

PRINCIPLES OF PLANT TAXONOMY, VIII*.

JOHN H. SCHAFFNER.

In the seventh paper of this series, a phylogenetic synopsis was presented of the orders of the META-THALLOPHYTA. A similar synopsis is now given of the orders of THALLOPHYTA. The two diagrammatic "trees" of relationships may be put together and thus a crude picture of the phyletic relationships of the entire plant kingdom will be represented from the lowest stage to the highest with all the multitudinous ramifications out to the orders.

The Archemycetæ as described in the Ohio Jour. of Sci. 27: 250, 1927, should be shifted in the list to immediately follow the Myxomycetæ and re-defined as being mostly sexual; since it now appears that most of them have some sort of a conjugation process.

There are many problems of a fundamental nature in the thallophytes which cannot be solved at present, because of a lack of knowledge of life histories. This is especially true of the lower green algæ, the lower brown algæ, the archemycetes, and the ascomycetes. So long as the genera and families are not properly segregated, it will be impossible to deal conclusively with the larger groups. This fact should not deter us, however, from attempting to make a correct phyletic taxonomy. Every careful attempt will bring the true taxonomic view nearer. The older morphological speculations, which did not distinguish progressive series from digressive movements or segregations, could not construct a true taxonomic system because they made no definite attempt to judge structures and individuals on a phyletic basis, but merely compared similarities and differences, and frequently deduced phylogenetic sequences which required a series of re-creations, if the one form was actually to be evolved from the other. Thus many of the taxonomic sequences which are at present widely accepted are a contradiction to any evolutionary theory of origins whatever unless one is willing to subscribe to the

* Papers from the Department of Botany, The Ohio State University, No. 245.

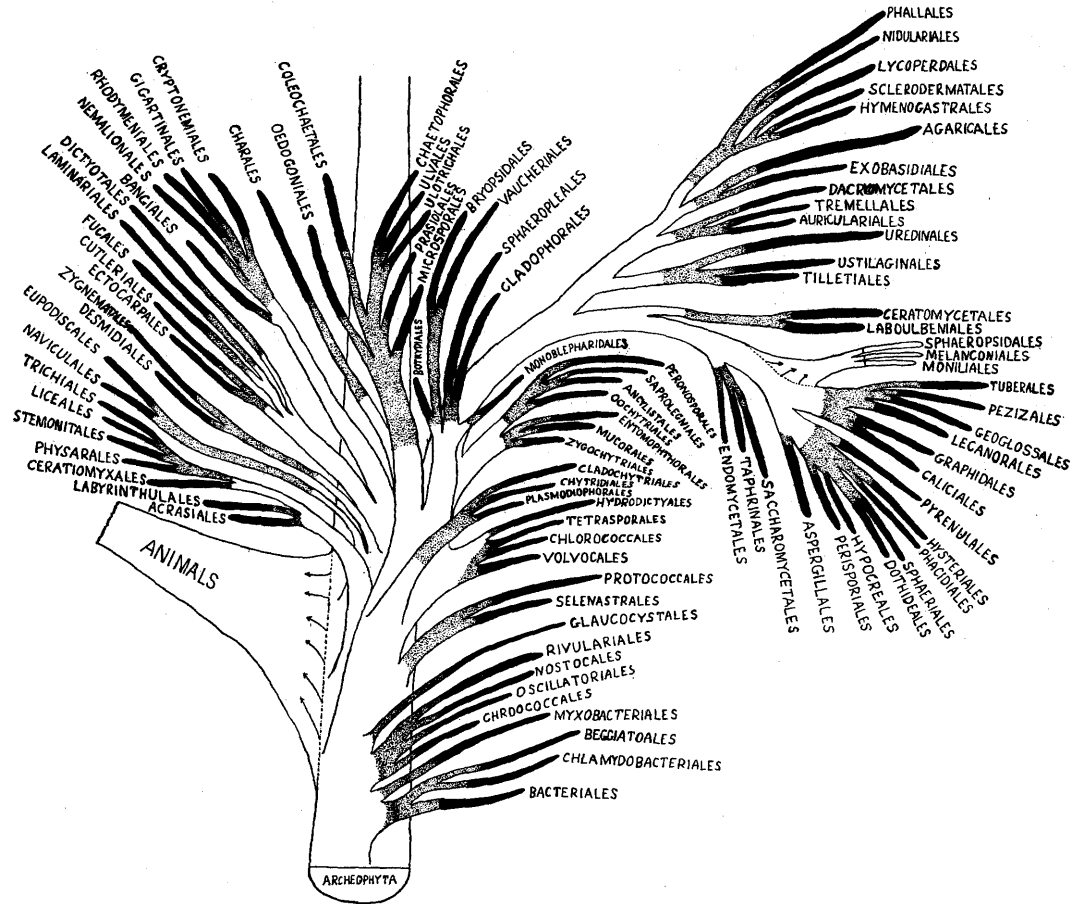


FIG. 1. Diagram of the phyletic relationships of the Orders of Thallophyta.

fantastic notion of frequent and violent re-creations in the phylogenetic series.

SYNOPSIS OF THE CLASSES AND ORDERS OF SCHIZOPHYTA.

- I. Cells without chlorophyll, sometimes with bacterio-purpurin; holophytic, saprophytic, or parasitic fungi.
- A. Cells not imbedded in a pseudo-plasmodium; life cycle not with two distinct, vegetative and fruiting periods; not forming a myxomycete-like fructification, altho the cells may be in gelatinous masses.
- SCHIZOMYCETÆ. Bacteria.
1. Cells without bacterio-purpurin and without sulfur granules; if in chains or filaments, then without a sheath. *Bacteriales*. Bacteria.
 2. Cells with bacterio-purpurin, with sulfur granules or with both; unicellular or filamentous; or filamentous bacteria with definite sheaths.
 - a. Cells in filaments covered with a more or less definite sheath, without sulfur granules and without bacterio-purpurin.

Chlamydo-bacteriales.
 - b. Cells separate or if in filaments not covered with a sheath; with sulfur grains, or with bacterio-purpurin, or with both.

Beggiatoales.
- B. Cells in a pseudo-plasmodium; life cycle with two distinct periods, a vegetative period and a fructification period when a myxomycete-like fruiting body is developed with or without a stalk. MYXOSCHIZOMYCETÆ.
- One order, *Myxobacteriales*. Slime Bacteria.
- II. Cells containing chlorophyll and phycocyanin; algæ usually of a blue-green or brownish color.
- A. Without a definite nuclear membrane and with a low type of chromatophore. CYANOPHYCEÆ. Blue-green Algæ.
1. Not filamentous; cells free or in masses or plates (superficial aggregates); or the cell individuals with definite base and apex, in fruiting sometimes forming a row of cells. *Chroococcales*.
 2. Cells arranged in definite filaments.
 - a. Filaments without hair-like tips, but sometimes narrowed at the ends.
 - (a) Without heterocysts; free filaments commonly massed into flat layers, sometimes several filaments enclosed in one common sheath. *Oscillatoriales*.
 - (b) With intercalary heterocysts. *Nostocales*.
 - b. Filaments with hair-like tips at one or both ends, without or with basal heterocysts. *Rivulariales*.
- B. With nuclear membrane and highly differentiated chromatophores, unicellular or in colonies. GLAUCOCYSTEÆ. Higher Blue-green Algæ.
- One order, *Glaucocystales*.

SYNOPSIS OF THE CLASSES AND ORDERS OF MYXOPHYTA.

- I. Without zoospores; the cells not fusing into a typical plasmodium, but simply aggregated; spore mass without a covering.
- ACRASIEÆ. Primitive Slime Molds.
- A. Cells ameboid, forming a typical aggregation plasmodium. . . . *Acrasiales*.
 - B. Cells not ameboid, but with rather rigid form, aggregating into a net-like plasmodium. *Labyrinthulales*.
- II. With zoospores containing a single flagellum; plasmodium of completely fused cells. MYXOMYCETÆ. Slime Molds.
- A. Spores developed superficially upon erect branching sporophores, no sporangia being produced. Subclass CERATIOMYXEÆ.
- One order, *Ceratiomyxales*.

- B. Spores developed within a sporangium-like body with a wall, the sporangia distinct or united into an æthelium. Subclass. MYXOGASTERÆ.
1. Spores dark, brown, black, or violet; capillitium present.
 - a. Fructification with lime, capillitium present. *Physarales*.
 - b. Fructification without lime; capillitium solid. *Stemonitales*.
 2. Spores generally yellowish in color, never black; capillitium present or absent; lime absent.
 - a. Capillitium absent; the frayed walls of the sporangium may sometimes resemble a capillitium. *Liceales*.
 - b. Capillitium present, tubular or solid. *Trichiales*.

SYNOPSIS OF THE CLASSES AND ORDERS OF ZYGOPHYTA.

- I. Cell walls impregnated with silica, composed of two valves. Subphylum and class, DIATOMÆ. Diatoms.
 - A. Valves with a raphe or pseudo-raphé or with a sagittal line, with a zygomorphic or insobilateral or sometimes irregular symmetry; never centric; valve-view mostly boat-shaped (naviculoid), rod-shaped, needle-shaped, or elliptic in outline; motile or non-motile; conjugation known in most groups. Mostly fresh water plants.

Naviculales. Long Diatoms
 - B. Valves without a raphe or pseudo-raphé, with a concentric or radiating symmetry around a central point, valve-view usually circular, polygonal, or broadly elliptical in outline, rarely boat-shaped or irregular; conjugation unknown; cells without spontaneous movement. Mostly marine plants. *Eupodiscales*. Round Diatoms.
- II. Cell walls without silica but with abundant development of gelatinous pectose, causing the plants to be slimy to the touch. Subphylum and class, CONJUGATÆ.
 - A. Thallus a filament, or commonly separating into single cells, mostly flattened, the cell wall divided into two symmetrical halves; cells mostly constricted at the middle, often of fantastic and beautiful form; cell contents mostly divided into symmetrical halves; conjugation by the breaking open of the cell walls or by the formation of a primitive conjugation tube. Fresh water algæ. *Desmidiæ*. Desmids.
 - B. Thallus a simple filament, or occasionally with rhizoid-like outgrowths, with cylindrical cells, the cells not constricted in the middle, but sometimes the contents divided into symmetrical halves; these latter forms distinguished from the preceding order by the definite filament and prominent conjugation tube; some species forming aplanospores. In fresh and brackish water. *Zygnematales*. Pond-scums.

SYNOPSIS OF THE CLASSES AND ORDERS OF GONIDIOPHYTA.

- I. Plants unicellular or colonial, not truly filamentous.
 - A. Nonsexual, unicellular or colonial algæ without zoospores, commonly with autospores; cells normally with one nucleus. AUTOSPORÆ. Primitive Green Algæ.
 1. Reproduction by autospores, the protoplast dividing within the mother cell, and the daughter cells escaping singly or in colonies. In fresh, brackish, or sea water, or on moist rocks, etc.; some endozoic in water animals. *Selenastrales*.
 2. Reproduction by vegetative division and separation by splitting of the daughter cells. Aerial, on damp-stones, trees, etc., or in fresh or salt water. *Protococcales*. (Pleurococcales).
 - B. Sexual primitive, parasitic or occasionally saprophytic, aquatic or aerial fungi, or perhaps some nonsexual. ARCHEMYCETÆ. Primitive Fungi.
 1. Ameboid zoospores uniting into plasmodial masses; plants holocarpic; zoospores with one flagellum; parasitic in the roots of higher plants. *Plasmodiophorales*. Clubroot Fungi.

2. Zoospores not uniting to form a plasmodium, with one or sometimes two flagella.
 - a. Plant body holocarpic, the whole forming a fructification; rhizoid-like processes, if present, without nuclei. *Chytridiales*.
 - b. Plant body eucarpic, forming an imperfect mycelium-like filament, divided into principal and secondary axes. *Cladochytriales*.
- C. Isogamous or heterogamous, sexual algæ or probable derivatives from them, with zoospores.
 1. Unicellular or colonial algæ, usually with one nucleus in each cell rarely cenocytic, the colonial forms not produced by the symmetrical aggregation of free zoospores; vegetative stage non-motile or active; isogamous or heterogamous. *CHLOROCOCCÆÆ*.
 - a. Cells ciliated and motile in the vegetative state; unicellular or in definite colonies. *Volvocales*.
 - b. Cells not active in the vegetative stage.
 - (a) Vegetative cell divisions absent, cells separate or somewhat cenocytic. *Chlorococcales*.
 - (b) Colonies increasing by vegetative cell division. *Tetrasporales*.
 2. Cenocytic algæ consisting of colonies of peculiar form, new colonies being produced by the definite arrangement of daughter cells developed in the parent cenocyte; isogamous, aquatic. *HYDRODICTYÆÆ*. One order, *Hydrodictyales*.
- II. Green algæ or aquatic fungi with a filamentous or massive body and 1, 2, 4, or many cilia on the zoospores and gametes.
 - A. Cenocytic, septate or nonseptate, isogamous or heterogamous.
 1. Algæ usually pure green in color.
 - a. Vegetative body usually septate, consisting of a series of cenocytes; chloroplasts forming a net, rarely in separate plates. *SIPHONOCLADEÆÆ*. Lower Tube Algæ.
 - (a) Plants isogamous or slightly heterogamous; filaments branched. *Cladophorales*.
 - (b) Plants heterogamous, with stationary eggs and motile spermatozooids; filaments septate, unbranched, free-floating. *Sphaeropleales*.
 - b. Vegetative body usually nonseptate, with distinct lenticular, oval, or plate-like chloroplasts. *SIPHONÆÆ*. Higher Tube Algæ.
 - (a) Sexual reproduction unknown or isogamous, the gametes sometimes of unequal size.
 - ((a)) Small globular terrestrial plants with branched rhizoids penetrating the ground; zoospores with cilia of unequal lengths. *Botrydiales*.
 - ((b)) Mostly large marine or sometimes endophytic algæ; zoospores if present not with unequal cilia. *Bryopsidales*.
 - (b) Sexual reproduction by highly specialized stationary eggs and motile spermatozooids; thallus tubular, branched or unbranched, growing in fresh or brackish water or on moist soil. *Vaucheriales*.
 2. Filamentous, saprophytic, aquatic fungi with stationary eggs and unciliated spermatozooids. *MONOBLEPHARIDEÆÆ*. One order, *Monoblepharidales*.
 - B. Algæ having normal vegetative cells with one nucleus, with a conjugation of free-swimming gametes, or with motile sperms and stationary eggs. *CONFERVEÆÆ*. *Confervas*.
 - (A) Isogamous, or the free-swimming gametes sometimes of unequal size.
 1. Thallus unbranched.
 - (1) Chloroplasts reticulate, without pyrenoids; fresh water plants. *Microsporales*.
 - (2) Chloroplasts central or parietal, with one or more pyrenoids.

- a. Chloroplast single, central, stellate, with one pyrenoid; no zoospores known; aerial in habit. *Prasiolales.*
- b. Chloroplasts parietal, with one to many pyrenoids.
 - (a) Unbranched filaments; chloroplasts with one to many pyrenoids. *Ulotrichales.*
 - (b) Thallus expanded, a 1-2-layered plane or tube; chloroplast single with one pyrenoid; mostly marine. *Ulvales.*
- 2. Thallus filamentous, branched, usually abundantly so, the branches often with attenuated or hair-like tips. *Chaetophorales.*
- B. Heterogamous, the egg stationary in the oogonium, sometimes with dwarf males as an intercalated phase.
 - 1. Oogonium not developing a cortical layer after fertilization. *Oedogoniales.*
 - 2. Oogonium with a trichogyne-like tip, and covered after fertilization by a cortical layer; thallus disk-like or cushion-like. *Coleochaetales.*

SYNOPSIS OF THE CLASSES AND ORDERS OF PHAEOPHYTA.

- I. Zoospores when present and ciliated gametes with two flagella; if with an alternation of generations, then the gametophyte minute.
 - A. Gametangia plurilocular; zoospores produced in unilocular sporangia; apparently without an alternation of generations. PHAEOSPORÆ. Little Kelps.
 - 1. Frond mostly filiform; zoospores and isogametes similar, rarely with gametes of unequal size. *Ectocarpales.*
 - 2. Frond flat and leathery, with filamentous branches; heterogamous, with micro- and mega-gametes, both motile; zoospores on diploid individuals (?) *Cutleriales.*
 - B. Gametangia unilocular or unicellular; zoospores none, or when present produced in unilocular sporangia and giving rise to minute male and female gametophytes.
 - 1. With a simple diploid sexual cycle and without zoospores; gametangia unilocular; eggs large and non-motile, but discharged from the oogonium; sperms minute and free-swimming. *CYCLOSPORÆ.* Rockweeds.
 - One order, *Fucales.*
 - 2. With an alternation of generations; nonsexual zoospores produced in unilocular sporangia and giving rise to small male and female gametophytes; gametangia unicellular; sporophyte often very large. LAMINARIÆ. Giant Kelps.
 - One order, *Laminariales.*
- II. Nonsexual spores non-motile; sperms with one flagellum; reproductive organs external; with a regular alternation of prominent sexual and non-sexual generations. DICTYOTÆ. One order, *Dictyotales.*

SYNOPSIS OF THE CLASSES AND ORDERS OF RHODOPHYTA.

- I. Nonsexual reproduction by single thallus cells, trichogyne imperfectly developed; no pits between the thallus cells. MONOSPORÆ.
 - One order, *Bangiales.*
- II. Nonsexual reproduction by tetraspores usually developed in groups of four; trichogyne well developed; cells protoplasmically connected through large pits in the walls. FLORIDÆ.
 - A. Sporophores ("Gonimoblasts" or branches bearing the carpspores) of the sporocarp produced directly from the fertilized oogonium; mostly plants with filiform fronds. Fresh water or marine. *Nemalionales.*
 - B. Sporophores produced by auxiliary cells after these conjugate with the fertilized oogonia or their branching processes (ooblastema).

1. Sporophores produced by nearby auxiliary cells. Marine plants.
 - a. Sporophores produced by nearby auxiliary cells and growing outward in the plant body; filiform, foliaceous, or massive plants. *Rhodynemiales*.
 - b. Sporophores produced by the nearby auxiliary cells and branching copiously in the surrounding tissues of the plant body; fronds parenchymatous, erect or spreading, branching, cylindrical, flattened, or leaflike. *Gigartinales*.
2. Sporophores produced by remote auxiliary cells after these have conjugated with the branched "ooblastema" filaments arising from the fertilized oogonium, fronds filiform, branched, often flattened. Mostly marine, but a few fresh water species.

Cryptonemiales.

PHYLUM, CHAROPHYTA.

One class and one order, CHAREÆ. *Charales*. Stoneworts.

THE TWO SUBPHYLA OF MYCOPHYTA.

- I. Plants with a cenocytic mycelium, without or with transverse septa.

PHYCOMYCETÆ. Algal Fungi.
- II. Plants with a septate mycelium, the vegetative cells containing one or two nuclei; normally with a conjugate phase in the life cycle.

MYCOMYCETÆ. Higher Fungi.

SYNOPSIS OF THE CLASSES AND ORDERS OF PHYCOMYCETÆ.

- I. Sexual spores, "zygospores," produced by the union of the contents of two similar or nearly similar conjugating branches of the mycelium, the one branch not penetrating the other; nonsexual spores rarely zoospores. Saprophytes or animal parasites, a few parasitic on other plants.

ZYGOMYCETÆ.

 - A. Nonsexual spores motile, with one flagellum, in terminal sporangia. Saprophytic, aquatic plants growing on dead insects. . . . *Zygochytriales*.
 - B. Nonsexual spores nonmotile, in sporangia or abstricted conidia; saprophytic or occasionally parasitic on other molds or on higher plants. *Mucorales*. Common Molds.
 - C. Nonsexual spores nonmotile, single at the ends of conidiophores; mostly parasitic on insects, as flies, grasshoppers, plant lice, etc., rarely on plants. *Entomophthorales*. Insect-cholera Fungi.
- II. Sexual spores, "oospores," formed by the union of the contents of two conjugating branches of unequal size, the smaller usually penetrating the wall of the larger by means of a fertilization tube; or discharging its contents into it, sometimes parthenogenetic; nonsexual spores, either zoospores with one or two cilia, or conidia. Plant or animal parasites or saprophytic, sometimes aquatic. OOMYCETÆ.
 - A. Nonsexual reproduction not by conidia; mostly aquatic fungi; a few on higher aerial plants.
 1. Mycelium present but poorly developed, either free or endophytic parasites; oospores formed by the conjugation of a larger and a smaller branch of the mycelium, the contents of the smaller branch passing over into the larger. *Oochytriales*.
 2. Mycelium usually poorly developed, with septa; endophytic parasites, mostly in fresh water algæ, some in the roots of higher plants; sporangia producing zoospores. *Ancylistales*.
 3. Mycelium well developed; mostly aquatic molds; saprophytic or parasitic; nonsexual reproduction by zoospores, rarely by non-motile spores. *Saprolegniales*.
 - B. Nonsexual reproduction by aerial conidia, which may give rise to zoospores; mycellium parasitic in higher plants. *Peronosporales*.

THE TWO MAIN PHYLETIC BRANCHES OF THE MYCOMYCETÆ.

- I. With ascospores, commonly 8 in an ascus; conjugate phase present, but usually not prominent. Here are included also all conidial types whose perfect stage is not known. ASCOMYCETOUS GROUPS.
- II. With basidiospores, commonly 4, developed on a basidium; one prominent stage of the mycelium with two nuclei in each cell (conjugate phase); conidia sometimes produced, or spores of various types.

BASIDIOMYCETOUS GROUPS.

SYNOPSIS OF THE CLASSES AND ORDERS OF ASCOMYCETOUS FUNGI.

- I. Asci developed after the conjugation of two cells of the mycelium, or parthenogenetically (?); occasionally fertilization by means of detached conidia-like spermatia; nonsexual conidia usually produced. Saprophytes or parasites on plants or animals, with an ordinary mycelium; many lichen fungi. In many species only the conidial form is known.
 - ASCOMYCETÆ. Sack Fungi.
 - (I) Ascus stage known, conidial stage also commonly present.
 - A. Asci not in a definite fruiting body, with a variable number of spores or with a definite number.
 - PROTO-ASCOMYCETÆ. Lower Sack Fungi.
 1. Plants developing a more or less typical mycelium.
 - a. Asci not arising from chlamydo-spores, (gemmæ), single or scattered, sometimes many-spored, thus resembling ordinary sporangia. *Endomycetales*.
 - b. Asci arising from intercalary chlamydo-spores (gemmæ), ellipsoidal or elongated. *Taphrinales* (Exoascales).
 2. No typical mycelium usually developed; asci entirely isolated; vegetative reproduction by budding of the cells; plants producing alcoholic fermentation.
 - Saccharomycetales*. Yeast Plants.
 - B. Asci with a definite number of spores, in typical cases commonly 4 or 8, collected on or in an ascocarp.
 - (A) Asci arranged at different levels in the fruiting body or fasciculate and surrounded by a spherical, cylindrical, pyriform, or shield-like wall which is commonly perforated at the top, but sometimes completely closed.
 1. Asci arranged at different levels in the fruiting body; or the hymenium lining cavities; mostly mold-like or tuber-like fungi. PLECTOMYCETÆ. Little Tuber Fungi.
 - One order, *Aspergillales*.
 2. Asci in fascicles arising from a common level in a perithecium or cleistothecium or under a shield-like wall, mostly of a dark color. PYRENOMYCETÆ. Black Fungi.
 - (I) Saprophytes, or parasites on higher plants, not symbiotic with algæ.
 - a. Cleistothecia globose, scattered, without apparent ostiole in the top; superficial parasites in leaves, stems, etc. *Perisporiales*. Powdery Mildews.
 - b. Perithecia typically with a distinct ostiole; commonly situated in a stroma.
 - (a) Perithecia, and stroma if present, fleshy or membranous, bright-colored, as white, yellowish, red, or blue. *Hypocreales*.
 - (b) Perithecia, and stroma if present, hardened, never fleshy, rarely membranous; dark-colored, as black or dark brown.
 - ((a)) Walls of the perithecia scarcely distinguishable from the stroma. *Dothideales*.
 - ((b)) Perithecia with distinct walls, either free or imbedded in a stroma. *Sphaeriales*.

- (c) Perithecia membranous to leathery, long enclosed in a covering which ruptures by a radiating or stellate fissure or by a slit at maturity.
 - ((a)) Perithecia rupturing by a stellate opening.....*Phacidiales*.
 - ((b)) Perithecia opening by a slit.
Hysteriales. Slit Fungi.

- (2) Helotic fungi living symbiotically with algæ, forming lichens.....*Pyrenulales*.

(B) Asci collected in a flattened concave, convex, or irregular hymenial layer; fruiting body (ascoma) a disk-like or cup-like apothecium or at first closed and opening at maturity, the hymenial layer sometimes becoming pulverulent; sometimes prominently stalked.....*Discomycetæ*. Disk Fungi.

- 1. Ascoma mostly elongated, or if round then becoming pulverulent, the spores and paraphyses forming a powdery mass.
 - a. Apothecia sphaeroidal, forming a powdery mass when mature, saprophytes or lichen fungi. *Caliciales*.
 - b. Apothecia linear, ellipsoidal or somewhat angular; lichen fungi symbiotic with algæ belonging to the Gonidiophyta.....*Graphidales*. Black Lichens.
- 2. Ascoma mostly round or irregular, not becoming pulverulent.

- (1) Ascoma not permanently hypogaeous.
 - a. Lichen fungi with circular apothecia, symbiotic with algæ belonging to the Gonidiophyta and to the Cyanophyceæ....*Lecanorales*. Disk Lichens.
 - b. Ordinary fungi, sometimes large, with fleshy or leathery bodies, or in the simpler forms the fruiting body only slightly developed; ascoma at length becoming cup-shaped or saucer-shaped, or developing into a convex and sometimes pitted head on a stalk, some of the primitive forms merely developing a flat open plate.
 - (a) Asci inoperculate, opening by an irregular rupture at the tip, texture usually tough to leathery; spores mostly comparatively small or slender and often multicellular.
Geoglossales.
 - (b) Asci operculate, opening by a definite lid or by a transverse or diagonal slit at the top; texture fleshy; spores comparatively large, unicellular.....*Pezizales*. Cup Fungi.

(2) Ascoma hypogaeous and fleshy, the hymenium lining cavities, permanently enclosed or finally opening. These plants show some resemblance to members of the *Plectomycetæ* and might belong to that series.
Tuberales. Truffles.

(II) Ascus stage not known, the hyphæ bearing conidia only and isolated conidial stages whose Asci are known; imperfect fungi with conidia superficial or in pycnidia, borne on loose innate hyphæ. A provisional subclass for conidial forms with uninucleate cells.
Deuteromycetæ. Imperfect Fungi.

- A. Conidia developed upon separate conidiophores which do not form a stroma; parasites and saprophytes.....*Moniliales*.
- B. Conidia developed on a stroma; mostly saprophytes, a few destructive plant parasites.....*Melanconiales*.
- C. Conidia developed in pycnidia; parasites and saprophytes.
Sphaeropsidales.

- II. Asci developed after fertilization by means of a trichogyne and spermatium, no conidia known, but the spermatia sometimes conidium-like; minute fungi with a peculiar vegetative body parasitic on various insects, especially water beetles. LABOULBENIÆ. Beetle Fungi.
- A. Sperm cells produced in closed antheridia.....*Laboulbeniales*.
 B. Sperm cells produced like conidia, terminally or laterally on appendages.....*Ceratomycetales*.

SYNOPSIS OF THE CLASSES AND ORDERS OF BASIDIOMYCETOUS FUNGI.

- I. Basidia arising from teliospores; often other types of spores also produced; plant parasites, often heterecious; conjugate phase often prominently developed. TELIOSPORÆ. Brand Fungi.
- A. Teliospores usually black, not stalked, produced in ovaries, leaves, or stems of the host.
1. Teliospores developing a nonseptate basidium which bears the spores at the apex.....*Tilletiales*. Stinking Smuts.
 2. Teliospores developing a several-celled or septate basidium which bears the spores at the sides of the cells.....*Ustilaginales*. Smuts.
- B. Teliospores usually stalked, producing black or brown pustules under the epidermis of leaves or stems; often producing, on the same or on a different host, clusters of cup-like or crater-like aecia with spores formed in chains inside of a membranous pseudoperidium; other spore types may be present as uredospores and pycniospores. *Uredinales*. Rust.
- II. Basidia produced directly on the vegetative mycelium, no proper teliospores being present, mostly saprophytes but some parasitic, especially on trees; often with massive fruiting bodies; conjugate phase prominently developed, with clamp-connections; terrestrial or epixylous; a few lichen fungi. Here are included the sterile mycelia known as mycorrhiza. BASIDIOMYCETÆ. Basidium Fungi.
- A. Basidia septate transversely or longitudinally, or sometimes merely deeply two-forked; fruiting body mostly gelatinous; saprophytes.
- PROTOBASIDIÆ.
1. Basidia with transverse septa.....*Auriculariales*. Ear Fungi.
 2. Basidia divided by diagonal or vertical septa.
Tremellales. Jelly Fungi.
 3. Basidia long clavate, divided at the summit into two long sterigmata; spores divided before germination proper; mostly small saprophytes.....*Dacryomycetales*.
- B. Basidia nonseptate.
1. Basidia on a distinct membranous hymenium exposed from the beginning or at first covered and finally naked, covering gills, pores, spines, or a smooth or wrinkled surface; rarely parasitic and without a special fruiting body, the basidia then arising out of the epidermis of the host plant. HYMENOMYCETÆ.
 - a. Without a definite fruiting body.....*Exobasidiales*.
 - b. Usually with a definite fruiting body, the basidia on a distinct membranous hymenium, covering gills, pores, spines, or a smooth or wrinkled surface.....*Agaricales*.
2. Basidia enclosed within a definite peridium but sometimes exposed at maturity, the spores then borne in more or less deliquescent gleba. GASTEROMYCETÆ.
 - (1) Fruiting body not dehiscing in such a manner as to expose the hymenium by emerging from the peridium, nor developing sporangioles attached to the peridium wall with cords.
 - a. Fruiting body not developing a hyphal capillitium, but remaining fleshy until the spores are mature, or becoming pulverulent.
 - (a) Fruiting body large, tuberous, fleshy, subterranean, with internal hymenium which lines the walls of cavities.....*Hymenogastreales*. False Truffles.

(b) Fruiting body small to large, becoming pulverulent; basidia uniformly distributed through the fruiting body or forming skein-like masses.

Sclerodermatales. Thick-skinned Puff-balls.

b. Fruiting body, when mature, filled with dust-like spores mixed with the hyphal capillitium. *Lycoperdales*. Puff-balls.

(2) Fruiting body breaking open and the spore-bearing part or gleba emerging or else developing sporangioles, attached by threads to the wall of the peridium.

a. Fruiting body small, leathery, spherial or top-shaped developing sporangioles.....*Nidulariales*. Birds-nest Fungi.

b. Fruiting body fleshy, at first tuberous and subterranean, but later the spore-bearing interior or gleba emerging from the peridium by an elastically expanding stalk; usually ill-smelling.....*Phallales*. Stink-horns.