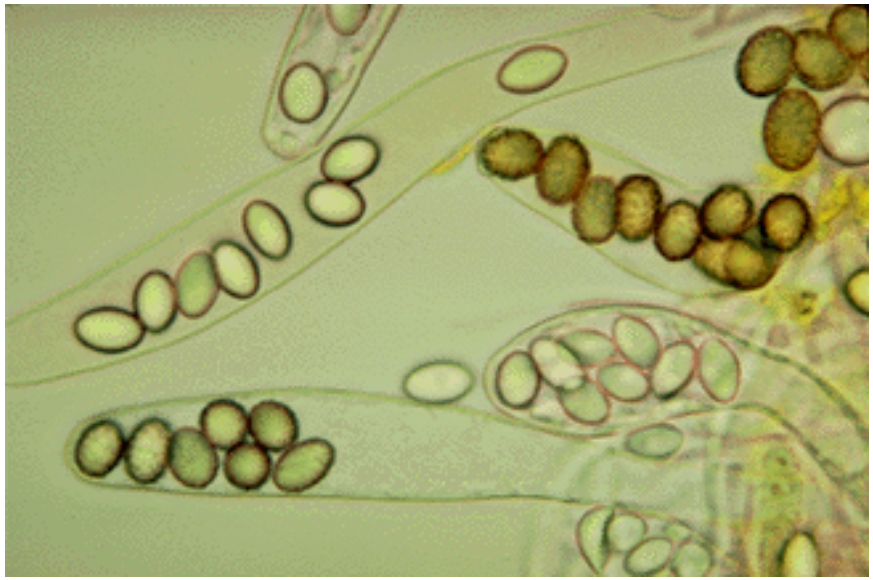
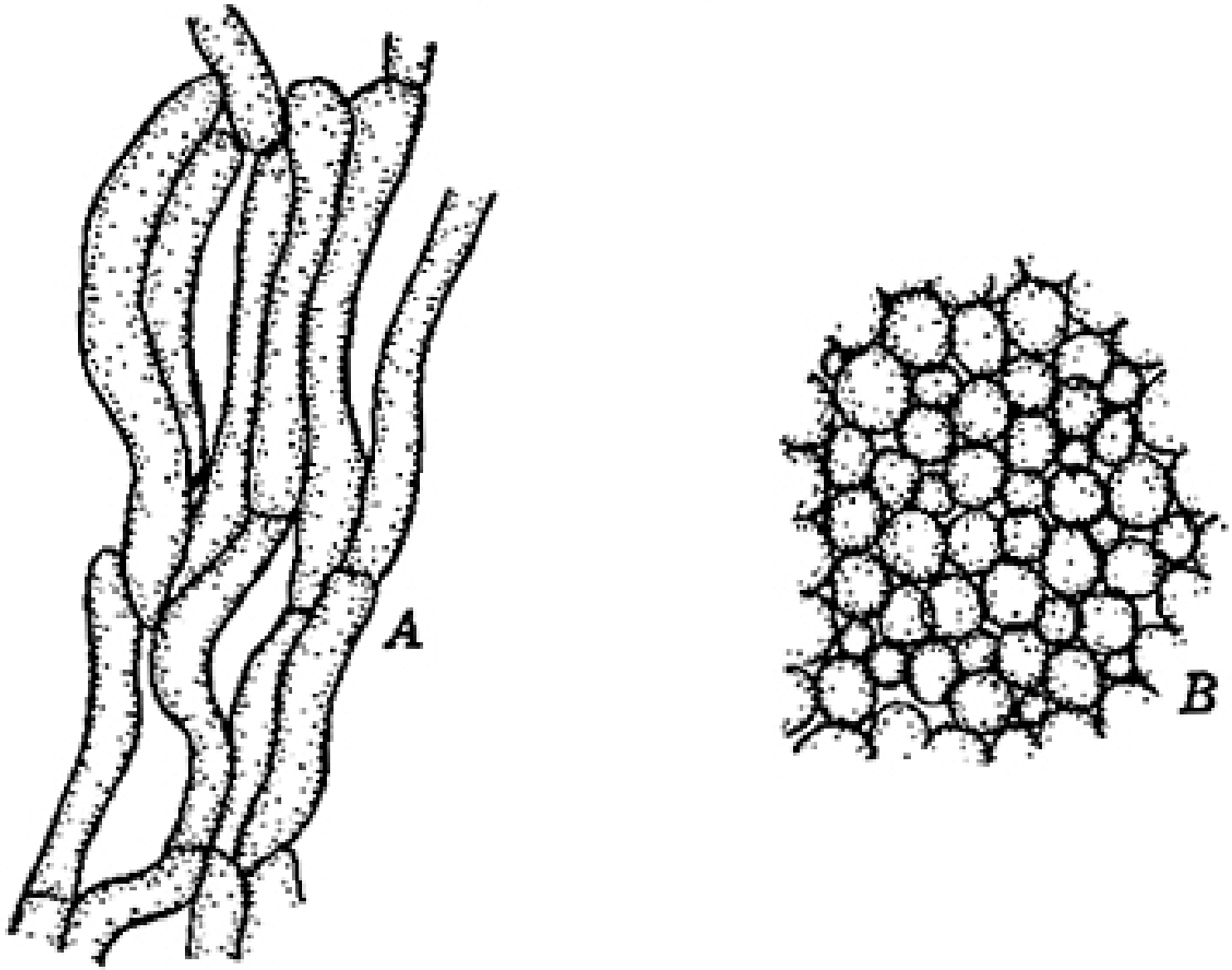
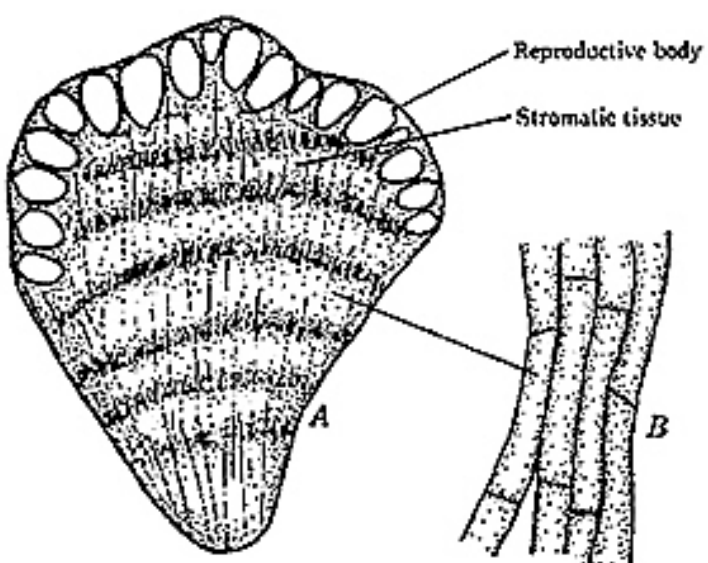




Fungal tissues (plectenchyma). *A*. Prosenchyma. *B*. Pseudoparenchyma.

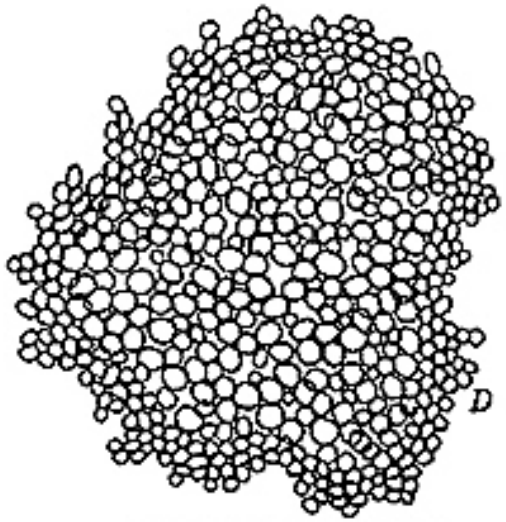
Redrawn & revised from Alexopoulos (1952)



Section through a stroma

Structural detail

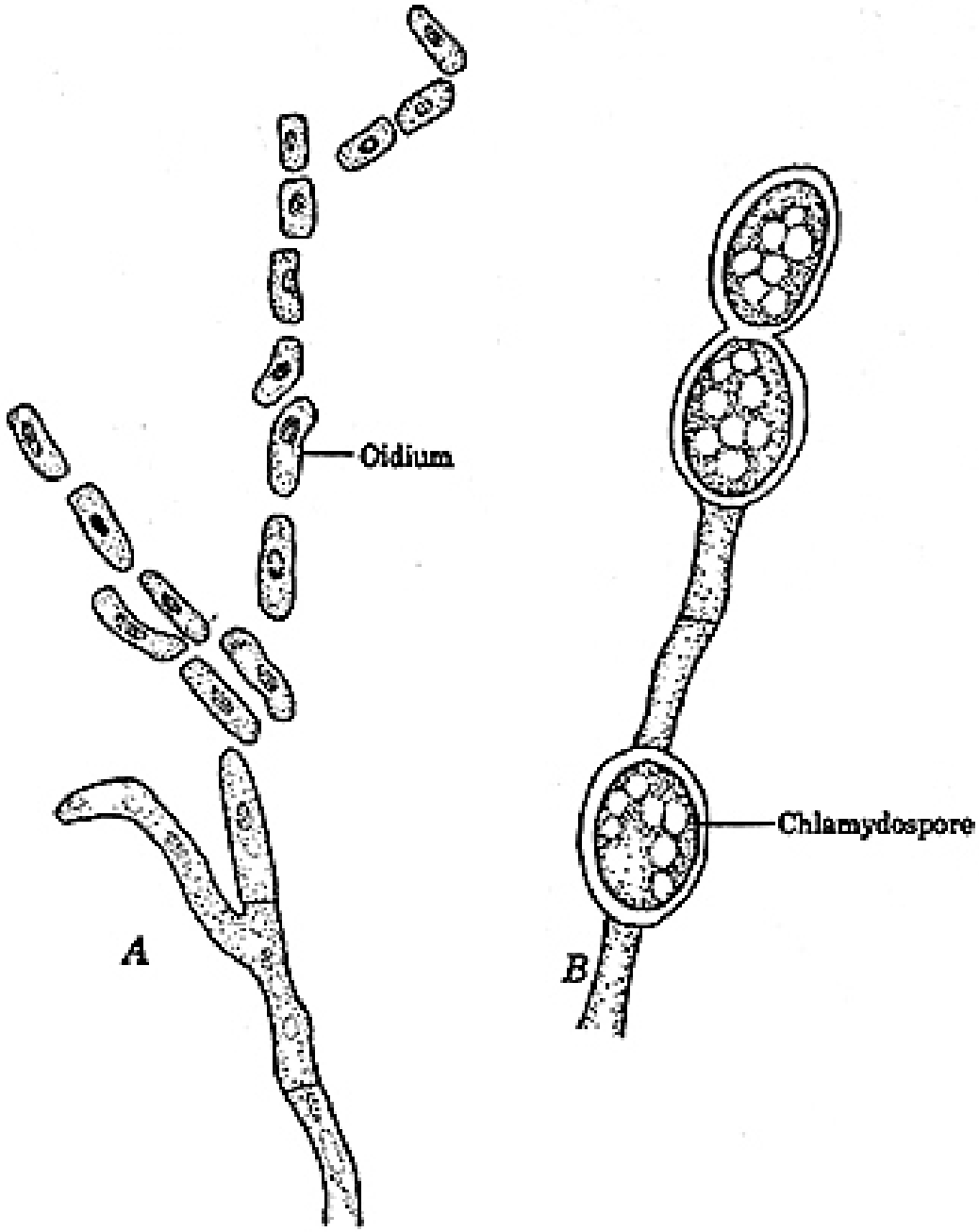
Sclerotium



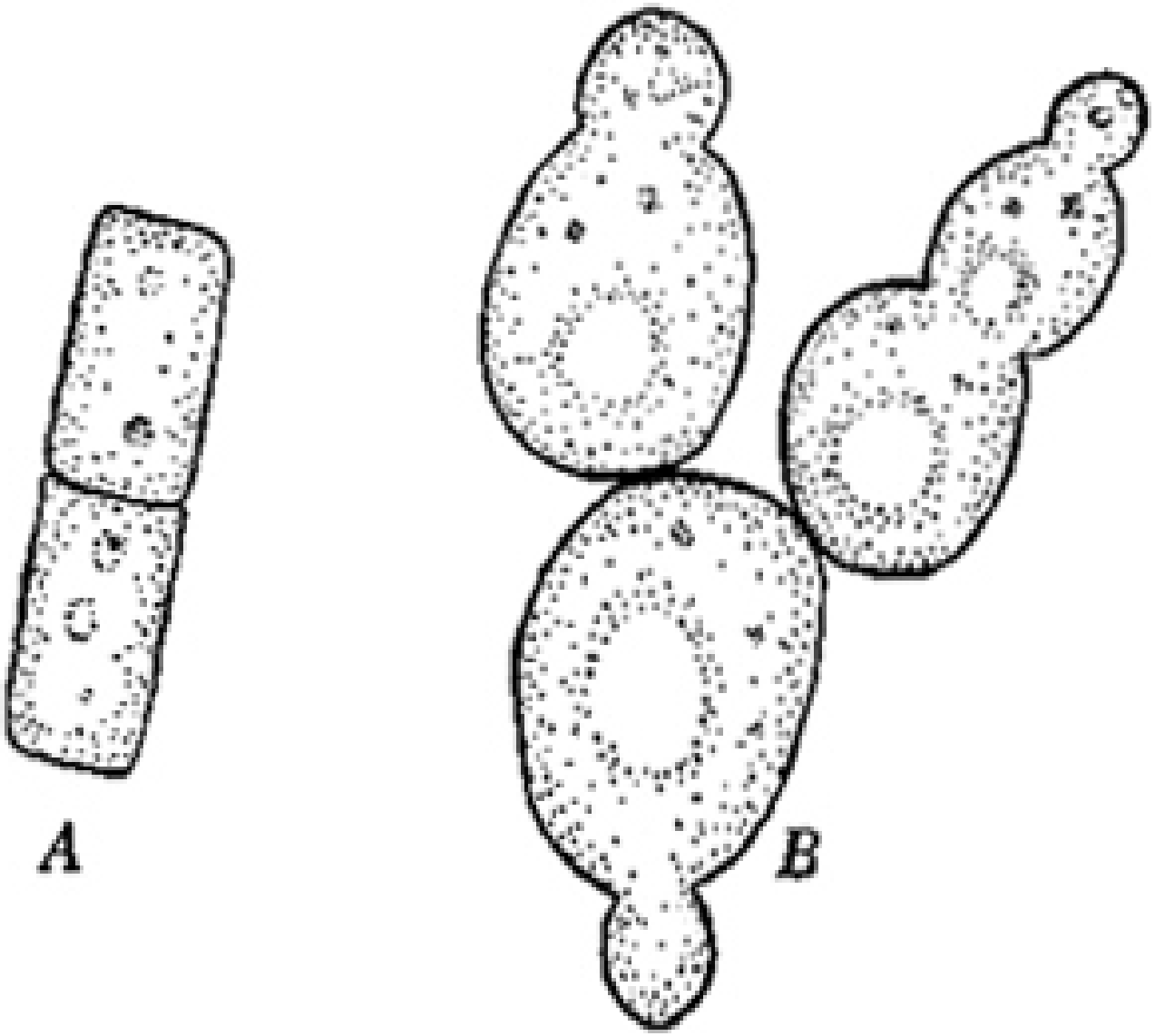
Cross section of sclerotium

Stroma and sclerotium. *A, B. Daldinia* sp. *C, D. Claviceps purpurea* (Fr.) Tul.

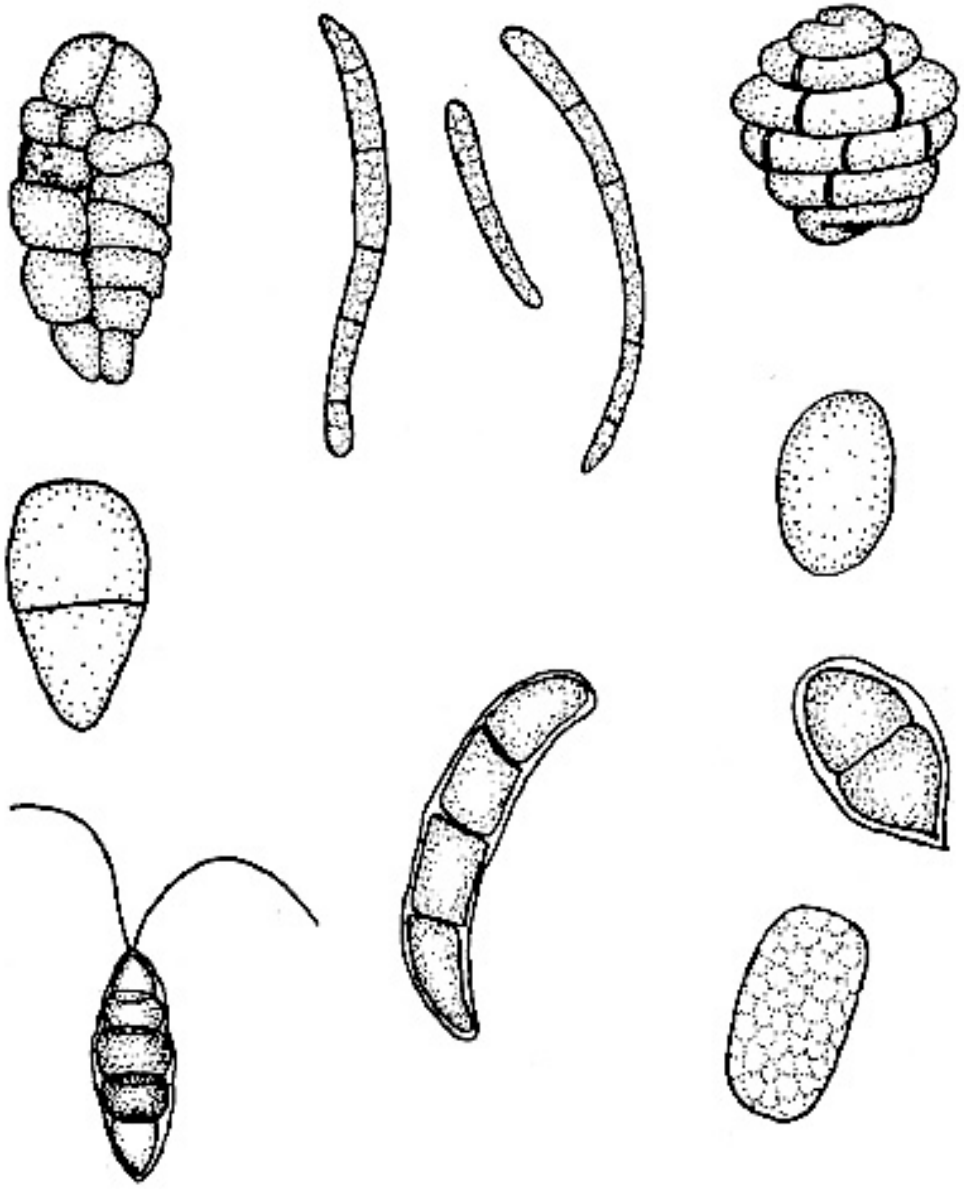
Redrawn & revised from Alexopoulos (1952)



Asexual reproduction. *A*. Hypha fragmenting into oidia. [*Collybia conigena* (Pers.) Quélet.] *B*. Chlamydospores (*Fusarium* sp.).

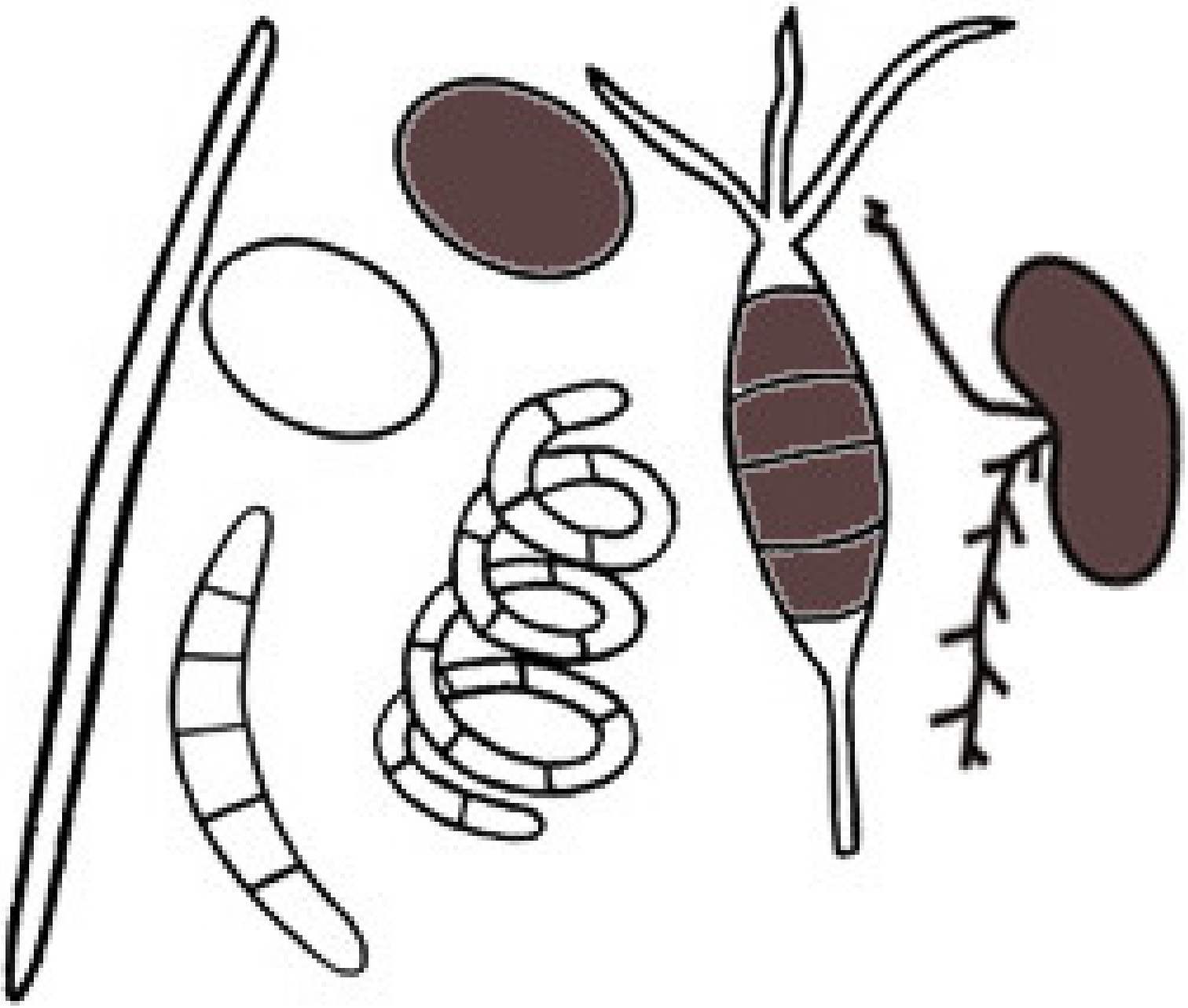


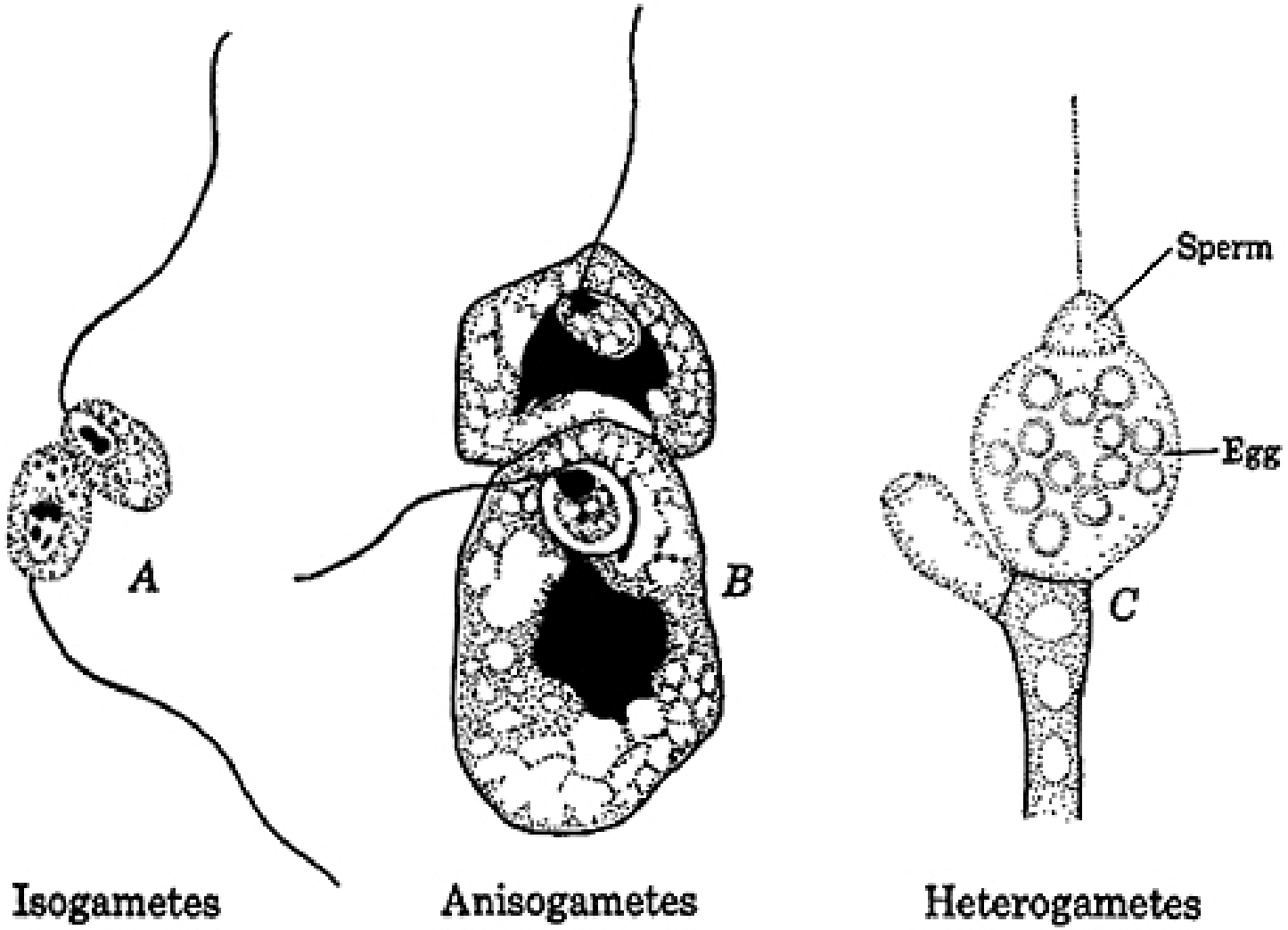
Asexual reproduction. *A*. Transverse cell division. *B*. Budding.



Asexual reproduction. Various types of fungal spores.

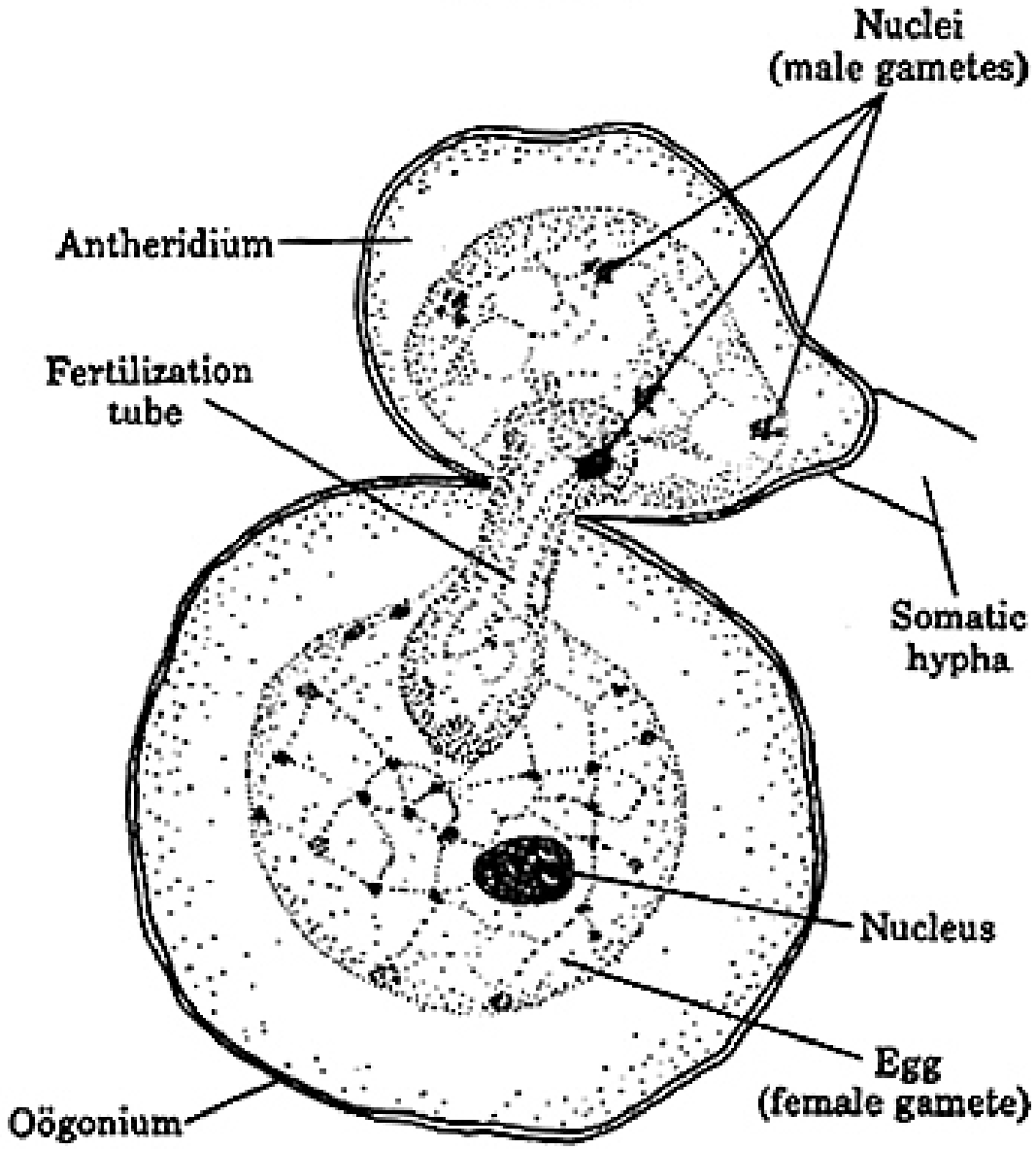
Redrawn & revised from Alexopoulos (1952)





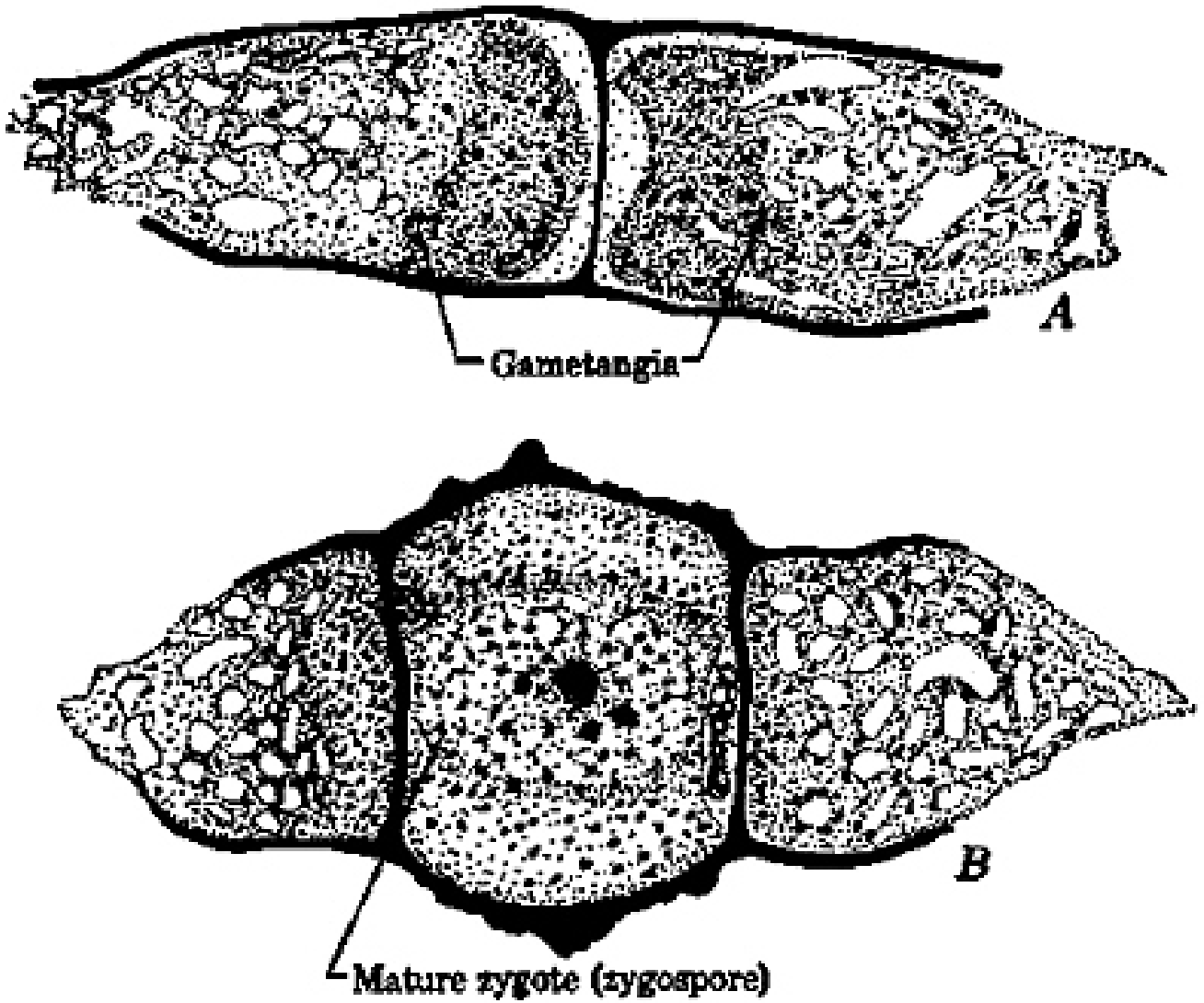
Sexual reproduction. Planogametic copulation. *A. Catenaria* sp. *B. Allomyces arbuscula*. *C. Monoblepharella taylori*.

A, redrawn from Karling, 1934, Mycologia, 26:528–542; *B*, redrawn from Hatch, 1938, Ann. Bot., n.s., 2:583–614; *C*, redrawn from Miss Springer, 1945, Am. Jr. Bot., 32:259–269.



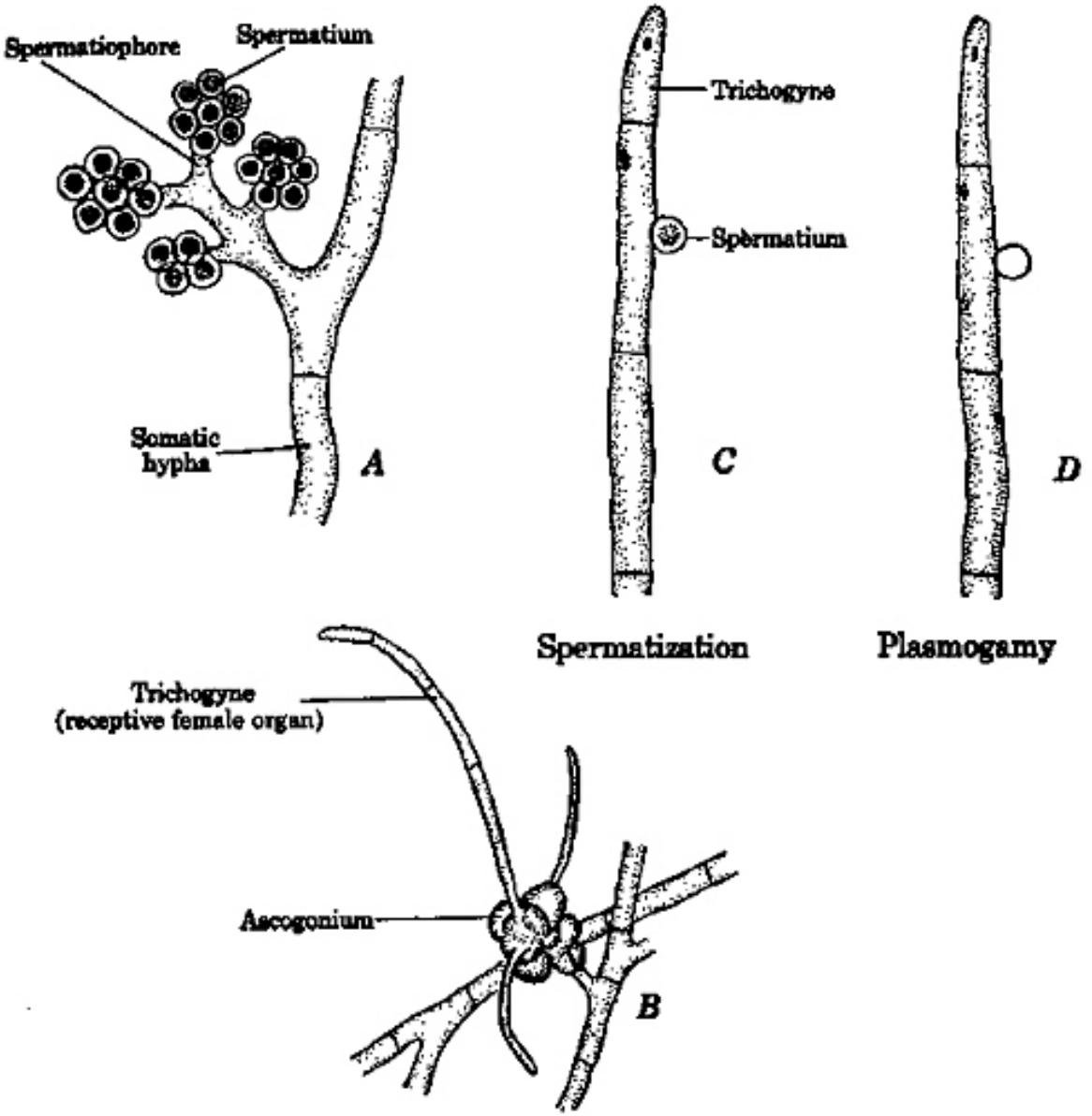
Sexual reproduction. Plasmogamy through gametangial contact in *Pythium aphanidermatum* (Edson) Fitzpatrick.

Redrawn from Edson, 1915, Jr. Agr. Res., 4:279–292.

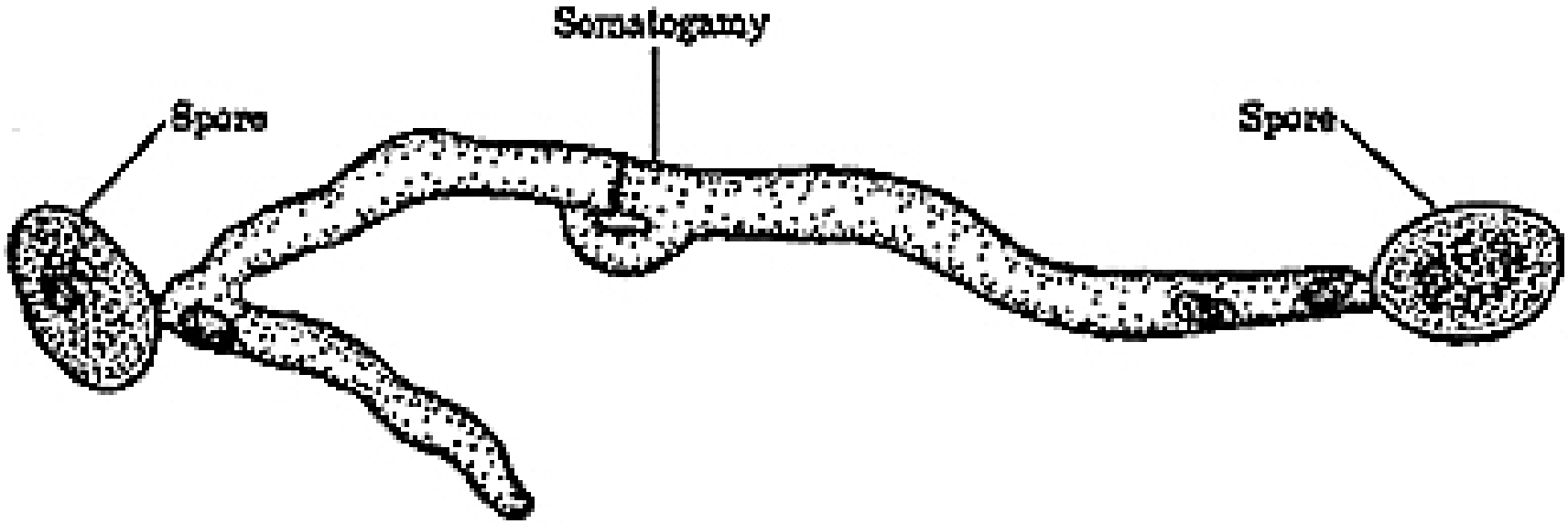


Sexual reproduction. Plasmogamy through gametangial copulation in *Sporodinia grandis* Link.

Redrawn from Miss Keene, 1914, Ann. Bot., 28:455-470.



Sexual reproduction by spermatization



Sexual reproduction. Plasmogamy through somatogamy in *Peniophora sambuci* (Pers.) Burt.

Redrawn from Lehfeldt, 1923, Hedwigia, 64:30–51.

PHYLUM CHYTRIDIOMYCOTA

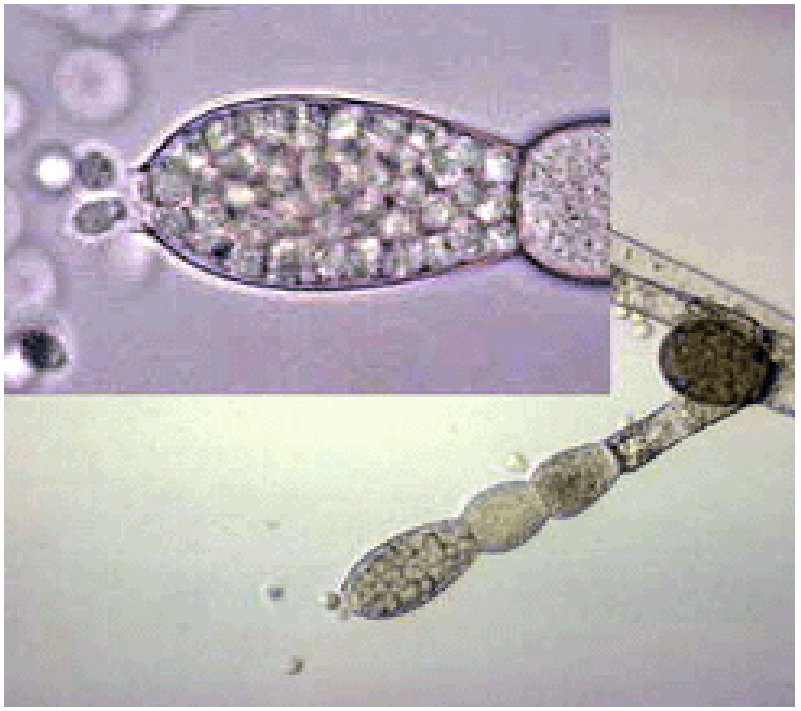
Class Chytridiomycetes

Order Chytridiales eg *Olpidium, Synchytrium*

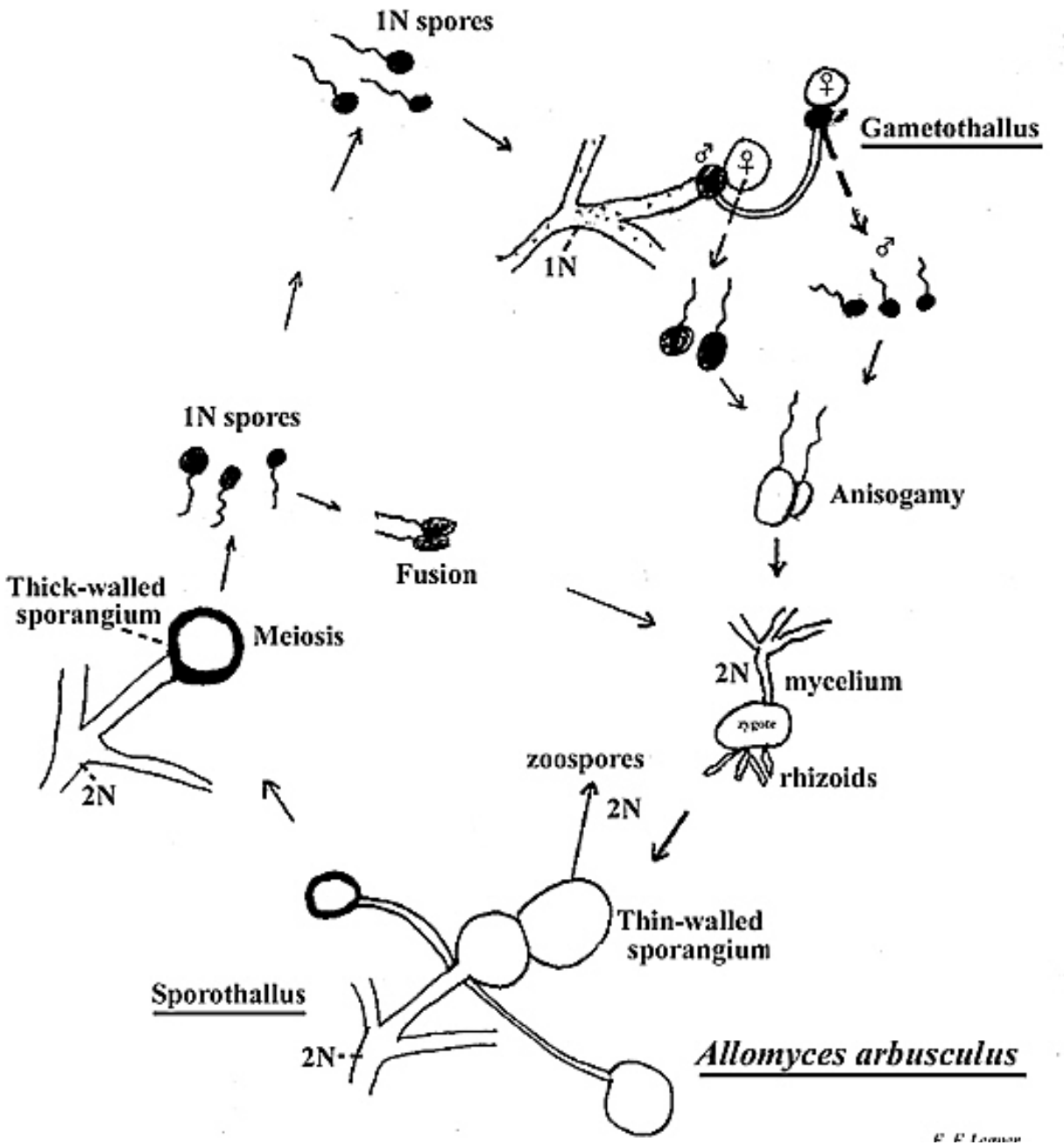
Order Blastocladiales eg *Allomyces, Coelomomyces*

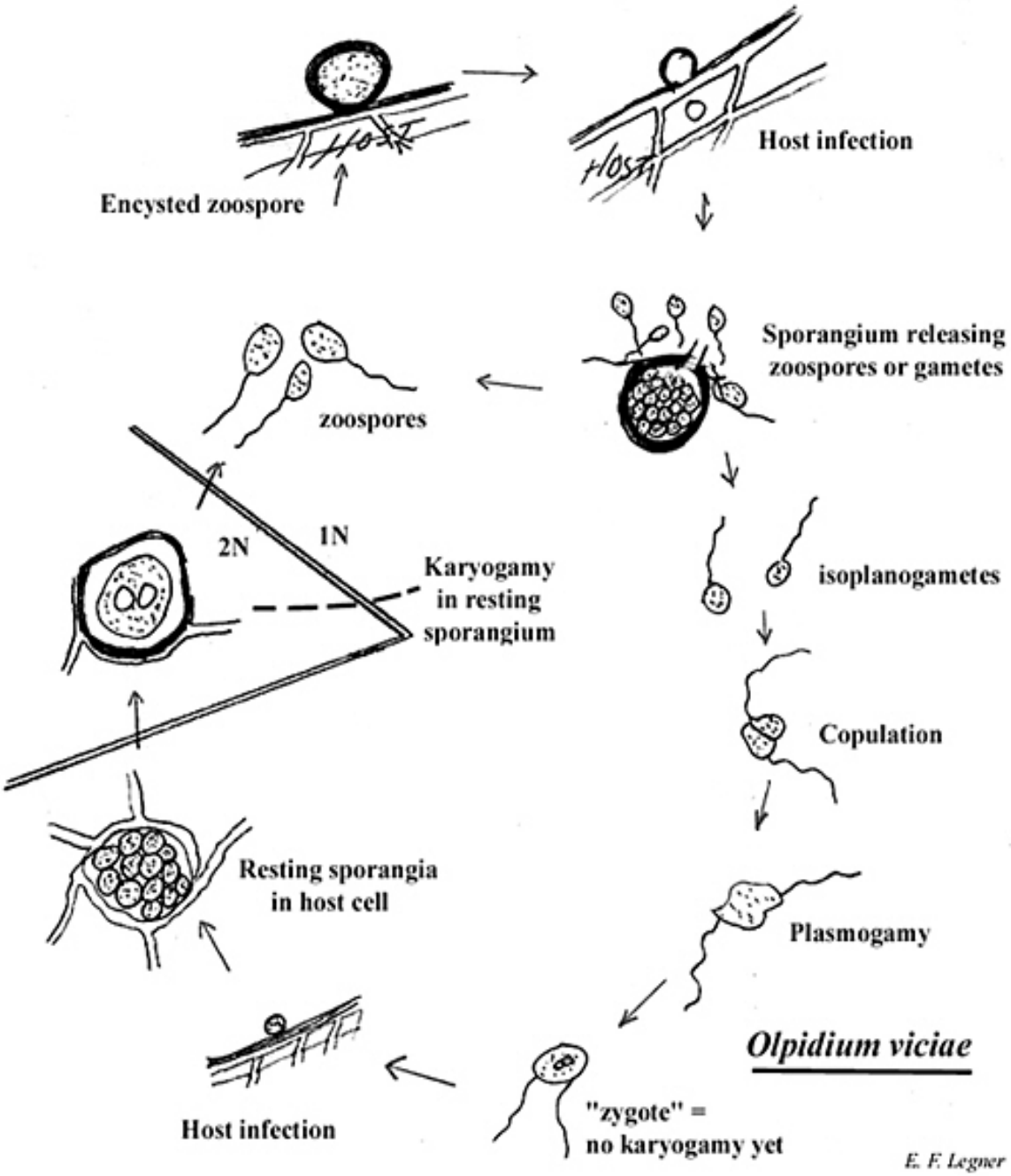
Order Monoblepharidales eg *Gonapodya, Monoblepharis*

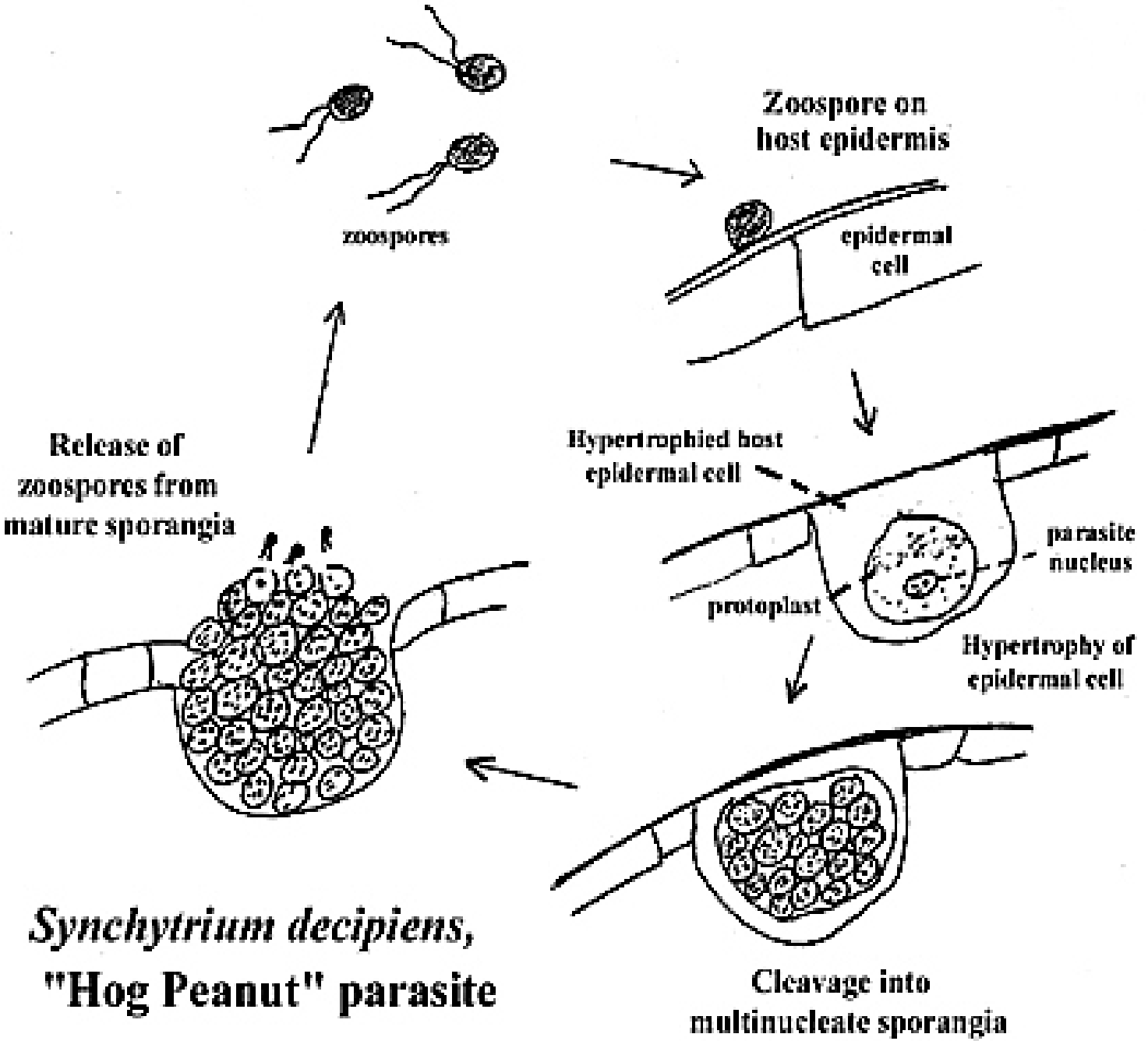
Allomyces gametangia



Zoospores of Allomyces
released from Zoosporangium


1N spores
Gametothallus
1N
1N spores
Anisogamy
Fusion
Thick-walled
sporangium
Meiosis
2N
mycelium
zygote
rhizoids
zoospores
2N
Thin-walled
sporangium
Sporothallus
2N
Allomyces arbusculus


Encysted zoospore
Host infection
Sporangium releasing zoospores or gametes
zoospores
2N
1N
Karyogamy in resting sporangium
isoplanogametes
Copulation
Resting sporangia in host cell
Plasmogamy
Olpidium viciae
Host infection
"zygote" = no karyogamy yet
E. F. Legner



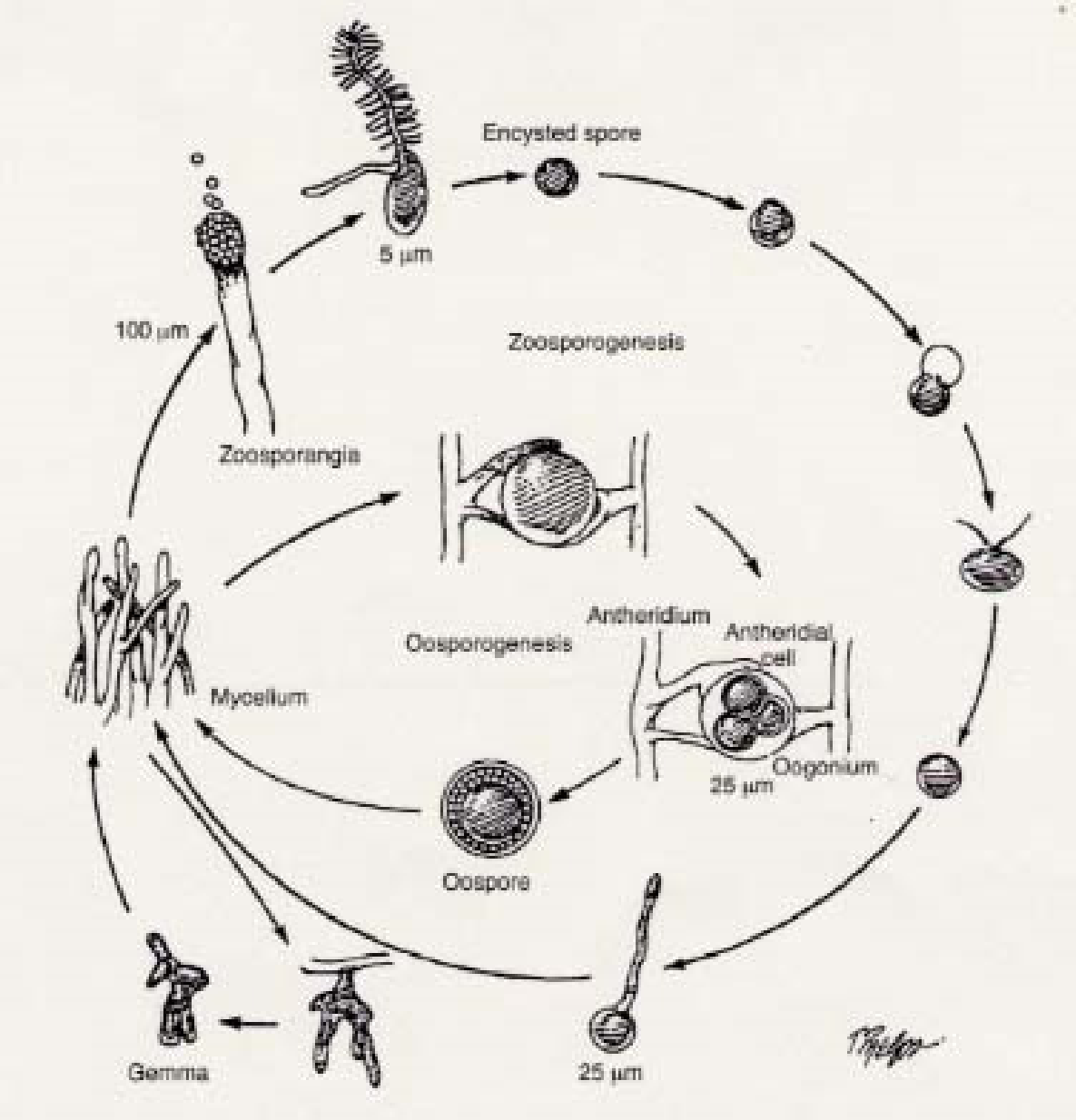
Synchytrium decipiens,

"Hog Peanut" parasite

E. F. Legner

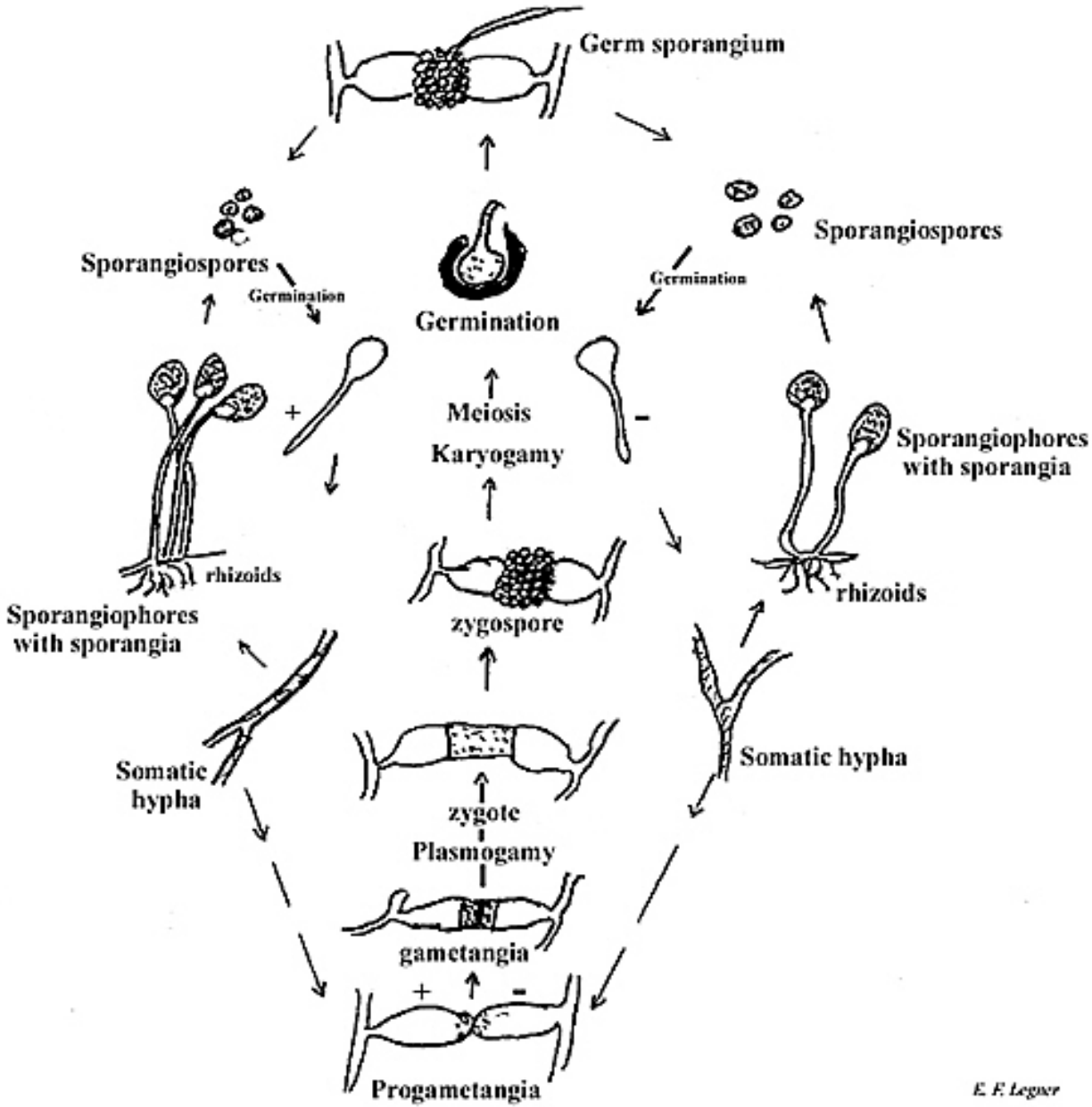
PHYLUM OOMYCOTA
Class Oomycetes

- **Order Saprolegniales**
- **Family Saprolegniaceae** eg *Saprolegnia*
- **Order Perenosporales**
- **Families** Pythiaceae, Albuginaceae and Perenosporaceae eg *Pythium, Albugo* and *Perenospora*



Life cycle of *Saprolegnia parasitica*

Plate 44. Life Cycle
Aflagellatae: Mucorales: *Rhizopus nigricans*



E. F. Legner

CLASS ASCOMYCETES

- All members of the Ascomycota produce an **ascus** that contains **ascospores**.
- The class includes the largest group and most successful of all fungi, with over 44,000 known species. The group has existed for many millions of years and there is some evidence that they took their origin from Zygomycotous forms.

- The Ascomycota are highly important in the break down of organic matter in the soil, as plant pathogens and for the production of antibiotics and other industrial substances.
- Many species are purely saprophytic; some are obligate parasites and others facultatively saprophytic or parasitic.
- Most species have a well-developed septate mycelium, and septations contain a septal pore or **perforate septum**.
- Cells primarily have only a single nucleus per cell but there are some with more than one nucleus per cell

- The yeasts are distinguished by not forming mycelia and individual cells multiply by fission or budding processes.
- The yeasts are not primitive organisms but special forms that evolved from a retrogressive process in evolution.
- A large proportion of the Ascomycetes have one or more means of vegetative reproduction. This imperfect stage produces conidia but never any zygospores. The perfect or sexual stage produces asci, which is the cardinal feature of the entire class.

- The production of asci terminates the relatively complicated sexual process. Asci occur in a spore sac, which may take various shapes.
- The number of ascospores is variable, but 8 per ascus are typical in 98 percent of species. Typically, ascospores are forcibly discharged (sporangiospores are not). The ascus is the seat of meiosis, which is not true in sporangia. In 99 percent of cases the ascus is also the site of nuclear fusion.

- Fruiting bodies (**ascocarps**) whose walls consist of closely interwoven hyphae may form various shapes. In contract there are no fruiting bodies in the Zygomycota.
- But not all of the Ascomycota produce fruiting bodies. There are none in the small sub-class Hemiascomycetes while all members of the much larger subclass Euascomycetes produce fruiting bodies (= ascocarps).

CLASSIFICATION OF ASCOMYCETES

Sub-Class: Hemiascomycetes

Order: Endomycetales
Order: Taphrinales

Sub-Class: Euascomycetes; **SERIES**: Plectomycetes

Order: Plectascales
Order: Myriangiales
Order: Erysiphales

SERIES: Pyrenomycetes

Order: Hypocreales
Order: Sphaeriales
Order: Pseudosphaeriales

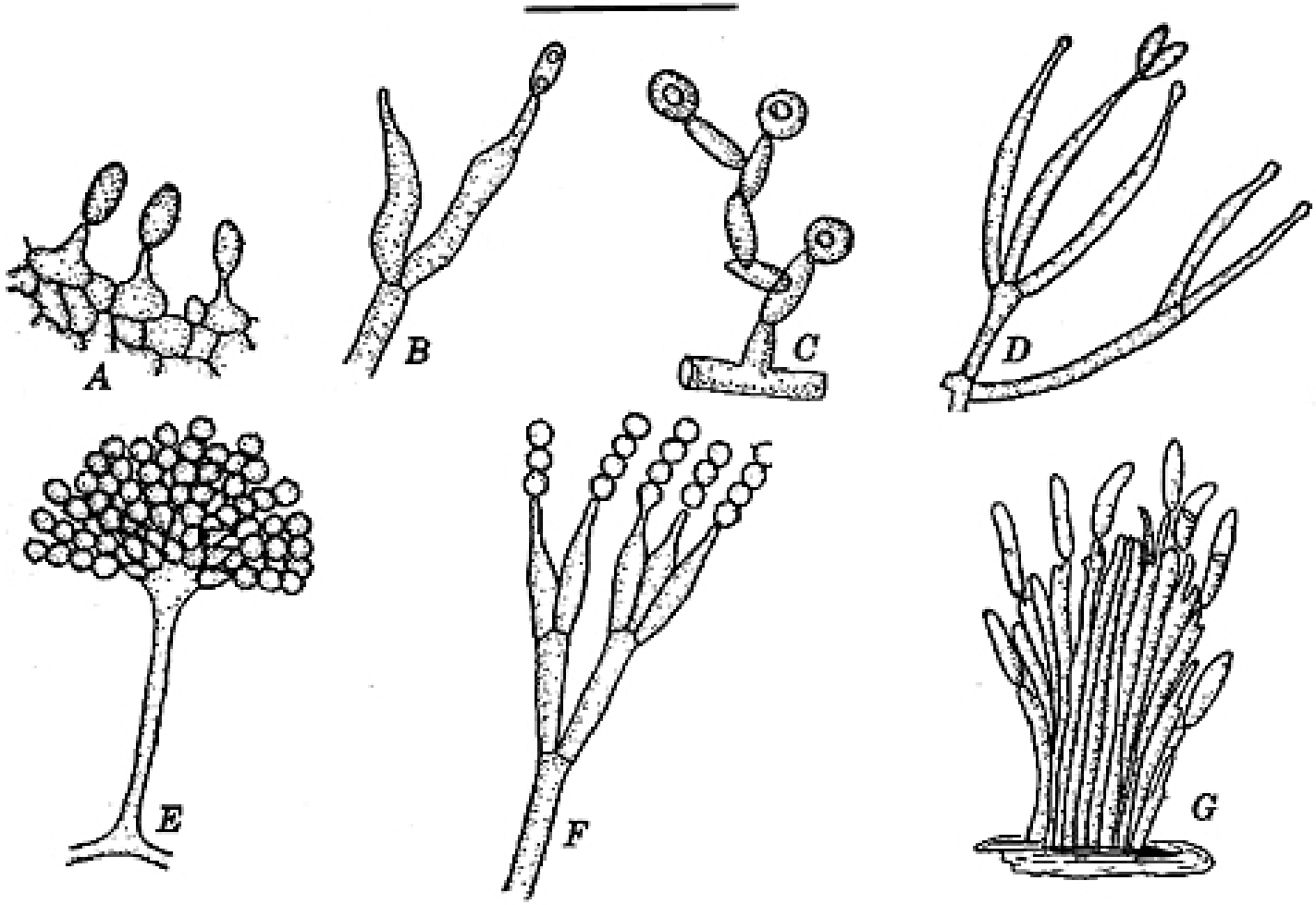
Order: Dothideales
Order: Hemisphaeriales
Order: Laboulbeniales
Order: Hysteriales

SERIES: Discomycetes; **Sub-SERIES**: Inoperculatae

Order: Helotiales
Order: Lecanorales

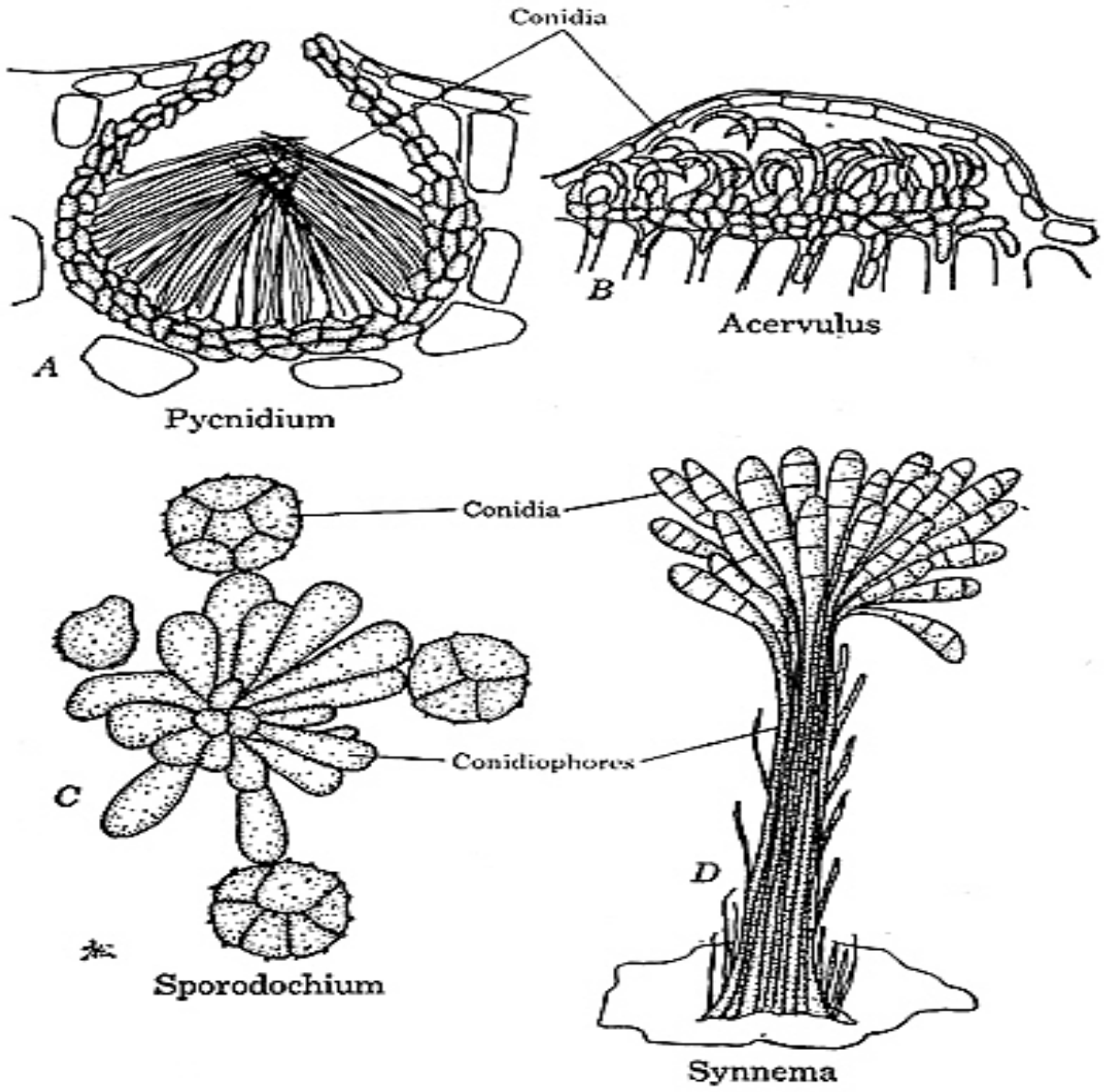
SERIES: Discomycetes; **Sub-SERIES**: Operculatae

Order: Pezizales
Order: Tuberales



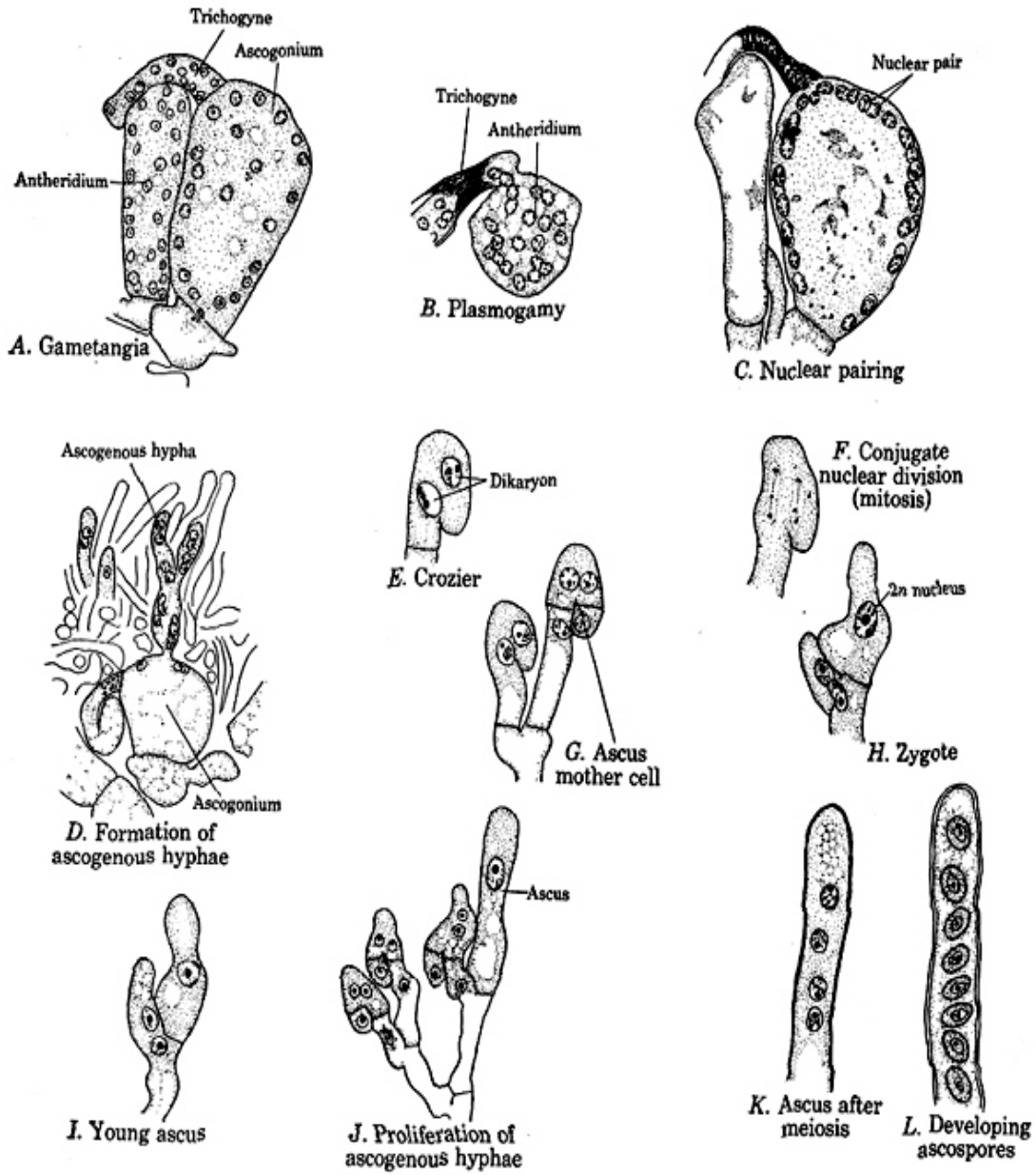
Various types of conidiophores bearing conidia. *A. Phyllosticta.* *B. Dendrophoma.* *C. Monopodium.* *D. Verticillium.* *E. Aspergillus.* *F. Penicillium.* *G. Isariopsis.*

C, redrawn from Delacroix; *G*, redrawn from Boudier; both in Engler and Prantl, 1900, Die natürlichen Pflanzenfamilien, Teil I, Abt. 1**, Wilhelm Engelmann, Leipzig.



Four types of asexual fruiting bodies. *A. Septoria. B. Marssonina. C. Epicoccum. D. Arthrobotryum.*

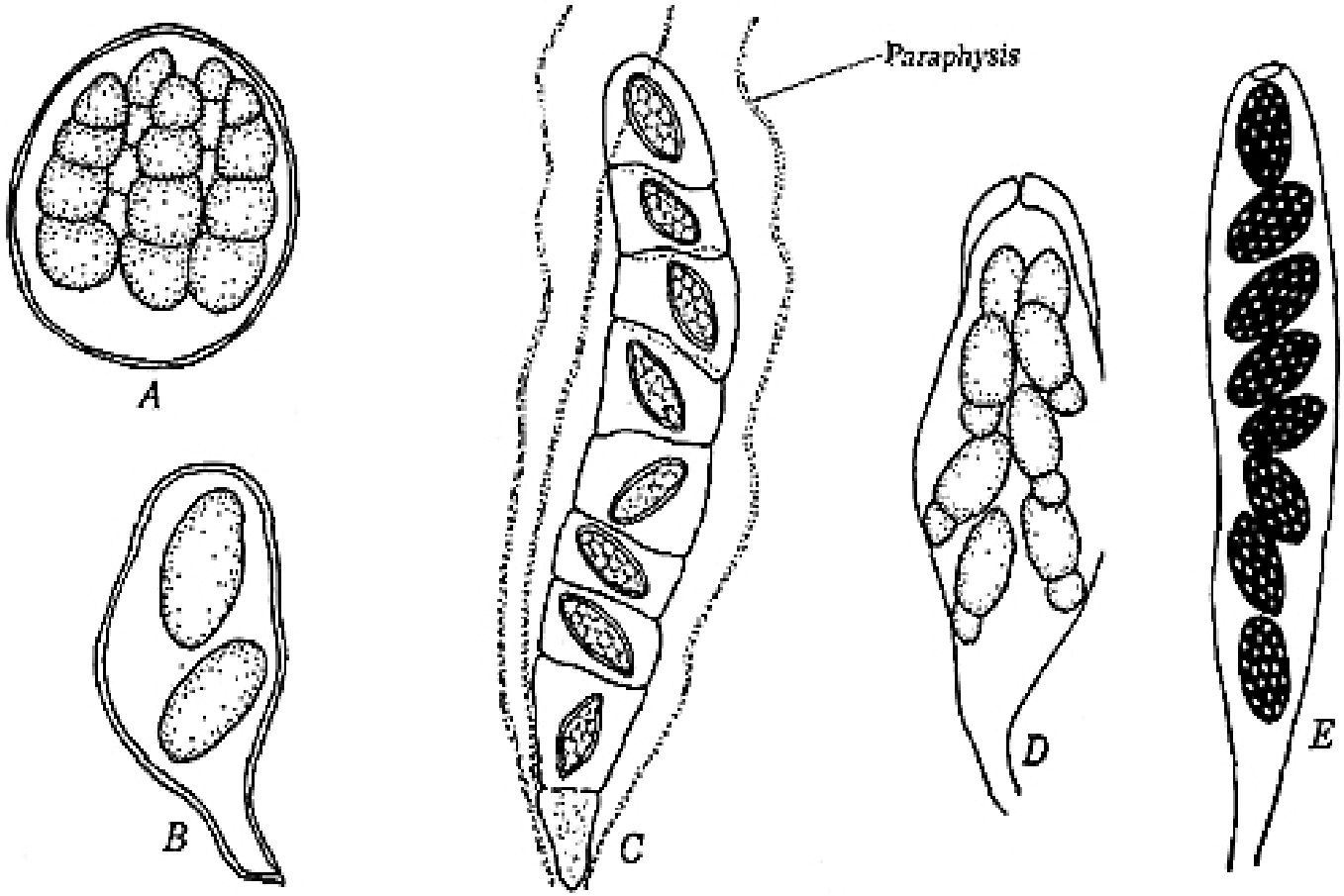
D, redrawn from Saccardo, in Engler and Prantl, 1900, Die natürlichen Pflanzenfamilien, Teil I, Abt. 1**, Wilhelm Engelmann, Leipzig.



Sexual reproduction and ascus development in the Ascomycetes as exemplified by *Pyronema omphalodes* (Bull.) Fuckel.

Redrawn from Claussen, 1912, Zeitschr. Botanik, 4:1–64.

Plate 105.



Various types of asci. *A*. Globose. *B*. Broadly ovate with stalk. *C*. Septate. *D*. Clavate. *E*. Cylindric.

A, redrawn from Burkholder, 1917, Cornell Univ. Agr. Exp. Sta. Bull., 395:157–183; *C*, redrawn from Stevens, 1927, Ill. Biol. Monogr., Vol. XI, No. 2.

Classification of Ascomycetes

- The main criteria for classifying Ascomycetes are;
- Type and structure of ascus
- Ascocarp centrum
- Type of ascocarp
- All ascogenous and conidial stages of the organism.
- Generally there is a great controversy among mycologists on the classification of Ascomycetes.

The four major sub-classes of Ascomycetes are;

1. **Sub-class Hemiascomycetidae**
   a) Order Endomycetales (Yeasts)
   b) Order Taphrinales *Taphrina*
2. **Sub-class Plectomycetidae**
   Order Eurotiales *Aspergillus, Penicillium*
3. **Sub-class Pyrenomycetidae**
   a) Order Erysiphales *Erysiphe*
   b) Order Meliolales
   c) Sphaeriales *Neurospora, Claviceps*
4. **Sub-class Discomycetidae**
   a) Order Pezizales *Peziza*
   b) Tuberales *Tuber*

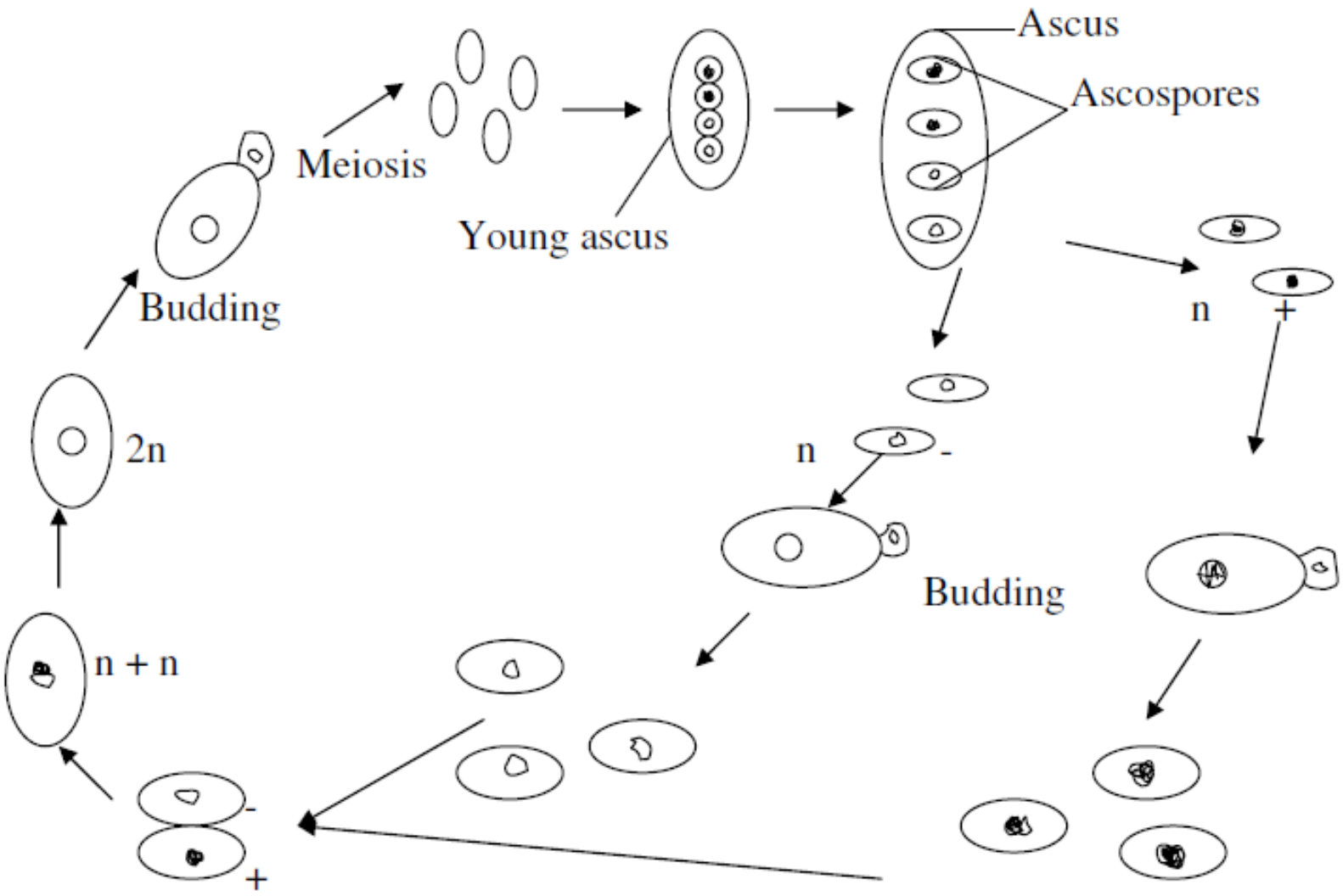
Sub-class Hemiascomycetidae

- Members are primitive and morphologically very simple.
- Mycelia are totally absent or poorly developed and they are generally yeast-like.
- They do not form ascogenous hyphae and ascocarps and the asci are formed directly from zygotes or single cells.
- There are two orders in the sub class; **Endomycetales** and **Taphrinales.**

Order Endomycetales (Yeasts)

- The word yeast is a general term with no taxonomic significance. Yeasts are those fungi which in a stage of their life cycle occur as single cell reproducing by budding or fission.
- The thallus is non-mycelial, microscopic and unicellular. The cells are circular, spherical, elliptical or oval.
- Nearly all members show ability to ferment. A typical example is *Saccharomyces cervisae* popularly known as bakers' or brewers' yeast.

- Asexual reproduction occurs only by budding,
- Sexual reproduction in yeast is by union of two somatic cells or two ascospores which assume the function of copulating gametangia. Plasmogamy and karyogamy occur and diploid zygote is formed; which changes into an ascus.
- Ascospores develop into ascus. The number of ascospores depends on the number of nuclear divisions in the zygotic nucleus, but the usual number is eight.
- On liberation, the ascospores germinate and form new cells by budding and fission.



Life cycle of *Saccharomyces cerevisae*

Order Taphrinales

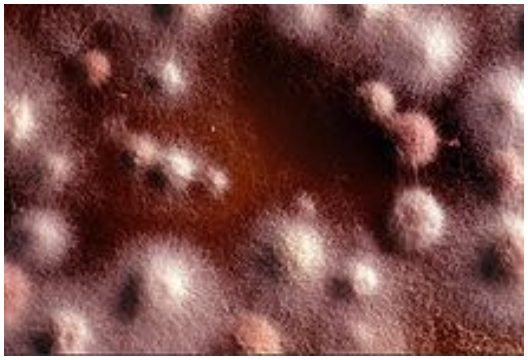
All members of this order are parasitic on higher vascular plants. They produce a definite mycelium in nature, but on artificial media, mycelia are absent. The asci lie parallel to one another in a palisade-like layer. The asci are not enclosed by peridium. Like yeasts, their ascospores also multiply by budding.

The ascus is produced from a special, binucleate, ascogenous cell developed from mycelium. The order Taphrinales includes only a single family (Taphrinaceae) and a single genus *Taphrina*.

- 1. Diseases of man. The most common fungal infections are of the skin, but other parts like respiratory tract, lungs, bones, viscera, intestines, liver, kidney, nasal sinuses, corneal tissue of the eye etc. are also sometimes affected
  - Species of *Rhizopus* and *Mucor* are known to infect lungs,gastric tissues and the brain.
  - *Neurospora* and *Fusarium* infect corneal tissues.
  - *Histoplasma* infect lungs, spleen, liver, kidney, nervous system and lymphatic system.
  - *Aspergillus* is a common infectant of lungs and nasal sinuses causing Aspergillosis whose symptoms resemble those of tuberculosis. They include *A. niger, A. flavus, A. terreus*.

  - *Candida albicans* is the cause of various types of candidiasis of humans like skin candidiasis, broncho-, oral-, pulmonary-, and vulvovaginal-candidiasis
  - Pandey *et.al*. (1981) reported a skin infection of the penis caused by the species of *Trichophyto*n and *Candida*, more prevalent in langota-wearing men in India.
  - Other fungal diseases of man include;
- Athlete's foot caused by *Epidermophyton floccosum*.
- Dermatomycosis – *Gymnoascus, Actinodendron*.
- Ringworm – *Gymnoascus, Myxotrichium*

Athlete’s foot



Ringworm

Diseases of wild animals and pests.

- Fungal diseases are also common in domestic and wild animals. *Microsprium canis* causes common ringworm of dogs and horses. *Aspergillus fumigatus* causes bovine abortion in birds (ducks and chicken), mycotic abortion of cattle and aspergillosis. Members of Entomorphthorales are parasites of insects and other animals. *Entomorphthora* species are typical insect parasites. A number of candidiasis, phycomycosis and rhinosporidiosis have been reported in various animals. *Saprolegnia* and *Achlya* are fungal parasites of fishes.

- Spoilage of food and stored grains
- Common food spoiling fungi are A*spergillus, Mucor* and *Penicillium.* Some like *Cladosporium herbaceum* infect food at very low temperature and can infect meat stored at -6^{o}C. This notorious fungus can spoil refrigerated food. Some ascomycetes and deuteromycetes contaminate stored harvested grains like maize and wheat. The hyphae grow at high relative humidity therefore if such grains are properly dried before storage; the hyphae hardly grow in them.

- 4. Poisonous fungi and their toxins
- Some fungi are deadly poisonous, and if ingested they may prove even fatal. Mushrooms like *Amanita phalloides* (the 'death cup'), *Amanita verna* (the 'destroying angel'), *Boletus satanus*, *Galerina*, *Helvella*, *Coprinus*, *Inocybe* and *Psilocybe* are highly poisonous. Symptoms like diarrhea and vomiting are seen two to three hours after ingestion.
- *Claviceps purpurea* causes ergot disease of rye. Its sclerotia contain many poisonous alkaloids like ergometimine, ergocrystinine,

- Wood-rotting fungi
- Many wood-rotting fungi cause a lot of monetary loss and pose danger in construction timber. Dry rot is caused by *Serpula lacrymans* and wet rot by *Coniphora cerebella*. These fungi break down the wood components and reduce its mechanical strength.