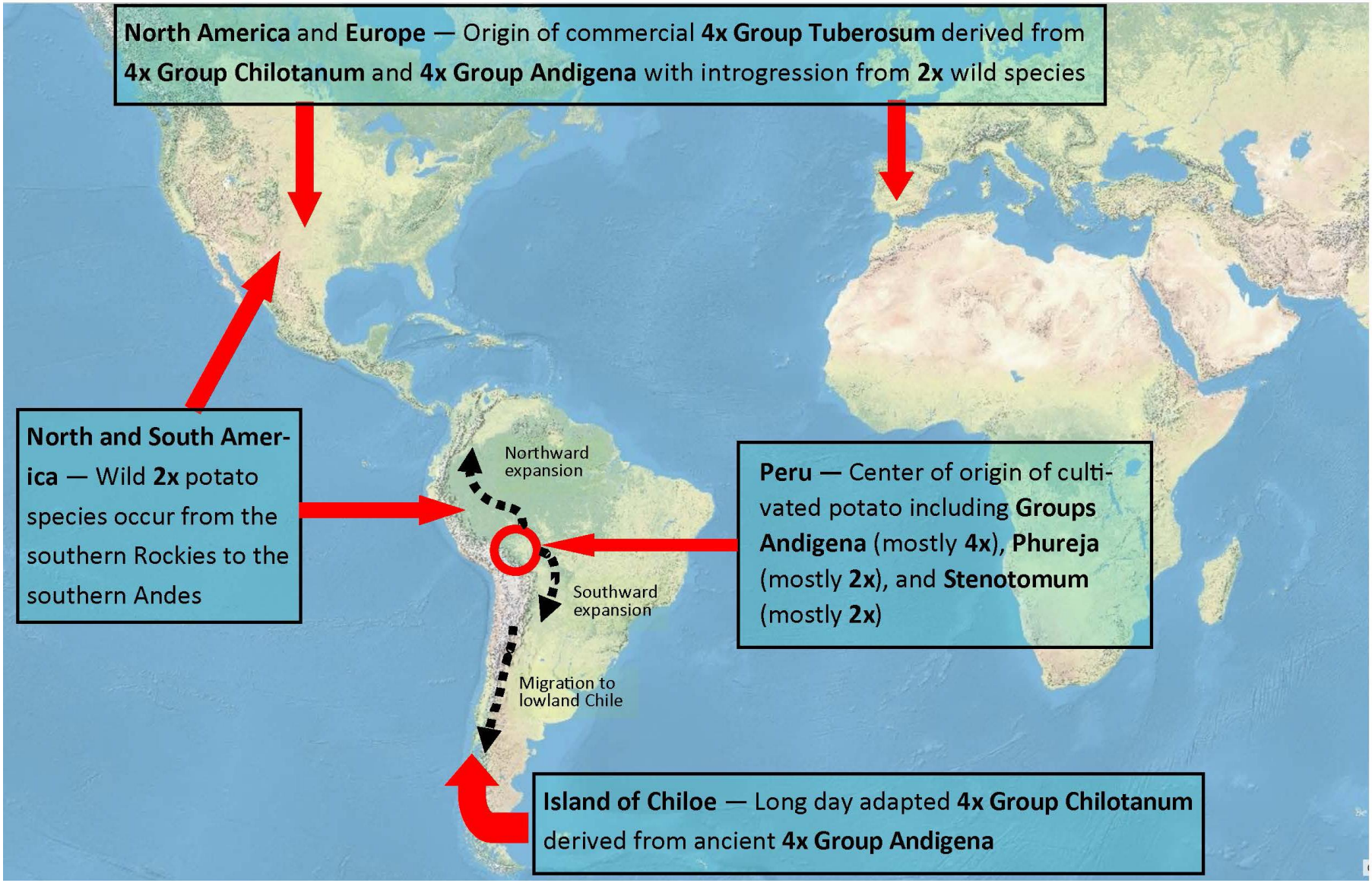

BLANCARD D. (INRA)

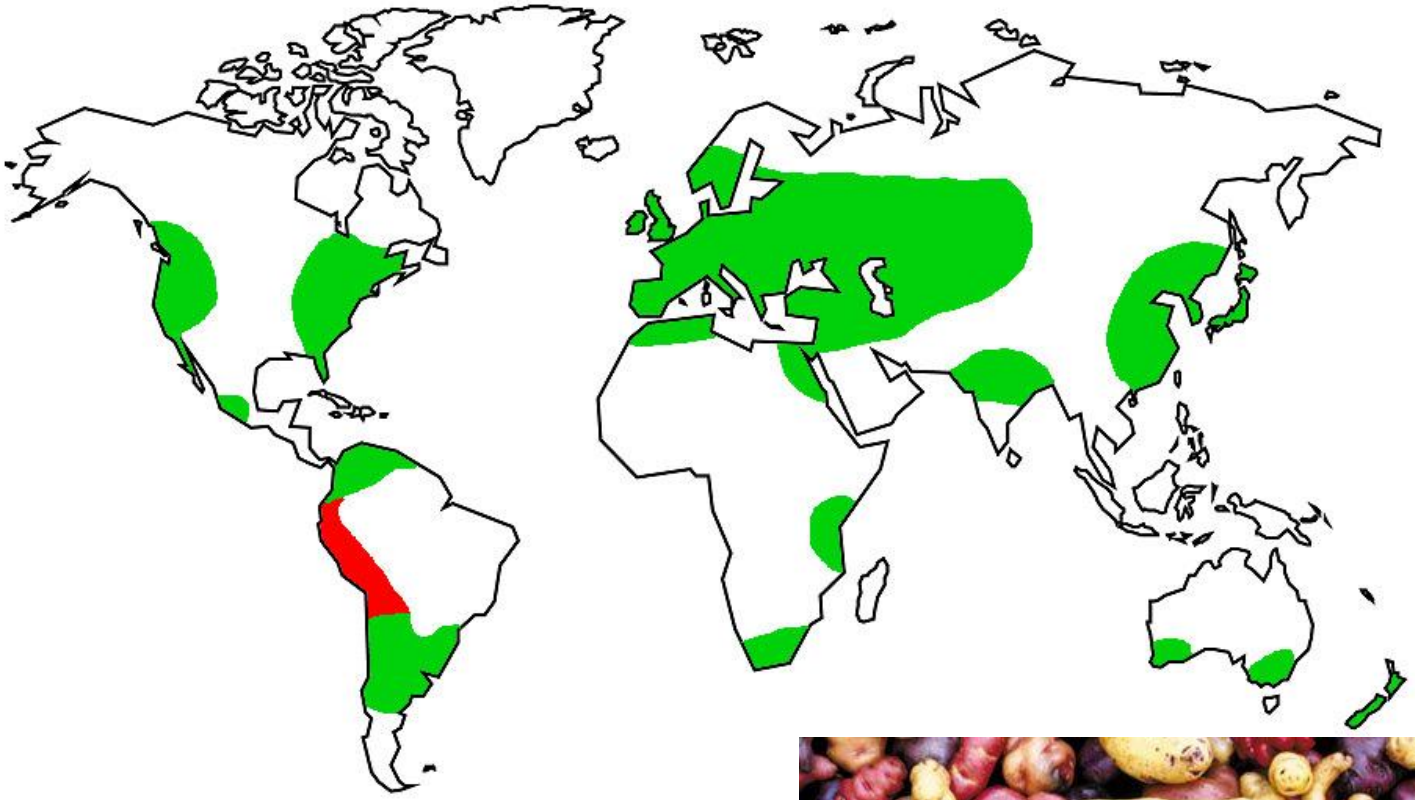
Innesti di *Vitis vinifera* (europaea) su *V. lambrusca* (americana)

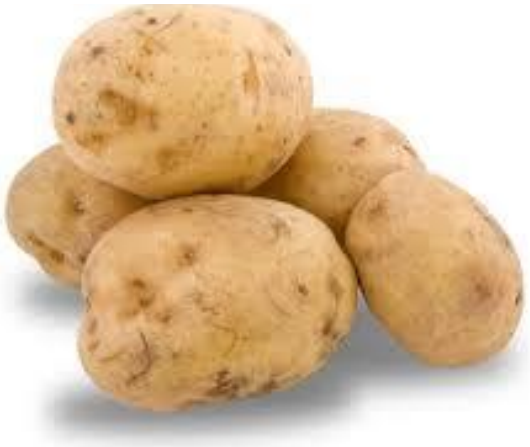
Solfato di rame

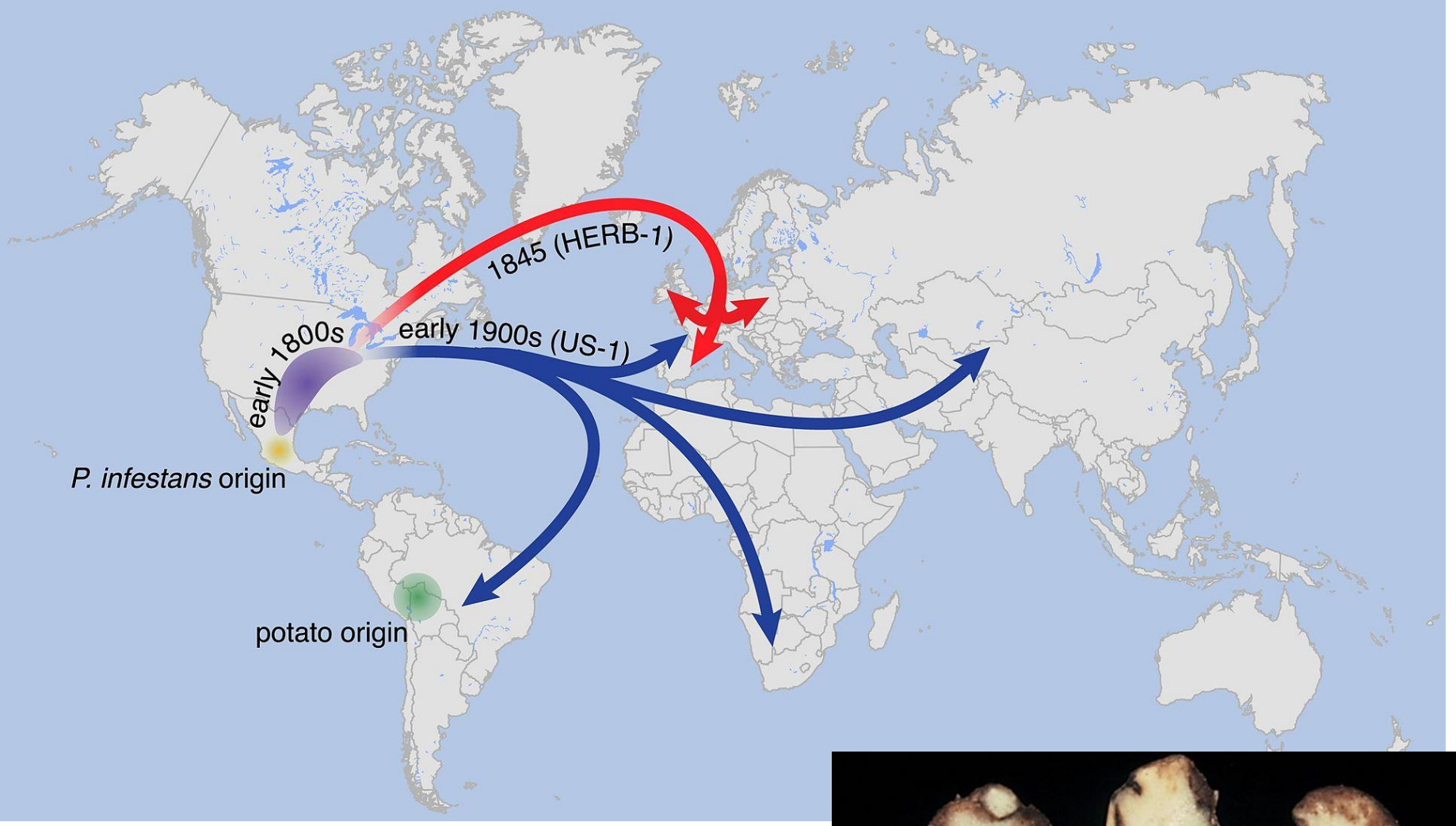
Phytophtora infestans

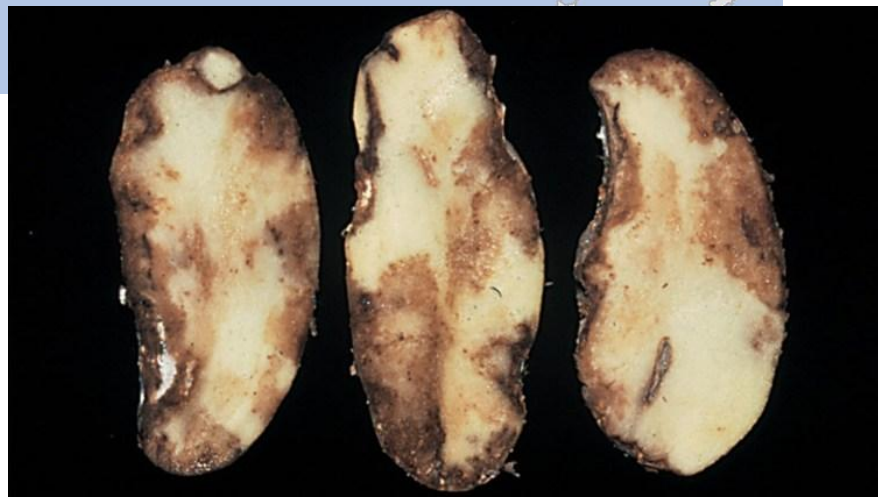
Peronospora della patata – potato blight


North America and **Europe** — Origin of commercial **4x Group Tuberosum** derived from **4x Group Chilotanum** and **4x Group Andigena** with introgression from **2x** wild species
North and South America — Wild **2x** potato species occur from the southern Rockies to the southern Andes
Northward expansion
Southward expansion
Migration to lowland Chile
Peru — Center of origin of cultivated potato including **Groups Andigena** (mostly **4x**), **Phureja** (mostly **2x**), and **Stenotomum** (mostly **2x**)
Island of Chiloe — Long day adapted **4x Group Chilotanum** derived from ancient **4x Group Andigena**

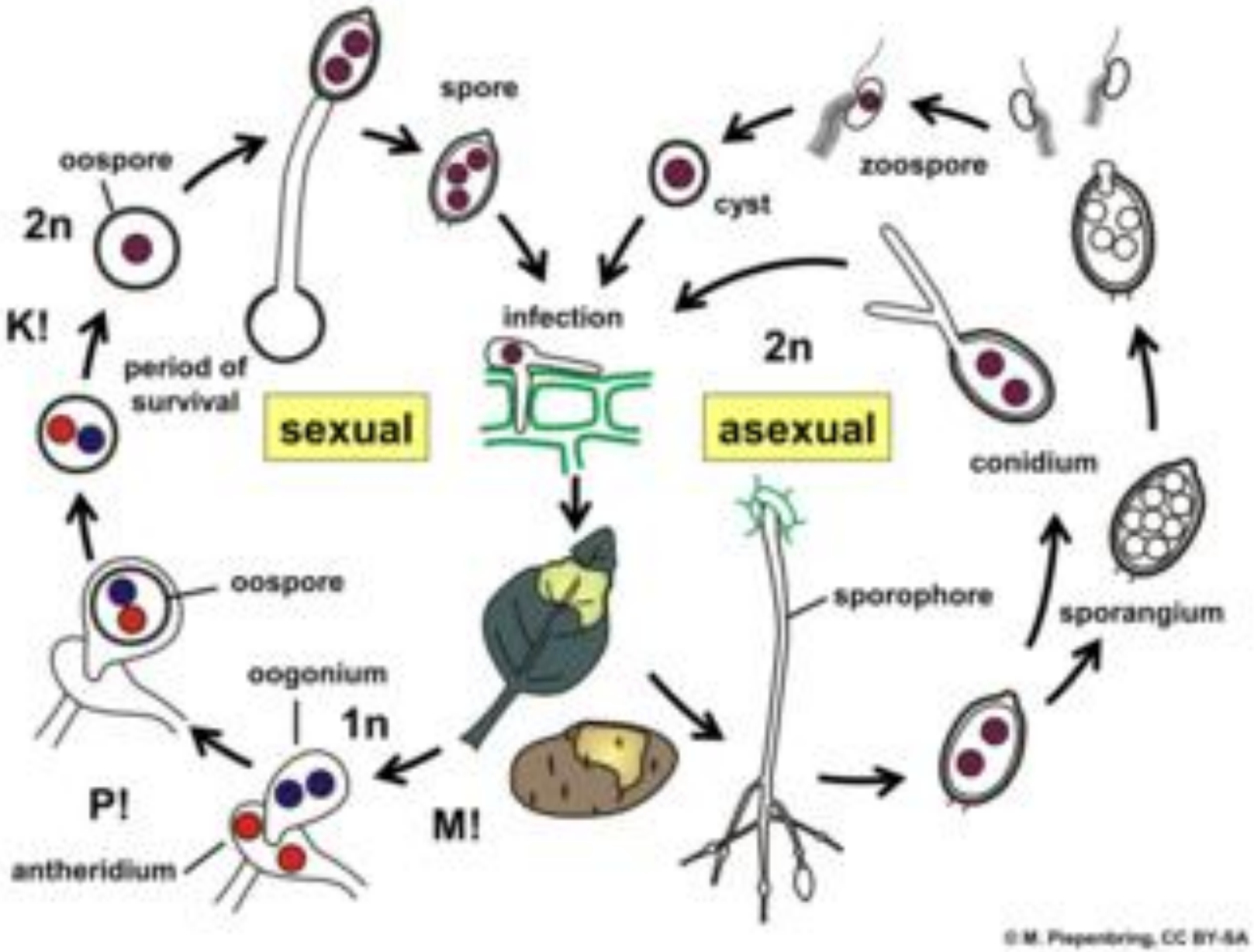





1845 (HERB-1)
early 1800s
early 1900s (US-1)
P. infestans origin
potato origin



Phytophtora infestans – Peronospora della patata – **life cycle**

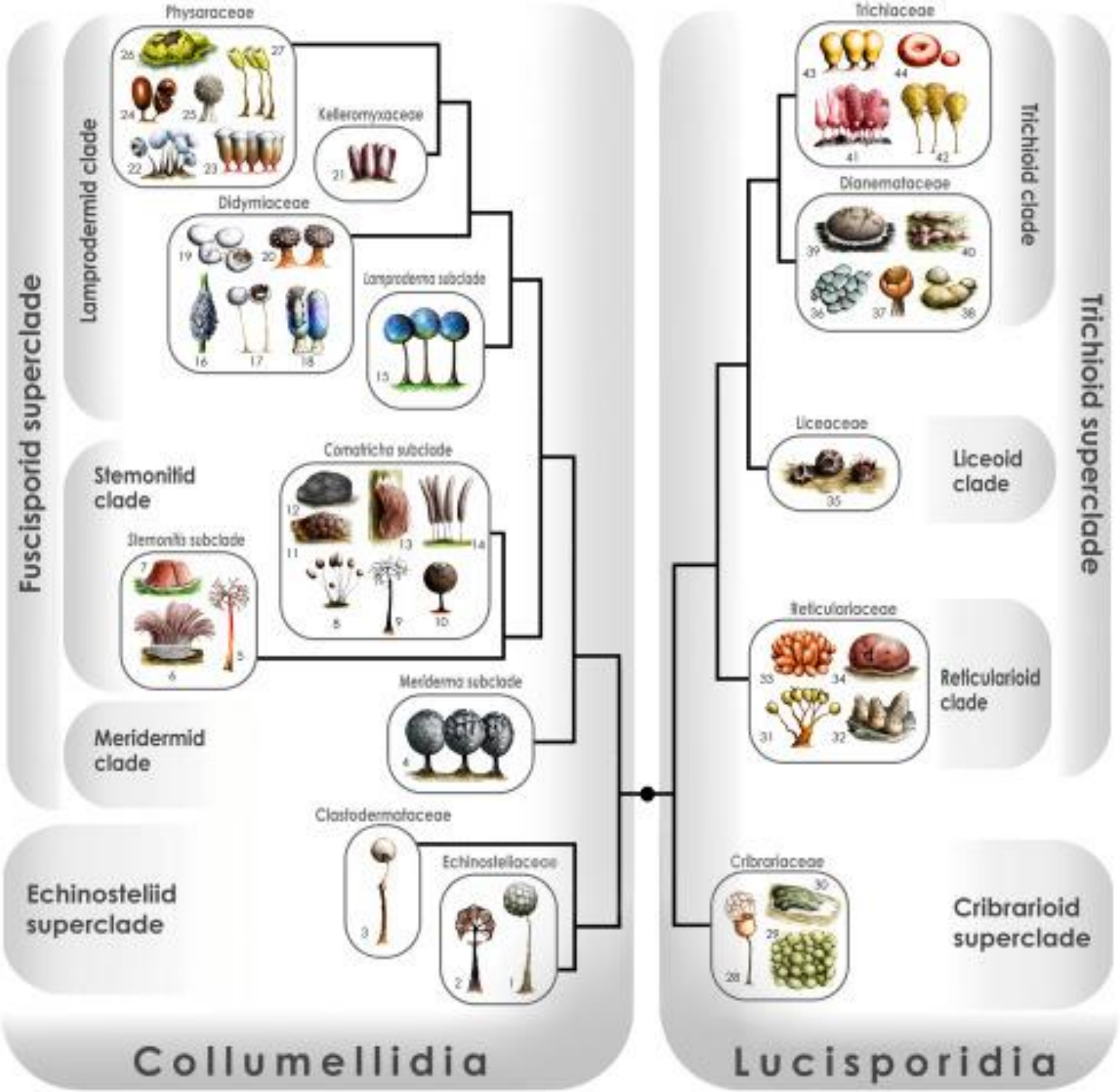


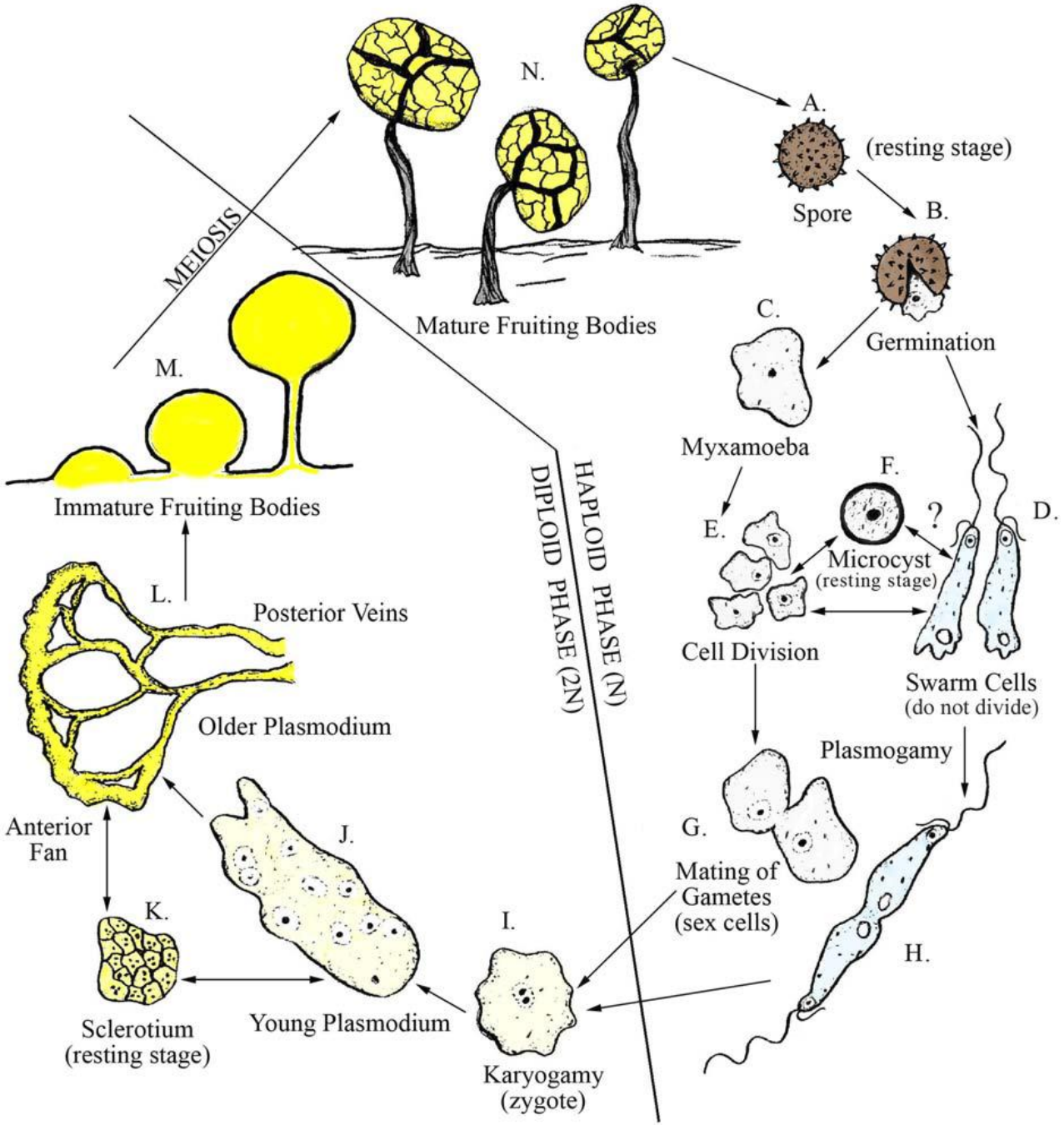
Myxomyceti

I Myxomyceti si nutrono di batteri, protozoi, spore, miceli, corpi fruttiferi di funghi, sostanza organica.

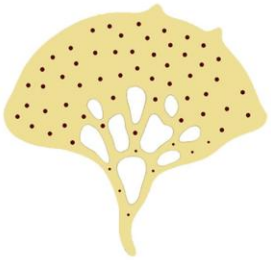
Hanno un ruolo biostatico nei confronti di funghi e/o batteri, impedendone la proliferazione incontrollata.

Se ne conoscono circa 1500 specie.


Physaraceae
Kelleromyxaceae
Didymiaceae
Lamprodermataceae
Lamprodermid clade
Fuscisporid superclade
Stemonitid clade
Stemonitis subclade
Comatricha subclade
Meridermid clade
Meridermataceae
Clastodermataceae
Echinostelliaceae
Echinostelliid superclade
Trichiaceae
Dianemataceae
Trichioid clade
Trichioid superclade
Liceaceae
Liceoid clade
Reticulariaceae
Reticularioid clade
Cribrariaceae
Cribrarioid superclade
Collumellidia
Lucisporidia



Life Cycle of a Myxomycete

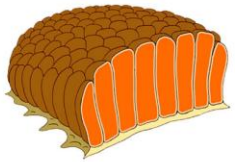


Plasmodium – a single multinucleate amoeba, capable of moving by protoplasmic streaming, often attaining macroscopic size.

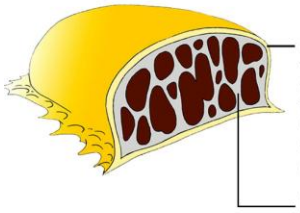
Pseudoplasmodium a multicellular structure formed by the aggregation of numerous uninucleate amoebae.

Plasmodiocarp – a fruiting body that maintains the initial shape of the plasmodium from which it is derived.

Sorocarp – a fruiting body formed from a pseudoplasmodium. It consists of spores and a stalk, which usually shows a cellular or, more rarely, an acellular (*Acytostelium* and *Fonticula*) structure.



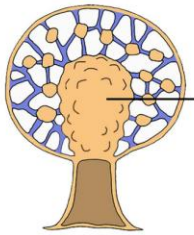
Pseudoaethalium – a compound fructification, formed by accreted, but still discernible sporocarps.



Cortex – covering that surrounds an aethalium, formed from the merged peridia of individual sporothecae and/or additional amorphous, often mineralized deposits.

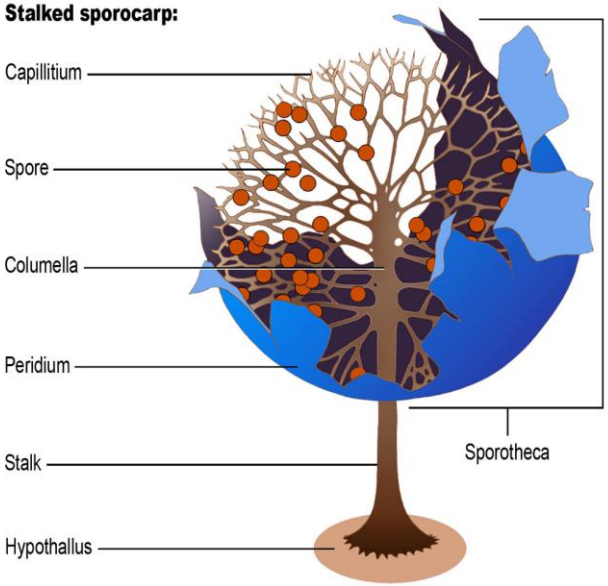
Pseudocapillitium – threads or plates that represent remnants of the peridia and/or columellae of merged sporothecae inside an aethalium or pseudoaethalium.

Aethalium – a compound fructification, formed by merged and hardly discernible sporocarps.



Pseudocolumella – amorphous, usually mineralized structure inside a sporotheca, similar to the columella but having a different nature and not connected to the stalk.

Stalked sporocarp:



Fruiting body (or **sporophore**) – spore-forming structure in slime molds.

Sporocarp – a fruiting body formed from a plasmodium. It consists of spores and auxiliary acellular structures (stalk, peridium, capillitium, columella, etc.). A large plasmodium usually splits into several (sometimes tens to hundreds) fragments, each forming one sporocarp.

Sporotheca – spore-bearing portion of the fruiting body. It consists of a spore mass, covered by a peridium, and may contain auxiliary structures (capillitium, columella, etc.).

Capillitium – a system of solid or hollow threads, interspersed within the spore mass inside the sporotheca. It serves to facilitate and regulate the spore dispersal.

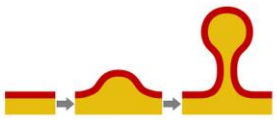
Spore – microscopic reproductive unit formed in the fruiting body.

Columella – continuation of the stalk inside the sporotheca.

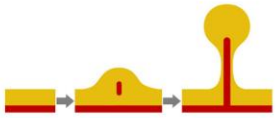
Peridium – fugacious or persistent covering that surrounds the sporotheca.

Stalk – a structure that elevates the spore-bearing portion of the fruiting body above the substrate.

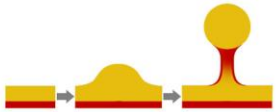
Hypothallus – a structure which serves to attach the fruiting body to the substrate.



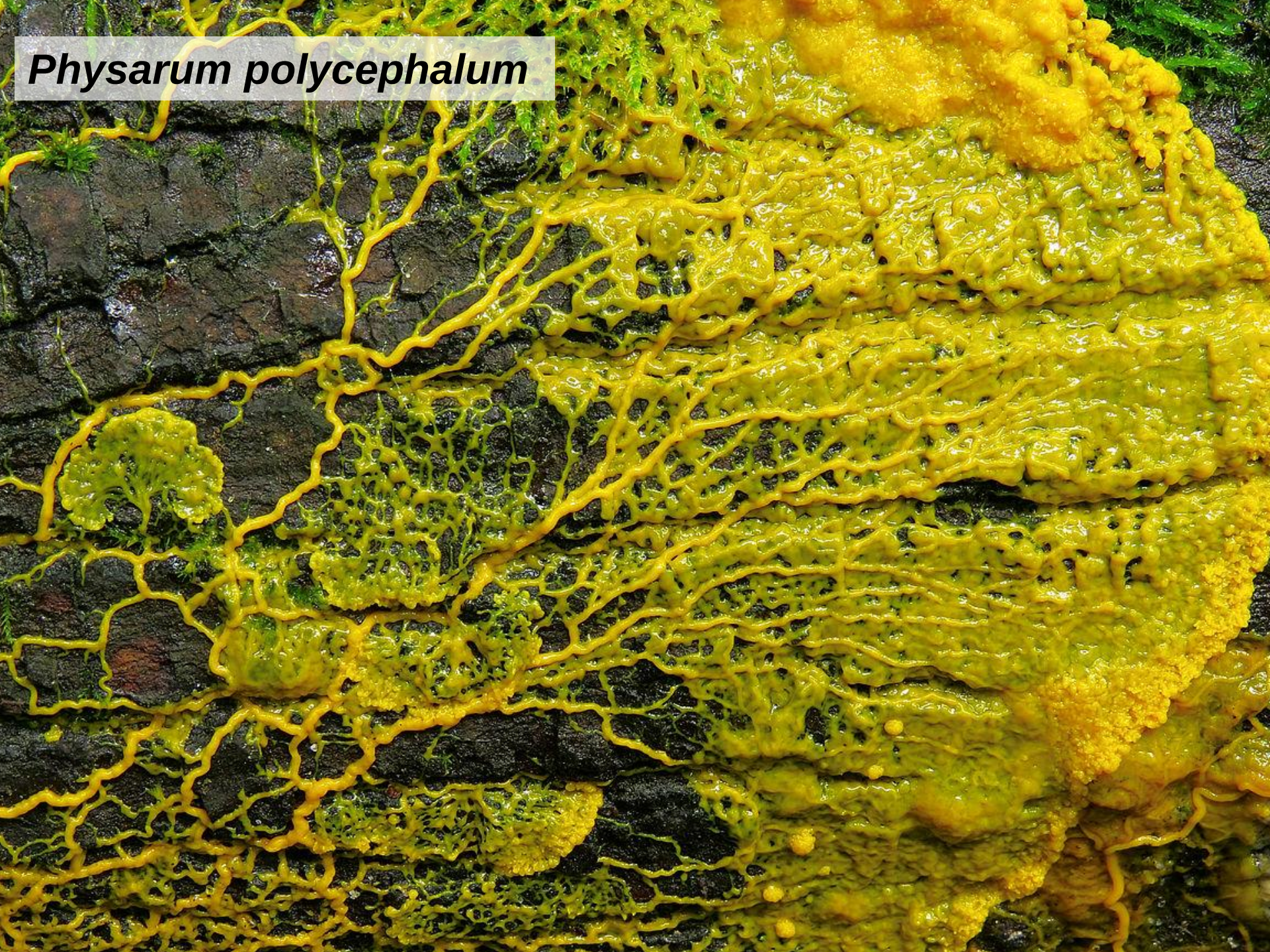
Subhypothallic development – a type of stalk formation in which the latter is formed from the outer slimy sheath of the plasmodium. A mature stalk can be filled with refuse matter, sporiform vesicles or amorphous, often mineralized material.



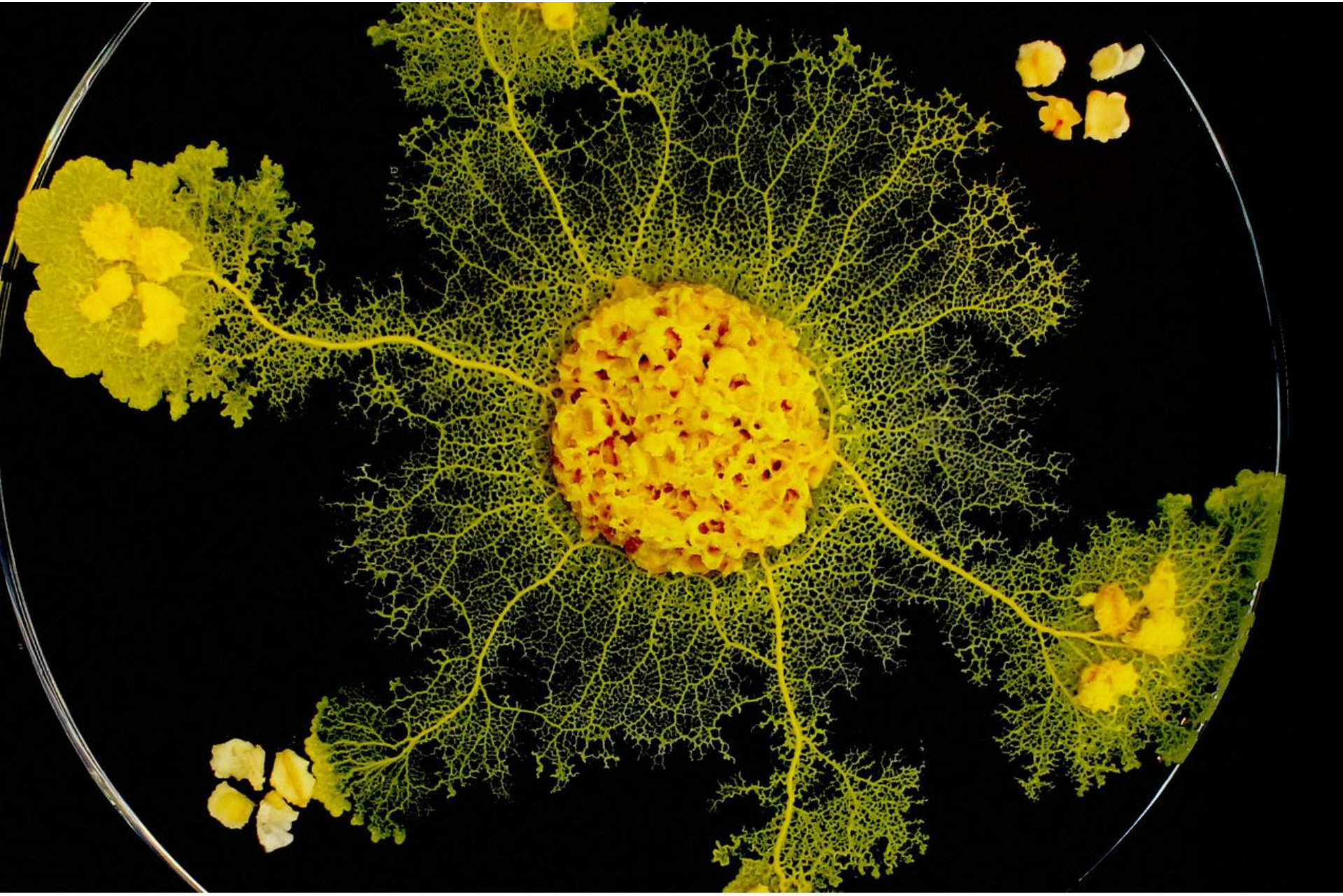
Epihypothallic development – a type of stalk formation in which the latter is formed internally by secretion of material into vacuoles. A mature stalk is solid or hollow but does not contain refuse matter.



Primary development – a type of stalk formation in which the stalk material is secreted from the cytoplasm of the plasmodium, but the mature stalk contains a large amount of refuse matter.


Physarum polycephalum

Physarum polycephalum

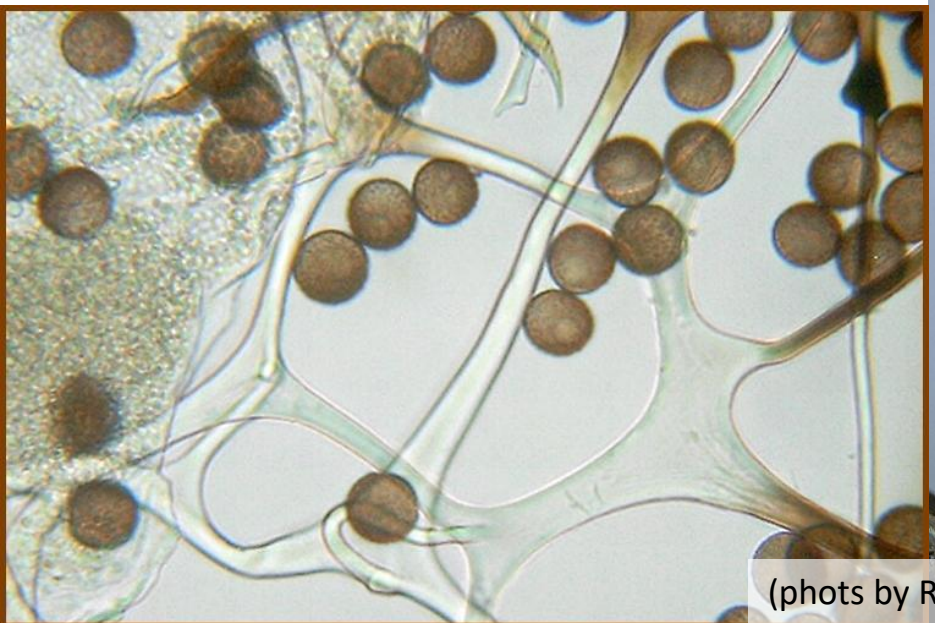


Fuligo septica
(var. *candida*)

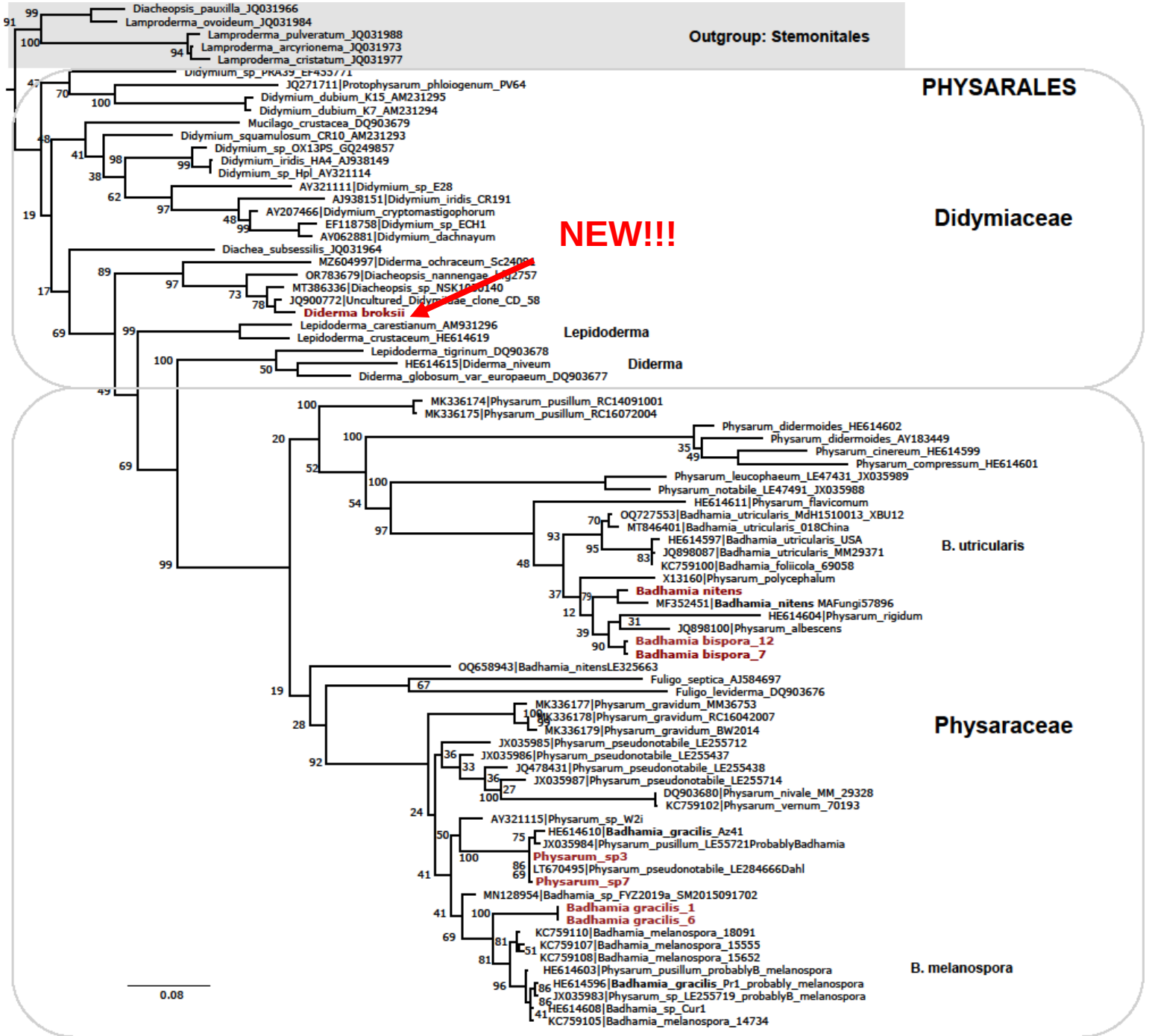
Lycogala epidendron


Acyria incarnata
© A.M. Rantet-Poux

Diderma brooksii (nivicolous species)



(phots by R. Cainelli)


Diacheopsis_pauxilla_JQ031966
Lamproderma_ovoideum_JQ031984
Lamproderma_pulveratum_JQ031988
Lamproderma_arcyrionema_JQ031973
Lamproderma_cristatum_JQ031977
Outgroup: Stemonitales
PHYSARALES
JQ271711|Protophysarum_phloiogenum_PV64
Didymium_dubium_K15_AM231295
Didymium_dubium_K7_AM231294
Mucilago_crustacea_DQ903679
Didymium_squamulosum_CR10_AM231293
Didymium_sp_OX13PS_GQ249857
Didymium_iridis_HA4_AJ938149
Didymium_sp_Hpl_AY321114
AY321111|Didymium_sp_E28
AJ938151|Didymium_iridis_CR191
AY207466|Didymium_cryptomastigophorum
EF118758|Didymium_sp_ECH1
AY062881|Didymium_dachnayum
Didymiaceae
NEW!!!
Diachea_subsessilis_JQ031964
MZ604997|Diderma_ochraceum_Sc2409
OR783679|Diacheopsis_nannengae_Hg2757
MT386336|Diacheopsis_sp_NSK1020140
JQ900772|Uncultured_Didymiaceae_clone_CD_58
Diderma broksii
Lepidoderma_carestianum_AM931296
Lepidoderma_crustaceum_HE614619
Lepidoderma
Lepidoderma_tigrinum_DQ903678
HE614615|Diderma_niveum
Diderma_globosum_var_europaeum_DQ903677
Diderma
MK336174|Physarum_pusillum_RC14091001
MK336175|Physarum_pusillum_RC16072004
Physarum_didermoides_HE614602
Physarum_didermoides_AY183449
Physarum_cinereum_HE614599
Physarum_compressum_HE614601
Physarum_leucophaeum_LE47431_JX035989
Physarum_notabile_LE47491_JX035988
HE614611|Physarum_flavicomum
OQ727553|Badhamia_utricularis_MdH1510013_XBU12
MT846401|Badhamia_utricularis_018China
HE614597|Badhamia_utricularis_USA
JQ898087|Badhamia_utricularis_MM29371
KC759100|Badhamia_foliicola_69058
B. utricularis
X13160|Physarum_polycephalum
Badhamia nitens
MF352451|Badhamia_nitens MAFungi57896
HE614604|Physarum_rigidum
JQ898100|Physarum_albescens
Badhamia bispora_12
Badhamia bispora_7
OQ658943|Badhamia_nitensLE325663
Fuligo_septica_AJ584697
Fuligo_leviderma_DQ903676
MK336177|Physarum_gravidum_MM36753
MK336178|Physarum_gravidum_RC16042007
MK336179|Physarum_gravidum_BW2014
Physaraceae
JX035985|Physarum_pseudonotabile_LE255712
JX035986|Physarum_pseudonotabile_LE255437
JQ478431|Physarum_pseudonotabile_LE255438
JX035987|Physarum_pseudonotabile_LE255714
DQ903680|Physarum_nivale_MM_29328
KC759102|Physarum_vernum_70193
AY321115|Physarum_sp_W2i
HE614610|Badhamia_gracilis_Az41
JX035984|Physarum_pusillum_LE55721ProbablyBadhamia
Physarum_sp3
LT670495|Physarum_pseudonotabile_LE284666Dahl
Physarum_sp7
MN128954|Badhamia_sp_FYZ2019a_SM2015091702
Badhamia gracilis_1
Badhamia gracilis_6
KC759110|Badhamia_melanospora_18091
KC759107|Badhamia_melanospora_15555
KC759108|Badhamia_melanospora_15652
HE614603|Physarum_pusillum_probablyB_melanospora
B. melanospora
HE614596|Badhamia_gracilis_Pr1_probably_melanospora
JX035983|Physarum_sp_LE255719_probablyB_melanospora
HE614608|Badhamia_sp_Cur1
KC759105|Badhamia_melanospora_14734
0.08