

ILLUSTRATED
GENERA OF
IMPERFECT
FUNGI

FOURTH EDITION

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With new introductory material by Barry B. Hunter

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INTRODUCTION

The *Deuteromycetes* or *Fungi Imperfecti* (former taxonomic designations) are an anomalous, heterogeneous assemblage of asexual ascomycetes and basidiomycetes which no longer have formal taxonomic status. These fungi were traditionally considered as lesser fungi because they lacked the perfect stage—sexual reproduction. The absence of asci (ascomycetes) and basidia (basidiomycetes) prevented their assignment to a natural taxon and necessitated artificial non-sexual characteristics to describe and classify them. This genetic inability of many imperfects to reproduce sexually is considered a primitive condition and in contemporary mycology presents a taxonomic quandary. Alexopoulos *et al.*, 1996, provide excellent scientific rationale for excluding imperfect fungi from contemporary fungal systematics, and discuss considerations needed to develop logical and valid taxonomic approaches to determine their phylogeny (1). Consequently, the taxons which previously were recognized as taxonomically valid for the deuteromycetes (imperfect fungi), are used in this book only to facilitate their identification.

The imperfects are important eucaryotic microorganisms (possessing nuclei and organelles) which affect humans and most other life forms in a myriad of ways. The need to determine their identities is paramount in research, industry, medicine, plant pathology and in many other disciplines. Imperfect fungi are identified according to their conidial or non-sexual states. Nevertheless, many imperfects possess sexual structures of known ascomycetes or basidiomycetes, whereas others produce no conidia and/or sexual structures. Roper, 1966, described a parasexual cycle in which genetic recombination can occur in hyphae (16). This observation suggests that some fungi may never have possessed sexual structures or required sexual reproduction for genetic exchange. However, while there is little data which substantiates that pansexuality occurs under natural conditions today, it could have occurred during the origin and evolution of these fungi.

When sexual structures are associated with the conidial state, a valid taxonomic status can be ascribed. However, this often does not occur, and for practical purposes is not important. Although the scientific name of the sexual state constitutes a valid taxonomic designation, the imperfect name is retained for practicality and for conventional use. Therefore, to identify the imperfect fungi, it is necessary to know their conidial morphologies regardless of whether the sexual state is also present in culture or in nature.

The deuteromycetes constitute an important group of fungi which require continued study despite their obscure and confounding systematic relationships both to themselves and to other fungi. Barron, 1968 (2), Hunter and Barnett, 1973 (10), Hunter *et al.*, 1978 (11), and Alexopoulos *et al.* (1) provide additional information on many aspects of the morphology, sporulation, growth, ecology and economic importance of imperfect fungi.

Scanning electron and light photomicrographs are provided on several of the following pages. They show conidia, conidiophores, and hyphal structures found on many different kinds of imperfect fungi. Compare them with like illustrations in the book to better understand how these structures are important in identifying imperfect fungi.

MAJOR GROUPINGS OF IMPERFECT FUNGI AND THEIR IMPORTANCE IN THE BIOSPHERE

The imperfect fungi or deuteromycetes have been classified according to principles established by Saccardo in *Sylloge fungorum* (17). While this taxonomic system is no longer valid, it is still the best way to learn the mycology that is necessary for identifying the imperfect fungi. It is also the primary means used in this book to identify imperfect fungi. The scientific names of imperfect fungi are still used, albeit, only in a non-taxonomic sense, and as a necessity to know their practical importance in the biosphere. The Hughes-Tubaki-Barron System (conidial ontogeny) has also been used as a way of classifying and identifying these fungi (2, 9, 18). Details pertaining to this system are provided on pages 40-44 and related identification keys are found on pages 44-57. The use of conidial and conidiophore ontogeny for identifying deuteromycetes should be used by individuals who are well versed in mycology. The shape, pigmentation, and septation of conidia are important characteristics in the Saccardo System but reduced to secondary importance in the Hughes-Tubaki-Barron System.

To better understand the Saccardo System, common and economically-important imperfect fungi of the four form orders will be presented. Following the Saccardoan System, the species of the form orders can be separated into four distinct groups of fungi. This provides a basis from which to begin a search (appropriate key) for the identity of an unknown fungus. The form orders are as follows: (1) **Moniliales** - Conidiophores and conidia occurring free and distributed over the mycelium. Conidiophores may be separate, in clusters, or in tightly-packed groups. Illustrative examples and accompanying descriptions of many of the diverse genera in this group are provided from pages 68 through 161; (2) **Sphaeropsidales** - Conidiophores and conidia contained within asexual fruiting bodies called pycnidia. See pages 162 through 187 for descriptions and illustrations of pycnidia-producing fungi. (3) **Melanconiales** - Conidia typically produced under natural conditions in an acervulus, an open saucer-shaped fruiting body. In culture, conidiophores may be single or in compact groups similar to sporodochia of the *Mormiales*. These fungi can be found on pages 188 through 194; (4) **Mycelia Sterilia** - Species in this form order are genetically incapable of producing conidia or any kind of reproductive cells. Sclerotia or other survival structures occur in the mycelium. Descriptions and illustrations of the three species depicted in this book are provided on pages 196 and 197.



Conidiophores of *Paecilomyces* sp. with typical flask-shaped phialides and catenulate conidia.



Conidia of *Trichoderma* sp. emerging from apices of the conidiophores.

Two of the spomlating form orders, Moniliales and Sphaeropsidales can be separated into several form families. Characteristics are predicated upon such artificial features as color, shape, and consistency of the pycnidium in the Sphaeropsidales, or color of the conidia and presence of synnemata or sporodochia in the Moniliales. The form family taxon is not used in Mycelia Sterilia and only one form family exists in the Melanconiales.

There are at least 1,400 form genera of imperfect fungi and several thousand species. The most common in nature and the most economically important are found in the form order Moniliales. Some are pathogens of plants, animals and humans, some produce toxins, while others are important in the production of antibiotics and other chemicals. In the Saccardo System, it is the color and morphology of the conidia which are used to separate form genera into sections. For example, one-celled hyaline (devoid of any color) conidia are called hyalospores; colored, one-celled conidia are phaeospores; didymospores are two-celled; and transversely septate conidia with three or more cells are phragmospores. Add hyalo to phragmospore (hyalophragmospore) and it is a hyaline, transversely septate conidium; cylindrically-spiraled, one to several cell formations are helicospores, regardless of the presence or absence of color. Problems encountered when using the Saccardo system are variations in type of fruiting body (acervulus, sporodochium, and pycnidium), conidium color and conidium morphology. These structures can vary on different media and in their response to varying environmental conditions. Consequently, what is described in the keys may differ slightly to significantly when the fungus in question is grown on different media or when it is incubated at different temperatures. Nevertheless, time and experience will negate these factors. Therefore, because of its simplicity and practicality, the Saccardo System is still the best way for students and others to study and identify imperfect fungi.

SACCARDOAN FORM ORDERS

FORM ORDER MONILIALES

Most species of deuteromycetes reside in this form order and are grouped into four form families (see page 7). This is the only form order in which form families are described in this book. Form families Moniliaceae and Dematiaceae have species which are delimited by one or more of the following



Conidia In basipetal chains radiating from the apex of an *Aspergillus* sp. conidiophore.

characteristics: conidial septation; conidiophore appearance and branching; conidial morphology; true and pseudomycelium (some imperfects are yeasts without true hyphae); the manner in which the conidia are produced; presence of chlamydo-spores and morphology; conidia produced in chains or in a head; presence or absence of mucilage; conidial number and arrangement at apex of the conidiophore; conidia produced on conidiophore or mycelium; and exogenous or endogenous production of conidia. Refer to page 68 through page 145 for numerous examples of the Moniliaceae and the Dematiaceae. Note that imperfects in this form order with hyaline conidia are members of the Moniliaceae; those with pigmented conidia and/or conidiophores reside in form family Dematiaceae. The reason that the fungi of these two form families are discussed together is because the only difference between the species is the color of their conidia and conidiophores. This seemingly obvious color difference is at times difficult to determine in culture and under the microscope. However, careful use of the microscope, diligence and experience in identifying these and other fungi, will in time allow orje to make accurate determinations of pigmentation, along with many other pertinent fungal characteristics.

Many of the more common fungi are found in the form families Moniliaceae and Dematiaceae. Species of *Aspergillus* (page 95), *Penicillium* (page 95), *Alternaria* (page 132) and *Stemphylium* (page 132) are routinely isolated from the air and numerous other substrates. These genera and several other species of the Moniliaceae are discussed here. *Aspergillus fumigatus* is an opportunistic pathogen of humans and other animals and is responsible for the human disease aspergillosis, a pulmonary disorder. *Penicillium chrysogenum* and closely related species are the sources of penicillin, an important antibacterial antibiotic, which has saved countless humans from death and serious illness for many decades. Other species of *Penicillium* are responsible for the contamination of food and clothing. *Gl'ocladium* spp. (page 93) are similar to the penicillia, but differ at maturity by having the spore mass encompassed by mucilage. One species, *G. roseum* is a good example where identification is confusing because it produces two different conidial types, one being the *Gliocladium* type and the other that of *Verticillium albo-atrum* (page 92). Fortunately, this is unusual, but warns one to not always consider fungal cultures contaminated when two distinct conidial types occur in the same culture. *Verticillium albo-atrum* is a destructive plant pathogen that causes a wilt of some economically-important plants. *Monilia* (page 73) *cinerea* var. *americana*, the pathogen of brown rot of peach and other fruits, is often found as a contaminant of microbial cultures. *Geotrichum candidum* (page 68) is the causative agent of geotrichosis, a human disease which can occur orally, in the intestine and as a pulmonary disease. Species of the genus *Candida* (page 71) are common in the Moniliaceae. Note that this fungus is not always filamentous, but can possess yeast-like cells. An important species *C. albicans*, is an opportunistic human pathogen causing oral and vaginal diseases and may become systemic. This filamentous yeast can be differentiated from other *Candida* spp. by the production of S to 12 pm spherical chlamydo-spores on corn meal agar.

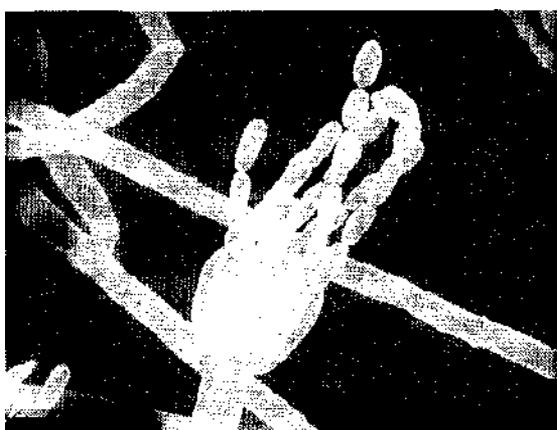


One-celled *Gliocladium* sp. conidia in mucilaginous masses on penicillate branches of conidiophores.

Many species having pigmented conidia and/or conidiophores, reside in the form family Dematiaceae. Many of these species are also common and/or economically-important fungi. *Stachybotrys* (page 89), a soilborne saprotroph, has pigmented single-celled conidia and conidiophores that slime down to form glistening beads. *Cladosporium* (page 107) is prevalent in the air, and some species are plant or human pathogens. This fungus has a highly branched conidiophore and one-or two-celled conidia that occur in chains. Since all conidia of one species are not always of the same cell number or size, purity of a culture cannot be determined by this means. *Aureobasidium* (page 71) is a filamentous yeast, hyaline when young, becoming dark with age. *Aureobasidium* is often confused with species of *Candida*, but pigmentation appears in its hyphae which is not found in *Candida*. One species, *A. pullulans* is saprotrophic, but can become an opportunistic pathogen of plants. This same fungus is also known to be a major agent in the deterioration of painted surfaces. Many species of *Helminthosporium* (page 125) are well known to plant pathologists as pathogens of grasses. These fungi produce dark cylindrical conidia, which are multiseptate and usually have rounded ends. The conidia of *Bipolaris* (page 127) and *Dreschlera* (page 123) are nearly identical to those of *Helminthosporium* but differ in the mode of conidial formation. The ends of the conidia vary only slightly making the differentiation of species between *Bipolaris*, *Dreschlera* and *Helminthosporium* difficult. Illustrations along with the keys are most helpful in correctly identifying species of these three genera. The most commonly encountered fungus in the Dematiaceae is *Alternaria* (page 133), which produces large muriform conidia, often borne acropetally in chains. Isolates of this fungus are readily recovered from air, soil, decaying vegetation and from diseased potatoes and tomatoes.

Imperfect species which have conidiophores united in columns or clusters reside in the form family Stilbaceae (pages 152 - 161). These multiple fused conidiophores are called synnemata or coremia and tend to be more plentiful in aging cultures. The conidia are produced on the upper portions of the synnemata. Some isolates of the Stilbaceae do not form synnemata on all media making identification most difficult. *Isaria* spp. (page 157) are frequently isolated from soil and grow profusely on most mycological agar media. One species, *Pestalotia ulmi*, is well known to plant pathologists because it is the imperfect form of the fungal pathogen that causes Dutch elm disease. The synnemata of *P. ulmi* are tall and have a rounded mass of light-colored conidia embedded in mucilage.

The presence of sporodochia in the mycelium distinguishes form family Tuberculariaceae from the other three form families of form order Moniliales. Refer to pages 146 - 151 and observe the many different types of sporodochial fungi. A sporodochium is a cushioned-shaped structure made up of closely grouped conidiophores. Definitive identification of sporodochial-producing fungi is often difficult because the structures often vary with cultural conditions. Some, but not all species of *Fusarium* (page 131), produce sporodochia. Species of *Fusarium*. are pathogens of humans, insects, plants and are



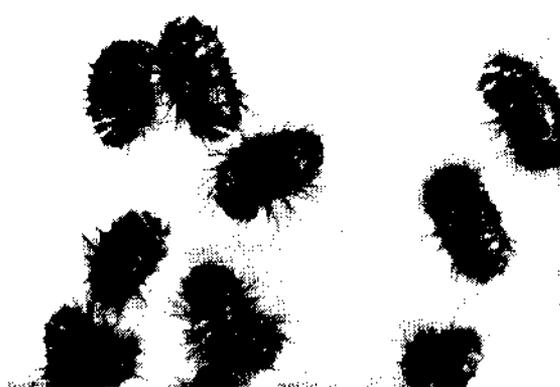
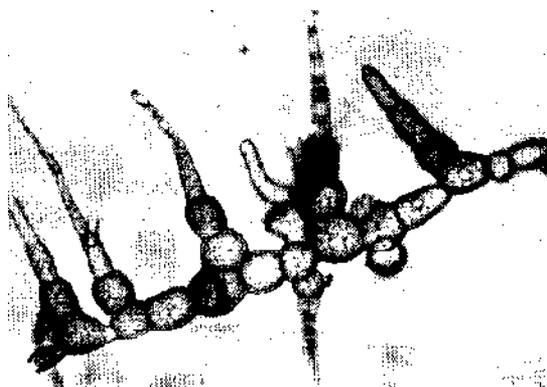
Catenulate conidia of *Penicillium* sp. on phialides of a conidiophore. Arthrospores of *Geotrichum* sp.

abundant in the air and soil. It is easy to identify isolates to genus because of their characteristic banana-shaped conidia. However the tremendous variability in conidial size, microconidia and macroconidia, make them difficult to speciate. Species in the genus *Epicoccum* (page 151) are frequently isolated from soil and decaying wood. This fungus has dark sporodochia, from which compact or loose conidiophores give rise to dark, globose dictyospores (conidium has both oblique and transverse septa).

FORM ORDER SPHAEROPSIDALES

There are four form families in this form order and all of the species have well defined asexual fruiting bodies i.e. pycnidia (page 162 through 187), Pycnidia are easily seen at low magnifications with a compound or stereo-microscope. They have conidia which are either endogenously produced (inside the pycnidium), or that differ from most other imperfect fungi and are exogenously produced. According to Saccardo, the form families are differentiated as follows. Sphaeropsidaceae - dark pycnidia, leathery to carbonaceous, which may or may not be produced on a stroma, usually having a circular opening; Zythiaceae - physical characteristics as in form order Sphaeropsidaceae, but the pycnidia are bright-colored and waxy; Leptostromataceae - upper half of pycnidium fully developed, rather than in the basal portion; Excipulaceae - Pycnidia are cupped or saucer-shaped. In this book, we do not separate pycnidia - producing fungi using the four form families, although we may use a particular characteristic from a given form family as part of the key composition.

Many members of the form order Sphaeropsidales are saprotrophic, although some are plant pathogens and others infect insects and other fungi. Among the more common form genera are *Phoma*, (page 163), *Phyllosticta* (page 163), *Sphaeropsis* (page 177), *Coniothyrium* (page 177) and *Septoria* (page 183). Many of the species of these five genera are pathogens of plant stems and leaves. Problems in identifying these fungi are obvious when comparing *Phoma* and *Phyllosticta*. Their pycnidia and conidia are so similar that distinctions are at best arbitrary. Both have dark, erumpent pycnidia enclosing short conidiophores that produce hyaline, non-septate conidia. *Sphaeropsis* is another form genus which is similar to *Phoma*. *Septoria* (page 183) is a form genus with approximately 1,000 species, most being plant pathogens. Many of the species names come from their hosts. Obviously, using the host to name the fungal species leads to confusion, the proliferation of species, and questionable scientific designations. The pycnidia of *Septoria* are dark, globose, ostiolate, erumpent; they enclose short conidiophores bearing long, thin scolecospores. Therefore, the dark pycnidia are round, have an opening, and break out through the surface of the substratum and produce endogenous narrow-elongate conidia.



Germinating cralamyospores of *Cylindrocladum scoparium*.

Bristle-covered pycnidia of *Chaetomella* sp.

FORM ORDER MELANCONIALES

Species in this form order are recognized by a saucer-shaped fruiting body, the acervulus (page 188 through 195). There is only one form family, Melanconiaceae. Two common form genera are *Gloeosporium* (page 189) and *Colletotrichum* (page 189). They are both very similar in appearance, except that the latter has prominent dark setae associated with the conidiophores. The many species of the two genera have conidia which are hyaline, one-celled, and ovoid to oblong. Under certain cultural conditions, however, the setae of *Colletotrichum* fail to form, thereby making it impossible to distinguish between the two genera. *Glomerella*, an ascomycete, is the teleomorph of both form genera which indicates that, because of their similar anamorphic states, they should really be in one genus. Another common genus is *Pestalotia*, which produces multiseptate conidia with pointed ends and apical appendages (page 193). Species can be either pathogenic or saprotrophic. Careful scrutiny will show that species of *Cylindrosporium* (page 193) are difficult to differentiate from species of *Gloeosporium*. Similar appearing species of different genera present problems even to those who are familiar with the fungi.

FORM ORDER MYCELIA STERILIA

Species placed here have no known anamorphic or teleomorphic states. They do however, produce somatic sporodochium-like bodies, chlamydo-spores, sclerotia or bulbils. These diversified fungi are grouped into approximately 20 genera and because of their heterogeneity there are no form families. No asexual or sexual structures are found in these fungi, and therefore they are identified solely by mycelial characteristics. *Rhizoctonia* and *Sclerotium* (page 197) are two common form genera, both containing plant pathogenic species. Clamp connections on their hyphae provide evidence to basidiomycetous affinities. *Papulospora*, another frequently encountered member of this form order produces bulbils (shown on page 197) which are sclerotium-like and serve in survival and reproduction. Species of *Papulospora* are saprotrophs of decaying vegetation and are pathogenic to storage structures of some plants.

The imperfect fungi include a diverse array of fungi which occupy every conceivable ecosystem within the Biosphere. There are aquatic and terrestrial species; some are saprotrophic, and some are pathogenic to humans, animals, plants, microorganisms and to even other fungi. Their many spore and somatic types have led to dispersal and invasion of many environments resulting in the evolution of this highly diverse group of fungi.

CYTOLOGICAL AND MORPHOLOGICAL FEATURES OF IMPERFECT FUNGI

The eucaryotic cellular structure, composition and ultrastructure of the imperfect fungi (Deuteromycetes) have been thoroughly investigated using light and electron microscopy (4, 5, 7, 8, 11, 12). Cells of imperfect fungi, like most fungi, are arranged in filaments or threads called hyphae. One filament of the hyphae is a hypha, and all hyphae of one fungus constitutes the mycelium. Fungal hyphal cells vary in size, color and in their extracellular matrix, when present. However, since hyphae among different kinds of fungi are more alike than different, they usually cannot be used as a differentiating character.

The cells of a hypha are separated from one another by crosswalls called septa. Imperfect fungi have one, two or more nuclei in their septate hyphal cells and can possess mitochondria, endoplasmic reticuli with ribosomes, microtubules, Golgi bodies, vacuoles, glycogen and lipid. Woronin bodies and Spitzenkorpers (8), which are unique structures involved in apical hyphal growth may also be present. Often, mitochondria and Golgi bodies are found to be closely associated in the cytoplasm. This ultrastructural feature has been seen only in imperfect fungi and ascomycetes. Consequently, this association suggests a relationship unique to these fungi that differentiates them from other fungi and other life forms (13). Therefore, they have cells, organelles and inclusions similar to, yet different in some respects, from protists, metaphytans and metazoans. The asexual spores of deuteromycetes, the conidia, contain similar organelles and inclusions. Under light microscopy however, the cytoplasm of the typical imperfect fungus appears translucent and granular and lacking discernible nuclei, organelles or other inclusions.

The hyphae and conidia of *Verticillium albo-atrum* and *V. nigrescens* are representative of imperfect fungi since they are uninucleate and possess most of the aforementioned intracellular structures within their plasma membranes (3). Newhouse *et al.* found these typical organelles, along with mycoviruses in the hyphal cells of *Cryphonectria parasitica* (14). The majority of fungal viruses do not appear to have any deleterious affect upon fungi, but some can debilitate their hosts and cause changes in colony morphology, growth rate and pigmentation. This can result in an infected fungal isolate having a cultural appearance far different from other fungi of the same species. This is an important consideration in fungal identification. Light microscopy of fungal cells reveals little cytological detail; however, transmission electron microscopy (TEM) and scanning electron microscopy (SEM) show with clarity the organelles, some inclusions, and nuclei within the fungal cell.

Alexopoulos *et al.* provide excellent information on fungal ultrastructure and cellular relationships of many and diverse fungi (1). Under light microscopy, the nuclei and organelles of the imperfects are minute and difficult to observe without killing the cells and applying one or more cytological stains. Consequently, intracellular characteristics of the cell(s) are of no value for identification. There is one notable feature of the hyphae that is easily seen with the light microscope and enables differentiation of an imperfect fungus from a typical phycomycete. This structure is the septum which separates individual hyphal cells. All imperfect fungi have septa, unlike most phycomycetes which are coenocytic (lack septa and are multinucleate). Ascomycetous and basidiomycetous fungi also possess septa. Within the septum there may be one or several pores which provide cytoplasmic continuity between cells. The pores are easily observed via TEM but not with light microscopy. Transmission electron micrographs demonstrate that nuclei and various organelles can traverse the pores thus moving from cell to cell. Woronin bodies or septal pore plugs are known to block pores, especially in hyphal cells that are old or damaged. Imperfect fungi with known ascomycetous teleomorphs usually have simple septa, whereas basidiomycetous teleomorphs have much more elaborate and complex dolipore septa.

External to the plasma membrane of the hyphal cell is the cell wall. This is apparent by light microscopy and by TEM. This of course is a major difference between metazoans and most protists which lack cell walls. Metaphytans also possess cell walls, but the chemical composition of the

microfibrils is different. The imperfect fungal cell wall, in conjunction with microtubules and microfilaments that comprise the cytoskeleton, preserve the cytoplasmic integrity of cells and also determines the shape of the hyphal cell. Hyphal cells of *Sclerotium rolfsii* possess an actin cytoskeleton (15).

Cell growth of the filamentous fungi occurs almost exclusively at the hyphal tip. Transmission electron micrographs of the hyphal apex by Grove, 1978 (6), and Grove and Bracker, 1970 (7), show apical vesicles which are spherical and membrane bound. The apical vesicles contain the necessary elements for plasma membrane extension and cell wall synthesis. More recent studies by Wessels in 1986 (19) and 1988 (20) provide evidence that the hyphal tip is elastic but ultimately becomes rigid with age.

Hyphae are the microscopic somatic structures of fungi which are embedded in various organic substrates or in soils. It is the hyphae that absorb nutrients required for growth and reproduction. The organization and size of the *mycelium* is predicated upon substrate availability and nutrient status. While additional structures are not usually formed by growing hyphae, some fungi form discrete microscopic and/or macroscopic somatic and reproductive structures. Hyphae of some fungi can develop two different kinds of fungal tissues (plektenchyma). These tissues develop from the apical growth of the hyphae. Prosenchyma tissue are evident by their loosely woven organization in which the hyphae are still mostly discernible. When the hyphae are not discernible and the cells become plant-like, the tissue is pseudoparenchyma. Many resistant and reproductive structures develop from the two types of plectenchymous tissue.

One type of somatic tissue structure is the rhizomorph which results from the thickening of the hyphae. Sclerotia (page 97) and microsclerotia are other structures in which the hyphae lose their typical thread-like appearance and become a mass of cells which are resistant to various adverse conditions. Another somatic structure, the stroma, is formed as a mass of fungal cells that usually supports various types of reproductive structures. Rhizomorphs, sclerotia, microsclerotia and stroma are important structures in determining the type and, in some few instances, the identity of an unknown fungus. The more identifiable structures (mainly reproductive, but also somatic) that can be determined for an unknown fungus, the easier it will be to identify.

The conidial cells, their conidiophores, acervuli, pycnidia, sporodochia, synnemata and chlamydo-spores are other cellular structures of imperfect fungi which are easily discernible with the light microscope, and are routinely used in identification. These structures are illustrated and discussed throughout this book. Complete familiarity with these structures will facilitate use of the keys for identifying unknown imperfect fungi.

FACTORS AFFECTING GROWTH AND SPORULATION OF IMPERFECT FUNGI

The imperfect fungi are adapted to *live* under diverse environmental and nutritional conditions. Conidia of some species often survive for years in a cold or dry environment and germinate upon exposure to favorable conditions. The conditions that favor or inhibit growth and sporulation of a given fungus are correlated with its habitat. For example, *Bispora*, which obtains its nutrients from decaying wood, is limited in growth only by temperature and moisture, whereas, other fungi have more precise requirements, such as for living tissue or preformed vitamins. In fact, the dissemination of plant pathogenic conidia is often limited to the growing season of the host plant, and the production of conidia at that time. This and other types of adaptation have led to the survival of the deuteromycetes that exist today. Several types of fungal responses to nutrition and environment are presented.

TEMPERATURE

Temperature and moisture are universal factors that affect all organisms and must be favorable for them to survive, grow and reproduce. The cardinal temperatures i.e. minimum, optimum, and maximum, are used to describe the range at which individual imperfect fungi can grow. The exact ranges are influenced by other factors. There is a great variation among the responses to temperature of the imperfect fungi; however, they all produce some growth at mesophilic temperatures. When growing unknown, fungi it is best to select a temperature between 20 and 30 degrees Centigrade for their initial incubation.

MOISTURE

Imperfect fungi are capable of growing in liquid nutrient solutions provided that sufficient oxygen is present. However, many deuteromycetes can grow in the absence of liquid water. *Botrytis cinerea* and *Penicillium expansum* are plant pathogens which cause rots of plant parts and obtain moisture from the decomposing plant cells. Species of *Aspergillus*, *Penicillium*, *Cladosporium*, and *Aureobasidium* are common decomposing agents of cloth, paper, leather, wood and even painted surfaces where there is no free moisture. *Aspergillus* and *Penicillium* spp. proliferate in stored grains when the moisture content is greater than 14%. Another *Aspergillus* sp., *A. glaucus* and its close relatives are well known for their ability to grow under conditions of severe physiological drought.

In contrast there are the many imperfect species that cannot grow without liquid water or a saturated atmosphere. Spores of most deuteromycetes require moisture for germination.

LIGHT

Imperfect fungi respond to light (radiation) in a myriad of ways, but are not photosynthetic. Like all fungi they are incapable of reducing CO₂ to carbohydrate via radiation. Nevertheless, phototropic growth of conidiophores has been amply demonstrated for *Aspergillus giganteus*, *A. clavatus*, *Penicillium claviforme* and numerous other fungi. When cultures receive unilateral illumination, the conidiophores grow toward the white light, irrespective of the position of the culture. Certain frequencies of radiation are also known to enhance or be necessary for the induction of sexual structures of imperfects having known teleomorphic states. Radiation also may affect the chemical composition of media thereby promoting growth patterns different from those that would occur when the media were stored in the dark.

Radiation has the greatest impact on sporulation of imperfect fungi. Sporulation of imperfects is either induced (i.e., light is necessary) or enhanced by exposure to different wavelengths of radiation. Ultraviolet, near ultraviolet, blue (most common), a wide band of blue-green-yellow and far red all affect fungal sporulation, albeit, quite differently. The red band is seldom effective for inducing sporulation.

White light may be as effective as any given color if the intensity is nearly equal. The intensity of white light necessary for sporulation by *Epicoccum nigrum* varied inversely with duration of exposure. An exposure of mycelial cultures on agar to sunlight (7,000 ft. candles) for 15 minutes induced the production of about as many conidia as a single exposure of 24 hours at 50 ft candles or 6 hours at 100 ft. candles. Spores were produced only in the zone of young hyphae at the time of exposure. It is well known that ultraviolet radiation is inhibitory, yet there are few^ concrete examples of inhibition of imperfect fungi by visible light. Remember, when growing imperfects which do not sporulate in culture, the absence of light or too little of it, may be an important factor. In general, expose fungal cultures to alternating periods of light and dark to induce sporulation.

HYDROGEN-ION CONCENTRATION (pH)

Most fungi grow optimally when the substrate is slightly acid between pH 5.0 and 6.0. However, they will generally achieve fair to good growth over a much wider range, from about pH 3.0 to 8.0. Certain species are able to tolerate even greater ranges: *Aspergillus niger*, pH 2.8 to 8.8; *A. oryzae*, 1 . 6 to 9.3; *PenicilUum italicum*, 1 . 9 to 9.3; *Fusarium oxysporum*, 1 . 8 to 11.1; *Botrytis cinerea*, 2.8 to 7.4; and *Rhizoctonia solani*, 2.5 to 8.5. When fungi are growing on most culture media, they alter the pH of the substrate. The extent of the pH change depends on the composition of the substrate as well as on the genetics of the imperfect fungus.

CARBON AND NITROGEN SOURCES

The requirement of fungi for carbon is greater than any other nutrient, however a source of nitrogen must also be provided. The ubiquitous nature of most deuteromycetes indicates that they possess the genetic determinants (synthesis of enzymes) to utilize carbon from many different sources; among these, cellulose is the most abundant utilizable source. Seldom does a fungus in nature encounter a pure carbon source, but rather will preferentially select from what is available.

To determine the ability of specific fungi to utilize single carbon sources, experiments in the laboratory must be conducted under controlled conditions, using a medium that is complete for all nutrients except carbon. Imperfect fungi respond to different carbon sources, and their preferred source is usually associated with the niche they occupy in the ecosystem. Growth on glucose, fructose and mannose are approximately the same for all fungi. Most natural media have more than one carbon source from which a fungus can obtain carbon requirements for growth and reproduction.

In nature, organic materials provide the nitrogen needed for growth; however, most fungi can use sources of inorganic nitrogen as well. Most imperfect fungi utilize nitrate, ammonium and amino acids as sources of nitrogen. Growth on inorganic nitrogen is often less than on a mixture of amino acids or on a complex organic nitrogen source. If one merely desires to cultivate deuteromycetes on a laboratory medium, yeast extract or casein hydrolysate is excellent. To study the relative rate of utilization of nitrogen sources, one should use single amino acids, such as asparagine, aspartic acid or glutamic acid.

VITAMINS

Most imperfect fungi are capable of synthesizing required vitamins from living or non-living substrates. Some imperfects, however, are deficient and cannot synthesize certain vitamins. Such deficiencies can be determined only by cultivation in suitable synthetic media with and without added vitamins. When imperfects are vitamin-deficient, it is usually thiamine that they are unable to synthesize. A deficiency may be single or multiple, complete or partial. Most species of *Aspergillus* synthesize all

required vitamins. *Botrytis cinerea*, species of *Penicillium*, *Cylindrocladium scoparium*, *Gliocladium roseum* and other imperfect fungi are also able to synthesize their vitamin requirements. The pycnidial producer, *Dendrophoma obscurans*, must have a preformed source of thiamine as do some species of the dermatophyte genus, *Trichophyton*. Biotin is needed for *Diplodia macrospora* and for *Stachybotrys atra*.

INORGANIC SALTS AND MICROELEMENTS

Natural organic compounds often furnish all of the inorganic salts necessary for growth. However, if one needs to culture imperfects on synthetic or semi-synthetic media, it is necessary to add certain compounds. Monobasic potassium phosphate (KH_2PO_4) and magnesium sulfate (MgSO_4) will supply potassium, phosphorus, magnesium and sulfur. The microelements Fe, Zn, Mn, Cu and Ca are frequently added to synthetic media to supply additional inorganic elements needed for optimal fungal growth.

ISOLATION, CULTURE MEDIA, MAINTENANCE OF STOCK CULTURES, AND PHYSIOLOGY

Information on these topics can be found on pages 1-3.

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PART I

PHYSIOLOGY

ISOLATION

Many different techniques for the isolation of fungi in pure culture have been described (246, 390). One should select and try first a method that is simple and easy, using a general purpose medium. Many species, especially common saprophytic hyphomycetes, sporulate readily in a moist chamber on pieces of wood, leaves, or other plant parts. Conidia may be lifted from the sporulating conidiophores by touching with a small bit of agar on the tip of a needle, while looking through a stereoscopic microscope. This simple method often results in a high percentage of cultures free of contamination. It can also be used to obtain conidia from oozing acervuli or pycnidia. Species growing in habitats with an abundance of bacteria may require the use of dilution plates or antibiotic agar (219). A water agar substrate may even be useful, but a rose bengal streptomycin agar has been recommended (390). A highly specialized medium containing antibiotics was used for isolation of *Verticillium procera* from diseased pine roots (428).

The use of geranium leaves placed on the soil surface has been recommended for recovering species of *Cylindrocladium* from soil (310). *Botrytis cinerea* and other soft rot fungi can be obtained easily in pure culture by passage through apples or other fruits. Pathogenic fungi within plant tissue often require surface sterilization with 10% chlorox for 2 minutes before plating the material on agar (246). The common method of obtaining the oak wilt fungus from diseased trees was stripping bark from twigs, dipping in 95% alcohol, and flaming (445). Wood chips were then plated on agar.

The necrotrophic mycoparasites, such as *Gliocladium roseum* and species of *Trichoderma*, do not require a special medium for isolation. However, the biotrophic mycoparasites are a highly specialized group in regard to nutrition, are usually isolated with a host species, and are best maintained as two-membered cultures.

Nematode trapping fungi may often be obtained by placing a bit of horse manure or soil rich in humus on an agar plate. Nematodes are usually abundant after a few days and the trapping fungi, if present, should appear a few days later. Transfers from pure cultures of these species to the plates with nematodes will assure the formation of the characteristic loops, rings, or nets. Common species belong to the genera *Arthrobotrys*, *Dactylella*, *Monacrosporium*, or close relatives (106).



Conidia of *Bispora* sp. Note the formation of a new conidium at the apex of the conidial chain.



A synnematus fungus (*Briosia* sp.) growing from decayed vegetation.

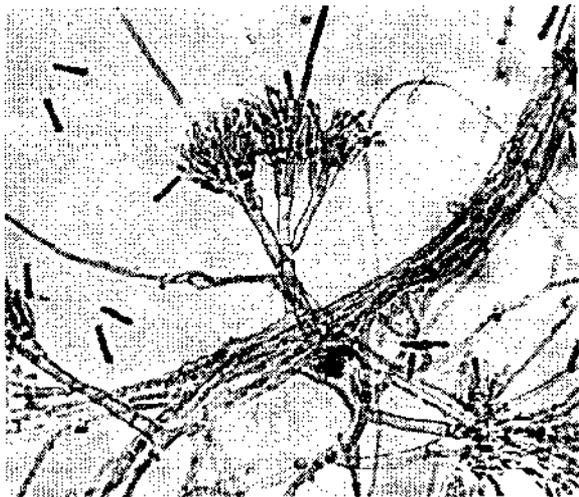
CULTURE MEDIA

A satisfactory general culture medium must contain all of the nutrients required by the fungus: utilizable carbon and nitrogen sources, certain salts and microelements, and water. Some species are favored by added vitamins or growth factors. Many plant parts or products contain these nutrients but not always in quantities optimum for growth or sporulation. A potato-dextrose (glucose) agar medium has been the favorite of many plant pathologists for many years. Other natural media have been developed and used by mycologists for specific fungi. A list of one hundred media is given in the *Mycological Guidebook* (390). The authors prefer a general medium containing 5 to 10 g glucose, 1 to 2 g yeast extract, and 1000 ml water. Addition of agar and changes in concentrations may be made as desired. This medium is easy to make, and the pH need not be adjusted.

The use of a synthetic medium, in which each nutrient and its concentration is known and can be altered as desired, is preferred in critical studies of fungus physiology. Such media can be duplicated exactly, and the effects of each nutrient can be measured. One satisfactory synthetic medium contains glucose (5 to 10 g), KNO_3 , asparagine or glutamic acid (1 to 2 g), KH_2PO_4 (1.0 g), MgSO_4 (0.5 g), microelements (Fe, Mn, Zn) (trace), and distilled water (1000 ml). Vitamins thiamine (100 μg), biotin (5 μg), and pyridoxine (100 μg) may be added routinely for the deficient species (259). This liquid medium may be used in flasks, or agar may be added for tube or plate culture. Five species of biotrophic mycoparasites require the new growth factor mycotrophein, which is a naturally occurring product in most filamentous ascomycetes and imperfects. It may be obtained in crude form by extracting from the mycelium with hot water (10, 12, 48, 138, 220, 469).

MAINTENANCE OF STOCK CULTURES

The choice of a method for keeping viable cultures over a long period of time depends on the period of time they are to be maintained and the convenience of the method (259). Frequent transfer of mycelium from a culture to a fresh agar slant in test tubes is satisfactory for short periods. Long term maintenance of viable mycelium can be accomplished using screw-cap test tubes. Allow mycelium to grow until it reaches the edge of the agar slant, then screw the caps down tightly and store at about 5°C . Transfer cultures after 6 to 12 mo. The use of screw cap tubes has the additional advantage of excluding mites. Many eonidia remain viable for months when collected and stored dry at low temperatures, or simply frozen. Mycelium of some fungi may be cultured on bits of wood or other plant tissue and stored dry-



Fruiting structures of *Cylindrocladium parvum* growing in culture.



Conidial heads of *Aspergillus niger*.

PHYSIOLOGY: NUTRITION AND ENVIRONMENT

See references 141, 157, 162, and 259 for textbooks on fungus physiology.

The same nutrients that favor vegetative growth are also generally favorable to sporulation, but often in different concentrations or ratios. A low concentration of available carbon usually favors sporulation. Sporulation by species pycnidia is often delayed until growth reaches a maximum.

Among the common carbon sources, glucose, fructose, mannose, and maltose are utilized most readily; xylose and sucrose intermediately; whereas lactose and sorbose are often poorly utilized or not at all.

The table lists as examples the relative amount of vegetative growth of selected species on several sugars (3 = good to excellent; 2 = fair; 1 = poor; 0 = not utilized) (218).

| | A | B | C | D | E | F | G | H |
|--------------------------------------|----|---|---|---|---|---|---|---|
| <i>Alternaria solani</i> | 14 | 3 | 3 | 1 | 3 | 3 | 2 | 2 |
| <i>Aspergillus niger</i> | 7 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| <i>Colletotrichum lindemuthianum</i> | 14 | 3 | 3 | 0 | 1 | 2 | 2 | 2 |
| <i>Cordana pauciseptata</i> | 14 | 3 | 3 | 0 | 3 | 1 | 1 | 1 |
| <i>Dendrophoma obscurans</i> | 14 | 3 | 3 | 1 | 2 | 2 | 2 | 2 |
| <i>Helminthosporium sativum</i> | 7 | 3 | 2 | 1 | 2 | 3 | 3 | 2 |
| <i>Penicillium expansum</i> | 4 | 3 | 2 | 3 | 3 | 3 | 3 | 1 |
| <i>Rhizoctonia solani</i> | 5 | 3 | 3 | 0 | 3 | 3 | 3 | 2 |
| <i>Thielaviopsis basicola</i> | 7 | 3 | 3 | 0 | 0 | 3 | 3 | 0 |
| <i>Choanephora cucurbitarum</i> | 3 | 3 | 3 | 0 | 1 | 3 | 0 | 0 |

A = days

B = glucose, fructose, mannose

C = galactose

D = sorbose

E = xylose

F = maltose

G = sucrose

H = lactose

Temperature is a universal factor affecting all physiological processes in fungi, most of which grow well within a range of 25 to 30 °C, but there is much variation. The approximate cardinal temperatures are given below for selected species (218).

| | Minimum | Optimum | Maximum |
|---|---------|---------|---------|
| <i>Aspergillus fumigatus</i> | <20 | 35 | 50 |
| <i>Botrytis cinerea</i> | 0 | 20 | 30 |
| <i>Diplodia zaeae</i> | 10 | 30 | 35 |
| <i>Epicoccum nigrum</i> | < 5 | 25 | 35 |
| <i>Helminthosporium sativum</i> | < 5 | 25-30 | 35 |
| <i>Humicola grisea</i> v. <i>thermoides</i> | 24 | 38-46 | 56 |
| <i>Rhizoctonia solani</i> | 2 | 25-30 | 35 |
| <i>Trichothecium roseum</i> | <10 | 30 | 35 |
| <i>Verticillium albo-atrum</i> | 5 | 25 | 35 |

Visible white light may affect imperfect fungi in different ways. Some species show a decided positive phototropism of the conidiophores (e.g., *Aspergillus giganteus*, *A. clavatus*, and *Penicillium claviforme*). The conidiophores grow directly toward the source of light, regardless of the position of the culture (259).

Sporulation of a number of species of imperfects is either induced (light is essential) or favored (increased) by exposure of the mycelium to radiation. In general, only the mycelium that is young at the time of exposure responds to radiation. Different species respond to different wave lengths, blue being the most effective range for most fungi. Some species that respond to exposure to white light or to specific wave lengths are: *Botrytis cinerea* (uv), *Cylindrocladium citri* (blue to far red), *Cylindrocladium* spp. (uv, near uv, blue), *Dendrophoma obscurans* (blue), some isolates of *Epicoccum nigrum* (uv), *Helminthosporium vagans* (near uv), and *Trichoderma lignorum* (blue). The intensity of white light required to induce sporulation by one isolate of *Epicoccus nigrum* varied inversely with the duration (430). Note that a long exposure to intense ultraviolet radiation is lethal to fungus mycelium.

USE OF IMPERFECT FUNGI TO ILLUSTRATE BIOLOGICAL PRINCIPLES

Certain species work well in demonstrating the effects of nutritional and environmental factors on growth and sporulation. A few demonstrations that can be easily performed in the classroom, together with the species used, are suggested below.

Effects of white light on production of conidia: *Trichoderma Ugnorum*, *Epicoccum nigrum* (390). Inoculate plates of general purpose agar at the center with conidia or mycelium. Place some cultures in continuous light, some in alternate light and darkness, and some in total darkness at 20 to 25 °C. Examine after 4 to 6 days. *E. nigrum* may also be used to demonstrate an inverse intensity-duration relationship required for sporulation (i.e., long exposures at low intensity compared with short exposures at high light intensity (429). Try a range from 5 to 1000 footcandles.

Positive phototropism of conidiophores: *Aspergillus clavatus*. Inoculate several plates of general purpose medium with conidia. Place some cultures beneath continuous light, some with single directional light, and some in total darkness. Wrap some in light-tight paper or foil, and cut one or two small windows. Examine after 4 or 5 days.

Effect of color (wave length) of light on fruiting: *Dendrophoma obscurans* (32). Place cultures of this fungus under white light, under blue, yellow, green, and red filters, and in darkness. Examine after 7 days.

Natural products may replace the light requirement for production of pycnidia: *Dendrophoma obscurans*. Use a synthetic agar medium with thiamine. Place on some plates autoclaved strawberry leaflets on the surface of the agar. Incubate cultures in alternate light (50 footcandles or more) and darkness for a few days, and examine for pycnidia.

Special light requirements for production of conidia: *Choanephora cucurbitarum* (11). Use plates of glucose-asparagine agar plus thiamine. Petri dishes with loose-fitting lids will allow adequate aeration. Place cultures under the following conditions: continuous light; continuous darkness; 2 days light — 12 hours darkness; 2 days darkness — 12 hours light. Examine for conidia in 3-day-old cultures.

Need for adequate aeration for production of conidia: *Choanephora cucurbitarum*. This can be done simultaneously with the light requirement demonstration. Provide adequate aeration of some of the cultures by using loose-fitting lids, and prevent exchange of gases in other cultures by taping dishes closed (II). Incubate in alternate light and darkness.

Sugar concentration affects growth of mycelium and production of conidia: *Helminthosporium sativum*, *Choanephora cucurbitarum*, or *Mektneconium JuKgenium* (or other species sporulating readily). Use a glucose-yeast extract medium, with glucose concentrations of 1, 5, 20, and 5 g/liter.

Sugar concentration affects size of conidia: *Helminthosporium victoriae* (or some other species of this genus) (110). Prepare the same medium as above, and measure the length of conidia formed at the different concentrations.

Thiamine deficiency: *Dendrophoma obscurans* or *Choanephora cucurbitarum* (11). Use a liquid glucose-asparagine medium (see section on media above) in small flasks (25-ml to 250-ml flasks are satisfactory). To half of the medium add thiamine at the rate of 1 0 0 //g/liter. Observe growth daily. If an accurate measure of growth is desired, the mycelium can be collected on a cloth or filter paper, dried and weighed.

Biotin deficiency: *Diplodia macrospora* (259). Repeat above procedure, except use biotin at the rate of 5 ^g/liter.

Multiple deficiency for thiamine and biotin: *Arthrobotrys musiformis*. Use the same basal medium as above; add vitamins singly and in combination, using basal medium as control.

Pyridoxine deficiency: *Graphium* sp. (9). Use the same basal medium as above, adding pyridoxine at the rate of 1 0 0 /ig/liter.

Destruction of pyridoxine by light(9): *Graphium* sp. Prepare a medium containing pyridoxine (liquid or agar). Store part of the medium under continuous bright light, and the remaining medium under total darkness for 10 to 14 days, Inoculate both media, and observe growth,

Trapping and consuming small nematodes (106). *Arthrobotrys* spp. Use of a glucose-yeast extract medium is suggested. Nematodes can be obtained easily by placing a bit of horse manure on agar plates. After a few days use a stereoscope to check for the presence of *Arthrobotrys*. If none is present, use pure culture of fungus to inoculate cultures of the nematodes. Observe after a few days for rings, nets, or other traps and for trapped nematodes.

Necrotrophic mycoparasitism: *Trichoderma lignorum*, *Gliocladium roseum* (10, 13). Prepare 3- to 5-day-old cultures of several common fungi. Inoculate these cultures at the edge of the mycelium with one of the above suggested species. Observe daily for the parasite overgrowing the host colony, and examine microscopically for destroyed host cells.

PART II

TAXONOMY AND IDENTIFICATION

THE SACCARDO SYSTEM OF CLASSIFICATION

The Saccardo System has long been in use for the classification of imperfect fungi. The primary basis of this system is the morphology of the sporulating structures as they are known in nature, as well as the morphology and pigmentation of conidia and conidiophores. In artificial culture, some species of imperfects fail to form typical fruiting structures (e.g., acervuli, sporodochia, and synnemaia).

Although an alternate system of classification may be more convenient for mycologists who have studied the different methods of conidium development, the authors recommend that others use the illustrations and key based on the Saccardo System. Moniliaceae and Dothideaceae, the two largest families, are presented according to the Hughes-Tubaki-Barron System of Classification beginning on page 41.

ORDERS INCLUDED

Conidia/Phycomycetes. Mycelium typically coenocytic; septa absent or infrequent; conidia (sporangioles) present; typical large, multi-spored sporangia may also be present in some genera. This group is included here because of similarity to some genera of the imperfect fungi.

MUCORALES

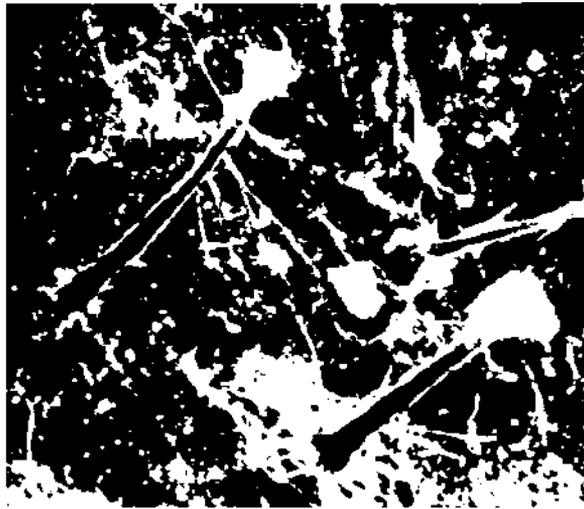
8

Mostly saprophytic, but some species parasitic on plants or other fungi.

Fungi Imperfectii. Mycelium (if present) typically septate with frequent septa; conidia normally present except in a few genera. Classification and identification are based on the conidial state, although the perfect state is often known and sometimes also present.



Fruiting heads of *Verticillium procera*.



Synnema and conidia of the Dutch elm fungus, *Pesotum ulmi*.

| | | |
|---|-----------------------------|--------|
| | TAXONOMY AND IDENTIFICATION | 7 |
| SPHAEROPSIDALES | | 28 |
| Conidia produced in well defined asexual fruit bodies, pycnidia. | | |
| MELANCONIALES | | 33 |
| Conidia typically produced in acervuli under natural conditions; in culture conidiophores may be single or in compact groups, resembling sporodochia of the Moniliales. | | |
| MONILIALES | | |
| Conidia produced directly on the mycelium, on separate conidiogenous cells, or on distinct conidiophores that may be separate, in clusters, or in tightly packed groups. This is the largest and most common order. | | |
| MYCELIA STERILIA | | 34 |
| No conidia produced. Usually sclerotia or other structures are formed for survival. This group does not include those fungi that do not sporulate because of unfavorable nutritional or environmental conditions. | | |
| FAMILIES OF MONILIALES | | |
| TUBERCULARIACEAE | | 25 |
| Conidiophores typically compacted into a rounded or flat sporodochium, often not well developed in artificial culture. Some species of Melanconiales produce structures resembling sporodochia in culture. | | |
| STILBACEAE | | 26 |
| Conidiophores typically compacted into synnemata, which may be more abundant in aging cultures. Single conidiophores may also be present in some cultures or may be the only conidial state present. Such cultures may be identified in one of the following families. | | |
| MONILIACEAE AND DEMATIACEAE | | 10, 17 |
| Conidiophores mostly single and separate or produced in loose clusters. These two families are considered together because the only described difference is the hyaline conidia of the former and the pigmented (dark) conidia or conidiophores of the latter. Conidia are considered pigmented if the walls appear dark either separate or in mass. | | |
| Only within this order (Moniliales) are families used in the identification of genera. | | |
| In the Saccardo System orders and families may be broken into sections as follows: Amerosporae, conidia 1-celled; Didymosporae, conidia 2-celled; Phragmosporae, conidia with transverse septa only; Dictyosporae, conidia with both transverse and oblique septations; Scolecosporae, conidia filiform; Staurosporae, conidia stellate or branched; Helicosporae, conidia typically coiled. The prefixes Hyalo- and Phaeo- are sometimes added to each section name to indicate hyaline or darkly pigmented conidia, respectively. | | |

KEY TO GENERA

Note that there is a separate key for each order.

MUCORALES

| | | | |
|-----|--|-------------------------|----|
| 1a | Conidia (sporangioles) globose, borne singly on apex of conidiophores (sporangiohores) or branches | <i>Mortierella</i> | 60 |
| 1b | Conidia (sporangioles) globose to elongate, borne in clusters or in heads | | 2 |
| 2a | Special spore-bearing branches (sporocladia) bearing conidia only on one side (upper or lower) | | 3 |
| 2b | Sporocladia not present | | 7 |
| 3a | Sporocladia borne on coiled or recurved branches | | 4 |
| 3b | Sporocladia not on coiled or recurved branches | | 5 |
| 4a | Sporocladia on coiled branches; conidia short ellipsoid | <i>Spirodactylon</i> | 64 |
| 4b | Sporocladia in umbels on recurved branches; conidia obovoid | <i>Martensiomycetes</i> | 64 |
| 4c | Sporocladia arising from loosely spiraled branches; conidia globose to subglobose | <i>Spiromyces</i> | 66 |
| 5a | Conidia borne only on upper (inner) side of sporocladium | | 6 |
| 5b | Conidia borne only on lower (outer) side of sporocladium | <i>Coemansia</i> | 62 |
| 6a | Conidiophore simple, bearing a few lateral or apical sporocladia | <i>Martensella</i> | 64 |
| 6b | Conidiophore simple, bearing a whorl of sporocladia on an apical disc | <i>Kickxella</i> | 64 |
| 6c | Conidiophore long, branched, bearing lateral, dome-shaped sporocladia | <i>Linderina</i> | 64 |
| 7a | Conidia produced in rows, or sporangioles in chains, often breaking up into rows of spores | | 8 |
| 7b | Conidia not in rows (chainlike); sporangioles do not break up into rows of spores | | 12 |
| 8a | Conidiophores nonseptate, simple or branched; conidia radiating apex | | 9 |
| 8b | Conidiophores septate, distinctly branched | | 10 |
| 9a | Conidiophores simple, with basal rhizoids | <i>Syncephalis</i> | 62 |
| 9b | Conidiophores usually branched; rhizoids absent | <i>Syncephalastrum</i> | 66 |
| 10a | Conidiophore branches dichotomous, all fertile | <i>Piptocephalis</i> | 62 |
| 10b | Conidiophore branches verticillate, all fertile | <i>Dimargaris</i> | 62 |

| | | |
|------|---|--------------------------|
| | MUCORALES | 9 |
| 10c | Conidiophore branches irregular, some with sterile tips | 11 |
| 1 1a | Fertile branches enlarged, bearing a head of cylindrical conidia | <i>Dispira</i> 66 |
| 1 1b | Fertile branches repeatedly branched; conidia not in compact heads | <i>Tieghemiomyces</i> 62 |
| 12a | Conidiophores with lateral or terminal branches | 13 |
| 12b | Conidiophores simple | 14 |
| 13a | Spore-bearing head compound; conidia ellipsoid, usually colored | <i>Choanephora</i> 66 |
| 13b | Spore-bearing head compound; conidia hyaline, reniform to ellipsoid | <i>Radiomycea</i> 64 |
| 13c | Spore-bearing head simple; conidia hyaline, globose to subglobose | <i>Cunninghamella</i> 60 |
| 14a | Conidia not produced in slime, dry | 15 |
| (4b) | Conidia produced in slime drop in a head | <i>Helicocephalum</i> 60 |
| J 5a | Conidia borne on enlarged globose apex | <i>Rhopalomyces</i> 60 |
| 15b | Conidia borne on cylindrical upper portion of conidiophore | <i>Mycotypha</i> 60 |

MONILIALES

| | | |
|----|--|----|
| 1a | Conidia more or less coiled or spirally curved, hyaline or dark (parts of Moniliaceae, Dematiaceae and Tuberculariaceae) | 2 |
| 1b | Conidia not coiled | 10 |

HELICOSPORES

| | | |
|------|---|--------------------------|
| 2a | Conidiophores forming a sporodochium | 3 |
| 2b | Conidiophores single or in loose clusters | 4 |
| 3a | Conidial coil flat; sporodochium stalked | <i>Everhartia</i> 150 |
| 3b | Conidial coil in a loose spiral; sporodochium not stalked | <i>Hobsonia</i> 150 |
| 4a | Conidial coil more or less flattened | 5 |
| 4b | Conidial coil spiral | 9 |
| 5a | Conidia thick in proportion to length | 6 |
| 5b | Conidia slender | 8 |
| 6a | Conidia hyaline or dark, with transverse septa only | 7 |
| 6b | Conidia dark, with transverse and oblique septa | <i>Xenosporium</i> 136 |
| C_7a | Parasitic on higher plants | <i>Helkomina</i> 136 |
| 7b | Saprophytic on wood or bark | <i>Helicotna</i> 136 |
| 8a | Conidiophores hyaline, short | <i>Helicomycetes</i> 136 |

10 KEY TO GENERA

| | | | |
|----|---|----------------------|-----|
| 8b | Conidiophores pigmented, pale or dark, tall | <i>Helicosporium</i> | 136 |
| 9a | Conidia borne singly | <i>Helicoon</i> | 136 |
| 9b | Conidia catenulate | <i>Helicodendron</i> | 136 |

NOT HEUCOSPORES

| | | | |
|-----|--|-------------------------|-----|
| 10a | Both conidia and conidiophores (if present) hyaline or brightly colored; conidiophores single or in loose clusters | <i>Moniliaceae</i> | 11 |
| 10b | Either conidia or conidiophores (or both) with distinct dark pigment; conidiophores single or in loose clusters | <i>Dematiaceae</i> | 105 |
| 10c | Conidiospores compacted into sporodochia | <i>Tuberculariaceae</i> | 202 |
| 10d | Conidiophores typically united into synnemata | <i>Stilbaceae</i> | 225 |

MONILIACEAE

| | | | |
|-------|---|-----------------------|--------|
| 11a | Conidia typically 1-celled, globose to several times longer than wide | | 12 |
| 11b | Conidia typically 2-celled, mostly ovoid to cylindrical | | 62 |
| 11c | Conidia typically 3- or more-celled, shape variable | | 74 |
| 12a | Conidiophores absent or like the mycelium, or reduced to phialides or peglike denticles | | 13 |
| 12b | Conidiophores distinct, although sometimes short | | 19 |
| V 13a | Pathogenic to humans | | 14 |
| 13b | Saprophytic or parasitic, mostly soil or on plant parts | | 15 |
| 14a | Filamentous in cultures at 25°C, with large chlamydozoospores.. <i>Blastomyces, Histoplasma</i> | | 80, 82 |
| 14b | Both filamentous and yeastlike cells at 25 °C, without large chlamydozoospores | <i>Candida</i> | 70 |
| 15a | Conidia (arthrospores) segment from branches of conidiophores, rounded | <i>Chrysosporium</i> | 68 |
| 15b | Conidia (arthrospores) formed by segmentation of hyphae, rod-shaped — <i>Geotrichum</i> | | 68 |
| 15c | Conidia not arthrospores, not formed by segmentation | | 16 |
| 16a | Setae absent | | 17 |
| 16b | Setae present, mostly circinate, unbranched | <i>Circinotrichum</i> | 90 |
| 16c | Setae present, branched, circinate or wavy | <i>Gyothrix</i> | 90 |
| 17a | Mycelium with clamp connections | <i>Itersonilia</i> | 70 |
| 17b | Mycelium without clamp connections | | 18 |
| 18a | Conidia produced on sterigmata and forcibly discharged | <i>Sporobolomyces</i> | 70 |
| 18b | Conidia borne on sides of mycelium or formed by budding, not forcibly discharged | <i>Candida</i> | 70 |

| | | |
|-----|---|------------------------------------|
| | MONIALES | 11 |
| 19a | Conidial state of powdery mildew; conidia catenulate | <i>Oidium</i> 68 |
| 19b | Conidial state of powdery mildew; conidia not catenulate | <i>Ovulariopsis</i> 70 |
| 19c | Not conidial state of powdery mildew , | 20 |
| 20a | Conidia distinct in shape from apical cells of conidiophore | 21 |
| 20b | Conidia (arthrospores) gradually become rounded from apical cells of conidiophore | <i>Wallemia</i> 92 |
| 20c | Conidia (blastospores) globose to ellipsoid, similar to apical cells of conidiophore | <i>Monilia</i> 72 |
| 20d | Conidia (blastospores) elongate, slender, much like cells of conidiophore | <i>Tilletiopsis</i> 12 |
| 21a | Conidiophores (or phialides) typically simple or with few branches; phialides, if present, not tightly clustered into heads | 22 |
| 21b | Conidiophores mostly branched; phialides, if present, clustered into groups or heads — | 38 |
| 22a | Conidia catenulate | 23 |
| 22b | Conidia not catenulate | 29 |
| 23a | Conidia endogenous; phialides prominent, simple | 24 |
| 23b | Conidia exogenous; conidiophores simple or branched | 26 |
| 24a | Dark aleuriospores (chlamydospores) present, rounded, usually single | <i>Chalaropsis</i> 90 |
| 24b | Dark aleuriospores (chlamydospores) in short chains of truncate cells, breaking up | <i>Thielaviopsis</i> 92 |
| 24c | Dark aleuriospores rarely formed | 25 |
| 25a | Dark setae present | <i>Chaetochalara</i> 90 |
| 25b | Dark setae absent | <i>Chalara</i> 90 |
| 26a | Conidia blastospores or botryoblastospores | 27 |
| 26b | Conidia otherwise | 28 |
| 27a | Conidia in chains on slender conidiophores | <i>Hyalodendron</i> 72 |
| 27b | Conidia on enlarged apex and nodes of conidiophores | <i>Gonatorrhodiella</i> 78 |
| 28a | Conidia phialospores; phialides simple | <i>Monocillium</i> 86 |
| 28b | Conidia arthrospores, nearly globose with a flat base | <i>Basipetospora</i> 70 |
| 28c | Conidia arthrospores, rod-shaped | <i>Oidiodendron</i> 68 |
| 29a | Conidiophores or conidiogenous cells short or indefinite | <i>Chrysosporium</i> 68 |
| 29b | Conidiophores or conidiogenous cells distinct; fertile portion rachislike | <i>Tritirachium, Beauveria</i> 100 |
| 29c | Conidiophores or conidiogenous cells distinct, fertile portion not rachislike | 30 |
| 30a | Conidiophores not inflated or only slightly so | 31 |
| 30b | Conidiophores or fertile cells distinctly inflated at middle or apex | 37 |

12 KEY TO GENERA

| | | | |
|------|---|---------------------------|------------|
| 31a | Conidia curved; aquatic on dead leaves | <i>Lunulospora</i> | 138 |
| 31 b | Conidia globose to ovoid; not aquatic | | 32 |
| 32a | Conidia sympodulospores | | 34 |
| 32b | Conidia aleuriospores | | 35 |
| 32c | Conidia blastospores or phialospores; single | | 33 |
| 33a | Conidia blastospores, on long denticles, dry | <i>Otpitrichum</i> | 74 |
| 33b | Conidia phialospores, in moist heads | | 36 |
| 34a | Conidiophores clustered | <i>Ovularia</i> | 104 |
| 34b | Conidiophores single, separate | <i>Sporothrix</i> | 98 |
| 35a | Conidiophores single, simple, forked at apex | <i>Glomerularia</i> | 86 |
| 35b | Conidiophores usually have branches arising from an enlarged cell | <i>Umbelopsis</i> | 86 |
| 35c | Conidiophores with variable short lateral branches | <i>Staphylotrichum</i> | 80 |
| 36a | Conidiophores branched verticillately | <i>Vertkillium</i> | 92 |
| 36b | Conidiophores in acervuli in nature; in culture, conidiophores separate or in poorly formed groups | <i>Gloeosporium</i> | 188 |
| 36c | Conidiophores simple or with few branches, never in acervuli | <i>Cephalosporium</i> | 94 |
| 37a | Fertile cells globose; conidiophores short, stout | <i>Phymaiotrkhum</i> | 78 |
| 37b | Fertile cells globose, single, apical; conidiophores slender | <i>Oedocephalum</i> | 76 |
| 37c | Fertile cells globose, apical and intercalary | <i>Gonatobotrys</i> | 76 |
| 37d | Fertile cells somewhat elongated; conidia borne on short denticles | <i>Rhinotrichum</i> | 76 |
| 37e | Fertile cells somewhat elongated; conidia borne on long pegs or branches | <i>Acladium</i> | 76 |
| 37f | Fertile cells elongated, cylindrical, enlarged branches of conidiophore; conidia on short denticles | <i>Chromelosporium</i> | 80 |
| 38a | Conidia in more or less compact heads; conidiophores simple | | 39 |
| 38b | Conidia not in compact heads; conidiophores simple or branched near the apex | | 41 |
| 39a | Conidia in dry heads | <i>Aspergillus</i> | 94 |
| 39b | Conidia held in heads of slime | | 40 |
| 40a | Simple diverging sterile arms subtending heads | <i>Gliocephalotrichum</i> | 94 |
| 40b | No sterile arms below conidial heads | <i>Gliocephalis</i> | 94 |
| 41a | Conidia in basipetal chains | | 42 |
| 41 b | Conidial chains formed by segmentation of cells or branches of conidiophore | | 44 |

| | | |
|--|-----------------------|-----|
| | MGNIHALES | 13 |
| 41 c Conidia not catenulate | | 45 |
| 42a Conidiophores usually separate, not in columns or cushions | | 43 |
| 42b Conidiophores and conidia in tall aggregates | <i>Metarrhizium</i> | 94 |
| 42c Conidiophores and conidia in slimy cushions | <i>Myroihecium</i> | 146 |
| 43a Conidia phialospores; phialides divergent, loose | <i>Paecilomyces</i> | 94 |
| 43b Conidia phialospores; phialides upright, brushlike | <i>Penicillium</i> | 94 |
| 43c Conidia annelospores | <i>Scopulariopsis</i> | 98 |
| 44a Arthrospores barrel-shaped, separated by prominent slender cells | <i>Amblyosporium</i> | 68 |
| 44b Arthrospores rod-shaped to globose, separating cells not prominent | <i>Oidiodendron</i> | 68 |
| 45a Rough-walled aleuriospores (chlamydospores) present | | 46 |
| 45b Rough-walled aleuriospores absent | | 48 |
| 46a Aleuriospores 1-celled, with attached hyaline cells | <i>Stephanoma</i> | 82 |
| 46b Aleuriospores 1-celled, smooth walled | <i>Botryoderma</i> | 86 |
| 46c Aleuriospores 1-celled, rough walled, without attached cells | <i>Sepedonium</i> | 82 |
| 46d Aleuriospores 2-celled; apical cell large, rough, basal cell small, smooth | | 47 |
| 47a Phialospore state verticillate (like <i>Verticillium</i>) | <i>Mycogone</i> | 82 |
| 47b Phialospore state aspergilliform (like <i>Aspergillus</i>) | <i>Chlamydomyces</i> | 82 |
| 48a Conidia produced at or near apex of phialides or branches of conidiophores | | 49 |
| 48b Conidia attached both at apex and side of conidiophore or its branches | | 57 |
| 49a Larger conidiophores (at least) verticillate | | 50 |
| 49b Branches of conidiophores irregular, not verticillate | | 51 |
| 50a Phialospores in mucilaginous clusters | <i>Verticillium</i> | 92 |
| 50b Sympodulospores in dry clusters | <i>Calcarisporium</i> | 102 |
| 51a Conidia not aggregated in slime drops | | 52 |
| 51 b Conidia held in heads by slime drops | | 54 |
| 52a Conidia abundant, borne on inflated apical cells | | 53 |
| 52b Conidia single or in small clusters, not on inflated cells | | 55 |
| 53a Conidiophores tall, with one (or few) central axis and several equal, lateral branches | <i>Botryosporium</i> | 76 |
| 53b Conidiophores tall, with irregular branches | <i>Botrytis</i> | 76 |
| 53c Conidiophores tall, with regular dichotomous branching | <i>Dichobotrys</i> | 78 |
| 53d Conidiophores short, with few branches | <i>Phymatotrichum</i> | 78 |
| 54a Conidiophore branches brushlike, similar to <i>Penicillium</i> | <i>Gliocladium</i> | 92 |

14 KEY TO GENERA

| | | | |
|-----|---|------------------------|------------|
| 54b | Conidiophore branches spreading, not brushlike | <i>Trichoderma</i> | 92 |
| 55a | Conidiophore branches loose, conidia present | | 56 |
| 55b | Reproductive structure compacted, globose or pyramidal, bearing globose cells but no true conidia | <i>Cristulariella</i> | 74 |
| 56a | Saprophytic on leaves | <i>Hansfordia</i> | 98 |
| 56b | Saprophytic on wood; conidial state of <i>Hypoxylon</i> | <i>Nodulosporium</i> | 100 |
| 57a | Fertile portion of conidiophore (or sporogenous cell) zig-zag rachishke | | 58 |
| 57b | Fertile portion of conidiophore (or cell) not zig-zag, or rachislike | | 60 |
| 58a | Conidiophores simple or verticillately branched | | 59 |
| 58b | Conidiophores irregularly branched | <i>Geniculosporium</i> | 100 |
| 59a | Conidiophores bulbous at base; parasitic on insects | <i>Beauveria</i> | 100 |
| 59b | Conidiophores slender, not bulbous; not parasitic on insects | <i>Tritirachium</i> | 100 |
| 60a | Conidia borne on short denticles | | 61 |
| 60b | Conidia apical on branches, not on denticles | <i>Botryoderma</i> | 86 |
| 61a | Conidiophores slender, with slender branches from main axis; not dichotomous | <i>Calcarisporium</i> | 102 |
| 61b | Conidiophores slender to stout; fertile cells somewhat inflated | <i>Chromelosporium</i> | 80 |
| 62a | Conidiophores well developed, branched | | 63 |
| 62b | Conidiophores mostly simple or with few branches | | 66 |
| 62c | Conidiophores none, reduced to cells of stroma | <i>Rhynchosporium</i> | 108 |
| 63a | Conidia ovoid to oblong | | 64 |
| 63b | Conidia (sympodulospores) obovoid | <i>Genicularia</i> | 110 |
| 63c | Conidia (phialospores) slender, cylindrical | <i>Cylindrocladium</i> | 108 |
| 64a | Conidiophore branches restricted to apical region | <i>Candelabrella</i> | 110 |
| 64b | Conidiophore branches not restricted to apical region | | 65 |
| 65a | Conidia in loose moist clusters | <i>Diplosporium</i> | 108 |
| 65b | Conidia in loose tangled chains | <i>Cladobotryum</i> | 108 |
| 66a | Apical cell of conidium much larger than basal cell | | 67 |
| 66b | Conidial cells not differing greatly in size | | 70 |
| 67a | Aquatic on submerged leaves | <i>Heliscus</i> | 108 |
| 67b | Not aquatic | | 68 |
| 68a | Both cells of conidium smooth walled | <i>Genicularia</i> | 110 |
| 68b | Apical cell of conidium rough walled; basal cell smooth | | 69 |

| | | |
|------|---|----------------------------|
| | MONILIALES | 15 |
| 69a | Microconidial state, if present, similar to <i>Aspergillus</i> | <i>Chlamydomyces</i> 82 |
| 69b | Microconidial state, if present, similar to <i>Verticillium</i> | <i>Mycogone</i> 82 |
| 70a | Conidiophores single, not clustered; mostly saprophytic | 71 |
| 70b | Conidiophores clustered; parasitic on leaves | 73 |
| 71a | Conidia borne singly on short pegs or denticles at or near apex of conidiophore | 72 |
| 71 b | Conidia borne successively at pointed apex of conidiophore | <i>Trichothecium</i> 108 |
| 72a | Conidiophores tall, slender; conidia obovate to oblong | <i>Arthrobotrys</i> 110 |
| 72b | Conidiophores short; conidia cylindrical to clavate | <i>Dactylaria</i> 110 |
| 73a | Conidia cylindrical, often in short chains | <i>Ramularia</i> 110 |
| 73b | Conidia ovoid to oblong, not catenulate | <i>Didymaria</i> 110 |
| 74a | Conidia long, cylindrical, often bent or curved; aquatic | 75 |
| 74b | Conidia shorter or not cylindrical; aquatic or not | 76 |
| 75a | Conidiophores branched near apex; conidia 1 - or few-celled | <i>Flagelhspora</i> 138 |
| 75b | Conidiophores simple; conidia single, apical | <i>Anguillospora</i> 140 |
| 76a | Conidia 2- to several-celled, phragmosporous, not branched | 77 |
| 76b | Conidia branched, staurosporous | 84 |
| 77a | Causing dermatomycoses of man or animals | 78 |
| 77b | Saprophytic or parasitic on plants | 79 |
| 78a | Macroconidia clavate, rounded at apex | <i>Trichophyton</i> 116 |
| 78b | Macroconidia spindle-shaped to ellipsoid | <i>Microsporium</i> 116 |
| 79a | Macroconidia typically curved, pointed (canoe-shaped), small conidia usually also present | <i>Fusarium</i> 130 |
| 79b | Other than in macroconidia, not canoe-shaped | 80 |
| 80a | Conidiophores short, mostly simple or with few branches | 81 |
| 80b | Conidiophores tall, simple or branched | 85 |
| 81 a | Conidia cylindrical, mostly straight, <i>or</i> slightly curved | 82 |
| 81 b | Conidia ellipsoid or long attenuated | 83 |
| 82a | Conidia catenulate; conidiophores clustered | <i>Septocylindrium</i> 128 |
| 82b | Conidia not catenulate (symptomulospores); conidiophores single | <i>Scolecobasidium</i> 114 |
| 82c | Conidia not catenulate (phialospores); conidiophores single | <i>Cylindrocarpon</i> 130 |
| 83a | Conidia ellipsoid, rounded at apex | <i>Fusoma</i> 116 |
| 83b | Conidia cylindrical to filiform | 84 |

| | | | |
|-----|--|------------------------|------------|
| 84a | Conidium with apical appendage | <i>Spermospora</i> | 128 |
| 84b | Conidia without appendages | <i>Cercosporella</i> | 128 |
| 85a | Conidiophores mostly simple, seldom branched | | 86 |
| 85b | Conidiophores typically branched | | 95 |
| 86a | Parasitic on grasses | <i>Pyricularia</i> | 128 |
| 86b | Saprophytic or parasitic on nematodes | | 87 |
| 87a | Middle cell of conidium greatly enlarged | <i>Monacrosporium</i> | 118 |
| 87b | Middle cell only slightly or not at all enlarged | | 88 |
| 88a | Conidia ovoid to clavate to cylindrical | <i>Dactylaria</i> | 110 |
| 88b | Conidia fusiform to cylindrical | <i>Dactylella</i> | 128 |
| 89a | Branches of conidiophore (phialides) verticillate | <i>Dactylium</i> | 130 |
| 89b | Conidiophores terminating in penicilliate branches | <i>Cylindrocladium</i> | 108 |
| 90a | True staurosporous conidia formed | | 91 |
| 90b | No true conidia known; "conidial" branches forming a well defined globose or conical structure, similar to a loosely formed sclerotium | <i>Cristulariella</i> | 74 |
| 91a | Conidiophores reduced, not evident | <i>Thallospora</i> | 142 |
| 91b | Conidiophores distinct, well formed, length variable | | 92 |
| 92a | Conidial branches not greatly divergent | | 93 |
| 92b | Conidial branches widely divergent | | 94 |
| 93a | Conidial branches typically 2-pronged | <i>Dicranidion</i> | 138 |
| 93b | Conidial branches typically 3-pronged | <i>Tridentaria</i> | 140 |
| 94a | Central cell of conidium much enlarged | | 95 |
| 94b | Central cell of conidium not enlarged | | 97 |
| 95a | Conidia pyriform or clavate, with 3 slender branches | <i>Clavariopsis</i> | 140 |
| 95b | Conidia with central globose cell and 4 to 5 slender branches | <i>Actinospora</i> | 140 |
| 95c | Conidia with 3 to 4 broad cells in main axis and 2 to 4 slender appendages | | 96 |
| 96a | Conidial appendages attenuated, pointed | <i>Ingoldia</i> | 138 |
| 96b | Conidial appendages not distinctly attenuated | <i>CuHcidospora</i> | 140 |
| 97a | Conidia borne on phialides or phialide-like branches of the conidiophore | | 98 |
| 97b | Conidia borne otherwise | | 99 |
| 98a | Conidium with elongated axis and 2 lateral branches arising side by side | <i>Alatospora</i> | 142 |
| 98b | Conidium with 4 divergent branches arising near base of conidium | <i>Lemonniera</i> | 138 |

| | | |
|------|---|---------------------------|
| | MONILIALES | 17 |
| 99a | Conidial branches formed one at a time | 100 |
| 99b | Conidial branches formed simultaneously | 103 |
| 100a | Conidial branches 4 or more | 101 |
| 100b | Conidial branches 3 or less | 104 |
| 101a | Main axis of conidium broader than branches | <i>Tetracladium</i> 140 |
| 101b | Main axis of conidium about the same width as branches | 102 |
| 102a | Number of branches variable mostly arising from one side of main axis | <i>Varicosporium</i> 138 |
| 102b | Conidial branches dendroid, not limited to one side of main axis | <i>Dendrospora</i> 140 |
| 103a | Conidial branches arising from different levels | <i>Tricladium</i> 138 |
| 103b | Conidial branches arising from base of central axis | <i>Triscelophorus</i> 138 |
| 104a | Conidial branches arising from near apex of main axis | <i>Articulospora</i> 142 |
| 104b | Two conidial branches arising about midway of slender axis | <i>Tetrachaetum</i> 140 |

DEMATIACEAE

| | | |
|------|---|-------------------------|
| 105a | Conidia typically 1-celled | 106 |
| 105b | Conidia typically 2-celled | 145 |
| 105c | Conidia typically 3- or more-celled phragmospores | 156 |
| 105d | Conidia typically 3- or more-celled dictyospores | 184 |
| 106a | Conidiophores absent or, if present, often poorly developed, consisting of 1 to few cells | 107 |
| 106b | Conidiophores mostly tall and well developed, cells distinct from conidia, simple or branched | 122 |
| 107a | Blastospores borne directly on sides of mycelium, budding freely | <i>Aureobasidium</i> 70 |
| 107b | Dark globose cells of the mycelium breaking up to form 1- to several-celled segments; conidiophorelike structures may also be present | <i>Torula</i> 74 |
| 107c | Conidia appearing as blastospores, not budding, broadly ovoid to lenticular, with a hyaline slit on one side | <i>Papularia</i> 82 |
| 107d | Conidia other than blastospores, not normally budding; conidiophore cells usually distinct but short | 108 |
| 108a | Conidiophores extending slightly in length; conidia formed as meristem arthrospores | <i>Wailemia</i> 92 |
| 108b | Conidia other than arthrospores | 109 |
| 109a | Conidia formed as aleuriospores | 110 |
| 109b | Conidia formed as phialospores, sympodulospores, or annellospores | 114 |
| 110a | Conidia globose | 111 |

18 KEY TO GENERA

| | | | | | | | | | |
|---------|--|---|---|---------|----------|-----------------------|--------------|---------|------------|
| I 10b | Conidia ellipsoid or pointed at apex | | | | | | | | 112 |
| II 1a | Conidia black and shiny, borne singly, apically on a special flat hyaline cell | | | | | <i>Nigrospora</i> | | | 82 |
| 11 lb | Conidia apical, brown, not on a flat special cell | | | | | <i>Humicola</i> | | | 84 |
| 11 lc | Conidiophore reduced to one cell; conidia single, with a hyaline germ pore on one side | | | | | <i>Gilmaniella</i> | | | 84 |
| 11 Id | Conidia single on short branch; no germ pore evident; dark setae present | | | | | <i>Botryothchwn</i> | | | 84 |
| 112a | Conidia rough-walled, pointed at apex | | | | | <i>Echinobotryum</i> | | | 84 |
| 112b | Conidia smooth-walled, ellipsoid | | | | | | | | 113 |
| 113a | Conidiophores short, hyaline, repeatedly branched | | | | | <i>Wardomyces</i> | | | 84 |
| II 3b | Conidiophore branches few; conidia borne on slender stalks | | | | | <i>Asteromyces</i> | | | 84 |
| 113c | Conidiophore branches few; conidia sessile; germ slit evident on one side | | | | | <i>Mammaria</i> | | | 84 |
| I 14a | Conidiophores separate; sympodulospores hyaline, somewhat curved | | | | | <i>Idriella</i> | | | 102 |
| 114b | Conidiophores compacted into stromalike layers; sympodulospores dark, pointed at apex | | | | | <i>Fusicladium</i> | | | 112 |
| 114c | Conidiophores compacted into stromalike layer; annellospores dark, pointed at apex | | | | | <i>Spilocaea</i> | | | 106 |
| 1 | 1 | 4 | d | Conidia | formed | as | phialospores | | 115 |
| 115a | Conidia slightly curved, narrowly ellipsoid; simple curved setae present.. | | | | | <i>Circinotrichum</i> | | | 90 |
| U5b | Conidia slightly curved, narrowly ellipsoid; branched, curved setae present... | | | | | <i>Gyothrix</i> | | | 90 |
| 115c | Conidia ovoid to rod-shaped; no setae present | | | | | | | | 116 |
| 116a | Conidia with slender appendage at each end; conidiophore branched | | | | | <i>Menispora</i> | | | 88 |
| 116b | Conidia with slender appendage at each end; conidiophore unbranched | | | | | <i>Codinae</i> | | | 88 |
| 1 | 1 | 6 | c | Conidia | without | appendage | | | 117 |
| 117a | Conidia ovoid, hyaline to dark, often in chains, not in heads | | | | | <i>Monilochaetes</i> | | | 86 |
| 117b | Conidia mostly ovoid, in small slimy heads, not catenulate | | | | | | | | 118 |
| 1 1 7 c | Conidia rod-shaped, with blunt ends, little or no slime, often present in long chains | | | | | | | | 119 |
| 118a | Phialides often with enlarged base with flaring collar; conidia hyaline | | | | | <i>Phialophora</i> | | | 88 |
| 118b | Phialides slender, collar not noticeably flared; conidia hyaline | | | | | <i>Chloridium</i> | | | 88 |
| 118c | Phialides slender, collar not flaring; conidia dark | | | | | <i>Gliomastix</i> | | | 86 |
| 1 | 1 | 9 | a | Dark | chlamydo | spores | present | | 120 |
| 1 | 1 | 9 | b | No | dark | chlamydo | spores | present | 121 |
| 120a | Chlamydo | spores nearly globose, mostly single | | | | <i>Chalaropsis</i> | | | 90 |
| 120b | Chlamydo | spores formed in a row, breaking up into single cells | | | | <i>Thielaviopsis</i> | | | 92 |

| | | |
|------|--|-----------------------------|
| | MONILIALES | 19 |
| 121a | Dark, simple, pointed setae present | <i>Chaetochalara</i> 90 |
| 121b | No setae present | <i>Chalara</i> 90 |
| 122a | Conidia, sympodulospores, formed on new growing points on conidiophores | 123 |
| 122b | Conidia formed in other ways, not sympodulospores | 130 |
| 123a | Conidiophores simple | 124 |
| 123b | Conidiophores branched | 125 |
| 124a | Apex of conidiophores enlarged, rounded, bearing numerous hyaline conidia on short sporogenous cells | <i>Basidiobotrys</i> 100 |
| 124b | Conidiophores pointed at apex; conidia hyaline, ovoid, attached at tip and sides of conidiophores | <i>Rhinocladiella</i> 104 |
| 124c | Conidia obconic, pointed at apex, dark | <i>Beltrania</i> 104 |
| 125a | Conidiophore branches or phialides borne on side of conidiophore | 126 |
| 125b | Branches of conidiophore confined to area near apex | 127 |
| 125c | Branches of conidiophores irregular | 128 |
| 126a | Branches in whorls; conidia somewhat curved | <i>Selenosporella</i> 102 |
| 126b | Conidia in unbranched chains, rod-shaped | <i>Symptodiella</i> 104 |
| Mid. | Branches loosely arranged; conidia dark, without slime | <i>Periconiella</i> 104 |
| 127b | Conidiophores repeatedly branched; branches compact; conidia hyaline in slime heads | <i>Verticicladiella</i> 104 |
| 127c | Conidiophores repeatedly branched near apex; conidia not borne in slime heads | <i>Verticicladium</i> 104 |
| 128a | Conidia borne on somewhat enlarged branch tips | <i>Nodulosporium</i> 100 |
| 128b | Conidia borne on elongated fertile portion of conidiophore branches | 129 |
| 129a | Conidiophores with main axis and numerous lateral branches; conidia dark... | <i>Conoplea</i> 102 |
| 129b | Main axis of conidiophore not evident; conidia hyaline, symmetric | <i>Geniculosporium</i> 100 |
| 129c | Main axis of conidiophores not evident; conidia dark, asymmetric | <i>Virgaria</i> 100 |
| 130a | Conidia blastospores or appearing to be produced as such | 131 |
| 130b | Other than in conidia, not blastospores | 136 |
| 131a | Conidia hyaline | 132 |
| 131b | Conidia dark | 133 |
| 132a | Dark special cells (falcs) bearing sporogenous cells | <i>Zygosporium</i> 72 |
| 132b | Without dark falcs on conidiophores | <i>Haplographium</i> 80 |
| 133a | Dark pointed setae present | 134 |
| 133b | Without dark setae | 135 |

| | | | |
|------|--|------------------------|------------|
| 134a | Conidiophore with enlarged rounded apical cell | <i>Lacellinopsis</i> | 78 |
| 134b | Conidiophores with slender apical cells | <i>Lacellina</i> | 78 |
| 135a | Conidia borne on apical inflated cells | <i>Periconia</i> | 74 |
| 135b | Conidia borne on inflated cells at apex and intercalary cells of conidiophores | <i>Gonatobotryum</i> | 78 |
| 135c | Conidia borne in acropetal chains of variable size and with scars | <i>Cladosporium</i> | 106 |
| 136a | Conidia (phialophores) borne at apex of conidiophores | | 137 |
| 136b | Conidia not phialospores | | 143 |
| 137a | Conidiophores simple, unbranched | | 138 |
| 137b | Conidiophores branched | | 139 |
| 138a | Conidia in moist (slimy) heads | <i>Stachybotrys</i> | 88 |
| 138b | Conidia in dry chains; apex of conidiophores not enlarged | <i>Memmoniella</i> | 88 |
| 138c | Conidia in dry chains; apex of conidiophores enlarged, rounded | <i>Aspergillus</i> | 94 |
| 139a | Branches of conidiophores lateral; conidiophores with sterile apex | | 140 |
| 139b | Conidiophore branches clustered at or near apex, without sterile apex | | 141 |
| 140a | Conidia ovoid; phialides dark | <i>Gonytrichum</i> | 98 |
| 140b | Conidia oblong, cylindrical; phialides hyaline | <i>Chaetopsina</i> | 96 |
| 141a | Conidiophores hyaline; few conidia large, dark, lemon-shaped | <i>Phialomyces</i> | 94 |
| 141b | Conidiophores dark; other than in conidia | | 142 |
| 142a | Conidia rod-shaped, elongate with blunt ends, catenulate | <i>Phialocephala</i> | 96 |
| 142b | Conidia elongate fusoid, ends pointed | <i>Thysanophora</i> | 96 |
| 142c | Conidia ovoid, not catenulate | <i>Stachylidium</i> | 92 |
| 143a | Conidia formed as meristem arthrospores; conidiophores with thick dark septa | <i>Arthrinium</i> | 74 |
| 143b | Conidia and conidiophores not as above | | 144 |
| 144a | Conidia annellospores, conidia in slime heads | <i>Leptographium</i> | 98 |
| 144b | Conidia aleuriospores; conidiophores simple with two dark conidia at apex | <i>Microclavia</i> | 80 |
| 144c | Conidia aleuriospores; conidiophores irregularly branched | <i>Staphylotrichum</i> | 80 |
| 145a | Conidia catenulate | | 146 |
| 145b | Conidia not catenulate | | 147 |
| 146a | Conidiophores simple, tall, segmenting into rod-shaped arthrospores | <i>Ampuliferina</i> | 106 |
| 146b | Conidia formed in acropetalous unbranched chains (blastospores) | <i>Bispora</i> | 106 |
| 146c | Conidia formed in branched chains, single-celled conidia also present (blastospores) | <i>Cladosporium</i> | 106 |
| 146d | Conidia formed as rows of dark chlamyospores (aleuriospores) | <i>Trichocladium</i> | 118 |

| | | |
|------|--|----------------------------|
| | MONILIALES | 21 |
| 146e | Conidia formed as lateral branches through pores (porospores) | <i>Diplococcium</i> 114 |
| 147a | Conidiophores clustered on surface or breaking out from stroma | 148 |
| 147b | Other than in conidiophores, mostly single | 153 |
| 148a | Conidiophores wavy, in loose clusters on surface of leaves | <i>Polythrincium</i> 112 |
| 148b | Conidiophores not wavy, arising from within leaf | 149 |
| 149a | Conidia on stroma, with apical, rounded cells | <i>Asperisporium</i> 112 |
| 149b | Conidia on stroma, apical cell pointed | 150 |
| 150a | Conidiophores very short, on flat stroma | 151 |
| 150b | Conidiophores tall | 152 |
| 151a | Conidia annellospores | <i>Spilocaea</i> 106 |
| 151b | Conidia sympodulospores | <i>Fusicladium</i> 112 |
| 152a | Conidiophores branched | <i>Passalora</i> 112 |
| 152b | Conidiophores unbranched | <i>Scolecotrichum</i> 112 |
| 153a | Conidiophores simple | 154 |
| 153b | Conidiophores branched | 155 |
| 154a | Conidiophores short, stout, composed usually of 1 or 2 cells | <i>Scolecobasidium</i> 114 |
| 154b | Conidiophores tall, slender; conidia clustered at apex | <i>Cordana</i> 112 |
| 154c | Conidiophores tall, slender; conidia formed from lateral pores | <i>Spadicoides</i> 114 |
| 155a | Branches restricted to apical area where radiating sporogenous cells form | <i>Pseudobotrytis</i> 106 |
| 155b | Several lateral branches of conidiophores end in sterile apical point | <i>Chaeiopsis</i> 96 |
| 155c | Conidiophore branches short, irregular, on short conidiophore | <i>Balanium</i> 106 |
| 156a | Conidia endogenous; conidiophore with a single swollen, terminal phialide | <i>Sporoschisma</i> 130 |
| 156b | Conidia exogenous; other than in conidiophores | 157 |
| 157a | Conidiophores typically branched | 158 |
| 157b | Conidiophores typically simple, rarely branched | 159 |
| 158a | Conidial chains basipetal, conidia not truly end to end | <i>Fusariella</i> 130 |
| 158b | Conidial chains acropetal, conidia truly end to end | <i>Septonema</i> 116 |
| 159a | Conidia slender, much longer than wide | <i>Cladosporiella</i> 92 |
| 159b | Conidia much broader, usually length not 3 to 4 times width | 160 |
| 160a | Conidia with very thick wall, formed by expansion of apical conidiophore cells | <i>Murogenella</i> 114 |

| | | | |
|------|--|-------------------------|------------|
| 160b | Conidia formed distinct from conidiophore cells | | 161 |
| 161a | Conidiophores clustered or fascicled | | 162 |
| 161b | Conidiophores single, separate | | 165 |
| 162a | Conidiophores in tall fascicles | <i>Phragmocephala</i> | 118 |
| 162b | Conidiophores in small, compact cushion-shaped structures | <i>Cercosporidium</i> | 122 |
| 162c | Conidiophores clustered at base; upper portion divergent | | 163 |
| 163a | Conidiophores short, bearing annellospores | <i>Stigmina</i> | 120 |
| 163b | Conidiophores tall, showing sympodial growth | | 164 |
| 164a | Conidia dark, oblong | <i>Heterosporium</i> | 122 |
| 164b | Conidia long, slender, hyaline | <i>Cercospora</i> | 128 |
| 165a | Conidiophores short, consisting of 1 to few cells, or absent | | 166 |
| 165b | Conidiophores tall, typically consisting of several cells | | 172 |
| 166a | Conidia of two kinds, dark phragmospores, and lighter scolecospores | | 167 |
| 166b | Dark phragmospores only | | 168 |
| 167a | Conidia in acropetalous chains | <i>Pseudotorula</i> | 116 |
| 167b | Conidia not in chains | <i>Dwayabeeja</i> | 116 |
| 168a | Conidia botryoblastospores | <i>Cephaliphora</i> | 116 |
| 168b | Conidia annellospores | <i>Deightoniella</i> | 118 |
| 168c | Conidia aleuriospores | | 169 |
| 169a | Conidia much longer than broad | | 170 |
| 169b | Conidia not much longer than broad | | 171 |
| 170a | Conidia long-cylindrical, separating cell at tip of conidiophore evident | <i>Camposporium</i> | 116 |
| 170b | Conidia somewhat broader at middle, apical cell attenuated or hooked; no separating cell | <i>Ceratophorum</i> | 118 |
| 170c | Conidia long, broadest at middle, narrowed toward each end; no separating cell | <i>Clasiei'osporium</i> | 118 |
| 171a | Conidia rounded, nearly globose (may appear as a chain of chlamydospores) | <i>Trichocladium</i> | 118 |
| 171b | Conidia broadly ellipsoid, phragmospores and dictyospores may be present | <i>Pithoniyces</i> | 132 |
| 172a | Conidiophores determinate, not elongating with successive conidial formation | | 173 |
| 172b | Conidiophores indeterminate, elongating after each successive conidial formation | | 174 |
| 173a | Conidia produced through pores at sides of conidiophores | <i>Spadicoides</i> | 114 |

| | MONILIALES | 23 |
|---|------------------------------|----------------|
| 173b Conidia apical, single, several-celled, parasitic on leaves | <i>Corynespora</i> | 120 |
| 173c Conidia apical, several-celled, saprophytic | <i>Sporidesmium</i> | 120 |
| 173d Conidia apical, 3- to 5-celled, saprophytic | <i>Endophragma</i> | 118 |
| 174a Conidiophores proliferating at apex, leaving annulate scars | | 175 |
| 174b Conidiophores elongating sympodially | | 176 |
| 175a Conidia narrowed or pointed at apex | <i>Annellophora</i> | 118 |
| 175b Conidia mostly ovoid with rounded apex | <i>Endophragma</i> | 118 |
| 176a Conidia with 1 to 4 slender hyaline appendages | <i>Pleiochaeta</i> | 128 |
| 176b Conidia without appendages | | 177 |
| 177a Conidia in apical clusters or heads | | 178 |
| 177b Conidia not confined to apex of conidiophore | | 181 |
| 178a Conidia borne on slender pedicels | <i>Brachysporium</i> | 126 |
| 178b Conidia not borne on slender pedicels | | 179 |
| 179a Conidia hyaline | <i>Pleurothecium</i> | 126 |
| 179b Conidia dark | | 180 |
| 180a Conidia borne on short hyaline projection through apex of conidiophore | <i>Cacumisporium</i> | 124 |
| 180b Conidia borne near apex but not on special cell of conidiophore | <i>Pleurographium</i> | 126 |
| 181a Conidia distinctly narrowed at both ends | | 182 |
| 181b Conidia straight or only slightly narrowed, ends rounded | | 183 |
| 182a Conidia porospores, borne in whorls on cells of straight, simple conidiophores | <i>Helminthosporium</i> | 124 |
| 182b Conidia sympodulospores | <i>Nakataea</i> | 128 |
| 183a Conidia catenulate | <i>Dendryphion</i> | 124 |
| 183b Conidia not catenulate, usually 4-celled, bent by enlargement of one of middle cells | <i>Curvulana</i> | 122 |
| 183c Conidia not catenulate, several-celled, straight or slightly curved | <i>Drechslera, Bipolaris</i> | 122,126 |
| 184a Conidia catenulate | | 185 |
| 184b Conidia not catenulate | | 186 |
| 185a Conidial development basipetal | <i>Coniosporium</i> | 134 |
| 185b Conidial development acropetal | <i>Alternaria</i> | 132 |
| 186a Conidium with large swollen apical cell | <i>Acrospeira</i> | 132 |
| 186b Apical cell of conidium not distinctly swollen | | 187 |

| | | | |
|------|--|-----------------------|------------|
| 187a | Conidiophores well developed, usually longer than conidia | | 188 |
| 187b | Conidiophores poorly developed or none | | 192 |
| 188a | Conidia apical, single | | 189 |
| 188b | Conidia appearing apical and lateral due to growth of conidiophore | | 192 |
| 189a | Conidia sharply attenuated at apex | <i>Alternaria</i> | 132 |
| 189b | Conidia somewhat narrower or not at apex | | 190 |
| 190a | Conidia subglobose, ovoid, or broadly ellipsoid | <i>Stemphylium</i> | 132 |
| 190b | Conidia elongate, straight to flexuous | <i>Sirosporium</i> | 134 |
| 191a | Conidia with 4 cells, cross-shaped | <i>Dictyoarthrium</i> | 134 |
| 191b | Conidia several celled, not cross-shaped, broadly elliptical, ends rounded | <i>Ulocladium</i> | 132 |
| 191c | Conidia several-celled, narrowly elliptical, ends pointed | <i>Dactylosporium</i> | 134 |
| 192a | Conidiophores single, not clustered | | 193 |
| 192b | Conidiophores clustered, often into a loose sporodochiumlike structure | | 194 |
| 193a | On living leaves, parasitic | <i>Stigmella</i> | 134 |
| 193b | Saprophytic in soil or humus | <i>Pithomyces</i> | 132 |
| 194a | Conidia globose to subglobose | <i>Epicoccum</i> | 150 |
| 194b | Conidia very large, oblong to obovoid | <i>Berkleasium</i> | 134 |
| 195a | Branches of conidium upright, parallel, or slightly divergent | | 196 |
| 195b | Branches of conidium upright or lateral, widely divergent | | 197 |
| 196a | Conidial branches connected | <i>Dictyosponum</i> | 144 |
| 196b | Conidial branches separate; conidia catenulate or produced successively | <i>Ceratosporella</i> | 144 |
| 196c | Conidial branches separate; conidia apical, single | <i>Speiropsis</i> | 142 |
| 197a | Conidiophores present, distinct, length variable | | 198 |
| 197b | Conidiophores absent or reduced to short pegs | | 199 |
| 198a | Conidia (aleuriospores) apical, single | <i>Triposporium</i> | 144 |
| 198b | Conidia (sympodulospores) apical on new sympodial growing points | <i>Diplodadiella</i> | 142 |
| 199a | Conidia with 2 to 3 straight or curved upright horns | | 200 |
| 199b | Conidia with 3 to 4 basal cells, each attenuated above | <i>Tetrapha</i> | 142 |
| 199c | Conidia with 4 to 5 divergent arms at wide angles | <i>Tripospermum</i> | 142 |
| 200a | Parasitic on leaves | <i>Hirudinaria</i> | 144 |
| 200b | Saprophytic, mostly on wood | <i>Ceratosporium</i> | 144 |
| 201a | Conidiophores united into sporodochia (Tuberculanaceae). Sporodochia may be poorly formed in culture; some species may be similar in appearance to Melanconiales | | 202 |

- 201b Conidiophores united into synnemata (Stilbaceae); free conidiophores often also present 225

TUBERCULARIACEAE

- 202a Conidia 1-celled, hyaline or dark 203
- 202b Conidia 2-celled, dark *Pucciniopsis* **148**
- 202c Conidia typically more than 2-celled, hyaline or dark 215
- 203a Conidia hyaline or brightly colored 204
- 203b Conidia or sporodochia with dark pigment 213
- 204a Sporodochia stromalike, spreading, on developing grain *Sphacelia* **148**
- 204b Sporodochia cushion-shaped to discoid, not on grain 205
- 205a Sporodochia with prominent setae or sterile hairs *Myrothecium* **146**
- 205b Sporodochia without setae or sterile hairs 206
- 206a Sporodochia developing in rust pustules on plants *Tuberculina* **148**
- 206b Sporodochia superficial, not in rust pustules 207
- 207a Conidia catenulate or in pillarlike masses 208
- 207b Conidia not catenulate or in pillarlike structures 210
- 208a Conidia hyaline or yellowish in mass *Sphaerosporium* **146**
- 208b Conidia usually greenish in mass 209
- 209a Conidiophores and conidia in tall columnar aggregates *Metarrhizium* 94
- 209b Conidiophores and conidia in slimy masses or loose columns *Myrothecium* **146**
- 210a Sporodochia discoid, flattened *Hymenella* **146**
- 210b Sporodochia cushion-shaped to hemispherical 211
- 211a Conidiophores verticillately branched *Dendrodochium* **146**
- 211b Conidiophore branching irregular 212
- 212a On wood or bark *Tubercularia* **146**
- 212b On leaves *Illosporium* **146**
- 213a On scale insects *Aegerita* 150
- 213b Not on scale insects 214
- 214a Sporodochia erumpent from leaves *Hadrotrichum* **146**
- 214b Sporodochia superficial on bark or wood *Strumella* **146**
- 215a Conidia hyaline or brightly colored 216

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| | | | |
|-------|---|----------------------|------------|
| 215b | Conidia with dark pigment | | 218 |
| 216a | Conidia large, cylindrical to ellipsoid; yellowish in mass | <i>Bactridium</i> | 148 |
| 216b | Conidia slender, hyaline in mass | | 217 |
| 217a | Macroconidia canoe-shaped; I-celled conidia also may be present | <i>Fusarium</i> | 130 |
| 217b | Conidia curved but not canoe-shaped | • <i>Ramulispora</i> | 148 |
| 218a | Conidia branched or lobed | | 219 |
| 218b | Conidia not branched or lobed | | 220 |
| 219a | Conidia with short, compact upright branches | <i>Cheiromyces</i> | 150 |
| 219b | Conidia 4-lobed, cross-shaped | <i>Spegazzinia</i> | 150 |
| 220a | Conidia (dictyospores) muriform | | 221 |
| 220b | Conidia (phragmospores) 3- to several-celled | | 223 |
| 221a | Conidia globose to subglobose | <i>Epicoccum</i> | 150 |
| 221 b | Conidia broadly cylindrical to ovoid, very large | <i>Berkleasium</i> | 134 |
| 222a | Sporodochia without setae | | 223 |
| 222b | Sporodochia with dark setae | <i>Excipularia</i> | 148 |
| 223a | Conidiophores arising from special enlarged cells | <i>Camptomeris</i> | 150 |
| 223b | Conidiophores not arising from special enlarged cells | <i>Bactrodesmium</i> | 150 |

STILBACEAE

| | | | |
|------|--|--|------------|
| 225a | Not parasitic (or saprophytic) on insects or spiders | | 226 |
| 225b | Parasitic (and probably saprophytic) on insects or spiders | | 243 |
| 226a | Conidia 1-celled | | 227 |
| 226b | Conidia 2- or more-celled | | 236 |
| 227a | Conidia hyaline | | 228 |
| 227b | Conidia dark | | 233 |
| 228a | Conidiogenous portion of synnemata located or near apex in more or less globose head | | 229 |
| 228b | Conidiogenous portion of synnemata elongate to cylindrical | | 232 |
| 229a | Head composed of loosely arranged conidiogenous hyphae | | 230 |
| 229b | Head composed of compact conidiogenous hyphae | | 231 |

| | | |
|-------|---|-------------------------------|
| | MONILIALES | 27 |
| 230a | Head with numerous radiating sterile hyphae | <i>Heterocephalum</i> 152 |
| 230b | Radiating sterile hyphae not present | <i>Tharoopama</i> 156 |
| 231a | Stalks of synnemata hyaline | <i>Stilbum</i> 152 |
| 231b | Stalks of synnemata dark | <i>Graphium, Pesoturn</i> 152 |
| 232a | Synnema with tall, central seta | <i>Menisporopsis</i> 152 |
| 232b | Central seta absent | <i>Harpographium</i> 156 |
| 233a | Conidiogenous portion of synnemata confined to compact apical region | 234 |
| 233b | Conidiogenous region cylindrical | 235 |
| 234a | Synnemata funnel-shaped with narrow base | <i>Endocalyx</i> 152 |
| 234b | Synnema slender, uniform, with globose head | <i>Briosia</i> 152 |
| 235a | Sterile hairs or setae present among conidiophores | <i>Trichurus</i> 156 |
| 235b | Sterile hairs not present | <i>Doratomyces</i> 154 |
| 236a | Conidia 2-celled | 237 |
| 236b | Conidia 3- or more-celled | 238 |
| 237a | Synnemata and conidia hyaline | <i>Didymostilbe</i> 154 |
| 237b | Synnemata and conidia dark | <i>Didymobotryum</i> 156 |
| 238a | Conidiogenous portion of synnema only at or near apex | 239 |
| 238b | Conidiogenous portion of synnema longer, cylindrical | 242 |
| 239a | Conidial portion in compact, more or less globose heads | 240 |
| 239b | Conidial portion with loose conidiophores, not so compact | 241 |
| 240a | Conidia with cross walls only (phragmospheres) | <i>Arthrobotryum</i> 154 |
| 240b | Conidia with both cross and oblique walls (dictyospores) | <i>Sclerographium</i> 158 |
| 241a | Conidial branches at apex, short; conidia pointed at apex | <i>Acarocybe</i> 158 |
| 241 b | Conidiophores in a loose fascicle, not branched; conidia pointed at apex | <i>hariopsis</i> 154 |
| 241c | Conidiophores compact at base, diverging near apex, conidia rounded at ends | <i>Dendrographium</i> 154 |
| 242a | Conidia hyaline | <i>Arthrosporium</i> 154 |
| 242b | Conidia dark, borne singly at apex of conidiophore | <i>Podosporium</i> 154 |
| 242c | Conidia dark, borne on sympodial conidiophore | <i>Spiropes</i> 158 |
| 243a | Phialides in globose or wedge-shaped heads | <i>Gibellula</i> 160 |
| 243b | Phialides not in definite heads | 244 |

| | | | |
|------|---|---------------------|------------|
| 244a | Phialides short, in compact layer | | 245 |
| 244b | Phialides usually large, not in compact layer | | 246 |
| 245a | Synnemata cylindrical; phialides obtuse at apex | <i>Hymenostilbe</i> | 158 |
| 245b | Synnemata clavate; phialides pointed at apex | <i>Insecticola</i> | 158 |
| 245c | Synnemata cylindrical to attenuated; phialides pointed | <i>Akanthomyces</i> | 158 |
| 246a | Phialides elongate, slender; conidia covered with slime | | 247 |
| 246b | Phialides not elongate; conidia dry | <i>Isaria</i> | 156 |
| 247a | Phialides enlarged at base; conidia not in heads | <i>Hirsutella</i> | 160 |
| 247b | Phialides not enlarged at base; conidia in heads | <i>Synnematium</i> | 160 |

SPHAEROPSIDALES

| | | | |
|-----|--|-----------------------|------------|
| 1a | Conidia globose to oblong or ellipsoid, not filiform | | 2 |
| 1b | Conidia filiform, at least several times longer than wide, 1- to several-celled (scolecosporous) | | 62 |
| 2a | Conidia 1-celled | | 3 |
| 2b | Conidia typically 2-celled | | 45 |
| 2c | Conidia typically 3- to several-celled | | 52 |
| 3a | Conidia hyaline, or sometimes brightly pigmented in mass | | 4 |
| 3b | Conidia with dark pigment, evident at least in mass | | 40 |
| 4a | Pycnidia complete, or with well developed base | | 5 |
| 4b | Pycnidia not complete, with only the upper portion well developed | | 37 |
| 5a | Pycnidia separate, not in stromata | | 6 |
| 5b | Pycnidia in stromata, frequently evident only by pycnidial cavities | | 29 |
| 6a | Pycnidia mostly ovoid; parasitic on powdery mildews | <i>Ampelomyces</i> | 166 |
| 6b | Pycnidia with long beak or neck; not parasitic on powdery mildews | | 7 |
| 6c | Pycnidial beak short or absent; not parasitic on powdery mildews | | 9 |
| 7a | Pycnidial walls dark | <i>Sphaeronaema</i> | 168 |
| 7b | Pycnidial wall hyaline or light colored | | 8 |
| 8a | Pycnidial wall composed of long parallel hyphae | <i>Hyalopycnis</i> | 168 |
| 8b | Pycnidial wall composed of short, angled pseudoparenchymatous cells .. | <i>Eleutheromyces</i> | 168 |
| 9a | Pycnidia breaking open irregularly, without a distinct ostiole | | 10 |
| 9b | Pycnidia opening by distinct ostioles | | 18 |
| 10a | Pycnidia with dark setae | | 11 |

| | | |
|------|---|-----------------------------|
| | SPHAEROPSIDALES | 29 |
| 10b | Pycnidia without dark setae | 12 |
| I 1a | Conidia with a slender appendage at each end | <i>Dinemasporium</i> 172 |
| II b | Conidia without appendages | <i>Amerosporium</i> 172 |
| I2a | Pycnidia superficial, on surface of substratum | 13 |
| 12b | Pycnidia at least partially within substratum | 14 |
| 13a | Pycnidia soft, leathery, subglobose, not on subiculum | <i>Cannula</i> 172 |
| 13b | Pycnidia hard, irregular, on subiculum | <i>Chaetophoma</i> 164 |
| 14a | Pycnidia large, resembling sclerotia; conidia ellipsoid | <i>Sclerotiopsis</i> 166 |
| 14b | Pycnidia not resembling sclerotia; conidia ovoid to ellipsoid | 15 |
| 15a | Pycnidia fleshy, bright colored when fresh | <i>Hainesia</i> 174 |
| 15b | Pycnidia hard, dark | 16 |
| 16a | Pycnidia subcortical, on woody twigs | <i>Dothichiza</i> 172 |
| 16b | Pycnidia subepidermal, on fleshy tissue or leaves | 17 |
| 17a | Pycnidia discoid, dehiscing radiately | <i>Sporonema</i> 172 |
| 17b | Pycnidia globose, opening at apex | <i>Plenodomus</i> 162 |
| 18a | Pycnidia on subiculum of radiating hyphae | <i>Asteromella</i> 164 |
| 18b | Pycnidia <i>not on</i> subiculum | 19 |
| 19a | Conidia of 2 kinds: short-ovoid and long-curved or bent | <i>Phomopsis</i> 164 |
| 19b | Conidia all of one kind | 20 |
| 20a | Conidia typically lunate | <i>Seienophoma</i> 162 |
| 20b | Conidia ovoid; dark dictyosporous chlamydospores present | <i>Peyronellaea</i> 164 |
| 20c | Conidia globose to ellipsoid, straight or slightly curved; without dictyosporous chlamydospores | 21 |
| 21 a | Conidiophores branched | 22 |
| 21 | b Conidiophores simple | 23 |
| 22a | Conidia with apical appendages | <i>Eleutheromycella</i> 168 |
| 22b | Conidia without appendages | <i>Dendrophoma</i> 162 |
| 23a | Conidia with hyaline membraneous appendages | 24 |
| 23b | Conidia without appendages | 25 |
| 24a | Conidial appendage apical, obconical | <i>Neottiospora</i> 166 |
| 24b | Conidial appendage slender, turned back | <i>Anthasthoopa</i> 174 |
| 25a | Pycnidia superficial on natural substratum | 26 |
| 25b | Pycnidia embedded in natural substratum | 27 |

30 KEY TO GENERA

| | | | |
|-----|---|----------------------------|------------|
| 26a | Pycnidia tapering below into a short stalk | <i>Rhizosphaera</i> | 164 |
| 26b | Pycnidia not tapering at base | <i>Aposphaeria</i> | 162 |
| 27a | Conidia longer than 15 microns | <i>Macrophoma</i> | 164 |
| 27b | Conidia 15 microns or shorter | | 28 |
| 28a | Setae present on pycnidia | <i>Pyrenochaeta</i> | 162 |
| 28b | No setae present on pycnidia | <i>Phyllosticta, Phoma</i> | 162 |
| 29a | Conidia having one or more apical appendages | | 30 |
| 29b | Conidia without appendages | | 3J |
| 30a | Conidia with an apical and a basal appendage | <i>Shanoria</i> | 172 |
| 30b | Conidia with short branched appendages at both ends | <i>Dilophospora</i> | 166 |
| 31a | Stromata superficial, soft, brightly colored | <i>Aschersonia</i> | 174 |
| 31b | Stromata subepidermal or subcortical, dark | | 32 |
| 32a | Conidia fusoid, ends pointed | <i>Fusicoccum</i> | 170 |
| 32b | Conidia not fusoid, ends rounded | | 33 |
| 33a | Conidiophores tall, slender, septate | | 34 |
| 33b | Conidiophores short, seldom septate | | 35 |
| 34a | Conidia borne apically only on conidiophores * | <i>Rabenhorstia</i> | 170 |
| 34b | Conidia borne apically and laterally on conidiophore | <i>Pleurostromella</i> | 170 |
| 35a | Conidia ovoid to broadly ellipsoid; pycnidial cavities globose | <i>Dothiorella</i> | 166 |
| 35b | Conidia narrow, ovoid to filiform; pycnidial cavities irregular | | 36 |
| 36a | Conidia mostly filiform, bent or curved | <i>Cytosporina</i> | 166 |
| 36b | Conidia short, curved | <i>Cytospora</i> | 170 |
| 36c | Conidia short, not curved | <i>Cytosporella</i> | 170 |
| 37a | Pycnidia shield-shaped, with or without ostiole | | 38 |
| 37b | Pycnidia flat, opening wide at maturity | | 39 |
| 38a | Pycnidia borne on a short stalk or column | <i>Actinopelte</i> | 174 |
| 38b | Pycnidia without stalk or column | <i>Leptothyrium</i> | 174 |
| 39a | Stroma present | <i>Melasmia</i> | 174 |
| 39b | Stroma absent | <i>Leptostroma</i> | 176 |
| 40a | Pycnidia with prominent dark bristles (setae) | <i>Chaetomella</i> | 176 |
| 40b | Pycnidia without bristles (setae) | | 41 |
| 41a | Pycnidia light colored; conidiophores long, filiform | <i>Harknessia</i> | 176 |

| | | |
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| | SPHAEROPSIDALES | 31 |
| 41 b Pycnidia dark; conidiophores short | | 42 |
| 42a Parasitic on powdery mildews | <i>Ampelomyces</i> | 166 |
| 42b Not parasitic on powdery mildews | | 43 |
| 43a Stromata embedded in bark or wood | <i>Haplosporetta</i> | 178 |
| 43b Pycnidia not in stromata | | 44 |
| 44a Conidia large, ovoid to elongate | <i>Sphaeropsis</i> | 176 |
| 44b Conidia small, globose to ovoid; without dark chlamydo spores | <i>Coniothyrium</i> | 176 |
| 44c Conidia small, ovoid; dark dictyosporous chlamydo spores present | <i>Peyronellaea</i> | 164 |
| 45a Conidia hyaline | | 46 |
| 45b Conidia with distinct dark pigment | | 51 |
| 46a Pycnidia in rust pustules; parasitic on rusts | <i>Darluca</i> | 178 |
| 46b Not parasitic on rusts | | 47 |
| 47a Conidia without appendages | | 48 |
| 47b Conidia with appendages | | 50 |
| 48a Pycnidia in necrotic spots on leaves, etc | <i>Ascochyta</i> | 178 |
| 48b Pycnidia not in necrotic spots | | 49 |
| 49a Pycnidia with distinct beaks | <i>Rhynchophoma</i> | 178 |
| 49b Pycnidia without distinct beaks | <i>Diplodina</i> | 178 |
| 50a Conidia with an apical awl-shaped unbranched appendage | <i>Kellermannia</i> | 178 |
| 50b Conidia with 3 to 4 hyaline appendages at one end | <i>Robillarda</i> | 178 |
| 51a Pycnidia separate, not in stroma | <i>Diplodia</i> | 180 |
| 51 b Pycnidia clustered in stroma | <i>Botryodiplodia</i> | 180 |
| 52-d Conidia with transverse septa only (phragmosporous) | | 53 |
| 52b Conidia dictyosporous or staurosporous | | 59 |
| 53a Conidia with apical appendages | | 54 |
| 53b Conidia without appendages | | 55 |
| 54a Pycnidia flattened; conidia with 1 appendage at each end | <i>Discosia</i> | 182 |
| 54b Pycnidia globose; conidia with 3 to 4 appendages | <i>Bartilinia</i> | 182 |
| 55a Pycnidia brightly colored with cushionlike stroma | <i>Aschersonia</i> | 174 |
| 55b Pycnidia brown or black, without stroma | | 56 |
| 55c Pycnidia dark, in stroma | | 58 |
| 56a Pycnidia with dark spines near ostiole; conidia hyaline | <i>Aristatoma</i> | 180 |

| | | | |
|-----|---|------------------------|------------|
| 56b | Pycnidia without spines; conidia hyaline | <i>Stagonospora</i> | 180 |
| 56c | Pycnidia without spines; conidia dark when mature | | 57 |
| 57a | Conidia single on conidiophores | <i>Hendersonula</i> | 180 |
| 57b | Conidia grouped at apex of conidiophores | <i>Prosthemium</i> | 186 |
| 58a | Conidia dark | <i>Hendersonia</i> | 184 |
| 58b | Conidia hyaline | <i>Dothistroma</i> | 180 |
| 59a | Conidia dictyosporous, globose to ellipsoid | | 60 |
| 59b | Conidia staurosporous | | 61 |
| 60a | Pycnidia within a stroma | <i>Dichomera</i> | 186 |
| 60b | Pycnidia not in a stroma | <i>Camarosporium</i> | 186 |
| 61a | Conidia typically with 4 equal radiating arms | <i>Tetranacrium</i> | 182 |
| 61b | Conidia with 3 to 5 equal arms | <i>Prosthemium</i> | 186 |
| 62a | Pycnidia in dark hard stroma | | 63 |
| 62b | Pycnidia not in stroma, not gelatinous | | 64 |
| 62c | Pycnidia gelatinous or with gelatinous stroma | | 72 |
| 63a | Conidia 1-celled, bent or curved | <i>Cytosporina</i> | 166 |
| 63b | Conidia several-celled, long, cylindrical, straight | <i>Dothistroma</i> | 180 |
| 64a | Pycnidia clavate or with long beak | | 65 |
| 64b | Pycnidia globose or flattened | | 66 |
| 65a | Conidia hyaline, 1- to 2-celled, filiform-fusoid | <i>Sphaerographium</i> | 184 |
| 65b | Conidia dark, several-celled, elongate | <i>Cornularia</i> | 186 |
| 66a | Pycnidia with distinct ostiole | | 67 |
| 66b | Pycnidia opening by wide mouth or slit | | 70 |
| 67a | Conidia pigmented, yellow to light brown | <i>Phaeoseptoria</i> | 184 |
| 67b | Conidia hyaline | | 68 |
| 68a | Pycnidia in necrotic spots on leaves, etc | | 69 |
| 68b | Pycnidia not in necrotic spots | <i>Rhabdospora</i> | 184 |
| 69a | Pycnidia with setae near ostiole | <i>Chaetoseptoria</i> | 184 |
| 69b | Pycnidia without setae | <i>Septoria</i> | 182 |
| 70a | Conidia 1-celled, bent or curved | <i>Phlyctaena</i> | 186 |
| 70b | Conidia several-celled, straight or curved | | 71 |
| 71a | Pycnidia flattened, irregular, opening by a slit; conidia not segmenting .. | <i>Leptostromella</i> | 184 |

| | | |
|------------|--|----------------------------|
| | SPHAEROPSIDALES | 33 |
| 71b | Pycnidia globose or cupulate, opening by a wide mouth | <i>Phleospura</i> 186 |
| 72a | Conidia 1-celled; stroma smutlike, on grass | <i>Ephelis</i> 184 |
| 72b | Conidia several-celled; stroma not smutlike, on wood or bark | 73 |
| 73a | Stroma elongate, stalked | <i>Chondropodium</i> 186 |
| 73b | Stroma rounded to irregular, not stalked | 74 |
| 74a | Stromal tissue waxy | <i>Mkropera</i> 182 |
| 74b | Stromal tissue cartilaginous | <i>Gelatinosporium</i> 182 |

MELANCONIALES

| | | |
|-----------|---|----------------------------|
| 1a | Conidia 1-celled, short, not filiform | 2 |
| 1b | Conidia 2- to several-celled, not filiform, didymosporous or phragmosporous | 7 |
| 1c | Conidia filiform, 1- to several-celled | 12 |
| 1d | Conidia dictyosporous or staurosporous | 14 |
| 2a | Conidia with distinct dark pigment | <i>Melanconium</i> 190 |
| 2b | Conidia hyaline | 3 |
| 3a | Conidia produced laterally on conidiophore | <i>Catenophora</i> 188 |
| 3b | Conidia produced apically on conidiophore | 4 |
| 4a | Conidia with apical, hyaline branched appendages | <i>Pestalozziella</i> 188 |
| 4b | Conidia without appendages | 5 |
| 5a | Dark setae present in acervulus | <i>Colletotrichum</i> 188 |
| 5b | Dark setae absent | 6 |
| 6a | Conidiophores arising from a stromalike base | <i>Sphaceloma</i> 188 |
| 6b | Stromalike base absent or poorly developed | <i>Gloeosporium</i> 188 |
| 7a | Conidia 2-celled, didymospores | 8 |
| 7b | Conidia 3- to several-celled, phragmospores | 9 |
| 8a | Conidia unequally 2-celled, hyaline, without appendages | <i>Marssonina</i> 190 |
| 8b | Conidia equally 2-celled, hyaline, with one appendage at each end | <i>Myculeptodiscus</i> 190 |
| 8c | Conidia typically 2-celled, dark, with basal appendages | <i>Polynema</i> 192 |
| 9a | Conidia hyaline | <i>Sepioglueum</i> 190 |
| 9b | Conidia with distinct dark pigment | 10 |
| 10a | All cells of conidia dark | <i>Coryneum</i> 194 |

34 KEY TO GENERA

| | | | |
|------|--|------------------------|------------|
| 10b | End cells of conidia hyaline, middle cells dark | | 11 |
| I 1a | Single beaklike appendages at apex of conidia | <i>Monochaetia</i> | 192 |
| II b | With 2 to 3 appendages at apex of conidia | <i>Pestalotia</i> | 192 |
| 1 1c | Conidia with single apical and basal appendages | <i>Seimatosporium</i> | 192 |
| 12a | Saprophytic on wood or bark | <i>Libertella</i> | 190 |
| 12b | Parasitic on leaves | | 13 |
| 13a | Conidia becoming septate | <i>Cylindrosporium</i> | 192 |
| 13b | Conidia remaining 1-celled | <i>Cryptosporium</i> | 190 |
| 14a | Conidia dictyosporous; some phragmospores may be present | | 15 |
| 14b | Conidia straurosporous | | 16 |
| 15a | Conidia catenulate | <i>Phragmotrichum</i> | 194 |
| 15b | Conidia not catenulate | <i>Steganosporium</i> | 194 |
| 16a | Conidia hyaline | <i>Entomosporium</i> | 194 |
| 16b | Conidia with distinct dark pigment | <i>Asterosporium</i> | 194 |

MYCELIA STERILIA

| | | | |
|-----|--|-----------------------|------------|
| 1a | Entire "conidiophore" (except stalk) closely branched, forming a globose or pyramidal reproductive structure, hyaline, dark sclerotia in culture and often on leaves | <i>Cristulariella</i> | 74 |
| 1 b | Conidiophorelike structures absent | | 2 |
| 2a | Sclerotia variable in form, pale to dark brown or black; usually formed on loosely woven, dark hyphae | <i>Rhizoctonia</i> | 196 |
| 2b | Sclerotia rounded, variable in size, black; mycelium hyaline | <i>Sclerotium</i> | 196 |
| 2c | Dark brown bulbils or small clusters of compact cells present; hyphae becoming dark brown | <i>Papulospora</i> | 196 |

SIMPLIFIED KEY TO SOME SELECTED COMMON GENERA

| | | |
|---|-------------------------------------|-----|
| 1a Having characteristics of the Mucorales; coenocytic mycelium and sporangioles that segment or otherwise appear as conidia | | 2 |
| 1 b Having septate mycelium and other characteristics of the imperfect fungi | | 3 |
| 2a Conidiophores (sporangiohores) unbranched except near apex where loose heads of dark spores are borne | <i>Choanephora</i> | 66 |
| 2b Conidiophores (sporangiohores) unbranched, bearing an apical cluster of elongate sporangioles that break up into 1-celled spores | <i>Syncephalastrum</i> | 66 |
| 2c Conidiophores (sporangiohores) very slender, dichotomously branched, bearing a cluster of slender sporangioles that segment into short rod-shaped spores.. | <i>Piptocephalis</i> | 62 |
| 3a Conidiophores distinct although short or reduced to pegs in some genera; conidia typically 1-celled, occasionally 2-celled | | 4 |
| 3b Conidiophores distinct or reduced to pegs; conidia typically and predominately with 2 or more cells | | 35 |
| 3c Conidiophores indefinite or absent; conidia rod-shaped with truncate ends, formed by fragmentation of the mycelium | <i>Geotrichum</i> | 68 |
| 3d No true conidiophores or conidia present; reproduction by sclerotia or similar structures | , | 53 |
| 4a Conidiophores contained within a pycnidium | | 5 |
| 4b Conidiophores compacted into an acervulus or sporodochium in nature, but may be evident as loosely arranged structure in culture | | 9 |
| 4c Conidiophore stalks compacted into synnemata | | 12 |
| 4d Conidiophores separate, not tightly clustered in any manner | * | 15 |
| 5a Pycnidia separate, not in a stroma | | 6 |
| 5b Pycnidia embedded in a stroma | | 8 |
| 6a Conidia relatively large, with dark pigment | <i>Sphaeropsis</i> | 176 |
| 6b Conidia small, hyaline, no pigment present | | 7 |
| 7a Conidiophores with a few upright branches | <i>Dendrophoma</i> | 162 |
| 7b Conidiophores short, simple, unbranched | <i>Phoma</i> or <i>Phyllosticta</i> | 162 |
| 8a Pycnidia formed as irregular cavities in a stroma; conidia small | <i>Cytospora</i> | 170 |
| 8b Pycnidia rounded, regular; conidia large | <i>Dothiorella</i> | 166 |
| 9a Conidia held together in moist, slimy masses | | 10 |

36 SIMPLIFIED KEY TO SOME SELECTED COMMON GENERA

| | | | |
|------|---|--------------------------|-------------|
| 9b | Conidia dry, without slime | | 11 |
| 10a | Conidia with dark pigment, more evident in mass | <i>Melanconium</i> | 190 |
| 10b | Conidia hyaline; dark setae present | <i>Colletotrichum</i> | 188 |
| 10c | Conidia hyaline; setae absent | <i>Gloeosporium</i> | 188, |
| I 1a | On leaves, twigs, or fruit; conidia dark, with pointed apex.." | <i>Spilocaea</i> | 106 |
| II b | On wood or bark; conidia hyaline, ovoid | <i>Tubercularia</i> | 146 |
| 12a | Both stalks or synnemata and conidia hyaline | | 13 |
| 12b | Both stalks of synnemata and conidia dark | | 14 |
| 12c | Stalks of synnemata dark; conidia hyaline | <i>Graphium, Pesotum</i> | 152 |
| 13a | Conidia held in moist, slimy heads | <i>Stilbum</i> | 152 |
| 13b | Conidia in dry clusters, not slimy | <i>Isaria</i> | 156 |
| 14a | Conidial heads rounded, ovoid to subglobose; parasitic on buds of Azalea or Rhododendron | <i>Briosia</i> | 152 |
| 14b | Conidial portion elongated, usually narrowed at apex and base, saprophytic | <i>Doratomyces</i> | 154 |
| 15a | Conidiophores branched or bearing a cluster of branches or phialides near or at the apex | | 16 |
| 15b | Conidiophores typically simple or only occasionally branched | | 26 |
| 16a | Conidia remaining together in chains of two or more | | 17 |
| 16b | Conidia not remaining together in chains | | 22 |
| 17a | Conidia acropetal, with youngest at the apex of chain | | 18 |
| 17b | Conidia basipetal, with the youngest at the base of chain | | 19 |
| 18a | Conidia dark, variable in shape, ovoid, lemon-shaped to oblong, mostly 1-celled, some may be 2- to 3-celled | <i>Cladosporium</i> | 106 |
| 1 8b | Conidia dark, uniformly globose, and 1-celled | <i>Perkonina</i> | 74 |
| 18c | Conidia hyaline, uniformly ovoid to short cylindrical | <i>Monilia</i> | 72 |
| 19a | Conidiogenous cells (phialides) borne on apex or swollen apex of conidiophores | <i>Aspergillus</i> | 94 |
| 19b | Conidiogenous cells borne on slender branches, not on swollen apex of conidiophore ... | | 20 |
| 20a | Conidiogenous cells bearing annulate scars of previous conidia | <i>Scopulariopsis</i> | 98 |
| 20b | Annulate scars not present on conidiogenous cells | | 21 |
| 21 a | Conidiogenous cells (phialides) closely arranged in a brushlike head | <i>PenicilUum</i> | 94 |
| 21 b | Conidiogenous cells divergent, not in a close head | <i>Paecilomyces</i> | 94 |
| 22a | Conidia in small clusters held together by slime | | 23 |

SIMPLIFIED KEY TO SOME SELECTED COMMON GENERA 37

| | | | |
|-----|--|------------------------|-----|
| 22b | Conidia dry, not held in slime | | 24 |
| 23a | Conidiophore branches verticillate, often 3 or more branches arise from the same level | <i>Verticillium</i> | 92 |
| 23b | Conidiophore branches irregular, not verticillate | <i>Thchoderma</i> | 92 |
| 24a | Conidia formed successively at apex of conidiophore, which continues to elongate | <i>Nociulosporium</i> | 100 |
| 24b | Conidia formed in a head on the more or less swollen apex of the conidiophore | | 25 |
| 25a | Apical sporogenous cell of conidiophore or branches slightly enlarged, globose | <i>Botrytis</i> | 76 |
| 25b | Apical conidiogenous portion and branches distinctly enlarged, cylindrical, or club-shaped | <i>Chromelosporium</i> | 80 |
| 26a | Conidia (chlamydospores, aleuriospores) terminal, single, globose | | 27 |
| 26b | Conidia otherwise | | 28 |
| 27a | Conidia black, shiny, smooth | <i>Nigrospora</i> | 82 |
| 27b | Conidia with yellow pigment, rough-walled | <i>Sepedonium</i> | 82 |
| 28a | Parasitic on plants, conidial states of powdery mildews | <i>Oidium</i> | 68 |
| 28b | Not conidial states of powdery mildews | | 29 |
| 29a | Conidiophores indeterminate, apex elongating as new conidia are produced | | 30 |
| 29b | Conidiophores determinate, not elongating as new conidia are produced | | 31 |
| 30a | Conidiogenous portion of conidiophore zig-zag, elongating to appear rachislike | <i>Beauveria</i> | 100 |
| 30b | Conidiogenous portion of conidiophore limited, not rachislike | <i>Sporothrix</i> | 98 |
| 31a | Conidia produced simultaneously on swollen apex of conidiophore | <i>Oedocephalum</i> | 76 |
| 31b | Conidia produced single or successively at apex of conidiophore or phialide | | 32 |
| 32a | Conidia exogenous, ovoid to globose, borne singly or in pairs on a dark hook (falca) of conidiophore | <i>Zygosporium</i> | 72 |
| 32b | Conidia endogenous, rod-shaped, often catenulate; no falcs present | <i>Chalara</i> | 90 |
| 32c | Conidia ovoid to globose, held together in small apical clusters by slime; falcs absent ... | | 33 |
| 33a | Conidiophores or phialides slender, hyaline | <i>Cephalosporium</i> | 94 |
| 33b | Conidiophores or phialides slender or somewhat inflated, with some dark pigment | | 34 |
| 34a | Conidiophores tall, slender, uniform in width | <i>Chytridium</i> | 88 |
| 34b | Conidiophores short or sometimes absent, often somewhat inflated | <i>Phialophora</i> | 88 |
| 35a | Conidia typically and uniformly 2-celled, seldom with fewer or more cells | | 36 |
| 35b | Conidia typically has more than 3 cells, sometimes variable | | 43 |
| 36a | Conidia hyaline, no pigment in walls | | 37 |

| | | | |
|-----|---|-------------------------|------------|
| 36b | Conidia with dark pigment in walls | | 41 |
| 37a | Conidiophores compacted into an acervulus in nature | <i>Marssonina</i> | 190 |
| 37b | Conidiophores separate, not clustered or compacted | | 38 |
| 38a | Conidiophores branched, with a sterile terminal branch and swollen apex; conidia long, cylindrical | <i>Cyindrocladium</i> | 108 |
| 38b | Conidiophores simple; conidia ovoid or ellipsoid | | 39 |
| 39a | Conidia borne singly, apical on sympodial growing points | | 40 |
| 39b | Conidia produced basipetally in irregular groups, not on sympodial growing points | <i>Trichothecium</i> | 108 |
| 40a | Conidia ellipsoid-elongate, cells equal | <i>Dactylaria</i> | 110 |
| 40b | Conidia ovoid to elongate, apical cell somewhat larger | <i>Arthrobotrys</i> | 110 |
| 41a | Conidiophores and conidia borne in a typical pycnidium | <i>Diplodia</i> | 180 |
| 41b | Conidiophores and conidia in an acervulus or a stroma in nature | <i>Spilocaea</i> | 106 |
| 41c | Conidiophores separate or in loose clusters | | 42 |
| 42a | Conidiophores slender, conidia in short acropetalous chains | <i>Bispora</i> | 106 |
| 42b | Conidiophores rather stout, zig-zag in appearance; conidia apical, not in chains | <i>Polyhrincium</i> | 112 |
| 43a | Conidia spiral or in coil | <i>Helicomyses</i> | 136 |
| 43b | Conidia phragmosporous, with cross but not oblique walls | | 44 |
| 43c | Conidia dictyosporous, with both cross and oblique walls | | 52 |
| 44a | Conidia with slender appendages, at least at apex | <i>Pestalotia</i> | 192 |
| 44b | Conidia without appendages | | 45 |
| 45a | Conidia dark | | 46 |
| 45b | Conidia hyaline | | 51 |
| 46a | Conidia borne in acervuli in bark | <i>Coryneum</i> | 194 |
| 46b | Conidia not borne in acervuli | | 47 |
| 47a | Conidia in acropetalous chains; some conidia with 1 or 2 cells | <i>Cladosporium</i> | 106 |
| 47b | Conidia single, not in chains | | 48 |
| 48a | Conidiophores with several upright branches | <i>Dendryphiopsis</i> | 120 |
| 48b | Conidiophores simple, without branches | | 49 |
| 49a | Conidia produced through pores on sides of conidiophores | <i>Helminthosporium</i> | 124 |
| 49b | Conidia borne apically on new sympodial growing points | | 50 |
| 50a | Conidia straight or slightly curved; cells nearly equal | <i>Hipolaris</i> | 126 |
| 50b | Conidia, with one median cell larger than others | <i>Curvuhria</i> | 122 |

SIMPLIFIED KEY TO SOME SELECTED COMMON GENERA 39

| | | | |
|------|---|-----------------------|------------|
| 51a | Conidiophores simple, clustered, dark; conidia long, attenuated | <i>Cercospora</i> | 128 |
| 51b | Conidiophores hyaline, branched; conidia long, cylindrical | <i>Cylindrodadium</i> | 108 |
| 51c | Conidiophores short, simple or branched, hyaline; larger conidia typically canoe-shaped, 1-celled conidia usually present | <i>Fusarium</i> | 130 |
| 5 Id | Conidiophore tall, slender, simple; conidia with pointed apex and rounded base | <i>Pyricularia</i> | 128 |
| 52a | Conidia borne in acervuli in bark | <i>Steganosporium</i> | 194 |
| 52b | Conidia borne typically in small sporodochia | <i>Epicoccum</i> | 150 |
| 52c | Conidia borne on separate conidiophores | | 53 |
| 53a | Conidia attenuate or pointed at apex, often in chains | <i>Ahernaria</i> | 132 |
| 53b | Conidia rounded, borne singly | <i>Stemphylium</i> | 132 |
| 54a | No conidiophores, no conidia formed; sclerotia more or less globose, compact | <i>Sclerotium</i> | 196 |
| 54b | No conidiophores, no conidia formed; sclerotia mostly flattened or irregular, often loose | <i>Rhizoctonia</i> | 196 |
| 54c | Large conidiophorelike structures present on leaves; many branches compacted into globose or pointed structures | <i>CristularieUa</i> | 74 |

THE HUGHES-TUBAKI-BARRON SYSTEM OF CLASSIFICATION

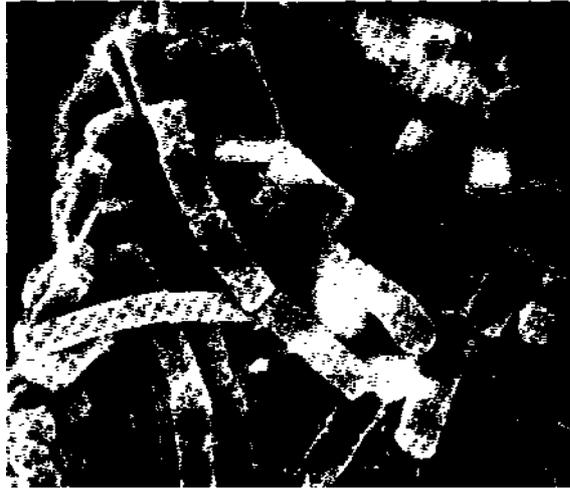
This newer system is based primarily on the development of the conidia and to a lesser extent on the development of the conidiophores. Shape, pigmentation, and septation of conidia are reduced to secondary characteristics. Although this classification, followed by Barron (1968), is not complete for all genera of imperfect fungi, it is well established and accepted by many mycologists and can be applied accurately to most of the Moniliales. The authors do not dispute the validity of the more recent system of classification proposed by the Kananaskis Conference (1971) and followed by Ellis (1971), but do not believe the time has come to shift to that system for the identification of genera by the student.

The following key to series, sections, and genera of the two largest families (Moniliaceae and Dematiaceae) is included for the convenience of those who can easily recognize and distinguish the types of conidia. It may not be helpful in identifying those genera in which the mode of conidial formation is unclear or indefinite. In these cases, use of the key based on the Saccardo System is recommended.

ALTERNATE KEY TO SERIES AND GENERA (Moniliaceae and Dematiaceae)

Tuberculariaceae and Stilbaceae, as well as some genera in which there is inadequate knowledge of conidial formation, are excluded from this key.

Conidia (arthrospores) formed by segmentation of vegetative hyphae or branches of nonmeristematic conidiophores; mature conidia usually with truncate ends, ellipsoid or cylindrical . . . (Examples: *Geotrichum*, *Amblyosporium*)... Series ARTHROSPORAE



Arthrospora, *Geotrichum*

lb Conidia (arthrospores) developing in basipetal succession by meristemic growth of the special portion of conidiophore, resulting in a gradual change from conidiophore to conidium; conidia usually, but not necessarily, hanging together in chains . . . (Examples: *Oidium*, *Basipetospora*) . . . Series MERISTEM ARTHROSPORAE



Meristem Arthrospora, *Oidium*

ALTERNATIVE TO SCRIPTS AND GENERA

Conidia (aleuriospores) usually single and apical on conidiophore or sporogenous cells, often thick-walled and pigmented but may be hyaline, often not easily deciduous or deciduous by means of a special cell at apex of conidiophore; accessory conidial states often present . . . (Examples: *Humicola*, *Sepe-donium*, *Microsporium*)
Series ALEURIOSPORAE10

Aleuriosporae, *Nigrospora*

Conidia (annellospores) produced successively on apex of conidiogenous cells or conidiophore which increases slightly in length by percurrent proliferation through previous conidial scars; successive scars appear as faint annellations at apex of conidiogenous cell... (Examples; *Spilocaea*, *Scopulariopsis*) ... Series ANNELEOSPORAE 52

Annelosporae, *Spilocaea*

Conidia (blastospores) developing as buds from simple or branched conidiophores, or directly from vegetative cells or previous conidia, often forming simple or branched acropetalous chains ... (Examples; *Aitrebasiidum*, *Monilia*, *Cladosporium*) ... Series BLASTOSPORAE 59

Blastosporae, *Monilia*

Conidia (blastospores) produced on well differentiated swollen cells which bear many conidia simultaneously, forming clusters or heads, solitary or in simple or branched aeropetalous chains; mature conidia easily deciduous revealing small denticles on sporogenous cells ... (Examples: *Oecofotvphalum*, *Boirviis*, *Gonuihoirvs*)... Series BO- f RYOBLASTO'SPORAE



Botryoblastosporae, *Batrytis*

Conidia (porospores) developing through pores in outer wall at apex or side of conidiophore, single or in some genera produced on successive new growing points formed by sympodial proliferation ... (Examples: *Helminthosporium*, *Bipolaris*, *Stemphyfium*) . . . Series PORO- SPORAE

90



Porosporae, Bipolaris

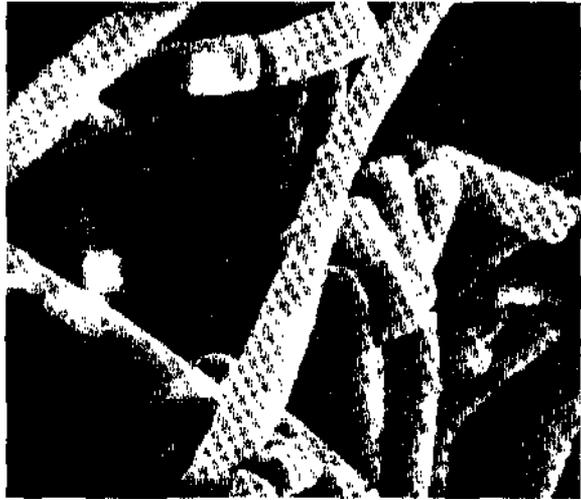
Conidia (sympodulosporae) developing at tips of conidiophores or conidiogenous cells (not from pores in outer wall) and forming successively on new growing tips by sympodial proliferation; increase may be slight but conidia are of different ages; (this key includes some genera placed by some authors in the Porosporae) . . . (Examples: *Fusicladium*, *Trichium*, *Cercospora*) Series SYMPODULO- SPORAE

102



Sympodulosporae, *Sporothrix*

ti Conidia (phialospores) formed successively from open apex of conidiophore or conidiogenous cell (phialide), which ordinarily does not increase in length; conidia often collect in droplet of mucilage or slime at apex or remain attached in basipetal chains; in a few genera the simple conidiophore proliferates percurrently and forms new phialides ... (Examples: *Chalara*, *Phialophora*, *Verticillium*, *Aspergillus*) ... Series PHIALOSPORAE..... 151



Phialosporae, *Chalara*

ARTHROSPORAE

- 2a Conidiophores poorly developed or none 3
- 2b Conidiophores distinct and well developed 4
- 3a Conidia truncate at both ends, formed by segmentation of mycelium *Geotrichum* 68
- 3b Conidia rounded with truncate base, formed by segmentation of mycelium *Chrysosporium* 68
- 4a Conidiophores simple 5
- 4b Conidiophores branched 6
- 5a Conidia globose *Wallemia* 92
- 5b Conidia cylindrical with truncate ends *Ampulliferina* 106
- 6a Conidiophores stout, branched only near apex *Amblyosporium* 68
- 6b Conidiophores slender with both apical and lateral branches *Oidiodendron* 68

MERISTEM ARTHROSPORAE

- 7a Parasitic on plants, powdery mildews 8
- 7b Saprophytic or weakly parasitic, not powdery mildews 9
- 8a Conidia in basipetal chains *Oidium* 68
- 8b Older conidia falling off before new one is formed *Ovulariopsis* 70
- 9a Conidia 1-celled, hyaline *Basipetospora* 70
- 9b Conidia 2-celled, hyaline *Trichothecium* 108
- 9c Conidia dictyosporous, dark *Coniosporium* 134

ALEURIOSPORAE

| | | | |
|-----|--|----------------------|------------|
| 10a | Conidia long, slender (scolecosporous), 1- to several-celled | <i>Anguillospora</i> | 140 |
| 10b | Conidia typically 1- to 2-celled, globose to oblong | | 11 |
| 10c | Conidia typically 3- to several-celled | | 24 |
| 11a | Conidia hyaline or subhyaline (with slight pigment) | | 12 |
| 11b | Conidia with distinct dark pigment | | 17 |
| 12a | Pathogenic to man; macroconidia tuberculate | <i>Histoplasma</i> | 82 |
| 12b | Pathogenic to man; macroconidia smooth | <i>Blastomyces</i> | 80 |
| 12c | Saprophytic or parasitic on plants or fungi | | 13 |
| 13a | Conidia 1-celled, in small groups at apex of forked conidiophores | <i>Glomerularia</i> | 86 |
| 13b | Conidia 1- or 2-celled, not in clusters at apex of conidiophores | | 14 |
| 14a | Conidiogenous cells slender, radiating from swollen cell | <i>Umbelopsis</i> | 86 |
| 14b | Conidiogenous cells short, stout; conidia smooth | <i>Botryoderma</i> | 86 |
| 14c | Conidiogenous cells slender; conidia rough-walled or with attached smooth cells | | 15 |
| 15a | Conidia with attached small smooth cells | <i>Stephanoma</i> | 82 |
| 15b | Conidia 1-celled, without attached smooth cells | <i>Sepedonium</i> | 82 |
| 15c | Conidia with large apical rough-walled cell and smaller smooth basal cell | | 16 |
| 16a | Basal cell of conidia rounded | <i>Mycogone</i> | 82 |
| 16b | Basal cell wedge-shaped | <i>Chlamydomyces</i> | 82 |
| 17a | Conidiophores short, poorly developed, or missing | | 18 |
| 17b | Conidiophores usually well developed | | 22 |
| 18a | Conidia with broad truncate base and pointed apex | <i>Echinobotryum</i> | 84 |
| 18b | Conidia ovoid to obclavate with rounded apex | <i>Asteromyces</i> | 84 |
| 18c | Conidia globose to broadly ellipsoid | | 19 |
| 19a | Conidia 1-celled, subglobose, shiny black, situated on a flat hyaline vesicle .. | <i>Nigrospora</i> | 82 |
| 19b | Conidia 2- or more-celled | | 20 |
| 19c | Conidia 1-celled, light to dark, not on vesicle | | 21 |
| 20a | Conidiophores tall, slender, simple, dark | <i>Endophragma</i> | 118 |
| 20b | Conidiophores mostly short, simple hyaline | <i>Trichocladium</i> | 118 |
| 20c | Conidiophores well developed, branched | <i>Balanium</i> | 106 |
| 21a | Setae present | <i>Botryotrichum</i> | 84 |
| 21b | Setae absent | <i>Humkola</i> | 84 |
| 22a | Conidia with small hyaline cells attached | <i>Stephanoma</i> | 82 |

| | | | |
|------|--|-------------------------------------|------------|
| 22b | Conidia without attached hyaline cells | | 23 |
| 23a | Conidiophores short, thick, branched | <i>Wardomyces</i> | 84 |
| 23b | Conidiophores tall, slender, repeatedly branched | <i>Staphylotrichum</i> | 80 |
| 23c | Conidiophores tall, simple | <i>Microclavia</i> | 80 |
| 24a | Conidia typically 3- to several-celled (phragmosporous) | | 25 |
| 24b | Conidia with cross and oblique septa (dictyosporous) | | 34 |
| 24c | Conidia (or propagules) branched (staurosporous) | | 38 |
| 24d | Conidia curved or coiled (helicosporous) | <i>Xenosporium</i> | 136 |
| 25a | Conidia hyaline or subhyaline | | 26 |
| 25b | Conidia with distinct dark pigment | | 29 |
| 26a | Parasitic on plants | <i>Fusoma</i> | 116 |
| 26b | Causing dermato mycoses of man or animals | | 27 |
| 26c | Saprophytic or trapping nematodes | | 28 |
| 27a | Macroconidia spindle-shaped or ellipsoid | <i>Microsporium</i> | 116 |
| 28a | Conidia ellipsoid, with broad enlarged middle cell | <i>Monacrosporium</i> | 118 |
| 28b | Conidia cylindrical to long and sometimes tapering, with distinctly enlarged middle cell | <i>Daciylella</i> | 128 |
| 29a | Conidia ovoid to ellipsoid to oblong | | 30 |
| 29b | Conidia much longer than wide | | 32 |
| 30a | Conidiophores tall, simple, single or clustered | <i>Endophragmia, Phragmocephala</i> | 118 |
| 30b | Conidiophores short, poorly developed, clustered | <i>Bactrodesmium</i> | 150 |
| 30c | Conidiophores usually short, single | | 31 |
| 31a | Conidia mostly 2- to 3-celled; ovoid to clavate | <i>Trichocladium</i> | 118 |
| 31 b | Conidia 3- to several-celled; broadly ellipsoid wall not unusually thick | <i>Pithomyces</i> | 132 |
| 31c | Conidia several-celled, ellipsoid, wall very thick | <i>Murogeneila</i> | 114 |
| 32a | Conidia cylindrical | <i>Camposporium</i> | 116 |
| 32b | Conidia narrower at ends, especially at apex | | 33 |
| 33a | Apical cell of conidia attenuated, hooked or pointed | <i>Ceratophorum</i> | 118 |
| 33b | Apical cell of conidia rounded, not attenuated | <i>Clasterosporium</i> | 118 |
| 34a | Conidiophores clustered, sometimes in loose sporodochia | | 35 |
| 34b | Conidiophores single, not clustered | | 36 |

| | | | |
|------------|--|-----------------------|------------|
| 35a | Conidia globose or subglobose | <i>Epicoccum</i> | 150 |
| 35b | Conidia large, elongate to obovoid | <i>Berkleasmium</i> | 134 |
| 36a | Apical cell of conidia darker, much enlarged | <i>Acrospeira</i> | 132 |
| 36b | Apical cell of conidia not enlarged, equally pigmented | | 37 |
| 37a | Conidia broadly ellipsoid, most septa transverse | <i>Pithomyces</i> | 132 |
| 37b | Conidia globose to ovoid, most septa oblique | <i>Stigmella</i> | 134 |
| 38a | Conidia hyaline or subhyaline | | 39 |
| 38b | Conidia with distinct dark pigment | | 49 |
| 39a | Propagule with many branches compacted into a large globoid or conical structure; no true conidia produced | <i>Cristulariella</i> | 74 |
| 39b | Conidia with few branches, symmetrical or nearly so | | 40 |
| 39c | Conidia with few branches distinctly asymmetrical | | 43 |
| 40a | Main axis of conidia distinctly swollen, with large cell | | 41 |
| 40b | Main axis of conidia slender or short, without swollen cell | | 42 |
| 41a | Central cell of conidia globose, with 4 slender radiating arms | <i>Actinospora</i> | 140 |
| 41 b | Main axis of conidia 2-celled, with 3 slender radiating arms | <i>Clavariopsis</i> | 140 |
| 42a | Main axis of conidia long, slender | <i>Tetrachaetum</i> | 140 |
| <i>Alb</i> | Main axis of conidia short; arms widely divergent | <i>Triscelophorus</i> | 138 |
| 42c | Main axis of conidia short; arms not widely divergent | <i>Tridentaria</i> | 140 |
| 43a | Not aquatic, parasitic on higher plants | <i>Thaltospora</i> | 142 |
| 43b | Aquatic, in fresh water on decaying leaves | | 44 |
| 44a | Branches of conidia developed one at a time | | 45 |
| 44b | Branches of conidia developed simultaneously | | 46 |
| 45a | Conidia with 3 slender branches on slender main axis | <i>Articulospora</i> | 142 |
| 45b | Conidia with 3 slender branches on thick main axis | <i>Culicidospora</i> | 140 |
| 46a | Conidia with 2 branches arising from primary axis | | 47 |
| 46b | Conidia with 3 or more branches arising from primary axis | | 48 |
| 47a | Branches of conidia long, tapering to fine point | <i>fngoldia</i> | 138 |
| <i>Alb</i> | Branches of conidia slender but not tapering to fine point | <i>Tricladium</i> | 138 |
| 48a | Branches of conidia more or less upright | <i>Tetracladium</i> | 140 |
| 48b | Branches of conidia widely divergent, irregular | <i>Dendrospora</i> | 140 |
| 49a | Conidiophores distinct; conidia triangular <i>or</i> with several upright branches | | 50 |
| 49b | Conidiophores reduced to a short peg; conidia with 2 to 3 upright or spreading "horns" | | 51 |
| 50a | Conidia triangular, with 3 short, radiating arms | <i>Triposporium</i> | 144 |

| | | | |
|-----|---|----------------------|------------|
| 50b | Conidia with several close upright branches | <i>Dictyosporium</i> | 144 |
| 51a | Mostly parasitic on leaves | <i>Hirudinaria</i> | 144 |
| 51b | Mostly saprophytic on wood | <i>Ceratosporium</i> | 144 |

ANNELLOSPORAE

| | | | |
|-----|---|-----------------------|------------|
| 52a | Conidia typically 1- to 2-celled | | 53 |
| 52b | Conidia mostly 3- to several-celled | | 55 |
| 53a | Conidiophores hyaline | <i>Scopulariopsis</i> | 98 |
| 53b | Conidiophores dark | | 54 |
| 54a | Conidiophores tall, branched; conidia in moist heads | <i>Leptographium</i> | 98 |
| 54b | Conidiophores short, simple, not in heads | <i>Spihcaea</i> | 106 |
| 55a | Conidia with 2 or more upright branches | <i>Ceratosporella</i> | 144 |
| 55b | Conidia unbranched | | 56 |
| 56a | Mostly parasitic; mycelium within leaves; conidiophores short | | 57 |
| 56b | Saprophytic or with external mycelium; conidiophores short | | 58 |
| 57a | Conidiophores single, arising from epidermal cells | <i>Deightonia</i> | 118 |
| 57b | Conidiophores clustered, arising through stomata | <i>Stigmata</i> | 120 |
| 58a | Conidiophore apex with distinct cuplike structures | <i>Endophragma</i> | 118 |
| 58b | Conidiophore apex with conidial scars or rings, not cuplike | <i>Annellophora</i> | 118 |

BLASTOSPORAE

| | | | |
|-----|---|------------------------|------------|
| 59a | Conidiophores arising from basal globose mother cells, with thick dark septa, increasing in length only in basal region | | 60 |
| 59b | Conidiophores, if present, not as above | | 61 |
| 60a | Conidia 1-celled | <i>Arthrimum</i> | 74 |
| 60b | Conidia 4-celled, cross-shaped | <i>Dictyoarthrimum</i> | 134 |
| 61a | Conidia more or less coiled (helicosporous) | | 62 |
| 61b | Conidia branched (staurosporous) | | 63 |
| 61c | Conidia neither coiled nor branched | | 66 |
| 62a | Small conidia produced by budding of large conidia | <i>Helkodendron</i> | 136 |
| 62b | Conidia not budding | <i>Helkoon</i> | 136 |
| 63a | Conidiophores present, distinct | | 64 |
| 63b | Conidiophores absent | | 65 |

| | | | |
|------|--|-----------------------|------------|
| 64a | Conidia hyaline, with slender divergent arms | <i>Varicosporium</i> | 138 |
| 64b | Conidia dark, branches more or less upright | <i>Speiropsis</i> | 142 |
| 65a | Conidia with 3 to 4 upright to spreading branches | <i>Tetraploa</i> | 142 |
| 65b | Conidia with 4 to 5 widely divergent branches | <i>TYipospermum</i> | 142 |
| 66a | "Conidiophores" (propagules) compactly branched, globose to conical, ultimate cells globose, conidialike; no true conidia produced | <i>Cristulariella</i> | 74 |
| 66b | Conidiophores poorly formed or reduced to pegs or short conidiogenous cells | | 67 |
| 66c | Conidiophores distinct, simple or loosely branched | | 70 |
| 67a | Mycelium with clamp connections; conidia forcibly discharged | <i>Itersonia</i> | 70 |
| 67b | With neither clamp connections nor forcibly discharged conidia | | 68 |
| 68a | Parasitic on grasses; conidia 2-celled, not budding | <i>Rhynchosporium</i> | 108 |
| 68b | Usually saprophytic; conidia 1-celled, budding | | 69 |
| 69a | Mycelium and conidia hyaline | <i>Candida</i> | 70 |
| 69b | Mycelium and conidia with dark pigment | <i>Aureobasidium</i> | 70 |
| 70a | Conidia hyaline, 2-celled | <i>Trichothecium</i> | 108 |
| 70b | Conidia hyaline or subhyaline, 1-celled | | 71 |
| 70c | Conidia with distinct dark pigment | | 74 |
| 71a | Conidia borne in acropetalous chains | | 72 |
| 71 b | Conidia not in chains ! | | 73 |
| 72a | Conidiophores dark; conidia in moist heads | <i>Haplographium</i> | 80 |
| 72b | Conidiophores hyaline; conidia uniform globose to short ellipsoid, in long branched chains | <i>Manilla</i> | 72 |
| 72c | Conidiophores hyaline branched; conidia variable, in short chains | <i>Hyaiodendron</i> | 72 |
| 72d | Conidiophores subhyaline, conidia elongate, slender | <i>Tilletiopsis</i> | 72 |
| 73a | Conidiophores dark; conidia ovoid, 2 to 3 on each swollen dark cell | <i>Zygosporium</i> | 72 |
| 73b | Conidiophores hyaline; conidia lunulate, not clustered | <i>Lunulospora</i> | 138 |
| 73c | Conidiophores hyaline; conidia globose to broad ellipsoid, single, apical on long denticles | <i>Olpitrichum</i> | 74 |
| 74a | Conidia all or mostly 1-celled | | 75 |
| 74b | Conidia mostly 2-celled | | 77 |
| 74c | Conidia 3- to several-celled (phragmosporous) | | 78 |
| 75a | Conidia variable, some typically lemon-shaped | <i>Cladosporium</i> | 106 |
| 75b | Conidia uniform, mostly ovoid to ellipsoid | <i>Papularia</i> | 82 |
| 75c | Conidia uniformly globose | | 76 |

50 ALTERNATE KEY TO SERIES AND GENERA

| | | | |
|------|--|------------------------|-----|
| 76a | Setae present; apex of conidiophore globose | <i>LaceHinopsis</i> | 78 |
| 76b | Setae present; apex of conidiophore not enlarged | <i>Lacellina</i> | 78 |
| 76c | Setae absent | <i>Periconia</i> | 74 |
| 11a. | Conidiophores branched; conidia variable | <i>Cladosporium</i> | 106 |
| lib | Conidiophores mostly simple; conidia uniformly ellipsoid | <i>Bispora</i> | 106 |
| 78a | Conidia borne on special globose cells | | 79 |
| 78b | Conidia not borne on special globose cells | | 80 |
| 79a | Conidia catenulate | <i>Pseudotorula</i> | 116 |
| 79b | Conidia not catenulate | <i>Dwayabeeja</i> | 116 |
| 80a | Conidia catenulate, cylindrical | <i>Septonema</i> | 116 |
| 80b | Conidia catenulate, cells strongly rounded | <i>Torula</i> | 74 |
| 80c | Conidia not catenulate | <i>Gonatophragmium</i> | 122 |

BOTRYOBLASTOSPORAE

| | | | |
|------|---|-------------------------|-----|
| 81 a | Conidia in simple or branched chains of 2 or more | | 82 |
| 81b | Conidia not catenulate | | 83 |
| 82a | Conidiophores tall, dark; conidia dark | <i>Gonatobotryum</i> | 78 |
| 82b | Conidiophores variable, hyaline; conidia hyaline | <i>Gonatorrhodiella</i> | 78 |
| 83a | Conidia dark, phragmosporous | <i>Cephaliphora</i> | 116 |
| 83b | Conidia hyaline, 1-celled | | 84 |
| 84a | Conidiophores short, reduced to 1 or few cells | <i>Phymotolrichum</i> | 78 |
| 84b | Conidiophores tall, well developed | | 85 |
| 85a | Conidiogenous cells globose or with globose lobes | | 86 |
| 85b | Conidiogenous cells or fertile portion of conidiophore elongated to irregular | | 89 |
| 86a | Conidiophores simple or with few branches | | 87 |
| 86b | Conidiophores with several branches, at least near apex | | 88 |
| 87a | Conidiophores determinate, with a single head of conidia | <i>Oedocephalum</i> | 76 |
| 87b | Conidiophores proliferating percurrently, with several clusters of conidia | <i>Gonatobotrys</i> | 76 |
| 88a | Conidiophore branches many, lateral on main axis | <i>Botryosporium</i> | 76 |
| 88b | Conidiophore branches regularly dichotomous | <i>Dichobotrys</i> | 78 |
| 88c | Conidiophore branches irregular | <i>Botrytis</i> | 76 |
| 89a | Conidiophore branches dichotomous near apex | <i>Chromelosporium</i> | 80 |
| 89b | Conidiophore branches irregular | <i>Aciadium</i> | 76 |

POROSPORAE

| | | | |
|------|--|----------------------------------|------------|
| 90a | Conidia with transverse and oblique septa (dictyosporous) | | 91 |
| 90b | Conidia with transverse septa only (phragmosporous) | | 93 |
| 90c | Conidia 2-celled, catenulate | <i>Diplococcium</i> | 114 |
| 91a | Conidia long-beaked, obclavate, or ovoid | <i>Allernaria</i> | 132 |
| 91 b | Conidia not beaked, globose to broadly ellipsoid | | 92 |
| 92a | Conidiophores elongating sympodially | <i>Ulocladium</i> | 132 |
| 92b | Conidiophores elongating percurrently | <i>Stemphylium</i> | 132 |
| 93a | Conidiophores tall, branched; conidia catenulate | <i>Dendryphion</i> | 124 |
| 93b | Conidiophores tall, branched; conidia not catenulate | | 94 |
| 93c | Conidiophores mostly simple | | 96 |
| 94a | Conidiophores dichotomous near apex; conidia mostly several-celled | <i>Dichotomophthora</i> | 120 |
| 94b | Conidiophores not dichotomous near apex | | 95 |
| 95a | Conidia mostly 3-celled | <i>Spondylocladiella</i> | 120 |
| 95b | Conidia 4- to several-celled | <i>Dendryphiopsis</i> | 120 |
| 96a | Conidia in acropetalous chains, often breaking up into 1- to several-celled fragments | <i>Torula</i> | 74 |
| 96b | Conidia not catenulate | | 97 |
| 97a | Conidiophores indeterminate, extending sympodially | | 98 |
| 97b | Conidiophores determinate | | 100 |
| 98a | Conidia bent by enlargement of one cell | <i>Curvularia</i> | 122 |
| 98b | Conidia not bent by enlarged cell, straight or slightly curved | | 99 |
| 99a | Mid-cells of conidia larger than end cells; germ tubes originate from any cell | <i>Drechslera</i> | 122 |
| 99b | Mid-cells of conidia not distinctly larger than others; germ tubes only from end cells | <i>Bipolaris</i> | 126 |
| 100a | Conidiophores clustered; conidia apical | <i>Exosporium</i> | 148 |
| 100b | Conidiophores single; conidia apical and lateral | | 101 |
| 100c | Conidiophores single; conidia single, apical | <i>Corynespora, Sporidesmium</i> | 120 |
| 101a | Conidia several-celled, cylindrical to obclavate | <i>Helminthosporium</i> | 124 |
| 101b | Conidia often less than 4-celled, ellipsoid to obovoid | <i>Spadicoides</i> | 114 |

SYMPODULOSPORAE

Note: The key to this section includes some genera described as producing porospores and in which the conidiophores commonly extend by sympodial growth.

| | | | |
|------|---|-----------------------------------|---------|
| 102a | Conidia coiled, helicosporous | | 103 - |
| 102b | Conidia not coiled | | 106 |
| 103a | Conidia thick in proportion to length, not hygroscopic | | 105 |
| 103b | Conidia thin in proportion to length, hygroscopic | | 104 |
| 104a | Parasitic on higher plants; some conidia nearly straight | <i>Helicomina</i> | 136 |
| 104b | Saprophytic on wood or bark; conidia uniformly coiled | <i>Heiicoma</i> | 136 |
| 105a | Conidiophores and conidia hyaline | <i>Helicomycetes</i> | 136 |
| 105b | Conidiophores dark; conidia pale to dark | <i>Helicosporium</i> | 136 |
| 106a | On living plants in nature, principally on leaves, mostly parasitic | | 107 |
| 106b | Closely associated with other fungi, often parasitic on them | | 122 |
| 106c | Saprophytic on various substrata | | 123 |
| 107a | Conidia hyaline or subhyaline | | 108 |
| 107b | Conidia distinctly pigmented, pale brown to dark | | 116 |
| 108a | Conidia predominantly 1-celled | | 109 |
| 108b | Conidia typically 2- to several-celled | | 111 |
| 109a | Conidiophores relatively short, simple | <i>Idriella</i> | 102 |
| 109b | Conidiophores tall, repeatedly branched near apex | | 110 |
| 110a | Conidia collecting in moist slimy heads | <i>Verticicladiella</i> | 104 |
| 110b | Conidia dry, not in moist heads | <i>Verticicladium</i> | 104 |
| 111a | Conidia catenulate in acropetalous chains | | 112 |
| 111b | Conidia not catenulate | | 113 |
| 112a | Conidia mostly 2-celled, with some 1-celled | <i>Ramularia</i> | 110 |
| 112b | Conidia mostly with 3 or more cells | <i>Septocylindrium</i> | 128 |
| 113a | Conidia filiform to cylindrical or long ellipsoid | | 114 |
| 113b | Conidia shorter, ovoid to pyriform or short ellipsoid | | 115 |
| 114a | Conidiophores hyaline; conidia with attenuated apical cell | <i>Spermospora</i> | 128 |
| 114b | Conidiophores hyaline; conidia! cell not attenuated | <i>Cercosporetta</i> | 128 |
| 114c | Conidiophores dark; conidial cell not distinctly attenuated | <i>Cercospora, Cercosporidium</i> | 128,122 |
| 115a | Conidia broader near base; cells unequal | <i>Pyricularia</i> | 128 |

ALTERNATE KEY TO SERIFSA AND GENERA 53

| | | | |
|-------|--|----------------------------------|------------|
| 115b | Conidia oblong; cells nearly equal | <i>Didymaria</i> | 110 |
| 116a | Conidiophores tall, dark, simple below, branched near apex and bearing a number of conidiogenous cells | <i>Periconiella</i> | 104 |
| 116b | Conidiophores and conidiogenous cells not as above | | 117 |
| ! 17a | Conidia mostly 1- to 2-celled | | 118 |
| 117b | Conidia 3- to several-celled (phragmosporous) | | 121 |
| 118a | Conidia rough-walled, cells equal | <i>Asperisporium</i> | 112 |
| 118b | Conidia smooth, cells unequal | | 119 |
| I 19a | Conidiophores distinctly wavy in appearance | <i>Polythrincium</i> | 112 |
| \ 19b | Conidiophores often irregular but not distinctly wavy | | 120 |
| 120a | Conidiophores usually arise from beneath cutical layer | <i>Fusicladiwn</i> | 112 |
| 120b | Conidiophores emerging through stomata or from surface of leaves | <i>Scolecotrichum, Passalora</i> | 112 |
| 121a | Conidia with 1 to 4 hyaline appendages on apical cells | <i>Pleiochaeta</i> | 128 |
| 121b | Conidia without appendages | <i>Nakataea</i> | 128 |
| 122a | Conidiophores and conidia hyaline; conidia 1-celled | <i>Calcarisporium</i> | 102 |
| 122b | Conidiophores and conidia hyaline; conidia 3- to 4-celled, mostly ovoid | <i>Dactylium</i> | 130 |
| 122c | Conidiophores and conidia dark; conidia long, slender | <i>Cladosporietta</i> | 92 |
| 123a | Conidia hyaline to subhyaline (slightly pigmented) | | 124 |
| J23b | Conidia with distinct dark pigment | | 139 |
| 124a | Conidia typically 1-celled | | 125 |
| 124b | Conidia typically 2-celled | | 135 |
| 124c | Conidia 3- to several-celled | | 137 |
| 125a | Conidiophores variously branched, rarely simple | | 126 |
| 125b | Conidiophores typically simple, rarely branched | | 131 |
| 126a | Conidiophores branched only near apex | | 127 |
| 126b | Conidiophore branches lower or lateral on main axis | | 128 |
| 127a | Conidia in moist heads of slime | <i>Verticicladiella</i> | 104 |
| I27b | Conidia dry, not in moist heads | <i>Verlicicladium</i> | 104 |
| 128a | Conidiophore branches verticillate on main axis | | 129 |
| 128b | Conidiophore branches irregular; conidiogenous cells may be verticillate | | 130 |
| 129a | Conidiophores hyaline; conidia ovoid | <i>Tritirachium</i> | 100 |
| I29b | Conidiophores pigmented; conidia long, slender | <i>Selenosporella</i> | 102 |

54 ALTERNATE KEY 10 SERIES AND GENERA

| | | | |
|------|--|------------------------|-------|
| 130a | Fertile area of conidiogenous cell slender, not enlarged | <i>Hamfordia</i> | 98 |
| 130b | Fertile area of conidiogenous cell somewhat enlarged, at least at apex .. | <i>Nodulosporium</i> | 100 |
| 130c | Fertile area of conidiogenous cell much elongated; not enlarged | <i>Geniculosporium</i> | 100 |
| 131a | Conidia catenulate | <i>Sympodiella</i> | 104 |
| 131b | Conidia not catenulate | | - 132 |
| 132a | Fertile area of conidiogenous cell slender, rachislike | | 133 |
| 132b | Fertile area of conidiogenous cell not slender or rachislike | | 134 |
| 133a | Base of conidiophore enlarged; mostly on insects | <i>Beauveria</i> | 100 |
| 133b | Base of conidiophore not enlarged; saprophytic | <i>Tritirachium</i> | 100 |
| 134a | Conidiophores slender, hyaline, single, only slightly enlarged at apex | <i>Sporothrix</i> | 98 |
| 134b | Conidiophores pigmented, single, greatly enlarged at apex | <i>Basidiobotrys</i> | 100 |
| 134c | Conidiophores hyaline, in clusters | <i>Ovularia</i> | 104 |
| 135a | Apical cell of conidium equal to or smaller than basal cell, sometimes elongated | <i>Dactylaria</i> | 110 |
| 135b | Apical cell of conidium larger or wider than basal cell, rounded | | 136 |
| 136a | Conidia in loose clusters, on short denticles | <i>Arirobotrys</i> | 110 |
| 136b | Conidia in loose clusters, on long pegs | <i>Candelabrella</i> | 110 |
| 136c | Conidia single on sympodial branches of conidiophore | <i>Genicularia</i> | 110 |
| 137a | Conidia forked, with 2 parallel prongs | <i>Dkranidion</i> | 138 |
| 137b | Conidia not forked | | 138 |
| 138a | Conidiophores short, hyaline; conidia cylindric to clavate | <i>Dactylaria</i> | 110 |
| 138b | Conidiophores tall, hyaline; conidia cylindric to fusoid | <i>Dactylella</i> | 128 |
| 138c | Conidiophores tall, dark; conidia fusoid | <i>Pleurothecium</i> | 126 |
| 139a | Conidiophores tall, dark, slender, bearing at apex several divergent conidiogenous cells | <i>Pseudobotrylis</i> | 106 |
| 139b | Conidiophores and conidiogenous cells not as above | | 140 |
| 140a | Conidia 1-celled | | 141 |
| 140b | At least some conidia 2- or more-celled | | 147 |
| 141a | Conidia biconic, tapering toward both ends | <i>Beltrania</i> | 104 |
| 141b | Conidia otherwise | | 142 |
| 142a | Conidia oblong-elongate | <i>Selenosporella</i> | 102 |
| 142b | Conidia mostly globose or ovoid | | 143 |
| 143a | Conidia symmetric, both sides rounded | | 144 |
| 143b | Conidia asymmetric, one side flat or concave | <i>Virgaria</i> | 100 |

| | | | |
|------|---|------------------------------------|------------|
| 144a | Conidiophores branched irregularly; conidiogenous cells somewhat enlarged, at least at apex | <i>Nodulisporium</i> | 100 |
| 144b | Conidiophores simple or branched; conidiogenous cells not enlarged at apex | | 145 |
| 145a | Conidiophore branches somewhat spiral, appearing wavy | <i>Conoplea</i> | 102 |
| 145b | Conidiophores or branches more or less straight, not wavy | <i>Rhinoctadiella</i> | 104 |
| 146a | Conidiophores or conidiogenous cells, short, mostly]- to 3-celled | | 147 |
| 146b | Conidiophores tall, well developed | | 148 |
| 147a | Conidia 1- to 2-celled, ovate, oblong or T-shaped | <i>Scolecobasidium</i> | 114 |
| 147b | Conidia staurosporous, several-celled, Y-shaped, with 2 pointed arms | <i>Diploctadiella</i> | 142 |
| 147c | Conidia staurosporous, with 3 or more branches | <i>Speiropsis</i> | 142 |
| 148a | Conidia dictyosporous, some phragmospores present | <i>Dactylosporium, Sirosporium</i> | 134 |
| 148b | Conidia typically phragmosporous | | 149 |
| 149a | Conidia often catenulate | <i>Heterosporium</i> | 122 |
| 149b | Conidia not catenulate | | 150 |
| 150a | Conidia attached by slender pedicels to apex of conidiophores | <i>Brachysporium</i> | 126 |
| 150b | Conidia attached directly to hyaline apex of conidiophores | <i>Cacumisporium</i> | 124 |

PHIALOSPORAE

| | | | |
|------|--|-----------------------|------------|
| 151a | Normally aquatic, growing on decaying vegetation | | 152 |
| 151b | Not normally aquatic | | 154 |
| 152a | Conidia or branches long, slender | | 153 |
| 152b | Conidia unbranched | <i>Heliscus</i> | 108 |
| 153a | Conidia long, slender, unbranched | <i>Flagellospora</i> | 138 |
| 153b | Conidia each with 4 slender arms | <i>Lemonniera</i> | 138 |
| 154a | Conidia typically 2- to several-celled | | 155 |
| 154b | Conidia typically 1-celled | | 159 |
| 155a | Conidiophores with dark pigment | | 156 |
| 155b | Conidiophores (or conidiogenous cells) hyaline | | 157 |
| 156a | Conidiophores tall with lateral branches and sterile apex; conidia not catenulate | <i>Chaetopsis</i> | 96 |
| 156b | Conidiophores with few branches near apex; conidia catenulate but not end to end | <i>Fusariella</i> | 130 |
| 156c | Conidiophores simple; conidia endogenous in end-to-end chains | <i>Sporochisma</i> | 130 |
| 157a | Conidiophores repeatedly branched; <i>one</i> sterile branch typically with swollen apex | <i>Cylindrodadium</i> | 108 |

| | | | |
|------|--|-----------------------|------------|
| 157b | Conidiophores simple or irregularly branched; without sterile branches | | 158 |
| 158a | Conidia mostly cylindrical, straight, 2- to several-celled | <i>Cylindrocarpon</i> | 130 |
| 158b | Conidia ovoid, 2-celled, not in slime heads | <i>Cladobotryum</i> | 108 |
| 158c | Conidia ovoid, 2-celled, in small slime heads | <i>Diplosporium</i> | 108 |
| 158d | Macroconidia typically canoe-shaped, several-celled; microconidia 1-celled | <i>Fusarium</i> | 130 |
| 159a | Apex of conidiophore much enlarged, covered with flask-shaped phialides; conidia in dry chains | <i>Aspergillus</i> | 94 |
| 159b | Conidiophores, phialides or conidia otherwise | | 160 |
| 160a | Conidia hyaline or subhyaline | | 161 |
| 160b | Conidia distinctly pigmented, at least in mass | | 178 |
| 161a | Conidia crescent-shaped, typically with hyaline apical appendages | | 162 |
| 161b | Conidia globose, ovoid, oblong, or hooked, without appendages | | 163 |
| 162a | Apical collarette of phialide small, inconspicuous | <i>Menispora</i> | 88 |
| 162b | Apical collarette of phialide large, flaring | <i>Codinaea</i> | 88 |
| 163a | Conidia produced well within phialide (endogenous), mostly rod-shaped | | 164 |
| 163b | Conidia produced at apex of phialide, not rod-shaped | | 167 |
| 164a | Dark aleuriospores (chlamydospores) also present | | 165 |
| 164b | Dark aleuriospores absent | | 166 |
| 165a | Aleuriospores rounded, 1-celled, single or in short chains | <i>Chalaropsis</i> | 90 |
| 165b | Aleuriospores cylindrical, breaking up into 1-celled fragments | <i>Thielaviopsis</i> | 92 |
| 166a | Tall dark setae present | <i>Chaetochalara</i> | 90 |
| 166b | Dark setae absent | <i>Chalara</i> | 90 |
| 167a | Conidiophores short or mostly reduced to a single phialide | | 168 |
| 167b | Conidiophores well developed, simple or branched | | 169 |
| 168a | Conidia in dry chains, no slime present | <i>Monocillium</i> | 86 |
| 168b | Conidia in small, moist, slimy heads | <i>Cephalosporium</i> | 94 |
| 169a | Conidia dry, not in moist heads | | 170 |
| 169b | Conidia held together in moist slimy heads | | 172 |
| 170a | Conidiophores mostly simple, dark; conidia single or catenulate | <i>Moniliaetes</i> | 86 |
| 170b | Conidiophores branched, dark; conidia catenulate | <i>Thysanophora</i> | 96 |
| 170c | Conidiophores branched, hyaline; conidia catenulate | | 171 |
| 171a | Conidia cylindrical, aggregated into dry columns | <i>Metarrhizium</i> | 94 |

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|------|---|---------------------------|-----|
| 171b | Conidia globose, ovoid or rod-shaped; conidiophore "brush" compact | <i>Penkillium</i> | 94 |
| 171c | Conidia fusiform to lemon-shaped; conidiophore "brush" loose | <i>Paecilomyces</i> | 94 |
| 172a | Conidiophores simple or reduced to short, 1-celled phialides | | 173 |
| 172b | Conidiophores variously branched, at least at apex | | 174 |
| 173a | Conidiophores dark; coiled setae absent | <i>Chloridium</i> | 88 |
| 173b | Conidiophores (phialides) hyaline; coiled setae present, unbranched | <i>Circinotrichum</i> | 90 |
| 173c | Conidiophores (phialides) hyaline, with coiled branched setae | <i>Gyroihris</i> | 90 |
| 174a | Conidial masses large, only at apex of conidiophore | | 175 |
| 174b | Conidial masses small, at apex of conidiophore | | 177 |
| 175a | Conidiophores hyaline, apex often enlarged, branches Aspergillus-like | | 176 |
| 175b | Conidiophores hyaline, branches Penicillium-like | <i>Gliocladium</i> | 92 |
| 175c | Conidiophores dark, branches Penicillium-like | <i>Phialcephala</i> | 96 |
| 176a | Conidial mass subtended by sterile arms | <i>Gliocephalotrichum</i> | 94 |
| 176b | Conidial mass not subtended by sterile arms | <i>Gliocephals</i> | 94 |
| 177a | Conidiophores hyaline, branches (or phialides) verticillate | <i>Verticillium</i> | 92 |
| 177b | Conidiophores hyaline, branches irregular | <i>Trichoderma</i> | 92 |
| 177c | Conidiophores dark, branches arising at points on main axis | <i>Gonylrichum</i> | 98 |
| 178a | Conidiophores mostly reduced to phialides | | 179 |
| 178b | Conidiophores well developed | | 180 |
| 179a | Phialides slender, tapering upward; collarette not evident | <i>Gliomastix</i> | 86 |
| 179b | Phialides cylindrical to inflated; collarette often flaring | <i>Phialphora</i> | 88 |
| 180a | Upper portion of conidiophores branched; phialides long, slender; conidia dark, in small, moist heads | <i>Stachylidium</i> | 92 |
| 180b | Upper portion of conidiophores branched; conidia dry, dark, lemon-shaped, catenulate | <i>Phialomyces</i> | 94 |
| 180c | Conidiophores unbranched; short thick phialides at base of simple conidiophores | | 181 |
| 181a | Conidia in moist slimy heads, not catenulate | <i>Stachybotrys</i> | 88 |
| 181b | Conidia not in slimy heads, catenulate | <i>Memnoniella</i> | 88 |

| | | | |
|------|---|---------------------------|-----|
| 171b | Conidia globose, ovoid or rod-shaped; conidiophore "brush" compact | <i>Penkillium</i> | 94 |
| 171c | Conidia fusiform to lemon-shaped; conidiophore "brush" loose | <i>Paecilomyces</i> | 94 |
| 172a | Conidiophores simple or reduced to short, 1-celled phialides | | 173 |
| 172b | Conidiophores variously branched, at least at apex | | 174 |
| 173a | Conidiophores dark; coiled setae absent | <i>Chloridium</i> | 88 |
| 173b | Conidiophores (phialides) hyaline; coiled setae present, unbranched | <i>Circinotrichum</i> | 90 |
| 173c | Conidiophores (phialides) hyaline, with coiled branched setae | <i>Gyroihris</i> | 90 |
| 174a | Conidial masses large, only at apex of conidiophore | | 175 |
| 174b | Conidial masses small, at apex of conidiophore | | 177 |
| 175a | Conidiophores hyaline, apex often enlarged, branches Aspergillus-like | | 176 |
| 175b | Conidiophores hyaline, branches Penicillium-like | <i>Gliocladium</i> | 92 |
| 175c | Conidiophores dark, branches Penicillium-like | <i>Phialcephala</i> | 96 |
| 176a | Conidial mass subtended by sterile arms | <i>Gliocephalotrichum</i> | 94 |
| 176b | Conidial mass not subtended by sterile arms | <i>Gliocephals</i> | 94 |
| 177a | Conidiophores hyaline, branches (or phialides) verticillate | <i>Verticillium</i> | 92 |
| 177b | Conidiophores hyaline, branches irregular | <i>Trichoderma</i> | 92 |
| 177c | Conidiophores dark, branches arising at points on main axis | <i>Gonylrichum</i> | 98 |
| 178a | Conidiophores mostly reduced to phialides | | 179 |
| 178b | Conidiophores well developed | | 180 |
| 179a | Phialides slender, tapering upward; collarette not evident | <i>Gliomastix</i> | 86 |
| 179b | Phialides cylindrical to inflated; collarette often flaring | <i>Phialphora</i> | 88 |
| 180a | Upper portion of conidiophores branched; phialides long, slender; conidia dark, in small, moist heads | <i>Stachylidium</i> | 92 |
| 180b | Upper portion of conidiophores branched; conidia dry, dark, lemon-shaped, catenulate | <i>Phialomyces</i> | 94 |
| 180c | Conidiophores unbranched; short thick phialides at base of simple conidiophores | | 181 |
| 181a | Conidia in moist slimy heads, not catenulate | <i>Stachybotrys</i> | 88 |
| 181b | Conidia not in slimy heads, catenulate | <i>Memnoniella</i> | 88 |

DESCRIPTIONS AND ILLUSTRATIONS
OF GENERA

HELICOCEPHALUM Thaxt. Conidiophores upright, long, slender, simple, nonseptate; conidia produced in a spiral, forming a head held in a slime drop, 1-celled, ellipsoid, hyaline or slightly pigmented; saprophytic on dung or decaying wood.

Illustration: (A) *H. sarcophilum*; redrawn from Thaxter (438); (B) *H. oiigosporum*; original, from material on decayed wood. Other reference (98).

RHOPALOMYCES Corda. Mycelium sparse; conidiophores upright, slender, simple; conidia borne on enlarged tip of conidiophore, which is hexagonally aerolate, 1-celled, hyaline, ellipsoid; saprophytic on plant material, or destroying nematode eggs.

Illustration: *R. strangulatus*; redrawn from Thaxter (436). (A) conidiophore and head of conidia; (B) head of conidia enlarged; (C) conidia. References (36).

CUNNINGHAMELLA Matr. Mycelium white, extensive in culture, nonseptate; conidiophores (sporangiophores) simple or branched, with enlarged tips bearing heads of conidia (sporangioles); conidia hyaline, 1-celled, globose; common saprophytes in soil.

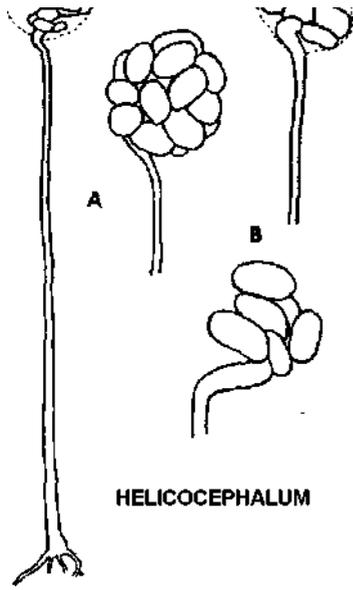
Illustration: *C. elegans*; original, from pure culture. (A) simple conidiophore and head of conidia; (B) branched conidiophore; (C) detail of tip of conidiophore showing denticles; (D) conidia. References (70, 171).

MYCOTVPHA Fennr. Mycelium at first nonseptate, later becoming septate, hyaline; conidiophores (sporangiophores) erect, tall, simple, septate; head of spores cylindrical; conidia (sporangioles) 1-celled, borne singly on short denticles; saprophytic.

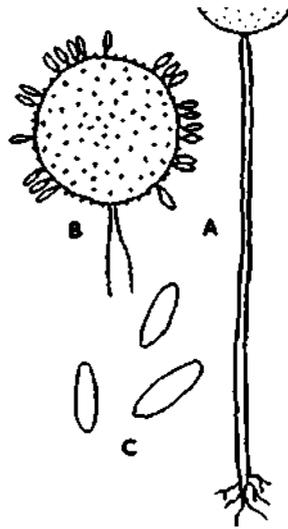
Illustration: *M. microspora*; original, from culture. (A) group of conidiophores; (B) head of conidia enlarged; (C) conidia. Reference (132).

MORTIERELLA Coemans. Mycelium typically appressed to substrate, fine; conidiophores (sporangiophores) hyaline, simple or branched, typically tapering upward; conidia (sporangioles) globose, hyaline, single, apical; typical multispored sporangia present in some species, absent in others; common in soil, saprophytic.

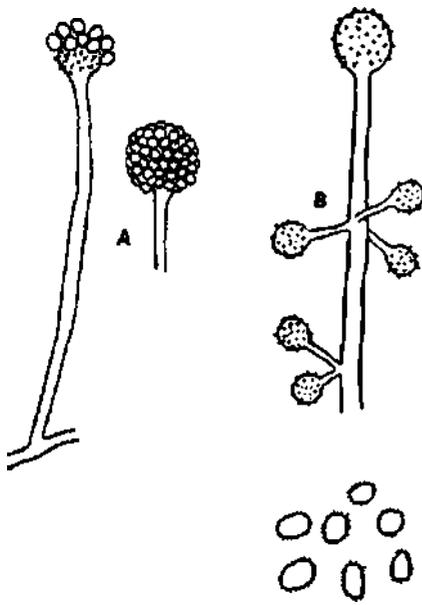
Illustration: *Mortierella* sp; original from culture. Reference (136).



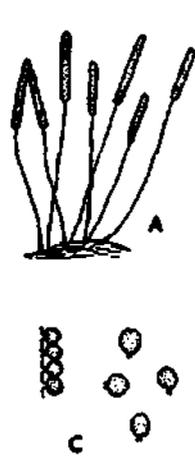
HELICOCEPHALUM



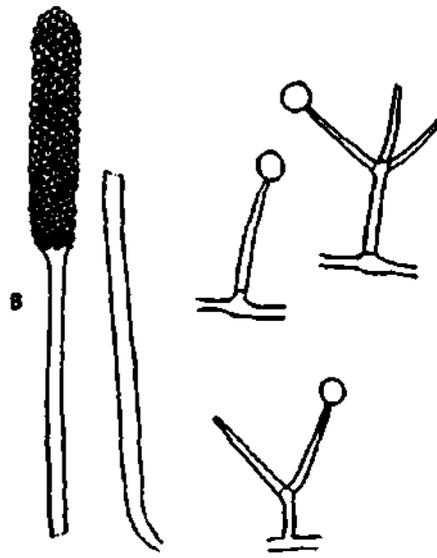
RHOPALOMYCES



CUNNINGHAMELLA



MYCOTYPHA



MORTIERELLA

SYNCEPHALIS Van Tiegh. and Le Monn. Conidiophores (sporangiophores) upright, straight or bent near the apex, with prominent rhizoids at the base; apex enlarged, producing branches, bearing rodlike sporangioles which break up to form short conidia; parasitic on other Mucorales.

Illustration: *S. pycnosperma*. (A) general habit of nearly mature fertile hypha; (B) formation of separate spores; redrawn from Thaxter (440). Other reference (17).

PIPTOCEPHALIS de Bary. Conidiophores (sporangiophores) erect, septate, repeatedly dichotomously branched, tips more or less swollen, deciduous, bearing cylindrical, rodlike sporangioles; sporangioles break up into short conidia at maturity; haustorial parasites on other fungi, principally Mucorales.

Illustration: *P. virginiana*; original, from a culture on Mucor. (A) conidiophore and sporangioles; (B) heads of spores; (C) chains of spores breaking apart; (D) haustorium of parasite in host mycelium. References (22, 256).

COEMANSIA Van Tiegh and Le Monn. Mycelium sparse, nonseptate; conidiophores upright, slender, septate, sparingly branched, at intervals bearing sporocladia that produce conidia only on the lower (outer) surface; conidia hyaline, 1-celled, ovoid to fusoid; saprophytic on dung.

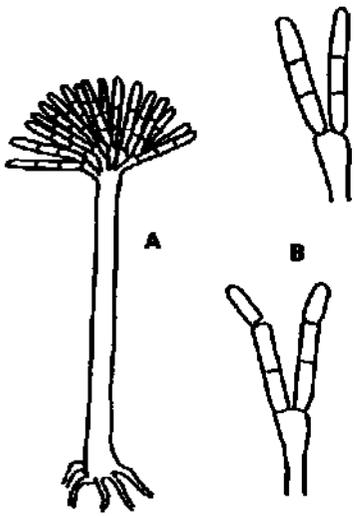
Illustration: *C. erecta*; (A) conidiophores; (B) sporocladia and conidia; redrawn from Linder (268). Other reference (22).

DIMARGARIS Van Tieghem. Conidiophores (sporangiophores) erect, septate, at first simple, becoming irregularly cymosely or verticillately branched and producing fertile terminal heads; sterile branches absent; conidial heads composed of many sporogenous branchlets, consisting of short chains of cells formed by budding, each cell giving rise to a whorl of 2-spored sporangioles; conidia finally separating, immersed in liquid at maturity, ellipsoid or rod-shaped; parasitic on other Mucorales, producing branched haustoria.

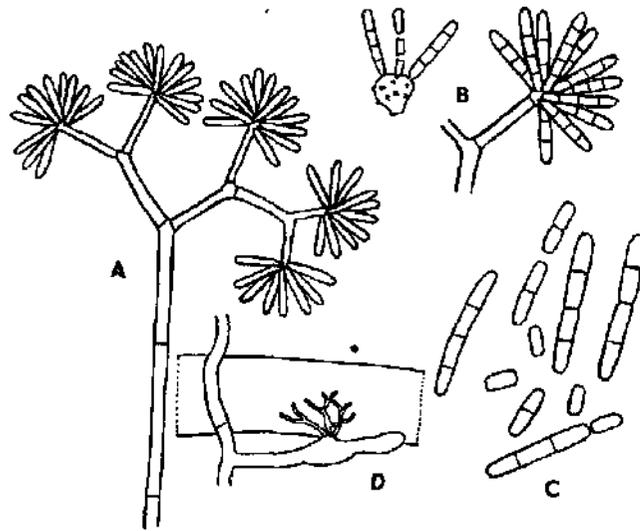
Illustration: *D. verticillata*; redrawn from Benjamin (23). (A) upper portion of sporangiophore; (B) enlarged branch apex; (C) branchlet with several 2-spored sporangioles; (D) conidia.

TIEGHEMIOMYCES Benjamin. Conidiophores (sporangiophores) erect, septate, simple below, giving rise above to fertile branch systems; branches septate, several repeatedly, irregularly branched, the ends consisting of fertile cells bearing whorls of 2-spored sporangioles; conidia finally separating, smooth subglobose to ovoid, dry at maturity; parasitic on other Mucorales, producing branched haustoria.

Illustration: *T. caHfornicus*; redrawn from Benjamin (23). (A) habit of sporangiophores; (B) branch of sporangiophore; (C) branchlets with 2-spored sporangioles; (D) conidia.



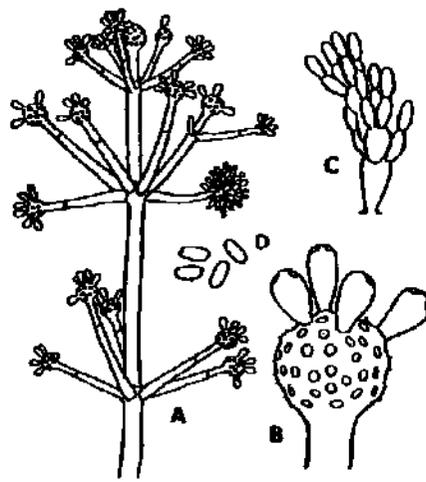
SYNCEPHAUS



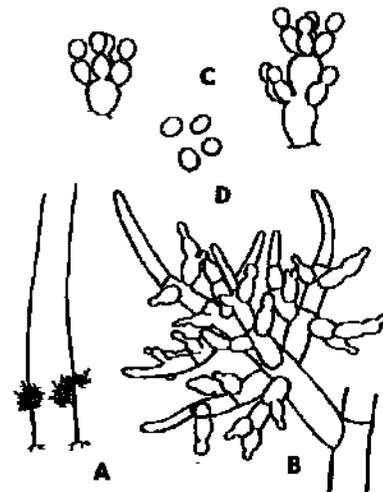
PIPTOCEPHALIS



COEMANSIA



DIMARGARIS



TIEGHEMIOMYCES

RADIOMYCES Embree. Conidiophores (sporangiohores) borne singly or sometimes in pairs near the ends of stolons that terminate in rhizoid systems; conidiophores dark brown, terminating in primary vesicles bearing radiate stalks and secondary vesicles; conidia borne on tertiary stalks, subglobose to ellipsoid, conidia hyaline, reniform to oblong-ellipsoid; saprophytic.

Illustration: *R. embreei*; (A) apex of conidiophore with conidia; (B) single branch of conidial head; (C) single branch void of conidia; (D) conidia; redrawn from Benjamin (24). Other reference (127).

MARTENSELLA Coemans. Mycelium sparse; conidiophores upright, simple, bearing lateral or apical sporocladia; conidia borne on upper surface of sporocladia, hyaline, 1-celled; saprophytic.

Illustration: *M. corticii*; (A) conidiophores; (B) sporocladia and conidia; redrawn from Jackson and Dearden (240). Other references (22, 268).

KICKXEELA Coemans. Mycelium sparse; conidiophores simple with an apical disk bearing sporocladia; conidia produced on the upper surface of sporocladia, hyaline, 1-celled; saprophytic on horse dung.

Illustration: *K. alahastrina*; (A) conidiophore; (B) sporocladium and conidia redrawn from Benjamin (22). Other reference (268).

LINDERINA Raper and Fennell. Conidiophores long, septate, branched, bearing several dome-like sporocladia with pseudophialides and conidia on the upper surface; conidia hyaline, 1-celled, elongated; saprophytic in soil.

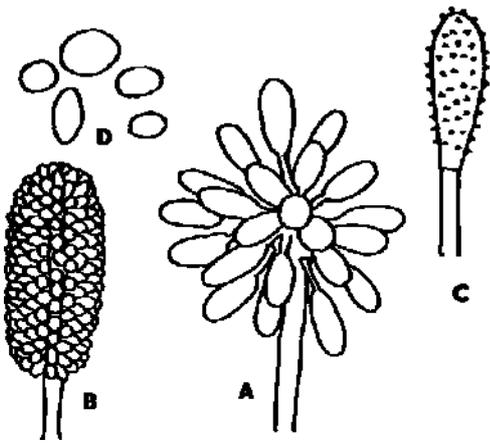
Illustration: *L. pennispora*; (A) diagram showing habit of growth; (B) a single sporocladium; redrawn from Raper and Fennell (348).

MARTENSIOMYCES Meyer. Conidiophores (sporangiohores) erect or ascending, becoming irregularly cymosely branched; sporocladia stalked, borne in umbels on recurved branchlets, producing pseudophialides on one side (resembling *Coemansia*); pseudophialides ellipsoid, each bearing a single conidium (sporangiole); conidia obclavate, hyaline, enveloped in liquid at maturity; saprophytic, from soil.

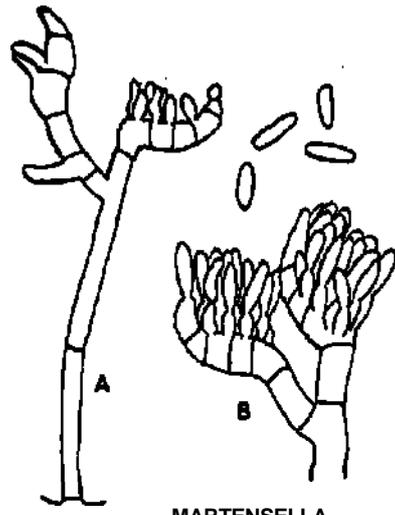
Illustration: *M. pterosporus*; redrawn from Benjamin (23). (A) conidiophore; (B) group of sporocladia; (C) sporocladium; (D) conidium.

SPIRODACTEON Benjamin. Conidiophores (sporangiohores) erect or ascending, septate, giving rise above to coiled, fertile branches; sporocladia borne successively on the lower surface of the coils, septate, with narrowed apices, producing laterally pseudophialides that bear single sporangioles (conidia); conidia short-ellipsoid, not enveloped in liquid at maturity; saprophytic on dung.

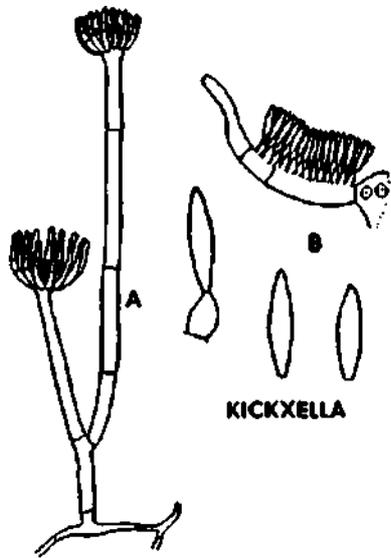
Illustration: *S. aureum*; redrawn from Benjamin (22). (A) conidiophore; (B) group of sporocladia; (C) sporocladium bearing conidia.



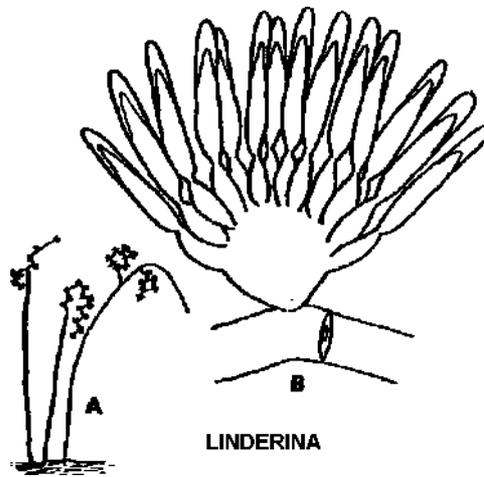
RADIOMYCES



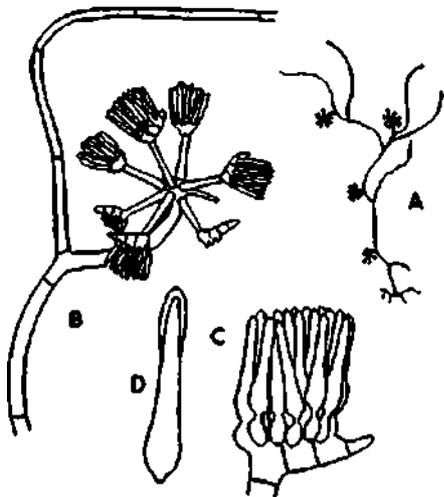
MARTENSELLA



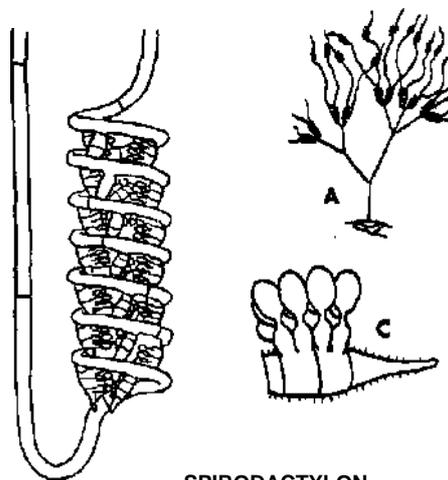
KICKXELLA



LINDERINA



MARTENSIOMYCES



SPIRODACTYLON

SYNCEPHALASTRUM Schroet. Mycelium growing rapidly, abundantly branched; conidiophores (sporangiohores) erect, branched, tips enlarged, bearing a head of rod-shaped sporangioles, each producing a row of nearly spherical conidia; wall of sporangiole dissolving to release conidia; saprophytic.

Illustration: *S. racemosum*; original, from pure culture. (A) conidiophore and head of spores; (B, C) heads of sporangioles and developing conidia, (D-G) stages in formation and release of conidia. References (23, 439).

DISPIRA Van Tiegh. Conidiophores (sporangiohores) erect, branched, the sterile branches slender and spiral, fertile branches enlarged, bearing a head of cylindrical sporangioles that produce rows of short conidia, parasitic on other Mucorales and one species on *Chaetomium*.

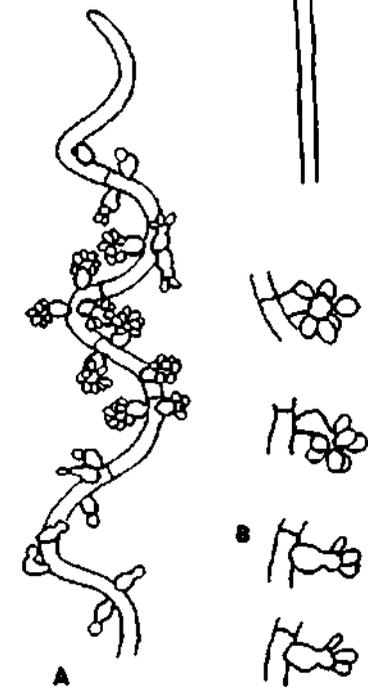
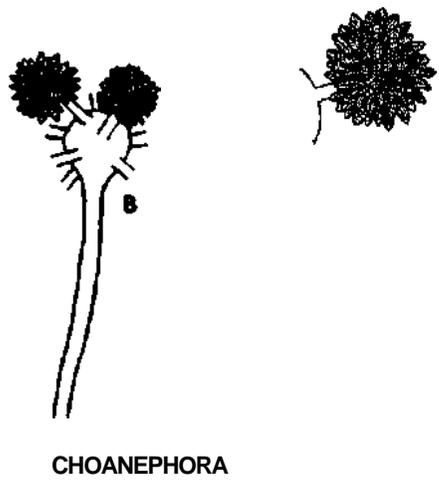
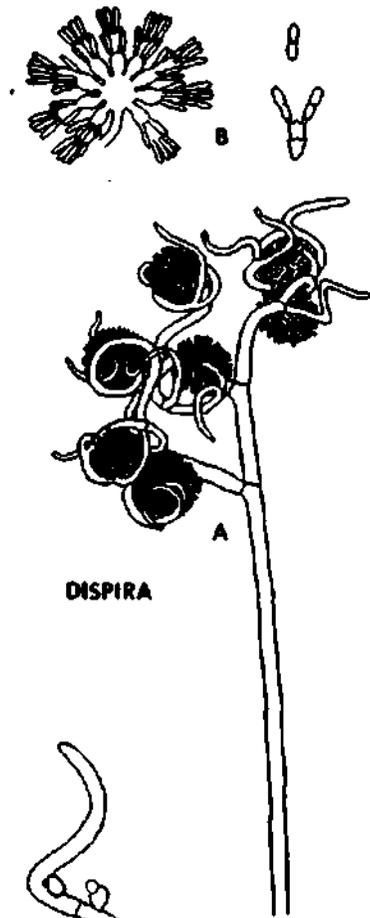
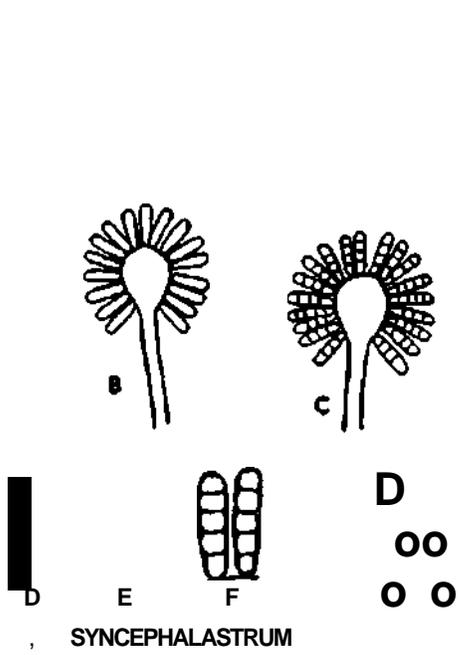
Illustration: *D. cornuta*. (A) terminal portion of fertile hypha; (B) portion of fertile head showing conidia; redrawn from Thaxter (438). Other references (26).

CHOANEPHORA Currey. Mycelium white, extensive and growing rapidly in culture; conidiophores (sporangiohores) long, enlarged, and branched at the apex, each branch bearing a head of conidia (sporangioles); conidia 1-celled, brown or purplish, ellipsoid; sporangia typical of the Mucorales also formed in culture; parasitic on flowers and fruits, or saprophytic, principally cucurbits.

Illustration: *C. curcubitarum*; original, from culture. (A) conidiophores; (B, D) portion of head of conidia; (C) conidia. References (136, 172, 335, 474, 475).

SPIROMYCES Benjamin. Conidiophores arising from substrate hyphae, forming a loose spiral as they develop upward, septate, each segment giving rise to 2 to 3 short, stout sporocladia, each of which forms a loose cluster of conidia (sporangioles) on terminal globose enlargements on denticles; conidia subglobose to globose; saprophytic.

Illustration: *S. minuius*; redrawn from Benjamin (23). (A) portion of conidiophore; (B) enlarged fertile branches.



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^ • **GEOTRICHUM** Link. Mycelium white, septate; conidiophores absent; conidia (arthrospores) hyaline, 1-celled, short cylindrical with truncate ends, formed by segmentation of hyphae; mostly saprophytic, common in soil. Some basidiomycetes form conidia in this manner.

{?'. **Illustration:** (A) *G. candidum*; original, from agar culture; (B) conidial state of *Polyporus adustus*; original from culture. Reference (50).

OIDIODENDRON Robak. Mycelium hyaline to brown; conidiophores sparsely branched only on upper portion, rebranched irregularly, branches segmenting into rod-shaped or rounded conidia, remaining in chains; conidia (arthrospores) 1-celled, hyaline or subhyaline; saprophytic.

Illustration: *O. griseum*; original, from culture. (A) branched conidiophore; (B) segmenting branch; (C) conidia. Reference (15).

AMBLYOSPORIUM Fres. Mycelium pale to yellow-orange; conidiophores erect, septate, lower portion unbranched, bearing a number of irregular branches near or at the apex, from which conidial chains are formed by segmentation; conidia (arthrospores) 1-celled, hyaline or yellow-orange in mass, barrel-shaped, catenulate; saprophytic in soil or often growing on fleshy or woody basidiomycetes.

Illustration: *A. spongiosum*; original, from culture. (A) conidiophore and conidia; (B) stages in development of conidial branches; (C) conidia. References (313, 332).

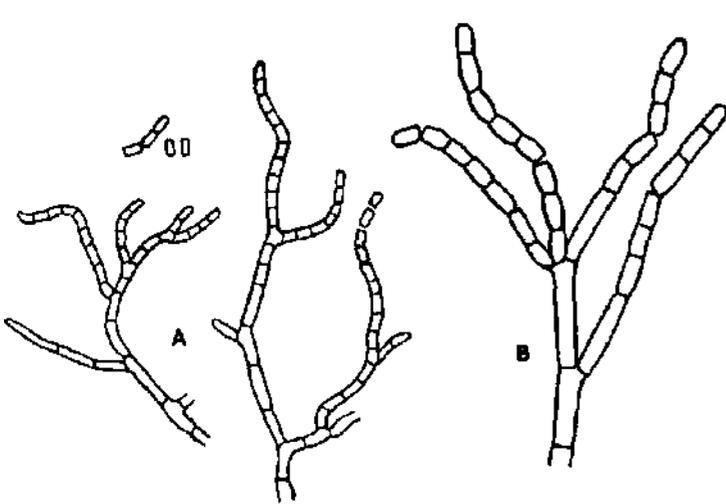
CHRYSOSPORIUM Corda. Conidiophores poorly differentiated, much like vegetative hyphae, mostly erect and branching irregularly, hyaline; conidia (aleuriospores or arthrospores) hyaline, 1-celled, globose to pyriform, terminal or intercalary, single or in short chains, usually with a broad basal scar; saprophytic. Carmichael (51) describes conidia as aleuriospores.

Illustration: *Chrysosporium* sp.; original from culture. (A) portions of conidiophores and conidia; (B) conidia. Reference (51).

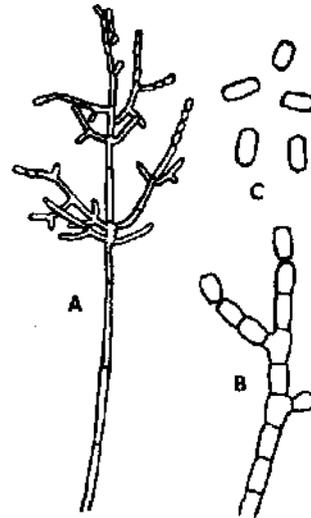
r- **OIDIUM** Sacc. Mycelium external on host, white; conidiophores upright, simple; upper portion increases in length as conidia are formed; conidia (meristem arthrospores) cylindrical, 1-celled, hyaline, produced in basipetal chains; parasitic on higher plants, producing powdery mildews. See Bisby (35) for relation of *Oidium* Link., *Oidium* Sacc. and *Acrosporium* Nees.

Illustration: *O. monilioides* (*Erysiphe graminis*); original, from fresh material. (A, B) mycelium with conidiophores and conidia; (C) conidia.

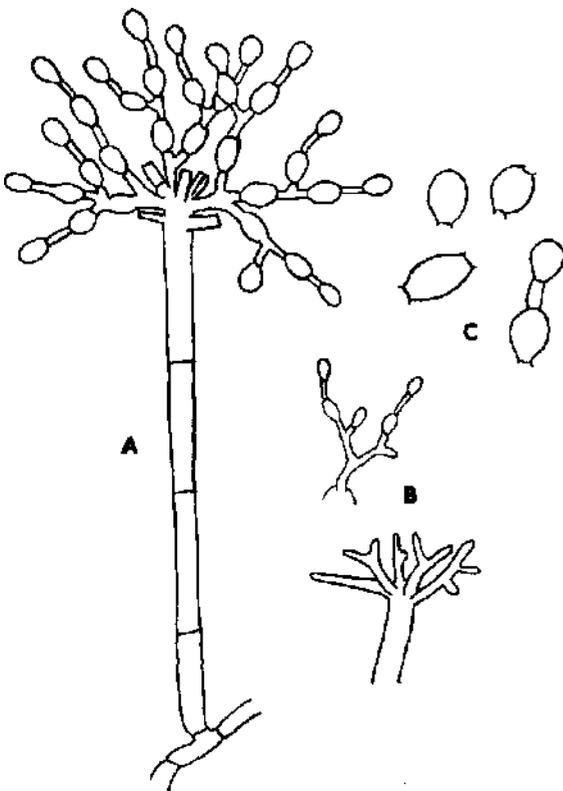
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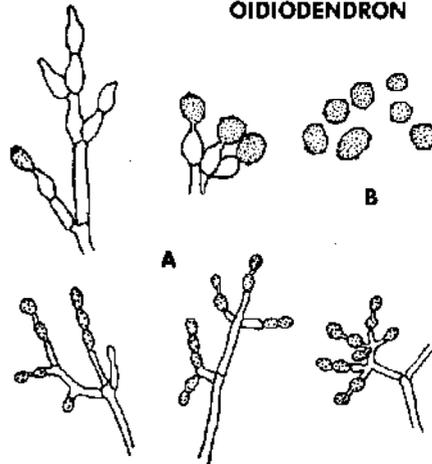
GEOTRICHUM



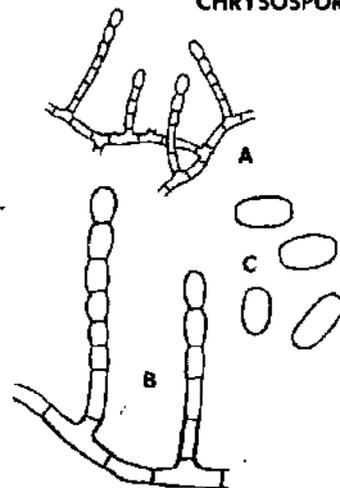
OIDIODENDRON



AMBLYOSPORIUM



CHRYSOSPORIUM



OIDIUM

SPOROBOLOMYCES K A u y v e r and van Niël. Cultures usually pink; reproduction principally by budding (blastospores); some cells producing sterigmata, each bearing an asymmetrical conidium that is discharged forcibly; saprophytic.

Illustration: *S. salmonieolor*; original, from culture. (A) hyphae with conidia produced on sterigmata; (B) budding cells. Reference (45).

ITERSONILIA Derx. Mycelium forming clamp connections; aerial hyphae simple, forming a sterigma bearing a single conidium (blastospore); conidia asymmetrical, smooth, hyaline, discharged forcibly; saprophytic or pathogenic on plants.

Illustration: *I. perlexans*; redrawn from Tubaki (446). (A) mycelium with clamp connections; (B) conidia and secondary conidia.

BASIPETOSPORA Cole and Kendrick. Conidiophores simple, resembling vegetative hyphae elongating slightly at apex as conidia are formed; conidia (meristem arthrospores) globose, with truncate base, hyaline to pale brown, 1-celled in simple basipetal chains; saprophytic; *B. rubra* is conidial state of *Monascus rubra*.

Illustration: *B. rubra*; original from culture. (A) stages in development of chain of conidia; (B) conidia. Reference (57).

OVULARIOPSIS Pat. and Har. Mycelium and conidiophores as in *Oidium*; conidia (meristem arthrospores) 1-celled, hyaline, pyriform to clavate, single at apex or sometimes in short chains; imperfect state of certain powdery mildews.

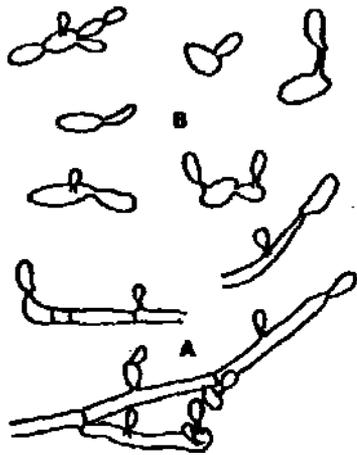
Illustration: *O. erysiphoides* (conidial state of *Phyllactinia corulea*); redrawn from Salmon (363). (A) conidiophore bearing single conidium; (B) conidia.

CANDIDA Berkhout. Mycelium, not extensive; conidia (blastophores) hyaline, 1-celled, ovoid to fusoid, forming short chains by budding; produced apically or laterally on mycelium; mostly common saprophytes; *C. albicans* is described as causing moniliasis of man; frequently considered as a filamentous yeast.

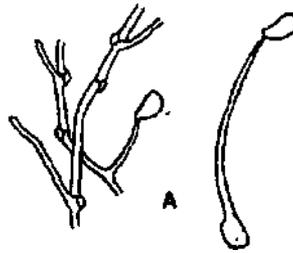
Illustration: *C. albicans*; original, from culture. (A, B) hyphae and conidia; (C) lateral production of conidia; (D) conidia budding. References (17, 59).

AHJREOBASIDIUM Viola and Boyer. Mycelium not extensive, hyaline when young, becoming dark with age, black and shiny in old cultures, bearing abundant conidia laterally; conidia (blastospores) subhyaline to dark, 1-celled, ovoid, producing other conidia by budding; saprophytic or weakly parasitic; common in soil.

Illustration: *A. (Pullularia) pullulans*; original from culture. (A, B) hyphae and conidia. References (17, 63).

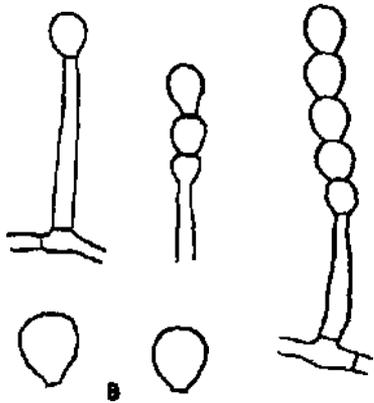


SPOROBOLOMYCES

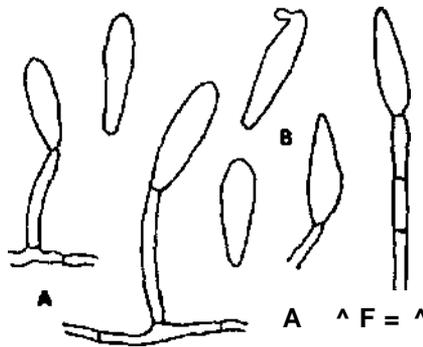


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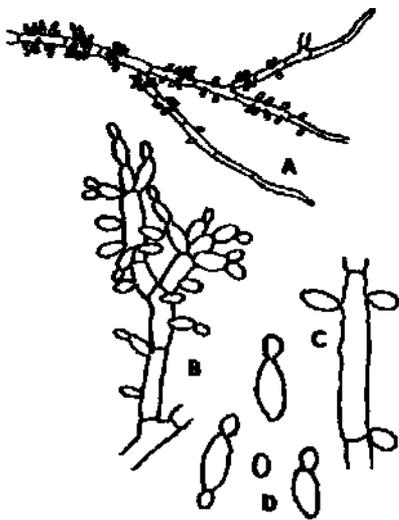
ITERSONILIA



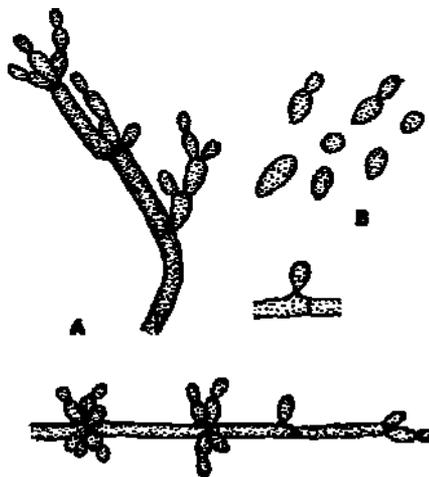
BASIPETOSPORA



OVULARIOPSIS



CANDIDA



AUREOBASIDIUM

TILLETIOPSIS Derx. Colonies restricted, white to cream colored, mycelium fine; conidiophores short or indefinite; conidia (blastospores) 1-celled, hyaline, curved, catenulate, acropetal; common on surface of leaves; saprophytic, but one species parasitic on powdery mildew. Similar to *Sporobolomyces* in appearance.

Illustration: *Tilletiopsis* sp.; original from culture. Reference (315).

HYALODENDRON Diddens. Mycelium white; conidiophores erect, variable in length, simple or branched, bearing one to a few conidia at the apex of the branches; conidia (blastospores) frequently in small clusters, becoming catenulate by acropetalous formation of new conidia, chains often branched, 1-celled, hyaline, variable in shape, ovoid to cylindrical or oblong; saprophytic or parasitic, mostly on wood; mostly imperfect states of species of *Ceratocystis*. This genus is like *Cladosporium* except for lack of pigmentation.

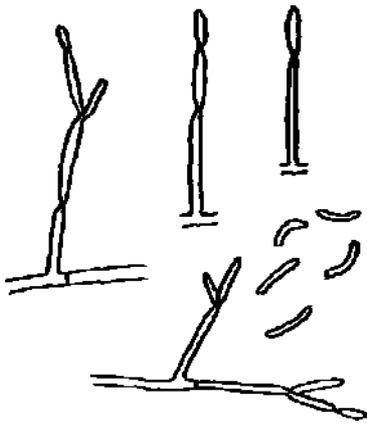
Illustration: *Hyalodendron* sp.; original, from culture. (A) conidiophore and conidia; (B) conidia. References (17, 149).

MONILIA Pers. ex Fr. Mycelium white or gray, abundant in culture; conidiophore branched, its cells differing little from the older conidia; conidia (blastospores) pink, gray, or tan in mass, 1-celled, short cylindrical to rounded, in acropetalous branched chains. Some species are imperfect states of *Neurospora* and are common saprophytes; others, whose perfect states are *Molinilia* (*Sclerotmia*) spp., cause brown rots of fruits.

Illustration: (A) *M. (Neurospora) sitophila*; (B) *M. americana* (*Monilinia fructicola*); original, from pure culture.

ZYGOSPORIUM Mont. Conidiophores erect, main axis usually simple, brown at base with hyaline or subhyaline apex, bearing special cells (falces), thick-walled, dark, and reflexed, each bearing 2 short hyaline conidiogenous cells; conidia (blastospores) 1-celled, hyaline, globose to ellipsoid; saprophytic.

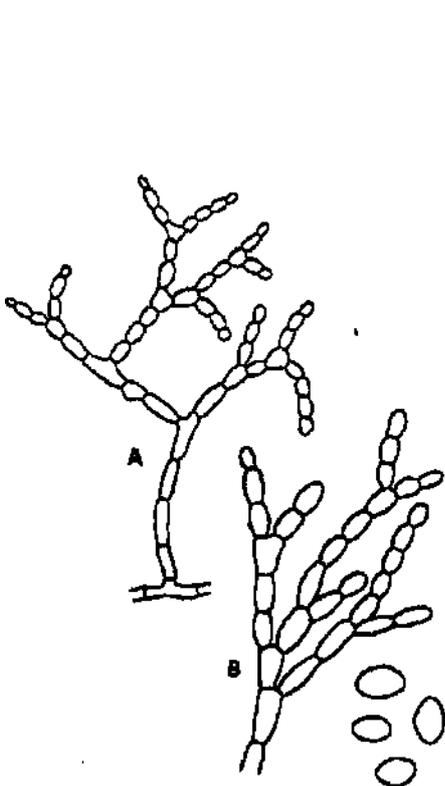
Illustration: *Z. masonii*; original, from culture. (A) conidiophores showing falces and conidia; (B) conidia; (C) *Z. gibbum*; original, from culture. References (188, 462).



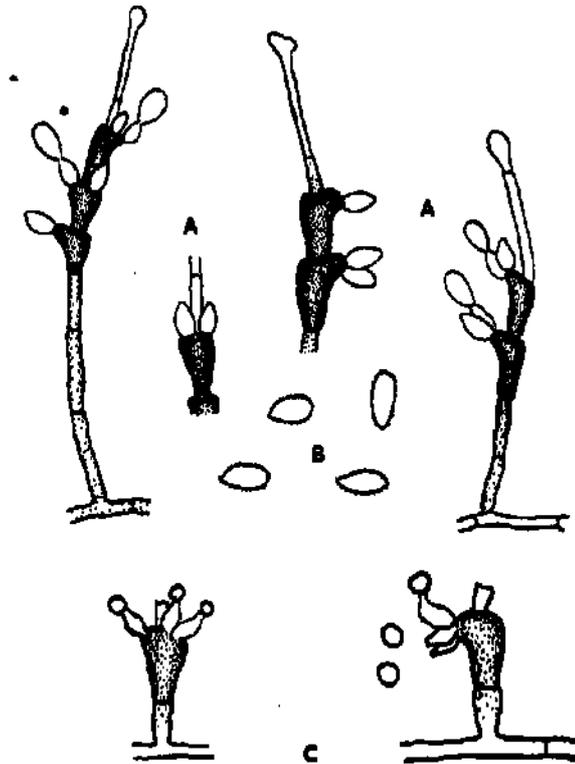
TILLETIOPSIS



HYALODENDRON



MONILIA



ZYGOSPORIUM

TORULA Pers. Conidiophores short, dark, simple, branched or absent; conidia (porospores, blastospores) 1- to several-celled, cells rounded, dark, in acropetalous chains; saprophytic. Barron (17) describes conidia as porospores.

Illustration: *T. herbarum* original from culture. Reference (365).

OLPITRICHUM Atkinson. Conidiophores stout, simple or irregularly branched in upper portion; method of branching irregular, often as extensions of the denticles; denticles medium to long, at nearly right angles; fertile portions of conidiophore not swollen as in *Acladium* conidia 1-celled, hyaline to pale brown, globose or ovoid to ellipsoid, borne singly on the denticles or branches; saprophytic or parasitic on other fungi. Relation to *Adadium* is not clear but separated here because of loose branching and long "denticles." See Subramanian (409) for his views.

Illustration: *O. macrosporum*; original, from culture. (A, B) conidiophores and conidia; (C) phialide state. References (17, 409, 414).

PERICONIA Bon. Conidiophores dark, tall, upright, stout, simple, determinate, somewhat enlarged at apex, which bears a loose head of conidia; conidia (blastospores) dark, 1-celled, globose, in dry chains, arising from globose conidiogenous cells; parasitic or saprophytic.

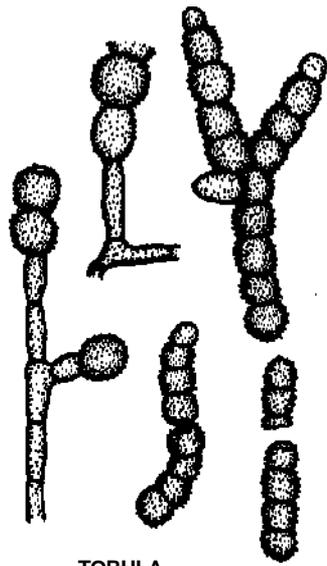
Illustration: *Periconia* sp.; original from fresh material on dead stem. (A) group of conidiophores; (B) conidiophore enlarged; (C) tip of conidiophores bearing conidia; (D) conidium. References (282, 401).

CRISTULARIELLA Hochn. Conidiophore-like structures hyaline, consisting of basal stalk and much branched upper portion that forms a globose or pyramidal head; branches compact and dichotomously or trichotomously rebranched; cells irregular, thick; conidia not produced, although ultimate cells resemble conidia; entire structure disseminated as a propagule; small phialides and microconidia produced in culture, as well as large black sclerotia; causing targetlike spots on living leaves. Niedbalski et al. (314) consider the entire branched structure as a conidium.

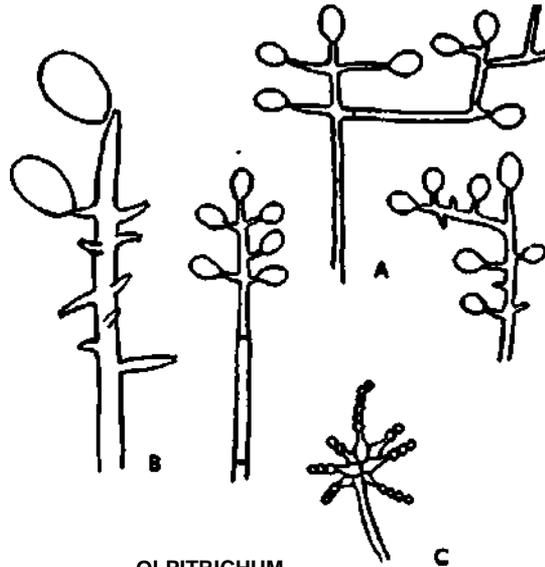
Illustration: (A-C, E) *C. pyramidalis*; (D), *C. depraedans*: original from fresh material on *Acer* leaves; (E), microconidia from culture. References (352, 464).

ARTHRIINIUM Kunze ex. Fr. Conidiophore mother cells subspherical; conidiophores simple, mostly hyaline except for thick dark septa, increasing in length near base; conidia (meristem blastospores) dark, 1-celled, broadly fusoid, ovoid, curved to cuspidate, attached on side and apex of conidiophore, often with slight germ slit on one side; saprophytic on plant material.

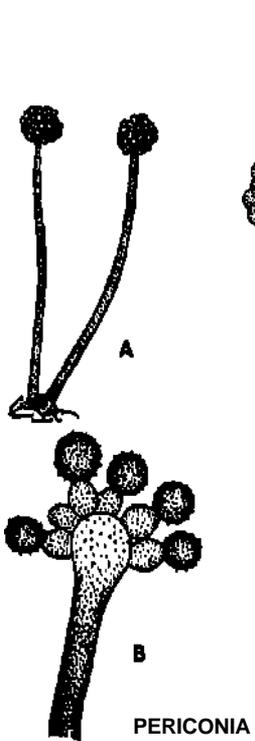
Illustration: (A-C) *A. cuspidatum*; (A) cluster of conidiophores; (B) conidiophores and conidia; (C) conidia; (D) *A. aphaerospermum*, showing basal conidiophore mother cell; redrawn from Ellis (120). References (62, 118, 120, 125).



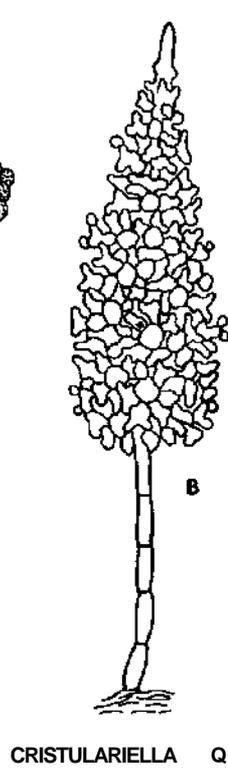
TORULA



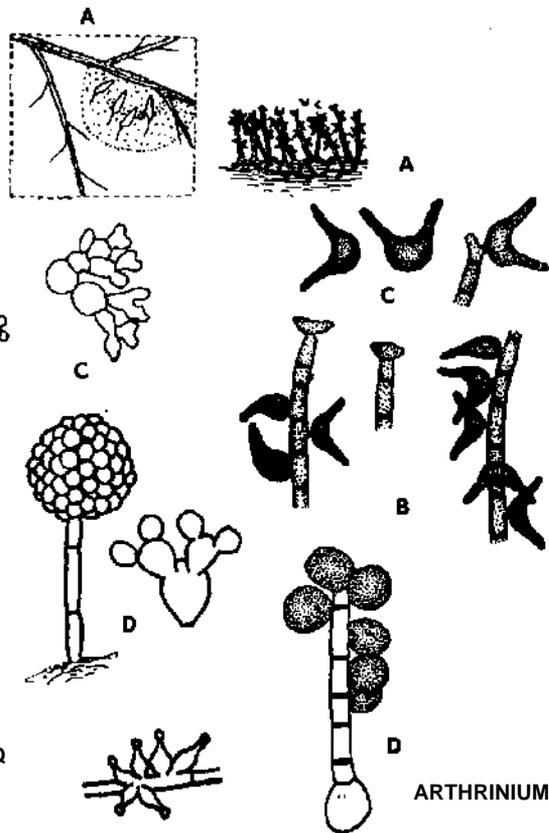
OLPITRICHUM



PERICONIA



CRISTULARIELLA



ARTHRINIUM

S* BOTRYTIS Pers. Conidiophores tall, slender, determinate, hyaline or pigmented, branched irregularly in upper portion, apical cells enlarged or rounded, bearing clusters of conidia simultaneously on short denticles; conidia (botryoblastospores) hyaline or gray in mass, 1-celled, ovoid; black irregular sclerotia often present; causing "gray mold" on many plants or saprophytic. See Hennebert (167) for recent classification.

Illustration: *B. cinerea*; original from culture. (A, B) conidiophores and conidia; (C, D) upper portion of conidiophore showing enlarged conidiogenous cells; (E) conidia. References { 17, 167, 294, 295).

OEDOCEPHALUM Preuss. Conidiophores simple, hyaline, enlarged and globose at the apex, bearing a head of dry conidia formed simultaneously; conidia (botryoblastospores) hyaline, 1-celled, globose to ovoid; usually saprophytic on plant materials or in soil. Some species are conidial states of Discomycetes and one species is the conidial state of *Fomes annosus*.

Illustration: *Oedocephalum* sp.; original, from culture. (A) conidiophores and conidial heads; (B) enlarged apex of conidiophore void of conidia; (C) conidia. References (17, 427, 448).

BOTRYOSPORIUM Corda. Conidiophores tall, slender, hyaline, composed of elongated axis and numerous, lateral branches of nearly equal length, these branches producing two or more secondary branches that are enlarged at the tips and bear heads of conidia; conidia (botryoblastospores) hyaline, 1-celled, ovoid; saprophytic on decaying plant material.

Illustration: *Botryosporium* sp.; original, from decayed leaf in greenhouse. (A) entire conidiophore; (B-F) stages in development of conidiophore branch and production of conidia; (G) conidia. Reference (17).

RHINOTRICHUM Corda (*Oidium* Link). Mycelium often forming a loose or dense substratum; conidiophores erect or suberect, simple or branched; conidium-bearing cells sometimes enlarged; conidia (blastospores) 1-celled, globose to ovoid, hyaline or slightly colored, borne on denticles; saprophytic, mostly on decayed wood. Not *Rhinotrkhum* Auct.

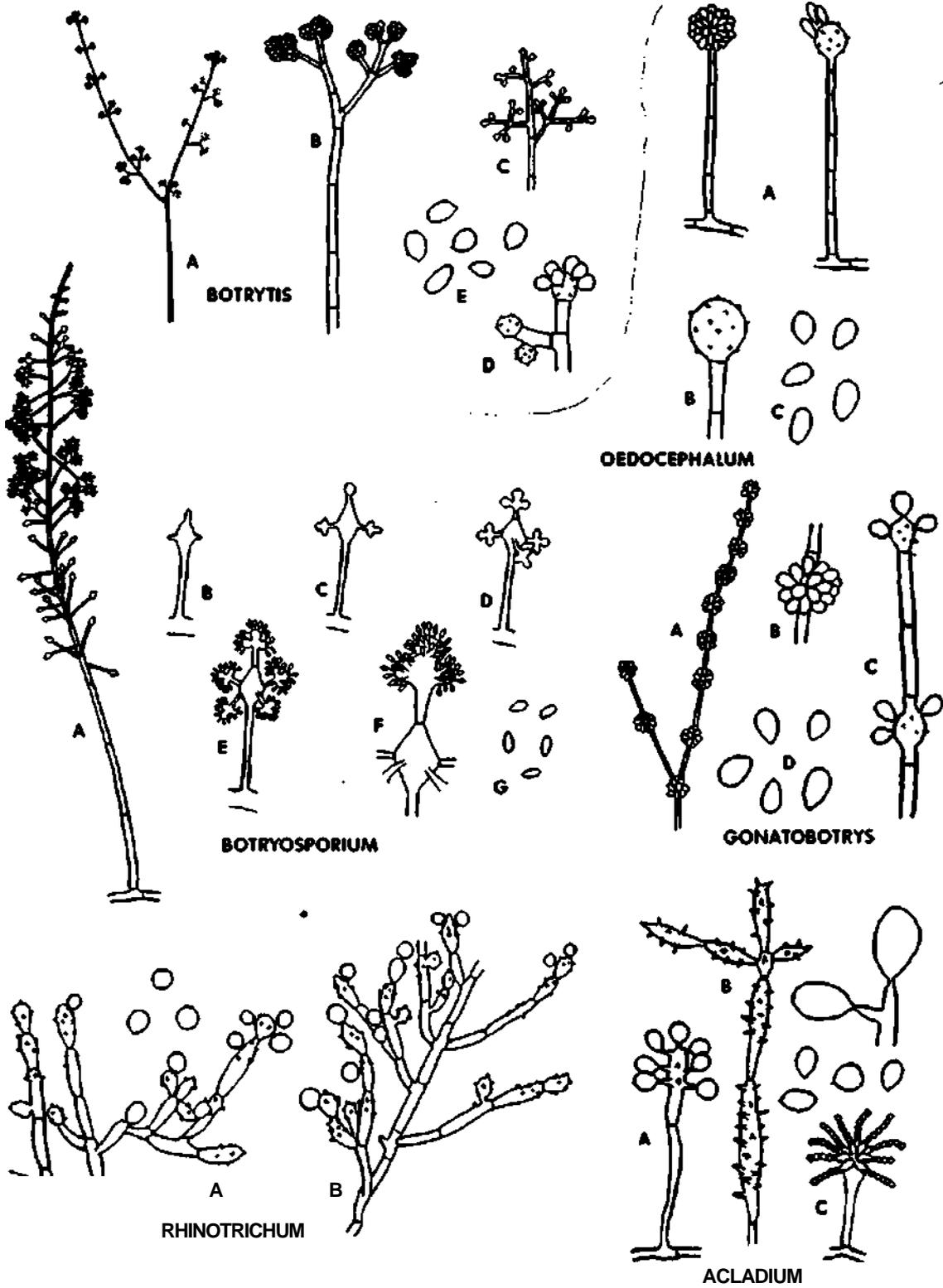
Illustration: *R. curtisii*; original, drawn from herbarium material; (A, B) mycelium, conidiophores and conidia. References (17, 35, 267, 409, 414).

GONATOBOTRYIS Corda. Conidiophores erect, sometimes tall, septate, simple or sparingly branched, percurrent with terminal and intercalary, inflated, denticulate cells bearing conidia simultaneously; conidia (botryoblastospores) borne singly on the teeth, 1-celled, hyaline, ovoid to subglobose; saprophytic or parasitic on other fungi. This genus differs from *Gonatobotryum* in being hyaline throughout, and from *Gonatorrhodiella* in having conidia not in chains. *G. simplex* is a mycoparasite.

Illustration: *G. simplex*; original, from culture. (A) conidiophore with clusters of conidia; (B) cluster of conidia; (C) portion of conidiophore void of conidia; (D) conidia. References (17, 469).

ACLADIUM Link ex Pers. Conidiophores stout, simple or irregularly branched in upper portion, often extending percurrently, resulting in a row of fertile cells; fertile cells irregular, somewhat inflated (not globose); conidia (blastospores) hyaline to pale brown, 1-celled, globose to ellipsoid, borne singly on short or medium denticles; saprophytic or closely associated with other fungi. Isolates are variable, some producing *Aspergillus-Wke* heads of microconidia. The relationship to *Olphrichum* Atkinson and *Rhinotrkhum* Auct. is not clear.

Illustration: *A. tenellum*; (A) young conidiophore and conidia; (B) chain of fertile cells with prominent denticles; (C) phialide state; original, from culture. Reference (409).



DICHOBOTRYS Hennebert. Conidiophores tall, slender, dichotomously branched twice or more from upper half, terminal fertile cells somewhat inflated, globose, producing conidia simultaneously, then collapsing, conidia (botryoblastospores) nearly globose, hyaline, 1-celled, nearly sessile or on short denticles.

Illustration: *D. abundans* (conidial state of *Trichophaea abundans*). (A) upper portion of conidiophore; (B) cluster of conidia; (C) conidia. Original from culture. Reference (167.)

PHYMATOTRICHUM Bon. Conidiophores rather short, stout, simple or branched, with inflated or lobed tips, bearing loose heads of dry conidia; conidia (botryoblastospores) hyaline, 1-celled, produced on mats on surface of soil, globose or ovoid; saprophytic or parasitic on soil, causing root rots; large black sclerotia produced in soil; branched setae often present on mycelium. Hennebert (167: 394, 432) places this genus in the newly formed genus *Phymatotrichopsis*.

Illustration: *P. omnivorum*; redrawn from photographs by J. Baniecki. (A) rope of hyphae; (B) mycelium, conidiophores and conidia. Reference (6).

GONATOBOTRYUM Sacc. Conidiophores dark, tall, stout, upright, typically simple, septate, forming a head of dry conidia on an inflated terminal cell, proliferating to form successive conidiogenous nodes; conidia (botryoblastospores) dark, 1-celled, ovoid to short cylindrical. *G. apiculatum* bears conidia in branched chains of several conidia; saprophytic or causing leaf spots of *Hamamelis*.

Illustration: original, from culture. (A) *B. apiculatum*, conidiophores and conidia; (B) *G. fuscum*, conidiophore and conidia. References (255, 459).

GONATORRHODIELLA Thaxter. Conidiophores stout, upright, hyaline, simple or sparingly branched, septate, with inflated apex and intercalary cells that bear loose dry heads of conidia; conidia (botryoblastospores) hyaline, 1-celled, ovoid to ellipsoid, in simple or branched acropetalous chains; frequently associated with *Hypoerea*, *Hypomyces*, or *Nectria*. *G. highlei* is parasitic on *TV coccinea varfaginaia*, the cause of beech bark disease in New England.

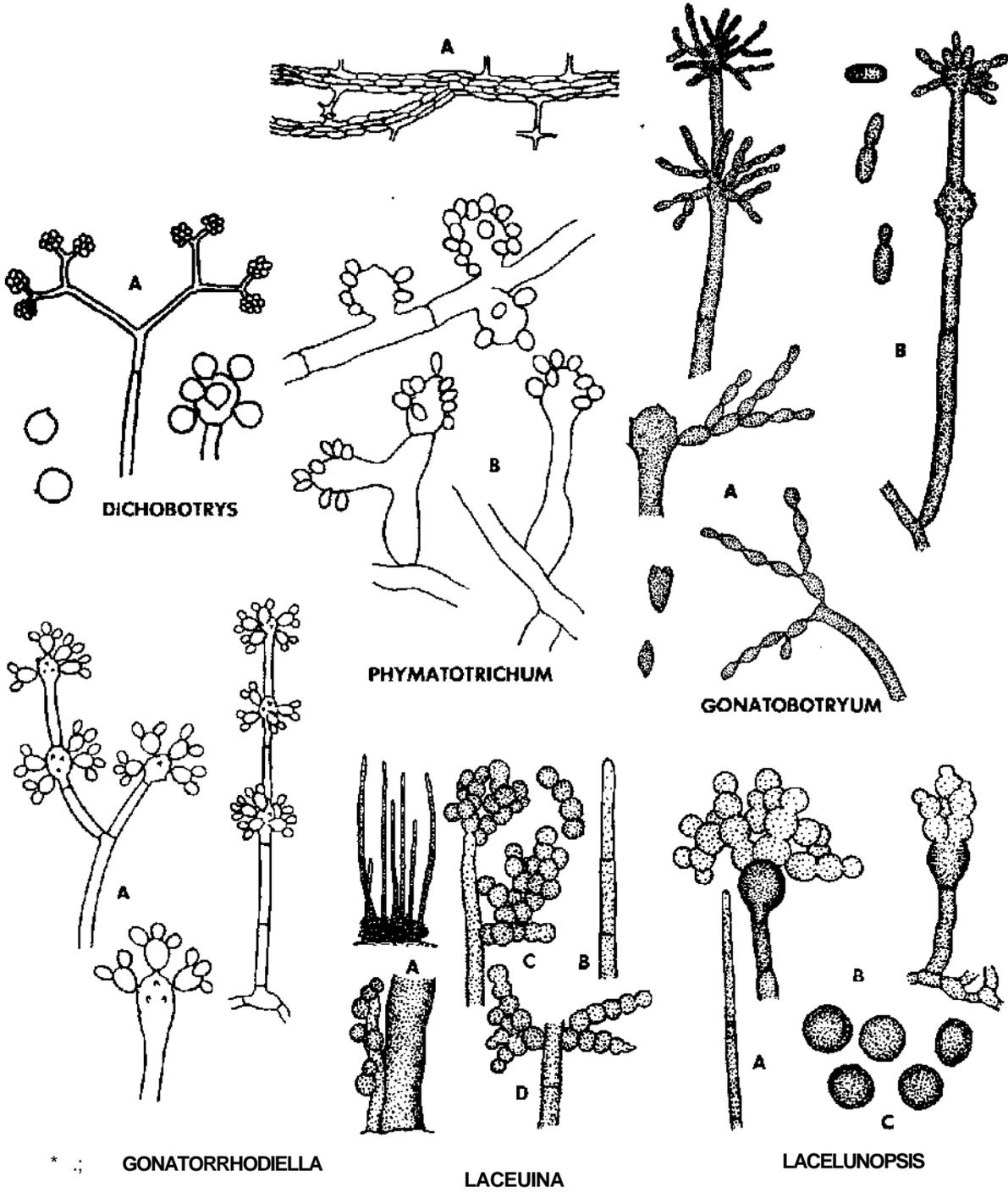
Illustration: *G. highlei*; original, from culture. (A) conidiophores and conidia; (B) apex of branch showing denticles; (C) conidia. Other references (138, 437, 459).

LACELLINA Sacc. Setae erect, tall, brown, simple; conidiophores determinate, intermixed with setae, shorter, pale, simple; conidia (blastospores) 1-celled, globose or ovoid, colored, produced at or near the apex in acropetalous chains; saprophytic.

Illustration: *L. graminkola*; (A) habit of setae and conidiophores; (B) tip of seta; (C, D) conidiophores and conidia; redrawn from Subramanian (396).

LACELLINOPSIS Subramanian. Setae simple, septate, brown; conidiophores determinate intermixed with setae, with globose fertile apex, becoming cupulate after detachment of conidia; conidia (blastospores) 1-celled, brown, globose, produced acropetally in chains.

Illustration: *L. sacchari*: (A) tip of seta; (B) conidiophores and conidia; (C) mature conidia; redrawn from Subramanian (397).



* ; GONATORRHODIELLA

LACEUINA

LACELUNOPSIS

CHROMELOSPORIUM Corda. Mycelium white to cinnamon, growing rapidly; conidiophores stout, hyaline, erect, main axis unbranched but dichotomously branched near apex, producing several clublike divergent branches that are covered by conidia on slender short denticles; conidia (botryblastospores) globose, 1-celled, hyaline or nearly so (tan in mass); saprophytic in soil, common in greenhouses.

Illustration: *C. ollare*; (*Ostracoderma* state of *Peziza ostracoderma*); original, from culture. (A) conidiophore and conidia; (B) fertile branch with conidia. References (17, 168).

HAPLOGRAPHIUM Berk, and Broome. Mycelium dark; conidiophores determinate dark, simple, erect, bearing an apical cluster of pale to hyaline short branches, entire apparatus penicillate; conidia (blastospores) terminal, hyaline, 1-celled, ovoid to oblong, collecting in slimy heads under moist conditions; saprophytic on wood or soil.

Illustration: *Haplographium* sp.; original, from fresh material on decaying wood. (A) conidiophores and conidia; (Q) conidia. Reference (17.)

MICROCLAVIA F.S. Stevens. Mycelium superficial; conidiophores simple, determinate, pale, expanded at apex into an obconical or ellipsoid structure, usually composed of 2 cells, apical cell bearing 2 (sometimes 3) large, brown, 1-celled, thick-walled conidia (aleuriospores), subglobose with flattened base, rarely deciduous; overgrowing and probably hyperparasitic on microthyriaceous fungi on leaves.

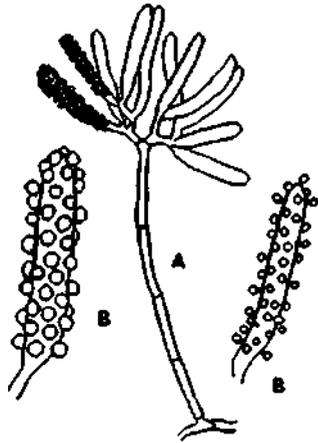
Illustration: *M. bispora*; redrawn from Deighton (80). (A) conidiophores and conidia; (B) portion of mycelium.

STAPHYLOTRICHUM Meyer and Nicot. Mycelium hyaline to lightly pigmented; conidiophores erect, tall, dark brown but paler above, branched irregularly in upper portion; conidia (aleuriospores) globose, 1-celled, thick-walled, light brown, apical and single on branches; saprophytic.

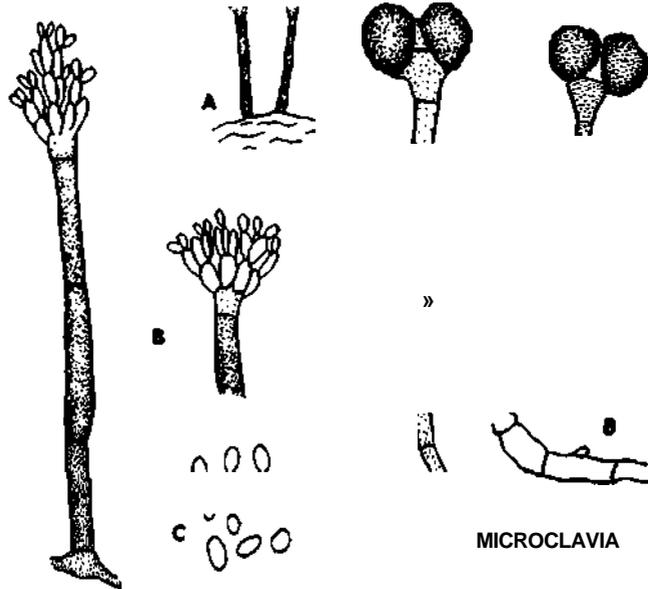
Illustration: *S. coccosporum*; original, from culture. References (275, 311).

BLASTOMYCES Cost, and Roll. Mycelium white in culture, filamentous at room temperature, yeastlike at 37 °C; conidia (aleuriospores) thick-walled, budding cells (blastospores) found in lesions; pathogenic in man, causing blastomycosis.

Illustration: *H. dermatitidis*; (A) hyphae and thick-walled cells (aleuriospores) produced in culture; (B) bud-cells produced in tissue; (C) budding cells on media at 37 °C. (A, B) redrawn from DeLamater (86); (C) drawn from a photography by Salvin (364). Other references (59, 129).

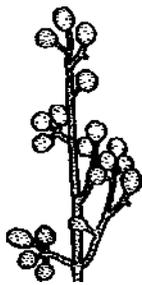


CHROMELOSPORIUM

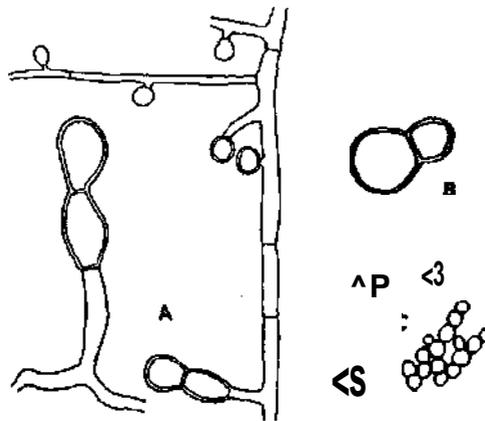


HAPLOGRAPHIUM

MICROCLAVIA



STAPHYLOTRICHUM



BLASTOMYCES

82 DESCRIPTIONS AND ILLUSTRATIONS OF GENERA

STEPHANOMA Wallr. Conidiophores slender, hyaline; conidia (aleuriospores) apical on pedicels, hyaline or brown, main cell large, globose, with several cell-like hyaline swellings; phialospore state may be present, with verticillate conidiophores bearing hyaline, 1-celled conidia (*Verticillium-like*); parasitic on other fungi; may be imperfect state of *Hypomyces*. The outgrowths on the aleuriospores separate this genus from *Sepedonium*. *S. phaeospora* has brown conidia, and is a biotrophic mycoparasite.

Illustration: *S. tetracoccum*; (A) hyphae and aleuriospores; (B) conidiophore and phialides; redrawn from Howell (178). References (46, 452).

MYCOGONE Link. Conidiophores much like branches of mycelium, simple or branched; conidia (aleuriospores) single, apical, hyaline or brightly colored, 2-celled, the apical cell globose and warty, basal cell smooth; phialospore state may also be present, hyaline, 1-celled *Verticillium-like*; parasitic on mushrooms, probably imperfect state of *Hypomyces*.

Illustration: *M. perniciosa*; (A) conidiophore and phialides; (B) hyphae and aleuriospores; redrawn from Howell (178). Reference (17).

SEPEDONIUM Link. Conidiophores indefinite, not differing much from branches of the mycelium, simple or branched; conidia (aleuriospores) single or in loose cluster, hyaline or bright yellow, globose, 1-celled, tuberculate; parasitic on fleshy fungi; a *Verticillium-like* state is usually also present; imperfect states of *Hypomyces*. Two species illustrated are similar except for the verticillate conidial state.

Illustration: *S. ampullosporum* original, from culture; (A) verticillate conidiophore and conidia; (B) aleuriospores; (C) *S. chrysospermum* original, from culture. References (17, 72).

HISTOPLASMA Darling. Cultures similar to *Blastomyces* but large, thick-walled, tuberculate, spherical aleuriospores formed in culture at room temperature; growth yeastlike, at 37 °C; pathogenic in man, causing histoplasmosis.

Illustration: *H. capsulatum*. (A) hyphae and tuberculate conidia; (B) stages in the development of tuberculate aleuriospores; (C) smooth-walled conidia developed below the surface of the agar; redrawn from Howell (178). Other reference (129).

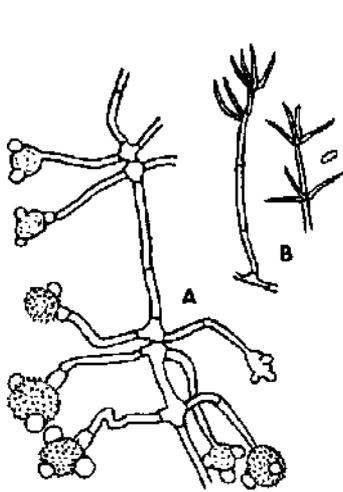
CHLAMYDOMYCES Bain. Conidiophores much like mycelium; conidia borne on slender branches; conidia (aleuriospores) 2-celled, with large tuberculate apical cell and small, smooth wedge-shaped basal cell, hyaline or slightly colored; phialospore state also produced, small, hyaline, 1-celled, borne on short phialides on swollen head; parasitic on mushrooms, probably imperfect state of *Hypomyces*. Compare with *Mycogone*,

NIGROSPORA Zimm. Conidiophores short, mostly simple; conidia (aleuriospores) shiny black, 1-celled, globose, situated on a flattened, hyaline vesicle (cell) at the end of the conidiophore; parasitic on plants or saprophytic.

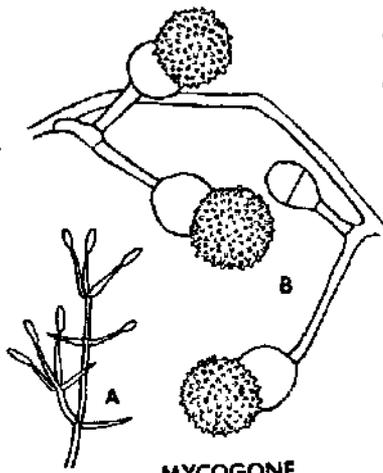
Illustration: *N. sphaerica*; original. (A, B) conidiophores and conidia; (C) tip of conidiophore showing hyaline vesicle; (B, C) from culture. References (17, 180)

PAPULARIA Fr. Conidiophores poorly developed in culture, mostly simple, hyaline, short branches of mycelium, conidia (blastophores may appear to be aleuriospores in culture) 1-celled, dark, ovoid, broadly lenticular or globose, often with a light band seen in side view; saprophytic. Compare with *Arthrinium* and see Ellis (120) for synonymy.

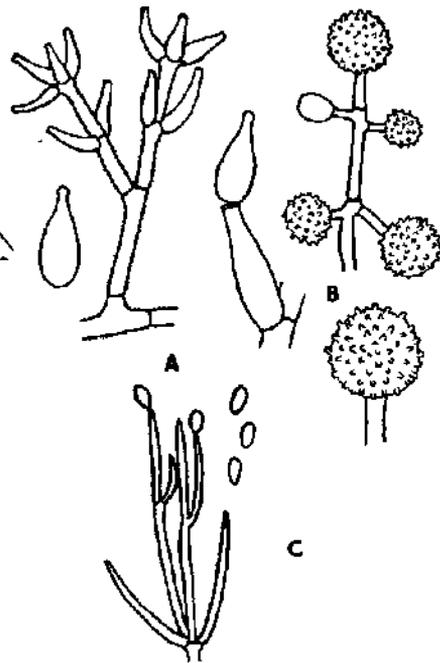
Illustration: *Papularia* sp.; original, from culture. References (124, 125).



STEPHANOMA

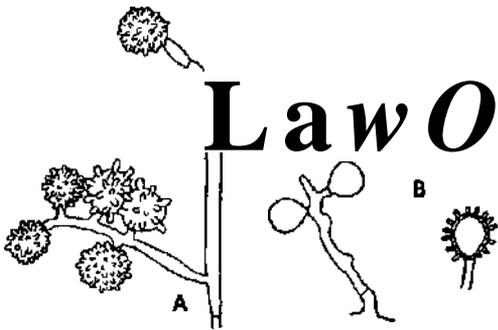


MYCOGONE

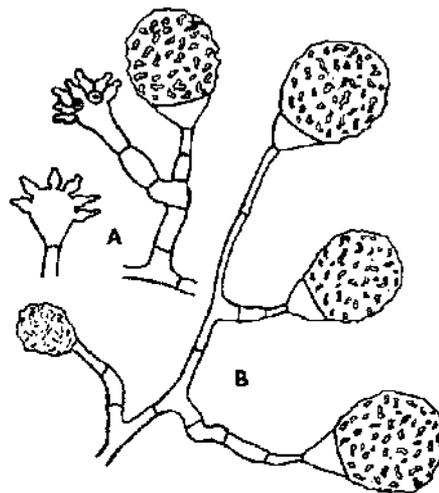


SEPEDONIUM

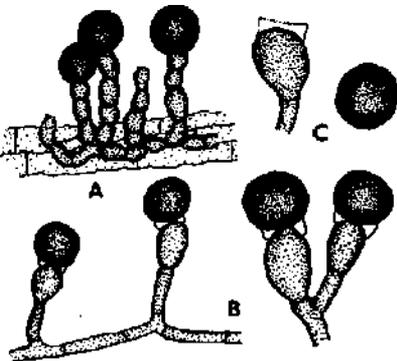
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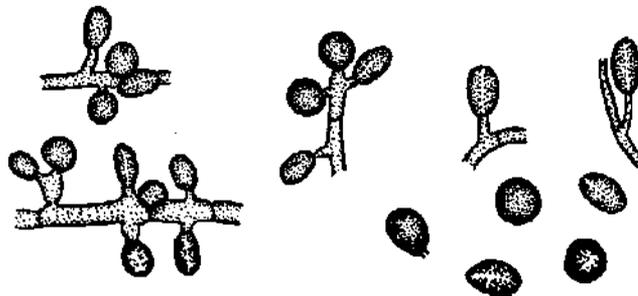
HISTOPLASMA



CHLAMYDOMYCES



NIGROSPORA



PAPULARIA

ASTEROMYCES Moreau. Hyphae hyaline to brown; conidiogenous cells sessile or with short stalk, dark, inflated as conidia are formed; conidia (aleuriospores) 1-celled, dark, clustered, borne on long denticles, obclavate to pyriform; saprophytic.

Illustration: *A. cruciatus*; redrawn from Hennebert (164). (A) mycelium with short conidiophores; (B) conidiophores and conidia. Redrawn by permission of the National Research Council of Canada from the *Canadian Journal of Botany*, 40, pp. 1203-1216 (1962).

MAMMARIA Cesati. Conidiophores erect or repent, often much like vegetative hyphae, simple or bearing very short branches, pale brown; conidia (aleuriospores) borne directly on aerial hyphae or on conidiophores, 1-celled, dark, ovoid to pointed, truncate at basal scar, with prominent longitudinal germ slit, in groups or clusters; saprophytic.

Illustration: *M. echinobotryoides*; redrawn from Hennebert (17, 166). (A) conidiophores and conidia; (B) mycelium bearing two types of conidia.

HUMICOLA Traaen. Conidiophores, simple or rarely with short branches, dark; conidia (aleuriospores) single, apical, globose or subglobose, brown, 1-celled; some species also produce simple phialides and phialospores in chains; saprophytic.

Illustration: *H. fuscoatra*; original, from culture. (A) conidiophores and conidia; (B) phialides and chains of small conidia. References (64,471).

BOTRYOTRICHUM Sacc. and March. Setae in loose tufts, simple, gray to brown; conidiophores short, irregularly branched, hyaline, bearing a loose cluster of conidia; conidia (aleuriospores) 1-celled, brown, borne singly, globose; saprophytic, frequently in soil. *B. piluliferum* also produces simple phialides and hyaline, 1-celled phialospores, in chains.

Illustration: *B. piluliferum*; original, from culture. (A) conidiophores with aleuriospores; (B) phialides with phialospores; (C) seta. References (75, 95).

WARDOMYCES Brooks and Hansford. Conidiophores, hyaline, short, branched repeatedly; conidia (aleuriospores) 1-celled, brown to black, ovoid to ellipsoid, produced singly at apices of branches; saprophytic.

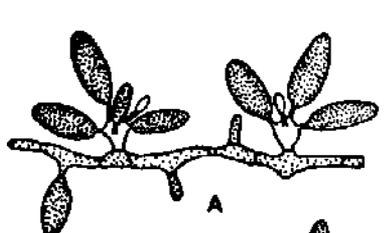
Illustration: *W. anomala*; original, from culture. (A) mycelium producing conidia; (B) conidiophores and conidia; (C) conidia. References (40, 91, 164, 166).

EC H I N O B O T R Y U M Corda. Conidiophores consisting of short, branched, undifferentiated hyphae, or nearly absent; conidia (aleuriospores) ovoid or somewhat flask-shaped, tapering to a pointed apex, smooth or rough, formed in clusters at hyphal tips, dark, 1-celled.

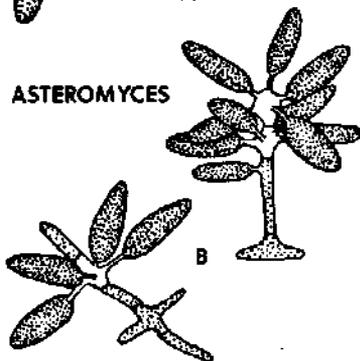
Illustration: *E. atrum*; original, from culture. Reference (166).

GILMANIELLA Barron. Conidiophores hyaline, short, often stout to inflated, mostly simple; conidia (aleuriospores) apical, single, dark brown or black, 1-celled, globose, with a thick wall, wall smooth or rough, with a prominent germ pore; saprophytic on wood or soil.

Illustration: *Gilmaniella* sp. Original, from decayed wood and from culture. (A) conidiophores and conidia; (B) stages in development of conidiophore and conidium; (C) mature conidia showing germ pore. Reference (16).



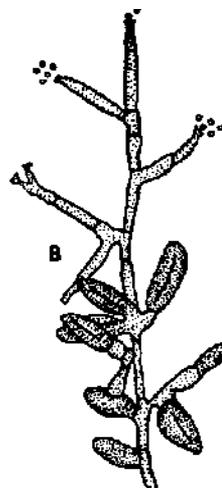
ASTEROMYCES



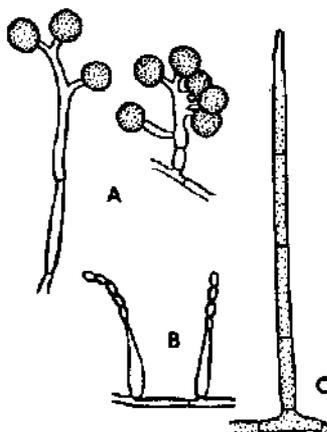
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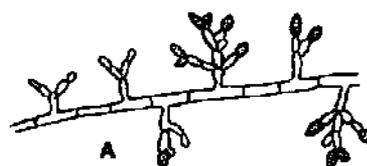
MAMMARIA



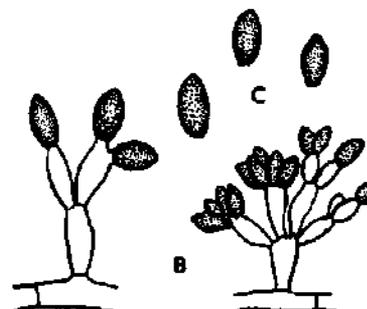
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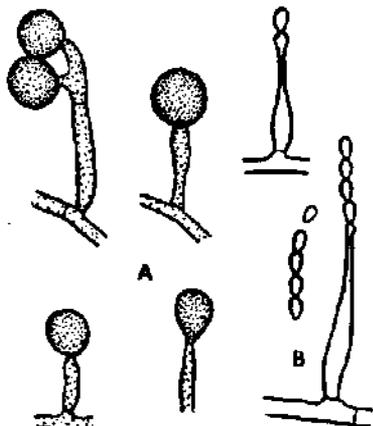
BOTRYOTRICHUM



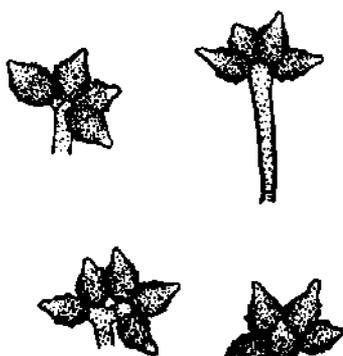
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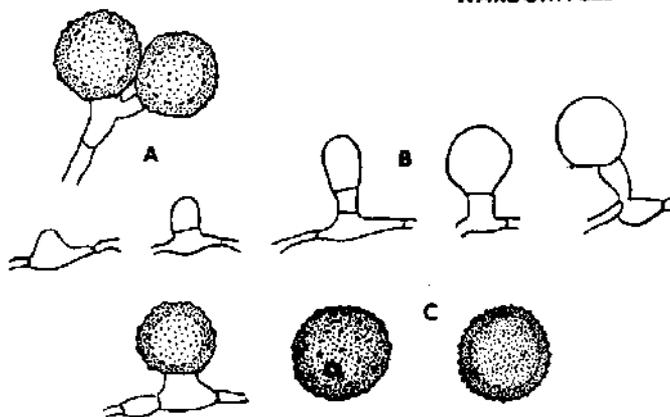
WARDOMYCES



HUMICOLA



ECHINOBOTRYUM



GILMANELLA

GLOMERULARIA Peck. Conidiophores borne in groups in spots on living leaves, mostly short, hyaline, simple or divided; conidia (aleuriospores) globose, somewhat unequally clustered forming few-spored heads, 1-celled, hyaline; parasitic on leaves.

Illustration: *G. corni*; original, from herbarium material on leaves of *Cornus canadensis*. (A) habit on leaf; (B) conidiophores and conidia.

BOTRYODERMA Papendorf and Upadhyay. Mycelium hyaline; conidiophores short, hyaline, variable, sometimes missing; conidiogenous cells subglobose or obpyriform; conidia (aleuriospores) terminal or lateral, sessile or on short sterigmata, 1-celled, broadly ellipsoid to globose, hyaline, smooth, often with prominent scar; saprophytic in soil.

Illustration: *B. lateritium*; redrawn from Papendorf and Upadhyay (321). (A) mycelium and branched conidiophores; (B) conidia.

UMBELOPSIS Amos and Barnett. Conidiophores hyaline, often septate, older conidiophores typically with a swollen apex bearing 2 to several long cylindrical branches, each with a single apical conidium; conidia (aleuriospores) 1-celled, hyaline, globose; saprophytic in soil. This fungus may prove to be a *Mortierella*, but because of its similarity to the imperfects it is included here.

Illustration: *U. versiformis*; original, from culture. (A-D) stages in development of conidiophores and conidia. References (2, 17).

MONILOCHAETES Halst. Conidiophores dark, erect, slender, usually simple, septate; conidia (phialospores) hyaline or becoming pigmented in age, borne singly at the apex or produced in chains under conditions of high humidity; parasitic.

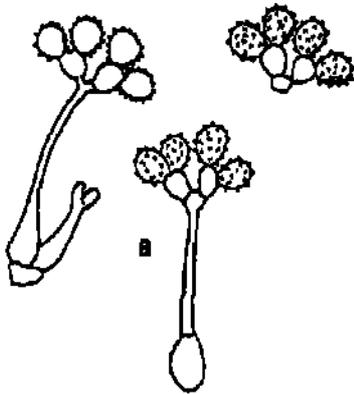
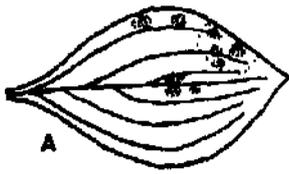
Illustration: *M. infuscans*; (A, C) conidiophores and conidia on sweet potato; (B, C) conidiophores and conidia produced in culture. (A, B) redrawn from Harter (160). (C, D) redrawn from Taubenhans (431).

MONOCILLIUM Saksena. Conidiophores simple, septate, consisting of a pedicel and a swollen vesicle terminating in a single phialide that bears a long chain of conidia formed basipetally; conidia (phialospores) 1-celled, hyaline, ovoid to ellipsoid, smooth; saprophytic, from soil.

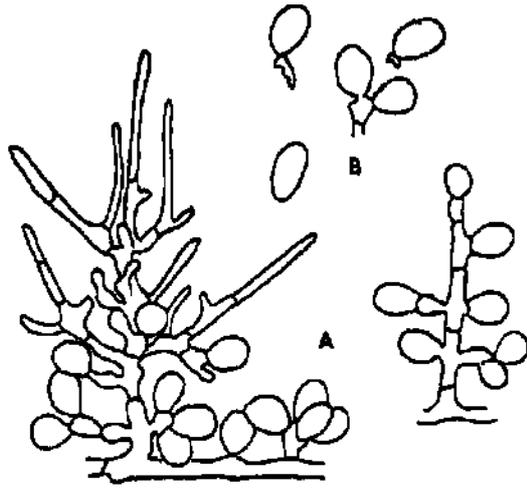
Illustration: *M. indicum*; redrawn from Saksena (362). (A) mycelial rope bearing conidiophores; (B) conidiophore and conidia.

GLIOMASTIX Gueg. Mycelium hyaline to dark, forming aerial "ropes" in culture; conidiophores mostly reduced to simple phialides, hyaline or dark, slender, tapering toward the apex; conidia (phialospores) dark, 1-celled, globose to ovoid to ellipsoid, formed in basipetal chains without slime or aggregated in slime droplets; saprophytic.

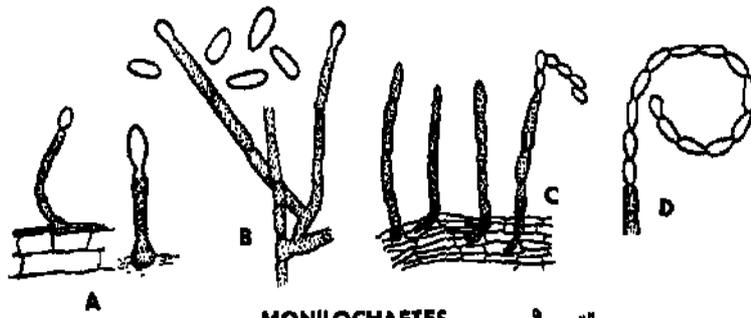
Illustration: *G. murorum*; original, from culture. (A) mycelial rope; (B) conidiophores (phialides); (C) conidia. References (42, 92).



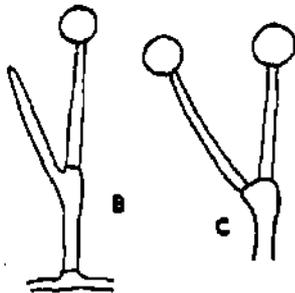
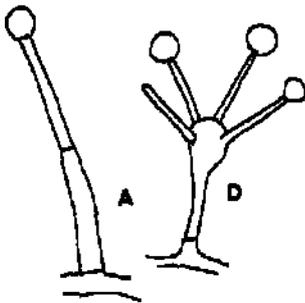
GLOMERULARIA



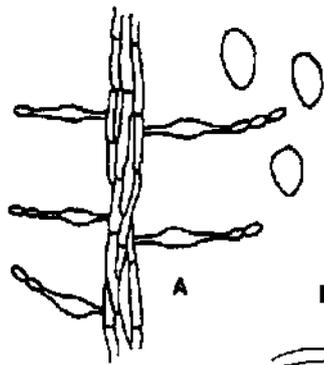
BOTRYODERMA



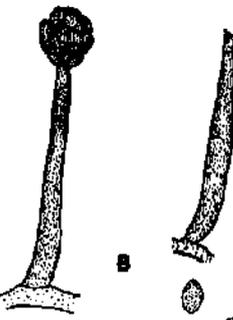
MONILOCHAETES



UMBELOPSIS



MONOCILLIUM



GL10MASTIX

88 DESCRIPTIONS AND ILLUSTRATIONS OF GENERA

PHIALOPHORA Medlar. Conidiophores short or reduced to phialides, dark, simple or branched; phialides cylindrical to inflated, often with flaring collarete at apex; conidia (phialospores) subhyaline to dark, 1-celled, globose to ovoid, extruding from phialide in moist heads; parasitic or saprophytic. The genus *Margarinomyces* is often included under *Phialophora*,

Illustration: (A-C) *Phialophora* sp.; original, from culture. (A) rope of mycelium with slime heads of conidia; (B) conidiophores (phialides); (C) conidia; (D, E) *Phialophora* sp. (*Margarinomyces bubaki*); original, from culture. (D) mycelium bearing phialides; (E) conidia. References (47, 312, 461, 140).

CHLORIDIUM Link. (*Bisporomyces* van Beyma). Conidiophores erect, simple, septate, dark, frequently proliferating at the apex after producing an apical head of conidia, with a distinct collarete at apex; conidia (phialospores) 1-celled, hyaline, frequently in pairs at the end of the conidiophore or held together in small heads by mucus; aleuriospores (where present) 1-celled, terminal; saprophytic, on decaying wood.

Illustration: *C. chlamydosporis*; original, from culture. (A) group of conidiophores with slime heads; (B) conidiophores with slime heads; (B) conidiophores and conidia; (C) conidia; (D) aleuriospores. References (280,281,318,452).

MENISPORA Pers. Setae (if present) straight, bent or coiled; conidiophores dark, simple, or branched; phialides slender, somewhat curved with an inconspicuous collarete; conidia (phialospores) hyaline, 1-celled (sometimes septate), borne apically in slimy masses, narrowly fusiform to curved; conidia of some species have a slender hyaline appendage at each end; saprophytic.

Illustration: (A) *M. cobaltina*; original, from herbarium material on dead leaves of *Nyssa*; conidiophores and conidia; (B) *M. ciliate*; original, from culture; conidiophore and ciliate conidia. References (174, 215).

STACHYBOTRYS Corda. Conidiophores subhyaline to dark, simple, determinate bearing at apex a cluster of thick, short phialides; conidia (phialospores) dark, 1-celled, globose to ovoid, borne in moist heads at the apex of the phialides, not catenulate; saprophytic.

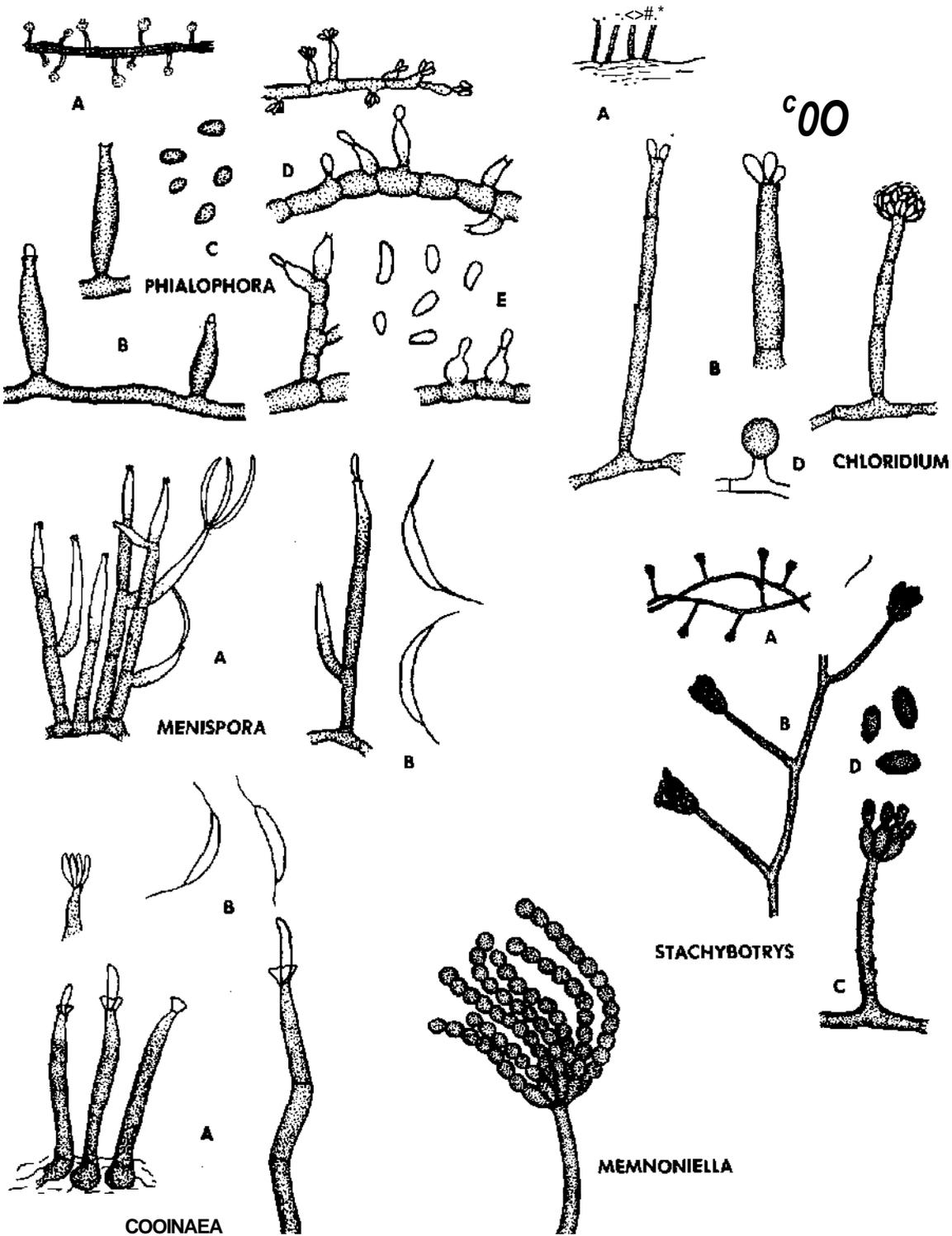
Illustration: *S. atra*; original, from culture isolated from soil. (A) habit sketch; (B, C) conidiophores and clusters of conidia; (D) conidia. References (33, 34, 480).

CODINAEA Maire (*MENISPORELLA* Agnihotrudu). Setae straight or slightly bent, thick-walled, dark, independent or a sterile portion of conidiophore; phialides mostly terminal, straight, sometimes proliferating, forming conspicuous collarettes that are cupulate, or funnel-shaped, flaring; conidia (phialospores) hyaline, 1-celled (sometimes to 4-celled), with a slender seta at each end; saprophytic on plant material or soil.

Illustration: *Codinaea* sp.; original, from fresh material on over-wintered acorn. (A) conidiophores showing collarete; (B) ciliate conidia. Reference (17).

MEMNONIELLA Hohn. Conidiophores dark, simple, bearing at apex a cluster of thick, short phialides; conidia (phialospores) dark, 1-celled, globose, catenulate; saprophytic; probably closely related to *Stachybotrys*.

Illustration: *Memnoniella* sp.; drawn from photography by Zuck (480). Reference (34).



CIRCINOTRICHUM Nees ex Persoon. Hyphae subhyaline to brown, bearing setae and phialides; setae simple, erect, verrucose, dark, brown, wider at base and tapering toward apex that is paler and circinate; phialides short, obclavate, hyaline or subhyaline, arising from superficial mycelium; conidia (phialospores) hyaline, (-celled, narrowly ellipsoid, straight or curved, aggregated into apical clusters. Saprophytic on leaves or twigs. Compare with *Gyrothrix*.

Illustration: *C. maculiforme*; redrawn from Pirozynski (330). (A) seta; (B) phialides and conidia.

CYROTHKIX (Corda) Corda. Mycelium subhyaline to brown; setae erect, repeatedly branched, straight or flexuous, pale to brown, broader and darker at the base; arising from the mycelium, obclavate, hyaline; conidia (phialospores) hyaline, 1-celled, narrowly ellipsoid, straight or curved, often aggregated. Compare with *Circinotrkhum*. Saprophytic on leaves and twigs.

Illustration: *G. circinata*; redrawn from Pirozynski (330). (A) branched seta; (B) phialides and conidia.

CHALARA Corda. Mycelium typically dark; conidiophore typically has some dark pigment but may be hyaline under some cultural conditions, unicellular or basal portion septate, the apical cell (phialide) sometimes tapering upward slightly and producing conidia endogenously; conidia (phialospores) hyaline, cylindrical, somewhat variable in length, often hanging together in chains; parasitic or saprophytic.

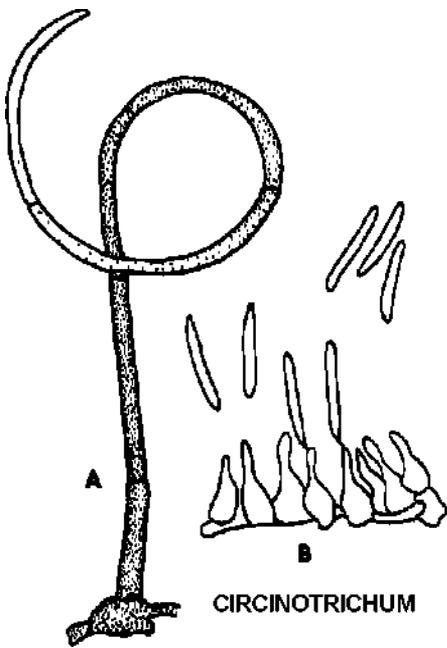
Illustration: (A) *C. quercina* (*Ceratocystis fagacearum*); original, from pure culture; conidiophores and conidia; (B-D) *Chaiara* sp.; original, from fresh material on rotted wood; (B) habit of conidiophores; (C) enlarged conidiophore showing deep collarette; (D) chain of conidia. References (17, 169).

CHAETOCALARA Sutton and Pirozynski. Mycelium partly immersed in leaves, emerging through stomata, giving rise directly to brown, simple, pointed setae and to hyaline to brown phialides; phialides cylindrical with swollen rounded base; conidia (phialospores) 1- to 2-celled, hyaline, cylindrical, in chains; saprophytic on leaves.

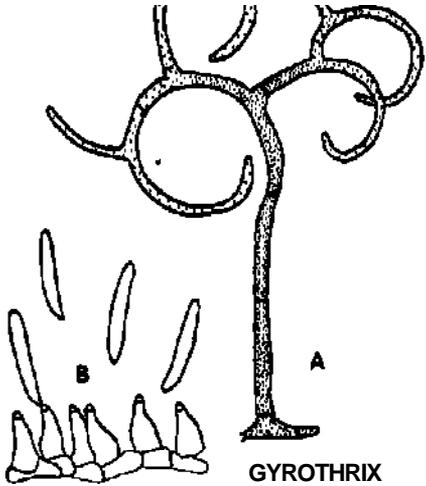
Illustration: *C. cladii*; redrawn from Sutton and Pirozynski (427). (A) phialides and seta; (B) enlarged phialide; (C) conidia.

CHALAROPSIS Peyron. Conidiophores usually pigmented or subhyaline, slender phialides slightly larger near the base and tapering upward; producing conidia endogenously; conidia (phialospores) hyaline, cylindrical, often in chains; aleuriospores present, ovoid, dark, thick-walled, single or in short chains; parasitic or saprophytic; similar to *Chaiara* except for the production of aleuriospores.

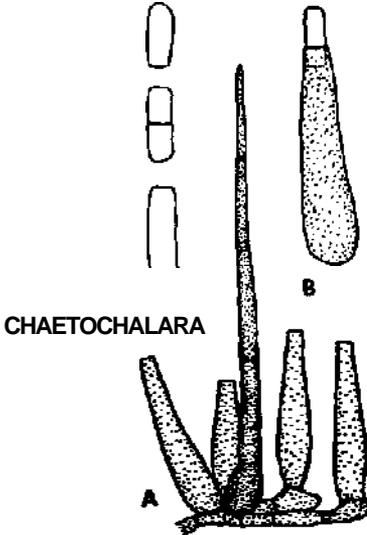
Illustration: *Chalaropsis* sp.; original from pure culture. (A) hyphae producing aleuriospores; (B) conidia and phialide.



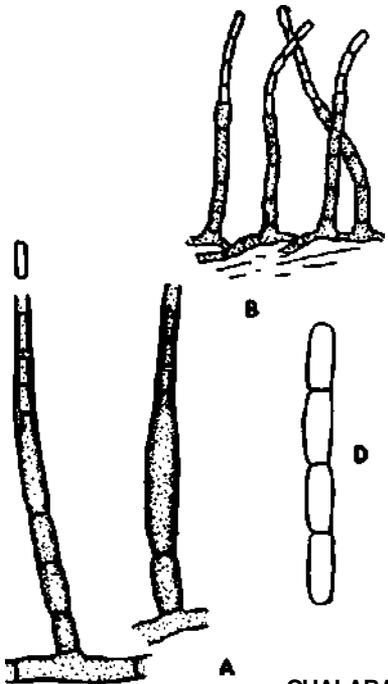
CIRCINOTRICHUM



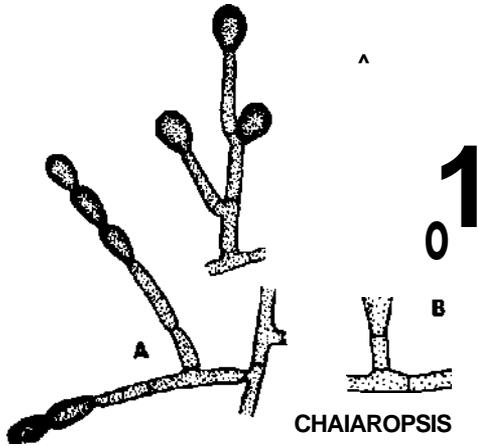
GYROTHRIX



CHAETOCALARA



CHALARA



CHAIAROPSIS

10

THIELAVIOPSIS Wctn. Conidiophores, phialides and phialospores like *Chalaropsis*: also forming thick-walled aleuriospores that eventually break apart; parasitic or saprophytic; conidial states of species of *Ceratocystis*.

Illustration: *T. basicola*, original, from culture. (A) phialide and phialospores; (B) chains of aleuriospores; (C) hyphae producing both kinds of spores.

GLIOCLADIUM Corda. Conidiophores hyaline, the upper portion bearing penicillate branches, forming a compact "brush" as in *Penicillium*; conidia (phialospores) hyaline or brightly colored in mass, 1-celled, produced successively apically and collecting in mucilaginous droplets; saprophytic, common in soil. *G. roseum* also produced a *Verticillium* state. See *Verticillium* figure D.

Illustration: *G. deliquescens*; original, from culture isolated from soil. (A) conidiophores and heads of conidia as seen in dry mount; (B) conidiophores and conidia in water. References {298, 350, 379}.

VERTICILLIUM Nees. Conidiophores slender, branched, at least some of the branches or phialides verticillate, conidia (phialospores) ovoid to ellipsoid, hyaline, 1-celled, borne singly or in small moist clusters apically; vascular parasites causing wilts on higher plants, parasitic on other fungi, or growing saprophytically. Also see *Verticillium* states of *Gliocladium roseum*, *Stilbum*, *Sepedonium*, *Mycogone*, *Stephanoma*, etc.

Illustration: *V. albo-atrum*; original, from pure culture. (A) conidiophores growing in moist atmosphere; (B) conidiophore in water mount; (C) conidia; (D) *Verticillium* state of *Gliocladium roseum*. References (44,236,237,359).

STACHYLIDIUM Link. Conidiophores dark, upright, slender, upper portion branched bearing whorls of phialides; conidia (phialospores) subhyaline to brown, 1-celled, ovoid, small, held in heads by slime; saprophytic on vegetable material.

Illustration: *Stachylidium* sp.; original from culture. (A) branched conidiophore; (B) phialides with heads of conidia. References (125, 193).

TRICHODERMA Pers. Conidiophores hyaline, much branched, not verticillate; phialides single or in groups; conidia (phialospores) hyaline, 1-celled, ovoid, borne in small terminal clusters; usually easily recognized by its rapid growth and green patches or cushions of conidia; saprophytic on soil or on wood, very common, some species reported as parasites on other fungi.

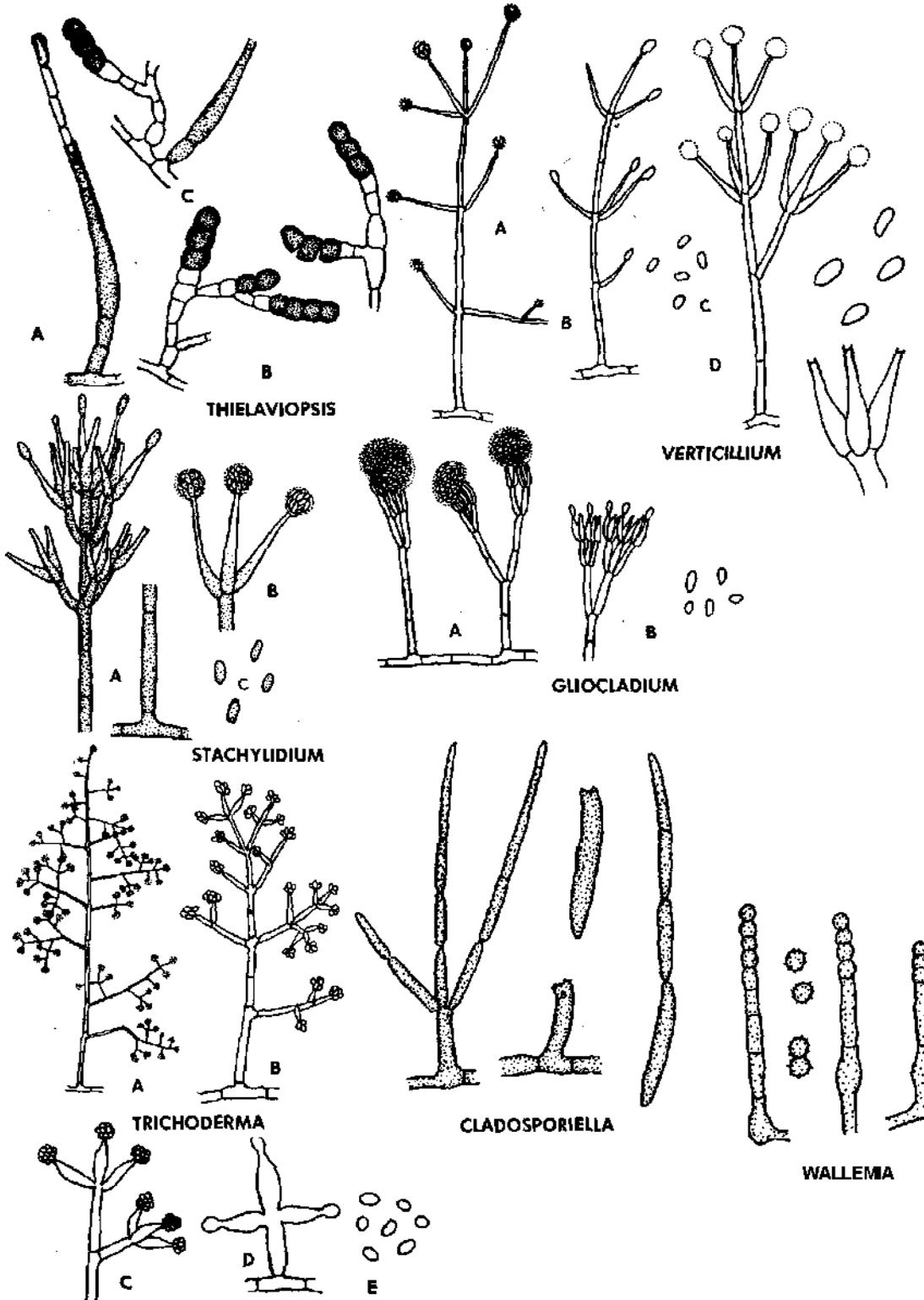
Illustration: *T. viride*; original, from pure culture. (A, B) large conidiophores showing extensive branching; (C, D) phialides showing production of conidia; (E) conidia. Reference (354).

CLADOSPORIELLA Deighton. Mycelium slow-growing, dark in culture, conidiophores simple, length variable, pale olive to pale brown, with distinct conidial scars; conidia (symptomulospores) catenulate, acropetal, variable, long-cylindrical to filiform, 1- to several-celled, pale olive-brown, associated with and possibly parasitic on *Cercospora*,

Illustration: *C. cercosporicola*; original from culture.

WALLEMIA Jøhan-Olsen. Colonies small, slow-growing, orange-brown to dark brown; conidiophores closely clustered, simple, with phialidelike lower portion with dark collarete, sometimes proliferating percurrently, base often somewhat swollen; conidiogenous cell protruding, cylindrical, becoming septate and fragmenting to form arthrospores; conidia subhyaline to brown in mass, 1-celled, becoming globose.

Illustration: *W. seba*; original from culture. References (17, 276).



PAECILOMYCES Bainier. Conidiophores and branches more divergent than in *Penicillium*; conidia (phialospores) in dry basipetal chains, 1-celled, ovoid to fusoid, hyaline; saprophytic.

Illustration: *Paecilomyces* sp.; original, from culture. (A) conidiophores with chains of conidia; (B) conidia. References (41, 319).

PENICILLIUM Link. Conidiophores arising from the mycelium singly or less often in synnemata, branched near the apex, penicillate, ending in a group of phialides; conidia (phialospores) hyaline or brightly colored in mass, 1-celled, mostly globose or ovoid, in dry basipetal chains.

Illustration: *Penicillium* sp.; original, from culture. (A, B, C) types of conidiophores; (D) branches, phialides, and chains of conidia. References (349).

ASPERGILLUS Link. Conidiophores upright, simple, terminating in a globose or clavate swelling, bearing phialides at the apex or radiating from the apex or the entire surface; conidia (phialospores) 1-celled, globose, often variously colored in mass, in dry basipetal chains.

Illustration: *Aspergillus* spp.; original, from culture. (A) habit sketch; (B, C) conidiophores with conidial heads. References (349).

PHIALOMYCES Misra and Talbot. Conidiophores tall, slender, hyaline, simple or sparingly branched, a single apical whorl of phialides; conidia (phialospores) 1-celled, dark, lemon-shaped, verrucose, in dry basipetal chains; saprophytic from soil.

Illustration: *P. macrosporus*; redrawn from Misra and Talbot (288). Redrawn by permission of the National Research Council of Canada from the *Canadian Journal of Botany*, 42, pp. 1287-1290 (1964).

METARRHIZIUM Sorok. Conidiophores hyaline, branched, forming a sporulating layer; phialides single, in pairs, or in whorls; conidia (phialospores) produced in basipetal chains, compacted into columns, long-ovoid to cylindrical, 1-celled, hyaline or slightly pigmented, olive-green in mass; parasitic on insects, or saprophytic in soil. Compare with *Myrothecium*.

Illustration: *M. anisoplae*; original, from culture. (A) sporulating fungus on insect larva; (B, C) conidiophores; (D) conidia. References (325).

GLIOCEPHALIS Matruchot. This genus is much like *Gftocephalotrichum*, but without sterile arms.

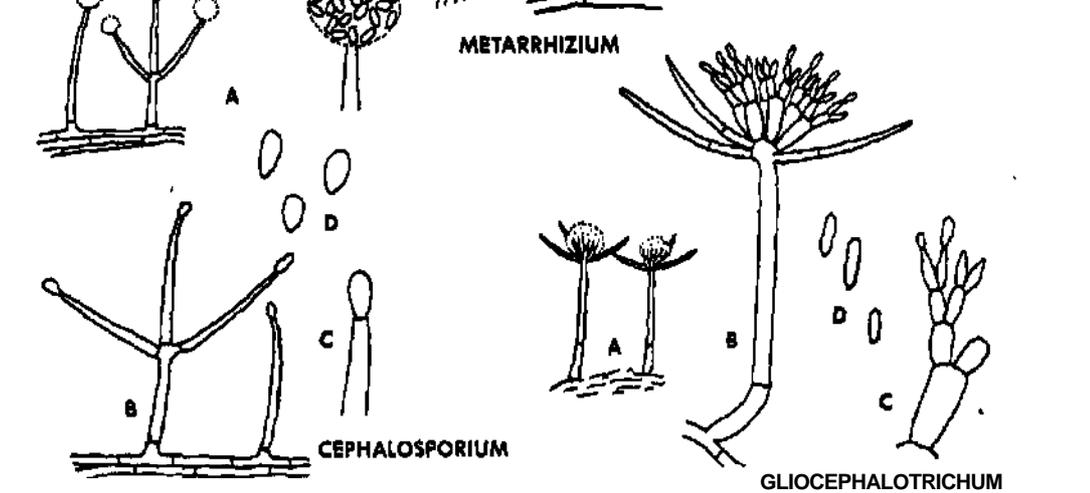
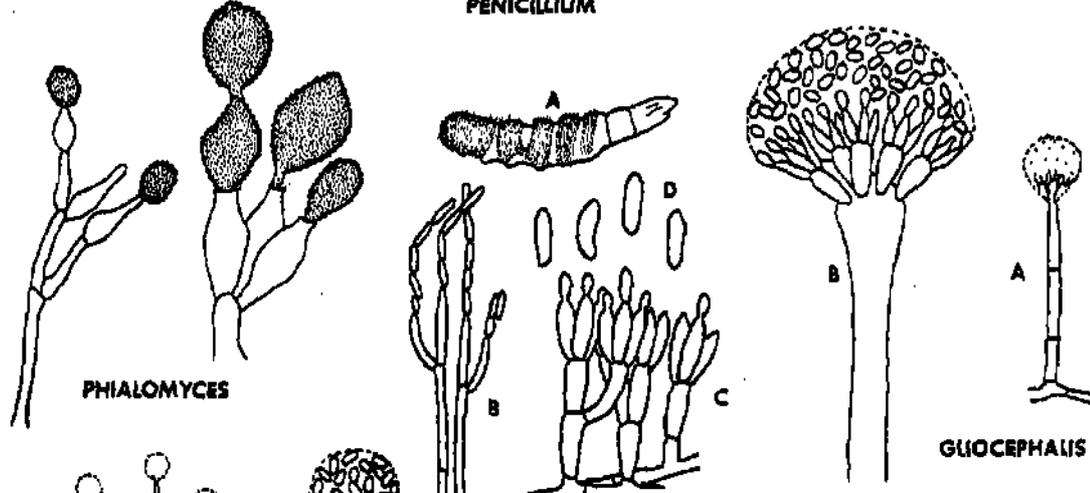
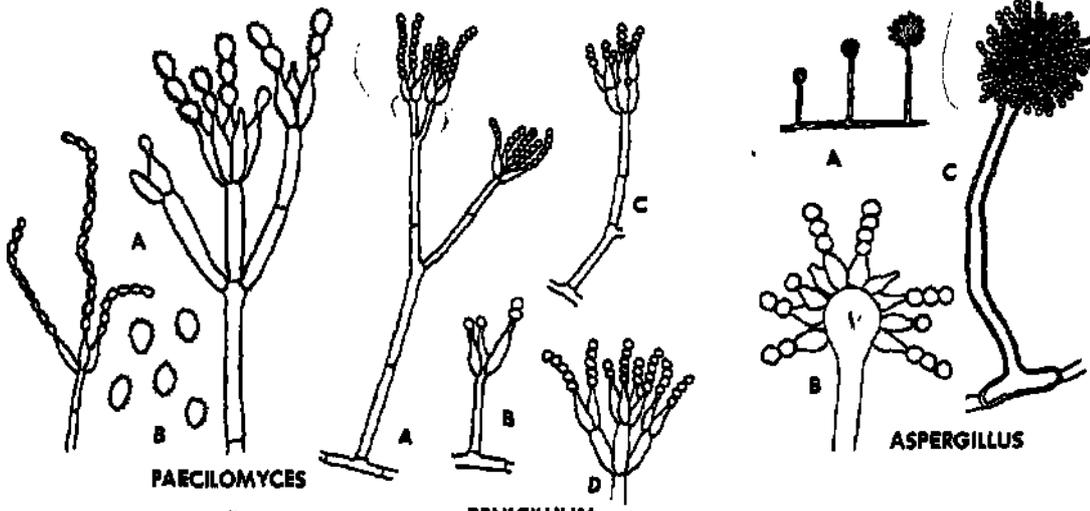
Illustration: *Gliocephalis* sp.; original, diagrammatic. (A) conidiophore and slime head; (B) phialides and conidia. Reference (128).

CEPHALOSPORIUM Corda. Conidiophore and phialides slender, mostly simple; conidia (phialospores) hyaline, 1-celled, collecting in a slime drop; saprophytic or parasitic, some species causing vascular wilts of trees. Microconidia of certain species of *Fusarium* are similar.

Illustration: *Cephalosporium* sp.; (A) conidiophores and conidia in slime heads; (B, C) phialides; (D) conidia; original from culture. References (108, 139, 329).

GLIOCEPHALOTRICHUM Ellis and Hesseltine. Conidiophores tall, simple, stout, bearing at the apex a series of primary and secondary branches that terminate in phialides; fertile area subtended by a few long sterile divergent arms; conidia (phialospores) hyaline, 1-celled, oblong-elliptical, in moist heads; saprophytic.

Illustration: *G. bulbilium*; original from culture. (A, B) conidiophores; (C) phialides; (D) conidia. References (17, 111).



CHAETOPSINA Rambelli. Conidiophores erect, stout, thick-walled, septate, sometimes swollen at the base, tapering upward to a sterile point; branches with phialides arising about the middle or lower portion of conidiophore; phialides in more or less compact layer, inflated below and tapering upward with a long neck; conidia (phialospores) hyaline, 1-celled, oblong-cylindrical, held in a droplet of slime around the axis of the conidiophore; saprophytic.

Illustration: *C. fulva*; original, from culture. (A) habit of conidiophores and spines. (B) enlarged conidiophore showing phialides and sterile tip; (C) enlarged phialides; (D) conidia. Reference (17).

THYSANOPHORA Kendrick. Conidiophores dark brown, single or clustered, bearing one to several penicilli on a single stipe, proliferating sympodially after producing a cluster of phialides, otherwise simple and ascending; 1-celled, subhyaline to pale brown, dry, in basipetal chains, subglobose to elongate fusoid, minutely roughened; saprophytic.

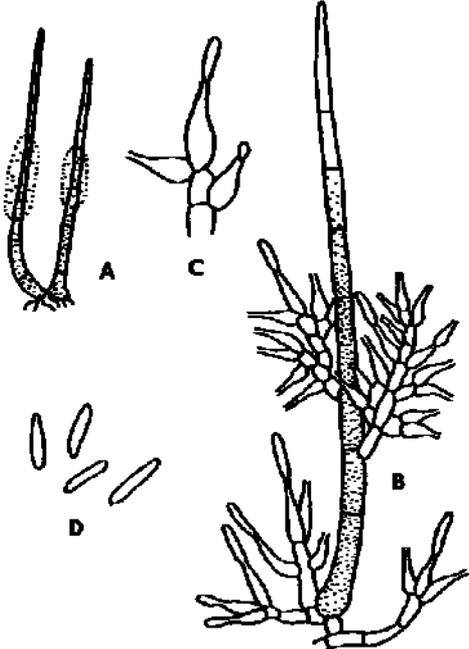
Illustration: *T. longispora* redrawn from Kendrick (248). (A) portion of conidiophore bearing phialides and chains of conidia; (B) conidia. Redrawn by permission of the National Research Council of Canada from the *Canadian Journal of Botany* 39, pp. 817-832 (1961).

CHAETOPSISIS Grev. Conidiophores dark, long, main axis slender with long sterile apex, bearing numerous primary side branches and secondary branches (phialides) that elongate and form polyphialides; conidia (phialospores) hyaline or subhyaline, 2-celled, small cylindrical, sticking together in bundles by means of slime; saprophytic on wood and bark.

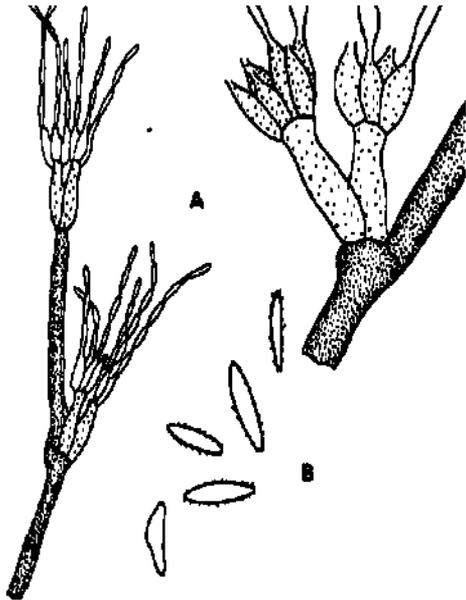
Illustration: *C. griseus*; (A) group of conidiophores; (B) conidiophore and conidia; redrawn from Hughes (93, 193).

PHIALOCEPHALA Kendrick. Conidiophores dark, mostly solitary, with a single stipe bearing an apical, complex fertile head, composed of 3 or 4 series of branches; apical phialides with conspicuous collarettes; conidia (phialospores) hyaline, 1-celled, globose to cylindrical, aggregate into a large head in slime.

Illustration: *P. bactrospora*; original, from culture. (A) habit of conidiophores; (B) mycelium with short conidiophores; (C) portion of tall conidiophore; (D) enlarged phialides; (E) conidia. Reference (249).



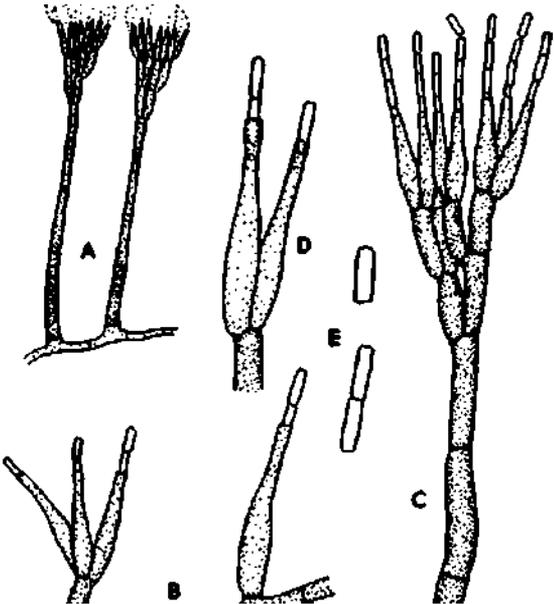
CHAETOPSINA



THYSANOPHORA



CHAETOPSIS



PHIALOCEPHALA

GYNYTRICHUM Nees. Conidiophores dark, mostly tall, slender, sometimes terminating in a long, slender sterile tip; phialides borne in groups on short lateral branches along main axis of conidiophore, tapering and often curved; conidia (phialospores) hyaline or subhyaline, ovoid, collecting in small heads; saprophytic.

Illustration: *S. macrodadium*; original, from culture, isolated from soil. (A) conidiophores and conidia, on a dry mount; (B) short simple conidiophores; (C) branch of conidiophore and phialides. Reference (193).

LEPTOGRAPHIUM Lagerb and Melin. Conidiophores upright, single or in clusters, branched, the upper portion with penicillate branches; lower portion dark but variable in shade, upper branches hyaline; conidiogenous cells slender; conidia (anellospores) hyaline, ovoid, held together in rather large heads by slime; parasitic on trees or saprophytic. Probably conidial state of *Ceratocystis*.

Illustration: *Leptographium* sp.; original, from culture. (A) habit of conidiophores; (B) conidiophores bearing conidia; (C) conidiogenous cells showing annellations; (D) conidia. References (77, 148, 369).

SPOROTHRIX Hektoen and Perkins. Conidiophores mostly simple, 1-celled or septate, hyaline, bearing a loose cluster of dry conidia at apex; conidia (sympodulospores) hyaline, 1-celled, globose to ovoid, borne on short, prominent denticles; mostly saprophytic. *S. schenckii* (*Sporotrichum schenckii*) causes sporotrichosis in humans.

Illustration: *Sporothrix* sp.; original, from culture. (A) conidiophores showing denticles and conidia; (B) conidia. References (17,129).

HANSFORDIA Hughes. Conidiophores hyaline or pigmented, erect to repent, branched above repeatedly and irregularly; conidiogenous cells elongated, bearing conidia near the apex on blunt denticles; new growing points arising sympodially; conidia (sympodulospores) 1-celled, hyaline, globose, ovoid or fusoid; saprophytic on leaves.

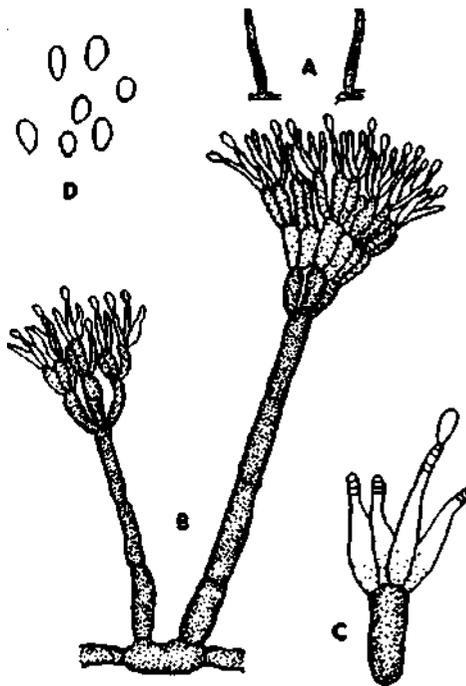
Illustration: *Hansfordia* sp.; original, from culture. (A) conidiophores bearing conidia; (B) conidia. Reference (187).

SCOPULARIOPSIS Bain. Conidiophores mostly branched or producing at the apex a cluster of conidiogenous cells that proliferate percurrently before producing succeeding conidia, leaving annellations at the tip; conidia (anellospores) hyaline or subhyaline, 1-celled, globose with a truncate base, produced in basipetal chains; colonies other than green or blue; saprophytic in soil.

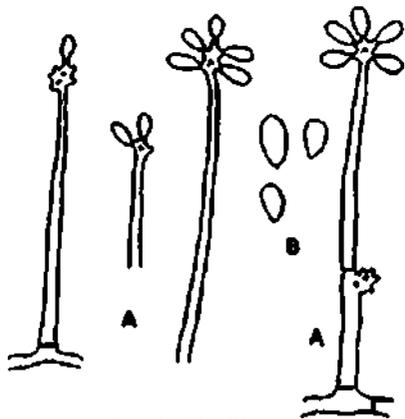
Illustration: *Scopulariopsis* sp.; original, from culture. (A) portion of conidiophore bearing conidia in chains; (B) conidiogenous cells showing annellations; (C) conidia. References (303).



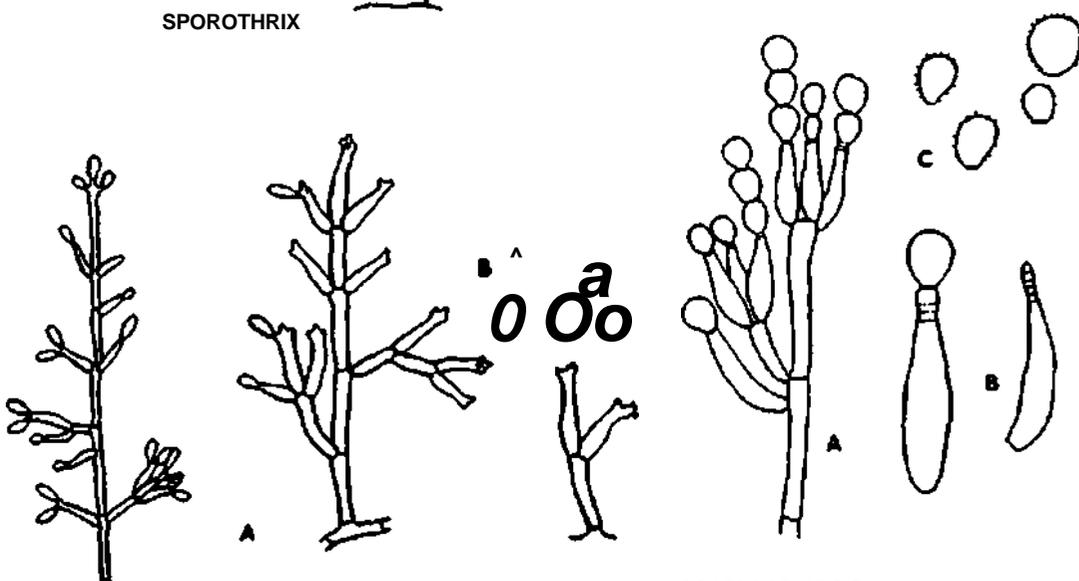
GONYTRICHUM



LEPTOGRAPHIUM



SPOROTHRIX



SCOPULARIOPSIS

HANSFORD) A

NODULOSPORIUM Preuss. Conidiophores erect or suberect, branched, hyaline to pigmented; conidiogenous cells slender or short and thick, attached irregularly or verticillately, bearing conidia apically, in succession on new denticles; conidia (sympodulospores) 1-celled, hyaline or subhyaline to distinctly pigmented; saprophytic on wood, conidial states of Xylariaceae.

Illustration: *Nodulosporium* spp.; original, from culture. (A) conidiophores and conidia of *Hypoxylon* sp.; (B, C) conidiophores and conidia of *Hypoxylon atropunctatum*. References (242, 357).

BEAUVERIA Vuill. Mycelium white or slightly colored with a white fluffy to powdery appearance; conidiophores single, irregularly grouped or in verticillate clusters; in some species inflated at the base, tapering to a slender fertile portion that appears zigzag after several conidia are produced; conidia (sympodulospores) hyaline, rounded to ovoid, 1-celled, dry, borne singly on small denticles; parasitic on insects.

Illustration: *B. bassiana*; original, from culture obtained from dead Nitidulid beetle. (A) infected beetle; (B, C, D) clusters on conidiophores; (E) single conidiophores; (F) conidia. References (21, 274).

BASIDIOBOTRYS Hohn. Conidiophores dark to subhyaline, elongate-clavate, simple, with an enlarged globose or clavate apex; conidia (sympodulospores) hyaline, fusoid, 1-celled, produced on tiny denticles on short thick conidiogenous cells that cover the apex of conidiophore; caused sapwood rot of hardwood trees; conidial state of *Hypoxylon* spp. Jong and Rogers suggest that this fungus should be placed in *Xylocladium* Syd.

Illustration: *Basidiobotrys* sp. (Conidial stage of *Hypoxylon punctulatum*); original, from culture isolated from oak wood. (A-C) conidiophores and heads of conidia; (D) conidia; (E) sporogenous cells showing development of conidia. Reference (7, 242, 243).

TRITIRACHIUM Limber. Conidiophores upright, long, slender, simple or verticillately branched, conidiogenous branches tapering to a rachislike, zigzag, fertile portion; conidia (sympodulospores) apical on new growing points, hyaline, 1-celled, globose or ovoid, saprophytic. Note similarity to *Beauveria*.

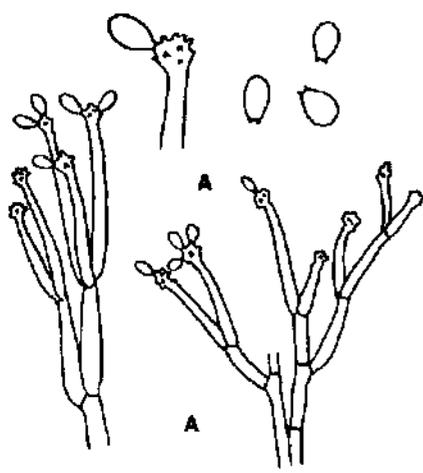
Illustration: *T. album*; original from culture. Reference (274).

VIRGARIA Nees. Conidiophores erect, simple or forked, or scantily upright-branched, septate, dark; conidia (sympodulospores) apical on sympodially formed new growing points, globose or ovoid, asymmetrical, 1-celled, dark; saprophytic.

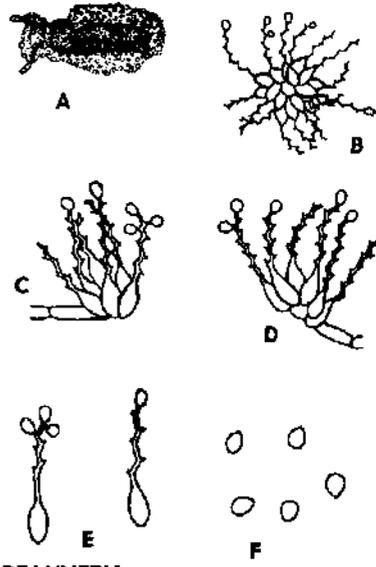
Illustration: (A) *V. nigra*; from herbarium material on bark of *Betula*; (B) *Virgaria* sp.; from culture; both original. Reference (404).

GENICULOSPORIUM Chesters and Greenhalgh. Conidiophores erect, branched, slender, branches originating from lower portion and giving a subdichotomous appearance, with main axis becoming indistinct; apical region of branches bearing conidia on new sympodial growing points, giving a geniculate appearance; conidia (sympodulospores) hyaline to subhyaline, 1-celled, ovoid to obovoid with truncate base; imperfect state of *Hypoxylon*.

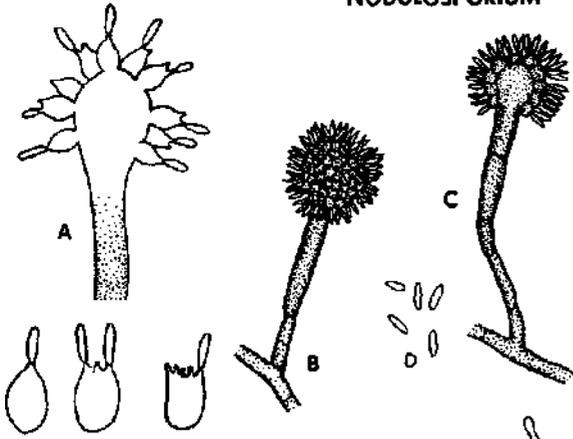
Illustration: *G. serpens*; redrawn from Chesters and Greenhalgh (53). (A) conidiophores; (B) conidia. Reference (243).



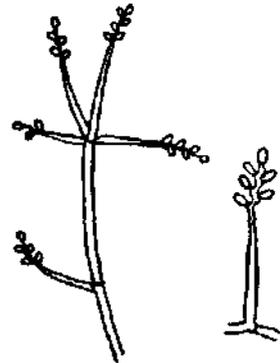
NODULOSPORIUM



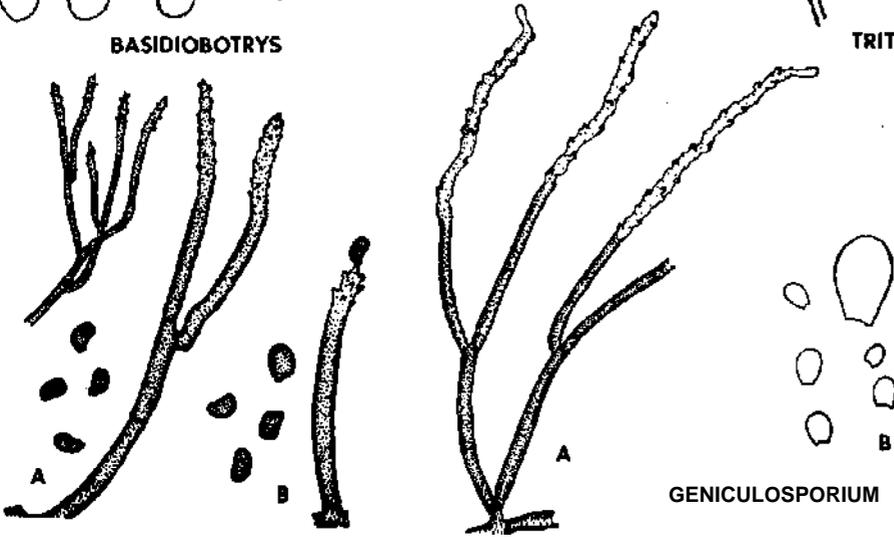
BEAUVERIA



BASIDIOBOTRYS



TRITIRACHIUM



VIRGARIA

GENICULOSPORIUM

CONOPEEA Pers. ex Mccr. (*Streptothrix* Corda). Mycelium dark, growing loosely on decaying vegetation; conidiophores erect, tall, branched, branches spirally coiled (appearing wavy); conidia (sympodulospores) single, apical or lateral, sessile or on short peglike structures, 1-celled, dark; saprophytic.

Illustration: *Canopied* sp.; original, from herbarium material on wood. (A) branched conidiophore; (B) branches with conidia; (C) conidia.

IDRIELLA Nelson and Welhclm. Mycelium hyaline to brown; conidiophores brown, simple, nonseptate, narrowed above, with prominent scars; conidia (sympodulospores) lunate to falcate, with pointed ends, produced in clusters near the apex of the conidiophore; aleuriospores brown, several-celled; believed to be parasitic on strawberry roots.

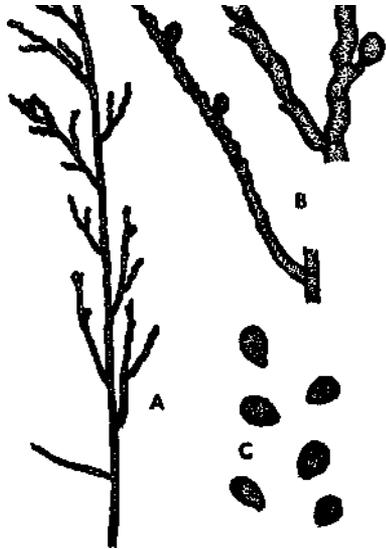
Illustration: *I. lunata*; drawn from photographs by Nelson and Wilhelm (307). (A) apex of conidiophore bearing conidia; (B) conidiophore with detached conidia; (C) chlamyospore.

CALCARISPORIUM Preuss. Conidiophores hyaline, slender, the larger ones verticillately branched, primary branches usually become slender conidiogenous cells; conidia (sympodulospores) hyaline, 1-celled, mostly oblong, borne singly on wartlike teeth on apical portions of the conidiophore branches, forming loose cluster; principally parasitic on other fungi.

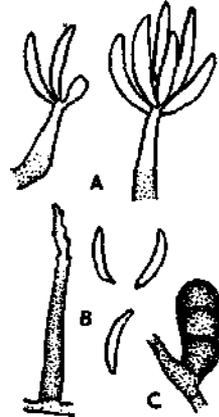
Illustration: (A-C) *C. arbwsacula*; original, from culture. (A) branched conidiophore with clusters of conidia; (B) branches with apical denticles; (C) conidia. (D-F) *C. parasiticum*; original, from culture. (D) tall conidiophore; (E) conidiogenous cell with cluster of conidia; (F) conidiogenous cell showing blunt denticles. References (8, 187, 465, 466).

SELENOSPORELLA Arnaud. Conidiophores brown, pale toward the apex, tall, branched, bearing several groups of conidiogenous cells verticillately; conidiogenous cells slender, new growing points formed sympodially; conidia (sympodulospores) hyaline or subhyaline, on short denticles, 1-celled, long-cylindrical, may be somewhat curved; saprophytic. Similar to *Calcarisporium* but with dark conidiophore. Description from Ichinoe (221).

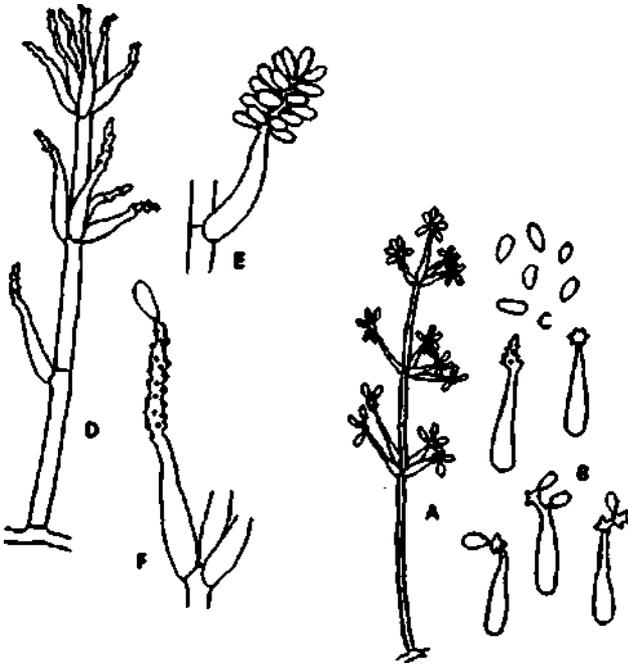
Illustration: *Selenosporella* sp.; original, from fresh materials on decayed wood. (A) conidiophore; (B) conidiogenous cell; (C) conidia.



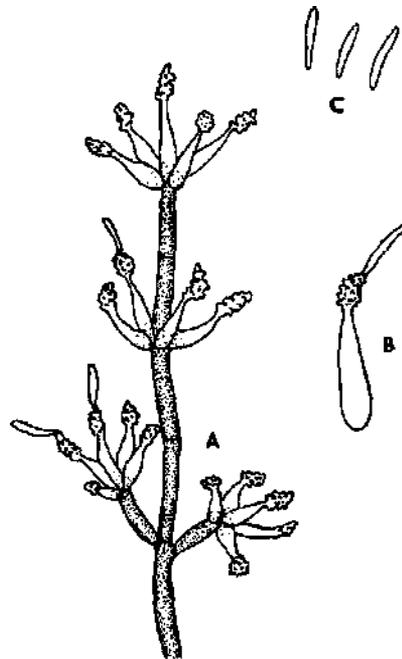
CONOPLEA



IDRIELLA



CALCARISPORIUM



SELENOSPORELLA

RHINOCLADIELLA Nannf. Conidiophores simple, or branched in some species, brown, upper spore-bearing portion becomes elongated by sympodial growth; conidia (sympodulospores) apical on new growing points, subhyaline to dark, mostly 1-celled, ovoid to oblong-ellipsoid, dry; saprophytic; frequently on wood.

Illustration: *Rhinocladiella* sp.; original, from fresh material on decayed wood. (A) habit of conidiophores; (B) conidiophores enlarged; (C) conidia. Reference (17).

PERICONIELLA Sacc. Conidiophores dark, upper portion branched, producing conidiogenous cells and conidia apically and on new sympodial growing points; conidia (sympodulospores) 1-celled, dark, ovoid or oblong.

Illustration: *P. velutina*; original, from herbarium material on *Brajjum stellatifolium*. (A) conidiophores; (B) conidia. Reference (122).

VERTICICLADIUM Preuss. Conidiophores brown, single or in clusters, branched verticillately above; conidia apical on new sympodial growing points; conidia (sympodulospores) 1-celled, hyaline or subhyaline, not in slime droplets; differs from *Verticicladiella* in its dry spores.

Illustration: *V. trijidium*; redrawn from Hughes (187).

SYMPODIELLA Kendrick. Conidiophores solitary, simple, dark; conidia (sympodulospores) 1-celled, hyaline, in unbranched chains, attached apically and laterally, cylindrical, with blunt ends; saprophytic, on pine needles.

Illustration: *S. acicola*; redrawn from Kendrick (247).

OVULARIA Sacc. Conidiophores in clusters, mostly simple; conidia (sympodulospores) hyaline, 1-celled, ovoid or globose, apical on new sympodially formed growing points. See Hughes (210) for synonymy with *Ramularia* Unger.

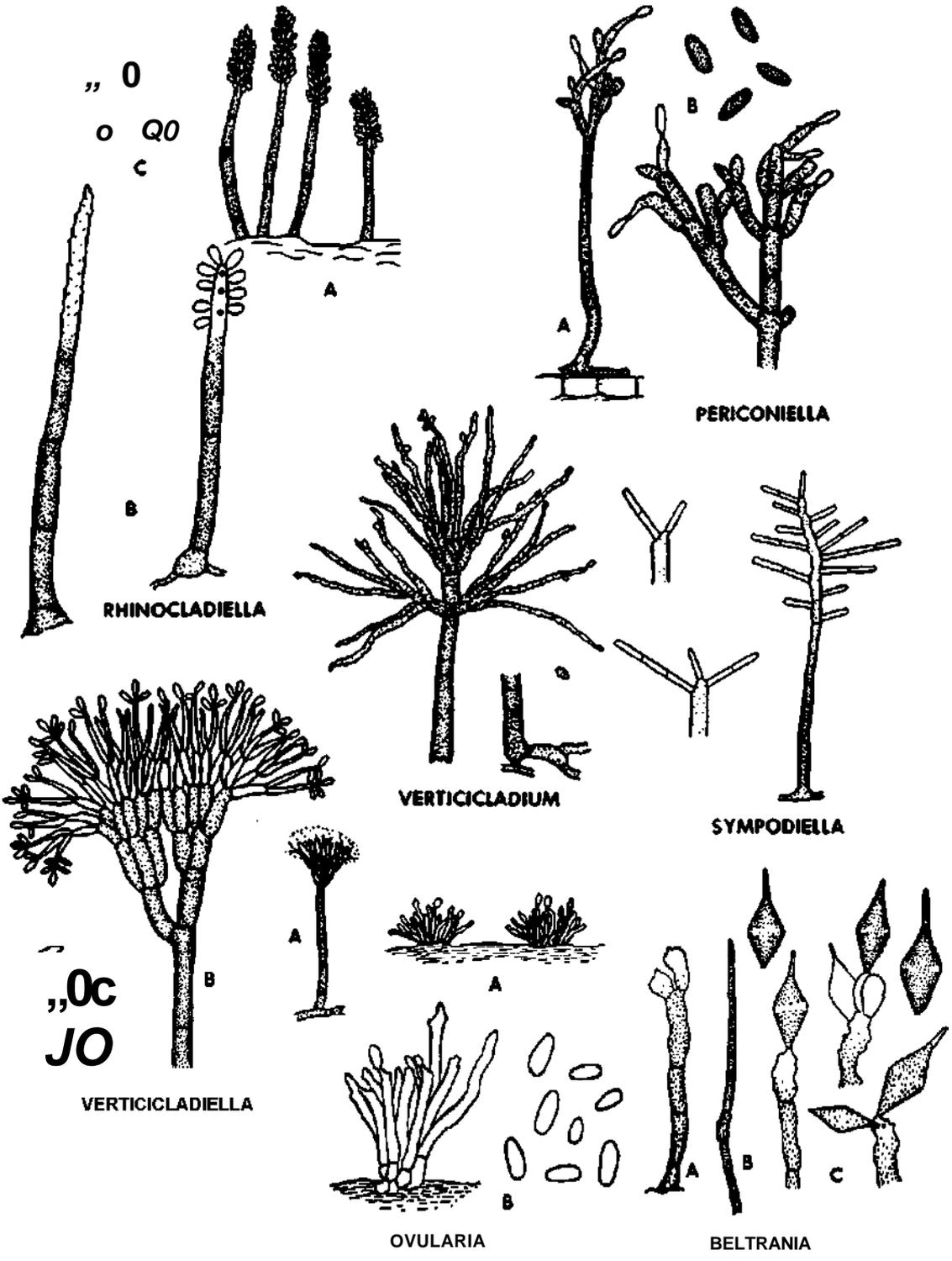
Illustration: *O. avicularis*. (A, B) conidiophores and conidia. Original, drawn from herbarium material on *Polygonum aviculare*. Reference (386).

VERTICICLADIELLA Hughes. Conidiophores upright, tall, brown, branched only near apex, penicillate; conidia (sympodulospores) hyaline, 1-celled, ovoid to clavate, often curved, apical on sympodially formed new growing points, in slime droplets; parasitic or saprophytic. Compare with *Verticicladium* and *Leptographium*. *V. procera* causes a root rot of white pine.

Illustration: *V. peniciliata*; redrawn from Kendrick (250). (A) conidiophore with head of moist conidia; (B) portion of conidiophore bearing conidia; (C) conidia. Redrawn by permission of the National Research Council of Canada from the *Canadian Journal of Botany*, 40, pp. 771-779 (1962).

BELTRANIA Penzig. Setae brown, simple, pointed; conidiophores simple or less often forked, brown; conidia (sympodulospores) biconic, 1-celled, brown with a paler middle band, borne single on denticles or ovoid separating cells; saprophytic. See Pirozynski (331) for descriptions of related genera.

Illustration: *B. indica*; (A, C) conidiophores and conidia; (B) seta. Redrawn from Subramanian (395). Other reference (191).



BISPORA Corda. Mycelium dark; conidiophores dark, short, simple or sparingly branched; conidia (blastophores) dark, oblong to ellipsoid, 2-celled or less often 3-celled, with thick, black septa; produced in acropetalous chains; saprophytic on wood.

Illustration: *B. punctata*; original. (A, E) conidiophores and conidia; (B, C) conidiophores; (D) conidia. (A-D) from fresh material on wood; (E) from culture.

AMPULLIFERINA Sutton. Superficial mycelium brown; hyphopodia lateral, brown, with a pore; conidiophores short, simple, tapering at the base; conidia (arthrospores) 2-celled, brown, cylindrical, truncate at both ends, catenulate, formed by fragmentation; saprophytic on fallen leaves.

Illustration: *A. persimplex*; redrawn from Sutton (421). (A) mycelium with hyphopodia; (B) conidiophore with chain of conidia; (C) conidia. Redrawn by permission of the National Council of Canada from the *Canadian Journal of Botany*, 47, pp. 609-616 (1969).

CLADOSPORIUM Link. Conidiophores tall, dark, upright, branched variously near the apex, clustered or single; conidia (blastophores) dark, 1- or 2-celled, variable in shape and size, ovoid to cylindrical and irregular, some typically lemon-shaped; often in simple or branched acropetalous chains; parasitic on higher plants or saprophytic. ^{V*!*}

Illustration: (A) *C. fulvum*; original, from herbarium material on tomato leaf; (B) *C. herbarum*; original, from fresh dead plant material. References (17, 90).

PSEUDOBOTRYTIS Krzem. and Badura. Conidiophores dark, erect, slender, simple, bearing at the apex a number of slender divergent conidiogenous branches arising from the same level and bearing conidia on somewhat enlarged denticulate tips; conidia (sympodulospores) dark, 1- or 2-celled, ovoid to oblong; saprophytic.

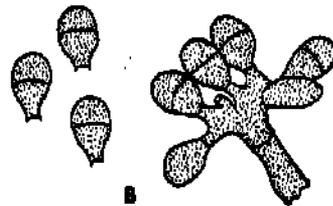
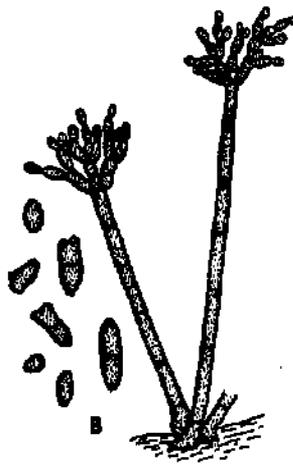
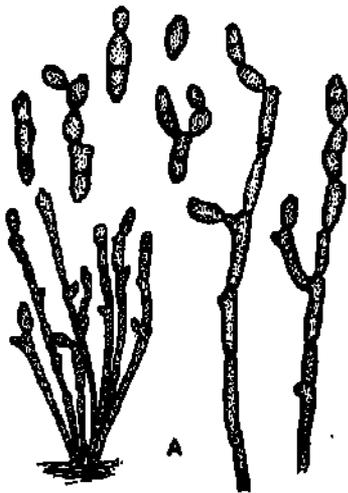
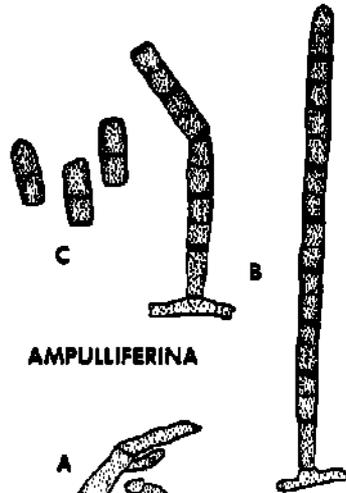
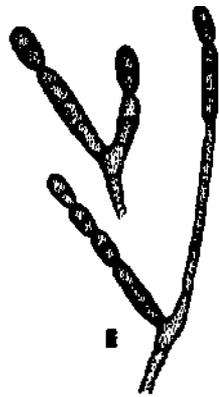
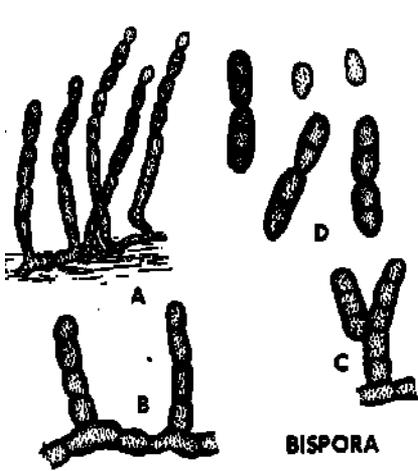
Illustration: *P. terrestris*; (A) redrawn from Subramanian (403); (B, C) redrawn from Morris (299).

[^] **SPILOCAEA** Fr. Mycelium subcuticular on the host, forming a stoma that bears upright conidiophores; ^{P\$kk\$} conidiophores dark, 1-celled, short, simple, markedly annulate near the tip due to the new conidia being pushed out through the apical conidial scars; conidia (annellospores) dark, typically 2-celled, although ^{t S/ >?} 1-celled conidia may predominate, broadly ovoid to pyriform or angled and pointed, with a truncate base; parasitic on higher plants; conidial states of *Venturia*. Compare with *Fusicladium*,

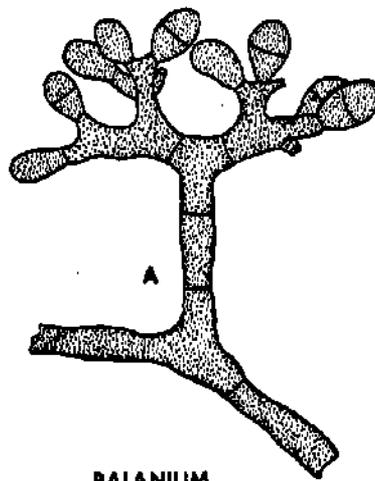
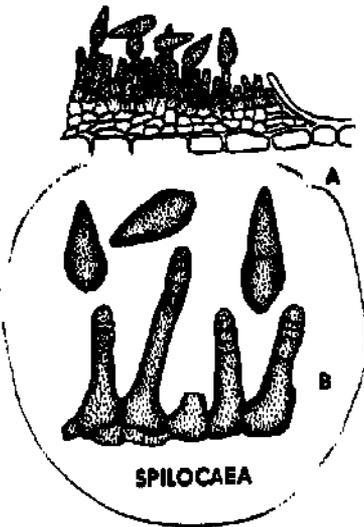
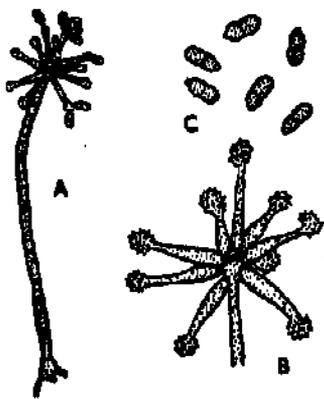
Illustration: *S. pomi* (*Fusicladium dendriticum*, *Venturia inequalis*); original. (A) section through stroma; (B) conidiophores and conidia from fresh material on apple leaf. References (17, 205).

BALANIUM Wallroth. Conidiophores solitary or in small groups septate, dark brown, thick, dichotomously branched, terminating in short conidiogenous cells; conidia (aleuriospores) 2-celled, thick-walled, dark brown, smooth, dry, ovoid to pyriform, saprophytic, on decaying wood.

Illustration: *B. stygium*; redrawn from Hughes and Hennebert (214). Redrawn by permission of the National Research Council of Canada from the *Canadian Journal of Botany*, 39, pp. 1505-1508 (1961).



CLADOSPORIUM



BALANIUM

CLADOBOTRYUM Corda. Conidiophores erect, hyaline, often arising from aerial mycelium, branching irregularly or verticillately and repeatedly, terminating in groups of phialides that taper toward the apex; conidia (phialospores) hyaline, mostly 2-celled (sometimes more), ovoid to oblong, held together in irregular or tangled chains; imperfect state of *Hypomyces*; saprophytic or parasitic on fleshy fungi.

Illustration: *Cladobotryum* sp.; original from culture. (A) conidiophore; (B) sporogenous cells; (C) conidia. References (17, 58).

CYLINDROCLADIUM Morgan. Conidiophores upright, hyaline, regularly and repeatedly dichotomously or trichotomously branched, each terminating in two or three phialides; typically with a slender elongated sterile branch terminating in a globose or ellipsoid swelling; conidia (phialospores) hyaline, 2- or several-celled, cylindrical, borne singly but held together in bundles by mucilage; parasitic on roots or saprophytic; small, yellow-brown sclerotia produced.

Illustration: *C. scoparium*; original, from culture. (A) conidiophores; (B) conidiophore with elongated branch and terminal vesicle; (C) conidia. References (37, 39, 302).

DIPLOSPORILUM Link. Conidiophores erect, well developed, septate, irregularly branched, ultimate branches (phialides) tapering upward, hyaline; conidia (phialospores) produced successively at the apex and held together in loose clusters, not catenulate, 2-celled, hyaline; saprophytic.

Illustration: *D. flavum*; redrawn from Tubaki (450). (A) conidiophores; (B) phialides; (C) conidia.

HELISCUS Sacc. Submerged, aquatic, with branched, septate mycelium; conidiophores simple or sparingly branched, bearing one or more phialides; submerged conidia (phialospores) hyaline, 2-celled, broader at the apex, usually bearing 3 short, apical protuberances; saprophytic, aquatic.

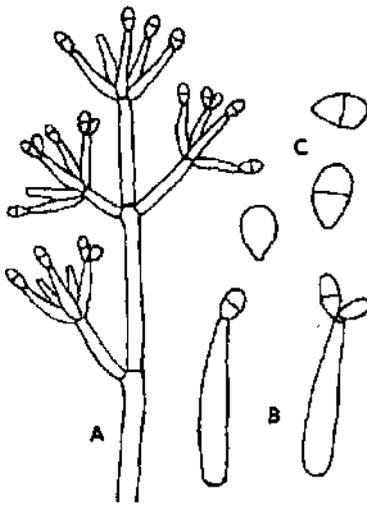
Illustration: *H. aquaticus*; redrawn from Ranzoni (346).

RHYNCHOSPORIUM Heinscn. Mycelium subcuticular at first, later developing into a superficial, loose stroma; conidiophores reduced to cells of stroma; conidia (blastospores) hyaline, 2-celled, frequently unequal, and often with a short lateral beak on the apical cell; parasitic, producing leaf spots, chiefly on grasses.

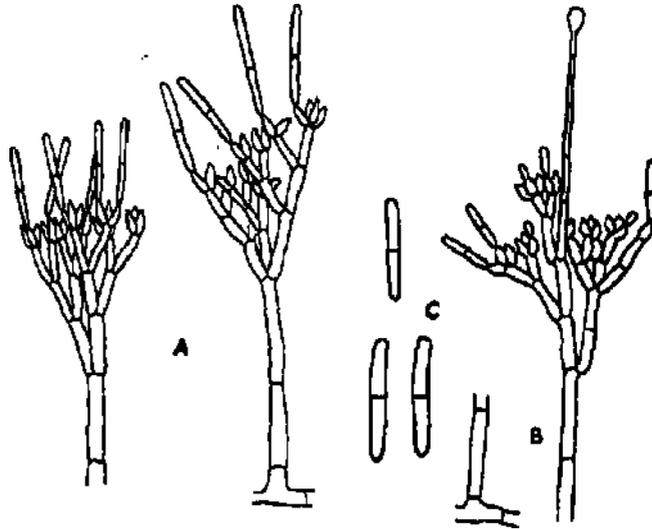
Illustration: *R. secalis*; original, from leaf spot on rye. (A) hyphae from stroma showing conidiogenous cells; (B) conidia. Reference (49).

TRICHOTHECIUM Link. Conidiophores long, slender, simple, septate, bearing conidia apically, singly, or successively by slight growth of conidiophore apex, held together in groups or chains, not end to end; conidia (meristem arthrospores — may appear to form as blastospores) hyaline or brightly colored, 2-celled, ovoid or ellipsoid; saprophytic or weakly parasitic.

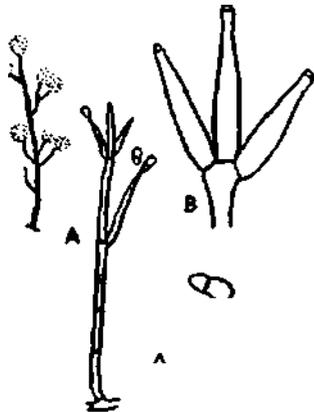
Illustration: *T. roseum*; original, from culture. (A-D) successive development of conidia. References (227, 254).



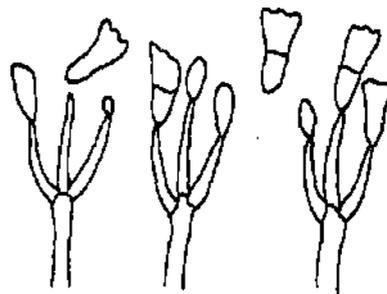
CLADOBOTRYUM



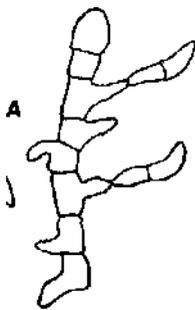
CYIINDROCLADIUM



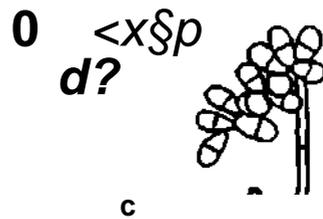
DIPLOSPORIUM



HEUSCUS



RHYNCHOSPORIUM



TRICHOTHECIUM

ARTHROBOTRYIS Corda. Conidiophores long, slender, simple, septate, hyaline, slightly enlarged at the apex and spore-bearing regions. New growing points formed sympodially or irregularly, conidia (sympodulospores) hyaline, unequally 2-celled, ovate-oblong, borne on peglike denticles in loose dry clusters; saprophytic or parasitic on nematodes. Compare with *Candelabrella*,

Illustration: *A. oligospore*; original, from culture. (A) conidiophores bearing conidia and showing prominent denticles; (B) conidia. References (61,106, 159).

CANDELABRELLA Rifai and Cooke. Mycelium hyaline; conidiophores slender, erect, straight, hyaline, tall, terminated by a small candelabrumlike branching system of the conidiophore apex; conidia (sympodulospores) apical and on new sympodial or irregular branches, hyaline, unequally 2-celled, obpyriform to ellipsoid; saprophytic or destroying nematodes. Species formerly placed in *Arthroboirys*.

Illustration: *C. musiformis* (*Arthrobotrys musiformis*); original, from culture. (A) conidiophores bearing conidia on elongated denticles; (B) conidia. Reference (355).

DACTYLARIA Sacc. Conidiophores more or less erect, simple, short, sometimes little differentiated from the mycelium, hyaline, septate, denticulate and sometimes enlarged at the apex; conidia (sympodulospores) hyaline, 2- to several-celled, cylindrical or clavate, sometimes longer and single at apex; saprophytic or parasitic on nematodes. See Bhatt and Kendrick (31) for synonymy of *Diphrrhinotrichum*.

Illustration: *Dactylaria* sp.; original, from fresh material on decaying wood. (A) conidiophores; (B) conidia. References (61, [04]).

DIDYMARIA Corda. Conidiophores arising from leaf surface in loose groups, simple; conidia (sympodulospores) hyaline, 2-celled, oblong, borne singly; parasitic on leaves.

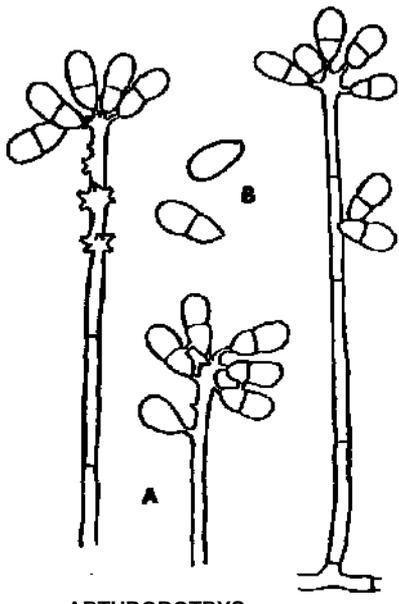
Illustration: *D. conferta*; original, from herbarium material. (A) conidiophores on surface of leaf; (B) group of conidiophores; (C) conidia.

RAMULARIA Sacc. Conidiophores growing out through stomata of host leaves, clustered, short, hyaline or subhyaline, frequently curved or bent, with prominent conidial scars; conidia (sympodulospores) hyaline, cylindrical, typically 2-celled, but many 1-celled and a few 3-celled, frequently in short chains; parasitic on plants, causing leaf spots,

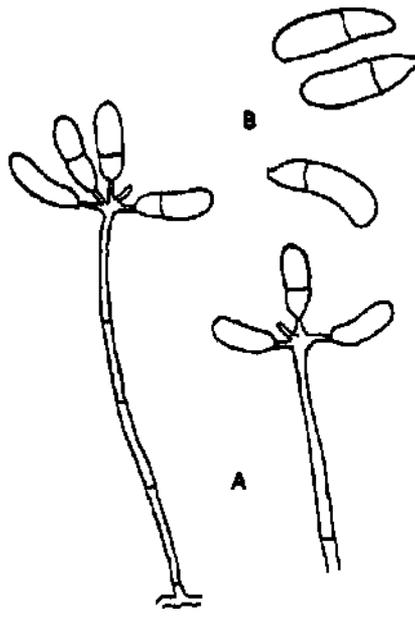
Illustration: *R. lulasnea* (*Mkosphaereliafragariae*); original, from herbarium material on strawberry leaf. (A) habit on leaflet; (B) conidiophores; (C) conidia.

GENICULARIA Rifai and Cooke. Conidiophores erect or ascending, hyaline, branching sympodially; conidia (sympodulospores) hyaline, unequally 2-celled, with large rounded apical cell, obovoid, formed singly on new extended sympodial branches from below previous conidium; trapping and destroying nematodes or saprophytic.

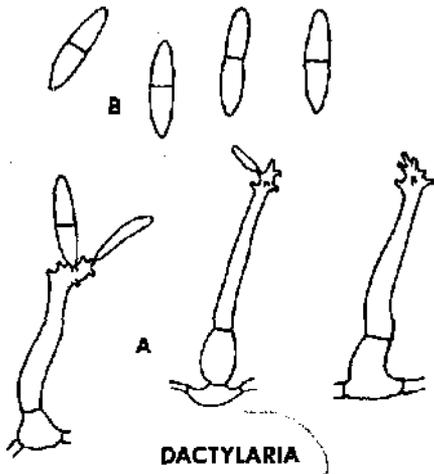
Illustration: *G. cystospora*; redrawn from Rifai and Cooke (355).



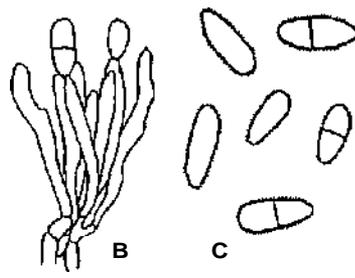
ARTHROBOTRYS



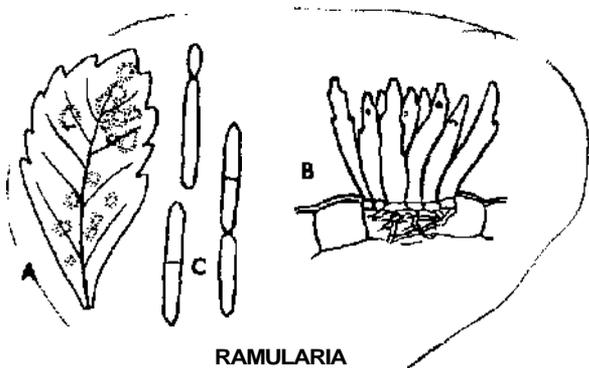
CANDELABRELLA



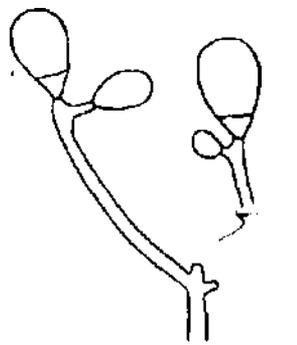
DACTYLARIA



DIDYMARIA



RAMULARIA



GENICULARIA

PASSALORA Fr. Mycelium internal; conidiophores emerging in tufts from stroma, simple or sparingly branched, dark; conidia (sympodulospores) subhyaline to dark, 2-celled, formed terminally and at apex of sympodial new growing tips; parasitic.

Illustration: *P. bacilligera*. (A) cluster of conidiophores arising from stroma; (C) conidiophores; (CJ) conidia; redrawn from Hughes (205). Reference (78).

ASPERISPORIL' M Maubl. Stroma subepidermal in the host, bursting through the epidermis, bearing short, crowded conidiophores; conidia (sympodulospores) dark, rough, 2-celled, produced at apex of sympodially formed new growing tips of conidiophores; parasitic.

Illustration: *A. caricae*. (A) section through stroma and cluster of conidiophores; (B) conidia; redrawn from Hughes (205).

SCOLECOTRICHUM Kunze ex Fr. Conidiophores in loose clusters, pigmented, simple, bearing conidia terminally on sympodial new growing points; conidia (sympodulospores) dark, 2-celled, ovoid or oblong, often pointed; parasitic. Similar to and may belong to *Cercosporidium*.

Illustration: *S. graminis*: original, from herbarium material on leaves of *Dactylis*. (A) habit of conidiophores on leaf; (B, C) clusters of conidiophores; (D) conidia.

FUSICLADIUM Bon. Mycelium as in *Sphicaea*; conidiophores dark, short, denticulate with conidial scars, young conidia produced successively at apex of sympodial new growing tips; conidia (sympodulospores) dark, ellipsoid to obpyriform, typically 2-celled, although 1-celled may predominate; parasitic on higher plants. Compare with *Sphicaea*. Some species are conidial states of *Venturia*.

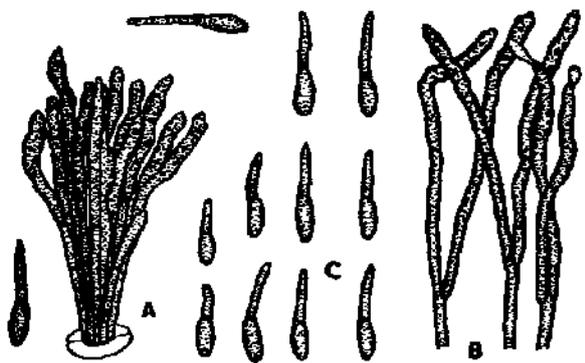
Illustration: *F. pirina* (conidial state of *Venturia pirina*); original, from herbarium material on pear leaf. (A) conidiophores bearing conidia; (B) conidia. References (78, 205).

POLYTHRINCIUM Kunze and Schum. Conidiophores in dense clusters on host leaves, dark, **simple**, with enlarged basal cell, regularly bent, giving a wavy appearance caused by successive sympodial growth at apex; conidial scars prominent, on same side of conidiophore; conidia (sympodulospores) dark, unequally 2-celled, the apical cell broader and rounded, easily deciduous; parasitic on leaves.

Illustration: *P. trijoliei* (conidial state of *Cymadothea thfolia*); original, from fresh material on white clover leaf. (A) cluster of conidiophores; (B) wavy conidiophores and conidia; (C) conidia. References (17, 199, 475).

CORDANA Preuss. Mycelium dark; conidiophores dark, upright, slender, simple, bearing a small, compact head of conidia; conidia (sympodulospores) dark, 2-celled, ovoid to broadly ellipsoid; saprophytic.

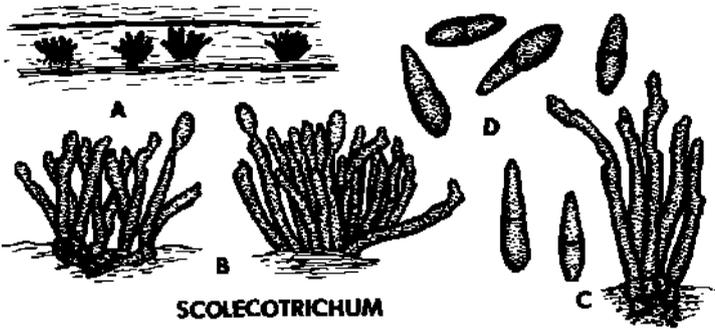
Illustration: *C. pauciseptata*; original, from culture. (A) conidiophore with cluster of conidia; (B) conidiophores; (C) conidia; (D) enlarged apex of conidiophore showing conidial attachment. References (17, 209).



PASSALORA



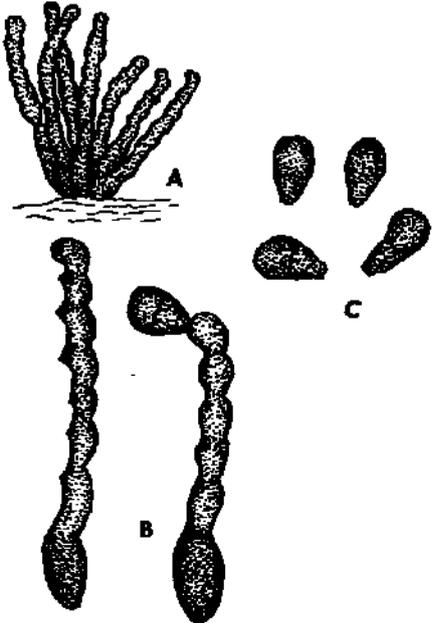
ASPERISPORIUM



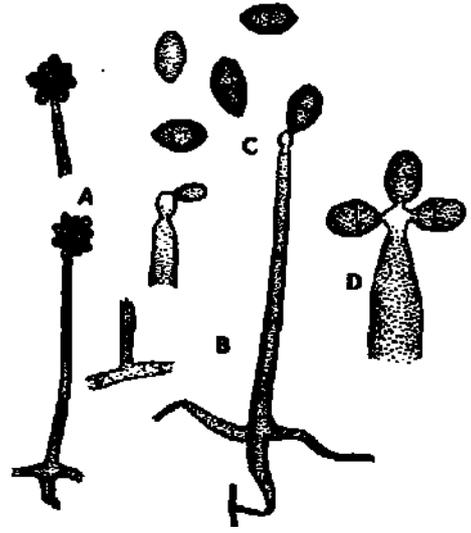
SCOLECOTRICHUM



FUSICLADIUM



POLYTHRINCIUM



CORDANA

SCOIXCOBASIDIUM Abbott. Conidiophores (or conidiogenous cells) arising from aerial hyphae or ropes of hyphae, single or in groups, relatively short, sometimes 1-celled, irregular in shape; conidia (sympodulospores) olive-brown, 1-celled or frequently 2- to 4-celled, ovoid, cylindrical or Y-shaped, produced on prominent denticles at apex of conidiogenous cells; saprophytic.

Illustration: *Scolecobasidium* sp.; original, from fresh material on decayed wood. (A) mycelium and conidiophores; (B) conidiophores with prominent denticles; (C) conidia. References (14, 17).

DIPLOCOCCIUM Grove. Mycelium partly superficial; conidiophores erect or ascending, frequently branched, brown; conidia (porospores) mostly 2-celled, short, brown, usually formed in acropetalous chains, developing through minute pores in wall or upper portion of conidiophores; differs from *Spadkoides* in branched conidiophores and catenulate conidia; saprophytic on wood or bark.

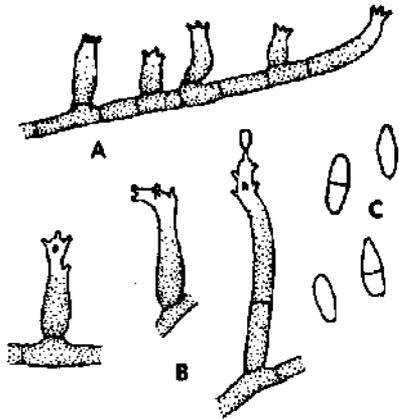
Illustration: *D. spicatum*; redrawn from Ellis (119). (A) branched conidiophore; (B) conidiophores bearing catenulate conidia; (C) conidium.

SPADKOIDES Hughes. Conidiophores mostly simple, erect, determinate, brown; conidia (porospores) develop singly through pores in apical or lateral wall of conidiophore, dark, ovoid to ellipsoid 1- to 4-celled in different species; saprophytic on decayed wood. Differs from *Diplococcium* in the simple conidiophores and conidia not in chains.

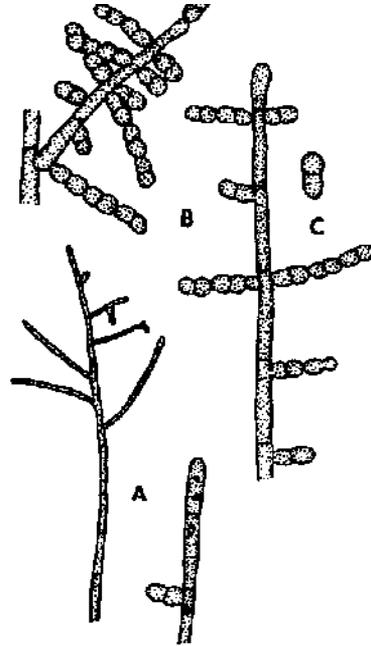
Illustration: (F-F) *S. ohovata*; (A-D) *S. bina*; original, from fresh material on decayed wood. (A) conidiophores with attached conidia; (B) portion of simple conidiophore; (C) enlarged apex of conidiophore showing conidial attachment; (D) conidia. Reference (119).

MUROGENEIA Goos and Morris. Conidiophores variable in length or absent; conidia (alcuriospores) single, terminal, dark, several-celled, ovoid to elliptical; conidia are murogenous (originating as expansions of the entire conidiophore tip); saprophytic in soil.

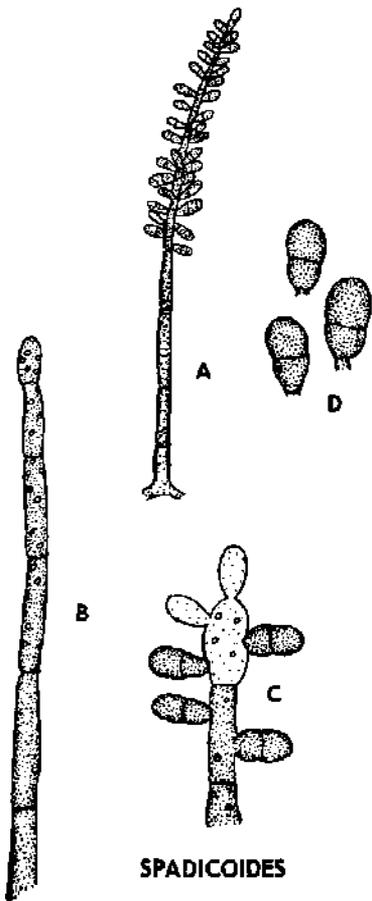
Illustration: *M. terricola*; redrawn from Goos and Morris (153). (A) sessile conidia and conidia produced on short conidiophores; (B) conidia.



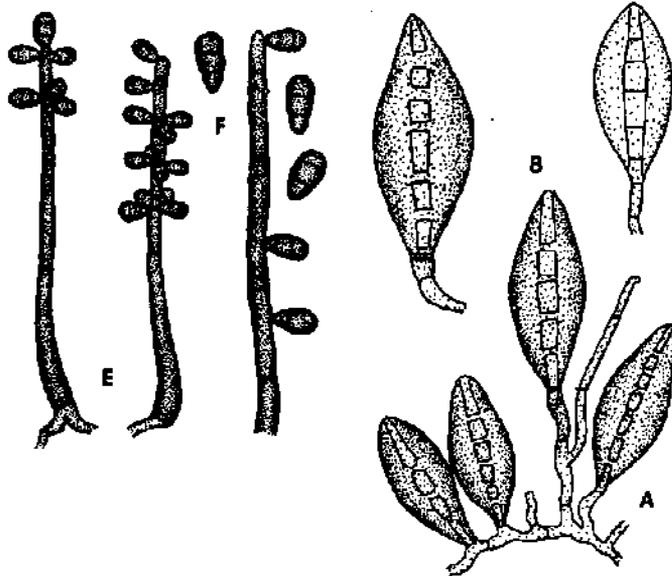
SCOLEOBASIDIUM



DIPLOCOCCIUM



SPADICOIDES



MUROGENELLA

CEPHALIOPHORA Thaxt. Conidiophore short, with enlarged, rounded apical cell, bearing simultaneously a dense cluster of conidia on all sides; conidia (botryoblastospores) lightly pigmented, usually 4- or more-celled, obovoid to elongate, narrower at the base; saprophytic on dung or decaying plant materials.

Illustration: *C. tropica*; redrawn from Thaxter (440). Reference (477).

PSEUDOTORULA Subram. Conidiophores dark, simple, torulose, with apical rounded conidiogenous cell; conidia of two types, brown, 4-celled (blastospores) in acropetalous chains, and long, slender, several-celled scolecospores.

Illustration: *P. heterospora*; redrawn from Subramanian (407). (A) conidiophore and phragmospores; (B) both types of conidia; (C) scolecospore.

DWAYABEEJA Subram. Much like *Pseudoforula* but differing in that conidia (blastospores) are not in chains.

Illustration: *D. sundara*; redrawn from Subramanian (407). (A) conidiophore; (B) phragmospores; (C) scolecospores.

MICROSPORUM Gruby. Conidiophores slender, simple, determinate, bearing apically a single, large macroconidium; macroconidia (aleuriospores) fusoid, several-celled, hyaline; microconidia also formed on sides of hyphae; causing dermatomycoses of animals and man.

Illustration: *M. gypseum*; original, from culture. (A) conidiophores and conidia; (B) development and separation of conidium. References (59, 129).

TRICHOPHYTON Malmsten. Microconidia hyaline, small, 1-celled, on sides of hyphae; macroconidia (aleuriospores) large, several-celled, thin-walled, hyaline, clavate with rounded apex; causing dermatomycoses in man.

Illustration: *T. violaceum*. (A) microconidia; (B) macroconidia; redrawn from Georg (143). References (129, 142, 143, 144).

FUSOMA Corda. Conidiophores short, simple, determinate; conidia (aleuriospores) hyaline, several-celled, fusoid to cylindrical; parasitic on higher plants.

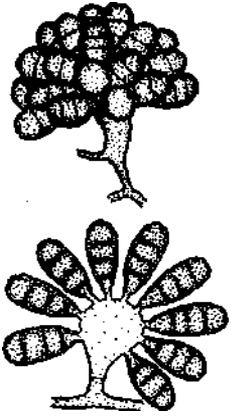
Illustration: *F. rubricosa*; original, from herbarium material of leaves of *Catamagrostis scabra*. (A, B) conidiophores and conidia.

CAMPOSPORIUM Harkn. Conidiophores straight or bent, brown; conidia (aleuriospores) apical, single, cylindrical with rounded ends, pale brown, several-celled, apical cell frequently with 1 to 3 hyaline, filiform appendages.

Illustration: *C. antennatum*; redrawn from Tubaki (450). (A-C) conidiophores and conidia. References (450, 194, 347).

SEPTONEMA Corda. Conidiophores dark, branched; conidia (blastospores) subhyaline to dark brown, typically 3- to several-celled; cylindrical to fusoid, catenulate in acropetal simple chains; saprophytic or parasitic.

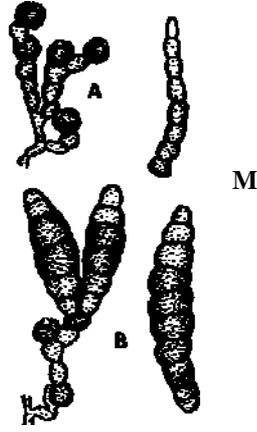
Illustration: *S. secedens*; redrawn from Hughes (196). (A, B) conidiophores with catenulate conidia. References (175, 202).



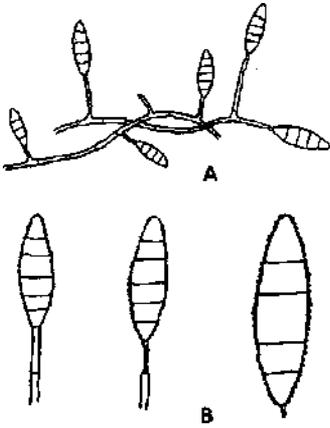
CEPHALOPHORA



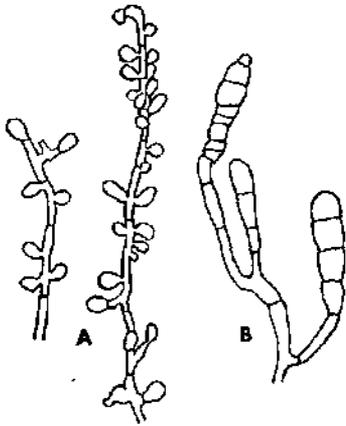
PSEUDOTORULA



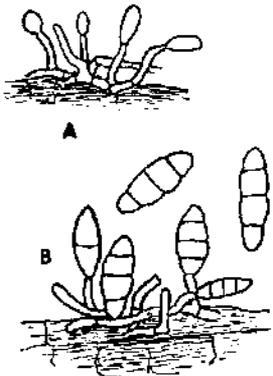
DWAYABEEJA



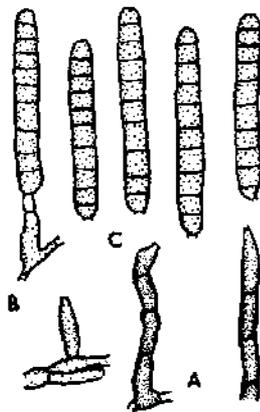
MICROSPORIUM



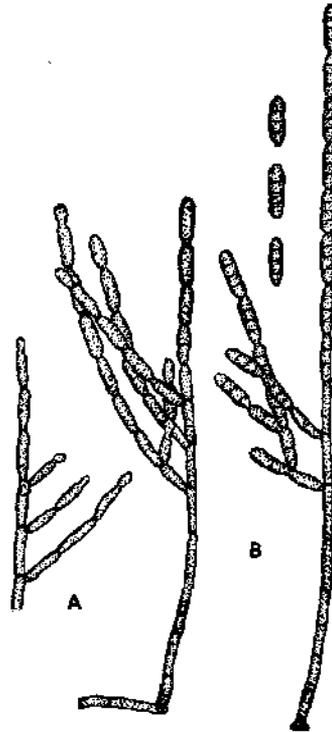
TRICHOPHYTON



FUSOMA



CAMPOSPORIUM



SEPTONEMA

CERATOPHORUM Sacc. Conidiophores dark, short, simple, determinate; conidia (aleuriospores or blastospores) dark, 3- to several-celled, single, fusoid to cylindrical, apical cell hyaline, often curved or hooked; saprophytic.

Illustration: *C. uncinatum*; original, drawn from herbarium material on *Hicora* leaves. (A, B) conidiophores and conidia. References (17, 184).

CLASTEROSPORIUM Schw. Mycelium superficial, bearing hyphopodia; conidiophores dark, short, determinate; conidia (aleuriospores) dark, 3- to several-celled, ovoid to long cylindrical, somewhat narrower at the ends; parasitic on higher plants.

Illustration: *C. caricinum*; original, from herbarium material on leaf of *Carex*. (A, B) conidiophores, hyphopodia and conidia. References (113, 114).

MONACROSPORIUM Subr. Conidiophores tall, usually simple, hyaline, slender, determinate; conidia (aleuriospores) single, apical, hyaline, several-celled, usually fusoid with one cell (near middle) larger; compare with *Dactyella*; saprophytic in soil or wood or parasitic on nematodes.

Illustration: *Monacrosporium* sp.; original, from culture. (A) conidiophore and conidium; (B-D) stages of development of a conidium; (E) conidium. Reference (60).

PHRACIMOCEPHALA Mason and Hughes. Conidiophores pigmented, simple, single, fascicled or in synnemata; conidia (aleuriospores) dark, more than 3-celled, ovoid to pyriform, cells unequally colored; saprophytic on dead plant material. Compare with *Endophragmia*.

Illustration: *P. cookei*; redrawn from Mason and Hughes (283). (A) clustered conidiophores with attached conidia; (B) conidia.

ENDOPHRAGMIA Duvernoy and Maire. Conidiophores simple, brown, mostly single, often proliferating percurrently; conidia (aleuriospores) 2- to several-celled, brown to black, single, apical; saprophytic.

Illustration: *E. mirabilis*; original, from decayed wood. (A) conidiophore bearing apical conidia; (B) apex of conidiophores showing annellations; (C) conidia; (D) *E. taxi*. References (4, 114, 117).

ANNEEEOPHORA Hughes. Conidiophores brown, simple, slender, elongating by successive proliferations through the conidial scars; conidia (annellospores) brown, mostly 3- to several-celled, obclavate to fusoid; mycelium superficial on leaves.

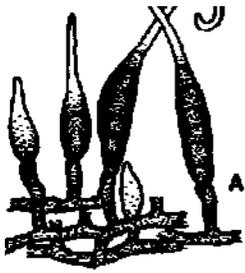
Illustration: *A. solani*; redrawn from Hughes (192). (A) conidiophores showing annellations; (B) conidia. Reference (117).

DEIGHTONIEEEA Hughes. Conidiophores arising from within epidermal cells, short, upper portion distinctly annellated; conidia (annellospores) dark, 3-celled; parasitic.

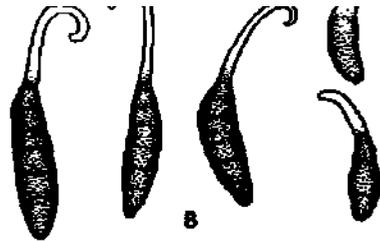
Illustration: *D. anmdinacea*. (A) conidiophores arising from epidermis of host; (B) conidia; redrawn from Hughes (205). Reference (17).

TRICHOCEADIUM Har/. Conidiophores short or absent; conidia (aleuriospores) dark, mostly 2- to several-celled, ovoid to ellipsoid to clavate; saprophytic on wood.

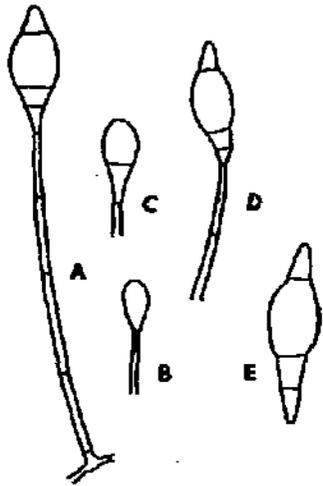
Illustration: *T. catuulense*; original. (A) sessile conidia; (B) conidiophores and conidia. References (158,200,211).



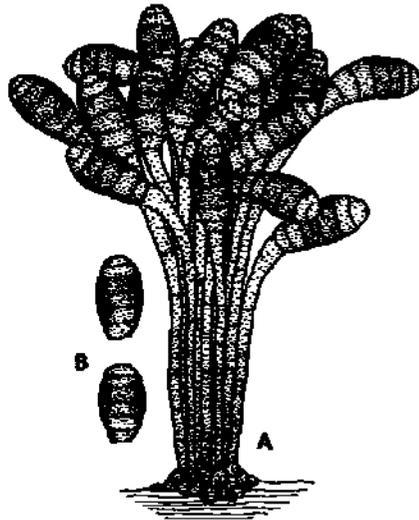
CERATOPHORUM



CLASTEROSPORIUM



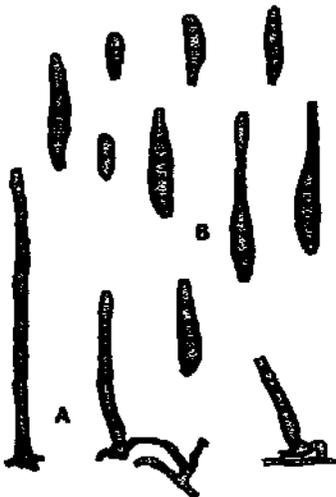
MONACROSPORIUM



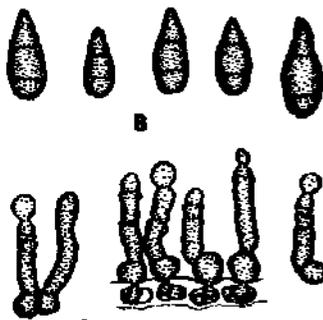
PHRAGMOCEPHALA



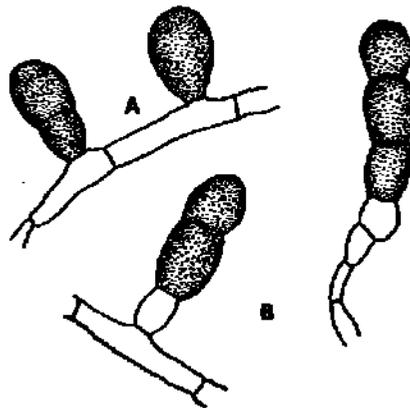
ENDOPHRAGMIA



ANNELLOPHORA



DEIGHTONIELLA



TRICHOCLADIUM

DENDRYPHIOPSIS Hughes. Conidiophores dark, stout, upright, dendritically branched, ultimate branches producing solitary apical conidia; conidia (porospores or blastospores) dark, 4- to several-celled, cylindrical, straight or slightly curved; saprophytic on wood.

Illustration: *D. atra*; original. (A, B) from fresh material on decayed wood; (C) from pure culture isolated from decayed wood. Reference (206).

STIGMINA Sacc. Conidiophores dark, rather short, simple, straight or bent, often arising in clusters from stromalike tissue and protruding through stomata of leaves, producing conidia apically and proliferating through previous spore scars, leaving annellate scars; conidia (annellospores) dark, 3- to several-celled, ovoid to ellipsoid; parasitic or saprophytic.

Illustration: *S. plantani*; original, from herbarium material on leaves of *Phytanum occidentale*. (A) section of leaf through clusters of conidiophores; (B) conidiophores with developing conidia; (C) conidia. References (118, 199, 304).

DICHOTOMOPHTHORA Mehrlick and Fitzpatrick. Conidiophores brown, branching, dichotomous to subdichotomous, elongated, terminally branched, 4- to 8-lobed, each lobe bearing a single conidium; conidia (porospores or blastospores) dark, ovoid to elongate-ovoid, 1- to 6-celled; parasitic on *Portulaca*.

Illustration: *D. portulacae*; redrawn from Mehrlick and Fitzpatrick (285). (A) conidiophore; (B) enlarged portion of conidiophore and conidia; (C) conidia.

SPONDYLOCLADIELLA Linder. Conidiophores dark, single or in small groups, branched; conidiogenous cells short, stubby, single or in groups; conidia (porospores or blastospores) dark, mostly 3-celled, oblong, borne singly, formed through small pores in apex of conidiogenous cells; saprophytic, often on hymenomycetes.

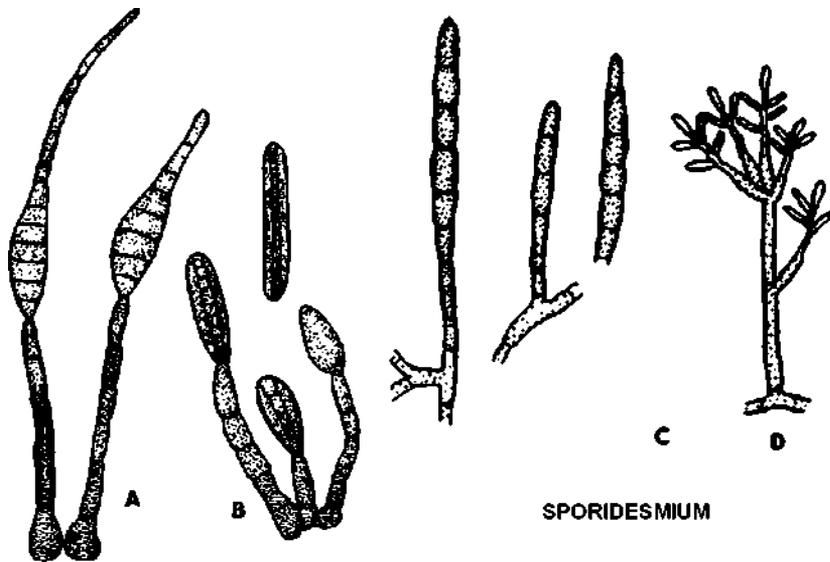
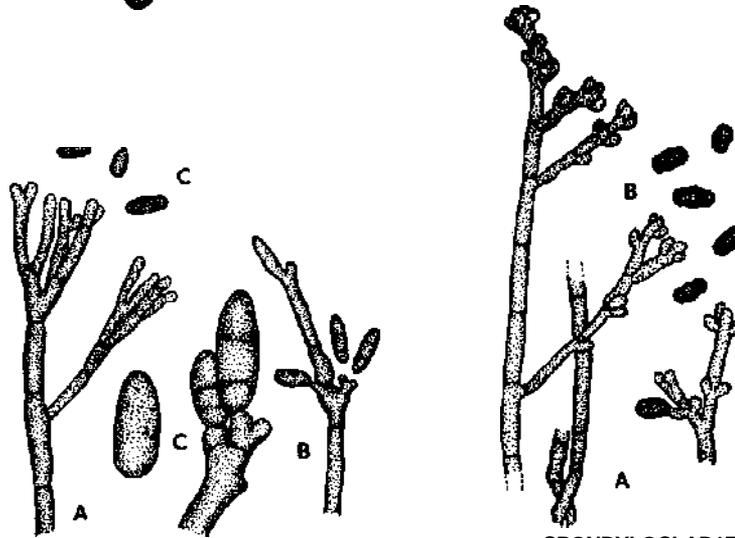
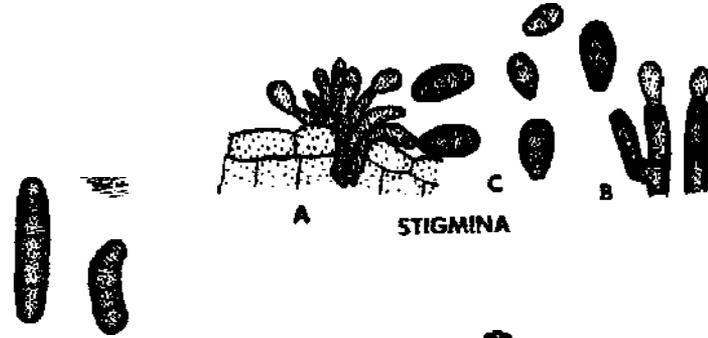
Illustration: *S. botrytioides*; redrawn from Linder (265). (A) conidiophores showing short, stubby sporogenous cells; (B) conidia.

CORYNESPORA Gussow. Mycelium internal in leaf; conidiophores emerge through leaf epidermis, slightly or conspicuously swollen at apex, simple, single, determinate or in tufts, proliferating terminally through scar of previous conidium; conidia (porospores) terminal, single or sometimes in short chains, brown, several-celled (pseudoseptate), with a thick, colorless exospore and prominent, dark basal scar; parasitic on leaves. Compare with *Helminthosporium*.

Illustration: *C. cassiicoia*; redrawn from Luttrell (273). (A) conidiophores and conidia; (B) conidium. References (119, 468).

SPORIDESMIUM Link. Conidiophores simple, determinate, brown; conidia (aleuriospores) several-celled, apical, single, brown, obclavate to long, fusoid; saprophytic or parasitic. *S. sderotivorum* is parasitic on sclerotia and has a secondary *Selenosporella* conidial state.

Illustration: (A) *S. tropicale*; (B) *S. folliculatum*; redrawn from Luttrell (273); (C) *S. sderotivorum*, original from culture; (D) *Selenosporella* state. References (118, 119, 455).



.CLIRVULARIA Boedijn. Conidiophores brown, mostly simple, bearing conidia apically or on new sympodial growing points; conidia (porospores) dark, end cells lighter, 3- to 5-celled, more or less fusiform, typically bent, with one of the central cells enlarged; parasitic or saprophytic.

Illustration: *C. lunata*; original, from culture. (A-C) conidiophores and conidia; (D) conidia. References (121, 308, 309, 322, 398).

HETEROSPORIUM Klotzch. Conidiophores dark, simple, conidia (blastospores, sympodulosporous) typically 3- to several-celled, cylindrical, wall often echinulate or verrucose, single or in acropetal chains; causing leaf spots or saprophytic. Compare with *Caldosporium*.

Illustration: *H. gracile*; original, from herbarium material on Iris leaf. (A) clusters of conidiophores; (B) conidia. Reference (238).

CERCOSPORIDIUM Erie. Stroma present; conidiophores densely fasciculate, brown, usually simple; conidia (sympodulosporous) single and apical on new sympodial growing points, clavate, cylindrical to obclavate, mostly pale brown, few- to several-celled; conidial scars conspicuous; on living leaves, causing leaf spots. Compare with *Fusicladium*, *Passalora* and *Cercospora*.

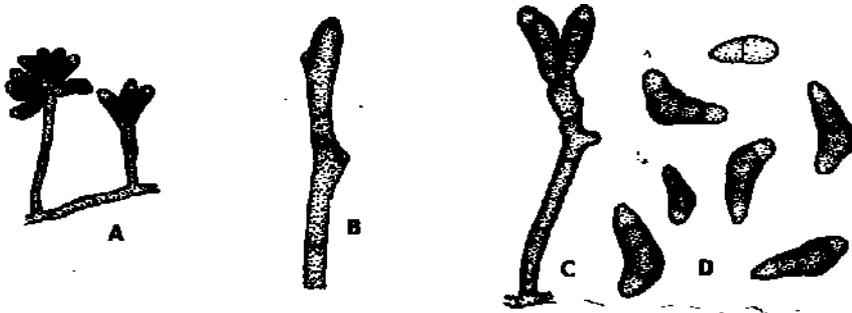
Illustration: *C. personatum*; redrawn from Deighton (78). (A) section through stroma; (B) apex of conidiophores; (C) conidia.

DRECHSLERA Ito. Conidiophores brown, mostly simple, producing conidia singly at apex through small pores, continuing growth sympodially from a point below apex and then forming a second spore on new apex; conidia (porospores) dark, several-celled (phragmosporous), cylindrical, germinating from any or all cells; parasitic or saprophytic. Compare with *Bipolaris*. Formerly included under *Helminthosporium*.

Illustration: (A-C) *D. avenaciwn*; redrawn from Luttrell (272). (A) conidiophores and conidia on leaf; (B) conidiophore showing scars; (C) germinating conidium; (D) *D. maydis*, conidia; (E) *D. carbonum*, conidia. References (96, 273, 372, 373).

GONATOPHRAGMIUM Deighton. Conidiophores well developed, brown, bearing conidia on short pegs on swellings or nodules; conidia (sympodulosporous) mostly 2- to 4-celled, pale brown, cylindrical-clavate; parasitic on leaves.

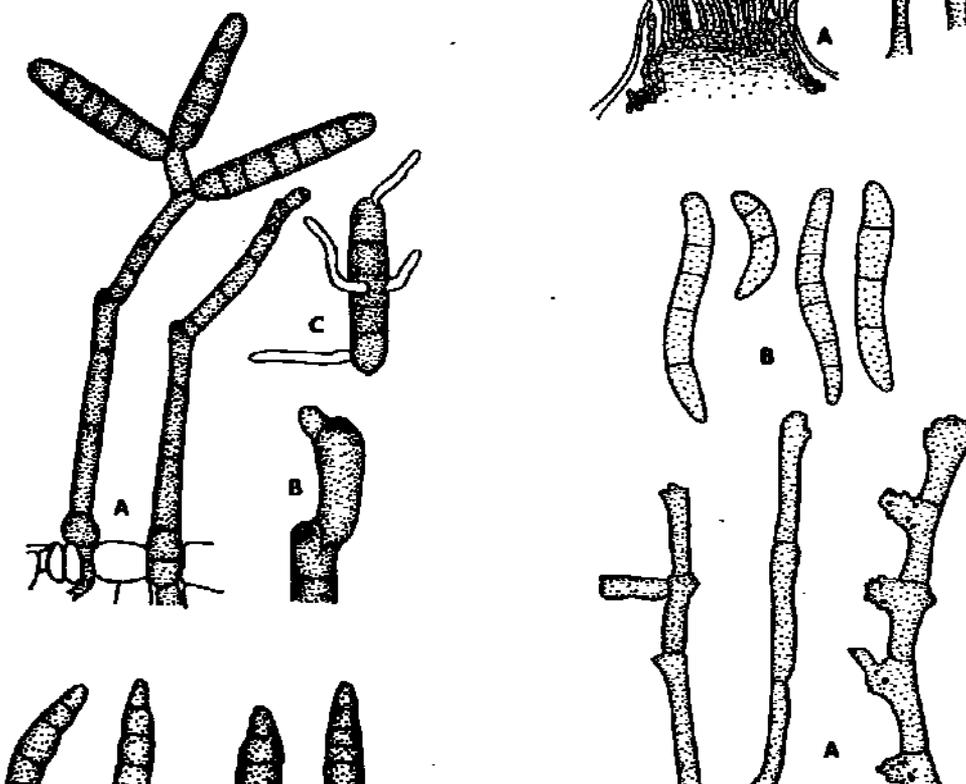
Illustration: *G. mori*; redrawn from Cejp and Deighton (52). (A) conidiophores; (B) conidia.



CURVULARIA



HETEROSPORIUM



DRECHSLERA

GONATOPHRAGMIUM

HELMINTHOSPORIUM Link ex Fr. Mycelium dark, often in substrate; stromata often present; conidiophores single or clustered, tall, erect, brown, simple; conidia (porospores) develop laterally through pores beneath septa while apex of conidiophore is still growing, often appearing in whorls, single, subhyaline to brown, obclavate, phragmosporous, pseudoseptate, with prominent basal scar; parasitic or saprophytic. Shoemaker (372-373) restricts the genus *Helminthosporium* to lignicolous species and classifies grassicolous species in *Bipolaris* and *Drechslera*,

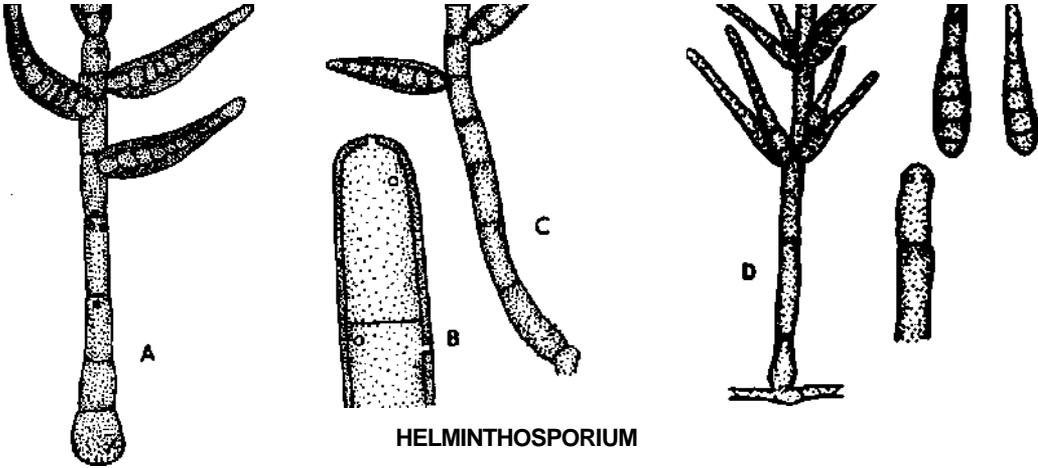
Illustration: *H. velutinum* (*Spondylocladium atrovirons*); redrawn from Luttrell (273). (A) conidiophores and conidia arising from stroma; (B) enlarged apex of conidiophore showing pores; (C) conidiophores and conidia from culture; (D) *H. solani*, original from culture. References (96, 272, 273, 372, 373, 375).

CACUMISPORIUM Preuss. Conidiophores dark, upright, septate, simple, bearing an apical head of conidia; conidia (sympodulospores or phialospores) dark, at first hyaline, mostly 4-celled, oblong to fusoid, straight or curved, produced on successively new growing points on hyaline projection of the conidiophore and aggregating in moist head; saprophytic. Conidiophore apex has been interpreted by some as a phialide.

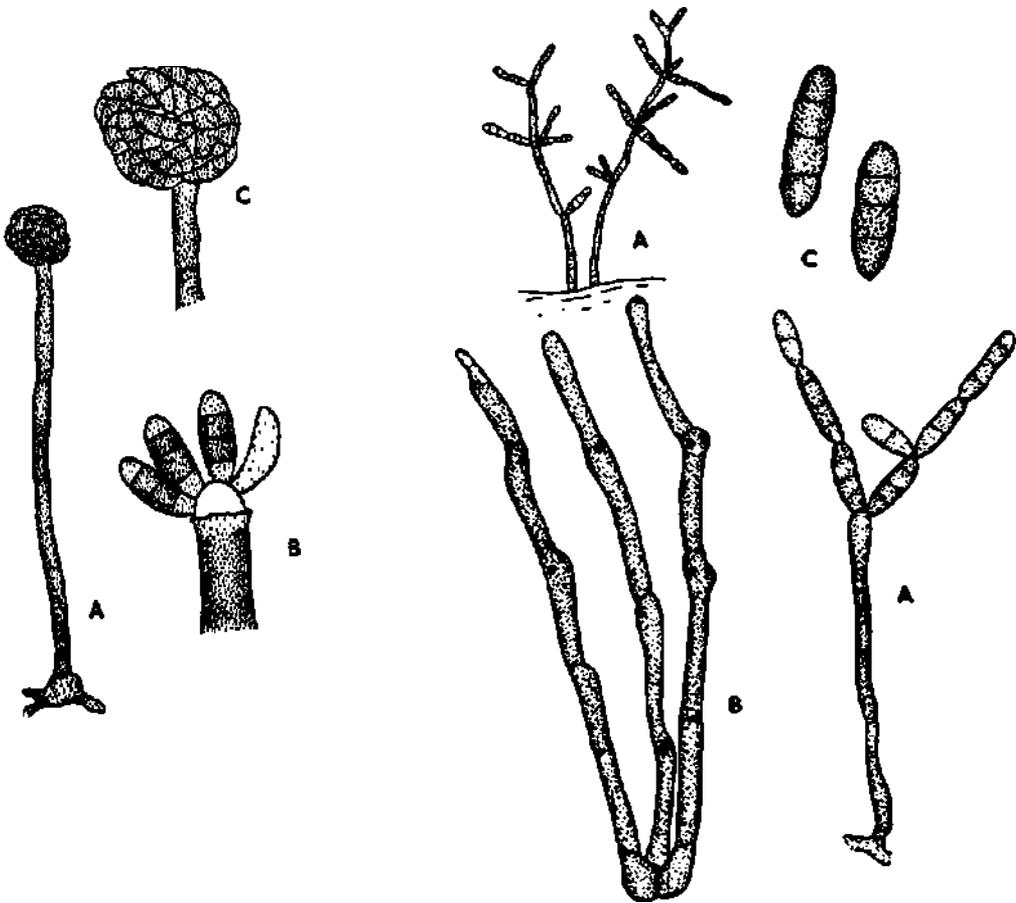
Illustration: *Cacumisporium* sp.; original, from decayed wood. (A) conidiophore and conidia; (B) conidial attachment at apex of conidiophore; (C) enlarged apex of conidiophore with conidia; (D) conidia. References (151, 206).

DENDRYPHION Wall. Conidiophores erect, dark, branched variously on upper portion, spore scars prominent; conidia (porospores) several-celled (phragmosporous), dark, catenulate, produced apically through pores in the conidiophores and new sympodial growing points; saprophytic on wood. See Barron (17) and Reisinger (353) for opinions on the genus *Dendryphiella*.

Illustration: *Dendryphion* sp.; original, from culture obtained from decayed wood. (A) conidia and conidiophores; (B) conidiophores; (C) conidia.



HELMINTHOSPORIUM



CACUMISPORIUM

DENDRYPHION

BIPOLARIS Schoemaker. Conidiophores brown, mostly simple, producing conidia through apical pore, resuming growth sympodially and forming conidia on successive new tips; conidia (porospores) brown, several-celled (phragmosporous), elliptical, straight or curved, germinating by one germ tube at each end; parasitic, chiefly on grasses; perfect stage, where known, *Cochliobolus*. Formerly included under *Helminthosporium*. Ellis (124) places this genus in *Drechslera*.

Illustration: *B. sorokinianum* (*B. sativum*); (A-C) redrawn from Luttrell (272). (A) conidiophore and conidia on leaf; (B) conidiophore showing scars; (C) germinating conidium; (D) original, from pure culture. References (96, 273, 372).

PLEUROPHRAGMIUM Constantin. Stroma sometimes present; conidiophores single or in groups, brown, pale near apex, septate, new growth sympodial; conidia (sympodulospores) pale brown, mostly 3-to 5-celled, phragmosporous, broadly ellipsoid to subclavate with rounded apex; conidial scars, mostly lateral, flat or on raised circles (described by Ellis as borne on denticles); saprophytic on wood or herbaceous stems. Compare with *Spiropes*.

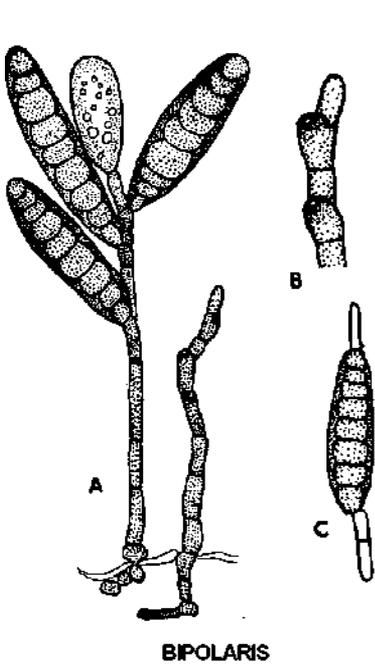
Illustration: *Pleurophragmium* sp.; original, fresh material on decayed wood. (A) habit of conidiophores; (B) simple conidiophore; (C) enlarged apex of conidiophores showing numerous scars; (D) conidia. Reference (123).

PLEUROTHECIUM Hohnel. Conidiophores single or in loose clusters, simple, dark, narrower and paler at apex; new growing points produced sympodially and producing new conidia; fertile area recurved to produce a curved cyme; conidia (sympodulospores) in moist heads, hyaline, typically 4-celled, ellipsoid or slightly curved.

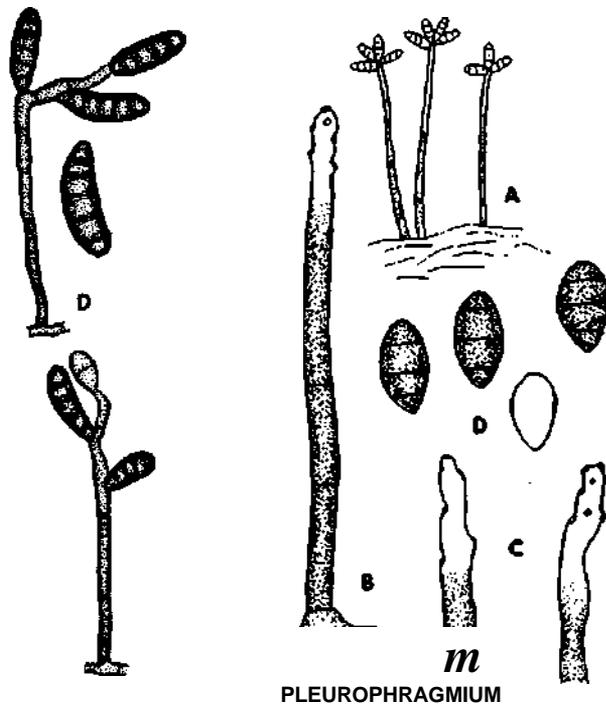
Illustration: *P. recurvaium*; original, from fresh material on decayed wood. (A) habit of conidiophores showing slime heads; (B) conidiophores and conidia; (C) cluster of conidia on conidiophore. Reference (17, 152).

BRACHYSPORIUM Sacc. Conidiophores brown, pale at apex, erect, solitary or in small clusters, simple, septate; conidia (sympodulospores) dark, ovoid to obovoid, unequally 3- to 4-celled, basal cell and apical cell may be nonpigmented, attached to apical cell of conidiophore by a slender pedicel, part of which remains attached to the fallen conidium; saprophytic on wood and bark.

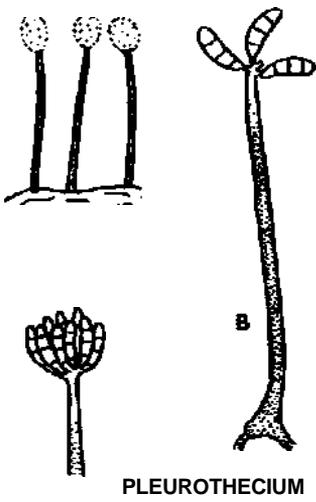
Illustration: (A, B) *B. nigrum*; (C, D) *B. obovatum*; all original, from fresh material on decaying wood. References (17, 121, 194).



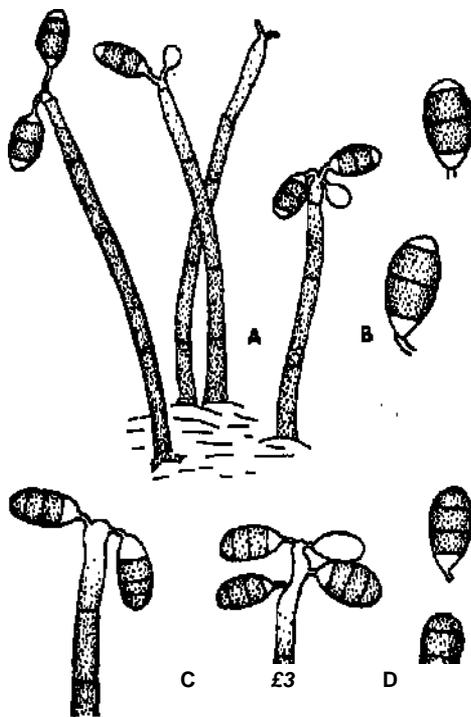
BIPOLARIS



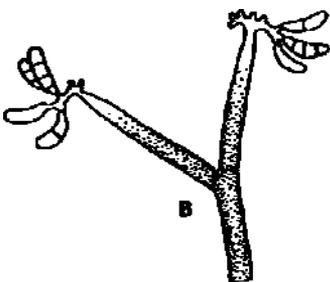
PLEUROPHRAGMIUM



PLEUROTHECIUM



BRACHYSPORIUM



NAKATAEA Hara. (VAKRABEEJA Subram.) Conidiophores simple, single, cylindrical, new growth sympodial, with prominent denticulate conidial scars near apex; conidia (sympodulospores) 3- to few-celled, phragmosporous, fusoid, straight to curved, light brown; parasitic on plants.

Illustration: *V. sigmoidea*; redrawn from Luttrell (272). (A) conidiophores and conidia; (B) apex of conidiophore.

DACTYLELLA Grove. Conidiophores tall, slender, simple, hyaline; conidia (sympodulospores, aleuriospores) hyaline, several-celled, ellipsoid, fusoid to cylindrical, borne singly at apex or in a loose cluster on prominent denticles; saprophytic or parasitic on nematodes.

Illustration: (A-C) *D. brochopaga*; original, from culture. (A-C) conidiophores and conidia; (D) conidiophore and conidium of *D. lepiospora*; original, from material on decaying wood. References (60, 61).

PYRICULARIA Sacc. Conidiophores long, slender, mostly simple; conidia (sympodulospores) obpyriform to nearly ellipsoid, attached at the broader end; hyaline, 2- to 3-celled, parasitic, chiefly on grasses.

Illustration: *P. grisea*; original, from leaf of *Setaria*.

PLEIOCHAETA Hughes. Conidiophores simple; conidia (sympodulospores) dark, mostly 5-celled, cylindrical to ellipsoid, sometimes slightly curved, the middle cell thick-walled and darker, bearing 1 to 4 long, slender, apical, hyaline appendages; parasitic, on plants.

Illustration: *P. setosa*; redrawn from DuPleissis and Truter (107). (A, B) conidiophores and appendaged conidia.

SEPTOCYLINDRIUM Bon. Conidiophores hyaline, simple; conidia (sympodulospores) hyaline, 2- to several-celled; oblong to cylindrical, catenulate; parasitic on higher plants or saprophytic. Compare with *Ramularia*.

Illustration: *S. aromaticum*; original, from herbarium material on leaves of *Acorum calamus*. (A, B) conidiophores and conidia.

CERCOSPORELLA Sac. Conidiophores hyaline, slender; conidia (sympodulospores) hyaline, several-celled, oblong, cylindrical to filiform, straight or curved; parasitic on higher plants; compare with *Cercospora*.

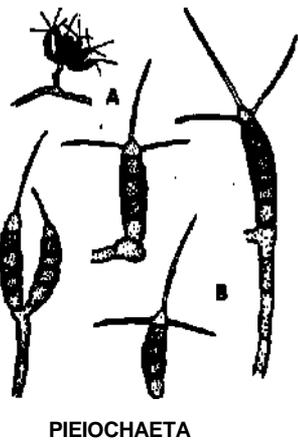
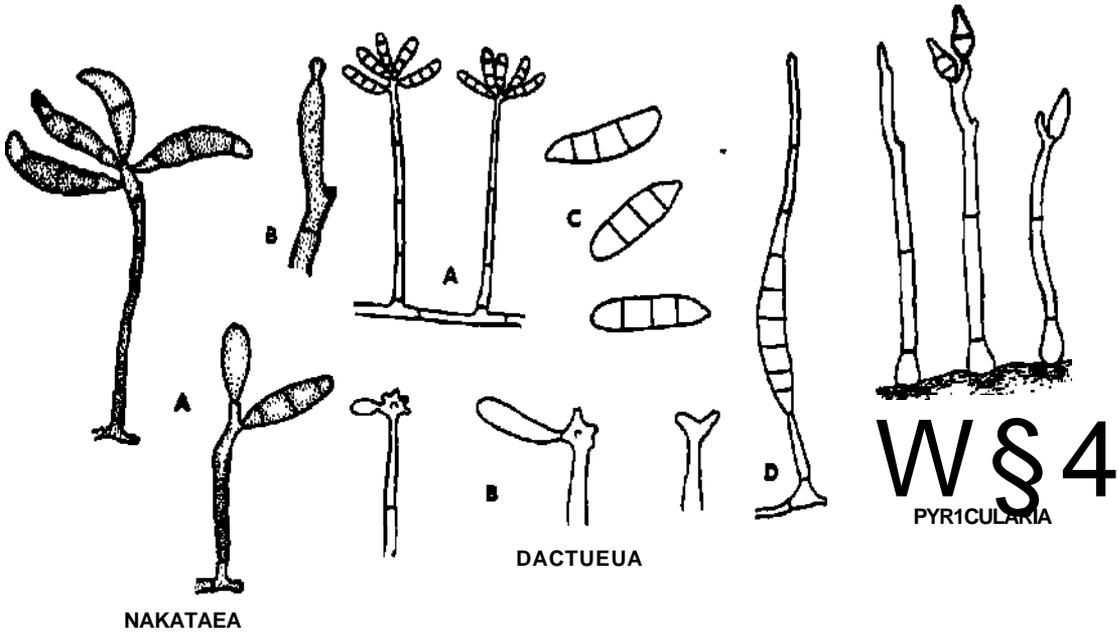
Illustration: *C. persica*; original, from herbarium material on peach leaf. (A) conidiophores and conidia; (B) conidia. Reference (81).

SPERMOSPORA Sprague. Conidiophores hyaline or nearly so, short, grouped; conidia (sympodulospores) hyaline, with distal cell elongated, attenuated, mostly 3- to 4-celled; parasitic on grasses, causing "leaf spots. Compare with *Cercospora*.

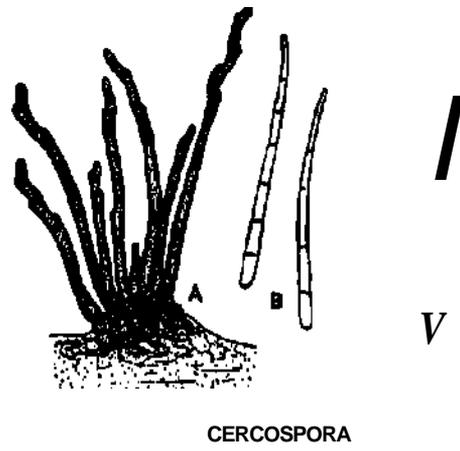
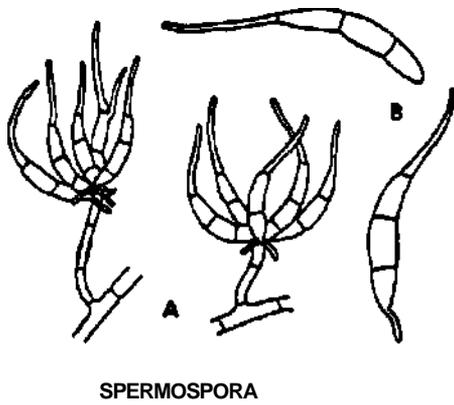
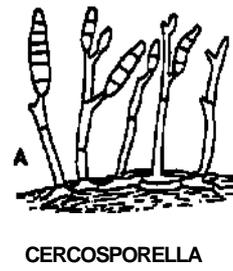
Illustration: *A. avenae*; original, from culture. (A) conidiophores and conidia; (B) conidia. References (79, 385, 386).

CERCOSPORA Frey. Conidiophores dark, simple, arising in clusters and bursting out of leaf tissue, bearing conidia successively on new growing tips; conidia (sympodulospores) hyaline or gray, long cylindrical to filiform, several-celled; parasitic on higher plants, commonly causing leaf spots.

Illustration: *C. apii*; original, from prepared slide of section through leaf. (A) cluster of conidiophores; (B) conidia; (C) *C. zea-niydis* conidia. References (55, 81, 82, 83, 84).



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FUSARIUM Link. Mycelium extensive and cotton-like in culture, often with some tinge of pink, purple, or yellow in the mycelium on medium; conidiophores variable, slender, and simple, or stout, short, branched irregularly or bearing a whorl of phialides, single or grouped into sporodochia; conidia (phialospores) hyaline, variable, principally of two kinds, often held in small moist heads; macroconidia several-celled, slightly curved or bent at the pointed ends, typically canoe-shaped; microconidia 1-celled, ovoid or oblong, borne singly or in chains; some conidia intermediate, 2- or 3-celled, oblong or slightly curved; parasitic on higher plants or saprophytic on decaying plant material. A large and variable genus, sometimes placed in the *Tuberculariaceae* because some species produce sporodochia. Thick-walled chlamydospores common in some species.

Illustration: *Fusarium* spp.; original, from culture. (A) hyphae with simple conidiophores; (B) variable conidiophores; (C) a loose sporodochium formed by branched conidiophores; (D) conidia. References (370, 444).

DACTYLIUM Nees. Conidiophores slender, branched verticillately; conidia (phialospores or sympodiuospores) borne singly or in small clusters on slightly elongating branches, hyaline 3- to 4-celled; saprophytic or parasitic on fleshy fungi; conidial states of *Hypomyces*. See Barron (17) for a discussion of *Dactylium*. Compare with *Cladobotryum*.

Illustration: *D. dendroides*; original from culture. (A, B) conidiophores and conidia; (C) conidia enlarged. Reference (258).

CYLINDROCARPON Wollen. Conidiophores erect, slender, hyaline, simple or branched irregularly, terminating in slender phialides, phialides usually with conspicuous collarette; conidia (phialospores) mostly 3- to 4-celled but often variable, hyaline, cylindrical, produced successively and aggregating in small fascicles; saprophytic or parasitic. Imperfect states of *Necfria*. Resembling *Fusarium* but larger, conidia typically not curved.

Illustration: *Cylindrocarpon* sp.; **original**, from culture. (A) conidiophores with attached conidia; (B) conidia. Reference (38).

FUSARIELLA Sacc. Conidiophores pigmented, typically branched, bearing conidia terminally on slender phialides; conidia (phialospores) dark, 3- to 4-celled, cylindrical, curved, borne in basipetal chains, not end to end, each conidium attached at the side of the conidium below; saprophytic on plant material.

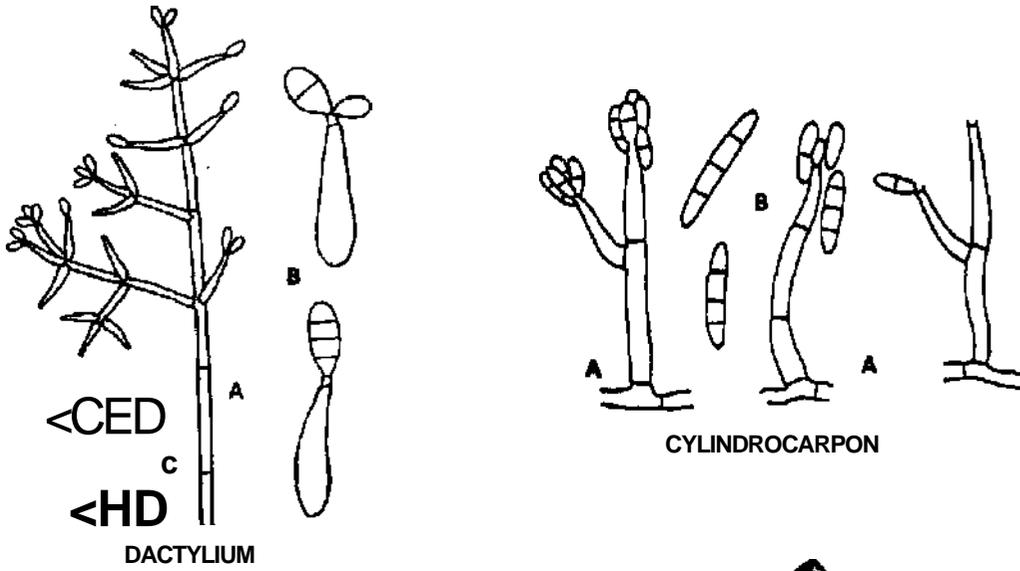
Illustration: *F. obstipa*; drawn from photographs by Pollack (336). (A) conidiophore and developing conidia; (B) chain of conidia. Reference (182).

SPOROSCHISMA Berk. and Dr. Conidiophores dark, upright, stout, simple, bearing conidia endogenously; conidia (phialospores) dark, 3- to 4-celled, cylindrical, sometimes in chains; saprophytic on decaying vegetation.

Illustration: *S. mirabile*; original, from culture. Mycelium, conidiophores, and endoconidia. References ((25, 173, 183).

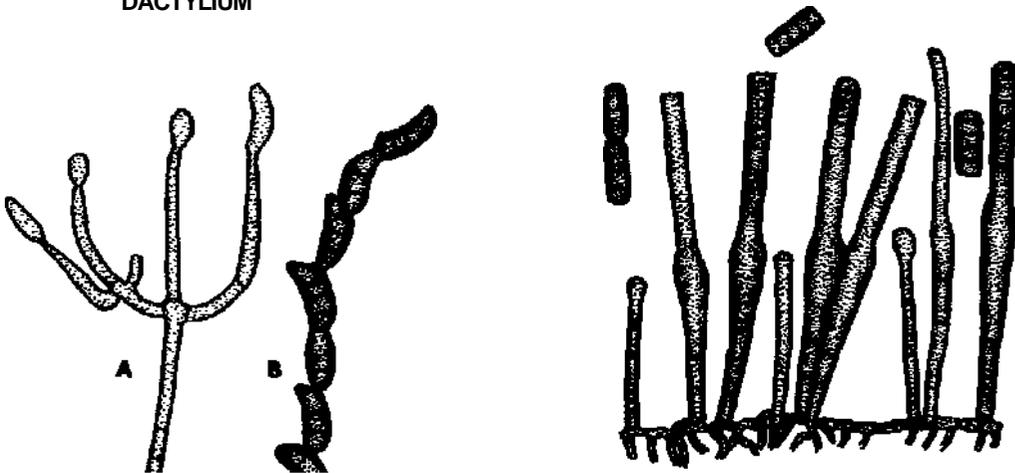


FUSARIUM



DACTYLIUM

CYLINDROCARPON



FUSARIEUA

SPOROSCHISMA

ALTERNARIA Nees. Conidiophores dark, mostly simple; determinate or sympodial, rather short or elongate; conidia (porospores) dark, typically with both cross and longitudinal septa; variously shaped, obclavate to elliptical or ovoid, frequently borne acropetally in apical simple or branched appendage; parasitic or saprophytic on plant material.

Illustration: (A-D) *Alternaria* sp.; (E) *A. solani*; both original, from culture. (A) conidiophore and chain of conidia; (B) simple conidiophore showing apical pore; (C) proliferating conidium; (D) conidia. References (239, 306, 376).

STEMPHYLIUM Wallr. Conidiophores dark, mostly simple with darker terminal swelling, short to long, bearing a single, terminal conidium, or successive conidia on new growing tips, conidiophore often proliferating through old conidial scar; conidia (porospores) dark, with cross and longitudinal septa, variable in shape, frequently globose, broadly ellipsoid, or ovoid, often constricted at major septum; parasitic or saprophytic. *

Illustration: 5". *sarcinaeforme*; original, from culture. (A) conidiophores and conidia; (B) conidiophore; (C) conidiophore proliferating through conidial scar. References (376, 377).

ULOCLADIUM Preuss. Conidiophores indeterminate, sympodial, dark, mostly simple, septate; conidia (porospores) dark, dictyosporous, usually without constriction at major septum, borne singly, apical, and on new sympodial growing points; saprophytic. Compare with *Alternaria* and *Stemphylium*.

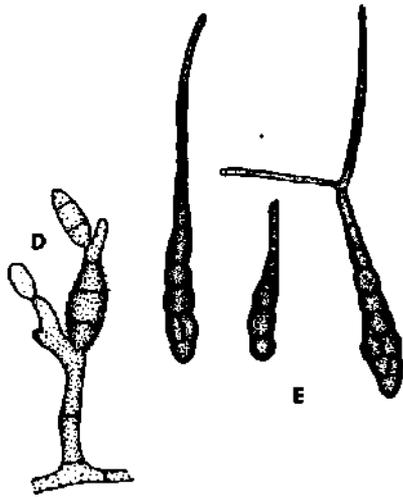
Illustration: *Ulocladium* sp.; original, from culture. (A) conidiophores showing development of conidia; (B) conidiophore showing conidial scars; (C) conidia. Reference (376).

PITHOMYCES Berkeley and Broome. Conidiophores short, simple, peglike, arising laterally from mycelium, subhyaline; conidia (aleuriospores) single, apical, mostly several-celled (dictyosporous), mostly broadly elliptical, oblong to pyriform or irregular, commonly verrucose or echinulate, usually detached by fracture of wall of conidiophore; saprophytic.

Illustration: *P. chartarum*; original, from culture. (A) mycelium, short conidiophores, and conidia; (B) conidia. Reference (17).

ACROSPEIRA Berk, and Br. Conidiophores short, simple, dark, variable, conidia (aleuriospores) apical, single, mostly 3- or 4-celled, cells arranged irregularly, apical cell enlarged, darker; hyaline phialides present, borne singly and producing chains of small, ovoid, hyaline conidia (phialospores).

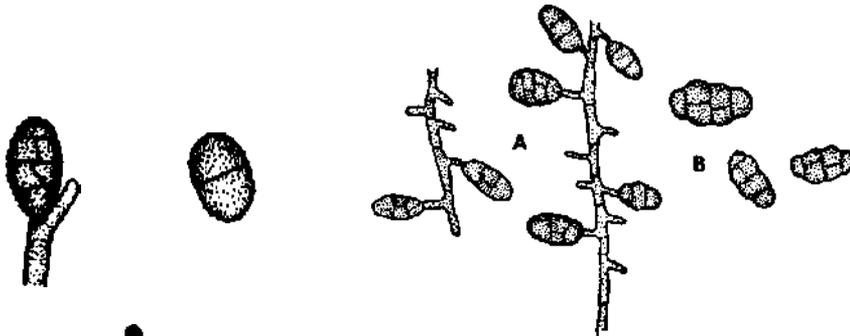
Illustration: *A. mirabilis*; redrawn from Wiltshire (473). (A) dark dictyospores; (B) phialides and chains of small conidia.



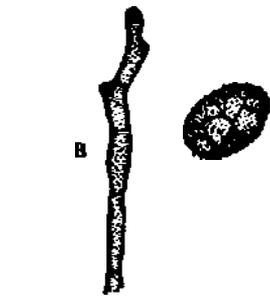
ALTERNARIA



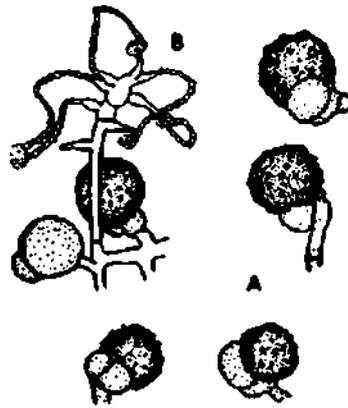
STEMPHYUUM



PITHOMYCES



ULOCLADIUM



ACROSPIRA

DICTY0ARTHRI1NRIM Hughes. Conidiophores much like *Arthrimum* (meristematic at base), simple, crowded, straight or curved, subhyaline, with thick, dark septa; conidia (meristem blastospores) 4-celled; cross-shaped, dark brown, apical and lateral on conidiophore; saprophytic.

Illustration: *D. quadralum*; redrawn from Subramanian (396). (A) conidiophore and conidia; (B) conidia. Reference (198).

CONIOSPORIUM Link. (= SIRODESMIUM deNot) Conidiophores dark, densely clustered, arising from a stroma, bearing terminal chains of conidia; conidia (meristem arthrospores) dark, elongate, septate, sometimes with longitudinal walls, borne in single chains, developing basipetally; saprophytic on wood.

Illustration: *C. granulorum*; original, from herbarium material on decaying wood. (A) conidiophores and conidia; (B) habit on wood; (C) chain of conidia. References (204).

DACTYLOSPORIUM Harz. Conidiophores dark, simple, paler at the tip, bearing conidia successively on new growing tips; conidia (sympodulospores) brown to subhyaline, ovoid, sometimes inequilateral, with cross and longitudinal or oblique septa; saprophytic.

Illustration: *D. marcopus*; redrawn from Hughes (203).

BERKLEASMIUM Zobel. Conidiophores clustered forming a loose sporodochium, dark, short, simple, each bearing a terminal conidium; conidia (aleuriospores) dark, large, containing many cells irregularly arranged (dictyosporous), oblong to obovoid; saprophytic on decaying wood.

Illustration: *B. conkinnum*; original, from herbarium material on decayed wood. Reference (293).

SIROSPORIUM Bubak and Serebianikov. Mycelium immersed in leaves or superficial; stroma may be present; conidiophores arising from hyphae or cells of stroma, simple or branched, brown, each bearing 1 to several conidial scars; conidia (sympodulospores) apical, single or successively on new growing tips that develop to side of previous conidium, subhyaline to brown, phragmosporous or dictyosporous, obovate to cylindrical, straight or flexuous; parasitic on leaves.

Illustration: *S. antenniforme*; redrawn from Ellis (118). (A) conidiophore and conidia; (B) mycelium and conidiophore; (C) conidia.

STIGMELLA Lev. Conidiophores simple, short, upright, composed of several cells or reduced to a peg; conidia (aleuriospores) dictyosporous, dark, single, apical, globose, elliptical, or cylindrical to obovoid, cells irregular in shape.

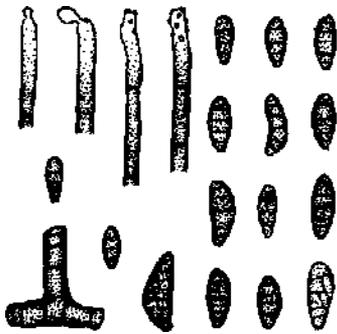
Illustration: *S. crataegi*; original, from herbarium material on leaves of *Crataegus*. (A, B) conidiophores and conidia in section of leaf; (C) conidia. References (113, 199).



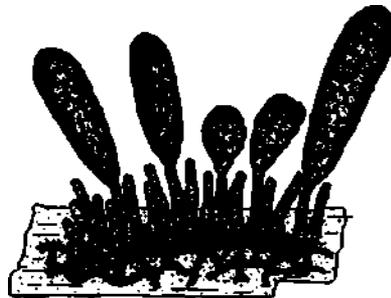
DICTYOARTHINIUM



CONIOSPORIUM



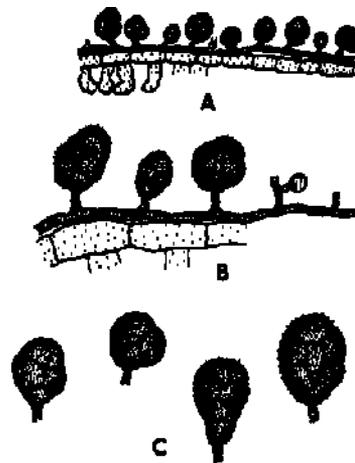
DACTYLOSPORIUM



BERKLEASMIUM



SIROSPORIUM



STIGMELLA

HELICOSPORIUM Nees. Conidiophores tall, slender, brown, septate, simple or branched, bearing conidia apically or laterally; conidia (sympodulosporcs) hyaline to pigmented, septate, coiled; saprophytic on decaying plant material.

Illustration: *Helicosporium* sp.; original, from culture. Mycelium, conidiophores, and conidia. References (30,289,290,453).

HELICOMA Corda. Conidiophores dark, upright, rather stout, septate, mostly simple; conidia (sympodulosporcs) hyaline or dark, septate, rather tightly curled; saprophytic on wood and bark.

Illustration: *H. muileri*; original, from herbarium material on maple wood, (A) conidiophores; (B) conidia. References (30, 289, 290, 453).

HELICOMIINA Olive. Conidiophores dark, slender, elongate, simple or branched, multiseptate; conidia (sympodulosporcs) dark, typically curved or coiled but with some straight conidia, septate, produced terminally and laterally; parasitic on higher plants. The genus differs from *Helicoma* in being parasitic and in producing a large number of straight conidia in addition to curved or coiled one.

Illustration: *H. caperoniae*; redrawn from Olive (316). (A) conidiophores; (B) conidia.

HELICOON Morgan. Conidiophores long, slender, simple or branched, hyaline or dark; bearing conidia terminally or laterally; conidia (biastospores or sympodulosporcs) hyaline or dark, coiled to form an ovoid or ellipsoid conidium, borne singly; saprophytic on decaying wood.

Illustration: (A) *H. auratum*; redrawn from Linder (264); (B) *H. thaxieri*; redrawn from Linder (265). Reference (289).

XENOSPORIUM Pen/ig. and Sacc. Conidiophores dark, comparatively short and stout, simple or branched, septate; conidia (aleuriospores) dark, tightly coiled, apical, having both transverse and longitudinal septa; saprophytic on decaying plant material.

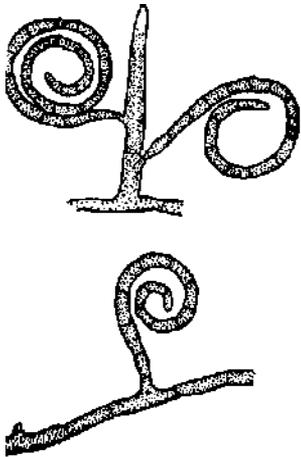
Illustration: *X. berkeleyi*; redrawn from Linder (264). Mycelium, conidiophores, and conidia. References (85, 290).

HELICODENDRON Peyron. Conidiophores hyaline, slender, branched, septate, bearing conidia terminally; conidia (biastospores) subhyaline to brown, coiled to form a large ovoid or ellipsoid spore, smaller, younger spores formed on the sides of the other spores; saprophytic on decaying plant material.

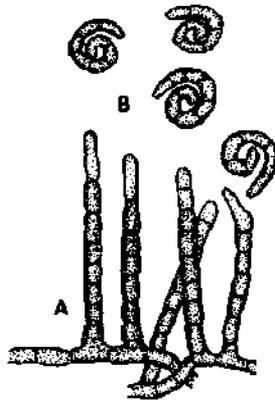
Illustration: *H. gigantium*; redrawn from Glen-Bott (146). Mycelium, conidiophores, and conidia. References (147, 263).

HELICOMYCES Link. Conidiophores hyaline, mostly simple, variable in length; conidia (symposulosporcs) hyaline or subhyaline, septate, conidial filaments thin, hygroscopic, tightly coiled in one plane; saprophytic on decaying wood.

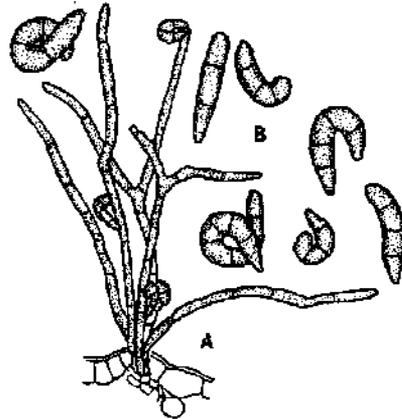
Illustration: (A) *H. scandens*; (B) *H. roseus*; redrawn from Linder (263). References (221, 289).



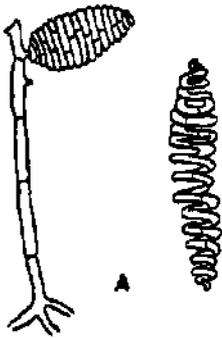
HEUCOSPORIUM



HELICOMA



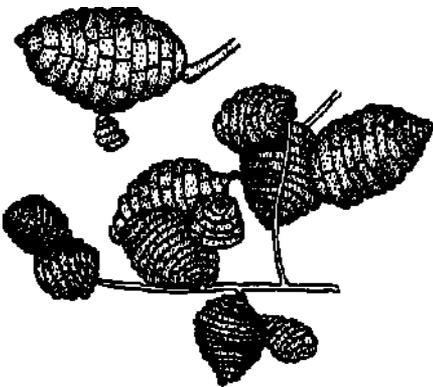
HELICOMINA



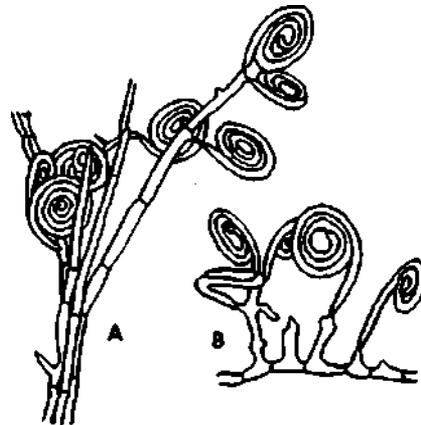
HELICOON



XENOSPORIUM



HELICODENDRON



HELICOMYCETES

FLAGELLOSPORA Ingold. Conidiophores long, slender, septate, branched above, ending in phialides that bear single conidia; conidia (phialospores) hyaline, 1- to several-celled, flagelliform, slender, curved; saprophytic on submerged decaying leaves.

Illustration: *F. penicillioides*; redrawn from Ingold (225). (A) portion of conidiophores and conidia; (B) conidia.

TRISCELOPHORUS Ingold. Submerged, aquatic, with branched, septate mycelium; conidiophores simple, slender; conidia single, apical, branched, consisting of (1) an elongated main axis continuous with the conidiophore and (2) elongated branches forming a whorl of 3 slender divergent branches arising from the lower part of the main axis, hyaline; saprophytic on decaying leaves in water.

Illustration: *T. monosporus*; redrawn from Tubaki (449). References (224, 327, 328).

LUNULOSPORA Ingold. Conidiophores long, slender, hyaline, branched **near** the apex, **the** branches bearing single conidia apically; conidia (blastospores) hyaline, 1-celled, elongate to filiform, bent, typically lunate; saprophytic on submerged leaves.

Illustration: *L. curvula*; redrawn from Ingold (223). (A) conidiophores and conidia; (B) conidia. References (327, 346).

LEMONNIERA DeWild. Conidiophores hyaline, slender, branched, ultimate branches bearing a few phialides; conidia apical, hyaline, ultimately septate, with 4 slender, widely divergent arms; saprophytic on submerged, decaying leaves.

Illustration: *L. aquatica*; redrawn from Ingold (223). References (228, 346).

VARICOSPORIUM Kegel. No sharp distinction between conidiophores and conidia; conidiophores simple *or* sparingly branched *near* the apex, bearing conidia apically; conidium consisting of a main elongated axis with 2 or 3 laterals on one side; each lateral is septate and branched again, hyaline; saprophytic, aquatic or in soil.

Illustration: *V. elodeae*; redrawn from Ingold (223). Reference (449).

TRICLADIUM Ingold. Conidiophores hyaline, long, slender, branched; conidia single, apical, hyaline, several-celled, curved, cylindrical, branched, the two branches usually arising from adjacent cells; saprophytic on submerged decaying leaves.

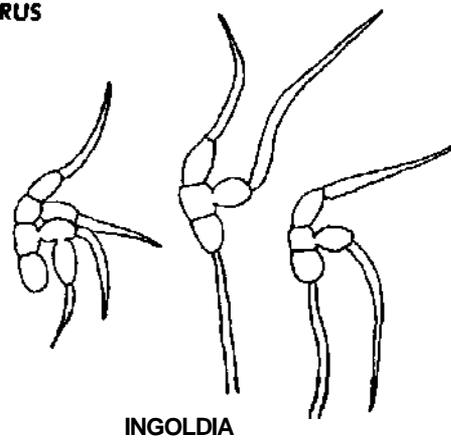
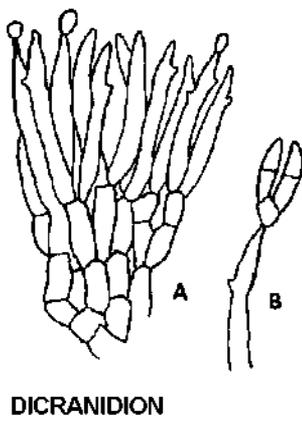
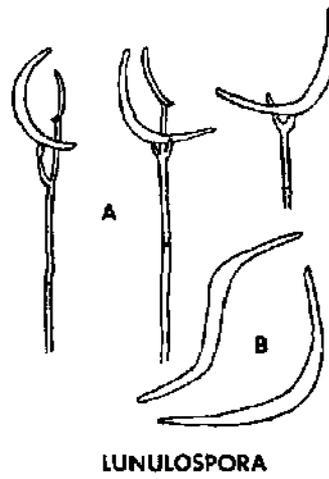
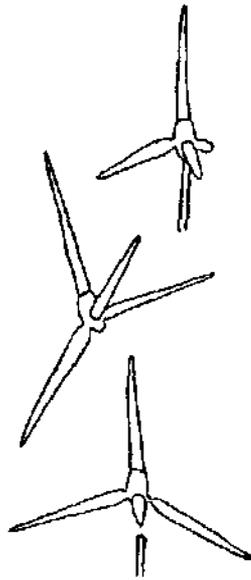
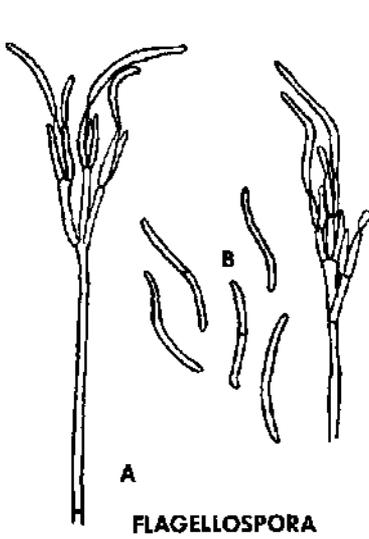
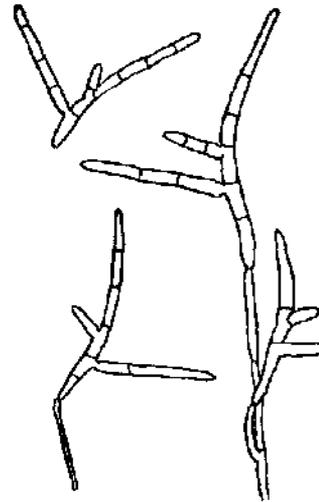
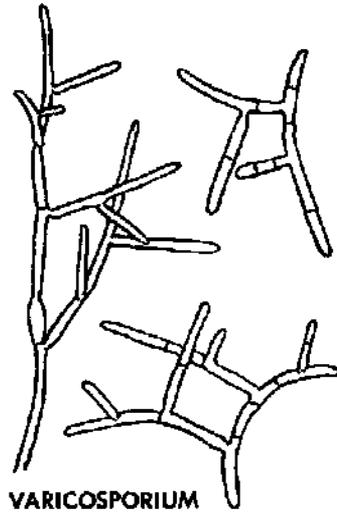
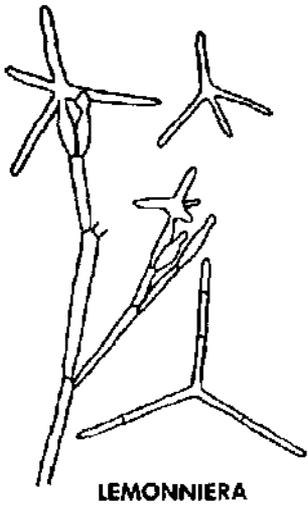
Illustration: *T. splendens*; redrawn from Ingold (223). Reference (327).

DICRANIDIUM Hark. Conidiophores hyaline, single or in loose masses (sporodochium-like), slender, simple or with a few branches, new growing points produced sympodially; conidia (sympodulospores) 5-celled, produced singly at apex or on new growing points on small denticles; saprophytic on wood.

Illustration: *D. fragile*; original, from decaying wood and from culture. (A) apical portions of conidiophores and immature conidia; (B) portion of conidiophore and mature conidium. Reference (97).

INGOLDIA Petersen. Submerged aquatic with septate mycelium; conidia single, apical, hyaline, septate, consisting of a curved, attenuated axis, two attenuated branches, and a single attenuated secondary branch; on submerged rotting leaves.

Illustration: *I. craginiformis*; redrawn from Petersen (327). References (231).



TRIDENTARIA Preuss. Conidiophores hyaline, long, slender, simple, septate, bearing a single conidium apically; conidia hyaline, trifurcate, rarely 2- or 4-pronged, the basal cell obconical, septate, prongs septate, tapering upward, slightly divergent; parasitic on nematodes or on soil rhizopods, or saprophytic on decayed wood.

Illustration: *77 implicans*; original, from culture isolated from decayed wood. (A) conidiophores and conidia showing tightly closed prongs as seen in a dry mount; (B) conidiophores and conidium as seen in water mount; (C) two mature conidia and one very young conidium. References (100, 101).

CULICIDOSPORA Petersen. Conidia single, apical, hyaline, elongate-clavate, 5-celled, subapical cell swollen and curved, with 2 straight hyphalike branches on the subapical cell and one on the apical cell; aquatic, on submerged rotting leaves.

Illustration: *C. gravida*; redrawn from Petersen (328). (A) conidiophores; (B) conidia.

ACTINOSPORA Ingold. Conidiophore hyaline, slender, septate, upper portion dichotomously branched, forming apical conidia singly; conidia hyaline, branched, the main body globose or ovoid, with 4 or 5 slender, radiating, septate branches; saprophytic on submerged twigs.

Illustration: *A. megalospora*; redrawn from Ingold (226).

TETRACHAETUM Ingold. Submerged, aquatic with septate mycelium; conidiophores simple or sparingly branched, slender; conidia single, apical, hyaline, several-celled, consisting of 4 long branches diverging from a common point, with one branch of the conidium (before liberation) continuous with the conidiophore; conidia produced under water, liberated by the breakdown of a special short separating cell.

Illustration: *T. elegans*; redrawn from Ingold (223). Reference (346).

DENDROSPORA Ingold. Submerged, aquatic with branched, septate mycelium; conidiophores simple, slender, hyaline; conidia apical, single branched, several-celled, each consisting of one main axis with several secondary and tertiary branches arising irregularly, hyaline; saprophytic, on decaying leaves in water.

Illustration: *D. erecta*; redrawn from Tubaki (449). Reference (87).

ANGUILLOSPORA Ingold. Submerged, aquatic, conidiophores hyaline, slender, simple; conidia single, apical, slender, several-celled, hyaline, separating from the conidiophore by the breakdown of a special separating cell at the apex; saprophytic.

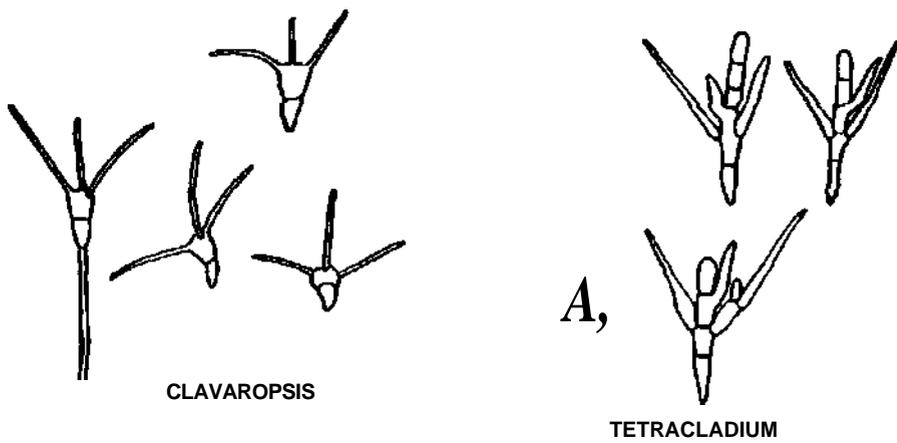
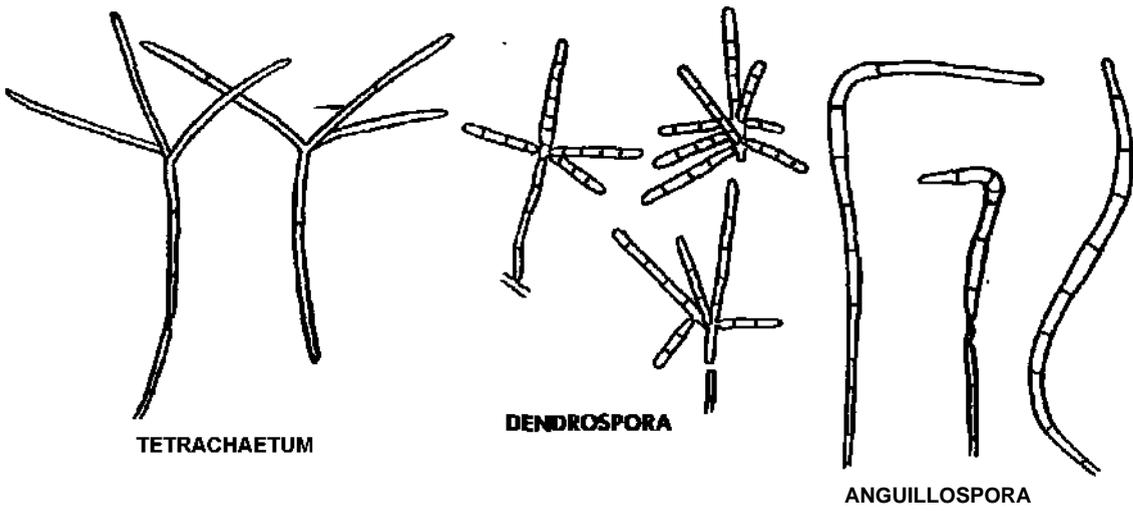
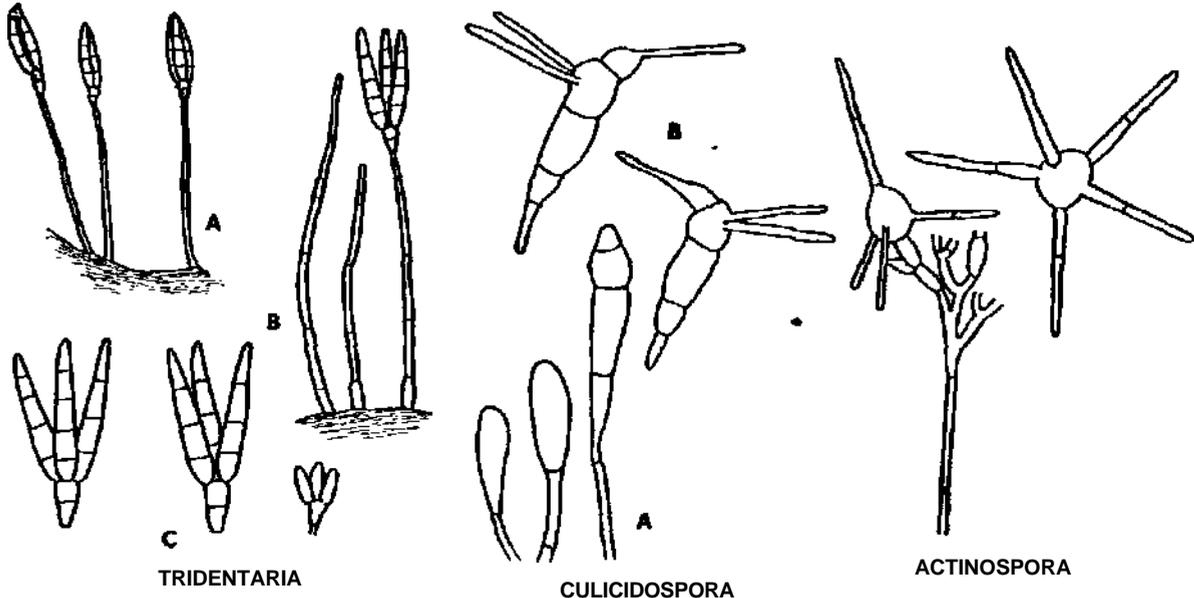
Illustration: *A. longissima*; redrawn from Ingold (223). References (228, 327).

CLAVARIOPSIS DeWild. Conidiophore long, slender, hyaline, simple; conidia hyaline, apical, single, branched, main axis pyriform, 2-celled, the three branches from the upper cell widely divergent at angles of about 120°; saprophytic on submerged decaying leaves.

Illustration: *C. aquatica*; redrawn from Tubaki (449). Reference (223).

TETRACLADIUM DeWild. Conidiophores hyaline, slender, septate, simple or branched in upper portion; conidia single, apical, hyaline, branched, the main axis narrowly clavate, finally septate, giving rise to three unequal, divergent, tapering branches; saprophytic on submerged decaying leaves.

Illustration: *77 setigerum*; redrawn from Tubaki (449). References (223, 346).



ALATOSPORA Ingold. Submerged, aquatic, with branched, septate mycelium; conidiophore simple or branched near the apex bearing a few phialides; conidia branched, consisting of 4 arms diverging from a common point; the conidium consisting essentially of a curved main axis (forming two arms) and 2 laterals inserted about the middle of the main axis, apical on the conidiophores, hyaline; saprophytic, on submerged leaves.

Illustration: *A. acuminata*; redrawn from Tubaki (449).

THAIXOSPORA Olive. No well developed conidiophores present; conidia develop as direct outgrowths from branching hyphae, slender, dichotomously branched, many-celled, hyaline, produced in a white mass inside the ovary of the host; systemic parasitic on higher plants (*Veronica peregrina*).

Illustration: *T. aspera*. (A, B) conidia; (C, D) conidia developing from hyphae; redrawn from Olive (316).

ARTICULOSPORA Ingold. Conidiophores hyaline, slender, upper part sparingly branched; conidia hyaline, apical, branched, septate, slender, the three branches slender and about the same diameter as the main axis; saprophytic on decaying submerged leaves.

Illustration: *A. inflata*; redrawn from Ingold (225). (A) conidiophores bearing conidia; (B) conidium. References (327, 346).

DIPLOCLADIELLA Arnaud. Conidiophores erect, producing apical and lateral conidia; conidia (sympodulospores) consisting of two septate, slender, pointed arms radiating from the basal cells; central cells dark, apical, and basal cells hyaline; saprophytic.

Illustration: *D. scalaroides*; redrawn from Tubaki (450). (A) conidiophores with attached conidia; (B) conidia.

TETRAPLOA Berk and Vr. Conidiophores absent; conidia borne directly on mycelium, each consisting of 3 to 4 initial cells, each of which develops into a long, attenuated, septate appendage, smooth or rough. brown; saprophytic.

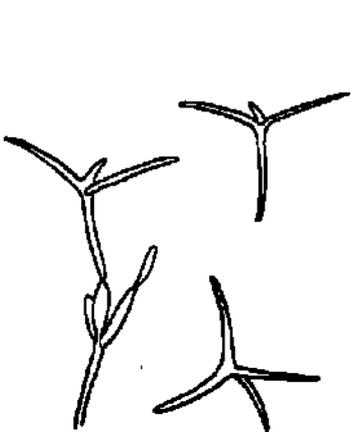
Illustration: (A, B) *T. aristita*; (C) *T. eliisii*; redrawn from Ellis (112).

SPEIROPSIS Tubaki. Conidiophores erect, simple, straight, septate; conidium single, apical, consisting of a basal cell and 3 to 5 somewhat divergent arms, each arm consisting of an acropetalous chain of cells, pale brown.

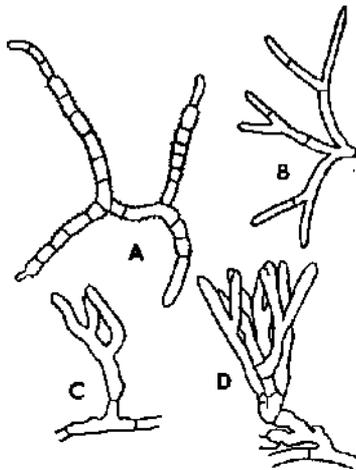
Illustration: *S. pedatospora*; redrawn from Tubaki (450).

TRIOSPERMUM Speg. Conidiophores absent; conidia (blastospores) subhyaline to dark brown, septate, staurosporous, borne directly on cells of the mycelium and consisting of a stalk and two pairs of divergent, pointed septate arms; branches not formed simultaneously; saprophytic.

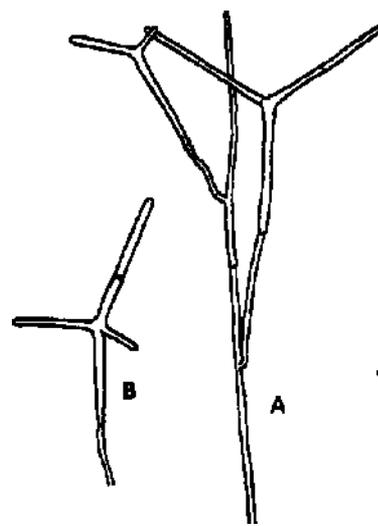
Illustration: *T. myrti*; original, from culture. (A) stages in development of a conidium from a hypha; (B) branched conidia. Reference (17, 234).



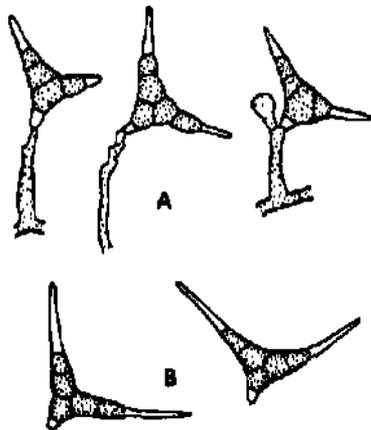
ALATOSPORA



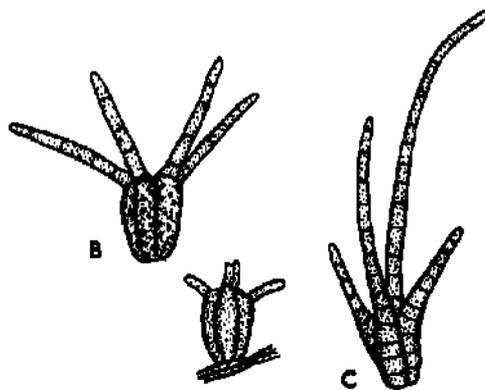
THALLOSPORA



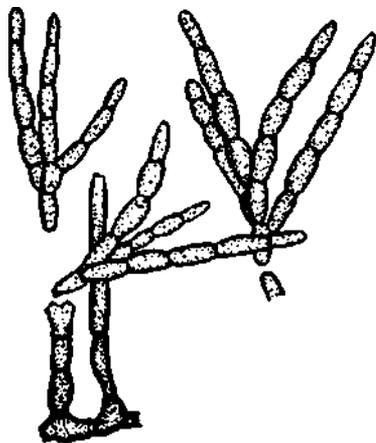
ARTICULOSPORA



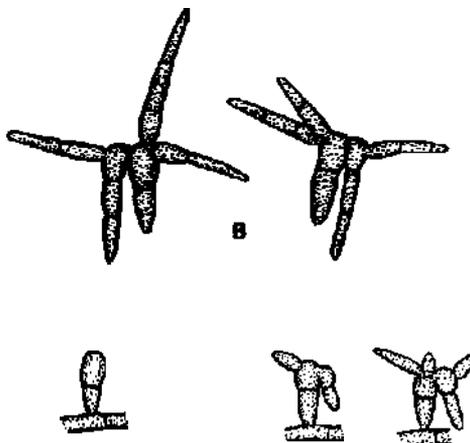
DIPLOCLADIELLA



TETRAPLOA



SPEIROPSIS



TRIOSPERMUM

CERATOSPORELLA Hohn. Conidiophores dark, simple, upright, bearing single conidia successively by protrusion of conidiophore through old conidial scars; conidia (annellospores) dark, composed of 2 or more septate branches, each arising separately from a basal cell; saprophytic.

Illustration: *G stipitata*; redrawn from Hughes (201). (A) conidiophores, some with an apical conidium; (B) conidia. Reference (190).

DICTYOSPORIUM Corda. Conidiophores dark, slender, simple or branched, usually short, bearing a single branched conidium apically; sometimes arranged in sporodochia; conidia with several close septate branches arising from different points (branches do not all arise separately from a basal cell); saprophytic.

Illustration: (A) *D. toruloides*; redrawn from Ellis (125); (B) *Dictyosporium* sp.; original from material on decayed wood. References (73, 190).

TRIPOSPORIUM Corda. Conidiophores dark, simple, slender, septate, bearing a single conidium apically; conidia dark, with three septate arms radiating from a central cell; parasitic on leaves, or saprophytic on plant material.

Illustration: *T. elegans*; redrawn from Ellis (125). (A) conidiophores; (B) conidia.

HIRUDINARIA Ces. Mycelium mostly superficial, subhyaline; conidiophores reduced to short lateral swellings on the mycelium, brown; conidia consisting of 2 (less often 3) straight or curved arms (horns) tapering upward, several-celled, dark; parasitic on leaves.

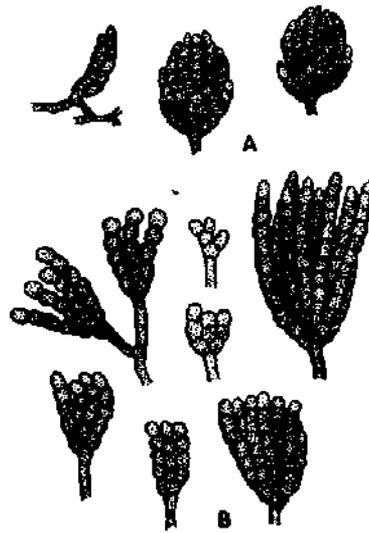
Illustration: *H. macrocarpa*; original, from herbarium material on *Crataegus* leaves. (A) much reduced conidiophores emanating from the mycelium; (B) conidia. Reference (186).

CERATOSPORIUM Schw. Conidiophores consisting of a short cylindrical cell; conidia consisting of 2 or 3 straight or curved arms (horns), tapering upward, several-celled, dark; saprophytic on wood or bark; near *Hirudinaria* morphologically.

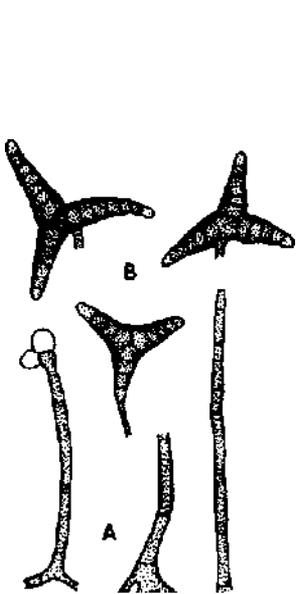
Illustration: *C. fuscescens*; redrawn from Hughes (186). (A) mycelium showing short conidiophores and developing conidia; (B) conidia.



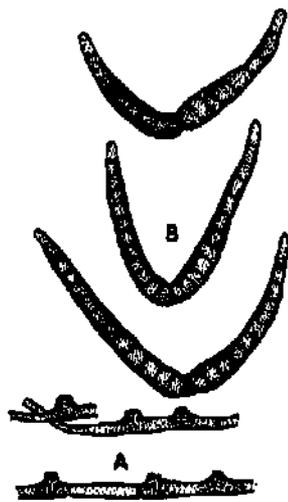
CERATOSPORELLA



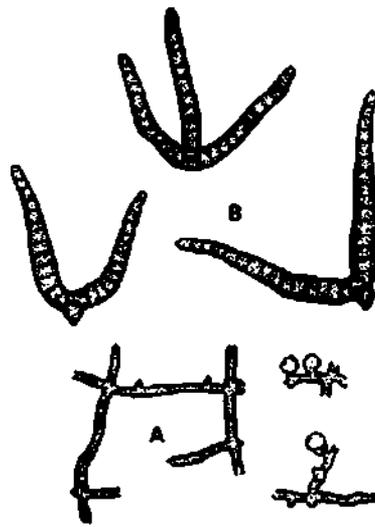
DICTYOSPORIUM



TRIPOSORIUM



HIRUDINARIA



CERATOSPORIUM

TUBERCULARIA Tode. Sporodochia rather large, light to orange in color, breaking out through the bark; conidiophores hyaline, elongate, repeatedly irregularly branched, and bearing conidia terminally; conidia hyaline, 1-celled, ovoid to elongate in a dry mass on the surface of the sporodochium; mostly saprophytic on wood.

Illustration: *T. vulgaris* (Conidial state of *Neclria cinnabarina*); original, from dried material on twigs. (A) sporodochia on twig; (B) section through sporodochium; (C) conidiophores and conidia.

HADROTRICHUM Fr. Sporodochia cushion-shaped, dark; conidiophores dark, simple, forming a palisade and arising from a stromalike layer; conidia dark, nearly spherical, 1-celled, borne singly; parasitic on leaves; the genus is often placed in the Dematiaceae.

Illustration: *IT blasdalei*; original, from herbarium material on leaves of *Vicia*. (A) sporodochia on leaf; (B) side view of sporodochium; (C) conidiophores and conidia. Reference (205).

ILLOSPORIUM Mart. Sporodochia cushionlike, light colored; conidiophores hyaline, branched, phialides bearing conidia apically; conidia hyaline, ovoid to oblong, collecting on the surface of the sporodochium in gelatinous material; parasitic or saprophytic on leaves, frequently as a secondary invader.

Illustration: *I. malifoliorum*; original, from dried material on apple leaves. (A, B) sporodochia and masses of conidia; (C) conidiophores and conidia.

STRUMELLA Fr. Sporodochia cushionlike, dark; conidiophores dark, branched; conidia dark, 1-celled, ovoid or oblong to irregular; parasitic or saprophytic on wood.

Illustration: *S. coryneoidea* (conidial state of *Urnulla craterium*); original, from herbarium material on oak. (A) sporodochia; (B) conidia. Reference (76).

HYMENELLA Fr. Sporodochia somewhat flattened or discoid, light colored; conidiophores hyaline, sparingly to moderately branched, bearing terminal conidia; conidia hyaline, 1-celled, ovoid to oblong, collecting in a dry mass (not in slime) on sporodochium; saprophytic.

Illustration: *H. cerealis*; original, from herbarium material on wheat straw. (A, B) sporodochia; (C) conidiophores and conidia.

SPHAEROSPORIUM Schw. Sporodochia yellowish when fresh, cushion-shaped to hemispherical; conidiophores short, compact, hyaline, bearing apical chains of conidia; conidia 1-celled, globose to ovoid, large with prominent scars of attachment, hyaline or yellowish; saprophytic on decayed wood.

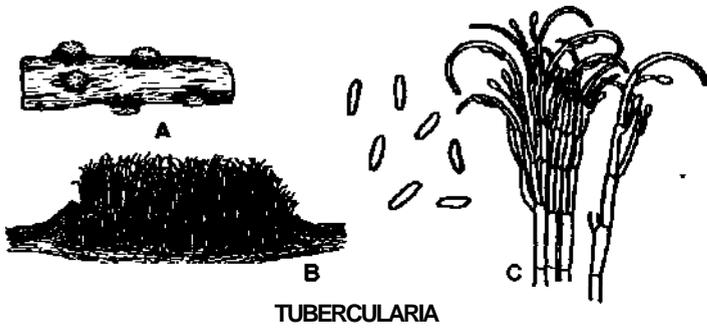
Illustration: *S. lignatile*; original, from fresh material on decayed wood. (A, B) sporodochia on wood; (C) conidiophores; (D) conidia.

DENDRODOCHIUM Bon. Sporodochia cushionlike, light, bursting out of bark; conidiophores hyaline, verticillately branched; conidia hyaline, 1-celled, ovoid to oblong, dry in mass; saprophytic on bark.

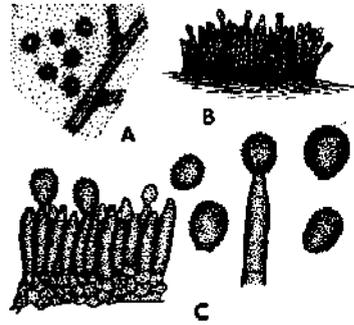
Illustration: *D. rubellum* var. *microsporum*; original, from herbarium material on bark of *Liriodendron*. (A, B) sporodochia on bark; (C) conidiophore; (D) conidia.

MYROTHECIUM Tode. Sporodochia cushionlike, sometimes with marginal hyaline setae; conidiophores subhyaline to colored, repeatedly branched, bearing conidia terminally; conidia subhyaline to dark, 1-celled, ovoid to elongate, dry in mass, parasitic or saprophytic.

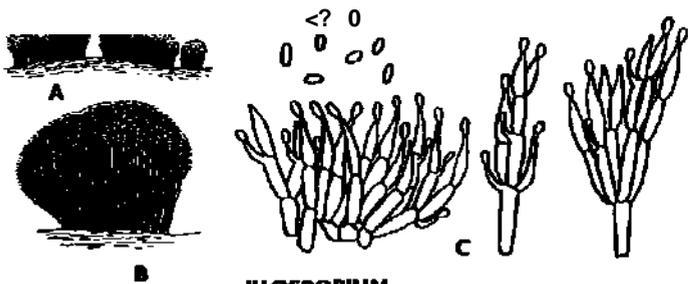
Illustration: *M. roridum*; original, from herbarium material on leaf on *Viola*. (A) sporodochium; (B) conidiophores and conidia. References (133, 337, 338, 339, 454).



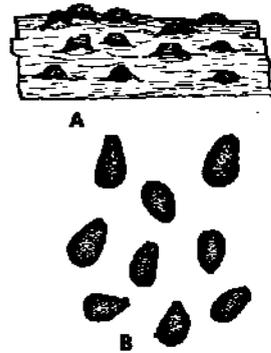
TUBERCULARIA



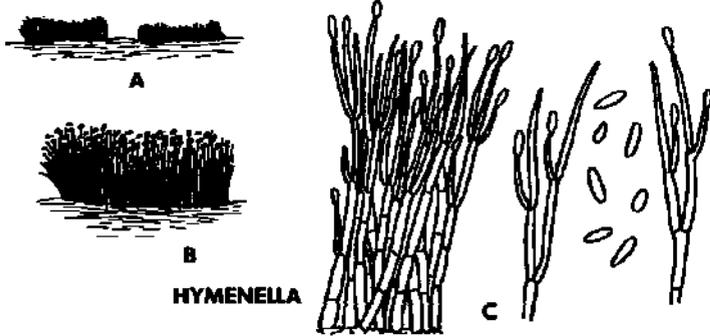
HADROTRICHUM



ILLOSPORIUM



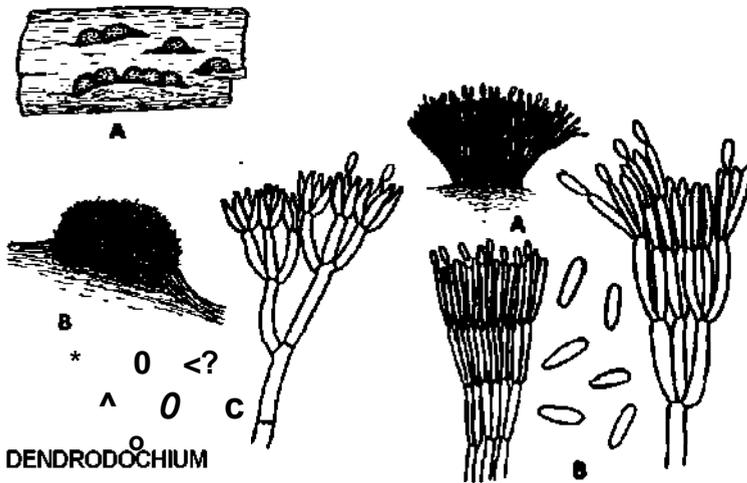
STRUMELLA



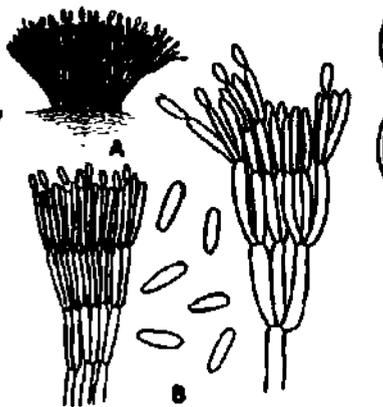
HYMENELLA



SPHAEROSPORIUM



DENDRODOCHIUM



MYROTHECIUM

TIJBERCUIJNA Sacc. Sporodochia small, breaking out in or near rust pustule; conidiophores hyaline, simple, bearing single conidia terminally; conidia hyaline, 1-celled, globose or ovoid to irregular; parasitic on rusts.

Illustration: *T. persincia*; original, from herbarium material on *Euphorbia marginala*. (A) section of sporodochia; (B, C) conidiophores and conidia; (D) aeciospore of rust. Reference (179).

SPHACELIA Lev. Sporodochium stromalike, spreading; conidiophores hyaline, simple, in a compact palisade; conidia hyaline, small, ovoid, 1-celled, produced in a sugary "honey dew"; parasitic in ovary of grain; conidial state of *Claviceps*.

Illustration: *S. segetum* (*Claviceps purpurea*); original, from prepared slide. (A) section through young sclerotium; (B) portion of A, enlarged; (C) palisade of conidiophores and conidia.

VOLUTELLA Tode. Sporodochia discoid, with marginal dark setae; conidiophores usually simple, in a compact palisade; conidia hyaline, 1-celled, ovoid to oblong; parasitic "or saprophytic.

Illustration: *V. fructii*; original, from herbarium material on apple fruit. (A) erumpent sporodochia on apple fruit; (B) conidiophores, conidia and setae.

PUCINIOPSIS Speg. Sporodochia dark, cushion-shaped; conidiophores dark, simple, in a layer, bearing conidia apically on successive new growing tips; conidia dark, typically 2-celled, ovoid to oblong; parasitic.

Illustration: *P. caricae*; original, from herbarium material on leaves of *Carica papaya*. (A) sporodochia on leaf; (B) section of sporodochia; (C) conidiophores and conidia. Reference (266).

RAMULISPORA Miura. Sporodochia small, arising from substomatal stromata and pushing through stomata; conidiophores hyaline, simple or branched, short; conidia hyaline, filiform, septate, with short lateral branches, produced in gelatinous material; superficial sclerotia present; parasitic on leaves.

Illustration: *R. sorghi*; redrawn from Olive *et ai* (317). Stroma, conidiophores, and conidia in stoma.

EXCIPULARIA Sacc. Sporodochia superficial, scattered, dark, with setae; setae simple, dark, septate, pointed; conidiophores short, simple, subhyaline; conidia several-celled, dark brown, fusiform, apical, single; saprophytic.

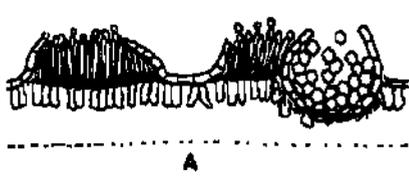
Illustration: *K narsapurensis*; redrawn from Subramanian (403). (A) sporodochium; (B) conidia; (C) seta.

BACTRIDIDIUM Kunze. Sporodochia cushion-shaped to hemispherical, bright-colored (yellow); conidiophores long, simple or branched, hyaline; conidia apical, single, hyaline or containing yellow pigment, several-celled, very large, cylindrical to long-ellipsoid; saprophytic, on decayed wood.

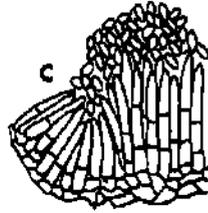
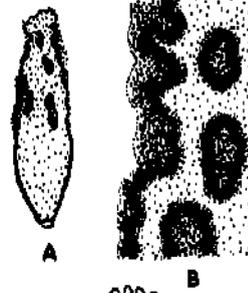
Illustration: *B. flava*; original, from fresh material on wood. (A) sporodochium; (B) conidiophores; (C) conidia.

EXOSPORIUM Link ex Schlech. Mycelium immersed, dark; stromata and sporodochia usually present, often well developed; conidiophores usually grouped, erect, brown; conidiophore growing out laterally or obliquely below conidial scar, splitting side wall, then forming new conidium through pore at apex of new growing point; conidia single, pseudoseptate several-celled, with prominent scar; mostly saprophytic.

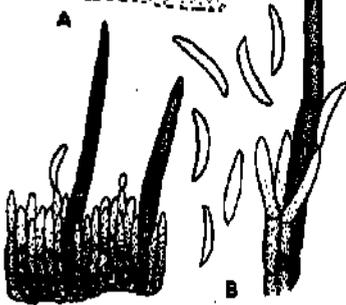
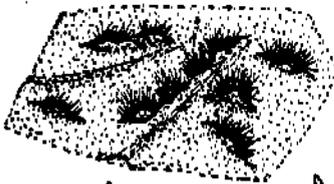
Illustration: *E. tiliae*; (A) sporodochium; (B) conidiophores and conidia; redrawn from Luttrell (272). Reference (117).



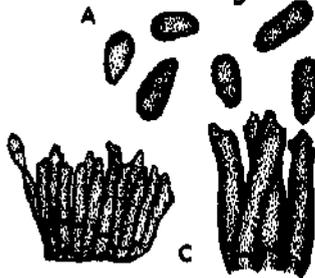
TUBERCULINA



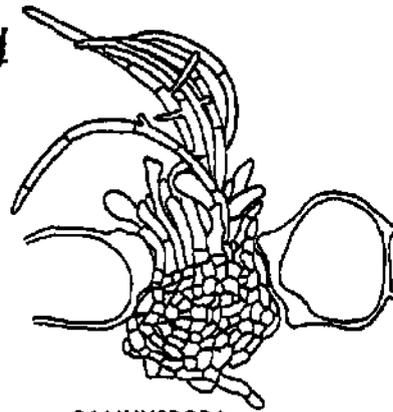
SPHACELIA



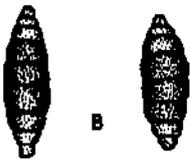
VOLUTELLA



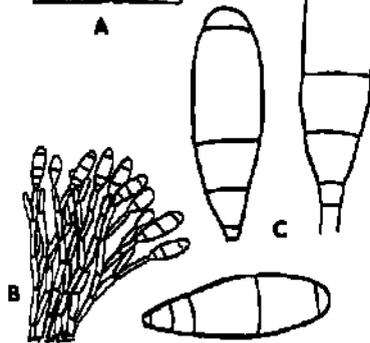
PUCCINIOPSIS



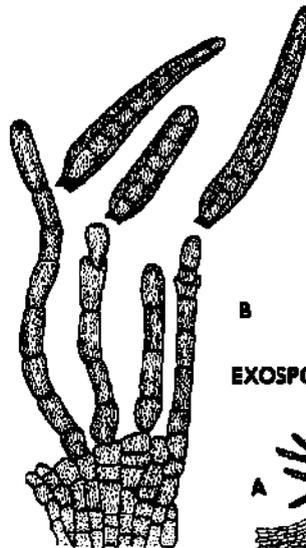
RAMULISPORA



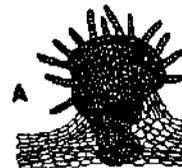
EXCIPULARIA



BACTRIDIUM



EXOSPORIUM



EPICOCCUM Link. Sporodochia dark, more or less cushion-shaped, variable in size; conidiophores compact or loose, dark, rather short; conidia dark, several-celled (dictyosporous), globose; mostly saprophytic, or weakly parasitic.

Illustration: *E. nigrum*; original, from fresh material on decayed wood. (A) sporodochia on decayed wood; (B) conidiophores and conidia. Reference (366).

SPEGAZZINIA Sacc. Sporodochium small, dark; conidia of two kinds: (1) 4-celled, spiny, borne apically on a long slender conidiophore; (2) 4-celled, smooth, borne on a short conidiophore; saprophytic on vegetable material; both conidiophore and conidia dark. The smooth conidia and sporodochium are apparently lacking in some species.

Illustration: *S. ornata*; redrawn from Bessey (27). Reference (74).

CHEJROMYCES Berk, and Curt. Sporodochium dark; cushionlike to hysteroid; conidiophores dark, short, simple or branched; conidia dark, branched into three or more upright arms, which do not all arise from the basal cell; saprophytic on wood. Compare with *Dhtyosporium*.

Illustration: *C. stelhtus*; (A) hysteroid sporodochia; drawn from photograph by Damon (71); (B) original, from herbarium material on decayed wood.

BACTRODESMIUM Cooke. Conidiophores short, clustered (sometimes into sporodochia), simple or branched, hyaline to pale brown, narrow at base, septate; conidia several-celled, pale to dark brown, apical cells often darker, apical, single; saprophytic.

Illustration: *Bactrodvsmium* sp.; original, from fresh material on decayed wood. (A) habit on wood; (B) conidiophores bearing conidia emerging from a piece of wood; (C) apical portion of conidiophores showing conidial attachments. Reference (114).

EVERHARTIA Sacc. and Ellis. Sporodochia somewhat stalked, with an expanded top, dark at the base; conidiophores slender, hyaline, branched; conidia hyaline, apical, septate, flat, curved or bent; saprophytic on wood.

Illustration: *E. lignatilis*; (A) sporodochium; (B) conidiophores and conidia; redrawn from Thaxter (437). References (263, 289).

HOBSONIA Berk. Sporodochia wartlike, light colored; conidiophores hyaline, slender; conidia hyaline, many celled, apical, coiled in a loose spiral; saprophytic on plant material.

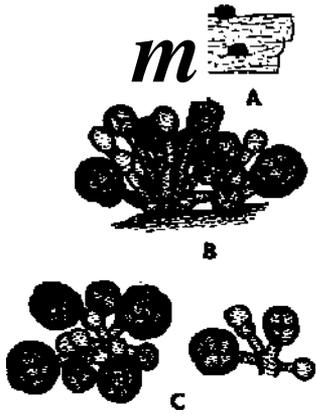
Illustration: *H. mirabilis*; (A) portion of sporodochium; (B) conidia redrawn from Under (263). Reference (289).

CAMPTOMERIS Syd. Sporodochia irregular, dark, poorly developed or lacking in some species; conidiophores dark, arising from special enlarged cells; conidia dark, 3- or more-celled, elongate, leaf parasites on *Mimosa*.

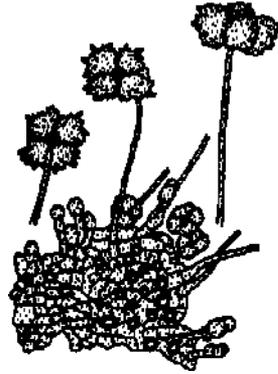
Illustration: *C. leuvaenae*. (A) sporodochium from above; (B) vertical section through sporodochium; (C) branch of sporodochium bearing three conidiophores; (D) conidia; redrawn from Bessey (29). Reference (199).

AECERITA Pers. Stroma covering scale insects; sporodochia somewhat spherical, somewhat colored, superficial; conidia spherical, 1-celled; on scale insects.

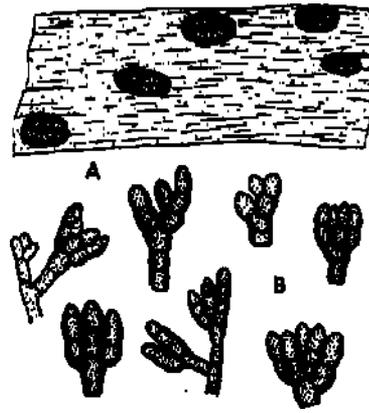
Illustration: *A. wehberi*; original, from herbarium material on citrus leaf (A) stroma covering scale insect on citrus leaf; (B) section through stroma; (C) two sporodochia showing sterile hyphae and conidium-like cells. Reference (131).



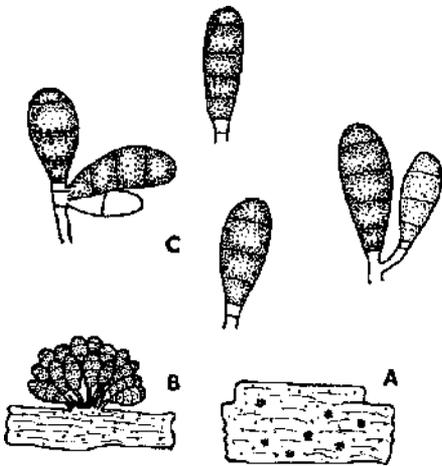
EPICOCCUM



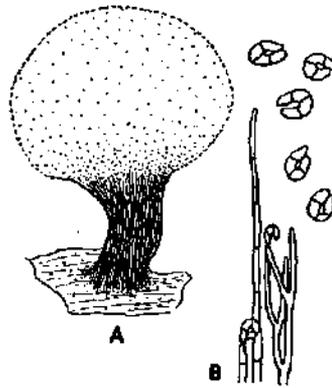
SPGAZZINIA



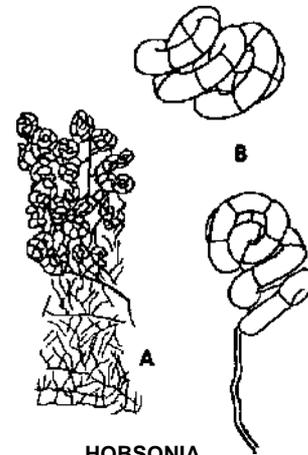
CHEIROMYCES



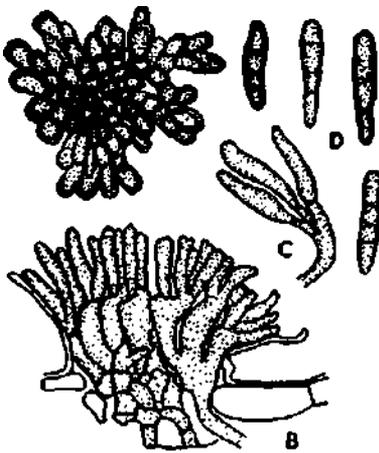
BACTRODESMIUM



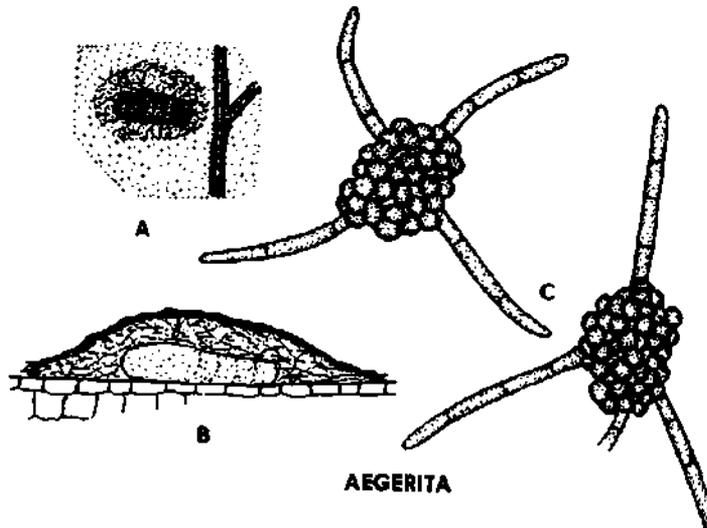
EVERHARTIA



HOBSONIA



CAMPTOMERIS



AEGERITA

HETEROCEPHALUM Thaxt. Synnemata with long, cylindrical stalk composed of a central large strand surrounded by cortical hyphae, fertile head with loose interwoven sterile hyphae and long slender spinelike hyphae surrounding the spore mass; fertile branches thick, terminating in phialides; conidia hyaline, small, ovoid; saprophytic on dung or soil.

Illustration: *//. auranriacum*; (A) young synnema; (B) upper portion of mature synnema; (C) phialides and conidia; redrawn from Thaxter (437). Reference (301).

STILBUM Tode ex. Fr. Synnemata hyaline or bright-colored, stipe cylindrical, bearing a head of conidia; conidiophores slender, verticillately branched; conidia 1-celled, hyaline, globose to ellipsoid, enveloped in slime, saprophytic, on bark and wood. Single conidiophores resemble *Veriicillium*.

Illustration: *Stilbum* sp.; original, from culture. (A) synnemata showing spores in head of slime; (B) portion of synnema; (C) single conidiophore; (D) conidia. References (17, 301).

MENISPOROPSIS Hughes. Synnema composed of a central emerging seta and an external shorter cortex; phialides, pale brown; conidia 1-celled, hyaline, curved, with a short filiform appendage at each end, produced in slime; saprophytic.

Illustration: *M. theobromae*; redrawn from Hughes (198). (A) synnema with central seta; (B) conidia. Reference (301).

ENDOCATYX Berk. and Br. Synnemata expanding upward into a funnel that is filled with conidia; conidia sessile or on short branches of conidiophore, 1-celled, brown, flattened, ovoid or irregular, with a germ slit; on twigs.

Illustration: *E. thwaitesii*; redrawn from Hughes (207). (A) synnemata; (B) conidia. Reference (301).

PESOTUM Crane and Schok. Synnemata mostly erect, simple or branched near base, dark brown to black, as in *Graphium*; single conidiophores hyaline, slender, mostly simple; conidia (sympodulospores) 1-celled, hyaline, borne on short blunt denticles; formerly placed in genus *Graphium*; recently described as the conidial state of *Ceratocystis ulmi*.

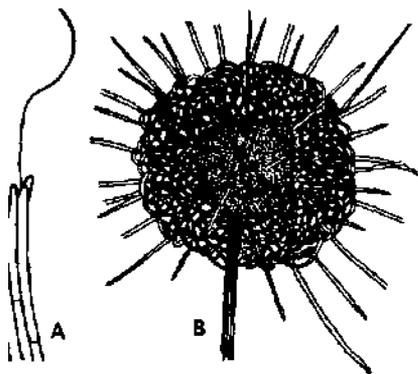
Illustration: *P. ulmi* (*Graphium ulmi*); original from culture. Reference (65).

GRAPHIUM Corda. Synnemata tall, dark, bearing a rounded, terminal mass of hyaline conidia embedded in slime; simple, hyaline conidiophores also produced in abundance, bearing oblong conidia that reproduce by budding; parasitic, often as vascular pathogens causing wilts of trees, or saprophytic. Some species are imperfect states of *Ceratocystis*. Mode of conidial development variable in different species.

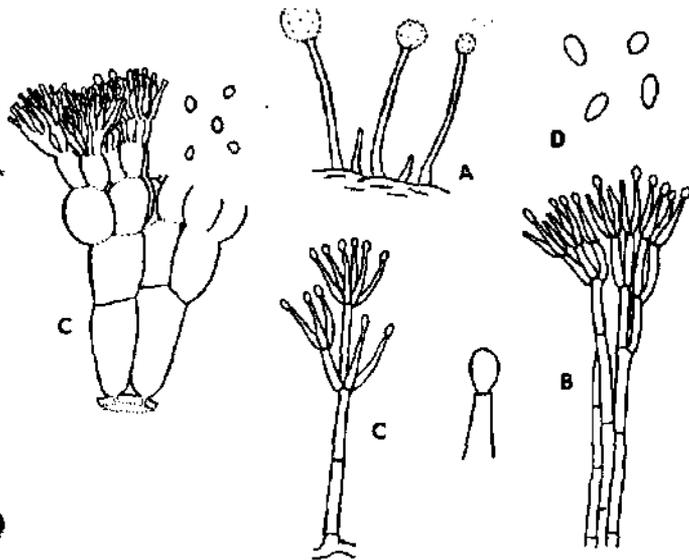
Illustration: *Graphium* sp.; original, from culture obtained from oak wood. (A) habit of synnemata; (B) synnema and conidial head enlarged; (C) conidiophores and conidia from water mount; (D) short, hyaline conidiophores and conidia similar to *Hyalodendron*, Reference (301).

BRIOSIA Cav. Synnemata dark, cylindrical, spore-bearing head ovoid to sub-globose; conidia dark, 1-celled, in chains, collecting in dry masses; parasitic, commonly causing blight of *Azalea* and *Rhododendron* flower buds.

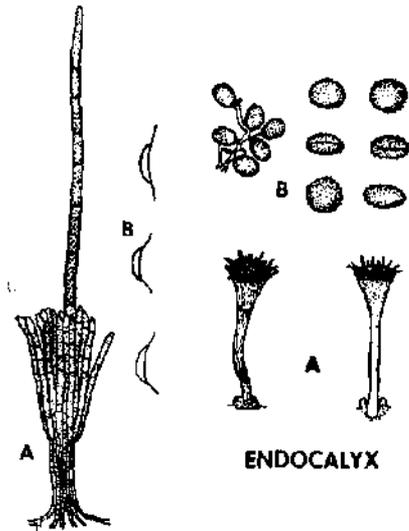
Illustration: *B. azalea*; original, from dried material. (A) synnemata on blasted *Rhododendron* flower; (B) two synnemata as seen under low magnification; (C) synnema showing sporulating head; (D) conidia. Reference (301).



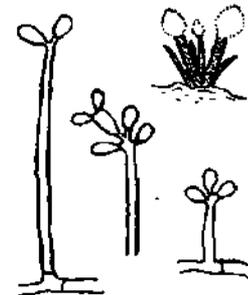
HETEROCEPHALUM



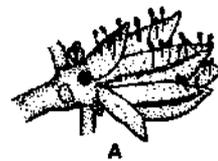
STILBUM



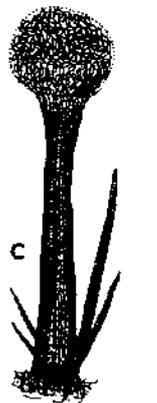
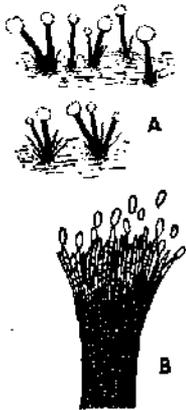
ENDOCALYX



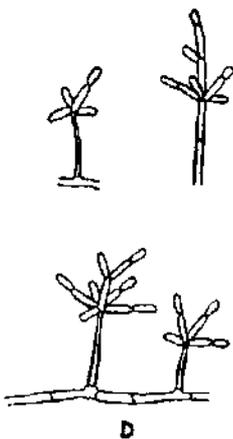
PESOTUM



MENISPOROPSIS



GRAPHIUM



BRIOSIA

DIDYMOSTILBE P. Henn. Synnemata light, stalk cylindrical, with an expanded, ovoid, or rounded spore-bearing head; conidiophores hyaline, branched, short conidiophores produced abundantly in culture, conidia hyaline, 1-celled, usually becoming 2-celled, contained in droplets of slime, ovoid to elongate; saprophytic, principally on wood.

Illustration: *Didymostilbe* sp.; original, from culture isolated from stump of *Liriodendron tulipifera*. (A) synnemata showing heads of conidia embedded in slime; (B) synnema dry; (C) synnema moist; (D) synnema showing conidiophores, from water mount; (E) branched conidiophore from synnema; (F) conidia. Reference (301).

ARTHROSPORIUM Sacc. Synnema cylindrical, subhyaline, with long spore-bearing upper portion; conidiophores diverging, bearing conidia at apex; conidia mostly 4-celled, hyaline to subhyaline, long-fusoid to falcate; saprophytic.

Illustration: *S. compositum*; original from herbarium material on dead bark. (A) synnema; (B) conidiophores; (C) conidia. Reference (301).

PODOSPORIUM Schw. Synnemata erect, clustered, black, cylindrical, with a long, apical fertile portion; conidiophores septate, dark, diverging; conidia several-celled, dark, apical, single.

Illustration: *P. rigidum*; original, from herbarium material on stems of *Ampelopsis quinquefolia*. (A) habit on stem; (B) synnema; (C) conidiophore and conidia. Reference (301).

DENDROGRAPHIUM Masec. Synnema with dark, cylindrical stipe, free ends of hyphae become conidiophores; conidiophores enlarged, radiating, simple or branched; conidia mostly 4-celled, dark, apical, in short acropetalous chains, cylindrical-ovoid; saprophytic.

Illustration: *D. interseminatum*; redrawn from Subramanian (404). (A) synnema with conidia; (B) enlarged apex of synnema with conidiophores bearing catenulate conidia; (C) conidia. Reference (301).

DORATOMYCES Corda. Hyphae dark; conidiophores dark, solitary or compacted into synnema with dense, elongated head of conidiogenous cells and chains of conidia, upper part of conidiophores branched penicillately, producing masses of dry spores apically on conidiogenous cells; conidia (annellospores) mostly dark, 1-celled, ovoid; saprophytic. Similar to *Trichurus* but without spines.

Illustration: *D. stemonitis* (*Stysanus stemonitis*); original, from culture. (A) synnema; (B) separate conidiophores; (C) conidia. Reference (301, 303).

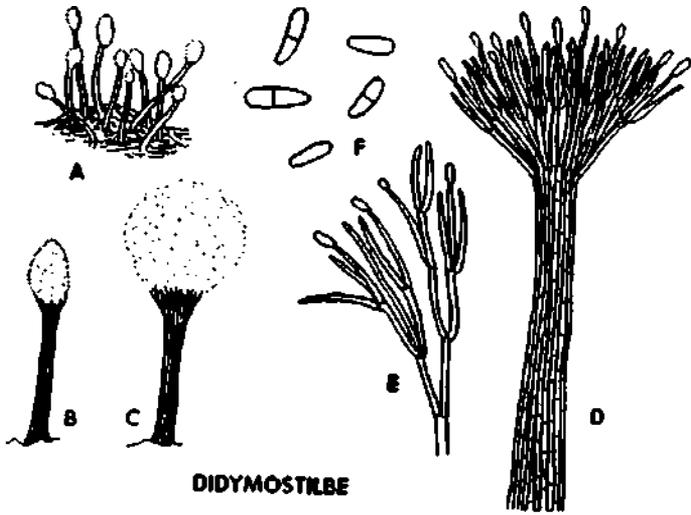
ISARIOPSIS Fres. Synnemata dark, composed of loose conidiophores, bearing conidia at or near the tips; conidia dark or pale, 2- or more-celled, cylindrical to obclavate, often curved; parasitic.

Illustration: *I. griseola*; original, from herbarium material on bark. (A, B) synnemata; (C) conidia.

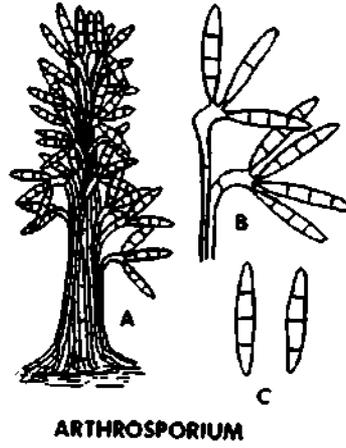
ARTHROBOTRYDM Ces. Synnemata dark, cylindrical, with a globose sporulating head; conidia hyaline to dark, 3- to 4-celled, produced in slime; saprophytic on wood.

Illustration: *A. stilboideum*; (A) synnemata; (B) conidiophores; (C) conidia; redrawn from Subramanian (405). References (195, 301).

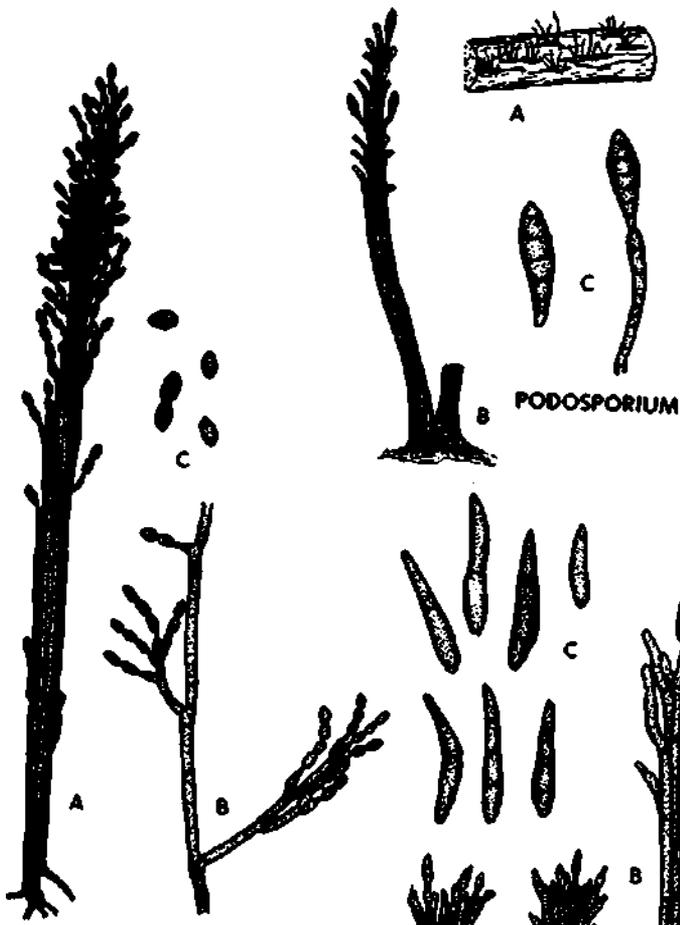
DESCRIPTIONS AND ILLUSTRATIONS OF GENERA



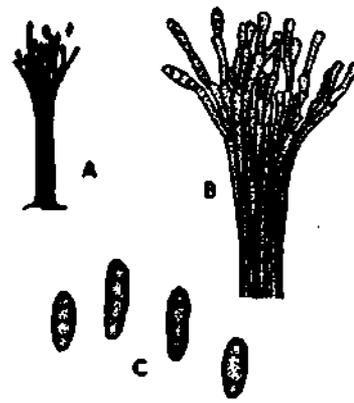
DIDYMOSTILBE



ARTHROSPORIUM



PODOSPORIUM



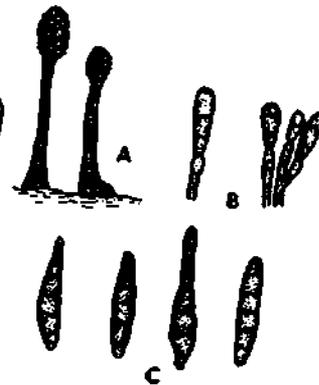
DENDROGRAPHIUM



DORATOMYCES



ISARIOPSIS



ARTHROBOTRYUM

ISARIA Hers. Synnemata light colored, cylindrical to clavate; conidia hyaline, 1-celled, ovoid, dry, not produced in gelatinous material; saprophytic or parasitic on insects. Some species are imperfect states of *Cordyceps*.

Illustration: *I. cretacea*; original, from culture. (A) synnemata in culture turning toward source of light; (B) portion of synnema; (C) conidiophores and conidia. Reference (301).

THAROOPAMA Subram. Synnemata with well-defined stalk and head, hyphae becoming free to form conidiophores; conidiophores subhyaline to brown, septate, branched 1 to 3 times, with apical hyaline fertile cells; conidia borne on small denticles, 1-celled, hyaline, globose,

Illustration: *T. trina*; redrawn from Subramanian (403). (A) synnema; (B) conidiophores and conidia; (C) conidia. Reference (301).

HARPOGRAPHIUM Sacc. Synnemata dark brown, the upper spore-bearing portion capitate to elongate, fibrous, the hyphae with thick stubby tips; conidia hyaline, more or less falcate, 1-celled; saprophytic on bark and wood.

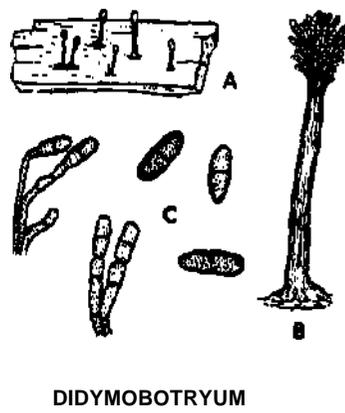
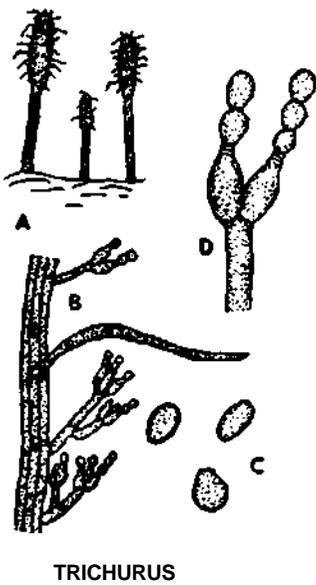
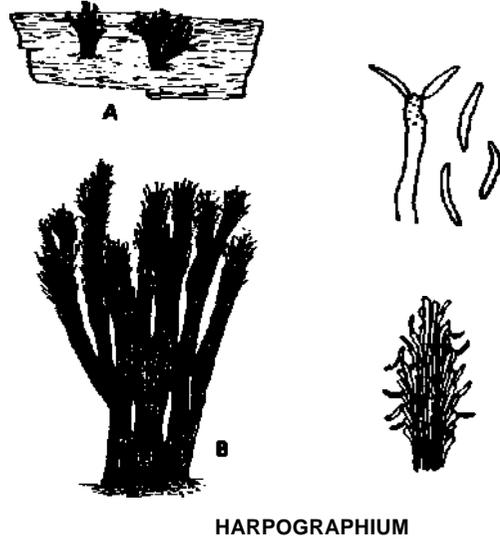
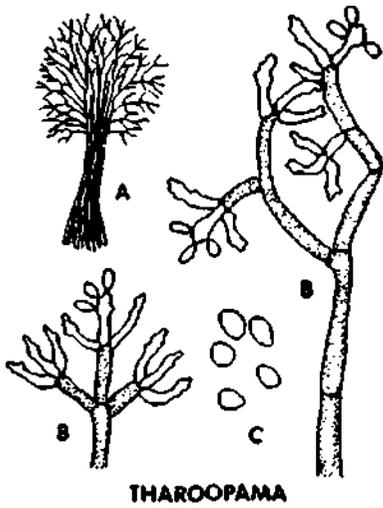
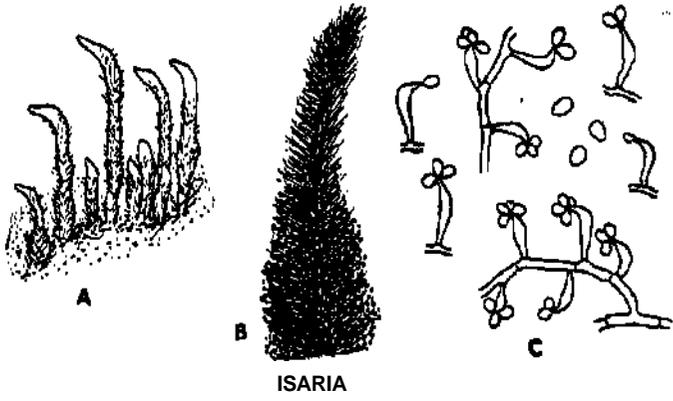
Illustration: *H. fasciculatum*; original, from herbarium material on bark. (A, B) synnemata; (C) redrawn from Subramanian (405). Reference (301).

TRICHURUS Clem, and Shear. Synnemata dark, stalk slender, conidium-bearing portion expanded; long, black, simple, or branched hairs on spines present among the conidiophores; conidia dark, 1-celled, ovoid, catenulate; saprophytic. Similar to *Doratomyces* but with spines.

Illustration: *T. terrophilus*; (A) synnema; (B) portions of synnema showing conidiophores and spines; (C) conidia; (D) sporogenous cells bearing conidia; original, from culture. References (301, 430).

DIDYMOBOTRYUM Sacc. Synnema with tall, cylindrical stipe and subglobose head, dark; conidiophores divergent, bearing conidia apically; conidia dark at maturity, 2-celled, oblong or cylindrical; saprophytic.

Illustration: *D. cookei*; original from herbarium material on dead stems. (A) habit of synnemata on wood; (B) synnema; (C) conidiophores and conidia. Reference (301).



SCLEROGRAPHIUM Berk. Colonies covering surface of leaflets; synnemata tail, slender, black; conidiophores diverging outward, bearing near the apex small truncate denticles that bear single conidia; conidia several-celled, dictyosporous, brown, dry.

Illustration: 5". *aterrimum*; redrawn from Hughes (197). (A) synnema; (B) conidiophores and conidia. Reference (301).

ACAROZYBE Sydow emend. M.B. Ellis. Mycelium superficial, brown; conidiophores erect, brown, branched to form tall, slender synnemalike structures, each with a head; synnema forms as hyphae branch and grows downward, branches closely appressed; head composed of short, thick fertile cells on short branches; conidia 2- to 3-celled, pale brown, obclavate, straight or curved; on living leaves.

Illustration: *A. hansfordii*; redrawn from Ellis (115, 120). (A) portions of synnemata showing unusual form of development; (B) conidiogenous cells; (C) conidia. Reference (301).

SPIROPES Ciferri. Colonies effused, hairy or velvety, pale to brown or black, often overgrowing and apparently parasitic on Meliolineae or other tropical leaf ascomycetes; conidiophores simple, single or clustered into synnemata, pale to dark brown, septate; conidiogenous area simple, sympodular, with numerous conspicuous conidial scars; conidia solitary, 2- to several-celled, variable but often obclavate, pale to dark brown.

Illustration: (A) separate conidiophores of 5". *capensis*; (B) synnema of *S. japonicus*; redrawn from Ellis (123).

AKANTHOMYCES Leb. Synnemata light colored, cylindrical or somewhat attenuated above, composed of compact hyphae; phialides produced as terminal cells of lateral branches in a compact layer, ellipsoid, obovoid or cylindrical, acute at the apex; conidia hyaline, 1-celled, smooth, catenulate; parasitic on insects and spiders.

Illustration: *A. aculeata*; (A) synnemata on dead moth; (B) phialides and conidia; (A) drawn from photograph; (B) redrawn from drawing; both from Mains (278). Reference (301).

INSECTICOLA Mains. Synnemata light colored, clavate, stipitate, upper fertile portion compact composed of branching hyphae terminating in phialides that form a compact layer; conidia hyaline, 1-celled, smooth, catenulate; parasitic on insects.

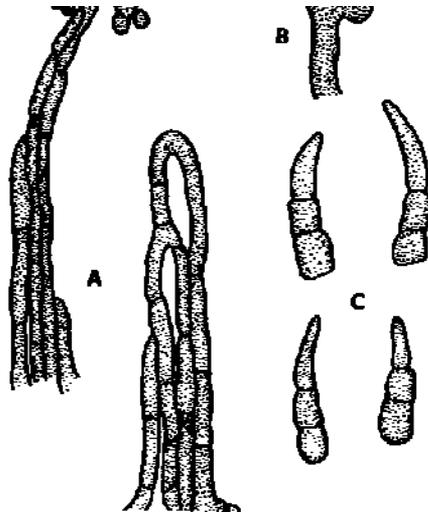
Illustration: *I. clavate*; (A) synnemata on infected cricket; (B) phialides and conidia; (A) drawn from photograph, (B) redrawn from drawing; both from Mains (278). Reference (301).

HYMENOSTILBE Petch. Synnemata nearly cylindrical, composed of longitudinal, closely compacted hyphae; phialides in a layer covering the synnema, produced on short, lateral branches, subcylindric to clavate, obtuse or narrowed on short sterigmata; conidia hyaline, 1-celled, smooth, borne singly; parasitic on insects or spiders.

Illustration: *H. verrucosa*; (A) synnemata of fungus on spider; (B) conidiophore branch, phialides, and conidia; (A) drawn from photograph; (B) redrawn from drawing; both from Mains (278). Reference (301).

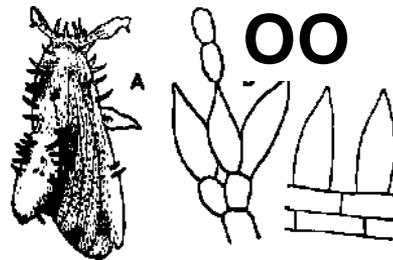


SCLEROGRAPHIUM



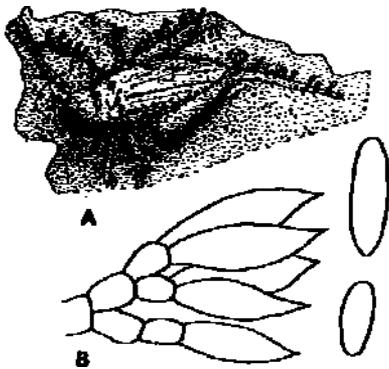
ACAROCYBE

m



AKANTHOMYCES

SPIROPES



INSECTICOLA



HYMENOSTILBE

GIBELLULA Cav. Synnemata light to brown, cylindrical, composed of loose, longitudinal hyphae; conidiophores brownish, terminal cell or cells hyaline, apex enlarged, bearing prophialides and phialides that compose a globose or broadly wedge-shaped head; conidia fusoid to ellipsoid, produced successively, single or in short chains; parasitic on spiders; conidial states of *Torrubiella*.

Illustration: *G. suffulta*; (A) synnemata on mummified spider; (B) portion of synnema showing conidiophores and conidial heads; (C) single conidiophore and conidial head; (D) portion of conidial head; (E) phialides; (F) conidia; redrawn from Speare (381). References (277, 301).

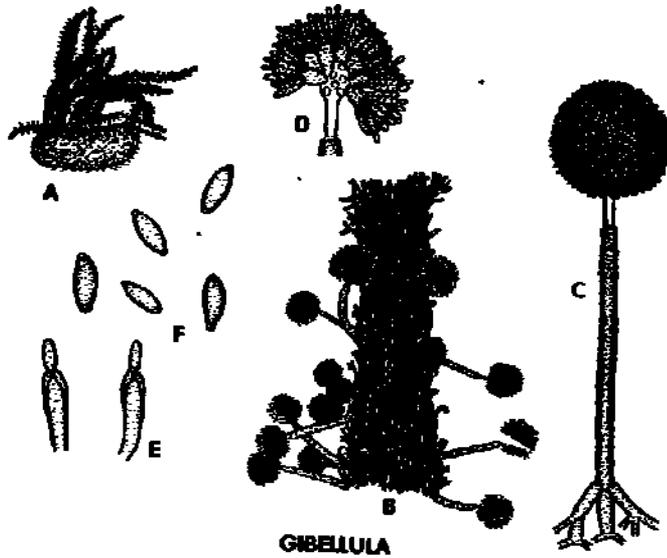
HIRSUTELLA Pat. Synnemata, simple or with numerous branches arising nearly at right angles (some species lack synnemata); phialides arising laterally on synnema or from mycelium on host, hyaline, inflated below, abruptly or gradually narrowing to long slender sterigmata; conidia hyaline, 1-celled, oblong to cylindrical, covered with slime; parasitic on insects.

Illustration: *H. saussurei*. (A, B) portions of synnemata; (C) phialides and conidia; redrawn from Speare (382). References (135, 279, 286, 301).

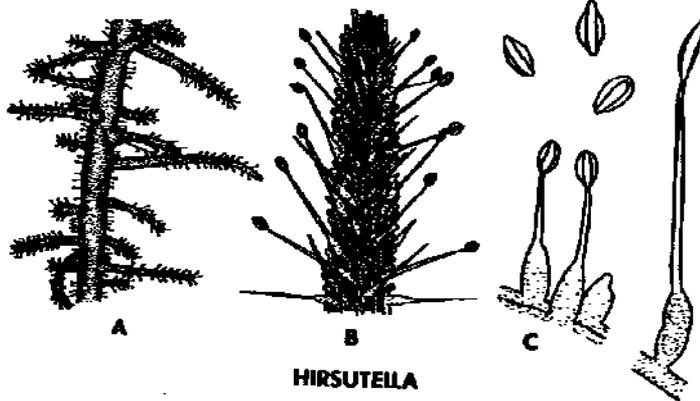
SYNNEMATIUM Speare. Synnemata simple or branched, brown when mature; phialides mostly at ends of branches, slender, tapering to a pointed tip; conidia hyaline to pale brown, covered with slime, several spores held together in clusters; sclerotia spherical, becoming brown with thick-walled cells; parasitic on insects.

Illustration: *S. jonesii*; (A) synnema producing sclerotia; (B) synnema producing conidia; (C) sclerotium germinating and producing synnemata; (D) phialide and conidium; (E) cluster of conidia in mucus; (F) sclerotium; redrawn from Speare (382). Reference (279).

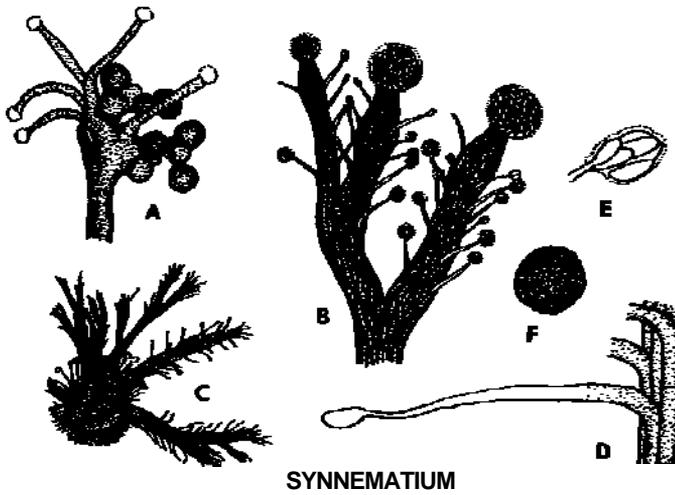
DESCRIPTIONS AND ILLUSTRATIONS OF GENERA



GIBELLULA



HIRSUTELLA



SYNNEMATUM

PHYLLOSTICTA Pers. Pycnidia dark, ostiolate, lenticular to globose, immersed in host tissue, erumpent or with a short beak piercing the epidermis; conidiophores short; conidia small, 1-celled, hyaline, ovoid to elongate; parasitic, producing spots, principally on leaves. Compare with *Phoma*.

Illustration: *P. minima*; original, from dried material; (A) leaf spot and pycnidia on leaf of maple; (B) section of leaf and pycnidium; (C) conidiophores; (D) conidia. Reference (52).

PHOMA Desm. Like *Phyllosticta*; parasitic, on various plant parts. Both generic names, *Phoma* and *Phyllosticta*, occur commonly in the literature but morphologically they are alike.

Illustration: (A-C) *P. hetae*, from culture; (D) *P. lingam*, from section of host; original; (A) side view of pycnidium; (B) top view of pycnidium; (C) conidia; (D) pycnidium and conidia. Reference (417).

PLENODOMUS Preuss. Pycnidia dark, immersed, irregular in shape, opening irregularly at the apex; conidia hyaline, 1-celled, oblong; parasitic.

Illustration: *P. destruens*; original. (A) surface view of erumpent pycnidia on sweet potato stem; (B) section through pycnidium; (C) pycnidia produced in culture; (D) conidia.

SELENOPHOMA Marie. Pycnidia brown, globose, immersed, erumpent, ostiolate; conidia hyaline, 1-celled, bent or curved, typically lunate or less often boomerang-shaped; parasitic, causing spots on grasses and some other hosts.

Illustration: *S. linicola*. (A, B) pycnidia on flax stem, drawn from photographs; (C) conidia; all redrawn from Vanterpool (457). Reference (386).

PYRENOCHAETA de Not. Pycnidia dark, ostiolate, nearly globose, erumpent with a few simple bristles, especially near the ostiole; conidiophores simple or rarely branched; conidia small, 1-celled, hyaline, ovoid to elongate; parasitic or saprophytic.

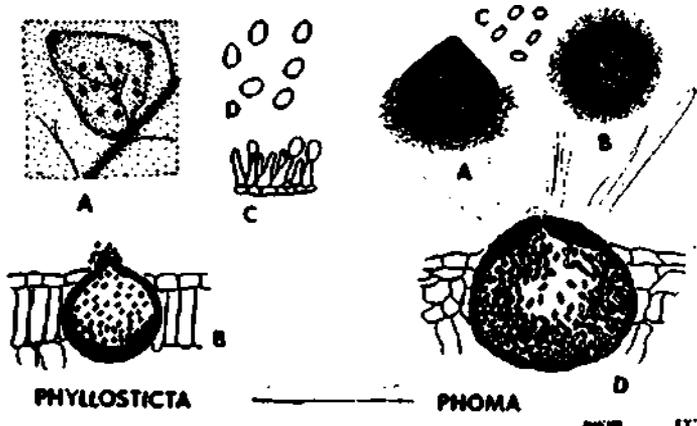
Illustration: *Pyrenochaeta* sp.; original, from culture. (A) group of pycnidia; (B) pycnidium; (C) conidiophores and conidia.

DENDROPHOMA Sacc. Like *Phoma* and *Phyllosticta* but conidiophores are branched.

Illustration: *D. obscurans*; original, from culture. (A, B) pycnidia and exuded masses of conidia; (C) conidiophores; (D) conidia.

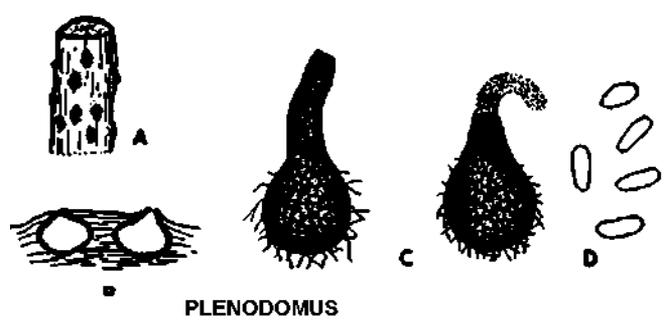
AOSPHAERIA Sacc. Pycnidia dark, rounded, with a short papillate ostiole; conidiophores short, 1-celled, conidia hyaline, 1-celled, elongate to globose; saprophytic on wood.

Illustration: *P. pezizoides* original, from herbarium material on *Fraxinus* wood. (A) habit of pycnidia; (B) section through pycnidia; (C) conidiophores; (D) conidia.



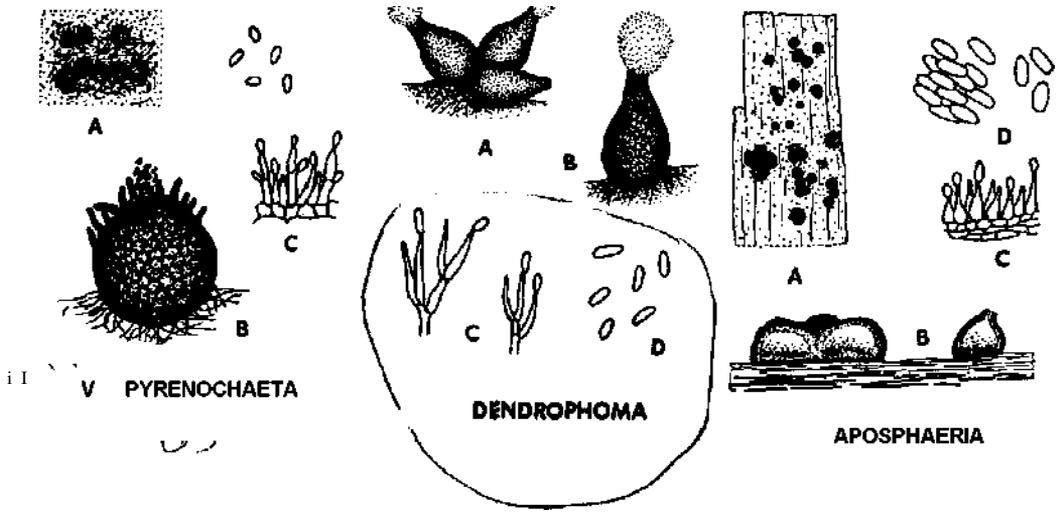
PHYLLOSTICTA

PHOMA



PLENODOMUS

SELENOFOMA



VI PYRENOCHAETA

DENDROFOMA

AOSPHAERIA

PEYRONELLAEA Goidanich. Pycnidia brown to black, superficial to partly immersed, rounded, with conspicuous ostiole, single to crowded; conidia 1-celled, hyaline or later becoming subhyaline to dark, ovoid to ellipsoid; chlamydospores many-ceiled, dark, apical or intercalary, with irregular septations; saprophytic or parasitic.

Illustration: *Peyronellaea* sp.; original, from culture. (A) habit of pycnidia in culture; (B) pycnidia; (C) conidia; (D) chlamydospores. References (150, 443).

RHIZOSPHAERA Mang. and Har. Pycnidia superficial, somewhat globose, dark, of cellular texture, with ostiole at apex, tapering below to a stalk; conidiophores short, simple; conidia 1-celled, hyaline, ovoid, smooth.

Illustration: *R. pini*; original, from herbarium material on leaves of *Abies balsamea*. (A, B, C) habit of pycnidia on leaf; (D) pyrenidium; (E) conidiophores and conidia.

PHOMOPSIS Sacc. Pycnidia dark, ostiolate, immersed, erumpent, nearly globose; conidiophores simple; conidia hyaline, 1-celled, of two types, ovoid to fusoid (alpha) conidia, and filiform, curved or bent (beta conidia); parasitic, causing spots on various plant parts. Imperfect state of *Diaporthe*.

Illustration: *P. (Diaporthe) vexans*; original, from egg plant fruit. (A) fruit spot showing pycnidia; (B) pycnidia; (C) alpha conidia; (D) beta conidia; (E) conidiophores. References (340, 342).

ASTEROMELLA Pass. and Thum. Pycnidia dark, small, globose, ostiolate, located in a mass of radiating dark hyphae (subiculum); conidia hyaline; 1-celled, ovoid to cylindrical; parasitic on leaves.

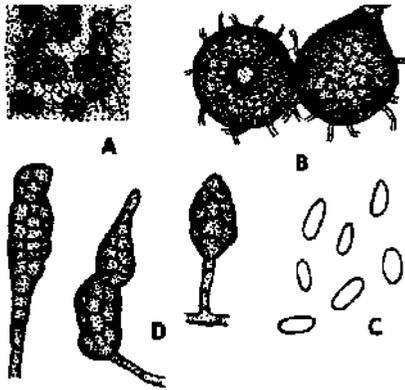
Illustration: *A. andrewsii*; original, from herbarium material on leaves of *Gentiana puberula*. (A) leaf spots and habit of fungus; (B) top view of pycnidia and radiating hyphae; (C) section of pyrenidium; (D) conidia.

CHAETOPHOMA Cooke. Pycnidia dark, small, globose to irregular, without ostiole, in dense or loose clusters, seated on an olive-colored subiculum; conidia hyaline, 1-celled, very small, ovoid; saprophytic on plant material.

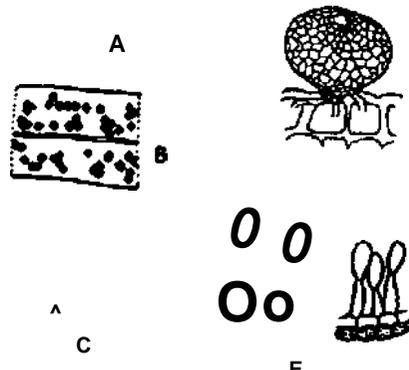
Illustration: *C. confluens*; original, from herbarium material on dead stems of *Spartina*. (A) habit, showing clusters of pycnidia on stem; (B) group of pycnidia, enlarged; (C) conidia.

MACROPHOMA Berl. and Vogl. Pycnidia dark, ostiolate, globose, erumpent; conidiophores simple, short or elongate; conidia hyaline, 1-celled, over 15 microns long, ovoid to broadly ellipsoid; parasitic; may be a stage in the development of *Botryodiplodia* or *Dothiorella* because the name commonly occurs in the literature.

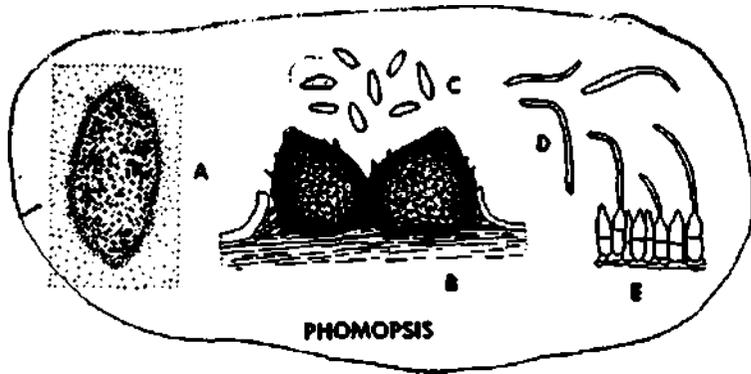
Illustration: *Macrophoma* sp.; original, from dried oak leaves. (A) leaf spot and pycnidia; (B) section through pyrenidium; (C) conidiophores and immature conidia; (D) mature conidia.



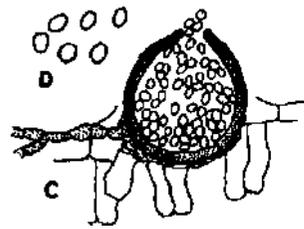
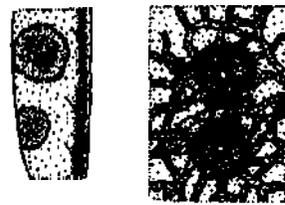
PEYRONELLAEA



RHIZOSPHAERA



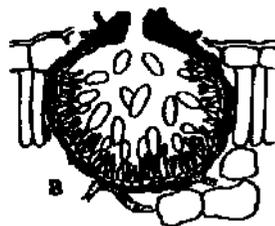
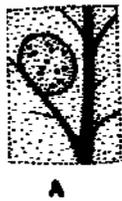
PHOMOPSIS



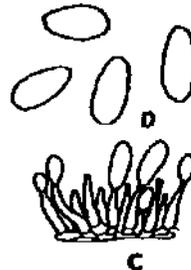
ASTEROMEUA



CHAETOPHOMA



MACROPHOMA



NEOTTIOSPORA Desm. Pycnidia separate, globose, membranous; dark, innate, ostiolate; conidiophores short, simple, hyaline; conidia 1-celled, hyaline, each with a single appendage; appendage mucoid, evanescent, in the form of an inverted, hollow cone with thin, hyaline walls, formed by the rupture of the outer wall, which later becomes everted and funnellike; saprophytic.

Illustration: *N. caricina*; redrawn from Cunnell (67). (A) section of pycnidium; (B) conidiophores showing developing conidia; (C) conidia with appendages. Reference (413).

CYTOSPORINA Sacc. Stroma black, cushion-shaped or tubercular; pycnidia distinct, sunken, arranged more or less in a circle in the stroma, with ostiole; conidia 1-celled, hyaline, filiform, curved or bent; saprophytic on bark.

Illustration: *C. ludibunda*; original, from herbarium material on bark of *Prunus serrulata*. (A) habit of pycnidia in bark; (B) section through stroma and pycnidia; (C) conidia.

SCEEROTIOPSIS Sperg. Pycnidia large, separate, smooth, without a pore, fleshy or membranous; conidiophores erect, simple, filiform; conidia 1-celled, hyaline, ellipsoid, angular at both ends.

Illustration: *S. concava*; original, from herbarium material on *Galas aphylla* leaf. (A) habit of pycnidia on leaf; (B) section of pycnidium; (C) conidiophores; (D) conidia.

AMPELOMYCES Ces. (*Cicinnoholus* Ehrenb.) Pycnidia dark, rounded, clavate or fusoid, developing inside conidiophores of powdery mildew fungi (Erysiphaceae), without ostiole; conidia hyaline or subhyaline to dark, 1-celled, ovoid to oblong; parasitic on Erysiphaceae.

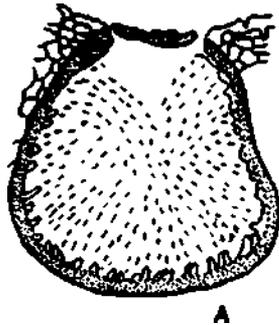
Illustration: *A. quisqualis*; original, from herbarium material on *Erysiphe* on leaf of *Grindelia*. (A) hyphae and conidiophores of *Erysiphe*, some bearing pycnidia of the parasite; (B, C) pycnidia enlarged; (D) conidia. References (270, 356).

DILOPHOSPORA Desm. Pycnidia dark, globose, ostiolate, usually stromatic, within plant tissue; conidia 1-celled, hyaline, cylindrical, with short, branched slender appendages at both ends.

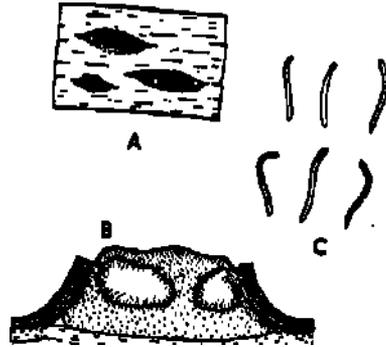
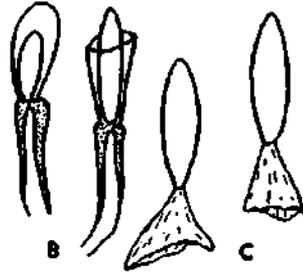
Illustration: *D. alepecuri*; original, from herbarium material on *Andropogon trachycaulum*. (A) habit of pycnidia in leaf; (B) pycnidia in stroma; (C) conidia with appendages.

— **DOTHIORELLA** Sacc. Pycnidia dark, globose, grouped in a well-developed stroma; stroma subcortical, breaking out; conidiophores simple, short; conidia hyaline, 1-celled, ovoid to broadly ellipsoid; parasitic or saprophytic on wood.

Illustration: *Dothiorella* sp.; original, from dried material on oak twigs. (A) habit of pycnidia and stromata; (B) section through stroma; (C) conidiophores; (D) conidia.



A
NEOTTIOSPORA



A
B
C
CYTOSPORINA



(f ^ J



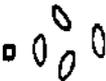
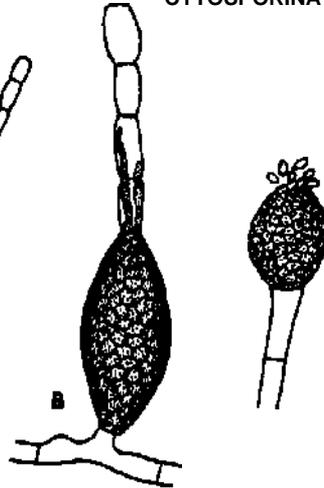
B
SCLEROTIOPSIS



C



C



B
D
AMPELOMYCES



A

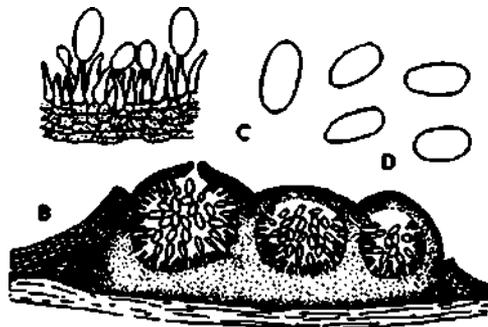


C



B

DILOPHOSPORA



B
C
D
DOTHIORELLA

ELEUTHEKOMYCELLA Hohn. Pycnidia single, black, smooth, soft-leathery, with ostiole; conidiophores simple or branched, septate; conidia 1-celled, hyaline, cylindrical-ellipsoid, with a filiform pedicel and a slender, apical appendage; on other fungi.

Illustration: *E. mycophila*; redrawn from Seeler (367). (A) pycnidium embedded in host fungus; (B) cells of pyenidial wall, (C) conidiophores and conidia.

SPHAERONAEMA Fr. Pycnidia dark, superficial or crumpled, base spherical, with a long beak; conidiophores simple; conidia hyaline, 1-celled, ovoid to elongate; chiefly saprophytic.

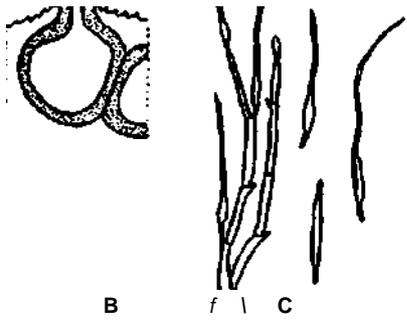
Illustration: *S. acerinum*; original, from herbarium material on dead branches of *Acer*. (A) habit of pycnidia; (B) section showing single pycnidium enlarged; (C) conidiophores, conidia, and sterile hyphae; (D) conidia.

HYALOPYCNIS Hohn. Pycnidia superficial, light-colored (shiny white) membranous, with a globose base and a long, subcylindrical neck, fimbriate at the apex; wall of pycnidium and neck composed of parallel hyphae fused laterally; conidiophores long, simple or branched; conidia 1-celled, hyaline, cylindrical or ovoid; on other fungi.

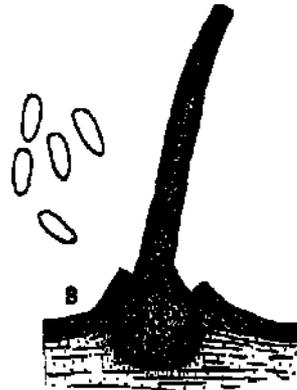
Illustration: *Hyalopycnis* sp.; original, from culture. (A) habit of pycnidia in culture; (B) pycnidium showing parallel hyphae; (C) conidiophore; (D) conidia from pycnidium; (E) conidia borne directly on mycelium. Reference (326).

EEUTHEROMYCES Fuckel em. Seeler. Pycnidia single, superficial, light-colored, soft leathery or gelatinous and translucent when wet, walls and neck composed of small irregular cells; conidiophores hyaline, lining neck as well as base of pycnidium, septate, bearing conidia apically and laterally; conidium 1-celled, hyaline, ellipsoid, attenuated at apex and at base; on basidiomycetes.

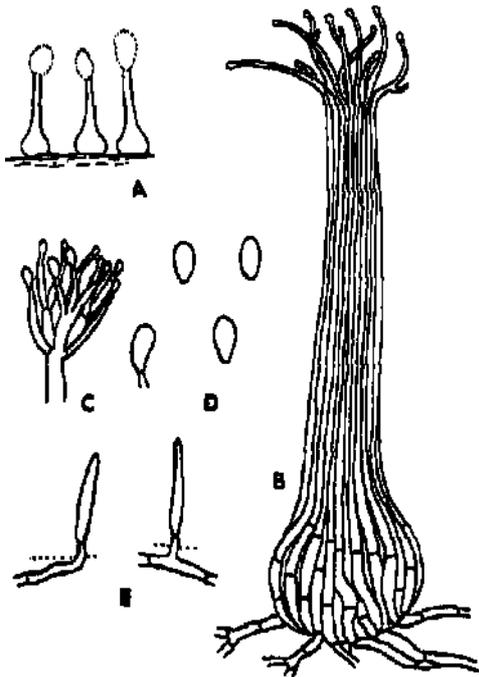
Illustration: *E. subulatus*; redrawn from Seeler (367). (A, B) pycnidia; (C) cells of pyenidial wall; (D) conidiophores; (E) conidia.



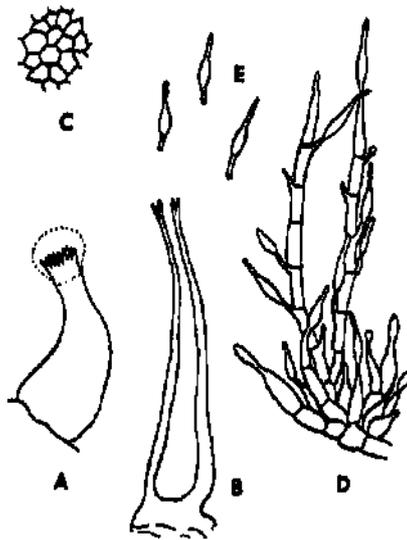
B
f | C
ELEUTHEROMYCELLA



A
C
B
SPHAERONAEMA



A
B
C
D
E
HYALOPYCNIS



A
B
C
D
E
ELEUTHEROMYCES

PEEUROSTROMELIA Petr. Pycnidia tufted thickly or hairy, on stroma, with or without ostioles; conidiophores long, simple or branched, septate; conidia 1-celled, hyaline, borne at the apex and on sides at the septa of the conidiophore.

Illustration: *P. deitiscens*; original, from herbarium material on bark of *Primus*. (A) habit of pycnidia in bark; (B, C) sections of stroma and pycnidia; (D) conidiophores; (E) conidia.

FUSICOCCUM Corda. Pycnidia in spherical or flattened, subepidermal, erumpent, dark stroma, one to several per stroma; opening separately or with a common pore; conidiophores simple, short; conidia hyaline. 1-celled, fusoid; parasitic or saprophytic on wood.

Illustration: *E. Uicinum*; original, from herbarium material on dead branch of *flex opaca*. (A) habit of pycnidia; (BJ) section through stroma and pycnidium; (CJ) conidiophores and conidia; (D) conidia.

RABENHORSTIA Fr. Pycnidia borne in black, erumpent, subcortical stroma; stroma nearly globose, wider at base, upper part truncate, often circularly split at the top, divided into several cavities; conidiophores filiform, simple, septate; conidia hyaline, 1-celled, ovoid to oblong; saprophytic on branches.

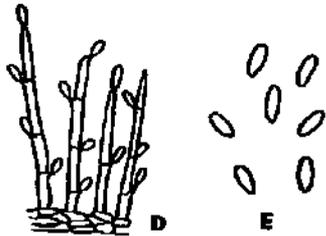
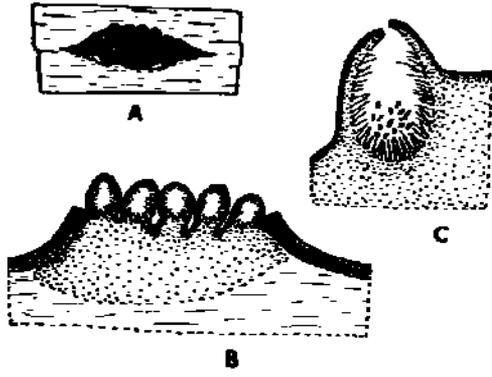
Illustration: *R. tiliae*; original, from herbarium material on dead branch of *Tilia*. (AJ) habit of pycnidia; (B) section through stroma; (C) conidiophores; (D) conidia.

CYTOSPORA Ehrenb. Pycnidia within a superficial or erumpent, tuberculate, globose, stroma; cavities irregular, incompletely separate; conidiophores slender; conidia hyaline, 1-celled, elongate-curved (allantoid); parasitic, or saprophytic on wood. Mostly imperfect states of *Vaha*.

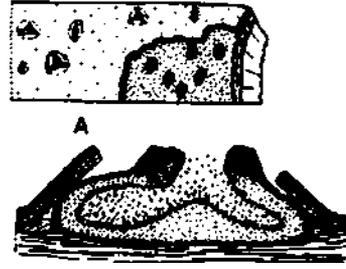
Illustration: *C. (Vaha) leucosioma*; original, from herbarium material on twigs of *Prunus domestica*. (A) habit of stromata; (B) section through stroma; (C) conidiophores; (D) conidia.

CYTOSPORELEA Sacc. Pycnidia forming irregular cavities within erumpent, tuberculate stroma; conidiophores slender, simple or branched; conidia hyaline, 1-celled, ovoid to oblong; parasitic or saprophytic on wood; similar to *Cytospora* except for shape of conidia.

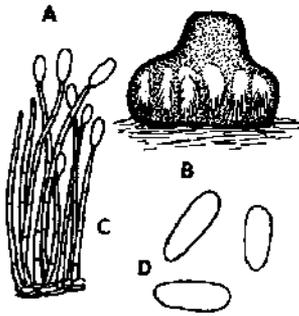
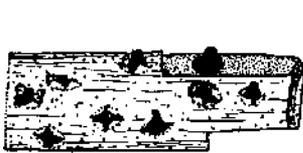
Illustration: *C. carnea*; original, from herbarium material on dead twigs of *Castanet* deniata*. (A) habit of stromata; (B) section through stroma; (C) conidiophores and conidia.



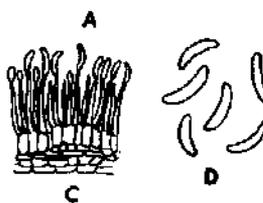
PLEUROSTROMELLA



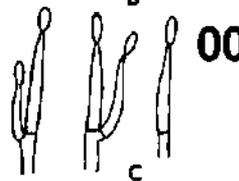
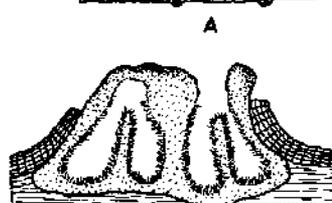
FUSICOCCUM



RABENHORSTIA



CYTOSPORA



CYTOSPORELLA

SPORONEMA Desm. Pycnidia subepidermal, slightly membranous, at first closed, later dehiscing radiately, gaping, dark; conidiophores slender, typically branched; conidia 1-celled, hyaline, ovoid to oblong; on leaves.

Illustration: *S. phacidioides*; redrawn from Jones (241). Reference (262).

CATINULA Lev. Pycnidia mostly globose-ovoid, dark, superficial, membranous-leathery, rather firm and solid, or somewhat fleshy when wet, nearly smooth, gaping at the top with a large mouth often brightly colored when fresh; conidiophores simple or branched; conidia 1-celled, subhyaline, globose to oblong.

Illustration: *C. thujae*; original, from herbarium material on *Thuja plicata*. (A) habit of pycnidia on leaves; (B) pycnidium; (C) conidiophores; (D) conidia.

AMEROSPORIUM Speg. Pycnidia superficial, subcupulate, opening wide at apex, black, surrounded by long, pointed, black setae; conidiophores crowded, branched; conidia 1-celled, hyaline to subhyaline, without bristles, cylindrical to ellipsoid; saprophytic.

Illustration: *A. caricum*; original, from herbarium material on *Carex* leaves. (A) habit of pycnidium on leaf; (B) pycnidium; (C) seta; (D) conidiophore; (E) conidia.

SHANORIA Subram. and Ramakr. Stromata black, carbonaceous, with one or more locules, lined with conidiophores, at maturity dehiscing by an irregular longitudinal rupture; conidiophores simple, cylindrical or clavate; conidia 1-celled, hyaline, with a filiform subapical appendage at each end-

Illustration: *S. bambusarum*; redrawn from Shanor (368). (A) habit of stromata in leaf; (B) section through stroma and pycnidia; (C) conidiophores and conidia. References (412).

DOTHICHIZA Lib. Pycnidia subglobose, smooth, dark, erumpent from bark, somewhat disc-shaped, irregularly dehiscent; conidiophores simple, slender; conidia 1-celled, hyaline, ovoid to cylindrical.

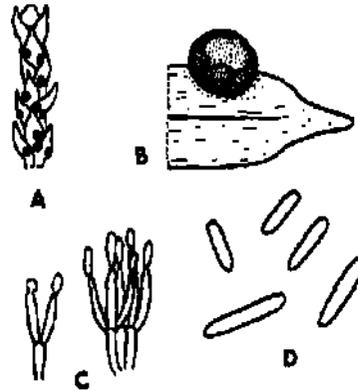
Illustration: *D. populae*; original, from herbarium material on *Populus* sp. (A) habit of pycnidia on wood; (B) section of pycnidium; (C) conidiophores; (D) conidia.

DINEMASPORIUM Lev. Pycnidia black, cup-shaped, superficial, with long dark setae; conidiophores rod-shaped, mostly simple; conidia hyaline, 1-celled, elongate or allantoid, with a slender appendage at each end; saprophytic.

Illustration: *Dinemasporium* sp.; original, from fresh material on dead grass stem. (A) habit of pycnidia; (B) side view of pycnidium; (C) top view of pycnidium, enlarged; (D) seta; (E) conidia.

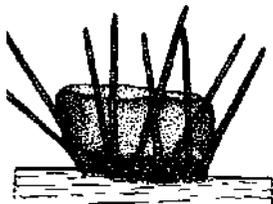


SPORONEMA

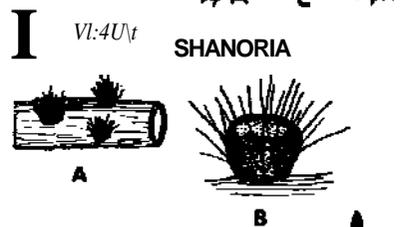
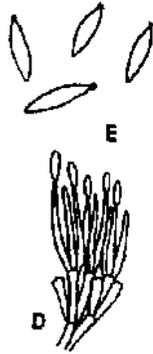


CATINULA

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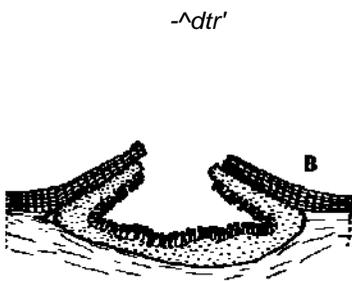


AMEROSPORIUM

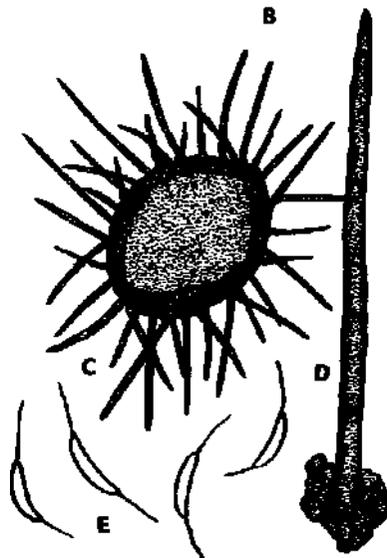


SHANORIA

I VI:4U/t



DOTHICHIZA



DINEMASPORIUM

ANTHASTHOOPA Subram. and Ramakr. Pycnidia immersed, with membranous wall, without stroma; conidiophores produced from surface of a cushion-shaped mound of tissue at base of pycnidial cavity; conidia f-celled, hyaline, concave-convex in outline, each with an apical, hyaline, mucoid appendage turned backwards and closely appressed to the concave side of the conidium; saprophytic.

Illustration: *A. simba*; redrawn from Subramanian and Ramakrishnan (410). (A) section through pycnidium; (B) conidia with appendages.

HAINESIA Ellis and Sacc. Pycnidia fleshy to gelatinous, bright-colored, globose at first, opening and becoming discoid, erumpent; conidiophores long, slender, branched; conidia hyaline; 1-celled, oblong to fusoid or somewhat allantoid; saprophytic.

Illustration: *H. rubi*; original, from herbarium material on leaves of cultivated *Rubus*. (A) habit of pycnidia; (B) section through open pycnidium; (C) conidiophores and conidia.

ASCHERSONIA Mont. Pycnidia in brightly colored, hemispherical or cushion-shaped stromata, somewhat sunken, opening by wide pores or ruptures that join to form irregular cracks; conidiophores slender, branched; conidia hyaline, usually 1-celled, but sometimes reported as being septate, fusoid; saprophytic or some species parasitic on insects.

Illustration: *A. aleyrodis*; original, from herbarium material on *Aleyrodes citri* on leaves of citrus. (A) habit of stromata covering insects; (B) section through stroma and pycnidia; (C) conidiophores; (D) conidia.

ACTINOPELTE Sacc. Pycnidia superficial, borne on a stalk or columella, dimidiate, shield-shaped, black, coalescing or scattered, ostiole variable; conidiophores simple; conidia hyaline, less often brownish, 1-celled, ovoid, oblong or fusoid; parasitic on leaves.

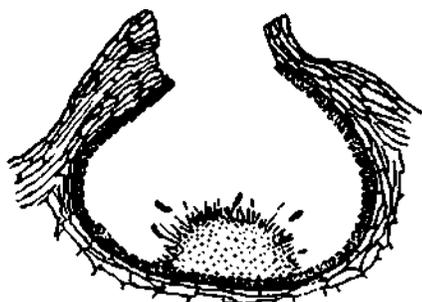
Illustration: *A. (Leptothyrium) dryina*; original, from fresh material on leaves of *Quercus coccinea*. (A) habit of pycnidia in leaf spot; (B) pycnidium, top view; (C) pycnidium, lower surface showing conidiophores and conidia; (D) conidiophores and conidia. Reference (435).

MELASMIA Lev. Pycnidia in a broad, black, flattened stroma that is superficial or nearly so, dimidiate; conidiophores simple or branched; conidia hyaline or subhyaline, 1-celled, allantoid or fusoid; parasitic on leaves; imperfect state of *Rhytisma*.

Illustration: *M. hypophylla*; original, from herbarium material on leaves of *Gleditsia triacanthos*. (A) habit of pycnidia; (B) section through pycnidium; (C) conidiophores; (D) conidia.

LEPTOTHYRIUM Kunze. Pycnidia superficial or erumpent, dimidiate, shield-shaped, dark, with or without ostiole; conidiophores simple; conidia hyaline, 1-celled, ovoid, oblong or curved; parasitic on leaves, fruit, etc.

Illustration: *L. lonicerae*; original, from herbarium material on leaves of *Lonicera invoicrata*. (A, B) habit of pycnidia; (C) pycnidium breaking open; (D) conidia.



A



B

ANTHASTHOOPA



A

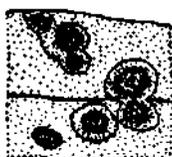


B

HAINESIA



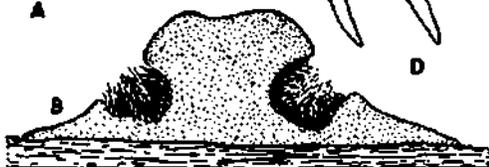
C



A



D



B

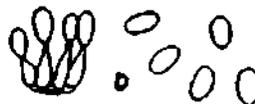
ASCHERSONIA



A



B



D



C

ACTINOPELTE



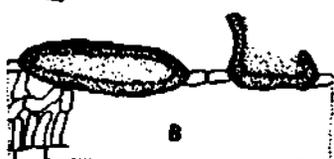
A



D



C



B

MELASMIA



A



B



C



D

LEPTOTHYRIUM

LEPTOSTROMA Fr. Pycnidia black, separate, dimidiate, subsuperficial, flattened to elongate, more or less cleft lengthwise; conidiophores short, simple, 1-celled; conidia hyaline, 1-celled, ovoid, elongate or allantoid; parasitic or saprophytic; probably imperfect state of Hysteriaceae.

Illustration: *L. actaea*; original, from herbarium material on *Cimicifuga racemosa*. (A) habit of pycnidia; (B, C) pycnidia enlarged; (D) section of pycnidium; (E) conidiophores and conidia.

CONIOTHYRIUM Sacc. Pycnidia black, globose, separate, erumpent, ostiolate; conidiophores short, simple; conidia small, dark, 1-celled, ovoid or ellipsoid; parasitic or saprophytic.

Illustration: *Coniothyrium* sp.; original, from fresh material on rose stems and culture obtained from rose. (A) habit, necrotic spot, and pycnidia; (B) pycnidia in culture; (C) conidiophores and conidia.

HARKNESSIA Cooke. Pycnidia globose, conical, thin, white, porous-lacerate at the apex, bursting out through the leaf tissue; conidiophores filiform; conidia dark, 1-celled, ellipsoid to ovoid, drawn out into a hyaline pedicel (conidiophore); saprophytic on leaves.

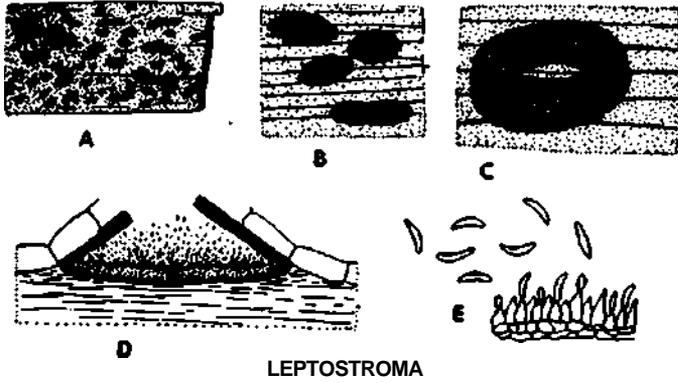
Illustration: *H. eucalypti*; original, from herbarium material on *Eucalyptus* leaves. (A) habit of pycnidia; (B) top and side views of pycnidia enlarged; (C) section through pycnidium; (D) conidiophores and conidia. Reference (422).

CHAETOMELIA Fuckel. Pycnidia black, superficial, separate, without ostiole, covered sparsely with dark bristles; conidiophores simple or branched; conidia dark to subhyaline, 1-celled, fusoid to somewhat curved; saprophytic.

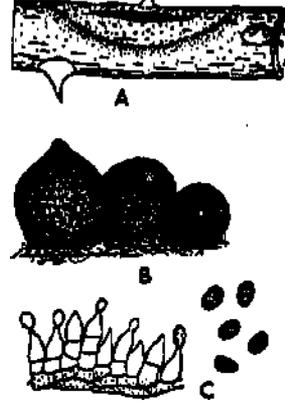
Illustration: *C. aira*; original, from herbarium material on dead stalks of *Sorghum vulgare*. (A) habit of pycnidia; (B) pycnidium enlarged; (C) bristle; (D) conidiophore and conidia; (E) pycnidium of *Chaetomella* sp. from culture. Reference (358).

SPHAEROPSIS Sacc. Pycnidia black, separate or grouped, globose, erumpent, ostiolate; conidiophores short; conidia large, dark, 1-celled, ovoid, elongate or somewhat irregular; parasitic.

Illustration: *S. malorum* (*Physalospora obtusa*); original, from herbarium material on apple leaf, fruit, and from culture. (A) pycnidia in leaf spot; (B) section of pycnidium in fruit; (C) conidia from culture.



LEPTOSTROMA

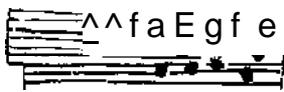


CONIOTHYRIUM

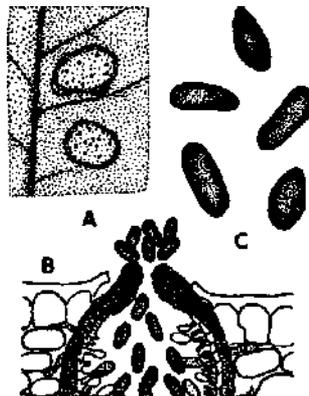
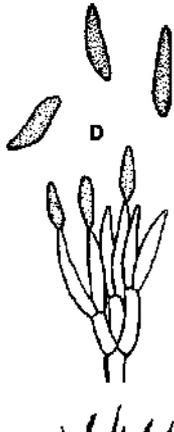


HARNESSIA

S||j| ssi



CHAETOMELLA



SPHAEROPSIS

HAPLOSPOREIXA Spcg. Pycnidia clustered in a black, wartlike stroma that bursts out of the bark, papillate; conidiophores simple; conidia large, dark, 1-celled, ovoid or oblong; parasitic or saprophytic. The genus may be synonymous with *Sphaeropsis*, but the latter is described as having no stroma.

Illustration: *H. longipes*; original, from herbarium material on dead limbs of *Morus alba*. (A) habit of pycnidia and stromata; (B) section through stroma; (C) conidiophores, conidia, and sterile hyphae; (D) conidia.

RHYNCHOPHOMA Karst. Pycnidia separate, not on leaves, somewhat globose, beaked, bursting out of substrate (usually bark) or superficial, opening by a large pore; conidiophores simple or branched; conidia 2-celled, hyaline, ovoid-oblong.

Illustration: *R. raduloides*; original, from herbarium material on stems of *Ribes hracteosum* (A) habit of pyrenidium in bark; (B) section of pyrenidium; (C) conidiophores; (D) conidia,

ASCOCHYTA Lib. Pycnidia dark, globose, separate, immersed in host tissue, ostiolate; conidia hyaline, 2-celled, ovoid to oblong; parasitic, principally causing leaf spots. Much like *Phyllosticta* but with 2-celled conidia.

Illustration: *Ascochyta* sp.; original, from fresh and dried material on barley leaf. (A) habit of pycnidia in leaf spot; (B, C) top and side views of pycnidia; (D) conidia. Reference (343).

DIPLODINA Westend. Pycnidia black, separate, immersed or erumpent, globose or flattened, ostiolate; conidiophores simple, slender; conidia hyaline, 2-celled, ovoid or ellipsoid; parasitic or saprophytic; similar to *Ascochyta* but not produced in spots.

Illustration: *D. macrospora*; original, from herbarium material on dead twigs of *Cornus*. (A) habit of pycnidia; (B) section through pyrenidium; (C) conidiophores; (D) conidia.

DARLUCA Cast. Pycnidia black, spherical, ostiolate, superficial, located in rust sori; conidia hyaline, 2-celled, ellipsoid or fusoid to oblong, tipped with mucous or bristlelike appendages at both ends; parasitic on rust fungi, chiefly on uredia.

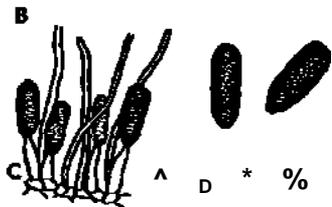
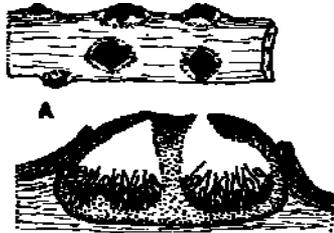
Illustration: *D. filum*; original, from dried material of *Puccinia* on grass leaf. (A, B) habit of pycnidia in uredia; (C) section through uredium of rust showing pycnidia; (D) conidia.

KELXERMANNIA Ellis and Everh. Pycnidia black, globose, separate, immersed in host tissue, ostiolate; conidiophores short, simple; conidia hyaline, mostly 2-celled, cylindrical with an awl-shaped appendage at the tip; parasitic or saprophytic.

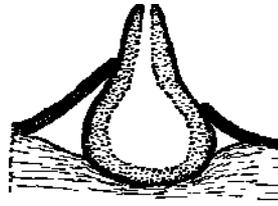
Illustration: *K. yuccaegena*; original, from herbarium material on *Yucca angustifolia*. (A) habit of pycnidia; (B) section of *Yucca* leaf showing location of pycnidia; (C) section of pyrenidium; (D) conidiophores; (E) conidia.

ROBILLARDA Sacc. Pycnidia brown to pale, in spots, erumpent to subsuperficial, globose to flattened, with small ostiole; conidia hyaline, 2-celled, cylindrical, with 3 to 4 hyaline setae at one end; parasitic on grasses, causing leaf spots.

Illustration: *R. phragmites*; redrawn from Cunnell (69). (A, B) pycnidia; (C) conidia with appendages. References (305, 385, 386).

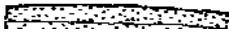


HAPLOSPORELU



RHYNCHOPHOMA

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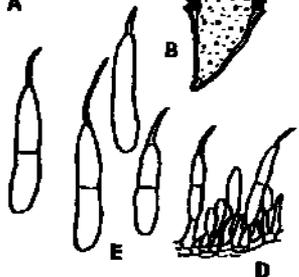


B

ASCOCHYTA

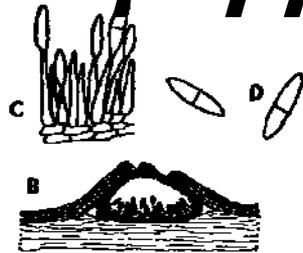


A



KEUERMANNIA

*r-n



DIPLODINA



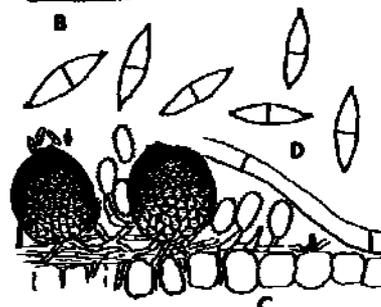
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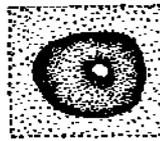
A



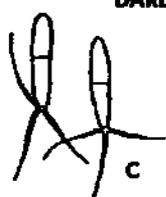
B



DARLUCA



A



C



B

ROBILLARDA

CL2

180 DESCRIPTIONS AND ILLUSTRATIONS OF GENERA

DIPLODIA Fr. Pycnidia black, single, globose, immersed, erumpent, ostiolate; conidiophores slender, simple; conidia dark, 2-celled, ellipsoid or ovoid; parasitic or saprophytic.

Illustration: *D. zaeae*; original, from herbarium material on dead corn stalk and from culture. (A, B) habit of pycnidia; (C) pyrenidium from culture; (D) conidia.

BOTRYODIPLODIA Sacc. Pycnidia black, ostiolate, erumpent, stromatic, confluent; conidiophores simple, short; conidia dark and 2-celled at maturity, ovoid to elongate; parasitic or saprophytic on twigs. This genus is much like *Macrophoma* or *Dothiorella*, if only immature conidia are present.

Illustration: *B. acerina*; original, from herbarium material on twigs of *Acer*. (A, B) habit of pycnidia and stromata; (C) section through pyrenidium; (D) conidiophores; (E) conidia.

HENDERSONULA Speg. Pycnidia black, stromate, 1 to several per stroma, locules occurring at different levels in stroma; conidiophores long, flexuous; conidia often extruded in cirri; at first 1-celled, hyaline to yellowish, later becoming 3- to 4-celled and dark; parasitic or saprophytic on wood or bark.

Illustration: *Hendersonula* sp.; original, from material from pine bark. (A) stroma bearing pycnidia breaking through bark; (B) section through stroma showing pycnidia; (C) immature conidia; (D) mature conidia.

STAGONOSPORA Sacc. Pycnidia dark, separate, superficial or erumpent, globose, ostiolate; conidiophores short; conidia hyaline, typically 3- to 4-celled, cylindrical to elliptical; parasitic or saprophytic on leaves and stems.

Illustration: *S. carpathica*; original, from herbarium material on leaves of *Trifolium repens*. (A, B) habit of pycnidia; (C) section through pyrenidium; (D) conidiophores; (E) conidia. Reference (68).

ARISTATOMA Tehon. Pycnidia brown, globose, erumpent, ostiolate, separate, bearing dark brown setae near the ostiole; conidiophores short, simple; conidia hyaline, several-celled, cylindrical; parasitic, causing leaf spots.

Illustration: *A. oeconimicum*; original, from herbarium material on leaves of *Vigna sinensis*. (A, B) habit of pycnidia; (C) section through pyrenidium; (D) conidia. Reference (418).

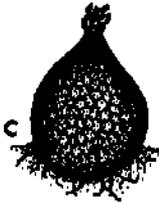
DOTHISTROMA Hulbray. Stroma dark, elongate, innate, becoming erumpent and swollen, with a stalk extending into the substratum, composed internally of dense, vertical hyphae; locules separate, one to several in the upper part of the stroma; conidiophores simple, slender; conidia several-celled, hyaline, long-cylindrical to filiform; on pine needles.

Illustration: *D. pini*; original, from herbarium material on needles of *Pinus nigra*. (A) habit of pycnidia on pine needle; (B) section through stroma and pyrenidium; (C) conidia. Reference (216).

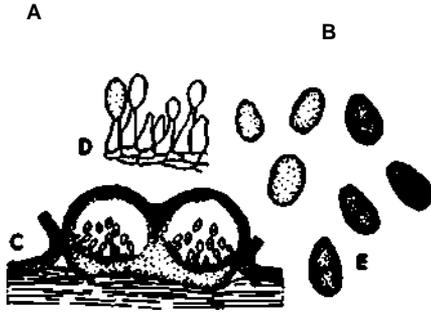


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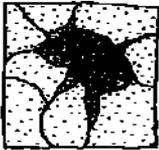
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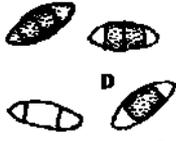
DIPLOZIA



BOTRYODIPLODIA



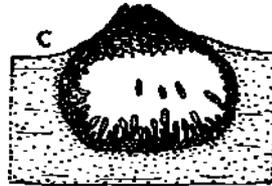
A



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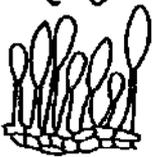
WSK&*



C



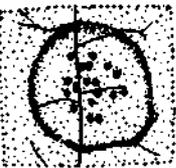
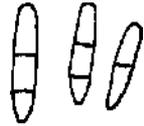
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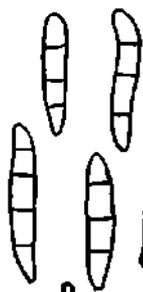
C



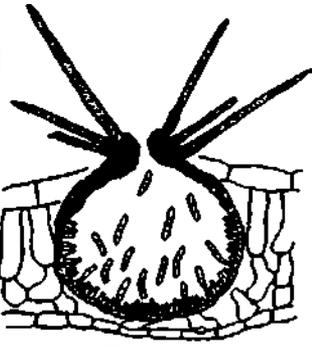
V STAGONOSPORA



A

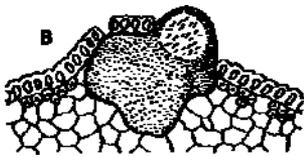


D



C

ARISTATOMA



B

DOTHISTROMA

DISCOSIA Lib. Pycnidia black, separate, circular, flattened, between the epidermis and cuticle; conidiophores short, simple; conidia hyaline, several-celled, allantoid to fusoid, with single appendage at each end; parasitic.

Illustration: *D. maculicila*; original, from herbarium material on *Smilax* leaves. (A) habit of pycnidia; (B) single pyrenidium, top view; (C) section of pyrenidium; (D) conidiophores and conidia. Reference (163).

BARTILINIA Tassi. Pycnidia dark, globose, separate, ostiolate, innate or erumpent; conidiophores short; conidia hyaline, usually 4-celled, the lower cell tapering, appendages delicate, arising from apical cell, usually 3 or 4; saprophytic.

Illustration: *B. nolinae*; (A) top view of pyrenidium; (B) section through pyrenidium; (C) conidia; drawn from photographs from Pollack (336).

TETRANACRIUM Hudson and Sutton. Pycnidia immersed, hystericiform; conidiophores erect, simple, hyaline, arising from inner cells of pyrenidium; conidia single, apical pale brown, branched, composed of 4 divergent branches, all arising from a globose basal cell; the main upright branch often somewhat longer, the side branches equal, each branch 3- to 5-celled; saprophytic.

Illustration: *T. gramineum*; redrawn from Hudson and Sutton (181). (A) section through pyrenidium; (B) conidiophore and developing conidium; (C) conidium.

MICROPERA Lev. Pycnidial cavities in yellowish to dark, waxy, erumpent stroma, opening irregularly, with one or more irregular cavities; conidiophores simple or branched; conidia hyaline, septate, elongate-filiform, pointed at the ends; frequently sickle-shaped; parasitic or saprophytic.

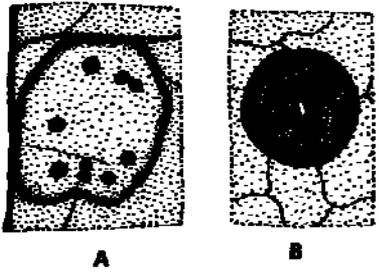
Illustration: *M. abietina* (*Dermea balsamea*); original, from fresh material on branches of *Tsuga canadensis*. (A) habit of stromata; (B) section through stroma showing pycnidial cavities; (C) conidiophore and conidia.

SEPTORIA Sacc. Pycnidia dark, separate, globose, ostiolate, produced in spots, erumpent; conidiophores short; conidia hyaline, narrowly elongate to filiform, several-celled; parasitic, typically causing leaf spots.

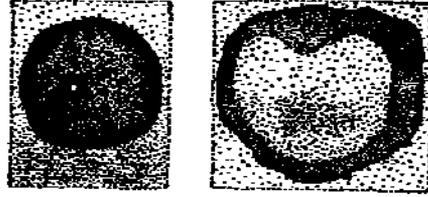
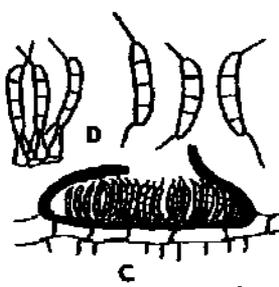
Illustration: *S. apii*; original, from dried material on leaves of *Apium*. (A) habit of pycnidia; (B) section through pyrenidium; (C) conidiophores and conidia.

GELATINOSPORIUM Peck. Pycnidia stromatic, arising from a dark hypostroma, splitting open irregularly, tissue cartilaginous; conidiophores simple or branched; conidia hyaline, 1- or more-celled, narrowly spindle-shaped, bowlike, both ends pointed; saprophytic on branches.

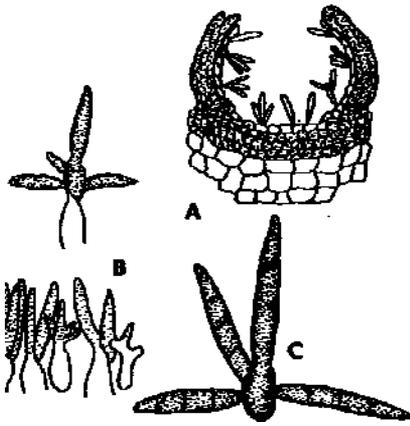
Illustration: *G. hetulinum*; original, from herbarium material on *Betula lenta*. (A, B) habit of pycnidial stroma; (C) section of stroma; (D) conidiophores and conidia.



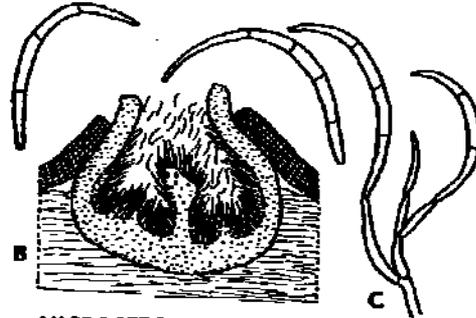
DISCOSIA



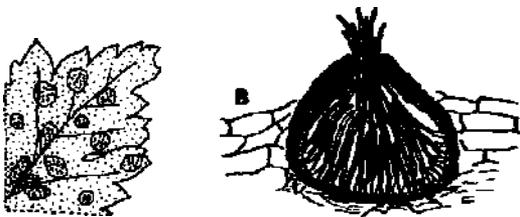
BARTILINIA



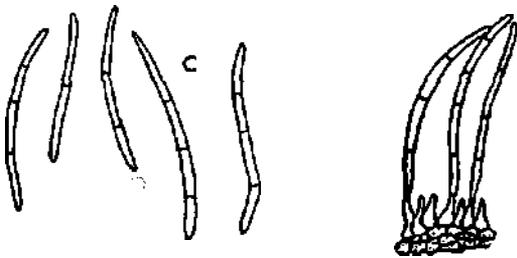
TETRANACRIUM



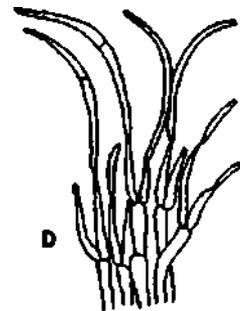
MICROPERA



GELATINOSPORIUM



SEPTORIA



GELATINOSPORIUM

EPHELIS Fr. Stroma dark, or lighter when young, resembling unopened smut galls; pycnidia erumpent, open cupulate, somewhat gelatinous; conidia hyaline, 1-celled, acicular; parasitic on grasses; conidial states of *Bahnsia*.

Illustration: *E. (Balansia) horealis*; original, from herbarium material on stems of grass. (A) stroma and pycnidia; (B) pycnidia enlarged; (C) conidia. Reference (94).

HENDERSONIA Sacc. Pycnidia dark, separate, globose, ostiolate, immersed, usually erumpent; conidia dark, several-celled, elongate to fusoid; saprophytic or parasitic.

Illustration: *H. celtifoUa*; original, from herbarium material on leaves of *Celtis occidentaHs*. (A) habit of pycnidia; (B) section through pycnidia; (C) conidia.

LEPTOSTROMELLA Sacc. Pycnidia black, elongate, longitudinally cleft, at first covered and at maturity appearing superficial, flattened to depressed; conidiophores simple, short; conidia hyaline, 1- to several-celled, elongate to filiform; saprophytic.

Illustration: *L. filicina*; original, from herbarium material on dead leaf stalks of *Dry op ten's spinulosa*. (A, B) habit of pycnidia; (C) section through pyenidium; (D) conidiophores and conidia.

PHAEOSEPTORIA Speg. Pycnidia dark, spherical, separate, ostiolate, subepidermal or erumpent; conidiophores simple, short; conidia yellowish to light brown, elongate to filiform, several-celled; parasitic principally on grasses.

Illustration: *P. festucae* var. *muhlenbergiae*; original, from culture obtained from *Muhlenbergia*. (A) pyenidium; (B) conidiophores and immature conidia; (C) mature conidia. Reference (384).

SPHAEROGRAPHIUM Sacc. Pycnidia black, separate, base globose, beak conical, spinelike, erumpent; conidiophores branched; conidia hyaline, 1- to 2-celled, filiform-fusoid, often curved; saprophytic.

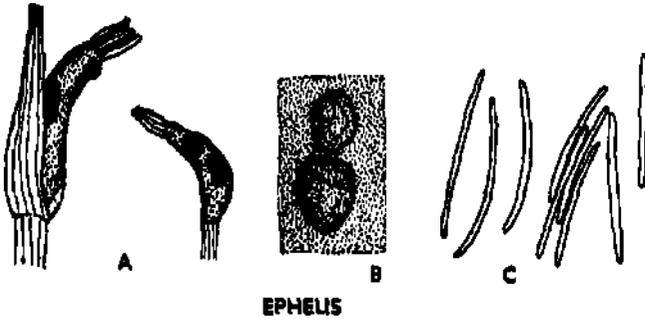
Illustration: *S. fraxini*; original, from herbarium material on twig of *Fraxinus*. (A) habit of pycnidia; (B) single pyenidium; (C) conidiophores and conidia.

RHABDOSPORIA Mont. Pycnidia dark, separate, not produced in spots, erumpent, ostiolate; conidiophores short, simple; conidia hyaline, narrowly elongate to filiform, several-celled parasitic or saprophytic.

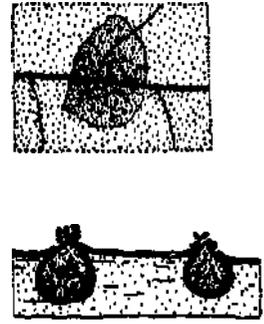
Illustration: /?, *solidaginis*; original, from herbarium material on stem of *Solidago canadensis*. (A, B) habit of pycnidia; (C) section through pyenidium; (D) conidia.

CHAETOSEPTORIA Tehon. Pycnidia complete, separate, spherical, innate, without clypeus, subicle or stroma, with ostiole, without beak, crowned with setae; conidia long, slender, several-celled, hyaline, parasitic on leaves, in spots.

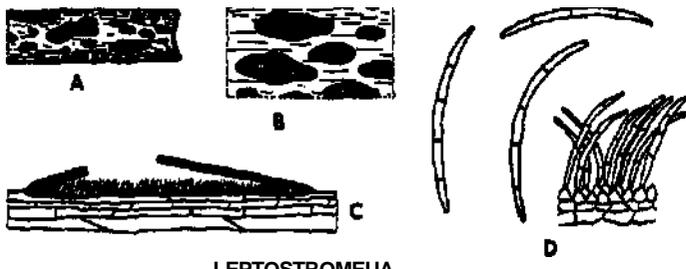
Illustration: *C. wellmanii*; redrawn from Yerkes (479). (A, B) pycnidia; (C) conidia.



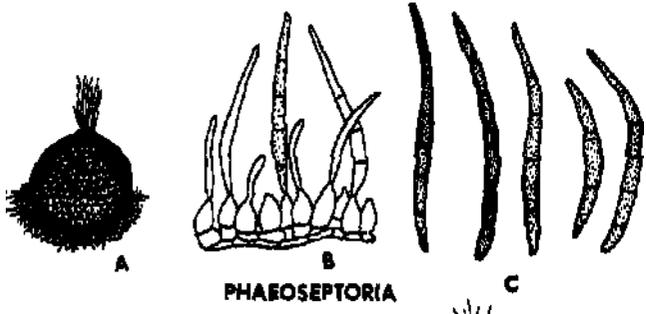
EPHELUS



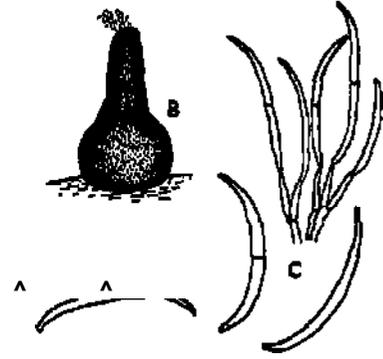
#CM
HENDERSONI*



LEPTOSTROMEUA



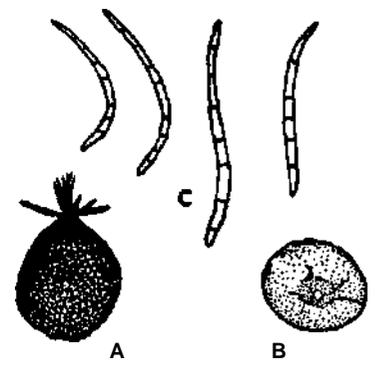
PHAEOSEPTORIA



SPHAEROGAPHIUM



RHABDOSPORA



CHAETOSEPTORIA

PHLYCTAENA Mont, and Desm. Pycnidia dark, separate or sometimes confluent, developing in or under the epidermis or bark, closed or ostiolate, usually with one chamber or divided by irregular folds; conidiophores simple or forked; conidia hyaline, 1-celled, cylindrical or long, spindle-shaped, mostly bent, sickle-shaped; saprophytic.

Illustration: *P. albocincta*; original, from herbarium material on stem of *Rhus radicans*. (A) habit of pycnidia; (B) section through pyrenidium; (C) conidiophores; (D) conidia.

PROSTHEMIUM Kunze. Pycnidia separate, covered, later breaking out, carbonaceous, globose-depressed, opening by a pore, dark; conidiophores filiform, hyaline, septate, conidia several-celled, dark, cylindrical to ellipsoid, stellately joined into few-spored groups, resembling a staurospore.

Illustration: *P. hetulinum*; original, from herbarium material on bark of *Betula alba*. (A) habit of pycnidia in bark; (B) section of pyrenidium; (C) conidia.

CHONDROPODIUM Hohnel. Pycnidia stromatic, stalked, columnar, externally black, hard, internally gelatinous, conidiophores simple, conidia hyaline, several-celled, crescent-shaped or sickle-shaped; weakly parasitic or saprophytic.

Illustration: *C. pseudotsugae*. (A) habit of pycnidia; (B) section through pyrenidium; (C) conidiophores and conidia; (A, B) drawn from photographs; (C) from drawing. All redrawn from White (470).

PHLEOSPORA Wallr. Pycnidia dark, imperfectly formed, globose, innate in tissue, not in distinct spots; conidia hyaline or subhyaline, several-celled, elongate fusoid to filiform; parasitic or saprophytic.

Illustration: *P. robinae*; original, from herbarium material on leaves of *Robinia pseudoacacia*. (A) habit of pycnidia; (B) section through pyrenidium; (C) conidia.

DICHOMERA Cooke. Pycnidia black, grouped on stroma, bursting out of bark, globose, ostiolate; conidiophores simple, conidia dark, globose, ovoid or ellipsoid, several-celled with oblique septa; saprophytic.

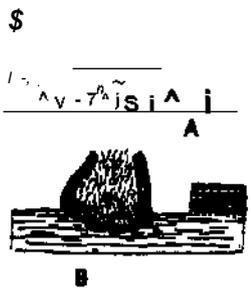
Illustration: *D. prunkola*; original, from herbarium material on twigs of *Prunus virginiana*. (A, B) habit of pycnidia; (C) section of stroma and pycnidia; (D) conidiophores and immature conidia; (E) mature conidia.

CAMAROSPORIUM Schulz. Pycnidia black, erumpent, globose, separate, ostiolate, papillate; conidiophores short, simple; conidia dark, ovoid to ellipsoid, with several cross walls and a few longitudinal or oblique walls; saprophytic on twigs.

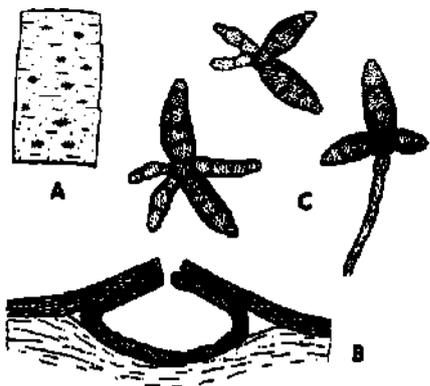
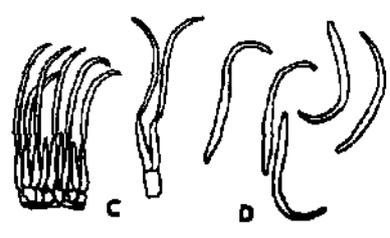
Illustration: *C. robinae*; original, from herbarium material on dead twigs of *Robinia pseudoacacia*. (A, B) habit of pycnidia; (C) section of pyrenidium; (D) conidiophores and immature conidia; (H) mature conidia.

CORNULARIA Sacc. Pycnidia dark, stalked, cylindrical, bulbous at the base, or clavate, usually in tufts or groups; conidia hyaline to colored, several-celled, fusoid to greatly elongated; parasitic or saprophytic.

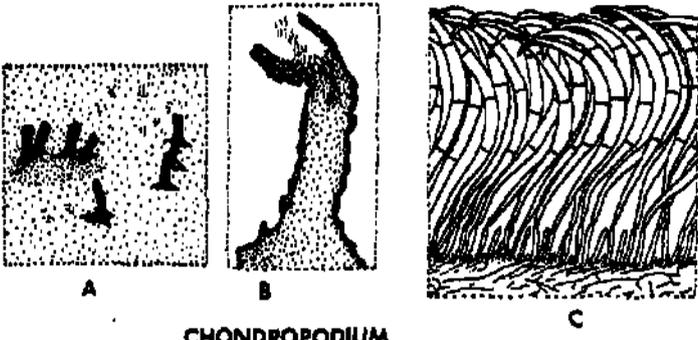
Illustration: *C. persicae*; original, from herbarium material on twig of *Prunus*. (A, B) pycnidia; (C) conidia.'



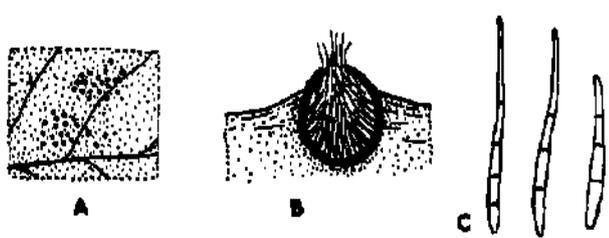
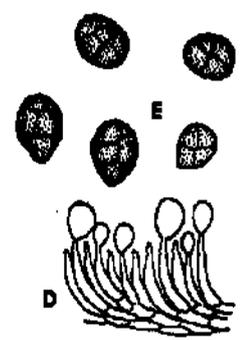
PHLYCTAENA



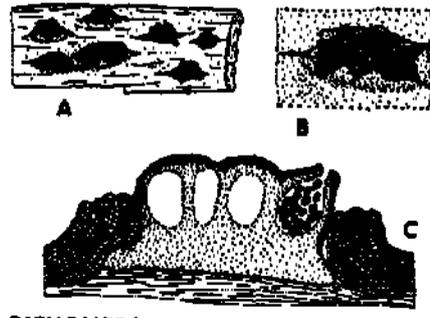
PROTHEMIUM



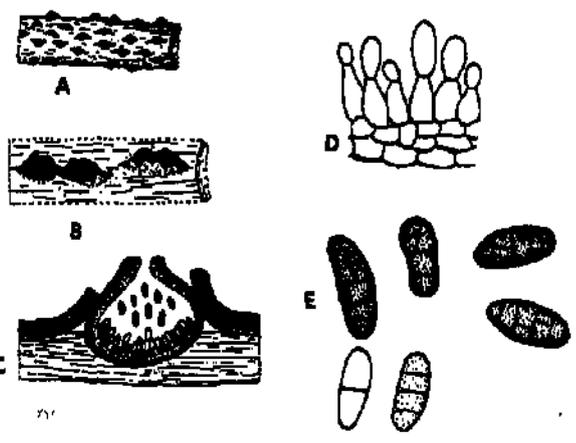
CHONDROPODIUM



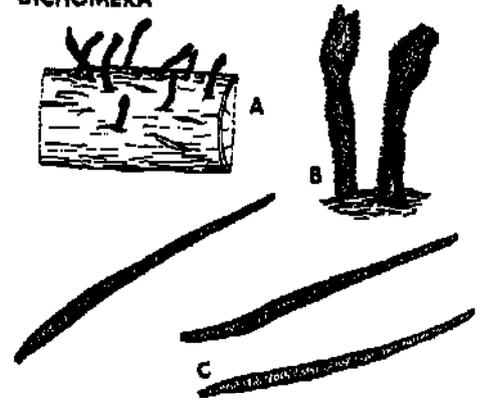
PHLEOSPORA



DICHOMERA



CAMAROSPORIUM



CORNULARIA

SPHACELOMA de Bary. Acervuli disc-shaped or cushion-shaped, waxy; conidiophores simple, closely grouped or compacted, arising from a stromalike base, sometimes almost appearing as a sporodochium; conidia hyaline, 1-celled, ovoid or oblong; parasitic; imperfect states of *Elsinoe*; similar to *Gloeosporium* and *Colletotrichum*.

Illustration: *S. ampelimum* (*Elsinoe ampelina*); original, from herbarium material on grape twigs and fruit. (A) habit on twig; (B) portion of acervulus on twig; (C) portion of acervulus on fruit; (D) conidia.

GLOEOSPORIUM Desm. and Mont. Acervuli subepidermal erumpent, disc-shaped or cushion-shaped, waxy; conidiophores simple, variable in length; conidia hyaline, 1-celled, ovoid to oblong, sometimes curved; parasitic, chiefly on leaves or fruits; mostly conidial states of *Glomerella*.

Illustration: (A-C) *G. nervisequum* (*Gnomonia veneta*); (D-F) *G. fruiligenum* (*Glomerella cingulata*); original, from fresh material on *Platanus* leaves and from culture. (A) habit of fungus; (B) section through acervulus; (C) conidiophores and conidia; (D) acervuli produced in culture; (E) conidia; (F) conidiophores and conidia in culture.

COLLETOTRICHUM Corda. Acervuli disc-shaped or cushion-shaped, waxy, subepidermal, typically with dark, spines or setae at the edge or among the conidiophores; conidiophores simple, elongate; conidia hyaline, 1-celled, ovoid or oblong, to falcate parasitic; imperfect states of *Glomerella*. This genus differs from *Gloeosporium* in having spines, which may be absent in some cultures.

Illustration: *C. lindemutheanum*; original from prepared slide and from culture. (A) section of acervulus from prepared slide; (B) conidiophores, conidia and setae from culture; (C) conidia; (D) conidia of *C. graminicola*.

CATENOPHORA Luttrell. Acervulus cushion-shaped; conidiophores simple, septate, elongate; conidia hyaline, 1-celled, ellipsoid, produced on lateral sterigmata, one per cell of the conidiophore; parasitic.

Illustration: *C. pruni*; (A) section through acervulus; (B) conidiophore producing conidia; (C) conidia; redrawn from Luttrell (271).

PESTALOZZIELLA Sacc. and Ellis. Acervuli subcuticular; conidiophores slender, simple or branched; conidia hyaline, 1-celled, ovoid or oblong; with a hyaline branched appendage at the apex; parasitic.

Illustration: *P. subsessilis*; original, from herbarium material on leaves of *Geranium caroliniana*. (A) habit on leaf; (B) conidiophores and conidia; (C) conidia.



A



B

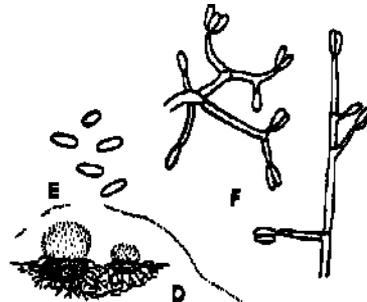


C

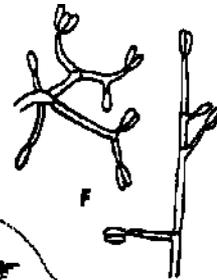


D

SPHACELOMA



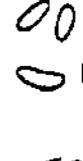
D



F



A

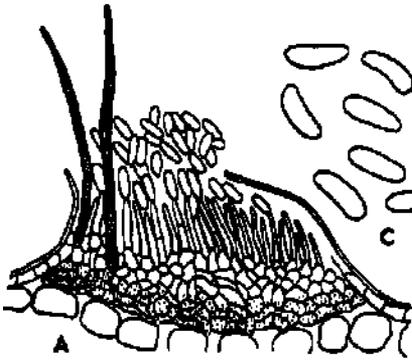


B



C

GLOEOSPORIUM



A



B

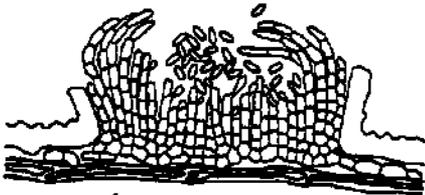


C



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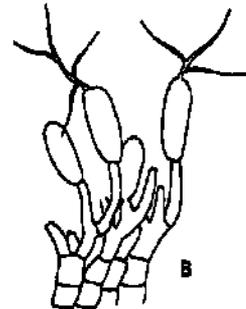
COLLETOTRICHUM



A



A



B

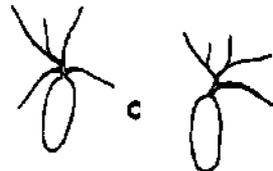


B



C

CATENOPHORA



C

PESTALOZZIELLA

MELANCONIUM Link. Acervuli subepidermal or subcortical, conic or discoid, black; conidiophores simple; conidia dark, 1-celled, ovoid to ellipsoid or oblong; parasitic or saprophytic.

Illustration: *M. oblongum*; original, from herbarium material on dead twigs of *Jugulans cinerea*. (A) habit of acervuli; (B) section through acervulus; (C) conidiophores and conidia. Reference (419).

MYCOLEPTODISCUS Ostazeski. Sclerotia small, round, black; acervuluslike fruiting structure; shieldlike, yellow to brown; stroma a single layer of cells bearing conidia; conidiophores obsolete; conidia hyaline, 2-celled, allantoid, with a filamentous appendage at each end (absent in some isolates), parasitic on legumes.

Illustration: *M. (Leptodiscus) lerrestris*; (A) spore-bearing upper surface of acervulus; (B) section through acervulus; (C) conidia; (A) drawn from unpublished photograph furnished by J.W. Gerdemann; (B, C) drawn from photographs from Gerdemann (145). References (284, 320).

MAKSSONINA Magn. Acervuli subepidermal, discoid, pale; conidiophores short, simple; conidia hyaline, 2-celled, ovoid to elongate; parasitic, chiefly on leaves.

Illustration: *M. populi*; original, from herbarium material on leaves of *Populus*. (A) habit on leaf; (B) section through acervulus; (C) conidiophores and conidia.

SEPTOGLOEUM Sacc. Acervuli subepidermal, erumpent, pale; conidiophores short, simple; conidia hyaline, several-celled, oblong to fusoid; parasites on leaves.

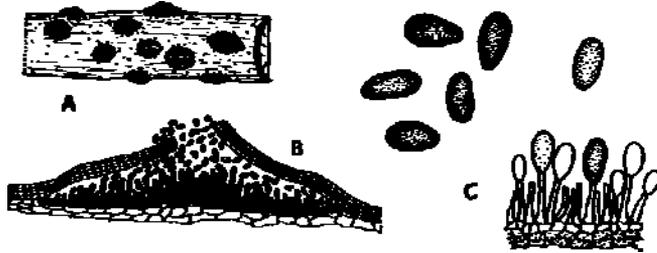
Illustration: *S. profusum*; original, from herbarium material on leaves of *Ulmus americana*. (A, B) habit of acervuli; (C) section through acervulus; (D) conidiophores and conidia.

CRYPTOSPORIUM Kunze. Acervuli erumpent, becoming cup-shaped or disc-shaped, stroma brownish; conidiophores simple or branched; conidia hyaline or subhyaline, 1-celled, elongate, falcate; parasitic.

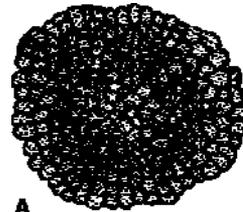
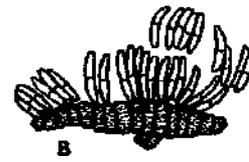
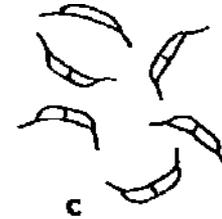
Illustration: *C. pinkoia*; (A) section through acervuli; (B) conidiophore and conidia; redrawn from Lindcr (269).

LIBERTELLA Desm. Acervulus subcortical, erumpent, yellow to red; conidiophores branched; conidia hyaline, 1-celled, filiform; saprophytic.

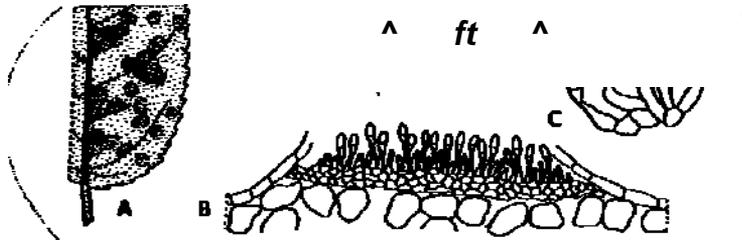
Illustration: *L. betulina*; original, from herbarium material on bark of *Betula lutea*. (A) habit of acervuli; (B) section through acervulus; (C) conidiophores; (D) conidia held together in matrix; (E) separate conidia.



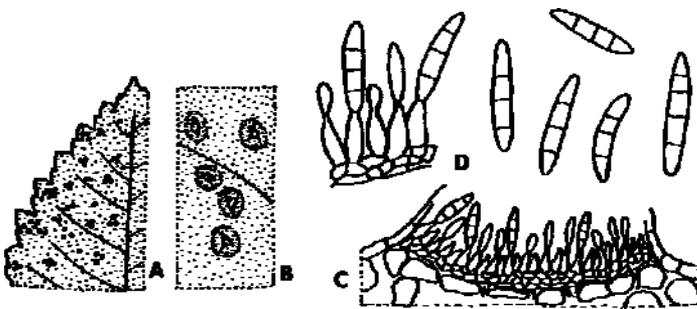
MELANCONIUM



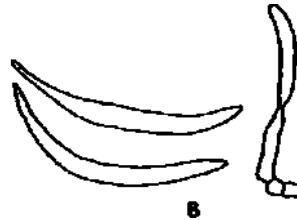
MYCOUPTODISCUS



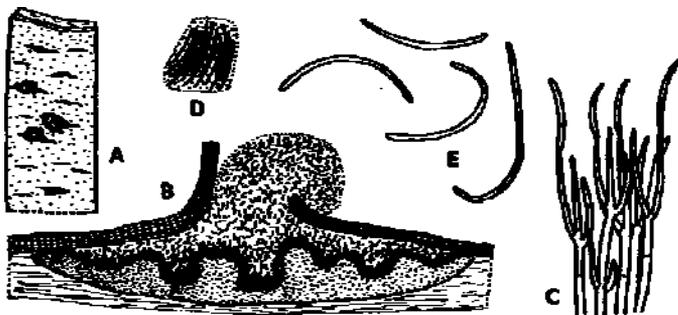
MARSSONINA



SEPTOGLOEUM



CRYPTOSPORIUM



LIBERTELLA

CYLINDROSPORIUM Unger. Acervuli subepidermal, white or pale, discoid or spread out; conidiophores short, simple; conidia hyaline, filiform, straight or curved, 1-celled or becoming septate; parasitic on leaves.

Illustration: *C. padi* (*Coccomyces hiemalis*); original, from dried material on cherry leaves. (A, B) habit of acervuli; (C) section through acervulum; (D) conidiophores and conidia.

MONOCHAETIA Sacc. Acervuli dark, discoid or cushion-shaped, subepidermal; conidiophores slender, simple; conidia dark, several-celled with hyaline, pointed end cells, elongate to fusoid, with a single apical appendage; parasitic.

Illustration: *M. mali*; original, from herbarium material on apple leaf. (A) habit on leaf; (B) section through acervulus; (C) conidiophores and conidia. Reference (391).

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PESTALOTIA de Not. Acervuli dark, discoid or cushion-shaped, subepidermal; conidiophores short, simple; conidia dark, several-celled, with hyaline, pointed end cells, ellipsoid to fusoid, with two or more hyaline, apical appendages; parasitic; or saprophytic. References (392, 416).
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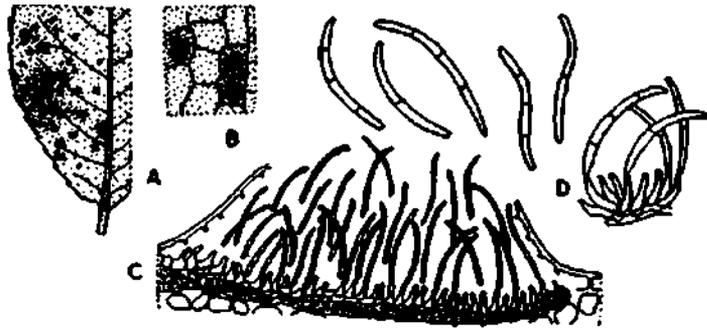
Illustration: *P. macrotricha*; original, from fresh material on leaves of *Rhododendron*. (A, B) habit of acervuli; (C) section through acervuli; (D) conidiophores and conidia; (E) conidia. References (392, 415).

POEYNEMA Lev. Mycelium immersed in substratum, hyaline; acervuli typical with little stromatic development; conidiophores arising from cells of stroma, conidia single, apical, cylindrical, obclavate, 2-to 3-celled, brown, with single simple or branched apical appendage and 1 to 3 basal appendages.

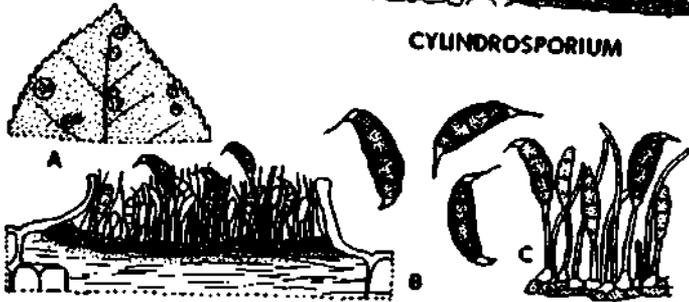
Illustration: *Polynema* (*Neobarclaya*) sp.; redrawn from Sutton (416). (A) section through acervulus; (B) conidia. Reference (420).

SEIMATOSPORIUM Corda. Acervuli typical, first immersed, erumpent; conidiophores cylindrical, slender, with a few apical proliferations; conidia borne single and successively on proliferating new growing points, fusiform to curved, 4- to 6-celled, 2 end cells hyaline, median cells dark, apical appendage single, simple or rarely branched, basal appendage usually simple; on leaves and twigs. Compare with *Pestaltia*.

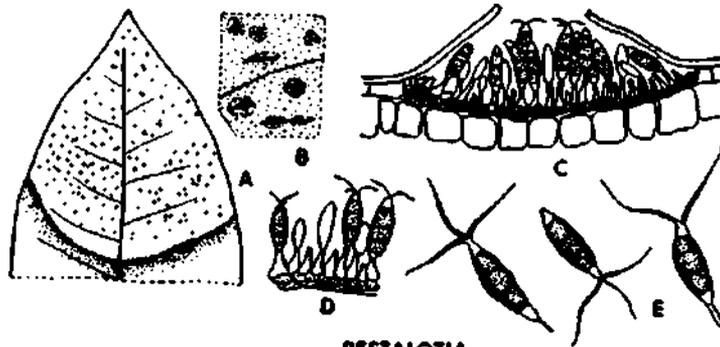
Illustration: *Seimatosporium* sp. (*Cryptostictis arbuti*); redrawn from Sutton (418). (A) portion of acervulus; (B) developing conidium; (C) conidia.



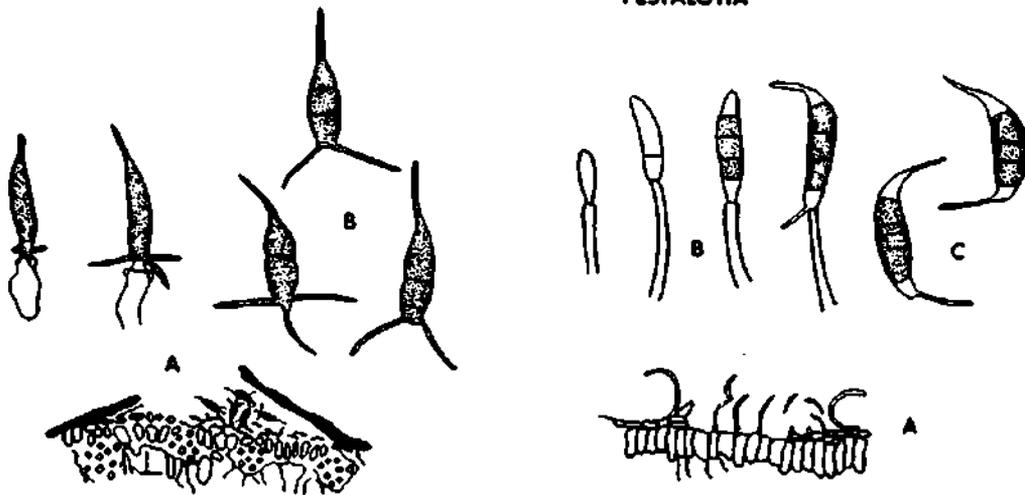
CYLINDROSPORIUM



MONOCHAETIA



PESTALOTIA



POLYNEMA

SEIMATOSPORIUM

ENTOMOSPORIUM Lev. Acervulus subcuticular, discoid, dark; conidiophores short, simple; conidia hyaline, 4-celled, cross-shaped, the two lateral cells smaller, all except the basal cell equipped with a slender bristle; parasitic on leaves and fruit.

Illustration: *E. maculatum* (*Fabrea maculata*); original from herbarium material on leaves of *Cydonia*. (A) habit on leaf; (B) section through acervulus; (C) conidia.

CORYNEUM Nees. Acervulus subcutaneous or subcortical, black, cushion-shaped to disc-shaped; conidiophores slender, simple; conidia dark, several-celled, oblong to fusoid; parasitic or saprophytic.

Illustration: *C. kunzei*; original, from fresh material on oak twigs. (A) habit of acervuli on twig; (B) section through acervulus; (C) conidiophores and conidia. Reference (425).

ASTEROSPORIUM Kunze. Acervuli bursting through bark; conidiophores slender, simple; conidia dark, typically 4-armed, each arm septate, saprophytic.

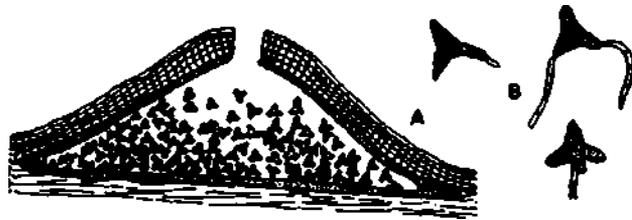
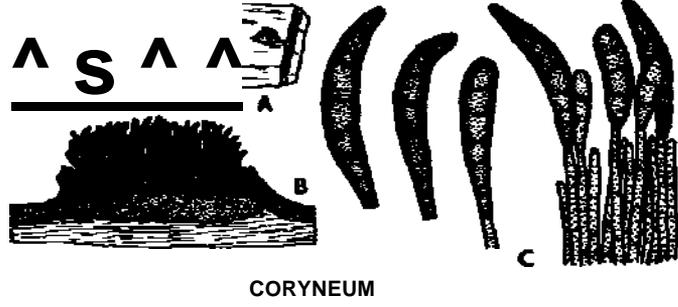
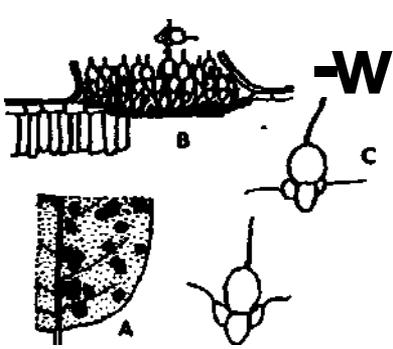
Illustration: *A. hoffmanni*; redrawn from Archer (3). (A) section through acervulus; (B) conidia.

PHRAGMOTRICHUM Kunze ex Fries. Fructifications interpreted as acervuli (sometimes pycnidium-like), stromatic; conidiophores short, upright, simple; conidia yellow or slightly darker, apical in basipetal chains, phragmosporous or dictyosporous; saprophytic on leaves or twigs.

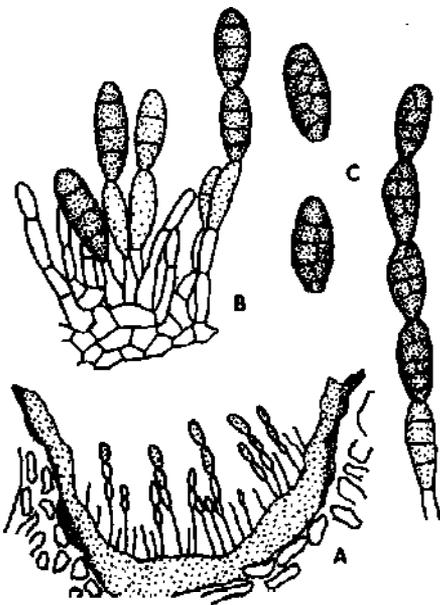
Illustration: *P. karstenii*; redrawn from Sutton and Pirozynski (428). (A) acervuluslike fruit structure; (B) conidiophores and conidia; (C) conidia.

STEGANOSPORIUM Corda. Acervulus subcortical, dark, cushion-shaped; conidiophores simple; conidia dark, dictyosporous, ovoid, oblong or pear-shaped; saprophytic on wood.

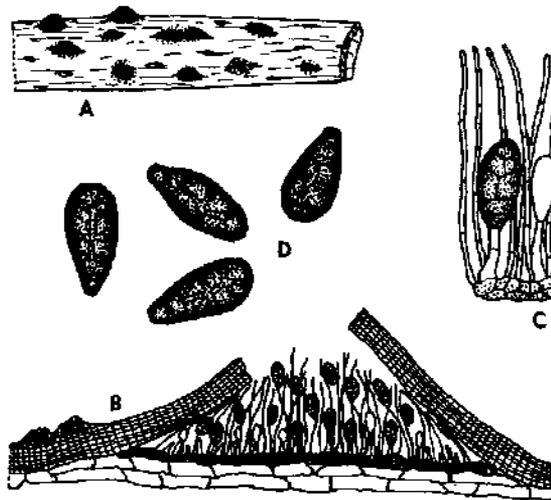
Illustration: *S. pyriforme*; original, from fresh material on bark of *Acer*. (A) habit of acervuli; (B) section through acervulus; (C) conidiophores, conidia, and sterile hyphae; (D) conidia. Reference (458).



ASTEROSPORIUM



PHRAGMOTRICHUM



STEGANOSPORIUM

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RHIZOCTONIA DC. Mycelium hyaline in some species to dark in others (such as *R. solani*), the most common species; cells of mycelium usually long, septa of branches usually set off from the main hyphae; asexual fruit bodies and conidia absent; sporodochium-like bodies and chlamydospore-like cells in chains produced in some species; sclerotia light colored and poorly formed in some species or brown or black and well formed in other; parasitic, chiefly on roots or other underground parts of plants.

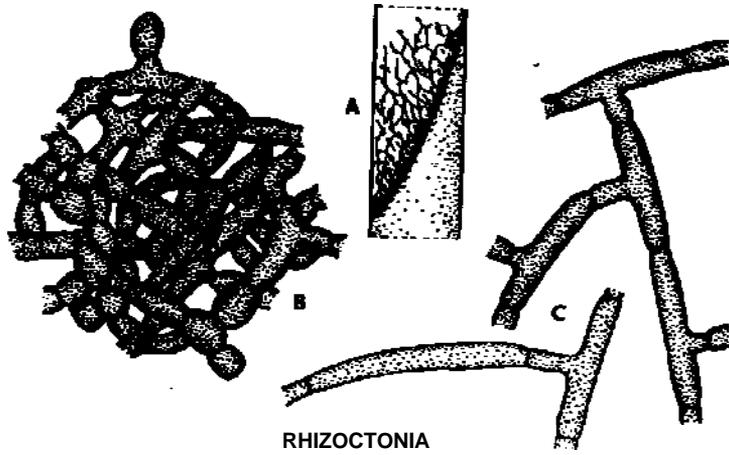
Illustration: *R. (Thanatephorus) solarri*; original, from culture. (A) small sclerotia and mycelium in tube culture; (B) section of loose sclerotium; (C) cells of mycelium. References (323, 361).

SCLEROTIUM Tode. Asexual fruit bodies and conidia lacking; sclerotia brown to black, globose or irregular, compact; mycelium usually light; parasitic, principally on underground parts of plants.

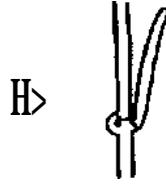
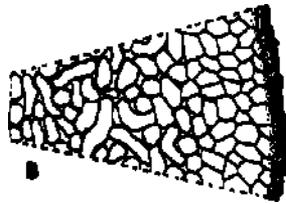
Illustration: *S. rolfsii*; original, from culture. (A) sclerotia in tube culture; (B) portion of section of sclerotium; (C) portions of mycelium showing clamp connections.

PAP15LOSPORA Preuss. Asexual spores lacking; mycelium light to dark brown, producing compact clusters of small cells or bulbils which are sclerotium-like and serve to reproduce the fungus; saprophytic, or parasitic on storage parts of some plants.

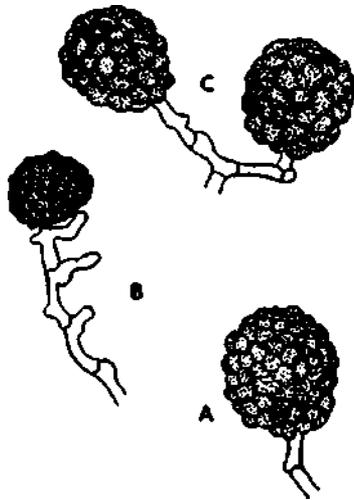
Illustration: *Papulospora* sp.; original, from decaying wood. (A-C) sclerotia produced on mycelium with clamp connections. References (17, 176, 177).



RHIZOCTONIA



SCLEROTIUM



PAPULOSPORA

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GLOSSARY

Definitions and Examples

Acicular: slender and pointed; needle-shaped. *Ephelis*, p. 184.

Acervulus: an erumpent, open, saucer-shaped fruit body, bearing conidiophores and conidia, characteristic of the Melanconiales.

Acropetal: chain of conidia having the youngest conidium at the apex. *Monilia*, p. 72; *Cladosporium*, p. 106.

Allantoid: conidia somewhat curved.

Aleuriospore: *see* p. 42.

Amerospore: a one-celled conidium.

Anastomosis: fusion between hyphal branches to form a network. *Rhizoctonia*, p. 196.

Anneilate: conidial scars appearing as rings at apex region of conidiophore or conidiogenous cell due to successive formation of terminal conidia. *Scopulariopsis*, p. 98; *Spilocaea*, p. 106.

Anellospore: *see* p. 42.

Arthrospores: *seep. 4*.

Attenuated: drawn out, narrowed, more or less to a point. *Alternaria*, p. 132; *Cercospora*, p. 128.

Ba si petal: successive chain of conidia having the youngest conidium at the base. *Oidium*, p. 68; *Aspergillus*, p. 94.

Biotrophic: a method by which some parasites obtain nutrients from living host cells. *Calcarisporium parasiticum*, *Gonatobotrys simplex*.

Blastospore: *see* p. 42.

Botryoblastospore: *see* p. 43.

Bulbil: a small number of cells aggregated into a sclerotiumlike structure. *Papularia*, p. 82.

Capitate: conidia formed into a more or less rounded head. *Aspergillus*, p. 94; *Botrytis*, p. 76.

Catenulate: conidia formed in chains of two or more. *Monilia*, p. 72; *Cladosporium*, p. 106.

Chlamydospore: a thick-walled terminal or intercalary conidium formed from a previous cell. Also *see* Aleuriospore. *Chalaropsis*, p. 90; *Sepedonium*, p. 82.

Circinate: recurved. *Circinotrichum*, p. 90; *Gyrothrix*, p. 90.

Clamp connection: a hyphal outgrowth connecting two adjacent cells of the mycelium, characteristic of certain basidiomycetes. *Sclerotium*, p. 196.

Clavate: club-shaped, broader toward the apex.

Coenocytic: nonseptate, with multinucleate hyphae or segments.

Collarete: a cup-shaped structure or flaring apex of a phialide. *Phialophora*, p. 88; *Chloëdium*, p. 88.

Conidiogenous cell: a cell or portion of a conidiophore bearing conidia (a sporogenous cell).

Cruciform: arranged in the form of a cross. *Dictyoarthrinum*, p. 134; *Entomosporium*, p. 194.

- Cupulate:** cup-shaped, deeper than saucer-shaped. *Hainesia*, p. 174; *Dinemasporium*, p. 172.
- Deciduous: referring to conidia falling off naturally.,
- Dehiscent:** breaking open at maturity. *Dothichiza*, p. 172; *Sporonema*, p. 172.
- Dendroid:** branched, treelike. *Trichoderma*, p. 92.
- Denticle:** small to medium sized, sharp or blunt, toothlike projection on which conidia are borne. *Gonatobotrys*, p. 76.
- Dermatomycosis:** a fungus disease restricted to the surface of the skin of man and animals.
- Determinate:** cessation of growth of a conidiophore when a terminal conidium is formed. *Microsporium*, p. 116; *Humkola*, p. 84.
- Dichotomous:** forked, branched into two more or less equal arms. *Dichobotrys*, p. 78.
- Dictyospore:** conidium having both transverse and oblique septa. *Ahernaria*, p. 132; *Steganosporium*, p. 194.
- Didymosporc:** a two-celled conidium.
- Dimidiate:** a half structure, or having one part smaller than the other. *Actinopehe*, p. 174; *Lepiostroma*, p. 176.
- Discoïd:** disc-shaped, flat, and circular.
- Echinulate:** with slight projections, usually pointed, on the surface of conidia or conidiophores. *Torula*, p. 74; *Heterosporium*, p. 122.
- Ellipsoid, Elliptical:** a conidium having an outline of an ellipse with rounded ends. *Pithomyces*, p. 132; *Bactridium*, p. 148.
- Endogenous:** conidia produced well within a phialide. *Chalara*, p. 90.
- Erumpent:** breaking out through the surface of the substratum. *Coryneum*, p. 194; *Botryodipodia*, p. I S O .
- Exogenous:** conidia produced on the outside of a conidiogenous cell.
- Falcate:** curved like the blade of a sickle.
- Falx:** a hook-shaped hypha or cell capable of bearing conidia. *Zygosporium*, p. 72.
- Fascicle:** tight cluster or group. *Graphium*, p. 152; *Doratomyces*, p. 154.
- Filiform:** threadlike, very slender. *Septoria*, p. 182; *Cylindrosporium*, p. 192.
- Flexuous:** wavy. *Polythrincium*, p. 112.
- Fusoid, Fusiform:** spindle-shaped. *Microsporium*, p. 116; *Monacrosporium*, p. 118.
- Fuscous:** brownish-gray, smoky.
- Geniculate:** bent like a knee, often giving a zig-zag appearance. *Geniculosporium*, p. 100.
- Globose:** nearly spherical.
- Haustorium:** a special absorbing structure formed by some parasitic fungi within cells of the host. *Piptocephalis*, p. 62.
- Helicospore:** a coiled or spiral-shaped conidium. *Helicomycetes*, p. 136.
- Hyaline:** clear, absence of dark pigment.
- Hyperparasite:** a parasite on another parasitic fungus. (A term used loosely; often, parasitism has not been proved.) See also Mycoparasite.
- Hyphopodium:** a 1- or 2-celled, branchlike structure on epiphytic mycelium of certain fungi.

Clasterosporium, p. 118.

Hysteriform: elongated, with a median cleft. *Leptostroma*, p. 176.

Indeterminate: growth of conidiophore does not cease with production of a terminal conidium or group of conidia. *Gonatobotrys*, p. 76; *Curvularia*, p. 122.

Innate: immersed in substratum. *Sphaeropsis*, p. 176; *Cytospora*, p. 170.

Intercalary: produced between other cells, not terminal.

Lenticular: in the form of a double convex lens.

Locule: a cavity, usually within a stroma. *Dothiorella*, p. 166; *Cytospora*, p. 170.

Lunate: crescent-shaped, like a half moon. *Lunulospora*, p. 138.

Macroconidia: large, often multicelled conidia, applied when fungus produces conidia of two distinct sizes. *Fusarium*, p. 130.

Meristem arthrospore: see p. 41.

Microconidia: small, usually 1-celled conidia, often applied to spermatia.

Muriform: conidia with both an oblique septa and a dictyopore. *Alternaria*, p. 132; *Steganosporium*, p. 194.

Murogenous: originating as an expansion of the entire conidiophore tip. *Murogenella*, p. 114.

Mycoparasite: a fungus parasitic on another fungus. *Gonatobotrys*, p. 76; *Piptocephalis*, p. 62.

Necrosis: death of cells; often applied to host of a micoparasite.

Obclavate: inversely clavate, widest at base.

Oblong: about twice as long as wide, usually with blunt ends.

Obovoid: inversely ovoid, narrowest at base.

Ostiole: opening or mouth of a pyrenidium. *Phoma*, p. 162.

Ovoid: egg-shaped, with narrower end at apex.

Papilla: a small rounded projection.

Pedicel: a short, slender stalk bearing a conidium. *Brachysporium*, p. 126.

Penicillus: a brush, referring to compactly branched conidiophores. *Penicillium*, p. 94; *Gliocladium*, p. 92.

Penicillate: a brushlike cluster of sporogenous cells on a conidiophore as in *Penicillium*, p. 94.

Percurrent: proliferation of conidiophore or conidiogenous cell in which each successive apex arises through the previous apex. *Gonatobotrys*, p. 76; *Spilocaea*, p. 106.

Phialide: a specialized sporogenous cell producing conidia from an open end in basipetal succession. *Chalara*, p. 90; *Phialocephala*, p. 96.

Phialospore: see p. 44.

Phragmospore: a several-celled conidium with transverse septa only. *Bipolaris*, p. 126; *Dendryphiopsis*, p. 120.

Pigmented: used to indicate presence of pigment in the cell walls, not in the internal contents.

Polyphialide: a phialide with more than one open end.

Porospore: see p. 43.

Pseudoparenchyma: isodiametric or oval fungus cells organized into tissues in which the individual hyphae have lost their identity. *Sclerotium*, p. 196.

Pycnidium: a closed or nearly closed asexual fruit body bearing conidiophores and conidia internally, characteristic of the Sphaeropsidales.

Pyriform: pear-shaped, narrower at the base.

Rachis: central axis of a conidiophore on which conidia are attached alternately. *Tritirachium*, p. 100.

Reniform: kidney-shaped.

Sclerotium: a compact resistant mass of hyphae or pseudoparenchyma.

Scoleospore: a long slender conidium. *Septoria*, p. 182; *Cylindrosporium*, p. 192.

Sessile: without a stalk. *Tripodermium*, p. 142; *Aureobasidium*, p. 70.

Seta: a sterile hypha associated with various fruiting structures. *Colletotrichum*, p. 188; *Gyrothrix*, p. 90.

Sporangiole: a small sporangium producing one to few spores, characteristic of some Mucorales. (In some genera the 1-celled sporangioles may be called conidia.) *Choanephora*, p. 66.

Sporocladium: a special short branch of a sporangiophore in certain Mucorales in which conidia are borne on one side only. *Martensella*, p. 64.

Sporodochium: a cushion-shaped structure made up of closely grouped conidiophores, characteristic of the Tuberculariaceae.

Sporogenous cell: a special cell or branch bearing conidia.

Staurospore: a branched or star-shaped conidium. *Tridentaria*, p. 140; *Tripodermium*, p. 142.

Sterigma: a short, pointed, peglike extension of a cell that supports a conidium, usually considered larger than a denticle.

Stipitate: having a stipe or stalk. *Cornularia*, p. 186.

Stroma: a compact mass of hyphae on which or in which conidia or fruit bodies are borne. *Botryodiplodia*, p. 180; *Cytospora*, p. 170.

Stylospore: an elongated conidium produced in a pycnidium. *Phomopsis*, p. 164.

Subhyaline: conidia generally classified as hyaline, but showing slight pigmentation in mass.

Subiculum: a loose crustlike growth on which fruit bodies are produced. *Asteromella*, p. 164.

Sympodulospore: see p. 43.

Sympodial: growth or branching of a conidiophore or sporogenous cell arising beneath or behind the previous conidium and pushing it to one side. *Curvularia*, p. 122; *Tritirachium*, p. 100.

Synnema: a cylindrical compact group of conidiophores, characteristic of the Stilbaceae.

Torulose: cylindrical but having swellings at intervals.

Truncate: cut off at the end, flat. *Scopulariopsis*, p. 98; *Geotrichum*, p. 68.

Tube reulate: having wartlike processes. *"

Verrucose: having small rounded processes, appearing as a minutely roughened wall. *Ulocladium*, p. 132; *Periconia*, p. 74.

Verticillate: having a whorl of three or more branches or sporogenous cells arising at the same level. *Verticillium*, p. 92,

Vesicle: an inflated cell or portion of conidiophore. *Cylindrocladium*, p. 108.

Whorl: a number of conidia or branches attached at the same level. *Verticillium*, p. 92.

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