Slime Molds

Jewels of the Forest

PVAS Master Naturalist, 2022
John C. Landolt, Professor of Biology, *Emeritus*
Shepherd University

Early Day 1

One hour later

Day 2

Day 3

https://www.youtube.com/watch?v=GY_uMH8Xpy0

https://www.facebook.com/groups/SlimeMold/

https://www.amazon.com/Creeping-Garden-Bryn-Dentinger/dp/B01MTAMW0X

Slime Mold Identification & Appreciation

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5 hrs

Its just 0.5 millimeter. Found on coconut leaf stalk...

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Melinda Landolt Invite Member

DESCRIPTION

A group for ID, discussion and photos of slime molds. These inte... See More

GROUP TYPE

General

An Introduction to the Morphology, Taxonomy and Ecology of Plasmodial Slime Molds

Dr. Steven L. Stephenson
University of Arkansas
slsteph@uark.edu

Myxomycetes (also called plasmodial slime molds) - a group of fungus-like organisms, with approximately 875 species known worldwide.

Introduction

Members of this class are commonly referred to as slime molds. These have thought to belong to both animal and fungi kingdoms at one time or another. It's now known that they are quite unrelated to animals and fungi and now are classified in the Kingdom Protista.

However slime moulds do exhibit characteristics of both fungi and animals. In the feeding stage, the slime mold moves about as a mass of protoplasm (the plasmodium) feeding on bacteria, spores, and other organic matter much like an amoeba. When the food supply is exhausted or other unfavorable conditions occur, the plasmodium changes, taking on the appearance of a fungus.

There are two “main” groups of slime molds now in the Protista Kingdom.

1 - Plasmodial slime molds or true slime molds are a large single-celled mass with thousands of nuclei called a plasmodium. They are formed when individual flagellated cells swarm together and fuse. The plasmodium oozes and feeds before transforming into fruiting bodies containing spores.

2 - Cellular slime molds spend most of their lives as separate single-celled feeding amoebae, but upon the release of a chemical signal, the individual cells aggregate into a great multicellular swarm, known as a pseudoplasmodia that subsequently transforms with some cells becoming spores.

Habitat

The plasmodial stage is found in cool, shady, moist places on rotting logs, leaf litter, moist shaded soil, or other organic matter. There are over 875 known species that feed on decaying organic matter, bacteria, protozoa, and other minute organisms, which it engulfs and digests. The plasmodium may reach several 100 millimetres in diameter and is often brightly coloured, although many are also inconspicuous.

(From http://www.hiddenforest.co.nz/slime/index.htm)

Life Cycle

1 - Once a spore is released from the fruiting body it's dispersed, either by insects, animals, and rain or air movement. On landing on a suitable location with appropriate moisture and temperature, one to four protoplasts are germinated

2 - The protoplasts once released from the spore's wall through either a pore or fissure will be either a flagellated swarm cell if conditions are wet, or a nonflagellated myxamoebae cell in dryer conditions.

(From http://www.hiddenforest.co.nz/slime/index.htm)

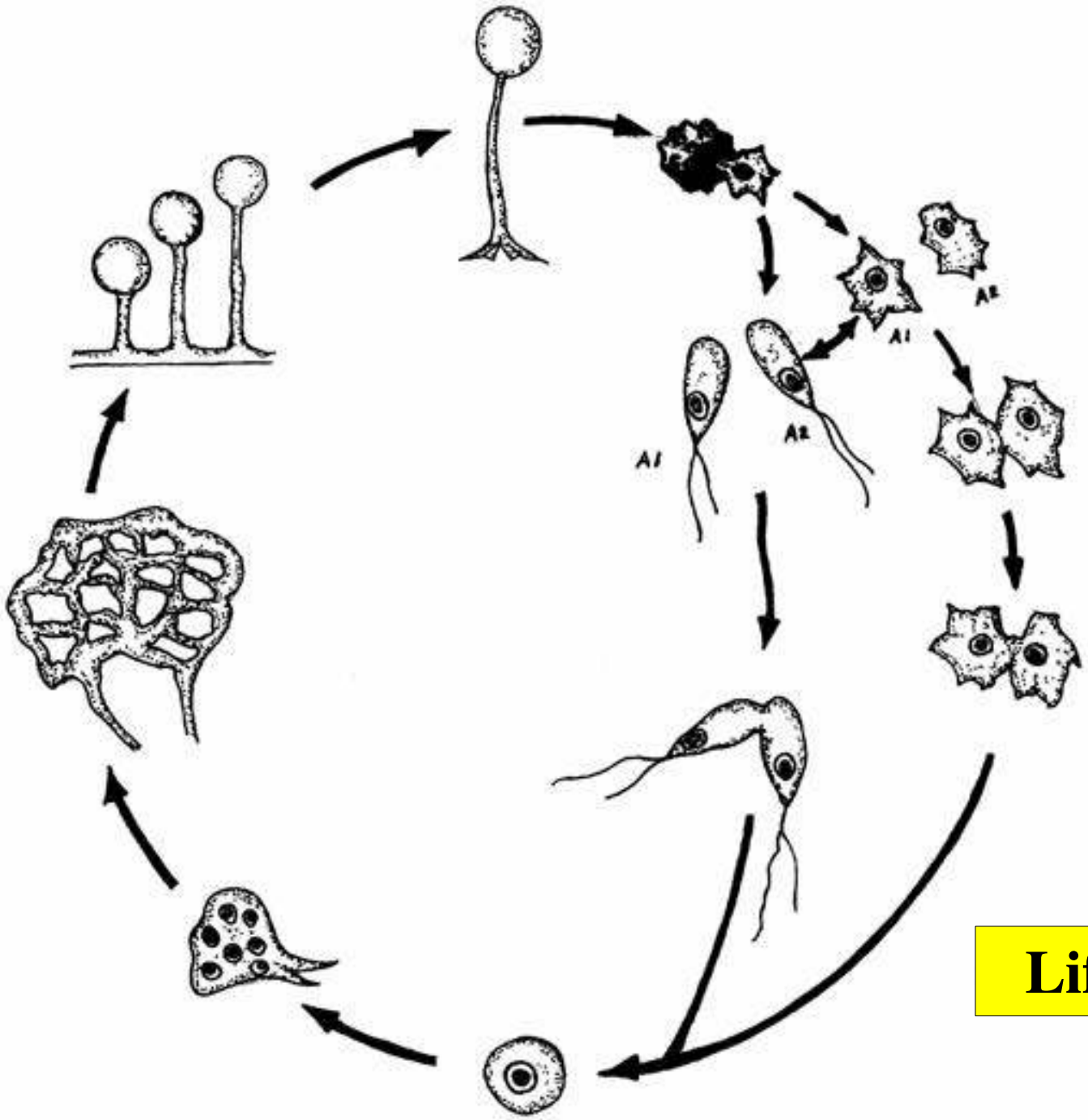
3 - If conditions for growth are not suitable, the cells can become microcysts to survive long periods of time.

4 - A diploid zygote is formed when two compatible myxamoebae or swarm cells fuse. This is known as plasmogamy and karyogamy.

5 - After a time of feeding and growing, the zygote develops into a single celled multinucleate structure known as a plasmodium.

6 - If environmental conditions are not suitable, then the plasmodium can change into another dormant state known as the sclerotium.

7 - When the conditions are right, the mature plasmodium produces one to many fruiting bodies containing spores depending on species. (http://www.hiddenforest.co.nz/slime/



Life Cycle

Slime Molds in Art and Popular Culture

The Garden of Earthly Delights

From Wikipedia, the free encyclopedia

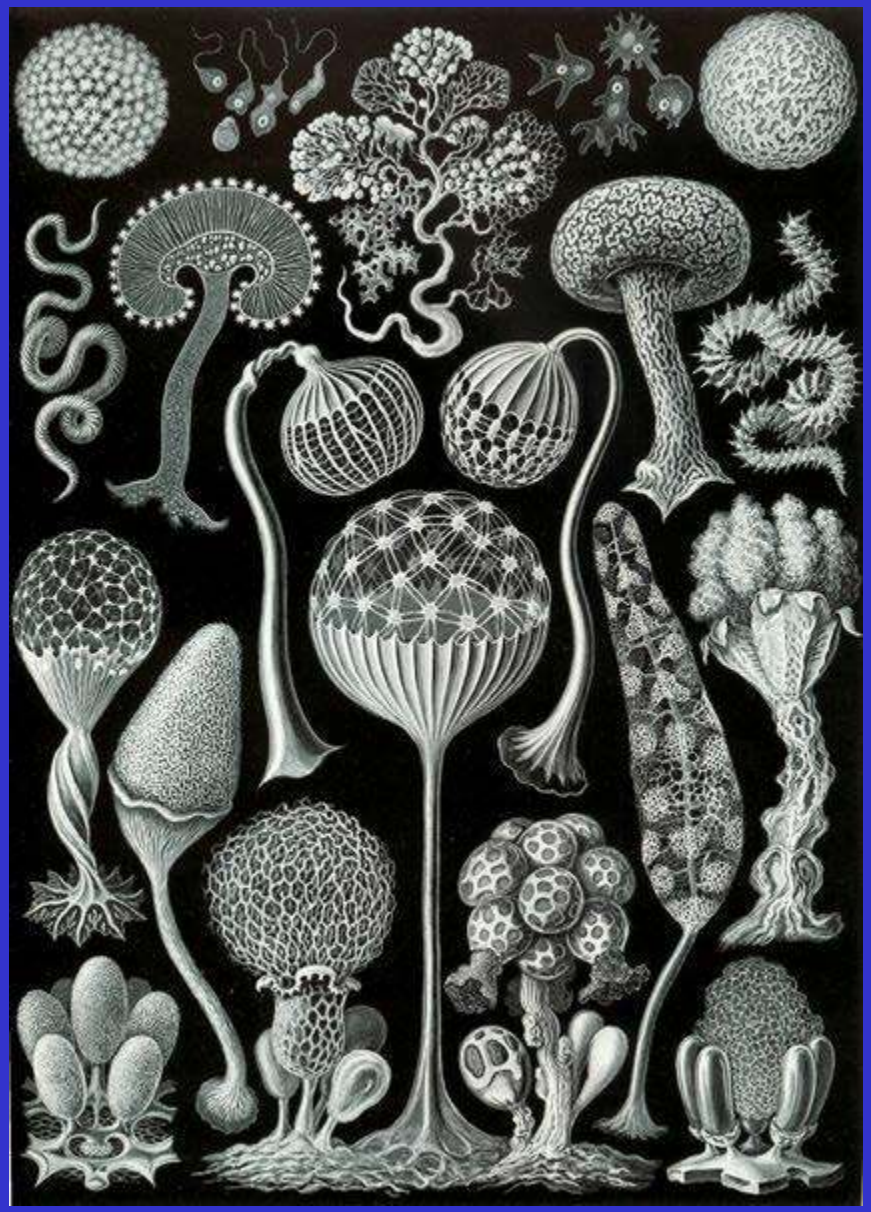
The Garden of Earthly Delights is the center panel of a triptych by Dutch painter Hieronymus Bosch. Painted around 1504, The Garden of Earthly Delights is perhaps his best-known work. It depicts the Creation of Earth and the infiltration of sin into mankind. It is currently hanging in the Museo del Prado, Madrid, Spain. The title is a later attribution. It was registered in the inventory of the Spanish crown as "the picture with the strawberry-tree fruits".

The Garden of Earthly Delights is an oil painting on wood panels. The centre panel measures 220 by 195 cm, and the wings measure 220 by 95 cm. Although the triptych format was standard for church altarpieces at the time, it is likely that The Garden of Earthly Delights was produced for the private enjoyment of a noble family.

The Garden of Earthly Delights in its entirety can be read from exterior to interior and then left to right, featuring a full narrative realized from all of the surfaces. Chronologically, the creation of the world becomes imparted onto the creation of Man, followed by earthly sin, culminating in damnation. The center panel, showing animals and humans coexisting and intermingling, supposedly includes images of 23 slime mold species.

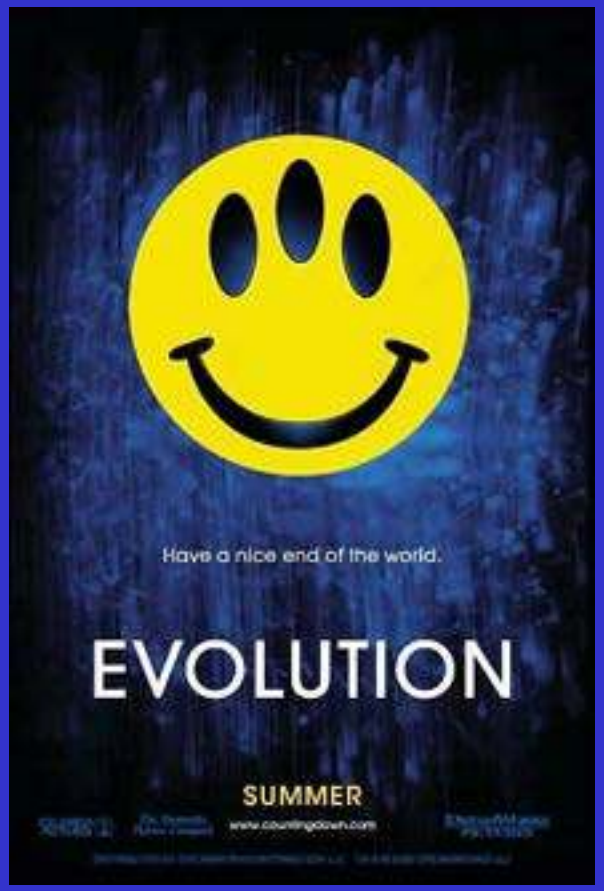
Middle panel of Bosch's triptych "Garden"

Slime mold sketches by E. Haekel - 1904



Metatrichia postage stamp (Randy Darrah)

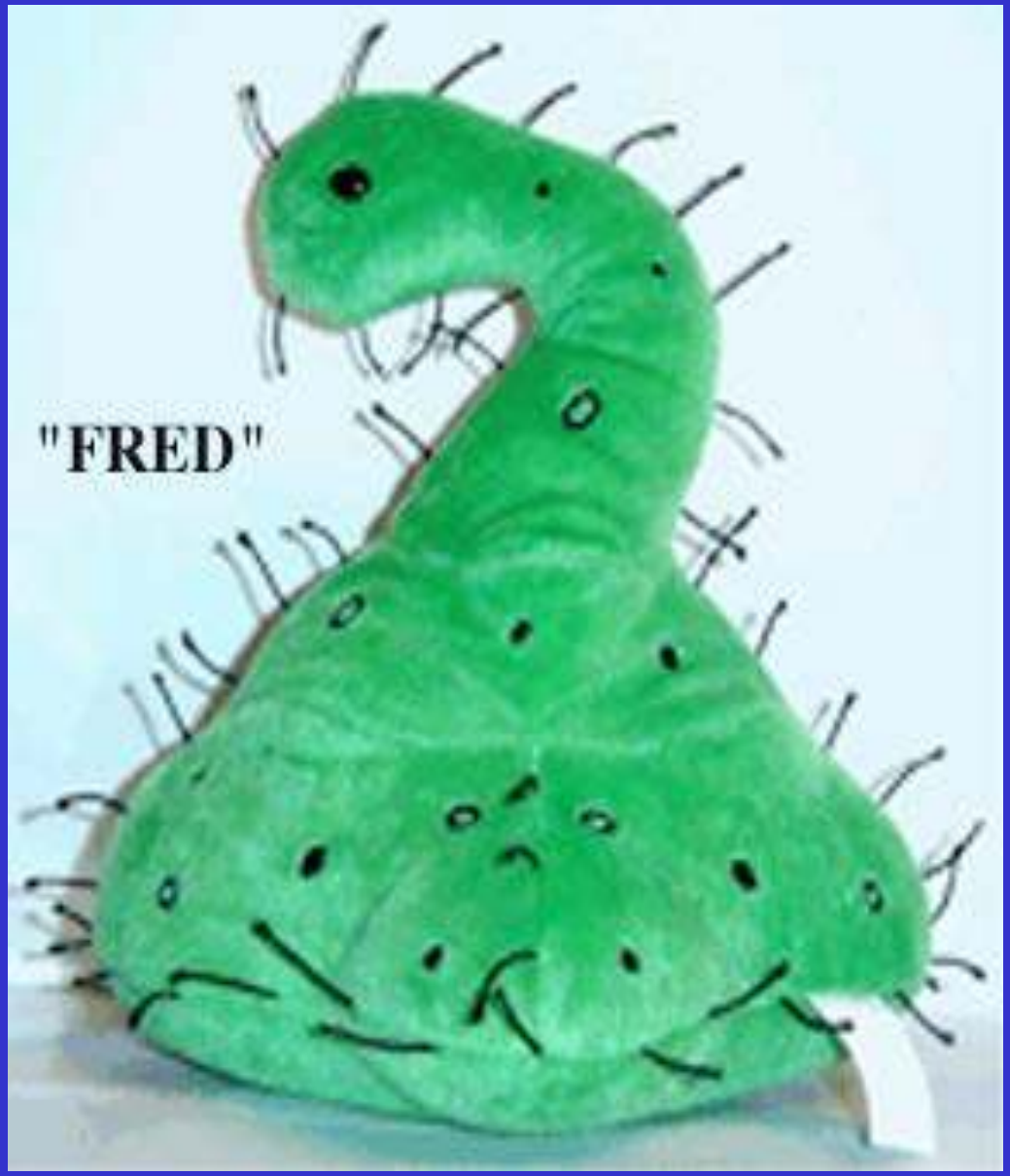
Popular Film – “Evolution” 2001



More “slime-lore” from Wikipedia

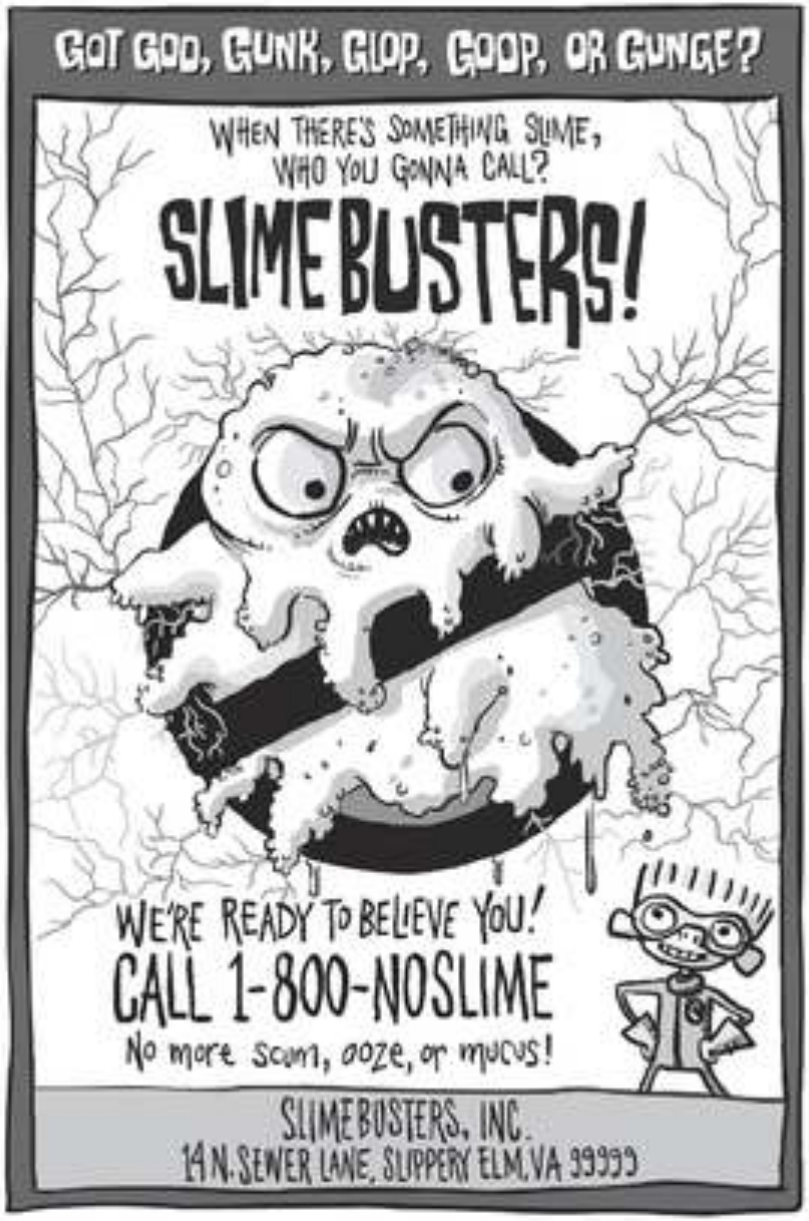
- Recently slimes were included in the Dungeons & Dragons Monster Manual and so are now a staple in many fantasy role-playing games and computer games. In the popular RPG NetHack, "slime mold" is the default name of a sought-after and delicious food item. Whether or not most actual slime moulds are delicious, or even edible, is unclear, however the plasmodium of *Fuligo* is eaten in Mexico.
- The graphic novel Nausicaä of the Valley of Wind features a highly dangerous mutated slime mould that engulfs entire cities.
- In Finnish traditional lore about malicious witches, yellow Fuligo was termed "paranvoi" (butter of the familiar), and reputed to be used to spoil milk.
- Philip K. Dick's novel Clans of the Alphane Moon contains a character called Lord Running Clam, that is a "Ganymedean Slime Mold", who talks and is very intelligent and has telepathic powers.
- In Jeffrey Darlington's comic General Protection Fault, one character's poor hygiene led to the development of a sentient species of slime mould (FRED) in his apartment that split the rent with him.

Stalking Wild Cellular Slime Molds



Frankenslime made himself as flat as a pancake and oozed under the door of Stink's room. He gurgled and burbled and bubbled his way across the hall. Glip. Glop. Gloop. Frankenslime hungry! Hungry for seven-year-old boy. A thick greenish drool dripped from the corners of the glob monster's slobbery, blobbery mouth. Help! Stink was going to be eaten alive!

Open wide and say . . .




Yuengling
TRADITIONAL

A slug grazing on a slime mold (*Lamproderma*)
Photo by Randy Darrah

From Wikipedia

In the slime mold beetle genus ***Agathidium***, a number of new species have been described by two former Cornell entomologists, Dr Kelly B. Miller (now at Brigham Young University) and Dr Quentin D. Wheeler (now at the Natural History Museum). According to Miller and Wheeler, the naming of the three of the beetles was done in homage to certain contemporary political figures. Other namesakes for species in this genus include Darth Vader, "who shares with *A. vaderi* a broad, shiny, helmetlike head" and and another species named for the indian princess Pocahontas.

Planetary Biodiversity Inventories (PBI)

MYXOMYCETES

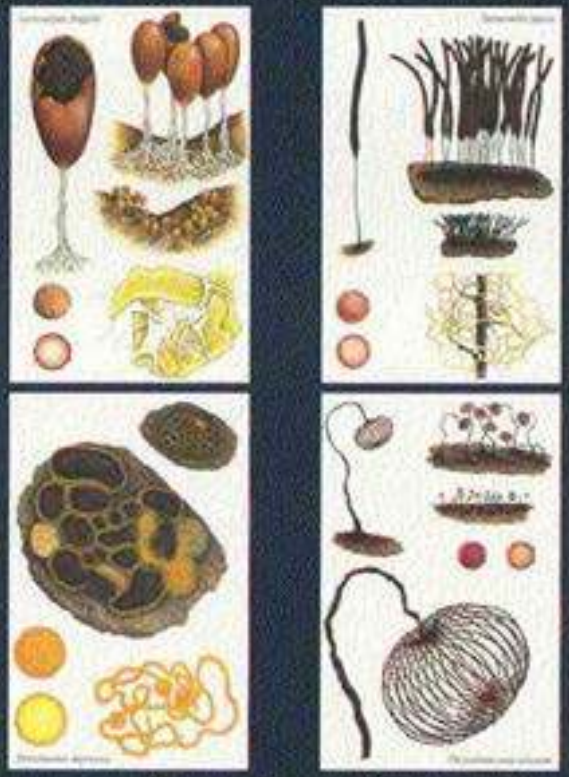
A Handbook of Slime Molds

STEVEN L. STEPHENSON
and HENRY STEMPEN

Myxomycetes of Ohio: Their Systematics, Biology, and Use in Teaching

by

Harold W. Keller and Karl L. Braun



Ohio Biological Survey, 1999

Slime mold image web pages

http://www.flickr.com/photos/myriorama/sets/1271006/

http://naturalhistory.uga.edu/~GMNH/Mycoherb_Site/myxogal.htm

http://jlcheype.free.fr/classification/Myxomycetes/Myxomycetes.htm

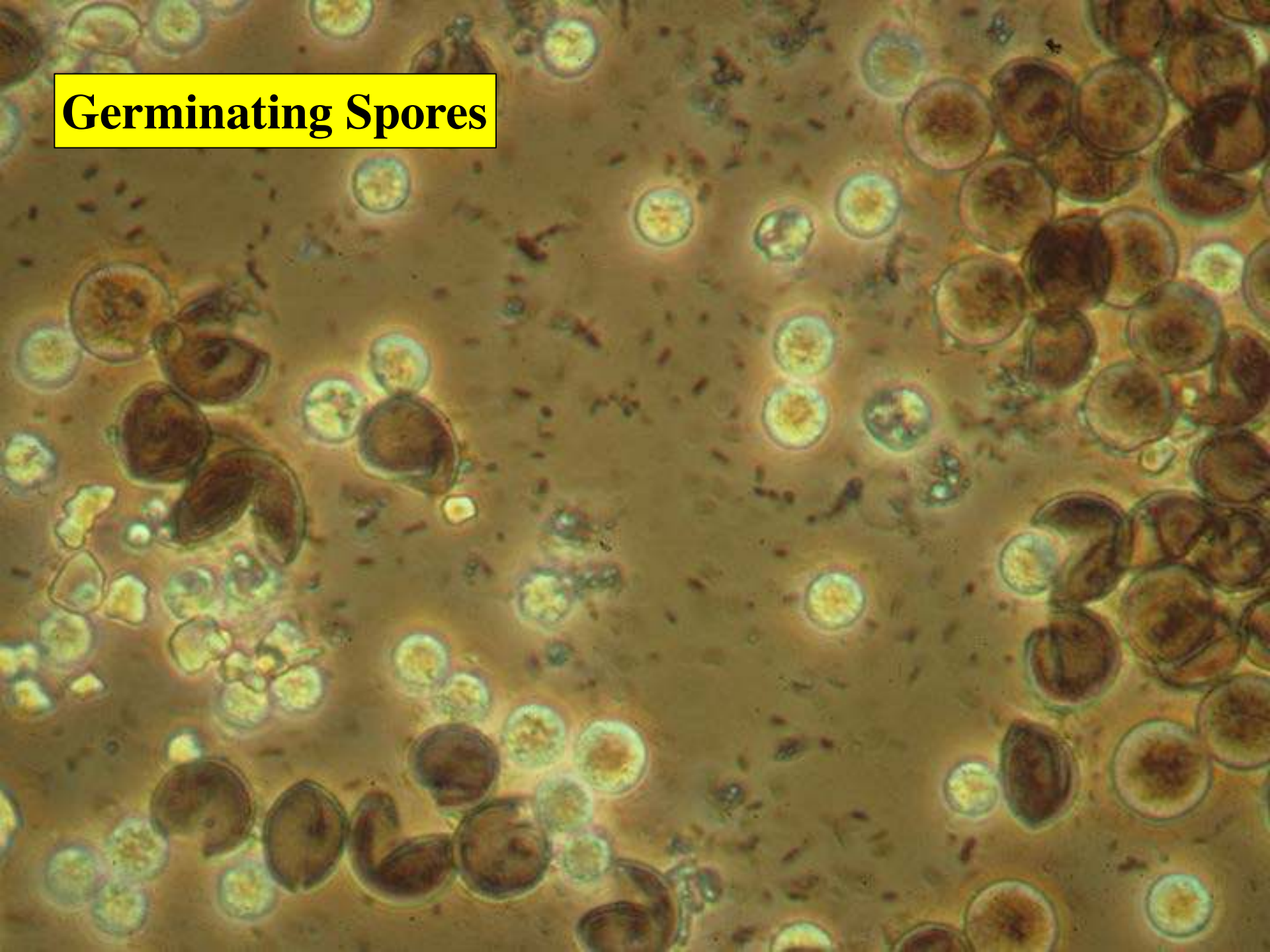
http://sanamyan.com/myxomycetes/index.php

http://slimemold.uark.edu/

http://www.hiddenforest.co.nz/slime/index.htm

Also a Facebook Group:

Slime Mold Identification & Appreciation


Germinating Spores

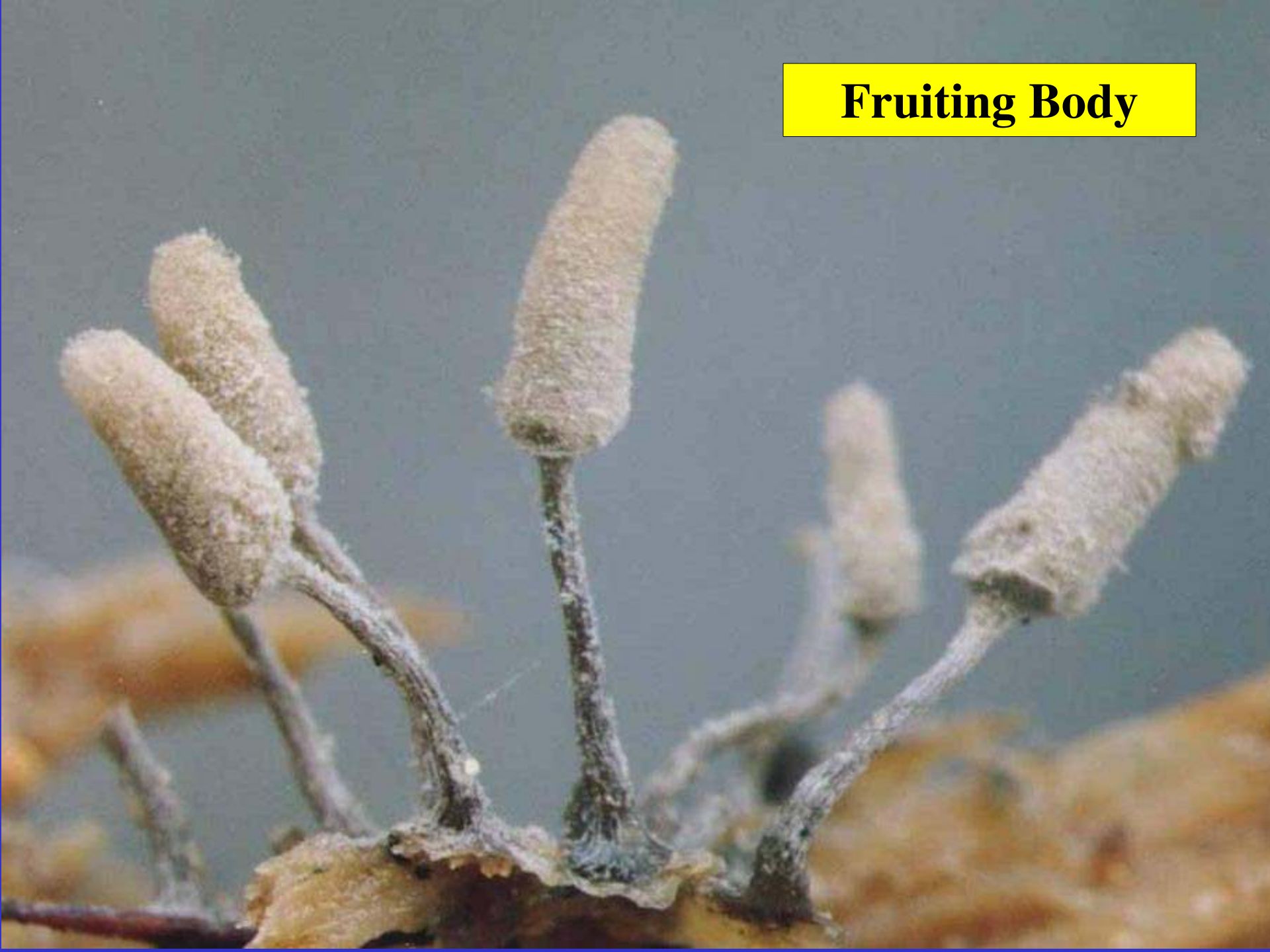
Amoeboflagellate Cell

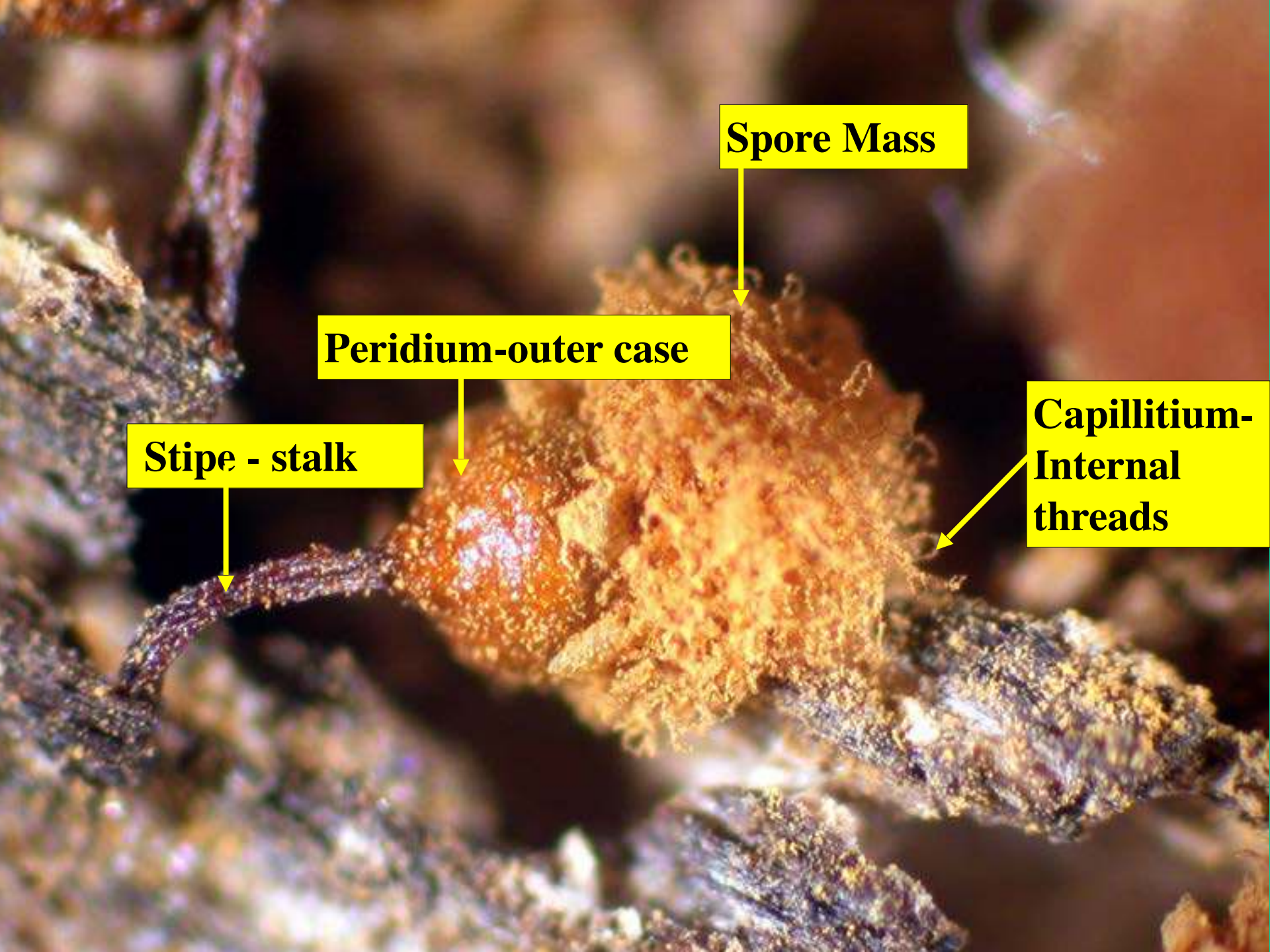

Plasmodium

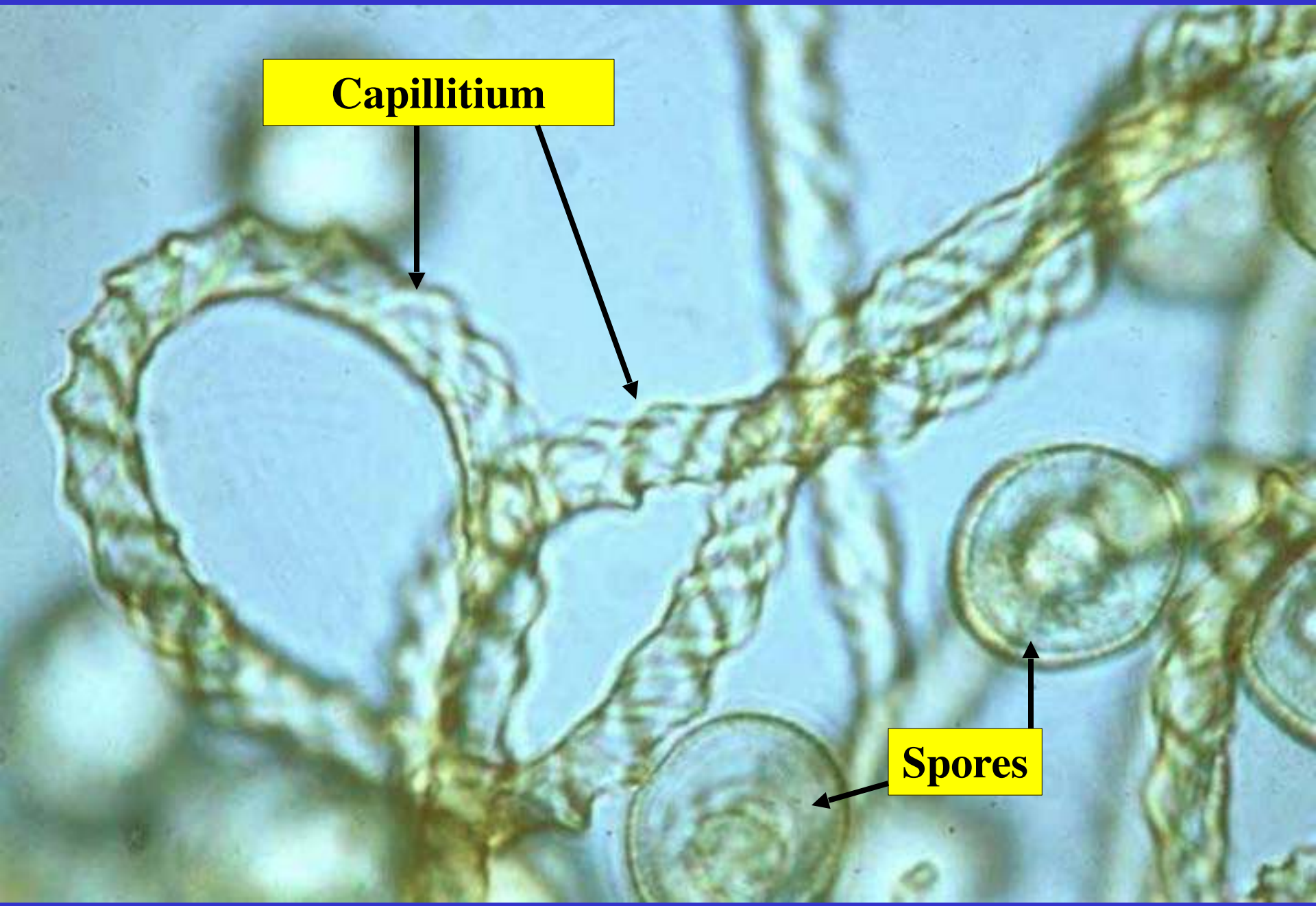
A small, multinucleate plasmodium


Plasmodium


Developing fruiting body


Fruiting Body


Spore Mass
Peridium-outer case
Stipe - stalk
Capillitium-Internal threads


Capillitium
Spores

Types of Fruiting Bodies

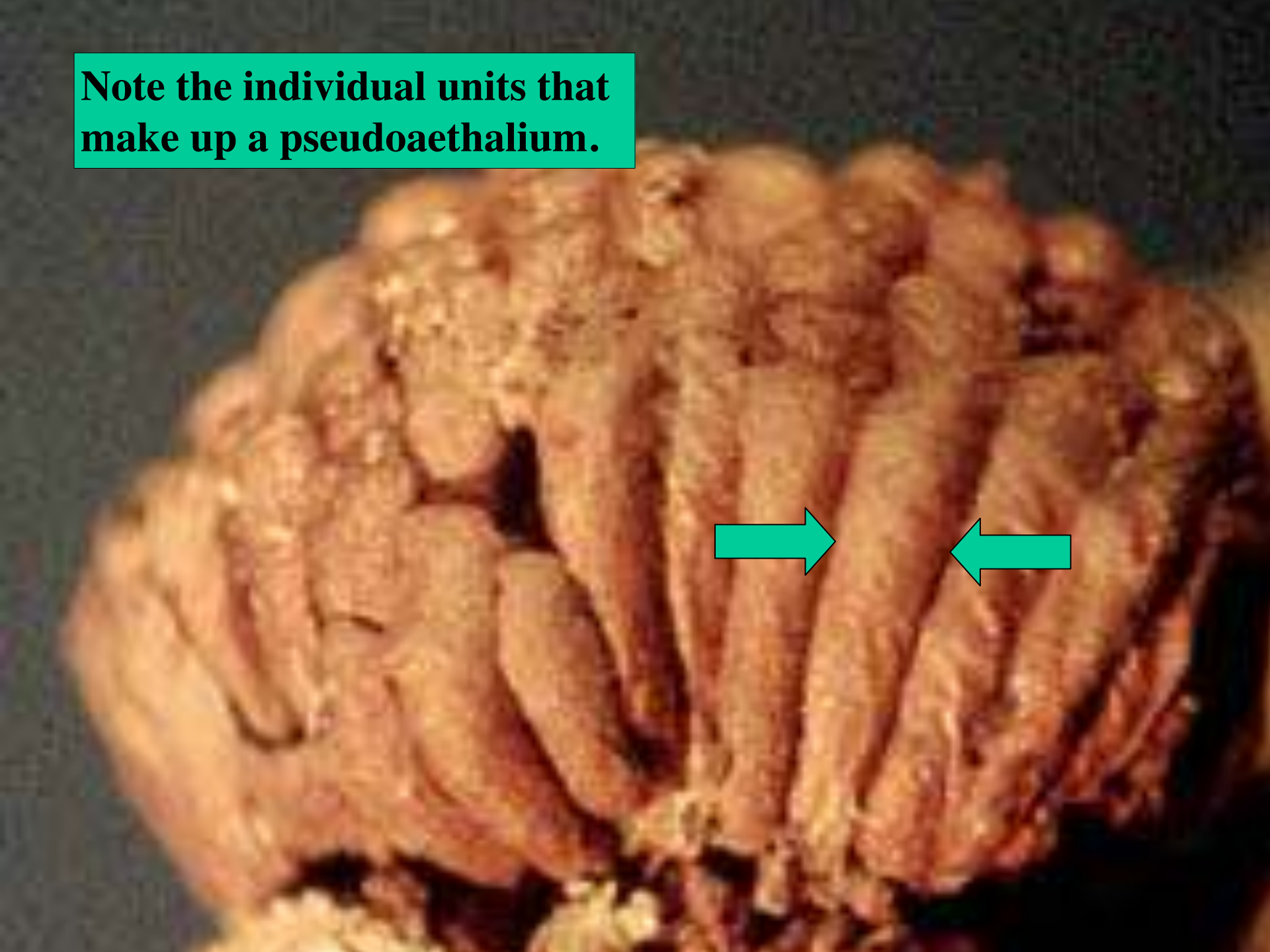
- **Sporangium** (single ball on sticks)
- **Plasmodiocarp** (hardened plasmodium)
- **Aethalium** (hardened, clumped plasmodium)
- **Pseudoaethalium** (bundle of sporangia)

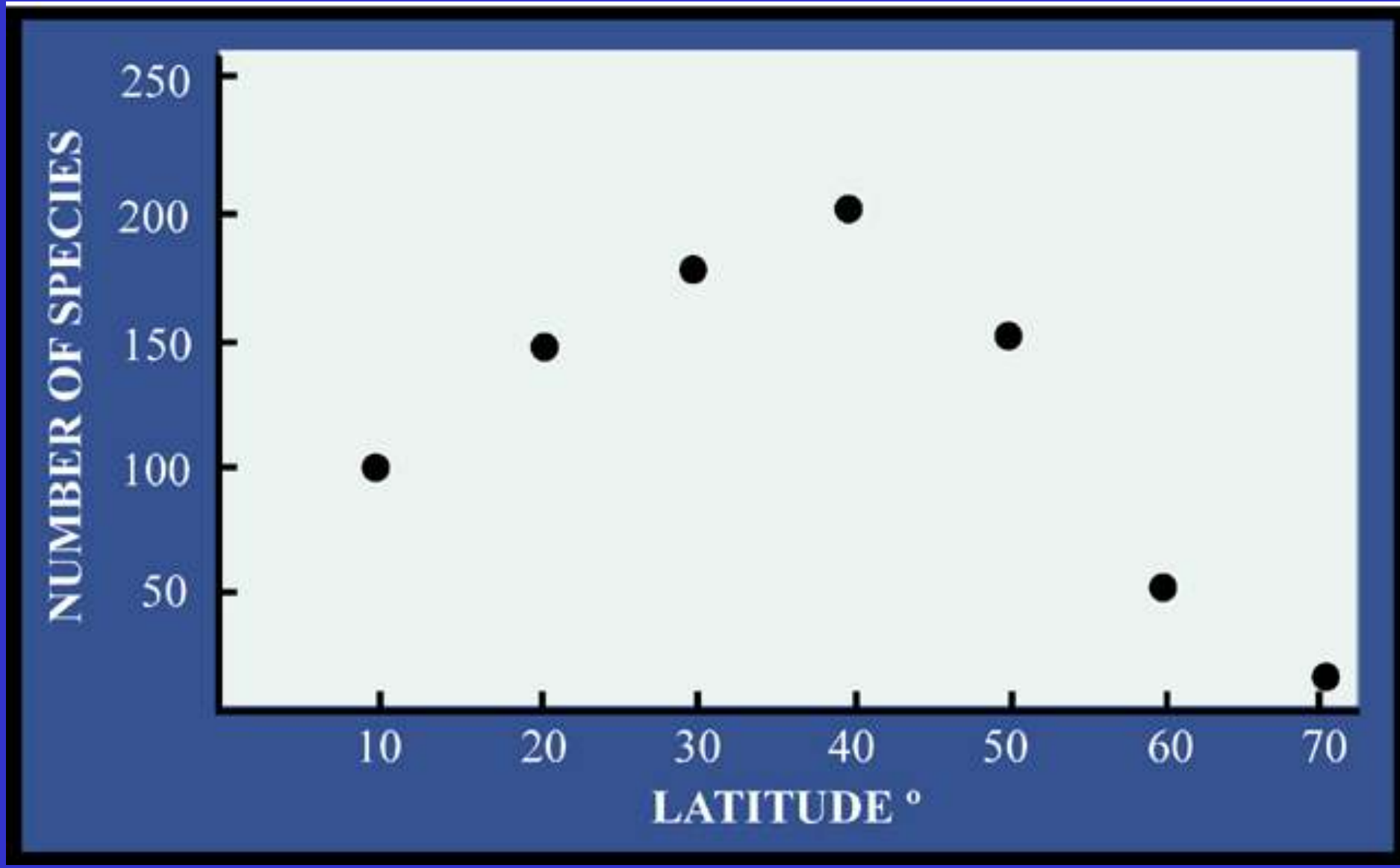

Sporangium


Plasmodiocarp


Aethalium


Pseudoaethalium


Note the individual units that make up a pseudoaethalium.


NUMBER OF SPECIES
250
200
150
100
50
10
20
30
40
50
60
70
LATITUDE °

Some general patterns of biodiversity

1. Species richness of myxomycetes varies considerably for different ecosystems.
2. Temperate deciduous forests seem to be characterized by the highest species richness.
3. Except for tropical forests, in which species richness is apparently lower than in temperate deciduous forests, species richness tends to decrease with increasing latitude.
4. Members of the order Liceales appear to be poorly represented in high-elevation ecosystems and deserts.
5. Members of the order Physarales are the overwhelming dominants in those ecosystems for which temperature and/or moisture are major limiting factors of the environment.

Kingdom: Protista

Division: Myxomycota (slime moulds)

Class: Myxomycetes (true slime moulds)

Subclass:	Orders:	Family:	Genus:
Ceratiomyxomycetidae	Ceratiomyxales	Ceratiomyxaceae	*Ceratiomyxa*
Myxogastromycetidae	Echinosteliales	Clastodermataceae	*Clastoderma*
		Echinosteliaceae	*Echinostelium*
	Liceales	Cribrariaceae	*Cribraria*
		Reticulariaceae	*Lycogala*
			Tubifera
		Liceaceae	*Licea*
	Physarales	Physaraceae	*Craterium*
			Fuligo
			Leocarpus
			Physarum
			Willkommlangea
		Didymiaceae	*Diderma*
			Didymium
	Stemonitales	Stemonitidaceae	*Amaurochaete*
			Stemonitopsis
			Stemonitis
			Lamproderma
	Trichiales	Arcyriaceae	*Arcyria*
		Dianemataceae	*Dianema*
		Trichiaceae	*Hemitrichia*
			Metatrichia
			Perichaena
			Trichia

Key to Orders of Myxomycetes

1	Spores borne externally	Ceratiomyxales
1	Spores borne internally	2
2	True capillitium absent	Liceales
2	True capillitium present	3
3	Fruiting bodies small (<0.5 mm tall)	Echinosteliales
3	Fruiting bodies larger (>0.5 mm tall)	4
4	Spore mass more or less brightly colored	Trichiales
4	Spore mass usually purple-brown to black	5
5	Lime present in some part of fruiting body	Physarales
5	Lime absent from all parts of fruiting body	Stemonitales

Order Ceratiomyxales

1. spores borne externally
2. fruiting bodies unlike those of other myxomycetes
1. each spore gives rise to eight swarm cells

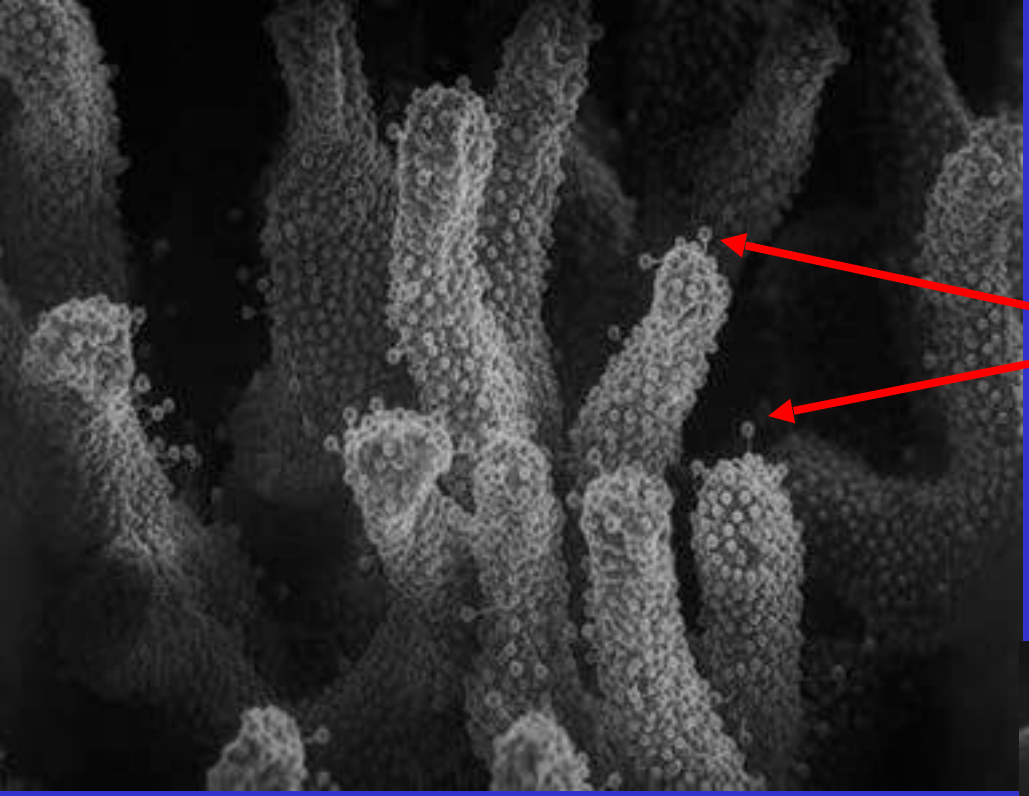
Order Ceratiomyxales

Ceratiomyxa


Ceratiomyxa fruticulosa

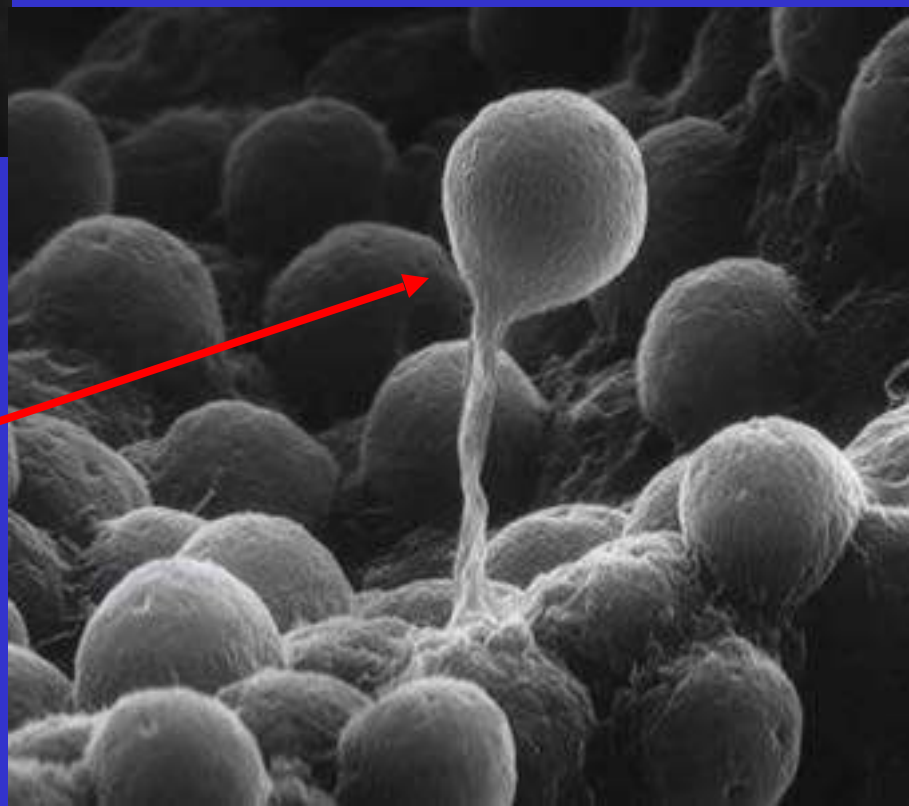
Ceratiomyxa fruiculosa

Ceratiomyxa fruticulosa



Spores of *Ceratiomyxa fruticulosa*

A single spore



Order Echinosteliales

1. minute to very small fruiting bodies
2. true capillitium present
3. fruiting bodies are stalked sporangia

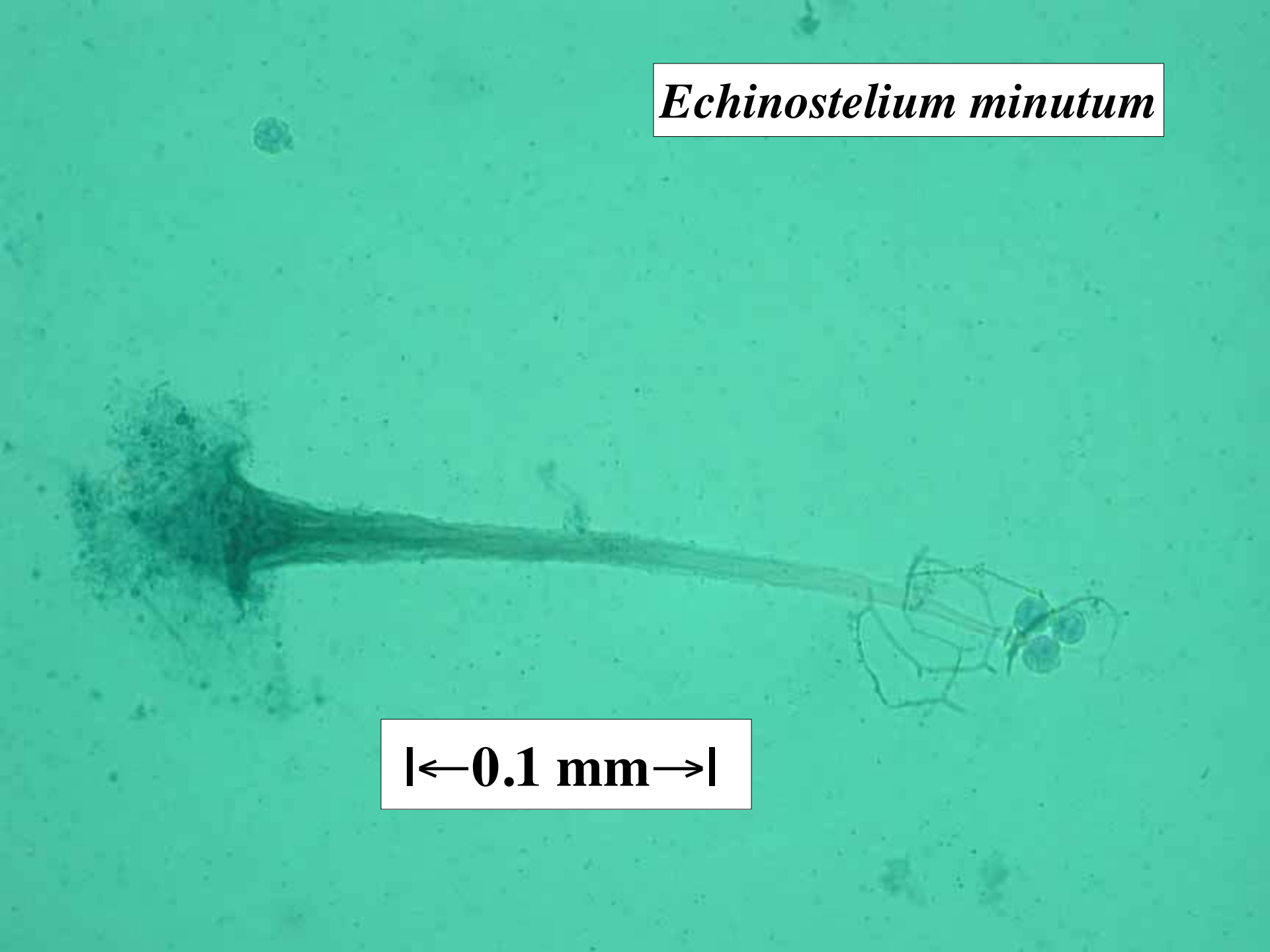
Order Echinosteliales

Barbeyella
Clastoderma
Echinostelium

Barbeyella minutissima appears to have an ecological distribution that is limited to a substrate complex consisting of leafy liverworts growing over the surface of a decorticated spruce log in montane forests.

Clastoderma debaryanum


Echinostelium minutum


Echinostelium minutum
|←0.1 mm→|

Order Stemonitales

1. capillitium thread-like, usually dark and smooth
1. spores black or at least dark
2. fruiting bodies are mostly sporangia

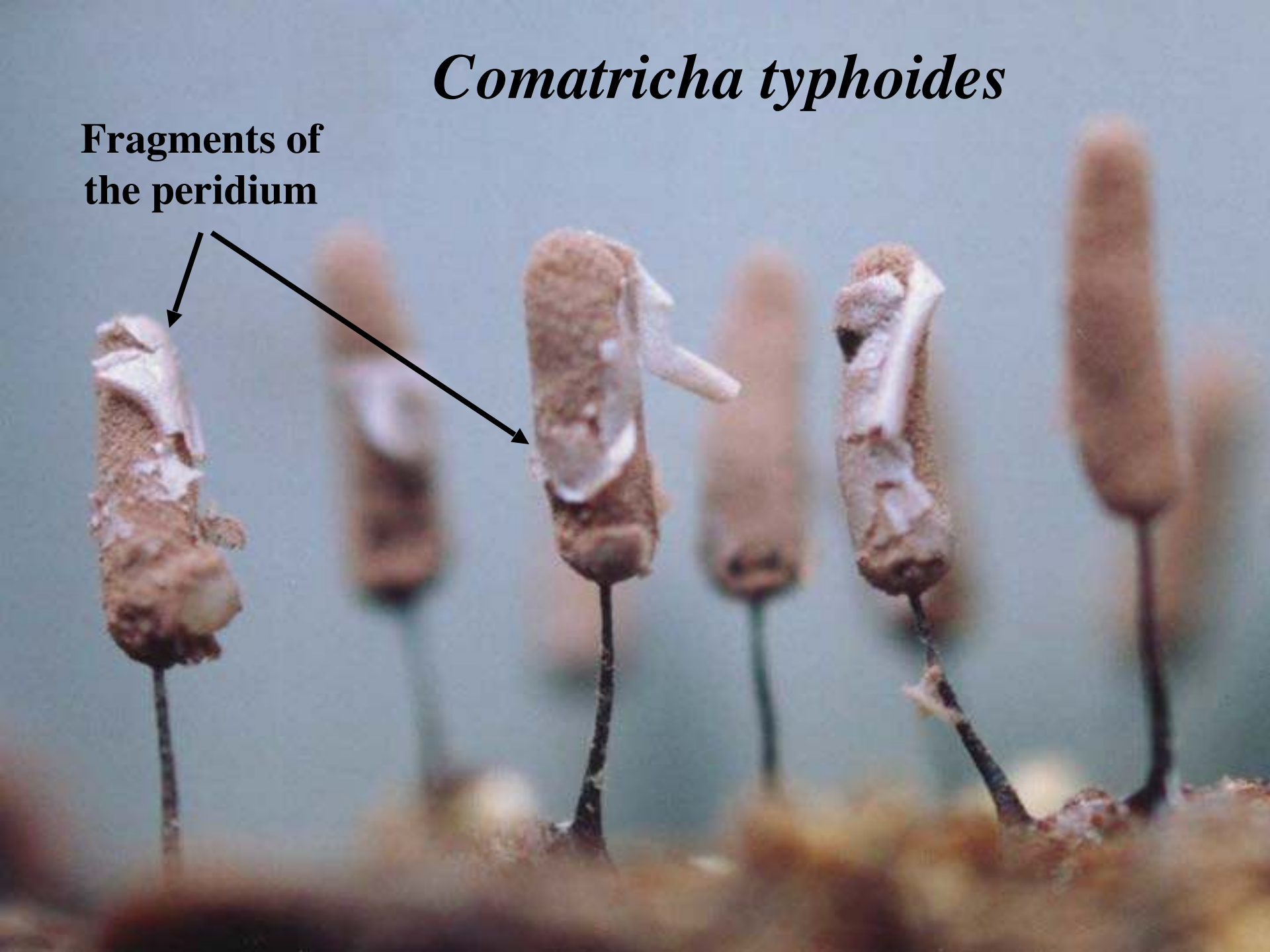
Order Stemonitales

Brefeldia
Colloderma
Comatricha
Enerthenema
Lamproderma
Macbrideola
Stemonitis

Brefeldia maxima


Colloderma oculatum

Comatricha typhoides



Comatrichia nigra


Enerthenema papillatum ©


Enerthenema papillatum


Lamproderma arcyrionema


Lamproderma columbinum

Lamproderma sp.

Lamproderma acyroides

L. ovoideum

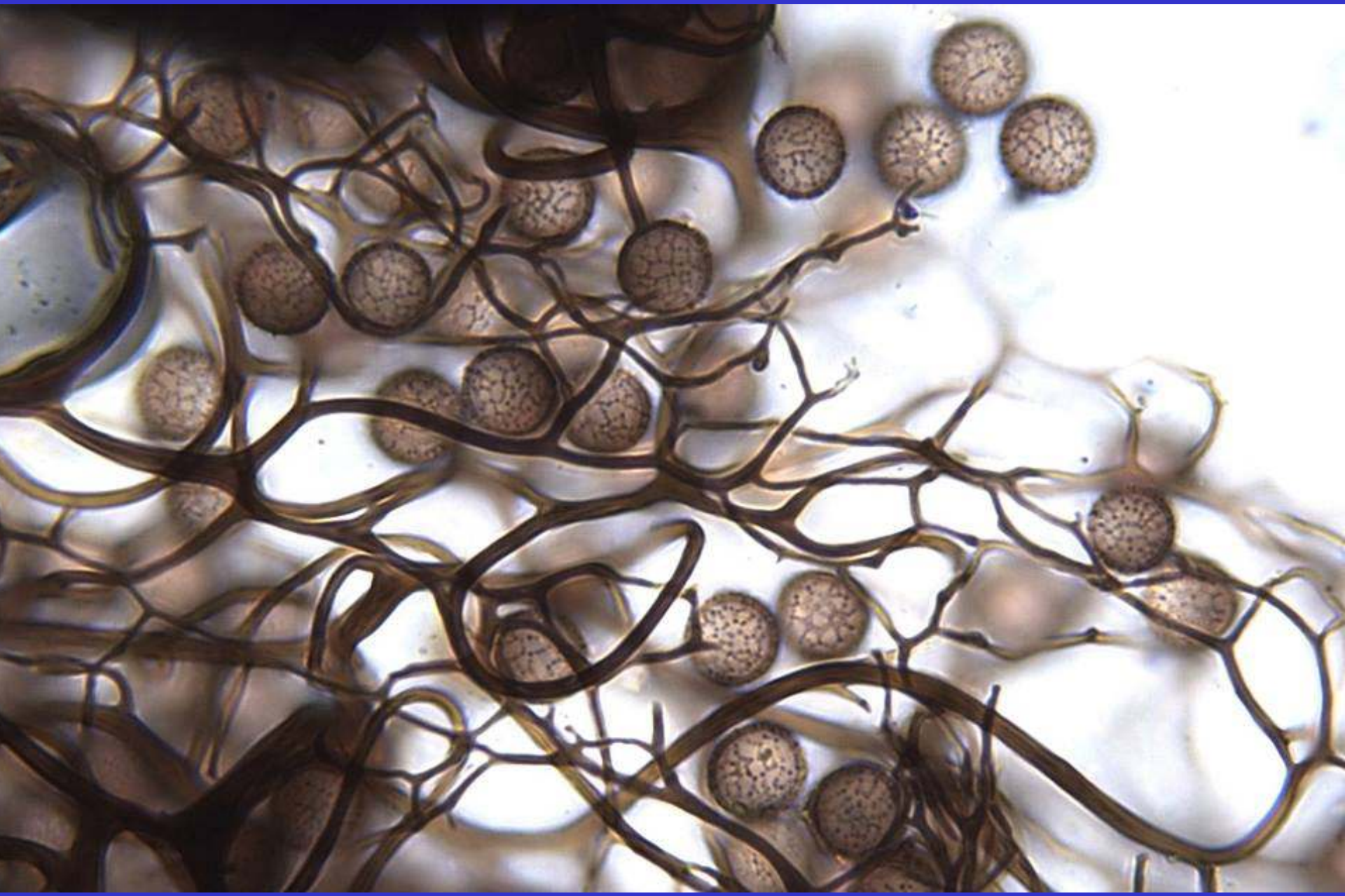
L. violaceum


Stemonitis axifera


Stemonitis splendens


Stemonitis fusca

Stemonitis fusca



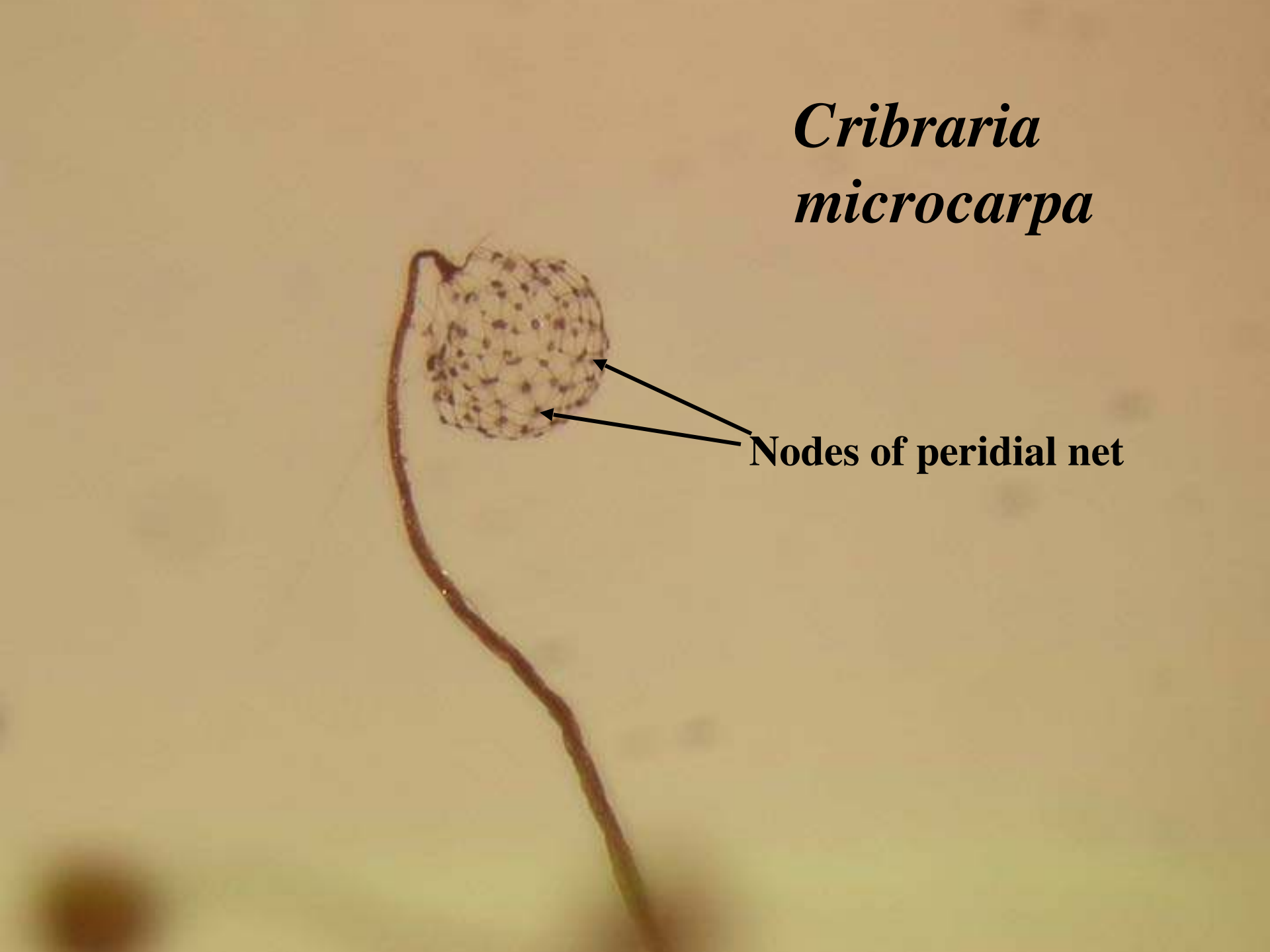
Order Liceales

1. no true capillitium
2. pseudocapillitium sometimes present
1. spores usually light colored

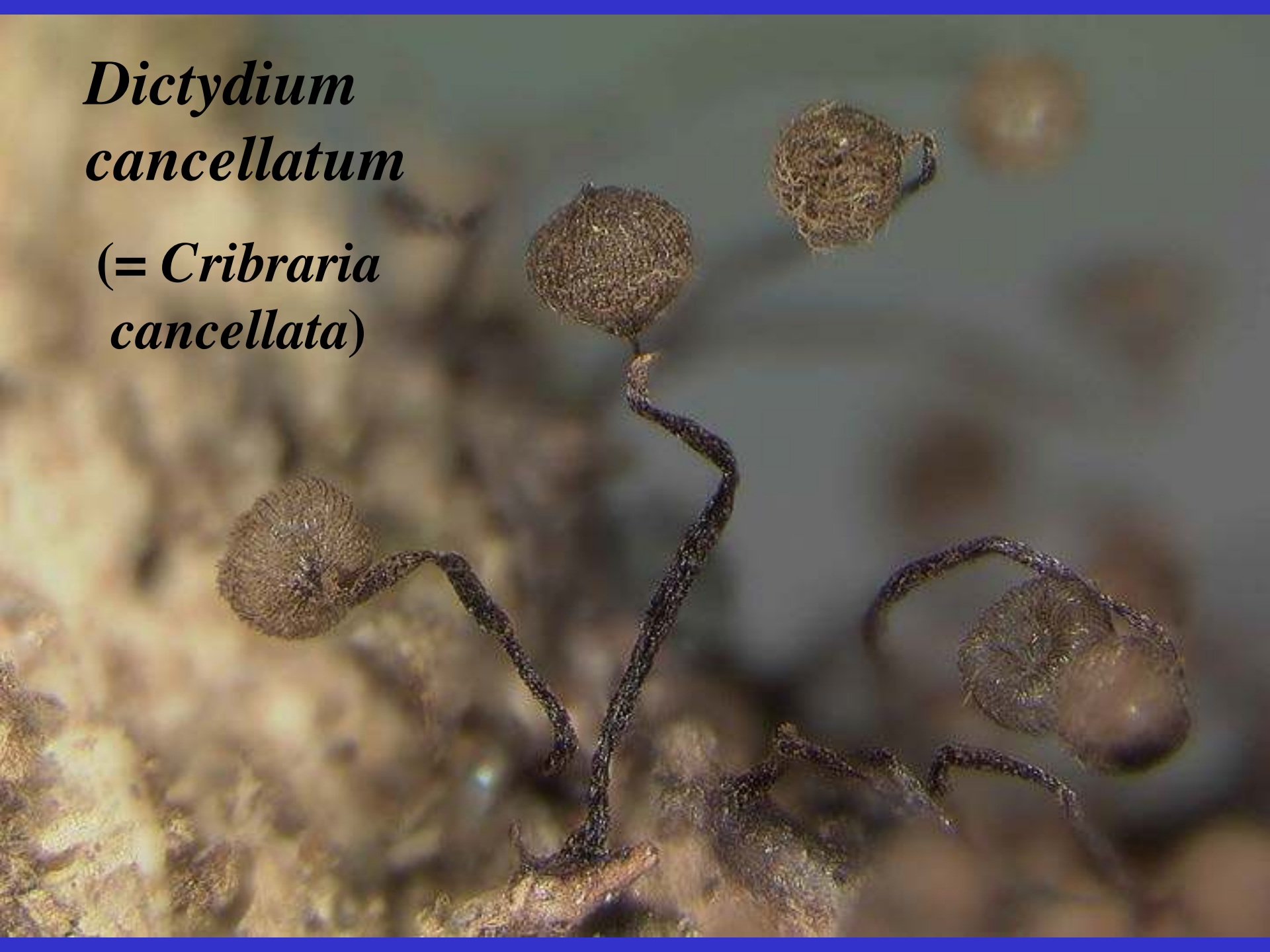
Order Liceales

Cribraria
Dictydiaethalium
Dictydium
Enteridium
Licea
Lycogala
Tubifera

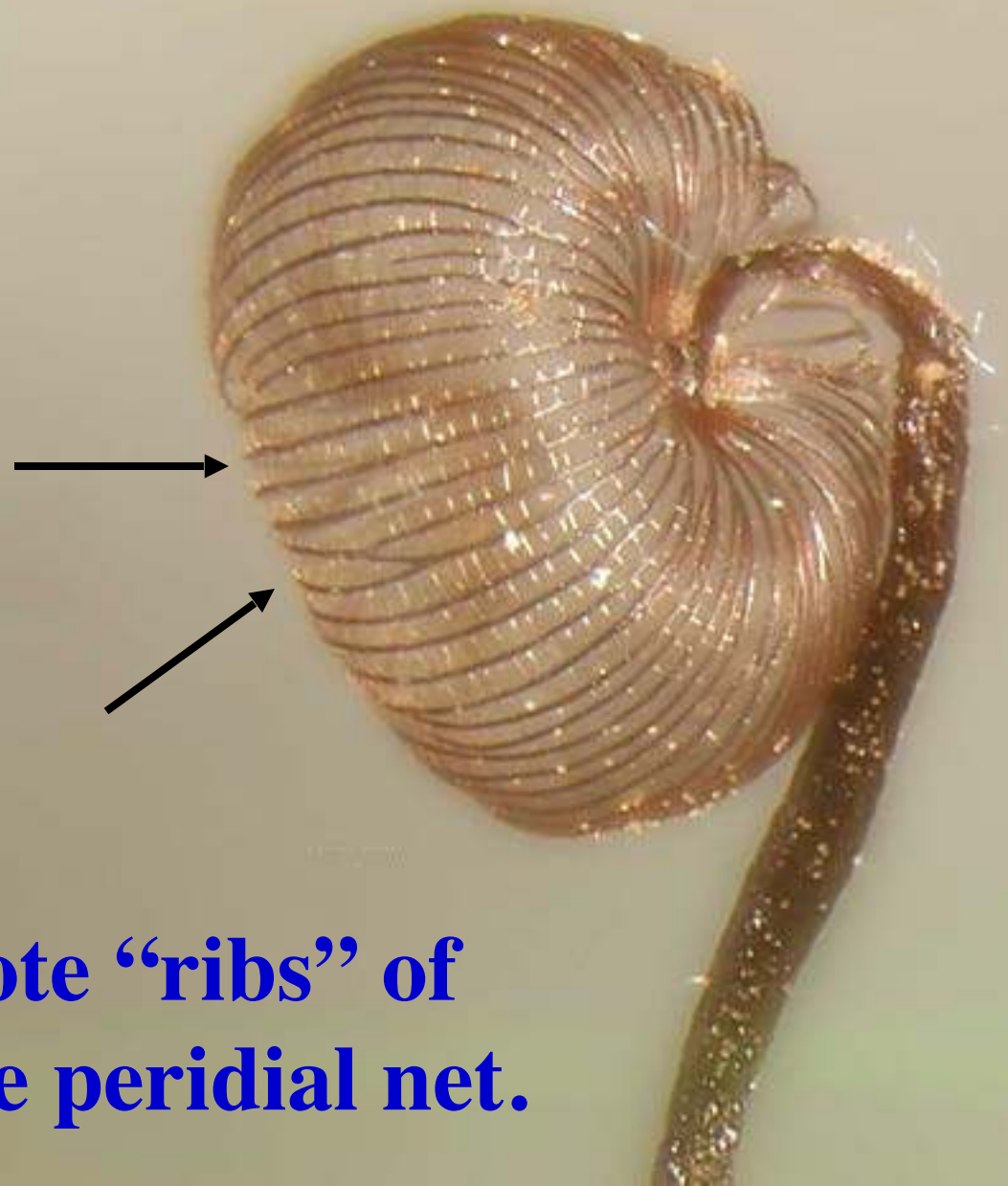
Cribraria microcarpa




Cribaria purpurea


Dictydium cancellatum
(= *Cribraria cancellata*)

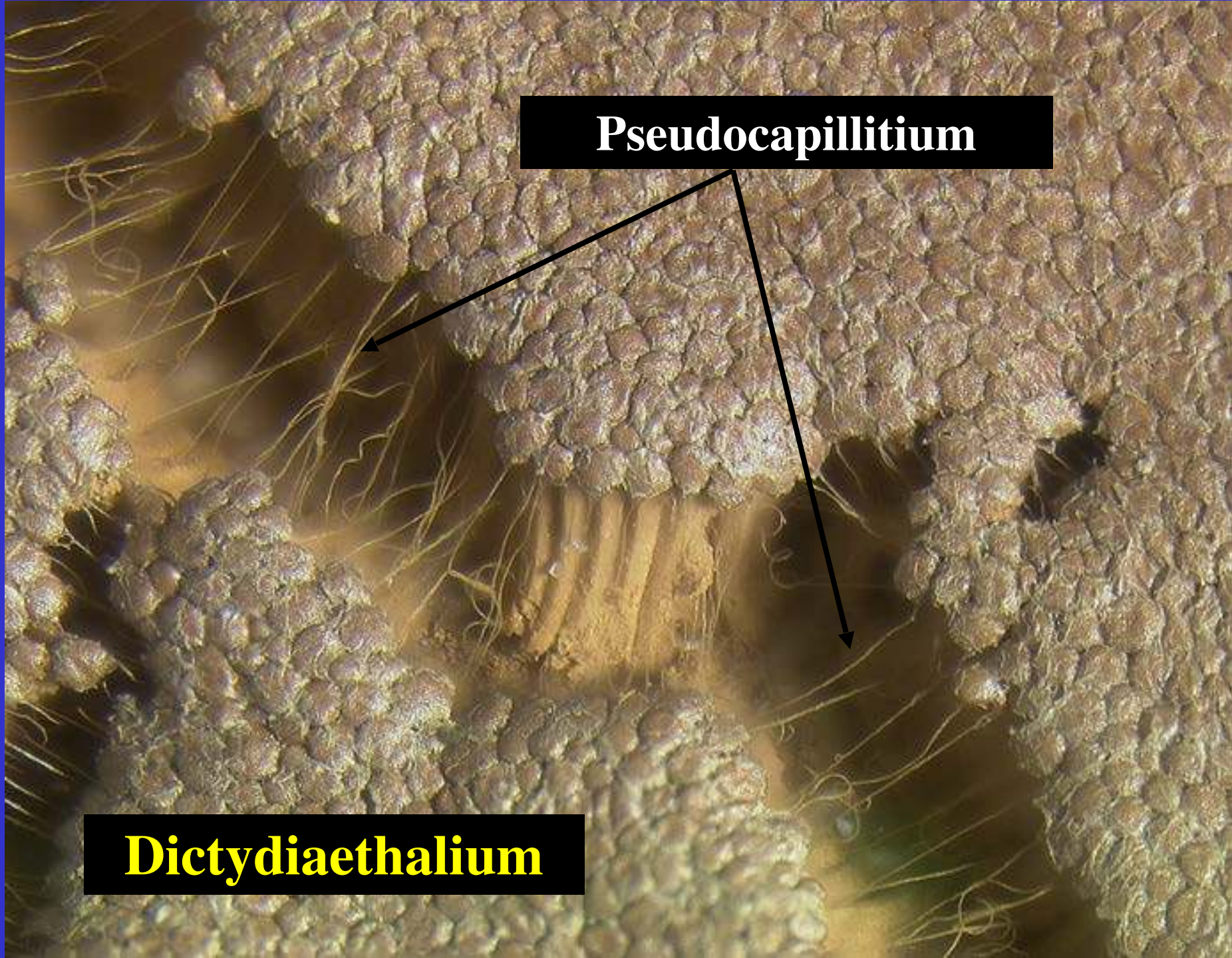
Sporotheca of *Dictydium cancellatum*



Note "ribs" of the peridial net.

Cribaria aurantiaca

Dictydiaethalium plumbeum


Pseudocapillitium
Dictydiaethalium


Licea biforis

Lycogala epidendrum (fresh) – Wolf's Milk slime


Lycogala epidendrum


Lycogala conicum

Tubifera ferruginosa – Red Raspberry slime


Tubifera
ferruginosa

Order Trichiales

1. columella never present
2. spores more or less brightly colored
1. capillitium thread-like, often sculptured

Order Trichiales

Arcyria
Calomyxa
Dianema
Hemitrichia
Metatrichia
Perichaena
Prototrichia

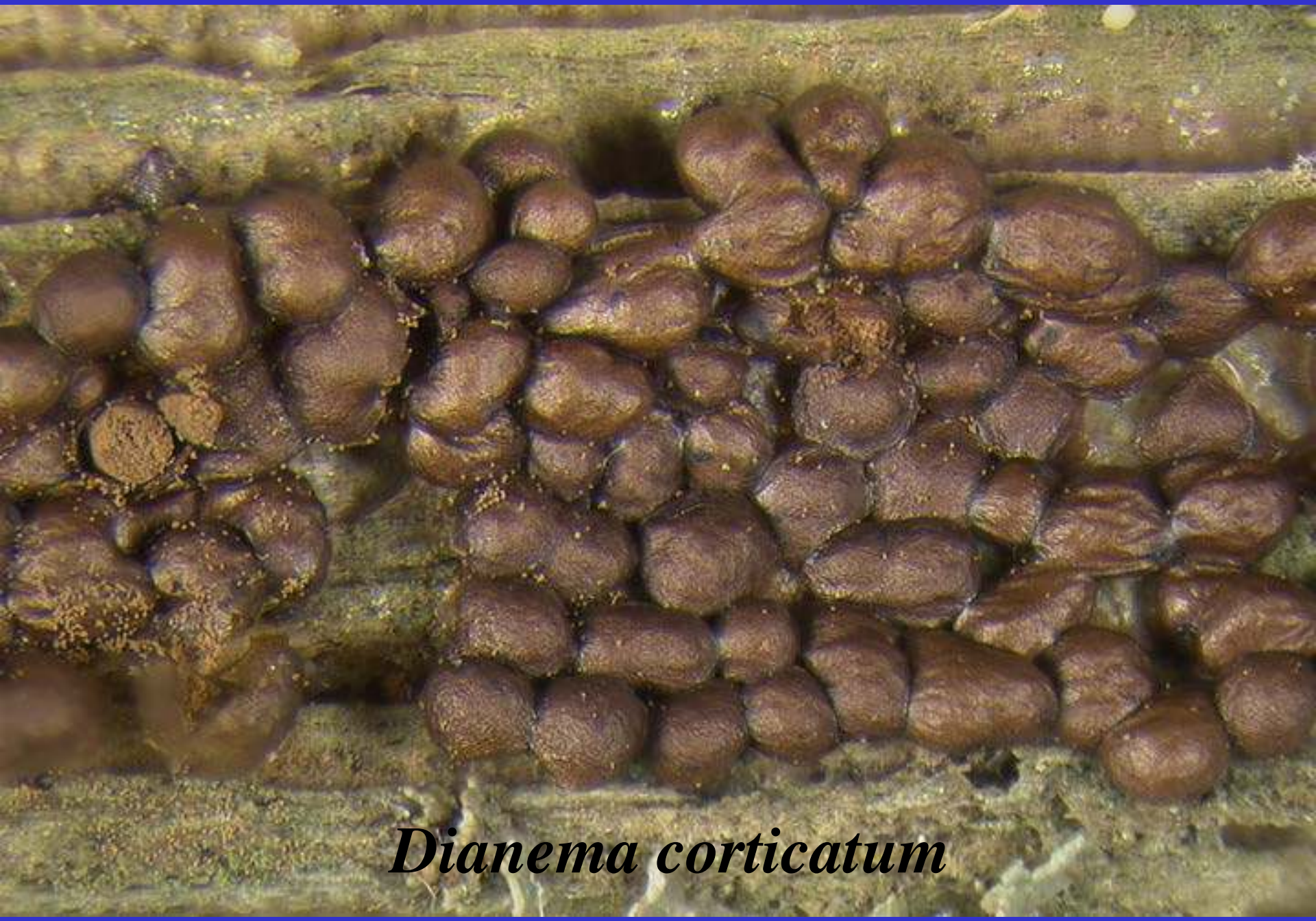
Arcyria cinerea

Arcyria denudata

Arcyria sp.

Arcyria nutans

Arcyria obvelata



Dianema corticatum

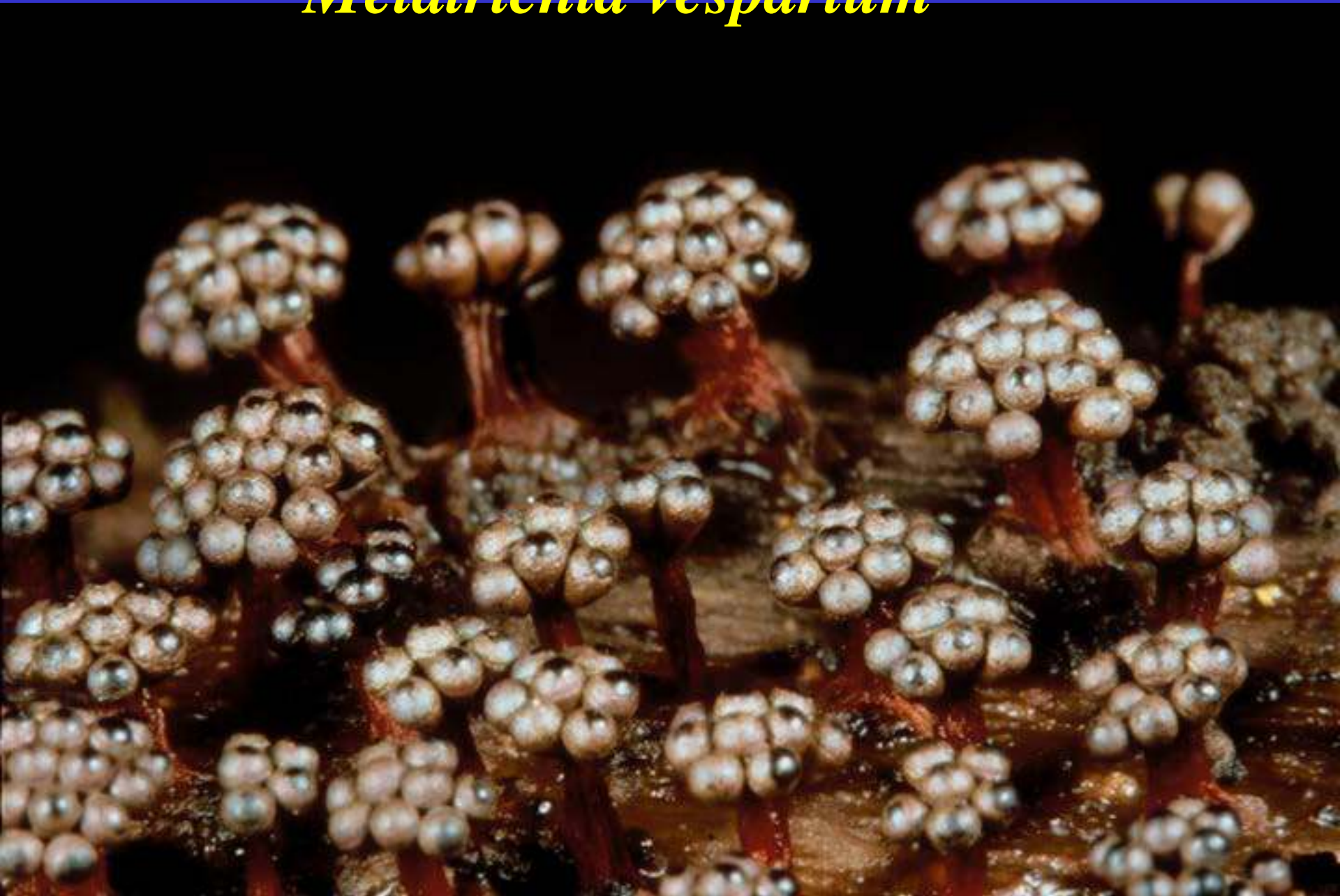
Hemitrichia calyculata

Hemitrichia serpula

courtesy of J.J. Hamrick


Hemitrichia serpula

Metatrichia vesparium



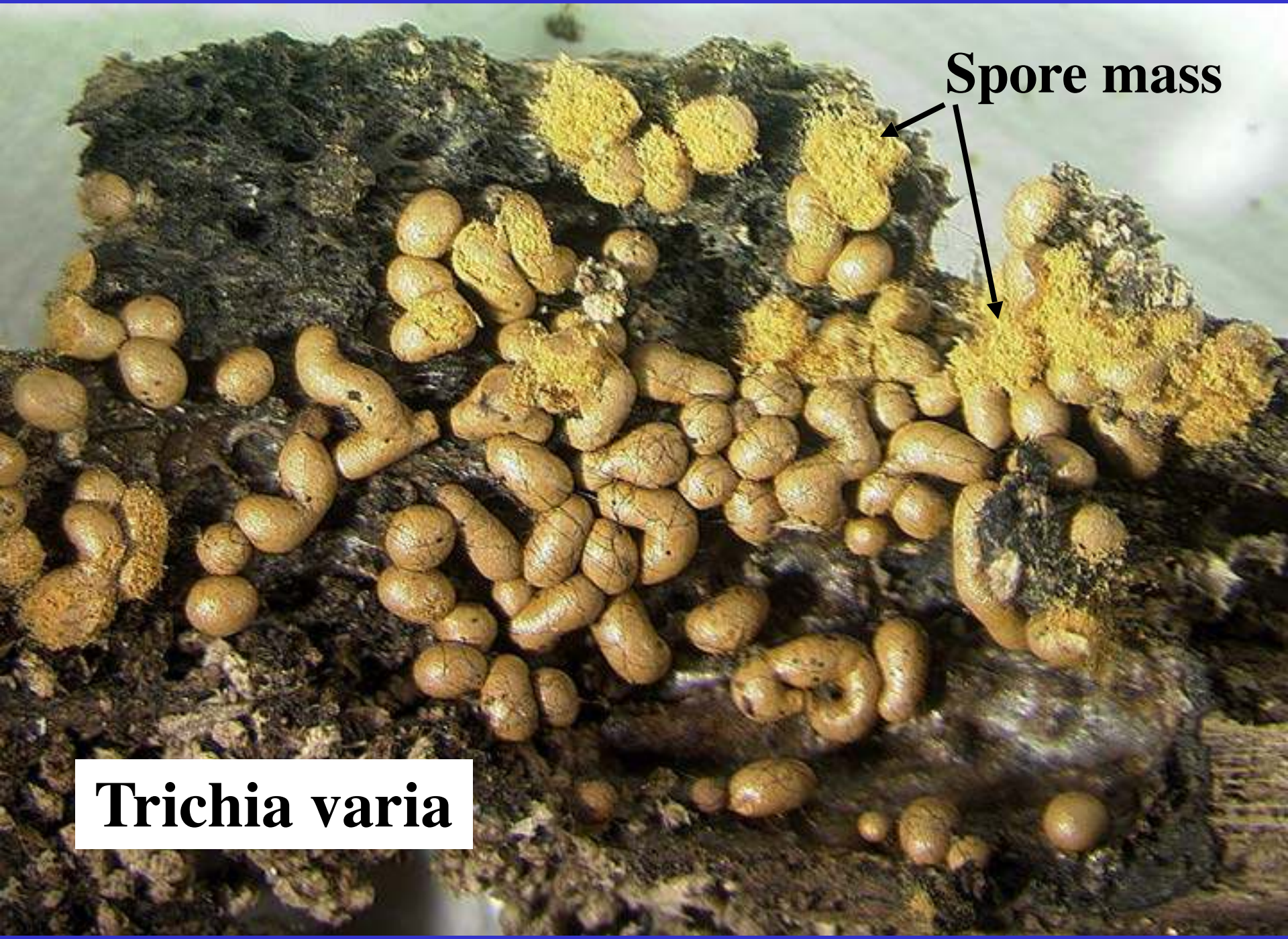

Metatrichia vesparium


Perichaena chrysosperma

Perichaena depressa


Perichaena minor

Prototrichia metallica


Spore mass
Trichia varia


Trichia decipiens

Order Physarales

1. lime present in some part of the fruiting body
1. spores always dark in mass
2. phaneroplasmodium

Order Physarales
Family Didymiaceae

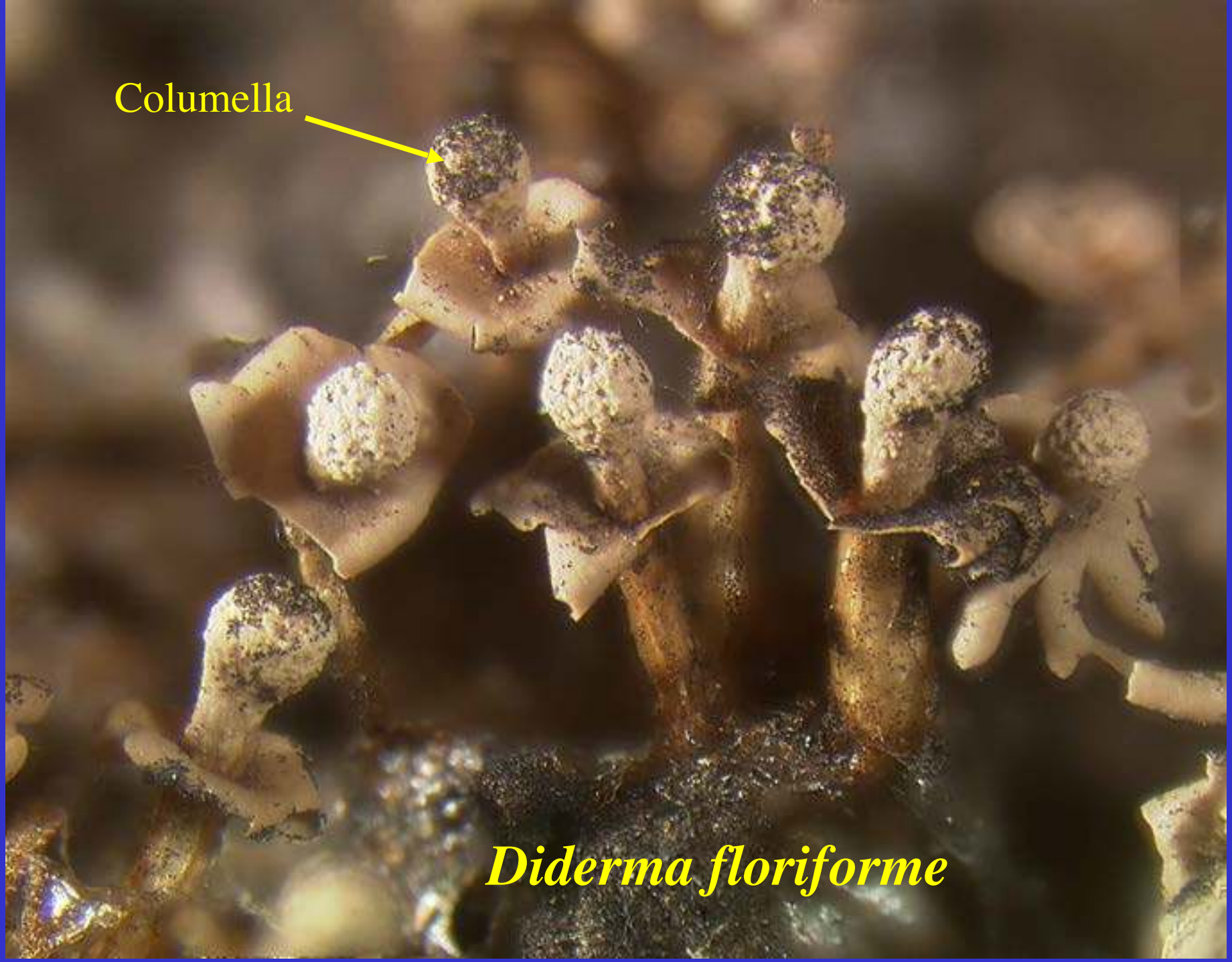
Diachea
Diderma
Didymium
Lepidoderma
Mucilago

Diachea leucopodia

Diachea leucopodia

D. leucopodia


Diderma effusum


Columella
Diderma floriforme

Diderma niveum

Didymium nigripes

Diderma hemisphaericum


Lepidoderma tigrinum

Lepidoderma tigrinum

Lepidoderma sp. Opened up

Mucilago crustacea

Order Physarales
Family Physaraceae

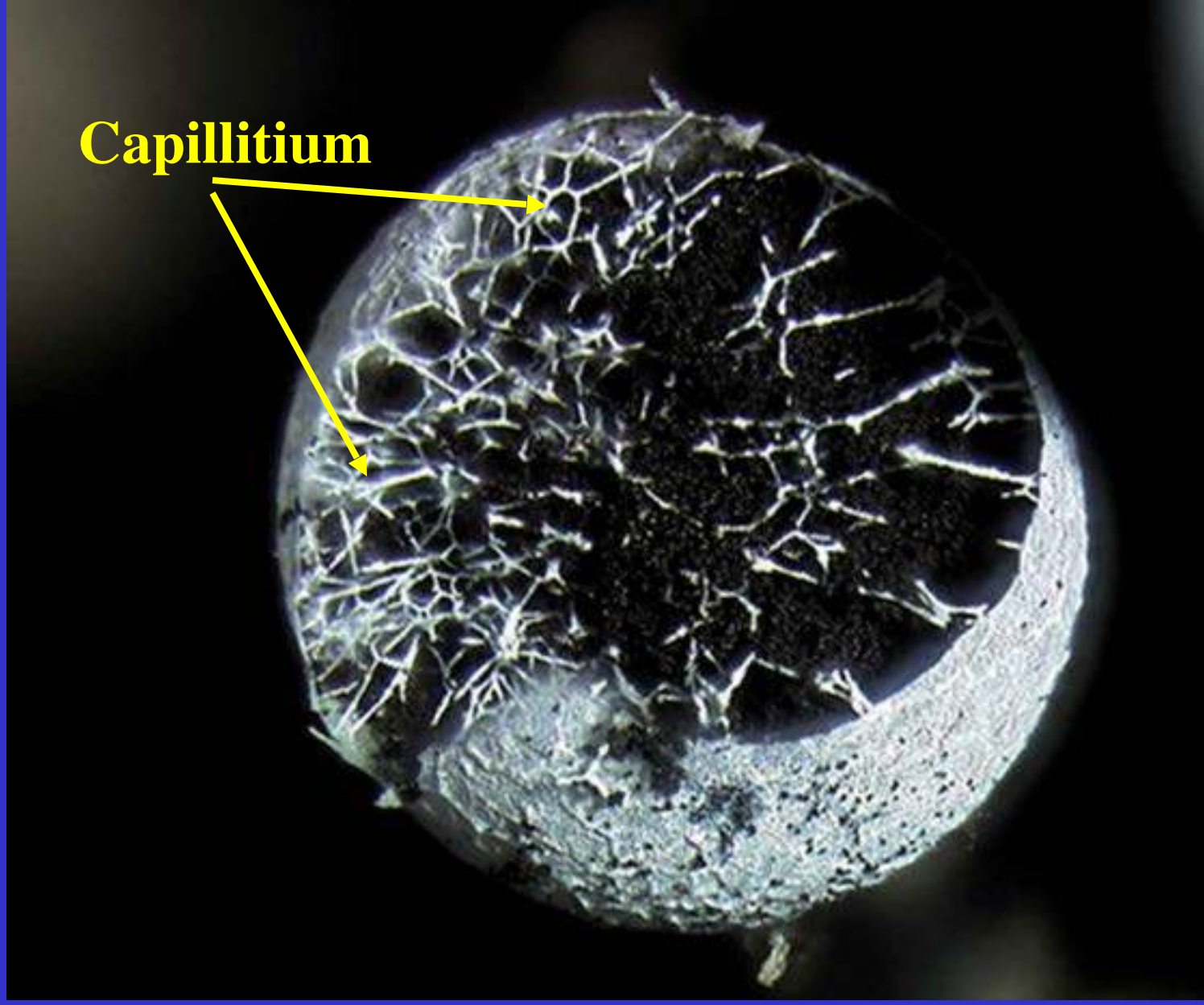
Badhamia
Craterium
Fuligo
Leocarpus
Physarella
Physarum
Willkommlangea

Badhamia utricularis

Badhamia utricularis

Note the long, thin, weak stalks.

In this genus the capillitium consists of a system of calcareous tubes.



Capillitium of *Badhamia utricularis*

Craterium minutum


Craterium minutum

Craterium minutum

Note the lime nodes (arrows) in the capillitium of *Craterium leucocephalum*.

Fuligo septica

Fuligo septica


Leocarpus fragilis

Leocarpus fragilis

Physarum melleum


Physarum melleum


Physarum viride


Physarum viride

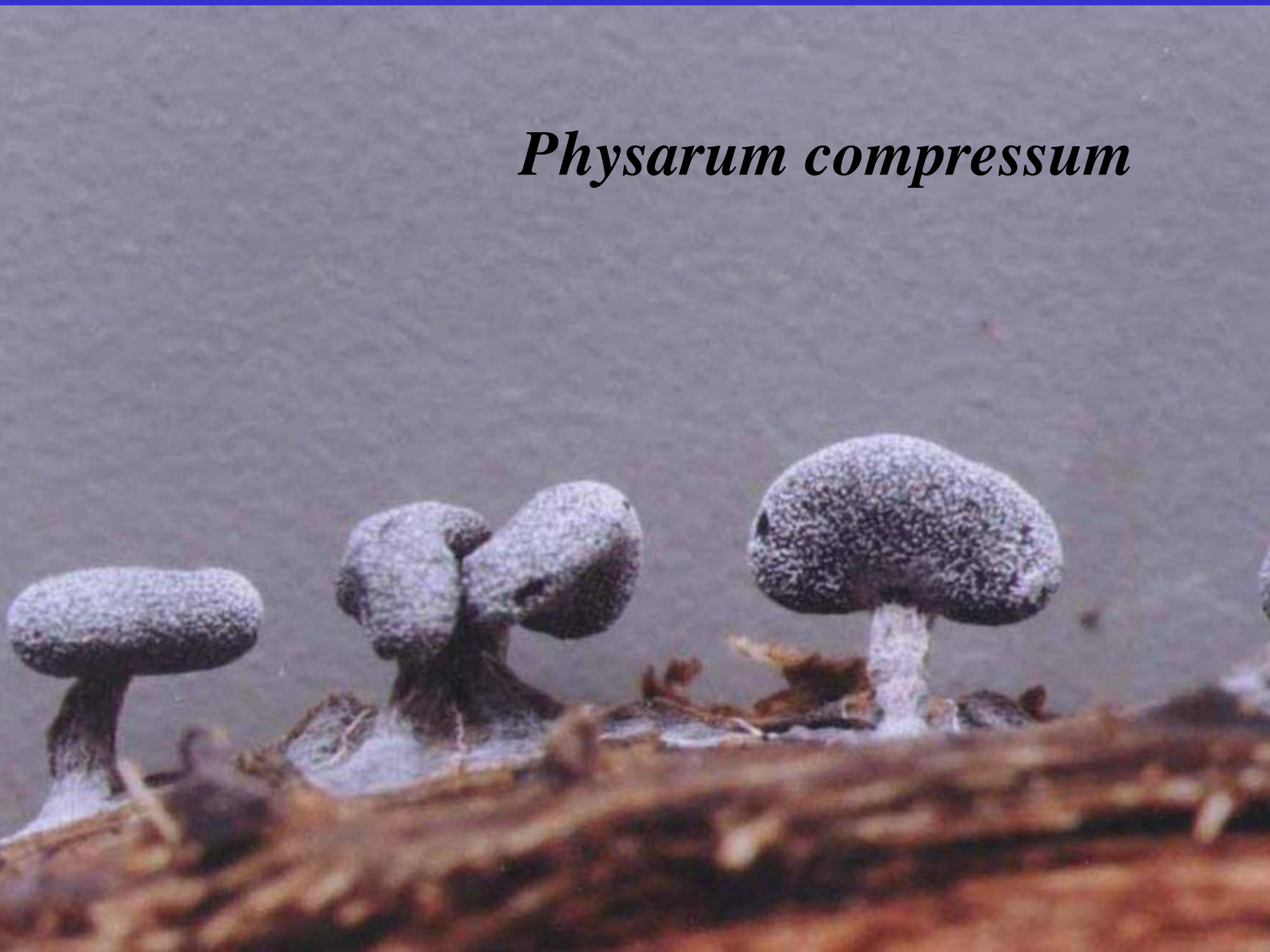
Physarum viride

- *Physarum leucophaeum*

Physarum leucopus

Physarum cinereum


Physarum hongkongense


Physarum compressum

Willkommlangea reticulata

Primary Microhabitats

- Coarse woody debris
- Ground litter
- Bark surface of living trees
- Dung, soil, and aerial litter


Coarse woody debris


Ground litter


Bark surface of living trees


Aerial litter

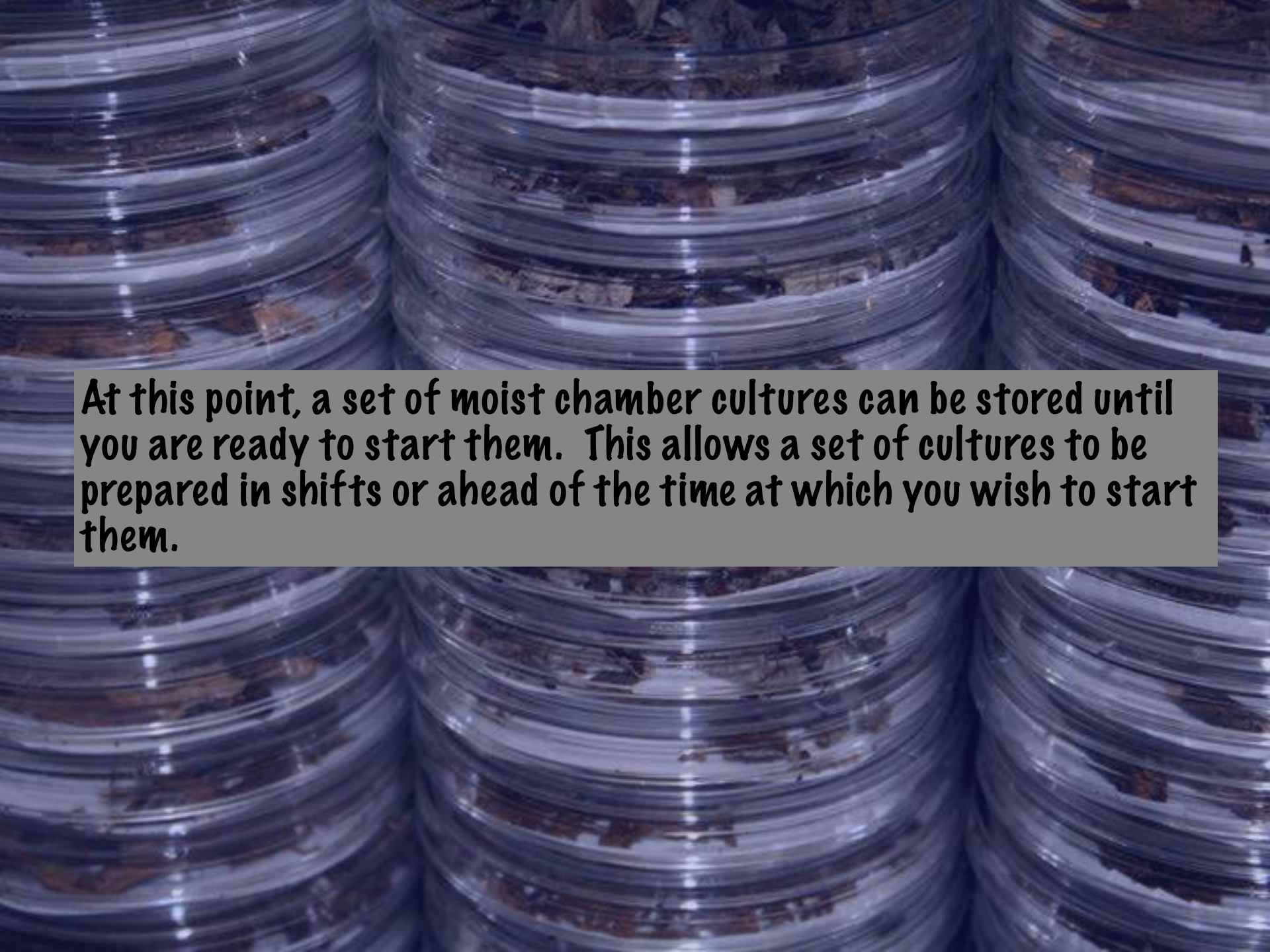
The moist chamber culture technique is often used to study the myxomycetes associated with such microhabitats as the bark surface of living trees, ground litter, and aerial litter.

Moist chamber culture prepared with a sample of ground litter.

Fill each Petri dish with a piece of filter paper. (Notice the paper doesn't exactly fit--that's o.k.)

The next step is to fill the dish with substrate material. Try for a single layer of material in the bottom of the dish.

Too much substrate will make searching for plasmodium and fruiting bodies difficult. Some think that too much material will also hinder fruiting.



At this point, a set of moist chamber cultures can be stored until you are ready to start them. This allows a set of cultures to be prepared in shifts or ahead of the time at which you wish to start them.

When you are ready to start or 'wet' the cultures, have sterile or deionized water available.

Enough water to cover the material (approx 20 mL) is added to the dish. (See arrow for an approximation of the water level)

The water level is necessary to soak the material and to provide substance for the probe of the pH meter.

Soak the material for 24 hours. There should be standing water remaining in the dish after this time.

After 24 hours, pH the sample using the remaining liquid. Our pH meter has an external probe that can be placed into the dish.

Once the pH of the sample is recorded, pour off excess water.

Check the plates using a dissecting microscope. Pull out any fruiting bodies and prepare for herbarium storage.

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