

OUTLINE OF THE FUNGI



By
G. W. MARTIN

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VOLUME XVIII

SUPPLEMENT

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STUDIES IN NATURAL HISTORY

Volume XVIII, Supplement

Published by the University of Iowa Press
Iowa City, Iowa
1941

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109
V. 18
SUPPLEMENT

OUTLINE OF THE FUNGI

This brief outline is intended to serve only as a taxonomic framework. The primary aim of taxonomy is and must remain the erection of a system of classification which will permit the recognition of an organism previously known with the greatest possible degree of convenience and precision, and the assignment of an organism previously unknown to its proper place in such a system. This aim can be and has been realized by means of systems which take little account of the relative values and implications of the characters utilized to separate the various categories. A more fundamental, although less immediately urgent, and therefore, in practice, secondary aim of taxonomy, is to have the system, while still capable of serving its primary purpose, express the relationships of the organisms under particular consideration to each other and to other groups of organisms. There can, of course, be but one such natural system, but our ignorance of the facts is so vast and our capacity to interpret the facts we do possess and to express such interpretation convincingly is so inadequate that so far as may be judged at the present time, the attainment of a close approximation to the natural system will for many years to come be an ideal rather than an accomplishment. Nevertheless the light shed by the great concept of evolution has been an invaluable guide, and is still capable of directing our exploration. We are probably far from the time when we shall discard phyletic theory for our framework.

In the case of the fungi, there may be found in current literature three views of their phylogeny. One, perhaps more widely accepted than any other, regards the fungi as a polyphyletic assemblage, derived from several distinct algal groups, including both green and red algae. If this opinion is correct, it follows that the natural system, as finally developed, will necessitate the interpolation of the fungi amongst the algae, each group of fungi following the group of algae from which it has been derived. A second view is that the fungi, excluding the Myxomycetes but with few other exceptions, and these all among the simpler forms, constitute a monophyletic series derived from filamentous green algae. A third view, adopted by

the present writer, is that the fungi are not closely related to the algae but have been derived from the Protozoa. The entire group, including the Myxomycetes, is regarded as constituting an independent phylum, probably to be traced back to simple, colorless flagellates and characterized, as are all major phyletic groups, by many divergent series. Supposed relationship with algal groups is regarded as an unproved assumption based upon superficial analogies rather than upon true homologies and as less probable and less logical than a protozoan ancestry. Fungi, accordingly, are not plants in the sense that plants are photosynthetic organisms, or organisms which, while they lack chlorophyll, are clearly derived from photosynthetic organisms, e.g., *Monotropa* or *Harveyella*. The retention of fungi in the Plant Kingdom is, and doubtless will continue to be, based upon historic association and reasons of convenience. Because fungi are not regarded as plants, terms which imply plant-like characters are not employed. The term *assimilative phase* is used for the stage commonly referred to as "vegetative." *Saprobe* and *saprobic* are used instead of the more familiar "saprophyte" and "saprophytic." Such terminology has the further advantage of being appropriate as applied to the fungi whatever view may be adopted concerning their phylogeny. Under any circumstances, reference to the reproductive structure of one of the higher fungi, considered alone, as a "plant," is thoroughly objectionable.

The Myxomycetes, as here delimited, are by no means the simplest forms included in the fungi. They do, however, represent a coherent and rather specialized group which has led to nothing higher in the scale. The Archimycetes, here included as a subclass of the Phycomycetes, and some of the lower forms included in the Oomycetes, are simpler in structure and apparently more primitive in their biology. There is much justification for the establishment of a class, whether it be called Archimycetes or by some other name, to be placed at the base of the fungi. From some primitive ancestors of such a group, still holozoic in their nutrition, the Myxomycetes might be regarded as representing one line of development. The Archimycetes, as here delimited, cannot be regarded as representatives of such an ancestral group for several reasons, but chiefly because their characteristic and often rather specialized parasitism involves a course of development quite distinct from

that which must have been followed by the forms leading to the Myxomycetes.

The relationship between the Archimycetes and the Oomycetes is less difficult to envisage. There may, however, be several distinct lines involved. Recent studies have tended to emphasize the importance of zoospore flagellation as a guide to phylogeny, and some of this work suggests that a new classification, cutting across several of the present groups, may be established. It may be assumed that the Zygomycetes represent the most highly specialized subclass of the Phycomycetes, although just how they are related to the other groups is still highly problematical. The most plausible suggestion that has been made is that they have been derived from terrestrial members of the Saprolegniales.

Most students who hold that the fungi are monophyletic are agreed that the Ascomycetes have been derived from the higher Phycomycetes. Such genera as *Basidiobolus*, *Ascoidea* and *Dipodascus* are frequently cited as exhibiting in one degree or another characteristics which the intermediate forms may well have possessed. Just how the Basidiomycetes originated from the Ascomycetes is not clear, but the striking homology between asci and basidia, croziers and clamp connections, and the curious interpolated dicaryon generation commonly occurring in both groups, can leave little doubt that the connection is intimate.

Within the Ascomycetes, the older classification is being replaced by one which takes into more careful account the nature of the ascus. The manner of spore release, whether by deliquescence of the ascus wall, by discharge through a preformed pore, or by discharge through an opening provided with a lid or operculum, is already emphasized in many works. Much more study must be given to the numerous modifications and variations of these methods before the significance of such characters can be fully evaluated. The difference between a perithecium and a locule has been stressed in recent studies and seems to be of first importance. The occurrence of a stroma probably ranks below this in significance but nevertheless may be taken as indicating degree of specialization within the several series in either group, provided it is interpreted with care and with due recognition of other characters and of the relation between the fungus and the substratum.

The basidium is probably better understood than the ascus, although much remains to be learned about its structure and mechanism. The viewpoint here adopted is that the primitive type of basidium is best represented by that of *Tulasnella* or the closely related *Ceratobasidium* and that from some such forms both the remaining Heterobasidiomycetes and the lower Homobasidiomycetes may be traced with fair continuity through living genera. The commonly recognized families of the Agaricales, including the great majority of the familiar fleshy fungi, are admittedly artificial, but none of the proposed modifications of the old system here adopted has won much recognition among English-speaking mycologists. Some, at least, of the Gasteromycetes, notably *Endoptychium* and *Podaxis*, bear clear evidence of their derivation from agarics. With others, any assumption of such derivation must, for the present, be accepted only as less improbable than any other possible derivation.

With some outstanding exceptions, it is still too early to insert the lichens among the other fungi with any great degree of confidence. An acceptable compromise at present is to attempt to arrange them into a parallel series, using, for this purpose, so far as possible, the same characters which are relied upon in the corresponding non-lichen fungi. This is barely suggested, rather than attempted, in the present key.

It is difficult to estimate, with any assurance, the total number of species of fungi. One obvious reason for this is the fact that many fungi are extremely inconspicuous and are very likely to escape observation unless special search is made for them. This is particularly true of the forms which, unlike the plant pathogens and similar groups, are not of immediate concern to some human interest. Another reason is the difficulty of formulating a species concept as applied to fungi comparable with that used in the study of other groups, notably the vascular plants. In the twenty-five volumes of Saccardo's SYLLOGE FUNGORUM, the latest of which appeared in 1931, over 89,000 species are listed. Some of these have been shown to include two or more related but distinct species and the number would be correspondingly increased. A larger number have been shown to be synonyms, thus decreasing the total. One suggestive approach is a comparison of parasitic fungi and

host plants. For several years the class in mycology at the University of Iowa has been asked to tabulate the number of parasitic fungi listed in Seymour's HOST INDEX as occurring on vascular plants selected from Gray's MANUAL by an arbitrary system of sampling designed to eliminate any selective factor. The result, when the sample is sufficiently large, has uniformly been a number of species of fungi varying from approximately the number of host species to several times that number. When the host sample is restricted to a large family, such as the Compositae, the number of species of fungi is relatively low, due to duplication, as might be expected. The vascular flora of Iowa may be regarded as well known, and the fungi as relatively so. Gilman and Archer (Iowa State Coll. Jour. Sci. 3:299-502. 1929) and Gilman (ib. 6:357-365. 1932) list 995 species of fungi occurring on 1035 host species, of which 1008 are vascular plants, almost exactly five-eighths of the vascular species occurring in Iowa. There is no reason to suppose that the remaining three-eighths are free from parasites. When to these are added the very large number of fungi occurring in soil and on organic debris of every sort it is not unreasonable to postulate that the number of species of fungi in this area is not less than the number of species of vascular plants and to hazard the suggestion that such relation may hold for much of the land area of the world.

The illustrations have been prepared by Miss Joan Cox. Except for four which have been adapted from well-known works, all are original and have been made either directly from the specimens or copied from my own camera lucida drawings or photographs.

THE FAMILIES OF FUNGI

The Thallophyta, an artificial division of the plant kingdom, arbitrarily defined as including all plants and plant-like organisms below the level of the Bryophyta, may be further subdivided as follows:

- a. Chlorophyll present.....Algal groups¹
(Note, however, that a few undoubted algae lack chlorophyll).
- a. Chlorophyll lacking.....Fungous groups b
 - b. Organic unit a single cell, often united with other cells into filaments or masses; nuclei lacking or not clearly defined; reproduction by fission.....Bacteria¹
 - b. Organic unit usually multicellular or multinucleate, or both; nuclei always clearly defined; reproduction various, often involving karyogamy, very rarely by fission.....Phylum FUNGI

FUNGI

- a. Assimilative phase a plasmodium².....Class MYXOMYCETES p. 9
- a. Assimilative phase not a plasmodium, usually filamentous..... b
 - b. Mycelium, if present, usually continuous throughout in active assimilative phase; if lacking, reproduction not by budding; perfect stage usually represented by oospores or zygospores; imperfect stage by sporangiospores or modified sporangia or sporangial parts serving as disseminules.....Class PHYCOMYCETES p. 11
 - b. Mycelium septate, rarely lacking, and cell in such case reproducing by budding or (very rarely) by fission; perfect stage characterized by asci or basidia. c
 - c. Parasitic on algae, forming with them symbiotic subaerial structures of characteristic morphology....Form Class LICHENES p. 31
 - c. Rarely parasitic on algae and, when so, not forming a characteristic symbiotic thallus; mycelium immersed in humus, soil, dung or the tissues of higher plants or sometimes animals, occasionally subaerial. d
 - d. Perfect stage characterized by spores borne in asci.Class ASCOMYCETES p. 15
 - d. Perfect stage characterized by spores borne on basidia.Class BASIDIOMYCETES p. 22
 - d. Neither asci nor basidia known and relationships not otherwise inferable with reasonable assurance.Form Class FUNGI IMPERFECTI p. 28

1. Not included.

2. Terms are used throughout in the sense indicated in the glossary.

OUTLINE OF THE FUNGI

9

MYXOMYCÉTÉS

- a. Hypothallus complex, erect; simple, branched or poroid; sporangia lacking, probably represented by the so-called spores, the latter stalked, 4-nucleate, giving rise on germination to a protoplasmic body which in turn forms a group of eight swarm-cells.Subclass EXOSPOREAE p. 9
- a. Hypothallus simple, consisting of a thin pellicle or reticulum prostrate on the substratum, sometimes not evident; spores borne internally, giving rise on germination to one or two myxamoebae or swarm-cells, rarely moreSubclass MYXOGASTRES p. 9

EXOSPOREAE

Including only the Family *Ceratiomyxaceae*,

Represented by the single genus.....*Ceratiomyxa* (4)³

MYXOGASTRES

- a. Spores in mass pallid, yellow, purplish, rosy or rarely olivaceous or dingy; lime never present..... b
- a. Spores in mass typically black or deep violaceous, sometimes ferruginous, rarely pallid; lime present or absent..... c
 - b. True capillitium lacking or scantily developed; pseudo-capillitium often present, of tubules or perforated plates, sometimes fraying out into threads; spores pallid, often with purplish or rosy tints, or dingy.Order LICEALES p. 9
 - b. Capillitium present, threadlike, attached to base or walls or free, sculptured, the markings usually distinct; spores pallid, yellow or rosy.Order TRICHIALES p. 10
- c. Neither peridium nor capillitium calcareous; lime rarely present and then restricted to hypothallus, stipe and columella.Order STEMONITALES p. 10
- c. Peridium or capillitium, or both, calcareous.Order PHYSARALES p. 11

LICEALES

- a. Fructification of separate sporangia or small plasmodiocarps, rarely a pseudoaethalium, and plasmodic (dictydine) granules then present..... b
- a. Fructification a pseudoaethalium or an aethalium; plasmodic granules never present..... c
 - b. Plasmodic granules lacking; peridium not covered with a net.....Family *Liceaceae*
Representative genera: *Licea*, *Hymenobolina* (5)

3. Numerals in bold face type after generic names refer to figures.

- b. Plasmodic granules present; peridium typically covered by a net which remains after spores are shed.
 Family **Cribrariaceae**
 Representative genera: *Cribraria, Dictydium* (6)
- c. Pseudoaethalium formed of closely appressed sporangia, with walls entire; individual sporangia dehiscent at apex. Family **Tubiferaceae**
 Representative genus: *Tubifera*
- c. Fructification a true aethalium, or a pseudoaethalium in which walls disappear at maturity; dehiscence irregular. d
- d. Pseudocapillitium perforated, frayed or fragmentary; spores ochraceous or umber under lens. Family **Reticulariaceae**
 Representative genera: *Reticularia, Enteridium, Dictydiaethalium*
- d. Pseudocapillitium of colorless, branched and often flattened tubes; spores pinkish or pallid under lens. Family **Lycogalaceae**
 With the single genus *Lycogala* (7)

TRICHIALES

- a. Capillitial threads slender, warted or spinulose, usually minutely so, sometimes nearly smooth. b
- a. Capillitial threads rather coarse, usually characterized by distinct sculptured markings. c
- b. Peridium usually single; capillitial threads perpendicular to the peridium, attached at base and usually at tip, often anastomosing to form a net; in *Listerella* jointed. Family **Dianemaceae**
 Representative genera: *Dianema, Margarita*
- b. Peridium usually double; capillitial threads irregularly disposed, free or attached at one end. Family **Perichaenaceae**
 Representative genera: *Perichaena, Ophiotheca* (8)
- c. Capillitium a net, usually elastic, arising from base of sporangium; markings in the form of spines, cogs, warts or rings. Family **Arcyriaceae**
 Representative genera: *Arcyria* (9), *Lachnobolus*
- c. Capillitium a network, usually not strongly elastic, or composed of short, free elaters, marked by distinct spiral bands, rarely nearly smooth. Family **Trichiaceae**
 Representative genera: *Trichia, Hemitrichia* (10), *Oligonema*

STEMONITALES

- a. Outer wall of peridium gelatinous, persistent; columella lacking. Family **Collodermataceae**
 With the single genus: *Colloderma*
- a. Peridium membranous, fugaceous or persistent; columella usually well-developed. b
- b. Fructification aethalioid or sporangiate; capillitium developed from entire length of columella. Family **Stemonitaceae**

- Representative genera: *Stemonitis* (11), *Comatricha, Diachea* (12)
- b. Always sporangiate; capillitium arising from tip of columella. Family **Lamprodermataceae**
 Representative genus: *Lamproderma* (15)

PHYSARALES

- a. Capillitium and usually peridium calcareous. Family **Physaraceae**
 Representative genera: *Physarum* (13), *Fuligo* (17), *Badhamia* (14)
- a. Capillitium non-calcareous; peridium, and sometimes stipe, limy. Family **Didymiaceae**
 Representative genera: *Didymium* (16), *Diderma*

PHYCOMYCETES

- a. Holocarpic; parasitic; thallus wholly immersed in living host, naked at least until shortly before reproductive phase begins. Subclass **ARCHIMYCETES** p. 11
- a. Eucarpic or rarely holocarpic; parasitic or saprobic; thallus with membrane from first. b
- b. Gametangia unlike; perfect stage represented by oospores; imperfect stage by zoospores or by zoosporangia functioning as conidia and germinating by the production of zoospores or, less commonly, directly. Subclass **OOMYCETES** p. 12
- b. Gametangia morphologically alike (frequently differing in size); perfect stage represented by zygospores; imperfect stage by sporangiospores, modified sporangia or part-sporangia functioning as conidia, or by true conidia. Subclass **ZYGOMYCETES** p. 13

ARCHIMYCETES

- a. Thallus naked at maturity; spore-mass naked or with a membrane; spores on germination producing each a swarm-cell with two unequal anterior flagella, only one of which is readily seen. Parasites on vascular plants, often causing hypertrophy. Order **PLASMODIOPHORALES** p. 11
- a. Thallus surrounded by a distinct membrane at maturity, preceding formation of reproductive phase; zoospores various, but never with two unequal flagella. Typically microscopic fungi parasitic on water and land plants.
 Order **MYXOCHYTRIDIALES** p. 12

PLASMODIOPHORALES

- With the single family **Plasmodiophoraceae**
 Representative genus: *Plasmodiophora* (18)

MYXOCHYTRIDIALES

- a. Zoospores reniform, each with two lateral or anterior flagella. Family **Woroninaceae**
Representative genera: *Woronina, Olpidiopsis* (19)
- a. Zoospores oval or pyriform, each with a single posterior flagellum. b
- b. Entire thallus transformed into a single sporangium. Family **Olpidiaceae**
Representative genus: *Olpidium*
- b. Thallus becoming divided into several or many sporangia, grouped as a sorus. Family **Synchytriaceae**
Representative genus: *Synchytrium* (20)

OOMYCETES

- a. Sterile portion of thallus represented by a basal haustorium or by slender and usually scanty mycelium, sometimes connecting vesicular enlargements. Mostly eucarpic parasites on water and land plants. Order MYXOCHYTRIDIALES p. 12
- a. Mycelium coarse or abundantly developed, or both b
- b. Mycelium coarse, scanty, often confined to a single host cell, and at maturity sometimes wholly transformed into reproductive structures. Order LAGENIDIALES p. 13
- b. Mycelium usually abundantly developed, never wholly transformed into reproductive structures. c
- c. Gametes differentiated into eggs and sperms; zoospores uniflagellate. Order BLASTOCLADIALES p. 13
- c. Gametangia not producing distinct gametes; zoospores biflagellate. d
- d. Oospores usually several to many, sometimes single, but always free from oogonial wall; zoospores produced in attached zoosporangia. Mostly saprobic in water or soil. Order SAPROLEGNIALES p. 13
- d. Oospore single, united with oogonial wall; zoosporangia usually functioning as aerial conidia, germinating after detachment by the production of zoospores or less commonly by a hyphal tube; mostly parasitic on vascular plants. Order PERONOSPORALES p. 13

MYXOCHYTRIDIALES

- a. Sterile portion varying from a button-like haustorium to a cluster of rhizoidal outgrowths, or slender mycelial threads, without swellings. Family **Rhizidiaceae**
Representative genera: *Rhizophidium* (21), *Polyphagus*
- a. Sterile portion mycelioid, sometimes profuse, usually with terminal or intercalary swellings. Family **Cladochytriaceae**
Representative genera: *Cladochytrium, Physoderma, Urophlyctis*

LAGENIDIALES

- With the single Family **Lagenidiaceae**
Representative genera: *Achlyogeton, Myzocytiium* (22)

BLASTOCLADIALES

- a. Gametes, when present, motile, uniflagellate, morphologically similar, but differing in size; thick-walled resting sporangia often conspicuous. Family **Blastocladiaceae**
Representative genera: *Blastocladia, Allomyces* (23)
- a. Sperms motile, uniflagellate; eggs solitary, non-motile. Family **Monoblepharidaceae**
With the single genus: *Monoblepharis*

SAPROLEGNIALES

- a. Oospores usually several to many, sometimes one, without periplasm; hyphae not constricted. Family **Saprolegniaceae**
Representative genera: *Saprolegnia, Achyla* (24), *Dictyuchus*
- a. Oospore single, with periplasm; hyphae constricted at regular intervals. Family **Leptomitaceae**
Representative genus: *Leptomitus*

PERONOSPORALES

- a. Conidiophores differing little, if at all, from assimilative hyphae; mycelium saprobic or parasitic, but, if latter, intracellular, without haustoria. Family **Pythiaceae**
Representative genera: *Pythium, Phytophthora* (25)
- a. Conidiophores specialized; mycelium intercellular, with haustoria; parasites on vascular plants. b
- b. Conidia (sporangia) catenulate on club-shaped conidiophores borne in dense sori beneath epidermis of host; haustoria globose. The white rusts. Family **Albuginaceae**
With the single genus: *Albugo* (26)
- b. Conidia borne singly or in clusters at the tips of usually branched, rarely clavate conidiophores which emerge through stomata; haustoria various. The downy mildews. Family **Peronosporaceae**
Representative genera: *Peronospora, Plasmopara* (27), *Bremia*

ZYGOMYCETES

- a. Outer wall of zygospore developed from gametangia; imperfect spores typically sporangiospores (sometimes borne in merosporangia or entire sporangia functioning as conidia). Mostly saprobic. Order MUCCGRALES p. 14
- a. Zygospore free within gametangial vesicle; imperfect spores modified sporangia functioning as conidia, or true

conidia, the latter sometimes catenulate. Frequently parasitic on insects or other animals, rarely on plants.

.....Order ENTOMOPHTHORALES p. 15

MUCORALES

- a. Sporocarp present, containing sporangia, zygospores or azygospores.Family **Endogonaceae**
Representative genus:*Endogone*
- a. Sporocarp lacking. b
b. Sporangia all columellate and alike. c
b. Columellate sporangia present or absent; non-columellate sporangia, sporangioles, merosporangia or conidia always present. d
- c. Sporangial membrane thin, fugaceous; sporangiospores liberated by breaking up of sporangial wall; zygospores rough, suspensors not tong-like.Family **Mucoraceae**
Representative genera: *Mucor*, *Rhizopus* (28), *Absidia*, *Phycomyces*
- c. Sporangial wall densely cutinized above, entire sporangium violently discharged or detached as a whole from sporangiophore; zygospores smooth, suspensors tong-like.Family **Pilobolaceae**
Representative genera:*Pilobolus* (29), *Pilaira*
- d. Terminal sporangium columellate, multispored, or sometimes replaced by a sterile spine; sporangioles (few or 1-spored) borne on whorled branches of same sporangiophore.Family **Thamniaceae**
Representative genera:
.....*Thamnidium*, *Helicostylum* (30), *Chaetocladium*
- d. Columellate sporangia lacking (except in Choanephoraceae); imperfect stage represented by non-columellate sporangia, sporangioles, merosporangia or conidia, or some combination of these structures. e
- e. Merosporangia borne on swollen tips of sporangiophores, at first cylindrical, then forming a single row of sporangiospores, simulating a chain of conidia. **Family Piptocephalidaceae**
Representative genera:*Piptocephalus*, *Syncephalastrum* (31)
- e. Merosporangia lacking. f
f. Sporangioles or conidia born on swollen tips (columellate sporangia also present in some genera); zygospores naked.Family **Choanephoraceae**
Representative genera:
.....*Choanephora*, *Cunninghamella* (32), *Rhopalomyces*
- f. Sporangia, if present, without columellae; sporangioles and conidia, when present, borne singly, not on swollen tips of sporophores; zygospores imbedded in a thick hyphal matrix.Family **Mortierellaceae**
Representative genera:*Mortierella* (33), *Haplosporangium* (34)

ENTOMOPHTHORALES

- a. Conidia borne singly or in chains, not forcibly discharged; parasitic on amoebae and nematodes.Family **Zoopagaceae**
Representative genus:*Zoopage*
- a. Sporangium functioning as a single conidium, forcibly discharged at maturity. b
b. Mycelium persistent, of uninucleate cells, giving cellulose reaction; gametangia unequal; not parasitic on insects.Family **Basidiobolaceae**
With the single genus:*Basidiobolus*
- b. Mycelium usually breaking up into multinucleate segments, not giving cellulose reaction; gametangia equal; often parasitic on insects.Family **Entomophthoraceae**
Representative genera:
Entomophthora, *Empusa* (36), *Conidiobolus*, *Delacroixia* (35)

ASCOMYCETES

- a. Asci formed singly, typically as direct result of karyogamy although this is frequently lacking, sometimes closely aggregated, but no ascocarp developed.
.....Subclass HEMIASCOMYCETES p. 15
- a. Asci borne in ascocarps.Subclass EUASCOMYCETES p. 16

HEMIASCOMYCETES

- a. Zygote or single cell transformed directly into an ascus; mycelium sometimes lacking; mostly saprobic.
.....Order ENDOMYCETALES p. 15
- a. Hyphal cells becoming chlamydospores, each of which germinates to become a single ascus; parasitic on vascular plants.Order TAPHRINALES p. 16

ENDOMYCETALES

- a. Spore-sacs (asci?) many-spored; gametangia, when present, sometimes multinucleate.Family **Ascoideaceae**
Representative genera:*Ascoidea* (38), *Dipodascus* (37)
- a. Asci with 8 ascospores, or fewer; gametangia, when present, always uninucleate. b
b. Asci borne on a well-developed mycelium. **Family Endomycetaceae**
Representative genera:*Endomyces*, *Eremascus*
- b. Mycelium lacking, reproduction by budding; asci formed by transformation of a single cell, or as the result of fusion of two cells.Family **Saccharomycetaceae**
Representative genera:*Saccharomyces* (39), *Zygosaccharomyces*

TAPHRINALES

- a. Chlamydo-spores thick-walled, germinating after a rest period, the exospore splitting and the endospore emerging to form a large, many-spored spore-sac.Family **Protomycetaceae**
Representative genus:*Protomyces*
- a. Chlamydo-spores thin-walled; endospore, on germination (less commonly a hyphal tip) protruding from host and cut off by a septum to form an 8-spored ascus, which may become many-spored by the budding of the ascospores.
.....Family **Taphrinaceae**
Representative genus:*Taphrina* (40)

EUASCOMYCETES

- a. Asci borne singly or in tufts at various levels in interior of ascocarp or stroma. b
- a. Asci borne in tufts or hymenial layers (rarely solitary) in specific portions of ascocarps. c
- b. Extensive stroma lacking (stalk or stalk-like base may be present); asci and ascogenous hyphae filling interior of ascocarp.Order **EUROTIALES** p. 17
- b. Stroma well developed, often gelatinous; asci borne singly in locules.Order **MYRIANGIALES** p. 17
- c. Asci borne in globose, ellipsoidal or elongated cavities with a small opening or none (Pyrenomycetes). d
- c. Asci borne in hymenial layers, typically in cup-shaped or saucer-like ascocarps, or in subterranean tuberous modifications of these (Discomycetes). j
- d. Stroma always present; asci borne in one to many cavities (locules) without differentiated perithecial walls but frequently resembling perithecia; true paraphyses and periphyses lacking. e
- d. Stroma present or absent; asci borne in cavities with true walls (perithecia), paraphyses and periphyses usually present. f
- e. Locules more or less spherical, resembling perithecial cavities.Order **DOTHIDEALES** p. 18
- e. Stroma flattened, dimidiate, opening by a pore or tear, the whole simulating the upper part of a perithecium.
.....Order **HEMISPHERIALES** p. 18
- f. Ostiole lacking, sometimes simulated by an apical lysigenous region (cleistothecia).Order **ERYSIPHALES** p. 19
- f. Ostiole present. g
- g. Perithecia and stromata, if present, bright colored, soft and fleshy.Order **HYPOCREALES** p. 19
- g. Perithecia or stromatic wall, when present, or both, dull colored, leathery or carbonaceous. h
- h. Minute parasites on insects or arachnids; mycelium represented by a small number of basal cells functioning as haustorium and stalk.Order **LABOULBENIALES** p. 21

- h. Saprobiic or, if parasitic, rarely on insects; mycelium well developed. i
- i. Ostiole typically circular in section; if elongated, on a more or less globose perithecium.Order **SPHAERIALES** p. 19
- i. Ostiole an elongated slit on a usually flattened, elongate perithecium, bearing the asci in a flat basal layer.
.....Order **HYSTERIALES** p. 21
- j. Hymenium covered with a membrane until ascospores are mature, the membrane then splitting in stellate or irregular fashionOrder **PHACIDIALES** p. 21
- j. Hymenium not provided with a membrane splitting in stellate fashion. k
- k. Asci inoperculate, provided with a definite pore.Order **HELOTIALES** p. 22
- k. Asci operculate, or, in the Tuberales, not discharging spores. 1
- l. Ascocarp epigeic, at least at maturity; hymenium usual exposed before maturity of spores.Order **PEZIZALES** p. 22
- l. Ascocarp typically hypogeic, remaining closed.Order **TUBERALES** p. 22

EUROTIALES

- a. Peridium composed of loosely interwoven hyphae.Family **Gymnoascaceae**
Representative genera:*Ctenomyces, Arachniotis*
- a. Peridium pseudoparenchymatous. b
- b. Ascocarp sessile, minute; peridium weak, tardily and irregularly dehiscent.Family **Eurotiaceae**
Representative genera:*Monascus, Eurotium* (41)
for conidial stages:*Aspergillus* (43), *Penicillium* (42)
- b. Ascocarp stalked and capitate, subaerial, small to medium; peridium tough, opening above.Family **Onygenaceae**
Representative genera:*Onygena, Trichocoma*
- b. Ascocarp sessile, hypogeous, indehiscent; medium to large.Family **Elaphomycetaceae**
Representative genus:*Elaphomyces*

MYRIANGIALES

- a. Asci arising at various levels. b
- a. Asci arising in a single layer. d
- b. Thallus gelatinous, superficial on leaves, typically of yeast-like cells; tropical fungi growing on insect secretions.Family **Atichiaceae**
Representative genus:*Atichia*
- b. Thallus not superficial nor composed of yeast-like cells. c
- c. Stroma massive, homogeneous, naked.Family **Myriangiaceae**
Representative genus:*Myriangium* (44)

- c. Stroma effused, with gelatinous interior and crustose rind. Family **Elsinoaceae**
With the single genus: *Elsinoe*
- d. Stroma naked. Family **Saccardiaceae**
Representative genus: *Saccardia*
- d. Stroma with rind; locules immersed, the intervening stromatic tissue compressed to form pseudoparaphyses. Family **Dothioraceae**
Representative genus: *Botryosphaeria*

DOTHIDEALES

- a. Stroma massive, carbonaceous, often extensively branched; conceptacles borne singly at tips of branches, perithecium-like; often on living plants, associated with insect secretions. Family **Capnodiaceae**
Representative genera: *Capnodium*, *Scorias*
- a. Stroma pulvinate or flattened, not extensively branched, often simulating a perithecium or a group of perithecia; saprobic on vegetable debris, or parasitic. b
- b. Stroma pulvinate, usually with a single locule; dehiscence by an ostiole-like pore. Family **Pseudosphaeriaceae**
Representative genus: *Pleospora*
- b. Stroma pluriloculate. c
- c. Stroma lobed, each lobe containing a single locule which is finally widely open. Family **Coryneliaceae**
Representative genus: *Caliciopsis*
- c. Stroma not markedly lobed; locules immersed in groups. d
- d. Stroma, at maturity, erumpent and superficial. Family **Dothideaceae**
Representative genus: *Dibotryon* (45)
- d. Stroma, at maturity, covered by host tissues. Family **Phyllachoraceae**
Representative genus: *Phyllachora* (46)

HEMISPHERIALES

- a. Stroma subcuticular; mycelium scanty or lacking. Family **Stigmateaceae**
Representative genus: *Stigmatea*
- a. Stroma superficial. b
- b. Mycelium largely internal, forming a hypostroma. Family **Polystomellaceae**
Representative genera: *Parmulina*, *Polystomella*
- b. Internal mycelium scanty. c
- c. Stromatic cover not of radially arranged hyphae. Family **[Hemisphaeriaceae] Micropeltaceae**
Representative genera: *Micropeltis*, *Microthyriella* (49)

- c. Stromatic cover radial. d
- d. Superficial mycelium reticulate or lacking. Family **Microthyriaceae**
Representative genera: *Asterina* (48), *Microthyrium* (47)
- d. Superficial mycelium radial or parallel, forming a flat thallus, one cell thick. Family **Trichopeltaceae**
Representative genus: *Trichopeltis*
- d. Superficial mycelium irregular or lacking; ascomata with basal tissue; parasitic on other fungi. Family **Trichothyriaceae**
Representative genus: *Trichothyrium*

ERYSIPHALES

- a. Mycelium white. Family **Erysiphaceae**
Representative genera: *Erysiphe*, *Microsphaera*, (50) *Uncinula*, *Podosphaera*
- a. Mycelium dark. b
- b. Neither mycelium nor upper part of perithecium becoming gelatinous. Family **Meliolaceae**
Representative genus: *Meliola*
- b. Upper portion of perithecium becoming gelatinous at maturity, exposing asci. Family **Englerulaceae**
Representative genus: *Englerula*

HYPOCREALES

- a. Perithecia superficial; stroma present or absent. Family **Nectriaceae** b
- a. Perithecia partially to entirely immersed in a stroma or stromatic base. Family **Hypocreaceae** c
- b. Stroma lacking. Tribe Nectriaceae
Representative genus: *Nectria* (51)
- b. Stroma present. Tribe Creonectriaceae
Representative genus: *Creonectria* (52)
- c. Stroma seated directly on substratum, usually patellate or effused, rarely clavate and erect. Tribe Hypocreaceae
Representative genera: *Hypocrea* (53), *Hypomyces*
- c. Stroma arising from a sclerotium, usually clavate and erect, rarely depressed. Tribe Cordycipiteae
Representative genera: *Cordyceps* (54), *Claviceps*

SPHAERIALES

- a. Perithecia wholly or partly superficial. (Note, however, comment under m.) b
- a. Perithecia immersed in substratum or stroma, with mouth or neck only projecting. h
- b. Subiculum lacking, or at most arachnoid. c
- b. Stroma present. f
- c. Perithecial walls membranous. d

- c. Perithecial walls carbonaceous. e
 d. Perithecia hairy, especially above; asci
 deliquescent. Family **Chaetomiaceae**
 Representative genus: *Chaetomium* (56)
 d. Perithecia naked or sparsely setose; asci discharging
 spores forcibly. Family **Sordariaceae**
 Representative genera: *Sordaria* (57), *Sporormia*
 e. Mouths of perithecia papillate. Family **Sphaeriaceae**
 Representative genera: *Lasiosphaeria*, *Neurospora*
 e. Perithecia with long, often hair-like
 beaks. Family **Ceratostomataceae**
 Representative genera: *Ceratostomella*, *Ceratosphaeria*
 f. Perithecia caespitose, completely emergent from
 stroma, at least at maturity. Family **Cucurbitariaceae**
 Representative genus: *Cucurbitaria*
 f. Bases of perithecia persistently immersed. g
 g. Mouths of perithecia circular. Family **Amphisphaeriaceae**
 Representative genus: *Amphisphaeria*
 g. Mouths of perithecia compressed, elongate. Family **Lophiostomataceae**
 Representative genus: *Lophiostoma*
 h. Perithecia immersed in substratum; stroma lacking or
 poorly developed. i
 h. Perithecia typically immersed in stroma or under a
 stromatic crust (stroma rarely present in conidial
 stage only, and disappearing at maturity of perithecia). j
 i. Asci not notably thickened at tips; mouths of perithecia
 mostly papillate. Family **Mycosphaerellaceae**
 Representative genera: *Mycosphaerella*, *Venturia* (58), *Physalospora*
 i. Asci thickened at tips; perithecia usually
 beaked. Family **Gnomoniaceae**
 Representative genera: *Gnomonia* (59), *Glomerella*
 j. Stroma a shield-like crust over perithecia, through
 which the necks protrude (a clypeus). Family **Clypeosphaeriaceae**
 Representative genus: *Anthostomella*
 j. Stroma not a clypeus. k
 k. Stroma composed of mixed host and fungous elements. l
 k. Stroma composed wholly of fungous elements. m
 l. Conidia borne in cavities in stroma. Family **Valsaceae**
 Representative genera: *Valsa*, *Eutypella* (60), *Diaporthe*
 l. Conidia borne superficially on surface of
 stroma. Family **Melanconidaceae**
 Representative genus: *Cryptosporrella*
 m. Ascospores small, cylindrical, usually allantoid, hyaline to
 yellow-brown. In several genera, of which *Calosphaeria*
 is the best known, the stroma is present only in the conidial
 stage, the perithecia developing under bark and often
 appearing superficial on wood when the bark is shed.
 Family **Diatrypaeae**
 Representative genera: *Diatrype* (61), *Calosphaeria*

- m. Ascospores various, but not as above. n
 n. Conidia typically borne in hollow chambers in stroma;
 ascospores 1-∞-celled, hyaline or
 brown. Family **Melogrammataceae**
 Representative genus: *Endothia*
 n. Conidia borne in superficial layer on surface of
 young stroma; ascospores 1-(rarely 2-) celled, blackish
 brown. Family **Xylariaceae**
 Representative genera: *Rosellinia*, *Nummularia*, *Ustulina*,
Hypoxylon, *Daldinia*, *Xylaria* (62)

LABOULBENIALES

- a. Antheridia lacking; spermatia borne exogenously on spe-
 cialized branches of appendages. Family **Ceratomycetaceae**
 Representative genus: *Ceratomyces*
 a. Antheridia present. b
 b. Antheridia unicellular, flask-shaped. Family **Laboulbeniaceae**
 Representative genera: *Laboulbenia* (55), *Stigmatomyces*
 b. Antheridia compound, the several cells discharging
 spermatia into a common cavity, whence they are
 later freed. Family **Peyritsiellaceae**
 Representative genus: *Rickia*

HYSTERIALES

- a. Ascocarps at first immersed in host tissue, then erumpent. b
 a. Ascocarps superficial from the first. c
 b. Walls black, tough-leathery. Family **Dichaenaceae**
 With the single genus: *Dichaena*
 b. Walls gray or black, thick, corky. Family **Ostropaceae**
 Representative genus: *Ostropa*
 c. Ascocarps black, carbonaceous; round or
 elongated. Family **Hysteriaceae**
 Representative genera: *Glonium*, *Hysterographium* (63)
 c. Ascocarps brown, tough-membranous, clavate,
 erect. Family **Acrospermaceae**
 Representative genus: *Acrospermum*

PHACIDIALES

- a. Ascocarps soft, fleshy; bright colored,
 never black. Family **Stictidaceae**
 Representative genera: *Stictis*, *Propolis*
 a. Ascocarps leathery or carbonaceous, black. b
 b. Ascocarps, immersed, finally erumpent; hypothecium
 thick. Family **Tryblidiaceae**
 Representative genus: *Tryblidium*

- b. Ascocarps remaining imbedded in host tissue or in stroma; hypothecium thin.Family **Phacidiaceae**
Representative genera:*Clithris* (64), *Rhytisma*, *Lophodermium*

HELOTIALES

- a. Ascocarps clavate or pileate, the hymenium covering the convex upper portion.Family **Geoglossaceae**
Representative genera: *Geoglossum*, *Leotia* (65)
- a. Ascocarps discoid, typically cupulate or saucer-shaped. b
- b. Apothecia leathery, horny, cartilaginous or gelatinous; tips of paraphyses united at tips to form an epithecium; asci thick-walled.Family **Patellariaceae**
Representative genera:*Patellaria*, *Cenangium*, *Phaeobulgaria*
- b. Apothecia usually fleshy or waxy, rarely gelatinous; tips of paraphyses not forming an epithecium; asci thin-walled. c
- c. Peridium of rounded or angular, mostly thick-walled and dark cells forming a pseudoparenchyma.Family **Mollisiaceae**
Representative genera:*Mollisia*, *Pseudopeziza*
- c. Peridium of elongate, thin-walled and bright colored hyphae, arranged in parallel strands.Family **Helotiaceae**
Representative genera:*Helotium*, *Sclerotinia* (66), *Chlorosplenium*

PEZIZALES

- a. Fructification a pear-shaped stroma with numerous apothecial pits; parasitic.Family **Cyttariaceae**
Representative genus:*Cyttaria*
- a. Saprobiic; widely distributed. b
- b. Apothecia cup-shaped or discoid; sessile or stipitate.Family **Pezizaceae**
Representative genera:*Lamprospora*, *Ascobolus*, *Pyronema*, *Humaria*, *Patella*, *Bulgaria*, *Urnula*, *Peziza* (67)
- b. Ascocarps pileate and stipitate, or columnar.Family **Helvellaceae**
Representative genera:*Helvella*, *Morchella* (67a)

TUBERALES

- With the singleFamily **Tuberaceae**
Representative genera:*Genea*, *Tuber*

BASIDIOMYCETES

- a. Basidia septate or deeply divided, or arising from a teliospore or probasidium; basidiospores often germinating by repetition, or by the production of conidia.....
.....Subclass **HETEROBASIDIOMYCETES** p. 23
- a. Basidia always simple, cylindrical, urniform, or broadly clavate; probasidium not as a rule differentiated; basidiospores, on germination, usually producing a mycelium directly.Subclass **HOMOBASIDIOMYCETES** p. 24

HETEROBASIDIOMYCETES

- a. Basidiocarp usually well developed, often gelatinous, but varying to waxy or coriaceous; mostly saprobes, sometimes parasitic on mosses, vascular plants, insects or other fungi.Order **TREMELLALES** p. 23
- a. Basidiocarp represented by a mass of probasidia, often compound (teliospores), with or without a peridium; accessory spore forms present or absent; always parasitic on vascular plants. b
- b. Epibasidium, or less commonly contents of teliospore, divided transversely into (usually) four cells, each producing a single basidiospore on a sterigma; basidiospores sometimes germinating by repetition but not budding. Spore-masses often yellow or orange. The rusts.Order **UREDINALES** p. 24
- b. Epibasidia septate or not, bearing sessile basidiospores ("sporidia") usually capable of germinating in yeast-like fashion, occasionally by repetition; teliospores rarely germinating to produce a mycelium directly. Spore-masses usually black. The smuts.
.....Order **USTILAGINALES** p. 24

TREMELLALES

- a. Epibasidia inflated, spore-like, finally cut off by septa from hypobasidium.Family **Tulasnellaceae**
Representative genera:*Tulasnella* (68), *Gloeotulasnella*
- a. Epibasidia neither spore-like nor notably inflated. b
- b. Probasidia cylindrical to narrowly clavate; basidia not septate but becoming furcate by the development of two thick epibasidia at either side of tip of hypobasidium.Family **Dacrymycetaceae**
Representative genera:*Dacrymyces* (69), *Calocera*, *Guepinia*
- b. Basidia at length septate, not furcate. c
- c. Probasidia subglobose, ovate or pyriform, or rarely broadly fusiform; primary septum longitudinal or oblique; secondary septa at right angles to primary. d
- c. Probasidia cylindrical, narrowly fusiform or globose, they, or the epibasidia arising from them, becoming transversely septate. f
- d. Basidia catenulate, epibasidia and sterigmata lacking.Family **Sirobasidiaceae**
With the single genus:*Sirobasidium* (70)
- d. Basidia not catenulate; epibasidia usually present. e
- e. Gymnocarpous; widely distributed.Family **Tremellaceae**
Representative genera:*Tremella* (71), *Exidia*, *Sebacina*
- e. Hemiangiocarpous; spores retained within a gelatinous sheath; known only from the tropics.Family **Hyaloriaceae**
With the single genus:*Hyaloria*

- f. Angiocarpous; basidiospores sessile.Family **Phleogenaceae**
 Representative genus:[*Pilacre*] *Phleogena* (73)
- f. Gymnocarpous; basidiospores borne on sterigmata. g
- g. Parasitic on scale insects, forming a characteristic lich-
 enoid growth on woody plants.Family **Septobasidiaceae**
 With the single genus:*Septobasidium*
- g. Saprobic or rarely parasitic on vascular plants, mosses,
 or other fungi.Family **Auriculariaceae**
 Representative genera:*Auricularia* (74), *Helicogloea*,
Platygloea, *Helicobasidium* (75)

UREDINALES

- a. Teliospores sessile, in crusts, cushions or cylindrical
 masses, or solitary or in clusters in mesophyll or epidermis
 of hosts.Family **Melampsoraceae**
 Representative genera: *Uredinopsis*, *Cronartium*, *Melampsora* (77),
Coleosporium (76)
- a. Teliospores usually stalked, separate or held together in
 gelatinous masses; sometimes several on a common stalk;
 less commonly sessile, catenulate, breaking apart. Family **Pucciniaceae**
 Representative genera:*Gymnosporangium*, *Uromyces* (78),
Puccinia (79), *Phragmidium* (80)

USTILAGINALES

- a. Fructification cupulate, with relatively thick peridium;
 teliospores catenulate, mostly interspersed with erect
 fascicles of sterile hyphae. On palms in warmer
 regions.Family **Graphioloaceae**
 With the single genus:*Graphiola*
- a. Fructification not cupulate; a mass of teliospores, some
 of them sometimes sterile, with or without a sterile
 peridial sheath. Widely distributed on various hosts. b
- b. Teliospores, on germination, giving rise to transversely
 septate epibasidia, producing a series of basidiospores
 ("sporidia") from each cell; rarely forming a mycelial
 hypha directly.Family **Ustilaginaceae**
 Representative genera: *Ustilago* (81), *Sphacelotheca*, *Sorosporium*
- b. Teliospores, on germination, giving rise to non-septate
 epibasidia bearing a cluster of elongated basidiospores
 at the tip.Family **Tilletiaceae**
 Representative genera:*Tilletia* (82), *Urocystis*

HOMOBASIDIOMYCETES

- a. Basidiocarp lacking; parasitic on vascular plants, the
 hymenium covering the surface of the modified and often
 hypertrophied host tissues.Order **EXOBASIDIALES** p. 25

- a. Basidiocarp present, varying from an arachnoid subiculum
 bearing a loose hymenium to a complex and highly spe-
 cialized sporocarp. b
- b. Hymenium present, often exposed from the beginning,
 always before the spores are matured.Order **AGARICALES** p. 25
- b. Hymenium present or absent; basidiocarp remaining
 closed until after the spores have been discharged from
 the basidia, sometimes permanently. (Gasteromycetes). c
- c. Hymenium present in early stages, lining chambers of
 gleba. d
- c. Hymenium lacking or indistinct. f
- d. Gleba fleshy or waxy; sometimes slimy and fetid at ma-
 turity, but if so, not exposed.Order **HYMENOGASTRALES** p. 26
- d. Gleba not fleshy nor waxy. e
- e. Gleba slimy and fetid at maturity and exposed on an
 elongated or enlarged receptacle.Order **PHALLALES** p. 26
- e. Gleba powdery and dry at maturity; spores commonly
 small, pale under lens.Order **LYCOPERDALES** p. 27
- f. Gleba powdery at maturity; chambers usually not sep-
 arating from peridium nor from each other; spores
 commonly large, dark.Order **SCLERODERMATALES** p. 27
- f. Gleba waxy; chambers with distinct walls forming peri-
 dioles which serve as disseminules.Order **NIDULARIALES** p. 27

EXOBASIDIALES

- Including only theFamily **Exobasidiaceae**
 Representative genus:*Exobasidium*

AGARICALES

- a. Hymenium smooth, or merely roughened or corrugated. b
- a. Hymenium covering the surface of spines, pores or lamellae. c
- b. Basidiocarp arachnoid, membranous, leathery or
 woody; hymenium inferior.Family **Thelephoraceae**
 Representative genera:*Corticium*, *Peniophora*, *Stereum* (83),
Hymenochaete (84), *Tomentella*, *Thelephora*
- b. Basidiocarp erect, simple or branched; fleshy or
 rarely gelatinous, cartilaginous or tough; hymenium
 amphigenous.Family **Clavariaceae**
 Representative genera:*Clavaria* (85), *Pistillaria*
- c. Hymenium covering downward-directed spines, warts or
 teeth.Family **Hydnaceae**
 Representative genera:*Odontia* (86), *Radulum*, *Steccherinum*,
Sarcodon, *Dentinum* (87), *Hydnum*
- c. Hymenium borne on surface of pores or gills. d
- d. Basidiocarp woody, tough or membranous, rarely sub-
 fleshy; hymenophore poroid or pitted, or rarely more or
 less lamellate.Family **Polyporaceae**

- Representative genera:*Merulius, Fistulina, Polyporus* (88),
Poria, Fomes, Lenzites
- d. Basidiocarp soft, fleshy, putrescent; hymenophore poroid, the pores typically separable. Family **Boletaceae**
Representative genera:*Boletus, Boletinus, Strobilomyces*
- d. Basidiocarp usually fleshy, sometimes tough or membranous; hymenophore lamellate or plicate, the gills rarely separable. Family **Agaricaceae** e
- e. Hymenium plicate, the folds obtuse. Tribe **Cantharelleae**
Representative genus:*Cantharellus* (89)
- e. Hymenium clearly lamellate. f
- f. Basidiocarp tough or membranous, not putrescent; reviving when moistened. Tribe **Marasmiaceae**
Representative genera:*Marasmius* (90), *Panus, Heliomycetes*
- f. Basidiocarp subfleshy to fleshy, putrescent. g
- g. Gills waxy, broad, sharp, more or less separable. Tribe **Hygrophoreae**
Representative genera:*Hygrophorus, Gomphidius*
- g. Gills thin, fleshy. h
- h. Trama vesiculose; texture usually brittle. Tribe **Lactariaceae**
Representative genera:*Lactarius, Russula* (91)
- h. Trama not vesiculose; texture usually fleshy. i
- i. Gills not autodeliquescent; spores variously colored, rarely black. Tribe **Agariceae**
Representative genera:*Agaricus, Hypholoma, Panaeolus, Clitopilus, Cortinarius, Pholiota, Pleurotus, Amanita* (92), *Lepiota, Armillaria, Tricholoma, Collybia*
- i. Gills autodeliquescent; spores black. Tribe **Coprineae**
Representative genus:*Coprinus* (93)

HYMENOGASTRALES

- a. Basidiocarp minute, with a single glebal cavity. Family **Protogasteraceae**
Representative genus:*Gasterella*
- a. Gleba compound, with numerous chambers. b
- b. Stem prolonged into a distinct columella reaching apex; dehiscence by separation of base of peridium from stem. Family **Secotiaceae**
Representative genera:*Endoptychium* (94), *Podaxis*
- b. Columella lacking or not reaching apex; indehiscent. c
- c. Tramal plates radiating from base, not closely connected with peridium. Family **Hysterangiaceae**
Representative genera:*Hysterangium, Phallogaster* (95)
- c. Tramal plates arising from peridium. Family **Hymenogastraceae**
Representative genera:*Hymenogaster, Rhizopogon*

PHALLALES

- a. Gleba borne on inner portion or between the arms of the receptacle. Family **Clathraceae**

- Representative genera:*Clathrus, Simblum*
- a. Gleba borne on outer portion of simple receptacle. Family **Phallaceae**
Representative genera:*Matinus, Phallus* (96)

LYCOPERDALES

- a. Peridium crumbling away after maturity; glebal chambers remaining intact and falling apart as fine sandlike particles. Family **Arachniaceae**
With the single genus:*Arachnion*
- a. Inner part of peridium persistent; glebal chambers disintegrating into a powdery mass. b
- b. Peridium of two layers; dehiscence various but never by splitting of outer portion into stellate rays leaving inner peridium intact. Family **Lycoperdaceae**
Representative genera:*Lycoperdon* (97), *Calvatia, Bovista*
- b. Peridium of four layers; inner peridium remaining intact and opening by a definite stoma; outer layers remaining united and splitting in stellate fashion, or outermost layer separating and remaining in ground as a cup, the two middle layers splitting and elevating the inner peridium with the spores. Family **Geastraceae**
Representative genera:*Geastrum* (98), *Myriostoma*

SCLERODERMATALES

- a. Sessile, or with a stalk-like base. b
- a. With a distinct, firm or gelatinous stalk. c
- b. Peridium without a distinct, separable outer layer. Family **Sclerodermataceae**
Representative genera:*Scleroderma* (99), *Pisolithus*
- b. Peridium with a distinct outer layer which at maturity splits in stellate fashion, exposing the persistent inner peridium. Family **Astraeaceae**
With the single genus:*Astraeus* (100)
- c. Stalk firm, fibrous; peridium membranous. Family **Tulostomataceae**
Representative genus:*Tulostoma* (102)
- c. Stalk and outer portion of peridium gelatinous. Family **Calostomataceae**
With the single genus:*Calostoma*

NIDULARIALES

- a. Glebal chambers (peridioles) remaining attached or free within outer peridium. Family **Nidulariaceae**
Representative genera:*Cyathus, Crucibulum* (101)
- a. Single glebal chamber violently discharged at maturity. Family **Sphaerobolaceae**
Representative genus:*Sphaerobolus*

FUNGI IMPERFECTI

- a. Fructification determinate, at first closed (Coelomycetes). b
 a. Fructification indeterminate, superficial or lacking. c
 b. Conidia borne in pycnidia or
 chambered cavities.Form order PHYLLOSTICTALES p. 28
 b. Conidia borne in acervuli, definitely circumscribed and
 finally free on substratum.Form order MELANCONIALES p. 28
 c. Conidiophores superficial, entirely free or bound in tufts
 or clusters.Form Order MONILIALES p. 28
 c. No spores known; mycelium or masses of fungous
 cells.MYCELIA STERILA p. 29

PHYLLOSTICTALES

- a. Pycnidia more or less globose, ostiolate or closed. b
 a. Pycnidia not globose when mature. c
 b. Walls dark, tough, leathery or
 carbonaceous.Form Family [Sphaerioidaceae] Phyllostictaceae
 Representative genera:*Phyllosticta*, *Phoma*, *Sphaeropsis*,
 Diplodia, *Septoria* (103)
 b. Walls or stroma bright-colored, fleshy or
 waxy.Form Family Nectrioidaceae
 Representative genus:*Zythia*
 c. Pycnidia dimidiate, usually radiate or
 hysterioid.Form Family Leptostromataceae
 Representative genus:*Leptothyrium*
 c. Pycnidia at length cupulate or
 discoid.Form Family Excipulaceae
 Representative genera:*Sporonema*, *Discella*, *Dinemasporium* (104)

MELANCONIALES

- With the singleForm family Melanconiaceae
 Representative genera:*Colletotrichum*, *Gloeosporium*,
 Pestalotia, *Coryneum* (105)

MONILIALES

- a. Hyphae scantily developed or nearly lacking; propagation
 by budding (false yeasts) b
 a. Hyphae present, well developed; reproduction not usually
 by budding. b
 b. Never germinating by
 repetition.Form family Pseudosaccharomycetaceae
 Representative genus:*Pseudosaccharomyces*
 b. Cells reproducing by budding and also germinating by
 repetition, as do the basidiospores of many of the
 Tremellales, of which these forms may be regarded as
 imperfect species.Form family Sporobolomycetaceae

- Representative genus:*Sporobolomyces* (106)
 c. Neither conidiophores nor hyphae bound together. d
 c. Conidiophores and often hyphae united into characteristic
 fructifications. e
 d. Hyphae, conidiophores and conidia hyaline or bright
 colored.Form family Moniliaceae
 Representative genera:*Verticillium* (107), *Botrytis*,
 Cephalothecium
 d. Hyphae or conidia, or both, dull colored, brownish
 to black.Form family Dematiaceae
 Representative genera:*Torula*, *Streptothrix* (108),
 Cladosporium, *Alternaria* (109)
 e. Conidiophores united into a
 coremium.Form family [Stilbaceae] Stilbellaceae
 Representative genera:*Coremium*, *Stilbella* (110), *Isaria*, *Graphium*
 e. Hyphae and conidiophores combined
 in a sporodochium.Form family Tuberculariaceae
 Representative genera:*Volutella*, *Tubercularia*, *Ecosporium* (111)

MYCELIA STERILA

- Not divided into form families.
 Representative genera:*Rhizoctonia*, *Sclerotium*

SPORE SECTIONS OF IMPERFECT FUNGI

Used within the families, in any case, however, carrying the divisions only to the point demanded by convenience.

Conidia 1-celled, globose, oval or short-cylindrical.	I. AMEROSPORAE
Conidia hyaline or bright.	1. <i>Hyalosporae</i>
Distinction between hyphae and conidia slight, or hyphae lacking.	a. Micronemeae
Hyphae elongate, distinct from conidia.	b. Macronemeae
Conidia dark or swarthy.	2. <i>Phaeosporae</i>
Distinction between hyphae and conidia slight, or hyphae lacking.	a. Micronemeae
Hyphae elongate, distinct from conidia.	b. Macronemeae
Conidia 2-celled, ovate or elongate.	II. DIMEROSPORAE
Hyaline or bright.	1. <i>Hyalodidymae</i>
Dark or swarthy.	2. <i>Phaeodidymae</i>
Conidia oblong to fusoid, transversely septate into 3 or more cells.	III. PHRAGMOSPORAE
Hyaline or bright.	1. <i>Hyalophragmiae</i>
Dark or swarthy.	2. <i>Phaeophragmiae</i>
Conidia ovate to elongate, muriform.	IV. DICTYOSPORAE
Hyaline or bright.	1. <i>Hyalodictyae</i>
Dark or swarthy.	2. <i>Phaeodictyae</i>
Conidia acicular to filiform, 1-∞-celled, hyaline or dark.	V. SCOLECOSPORAE
Conidia cylindric, spirally coiled, 1-∞-celled, hyaline or dark.	VI. HELICOSPORAE
Conidia stellate or irregular, 1-∞-celled, hyaline or dark.	VII. STAUROSPORAE

LICHENS

In Zahlbruckner's general treatment of the lichens of the world, over sixty families are recognized. No less than forty-six are listed in Fink's Lichen flora of the United States. The latter work has complete keys and descriptions of nearly all species reported from this wide area. It is deemed unnecessary to attempt to duplicate Fink's work by including a key to all lichen families in the present summary, but in the interest of completeness and to emphasize the fact that lichens are regarded as fungi, eventually to be distributed amongst the other fungi, a key to the orders and brief references to a few of the principal families and their representative genera are inserted. A lichen thallus is a specialized structure in essentially the same sense that a *Gymnosporangium* gall on a cedar tree is a specialized and characteristic structure. Both are the result of two organisms, host and parasite, reacting upon each other; the obvious differences may be very largely explained by the fact that in the case of the cedar apple the host is much larger than the parasite, while in the case of a lichen thallus the reverse is true. In lichens, such as those belonging to the genus *Collema*, where the development of the algal host is relatively extensive, it exercises a proportionately great influence upon the character and appearance of the lichen thallus.

a. Spores of perfect stage borne in asci.Form subclass ASCOLICHENES p. 31

a. Spores of perfect stage borne on basidia.Form subclass BASIDIOLICHENES p. 33

ASCOLICHENES

a. Asci early disintegrating; spores, interspersed with elongate paraphyses, forming a mazaedium.	Form order CALICIALES p. 32
a. Not forming a mazaedium.	b
b. Asci borne in perithecia.	Form order PYRENULALES p. 32
b. Asci not borne in perithecia; ascocarp more or less open, discoid or hysterioid, with asci in hymenium.	c
c. Ascocarps mostly elongate or angular, rarely discoid.	Form order GRAPHIDIALES p. 32
c. Ascocarps typical apothecia, with round disk.	Form order LECANORALES p. 32

CALICIALES

A small order, in which the character of the fructification suggests relationship with the Eurotiales, particularly the Onygenaceae. The best known family is the **Caliciaceae**, represented by the genera *Calicium* and *Mycocalicium* (113) in which the small but rather striking stalked and capitate ascocarps arise from a usually inconspicuous or evanescent but widespread thallus.

PYRENULALES

This order includes all lichens in which the ascocarp takes the form of a typical flask-shaped perithecium, with a small ostiole. The suggested relationships are with the pyrenomycete orders, and particularly the Sphaeriales and Hypocreales. The most important families are the **Verrucariaceae**, represented by *Verrucaria*, the species of which often occur on wet or partially submersed rocks, and the **Dermatocarpaceae**, represented by *Dermatocarpon* (112), several species of which are widely distributed and common.

GRAPHIDIALES

The genera included in this order are assigned to the Hysteriales in Fink's manual. Most of the genera probably do belong in that order, but some exhibit suggestive resemblances to certain of the Patellariaceae, hence it seems preferable to retain for this group a name definitely restricted to lichens. The family **Graphidiaceae**, with the proper exciple usually well developed and dark, is represented by the genus *Graphis* (114) containing numerous species, some widely distributed and common.

LECANORALES

This enormous order contains nearly three-fourths of all the lichens. The numerous genera, differing widely in the character of the thallus, agree in possessing ascocarps that are always recognizable as apothecia, although sometimes greatly modified. Some of the larger and more familiar genera are:

Collema. The algal host is *Nostoc* and in color and gelatinous consistency the thallus exhibits marked similarity to large

colonies of the host. Several species are common on soil and rocks throughout much of the United States.

Peltigera (115). In this genus the algal host also belongs to *Nostoc* or a related genus of blue-green algae, but the influence of the host is less apparent. The thallus is foliose, usually large, and commonly occurs on soil or moss-covered rocks.

Rhizocarpon. This and the related genus *Lecidia*, are characterized by a crustose, usually rather inconspicuous thallus, often on rocks. The apothecia, rather consistently suggesting those of the Patellariaceae, are sometimes prominent.

Cladonia (116). This very large genus with many common species includes the familiar reindeer lichens and cup lichens. The primary thallus is crustose or squamulose and inconspicuous, but it gives rise to podetia which may persist long after the primary thallus has disappeared.

Gyrophora. The thallus is foliose, greenish-gray above, black below and is attached by an umbilicus, usually to rocks. The apothecial disk is often grooved, making it appear compound.

Parmelia. The thallus is foliose or somewhat fruticose, often large and with prominent apothecia. Many species are common, usually occurring on trees.

Usnea. The thallus is definitely fruticose, in the commoner species pendent, the long branches with apothecia at their tips.

Physcia (117). Thallus medium sized, foliose, with radiating lobes, the apothecia usually clustered at the center. *Physcia stellaris* is one of the commonest lichens in the United States and is perhaps more often used as an example in elementary classes than any other species.

BASIDIOLICHENES

A small group containing only four genera and few species. The fungus shows very close relationship with the Thelephoraceae and there is little doubt that these forms should be included in that family near *Stereum*. Nearly all tropical or subtropical, *Cora* (118) and *Dictyonema* are represented in Florida.

GLOSSARY

Certain terms of wider meaning are defined with reference to their mycological usage only. For other definitions see works of Jackson and Snell, cited in bibliography.

Acervulus—a disk-like or saucer-like, subcuticular or subepidermal, determinate group of conidiophores, sometimes with accessory structures, characteristic of the Melanconiales.

Aethalium—a Myxomycete fructification in which the plasmodium becomes aggregated into a continuous mass and fruits as a whole, hence usually comparatively large.

Allantoid—sausage-shaped; of spores.

Amoeboid—destitute of permanent cell wall and exhibiting changes of shape as in *Amoeba*; of plasmodium of Myxomycetes, and of the swarm-cells of these and the zoospores of certain Phycomycetes.

Amphigenous—of hymenium, when borne on all sides of hymenophore.

Angiocarpous—of a sporocarp, remaining closed at least until the maturity of the spores.

Antheridium—the male gametangium.

Apothecium—a cup-shaped or saucer-shaped, sometimes irregular ascocarp, in which the asci are borne in a usually clearly defined, exposed hymenium.

Arachnoid—like a cobweb.

Ascocarp—a specialized fruiting body in which asci are borne.

Ascogenous—ascus-producing (of certain hyphae); ascus-bearing (of fructifications or their parts).

Ascospore—a spore borne in an ascus, typically as the result of free cell formation, following karyogamy and at least three subsequent mitoses.

Ascus—a sac-like structure producing ascospores, typically following nuclear fusion.

Basidiocarp—a specialized fruiting body on or in which basidia are produced.

Basidiospore—a spore borne exogenously on a basidium, typically following karyogamy and subsequent divisions.

Basidium—a cell in which nuclear fusion is followed by

meiosis, after which the haploid nuclei pass into extensions of the wall which are separated as exogenous spores; or a morphologically equivalent structure in which fusion and meiosis do not occur.

Budding—a process of multiplication in unicellular fungi or spores in which a small outgrowth develops into a new cell; opposed to fission.

Capillitium—sterile, thread-like tubes or fibers occurring amongst the spores of various fungi, particularly Myxomycetes and Gasteromycetes.

Catenulate—occurring in chains or linear series. Often written *catenate*.

Chlamydospore—a spore formed by direct transformation of a portion of the mycelium; usually thick-walled and often undergoing a resting period.

Cleistothecium—a perithecium-like ascocarp lacking an ostiole, as in the Erysiphales.

Clypeus—a shield-like, stromatic growth covering the perithecia in certain Sphaeriales, and through which the necks protrude.

Coenocyte—a cell or larger unit with numerous nuclei enclosed within a common membrane.

Columella—a persistent sterile central axis in a fructification.

Conceptacle—ascus-bearing chamber in certain fungi; a stalked locule.

Conidiophore—a more or less specialized hymenial branch bearing conidia.

Conidium—an imperfect spore, produced neither as a direct result of karyogamy nor in a sporangium; typically pinched off from the tip of a hyphal branch; 1-many-celled; in certain Phycomycetes a modified sporangium.

Context—a fleshy, fibrous or woody pseudotissue which supports the trama in most of the larger and especially the pileate species of Agaricales; often regarded as synonymous with trama.

Coremium—a tuft of conidiophores united in columnar fashion.

Crustose—crust-like, especially of lichens when closely attached to the substratum and without distinct lower cortex.

Determinate—with sharply limited boundaries (of fructification).

Dichotomous—forking, usually repeatedly; cp. monopodial.

Dictydine granules—the same as plasmodic granules.

Endospore—(1) the inner layer of the wall of a spore having two or more layers; (2) spores formed internally and parthenogenetically, often resembling ascospores.

Epibasidium—a filament or outgrowth arising from the probasidium of a heterobasidiomycete upon which one or more usually sterigmate basidiospores are borne.

Epigeic—developing above the ground or substratum.

Epithecium—a distinct layer above the asci formed by the tips of paraphyses in many discomycetes.

Erumpent—bursting through; of fructifications formed beneath bark or other substratum, and then emerging.

Eucarpic—of fungi, when entire thallus is not transformed into a fructification; cp. holocarpic.

Exciple—outer layer of an apothecium. Often written *excipulum*. cp. proper, thalloid exciple.

Exogenous—developing on the outside, e.g., a basidiospore.

Exospore—the outer layer of the spore wall in spores with two or more wall layers.

Fission—splitting into two; of bacteria and a few species of unicellular fungi; cp. budding.

Flagellum—the whip-like organelle of a motile spore or gamete.

Foliose—of lichen thallus, when flat and more or less leaf-like.

Fruticose—of lichen thallus, when the branches are free from the substratum and usually more or less circular in section.

Fugaceous—evanescent; not persisting.

Gametangium—a structure in which gametes are produced, or the contents of which function in place of gametes.

Gamete—a reproductive cell which is capable of fusing with another, like or unlike, preceding karyogamy.

Gleba—the spore-bearing tissue in any angiocarpous fungous fructification, particularly in the Gasteromycetes.

Gymnocarpous—said of a sporocarp in which the spore-bearing region is exposed from the beginning or from an early stage.

Haustorium—a root-like or knob-like extension of the hypha of a parasitic fungus, which enters the host cell.

Holocarpic—of fungi, when entire thallus is transformed into a fructification; cp. eucarpic.

Hyaline—colorless and translucent.

Hymenium—a continuous layer of asci or basidia borne on a specialized area.

Hymenophore—that part of an ascocarp or basidiocarp upon which the hymenium is produced.

Hypha—a single fungous thread or filament.

Hypobasidium—the lower portion of the basidium of a heterobasidiomycete, after it has produced epibasidia.

Hypogeic—developing and attaining maturity beneath the surface of the earth.

Hypothallus—a horny base beneath the fructification of Myxomycetes.

Indehiscent—remaining unopened as, e.g., of certain hypogeic fungi.

Indeterminate—lacking a definite margin, esp. of fructification.

Intercellular—between cells; esp. of the mycelium of a parasitic fungus with reference to the cells of the host.

Intracellular—within cells; esp. of the mycelium or thallus of a parasitic fungus with reference to the cells of the host.

Karyogamy—nuclear fusion, usually as preceding the formation of specialized reproductive organs or spores.

Lamella—the gill of a mushroom, on which the hymenium is borne.

Locule—a cavity in a stroma, without perithecial wall, in which asci are produced.

Lysigenous—of a cavity or opening formed by the dissolving of cells.

Mazaedium—a capitate mass of ascospores usually interspersed with sterile elements as found in Onygenaceae and Caliciales.

Merosporangium—a cylindrical outgrowth from the swollen tip of the sporangiophore in certain of the Mucorales, the contents usually becoming divided into a chain-like series of sporangiospores.

Monopodial—a type of branching in which a single con-

tinuous axis gives off single branches, often in an alternate or spiral series; cp. dichotomous.

Mycelium—the aggregation of threadlike hyphae forming the assimilative portion of most fungi.

Myxamoeba—an amoeboid condition frequently assumed by the swarm-cell of a Myxomycete after retracting its flagellum.

Oidia—catenulate conidia, formed by direct transformation of a hypha.

Oogonium—a female reproductive structure, commonly a more or less spherical sac, containing, at maturity, one or more oospores.

Oospore—a resting spore produced in an oogonium as a result of the fusion of its contents with those of an antheridium; a similar structure produced parthenogenetically.

Ostiole—the morphologically differentiated opening in a perithecium through which spores are discharged; to be distinguished from a tear or a pore of lysigenous origin.

Paraphyses—sterile elements in the hymenium of Ascomycetes and Basidiomycetes, usually hairlike in the former, often clavate in the latter.

Parasite—a fungus living at the expense of another living organism. cp. saprophyte, saprobe.

Perfect stage—that stage in the life cycle of a fungus characterized by spores formed as a result of nuclear fusion, or by morphologically similar spores produced parthenogenetically.

Peridiole—a chamber of a gleba with a more or less independent wall of its own, often serving as the unit of dissemination.

Peridium—the wall layers of a spore-bearing structure in which the spores are developed in the interior; particularly in the Gasteromycetes and Myxomycetes; also applied to walls of apothecia and perithecia.

Periphyses—hairs lining the ostioles of many perithecia.

Periplasm—protoplasm in an oogonium which has not entered into oospore formation and is consequently left as a thin layer surrounding the oospore(s).

Perithecium—an enclosed structure, usually subglobose or flask shaped, surrounded by a definite wall and usually opening by an ostiole, in which asci are borne.

Plasmodic granules—microscopic, dark-colored granules, scattered, clustered or in lines on the outside of the peridium

or net and often on the spores of the Cribrariaceae. Also called dictydine granules.

Plasmodiocarp—a type of Myxomycete fructification in which the sporangia are sessile and vein-like, as though developed directly from the larger veins of the plasmodium.

Plasmodium—the semi-naked, multinucleate, motile and usually reticulate assimilative phase of a Myxomycete.

Podetium—an erect branch or stalk in certain lichens, arising from a primary thallus and bearing ascocarps.

Probasidium—the young stage of a basidium up to the time protuberances begin to develop; especially used of the Heterobasidiomycetes; sometimes thick-walled, as in the teliospores of rusts.

Proper exciple—an apothecial margin in lichens devoid of algal cells.

Pseudoaethalium—a dense cluster of myxomycete sporangia, simulating an aethalium, but in which the sporangia are distinct and separate.

Pseudocapillitium—in Myxomycetes: plates, tubes, or thread-like bodies in the fructification apparently not developed in direct connection with the sporogenous protoplasm, but representing the outer region of the plasmodial veins, or the walls of the constituent sporangia in a pseudoaethalium.

Pseudoparenchyma—a pseudotissue resembling parenchyma but formed by the modification and fusion of hyphal elements.

Pycnidium—a more or less globose or flask-like cavity or fructification in which conidia are borne; characteristic of the imperfect fungi belonging to the Phyllostictales.

Repetition—a type of spore germination in which a stalk is produced, at the tip of which a spore is formed morphologically similar to the first spore and forcibly discharged, the secondary spore often germinating in the same way.

Rhizoidal—used of a fungus in which the sterile portion of the thallus is composed of fine, usually branching, hair-like filaments.

Saprobe—an organism securing nourishment by absorption from dead organic matter.

Saprophyte—a plant securing nourishment by absorption from dead organic matter. Inadvisedly used of fungi.

Septum—a transverse wall in a hypha.

Sorus—a cluster of sporangia or of resting spores.

Spermatia—non-motile male gametes, as in Laboulbeniales.

Sporangiole—a small sporangium, without columella, usually relatively few-spored, characteristic of certain Mucorales.

Sporangiophore—a more or less specialized mycelial branch bearing a sporangium.

Sporangiospore—a spore borne in a sporangium.

Sporangium—a sac in which spores are formed as result of cleavage.

Spore—a general term for a reproductive structure in Cryptogams, commonly unicellular, but in the Fungi frequently multicellular.

Sporidia—term used for the spores borne upon the “promycelium” of the rusts and smuts, here regarded as basidiospores borne upon an epibasidium.

Sporocarp—a general term for a specialized fructification of any sort in or on which spores are produced.

Sporodochium—a determinate, cushion-like cluster of conidiophores, typically stromatic, characteristic of the Tuberculariaceae.

Sporophore—a more or less specialized branch of mycelium which bears spores; especially a conidiophore.

Sterigma—a stalk on a basidium upon which a basidiospore is borne, and from which it is as a rule forcibly discharged. Inadvisedly used for somewhat analogous structures in groups other than the Basidiomycetes.

Stroma—a cushion-like mass of fungous cells, or mixed fungous cells and host tissue, in or on which fructifications are developed.

Subiculum—an arachnoid or floccose mycelial web upon which fructifications are formed.

Suspensor—the swollen hyal tip bearing a gametangium in the Mucorales.

Swarm-cell—a motile cell issuing from the spore of a Myxomycete and functioning, with or without further division, as an isogamete.

Teliospore—the terminal stage in the life-cycle of a rust or smut, composed of one or more usually thick-walled probasidia; in a compound teliospore the constituent probasidia are arranged in characteristic fashion, varying with different genera.

Thalloid exciple—an apothecial margin in lichens provided with algal cells and similar to the thallus.

Thallus—a general term used for the vegetative portion of a non-vascular plant; as extended to fungi, the entire assimilative phase of the individual organism.

Trama—a pseudotissue bearing a hymenium. cp. context.

Verticillate—a type of branching in which a continuous main axis gives rise at intervals to whorls of subordinate axes.

Volva—an external envelope covering the young fructifications of certain Hymenomycetes and Gasteromycetes, and rupturing in course of development, remaining as a cup-like base.

Zoosporangium—a sporangium producing zoospores.

Zoospore—a motile sporangiospore.

Zygospor—a thick-walled spore produced as a result of the fusion of equal or morphologically similar gametangia; if produced without fusion, referred to as an *azygospor*.

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Not intended to be complete. The list includes the most important general works on the classification of the fungi, and many of the better known and more readily available treatments of special groups, with particular reference to those based on the fungi of the eastern United States and Canada. For a more extensive bibliography see Chapter XV of the Bessey text, pp. 393-468: "Guide to the literature for the determination of fungi."

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PLATE I. MYXOMYCETES. 1. Portion of plasmodium. 2. Swarm-cell (after Howard). 3. Fusion of swarm-cells to form zygote (after Howard). 4. *Ceratiomyxa fruticulosa*, portion of fructification, with single stalked spore at right. 5. *Hymenobolina parasitica*, in section. 6. *Dictydium cancellatum*, empty sporangium and spore with dictydine granules attached. 7. *Lycogala epidendrum*, aethalium, with portion of pseudocapillitium. 8. *Ophiotheca chrysosperma*, two plasmodiocarps and portion of capillitium. 9. *Arcyria denudata*, sporangium and portion of capillitium. 10. *Hemitrichia stipitata*, sporangium and portion of capillitium. 11. *Stemonitis fusca*, cluster of sporangia, single sporangium, detail of columella, capillitium and surface net, and spore. 12. *Diachea leucopodia*, sporangium. 13. *Physarum viride*, sporangium and detail of capillitium. 14. *Badhamia utricularis*, sporangium. 15. *Lamproderma columbinum*, sporangium, showing columella, capillitium and portion of persistent peridium. 16. *Didymium squamulosum*, sporangium, diagrammatic longitudinal section of same, crystal from peridium and spore. 17. *Fuligo septica*, aethalium.

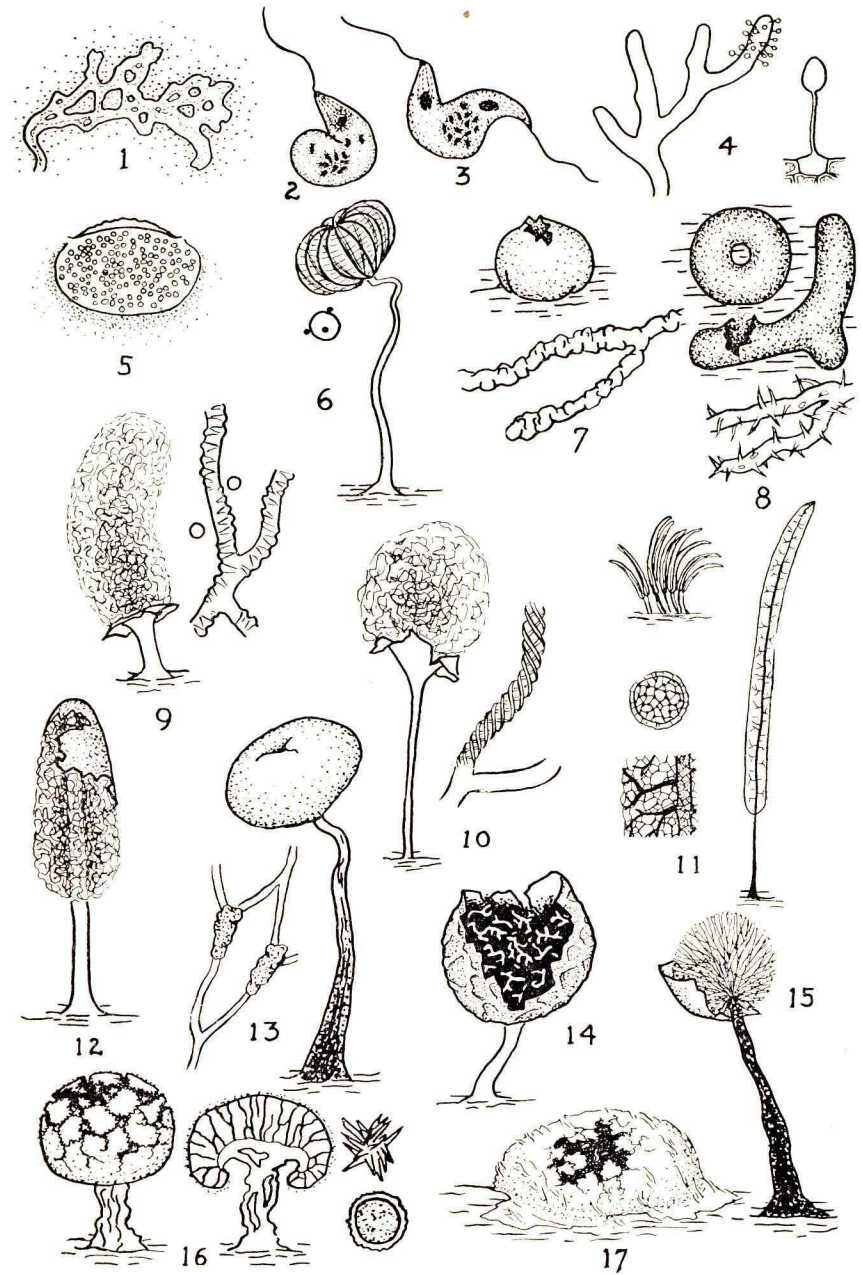


PLATE II. ARCHIMYCETES, OOMYCETES. 18. *Plasmodiophora Brassicae*, parasitized root of mustard; thallus in enlarged host cell with host nucleus still present; cell filled with spores. 19. *Olpidiopsis Saprolegniae*, two nearly mature thalli in gall on *Achlya*; emptied sporangium. 20. *Synchytrium decipiens*, mature uninucleate thallus and sorus with conidia-like sporangia. 21. *Rhizophidium Polysiphoniae* on *Callithamnion*. 22. *Myzocyttium proliferum* on *Cladophora*, oogonium, antheridium and two sporangial segments. 23. *Allomyces javanicus*, male and female gametangia, zoosporangium and resting spore. 24. *Achlya racemosa*, empty zoosporangium with spores encysted at tip and young proliferating zoosporangium; oogonium with oospores and antheridium. 25. *Phytophthora infestans*, conidiophore with conidia. 26. *Albugo candida*, portion of sorus on *Capsella*; detail of conidiophore with two conidia. 27. *Plasmopara viticola*, conidiophore with conidia.

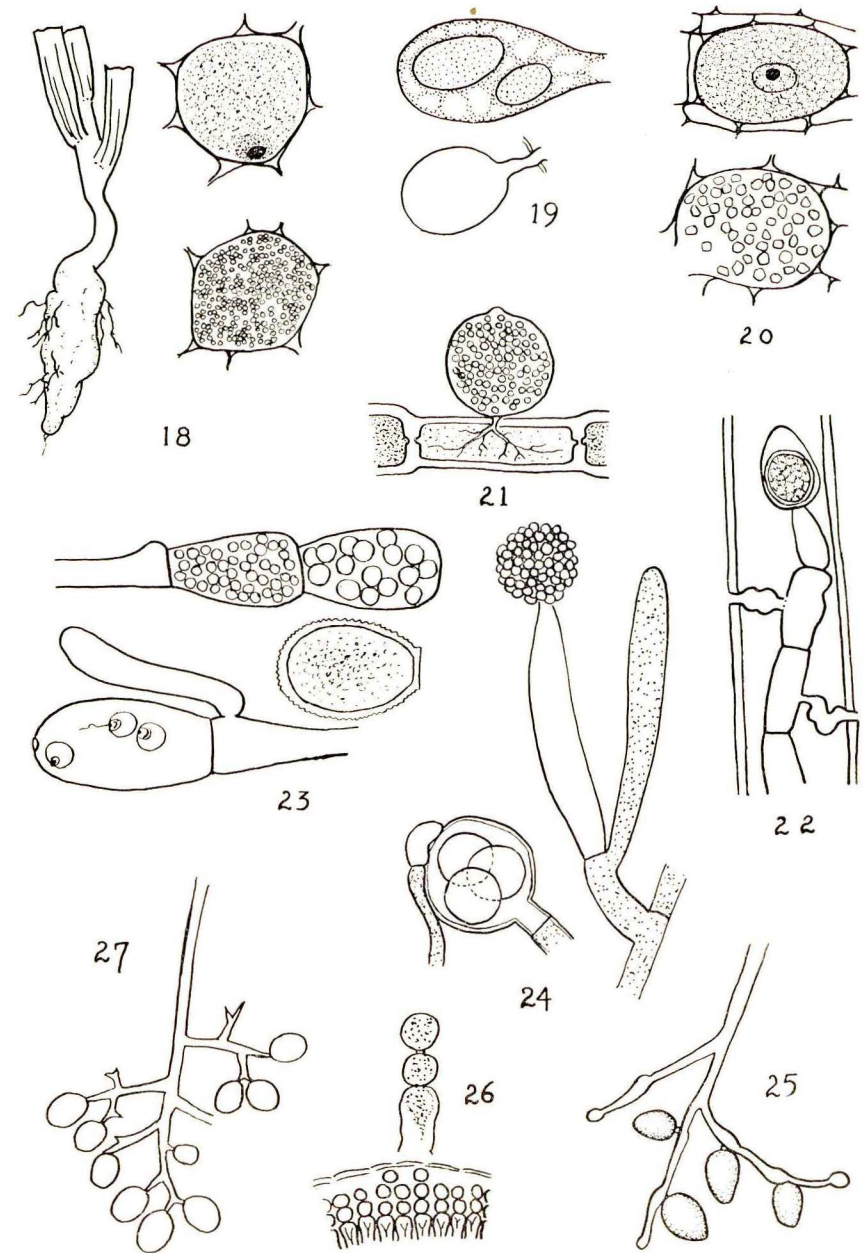


PLATE III. ZYGOMYCETES, HEMIASCOMYCETES.

28. *Rhizopus nigricans*, habit, showing clustered sporangiophores, stolons and rhizoids; columella; zygosporangium. 29. *Pilobolus Kleinii*, sporangiophore. 30. *Helicostylum piriforme*, tip of sporangiophore with sterile terminal spine and clusters of sporangioles; a single sporangiole and a sporangiospore. 31. *Syncephalastrum racemosum*, tip of sporangiophore with radiating merosporangia; a single merosporangium. 32. *Cunninghamella echinulata*, tip of conidiophore with four conidial heads; a single conidium. 33. *Mortierella candelabrum*, sporangiophores and non-columellate sporangia. 34. *Haplosporangium lignicola*, conidiophore and conidium. 35. *Delacroixia coronata*, conidiophore with conidium; conidium germinating by repetition; resting spore. 36. *Empusa muscae*, dead fly from which spores have been discharged; detail of conidiophore and conidium; resting spore. 37. *Dipodascus albidus*, ascus. 38. *Ascoidea rubescens*, conidium and new ascus proliferating through emptied ascus. 39. *Saccharomyces cerevisiae*, budding cell and ascus. 40. *Taphrina communis*, healthy and diseased plum; ascus with basal cell.

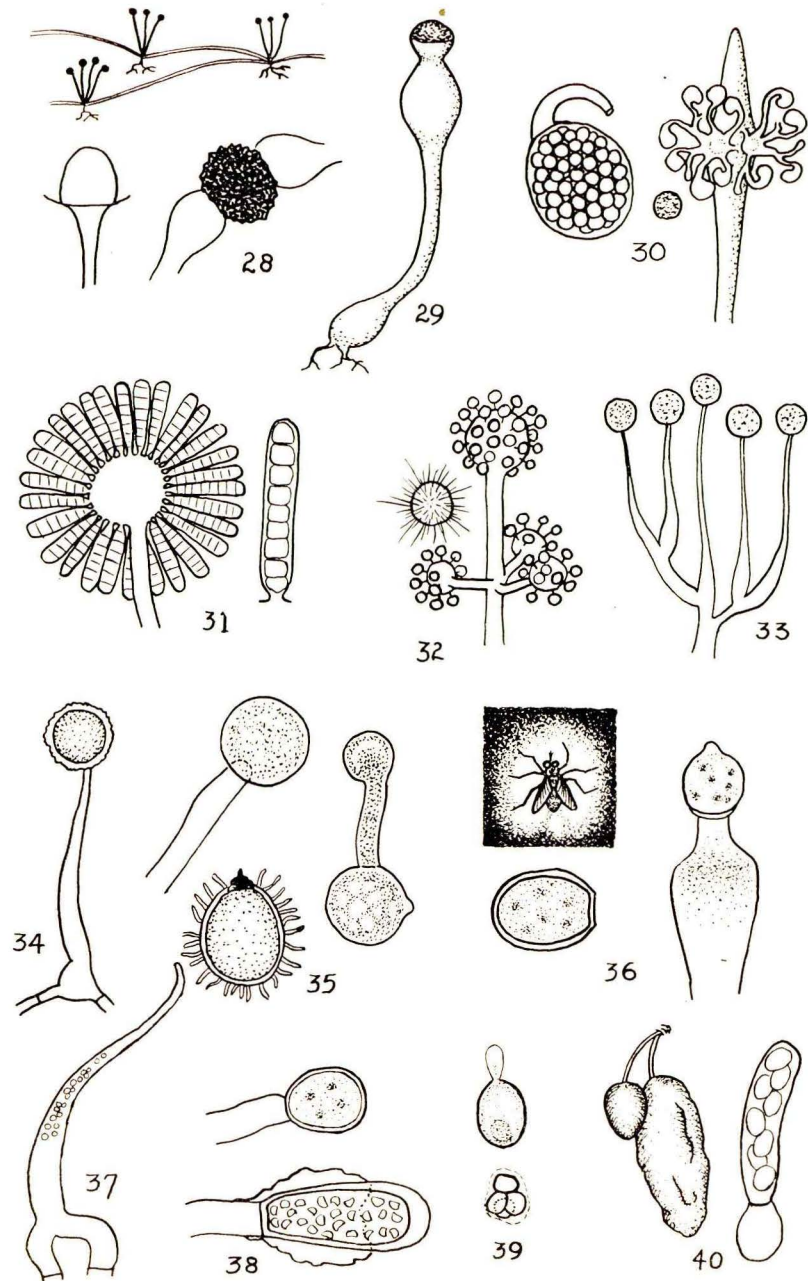


PLATE IV. EUASCOMYCETES. 41. *Eurotium* sp., section of ascocarp; ascospores, two aspects. 42. *Penicillium* sp., conidiophore with chains of conidia. 43. *Aspergillus* sp., conidiophore with chains of conidia. 44. *Myriangium asterinosporum*, fertile lobe of thallus; locule with ascus; ascospore. 45. *Dibotryon morbosum*, stroma on twig of plum, locules in stromatic lobes. 46. *Phyllachora graminis*, stromata on grass leaf; locules in stroma. 47. *Microthyrium microscopicum*, radiate stroma, from above. 48. *Asterina pulchella*, diagram of longitudinal section of stroma. 49. *Microthyriella rubi*, ascus and ascospore. 50. *Microsphaera alni*, cleistothecium with appendage; ascus. 51. *Nectria* sp., perithecium and ascospore. 52. *Creonectria cinnabarina*, group of perithecia on stroma. 53. *Hypocrea sulphurea*, perithecia immersed in stroma; ascus. 54. *Cordyceps militaris*, clavate stroma arising from insect pupa; diagram of longitudinal portion of head; single perithecium; ascospore.

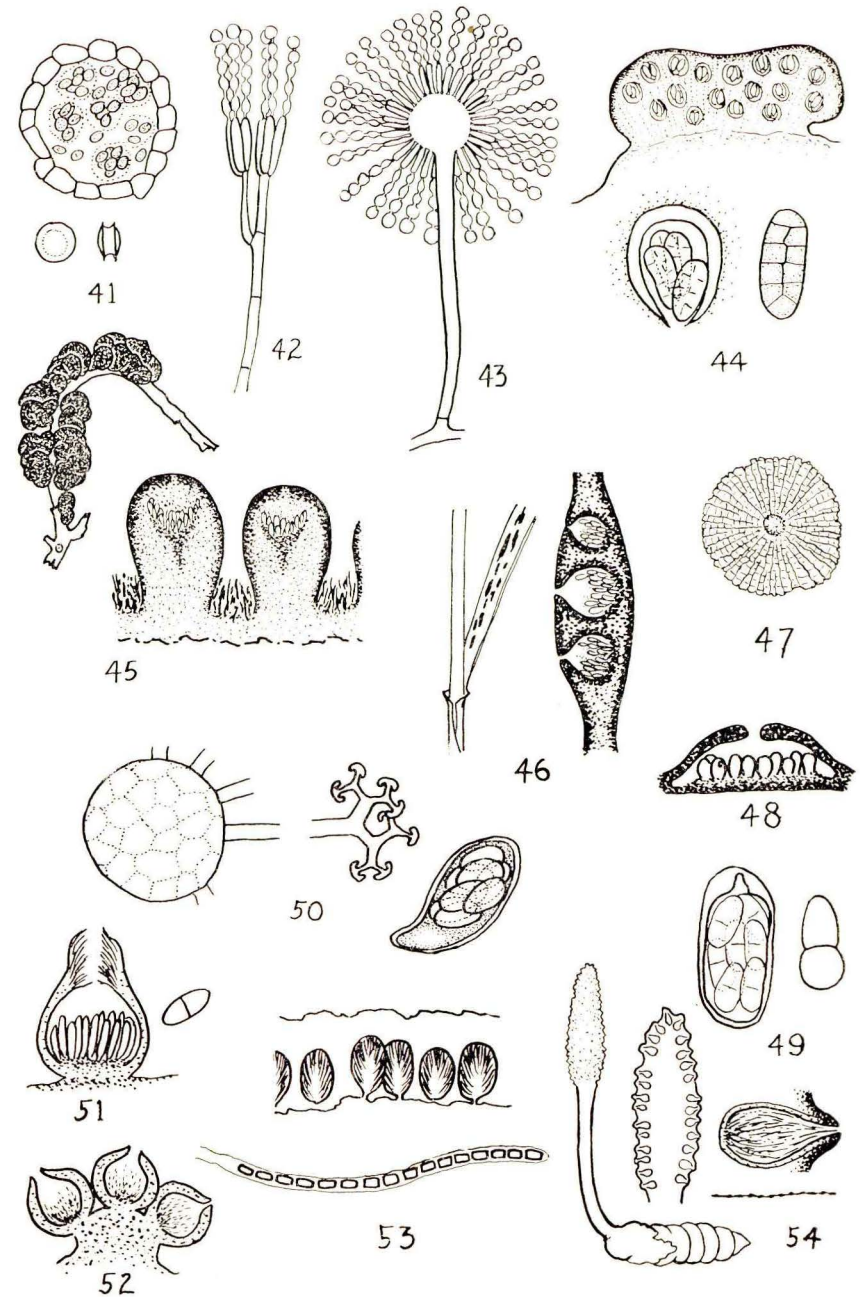


PLATE V. EUASCOMYCETES (cont.). 55. *Laboulbenia Galeritae*, perithecium at left, empty antheridia at right. 56. *Chaetomium spirochaete*, perithecium, ascus, ascospore. 57. *Sordaria Rabenhorstii*, perithecium, with asci visible through transparent walls. 58. *Venturia inaequalis*, section of perithecium in apple leaf. 59. *Gnomonia ulmea*, section of perithecium in elm leaf. 60. *Eutypella stellulata*, section of valsoid stroma, ascus, ascospore. 61. *Diatrype albopruinosa*, section of pulvinate stroma, ascus. 62. *Xylaria multiforme*, habit showing erect stroma, cross section of stroma. 63. *Hysterographium mori*, hysterothecia on wood, cross section, ascospore. 64. *Clithris quercina*, habit, inoperculate ascus and paraphysis. 65. *Leotia stipitata*, habit. 66. *Sclerotinia fructicola*, apothecia arising from sclerotium in mummied plum. 67. *Peziza vesiculosa*, habit, tip of operculate ascus. 67a. *Morchella esculenta*, habit.

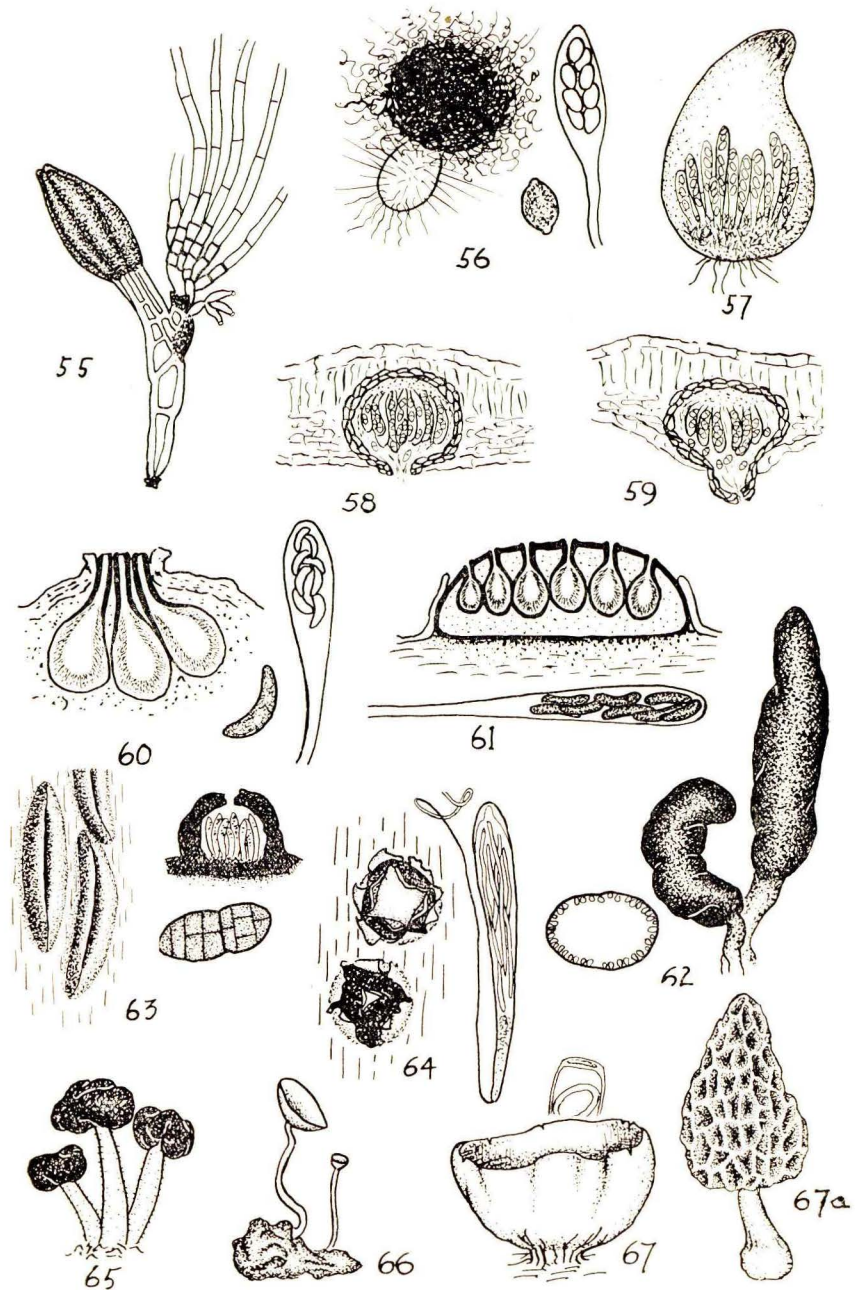


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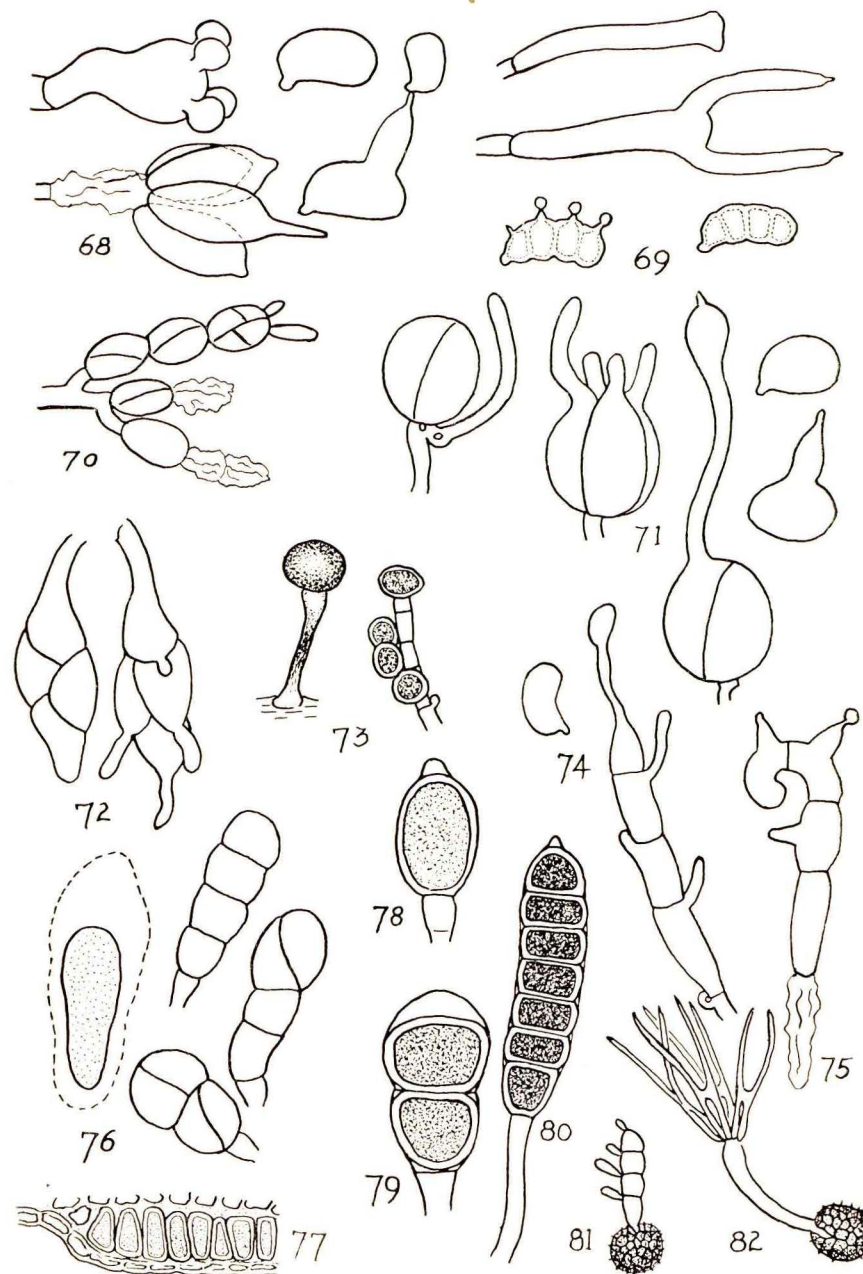
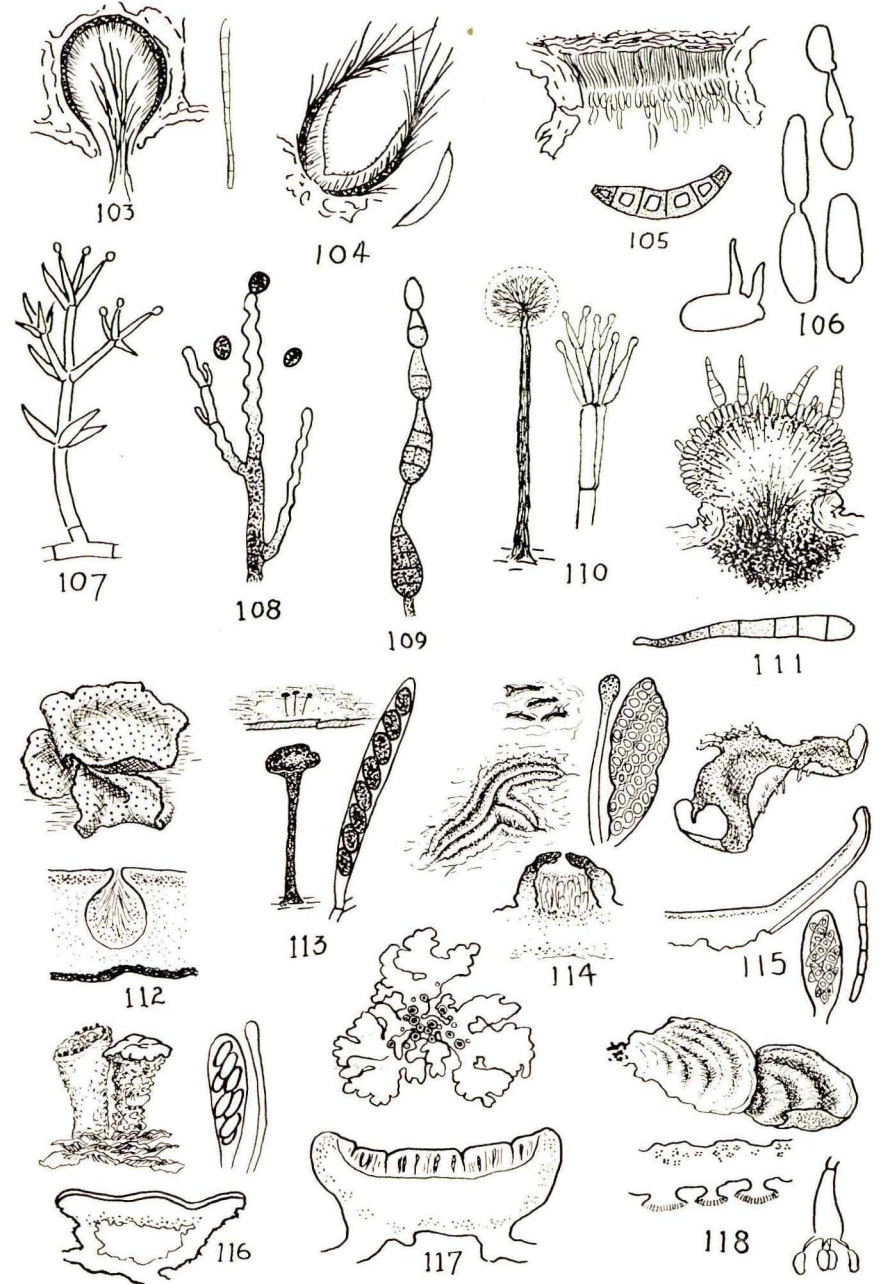


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