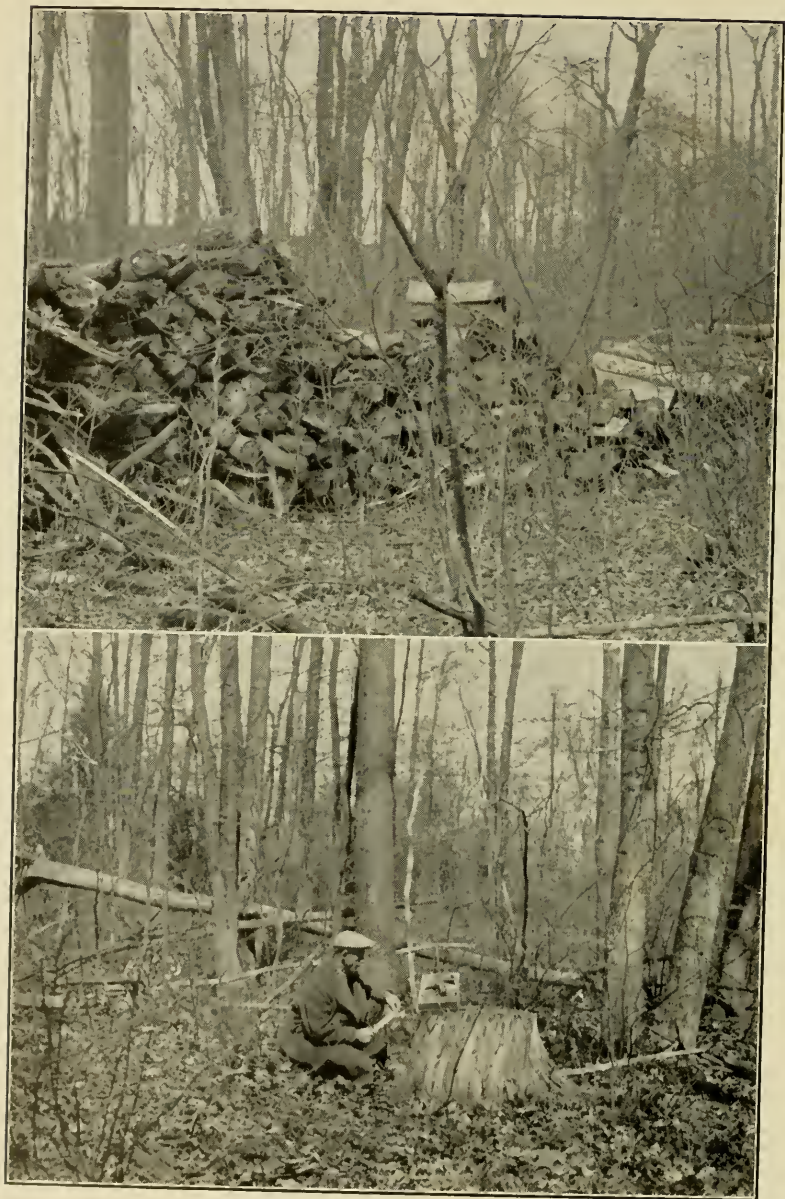


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THE MYCETOZOA OF NORTH AMERICA



WOODLAND SCENES

12

THE MYCETOZOA OF NORTH AMERICA

*BASED UPON THE SPECIMENS IN
THE HERBARIUM OF THE
NEW YORK BOTANICAL GARDEN*

BY

ROBERT HAGELSTEIN

HONORARY CURATOR OF MYXOMYCETES

ILLUSTRATED

MINEOLA, NEW YORK

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To My Friend

JOSEPH HENRI RISPAUD

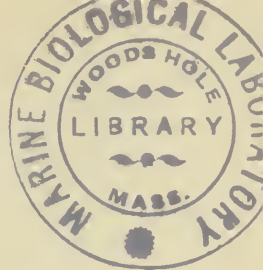
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PREFACE

In the Herbarium of the New York Botanical Garden are the large private collections of Mycetoza made by the late J. B. Ellis, and the late Dr. W. C. Sturgis. These include many specimens collected by the earlier American students, Bilgram, Farlow, Fullmer, Harkness, Harvey, Langlois, Macbride, Morgan, Peck, Ravenel, Rex, Thaxter, Wingate, and others. There is much type and authentic material. There are also several thousand specimens received from later collectors, and found in many parts of the world. During the past twenty years my associates and I have collected and studied in the field more than ten thousand developments in eastern North America. The larger part and best of these have been placed in the Herbarium. The entire collection is large enough to enable one to form a proper idea of the distribution in North America; and the geographical records, as given, have been taken therefrom unless preceded by an asterisk. The latter refer to reports by other authors, and it is possible a few of them are erroneous, particularly in instances of single reports of rare or obscure forms. Reports of rare species, published by students who it is believed have had no access to authentic material to verify their determinations, have been ignored.

The classification and division into families and genera follows that of Lister, which has been found more workable than others. The species within a genus are arranged, generally, in the order of their affinities, which assists in locating a species. The keys occasionally depart from this order when more prominent characters are used. Complete lists of synonyms are not given. They may be found in the monographs of Lister, and of Macbride, and it is unnecessary to repeat them. The colors of the spores are given throughout as they are seen in the microscope by transmitted light when separated, and with magnifications of 600 to 800 diameters.

The following words are used after Herbarium numbers to designate important specimens. Type or cotype: the particular specimen used for the original description. Type or cotype material: material distributed by an author as part of the type or

cotype. Authentic material: material determined and distributed by the author as typical of the form described.

My thanks are due to Miss G. Lister who, has extended her kindly aid on many occasions. Also, to Mr. John D. Thomas and Mr. Leon J. Chabot, who have accompanied me on many collecting excursions; and to the many friends who have helped by sending rare and unusual forms. The work of editing and proof-reading has been done by Dr. John Hendley Barnhart, Bibliographer Emeritus of the New York Botanical Garden, to whom I am greatly indebted. Mr. Joseph H. Rispaud, my constant companion in the field, is part and parcel of this book. His wide field experience, and indefatigable collecting activities, have made possible the major portion of the material on which it is based. My gratitude to him cannot be expressed in words.

ROBERT HAGELSTEIN

MINEOLA, NEW YORK
APRIL 27, 1944

THE MYCETOZOA

INTRODUCTION

The Mycetozoa, Myxomycetes, or Slime-Molds, as they are variously named, are an interesting group of organisms that have both animal and vegetable characteristics, yet are not definitely intermediate. They produce fruiting bodies with spores, which resemble certain fungous growths, and the formative processes of these bodies are similar to those of some of the fungi. The spores when wetted, however, germinate into small amoeboid bodies which develop flagella, move, feed, and multiply by division, and are regarded by zoologists as Protozoa. After some transformations, they fuse in great numbers into a mass of naked protoplasm, with many nuclei, called the plasmodium. The plasmodium moves by extending pseudopodia in the direction of its movement, feeds on bacteria and other organic material, and increases in size by the division of the nuclei. It may grow to a size of several feet across, functions somewhat like a giant amoeba, and is regarded by many as an animal. The plasmodia vary in color and size in different species, and are sometimes confined to a particular habitat; otherwise, there is no way of differentiating between various plasmodia. This vegetative phase, as it is called, may continue for weeks or months, until the time arrives—depending on several factors—when the plasmodium must go into fruit in order to perpetuate the organism. It then emerges from its habitat (wood or ground) and by changes which closely resemble fungous processes produces fruiting bodies which simulate vegetable growths, but which perform no further living functions, and are dead except for the germ of life contained in each individual spore. The process occurs usually at night, and in the morning the area close to the last position of the plasmodium is covered by the sporangia or fruiting bodies, often in great numbers. The life cycle is then repeated through the germination of the spores.

The unprotected plasmodium is delicate and subject to destruction in dry or cold weather. Under such conditions, the mass may transform itself into a hard, brittle substance, known as sclerotium, which is inactive, but which will revive with warmth and water. In this condition, plasmodia will survive the winter months or other unfavorable periods.

The fruiting bodies, excepting in one species which produces

sporophores, are of three kinds. (1) True sporangia, produced by the majority of the species, are often in thousands of individuals from a single plasmodium, and are almost symmetrical and uniform in shape and size. Most of them are small, averaging in height about 1 mm., but in some species they may reach 15 to 25 mm. They may be sessile, or on stalks of varying height, and exhibit great diversity in form, color, and structure, among the different species. (2) Plasmodiocarps, produced habitually by certain species, and frequently by others that normally produce true sporangia, are sporangiate in character, particularly in their internal structure, but are not uniform in shape or size. The form may be extended in the linear direction many times the height or breadth, and again curved, serpentine, ring- or crescent-shaped. The form may be in thinly or thickly effused masses, or there may be a netted structure with numerous meshes or openings. In the latter formations the plasmodiocarps may extend several inches. Plasmodiocarps usually are sessile; are frequently produced in considerable numbers by an individual plasmodium; and occur often along with true sporangia in the same fructification. (3) Aethalia. Here the entire mass of plasmodium forms one or a small number of fruiting bodies. Aethalia are much larger, as a rule, than sporangia or plasmodiocarps, and in some species a single one may be as much as a foot across. The aethalium consists of confluent sporangia, the intervening walls more or less developed or degenerate, and the whole covered by a firm or fragile cortex or wall.

The Mycetozoa require for their development a habitat of decaying vegetable material with warmth and moisture and the consequent growth of bacteria as a food supply. The plasmodia thrive in decaying wood (preferably in the earlier stages of decay), leaves, twigs, refuse and manure piles, and the ground, wherever favorable conditions prevail, and travel through the crevices and cavities in the search for food. The fructifications are produced on the habitat or in close proximity thereto. The time for their most prolific development in the northern temperate zone is in the months from June to October inclusive, although they may often be found in the other months, including those of the winter, if weather conditions are propitious. The appearances are not so abundant during long periods of wet or dry weather, but in the first week or so of dry weather, after a rainy spell, they may be expected plentifully. They may be sought for in the most un-

usual places, but more successfully in places well suited for their development and with much habitat material. Such localities are secluded forest-areas with large trees of different kinds. There should be many fallen trees and logs in various stages of decay, with undergrowth and bushes to provide shade. The situation should be moist, either by the natural topography of the land and drainage, or by the presence of brooks, lakes, or springs. Localities suitable for mushrooms and other fungi are also fit for the Mycetozoa. It is surprising how many species may be found in a small area if repeatedly visited and intensively searched, and it is not unusual to collect fifty or more species in a single day.

Specimens of the fruiting bodies collected in the field, should be transported in old cigar-boxes in the bottom of which a layer of corrugated cardboard has been placed. They should be pinned therein with pins having large, glass heads. On arrival home, the specimens should be removed, trimmed somewhat of the unnecessary wet material, and placed in porous, cardboard boxes so that they will dry thoroughly. Precautions should be taken against insects and the growth of molds. When dry, they should be trimmed to the size desired and glued into small cardboard boxes, where, with the addition of a pinch of ordinary naphthaline flakes, they will keep indefinitely.

The classification of the Mycetozoa is based upon the characters of the fruiting bodies, and (following Lister) the group is regarded as a class and divided into two subclasses, the *Exosporeae* and the *Endosporeae*. The first has but a single species, *Ceratiomyxa fruticulosa*, which develops sporophores with spores on the outside. All other species are in the *Endosporeae* and develop sporangia or similar bodies with spores on the inside. The *Endosporeae* are divided into the orders *Amaurochaetales* with spores violet-brown or purplish gray in color, and the *Cribrariales* with spores variously colored but not violet-brown or purplish gray. The *Amaurochaetales* have two suborders, the *Physariineae* in which the sporangia are provided with lime, and the *Amaurochaetineae* which have no lime. The *Cribrariales* have two suborders, the *Dictydiineae* which have no capillitium, and the *Calonematineae* in which a capillitium is present. The further division into families, genera, and species, as they are known to occur in North America, is followed later in the text. Several other genera, and about forty more species, are known from other parts of the world, but so far have not been reported from North

America, and are not included. There are some exceptions in the various divisions of the classification, but on the whole it is very satisfactory and workable, so that the great majority of the species can be determined without much trouble if the specimens are fairly typical. All sorts of intermediate forms do occur; these present problems, and are of great interest from an evolutionary point of view.

In studying the Mycetozoa for the determination of species, certain field conditions should be noted, such as the size of the fructification, the habitat, the color of the plasmodium if seen, and whether the sporangia are closely aggregated or scattered. The microscopical examination, at first, should be as an opaque object, with a few of the sporangia blown out by a small hand-blower to free them from spores. After that a few of the blown out sporangia should be picked off, placed on a slide in water under a cover glass, and studied by transmitted light. The water may not permeate sufficiently to drive out the air, in which case a mixture of water and alcohol will work better. Badly contracted spores may be swollen rapidly by the admission of a drop of a five per cent solution of potassium hydrate in water, but this has a tendency to alter the color of the spores of certain species. Permanent preparations may be mounted in glycerine, glycerine jelly, or canada balsam—remembering that glycerine is not suitable for forms with lime—but is only required for certain purposes, and the examination in water is usually all that is necessary. The main characters recognized in the classifications of species are the shape, the color, the wall or peridium, and the spores; the absence or presence of lime, stalk, columella, and capillitium; and the form, size, color, and markings that may apply to them. There are others, but those must be studied in the species descriptions.

The collection and study of the Mycetozoa presents an almost untrodden field. There have been few students, and there are few today, as compared with the many in other pursuits. There are opportunities for research, not only in the morphology and physiology of the group, but in the taxonomy. The roaming and collecting through the forests is a healthy hobby, with many thrills that come when an interesting form is found. The beauty of the fruiting bodies, with their variety of form and color, and the study of their curious life history, provide fascinating subjects for the microscopist.

GLOSSARY

AETHALIUM. A compound fruiting body, often large, formed by the close union of many sporangia, with the intervening sporangial walls more or less imperfectly developed, and enclosed usually in a cortex.

ANASTOMOSING. Applied to the threads of a capillitium, when they are joined repeatedly to form a mesh or network.

APPLANATE. Flattened out.

CAPILLITIUM. The system of threads, or, the branches from the columella, within the sporangium, among which the spores are distributed.

CARTILAGINOUS. Applied to a stout, uniformly thickened membrane.

COLUMELLA. That part of the stalk, or an elongation thereof extending into the sporangium; or, in sessile forms, a supporting structure for the capillitium, arising within and from the floor of the sporangium.

CORTEX. The stout covering or wall usually enclosing the component sporangia of an aethalium.

DEXTRAL. Winding like the threads of a right handed screw as seen from the outside. Applied to the spirals on the threads of the capillitium in species of the family *Trichiaceae*.

DEXTORSE. Same as dextral.

EFFUSED. Flattened and thinly spread.

ELATERS. Single threads of the capillitium, free, doubly terminated, and marked with spiral bands or thickenings. Applied to the capillitium in the genera *Trichia* and *Oligonema*.

FRUITING BODY. A form produced by the plasmodium and carrying spores, which germinate and eventually produce another plasmodium.

FUSIFORM. Spindle-shaped; tapering at both ends.

GREGARIOUS. Developing closely in association, not solitary, and not clustered.

HYALINE. Glassy or transparent.

HYPOTHALLUS. The membrane or strands at the bases of sporangia and aethalia, sometimes connecting them.

LENTICULAR. Resembling in shape a convex lens.

LIME-KNOTS. Expansions in the threads of the capillitium containing granules of lime.

NODES. In the genus *Cribraria*, the thickenings at the junctions of the threads of the net in the upper part of the sporangial wall.

OBCONIC. Inversely conical.

PERIDIUM. The outer wall or covering of a sporangium, which encloses the capillitium and spores, and may be of more than one layer.

PIRIFORM. Pear-shaped.

PLASMODIC GRANULES. Minute, usually colored granules in the walls of sporangia in the genera *Cribraria*, *Dictydium*, and *Lindbladia*.

PLASMODIOCARP. An individual unit of a colony of sessile fruiting bodies, similar internally to sporangia, but not uniform in size or shape, and elongated, curved, branched, netted, or effused.

PLASMODIUM. A mass of naked protoplasm, formed by the union of many swarm-cells, which latter emerge from the spores on germination; from the plasmodium, the fruiting bodies are developed as sporangia, plasmodiocarps, aethalia, or sporophores.

PSEUDO-CAPILLITIUM. The partly developed walls of the component sporangia of an aethalium, which may resemble the threads of a capillitium.

PSEUDO-COLUMELLA. In the calcareous genera, a mass of confluent lime-knots resembling a columella, but not attached to, or forming part of the stalk or base.

PULVINATE. Cushion-shaped.

RUGOSE. Marked with wrinkles.

RUGULOSE. Marked with fine wrinkles.

SCLEROTIUM. The resting stage of the plasmodium.

SINISTRAL. Opposite of dextral, that is, like a left handed screw.

SINISTORSE. Same as sinistral.

SPORANGIUM. An individual member of a colony of small, symmetrical fruiting bodies, uniform in size, shape, and general characters, and enclosing spores.

SPOROPHORE. A fruiting body bearing spores on the outside.

SUBULATE. Awl-shaped.

TERETE. Cylindrical; circular in cross-section.

TURBINATE. Top-shaped.

FAMILIES AND GENERA OF THE MYCETOZOA OF NORTH AMERICA

SUBCLASS I. EXOSPOREAE

Spores developed outside of sporophores.

Family I. CERATIOMYXACEAE. Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from the areolate sporophore.

Genus 1. **Ceratiomyxa** Schroet.

SUBCLASS II. ENDOSPOREAE

Spores developed within sporangia, plasmodiocarps, or aethalia.

Order I. AMAUROCHAETALES. Spores violet-brown or purplish gray (ferruginous in *Stemonitis axifera* and *S. flavogenita*, colorless in *Echinostelium*).

Suborder I. PHYSARIINEAE. Sporangia provided with lime (calcium carbonate).

Family I. PHYSARACEAE. Lime in the form of minute round granules (sometimes in rounded nodules or absent in *Diachea*).

- Genus 2. **Badhamia** Berk.
3. **Physarum** Pers.
4. **Fuligo** Haller
5. **Physarella** Peck
6. **Cienkowskia** Rost.
7. **Craterium** Trent.
8. **Leocarpus** Link
9. **Diderma** Pers.
10. **Diachea** Fries

Family II. DIDYMIACEAE. Lime in crystals deposited outside of the sporangial wall (scanty or none in *Leptoderma*).

- Genus 11. **Didymium** Schrad.
12. **Mucilago** Mich.
13. **Lepidoderma** de Bary
14. **Leptoderma** G. Lister



Suborder II. AMAUROCHAETINEAE. Sporangia without lime.

Family I. COLLODERMATACEAE. Sporangia distinct, sessile, with outer gelatinous walls.

Genus 15. *Colloderma* G. Lister

Family II. STEMONITIDACEAE. Sporangia distinct, provided usually with stalks and columellae.

Genus 16. *Stemonitis* Gled.

17. *Comatricha* Preuss.

18. *Enerthenema* Bowm.

19. *Lamproderma* Rost.

20. *Clastoderma* Blytt

21. *Echinostelium* de Bary

22. *Macbrideola* Gilb.

Family III. ELAEOMYXACEAE. Sporangia distinct, provided with a waxy or oily substance.

Genus 23. *Elaeomyxa* Hagelstein

Family IV. AMAUROCHAETACEAE. Sporangia combined to form an aethalium; without wax.

Genus 24. *Amaurochaete* Rost.

25. *Brefeldia* Rost.

Order II. CRIBRARIALES. Spores variously colored, not violet-brown or purplish gray (except in *Licea minima*).

Suborder I. DICTYDIINEAE. Capillitium wanting, or if present not forming a system of uniform threads (except in *Alwisia*).

Family I. CRIBRARIACEAE. Sporangial wall membranous, beset with microscopic round, plasmodic granules, and (except in *Lindbladia*) forming a net in the upper part.

Genus 26. *Lindbladia* Fries

27. *Cribraria* Pers.

28. *Dictydium* Schrad.

Family II. LICEACEAE. Sporangia solitary; sporangial wall cartilaginous or membranous.

Genus 29. *Licea* Schrad.

30. *Orcadella* Wing.

Family III. TUBULINACEAE. Sporangial wall membranous, without plasmodic granules; sporangia clustered, cylindrical or ellipsoid.

Genus 31. *Tubifera* Gmel.

32. *Alwisia* Berk. & Br.

Family IV. RETICULARIACEAE. Sporangia closely compacted and usually forming aethalia; sporangial walls incomplete, perforated, or forming a spurious capillitium; true capillitium none, or in *Liceopsis* consisting of a few branching threads or strands.

Genus 33. *Dictydiaethalium* Rost.

34. *Enteridium* Ehrenb.

35. *Reticularia* Bull.

36. *Liceopsis* Torrend

Family V. LYCOGALACEAE. Sporangia forming aethalia; pseudo-capillitium consisting of branched colorless tubes.

Genus 37. *Lycogala* Mich.

Suborder II. CALONEMATINEAE. Capillitium present as a system of uniform or sculptured threads.

Family I. TRICHIACEAE. Capillitium consisting of tubular threads, which are either free and usually unbranched (elaters), or form a network branching at wide angles, with thickenings in the form of spirals.

Genus 38. *Trichia* Haller

39. *Oligonema* Rost.

40. *Calonema* Morg.

41. *Hemitrichia* Rost.

Family II. ARCYRIACEAE. Capillitium a network of tubular threads branching at wide angles, smooth or thickened with cogs, half-rings, spines, or warts (capillitium often scanty and of free threads in *Perichaena corticalis*).

- Genus 42. **Arcyria** Wiggers
43. **Lachnobolus** Fries
44. **Perichaena** Fries

Family III. MARGARITACEAE. Capillitium consisting of solid threads, either coiled and hair-like or nearly straight and attached to the sporangial wall, simple or branching at acute angles.

- Genus 45. **Margarita** Lister
46. **Dianema** Rex
47. **Prototrichia** Rost.

MYCETOZOA

(MYXOMYCETES)

SUBCLASS I. EXOSPOREAE

Spores developed outside of sporophores.

Family I. CERATIOMYXACEAE

Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from the areolate sporophores.

A SINGLE GENUS.

Genus 1. **CERATIOMYXA** Schroeter, in Engler & Prantl, Nat. Pflanzenfam. 1 (i): 16. 1889.

Sporophores consisting of flattened, membranous tubes, either branching from a common base or forking repeatedly, or forming a network; the surface mapped out into polyhedral areolae, from the center of each of which arises a slender stalk bearing a single, ellipsoid, colorless spore.

A SINGLE SPECIES.

1. **Ceratiomyxa fruticulosa** (Müll.) Macbr. N. A. Slime-Moulds 18. 1899.

Byssus fruticulosa Müll. Fl. Dan. Ic. 4 (12): 6. pl. 718. 1777.

Plasmodium colorless or tinted. Sporophores white, occasionally pinkish or yellowish, rarely with other tints, forming tufts of simple or forked, fasciculate branches 1 mm. or more high, 0.07 mm. thick, or consisting of more or less anastomosing broad bands from which arise irregular lobes. Spores white, smooth, usually ellipsoid or ovoid, 10×6 to $13 \times 7 \mu$. (PLATE 16, FIG. 16.)

Var. **flexuosa** Lister, Mycetozoa 26. 1894.

Ceratium arbuscula Berk. & Br. Jour. Linn. Soc. 14: 97. 1873.

Ceratium filiforme Berk. & Br. Jour. Linn. Soc. 14: 97. 1873.

Sporophores long, slender, white, profusely branching but not anastomosing, 2 to 5 mm. high.

Var. **porioides** (Alb. & Schw.) Lister, Mycetozoa 26. 1894.

Ceratium porioides Alb. & Schw. Consp. Fung. 359. 1805.

Sporophores densely compacted to form a honeycomb-like structure.

TYPE LOCALITY: Europe.

HABITAT: On rotten wood; common and abundant.

DISTRIBUTION: Throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 1.

The two varieties are useful for purposes of classification, but depend entirely upon meteorological conditions prevailing during the period of fructification. *C. arbuscula* and *C. filiforme* cited as synonymous with var. *flexuosa* are not separable, as they occur together in the same developments. Var. *flexuosa* forms under perfect drying conditions, usually on a higher or drier habitat. It is the most perfect development of the species. Var. *porioides*, on the contrary, develops closer to the ground and under wet conditions. If, at the proper time of development of var. *porioides*, the conditions of moisture change slightly to drier, the resultant fruit may show the variety and the typical form from the same plasmodium; specimens exhibiting the transition are found occasionally. The plasmodium of *C. fruticulosa* is sensitive to certain stimulants, perhaps food, and may be faintly colored, indicating the various tints observed sometimes later in the fruiting bodies. Var. *caesia*, found so far only in Germany, is bluish or bluish green, developing from a similarly colored plasmodium.

Dr. G. W. Martin reported the collection of specimens in the Panama Canal Zone and in Costa Rica (Mycologia **34**: 698. 1942), which he believes agree with the description and figures of *Ceratiomyxa sphaerosperma* Boedijn (Misc. Zool. Sumatrana **24**: 1. 1927). Authentic material from Sumatra is unavailable now because of world-wide conditions. This may be another species of *Ceratiomyxa*, and if so, it should occur in the tropics generally, as *Ceratiomyxa* is abundant there, particularly *C. fruticulosa* var. *flexuosa*. It may, however, be only a phase of *C. fruticulosa*, which in a number of specimens here from the American tropics discloses variation not seen in specimens from the temperate zones. Similar conditions of variation between tropical and temperate forms are found in other species, notably in *Diachea bulbillosa*. I believe with other students that there is but a single species of *Ceratiomyxa*, the fruiting bodies of which may be modified by external conditions at the time of development. These modifications extend to such extremes as vars. *flexuosa* and *porioides*, but are not confined to them solely. The description

and figures of *C. sphaerosperma* do not show differences greater than those observed in the two varieties mentioned, and appear to be only varietal.

SUBCLASS II. ENDOSPOREAE

Spores developed within sporangia, plasmodiocarps, or aethalia.

Order I. AMAUROCHAETALES

Capillitium present. Spores violet-brown or purplish gray, ferruginous in *Stemonitis axifera* and *S. flavogenita*, colorless in *Echinostelium*.

Suborder I. PHYSARIINEAE

Deposits of lime either in minute granules included in the sporangial wall, in expansions of the capillitium, or in the stalk; or in the form of stellate or lenticular crystals scattered over the sporangial wall.

Family I. PHYSARACEAE

Deposits of lime in minute, round granules more or less aggregated, included in the sporangial wall and in vesicular expansions of the capillitium called lime-knots, except in *Diderma* where there are no lime-knots, and in *Diachea* in which the lime is confined to the stalk and columella, and is sometimes in the form of rounded nodules. In this family, and also in Family II, *Didymiaceae*, the stalk of the sporangium is developed as an open tube, through which the protoplasm passes to form the young, swelling sporangium; later, the walls of the stalk contract in folds, often enclosing refuse matter (a probable exception in *Physarum penetrale*).

- | | |
|---|---------------|
| Capillitium a coarse network charged with lime throughout. | 2. BADHAMIA |
| Capillitium a network of slender threads with vesicular expansions filled with lime-granules (lime-knots). | |
| Sporangia combined into a convolute aethalium. | 4. FULIGO |
| Sporangia single, scattered or aggregated. | |
| Sporangia subglobose, lenticular, or in the form of plasmodiocarps; capillitium without free hooked branches. | 3. PHYSARUM |
| Sporangia stalked, shortly cylindrical, hollow, with spike-like processes. | 5. PHYSARELLA |
| Plasmodiocarps cylindrical or applanate, branching and anastomosing; capillitium with free hooked | |

- branches; lime-knots taking the form of vertical plates. 6. CIENKOWSKIA
- Sporangia in the shape of a covered goblet, obovoid; stalks cartilaginous. 7. CRATERIUM
- Sporangia obovoid, shining, clustered; stalks membranous. 8. LEOCARPUS
- Capillitium without lime-knots.
- Sporangial wall opaque, smooth. 9. DIDERMA
- Sporangial wall hyaline, without lime. 10. DIACHEA

Genus 2. **BADHAMIA** Berkeley, Trans. Linn. Soc. 21: 153. 1853.

Sporangia stalked, sessile, or forming plasmodiocarps; sporangial wall single, with included lime-granules; capillitium consisting of a coarse network charged with granules of lime, sometimes constricted here and there into narrow, hyaline threads; spores clustered or free.

TYPE SPECIES: *Badhamia hyalina* (Pers.) Berk.

Spores clustered.

Spores warted chiefly on one side.

Sporangia 1 to 1.5 mm. diam.

Lime in sporangia and capillitium white.

Plasmodium yellow; sporangia gray, clustered or scattered, sessile or with membranous stalks.

Sporangia gray with dark, firm stalks.

Plasmodium white; sporangia white, heaped.

Lime in sporangia and capillitium yellow.

Sporangia 0.3 to 0.6 mm. diam.; capillitium white or faintly tinted.

Spores equally warted all over.

Spores not clustered.

Sporangia yellow, usually accompanied by plasmodiocarps.

Sporangia white or gray.

Sporangia globose, sessile or on short membranous stalks; spores violet-brown, occasionally loosely clustered.

Sporangia globose, usually clustered on long, membranous stalks.

Sporangia subglobose, sessile or with firm, yellow or brown stalks; spores dark purplish brown, spinulose.

Sporangia small, flattened or concave beneath, on short, membranous stalks; spores dark purplish brown.

1. *B. capsulifera*
2. *B. papaveracea*
3. *B. populina*
7. *B. nitens*
8. *B. versicolor*
4. *B. utricularis*
9. *B. decipiens*
5. *B. foliicola*
6. *B. magna*
10. *B. macrocarpa*
11. *B. gracilis*

- | | |
|--|--------------------------|
| Sporangia globose, sessile; spores encircled by a pale, narrow band. | 12. <i>B. Dearnessii</i> |
| Sporangia flattened or discoid, sessile or stalked; stalks black; spores violet-brown. | 13. <i>B. affinis</i> |
| Sporangia sessile, clustered, on a red hypothallus; spores violet-brown, nearly smooth. | 14. <i>B. panicea</i> |
| Sporangia sessile, small, chalk-white, hemispherical or forming plasmodiocarps; spores smooth ellipsoid. | 15. <i>B. ovispora</i> |
| Sporangia sessile, globose, pinkish or lilac; without a true columella; spores prominently marked. | 16. <i>B. lilacina</i> |
| Sporangia stalked, obovoid, rufous or purplish brown, the stalk continued as a columella. | 17. <i>B. rubiginosa</i> |

1. **Badhamia capsulifera** (Bull.) Berk. Trans. Linn. Soc. 21: 153. 1853.

Sphaerocarpus capsulifer Bull. Herb. Fr. *pl.* 470, *fig.* 2. 1789; Bull. Champ. 139. 1791.

Badhamia hyalina (Pers.) Berk. Trans. Linn. Soc. 21: 153. 1853.

Plasmodium chrome-yellow (Lister). Sporangia more or less clustered, usually sessile, globose or piriform, 0.5 to 1 mm. diam., grayish white; sporangial wall hyaline, with scanty deposits of lime-granules. Stalk when present short, yellowish, membranous. Capillitium a network of flat bands with broad, thin expansions at the angles, evenly and sparsely charged with white lime-granules. Spores purplish brown, adhering in firm clusters of 8 to 20, more strongly warted or spinose on the outer surface, 11–13 μ diam.

TYPE LOCALITY: France.

HABITAT: On dead bark; not common.

DISTRIBUTION: Colorado, *Iowa, *Maine, Massachusetts, *Michigan, New York, *Ohio, Pennsylvania, Tennessee, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 3, *figs.* a–c.

This species forms small colonies, often on piles of dead wood and associated with other species of *Badhamia*. Together with *B. papaveracea* and *B. populina* it comprises a group of related species having spores firmly adherent in clusters. The spores are not as dark as reported in European specimens and, generally, there is considerable variation in the color of the spores of this and the related species, and also in the group centering around *B. utricularis*. Several European varieties are as yet unknown from North America.

2. ***Badhamia papaveracea*** Berk. & Rav.; Berk. *Grevillea* 2: 66. 1873. (N. Y. B. G. no. 6685, type material.)

Plasmodium? Sporangia gregarious, subglobose or obovoid, stalked, smooth or rugose, grayish or bluish, 0.5 to 1 mm. diam.; sporangial wall usually with scanty deposits of lime. Stalk firm, dark, nearly black. Capillitium of slender strands as in *B. capsulifera*. Spores purplish brown, in firm clusters of 6 to 10, more strongly warted on the outer third, 10–13 μ diam.

TYPE LOCALITY: South Carolina.

HABITAT: On dead bark; not common.

DISTRIBUTION: *Alabama, *California, Connecticut, *Iowa, *Maine, New Jersey, New York, *Ohio, Pennsylvania, South Carolina, *Wisconsin.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. pl. 3, figs. d, e.

This species is close to *B. capsulifera*, but distinguished by the firm stalks, which are darker, longer, and thinner. The spores are usually paler, and the clusters smaller than those of *B. capsulifera*. Sessile and intermediate forms mentioned by Lister, should be placed with *B. capsulifera*, as there is no way of separating them satisfactorily.

3. ***Badhamia populina*** A. & G. Lister, *Jour. Bot.* 42: 129. 1904. (N. Y. B. G. no. 10730, authentic material.)

Plasmodium white or cream-white (Lister). Sporangia sessile and heaped, or solitary on short, yellowish, membranous stalks, subglobose or obovoid, 1.5 mm. diam., smooth, white, rarely pinkish; sporangial wall with dense deposits of lime-granules, sometimes partly veined or ribbed. Capillitium a coarse network of broad strands charged with white lime-granules. Spores 10–12 μ diam., in clusters of 16 to 20 or more, purplish brown, minutely warted, somewhat stronger on one side, and usually showing narrow lines or ridges on many of the spores.

TYPE LOCALITY: England.

HABITAT: On dead wood, usually poplar.

DISTRIBUTION: Colorado, *Montana, Oregon, *Washington.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. pl. 2.

This species, so far, has been found only in the western mountains. It is readily distinguished from *B. capsulifera* by the larger, more robust sporangia, superimposed in clusters, and the dense deposits of lime in the sporangial walls. The capillitium is coarser, and the spores often show lines and ridges.

4. **Badhamia utricularis** (Bull.) Berk. Trans. Linn. Soc. 21: 153. 1853.

Sphaerocarpus utricularis Bull. Herb. Fr. pl. 417, fig. 1. 1788; Bull. Champ. 128. 1791.

Plasmodium chrome-yellow (Lister). Sporangia subglobose or obovoid, 0.5 to 1 mm. diam., free, confluent and lobed, or clustered, sometimes sessile, usually on clustered, often long, branching, straw-colored, membranous stalks, cinereous or iridescent violet and veined with white; sporangial wall hyaline, with sparsely distributed minute granules of lime. Capillitium as in *B. capsulifera*. Spores bright brown or violet-brown, adhering in loose clusters of 7 to 10, spinulose, 9–12 μ diam.

TYPE LOCALITY: France.

HABITAT: On dead wood and bark.

DISTRIBUTION: *California, Colorado, *Indiana, *Maine, Massachusetts, *Montana, New Hampshire, New Jersey, New York, *Ohio, Ontario, Oregon, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 4.

B. utricularis, *B. magna*, and *B. foliicola* form a group with free or loosely clustered spores, and sporangia which, except for the stalks, appear similar. In each species the spores vary in size, color, and markings, so that these overlap in their characters, but in all three the warts or spines are uniformly distributed over the entire spore. The spores of *B. utricularis* are sometimes free, or at least become so after dessication, so that the clusters are not noticeable as they are in those species where the spines are stronger on the exposed surfaces. *B. utricularis* merges into *B. magna*, which has much longer stalks, and usually the darkest spores of the three species; and *B. utricularis* usually has the most strongly marked spores. The stalks of *B. foliicola* are short, and each bears but a single sporangium. Sessile sporangia of *B. utricularis*, or *B. foliicola* when on wood, and with free spores, are difficult to distinguish. *B. magna* is never sessile.

5. **Badhamia foliicola** Lister, Jour. Bot. 35: 209. 1897. (N. Y. B. G. no. 10733, authentic material.)

Plasmodium orange (Lister). Sporangia subglobose or occasionally piriform, 0.5 to 1 mm. diam., sessile and crowded, or on short, yellowish gray stalks standing singly, grayish or bluish,

iridescent; sporangial wall with scanty lime deposits, often absent. Capillitium a network of slender strands filled with white lime-granules. Spores free, rarely loosely clustered, violet-brown, minutely spinulose, 8–11 μ diam.

TYPE LOCALITY: Wanstead Park, Essex, England.

HABITAT: On leaves, straw, twigs, etc., also on wood.

DISTRIBUTION: California, Iowa, Massachusetts, New Jersey, New York, *Ontario, *Oregon, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 11.

This species has been found repeatedly on Long Island, New York, in large developments. It is allied to *B. utricularis*, but the stalks are much shorter, firmer, often more grayish, and each carries but a single sporangium. The more frequent habitat is on herbaceous ground remains, although it also occurs on dead wood.

6. **Badhamia magna** Peck, Rept. N. Y. State Mus. 31: 57. 1879.
(N. Y. B. G. nos. 6164, 7949, 10687, type material.)

Dictydium magnum Peck, Rept. N. Y. State Mus. 24: 84. 1872.

Plasmodium yellow. Sporangia globose, obovoid, or ellipsoid, normally about 1 mm. diam., bluish, iridescent, clustered on long, yellow, slender, branching, membranous stalks, 5 mm. or more high; sporangial wall with scanty deposits of lime. Capillitium a network of slender strands charged with white lime-granules. Spores free, globose, usually dark purplish brown with a paler area of dehiscence, minutely spinulose, 9–12 μ diam. (PLATE 6, FIG. 3.)

TYPE LOCALITY: Center, New York.

HABITAT: On dead wood; not uncommon.

DISTRIBUTION: Colorado, Maine, Massachusetts, *Minnesota, New Hampshire, New Jersey, New York, Ontario, Oregon, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 9.

This species is related to *B. utricularis* but can be distinguished by the more robust sporangia on longer stalks, and the spore differences of color, fainter markings, and pale area, when present. The spores are sometimes paler, as in *B. utricularis*, and this is true of the type specimen of Peck, in the New York State Museum, which is not perfectly developed, and appears to have formed during rain.

7. **Badhamia nitens** Berk. Trans. Linn. Soc. 21: 153. 1853.

Plasmodium yellow (Lister). Sporangia gregarious or clustered, sessile, 0.5 to 1 mm. diam., subglobose, or forming short plasmodiocarps, orange-yellow or greenish, rugose; sporangial wall membranous, with included clusters of yellow lime-granules. Capillitium a coarse network of rugged strands with yellow lime-granules. Spores adherent in small, close clusters, purplish brown, spinulose with the spines coarser on the outer third, 10–12 μ diam.

Var. **reticulata** (Berk. & Br.) G. Lister, Trans. Brit. Myc. Soc. 5: 71. 1915.
Didymium reticulatum Berk. & Br. Jour. Linn. Soc. 15: 83. 1876.

Sporangia forming simple or branched plasmodiocarps; spores often less strongly crowned with spines, and less closely clustered.

TYPE LOCALITY: England.

HABITAT: On dead wood and mosses.

DISTRIBUTION: *California, Colorado, *Michigan, *Montana, Oregon, *West Indies; var. *reticulata*, *Iowa, *West Indies.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 5.

The clustered spores, and yellow lime, are the distinguishing characters of this species. It is very rare in North America.

8. **Badhamia versicolor** Lister, Jour. Bot. 39: 81. 1901. (N. Y. B. G. nos. 10629, 10630, 10631, authentic material.)

Plasmodium hyaline (Lister). Sporangia sessile, scattered or in small clusters, subglobose, 0.3 to 0.6 mm. diam., grayish white, rugulose; sporangial wall with scanty deposits of lime, usually in clusters. Capillitium a network of broad or narrow strands charged with white or apricot-colored lime-granules. Spores in clusters up to 40, pale purplish brown, spinulose on the outer surface but nearly smooth elsewhere, globose when swollen, 10–12 μ diam.

TYPE LOCALITY: Aberdeenshire, Scotland.

HABITAT: On dead bark.

DISTRIBUTION: Colorado, *Ontario.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 6.

The description applies to various collections from Colorado by Bethel, Sturgis, and Smith. The apricot-colored capillitium, mentioned by Lister in the original description as present in

nearly 40 per cent of the sporangia, is not conspicuous in the Colorado specimens where only traces of color are seen, although the inside bases of the sporangia are occasionally tinted. The spores show the usual more or less persistent effects from compression in the clusters, tending to produce temporary ovoid or ellipsoid bodies, but when swollen, they regain, in most instances, the normal globose form.

9. **Badhamia decipiens** (Curt.) Berk. *Grevillea* 2: 66. 1873.

Physarum decipiens Curt. *Am. Jour. Sc.* II. 6: 352. 1848. (N. Y. B. G. no. 10738, type material.)

Plasmodium yellow? (Lister). Sporangia sessile, scattered, subglobose, 0.3 to 0.7 mm. diam., or forming terete curved or straight plasmodiocarps up to 4 mm. in length, rugulose or nearly smooth, yellow or orange; sporangial wall membranous, with included clusters of yellow lime-granules, the wall yellow on the inside. Capillitium yellow or pale orange, a coarse network charged with yellow lime-granules, sometimes with a few hyaline threads. Spores free, 10–13 μ diam., violet-brown, spinulose, often paler and smoother on one side.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood.

DISTRIBUTION: *Colorado, New Hampshire, New Jersey, New York, *Ohio, Ontario, Pennsylvania, South Carolina.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 7.

This species forms small developments, and is rare in North America. It resembles sessile forms of *Physarum oblatum*, and is difficult to separate. The usual presence of plasmodiocarps, the more complete badhamioid capillitium, and the somewhat darker spores, are the distinguishing characters. The species is not clearly understood by many students, as shown by specimens in the Herbarium of the New York Botanical Garden. Forms more often found, and erroneously regarded as *B. decipiens*, are *Physarum auriscalpium*. They have depressed sporangia, with little tendency to form plasmodiocarps. The lime-clusters on the wall are reddish, yellow, or nearly white, more separated, so that the darker wall shows between, and the appearance is mottled. There is usually a red or brown base on the inside of the sporangium, and the capillitium often has white or nearly white lime with

longer threads. Plasmodiocarps of *Physarum Serpula* and *P. sulphureum* var. *sessile* may also resemble *B. decipiens* superficially.

10. **Badhamia macrocarpa** (Ces.) Rost. Mon. 143. 1874.

Physarum macrocarpon Ces. in Klotzsch, Herb. Viv. Myc. no. 1968. 1854.
[Flora 38: 271. 1855.]

Plasmodium white (Lister). Sporangia scattered or united in small clusters, sessile or stalked, subglobose, 0.5 to 1 mm. diam., white, rugose; sporangial wall membranous with scanty or abundant included lime-granules. Stalk firm, about half the total height, furrowed, yellow, or brown with refuse matter. Capillitium an irregular network, charged throughout with white lime-granules, and with a few short, connecting threads. Spores free, with thick walls, dark purplish brown, spinulose, 11–15 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Delaware, Kansas, Maine, New Jersey, New York, North Carolina, Ontario, Pennsylvania, West Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 8, figs. a–c.

This species is not common in North America, and typical examples are rare. It forms small developments, more often sessile, and prefers a sheltered habitat such as the middle of a wood pile. It merges into *B. panicea*, and when there are no other characters prominent enough, the distinction must be based on the spores; this is sometimes unsatisfactory, as the spores may approach those of the latter species. The spores, in typical examples, are much darker and more strongly spinulose than those of *B. panicea*. Often the spines are irregularly arranged with smooth intervals between patches of spines, or the spores may be slightly paler on one side. Small portions of a fruiting of *B. affinis*, that do not show the characteristic, flattened sporangia, are often difficult to separate. Likewise, with sessile sporangia of *Physarum notabile*, having large and dark spores. Swelling and examination of the spores should be made in water, as the use of an alkali alters the color, and tends to an incorrect conception of its shade. The sporangia of *B. macrocarpa* do not have the reddish bases indicative of the red hypothallus and stalks of *B. panicea*.

11. **Badhamia gracilis** Macbr.; Macbr. & Martin, Myxomycetes
35. 1934. (N. Y. B. G. no. 10626, type material.)

Badhamia macrocarpa (Ces.) Rost. var. *gracilis* Macbr. N. A. Slime-Moulds ed.
2. 37. 1922.

Plasmodium? Sporangia gregarious or clustered, subglobose or irregular, 0.4 to 0.7 mm. diam., stalked or sessile, more or less flattened or concave beneath, grayish white; sporangial wall membranous, with scanty deposits of lime-granules. Stalk thin, membranous, yellowish. Capillitium a very close network of delicate strands filled with white lime-granules. Spores globose, purplish brown, irregularly spinulose in patches with smooth areas between the patches, 12–15 μ diam. (PLATE 6, FIG. 4.)

TYPE LOCALITY: Colorado.

HABITAT: On wood, leaves, herbaceous stalks, and living plants.

DISTRIBUTION: *Arizona, California, *Canal Zone, Colorado, Florida, Iowa, Kansas, Maryland, Nebraska, New Mexico, New York, Puerto Rico, *West Indies.

ILLUSTRATION: Macbr. & Martin, Myxomycetes *pl.* 3, *f.* 37, 38.

This species is undoubtedly related to *B. macrocarpa*, but is a convenient center, with its small, stalked, umbilicate sporangia, and delicate capillitium, for the forms often collected and widely distributed. The spores are not reticulate, but the smooth areas are often linear, and form persistent pressure ridges when the spores contract. Occasionally the capillitium is coarser, with expansions, or the lime densely massed in the center. Such collections merge into the more robust *B. macrocarpa*, yet maintain the graceful characteristics of *B. gracilis*.

12. **Badhamia Dearnessii** Hagelstein, Mycologia **34**: 117. 1942.
(N. Y. B. G. nos. 2530 type, 2512 and 2514 cotypes.)

Plasmodium? Sporangia scattered or loosely clustered in small developments, globose to subglobose, sessile on a narrow base, grayish white, 0.5 to 1 mm. diam.; sporangial wall membranous, with deposits of white lime-granules, often arranged to show veins or thickenings, iridescent when limeless. Capillitium a network of slender strands scantily charged with white lime-granules, the latter sometimes absent, when the capillitium is very delicate and may appear pale yellow in color. Spores free, glo-

bose, minutely and closely spinulose over the entire surface, purplish brown with a narrow pale area around the spores, 13–16 μ diam. (PLATE 7, FIG. 1.)

TYPE LOCALITY: Island of Jesus, Quebec.

HABITAT: On dead spruce twigs and sticks.

DISTRIBUTION: Maine, Quebec.

ILLUSTRATION: Hagelstein, *Mycologia* 34: 117, f. 1.

The large, dark spores resemble those of *B. macrocarpa*, and the slender capillitium that of *B. foliicola*. The pale spinulose band encircling the spores is not known in any other species of *Badhamia*.

13. *Badhamia affinis* Rost. Mon. 143. 1874.

Plasmodium white, then cream-colored (Lister). Sporangia scattered or in numerous, small, close clusters, hemispherical or depressed, flattened or umbilicate beneath, often curved or irregular in the clusters or inclining to plasmodiocarps, grayish white, rugulose, stalked or sessile, 0.5 to 1.5 mm. diam.; sporangial wall rough, with included clusters of lime-granules, rarely smooth. Stalks, when present, black, furrowed. Capillitium a network of tubes filled with white lime-granules. Spores violet-brown, closely and minutely spinulose, 10–15 μ diam.

Var. *orbiculata* (Rex) G. Lister, *Mycetozoa* ed. 3. 16. 1925.

Badhamia orbiculata Rex, *Proc. Acad. Nat. Sc. Phila.* 1893: 372. 1893.
(N. Y. B. G. no. 5467, type material.)

Sporangia smaller, scattered, discoid, much flattened or concave above and concave beneath, usually stalked. Capillitium often of slender, simple tubes.

TYPE LOCALITY: Chile.

HABITAT: On bark of dead trees.

DISTRIBUTION: The typical form and variety are common and widely distributed in North America.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. pl. 8, figs. d–f (var. *orbiculata*).

This species forms large developments, the typical form usually on poplar, and var. *orbiculata* often on locust. The plasmodium, when forming sporangia, spreads in horizontal rings, which closing, leave circular or linear depressions in the resultant, flattened sporangia, and characteristic of the species. The capillitium is about the same as that of *B. macrocarpa*, or occasionally *B.*

panicea. The spores are about intermediate between those of the two latter species. Small fruitings found occasionally on mossy logs are not representative, and have spores somewhat larger, up to $17\ \mu$ diam. They appear to be nearer *B. macrocarpa*. Var. *orbiculata* merges into the typical form, and there is no sharp line of demarcation.

The type specimen of *B. affinis* Rost. appears to be lost. The present conception of the species follows the interpretation of Lister, and the description of *B. orbiculata* Rex. Prof. Macbride always regarded *B. affinis* as specifically distinct from *B. orbiculata*, emphasizing a larger spore-size, although Rostafinski wrote it $12.5\text{--}15\ \mu$ diam.

14. ***Badhamia panicea*** (Fries) Rost.; Fuckel, Symb. Myc. Nachtr. 2: 71. 1873.

Physarum paniceum Fries, Syst. Myc. 3: 141. 1829.

Physarum nudum Macbr.; Peck & Gilb. Am. Jour. Bot. 19: 134. 1932. (N. Y. B. G. no. 7379, cotype material.)

Plasmodium white (Lister). Sporangia scattered or closely aggregated and angled by mutual pressure, sessile on a dark red hypothallus, rarely with short, dark red stalks, subglobose, 0.4 to 1.2 mm. diam., white or cinereous; sporangial wall membranous, with included lime-granules in dense clusters forming raised warts and veins. Capillitium white, a profuse network of tubes charged with lime-granules, often densely confluent at the base and forming a pseudo-columella, sometimes with a few hyaline connecting threads. Spores violet-brown, minutely and faintly spinulose, $11\text{--}13\ \mu$ diam.

Var. ***heterospora*** G. Lister, Mycetozoa ed. 3. 17. 1925.

Spores darker, purplish brown, paler on one side.

TYPE LOCALITY: Europe.

HABITAT: On dead bark; not uncommon.

DISTRIBUTION: Widely distributed throughout the United States and Canada; var. *heterospora*, Colorado and New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 10.

The red hypothallus, or red bases of the sporangia, are characteristic of this species. They may be yellowish at times. The capillitium varies, often approaching that of *B. macrocarpa* or *B. affinis*, but the latter species has flattened or depressed sporangia. The spores of *B. panicea*, in typical examples, are pale

and almost smooth, but they vary much in color and markings in other gatherings. There are many developments with darker and more spinulose spores, not paler on one side, which are therefore not var. *heterospora*. A specimen from Ontario (N. Y. B. G. no. 8921) has dark and spinose spores like those of *B. macrocarpa*, but the reddish hypothallus is present. The cotype of *Physarum nudum* Macbr. is a limeless form of *B. panicea* having the reddish bases and reddish stalks, with clustered, angled sporangia. Such forms are found occasionally associated with normal sporangia.

15. **Badhamia ovispora** Racib. Rozpr. Mat.-przycz. Akad. Umiej. Kraków 12: 72. 1884.

Plasmodium? Sporangia white or pale ochraceous, smooth or rugulose, subglobose, up to 0.5 mm. diam., or forming irregular or branching plasmodiocarps, crowded or scattered; sporangial wall thick, but friable, with dense deposits of lime-granules. Capillitium white, fragile, consisting of an irregular network of tubes filled with loosely adhering lime-granules, usually uniting to form a pseudo-columella at the base of the sporangium. Spores free, purplish brown, smooth, shining in mass, ellipsoid, 10×8 to $16 \times 10 \mu$, traversed lengthwise by a ridge or fold marking the line of dehiscence.

TYPE LOCALITY: Poland.

HABITAT: On old straw, manure, rabbit dung, and dead wood.

DISTRIBUTION: Colorado, Massachusetts, New York, Ontario, *Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 12.

A conspicuous little species forming large colonies. It has been found repeatedly by Mr. Eli Davis, on manure in a greenhouse at Byron, Ontario. It resembles phases of *Fuligo cinerea*, and is found on similar habitats, and often associated. It may be recognized by the appearance of the spores in mass. The spinose spores of *F. cinerea* appear dull, and the smooth spores of *B. ovispora* shine by reflected light.

16. **Badhamia lilacina** (Fries) Rost. Versuch 10. 1873.

Physarum lilacinum Fries, Syst. Myc. 3: 141. 1829.

Plasmodium watery white changing to yellow. Sporangia globose or obovoid, sessile, crowded and angled by pressure, smooth or slightly roughened, and white, pinkish, or lilac, about

0.5 mm. diam.; sporangial wall thick, densely charged with lime-granules. Capillitium white or nearly so, rugged, with large nodes of irregular shape filled with lime, often confluent in the center to form a pseudo-columella. Spores dark purplish brown, with prominent warts more or less confluent to form ridges, 10–15 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves etc., in wet areas; common.

DISTRIBUTION: Throughout eastern continental North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 13.

This species requires much moisture, and under such circumstances develops abundantly. The sporangia are very uniform in appearance and characters.

17. **Badhamia rubiginosa** (Chev.) Rost. Mon. App. 5. 1876.

Physarum rubiginosum Chev. Fl. Par. 1: 338. 1826. Not *P. rubiginosum* Fries. 1817.

Didymium Curtisii Berk. Grevillea 2: 65. 1873. (N. Y. B. G. no. 10716, type material.)

Craterium obovatum Peck, Rept. N. Y. State Mus. 26: 75. 1874. (N. Y. B. G. nos. 7950 and 10705, type material.)

Badhamia subaquila Macbr. N. A. Slime-Moulds 64. 1899.

Plasmodium bright yellow (Lister). Sporangia scattered and in loose clusters, obovoid, stalked, rarely sessile, about 0.5 mm. diam., pale rufous or purplish brown, usually paler above, the upper part breaking away in fragments from the more persistent lower part, sometimes with a distinct lid; sporangial wall membranous, purplish, more or less charged with lime-granules. Stalk cylindrical or widened at the base, usually about the length of the sporangium, smooth, reddish brown, continued into the sporangium to more than half of its height as a pale, clavate or cylindrical columella, often containing calcareous nodules. Capillitium a white or pale rufous rugged network, usually densely charged with lime-granules, spreading from all parts of the columella to the sporangial wall, sometimes with a few, hyaline, connecting threads. Spores dark purplish brown, spinulose, 11–15 μ diam. (PLATE 15, FIG. 1.)

TYPE LOCALITY: France.

HABITAT: On dead leaves, twigs, and living plants in wet areas, and on dead wood in the forests.

DISTRIBUTION: Common and abundant throughout continental North America

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 14*.

This species forms large and many developments of sporangia at one time. I have seen, in the swamps, sporangia covering the stalks of living ferns for several hundred square feet, and dozens of covered logs in the forests. Two varieties, known from Europe and elsewhere, var. *dictyospora* and var. *globosa*, have not yet been found in North America. The type of *Didymium Curtisii* Berk., from South Carolina, differs from typical *B. rubiginosa* only in being sessile or shortly stalked, as Lister says, and a specimen collected by Prof. Thaxter (N. Y. B. G. no. 10711) at Eustis, Florida, is similar, and almost limeless. The type of *Craterium obovatum* Peck is typical *B. rubiginosa*. Lister has examined the type of *B. subaquila* Macbr. from Maine, and regards it as a sessile form of *B. rubiginosa* similar to *D. Curtisii* Berk.

Genus 3. **PHYSARUM** Persoon, Neues Mag. Bot. 1: 88. 1794.

Sporangia stalked, sessile, or forming plasmodiocarps; sporangial wall either single, or consisting of two more or less separable layers, with deposits of minute, rounded lime-granules distributed in loose or dense clusters, or compacted into a crust. Stalk membranous, tubular (except in *P. penetrale*, in which the stalk is solid and translucent), wrinkled with longitudinal folds, either translucent, or opaque with deposits of lime or refuse matter in the wall-substance or in the cavity of the tube. Capillitium forming a network of hyaline threads with vesicular expansions containing calcareous deposits (lime-knots), occasionally without such deposits in weak forms.

TYPE SPECIES: *Physarum aureum* Pers.

Sporangia stalked (occasional sessile forms).

Stalks charged with lime throughout.

Capillitium lax.

Stalk white; sporangia white or gray; lime-knots large, white; columella none.

1. *P. leucopus*

Stalk white, rarely yellow or rufous; sporangia tawny or yellow; columella conical.

2. *P. melleum*

Stalk white or yellow; sporangia sulphur-yellow or olive-yellow; columella none.

3. *P. sulphureum*

Capillitium dense, persistent.

Stalk, sporangium and lime-knots yellow, pale yellow or orange.

- Yellow or orange; columella large, subglobose or clavate. 4. *P. Listeri*
- Yellow; sporangia robust; columella small, conical or obtuse. 10. *P. citrinum*
- Pale yellow; sporangia slender; columella none. 11. *P. tenerum*
- Sporangia and lime-knots white.
- Stalk white or brown below; lime-knots small; columella conical. 5. *P. globuliferum*
- Stalk white; columella none, replaced by a central ball of lime. 12. *P. Wingatense*
- Stalk ochraceous, often absent; sporangia subglobose, obovoid or cylindrical, with a long pseudo-columella, or forming plasmodiocarps. 13. *P. mutabile*
- Stalk, sporangium, and lime-knots red. 6. *P. pulcherripes*
- Stalk, sporangium, and lime-knots brown. 7. *P. murinum*
- Stalk, sporangium, and lime-knots purple. 8. *P. pulcherrimum*
- Stalk, sporangium, and lime-knots lilac. 9. *P. Bilgramii*
- Stalks without lime, or with deposits in the wall only (see also 13).
- Sporangium and lime-knots purplish red. 14. *P. roseum*
- Sporangium and lime-knots violet-purple. 15. *P. Newtoni*
- Sporangium glossy, mottled blue with red; stalk red or orange; lime-knots orange. 16. *P. psittacinum*
- Lime-knots yellow or orange; sporangia yellow, orange, or gray.
- Sporangia subglobose or lenticular, usually on slender stalks; lime-knots fusiform, rarely angular; spores pale. 17. *P. viride*
- Sporangia discoid, with rod-like lime-knots; spores purplish-brown. 18. *P. rigidum*
- Sporangia contorted, stalked, usually adhering in clusters; capillitium lax; lime-knots fusiform. 19. *P. polycephalum*
- Sporangia subglobose, yellow or iridescent bronze; stalks red-brown; capillitium dense, persistent; lime-knots small, angular. 20. *P. flavicomum*
- Sporangia small, globose, yellow, on leaves; stalks slender, yellow; lime-knots angular. 21. *P. galbeum*
- Sporangia globose, yellow, on wood; stalks reddish; lime-knots large and branching. 22. *P. oblatum*
- Sporangia subglobose, pale yellow; stalks when present membranous. 23. *P. albescens*
- Stalk red, translucent, penetrating the sporangium to near the apex. 24. *P. penetrale*

- Lime-knots white; sporangia yellow or brown.
 Sporangia subglobose, rugose, yellow; stalks red. 25. *P. citrinellum*
- Sporangia subglobose, pale yellow; stalks flesh-colored. 26. *P. carneum*
- Sporangia brown, smooth, shining; stalks when present red. 27. *P. brunneolum*
- Lime-knots white; sporangia gray or white.
 Stalks free from refuse matter.
 Stalks straw-colored; sporangia globose; capillitium persistent with a central ball of lime. 28. *P. nucleatum*
- Stalks straw-colored, slender; sporangia compressed; spores marked with patches of warts. 29. *P. straminipes*
- Stalks red-brown; sporangia white, subglobose, umbilicate. 30. *P. pusillum*
- Stalks white, membranous, short or absent; sporangia obovoid or subglobose, often sessile. 31. *P. didermoides*
- Stalks red-brown, translucent; sporangia discoid or saucer-shaped. 32. *P. pezizoideum*
- Stalks containing refuse matter.
 Stalks buff, black, or white; sporangia subglobose; spores brownish violet. 33. *P. nutans*
- Stalks white or yellowish; sporangia discoid, often umbilicate above; spores brownish violet. 34. *P. javanicum*
- Stalks black, or black below and white above; sporangia obovoid or subglobose, usually with a long columella; spores dull lilac. 35. *P. crateriforme*
- Stalks usually black, stout; sporangia compressed, often lobed; lime-knots more often rounded; spores dark purplish brown. 36. *P. compressum*
- Stalks brown or white; sporangia subglobose; lime-knots more often angular; spores dark purple-brown. 37. *P. notabile*
- Stalks black; sporangia subglobose or discoid; spores dark purplish brown with a paler spot. 38. *P. megalosporum*
- Stalks yellowish or dark, slender; sporangia compressed and lobed, often clustered, smaller than *P. compressum*. 39. *P. reniforme*
- Sporangia sessile, never stalked except *P. auriscalpium*.
 (For occasional sessile forms see 3, 13, 22, 23, 27, 29, 31, 33, 36, 37.)

Lime-knots white.

Sporangial wall single.

Sporangia subglobose or forming plasmodiocarps, white or gray; spores pale brownish violet, 7-10 μ diam.

40. *P. cinereum*

Sporangia subglobose, dark gray, heaped, the walls usually with scanty or no lime deposits; spores brownish violet, 10-13 μ diam.

41. *P. confertum*

Sporangia white, also forming plasmodiocarps; spores often ovoid, purplish brown marked with a pale line.

42. *P. ovisporum*

Sporangia forming yellow or orange-yellow, laterally compressed plasmodiocarps; lime-knots angular.

43. *P. superbum*

Sporangia gray, much compressed, forming rosettes; lime-knots fusiform.

44. *P. gyrosum*

Sporangia small, crowded, chestnut-brown; capillitium elastic, expanding.

45. *P. famintzini*

Sporangial wall double.

Sporangia scattered, forming plasmodiocarps.

Plasmodiocarps sinuous, much compressed, white; spores purplish brown, marked with strong spines and ridges.

46. *P. echinosporum*

Plasmodiocarps sinuous, much compressed, white or buff; inner wall fragile, colorless; spores purplish brown, spinulose.

47. *P. bivalve*

Plasmodiocarps sinuous, buff or brown, marked with pale lines of dehiscence; spores pale brownish violet, nearly smooth.

48. *P. bogoriense*

Plasmodiocarps white, usually compressed; inner wall purplish, persistent; spores dark purplish brown, spinulose.

49. *P. bitectum*

Sporangia crowded, reniform or subglobose. Sporangia white, subglobose; outer wall shell-like.

50. *P. testaceum*

Sporangia yellow; spores dark, rough, 10-13 μ diam.

51. *P. contextum*

Sporangia yellow; spores pale, nearly smooth, 8-10 μ diam.

52. *P. conglomeratum*

Lime-knots yellow, red, or brown.

Plasmodiocarps slender, yellow; lime-knots branching, pale yellow.

53. *P. Serpula*

Plasmodiocarps and lime-knots brown.

54. *P. aeneum*

Sporangia red or brown; lime-knots large, angular, red or brown.

55. *P. rubiginosum*

- Sporangia flattened, speckled with brown, red, yellow, or white; lime-knots large, angular, pale yellow. 56. *P. auriscalpium*
- Sporangia subglobose, brown, speckled with paler spots; lime-knots small, angular, yellowish or brownish. 57. *P. Braunianum*
- Sporangia red; lime-knots rounded, yellow, often with red centers. 58. *P. lateritium*
- Sporangia bright yellow, subglobose, not heaped; lime-knots small, angular, yellow. 59. *P. luteolum*
- Sporangia heaped in small clusters, greenish yellow; lime-knots irregular, yellow. 60. *P. virescens*
- Sporangia clustered, not heaped, light brown or tawny; spores small with scattered clusters of warts. 61. *P. digitatum*
- Sporangia large, yellow, with an outer crust of yellow lime easily separating in flakes from the inner wall. 62. *P. alpinum*

1. **Physarum leucopus** Link, Ges. Nat. Fr. Berl. Mag. 3: 27. 1809.

Plasmodium opaque white or yellowish (Lister). Sporangia gregarious, stalked, globose, about 0.5 mm. diam., grayish white; sporangial wall membranous, containing scattered or clustered lime-granules. Stalk white, stout, tapering upward, erect, brittle with enclosed lime-granules, rising from a more or less developed white, circular hypothallus. Columella none. Capillitium of delicate, branching, hyaline threads connecting large, irregular lime-knots filled with large, white lime-granules. Spores violet-brown, minutely spinulose, 7–10 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves, occasionally on dead wood; not uncommon.

DISTRIBUTION: Widely distributed throughout the United States and Canada; *Canal Zone.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 15.

This species is distinguished from *P. globuliferum* by the loose capillitium, the large irregular lime-knots, and the absence of a definite columella, although traces of the latter are sometimes present. It forms small colonies on dry leaves, often associated with *Didymium squamulosum*, which it resembles superficially, so that it is often overlooked by inexperienced collectors. The hypothallus may be absent, and the stalks thinner or stained, but

there is no refuse matter in the stalks as in varieties of *Physarum nutans* which it also resembles at times.

2. ***Physarum melleum*** (Berk. & Br.) Masee, Mon. 278. 1892.

Didymium melleum Berk. & Br. Jour. Linn. Soc. 14: 83. 1873.

Physarum perfectum M. E. Peck; Peck & Gilb. Am. Jour. Bot. 19: 134. 1932.

Plasmodium yellow (Lister). Sporangia stalked, erect, globose, about 0.5 mm. diam., yellow or brownish yellow; sporangial wall membranous, rugulose, persistent at the base, yellowish, with small, yellow lime-granules. Stalk white, buff, yellow, or orange, stout, opaque, chalky in section, charged with lime-granules. Columella short, conical. Capillitium of irregularly branching, delicate, hyaline threads, often expanded at the axils, with white or yellow lime-knots, usually large and angled, but various in size and shape. Spores violet-brown, almost smooth, 7–10 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead leaves; common and abundant.

DISTRIBUTION: Throughout the eastern United States; Ontario, *Oregon, Quebec, and the tropics.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 23.

A variety with orange stalks has been found on two occasions in Ontario. *Physarum perfectum* M. E. Peck, from Oregon, is perhaps a pale, robust form of *P. melleum*.

3. ***Physarum sulphureum*** Alb. & Schw. Consp. Fung. 93. 1805.

Physarum variabile Rex, Proc. Acad. Nat. Sc. Phila. 1893: 371. 1893. (N. Y. B. G. no. 6149, type material.)

Plasmodium? Sporangia gregarious, stalked, sessile or forming plasmodiocarps, piriform, subglobose, or obovoid, rugulose, 0.5 to 0.8 mm. diam., sulphur or olive-yellow; sporangial wall membranous, with dense clusters of yellow lime-granules. Stalk stout, white, dirty white, yellowish, or brownish, short, charged with lime. Columella none. Capillitium with many, large, irregular, often branched and confluent, white or yellow lime-knots. Spores violet-brown, spinulose, 9–11 μ diam. (PLATE 7, FIG. 2.)

Var. **sessile** Hagelstein, Mycologia 31: 346. 1939.

Physarum variabile Rex var. *sessile* Lister, Jour. Bot. 36: 114. 1898.

Physarum sessile Brândză; Lister, Mycetozoa ed. 3. 55, in part, pl. 22, fig. b (non a). 1925.

Sporangia sessile or forming simple, curved, or branching plasmodiocarps.

TYPE LOCALITY: Germany.

HABITAT: On dead leaves and wood; not rare.

DISTRIBUTION: Widely distributed throughout the United States; Ontario, Puerto Rico, Quebec.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 21, 65.

There are no differences between *P. sulphureum* and *P. variable* Rex sufficient to regard them as distinct. Var. *sessile* is unworthy of varietal rank, and is placed here merely to assist in clearing the confusion about the various phases of *P. sulphureum*. The sessile and plasmodiocarpous forms are usually found when the species is fruiting in abundance. When separated or isolated, it is often difficult to distinguish them from *P. Serpula* Morg. The plasmodiocarps are stouter, shorter, and darker than those of *P. Serpula*, and the spores are a little smaller. *P. sulphureum* forms single colonies with much variation in color and sporangial shape. *P. Serpula* usually appears in many small developments at one time.

4. **Physarum Listeri** Macbr.; Macbr. & Martin, Myxomycetes 62, 1934.

Physarum luteo-album A. & G. Lister, Jour. Bot. 42: 130. 1904. (N. Y. B. G. nos. 10906, 10907, authentic material.) Not *P. luteo-album* Schum. 1803.

Plasmodium orange (Lister). Sporangia gregarious, stalked, smooth or rugulose, subglobose, about 1 mm. broad, 0.7 mm. high, yellow shading into white, deep orange, or olivaceous; sporangial wall pale yellow or orange, with deposits of yellow lime-granules, often dense and compacted to form an outer separable wall, persistent at the base. Stalk stout, smooth, 0.5 to 1 mm. long, bright yellow, orange, or reddish brown, usually paler below, cylindrical, tapering upward or narrowed below, charged with lime-granules throughout, or the lime in the form of crystalline nodules toward the base. Columella large, subglobose or shortly clavate, pale yellow or orange. Capillitium radiating from the columella and persistent after dispersal of the spores, of slender, straight, pale yellow threads, branching at acute angles, or netted and anastomosing; lime-knots either few or many, yellow, small and rounded, or spindle-shaped, or large and angular. Spores purplish brown, strongly spinulose, about 12 μ diam.

TYPE LOCALITY: Italy.

HABITAT: On dead leaves, twigs, etc., occasionally on wood.

DISTRIBUTION: Colorado, Kansas, North Carolina, Ontario, Quebec, Tennessee, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 24, as *P. luteoalbum*.

This species looks like a *Diderma*. It is sharply marked, but extremely variable, often in the same development. Var. *aureum* Rönn, based on color, is unworthy of recognition, as the color variations are present in nearly every colony. Prior to 1937, the species was known from North America by a single collection made by Dr. W. C. Sturgis in Colorado. Since then it has been found repeatedly in mountainous regions, usually late in the season after the middle of August. The favorite habitat is on the inside of curled and twisted, dry, decaying leaves.

5. **Physarum globuliferum** (Bull.) Pers. Syn. Meth. Fung. 175. 1801.

Sphaerocarpus globuliferus Bull. Herb. Fr. *pl.* 484, fig. 3. 1790.

Sphaerocarpus globulifer Bull. Champ. 134. 1791.

Didymium subroseum Peck, Rept. N. Y. State Mus. 28: 54. 1876.

Physarum albicans Peck, Rept. N. Y. State Mus. 30: 50. 1878. (N. Y. B. G. no. 7984, type material.)

Physarum relatum Morg. Jour. Cin. Soc. Nat. Hist. 19: 26. 1896.

Plasmodium pale yellow (Lister). Total height 0.6 to 1.5 mm. Sporangia gregarious or united in small clusters, often connate, globose or irregular in shape, stalked, usually erect, about 0.5 mm. diam., white; sporangial wall membranous, with crowded clusters of included lime-granules. Stalk white, buff, or reddish, sometimes darker toward the base, 0.1 to 1 mm. long, often tapering upward, nearly smooth, brittle and chalky in cross-section. Columella conical. Capillitium persistent, retaining the form of the sporangium after dispersal of the spores, forming a close network of hyaline threads with numerous, fusiform or rounded, white lime-knots, occasionally angular and branching. Spores lilac-brown, faintly warted, 6–8 μ diam.

TYPE LOCALITY: France.

HABITAT: On dead wood; common and abundant.

DISTRIBUTION: Throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 16.

This species is variable in shape and general appearance, but may be recognized by the persistent capillitium with usually

rounded lime-knots, the columella, and the small pale spores. In many collections there is a pale yellow shade to the lime, showing an approach to *P. citrinum* or *P. murinum*. Colonies of sporangia with angular and branching lime-knots are sometimes found. Together with *P. murinum*, *P. citrinum*, *P. pulcherrium*, *P. pulcherripes*, and *P. Bilgramii*, it forms a group, the species of which are separated mainly by color distinctions, but similar otherwise, so that intermediate forms occur. *P. globuliferum* prefers a dryer habitat than some of the related species.

6. **Physarum pulcherripes** Peck, Bull. Buff. Soc. Nat. Hist. 1: 64. 1873. (N. Y. B. G. no. 11010, type material.)

Plasmodium orange-red. Total height 1 to 2 mm. Sporangia stalked, globose, about 0.5 mm. diam., yellow-orange, orange-red, or brownish, sometimes gray from absence of lime; sporangial wall membranous, with deposits of orange-red lime, usually abundant. Stalk brittle, thick, 0.5 to 1.5 mm. long, somewhat narrowed upward, densely charged with red or brown lime-granules or crystalline nodules, usually darker at the base. Columella small, conical or subglobose, often dark red in color. Capillitium persistent, a dense network of hyaline threads with red or reddish brown lime-knots. Spores violet-brown, nearly smooth, 8–10 μ diam.

TYPE LOCALITY: New York.

HABITAT: On rotten wood and mossy logs; common.

DISTRIBUTION: Throughout the eastern United States; *Canal Zone, Oklahoma, Ontario, Quebec, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 17.

7. **Physarum murinum** Lister, Mycetozoa 41. 1894. (N. Y. B. G. no. 11098, authentic material.)

Plasmodium? Sporangia scattered, stalked, globose, rugulose, about 0.5 mm. diam., grayish or yellowish brown; sporangial wall membranous, with included clusters of brown lime-granules. Stalk erect, 0.5 mm. long or longer, of uniform breadth, brown or brownish, furrowed, containing dense deposits of white or brown lime-granules. Columella small, conical or subglobose. Capillitium a dense network of branching, hyaline threads, persistent after dispersal of the spores, with ovoid, brown lime-knots, or a looser network with numerous, elongate, irregularly branch-

ing lime-knots. Spores pale brownish lilac, nearly smooth, 8–10 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead wood and mossy logs; common.

DISTRIBUTION: Throughout the eastern United States; *Iowa, *Missouri, Quebec, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 18.

In typical examples, the brown color is pronounced throughout. In other specimens, the brown lime is only in the capillitium. There are also intermediates merging into *P. globuliferum*, from which the species is separated mainly by color.

8. **Physarum pulcherrimum** Berk. & Rav.; Berk. *Grevillea* 2: 65. 1873. (N. Y. B. G. no. 6049, type material.)

Physarum atrorubrum Peck, Rept. N. Y. State Mus. 31: 40. 1879. (N. Y. B. G. no. 7989, type material.)

Plasmodium dark red (Lister). Sporangia gregarious, stalked, globose, about 0.5 mm. diam., erect or curved, flattened beneath, reddish purple varying in shade; sporangial wall membranous, persistent below, pale purple, with scattered clusters of purple lime-granules. Stalk concolorous or darker, subulate, brittle, 0.5 to 1 mm. high, containing lime. Columella small, convex, conical, or absent. Capillitium a close, persistent network of delicate, purplish threads, with numerous, small, rounded, purplish lime-knots. Spores pale red, nearly smooth, 7–8 μ diam.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood; common.

DISTRIBUTION: Throughout the eastern United States; Ontario, Quebec, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 19.

Physarum roseum, a tropical species, resembles *P. pulcherrimum* in color, but has a translucent stalk and large, branching lime-knots.

9. **Physarum Bilgramii** Hagelstein, *Mycologia* 33: 306. 1941.

Physarum lilacinum Sturg. & Bilgr.; Sturg. *Mycologia* 9: 324. 1917. (N. Y. B. G. no. 10925, type.) Not *P. lilacinum* Fries. 1829.

Plasmodium? Sporangia gregarious, globose, about 0.5 mm. diam., stalked, pale lilac, pale indian-red, or pale blue; sporangial wall membranous, with clusters of similarly colored lime-granules.

Stalk 0.5 to 1 mm. high, concolorous or paler. Columella short, conical. Capillitium delicate, persistent, with small rounded lime-knots, concolorous with the other lime. Spores pale brownish lilac, nearly smooth, 7-8 μ diam.

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead wood.

DISTRIBUTION: Pennsylvania.

ILLUSTRATION: None published?

This species is intermediate in color between *P. pulcherrimum* and *P. globuliferum*. In the latter species the lime is sometimes faintly pink or lilac. Such collections must be regarded as *P. globuliferum*, as the color should be deep enough to be seen when viewing the colony as a whole with a hand-lens. The species is known only from Pennsylvania, where it was found by the late Mr. Hugo Bilgram, and the author with his associates.

10. *Physarum citrinum* Schum. Enum. Pl. Saell. 2: 201. 1803.

Plasmodium bright yellow (Lister). Total height 0.8 to 2 mm. Sporangia gregarious, stalked, erect, rarely sessile, globose, 0.4 to 0.7 mm. diam., rugose, yellow to yellowish gray; sporangial wall membranous, with included clusters of yellow lime-granules. Stalk yellow, stout, somewhat furrowed, 0.1 to 1.3 mm. high, chalky in cross-section from the presence of lime, which is sometimes in nodules. Columella short, conical, or obtuse. Capillitium a somewhat close, persistent network of hyaline threads, with flat expansions at the axils, and numerous yellow lime-knots, varying in shape and size, usually rounded. Spores lilac-brown, almost smooth, 7-10 μ diam.

TYPE LOCALITY: Denmark.

HABITAT: On dead wood and mosses.

DISTRIBUTION: *Colorado, New Hampshire, Ohio, *Oregon, Pennsylvania, Tennessee, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 20.

Typical examples of this species, with pronounced yellow lime, are very rare from North America; it is more abundant in Europe. It is practically the same as certain phases of *P. globuliferum*, differing only in color. In the latter species, the lime often shows pale yellowish tints, approaching thereby *P. citrinum*, but such specimens must be regarded as intermediate, and closer to *P. globuliferum*. The yellow hypothallus mentioned in other de-

scriptions of the species, is not always present, and is not characteristic, as a similar hypothallus may often be observed in *P. globuliferum*. A beautiful collection made by Mr. Rispaud and the author (N. Y. B. G. no. 4747) in Pike County, Pennsylvania, is about as representative as can be found.

11. **Physarum tenerum** Rex, Proc. Acad. Nat. Sc. Phila. 1890: 192. 1890. (N. Y. B. G. nos. 10905, cotype material, 6463, 7610, authentic material.)

Physarum maculatum Macbr. Bull. Nat. Hist. S. U. Iowa 2: 383. 1893.

Physarum simplex (?) M. E. Peck; Peck & Gilb. Am. Jour. Bot. 19: 136. 1932.

Plasmodium primrose-yellow (Lister). Sporangia gregarious, globose, 0.4 mm. diam., stalked, erect or nodding, yellow, often gray; sporangial wall membranous, with closely set rounded clusters of lime-granules. Stalk subulate, slender, straight, curved or twisted, opaque, 0.5 to 1.7 mm. long, yellow and filled with lime above, usually darker below from included refuse matter. Columella none. Capillitium a close, persistent network of slender, hyaline threads, with numerous, rounded, yellow lime-knots, often pale. Spores brownish lilac, nearly smooth, 7-8 μ diam.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On dead wood; common.

DISTRIBUTION: Throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 25.

This species forms small colonies, rarely more than an inch across. The sporangial wall frequently dehisces in petal-like lobes. The amount of lime in the stalk varies, sometimes abundant so that the stalk is erect and stiff, and at other times scanty, so that it is flexible with the sporangia nodding. There is often a sharp bend near the apex of the stalk. The lime in the wall and capillitium is often pale, or nearly white, but the yellow color of the stalk is more constant. *P. citrinum* is a more robust form with a stout stalk, and a columella. *P. simplex*, from Oregon, appears to be a form of the present species.

12. **Physarum Wingatense** Macbr. N. A. Slime-Moulds ed. 2. 72. 1922.

Didymium columbinum Berk & Curt., not published.

Tilmadoche columbina Rost. Mon. App. 13. 1876. (N. Y. B. G. no. 5614, type material.)

Tilmadoche compacta Wing. Proc. Acad. Nat. Sc. Phila. 1889: 48. 1889.

Physarum compactum (Wing.) Lister, Mycetoza 44. 1894. Not *P. compactum* Ehrenb. 1818.

Physarum columbinum (Rost.) Sturg. Mycologia 8: 200. 1916. Not *P. columbinum* Pers. 1796.

Plasmodium light gray (Lister). Total height 1 to 2 mm. Sporangia gregarious, scattered, or loosely clustered, stalked, subglobose and flattened beneath, or hemispherical, 0.5 mm. diam., erect or nodding, gray or bronze-colored, spotted with white and iridescent between the spots, often dehiscing in petal-like lobes; sporangial wall membranous, with numerous, separated, rounded clusters of closely compacted lime-granules. Stalk 0.5 to 1.5 mm. long, erect or flexuose, subulate, furrowed, thick at the base, white and densely charged with lime, often in the form of granules or crystalline nodules, brown or black below from included refuse matter. Columella none, replaced usually by a calcareous ball near the base of the sporangium. Capillitium abundant, of extremely delicate, branching and anastomosing threads, without expansions at the axils, somewhat persistent, white or pale bluish; lime-knots white, few, small, fusiform when accompanied by the ball or cluster of lime, or uniformly distributed and larger and irregular when the cluster is absent. Spores violet-brown, almost smooth, 7-9 μ diam.

TYPE LOCALITY: Venezuela.

HABITAT: On dead wood; common.

DISTRIBUTION: Throughout North America.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 26, as *P. columbinum*.

The rounded lime-clusters in the sporangial wall are sometimes replaced by crystalline scales as in the genus *Lepidoderma*. This feature is also found occasionally in other species of *Physarum*. The capillitium of *P. Wingatense* is not always persistent, and being delicate, is liable to break away, leaving the persistent base of the sporangial wall. Some phases appear somewhat like varieties of *P. nutans*, but the central ball of lime and calcareous stalk distinguish it therefrom; and *P. nucleatum* has the inner cluster of lime, but a limeless stalk.

13. *Physarum mutabile* (Rost.) Lister, Mycetoza ed. 2. 53. 1911.

Crateriachea mutabilis Rost. Mon. 126. 1874.

Physarum Gilkeyanum(?) Gilb.; Peck & Gilb. Am. Jour. Bot. 19: 133. 1932

Plasmodium watery gray (Lister). Sporangia erect, cylindrical, obovoid, or subglobose, 0.3 to 0.6 mm. diam., stalked or sessile, or forming elongate and branched plasmodiocarps, rugulose or wrinkled, white; sporangial wall with rather evenly distributed deposits of lime-granules. Stalks stout or slender, 0.1 to 0.4 mm. high, ochraceous yellow, rarely orange-brown, usually enclosing white lime-granules, but sometimes almost free from lime, connected by a yellowish or white hypothallus. Capillitium a persistent network of firm, hyaline threads, with expansions at the axils; lime-knots white, varying in size and shape, either scattered through the capillitium, or in the stalked forms for the most part confluent in the center of the sporangium, and forming a clavate columella, which is either free or continuous with the apex of the stalk. Spores purplish brown, spinulose, 7–10 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On leaves and herbaceous stems.

DISTRIBUTION: Ontario, *Oregon?

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 44.

Stalked phases of this species may resemble *Craterium aureum* superficially, but the persistent capillitium is diagnostic. *P. Gilkeyanum* from Oregon, is probably a sessile form of *P. mutabile*.

14. ***Physarum roseum*** Berk. & Br. Jour. Linn. Soc. 14: 84. 1873.

Plasmodium maroon-red (Lister). Total height about 1 mm. Sporangia gregarious, globose, 0.3 to 0.4 mm. diam., nearly smooth, bright purplish red, stalked; sporangial wall membranous, with innate clusters of purplish red lime-granules. Stalk erect, slender, subulate, rugulose, translucent, concolorous. Columella none. Capillitium a loose network of slender, pale lilac threads, with large, irregularly branching, purplish red lime-knots. Spores reddish lilac or reddish brown, minutely spinulose, 7–10 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead leaves.

DISTRIBUTION: Florida.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 27.

Distinguished from *P. pulcherrimum* by the more reddish color; the translucent stalk; the loose capillitium, with angular, branching lime-knots; and the absence of a columella. It is smaller than *P. Newtoni*; the wall is much smoother; the color is brighter; and the capillitium is not firmly attached to the sporangial wall.

15. **Physarum Newtoni** Macbr. Bull. Nat. Hist. S. U. Iowa 2: 390. 1893.

Plasmodium dark violet (Macbr. & Martin). Sporangia simple, gregarious, short-stipitate or sessile, globose or flattened, when not globose depressed and deeply umbilicate above, purple, smooth, thin-walled, stipe when present very short and concolorous; columella none; hypothallus none; capillitium abundant, delicate, with more or less well developed nodules, which are also concolorous; spores by transmitted light dark brown, thick-walled, rough, nucleated, about 10 μ .

TYPE LOCALITY: Colorado.

HABITAT: On sticks.

DISTRIBUTION: *Colorado, *Oregon.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 28.

The description is the original one of Macbride based on the type collection from Colorado which I have not seen. Two specimens from Japan in the Herbarium of the New York Botanical Garden, believed to be *P. Newtoni*, differ materially from the description of the Colorado collection. The sporangia are purple, globose, 0.6 mm. diam., on stalks 0.6 to 0.8 mm. high, rising from a well-marked, circular hypothallus. The sporangial wall is rough with many large clusters of purple lime-granules and refuse matter, thicker at the base, and persisting for nearly half the height of the sporangium. There is no columella. The capillitium has delicate, branched, pale violet threads, attached to the sporangial wall, and converging inward, with many irregular, purple lime-knots. The spores are purplish red, irregularly spinulose, 8–10 μ diam.

16. **Physarum psittacinum** Ditm. in Sturm, Deutsch. Fl. Pilze 1: 125. 1817.

Plasmodium orange (Lister). Sporangia gregarious or occasionally loosely clustered and angled, globose, 0.5 to 1 mm. diam., purplish blue mottled with red, iridescent, stalked; sporangial wall membranous, thin, hyaline, sprinkled with orange spots of granular matter, limeless. Stalk erect, or curved, furrowed, tapering upward, without lime, vermilion or orange-red, rising from a well-developed hypothallus of the same color. Columella none. Capillitium a close network of flat, arching, colorless or yellowish threads, broad at the axils; lime-knots numerous,

sharply angular, often branching or confluent in the center, bright orange, obscurely granular, sometimes hyaline and translucent. Spores pale violet-brown, minutely warted, 7–10 μ diam.

Var. *fulvum* A. & G. Lister, Jour. Bot. 44: 228. 1906.

Stalk and base of sporangium fulvous yellow instead of vermilion.

TYPE LOCALITY: Germany.

HABITAT: On rotten wood and mossy logs.

DISTRIBUTION: Florida, Maine, Massachusetts, New Hampshire, New York, Ontario, *Oregon, Pennsylvania, Quebec, Vermont, *West Virginia; var. *fulvum*, Florida, *Minnesota, Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 29.

Like *P. pulcherripes*, the favorite habitat is on very wet, rotten wood, often causing imperfect developments. It bears little resemblance, however, to *P. pulcherripes*, as it is practically limeless except for the lime-knots, and there is no columella.

17. *Physarum viride* (Bull.) Pers. Ann. Bot. Usteri 15: 6. 1795.

Sphaerocarpus viridis Bull. Herb. Fr. pl. 407, fig. 1. 1788; Bull. Champ. 135. 1791.

Physarum aureum Pers. Neues Mag. Bot. 1: 88. 1794.

Plasmodium yellow (Lister). Sporangia subglobose or lenticular, sometimes concave beneath, nodding, 0.3 to 0.5 mm. diam., yellow, stalked; sporangial wall membranous, dehiscing in fragments, with innate clusters of yellow lime-granules. Stalk subulate, slender, striate, gray or straw-colored, sometimes yellow at the top shading to red below, usually brown or black in the lower half from enclosed refuse matter, rarely with lime. Columella none. Capillitium a loose, irregular network of slender, acutely branching, hyaline threads, with fusiform, yellow lime-knots. Spores pale brownish lilac, almost smooth, 7–10 μ diam. (PLATE 15, FIG. 2.)

Var. *aurantium* (Bull.) Lister, Mycetozoa 47. 1894.

Sphaerocarpus aurantius Bull. Herb. Fr. pl. 484, fig. 2. 1790; Bull. Champ. 133. 1791.

Sporangia and lime-knots orange.

Var. *incanum* Lister, Mycetozoa 47. 1894.

Sporangia gray or pale yellow; lime-knots pale yellow.

Var. *Bethelii* (Macbr.) Sturg. Colo. Coll. Pub. Sc. Ser. 12: 439. 1913.
Physarum Bethelii Macbr.; Lister, Mycetozaa ed. 2. 57. 1911. (N. Y. B. G. nos. 7325, 9969, type material.)

Sporangia subglobose, umbilicate beneath, pale yellow or iridescent blue from absence of lime; capillitium a dense network with large, irregular, pale yellow lime-knots.

TYPE LOCALITY: France.

HABITAT: On dead wood; common.

DISTRIBUTION: The typical form, var. *aurantium*, and var. *incanum* are abundantly distributed throughout North America; var. *Bethelii*, Colorado and New York.

ILLUSTRATIONS: Lister, Mycetozaa ed. 3. pl. 31, 200.

Collections are sometimes made with branching stalks, each branch carrying a sporangium, and these may be of different shades of color on one stalk. Var. *hinnuleum* G. Lister has not yet been found in North America. It has reddish brown lime in the sporangial walls and lime-knots, with buff-colored stalks enclosing lime. Buff, as applied to the spores of the variety in the Lister Monograph, is a clerical error. Occasional colonies of *P. viride* have reddish orange lime, but no calcareous stalks. From this the color shades in all gradations to the almost white phases of var. *incanum*, some of which are difficult to distinguish from *P. nutans*, as there is little but color distinction between the two species. *P. viride* usually has paler spores than *P. nutans*.

18. *Physarum rigidum* G. Lister, Mycetozaa ed. 3. 36. 1925.

Physarum viride (Bull.) Pers. var. *rigidum* Lister, Mycetozaa ed. 2. 56. 1911.

Plasmodium yellow (Lister). Sporangia gregarious, discoid, often umbilicate above, yellow, dull orange, or iridescent from absence of lime, stalked. Stalk slender, orange or yellow above, dark below from included refuse matter, 0.3 to 1.5 mm. high. Capillitium of sparingly branched threads or flattened tubes with long, narrow, orange lime-knots, or consisting almost entirely of slender, rod-like tubes enclosing lime-granules. Spores rich violet-brown, minutely spinulose, 9–10 μ diam.

TYPE LOCALITY: Japan.

HABITAT: On dead wood.

DISTRIBUTION: *West Indies.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 199, *figs.* *a-c*.

Distinguished from *P. viride* by the rigid capillitium, and somewhat larger, darker spores.

19. **Physarum polycephalum** Schw. Schr. Naturforsch. Ges. Leipzig 1: 63. 1822.

Plasmodium yellow. Total height 1.5 to 2 mm. Sporangia much compressed, lenticular, undulate or lobed, singly or in clusters of many sporangia on one stalk, gray or yellow, stalked; sporangial wall membranous, with scattered thin, innate clusters of white or yellow lime-granules. Stalks subulate, slender, inclined or flexuose, usually fasciculate of several combined, yellow or tawny, translucent. Capillitium a loose network of slender threads with many flat expansions at the axils; lime-knots yellow or white, variable in shape, size, and abundance. Spores violet-brown, minutely spinulose, 8–11 μ diam. (PLATE 7, FIG. 3.)

TYPE LOCALITY: Wilkes County, North Carolina.

HABITAT: On dead wood and leaves; common and abundant.

DISTRIBUTION: Throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 34.

This species forms large plasmodia, spreading over a wide area, and often, after emergence, feeding on the oyster mushroom (*Pleurotus ostreatus*) and similar fungi. It is often associated with *P. gyrosum*, to which it is related, or in the company of *Physarella oblonga*. Var. *obrusseum* (Berk. & Curt.) Lister is hardly worthy of recognition, as single sporangia are seen in almost every development, although small colonies of single sporangia do occur. The usual phase is in the form of several sporangia on one stalk, or the sporangia on many stalks and united to form masses comprising up to 30 or more sporangia.

20. **Physarum flavicomum** Berk. London Jour. Bot. 4: 66. 1845.

Plasmodium yellowish green (Lister). Total height 1 to 2 mm. Sporangia subglobose, flattened beneath and sometimes above, nodding, about 0.5 mm. diam., yellow, gray, bronze, or dark and iridescent from the absence of lime, stalked; sporangial wall membranous, colorless above, yellowish below, stouter and persistent at the base. Stalk slender, subulate, twisted, without lime, red, copper-colored, or pale brown. Capillitium a close network of hyaline threads, with numerous yellow, flat expansions

at the axils, firmly attached to the base of the sporangium, and usually persistent after dispersal of the spores; lime-knots usually small, angular, yellow. Spores violet-brown, nearly smooth, 7-10 μ diam.

TYPE LOCALITY: Australia.

HABITAT: On dead wood

DISTRIBUTION: Common in the eastern United States; Colorado, Iowa, *Minnesota, Ontario, Quebec.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 32, *figs.* a, b.

This species forms large colonies, and is probably common everywhere, as it is eastward. The conspicuous feature by which it may be distinguished from other species with reddish stalks, is the persistent base of the sporangial wall to which the capillitium is attached by erect threads, and the persistence of the capillitium after dispersal of the spores.

21. **Physarum galbeum** Wing.; Macbr. N. A. Slime-Moulds 53. 1899. (N. Y. B. G. *nos.* 6152, 7612, authentic material).

Plasmodium? Sporangia scattered, usually erect, globose, 0.3 to 0.6 mm. diam., smooth, bright yellow, stalked; sporangial wall membranous, with rather dense clusters of yellow lime-granules. Stalk subulate or almost cylindrical, 0.6 to 0.8 mm. high, translucent yellow, or yellow above and orange-red below. Capillitium a dense network of pale yellow threads or flattened strands; lime-knots reduced to scanty deposits of lime in the expanded axils of the branches. Spores pale violet, almost smooth, 7-10 μ diam.

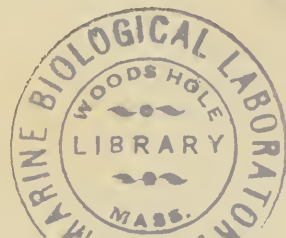
TYPE LOCALITY: Pennsylvania.

HABITAT: On dead leaves and stems, occasionally on wood.

DISTRIBUTION: *Iowa, Massachusetts, *Minnesota, New York, *Nova Scotia, *Ohio, *Oregon, Pennsylvania, Vermont, Virginia.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 199, *figs.* d-f.

This species forms very small developments of a few scattered sporangia on leaves. It is probably widely distributed, but rarely reported because of the difficulty in finding it. The characters that distinguish it from related species are the scattered habit; the yellow stalks without lime; and the nearly limeless, pale yellow capillitium. It resembles, superficially, some phases of *P. tene-rum* and *P. flavicomum*.



22. **Physarum oblatum** Macbr. Bull. Nat. Hist. S. U. Iowa 2: 384. 1893.

Physarum ornatum(?) Peck, Rept. N. Y. State Mus. 31: 40. 1879.

Craterium Maydis Morg. Jour. Cin. Soc. Nat. Hist. 19: 15. 1896.

Physarum Maydis (Morg.) Torrend, Fl. Myx. 193. 1909.

Plasmodium? Sporangia stalked, rarely sessile, globose or subglobose, 0.4 to 0.6 mm. diam., yellow or pale yellow, roughened; sporangial wall membranous, yellow, with innate closely set clusters of yellow or pale yellow lime-granules. Stalk erect, slender, furrowed, 0.3 to 0.8 mm. high, reddish brown, translucent. Capillitium of many angular and branching yellow or pale yellow lime-knots, connected by fairly long threads, sometimes a *Badhamia*-like network. Spores violet-brown, spinulose, 9–12 μ diam.

TYPE LOCALITY: Iowa.

HABITAT: On dead wood, usually cottonwood poplar.

DISTRIBUTION: Common and abundant throughout the United States, Canada, and the West Indies.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 32, *figs.* c–e, as *P. Maydis*.

This species forms small colonies with several or many on a single log. The occasional sessile sporangia closely resemble *Badhamia decipiens*, but are generally associated with colonies of stalked sporangia on the same habitat. Still more rarely plasmodiocarps may be present with sessile sporangia. The species is distinguished from *P. auriscalpium* by the long stalks, the uniformly smaller globose sporangia, and the evenly distributed color. *P. ornatum* Peck is probably the same form, but the opinion is uncertain, as my examination of the type specimen in the New York State Museum discloses that only stalks remain. Macbride's name must be accepted until an authentic and perfect specimen from Peck is produced. *Craterium Maydis*, undoubtedly a *Physarum*, and regarded by Torrend and the Listers as a distinct species, is merely a small form of *P. oblatum*. The statement, frequently expressed, that its habitat is on corn stalks is a myth. I have examined many corn stalks in the field without results, and the only specimens here on that habitat are typical *P. oblatum*. I have found the small form several times on other habitats, and also forms of intermediate sizes, and there are no differences between them and *P. oblatum* except size.

23. **Physarum albescens** Ellis; Macbr. N. A. Slime-Moulds ed. 2. 86. 1922. (N. Y. B. G. no. 5704, type material.)

Leocarpus fulvus Macbr. N. A. Slime-Moulds 82. 1899.

Physarum fulvum (Macbr.) Lister, Mycetoza ed. 2. 60. 1911. Not *P. fulvum* Fries. 1829.

Plasmodium yellow (Lister). Sporangia globose or obovoid, 0.6 to 0.8 mm. diam., cream-white, pale fulvous, or yellow, nearly smooth or rugulose, stalked or sessile, with a hypothallus of branching, fulvous strands; sporangial wall of two closely connected layers, sometimes separable, enclosing abundant deposits of lime-granules. Stalk 0.1 to 0.5 mm. long, fulvous, weak and almost membranous, expanding below into strands of the hypothallus. Capillitium a dense persistent network of nearly colorless threads, with membranous expansions at the axils, and usually with scattered, large, angular, often branched, pale yellow or orange lime-knots, but sometimes with scanty lime. Spores purplish brown, spinulose, 10–12 μ diam.

TYPE LOCALITY: Colorado.

HABITAT: On dead leaves, stems, and twigs.

DISTRIBUTION: *California, Colorado, Florida, *Idaho, Iowa, Louisiana, *Montana, *Nevada, *Oregon, Utah, Wisconsin.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 66, as *P. fulvum*.

This species bears a striking resemblance to the genus *Leocarpus*, but can generally be distinguished by the paler color and persistent capillitium. The lime in the capillitium is scattered and occasionally scanty.

24. **Physarum penetrale** Rex, Proc. Acad. Nat. Sc. Phila. 1891: 389. 1891. (N. Y. B. G. no. 6142, authentic material.)

Plasmodium orange-yellow (Lister). Sporangia stalked, erect, and globose, ellipsoid, or obovoid, 0.3 to 0.5 mm. diam., gray or pale greenish yellow, smooth; sporangial wall membranous, with innate, scattered clusters of pale yellow or white lime-granules. Stalk erect or curved, 0.5 to 2 mm. high, slender, subulate, solid, translucent, dull red or golden red. Columella an extension of the stalk penetrating the sporangium nearly to the apex, slightly tapering to the expanded end, yellow. Capillitium a close network of slender, hyaline threads with triangular expansions at the axils of the branches, springing from the whole length of the columella, persistent after the dispersal of the spores; lime-knots

scattered, small, rounded, yellow or white. Spores pale brownish violet, minutely spinulose, 5–7 μ diam.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On dead wood and mosses.

DISTRIBUTION: *California, *Maine, New Hampshire, New York, North Carolina, *Ohio, Ontario, Oregon, Pennsylvania, Quebec, Tennessee, Virginia, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 36.

This species may be expected anywhere, as it is not rare, although usually forming small colonies so that it may easily be overlooked. The distinctive and characteristic feature is the translucent stalk, penetrating the sporangium to near the top.

25. **Physarum citrinellum** Peck, Rept. N. Y. State Mus. 31: 57. 1879. (N. Y. B. G. no. 7977, type material.)

Didymium flavidum Peck, Rept. N. Y. State Mus. 28: 54. 1876. (N. Y. B. G. nos. 5629, 7978, 10919, type material.)

Plasmodium greenish white (Lister). Sporangia gregarious, subglobose, 0.6 to 0.8 mm. diam., stalked, erect, rugose, yellow or ochraceous, tinged with orange at the base; sporangial wall of two layers, the outer cartilaginous, yellow, rugose, with dense included deposits of lime, separating easily from the colorless, membranous inner layer. Stalk cylindrical, 0.2 to 0.4 mm. high, stout, plicate, orange-red or reddish brown, translucent. Capillitium a network of hyaline threads, with many large, irregular and branching, white lime-knots. Spores purplish brown, strongly spinulose, 10–12 μ diam.

TYPE LOCALITY: New York.

HABITAT: On mosses and dead wood.

DISTRIBUTION: New Hampshire, New York, North Carolina, *Oregon, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 68.

A favorite habitat for the species is on the sides of wet, mossy rocks in secluded places. It is a large form and easily recognized.

26. **Physarum carneum** G. Lister & Sturg.; G. Lister, Jour. Bot. 48: 73. 1910. (N. Y. B. G. no. 11084, type.)

Plasmodium mustard-yellow (Lister). Sporangia gregarious, subglobose, 0.4 to 0.6 mm. diam., stalked, rarely sessile or forming short plasmodiocarps, ochraceous yellow with a reddish base, or

dark gray from absence of lime, smooth or rugulose; sporangial wall membranous, usually with evenly distributed lime-deposits, thicker at the base. Stalk cylindrical from a broader base, rugulose, flesh-colored or pinkish, translucent, or opaque with refuse matter, 0.2 to 0.5 mm. high. Capillitium a dense network of fragile, angular, branching, white lime-knots with short connecting threads. Spores purplish brown, spinulose, with a paler, smoother area of dehiscence, 8-9 μ diam.

TYPE LOCALITY: Colorado.

HABITAT: On dead wood and twigs.

DISTRIBUTION: California, Colorado, *Montana, *Oregon, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 204.

Certain phases of *P. oblatum* or *Craterium leucocephalum* var. *scyphoides* may be confused with *P. carneum*, but the spores and short, pinkish stalks of the latter are characteristic. *P. citrinellum* is a larger form with usually prominent, double walls and stout stalks. A collection made by W. C. Blasdale, in California in 1893, is the present species. (N. Y. B. G. no. 5709.)

27. *Physarum brunneolum* (Phill.) Masee, Mon. 280. 1892.

Diderma brunneolum Phill. Grevillea 5: 114. 1877.

Plasmodium yellow (Lister). Sporangia globose to subglobose and slightly depressed, 0.6 to 1.7 mm. diam., stalked or sessile, rarely forming plasmodiocarps, gregarious, yellow-brown to brown, glossy; sporangial wall dehiscing in revolute lobes, or breaking up into fragments, consisting of two layers, the outer yellowish brown, cartilaginous, the inner membranous, enclosing abundant deposits of white lime-granules. Stalk firm, cylindrical, red-brown or nearly black, without lime, 0.1 to 0.4 mm. high. Capillitium a network of colorless threads with numerous, large, irregular, white lime-knots, combined occasionally to form a pseudo-columella. Spores purplish brown, spinulose, 8-10 μ diam.

TYPE LOCALITY: California.

HABITAT: On dead wood.

DISTRIBUTION: California, Colorado, *Montana.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 69.

This species is based upon a collection made by Harkness in California in 1877. It is rare, and has been collected infrequently

in various parts of the world. A collection made by Dr. E. Bethel in Colorado seems to be the form, although little but bases are left. A gathering by Dr. R. Thaxter, in Chile in 1906, is representative, and the spores measure 10–12 μ diam. Collections made by Prof. C. Torrend in Portugal, have sporangia much smaller than those of the Chile collection but the spores have the same size. A collection made by Gardner, in 1903, in California, is like the Portuguese specimens. Massee gave the spore size as 6–7 μ , perhaps an error.

28. **Physarum nucleatum** Rex, Proc. Acad. Nat. Sc. Phila. 1891: 389. 1891. (N. Y. B. G. no. 6441, type material.)

Plasmodium milk-white (Lister). Total height 1 to 2 mm. Sporangia gregarious, rarely clustered, globose, about 0.5 mm. diam., stalked, erect or inclined, white, rarely iridescent from absence of lime; sporangial wall membranous, with scattered included clusters of white lime-granules. Stalk subulate or nearly cylindrical, 0.5 to 1.5 mm. long, wrinkled, pale buff or yellow, rarely reddish yellow or streaked with red, translucent above, without lime, and enclosing refuse matter at the base. Capillitium a close, persistent network of very slender, colorless threads with minute, scattered, rounded, white lime-knots; in the center of the capillitium is usually a white, calcareous ball, 0.1 to 0.15 mm. diam., sometimes replaced by a cluster of irregular lime-knots, occasionally absent entirely. Spores pale brownish lilac, minutely spinulose, 6–7 μ diam.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On dead wood and leaves.

DISTRIBUTION: Florida, Indiana, *Iowa, *Maryland, New York, *Nicaragua, Ohio, *Oregon, Pennsylvania, Tennessee, Virginia, *Wisconsin.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 35.

This species forms small colonies. It resembles *P. globuliferum*, but may be distinguished by the semi-translucent stalk, and the absence of a columella. Usually, but not always, the central ball of lime is present. Var. *robustum* G. Lister (Jour. Bot. 64: 226. 1926) is somewhat intermediate with *P. psittacinum*. It has not been reported from North America.

29. **Physarum straminipes** Lister, Jour. Bot. 36: 163. 1898.
(N. Y. B. G. no. 10931, type material.)

Plasmodium milk-white (Lister). Sporangia obovoid or wedge-shaped, 0.7 mm. diam., grayish white, clustered or scattered, on long or short stalks, two or more often borne on a single stalk, or sessile and subglobose or irregularly ellipsoid; sporangial wall colorless or pale purple, membranous, rather firm, with dense, included clusters of lime-granules. Stalks straw-colored, translucent, often 2 mm. long, membranous or cartilaginous, flattened or filiform, free from refuse matter, often continued below into a strand-like hypothallus. Capillitium a persistent network of stout, hyaline threads, with expansions at the axils, and numerous white, rounded lime-knots, some of which often unite to form a pseudo-columella. Spores purplish brown, marked with broad patches of warts separated by smoother tracts, 10–11 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead leaves and straw.

DISTRIBUTION: *Oregon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 42.

30. **Physarum pusillum** (Berk. & Curt.) Lister, Mycetozoa ed. 2. 64. 1911.

Didymium pusillum Berk. & Curt.; Berk. Grevillea 2: 53. 1873.

Physarum calidris Lister, Jour. Bot. 29: 258. 1891.

Physarum gravidum Morg. Jour. Cin. Soc. Nat. Hist. 19: 24. 1896.

Plasmodium watery white (Lister). Total height 1 to 2 mm. Sporangia scattered or gregarious, stalked, erect or inclined, subglobose or lenticular, usually umbilicate beneath, rarely obovoid, 0.4 to 0.6 mm. diam., rugulose, white with a reddish base; sporangial wall membranous, colorless above, with clusters of included, white lime-granules, scanty or dense, thickened and rufous at the base. Stalk subulate or cylindrical, furrowed, 0.5 to 1.5 mm. long, red-brown, usually free from refuse matter. Capillitium a network of colorless, branching threads; lime-knots either few and small, or large, numerous, and branching, or *Badhamia*-like. Spores pale brownish lilac, almost smooth or marked with patches of minute warts, 8–11 μ diam.

TYPE LOCALITY: South Carolina.

HABITAT: On dead leaves, stems, twigs, and wood.

DISTRIBUTION: Common in the United States; Ontario, Puerto Rico, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 43.

The typical form is found in great abundance on composts and other piles of decaying vegetable matter, or manure. The small, delicate, somewhat flattened and umbilicate sporangia, on reddish stalks, have a superficial resemblance to *Didymium xanthopus*. The lime in the wall and capillitium is usually scanty, although occasionally denser. Intermediate forms, usually on wood, form a series approaching and ending in the one figured by Lister in the Monograph on *pl.* 43, *fig. c*, and formerly known as *P. calidris*. This is larger, more robust, with dense lime in the sporangial wall, and *Badhamia*-like lime in the capillitium. The shape of the sporangia is globose or obovoid, and not umbilicate beneath. It is practically the same as *P. oblatum* except for color.

The following, distributed in various exsiccatae, are forms of the present species: C. Roumeguère *no.* 4642 as *Tilmadoche nutans*; de Thümen *no.* 1498 as *Tilmadoche nutans*; J. B. Ellis, N. A. F. *no.* 614 as *Physarum leucophaeum*; H. W. Ravenel *no.* 478 as *Physarum leucophaeum*; H. W. Ravenel *no.* 479 as *Physarum nodulosum*. This applies to the specimens in the Herbarium of the New York Botanical Garden, but sometimes the material distributed in exsiccatae is not all alike.

31. *Physarum didermoides* (Pers.) Rost. Mon. 97. 1874.

Spumaria? didermoides Pers. Syn. Meth. Fung. xxix. 1801.

Plasmodium white (Lister). Total height 0.5 to 1.3 mm. Sporangia stalked, erect, and obovoid, ellipsoid, or cylindrical, about 0.8 mm. high, 0.5 mm. broad, or sessile and obovoid or subglobose, crowded, white, or dark gray above from falling away or discontinuance of the outer, calcareous crust; sporangial wall of three layers, the outer a dense deciduous deposit of white lime-granules, the middle layer a delicate, colorless membrane with scattered lime-granules, closely combined with an inner purplish, areolate, thicker layer. Stalk variable in length and thickness, white, membranous, not containing refuse matter and rarely enclosing lime-granules, rising from a plicate, white hypothallus. Capillitium consisting of numerous white, rounded lime-knots, connected by short, hyaline threads, which are purple at the attachments to the sporangial wall. Spores very dark purplish

brown, closely and minutely spinulose, 10–13 μ diam. (PLATE 7, FIG. 4.)

var. **lividum** Lister, Jour. Bot. **36**: 161. 1898. (N. Y. B. G. nos. 11089, 11090, authentic material.)

Differing from the type in the gray sporangia being always sessile, and having the sporangial wall usually of a single layer only; in the lime-knots being more angular; and in the rougher, purple-black spores being paler and smoother on one side.

TYPE LOCALITY: Europe. (Sweden?)

HABITAT: On dead wood, leaves, stems, and straw.

DISTRIBUTION: Common throughout North America.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 45, 46.

The large developments of white, crowded sporangia are often found on locust bark. The species is very variable, and the var. *lividum* can hardly be regarded as more than a combination of variations present in certain collections made in England. We have here sporangia with single or double walls, and either may have rounded or angular lime-knots. Spores paler on one side are unknown here, or at least I have never observed them. In my experience I have never found these variations separated and alone, but always as patches within a development of typical sporangia. The inner purplish wall may be absent, the capillitium unattached to the sporangial wall, or the lime aggregated into a dense mass in the center of the sporangium. Different combinations of these aberrations may be expected in any fruiting.

32. **Physarum pezizoideum** (Jungh.) Pav. & Lag. Bull. Soc. Myc. Fr. 19: 87. 1903. (N. Y. B. G. no. 11236, authentic material Pav. & Lag.)

Trichamphora pezizoidea Jungh. Fl. Crypt. Jav. 12. 1838.

Plasmodium grayish white (Lister). Total height 1 to 2.5 mm. Sporangia gregarious, erect or somewhat inclined, discoid or saucer-shaped, 0.8 to 1.3 mm. broad, 0.2 to 0.4 mm. thick, stalked, grayish white; sporangial wall membranous, with thin deposits of lime-granules evenly distributed, breaking up at maturity into areolae which remain attached to the capillitium after dispersal of the spores. Stalk subulate, longitudinally striate, reddish brown, translucent. Capillitium very variable, consisting either of branching, anastomosing, colorless threads,

with broad expansions at the axils and at the attachments to the sporangial wall, and either with or without fusiform lime-knots, or *Badhamia*-like and formed of membranous tubes filled with lime throughout. Spores dark or pale purplish brown, spinose, spinulose, or nearly smooth, 9–17 μ diam. (PLATE 7, FIG. 5.)

TYPE LOCALITY: Java.

HABITAT: On dead wood.

DISTRIBUTION: Florida, Puerto Rico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 72, as *Trichamphora pezizoidea*.

The description is that of the Listers covering the wide range of variation they have observed in their many years of study. There are no valid reasons for regarding this species as other than a *Physarum*. It is so close to *P. javanicum* that the latter might be united with it as a phase with paler stalks. Specimens from Puerto Rico are practically identical except for the stalks, which in *P. javanicum* are straw-colored, and reddish brown in *P. pezizoideum*. Specimens from Florida have dark, strongly spinose spores about 12 μ diam. The species is abundant in the tropics, but also occurs in the temperate zones. The specimen collected by Pavillard and Lagarde, at Montpellier, France, has medium colored, spinose spores 12 μ diam. Other specimens vary considerably in the color, size, and roughness of the spores, and in the capillitium.

33. *Physarum nutans* Pers. Ann. Bot. Usteri 15: 6. 1795.

Plasmodium watery white or yellowish gray (Lister). Total height 1 to 1.5 mm. Sporangia gregarious, erect or nodding, subglobose or lenticular, more or less flattened or concave beneath, 0.4 to 0.7 mm. broad, stalked, white, grayish white, or iridescent from absence of lime; sporangial wall membranous, with included white lime-granules in more or less dense clusters. Stalk subulate, longitudinally wrinkled, and gray, yellowish, olivaceous, or black, translucent above, sometimes opaque and white from deposits of lime in the wall, the tube of the stalk containing refuse matter. Capillitium of colorless slender threads, branching at acute angles and anastomosing, with few flat expansions at the axils, and few small, white lime-knots. Spores brownish violet, minutely spinulose or nearly smooth, 8–10 μ diam.

Var. **leucophaeum** (Fries) Lister, Mycetozoa 51. 1894.

Physarum leucophaeum Fries, Symb. Gast. 24. 1818; Macbr. & Martin, Myxomycetes 77. 1934.

Sporangia erect, 0.5 to 1 mm. diam., stalked, sessile or forming plasmodiocarps; stalks stouter; columella none, or occasionally present as an irregular or conical continuation of the stalk; capillitium with larger and often branching lime-knots; spores 9–11 μ diam.

Var. **robustum** Lister, Mycetozoa 51. 1894.

Sporangia erect, often forming plasmodiocarps; stalks gray or white from enclosed lime; capillitium more rigid with the central lime-knots often confluent to form a pseudo-columella.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 37, 38.

The typical form is quite distinct and easily recognized. It is connected with *P. viride* through var. *incanum* of that species which may be almost white except for pale yellow lime-knots. On the other side, *P. nutans* merges gradually into *P. notabile* through a long line of intermediate forms, some of which have been regarded as species at other times. The Listers have set out vars. *leucophaeum* and *robustum* as centers approaching *P. nutans*, and the arrangement is probably best for this series of confusing forms. The treatment by Macbride & Martin in the Myxomycetes is illogical. They recognize *P. leucophaeum* as a distinct species, and then apply var. *robustum* as a variety of *P. nutans*, although it is a more robust form and clearly intermediate between var. *leucophaeum* and *P. notabile*. Both varieties form sessile sporangia and plasmodiocarps which are not present in normal developments of the typical form. The spores of *P. nutans* and its varieties are usually smaller and paler than those of *P. notabile*, but there are colonies of the latter which have paler or smaller spores. The spores should be studied in mass as well as by transmitted light. There are many collections which cannot be placed definitely, although a knowledge of the field conditions will help, sometimes, to determine them. The species and its varieties produce small developments.

34. **Physarum javanicum** Racib. Hedwigia 37: 53. 1898.

Physarum discoidale Macbr. N. A. Slime-Moulds ed. 2. 74. 1922. (N. Y. B. G. no. 7701, type material?)

Plasmodium? Sporangia scattered, orbicular, flattened, convex, or obconical below, concave or umbilicate above, 0.6 to 0.8 mm. diam., 0.25 mm. thick, stalked, grayish white; sporangial wall membranous, with evenly distributed or clustered lime-granules, fragile and fugacious, often dehiscing by spreading lobes. Stalk subulate, slender, flexuose, 1.5 to 1.8 mm. high, white or pale straw-colored above, darker from included refuse matter below. Capillitium a lax network of slender threads with long, fusiform and branching, white lime-knots, or almost *Badhamia*-like, and consisting of a network of branching tubes filled with lime-granules and attached to the sporangial wall by straight, hyaline threads. Spores brownish or grayish lilac, nearly smooth, 9–10 μ diam.

TYPE LOCALITY: Java.

HABITAT: On dead wood, twigs, and grasses.

DISTRIBUTION: *California, Florida, Puerto Rico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 197.

This species resembles *P. pezizoideum*, but in the latter species the stalks are dark red. The description and figures of *P. discoidale*, from California, indicate this may be a form of *P. javanicum*, and an authentic specimen discloses nothing otherwise, except that the stalks are somewhat shorter than usual.

35. **Physarum crateriforme** Petch, Ann. R. Gard. Perad. 4: 304. 1909.

Plasmodium dull ochraceous (Lister). Sporangia scattered or in groups, cylindrical, obovoid, spherical, or reniform, sometimes depressed, stalked, with occasional plasmodiocarp forms, grayish white, rarely pale brown; sporangial wall membranous, with clustered deposits of white lime-granules. Stalk conical, black or black below and white above, opaque from included refuse matter, 0.1 to 0.7 mm. long. Columella variable in color and shape, white, yellowish brown, or black, cylindrical, and reaching to the apex of the sporangium, or ending below it and then clavate or shortly conical, sometimes absent. Lime-knots white or pale brown, either united to form a massive columella giving off horizontal, spike-like points which end in simple or forked hyaline

threads attached to the sporangial wall, or in the spherical sporangia branched, and forming an almost *Badhamia*-like network with few connecting threads. Spores dull lilac, closely spinulose, 10–13 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead wood, herbaceous stalks, or bark of living trees.

DISTRIBUTION: *Antigua, *Iowa.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 76.

This species is extremely variable, sometimes within the same development. In certain phases it closely resembles forms of *P. nutans* var. *leucophaeum*.

36. ***Physarum compressum*** Alb. & Schw. *Consp. Fung.* 97. 1805.

Physarum lepidoides Gilb.; Peck & Gilb. *Am. Jour. Bot.* 19: 133. 1932.

Plasmodium white (Lister). Sporangia scattered, obovoid or reniform, compressed, splitting at the ridge, stalked, erect, or sessile and subglobose, sometimes confluent in clusters or forming plasmodiocarps, white or gray, rugose or spotted with white; sporangial wall membranous, colorless or purplish below, with clusters of white lime-granules on the outside. Stalk when present, stout, long or short, furrowed, black from refuse matter, brownish, or white from included lime. Capillitium a close network with numerous small, usually rounded, white lime-knots, connected by short hyaline threads. Spores dark purplish brown, more or less faintly or strongly spinulose, 8–14 μ diam. (PLATE 8, FIG. 1.)

TYPE LOCALITY: Germany.

HABITAT: On leaves, twigs, and dead wood.

DISTRIBUTION: Widely distributed throughout North America, and not uncommon.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 39.

This rather common and variable species is particularly variable in the size, color, and roughness of the spores. As a rule, the spores are not as dark as those of European specimens, and are much like those of *P. notabile*, to which it is related. The spores sometimes have the spines arranged in patches with smooth tracts between, not as prominent as in *P. straminipes*, but sufficiently so to make the character of value in the case of obscure forms. The somewhat deciduous crust of lime on the walls of sessile sporangia and plasmodiocarps is also characteristic, and

resembles that of *P. didermoides*. This lime if wetted and dried again will form into vitreous plates or nodules, giving an appearance like that in *Lepidoderma*. This feature is also found in other species, as well as occasionally in the lime of the capillitium. The numerous lime-knots, usually small and rounded and with short connecting threads, form a somewhat persistent capillitium.

The foregoing distinguishing characters apply more to the sessile, subglobose sporangia and plasmodiocarps, rarely compressed, and usually developing on wood. The laterally compressed, stalked sporangia with firmer walls are usually on dead herbage or composts, and are easily recognized. From *P. cinereum* the sessile sporangia and plasmodiocarps are separated by the darker and larger spores. The spores of *P. compressum* resemble those of *P. vernum* Somm. with which the plasmodiocarps have been confused, but *P. vernum* is not known definitely from North America, and reports of its collection are doubtful. *P. vernum* forms large, massive sporangia and plasmodiocarps with thick, densely calcareous walls, the lime more evenly distributed. Besides, it develops on herbage, whereas similar appearing forms of *P. compressum* are found on wood. *P. lepidoidium* is probably a form of the present species with naturally rewetted lime. Such forms are found occasionally. The specimens referred to *P. vernum* (Mycologia 30: 351. 1938) are also phases of *P. compressum*, having scaly walls but small spores. *P. compressum* forms small developments in contrast with the large fruitings of *P. notabile* in the later months.

37. **Physarum notabile** Macbr. N. A. Slime-Moulds ed. 2. 80. 1922.

Didymium connatum Peck, Rept. N. Y. State Mus. 26: 74. 1874. (N. Y. B. G. nos. 7979, 7980, authentic material.)

Physarum tropicale(?) Macbr. N. A. Slime-Moulds 45. 1899.

Physarum connatum (Peck) Lister, Mycetozoa ed. 2. 71. 1911. Not *P. connatum* Ditm. 1817, nor *P. connatum* Schum. 1803.

Plasmodium white or gray (Lister). Sporangia scattered, free or connate, subglobose, turbinate or reniform, occasionally flattened above or beneath, 0.5 to 0.7 mm. diam., grayish white, stalked, or, forming subglobose, sessile sporangia, or plasmodiocarps, which may be clustered or angled by mutual pressure; sporangial wall membranous, with clustered deposits of lime-granules on the outside. Stalk stout, furrowed, dark brown, red-

brown, yellowish, or white, with either refuse matter or lime. Capillitium a network of hyaline threads with numerous small, usually angular, white lime-knots. Spores purple-brown, spinulose, 9–12 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant in the eastern United States; Colorado, Ontario, Quebec, and probably elsewhere in North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 40, *figs.* c–e, as *P. connatum*.

This species as described represents a center around which are innumerable forms differing in particulars of size, shape, stalk, lime and lime-knots, even to the size, color, and roughness of the spores. Usually the spores are not as dark in color as those of *P. compressum*, but the color is an unreliable character, as it is inconstant. In late September and in October, and in cottonwood areas, *P. notabile* appears in great abundance, covering almost every decaying log with large colonies. Single colonies may have stalked and sessile sporangia, plasmodiocarps, and all sorts of variations. It is advisable to study the species on such occasions in order to understand its relations to *P. compressum* and *P. nutans*, with each of which it is connected by intermediate forms. Developments in the earlier months of the season are much smaller, rarely more than two or three inches across, and are usually confined to a single phase. *P. notabile* is connected with *P. compressum* through the sessile sporangia and plasmodiocarps, but can be distinguished by the firmer appearance and angular lime-knots. The sporangia and plasmodiocarps of *P. compressum* have crusty walls and rounded lime-knots. The approach to *P. nutans* is through vars. *robustum* and *leucophaeum* of the latter species. These latter are also centers and variable, but generally show some resemblance to *P. nutans*, and usually have paler spores than *P. notabile*. Flattened phases of *P. notabile*, when sessile, may look like *Badhamia affinis*. The sporangia may also resemble *Badhamia panicea*, if sessile, with a *Badhamia*-like capillitium, and a pseudo-columella, which is present sometimes. Altogether, the species is a difficult one, and requires considerable study of much material in order to understand it, and particularly in the line approaching *P. nutans*. There are specimens which it is impossible to place definitely, as in many instances there are

no sharp distinctions. *P. tropicale* is regarded by Lister as a form of the present species.

38. **Physarum megalosporum** Macbr. N. A. Slime-Moulds ed. 2. 63. 1922.

Physarum melanospermum Sturg. Mycologia 9: 323. 1917. (N. Y. B. G. no. 12805, type.) Not *P. melanospermum* Pers. 1794.

Plasmodium? Sporangia stalked, gregarious, turbinate or discoid, usually umbilicate above, 0.4 to 0.7 mm. diam., grayish white, rugulose; sporangial wall membranous, with abundant deposits of white lime-granules, occasionally brown and charged with refuse matter toward the base. Stalk stout, black or sometimes grayish, furrowed, 0.1 to 0.3 mm. long. Capillitium consisting of numerous white, angular, branching lime-knots connected by short, hyaline threads. Spores dark, brownish purple, minutely and closely spinulose, with a pale, nearly smooth germinal spot, 12.5–16 μ diam. (PLATE 2, FIGS. 1–3.)

TYPE LOCALITY: Colorado.

HABITAT: On dead leaves and twigs.

DISTRIBUTION: Colorado, Iowa, Kansas.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 201, as *P. melanospermum*.

This well-marked species resembles somewhat *Badhamia affinis* var. *orbiculata* when stalked, but may be distinguished by the character of the capillitium, the usually larger and darker spores, and the pale areas on the spores. Curiously enough, it is occasionally associated with *Didymium Clavus*, which it also resembles superficially.

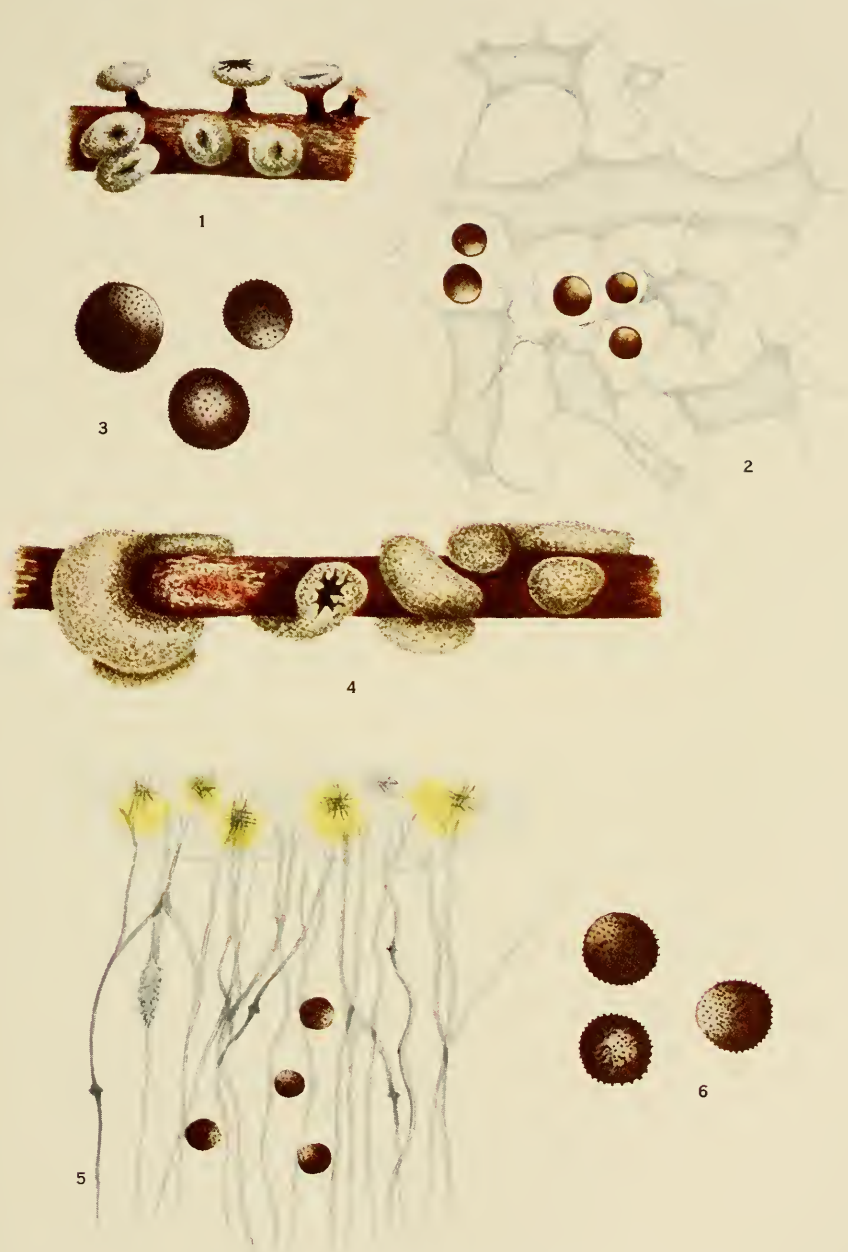
39. **Physarum reniforme** (Masse) Lister, Mycetozoa ed. 2. 72. 1911.

Tilmadoche reniformis Masee, Mon. 336. 1892.

Physarum nicaraguense Macbr. Bull. Nat. Hist. S. U. Iowa 2: 382. 1893.

Badhamia cinerascens Martin, Jour. Wash. Acad. Sc. 22: 88. 1932.

Plasmodium? Sporangia scattered or clustered, stalked or almost sessile, reniform, obconic, bolster-shaped, or lobed, usually compressed, 0.4 to 0.9 mm. diam., often confluent in clusters of from three to forty or more, grayish white; sporangial wall membranous, with clusters of lime-granules. Stalk wrinkled, variable in color, either pale yellow, yellowish brown, or fuscous, usually



1-3. *PHYSARUM MEGALOSPORUM*
4-6. *DIDYMIUM FULVUM*

slender and flexuose, 0.3 to 1 mm. long, enclosing refuse matter at the base. Capillitium with short, hyaline threads connecting numerous, angular lime-knots, which often unite to form a pseudocolumella, sometimes almost *Badhamia*-like. Spores brownish purple, either faintly or strongly spinulose, often faceted with patches of spinules or warts, 9–15 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead wood and bark.

DISTRIBUTION: Costa Rica, Nicaragua, *Pennsylvania, Puerto Rico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 41.

This species is somewhat related to *P. compressum*. An examination of the type specimen of *Badhamia cinerascens* in the United States National Herbarium indicates that this is a poorly developed form of the present species.

40. **Physarum cinereum** (Batsch) Pers. Neues Mag. Bot. 1: 89. 1794.

Lycoperdon cinereum Batsch, Elench. Fung. 155. 1783.

Didymium oxalinum Peck, Rept. N. Y. State Mus. 28: 54. 1876. (N. Y. B. G. no. 7976, type material.)

Physarum sessile Brândză, Bull. Soc. Myc. Fr. 44: 260. 1928. (N. Y. B. G. nos. 10002, 10036, authentic material.)

Plasmodium watery white or yellow (Lister). Sporangia sessile, subglobose, or pulvinate, heaped, crowded, or scattered, often forming simple or branched plasmodiocarps, 0.3 to 0.5 mm. broad, cinereous, more or less warted or veined with white; sporangial wall membranous, with included clusters of white lime-granules, often limeless and iridescent. Capillitium of branching hyaline threads, with numerous, rounded or angular, white lime-knots, varying in size, sometimes consisting of a *Badhamia*-like network with few hyaline threads. Spores brownish lilac, almost smooth or spinulose, 7–10 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves and ground debris.

DISTRIBUTION: Common everywhere in North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 47.

The species is extremely variable in all characters. The size of the spores as given is approximate for most of the collections, but may be larger, and the color varies in different gatherings. The lime in the capillitium may be dense and massed in the cen-

ter, scanty, or lacking entirely. When the sporangia have little lime, and are clustered besides, it is often difficult to distinguish them from *P. confertum*, but the latter species often has irregularly ovoid sporangia, which helps somewhat. *P. vernum* Somm., which has not yet been found in North America, is related to *P. cinereum*. It forms robust sporangia and large, long, plasmodiocarps, with thick walls densely charged with lime, and has darker spores. There are phases of *P. cinereum* with larger and darker spores, but I have seen none from North America that have the massive sporangia and plasmodiocarps of *P. vernum*. *P. sessile*, as separated by Brândză from a yellow form, is a phase of *P. cinereum*.

41. **Physarum confertum** Macbr. N. A. Slime-Moulds ed. 2. 64. 1922.

Plasmodium yellow or white (Lister). Sporangia subglobose or irregularly obovoid, 0.2 to 0.4 mm. diam., sessile, confluent, clustered, or heaped, dull violet-brown or dark gray, often veined with white or sprinkled with white spots; sporangial wall membranous, pale purplish, with scanty deposits of lime. Capillitium a sparse network of hyaline threads with small, angular or branching, white lime-knots, often limeless. Spores pale brownish violet, minutely warted, 10–13 μ diam.

TYPE LOCALITY: North America.

HABITAT: On dead leaves and wood.

DISTRIBUTION: Maine, Massachusetts, New Brunswick, New Hampshire, New York, Ontario, Pennsylvania, Quebec, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 64.

This species is practically identical in appearance with *P. virescens*, only in the latter, the color is yellow or greenish yellow. It is closely related to *P. cinereum*, but the small sporangia are always heaped in numerous, little clusters. The spores are usually paler and larger than those of *P. cinereum*, and the lime in the capillitium is scanty, although gatherings with more lime and darker spores are not uncommon. The wall is often entirely limeless, but this is rather a result than a character. The lime is formed on the outside of the wall, and if development takes place in moist places or during wet weather, it may be washed off, so that the sporangia may appear almost black, and more or less imperfectly developed.

42. *Physarum ovisporum* G. Lister, Jour. Bot. 59: 90. 1921.

Plasmodium white (G. Lister). Sporangia scattered, sessile, pulvinate, 0.5 to 0.8 mm. diam., or forming straight, curved or irregular plasmodiocarps, white; sporangial wall roughened with deposits of lime-granules, often with smoother areas where the lime is scanty. Capillitium of numerous, white, rounded or angular lime-knots, varying in size, connected by short hyaline threads. Spores purplish brown, either globose, 9–11 μ diam., or ovoid, 10 \times 12 to 13 μ , minutely warted, often with a pale, smooth line of dehiscence.

TYPE LOCALITY: England.

HABITAT: On dead leaves, twigs, and ground wood.

DISTRIBUTION: Kansas, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 202, *figs.* a–c.

This appears to be a center for forms similar to *P. cinereum*, but with spores somewhat darker and ovoid in shape. Globose and ovoid spores are present together in the sporangia. Collections made by Mr. Travis E. Brooks, in Kansas, are typical, with rounded lime-knots as described by Miss Lister for the English gatherings. On Long Island, New York, I have found repeatedly similar forms with ovoid spores and a pale, smooth dehiscence line, but these have angular lime in the capillitium. The manifest character is in the spores, and variations in the capillitium must be expected as in *P. cinereum*.

43. *Physarum superbum* Hagelstein, Mycologia 32: 385. 1940.

Physarum variabile Rex var. *sessile* Lister, Mycetozoa ed. 2. 47, in part; *pl.* 22, *fig. a*, non *b.* 1911. (N. Y. B. G. no. 11027, type material.)

Physarum sessile Brândză, Ann. Sc. Univ. Jassy 11: 116, in part? 1921; Lister, Mycetozoa ed. 3. 55, in part; *pl.* 22, *fig. a*, non *b.* 1925.

Physarum aureum(?) Brândză, Bull. Soc. Myc. Fr. 44: 261. 1928. Not *P. aureum* Pers. 1794.

Plasmodium? Fructification mainly in simple, sinuous, branched, netted or annular plasmodiocarps up to 12 mm. in length, more or less laterally compressed and on broad bases, yellow to orange-red, and with cylindrical, clavate or laterally compressed sporangia intermingled; sporangial wall with heavy deposits of yellow or orange-red lime-granules, often unevenly distributed or scanty in the lower part, and presenting a mottled appearance. Capillitium of numerous, angular or branching,

white or pale yellow lime-knots, sometimes densely massed in the middle, and connected by short threads. Spores brownish lilac, minutely and evenly spinulose, 7–8.5 μ diam. (PLATE 8, FIG. 2.)

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On dead leaves.

DISTRIBUTION: Florida, Kansas, New Jersey, New York, North Carolina, Ontario, Pennsylvania, Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 22, *fig.* a, as *P. sessile*.

On the Lister plate cited, *fig.* b represents a form now regarded as *P. sulphureum* var. *sessile*, and entirely different from *P. superbum*. *P. sessile* was described originally by Brândză to include two different forms, a white one, and a yellow one. Later, Brândză proposed the name *P. aureum* for the yellow form separated from *P. sessile*, describing it with spores 10–12 μ diam., and figuring cylindrical plasmodiocarps. Whether or not *P. aureum* Brândză is the same as *P. superbum* is unknown here, but the name is untenable as it was used by Persoon (Roemer, N. Mag. Bot. 1: 88. 1794) for a form now regarded as synonymous with *P. viride* (Bull.) Pers. The white form retained by Brândză as *P. sessile* is a phase of *P. cinereum* as indicated by specimens in the Herbarium of the New York Botanical Garden.

P. superbum is a handsome form, rich in colors when perfectly matured. It is well distributed in North America, and probably not rare.

44. *Physarum gyrosum* Rost. Mon. 111, in part. 1874.

Plasmodium white or yellowish. Sporangia sessile, much compressed, confluent, clustered, and forming rosettes 1 to 4 mm. diam., pinkish gray, usually attached by strands to a dull red hypothallus; sporangial wall membranous, with clustered deposits of white or reddish lime-granules. Capillitium a scanty network of hyaline threads with numerous, large, white, transversely placed, fusiform or irregular lime-knots. Spores pale brownish violet, minutely spinulose, 7–10 μ diam. (PLATE 8, FIG. 3.)

TYPE LOCALITY: Europe.

HABITAT: On decaying ground material, composts, etc.

DISTRIBUTION: Florida, Indiana, *Iowa, Kansas, Louisiana, Mississippi, New York, Pennsylvania, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 52.

This species forms large colonies of many small clusters spreading over a wide area on piles of decaying vegetation. It connects the genera *Fuligo* and *Physarum*, being intermediate between *F. septica* and *P. polycephalum*, and is often associated with the latter species on the same habitat. Other forms of an aethalioid nature, small and solitary, and on other habitats like stumps, twigs, and dry leaves, are found occasionally. They have a labyrinthine structure, but it is continuous, and not broken into small, uniform clusters. They have often been regarded as plasmodiocarps of *P. gyrosum*, and while they appear to connect it with *F. septica*, the habit is aethalioid, and they belong with *F. septica* as mentioned under that species. Without their inclusion, *P. gyrosum* is a sharply defined form, but may at times form something like plasmodiocarps by the confluence of many rosettes, and associated with the separated ones.

45. *Physarum Famintzini* Rost. Mon. 107. 1874.

Physarum Gulielmae Penzig, Myx. Buit. 34. 1898; Lister, Mycetoza ed. 2. 76. 1911.

Plasmodium orange (Lister). Sporangia subglobose or reniform, sessile, about 0.4 mm. diam., brownish orange or chestnut-brown, rugulose, clustered or heaped, with a colorless or yellow, membranous hypothallus; sporangial wall stout, somewhat cartilaginous, with abundant clustered deposits of brownish yellow lime-granules. Capillitium an elastic, expanding network of hyaline threads, with large, white, angular or branching lime-knots, sometimes forming a pseudo-columella. Spores purplish brown, spinulose, 10–12 μ diam.

TYPE LOCALITY: Poland.

HABITAT: On herbaceous stems, twigs, etc.

DISTRIBUTION: *Maryland.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 63.

The characteristic feature of the closely clustered sporangia is the elastic capillitium which expands at maturity to twice the height of the sporangium. The only North American record is by Macbride & Martin (Myxomycetes 52. 1934) and based on five sporangia among the sporangia of *Didymium squamulosum* on a specimen in the United States National Herbarium. The authors, in their description of the species, do not mention the unusual capillitium, which is otherwise unknown in the genus.

46. **Physarum echinosporum** Lister, Jour. Bot. **37**: 147. 1899.

Plasmodium? Sporangia scattered, forming chalk-white, usually curved plasmodiocarps, strongly compressed laterally, dehiscing along the thin upper ridge; sporangial wall of two layers, the outer smooth, eggshell-like, charged with minute lime-granules, separating from the inner membranous, iridescent, pale purplish layer. Capillitium consisting of numerous smooth white lime-knots, irregular in shape and size, connected by short hyaline threads. Spores purple, marked with strong ridges and spines, $8\ \mu$ diam.

TYPE LOCALITY: Antigua.

HABITAT: On dead leaves.

DISTRIBUTION: *Known only from the type locality.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 53.

47. **Physarum bivalve** Pers. Ann. Bot. Usteri **15**: 5. 1795.

Reticularia sinuosa Bull. Herb. Fr. *pl.* 446, *fig.* 3. 1789; Bull. Champ. 94. 1791.

Physarum sinuosum (Bull.) Weinm.; Fries, Syst. Myc. **3**: 145. 1829. Not *P. sinuosum* Link. 1809.

Plasmodium white (Lister). Sporangia scattered, sessile with a contracted base, or forming elongate, sinuous, or branching plasmodiocarps, laterally compressed with parallel sides, the upper ridge flattened and finally splitting longitudinally, white, gray, or yellowish; sporangial wall double, the outer layer with more or less dense deposits of lime, smooth or reticulate, the inner layer wrinkled and colorless, membranous, usually adhering to the outer layer. Capillitium consisting of numerous white, often branching, large or small lime-knots connected by rather short hyaline threads. Spores violet-brown, spinulose, 8–10 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves and ground matter.

DISTRIBUTION: Common everywhere in North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 49, as *P. sinuosum*.

This species usually forms sporangia and plasmodiocarps in the same development. It reflects in a marked degree the abundance or scarcity of lime in the habitat. In limestone regions, the outer wall may be white, densely encrusted with lime; and with little lime in the soil, it may be dark and almost limeless.

The species is easily recognized by the parallel walls dehiscing along the ridge. Sometimes the species forms rounded plasmodiocarps like *P. bitectum*, but the latter has larger and smoother lime-knots, and larger and darker spores. Yellowish or yellowish brown forms approach *P. bogoriense* and are sometimes difficult to separate if the manner of dehiscence is obscure.

48. **Physarum bogoriense** Racib. *Hedwigia* 37: 52. 1898.

Plasmodium? Sporangia scattered or gregarious, sessile on a narrow base, subglobose, ovoid and angular at the top, or forming flexuose plasmodiocarps, reddish brown, yellow, or nearly white; sporangial wall of two layers, the outer smooth, white on the inside, charged with white lime-granules, usually marked with pale lines of dehiscence, and breaking away in reflexed lobes from the inner, persistent, membranous wall. Capillitium of numerous white, smooth-walled, rounded or branching lime-knots, small or large, connected by hyaline threads. Spores violet-brown, spinulose, 8–10 μ diam.

TYPE LOCALITY: Java.

HABITAT: On dead leaves and ground matter.

DISTRIBUTION: Antigua, *California, *Canal Zone, Colorado, Florida, Louisiana, New York, North Carolina, Ontario, Pennsylvania, Puerto Rico, Quebec, *Saint Croix, South Carolina, Virginia.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 50.

When prominent, the manner of dehiscence by reflexed lobes is characteristic of this species. It may be otherwise, longitudinally along the sharp, upper edges of the plasmodiocarps, the sides separating from the inner walls. The spores and lime-knots are similar to those of *P. bivalve*, but the lime-knots are smooth.

49. **Physarum bitectum** Lister, *Mycetozoa* ed. 2. 78. 1911.

Physarum Diderma Lister, *Jour. Bot.* 29: 260. 1891. (N. Y. B. G. nos. 11813, 11816, authentic material.) Not *P. Diderma* Rost. 1874.

Plasmodium white (Lister). Sporangia scattered, sessile, subglobose or obovoid, 0.6 to 0.8 mm. diam., or forming curved or flexuose plasmodiocarps 2 to 6 mm. long, rounded or slightly compressed laterally, smooth, white or buff, sometimes purplish brown below from absence of lime, or entirely limeless; sporangial

wall double, the outer densely charged with white lime-granules, free and deciduous above, recurved and persistent below; inner wall smooth, membranous, pale purplish, more persistent. Capillitium a network of hyaline threads, with many variously shaped, large, smooth-walled, white lime-knots. Spores 10–12 μ diam., dark purplish brown, spinulose, often with a paler, smoother area of dehiscence.

TYPE LOCALITY: England.

HABITAT: On dead leaves and twigs.

DISTRIBUTION: California, Colorado, Kansas, *Montana, *Ohio, Oregon, *Puerto Rico, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 51.

This species is related to *P. bivalve*, associated therewith occasionally, and connected by intermediate forms. Some of these have the external appearance of *P. bitectum*, but the lime-knots and spores of *P. bivalve*. In doubtful examples, where the inner wall is not clearly recognizable, the lime-knots and spores are the deciding characters.

50. **Physarum testaceum** Sturg. Colo. Coll. Pub. Sc. Ser. 12: 18. 1907. (N. Y. B. G. no. 11812, cotype.)

Physarum Diderma Macbr. N. A. Slime-Moulds 30. 1899. Not *P. Diderma* Rost. 1874.

Plasmodium? Sporangia sessile, subglobose, clustered and polygonal from mutual pressure, 0.7 mm. diam., white; outer sporangial wall white, eggshell-like, separating from the membranous and colorless inner wall. Capillitium consisting of numerous large and small, angular, branching, white lime-knots, connected by short, hyaline threads. Spores purplish brown or grayish purple, spinulose, distinctly darker and more spinulose on one side, 8–10 μ diam.

TYPE LOCALITY: Colorado.

HABITAT: On dead wood; not rare.

DISTRIBUTION: Colorado, *Iowa, Maine, *Michigan, *Montana, New Hampshire, New York, Ohio, Ontario, *Oregon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 54.

This species is widely distributed in North America and not rare. The white, shell-like, outer wall is a conspicuous feature. Occasionally, the sporangia have a large, hollow columella, noticed in specimens from Colorado and Ontario.

51. **Physarum contextum** Pers. Syn. Meth. Fung. 168. 1801.

Diderma flavidum Peck, Rept. N. Y. State Mus. 28: 54. 1876. (N. Y. B. G. no. 11798, type material.)

Physarum Mortoni Macbr. N. A. Slime-Moulds ed. 2. 58. 1922.

Plasmodium yellow (Lister). Sporangia sessile, subglobose or obovoid, 0.4 to 0.6 mm. diam., or reniform and elongate on a broad base, free or more often crowded in colonies, often angled by mutual pressure, rounded above or flattened, smooth and yellow, ochraceous, or white; sporangial wall double, the outer layer thick with dense deposits of lime, often breaking away in the upper part from the thin, colorless, inner layer. Capillitium with scanty hyaline threads and numerous large, irregularly branching, white or yellowish lime-knots, occasionally densely massed in the middle. Spores dark violet-brown, spinulose, 10–13 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves, twigs, mosses, and wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 55.

This species is variable in the manner of sporangial formation. Usually, the sporangia are densely compacted in small clusters, but may be perfectly free and sometimes with vestiges of short stalks. The walls may be uniformly dense with lime, and the tops confluent, appearing as a pseudo-aethalium, or, the lower parts only may be stout, persisting as distinct cups. These variations appear in different clusters of the same large development. *P. Mortoni* is one of these phases, and unworthy even of varietal rank. Similar conditions are present in many other species. The color of the spores of *P. contextum* ranges from dark to light purplish brown, and the spines, often prominent, may be much fainter, and scattered, or arranged irregularly with smooth areas between.

52. **Physarum conglomeratum** Rost. Mon. 108. 1874.

Plasmodium? The description of *Physarum contextum* applies to this species in general except that the spores are pale violet-brown, almost smooth, 8–10 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On habitats similar to those of *P. contextum*.

DISTRIBUTION: *Antigua, *Louisiana, *Pennsylvania, Quebec, *Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 56.

Lister mentions that the inner layer of the convex upper wall has translucent, pale yellow, curved, thickened areas with a vitreous fracture. I have never seen this character in European specimens, and doubt that it is a constant one. The species is distinguished from *P. contextum* essentially by the spore characters alone. These are somewhat variable in *P. contextum*, and any one of them may be present, but I have not observed the combination of small, pale, almost smooth spores in any collection from North America or Europe. The specimen personally collected in Quebec (N. Y. B. G. no. 4502) has extremely pale and almost smooth spores, but the size is 10–13 μ diam. *P. contextum* is abundant in eastern North America and I have found it frequently. It may be that *P. conglomeratum* does not occur in North America, or that it is no more than a phase of *P. contextum*. The specimen in the Herbarium of the New York Botanical Garden collected by the Rev. A. B. Langlois at St. Martinville, Louisiana, and distributed by Ellis and Everhart as *P. conglomeratum* (Fungi Columbiana no. 1396) is not that species, but typical *Physarum bogoriense*.

53. **Physarum Serpula** Morg. Jour. Cin. Soc. Nat. Hist. 19: 29. 1896. (N. Y. B. G. No. 11587, authentic material.)

Plasmodium greenish yellow to yellow (Lister). Sporangia sessile, subglobose, or forming long, straight, flexuose, branched or ring-shaped plasmodiocarps, 0.3 mm. diam., yellow or ochraceous; sporangial wall membranous, with dense, evenly distributed deposits of yellow lime-granules. Capillitium of numerous, angular and branching, pale yellow or white lime-knots, connected by short and scanty hyaline threads. Spores purplish brown, spinulose, with a paler and smoother area of dehiscence, 10–12 μ diam.

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead leaves, twigs, and sticks.

DISTRIBUTION: Florida, Indiana, *Iowa, Massachusetts, *Nebraska, New York, North Carolina, Ohio, Ontario, Pennsylvania, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 57.

From *Badhamia decipiens*, which it often resembles in appearance, capillitium and spores, it may be distinguished by the even distribution of the lime in the wall. In *B. decipiens* this is uneven, making the wall rugulose and veined. The latter is also a stouter

form. *P. Serpula* is sometimes difficult to distinguish from *P. sulphureum* var. *sessile*, but the plasmodiocarps of *P. Serpula* are usually longer, narrower, and brighter in color.

54. **Physarum aeneum** (Lister) R. E. Fries, Arkiv Bot. 1: 62. 1903.

Physarum murinum Lister var. *aeneum* Lister, Jour. Bot. 36: 117. 1898.

Plasmodium? Sporangia sessile, subglobose, or forming straight or curved, simple, branched or netted plasmodiocarps, 0.3 to 0.4 mm. diam., brown, yellowish brown, or bronze colored, glossy; sporangial wall of two layers, the outer cartilaginous, brown, brittle with deposits of lime-granules, separating and folding back above from the shining or iridescent, membranous, inner wall. Capillitium a network of hyaline threads with numerous, small, rounded or angular, dark or pale brown lime-knots, occasionally uniting to form a pseudo-columella. Spores pale brownish lilac, nearly smooth, 6–10 μ diam.

TYPE LOCALITY: Dominica.

HABITAT: On dead leaves, twigs, etc.

DISTRIBUTION: Kansas, Louisiana, New York, Virginia, *West Indies.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 58.

This species is the only *Physarum* regularly forming plasmodiocarps and with brown lime in the capillitium.

55. **Physarum rubiginosum** Fries, Symb. Gast. 21. 1818.

Plasmodium orange-red (Lister). Sporangia sessile, gregarious or clustered, subglobose, 0.5 to 1 mm. diam., smooth or rugulose, and scarlet, red, or brown; sporangial wall membranous, with dense included clusters of red or orange lime-granules. Capillitium an abundant network of hyaline threads with frequent triangular expansions at the axils, and large, angular, branching, red or brown lime-knots, occasionally white and only partially colored. Spores pale violet-brown, minutely spinulose, 8–11 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood and mosses.

DISTRIBUTION: Colorado, Florida, Iowa, Maine, *New Hampshire, New Jersey, New York, *Ohio, *Ontario, *Pennsylvania, Quebec, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 59.

This species forms small developments and is not common. From *P. lateritium* it is distinguished by the larger sporangia, the smoother walls, and the coarse, angular lime-knots.

56. **Physarum auriscalpium** Cooke, Ann. Lyc. Nat. Hist. N. Y. 11: 384. 1877.

Plasmodium? Sporangia gregarious or clustered and angled by mutual pressure, sessile, rarely with traces of short stalks, circular to irregular shapes, pulvinate or depressed, 0.5 to 1.2 mm. diam., or forming short, curved or straight plasmodiocarps, mottled with brown, red, yellow, or white, with a dark red or brown inner base; sporangial wall membranous, firmer and persistent below, yellow, speckled on the outside with large, separated, clusters of reddish, yellowish, or white lime-granules. Capillitium consisting of many large, angular, branched, or netted lime-knots, yellow, pale yellow, or nearly white, rarely tinged with red, connected by long or short hyaline threads. Spores violet-brown, spinulose, 9–12 μ diam.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Kansas, Maine, New Jersey, New York, Ohio, Ontario, Pennsylvania, *South Carolina.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 33.

This species forms small, solitary colonies, and is not rare, as is indicated by 30 collections from the States mentioned. It is a sessile form, practically, rarely with traces of stalks, which may be regarded as obsolete. *P. oblatum*, which the Listers regard as synonymous with *P. auriscalpium*, sometimes forms sessile sporangia, or sporangia with short stalks, but the sporangia are not flattened nor mottled. The speckled appearance of the sporangia of *P. auriscalpium*, due to the vari-colored clusters of lime-granules on the outside of the wall, distinguish it from every related species of *Physarum* except *P. Braunianum*. The form is constant in the important characters given, which make it so different that it cannot logically be combined with *P. oblatum*. Some yellow phases have at times been regarded by students as *Badhamia decipiens*, but it is not a *Badhamia*, and, while the capillitium may appear *Badhamia*-like occasionally, there are always short threads present, and when the lime-knots are

smaller, the threads are long and clearly physaroid. There is still uncertainty whether the name *P. auriscalpium* represents the form as described here, or a phase of the later proposed *P. oblatum*. If the final judgment is to abandon the name *P. oblatum*, a new name must be applied to the present form.

57. **Physarum Braunianum** de Bary; Rost. Mon. 105. 1874.

Physarum Braunianum de Bary; Lister, Mycetozoa 63. 1894.

Physarum lateritium (Berk. & Rav.) Morg.; Lister, Mycetozoa ed. 2. 82, in part; *pl. 61, fig. d.* 1911.

Plasmodium? Sporangia sessile, subglobose, occasionally elongate, 0.3 to 0.5 mm. diam., scattered or clustered but not heaped, not rugose, brown or reddish brown speckled with many pale spots, sometimes without lime and then uniformly purplish brown; sporangial wall membranous, yellow, with separated included clusters of white or pale yellow lime-granules, often streaked with red. Capillitium a network of hyaline threads with numerous small, angular or branching, white, yellowish, or brownish lime-knots. Spores violet-brown, spinulose, 8–10 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead leaves.

DISTRIBUTION: Florida, Maine, Massachusetts, New Hampshire, New York, Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 61, fig. d.*, as *P. lateritium*.

This species forms small colonies and is not rare in the eastern United States. From *P. lateritium* it is distinguished by the smaller sporangia and absence of plasmodiocarps; the different wall and color; and the angular lime-knots. The sporangia are much smaller and more rounded than those of *P. auriscalpium*, the appearance is brown with pale spots, the wall does not have the clusters on the outside, and the lime-knots are small.

58. **Physarum lateritium** (Berk. & Rav.) Morg. Jour. Cin. Soc. Nat. Hist. 19: 23. 1896.

Didymium lateritium Berk. & Rav.; Berk. Grevillea 2: 65. 1873. (N. Y. B. G. no. 11566, type material.)

Physarum inaequale Peck, Rept. N. Y. State Mus. 31: 40. 1879. (N. Y. B. G. no. 7987, type material.)

Plasmodium orange-yellow (Lister). Sporangia gregarious, rarely clustered, sessile, subglobose, 0.3 to 0.7 mm. diam., or forming short terete plasmodiocarps, rarely branched or netted, scarlet or orange-red; sporangial wall an outer crust of compacted scarlet or yellow lime-granules, lightly affixed, separating and breaking away in flakes from the inner, membranous wall. Capillitium a network of slender, colorless or pale yellow threads, with rounded lime-knots, orange or yellowish, usually with red centers. Spores pale brownish lilac, 7–9 μ diam., almost smooth.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood and leaves.

DISTRIBUTION: Widely distributed and common in the United States and Canada.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 60.

This species forms small, solitary colonies. As described and restricted, it is remarkably constant in characters with hardly any obscure forms. From *P. rubiginosum* it is distinguished by the smaller, rounded lime-knots, usually with red centers, and the flaky wall.

59. *Physarum luteolum* Peck, Rept. N. Y. State Mus. 30: 50. 1878.

Physarum virescens Ditm. var. *nitens* Lister, Mycetoza 59. 1894.

Plasmodium? Sporangia gregarious or clustered but not heaped, sessile, subglobose, 0.4 to 0.8 mm. diam., rugulose, rarely smooth, bright yellow; sporangial wall membranous, with included yellow lime-granules. Capillitium a network of hyaline threads with numerous small, yellow, angular or branching lime-knots. Spores pale lilac, minutely spinulose, 8.5–11 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead leaves.

DISTRIBUTION: Colorado, *Iowa, Massachusetts, New Hampshire, New Jersey, New York, Ontario, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 62, *figs. a-c*, as *P. virescens* var. *nitens*.

This species forms small, solitary colonies in dry places, and is not rare. It is not heaped like *P. virescens*, although occasionally clustered, and is much larger with a brighter color. Its general appearance is more like *P. cinereum*, except that it is yellow.

60. *Physarum virescens* Ditm. in Sturm, Deutsch. Fl. Pilze 1: 123. 1817.

Plasmodium lemon-yellow (Lister). Sporangia irregularly obovoid or ellipsoid, 0.2 to 0.4 mm. diam., sessile, heaped and superimposed in small clusters, rugose, yellow or greenish yellow; sporangial wall membranous, with dense included clusters of yellow lime-granules, rarely without lime. Capillitium a network of hyaline threads with fusiform or irregular, yellow lime-knots. Spores pale violet-brown, minutely spinulose, 7–10 μ diam. (PLATE 8, FIG. 4.)

TYPE LOCALITY: Germany.

HABITAT: On dead leaves, mosses, and twigs.

DISTRIBUTION: Common and abundant in the United States and Canada.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 61, figs. a–c.

As described, this species is restricted to the small, heaped, yellow or greenish yellow sporangia of irregular shape. Var. *nitens* Lister, regarded here as synonymous with *P. luteolum*, is a much larger form which is never heaped or superimposed, and with a bright yellow color. Var. *obscurum* Lister, as the name implies, covers certain obscure forms, rarely found, which probably belong with related species but cannot be placed accurately. As a rule they have some aspects of imperfect or abnormal development, such as lack of lime, hardening, or otherwise. *P. virescens* forms many developments of numerous clusters at one time in wet places.

61. *Physarum digitatum* G. Lister & Farquh.; G. Lister, Jour. Bot. 54: 128. 1916.

Physarum thejoteum Morg. Jour. Cin. Soc. Nat. Hist. 19: 22. 1896. Not *P. thejoteum* Fries. 1818.

Physarum instratum Macbr. N. A. Slime-Moulds ed. 2. 62. 1922.

Plasmodium grayish yellow (Lister). Sporangia closely clustered, sessile, and subglobose, obovoid, or ellipsoid, simple or branched and irregularly lobed, 0.2 to 0.4 mm. diam., tawny yellow or light brown, roughened, seated on a membranous hypothallus; sporangial wall membranous, with abundant deposits of pale yellowish brown lime-granules. Capillitium a network of hyaline threads with fusiform or angular, pale yellowish brown lime-knots, which may unite to form a pseudo-columella. Spores

pale violet-gray, 5–6 μ diam., marked with three to five small, scattered clusters of minute warts on the hemisphere.

TYPE LOCALITY: South Nigeria.

HABITAT: On dead wood.

DISTRIBUTION: *Illinois, Iowa, Maryland, *Missouri, *Nebraska, *Ohio, Pennsylvania, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 203.

This species has been reported frequently from the western states, but seems to be rare along the Atlantic seaboard. It differs from *Physarum virescens* in color, habit, and habitat.

62. **Physarum alpinum** G. Lister, Jour. Bot. **48**: 73. 1910.
(N. Y. B. G. no. 5494, type material.)

Physarum virescens Ditm. var. *alpinum* A. & G. Lister, Jour. Bot. **46**: 216. 1908.

Physarum alpinum G. Lister; Macbr. N. A. Slime-Moulds ed. 2. 54. 1922.

Plasmodium? Fructification sporangiate. Sporangia sessile, scattered or loosely clustered, subglobose, 1 to 1.4 mm. diam., yellow, seated on a membranous hypothallus; sporangial wall with an outer, dense crust of yellow lime, lightly affixed and separating in flakes from the white, membranous, inner wall. Capillitium a network of hyaline threads with numerous large, angular, and branching, yellow or yellowish lime-knots. Spores purplish brown, faintly warted, 11–12 μ diam.

TYPE LOCALITY: California.

HABITAT: On dead wood.

DISTRIBUTION: California, *Washington?

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 62, *figs.* d–f.

The foregoing description is based solely on the collection made by Harkness in California, and named in Phillips's herbarium *Badhamia inaurata*. A portion of the collection, finely matured, is in the Herbarium of the New York Botanical Garden. Miss Lister has added, jointly as typical, certain forms on herbaceous stalks found in Switzerland. Five collections of the Swiss form made by M. Ch. Meylan, and courteously sent, are in the Herbarium here, and are quite different from the California specimen. The fructification is primarily plasmodiocarpous, some of the plasmodiocarps being more than 25 mm. in length. The walls are firm, with massive, very pale yellow lime. Some of the few smaller plasmodiocarps, which may be considered as

sporangia, have conical masses of lime arising from the bases, like columellae, and in some of the larger ones, these are extended as low ridges. The lime-knots are small, angular, and pale yellow. The spores are about the same as in the American form. Neither of these resemble *P. virescens*, as the Listers indicate, nor are they related to *P. contextum*, as Macbride says, and the collection reported by him from Washington must be regarded as doubtful. The two forms may represent different species, but further American material is needed to show this.

Genus 4. **FULIGO** Haller, Hist. Stirp. Helv. 3: 110. 1768.

Sporangia elongate, branched, and interwoven, combined to form a pulvinate aethalium, the outer layer of sporangia often barren and forming a cortex charged with deposits of lime-granules and without spores; columella none; capillitium with few or many lime-knots.

TYPE SPECIES: *Mucor septicus* L.

Aethalium usually corticate, white, yellow, reddish, or brown; spores 7–10 μ diam.

1. *F. septicus*

Aethalium ecorticate, the outer layer of sporangia well developed, white or ochraceous; spores 9–12 μ diam.

2. *F. intermedia*

Aethalium usually corticate, white; lime-knots often large; spores large, ellipsoid.

3. *F. cinerea*

Aethalium ecorticate, yellow or grayish, surface smooth except for the tops of the upper sporangia; spores 10–11 μ diam.; habitat in wet places.

4. *F. muscorum*

Aethalium with a thick, white, spongy cortex; lime-granules large; spores 12–24 μ diam., very dark and tuberculate.

5. *F. megaspora*

1. **Fuligo septicus** (L.) Weber; Wigg. Pr. Fl. Holsat: 112. 1780.

Mucor septicus L. Sp. Plant. ed. 2. 1656. 1763.

Plasmodium yellow or white. Aethalia pulvinate, varying in size from 2 mm. to more than 30 cm., various shades of yellow in the typical form, also greenish, reddish, and brown to deep chocolate. The sporangia constituting the aethalium are intricately coiled and anastomosing, but often more or less separated in the mass, with spaces in between; cortex thick or thin, a dense crust of lime or undeveloped plasmodium, loose or firm, or absent entirely; sporangial walls within the aethalium membranous, fragile, colorless, with scattered deposits of lime-granules. Capillitium scanty or abundant, consisting of a loose network of slender hyaline threads, more or less expanded at the axils, with fusiform

or branching lime-knots, usually white but often yellow, or occasionally reddish or brownish. Spores violet, almost smooth, 7–10 μ diam.

Var. **candida** (Pers.) R. E. Fries, Svensk Bot. Tidskr. 6: 744. 1912.

Fuligo candida Pers. Obs. Myc. 1: 92. 1796.

Aethalia and lime-knots white.

Var. **rufa** (Pers.) R. E. Fries, Svensk Bot. Tidskr. 6: 745. 1912.

Fuligo rufa Pers. Neues Mag. Bot. 1: 88. 1794.

Aethalia dull brick-red; lime-knots concolorous or white.

TYPE LOCALITY: Europe.

HABITAT: On dead wood and piles of decaying vegetation.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3, *pl.* 74.

Other varieties have been supported on the texture and color of the cortex, and the color of the plasmodium, but much of this variation is probably due to atmospheric conditions prevailing at the time of development, or the food of the plasmodium. Fruitings on similar habitats, and at the same time, are usually alike. On one occasion in Pennsylvania, all developments in different places were of about the same size, and had a firm, persistent cortex. Often, in quiet, shaded places, the species, and particularly var. *candida*, will form ecorticate aethalia which may be as much as a foot across. The surface will then have a labyrinthine structure, and, when the aethalia are small and with little lime on the surface, will bear a marked resemblance to the rosettes of *Physarum gyrosum*. They have been mistakenly regarded as plasmodiocarps of that species, but are merely small, ecorticate phases of var. *candida* of *F. septica*. Aethalia also occur with a labyrinthine structure perfected below a cortex, which is firm and separable therefrom. This species is extremely variable in size, form, and color of the aethalia, but in contrast, the spores are fairly constant, usually somewhat pale and almost smooth, and rarely a little darker and rougher. Occasionally the line in the sporangial wall is in the form of crystalline nodules.

2. **Fuligo intermedia** Macbr. N. A. Slime-Moulds ed. 2. 30. 1922.

Fuligo cinerea (Schw.) Morg. var. *ecorticata* Lister, Mycetozoa ed. 3. 69, in part. 1925.

Plasmodium? Aethalia pulvinate or depressed, sometimes confluent or annulate, 1 to 6 cm. across, dirty white, greenish white, or ochraceous, usually forming many aethalia from a single plasmodium, occasionally forming small clusters of heaped sporangia. Cortex absent. The inner structure of the aethalium like that of *F. septica*. The twisted and confluent sporangia of the outer layer are well developed with walls, capillitia, and spores. Sporangial wall membranous, colorless, densely covered with a compacted shell of white lime-granules, sometimes separable. Capillitium of short threads connecting large, white, branching lime-knots, united in a dense mass at the center and *Badhamia*-like. Spores purplish brown, globose, 9–12 μ diam., a few occasionally ellipsoid or ovoid, distinctly spinulose. (PLATE 15, FIG. 3.)

TYPE LOCALITY: Colorado.

HABITAT: On dead wood, usually poplar.

DISTRIBUTION: *Arizona, California, Colorado, Florida, *Iowa, Kansas, *Montana, *New Mexico, New York, *Oregon.

ILLUSTRATION: Hagelstein, Jour. N. Y. Bot. Gard. **38**: 113, fig., as *F. septica*.

Unfortunately, the species was poorly described originally, particularly in reference to the presence of a cortex. Hundreds of aethalia personally collected in Nassau and Schoharie counties, New York, indicate there is no cortex, and this character is the most important one of the species. The spores are always larger, darker, and rougher than those of *F. septica*, and proportionately paler and smoother than those of *F. cinerea*. The spherical spores predominate, there being only a few that are ellipsoid or ovoid. The form was formerly regarded by Miss Lister as a variety of *F. cinerea* with globose spores, but she writes now that she is inclined to regard it as a distinct species. It seems to be intermediate between *F. septica* and *F. cinerea*, but constant in many gatherings. Forms referred to as *F. septica* (Mycologia **29**: 398, 1937) are now regarded as the present species.

3. **Fuligo cinerea** (Schw.) Morg. Jour. Cin. Soc. Nat. Hist. **19**: 33. 1896.

Enteridium cinereum Schw. Trans. Am. Phil. Soc. II. **4**: 261. 1832.

Lachnobolus cinereus Schw. Trans. Am. Phil. Soc. II. **4**: 262. 1832.

Plasmodium white (Lister). Aethalia pulvinate, elongate, simple or branched, 4 to 60 mm. long, scattered or gregarious,

formed of closely interwoven sporangia, usually enclosed in a smooth, white cortex, densely covered with lime, sometimes ecorticate, seated on a white hypothallus. Sporangial walls within the aethalium more or less perfect, membranous with deposits of lime-granules. Capillitium of simple or branched, hyaline threads, and large white lime-knots that may unite to form a pseudocolumella, or almost *Badhamia*-like. Spores brownish violet, spinulose, ellipsoid, $13-17 \times 8-12 \mu$, with spherical spores present.

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead leaves, composts, and decaying plant remains.

DISTRIBUTION: *California, Colorado, Iowa, Kansas, Massachusetts, Mississippi, New York, Ohio, Ontario, *Oregon, *Pennsylvania, Virginia, *West Indies.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 75.

This species is not rare and is found usually on composts and manure piles. It is often associated with a small phase of *Mucilago spongiosa*, and the two forms are similar superficially, but the character of the lime distinguishes them. The spores distinguish it from *F. septica* and *F. intermedia*. The ellipsoid spores predominate, although a few globose ones may be present. *Badhamia ovispora* also develops on similar habitats, but may be distinguished by the smooth spores, which appear shining by reflected light. *F. cinerea* occasionally forms ecorticate aethalia among the normal ones, but it is hardly necessary to retain the var. *ecorticata* Lister, which formerly included the form now regarded as *F. intermedia*, and the small ecorticate aethalia mentioned under *F. septica*. The spores of the latter are spherical, smaller, and smoother than those of *F. intermedia* or *F. cinerea*, although a trifle darker than those of *F. septica*.

4. *Fuligo muscorum* Alb. & Schw. Consp. Fung. 86. 1805.

Licea ochracea Peck, Rept. N. Y. State Mus. 28: 55. 1876. (N. Y. B. G. no. 11789, type material.)

Fuligo ochracea Peck, Rept. N. Y. State Mus. 31: 56. 1879.

Plasmodium apricot-yellow (Lister). Aethalia pulvinate or effused, 2 mm. to 5 cm. diam., scattered or clustered, nearly smooth, formed of very closely interwoven sporangia, yellowish or grayish, seated on a pale orange hypothallus; cortex absent or indefinite; sporangial wall with scattered deposits of orange lime-granules. Capillitium of numerous irregular, often branching,

orange lime-knots, connected by short, hyaline threads. Spores violet-brown, spinulose, 10–11 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On mosses and other living plants in wet places.

DISTRIBUTION: Maine, Massachusetts, New Hampshire, New York, *Ontario, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 77.

This species is not found often, but when once located is in fair abundance, the aethalia materializing all at one time. It is usually found in wet sphagnum swamps, the plasmodium apparently vegetating in the substratum beneath the water, and rising to fruit on the tips of mosses and other plants. The normal color is yellow from yellow lime deposited on the outside of the aethalia. The grayish color is due to the absence of some of the yellow lime washed away by water while the aethalia are forming. There is no definite cortex, and the surface is almost smooth, although usually showing the circular indentations of the tops of the component sporangia. The aethalia are small, the majority 1 to 3 cm. across.

5. *Fuligo megaspora* Sturg. Colo. Coll. Pub. Sc. Ser. 12: 443. 1913. (N. Y. B. G. nos. 11716, 11717, type and cotype.)

Plasmodium? Aethalia pulvinate, 15 to 40 mm. diam., with a thick, white, spongy cortex, white or yellowish below; walls of the closely convolute sporangia membranous, charged throughout with lime-granules, 1.5–2 μ diam. Capillitium scanty, somewhat *Badhamia*-like, with few hyaline threads connecting the branching lime-knots to the walls. Spores spherical or slightly ovoid, dark purplish brown, 12–24 μ diam., roughly tuberculate, the tubercles sometimes arranged in irregular lines.

TYPE LOCALITY: Colorado.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Florida, Guatemala, Nebraska, *New Mexico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 202, *figs.* d–f.

Sturgis gave the size of the aethalia as 15–40 cm. diam., and this has been repeated by subsequent authors. The two type specimens measure respectively 15 and 40 mm., and other specimens are within that range. It is probable, therefore, that the designation in centimeters was an error. The species has been rarely collected. The large, dark, rough spores are characteristic.

Genus 5. **PHYSARELLA** Peck, Bull. Torr. Bot. Club 9: 61. 1882.

Sporangia stalked, shortly cylindrical or bell-shaped, hollow, or forming plasmodiocarps; exterior part of sporangial wall studded with long, spike-like processes on the inner side; interior part persisting as a hollow columella after dehiscence. Capillitium of slender threads with few lime-knots, or many if the processes are absent.

A SINGLE SPECIES.

1. **Physarella oblonga** (Berk. & Curt.) Morg. Jour. Cin. Soc. Nat. Hist. 19: 7. 1896.

Trichamphora oblonga Berk. & Curt.; Berk. Grevillea 2: 66. 1873.

Physarella mirabilis Peck, Bull. Torr. Bot. Club 9: 61. 1882.

Plasmodium rich yellow (Lister). Total height up to 3 mm. Sporangia gregarious, stalked, inclined or nodding, shortly cylindrical, 0.6 to 1 mm. long, 0.4 to 0.6 mm. broad, cup-shaped or funnel-shaped, hollow, or sometimes forming twisted and contorted sporangia and similar plasmodiocarps, olive-brown or reddish brown, speckled with small, yellow spots; sporangial wall a stout yellow membrane, thickened with yellow lime-granules, the exterior part attached to the stalk and studded on the inside with long, yellow or orange, spike-like, calcareous processes, extending toward the interior part, which is a continuation of the stalk, and persists as a long, hollow columella after dehiscence at the rim of the cup-like sporangium. Upon dehiscence, the outer part of the wall recurves in lobes at right angles to the stalk, exposing the spike-like processes extending outward. Stalk cylindrical, striate, red-brown, translucent, slender, broader at the base, 1 to 2 mm. high, or thick and irregular. Capillitium consisting of many forking, slender, pale yellow threads, with few small, fusiform, yellow lime-knots, or in sessile and plasmodiocarpous forms where the processes may be absent, a network of yellow threads with large irregular yellow or orange lime-knots. Spores violet-brown, almost smooth, 6-8 μ diam. (PLATE 8, FIG. 5.)

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead wood and piles of decaying vegetable matter.

DISTRIBUTION: Distributed throughout North America and not uncommon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 71.

One of the most beautiful of the Mycetozoa, and fortunately not uncommon; nor can it be confused with anything else. It is often found on rubbish piles in company with *Physarum polycephalum* or *Physarum gyrosum*, so that all three species may be looked for if one is present. They all form large developments, spreading over a considerable area with many colonies.

Genus 6. **CIENKOWSKIA** Rostafinski, Versuch 9. 1873.

Fructification plasmodiocarpous, vari-colored yellow, red, and brown; sporangial wall persistent below. Capillitium a dense network of rigid threads with many sharp pointed branchlets or spines, and numerous flattened, angular or branching nodules composed of lime-granules, or in the form of calcareous plates transversely placed.

A SINGLE SPECIES.

1. **Cienkowskia reticulata** (Alb. & Schw.) Rost. Versuch 9. 1873.

Physarum reticulatum Alb. & Schw. Consp. Fung. 90. 1805.

Diderma reticulatum (Alb. & Schw.) Fries, Syst. Myc. 3: 112. 1829.

Plasmodium deep orange-red (Lister). Plasmodiocarps scattered, cylindrical, simple, branched or netted, 0.3 to 0.5 mm. diam., attached by a narrow base, or confluent and applanate, mottled yellow, orange, red, or brown, or entirely red; sporangial wall membranous, stouter and persistent below, yellow, with closely set deposits of lime, marked with the bases of the calcareous parts of the capillitium. Capillitium a dense, elastic network of rigid, yellow threads with many pointed branchlets or spines, and surrounding numerous, large, angular, branching or irregular, white or yellow nodules composed of lime-granules, which are usually flattened, or often formed as flattened plates transversely placed; the capillitium delicately attached to the sporangial wall or its lime-deposits, so that it becomes detached eventually as an entire mass. Spores violet or violet-brown, minutely spinulose, 9–12 μ diam. (PLATE 8, FIG. 6.)

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: California, *Canal Zone, Colorado, Iowa, Kansas, New York, *Ohio, Ontario, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 70.

This species is not rare, and can be discovered if diligently sought for in August and later. It forms small developments which are difficult to see if wet. The capillitium with its pointed branchlets and unusual calcareous formations is the important diagnostic character. The lime-nodules are not exactly like the lime-knots of *Physarum*. They appear to be free, or very lightly attached to the points of the capillitium, as they may be removed or shaken out. Eventually the entire capillitium becomes detached from the sporangial wall. The rounded, cylindrical, simple or branched plasmodiocarps usually have the transverse plates, although they may be absent. In the confluent phases, still showing traces of the cylindrical formation, they are sometimes represented by flattened fragments, but more often, and always in the continuous depressed phases, they are replaced, in great numbers, by the angular and branching nodules.

Genus 7. **CRATERIUM** Trentepohl, in Roth, Cat. Bot. 1: 224. 1797.

Sporangia stalked, goblet-shaped with a lid of thinner substance, or without a distinct lid and obovoid or subglobose; sporangial wall charged with granules of lime, and cartilaginous at least in the lower part. Capillitium consisting of hyaline threads connecting large lime-knots, often combined in the center to form a pseudo-columella. Stalk cartilaginous.

TYPE SPECIES: *Craterium pendunculatum* Trent.

Sporangial wall smooth, glossy; lid distinct.

Lime-knots white.

1. *C. minutum*

Lime-knots yellow or brown.

2. *C. concinnum*

Sporangial wall mealy, often rugose; lid less distinct or indefinite.

Sporangia violet,

3. *C. paraguayense*

Sporangia brown below, white above.

4. *C. leucocephalum*

Sporangia bright yellow.

5. *C. aureum*

1. **Craterium minutum** (Leers) Fries, Syst. Myc. 3: 151. 1829.

Peziza minuta Leers, Fl. Herborn. 277. 1775.

Craterium pedunculatum Trent., in Roth, Cat. Bot. 1: 224. 1797.

Plasmodium rich yellow (Lister). Total height 0.7 to 1.5 mm. Sporangia goblet-shaped, funnel-shaped, or long-cylindrical, stalked, erect, gregarious, 0.4 to 1.2 mm. high, smooth, yellow,

pale brown, or brown; lid convex and above the rim of the sporangium, or flat and below it, white or concolorous; sporangial wall of two layers, the outer cartilaginous, thickened at the rim below the lid, translucent below and continued into the translucent stalk, the inner layer more or less charged with lime-granules. Stalk cylindrical, plicate, 0.3 to 0.5 mm. long, yellowish, pale brown, or dark brown, rising from a circular hypothallus. Capillitium of slender, colorless threads, connecting numerous, large, white lime-knots, often combined in the center to form a pseudo-columella. Spores violet-brown, minutely warted, 8-9 μ diam. (PLATE 9, FIG. 1.)

TYPE LOCALITY: Germany.

HABITAT: On dead leaves.

DISTRIBUTION: Common in the United States and Canada.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 78.

This species is said to have yellow threads and yellow lime-knots in the capillitium at times, but I have never seen them in American specimens. Two distinct phases occur; the small, dark one with lids below the rims; and the larger, paler form with convex lids extending above the rims; the latter is not uncommon, but the former is more abundant. Another phase with long, dark, cylindrical sporangia, and convex lids, is occasionally found. A collection from Pike County, Pennsylvania, consists of minute goblet-shaped sporangia, 0.2 to 0.3 mm. in height over all.

2. **Craterium concinnum** Rex, Proc. Acad. Nat. Sc. Phila. 1893: 370. 1893.

Plasmodium at first milky, then cream-colored (Lister). Total height 0.5 to 0.7 mm. Sporangia broadly funnel-shaped or goblet-shaped, 0.2 to 0.5 mm. diam., stalked, smooth, pale or dark brown, often paler above, opening by a well-defined, paler, convex lid; sporangial wall cartilaginous. Stalk red-brown, 0.2 to 0.3 mm. high. Capillitium consisting of numerous small, angular, brownish lime-knots, connected by short, hyaline threads, sometimes with a small pseudo-columella. Spores purplish brown, minutely warted, 8-9 μ diam.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On decaying chestnut burs of the preceding year.

DISTRIBUTION: Connecticut, Massachusetts, New York, *Ohio, Pennsylvania, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 79.

This species was common in eastern North America before the disappearance of the chestnut trees. I have found it since on much decayed chestnut wood, and on the leaves of new saplings. In the Alleghenies, at elevations of 3000 feet and more, there are still small groves of chestnut which have survived the blight until now. I have visited groves in Giles and Wythe Counties, Virginia, and in Franklin County, North Carolina, where the associated species, *Arcyria globosa*, was found in abundance, but *C. concinnum* was not observed. Later, a student wrote that it appeared in Virginia as late as 1937. The form is much like *C. minutum*, only the lime in the capillitium is yellowish brown, and the sporangia are somewhat smaller. While the species has been reported on other habitats, it seems to be restricted in eastern North America to the burs of the chestnut tree.

3. **Craterium paraguayense** (Speg.) Lister, Mycetozoa ed. 2. 95. 1911.

Didymium paraguayense Speg. Anal. Soc. Cient. Argent. 22: 186. 1886.

Craterium rubescens Rex, Proc. Acad. Nat. Sc. Phila. 1893: 370. 1893.
(N. Y. B. G. nos. 5325, 5326, type material.)

Plasmodium? Sporangia gregarious, goblet-shaped or cylindrical, 0.6 to 0.8 mm. high, 0.3 to 0.6 mm. broad, stalked, erect, rugose, bright reddish violet, with a convex top dehiscing irregularly and not as a distinct lid, although in a circumscissile manner, if firmer; sporangial wall cartilaginous, with deposits of pale violet lime-granules. Stalk cylindrical, 0.4 mm. high, thick plicate, purple, opaque, rising from a circular hypothallus. Capillitium consisting of pale, violet threads connecting large, violet lime-knots, that combine in the center to form a columella either free from or connected to the top of the stalk. Spores violet, nearly smooth, 8–9 μ diam.

TYPE LOCALITY: Paraguay.

HABITAT: On dead leaves and fallen Spanish moss.

DISTRIBUTION: *Canal Zone, Florida, *Iowa?, Louisiana.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 80.

The species is probably not rare in the territory bordering on the Gulf of Mexico. Dr. Erdman West writes he has collected it frequently on fallen Spanish moss in Florida. It is related to *C. leucocephalum*, connected through var. *rufum* of the latter, but differing in the purple or violet color.

4. **Craterium leucocephalum** (Pers.) Ditm. in Sturm, Deutsch. Fl. Pilze 1: 21. 1813.

Stemonitis leucocephala Pers.; Gmel. Syst. Nat. 2: 1467. 1791.

Plasmodium rich yellow (Lister). Total height about 1 mm. Sporangia more or less obovoid or turbinate, stalked, erect, white above and brown or reddish brown below, sometimes free of lime in the upper part and then yellowish; lid white, convex, often well developed; sporangial wall thin, yellow, firmer and darker below, usually with lime in the upper part. Stalk cylindrical, plicate, translucent, reddish brown, 0.3 to 0.5 mm. long, rising from a circular hypothallus. Capillitium of large irregular, white lime-knots, rarely yellow, connected by threads with flattened expansions at the axils, often with a prominent pseudo-columella. Spores violet-brown, minutely warted, 7-9 μ diam.

Var. **cylindricum** (Masse) Lister, Mycetoza ed. 2. 97. 1911.

Craterium cylindricum Masse, Mon. 268. 1892.

Sporangia cylindrical, otherwise like the typical form.

Var. **scyphoides** (Cooke & Balf.) Lister, Mycetoza ed. 2. 97. 1911.

Physarum scyphoides Cooke & Balf.; Masse, Jour. Myc. 5: 186. 1889.

(N. Y. B. G. no. 6193, type material.)

Sporangia globose or shortly turbinate with a reddish base, dehiscing irregularly.

Var. **rufum** G. Lister, Mycetoza ed. 3. 78. 1925.

Sporangia somewhat cylindrical with short stalks; reddish brown all over including the well-defined lids.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves and twigs, sometimes on wood.

DISTRIBUTION: The typical form and var. *cylindricum* are common throughout the United States and Canada; var. *scyphoides*, not so common; var. *rufum*, New York, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 81.

Lister mentions crystalline discs in the sporangial wall, but these are not always present in American specimens. Numerous variations in the form and coloring of the sporangia are found merging one into another, often in the same large colony. The recognized varieties are therefore centers around which the others are clustered. Var. *cylindricum*, in its highest development, has

the same shape as the long, cylindrical phase of *C. minutum*. It merges by intermediate steps into the typical form, which may also be said about the other varieties. Furthermore it is not constant, but may be uniformly cylindrical, or compressed and angular.

5. **Craterium aureum** (Schum.) Rost. Mon. 124. 1874.

Trichia aurea Schum. Enum. Pl. Saell. 2: 208. 1803.

Plasmodium lemon-yellow (Lister). Sporangia gregarious, and globose, obovoid, piriform, or ellipsoid, 0.4 to 0.6 mm. diam., stalked, erect, rugose, and golden yellow, greenish, gray, or white, without a definite lid and dehiscing irregularly; sporangial wall membranous, with deposits of included lime-granules, denser and of a deeper color on top, the wall stouter and more persistent as a cup at the base, which is continued into the cartilaginous stalk. Stalk cylindrical, 0.2 to 0.5 mm. long, stout, furrowed, charged with lime-granules, yellow or reddish, often rising from a circular hypothallus. Capillitium consisting of a network of hyaline threads, with triangular expansions at the axils, connecting angular or irregularly shaped white or yellow lime-knots, often confluent in the center as a pseudo-columella. Spores violet-brown, spinulose, 8–10 μ diam.

TYPE LOCALITY: Denmark.

HABITAT: On dead leaves.

DISTRIBUTION: Throughout North America, not uncommon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 67.

Forming small colonies, it may be found almost anywhere on fertile leaf-piles, associated with a dozen or more other leaf-species. It is intermediate between the genera *Craterium* and *Physarum*, and retained in *Craterium* because of the firmer, lower part of the sporangial wall, persisting as a distinct cup. The sporangia are often white, and also the lime in the capillitium. This is not due to fading, and may be observed in freshly formed and unopened sporangia. The same feature is seen in many of the yellow species of *Physarum*.

Genus 8. **LEOCARPUS** Link, Ges. Nat. Fr. Berl. Mag. 3: 25. 1809.

Sporangial wall of two layers, the outer cartilaginous, shining, with deposits of lime on the inner side, the inner layer hyaline.

Capillitium consisting of a network of rigid, hyaline threads, with branching and anastomosing, yellowish or brownish lime-knots.

A SINGLE SPECIES.

1. **Leocarpus fragilis** (Dicks.) Rost. Mon. 132. 1874.

Lycoperdon fragile Dicks. Pl. Crypt. Brit. 1: 25. 1785.

Plasmodium lemon, then orange-yellow (Lister). Sporangia clustered, obovoid, rarely globose, 2 to 4 mm. long, stalked or occasionally sessile, smooth, yellowish brown, chestnut or purplish brown, shining, sometimes dehiscing in revolute lobes; outer layer of the sporangial wall cartilaginous, brittle, orange-brown, usually with dense deposits of lime-granules on the inner side; inner layer a firm, hyaline membrane, giving attachment to the capillitium. Stalk short, or as long as the sporangium, weak, yellowish, translucent, rising from a membranous hypothallus. Capillitium a network of rigid, hyaline threads with flattened expansions at the axils, connected with angular, branching, and anastomosing, yellowish or brownish lime-knots. Spores more or less spinulose, very variable in size but usually 10–14 μ diam., sometimes slightly clustered, dark purplish brown or paler, with a pale area of dehiscence. (PLATE 15, FIG. 4.)

TYPE LOCALITY: England.

HABITAT: On dead leaves, twigs, and ground wood.

DISTRIBUTION: Common and abundant throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 82.

This strikingly handsome species is remarkable for the inconstancy of the spores. They may be dark or paler, sometimes strongly spinulose, and the size is often outside of the range given. The capillitium may be almost entirely calcareous throughout, or the solidly calcareous portion may be massed in a part or parts of the sporangium, but connected with the hyaline net, the remaining portion then being limeless or nearly so.

Genus 9. **DIDERMA** Persoon, Neues Mag. Bot. 1: 89. 1794.

Sporangia stalked, sessile, or forming plasmodiocarps; sporangial wall of two layers (single in *D. simplex* and *D. rugosum*), containing deposits of lime in granules (in crystalline nodules in *D. Trevelyani*). Columella usually present. Threads of the capillitium simple or branched, without lime-knots.

TYPE SPECIES: *Sphaerocarpus floriformis* Bull.

Section 1. EUDIDERMA. Outer sporangial wall a smooth crust composed of densely compacted lime-granules.

Sporangia stalked.

Sporangia white or pinkish, subglobose, always stalked; spores pale, faintly marked.

1. *D. montanum*

Sporangia white, flattened, disc-shaped, usually on stout stalks, rarely sessile; spores pale, faintly marked.

2. *D. hemisphericum*

Sporangia shortly stalked or sessile, white or mottled with flesh-colored spots, subglobose; columella prominent; spores dark, coarsely warted.

9. *D. Lyallii*

Sporangia usually sessile or forming plasmodiocarps.

Sporangia white or nearly so.

Sporangia rounded or forming plasmodiocarps; columella depressed, brownish flesh-colored; spores 6-10 μ .

3. *D. effusum*

Similar to No. 3, but sporangia scattered and spores 10-15 μ .

4. *D. Chondrioderma*

Sporangia crowded, subglobose; columella white, convex; layers of the sporangial walls closely combined; spores violet-brown, 8-11 μ .

5. *D. spumarioides*

Sporangia crowded, subglobose; columella small, white, convex; outer sporangial wall shell-like, separating from the persistent, colorless, inner wall; spores purplish brown, 10-14 μ .

6. *D. globosum*

Sporangia crowded, usually forming plasmodiocarps with shell-like outer walls; columella convex, flesh-colored.

7. *D. alpinum*

Sporangia crowded, subglobose; inner wall orange below; columella subglobose or hemispherical, orange or flesh-colored; spores 9-13 μ , spinulose.

8. *D. niveum*

Sporangia pinkish or reddish when fresh, later white, rounded, circular, and depressed, or subglobose.

10. *D. testaceum*

Sporangia ochraceous, yellowish, or brownish, depressed, irregular or forming plasmodiocarps; wall single.

11. *D. simplex*

Section 2. LEANGIUM. Outer sporangial wall cartilaginous.

Sporangia stalked.

Sporangia globose, smooth, gray to ochraceous brown; stalks thick, ochraceous brown; spores with scattered warts.

15. *D. floriforme*

- Sporangia subglobose, the single wall wrinkled with many reticulations; stalk slender, black. 19. *D. rugosum*
- Sporangia flattened, disc-shaped, mottled red-brown; stalk black, slender or stout, short. 17. *D. roanense*
- Sporangia sessile.
- Sporangia subglobose, ochraceous or pinkish; capillitium usually colorless; spores dark, 10–16 μ . 12. *D. Sauteri*
- Sporangia or plasmodiocarps ochraceous; capillitium purplish brown; spores purplish gray, 9–11 μ . 13. *D. ochraceum*
- Sporangia stalked or sessile, dehiscing by petaloid lobes. (See also 15.)
- Sporangial wall enclosing a middle layer of coarse, irregular lime crystals; sporangia reddish brown; columella minute or absent. 14. *D. Trevelyani*
- Sporangial wall without an inner crystalline layer.
- Sporangia gray or brown, often mottled; columella usually prominent; stalk stout, ochraceous; spores minutely spinulose. 16. *D. radiatum*
- Sporangia brown, usually sessile, the wall marked with close, radiating lines; columella pale, subglobose, prominent. 18. *D. asteroides*

1. **Diderma montanum** Meylan, Ann. Conserv. Bot. Genève 16: 311. 1913. (N. Y. B. G. no. 7063, authentic material.)

Chondrioderma montanum Meylan, Bull. Soc. Bot. Genève II. 2: 262. 1910.
Diderma cor-rubrum Macbr. N. A. Slime-Moulds ed. 2. 140. 1922.

Plasmodium white or pale yellow? (Lister). Sporangia scattered or in small groups, subglobose, 0.6 to 0.8 mm. diam., flattened or umbilicate beneath, white or pinkish, smooth or somewhat wrinkled, stalked; sporangial wall of two often separating layers, the outer densely charged with lime-granules, the inner membranous, reddish brown throughout or toward the base. Stalk pale or bright yellow-brown, slender or stout, enclosing white lime-granules, 0.1 to 0.8 mm. high. Columella usually globose, small, brownish red, sometimes stalked. Capillitium consisting of slender purplish or hyaline threads, branching and anastomosing towards the ends. Spores pale purplish brown, faintly spinulose, 8–10 μ diam.

Var. **album** (Torrend) G. Lister, Mycetozoa ed. 3. 84. 1925.

Chondrioderma radiatum (L.) Rost. var. *album* Torrend, Fl. Myx. 168. 1909.

Sporangia gregarious, white or bluish white; stalks and columellae white or cream-colored; capillitium colorless.

TYPE LOCALITY: Switzerland.

HABITAT: On mosses and dead leaves in wet places.

DISTRIBUTION: *Iowa, New York, Ontario, Pennsylvania, Virginia; var. *album*, Ontario.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 207.

This species is very close to *D. radiatum* var. *umbilicatum*, and may be only a phase thereof. There are no sharp distinguishing characters, so that habit and habitat are important. The sporangia are scattered, or in small groups, on moss and other ground material in wet places, and often associated with *Lamproderma columbinum* (Pers.) Rost. Such collections, and conforming closely to the description, are usually this species. Any or all of the characters may, however, be found in phases of *D. radiatum*, although that species is usually on wood, and the sporangia are more closely crowded. Var. *album* was found by Mr. Eli Davis twice, in different years, at Komoko, Ontario, associated with the typical form.

2. ***Diderma hemisphericum*** (Bull.) Hornem. Fl. Dan. 33: 13. 1829.

Reticularia hemispherica Bull. Herb. Fr. *pl.* 446, *fig.* 1. 1789; Bull. Champ. 93. 1791.

Plasmodium opaque white (Lister). Sporangia scattered, flat, discoid, on a central stalk, 0.6 to 1.2 mm. diam., occasionally sessile and confluent, chalk-white; sporangial wall of two layers on the upper, flat surface; the outer a smooth crust composed of globular lime-granules, 1–3 μ diam., easily separating and breaking away from the more persistent, membranous inner layer; under surface rugose, thickened. Stalk ochraceous or brownish, 0.2 to 0.8 mm. long, thick, furrowed with wrinkles which are continued over the flat under side of the sporangium, densely calcareous, often seated on a white hypothallus. Columella consisting of the broad, thickened base of the sporangium, reddish or brownish, charged with calcareous deposits, usually in the form of nodules or large rhomboidal crystals. Capillitium of slender, colorless threads, branching and anastomosing, or of violet-brown threads sparingly branched except at the pale extremities. Spores pale violet-brown, nearly smooth, 7–9 μ diam.

TYPE LOCALITY: France.

HABITAT: On dead leaves, twigs, and plant stems, occasionally on wood.

DISTRIBUTION: Throughout North America; not uncommon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 83, *figs.* a-e.

The small colonies are not uncommon on leaf piles in company with other leaf species. Sessile phases, resembling and approaching subglobose sporangia of *D. effusum*, may be recognized by traces of stalks, or the central attachments of the sporangia to the habitat.

3. *Diderma effusum* (Schw.) Morg. Jour. Cin. Soc. Nat. Hist. 16: 155. 1894.

Physarum effusum Schw. Trans. Am. Phil. Soc. II. 4: 257. 1832.

Didymium reticulatum Rost.; Fuckel, Symb. Myc. Nachtr. 2: 73. 1873.

Chondrioderma reticulatum Rost. Mon. 170. 1874.

Plasmodium white (Lister). Sporangia sessile, gregarious or crowded, depressed, smooth, white or nearly so, either rounded, 0.7 mm. diam., or forming elongate and flat, simple or branching, net-like or effused plasmodiocarps, up to 6 cm. long and 1 cm. broad, or more; sporangial wall of two layers, the outer a fragile crust of globular lime-granules, separating from the membranous, colorless, inner layer. Columella pulvinate, depressed, brownish flesh-colored, enclosing white lime-granules. Capillitium consisting of delicate, colorless or pale purplish threads, sparingly branched and anastomosing. Spores pale violet-brown, nearly smooth, 6-10 μ diam.

TYPE LOCALITY: Salem, North Carolina.

HABITAT: On dead leaves, sometimes on wood.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 83, *fig.* f.

The method of Lister in broadening the description to include all variations in form is accepted. The species as described by Schweinitz is restricted to the effused and appanate plasmodiocarps which are not so common, and the other phases collected in greater abundance, and surely more representative, are treated by other students as var. *reticulatum*. Similar conditions of sporangia and plasmodiocarps exist in many other species, and with our greater knowledge of the group, the present trend is to

ignore these variations in form by combining them in a broadened description. This policy has been followed in many species and should be extended. *D. effusum* is closely related to *D. hemisphericum* and to *D. testaceum*, and connecting forms are not rare. From *D. testaceum* it is distinguished by the more frequent plasmodiocarpous habit, the more flattened sporangia, the form of the columella, and the absence of the pinkish color. Occasionally the sporangia may be dotted with vitreous plates as in the genus *Lepidoderma*.

4. **Diderma Chondrioderma** (de Bary & Rost.) G. Lister, Mycetoza ed. 3. 258. 1925.

Didymium Chondrioderma de Bary & Rost.; Alex. Stro. Miksom. 89. 1872.
Chondrioderma Alexandrowiczii Rost. Mon. 169. 1874.

Diderma arboreum G. Lister & Petch; G. Lister, Jour. Bot. 51: 2. 1913.

Plasmodium? Sporangia scattered, discoid, sessile, rarely stalked, 0.5 to 0.7 mm. diam., or forming expanded and lobed, flattened plasmodiocarps 1 to 3 mm. diam., white or purplish gray from absence of lime; sporangial wall membranous, with deposits of round or angular lime-granules, either united to form a thin crust or sparsely distributed, often with scattered deposits of refuse matter. Stalk when present very short, dark brown. Columella low, convex, flesh-colored, or reduced to a slight thickening of the sporangium-floor, with deposits of lime in the form of granules or small nodules, often mixed with refuse matter. Capillitium consisting of simple or branching and anastomosing, colorless or purplish, rather stout threads, often with membranous expansions at the axils. Spores very minutely and closely spinulose, pale purplish gray, 10–15 μ diam.

TYPE LOCALITY: Poland.

HABITAT: On bark of dead and living trees, mosses, and lichens.

DISTRIBUTION: California, *Iowa.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 206, as *D. arboreum*.

The California collection made by Miss E. E. Morse is typical. The sporangia and plasmodiocarps are scattered on wood, and have scanty lime interspersed by deposits of dark refuse matter. The capillitium consists of coarse threads, and the spores are pale, measuring 11–12 μ diam. The species is allied to *D. effusum*, and resembles the latter superficially, but is distinguished by the larger spores and coarser threads of the capillitium.

5. *Diderma spumarioides* Fries, Syst. Myc. 3: 104. 1829.

Didymium spumarioides Fries, Symb. Gast. 20. 1818.

Diderma cinereum Morg. Jour. Cin. Soc. Nat. Hist. 16: 154. 1894.

Plasmodium opaque white (Lister). Sporangia crowded, forming large colonies, sessile, globose, 0.4 to 0.8 mm. diam., smooth or rugose, white, often seated on or imbedded in a strongly developed, white hypothallus; sporangial wall of two layers, the outer fragile, composed of large, globular lime-granules, more or less adhering to the membranous inner layer. Columella convex or hemispherical, white or pale flesh-colored. Capillitium consisting of slender, flexuose, purplish threads, branching at acute angles and anastomosing. Spores violet-brown, spinulose, 8–11 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves.

DISTRIBUTION: Common throughout North America in the forested regions.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 84.

The sporangia of the American form are smaller than those of European specimens. The species as represented here has two fairly distinct phases, distributed seasonally about equally, although either form may appear at any time, and there are intermediates. From May to July, the colonies usually have separated sporangia and grayish smooth walls with less lime, little hypothallus, and the capillitium more abundant. Later, the prevailing developments have densely crowded sporangia with thick calcareous walls, and a copious hypothallus in which the sporangia are often imbedded. The early phase is probably *D. cinereum* Morg., but there is no occasion for regarding the differences as specific. The early fruitings come from the revived sclerotium of the preceding winter, and the later ones from the spores of the earlier sporangia. Similar seasonal differences may be noted in other species of the Mycetozoa. Lime is found occasionally in the capillitium of *D. spumarioides*. An extensive collection made by Dr. W. C. Sturgis, in Colorado, has long, fusiform lime-knots, and in many sporangia there are long, thin, flattened or cylindrical columellae, sometimes bifurcate, and extending to the tops of the sporangia. A collection, personally made in Pike County, Pennsylvania, also has long, fusiform lime-knots in the capillitium. A specimen from Corunna, Maryland, has lime in

the sporangial wall, which is pale lilac in color. The species is closely related to *D. globosum* and connected therewith by forms with varying spores. It differs by the more closely connected sporangial walls, and the usually paler, smaller spores.

6. *Diderma globosum* Pers. Neues Mag. Bot. 1: 89. 1794.

Diderma crustaceum Peck, Rept. N. Y. State Mus. 26: 74. 1874. (N. Y. B. G. nos. 7958, 7959, 7960, 11606, 11607, 11608, type and authentic material.)

Plasmodium white (Lister). Sporangia subglobose, sessile, crowded, often forming large colonies, 0.5 to 1 mm. diam., rarely forming plasmodiocarps, smooth, white or cream-colored, usually seated on a well-developed, white or cream-colored hypothallus; sporangial wall of two layers, the outer eggshell-like, composed of globular lime-granules 1–2 μ diam., often separating widely from the membranous, inner layer. Columella hemispherical or subglobose, usually small, white or pale flesh-colored. Capillitium consisting of slender, irregularly branching and anastomosing, pale purplish threads, often with irregular expansions toward the base, enclosing a few lime-granules. Spores dark purplish brown, spinulose, 10–14 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves, twigs, etc.

DISTRIBUTION: Common in the United States and Canada.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 85.

The eggshell-like outer wall, distinctly and often widely separated from the inner one, is the important character separating this species from *D. spumarioides*. The spores vary considerably in size and color, and occasional specimens have spores overlapping those of *D. spumarioides*. Various specimens from collections made by Dr. C. H. Peck, and named *D. crustaceum*, are in the Herbarium of the New York Botanical Garden. The specimen from Karnak, New York, has dark spores, 12–14 μ diam., and in the one from Memphis, New York, the spores are also dark and measure 12 μ diam. In other specimens the size is irregular, but they are imperfectly developed, a condition often found in the species. Following the Lister conception of the species, which is based on the examination of an authentic specimen of Rostafinski, the conclusion here is that *D. crustaceum* is typical *D. globosum* Pers. as interpreted by Rostafinski. The reader is

referred to the various editions of the Lister and Macbride monographs for further particulars.

7. **Diderma alpinum** Meylan, Bull. Soc. Vaud. Sc. Nat. 51: 261. 1917. (N. Y. B. G. nos. 7171, 8774, authentic material.)

Plasmodium white (Meylan). Sporangia crowded, sessile, white, hemispherical or subglobose, or lengthened more or less and confluent, 0.8 to 2 mm. diam., or forming long plasmodiocarps up to 12 mm. or more long, seated on a white hypothallus; outer layer of the sporangial wall smooth, shell-like, separating freely from the membranous inner one. Columella large, convex, rugged, together with the base of the sporangium yellow or flesh-colored. Capillitium of rather stout, colorless or purplish threads, branching or anastomosing, straight or flexuose. Spores brownish purple, distinctly spinulose, 10–12 μ diam.

TYPE LOCALITY: Switzerland.

HABITAT: On herbaceous stems, etc.

DISTRIBUTION: *California.

ILLUSTRATION: None published?

Closely related to *D. globosum*, the species differs practically only in the larger, more robust sporangia and plasmodiocarps.

8. **Diderma niveum** (Rost.) Macbr. N. A. Slime-Moulds 100. 1899.

Chondrioderma niveum Rost. Mon. 170. 1874.

Diderma albescens Phill. Grevillea 5: 114. 1877. (N. Y. B. G. no. 5636, type material.)

Plasmodium white (Lister). Sporangia crowded, subglobose or hemispherical, sessile, 0.7 to 1.8 mm. diam., smooth, white, sometimes seated on a white hypothallus; sporangial wall of two layers, the outer densely charged with white lime-granules, separating from the more persistent inner layer, which is membranous and often iridescent and veined with scanty deposits of lime above, cartilaginous and orange below. Columella large, convex or hemispherical, orange or buff. Capillitium of branching and anastomosing rather stout, purple threads, with pale extremities, sometimes intermixed with more delicate threads, often beaded with wart-like thickenings. Spores purple-brown, minutely spinulose, 9–13 μ diam. (PLATE 9, FIG. 2.)

TYPE LOCALITY: France.

HABITAT: On dead plant stems, twigs, etc., in mountainous regions.

DISTRIBUTION: California, *Colorado, *Oregon, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 89, *figs.* a-c.

This species is not common, and seems to be restricted to the western states. Together with *D. Lyallii* and *D. deplanatum* Fries it constitutes a group with related forms. *D. deplanatum* has not been definitely reported from North America, but may be present. In Europe it is a lowland form resembling *D. effusum*, but distinguished by the orange colored inner wall. The habit is scattered, not crowded as in *D. niveum*, and it forms pulvinate or flattened sporangia and plasmodiocarps, which are sometimes annular. The columella is usually almost obsolete, and represented by a thickening of the sporangial floor, or a slight convex elevation.

9. **Diderma Lyallii** (Masse) Macbr. N. A. Slime-Moulds 99. 1899.

Chondrioderma Lyallii Massee, Mon. 201. 1892.

Diderma niveum (Rost.) Macbr. var. *Lyallii* Lister, Mycetozoa ed. 2. 105. 1911.

Plasmodium white (Lister). Sporangia crowded, subglobose or obliquely obovoid, 1 to 1.5 mm. diam., sessile or short-stalked, white, cream-white, or mottled with flesh-colored spots, smooth or somewhat wrinkled, usually seated on an abundant white hypothallus; sporangial wall of two layers, the outer with dense calcareous deposits, separating from the membranous inner layer, which has scanty deposits of lime-granules and is pinkish flesh-colored. Stalk short, stout, furrowed, white or ochraceous. Columella hemispherical, globose, clavate, or ligulate, cream-white or flesh-colored. Capillitium consisting of dark purple or colorless, straight or flexuose threads, branching and anastomosing. Spores dark brownish purple, rather coarsely warted, 10-15 μ diam.

TYPE LOCALITY: Fort Colville, Washington.

HABITAT: On dead plant stems, twigs, etc. in mountainous regions.

DISTRIBUTION: California, Idaho, Kansas, Nevada, Utah, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 90.

This species is more common than *D. niveum*, and like it is confined to the more western part of North America. It is distinguished from *D. niveum* by the paler, flesh-colored inner wall, and the spores, which are usually larger, darker, and more coarsely marked. The spores of American specimens are not as dark nor as rough as those of European forms, generally. The columella is more prominent than that of *D. niveum*. The lime in the sporangial wall is sometimes in the form of vitreous plates which makes the sporangia appear gray.

10. ***Diderma testaceum*** (Schrad.) Pers. Syn. Meth. Fung. 167. 1801.

Didymium testaceum Schrad. Nov. Gen. Pl. 25. 1797.

Plasmodium yellowish buff (Torrend). Sporangia gregarious, subglobose, 0.6 to 0.8 mm. diam., sessile, depressed on a broad base, sometimes confluent, smooth, flesh-colored or pale pinkish, often faded to white; sporangial wall of two layers, the outer thin, brittle, eggshell-like, composed of globular lime-granules, separating freely from the more persistent, pinkish gray, membranous, inner layer. Columella large, convex or hemispherical, together with the base of the sporangium flesh-colored or reddish brown. Capillitium consisting of delicate, pale purplish, branching, flexuose threads. Spores pale violet-brown, almost smooth, 7-10 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves, mosses, etc., in wet places.

DISTRIBUTION: Common in North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 87, figs. a-c.

Appearing in June, and repeatedly thereafter during the summer and autumn, in wet bogs and swamps, it is often in great abundance. From other similar forms it is distinguished by its color, the large, often dark columella, the depressed shape, and the scattered habit. The sporangia are often white.

11. ***Diderma simplex*** (Schroet.) Lister, Mycetozoa ed. 2. 107. 1911.

Chondrioderma simplex Schroet. in Cohn, Krypt. Fl. Schles. 3 (1): 123. 1885.

Plasmodium orange-brown (Lister). Sporangia sessile, scattered, crowded, in small clusters, or heaped, 0.4 to 1 mm. diam., subglobose, pulvinate, or depressed, or forming short, curved, or

irregular plasmodiocarps, ochraceous yellow, yellow, or reddish, sometimes fading to white, smooth or rugulose, rarely on a hypothallus; sporangial wall single, membranous, densely charged with colored lime-granules. Columella lacking, represented by an elevation of the sporangial floor to form a hollow pseudo-columella, prominent or indefinite. Capillitium consisting of slender, colorless or dark branching threads, often with expansions at the base. Spores brownish violet, spinulose, 8–12 μ diam.

Var. **echinulatum** Meylan, Bull. Soc. Vaud. Sc. Nat. 52: 450. 1919.

Sporangia hemispherical, rotund, bright yellow; spores strongly spinose.

TYPE LOCALITY: Silesia.

HABITAT: On dead leaves, mosses, etc., in wet places.

DISTRIBUTION: Florida, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ontario, Pennsylvania, Virginia, Wisconsin; var. *echinulatum*, *New Hampshire, New York, Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 88.

In North America, the species seems to be confined to the eastern part, where it is common and often found in abundance. There have been times when I have seen hundreds of fruitings in a single day. The form is very variable in every particular, yet not difficult to recognize because of its single wall, which gives it an appearance distinct from that of any other *Diderma*. European specimens have a darker, brick-red color which is also seen here occasionally. The hypothallus mentioned by other authors is found in such collections, but is more the result of imperfect development, and is not seen in the yellow and ochraceous forms, which constitute practically all the developments. The hollow columella is unique, and appears in most of the material. Lime-knots and spike-like processes are occasionally present in the capillitium. Var. *echinulatum* is well marked by the trim appearance of the bright yellow sporangia, and the more coarsely marked spores. I have found it on a number of occasions associated with the typical form, when the latter appeared abundantly.

12. **Diderma Sauteri** (Rost.) Macbr. N. A. Slime-Moulds 103. 1899.

Chondrioderma Sauteri Rost. Mon. 181. 1874.

Chondrioderma aculeatum Rex, Proc. Acad. Nat. Sc. Phila. 1891: 390. 1891.

Plasmodium opaque white (Lister). Sporangia scattered or somewhat clustered, sessile, subglobose, depressed, 0.6 to 1 mm. diam., smooth, ochraceous, pinkish, or brownish red; sporangial wall of two layers, the outer cartilaginous, thin, brittle, glossy, charged with innate lime-granules, separating from the membranous inner layer. Columella hardly evident, a rugose thickening of the brownish red base of the sporangium. Capillitium consisting of rather scanty, flaccid, sparingly branched, colorless or pale violet threads 2–4 μ broad, persistent at the base. Spores dark violet-brown, spinulose, 10–16 μ diam.

TYPE LOCALITY: Austria.

HABITAT: On mosses and mossy logs.

DISTRIBUTION: *Maine, New Hampshire, New York, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 96.

This species is very rare. American specimens are usually wrinkled because of the separation of the two walls, and pale ochraceous in color. The developments are small and may be easily mistaken for imperfect phases of *D. effusum*. The pale, scanty capillitium, and larger, darker, rougher spores distinguish the form from *D. ochraceum*.

13. **Diderma ochraceum** Hoffm. Deutsch. Fl. Crypt. *pl.* 9, *fig.* 2b. 1795.

Plasmodium lemon-yellow (Lister). Sporangia scattered or in small clusters, sessile, hemispherical or subglobose, 0.4 to 1 mm. diam., often forming curved and sometimes ring-shaped plasmodiocarps, ochraceous, rarely pale red; outer sporangial wall somewhat cartilaginous, with abundant deposits of angular or round, yellow lime-granules, adhering to or free from the firm, membranous, yellow, inner one. Columella indefinite. Capillitium consisting of abundant, simple or branching, purplish brown threads, often hyaline at the base. Spores purplish gray, minutely spinulose, 9–11 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On mosses, or mossy logs and rocks, in wet places.

DISTRIBUTION: *Massachusetts, Pennsylvania, Quebec, Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 95.

Another species that has been found rarely in North America. It seems to appear from late August until November. Mr.

Rispaud and I found a dozen or so small colonies on the tips of moss in a wet sphagnum swamp in Pike County, Pennsylvania. Another gathering was made in upper Quebec (*Mycologia* **31**: 342. 1939), and has speckled walls apparently without lime. The form has been found repeatedly in Europe in company with *Lepidoderma tigrinum*, and with indications that the two species may be closely related.

14. Diderma Trevelyani (Grev.) Fries, Syst. Myc. **3**: 105. 1829.

Leangium Trevelyani Grev. Scot. Crypt. Fl. *pl.* 132. 1824.

Diderma geasterodes Phill. Grevillea **5**: 113. 1877. (N. Y. B. G. nos. 5498, 5677, type material.)

Didymium subcastaneum Romell, Fung. Exsicc. no. 100, not published. (N. Y. B. G. no. 5577.)

Plasmodium pale yellow-brown (Lister). Sporangia scattered or clustered, globose or ellipsoid, 0.8 to 1.5 mm. diam., sessile or short-stalked, rarely forming plasmodiocarps, smooth, or angular with areas of dehiscence, orange-brown, reddish brown, or brown; sporangial wall dividing into unequal revolute, petaloid lobes, white and glossy on the inner side; of three closely connected layers, the outer cartilaginous, brown, the inner delicately membranous, giving attachment to the threads of the capillitium, the middle one composed of coarse, irregular crystals of lime. Stalk furrowed, short, reddish brown. Columella minute, globose or subglobose, usually absent. Capillitium profuse, purple or purplish brown, somewhat rigid, either forming a network with dark, bead-like thickenings at the nodes and on the threads, or slender and branched with few thickenings. Spores dark violet-brown, with a paler area of dehiscence, spinulose, 10–13 μ diam. (PLATE 9, FIG. 3.)

TYPE LOCALITY: England.

HABITAT: On dead leaves, mosses, etc.

DISTRIBUTION: California, Colorado, *Ohio, *Oregon, Virginia, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 91.

The species is separated from all others of the *Leangium* section by the layer of crystalline lime between the inner and outer sporangial walls. The minute, occasionally stalked columella is often absent throughout, or both conditions may be present in the same colony. It was found repeatedly by Dr. W. C. Sturgis in Colorado, and is probably abundant in our western mountains. Mr. Lloyd G. Carr has found it in the mountains of Augusta County,

Virginia. Var. *nivale*, found in the Swiss Alps, is unknown from North America.

15. **Diderma floriforme** (Bull.) Pers. Neues Mag. Bot. 1: 89. 1794.

Sphaerocarpus floriformis Bull. Herb. Fr. pl. 371. 1787; Bull. Champ. 142. 1791.

Plasmodium grayish white (Lister). Total height 1 to 2 mm. Sporangia crowded, often forming large colonies, globose, stalked, erect, smooth, about 0.8 mm. diam., varying from grayish white to ochraceous brown; sporangial wall splitting into revolute petaloid lobes, pale brown on the inner side, cartilaginous, opaque, with a closely adhering, membranous inner layer. Stalks cylindrical, furrowed, 0.5 to 1 mm. long, 0.15 mm. thick, ochraceous brown, often connected below by a well-developed hypothallus. Columella usually clavate, buff to brownish, densely calcareous. Capillitium consisting of slender, sparingly branched threads, with scattered bead-like thickenings, thicker and anastomosing at the base, dark violet-brown. Spores reddish violet-brown, paler on one side, marked with scattered obtuse warts, 8-11 μ diam. (PLATE 9, FIG. 4.)

TYPE LOCALITY: France.

HABITAT: On decaying wood.

DISTRIBUTION: Common in eastern North America, and probably elsewhere.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 92.

The large colonies appear about the middle of August on very rotten wood. The spores, with strong, scattered warts, distinguish the species from all forms of *D. radiatum*, or the columella, when clavate, is usually sufficient. Limeless developments, purple-brown in color and on dark stalks, are occasionally found. The lime is sometimes in the form of vitreous discs or plates, a feature not unusual in other species of *Diderma*.

16. **Diderma radiatum** (L.) Morg. Jour. Cin. Soc. Nat. Hist. 16: 151. 1894.

Lycoperdon radiatum L. Sp. Plant. ed. 2. 1654. 1763.

Plasmodium white or pale yellow (Lister). Sporangia scattered or crowded, subglobose or hemispherical and depressed, flattened or umbilicate beneath, stalked or sessile, smooth or somewhat wrinkled and rimose, 0.5 to 1.2 mm. diam., pale gray,

brownish, or red-brown, often mottled or areolate with pale lines of dehiscence; sporangial wall dehiscing in a stellate manner by revolute lobes, white or pale brown on the inner side, the outer layer cartilaginous, with granular deposits of lime, closely connected with the membranous inner layer. Stalk ochraceous or reddish brown, usually short and stout, enclosing white lime deposits. Columella hemispherical or subglobose, often large, white, cream-colored, or red-brown, densely calcareous. Capillitium abundant, dark violet-brown, radiating from the columella in somewhat rigid threads, sparingly branched except at the colorless extremities, rarely pale, slender, and flexuose. Spores purplish brown, often paler, closely and minutely spinulose, 9–12 μ diam. (PLATE 9, FIG. 5.)

Var. **umbilicatum** (Pers.) Meylan, Ann. Conserv. Bot. Genève **15-16**: 312. 1913.
Diderma umbilicatum Pers. Syn. Meth. Fung. 165. 1801.

Sporangia smaller, white or gray, umbilicate beneath, dehiscing irregularly.

TYPE LOCALITY: Sweden.

HABITAT: On dead wood.

DISTRIBUTION: Throughout the United States and Canada.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 93; *pl.* 94, *figs.* a, b.

This species is not common in eastern North America, and colonies are usually small. The many large collections made by Bethel, and by Sturgis, in Colorado, indicate it is more of a western mountain-form. Var. *umbilicatum* is rare after removal of forms now regarded as *D. montanum*. The color of the spores is dark in only occasional specimens. Usually they are normal purplish brown, and frequently paler, which also applies to some European collections. Specimens of *D. radiatum*, *D. radiatum* var. *umbilicatum*, and *D. montanum*, from Switzerland, courteously sent by M. Ch. Meylan, have pale spores in all three. Two other varieties, found in Europe, have not been reported from North America.

17. **Diderma roanense** (Rex) Macbr. N. A. Slime-Moulds 104. 1899.

Chondrioderma roanense Rex, Proc. Acad. Nat. Sc. Phila. **1893**: 368. 1893.

Plasmodium? Sporangia scattered, stalked, discoidal and flattened, or slightly convex, 0.8 to 1.2 mm. diam., mottled red-

brown or dark umber, with paler lines of dehiscence; sporangial wall dehiscing irregularly or in a somewhat stellate manner, consisting of two layers, the outer cartilaginous, brown on the outer and white on the inner side, more or less adhering to the membranous inner layer. Stalk short, black, furrowed, slender or stout. Columella large, flat, discoidal, yellow to ochraceous brown. Capillitium consisting of slender, simple or branched, colorless threads. Spores purplish brown, spinulose, 10–14 μ diam.

TYPE LOCALITY: Tennessee.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, *Maine, New Hampshire, New York, North Carolina, Ontario, Pennsylvania, *Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 94, *figs. c. d.*

The flat, discoid sporangia on black stalks, similar in shape to the sporangia of *D. hemisphericum*, distinguish the form from *D. radiatum*, with which it is connected by intermediate forms with more hemispherical sporangia and columellae, and usually on red-brown stalks.

18. **Diderma asteroides** Lister, Mycetozoa ed. 2. 113. 1911.
(N. Y. B. G. no. 12495, authentic material.)

Chondriodermma asteroides A. & G. Lister, Jour. Bot. 40: 209. 1902.

Licea antarctica (?) Speng. Bol. Acad. Cienc. Córdoba 11: 58. 1887.

Diderma antarcticum ("antarctica") Sturg. Mycologia 8: 37. 1916. (N. Y. B. G. nos. 12486, 12487, type.)

Plasmodium cream-yellow to bright orange (Lister). Sporangia scattered or crowded, hemispherical or somewhat conical, 0.6 to 0.8 mm. high, sessile, rarely short-stalked or forming plasmodiocarps, purplish brown, chocolate, or pinkish brown, often mottled with darker spots or marked with numerous darker lines radiating from near the apex to the base of the sporangium; sporangial wall dehiscing by petaloid lobes, white on the inner side, the outer layer brown, cartilaginous, with abundant deposits of lime on the inner side, usually connected with the membranous inner layer. Stalk very short, stout, white, often rising from a white hypothallus. Columella ochraceous or cream-colored, usually large, hemispherical, subglobose or depressed, but variable and irregular, or small, rough or rugose. Capillitium of slender, simple or anastomosing, colorless or purplish threads. Spores purple-brown, minutely warted, 9–12 μ diam.

TYPE LOCALITY: Italy.

HABITAT: On dead wood, leaves, and mosses.

DISTRIBUTION: *California, Colorado, *Ontario, Oregon, *Washington.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 97; 209, as *D. antarctica*.

This species, although distinct, resembles *D. radiatum* and *D. Trevelyani* in the manner of dehiscence, and may be confused, particularly with the latter. There are often masses of lime within the sporangium between the capillitium and inner wall, and the columella may be minute or almost obsolete. In *D. Trevelyani* there is a layer of crystalline lime between the two layers of the wall. *D. antarcticum* was described by Sturgis from a collection made by Prof. Thaxter at Punta Arenas, Chile, and the specimens are now in the Herbarium of the New York Botanical Garden. It is surely an erratic phase of *D. asteroides*. The spores do not have raised bands, but show the lines so often seen on old and dried spores due to contraction and pressure. The columellae and capillitia are extremely irregular, accompanied occasionally by spike-like, calcareous processes, and the conditions throughout the sporangia are not uniform. Similar abnormal conditions appear occasionally in developments of other species of *Diderma* and are mentioned under *D. spumarioides* and *D. simplex*. They are due often to changes in temperature or moisture during the formation of the sporangia. Dr. Plunkett (Pub. Univ. Calif. Biol. Sc. 1: 41. 1934), reports as *D. antarcticum* two collections from California, and mentions differences between them and published descriptions and figures of *D. antarcticum*. Sturgis regarded the specimens collected by Thaxter in Chile as agreeing with the description of *Licea antarctica* Speg., and this opinion has been followed by later authors.

19. ***Diderma rugosum*** (Rex) Macbr. N. A. Slime-Moulds 105. 1899.

Chondrioderma rugosum Rex, Proc. Acad. Nat. Sc. Phila. 1893: 369. 1893. (N. Y. B. G. no. 5616, type material.)

Plasmodium gray (Rex). Sporangia scattered, stalked, rarely sessile, subglobose or hemispherical, 0.4 to 0.5 mm. diam., grayish white, brown at the base, wrinkled and depressed between the wrinkles which divide the wall into numerous, irregularly polyhedral reticulations; sporangial wall single, thin, with scanty deposits of lime in minute granules. Stalk subulate, 0.4 to 0.8

mm. high, black, furrowed. Columella clavate, about half the height of the sporangium, rugose, chalky or yellowish white. Capillitium consisting of slender, colorless or purplish threads, anastomosing and branching towards the tips. Spores violet or purplish brown, minutely warted, 8–12 μ diam.

TYPE LOCALITY: Cranberry, North Carolina.

HABITAT: On dead leaves and mosses.

DISTRIBUTION: Florida, *Iowa, North Carolina, Tennessee, *West Indies.

ILLUSTRATION: Lister, Mycetozaa ed. 3. *pl.* 86.

The black stalks, the wrinkled sporangia, and the clavate, white columellae distinguish the species from immature phases of *Didymium xanthopus* which it sometimes resembles.

Genus 10. **DIACHEA** Fries, Syst. Orb. Veg. 1: 143. 1825.

Sporangia stalked or sessile. Sporangial wall hyaline, iridescent, without deposits of lime. Walls of stalk and columella membranous, charged with lime in the form of granules or crystalline nodules, sometimes without lime. Capillitium a profuse network of purplish threads without lime-knots.

This genus is a connecting link between the *Calcarineae* and the *Stemonitaceae*. The limeless forms, *D. cylindrica* and *D. caespitosa*, although showing affinities to *Lamproderma*, are retained in *Diachea* because of the tubular character of the stalks.

TYPE SPECIES: *Stemonitis elegans* Trent.

Sporangia globose.

Lime in stalk white, sometimes absent.

Spores with scattered warts or spines.

Spores with coarse scattered protuberances and ridges.

Spores reticulate with spines.

Sporangia usually sessile; spores minutely warted.

Lime in stalk orange.

Sporangia cylindrical (globose in *D. leucopodia* var. *globosa*).

Sporangia distinct; lime in stalk white; spores minutely spinulose.

Sporangia clustered; lime absent; spores reticulated.

Sporangia clustered; lime absent; spores warted.

2. *D. bulbilosa*

3. *D. splendens*

4. *D. subsessilis*

5. *D. radiata*

6. *D. Thomasii*

1. *D. leucopodia*

7. *D. cylindrica*

8. *D. caespitosa*

1. **Diachea leucopodia** (Bull.) Rost. Mon. 190. 1874.

Trichia leucopodia Bull. Herb. Fr. *pl.* 502, fig. 2. 1790; Bull. Champ. 121. 1791.

Stemonitis elegans Trent. in Roth, Cat. Bot. 1: 220. 1797.

Diachea elegans (Trent.) Fries, Syst. Orb. Veg. 1: 143. 1825.

Plasmodium opaque white (Lister). Sporangia gregarious, cylindrical, obtuse, 0.7 to 1.2 mm. high, 0.3 to 0.8 mm. broad, stalked, occasionally sessile, iridescent blue, purple, or brown; sporangial wall membranous, hyaline. Stalk white, rarely brownish, stout, tapering, brittle, 0.4 to 0.9 mm. high, rising from a well-developed hypothallus, densely charged with round granules or crystalline nodules of lime. Columella cylindrical or narrowed upwards, reaching half-way or nearly to the apex of the sporangium, white, charged with lime like the stalk. Capillitium consisting of profusely branched and anastomosing threads connecting the columella with the sporangial wall, dark violet-brown, colorless at the extremities. Spores dull violet, minutely spinulose, 7-9 μ diam. (PLATE 15, FIG. 5.)

Var. *globosa* Lister, Mycetozoa ed. 2. 118. 1911.

Sporangia globose.

TYPE LOCALITY: France.

HABITAT: On dead leaves, twigs, and other ground material.

DISTRIBUTION: Common and abundant throughout North America; var. *globosa*, Connecticut, New York, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 99, *figs.* a-c.

This species is very common and forms large developments in dry places. The stalk varies considerably in length in relation to the sporangium. Usually from one third to one half, it may be longer than the sporangium, or very short and occasionally lacking so that the sporangia are sessile. The sporangia are usually long-cylindrical, but may be shortened, gradually becoming globose and forming var. *globosa*. The variety is rare and always accompanied by sporangia more or less cylindrical. This separates them roughly from *D. bulbillosa*, where the sporangia are always uniformly globose. The spores are closely and faintly marked with minute spines.

2. *Diachea bulbillosa* (Berk. & Br.) Lister, Jour. Bot. 36: 165. 1898.

Didymium bulbillosum Berk. & Br. Jour. Linn. Soc. 14: 84. 1873.

Plasmodium white (Lister). Sporangia gregarious, globose, 0.3 to 0.5 mm. diam., iridescent blue, purple, or brown, stalked; sporangial wall membranous, colorless. Stalk white, occasionally brown, tapering, 0.5 to 1 mm. high, filled with granules or

crystalline nodules of lime. Columella clavate or conical, white or brown, filled with lime like the stalk or limeless. Capillitium a rather lax network of purplish brown threads spreading from the columella. Spores violet-gray, marked with scattered warts, 7–11 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On leaves, twigs, and other ground material.

DISTRIBUTION: Canal Zone, Florida, Indiana, Kansas, Massachusetts, New York, North Carolina, Ohio, Ontario, Puerto Rico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 99, *figs.* g, h.

This species sometimes forms large developments. Southern specimens, tropical and subtropical, usually have the stalks more slender, the lime in the form of crystalline nodules, the columella conical, and prominent scattered spines on the spores. Northern specimens have a stouter stalk with the lime in granules, and a clavate columella. Also, the spores are sometimes brownish, and the spines on the spores while scattered, are not so dark. The scattered spines on the spores, and the uniformly globose sporangia, distinguish the form from *D. leucopodia* var. *globosa*. Martin (Trans. Am. Mic. Soc. 55: 279. 1936) reports the plasmodium as yellow in material from the Panama Canal Zone.

3. ***Diachea splendens*** Peck, Rept. N. Y. State Mus. 30: 50. 1878. (N. Y. B. G. nos. 5492, 7956, 12570, type material.)

Diachea bulbillosa (Berk. & Br.) Lister var. *splendens* G. Lister, Mycetozoa ed. 3. 103. 1925.

Plasmodium? Sporangia gregarious, globose, 0.4 to 0.6 mm. diam., brilliant blue, stalked; sporangial wall membranous, colorless. Stalk stout, tapering, white, 0.4 to 1 mm. high, filled with lime. Columella clavate or cylindrical, containing lime. Capillitium a network of purplish brown threads spreading from the columella. Spores violet-gray, 7–9 μ diam., marked with large stout scattered protuberances, often confluent to form ridges.

TYPE LOCALITY: New York.

HABITAT: On dead leaves, twigs, and other ground matter.

DISTRIBUTION: *Iowa, Kansas, Massachusetts, Mississippi, *Nebraska, New Jersey, New York, Ohio, *Ontario, Pennsylvania, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 99, *figs.* d–f, as *D. bulbillosa*.

This species is prominently distinguished by the spores with their large, dark, stout protuberances, flared at the tops, which are not spines nor warts. The brilliant blue sporangia, somewhat larger than those of related species, provide easy recognition in the field. The developments appear usually after the middle of August. For further remarks see *Mycologia* 30: 340. 1938.

4. *Diachea subsessilis* Peck, Rept. N. Y. State Mus. 31: 41. 1879. (N. Y. B. G. no. 12708, type material.)

Plasmodium yellow (Lister). Sporangia gregarious, somewhat clustered, globose, 0.4 to 0.6 mm. diam., stalked or sessile, shining iridescent bronze, rarely blue; sporangial wall membranous, colorless. Stalk stout, tapering, white, 0.2 to 0.5 mm. high, filled with lime either in the form of granules or crystalline nodules, rarely brown and without lime. Columella small, conical, white or brownish, usually absent in the sessile forms. Capillitium radiating from the columella or base, and consisting of branched and anastomosing, purple-brown threads, usually stouter and paler below, slender and colorless at the tips. Spores purplish gray, 7–10 μ diam., reticulated with rows of close-set warts or spines, forming a net of small or large meshes.

TYPE LOCALITY: New York.

HABITAT: On dead leaves, twigs, etc.

DISTRIBUTION: Colorado, Connecticut, Florida, *Iowa, Kansas, Massachusetts, New York, Ontario, Pennsylvania, Quebec.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. pl. 100.

This species forms small colonies in dry places, and is not uncommon. The species of *Diachea* forming globose sporangia are sharply separated by spore characters. In the present one the reticulations on the spores are diagnostic. They are often large and prominent, but may be small and faint. The color of the spores varies somewhat, also.

5. *Diachea radiata* G. Lister & Petch; G. Lister, Jour. Bot. 54: 130. 1916. (N. Y. B. G. nos. 12567, 12568, authentic material.)

Plasmodium orange-yellow (Lister). Sporangia loosely clustered or crowded in large colonies, hemispherical or globose, 0.4 to 0.5 mm. diam., sessile, rarely stalked, iridescent gray or

bronze, seated on a white hypothallus; sporangial wall membranous, colorless. Stalks when present short, stout, furrowed, charged with white lime-granules. Columella white, convex, conical, or short-cylindrical. Capillitium a network of slender, purple-brown threads radiating from the columella. Spores pale violet-gray, spinulose or warted, 8–11 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead leaves and stems.

DISTRIBUTION: *Canal Zone, Florida.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 211.

The characters of the sporangium proper are those of *D. bulbillosa*, and it would seem to be a sessile form of that species were it not for the unusual hypothallus, which is the important character. The authors say in their description that the spores in material from Ceylon are distinctly rougher than those of *D. leucopodia*, and this is confirmed by an examination of the material. The Florida collection made by Dr. Erdman West has sporangia typically embedded in the hypothallus, and the spines on the spores are coarse and scattered as in *D. bulbillosa*. In authentic material from Ceylon and South Nigeria, the dense, continuous hypothallus is drawn into small patches with shallow pits, one to each sporangium, and in which the sporangia are partly embedded. The columella is usually a projection from the hypothallus in the center of the pit, but is often absent. The capillitium springs from this projection, or if absent, directly from the hypothallus. There seem to be no floors to the sporangia. The color of the plasmodium cannot be regarded as a specific character because Martin (see *D. bulbillosa*) has observed *D. bulbillosa* developing from a yellow plasmodium. *D. radiata* may be a sessile phase of *D. bulbillosa*, developing under tropical conditions, and this is indicated somewhat by the Florida specimen, in which there are many sporangia entirely free from the hypothallus.

6. *Diachea Thomasii* Rex, Proc. Acad. Nat. Sc. Phila. 1892: 329. 1892. (N. Y. B. G. no. 5306, type material.)

Plasmodium yellow. Sporangia in small clusters or crowded, forming large colonies on a common, orange hypothallus, globose, 0.4 to 0.7 mm. diam., short-stalked or sessile, iridescent, metallic brown or copper-colored; sporangial wall membranous, hyaline. Stalk short, stout, orange, densely charged with orange lime-

granules, continued above into the conical or short-cylindrical columella. Capillitium radiating from all parts of the columella, composed of rather rigid, violet-brown threads, branching and anastomosing, tapering to the hyaline extremities. Spores olive-brown, marked with small, scattered warts, and several patches composed of clusters of warts, 10–12 μ diam.

TYPE LOCALITY: North Carolina.

HABITAT: On the bark of dead and mossy trees.

DISTRIBUTION: North Carolina, Pennsylvania, Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 101.

This beautiful species is rare, and so far has been found only in the States mentioned. It forms large, densely crowded colonies of sporangia, and is readily recognized in the field by the prevailing orange color of the stalks and hypothallus. When somewhat imperfectly developed, the color of the sporangia may be blue, but the normal color is brown, if properly matured. Similar conditions are found in other species of *Diachea*, and also in species of *Lamproderma*.

7. *Diachea cylindrica* Bilgr. Proc. Acad. Nat. Sc. Phila. 57: 524. 1905. (N. Y. B. G. no. 12707, type material.)

Comatricha cylindrica (Bilgr.) Macbr. N. A. Slime-Moulds ed. 2. 173. 1922.

Plasmodium? Sporangia clustered in small groups, sessile, cylindrical, 1 to 1.7 mm. high, 0.5 to 0.65 mm. thick, shining, iridescent bronze or steel-gray; sporangial wall membranous, colorless, persistent, at length breaking away in large fragments. Columella without lime, pale brown, slender, tubular, extending nearly to the apex of the sporangium, or breaking into irregular, branching strands. Capillitium of branched and anastomosing, purplish brown threads, spreading from all parts of the columella, slender and colorless at the tips. Spores pale purplish gray, 11–12 μ diam., reticulate with small or large meshes, the lines of the reticulations composed of minute spines.

TYPE LOCALITY: Pennsylvania.

HABITAT: On leaves and twigs.

DISTRIBUTION: Florida, New Hampshire, Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 103, *figs.* a–e.

This species is rare, and following the New Hampshire and Pennsylvania collections, was not found again for 35 years until Dr. H. C. Beardslee collected it in Florida in 1940. It is allied

to *D. caespitosa*, but differs in having spores that are reticulated with small spines.

8. *Diachea caespitosa* (Sturg.) A. & G. Lister, Jour. Bot. **45**: 186. 1907.

Comatricha caespitosa Sturg. Bot. Gaz. **18**: 186. 1893. (N. Y. B. G. no. 12698, type.)

Plasmodium orange-yellow. Sporangia in clusters of six to thirty, sessile or short-stalked, cylindrical or clavate-cylindrical, 0.7 to 1.5 mm. high, 0.5 mm. thick, iridescent blue or bronze; sporangial wall membranous, colorless, soon breaking away above, more persistent below. Stalk slender, dark brown, very short, without lime, rising from a yellowish membranous hypothallus. Columella without lime, a slender membranous wrinkled tube, brown below, yellowish above, reaching nearly to the apex of the sporangium. Capillitium a network of purple-brown threads, spreading from all parts of the columella. Spores pale purplish gray, 9–11 μ diam., marked with small, scattered warts, and several clusters of stronger warts.

TYPE LOCALITY: Massachusetts.

HABITAT: On mosses.

DISTRIBUTION: Maine, Massachusetts, New Hampshire, *North Carolina, Ontario.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 103, *figs.* f–j.

Related to *D. cylindrica*, it differs in the spore characters. The form is rare, and the collection by Mr. Eli Davis at Byron, Ontario, in 1940, was the first in over 30 years. *D. cylindrica* and *D. caespitosa* connect the genera *Diachea* and *Lamproderma*, having the thin, iridescent, persistent, sporangial walls common to species of both genera, and the tubular stalks and columellae of *Diachea*, although free from lime. Limeless forms are found occasionally in several species of the genus *Diachea*. The two forms have only a superficial resemblance to *Comatricha*, where the sporangial wall is of a different nature, and more or less evanescent with complete maturity of the sporangia.

Family II. DIDYMIACEAE

Deposits of lime in the form of crystals or crystalline discs distributed over the sporangial wall; capillitium without lime-knots (except in *Didymium Sturgisii*); sporangia simple, except in *Mucilago*, where they are combined into an aethalium.

- | | |
|---|-----------------|
| Lime-crystals stellate; sporangia simple. | 11. DIDYMIUM |
| Lime-crystals stellate, heaped together, at first concealing the confluent sporangia. | 12. MUCILAGO |
| Lime-crystals more or less lenticular and scale-like, thickly scattered over the sporangial wall. | 13. LEPIDODERMA |
| Lime-crystals few, minute, flat, sometimes absent. | 14. LEPTODERMA |

Genus 11. **DIDYMIUM** Schrader, Nov. Gen. Pl. 20. 1797.

Sporangia stalked, sessile, or forming plasmodiocarps; sporangial wall membranous or cartilaginous, with superficial crystals of lime either scattered over the surface or combined into a separable crust. Capillitium of branching threads, which are thickened at intervals with dark calyciform nodes, in normal developments without lime-knots, in *D. Sturgisii* consisting of simple tubes containing lime-crystals.

TYPE SPECIES: *Didymium farinaceum* Schrad.

Crystals closely combined to form a thin, eggshell-like crust.

Sporangia or plasmodiocarps always sessile, white or gray.

Sporangia pulvinate; capillitial threads scanty, broad at the base, or profuse and slender throughout; spores nearly smooth.

1. *D. difforme*

Sporangia pulvinate; capillitium a network of stout, purple threads; spores rough with close-set warts and ridges.

2. *D. quitense*

Sporangia pulvinate or branching plasmodiocarps; spores rough with short spines.

3. *D. trachysporum*

Sporangia flat or convex; capillitium dark, profuse, slender at the points of attachment.

4. *D. Listeri*

Sporangia short-stalked or sessile, turbinate, white or cream-colored; capillitium rigid, usually colorless.

5. *D. vaccinum*

Crystals scattered or loosely combined into a crust.

Sporangia and plasmodiocarps always sessile (except in *D. fulvum*).

Plasmodiocarps white or gray; capillitium with large, vesicular spore-like bodies.

Plasmodiocarps depressed, flattened or effused; columella absent.

6. *D. complanatum*

Plasmodiocarps branched and netted, laterally compressed; columella a thin, vertical plate.

7. *D. parietale*

Sporangia or plasmodiocarps without vesicular bodies.

White or gray.

Plasmodiocarps thinly effused; capillitium of simple tubes containing lime crystals and forming vertical columns.

14. *D. Sturgisii*

Sporangia and slender plasmodiocarps with scanty deposits of lime, dehiscing in a circumscissile manner; columella absent.

15. *D. anellus*

Plasmodiocarps large, pulvinate, 1 to 20 mm. long, or more, dehiscing irregularly; columella absent; capillitium an elastic network.

17. *D. dubium*

Sporangia or plasmodiocarps yellow.

Sporangia or slender plasmodiocarps with scanty, yellow lime deposits; otherwise as in *D. anellus*.

16. *D. ochroideum*

Sporangia and plasmodiocarps robust with orange-spotted walls; occasionally with short, orange stalks.

19. *D. fulvum*

Sporangia always stalked, gray or white except occasionally in *D. eximium*.

Sporangia disc-shaped.

Stalk dark brown or black; spores 5-8 μ diam., pale and nearly smooth.

8. *D. Clavus*

Stalk yellowish; spores 9-12 μ diam., dark, reticulate.

20. *D. intermedium*

Sporangia more or less globose and umbilicate beneath.

Stalk long, dark; columella small, dark, globose.

10. *D. nigripes*

Stalk long, orange; columella large, discoidal, yellow or pale; sporangia often with yellow lime crystals.

11. *D. eximium*

Stalk long, red-brown; columella subglobose or turbinate, pale.

12. *D. xanthopus*

Sporangia stalked, sessile or forming plasmodiocarps, white or gray.

Sporangia usually stalked, subglobose, umbilicate beneath; stalk short, dark; columella large, dark.

9. *D. melanospermum*

Sporangia stalked, sessile or forming effused plasmodiocarps; stalks when present, short, pale; columella pale.

13. *D. squamulosum*

Sporangia with an outer smooth, deciduous crust of lime-crystals; stalk when present short, membranous, pale buff.

18. *D. crustaceum*

1. **Didymium difforme** (Pers.) Duby, Bot. Gall. 2: 858. 1830.

Diderma difforme Pers. Tent. Disp. Meth. 9. 1797.

Plasmodium colorless or yellow (Lister). Sporangia scattered, pulvinate, on a broad base, or forming plasmodiocarps 0.4 to 2 mm. or more long, smooth, white; sporangial wall of two layers, the outer a thin eggshell-like crust of densely combined minute crystals of lime, separating from the iridescent membranous inner layer, which is purplish or colorless above, yellowish brown and thickened at the margin. Floor of sporangium an orange or purplish membrane with scanty deposits of small lime-crystals. Capillitium rather scanty, consisting of coarse or slender, purple or colorless, flattened threads, usually broad at the base, branching dichotomously, and slender above. Spores dark purple-brown or purplish gray, faintly and closely warted, with a pale area of dehiscence, 11–14 μ diam.

Var. **comatum** Lister, Jour. Bot. 39: 8. 1901.

Capillitium profuse, of slender, straight, branching threads, not thicker below, dark or colorless; spores purplish gray.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves, herbaceous stalks, and twigs.

DISTRIBUTION: California, Colorado, Kansas, Massachusetts, New York, Ontario, *Oregon, Pennsylvania, *Washington; var. *comatum*, *Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 104.

D. difforme and the two following species, *D. quitense* and *D. trachysporum*, constitute a group the members of which are very much alike in their general appearance when observed with a hand-lens, and are separated mainly by their spore-characters. Their habitats also are similar, often on composts, or under shrubbery on dry, black, curled and twisted leaves. Var. *repandum* G. Lister, not rare in Europe, has not been reported from North America.

2. **Didymium quitense** (Pat.) Torrend, Fl. Myx. 150. 1909.

Chondrioderma quitense Pat.; Pat. & Lag. Bull. Soc. Myc. Fr. 11: 212. 1895.

Plasmodium? Sporangia scattered, sessile, hemispherical, depressed, 0.4 to 0.5 mm. diam., or forming long plasmodiocarps, smooth, white; outer sporangial wall of small lime-crystals combined to form a white, eggshell-like crust, separating from the membranous, pale purplish, inner layer. Capillitium a network

of rather stout, purplish brown, straight or flexuose threads, equal in thickness throughout. Spores dark brownish purple, 13–14 μ diam., marked with warts and ridges more or less united to form a close reticulation.

TYPE LOCALITY: Ecuador.

HABITAT: On dead leaves and herbaceous stalks.

DISTRIBUTION: *California, Colorado.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 218, *figs.* f–h.

Allied to *D. difforme*, from which it differs in the dark network of the capillitium and in the uniformly dark spores being marked with an imperfect reticulation.

3. ***Didymium trachysporum*** G. Lister, Essex Nat. 20: 113. 1923. (N. Y. B. G. no. 8963, authentic material.)

Plasmodium colorless (Lister). Sporangia more or less scattered, hemispherical, 0.2 to 0.6 mm. diam., or forming slender, simple, curved, branched or ring-shaped plasmodiocarps, white or cream-colored; outer sporangial wall a smooth or wrinkled crust of closely compacted lime-granules, the inner one membranous, colorless. Floor of sporangium pale yellow, membranous with a thickened margin, and with scanty, rarely abundant, deposits of lime-crystals. Capillitium rather scanty, variable, consisting usually of a network of colorless or purplish, stout or slender threads, sometimes with vesicular expansions enclosing lime-crystals. Spores brownish purple, 9–10 μ diam., marked with short spines, scattered or grouped in clusters, rarely with patches of broken reticulation; spores often traversed by a low ridge.

TYPE LOCALITY: England.

HABITAT: On dead leaves and herbaceous stalks.

DISTRIBUTION: *Oregon.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 218, *figs.* a–e.

Also related to *D. difforme* and similar in appearance, but differing in the spore-characters. The species is not rare in Europe.

4. ***Didymium Listeri*** Masee, Mon. 244. 1892.

Didymium dubium Rost.; Lister, Mycetoza 95, in part. 1894. (N. Y. B. G. nos. 13082, 13083, Lister material.)

Plasmodium watery white (Lister). Sporangia solitary, hemispherical, flattened, 0.5 to 1 mm. diam., or forming broad,

flattened plasmodiocarps 2 to 12 mm. across, 0.15 mm. thick; sporangial wall of two layers; outer layer an eggshell-like crust of closely combined large stellate crystals of lime, often extending beyond the broad, membranous base of the sporangium, and powdered with free crystals, which often break away entirely; inner layer membranous. Columella none. Capillitium profuse, of rigid, dark purplish brown or pale threads, anastomosing chiefly above and below, more or less connected by bars, and attached by slender, colorless branches to the sporangial wall. Spores violet-gray, spinulose or nearly smooth, 8–15 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead leaves and stems.

DISTRIBUTION: *Bermuda, *Iowa, Kansas.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 105, as *D. dubium*.

The Kansas collections are probably as representative of this species as may be found in North America. They consist of thinly effused, flattened plasmodiocarps, similar to those of *D. squamulosum* and *D. complanatum*. From the former it is distinguished by the connecting bars of the threads of the capillitium, and from *D. complanatum* by the absence of vesicles in the capillitium.

5. **Didymium vaccinum** (Dur. & Mont.) Buchet; Buchet, Cherm. & Evrard, Bull. Soc. Myc. Fr. 36: 110. 1920.

Diderma vaccinum Dur. & Mont. Expl. Sc. Alg. Bot. 1: 408. 1848.

Didymium Trochus Lister, Jour. Bot. 36: 164. 1898. (N. Y. B. G. no. 13080, authentic material.)

Plasmodium bright yellow (Lister). Sporangia scattered, hemispherical or turbinate, 0.6 to 1 mm. diam., short-stalked or sessile, rarely forming plasmodiocarps, smooth, white or cream-colored; sporangial wall readily falling away entire, and consisting of two layers; outer layer brittle and shell-like, composed of closely compacted angular or stellate crystals of lime, forming a hemispherical cap fitting upon the yellowish brown, thickened margin of the large hemispherical columella; inner layer membranous, usually adhering to the outer layer. Stalk obconical or shortly cylindrical, yellowish brown, 0.2 to 0.4 mm. high, filled like the columella with stellate crystals of lime. Capillitium consisting of rigid and persistent colorless or purplish brown threads, nearly simple or branched, sometimes expanded below

into membranous vesicles filled with lime-crystals. Spores purplish brown, 9–12 μ diam., paler on one side, strongly warted, with the warts smaller on the pale side; in irregular developments, the warts may be replaced by small patches of close reticulation.

TYPE LOCALITY: Algeria.

HABITAT: On decaying leaves and straw.

DISTRIBUTION: *California.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 106.

A well-marked species with characters not present in any other species of *Didymium*.

6. *Didymium complanatum* (Batsch) Rost. Mon. 151. 1874.

Lycoperdon complanatum Batsch, Elench. Fung. Cont. 1: 251. 1786.

Plasmodium lemon-yellow (Lister). Sporangia forming scattered or solitary depressed plasmodiocarps 2 to 8 mm. broad, 0.1 to 0.15 mm. thick, either effused, perforated and net-like, or vermiform, gray; sporangial wall membranous, colorless, with scattered superficial stellate crystals of lime. Columella none. Capillitium consisting of very slender, pale violet threads, somewhat branching and anastomosing, connected with numerous, subglobose vesicles 20–50 μ diam., filled with yellow, obscurely granular matter. Spores pale violet-brown, minutely warted, 7–9 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves and stems.

DISTRIBUTION: Florida, *Iowa, *Maine, *New York, *Pennsylvania, Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 107.

This species is distinguished from all other species of *Didymium* forming similar effused and depressed plasmodiocarps by the vesicles in the capillitium.

7. *Didymium parietale* Martin & Brooks, Trans. Am. Mic. Soc. 57: 320. 1938. (N. Y. B. G. no. 8944, type material.)

Plasmodium? Sporangia sessile, crowded, forming branched or netted plasmodiocarps, laterally compressed, 0.2 to 0.4 mm. broad, 0.3 to 0.5 mm. high, and up to 12 mm. or more across, white or gray; sporangial wall membranous with sparsely dis-

tributed deposits of lime in the form of stellate or angular crystals. Columella a thin ridge or plate extending along the plasmodiocarp from the base upward to nearly the top, and filled with angular lime-granules. Capillitium a dense network of pale, slender threads, among which are numerous vesicular bodies several times the size of the spores, paler in color, and spinulose. Spores dark purple-gray, 10–12 μ diam., marked with coarse, scattered spines, which are often confluent to form short ridges.

TYPE LOCALITY: Kansas.

HABITAT: On dead leaves.

DISTRIBUTION: *Iowa, Kansas.

ILLUSTRATION: Martin & Brooks, Trans. Am. Mic. Soc. 57: 320, figs. 1–5.

This species has been found in Kansas repeatedly over several years by Mr. Travis E. Brooks, the junior author, and he has also found it in Iowa. It is interesting, not only because of the large vesicular bodies in the capillitium, similar to those in *D. complanatum*, but because of the thin, plate-like columellae extending longitudinally throughout the plasmodiocarps from the bases nearly to the tops. In the type collection, the surface lime is in the form of crystalline, angular nodules. In other gatherings, the stellate crystals, characteristic of the genus *Didymium*, are present.

8. **Didymium Clavus** (Alb. & Schw.) Rabenh. Deutsch. Krypt. Fl. 1: 280. 1844.

Physarum Clavus Alb. & Schw. Consp. Fung. 96. 1805.

Plasmodium gray or colorless (Lister). Total height 0.4 to 1 mm. Sporangia scattered, disc-shaped, often centrally depressed, 0.7 to 1 mm. diam., 0.2 mm. thick, stalked, erect, grayish white; sporangial wall membranous, more or less spotted with brown, and with superficial clusters of stellate crystals of lime above, thickened and brown at the base. Stalk cylindrical, longitudinally striate, brown or black. Columella represented only by the thickened discoid base of the sporangium. Capillitium profuse, consisting of sparingly branched colorless or purple-brown threads. Spores pale violet-brown, almost smooth, 5–8 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead leaves, twigs, and wood.

DISTRIBUTION: *California, Colorado, Florida, Iowa, Kansas, New York, North Carolina, *Ohio, Ontario, *Oregon, *Pennsylvania, Quebec, South Carolina, *Washington, *Wisconsin.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 108.

This species is not at all rare, but forms small colonies so that it may be overlooked. It is distinguished from *D. melanospermum*, which also has dark stalks, by the shape of the sporangia and absence of a definite columella. It also superficially resembles *Physarum megalosporum*, but the generic characters are different.

9. **Didymium melanospermum** (Pers.) Macbr. N. A. Slime-Moulds 88. 1899.

Physarum melanospermum Pers. Neues Mag. Bot. 1: 88. 1794.

Didymium farinaceum Schrad. Nov. Gen. Pl. 22. 1797.

Physarum sinuosum Link, Ges. Nat. Fr. Berl. Mag. 3: 27. 1809.

Plasmodium colorless or gray (Lister). Total height 0.5 to 1 mm. Sporangia gregarious, subglobose or hemispherical, deeply umbilicate beneath, 0.7 to 1 mm. diam., stalked or sessile, often confluent, and occasionally forming flattened plasmodiocarps, white or gray; sporangial wall firm, clothed with stellate crystals of lime. Stalk cylindrical from a broad base, striate, dark brown, occasionally rufous or partly so, 0.2 to 0.7 mm. long, 0.05 to 0.2 mm. thick, opaque and granular from enclosed refuse matter, sometimes containing crystalline nodules of lime. Columella large, hemispherical, umbilicate, dark brown, rarely whitish, chambered, containing irregular nodules of lime. Capillitium of stout, sparingly branched or simple, flexuose threads, colorless or purplish brown, often showing dark, calyciform thickenings. Spores dark purplish brown or purplish gray, with thick spore-walls, nearly smooth or spinose, 9–12 μ diam.

Var. **minus** Lister, Mycetozoa ed. 2. 129. 1911.

Didymium farinaceum Schrad. var. *minus* Lister, Mycetozoa 97. 1894.

Didymium minus (Lister) Morg. Jour. Cin. Soc. Nat. Hist. 16: 145. 1894.

Sporangia smaller; threads of capillitium slender; spores smaller, 7–9 μ diam.

Var. **bicolor** G. Lister, Mycetozoa ed. 3. 115. 1925.

Columella and upper part of stalk nearly white from enclosed calcareous deposits.

TYPE LOCALITY: Europe.

HABITAT: On dead wood, twigs, and leaves.

DISTRIBUTION: The typical form and var. *minus* are common throughout North America; var. *bicolor*, *Bermuda, Kansas.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 112.

This species produces large colonies, and is often found fruiting in many developments at one time, usually in moist places. In limestone regions the large, massive form, with heavy deposits of lime, develops. The sporangia are often sessile, irregular in shape, or confluent in groups. In areas without lime, the smaller, neater var. *minus* is found. On Long Island, New York, where lime is deficient in the soil, I have never found the typical form, although var. *minus* is common. Intermediate forms, however, are frequent, and have larger sporangia, stouter capillitia, and larger spores. They connect the variety with the typical form. Similar conditions may be observed in many other species of the calcareous genera, and in those, as well as var. *minus*, the frail forms cannot be regarded as distinct species. *D. melanospermum* is very variable, particularly in the shape of the sporangia, the quantity of lime present, the stalk, and the columella. Lime is often present in the stalk. The specimens from Kansas regarded as var. *bicolor* have stalks with lime throughout, but the wall of the stalk is stained brownish.

10. *Didymium nigripes* (Link) Fries, Syst. Myc. 3: 119. 1829.

Physarum nigripes Link, Ges. Nat. Fr. Berl. Mag. 3: 27. 1809.

Plasmodium gray or colorless (Lister). Total height 1 to 1.5 mm. Sporangia gregarious, globose, umbilicate beneath, 0.4 to 0.7 mm. diam., stalked, erect, white; sporangial wall membranous, clothed with white, stellate crystals of lime. Stalk cylindrical, 0.6 to 1 mm. high, longitudinally striate, translucent, dark brown, almost black. Columella small, often minute, globose, dark brown. Capillitium of delicate colorless or purplish brown, branching threads. Spores pale violet-brown, faintly warted or nearly smooth, 7–10 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead leaves and twigs.

DISTRIBUTION: Throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 102, *figs.* a–c.

This species, with *D. eximium* and *D. xanthopus*, forms a group the members of which are distinguished mainly by the stalks

and columellae. *D. nigripes* forms small, solitary colonies in shaded woods of the uplands, rarely in the marshes, and if so, on higher and dryer ground. It is separated from the two allied species by the dark, almost black stalk, and the small, globose, dark columella. From *D. melanospermum* it is distinguished by the longer stalk and its translucent character, and the small columella.

11. **Didymium eximium** Peck, Rept. N. Y. State Mus. 31: 41. 1879.

Didymium megalosporum (?) Berk. & Curt.; Berk. Grevillea 2: 53. 1873.

Didymium nigripes (Link) Fries, var. *eximium* (Peck) Lister, Mycetoza 98. 1894.

Plasmodium? Total height 1 to 1.5 mm. Sporangia gregarious, subglobose, depressed above, uniliculate beneath, 0.4 to 0.6 mm. diam., stalked, erect, yellow, tawny, or white; sporangial wall membranous, clothed with yellowish or white stellate crystals of lime. Stalk cylindrical, 0.6 to 0.8 mm. high, longitudinally striate, yellowish to reddish brown, translucent. Columella large, more or less discoid, often thin and flat, or rough and spinose, yellow or tawny. Capillitium of delicate, colorless or purplish brown, branching threads. Spores violet-brown, warted or nearly smooth, 7–10 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead leaves and twigs.

DISTRIBUTION: Colorado, *Iowa, Kansas, *Mexico, New Hampshire, New Jersey, New York, North Carolina, Ontario, Pennsylvania, Quebec, Vermont, Virginia.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 102, *fig. d*, as *D. nigripes* var. *eximium*.

This species forms small, solitary colonies in dry places like *D. nigripes*. It is distinguished from *D. nigripes* and *D. xanthopus* by the frequent sprinkling of yellowish lime over the peridium, which is never present in the other species, and the columella, often consisting of a thin, circular plate, yellowish in color, and to which the capillitium is attached on both sides. The sporangia then are flattened considerably, but will be more globose if the columella is thicker. The columella, when thin and disc-like, is usually smooth, but when more convex is often rough or covered with rather long spines. The stalk is usually somewhat paler than that of *D. xanthopus*, and the spores are somewhat

darker and rougher than those of the related species. It is possible that *D. megalosporum* Berk. & Curt. represents the present species, and if so, the name would take precedence.

12. *Didymium xanthopus* (Ditm.) Fries, Syst. Myc. 3: 120. 1829.

Cionium xanthopus Ditm. in Sturm, Deutsch. Fl. Pilze 1: 87. 1816.

Didymium nigripes (Link) Fries var. *xanthopus* (Ditm.) Lister, Mycetozoa 98. 1894.

Plasmodium? Total height 1 to 1.5 mm. Sporangia gregarious, globose, umbilicate beneath, 0.4 to 0.8 mm. diam., stalked, erect, white; sporangial wall membranous, clothed with white, stellate crystals of lime. Stalk cylindrical, longitudinally striate, 0.6 to 1 mm. high, translucent, reddish brown, not dark. Columella white or pale, globose, subglobose, or turbinate. Capillitium of delicate, colorless or purplish brown, branching threads. Spores pale violet-brown, faintly warted or nearly smooth, 7–10 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead leaves, mosses, and twigs.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 102, *figs.* e–g, as *D. nigripes* var. *xanthopus*.

This species is very prolific, with a short life-cycle from germination of the spores to maturity of the fruit, and with many broods, so that under favorable conditions it will be found developing continuously in great abundance throughout the season. It is rarely found in dry areas, and prefers those parts of swamps and marshes where the water flows or seeps away, leaving the substratum moist. In the swamps of Long Island, New York, I have often observed hundreds of large developments in a single day, but *D. nigripes* has only been found four times, and *D. eximium* but once, over a period of twenty years. Contrariwise, the two latter species have been collected frequently each season in dry, inland regions. *D. xanthopus* is distinguished from *D. nigripes* by the reddish brown stalk and pale columella.

Somewhat reluctantly, the three foregoing forms are treated as distinct species. There are occasional intermediates, and they seem to form when dry or moist conditions of habitat are reversed. The forms are very constant in nearly all collections

that developed under preferred conditions of environment, and there is little difficulty in separating them. It is possible that they are variations of the same general form, similar to the numerous variations found in *D. squamulosum* and *D. melanospermum*, but they are convenient centers, much more so than any variations of the two latter species, among which it is difficult to find a combination of characters that are uniform and constant.

13. **Didymium squamulosum** (Alb. & Schw.) Fries, Symb. Gast.
19. 1818.

Diderma squamulosum Alb. & Schw. Consp. Fung. 88. 1805.

Plasmodium colorless (Lister). Sporangia gregarious, subglobose or hemispherical, umbilicate beneath, 0.5 to 1 mm. diam., stalked, sessile, or forming effused, pulvinate or netted plasmodiocarps, either white from abundant stellate crystals of lime, which often form a wrinkled, deciduous, scaly, outer crust, or gray when the lime-deposits are scanty; in the plasmodiocarp forms the crystals often sparsely distributed; sporangial wall membranous, sometimes mottled with red-brown towards the base, at length breaking into small fragments. Stalk white or pale yellow, rarely orange, cylindrical, deeply furrowed, rough with deposits of lime in minute crystals in the wall, varying much in length, usually spreading at the base into a white, discoid hypothallus. Columella large or small, white or yellowish, hemispherical, absent in effused plasmodiocarps. Capillitium variable, of slender or coarse threads, either almost simple or branching at acute angles, colorless, violet, or purplish brown, often with dark calyciform thickenings. Spores violet-brown, 8–11 μ diam., faintly or distinctly spinulose, the spinules often grouped in clusters. (PLATE 15, FIG. 6.)

TYPE LOCALITY: Germany.

HABITAT: On dead leaves, herbaceous stalks, etc.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 109.

This common and abundant species often has large colonies spreading widely over piles of decaying vegetable matter. It is very variable, and some of the phases are often seen on different parts of the same general habitat. The lime on the wall may be densely or sparsely distributed, smooth or wrinkled. The stalk.

columella, and capillitium may vary in color, and the form of the capillitium may be different in otherwise similar collections. The spores occasionally are very dark and coarsely spinose, appearing in those respects somewhat like the spores of *D. intermedium*, a related species, but the latter is distinguished by the shape of the sporangia, and the long, tapering stalks. Many of the variations have been regarded as distinct species in the past, although now it is generally admitted that they are all phases of the same form. The species often forms thin, effused or netted plasmodiocarps, without a columella, which if accompanied by normal sporangia may be readily recognized. If not, the determination is more difficult, as they may appear like plasmodiocarps of *D. anellus* or some other species of *Didymium*. Var. *claviforme* Sturg. (Colo. Coll. Pub. Sc. Ser. 12: 27. 1907), from Colorado, is hardly worthy of recognition. It is one of the numerous variations of the species that may occur.

14. *Didymium Sturgisii* Hagelstein, *Mycologia* 29: 397. 1937.

Didymium anomalum Sturg. Colo. Coll. Pub. Sc. Ser. 12: 444. 1913. (N. Y. B. G. no. 13109, type.) Not *D. anomalum* (Rost.) Masee. 1892.

Plasmodium? Sporangia forming very thin, white or grayish white, rounded or irregularly shaped, effused plasmodiocarps up to 10 mm. across, 0.1 to 0.2 mm. thick, rough, pitted, or wrinkled; sporangial wall membranous, hyaline or yellowish, sprinkled with white or grayish, angular or stellate crystals of lime. Columella none. Capillitium of numerous, hyaline tubes, widely expanded for the greater part, and enclosing crystals of lime, terminating in short, slender threads attached to the upper and lower sporangial walls. Spores violet-brown, 10–12 μ diam., minutely warted, with some of the warts arranged in clusters. (PLATE 10, FIG. 1.)

TYPE LOCALITY: Colorado.

HABITAT: On dead bark.

DISTRIBUTION: Colorado, Iowa, Minnesota, *Montana, New Jersey, New York, Pennsylvania.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. pl. 213, as *D. anomalum*.

The widely expanded threads of the capillitium are filled with lime-crystals, and form columns connecting the top of the plasmodiocarp with the base. They are weakly attached with

short, slender threads, rupturing in unison, and permitting the plasmodiocarp to open as a whole for spore-dispersal. It is an anomalous form, having lime in the capillitium like a *Physarum*, but nevertheless a *Didymium*. The thin plasmodiocarps, appearing in the field as smears on the bark, resemble a common fungus, and may be easily taken therefor. The species probably forms large plasmodia, as on one occasion we obtained hundreds of plasmodiocarps from the bark of a single dead tree.

15. *Didymium anellus* Morg. Jour. Cin. Soc. Nat. Hist. 16: 148. 1894. (N. Y. B. G. no. 13125, authentic material.)

Plasmodium colorless (Lister). Sporangia scattered, sessile, pulvinate or flattened, centrally depressed, 0.3 to 0.5 mm. diam., often forming slender plasmodiocarps also depressed, elongate, branched, netted or perforated, gray, glossy brown or iridescent from the absence of lime; sporangial wall membranous, colorless or purplish brown, with scanty deposits of small crystals of lime, usually dehiscing in a circumscissile manner. Columella none. Capillitium abundant, consisting of slender, flexuose, violet-brown threads, simple or somewhat branching and anastomosing. Spores purplish gray or purplish brown, minutely spinulose, 7-12 μ diam.

TYPE LOCALITY: Ohio.

HABITAT: On dead leaves, herbaceous stalks, and twigs.

DISTRIBUTION: *California, Colorado, *Iowa, Kansas, *New Mexico, New York, Ohio, Ontario, *Oregon, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 110, figs. a-c.

This species has been collected repeatedly by experienced students in their local areas, and is probably more widely distributed. The spores are very variable in their characters, so that they, and also the capillitium, are of little aid as determining factors. The shape and appearance of the sporangia and plasmodiocarps, their usual association in one development, and the circumscissile manner of dehiscence are the important features. Sometimes large netted or perforated plasmodiocarps are found, and these resemble similar plasmodiocarps of *D. squamulosum*. Unless accompanied by sporangia of either species, they are often indeterminate. The circular depressions in the sporangia, and the linear ones in the plasmodiocarps of *D. anellus*, indicate that the plasmodium in forming spreads in rings which close and leave

the depressions. This is of value in recognizing the species, although not evident in the netted or perforated plasmodiocarps.

16. **Didymium ochroideum** G. Lister, Jour. Bot. **69**: 297. 1931 (N. Y. B. G. no. 986, cotype.)

Plasmodium? Sporangia scattered, sessile, pulvinate or flattened, about 0.5 mm. diam., or forming slender, simple or branched plasmodiocarps, depressed centrally or linearly as in *D. anellus*, brownish yellow, ochraceous, or tawny; sporangial wall membranous, pale yellow, closely covered with small crystals of lime; floor of sporangium pale yellow, somewhat thickened with scanty lime. Columella indefinite or absent. Capillitium of slender, pale purplish threads, branching and anastomosing. Spores purplish gray or purplish brown, minutely spinulose, 7–10 μ diam.

TYPE LOCALITY: Japan.

HABITAT: On dead leaves, herbaceous stems, mosses, etc.

DISTRIBUTION: Iowa, Kansas, New York, Ontario, Pennsylvania.

ILLUSTRATION: G. Lister, Jour. Bot. **69**: pl. 598, figs. 1a–1d.

This form is very close to *D. anellus* and differs practically only in the ochraceous color, and the more compact layer of lime-crystals on the sporangial wall. It forms small, solitary developments in contrast to the larger, spreading fruitings of *D. anellus*. It has little resemblance to *D. fulvum* except in the tawny or yellowish color. The latter forms larger, more robust, and clustered sporangia and plasmodiocarps, with dense clusters of large lime-crystals, and has entirely different spores. *D. ochroideum* has now been found fifteen times in the territory mentioned. In some of the collections, the color is very pale, almost grayish white.

17. **Didymium dubium** Rost. Mon. 152. 1874.

Didymium Wilczekii Meylan, Bull. Soc. Vaud. Sc. Nat. **44**: 290. 1908. (N. Y. B. G. nos. 7147, 13107, authentic material); Lister, Mycetozoa ed. 2. 134. 1911.

Didymium nivicolium Meylan, Bull. Soc. Vaud. Sc. Nat. **57**: 40. 1929. (N. Y. B. G. no. 7137, authentic material.)

Plasmodium gray (Lister). Sporangia scattered, sessile, forming pulvinate, elongate, curved, or almost net-like plasmodiocarps, 1 to 2 mm. wide, 1 mm. to 3 cm. long, 0.3 to 0.5 mm.

thick, white, smooth or scaly, or glossy brownish purple when without lime; sporangial wall dehiscing irregularly, membranous or somewhat stouter, colorless, mottled with yellow or pale purplish, with a crust of minute, stellate, rod-shaped, or nodular crystals of lime; crust often broken into numerous discoid or concave scales, 0.1 to 0.2 mm. diam., each scale attached by the center to the membranous layer. Columella convex or represented by the colorless or yellowish brown base of the sporangial wall, which is usually thickened beneath with a network of strands containing a few minute lime-crystals. Capillitium abundant, of pale brownish purple threads, often slender, more or less connected by transverse bars, and combined to form an elastic network, readily separating from the sporangial wall. Spores purple-brown, minutely or strongly and closely spinulose, 9–17 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On herbaceous stalks and twigs.

DISTRIBUTION: *Colorado.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 194, as *D. Wilczekii*.

This species is distinguished from *D. Listeri*, which also has transverse, connecting bars between the threads of the capillitium, by the more pulvinate plasmodiocarps, the elastic capillitium separating as a mass, the usually larger spores, and other minor characters. Transverse, connecting bars are found occasionally in other forms of *Didymium*, but those species can be recognized by other characters. *D. niviculum* Meylan is a phase of the present species with a scaly sporangial wall like that seen often in *D. squamulosum*.

18. *Didymium crustaceum* Fries, Syst. Myc. 3: 124. 1829.

Plasmodium white (Lister). Sporangia confluent, clustered, or scattered, short-stalked or sessile, globose, 0.7 to 2 mm. diam., smooth and white from the thick, fragile, deciduous crust of loosely compacted crystals of lime in which they are enclosed; when the crust has fallen away the sporangia appear reniform or hemispherical and gray; sporangial wall membranous, colorless, clothed with large stellate crystals of lime. Stalks pale buff, 0.2 to 0.4 mm. high, slender, membranous, several often clustered together on an expansion of the membranous hypothallus, at first

concealed under the crust of lime surrounding the sporangia. Columella small, irregular, depressed, hardly evident in the sessile forms, white or pale buff, with rather scanty deposits of lime in the form of nodules. Capillitium consisting of colorless or pale violet branching threads, $0.5\text{--}1\ \mu$ diam., often with minute fusiform thickenings. Spores purplish gray, strongly spinulose, $10\text{--}13\ \mu$ diam. (PLATE 10, FIG. 2.)

TYPE LOCALITY: Europe.

HABITAT: On dead leaves and twigs.

DISTRIBUTION: Colorado, Iowa, North Carolina, Ohio, Ontario, Pennsylvania, *South Dakota, Tennessee, Virginia, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 111.

A remarkably interesting species. The sporangia, covered with crystals of lime and on membranous stalks which are expansions of the hypothallus, are surrounded at a considerable distance by an outer smooth but fragile crust of compacted lime-crystals, like an inverted jar for each sporangium. The outer wall or crust seems to form separately and disappears rapidly, so that most of the collections show only fragments. When the outer crusts are gone completely, the clustered mass of inner sporangia looks like phases of *Mucilago spongiosa*, where the outer crust or cortex has disappeared. The species provides a good example for study of the relationship between the sporangial and aethalioid forms of fructification, and the transition from one to the other.

19. *Didymium fulvum* Sturg. Mycologia 9: 327. 1917. (N. Y. B. G. no. 11338, type.)

Plasmodium? Sporangia in clusters, usually sessile, subglobose, concave beneath, 0.5 to 0.8 mm. diam., or forming curved plasmodiocarps, pale tawny from an abundant covering of yellowish lime-crystals; sporangial wall membranous, spotted with orange-yellow, clothed with large sharp-pointed crystals of lime. Stalk when present, short, orange, enclosing lime-crystals, and merging into strands of tawny hypothallus which are rough with crystalline deposits. Columella conical, or almost obsolete, orange, enclosing lime-crystals. Capillitium an abundant network of purplish threads, hyaline at the extremities. Spores purplish brown, closely warted, or marked with curved, branching lines, paler and smoother on one side, $12\text{--}14\ \mu$ diam. (PLATE 2, FIGS. 4-6.)

TYPE LOCALITY: Colorado.

HABITAT: On dead leaves and twigs.

DISTRIBUTION: Colorado.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 221.

This species is based on a single large and perfect collection made by Dr. W. C. Sturgis in Colorado in 1913, and so far as I know it has not been found since. It does not seem to be clearly related to any other species. If found again there should be no difficulty in recognizing it, as there are but two sessile forms of *Didymium* with yellow lime, and the other one, *D. ochroideum*, is distinguished as mentioned under that species.

20. **Didymium intermedium** Schroet.; P. Henn. Hedwigia **35**: 209. 1896.

Plasmodium? Sporangia gregarious or clustered, stalked, discoid, convex above, widely and deeply umbilicate beneath, often lobed or sinuous, 0.5 to 1 mm. diam., grayish white; sporangial wall membranous, clothed with deposits of lime-crystals. Stalk 0.7 to 1 mm. long, yellowish white or buff, smooth, broad at the base and tapering upward, filled, like the columella, with crystalline nodules of lime. Columella convex, discoid, pale yellow or white, formed by a shallow thickening of the base of the sporangial wall, recurved at the margin owing to the deeply umbilicate character of the sporangium. Capillitium of simple or branched, slender, colorless threads. Spores dark purple-brown, 9–12 μ diam., marked with a close, irregular reticulation of minute ridges, making a border about 0.7 μ deep.

TYPE LOCALITY: Brazil.

HABITAT: On dead leaves and herbaceous stems.

DISTRIBUTION: *California, *Canal Zone.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 110, *figs.* d–f.

Related somewhat to *D. squamulosum*, but must not be confused with phases of the latter having dark spores, as the sporangia and spores of *D. intermedium* are entirely different.

Genus 12. **MUCILAGO** Micheli; Adanson, Fam. Pl. **2**: 7. 1763.

Sporangia confluent to form an aethalium, otherwise with the characters of the genus *Didymium*.

A SINGLE SPECIES.

1. *Mucilago spongiosa* (Leyss.) Morg. Bot. Gaz. 24: 56. 1897.

Mucor spongiosus Leyss. Fl. Hal. ed. 2. 305. 1783.

Reticularia alba Bull. Herb. Fr. pl. 326. 1786; Bull. Champ. 92. 1791.

Spumaria alba (Bull.) DC. Fl. Fr. 2: 261. 1805.

Plasmodium white or yellow (Lister). Aethalia composed of elongate, compressed, lobed and branched, gray sporangia, arising in loose or compact clusters from branching strands of the membranous hypothallus, clothed with a thick, fragile, deciduous covering of crystals of lime, 2 to 6 cm. long, 1 to 6 cm. wide, and 1 cm. or more thick; sporangial wall membranous, colorless or purplish. Columella membranous, hollow, compressed, sometimes absent. Capillitium a network of widely branching, anastomosing, stout, purplish brown or colorless threads, often with dark calyciform thickenings, hyaline at the extremities; sporangia sometimes penetrated by tubular processes which open externally, and either perforate the lobes of the sporangia, or continue into the threads of the capillitium. Spores dull purple, strongly spinulose, 10–13 μ diam. (PLATE 10, FIG. 3.)

Var. *solida* (Sturg.) Lister, Mycetoza ed. 2. 138. 1911.

Spumaria alba (Bull.) DC. var. *solida* Sturg. Colo. Coll. Pub. Sc. Ser. 12: 29. 1907. (N. Y. B. G. nos. 12770, type; 12785, cotype.)

Aethalia pulvinate, compact, 2 to 5 cm. diam., 1 to 3 cm. thick; lime-crystals small, often nodular; capillitium scanty, colorless, irregular; spores spinulose, 9–11 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On leaves, twigs, and dead wood.

DISTRIBUTION: Throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 117.

This species is closely related to *Didymium crustaceum*, and in some intermediate specimens the connection is clearly shown by more or less distinct sporangia even to the partly developed outer deciduous walls of *D. crustaceum*. Var. *solida* is not rare wherever the species is fruiting in abundance, usually on cottonwood poplar and associated with *Fuligo intermedia*, or on manure piles and composts accompanied by *F. cinerea*. It appears to be the highest aethalioid formation of the species, but there are all sorts of intermediates between it and the forms approaching *D. crustaceum*. Var. *solida* forms compact, firm aethalia, sometimes appearing externally like *Fuligo septica* var. *candida*, but

more often with a dense, thick, spongy, crust of crystalline lime. The variety seems to connect the genera *Mucilago* and *Fuligo* through *F. intermedia*, as lime in the form of crystalline nodules is found occasionally in species of *Fuligo*. Similar variations from nearly free sporangia to compact aethalia are also found in *Tubifera ferruginosa*. Var. *dictyospora* R. E. Fries (Arkiv. Bot. 1: 66. 1903) with reticulate spores has not been reported from North America.

Genus 13. **LEPIDODERMA** de Bary; Rost. Versuch 13. 1873.

Sporangia stalked, sessile, or forming plasmodiocarps; sporangial wall cartilaginous, more or less clothed with apparently superficial crystalline discs or scales, the scales enclosed in pockets or vesicles of the sporangial wall, but easily dislodged; capillitium rigid and without lime, except in *L. Carestianum* var. *granuliferum*.

TYPE SPECIES: *Didymium tigrinum* Schrad.

Sporangia with orange stalks and walls.	1. <i>L. tigrinum</i>
Sporangia forming plasmodiocarps with brownish or purplish walls.	2. <i>L. Carestianum</i>
Sporangia usually sessile, with pale yellow walls.	3. <i>L. Chailletii</i>

1. **Lepidoderma tigrinum** (Schrad.) Rost. Versuch 13. 1873.

Didymium tigrinum Schrad. Nov. Gen. Pl. 22. 1797.

Plasmodium orange-yellow (Lister). Sporangia scattered, subglobose, flattened and umbilicate beneath, stalked, rarely sessile. 0.8 to 1.5 mm. diam., olive or purplish gray, glossy, more or less covered with flat, rounded, angular, or star-shaped crystalline scales of lime; sporangial wall cartilaginous, of two closely combined layers, orange-yellow. Stalk stout, cylindrical, 0.5 to 1.2 mm. high, furrowed, orange or orange-brown, of a spongy texture within, containing deposits of lime, rising from a yellowish or orange hypothallus. Columella large, hemispherical, orange, of the same texture as the stalk, containing deposits of lime in rounded granules. Capillitium profuse, of straight or flexuose threads, sparingly branched, dark purplish brown or gray. Spores dark purplish gray, minutely spinulose, 10–13 μ diam. (PLATE 10, FIG. 4.)

TYPE LOCALITY: Europe.

HABITAT: On rotten coniferous wood among mosses and lichens.

DISTRIBUTION: *British Columbia, California, Colorado, *Montana, New Hampshire, New York, North Carolina, *Ohio, Ontario, Oregon, Pennsylvania, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 114.

This species is rarely collected, but this is explained by the concealment of the sporangia among mosses and lichens, and the fruiting period, which appears to be once a year in late autumn when many of the collectors are inactive. It forms large developments, and is readily recognized by the massive sporangia on large, stout, orange stalks, and the numerous crystalline scales scattered over the peridial walls. It is probably more widely distributed in the east than the records indicate.

2. **Lepidoderma Carestianum** (Rabenh.) Rost. Mon. 188. 1874.

Reticularia Carestiana Rabenh. Fung. Eur. II. *no.* 436. 1862. [Bot. Zeit. 20: 198. 1862.] (N. Y. B. G. *no.* 6816, type material.)

Amaurochaete minor Sacc. & Ellis; Sacc. *Michelia* 2: 566. 1882. (N. Y. B. G. *nos.* 5607, 5608, type material.)

Plasmodium black (Lister). Fructification plasmodiocarpous, forming effused, flattened, or pulvinate plasmodiocarps, or elongate and confluent sporangia, 1 to 15 mm. long, 0.4 to 1 mm. thick, brownish gray, more or less clothed with white, crystalline scales of lime; sporangial wall cartilaginous, brown or purplish. Columella convex, absent, or represented by the thickened, dark brown base of the sporangium, spongy within, and enclosing rounded nodules of lime. Capillitium of colorless or purple-brown threads, 1–2 μ thick, branching and anastomosing, often marked with dark, bead-like warts. Spores purplish gray or purplish brown, spinulose, 10–15 μ diam.

Var **granuliferum** (Phill.) Lister, Mycetozoa ed. 2. 140. 1911.

Didymium granuliferum Phill. *Grevillea* 5: 114. 1877. (N. Y. B. G. *no.* 5570, type material.)

Lepidoderma granuliferum (Phill.) R. E. Fries, *Arkiv Bot.* 6 (7): 3. 1906.

Capillitium of branching, anastomosing, or netted, purplish brown or nearly colorless threads, with expansions or vesicles enclosing nodules of lime. Spores larger than in the typical form, usually 12–18 μ diam., sometimes paler on one side.

TYPE LOCALITY: Italy.

HABITAT: On leaves, twigs, stems, etc.

DISTRIBUTION: *California, New Hampshire, *Oregon, Utah, *Washington; var. *granuliferum*, California, Utah, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 115.

This species, its var. *granuliferum*, and *L. Chailletii* are difficult to understand and separate, somewhat because of the rarity of collection, but also because the impression prevails that the principal distinctions are in the spore-characters. The spores in all three forms exhibit considerable variation beside the size. The color may be grayish or brownish, the spines stronger or fainter, and the spores may be paler on one side or not. The forms are more abundant in Europe, and there show many connecting stages, between the three, in other characters. The principal characters separating *L. Carestianum* from *L. Chailletii* are the plasmodiocarpous habit, the darker, brown or purple walls, and the coarser threads of the capillitium, often with bead-like thickenings. Var. *granuliferum* is separated from the typical form by the presence of nodules of lime in the capillitium. The type material of *Didymium granuliferum* Phill. has the characteristic lime-nodules in the capillitium, but the spores are abnormally large and irregular, 20–30 μ diam. It is one of those gatherings, often made in other species, where the spores are beyond the usual range, because of somewhat imperfect development. The collection made by Garrett, in Utah (N. Y. B. G. no. 11223), has numerous lime-nodules in the capillitium and brownish spores, paler, on one side, measuring 14–16 μ diam. This is representative var. *granuliferum*. Several collections of the typical form made by Dr. W. G. Farlow in the mountains of New Hampshire, have the effused, flattened plasmodiocarps shown by the type material of *Reticularia Carestiana* Rabenh., and the spores are 14–15 μ diam., the same as those of the Rabenhorst specimen. Macbride & Martin (Myxomycetes 142. 1934) say that Harkness no. 35 from Utah, in the Ellis collection of the New York Botanical Garden, belongs with *Lepidoderma granuliferum* (Phill.) R. E. Fries, as they prefer to regard *L. Carestianum* var. *granuliferum*. The particular specimen is one of two mentioned by the authors on the following page (143) under *L. Carestianum*, as representing *Amaurochaete minor* Sacc. & Ellis. Both specimens have flattened plasmodiocarps, without lime in the capillitium, and spores 15–18 μ diam. The spores are a trifle larger, otherwise the specimens are typical examples of *L. Carestianum*, agreeing

in all respects with the type material of *R. Carestiana*. It is possible that Macbride & Martin intended to refer to Harkness no. 23/29, from California, which is type material of *Didymium granuliferum* Phill.

3. **Lepidoderma Chailletii** Rost. Mon. 189. 1874.

Plasmodium dirty white (Lister). Sporangia loosely clustered or crowded, globose or hemispherical, 0.5 to 1 mm. diam., short-stalked, sessile, or forming plasmodiocarps, gray or drab, with close-set crystalline scales of lime; sporangial wall somewhat cartilaginous, yellow or pale purplish. Hypothallus orange or brown, sprinkled with calcareous scales, of spongy texture within. Stalk short, brown, rising from the hypothallus. Columella pale or dark brown, rarely orange, clavate, hemispherical, or absent, of a spongy texture and containing lime-nodules. Capillitium of slender purplish threads, branched and anastomosing. Spores purplish gray or purplish brown, spinulose, sometimes paler on one side, 10–14 μ diam.

TYPE LOCALITY: Bohemia.

HABITAT: On dead leaves, stems, and twigs.

DISTRIBUTION: California, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 116.

This species is distinguished from *L. Carestianum* by the more frequent habit of forming distinct sporangia, often with stalks arising from a hypothallus, the paler sporangial walls, and the more slender and smoother threads of the capillitium. Numerous intermediate forms are said to occur in Europe, where it and the allied forms are more abundant, and may be expected here with more plentiful collections. The spores in the California collection are normal in size, although more brownish than in other specimens from Europe. The columella is lacking.

Genus 14. **LEPTODERMA** G. Lister, Jour. Bot. 51: 1. 1913.

Sporangia subglobose, the membranous walls thickened towards the base with dark granular deposits, among which small, calcareous scales are often embedded. Capillitium a dense network of blackish threads. Spores purplish gray.

A SINGLE SPECIES.

1. *Leptoderma iridescens* G. Lister, Jour. Bot. 51: 1. 1913.
(N. Y. B. G. no. 11238, authentic material.)

Plasmodium gray or drab (G. Lister). Sporangia scattered or loosely clustered, sessile, rarely very shortly stalked, subglobose, 0.5 to 0.8 mm. diam., grayish purple, glossy, iridescent; sporangial wall nearly hyaline above, purplish below, thickened and veined with brownish granular deposits and refuse matter, often including scattered, crystalline flakes of lime 2–15 μ diam. Stalk short, stout, dark from enclosed refuse matter, spreading below into a dark hypothallus. Columella dark, convex, or absent. Capillitium consisting of a persistent network of arching or flexuose, dark purple threads, colorless at the extremities, radiating from the floor of the sporangium, the pale bases often expanded and tubular, and sometimes enclosing granular matter. Spores purplish gray, spinulose, 10–11 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead leaves and stems.

DISTRIBUTION: Colorado.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. pl. 131, figs. h, i; pl. 218, figs. i–m.

Distinguished from sessile phases of *Diachea* and *Lamproderma*, which it resembles, by the thickened, stiffened, and veined lower sporangial wall and base, and the very dark capillitium. The calcareous flakes are more likely to be absent or obscure. The Colorado collection by Dr. E. C. Smith is practically typical.

Suborder II. AMAUROCHAETINEAE

Sporangia single or combined into an aethalium, without deposits of lime; capillitium and spores dark brown or violet-brown, rarely ferruginous or colorless.

Family I. COLLODERMATACEAE

Sporangial wall with an outer gelatinous layer.

A SINGLE GENUS.

Genus 15. *COLLODERMA* G. Lister, Jour. Bot. 48: 312. 1910.

Sporangia usually sessile; sporangial wall consisting of two layers, the outer gelatinous with superficial deposits of granular

refuse matter, the inner layer membranous. Capillitium a network of purplish threads without lime-knots.

A SINGLE SPECIES.

1. **Colloderma oculatum** (Lipp.) G. Lister, Jour. Bot. **48**: 312. 1910.

Didymium oculatum Lipp. Verh. Zool.-Bot. Ges. Wien **44** (Abh.): 72. 1894.

Plasmodium purplish brown (Lister). Sporangia scattered or grouped in small clusters, sessile, rarely stalked, either subglobose, 0.3 to 1 mm. diam., or forming straight or curved plasmodiocarps 1 to 3 mm. long, olivaceous or purplish brown, glossy, sometimes seated on a brownish purple hypothallus; sporangial wall of two layers; outer layer, when moist, thick, gelatinous, hyaline, more or less encrusted with yellowish olive, granular, refuse matter; inner layer colorless, membranous, firm; the outer layer, on drying, retreats to the base, when the sporangia appear shining, iridescent blue or violet. Stalk when present, short, stout, dark brown. Columella absent. Capillitium persistent, consisting of branching, anastomosing, pale or dark purplish brown threads, colorless at the extremities, rising from the flat base of the sporangium, 2-4 μ thick below, very slender towards the surface, often with a jointed appearance. Spores purplish gray, distinctly spinulose, 11-15 μ diam.

TYPE LOCALITY: Austria.

HABITAT: On dead wood among mosses and lichens.

DISTRIBUTION: New Hampshire, *Oregon, Pennsylvania, *Vermont.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 214.

A curious species. The sporangium is invested with an outer, hyaline, gelatinous sheath, which covers it partly when wet, and gives the form an eye-like appearance. The sheath retracts to the base on drying, but will expand again if wetted. The species has been rarely collected in North America, due undoubtedly to its scattered, concealed habit of developing among mosses and lichens, so that the sporangia cannot be noticed in the field.

Family II. STEMONITIDACEAE

Sporangia stalked; sporangial wall a delicate membrane, often evanescent; stalk solid, at least in the upper part, usually extending within the sporangium as a columella from which the branch-

ing threads of the capillitium take their origin. In this family the more or less solid stalk is developed within the young, rising sporangium.

- | | |
|---|-------------------|
| Sporangial wall evanescent; capillitium springing from all parts of the elongate columella, the ultimate branchlets united to form a surface-net. | 16. STEMONITIS |
| Sporangial wall evanescent; capillitium as in <i>Stemonitis</i> , but not forming a surface-net, or only imperfectly towards the base. | 17. COMATRICHA |
| Sporangial wall evanescent; columella reaching to the apex of the sporangium, and there expanding to a circular disc from which the capillitium is suspended. | 18. ENERTHENEMA |
| Sporangial wall more or less persistent as an iridescent membrane; capillitium radiating from the columella. | 19. LAMPRODERMA |
| Sporangial wall persistent in the form of small discs at the tips of the rigid, forking threads of the capillitium; columella short or hardly evident. | 20. CLASTODERMA |
| Capillitium scanty, colorless, branching from a short columella; sporangia very small. | 21. ECHINOSTELIUM |
| Sporangia minute, stalked, brown; capillitium absent. | 22. MACBRIDEOLA |

Genus 16. **STEMONITIS** Gleditsch, Meth. Fung. 140. 1753.

Sporangia cylindrical, stalked, distinct or fasciculate; stalk solid, black, extending to near the apex as a columella, except in confluent forms; capillitium composed of numerous threads radiating from all parts of the columella and combined into a loose network, the ultimate branches united into a surface-net, often incomplete in irregular developments.

TYPE SPECIES: *Stemonitis fusca* Roth.

Several members of the genus are susceptible to drying conditions prevalent during the period of sporangial formation. If the habitat is exposed to the sun, or to strong winds, or the air is so dry that drying proceeds too rapidly, erratic forms may be produced. The differences appear as wide divergence in the sizes of the meshes of the surface-net, or its partial or entire absence; weakness or irregularity in the capillitium or stalk; or partly confluent sporangia. Some of these forms approach the genus *Comatricha*, and others the genus *Amaurochaete*, and have been erroneously considered as distinct species. As conditions vary the forms will vary, so that few are comparatively alike. In most instances relationship to a particular species of *Stemonitis* may be established by the characters of the spores. While not true varie-

ties, the more common ones are included in the analysis of the genus as centers around which the forms may be grouped.

Spores reticulate.

Spores reticulate with spines or warts.

Sporangia large, dark; spores more or less prominently reticulate.

1. *S. fusca*

Sporangia small, pale, appearing superficially like *Comatricha typhoides*; spores faintly reticulate.

2. *S. hyperopta*

Spores reticulate with raised bands.

Sporangia brown, usually on wood in small groups; spores pale, uniformly and regularly reticulate.

3. *S. virginensis*

Sporangia almost black, in small clusters but large developments on leaves and moss; spores dark, often imperfectly reticulate.

4. *S. trechispora*

Spores not reticulate.

Sporangia confluent, small, black, in small clusters.

5. *S. confluens*

Sporangia not confluent.

Meshes of the surface-net usually large.

Spores free.

6. *S. splendens*

Spores clustered, adherent.

7. *S. uvifera*

Meshes of the surface-net small.

Sporangia brown, often on leaves in large tufts; surface-net smooth, even along the edge.

8. *S. herbatica*

Similar to *S. herbatica* but sporangia on wood, erect and in small tufts; surface-net paler and uneven.

9. *S. pallida*

Sporangia usually on leaves and stalks, reddish; surface-net spinose and with expansions in the capillitium; spores pale, 7-9 μ .

10. *S. flavogenita*

Sporangia on wood, reddish; surface-net smooth; spores nearly colorless and smooth, 4-6 μ .

11. *S. axifera*

1. ***Stemonitis fusca*** Roth, Mag. Bot. Roemer & Usteri 1 (2): 26. 1787.

Stemonitis dictyospora Rost. Mon. 195. 1874; Rost. Mon. App. 27. 1876; Macbr. N. A. Slime-Moulds ed. 2. 161. 1922.

Plasmodium white (Lister). Total height 5 to 20 mm. Sporangia cylindrical, obtuse, stalked, brownish purple or almost black, usually in large clusters, sometimes scattered. Stalk black, shining, 1 to 4 mm. high, rising from a brown, membranous hypothallus. Columella reaching nearly to the top of the sporangium. Capillitium of dark brown threads springing from all parts of the columella, combined into a loose network, the ultimate branches forming a delicate smooth or spinose surface-net with angular, unequal meshes, varying from 6-16 μ wide. Spores

grayish violet or brownish violet, 6–8 μ diam., faintly or strongly spinulose, the spines arranged in a more or less reticulate pattern.

Var. *flaccida* Lister, Mycetozoa ed. 2. 144. 1911.

Sporangia weak; capillitium scarcely forming a surface-net, or a net with very wide meshes connected by a few slender threads to the columella.

Var. *nigrescens* (Rex) Torrend, Fl. Myx. 141. 1909.

Stemonitis nigrescens Rex, Proc. Acad. Nat. Sc. Phila. 1891: 392. 1891.
(N. Y. B. G. nos. 6183, 11961, type material.)

Developments separated into numerous small groups of clustered sporangia, each group on a common hypothallus; sporangia 4 to 5 mm. high, almost black, with short stalks, the capillitium often close to the base of the stalk; capillitium often lax with incomplete surface-net, sometimes complete; spores grayish violet, darker and larger than in the typical form, 8–9 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood; var. *nigrescens* on leaves, mosses, and ground sticks in moist places.

DISTRIBUTION: Common and abundant throughout North America, except the varieties which are not common.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 118; *pl.* 125, *figs.* *n-p*.

This species is readily recognized by the reticulate arrangement of the spines on the spores. This may occasionally be partly incomplete, and strongly or weakly marked. The spores in practically all American specimens here range from 6–8 μ diam., with few a little larger, and the color may be grayish or brownish. Var. *flaccida* is rare. It bears about the same relationship to typical *S. fusca* that the more common *S. splendens* var. *flaccida* bears to the typical form. Such forms are not true varieties, but produced when conditions are unfavorable at the time of development. Poorly developed forms of *Comatricha longa* may be mistaken for *S. fusca* var. *flaccida*, as the spores are similar. Typical var. *nigrescens* is quite common in the mountains of northeastern Pennsylvania, occurring on leaves, mosses and ground sticks, the plasmodium inhabiting the soil instead of rotten wood, the latter being always the habitat for the typical form of *S. fusca*. The type specimen of Rex was collected in Pennsylvania, and the fact that it is on wood has little significance. It is the common practice to include with the variety all very small dark phases of

S. fusca on wood, and having short stalks, but there are similar small forms where the stalks are longer, or the spores smaller, or the spores may be brownish with a consequent brownish color to the sporangia. The significant character of typical examples of this variety is the habitat of the plasmodium, and if this is confirmed by other students, the form well deserves specific rank; as it is now generally recognized that the habitat of the plasmodium is an important character, and particularly so in *S. fusca*. Var. *rufescens* (Lister, Mycetozoa 110. 1894) was proposed for forms of *S. fusca* with rufous gray spores instead of violet gray. The different spore-colors are covered by the description, and as intergrading shades are often seen, it seems unnecessary to retain the variety. Var. *confluens* (Lister, Mycetozoa 110. 1894. N. Y. B. G. no. 11987, authentic material) has not been reported from North America. It has confluent sporangia without surface nets or columellae, and is close to the genus *Amaurochaete*, but with spores like those of *S. fusca*. The history of *Stemonitis dictyospora* Rost. is confusing. Rostafinski mentions it as including the type specimen of *Stemonitis trechispora* from Venezuela, and he may have meant the name for that species; but he also included a phase of *S. fusca* with rufous spores (Lister, Mycetozoa ed. 3. 133. 1925). Macbride applied the name to a form that appears to be a large phase of *S. fusca*.

2. **Stemonitis hyperopta** Meylan, Bull. Soc. Vaud. Sc. Nat. 52: 97. 1918. (N. Y. B. G. nos. 7455, 7777, 8043, authentic material.)

Comatricha typhina (Wigg.) Rost. var. *heterospora* Rex, Proc. Acad. Nat. Sc. Phila. 1893: 367. 1893.

Plasmodium watery white (Lister). Sporangia in small clusters or scattered, short-stalked, broadly cylindrical, lilaceous brown. Total height 2.5 to 5 mm. Stalk 0.1 to 0.5 mm. high, continued into the slender columella. Capillitium a close network of slender, flexuose, brown threads springing from all parts of the columella, the ultimate branchlets forming a more or less complete surface-net in the lower half. Spores pale lilac, 5-6 μ diam., marked with faint spines arranged to form a faintly appearing, lax net.

Var. **microspora** Lister, Mycetozoa ed. 3. 134. 1925. (N. Y. B. G. no. 11878, authentic material.)

Comatricha typhoides (Bull.) Rost. var. *microspora* Lister, Mycetozaa 121. 1894.

Comatricha microspora G. Lister, Guide Brit. Mycet. ed. 4. 39. 1919.

Sporangia loosely clustered or scattered; capillitium with a close uneven surface-net, formed of flexuose threads; spores 3.5–4 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Maine, Massachusetts, New York, *North Carolina, Pennsylvania, Puerto Rico, *Virginia, *Washington; var. *microspora*, *Ohio.

ILLUSTRATION: Lister, Mycetozaa ed. 3. pl. 125, figs. d–i.

The reticulations on the spores may be seen with a good lens, but are faint, and the component structure is difficult to follow with the best equipment, so that conceptions may differ. I believe it is similar to that on the spores of *S. fusca*. The point is hardly material as the mere reticulate pattern is sufficient to identify the species when other characters are present. The form may be roughly recognized in the field by the small developments of small, pale sporangia. Small phases of *S. axifera* have more slender sporangia with a more reddish color. *S. hyperopta* is not difficult to find in any particular area in the East, by one familiar with its appearance. I have found it repeatedly in New York and Pennsylvania.

3. *Stemonitis virginiensis* Rex, Proc. Acad. Nat. Sc. Phila. 1891: 391. 1891. (N. Y. B. G. nos. 6830, 7633, 11772, type material.)

Comatricha reticulata Gilb.; Peck & Gilb. Am. Jour. Bot. 19: 140. 1932.

Plasmodium? Total height 2 to 8 mm. Sporangia in small clusters, cylindrical, stalked, lilac-brown. Stalk 0.5 to 2 mm. high. Capillitium a dense network of flexuose, dark brown threads, the ultimate branchlets slender, uniting to form a smooth or spinose, close surface-net, which is usually incomplete or sometimes absent entirely. Spores pale lilac-brown, 6–8 μ diam., reticulate with narrow, raised bands.

TYPE LOCALITY: Mountain Lake, Virginia.

HABITAT: On dead wood and leaves.

DISTRIBUTION: *California, Colorado, Florida, *Iowa, New Hampshire, New York, *Oregon, Pennsylvania, South Carolina, Virginia.

ILLUSTRATION: Macbr. & Martin, *Myxomycetes* pl. 11, figs. 251, 252.

The banded character of the spores sharply defines this species from the two preceding ones. The bands form a net on the spores which is usually complete, although the number of meshes varies. The surface-net of the capillitium is usually present only in the lower half or three-quarters of the sporangium and may be absent entirely. *Comatricha reticulata* Gilb., from Oregon, is apparently a form of *S. virginiensis* without surface net, and deserves no specific recognition.

4. ***Stemonitis trechispora*** (Torrend) Macbr. N. A. Slime-Moulds ed. 2. 159. 1922.

Stemonitis trechispora Berk., not published. (N. Y. B. G. nos. 6184, 11971, type material.)

Stemonitis fusca Roth var. *trechispora* Torrend, Fl. Myx. 141. 1909; Lister, Mycetozoa ed. 2. 144. 1911; Currie, Trans. Roy. Can. Inst. 12: 296. 1920.

Stemonitis trechispora (Berk.) Torrend; Jahn, Ber. Deutsch. Bot. Ges. 41: 394. 1924.

Amaurochaete trechispora Macbr. & Martin; Martin, Jour. Wash. Acad. Sc. 22: 89. 1932. (N. Y. B. G. no. 6897, type material); Hagelstein, Mycologia 34: 250. 1942.

Stemonitis trechispora Macbr.; Macbr. & Martin, Myxomycetes 160. 1934; Hagelstein, Mycologia 28: 615. 1936.

Plasmodium milk-white. Developments 10 to 15 cm. across, dividing into many small clusters of closely combined sporangia. Total height 3 to 7 mm. Sporangia cylindrical, dull black, stalked, sometimes free and distinct, more often confluent near the base, and occasionally confluent throughout or nearly so. Stalks short, up to 1 mm. long, usually recumbent, slender, black, continuing into a more or less slender, crooked columella extending nearly to the summit of the sporangium, or dissipated. Capillitium dense, of dark brown threads, very irregular, sometimes ending in a fairly defined surface-net with small meshes, or the meshes may be larger, or the net absent. Spores 9–12 μ diam., rather dark, purplish brown, reticulate with raised bands, continuous or broken, or with spines.

TYPE LOCALITY: Venezuela (Fendler).

HABITAT: On leaves, mosses, and sticks, in wet marshes.

DISTRIBUTION: Maine, New York, Ontario, Quebec, *South Carolina, Virginia.

ILLUSTRATION: Jahn, Ber. Deutsch. Bot. Ges. 41: 394, fig. 1.

This species is clearly a departure from *S. fusca*, perhaps caused by changing of the habitat of the plasmodium to the soil. It has an extremely wide range of variation in the capillitium and spores, and this, with the different habitat, requires its separation from *S. fusca*. In some well-developed phases on drier material, the resemblance to *S. fusca* is pronounced, and separated specimens may erroneously be taken for that species. The more variable phases are in the wetter places, and the confluent character of some of the sporangia bears a strong resemblance to the genus *Amaurochaete*. In order to understand the species properly, it must be studied from sufficient material in all its phases. Fortunately, it is abundant when discovered, but does not last long. The developments are fragile, and immediately on maturity they are attacked by insects and devoured completely, so that nothing is left after two or three days. It fruits apparently only once in a season, usually in August, and these factors contribute to the rarity of its collection. I have watched it, year after year, developing in great abundance in the swamps of Long Island. *Amaurochaete trechispora* is based on a collection made by Dr. J. H. Faull, at Lake Timagami, Ontario, and described by Miss Currie *loc. cit.* as *S. fusca* var. *trechispora*. There is nothing in the type material to indicate other characters than those that appear in *Stemonitis trechispora*. The collection is one that developed in a very wet area as seen by comparison with Long Island material.

5. **Stemonitis confluens** Cooke & Ellis, Grevillea 5: 51. 1876.
(N. Y. B. G. nos. 6180, 6181, 11995, authentic material.)

Stemonitis splendens Rost. var. *confluens* Lister, Mycetoza 112. 1894.
(N. Y. B. G. no. 11753, type material.)

Plasmodium white (Lister). Total height 1 to 3 mm. Fructification dividing into many small groups of stalked, confluent sporangia, 1 to 10 mm. across, rarely larger, almost black. Sporangial wall evanescent, except for small, circular discs on lateral extensions of the capillitium. Stalk weak, short, black, continuing into the sporangium as a tortuous, irregular columella, either to the top or dissipated in the capillitium. Capillitium of rigid, dark brown threads, coarsely meshed to form an open network, and continued as a surface-net which may be imperfect

below; sporangia connected by rigid, lateral threads of the capillitium, which carry the circular discs mentioned; sporangia usually free above and below. Spores purplish brown, minutely but distinctly spinulose, 11–12 μ diam. (PLATE 10, FIG. 5.)

TYPE LOCALITY: New Jersey.

HABITAT: On dead wood.

DISTRIBUTION: New Jersey, New York, North Carolina, Pennsylvania.

ILLUSTRATION: Macbr. N. A. Slime-Moulds ed. 2. *pl. 11, figs. 4, 4a, 5.*

The small, black groups of confluent sporangia cannot be mistaken, even in the field, where they are often on the inner side of oak bark when it has sprung away from the trunk. The circular discs on the lateral extensions of the capillitium are characteristic, and both features are not seen in any other species of the genus *Stemonitis*. This species is quite distinct from *S. splendens*, with which it has been confused, although some gatherings of the latter species resemble it in the open, rigid capillitium of the free sporangia. It seems to be a link, connecting the genera *Stemonitis* and *Amaurochaete*, but the distinct sporangia place it in *Stemonitis*. The former confusion about the species leaves some records doubtful, and they have not been included in the distribution. The only certain collections that I know of are by Ellis (4) in New Jersey; Palmer (1) in southeastern Pennsylvania; myself and associates (8) on Long Island; and the material collected at Hillsborough, North Carolina, (Curtis 419, *B. M.* 935; N. Y. B. G. 11753) named *Lachnobolus cribrosus* Fries, and described by Lister as *Stemonitis splendens* var. *confluens*. These indicate a limited range of distribution in North America, with the possibility that European records are also doubtful.

6. *Stemonitis splendens* Rost. Mon. 195. 1874.

Stemonitis Morgani Peck, Bot. Gaz. 5: 33. 1880. (N. Y. B. G. no. 6539, authentic material.)

Stemonitis fenestrata Rex; Macbr. N. A. Slime-Moulds 119. 1899.

Plasmodium white, rarely pale yellow. Total height 6 to 20 mm. Sporangia cylindrical, obtuse, stalked, purplish brown, closely fasciculate and forming large colonies. Stalk black, shining, slender, 1 to 4 mm. long, rising from a silvery or purplish hypothallus. Columella reaching nearly to the summit of the

sporangium and rigid. Capillitium of purplish brown threads, the principal branches springing at distant intervals from the columella, at first almost simple, suddenly branching to form a smooth surface-net with rounded or angular meshes of various sizes, 20–70 μ wide. Spores pale reddish purple, faintly and closely warted, 7–9 μ diam.

Var. **Webberi** (Rex) Lister, Mycetozaa 112. 1894.

Stemonitis Webberi Rex, Proc. Acad. Nat. Sc. Phila. 1891: 390. 1891. (N. Y. B. G. no. 11767, type material.)

Similar to the typical form but meshes of the surface-net larger, 50–100 μ .

Var. **flaccida** Lister, Mycetozaa 112. 1894.

Stemonitis Tubulina (?) Alb. & Schw. Consp. Fung. 102. 1805.

Conatricha flaccida Morg. Jour. Cin. Soc. Nat. Hist. 16: 135. 1894. (N. Y. B. G. nos. 10549, 10574, authentic material.)

Amaurochaete ferruginea Macbr. & Martin; Martin, Jour. Wash. Acad. Sc. 22: 89. 1932. (N. Y. B. G. nos. 6898, 9962, type material.)

Sporangia weak and poorly developed; capillitium weak, often lax, with a poorly developed surface-net or none; columellae irregular, sometimes slender or tortuous; sporangia often collapsing and leaving only columellae and spores.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America; varieties not so common.

ILLUSTRATION: Lister, Mycetozaa ed. 3. pl. 121, figs. a–i.

This species has several characters which distinguish it from related ones. The capillitium is open, consisting practically of only the supporting branches of the surface-net; the meshes of the latter are large and not regular in size; and the spores are remarkably constant in all their characters. It is subject to considerable variation in the size of the sporangia, and the meshes of the surface-net are usually large and small in the same sporangium. Collections with more uniform small meshes approach *S. herbatica*. Those with very large meshes are var. *Webberi*, and the same variation of large and small meshes is found in the variety, so that it overlaps with the typical form. The sporangia of var. *Webberi* also vary in size, but otherwise there are no differences to separate it specifically. *S. splendens* is sensitive to conditions at the time of fruiting, and many abnormal, erratic or weak forms are pro-

duced then. *S. fenestrata* Rex is a form with a weak inner capillitium, so that when the sporangia are thoroughly desiccated, the net will become collapsed, and the columella displaced laterally and twisted, rising in a loose spiral. Specimens that have undergone the change may be found in any herbarium after a long period of drying. Abnormal forms often have a basal structure of wide, irregular and interwoven stalks, which after the capillitia and nets are gone remind one of the genus *Amaurochaete*. Weak forms vary as the conditions varied when and where they developed. This is seen in many collections, including the two authentic specimens of Morgan, named *Comatricha flaccida*. The two are not alike and merely weak forms of *S. splendens*. The weakness may indicate itself in irregular stalks, but always extends to the capillitium and surface-net, which latter may be absent entirely, and in most cases both will break away with time, leaving only stalks and spores. All such weak forms are var. *flaccida*. The specimen of *Amaurochaete ferruginea* Macbr. & Martin, kindly provided by Prof. G. W. Martin as probably from the type material collected in California, is *S. splendens*. It is abnormal and probably var. *flaccida*. In all these weak forms mentioned the spores are like those of *S. splendens*.

7. **Stemonitis uvifera** Macbr. N. A. Slime-Moulds ed. 2. 161. 1922.

Plasmodium? Sporangia clustered, 7 to 9 mm. high, resembling those of *S. splendens* in habit and capillitium; the latter has membranous expansions in the axils of many of the branches. Spores purplish gray, 7-9 μ , grouped in clusters of four or more, and marked with a cap of minute spines on the side facing outwards in the cluster.

TYPE LOCALITY: Washington.

HABITAT: On dead wood.

DISTRIBUTION: *District of Columbia, *Pennsylvania, *Montana, *Washington.

ILLUSTRATION: Macbr. N. A. Slime-Moulds ed. 2. pl. 20, figs. 8, 8a-c.

The description is taken from that of Lister based on the type collected on Mt. Ranier, Washington, in 1914. Quoting Lister further, "A specimen collected by Mr. Hugo Bilgram, near Philadelphia, is similar in having the spores adhering loosely in clusters, but they measure 9-11 μ and are equally spinulose all

over; the capillitium forms a lax and irregular network of stout, rugged threads, and has the appearance of being an abnormal development."

In the Herbarium of the New York Botanical Garden, the form is represented by two specimens from the Herbarium of the late A. P. Morgan, of Ohio, but without locality data. One was gathered in June 1895, and nearly all the spores are free, 7-9 μ diam., with a few small loose clusters. The second collection, found in August 1896, has spores 8.5-11 μ diam., firmly clustered in small groups. The spores in both specimens are uniformly spinulose over the entire surface, or practically so. There are no clear signs of abnormality, but in all respects except the spores the sporangia appear to be no different from those of typical *S. splendens*. Occasional gatherings with clustered spores are known in a number of species of the *Mycetozoa* that normally have free spores, and little importance is attached thereto. This form appears to be a dubious species, perhaps no more than a "sport." The variation in the spore-characters, as reported, would indicate that.

8. **Stemonitis herbatica** Peck, Rept. N. Y. State Mus. 26: 75. 1874. (N. Y. B. G. nos. 7992, 12027, type material.)

Plasmodium white, rarely pale yellow (Lister). Sporangia cylindrical, closely clustered in scattered tufts, 5 to 9 mm. high, brown or reddish brown. Stalk 0.8 to 2 mm. high, rising from a membranous hypothallus. Capillitium of dark brown threads, springing from the columella and forming a loose network, uniting at the surface into a net with usually angular meshes, 10-20 μ diam. Spores pale reddish, minutely spinulose, 6-8 μ diam.

Var. **confluens** Lister, Mycetozoa ed. 2. 148. 1911. (N. Y. B. G. nos. 11984, 12021, 12022, 12023, authentic material.)

Sporangia united to form a convolute aethalioid mass, with somewhat persistent sporangial walls, without distinct stalks or columellae; capillitium an irregular network without surface-net.

TYPE LOCALITY: Albany, New York.

HABITAT: On leaves and dead wood.

DISTRIBUTION: The typical form is common throughout North America; var. *confluens*, Connecticut.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. pl. 120, figs. a-g; var. *confluens* Lister, Mycetozoa ed. 1. pl. 77A, as *S. fusca* var. *confluens*.

This species holds an intermediate position between *S. splendens* and *S. flavogenita*, and must be considered as a center with connecting forms between the two mentioned, and more often with *S. pallida*. Typical examples are distinguished from *S. splendens* by the denser capillitium, the closer surface-net, and the frequent habit of fruiting on herbaceous matter; from *S. flavogenita* by the somewhat larger meshes of the surface-net, and the slightly darker, more purplish spores; from *S. pallida*, by the appearance of the net as observed along the edge which is more even, and the habit and habitat. In *S. pallida* the net often has closer meshes, and is uneven along the edge, in both respects more like that of *S. flavogenita*. At Albertson, Long Island, there occur each year many developments of a small form of the species on leaves and otherwise typical, but the spores are constantly 5 μ diam. Var. *confluens* is a curious form. The Connecticut collection was made at New Haven, in 1890, by Prof. R. Thaxter, and used by Lister as one of the specimens on which the variety was based. It is finely matured and close to the genus *Amaurochaete* in its capillitium, but the spores are those of *S. herbatica* and measure 6 μ diam. The form represents those obscure forms connecting the genera *Stemonitis* and *Amaurochaete*, which must be classified on the characters of the spores.

9. ***Stemonitis pallida*** Wing.; Macbr. N. A. Slime-Moulds 123. 1899. (N. Y. B. G. no. 12045, authentic material.)

Stemonitis tenerrima Morg. Jour. Cinc. Soc. Nat. Hist. 16: 137. 1894. Not *S. tenerrima* Curt. 1848.

Stemonitis carolinensis Macbr. N. A. Slime-Moulds 122. 1899.

Plasmodium white. Sporangia resembling those of *S. herbatica*, but erect, somewhat smaller, scattered or in small groups of a few sporangia. The pale surface-net is uneven, with closer meshes, and formed of flexuose threads. Spores similar to those of *S. herbatica*.

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead wood.

DISTRIBUTION: Not rare throughout eastern continental North America; *Iowa, *Oregon, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 120, figs. h-l.

This form merges directly into *S. herbatica*, and in large developments on wood the extremes with intermediates may be observed. It is perhaps no more than a variety of *S. herbatica*,

but in colonies of uniform sporangia it may be distinguished by the erect, scattered habit, or small clusters of separated sporangia. In mixed gatherings the separation is more difficult, sometimes impossible. *S. carolinensis* is one of a number of intermediate forms that may be noticed, and unworthy of distinction. In view of present knowledge of the variation and connecting forms between *S. herbatica*, *S. pallida*, *S. flavogenita*, and *S. axifera*, here recognized as species and centers, it is necessary to discard all others that have only trivial differences in characters.

10. **Stemonitis flavogenita** Jahn, Verh. Bot. Ver. Brandenb. 45: Abh. 165. 1904. (N. Y. B. G. no. 8672, authentic material.)

Plasmodium translucent citron-yellow (Lister). Total height 4 to 7 mm. Sporangia cylindrical, obtuse, closely clustered in scattered groups, short-stalked, usually rusty brown. Stalk black, 0.5 to 1 mm. high. Columella often ceasing below the summit of the sporangium, sometimes expanded. Capillitium of ferruginous or brown threads springing from the columella and forming a loose network with numerous, broad, membranous expansions; meshes of the delicate surface-net angular, rather uneven, varying from 6 to 16 μ diam., with the threads spinose. Spores pale reddish, faintly warted, 7-9 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On ground material, also on wood.

DISTRIBUTION: *California, Florida, New York, *Oregon, Pennsylvania, South Carolina, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 119, figs. a-d.

A rare species in North America, and somewhat difficult to distinguish from others to which it is related. It seems to be intermediate between *S. herbatica* and small phases of *S. axifera*, differing from the former by the spinose net of the capillitium and the more reddish spores, and from the latter by the short-stalked sporangia, and the larger size of the spores. The color of the plasmodium is not an absolutely distinguishing character, as in either other species the plasmodium may occasionally be yellow. The more usual habit of developing on leaves and herbage is helpful, but the expanded tip of the columella is of little value in diagnosis, as it is seen very rarely. The color of the spores is a little darker than those of *S. axifera*.

11. **Stemonitis axifera** (Bull.) Macbr. N. A. Slime-Moulds 120. 1899.

Trichia axifera Bull. Herb. Fr. *pl.* 477, *fig.* 1. 1789; Bull. Champ. 118. 1791.
Stemonitis ferruginea Ehrenb. Sylv. Myc. Berol. 25. 1818.

Plasmodium white, rarely pale yellow. Total height 7 to 20 mm. Sporangia narrowly cylindrical, in dense and often large clusters, stalked, usually curved, rusty brown. Stalks black, 3 to 7 mm. high, rising from a membranous hypothallus. Columella ending below the summit of the sporangium. Capillitium with a smooth and usually close surface-net, connected with the columella by few stout branches, and composed of rather firm threads bounding rounded meshes, which are usually small although varying in size. Spores very pale ferruginous, nearly smooth or faintly warted, 4-6 μ diam. (PLATE 15, FIG. 7.)

Var. **Smithii** (Macbr.) Lister, Mycetozoa ed. 2. 150. 1911.

Stemonitis Smithii Macbr. Bull. Nat. Hist. S. U. Iowa 2: 381. 1893.

Sporangia 3 to 6 mm. high, with surface-net of very slender threads, often uneven, the inner capillitium well developed.

TYPE LOCALITY: France.

HABITAT: On dead wood.

DISTRIBUTION: The typical form is common and abundant throughout North America; var. *Smithii* not so common.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 119, *figs.* e-g, as *S. ferruginea*.

This common species, so easily recognized by its rusty brown color, and pale, almost colorless, small spores, requires little comment. It is subject to extreme variation in size, and var. *Smithii* appears to be but a small phase developing from a weak plasmodium. The plasmodium of *S. axifera* is usually reported as white, but on a number of occasions I have seen typical sporangia of large size developing from a yellow one.

Genus 17. **COMATRICHA** Preuss, Linnaea 24: 140. 1851.

Sporangia globose, cylindrical, or obovoid, gregarious or scattered, or clustered, stalked (except in *C. Rispaudii*); sporangial wall evanescent (subpersistent in *C. typhoides*); stalk extending within the sporangium as a columella; capillitium consisting of numerous threads usually combined into a more or less uniform network, not uniting to form an even, regular surface-net.

TYPE SPECIES: *Comatricha obtusata* Preuss.

This genus differs from *Stemonitis* by the absence of a defined, even surface-net, although intermediate forms occur. Globose members differ also by the shape of the sporangia, as there are no globose forms in *Stemonitis*.

Sporangia usually globose, or nearly so (also cylindrical in *C. Suksdorfii*).

Columella extending into the sporangium, with the capillitium attached to all parts.

Capillitium with threads of even thickness, densely netted; sporangia brown.

1. *C. nigra*

Similar to *C. nigra*, but sporangia dark, almost black, scattered (also cylindrical forms).

2. *C. Suksdorfii*

Similar to *C. nigra*, but capillitium open.

3. *C. laxa*

Capillitium with stouter primary branches, the lower branchlets attached also to the persistent base of the sporangial wall; sporangia pale, on leaves.

4. *C. rubens*

Columella extending into the sporangium, with the capillitium springing only from the upper part.

Columella dividing into stout branches; capillitium springing from the upper part; sporangia on leaves.

5. *C. lurida*

Capillitium a scanty tuft of slender threads springing from the summit of the columella; sporangia very small, on wood.

6. *C. fimbriata*

Columella or stalk merging into the capillitium.

Stalk black, dividing into the primary branches of the capillitium; otherwise similar to *C. nigra*.

7. *C. elegans*

Sporangia very small; stalk reddish or yellowish brown.

8. *C. cornea*

Columella absent; capillitium springing directly from the top of the stalk, elastic and expanding.

9. *C. extendens*

Sporangia usually more or less cylindrical or obovoid.

Spores warted or spinulose.

Sporangia purplish brown.

Sporangia 4 to 9 mm. tall; stalks one half the total height; spores uniformly warted.

10. *C. aequalis*

Sporangia 2 to 3 mm. tall; stalks one quarter the total height; spores uniformly warted.

11. *C. subcaespitosa*

Sporangia 2 to 4 mm. tall; stalks about one half the total height; spores marked with 3 to 5 large, dark, warts on the hemisphere.

12. *C. typhoides*

Sporangia pale, lilac-brown.

Sporangia usually inversely obovoid; cylindrical and darker in vars. *fuscum* and *gracilis*.

13. *C. pulchella*

Sporangia cylindrical, pale with a pale capillitium.

14. *C. tenerrima*

Sporangia dark, almost black, crowded.

15. *C. irregularis*

Spores reticulate.

Reticulate with spines; sporangia black, slender and very long, in large clusters. 16. *C. longa*

Reticulate with raised bands; sporangia brown, sessile, small and in small clusters. 17. *C. Rispaudii*

1. **Comatricha nigra** (Pers.) Schroet. in Cohn, Krypt. Fl. Schles. 3 (1): 118. 1885.

Stemonitis nigra Pers.; Gmel. Syst. Nat. 2: 1467. 1791.

Comatricha obtusata Preuss, Linnaea 24: 141. 1851.

Plasmodium watery white (Lister). Total height 1 to 8 mm. Sporangia globose, ellipsoid, rarely short-cylindrical, scattered or gregarious, size variable depending on the length of the stalk, purplish brown; sporangial wall evanescent. Stalk subulate, slender, shining, black, usually 2 to 8 times the length of the sporangium in globose forms, shorter in cylindrical ones, rising from a more or less distinct hypothallus. Columella usually reaching almost to the summit of the sporangium, branching above and continued into the capillitium. Capillitium a more or less dense tangle of purplish brown threads springing from all parts of the columella, anastomosing and branching, of nearly equal thickness throughout, the ultimate branches looped and showing few free ends or marked with short spine-like branchlets. Spores violet-brown, minutely and closely spinulose, 7–10 μ diam.

Var. **alta** (Preuss) Lister, Mycetozoa ed. 2. 152. 1911.

Comatricha alta Preuss, Linnaea 24: 141. 1851.

Sporangia lengthened or cylindrical; capillitium a tangle of long, flexuose threads attached chiefly by a few branches to the base of the columella.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America; var. *alta*, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 123, figs. a–h.

Accepting the basic, typical form of *C. nigra* as brown, having globose sporangia on long stalks, a columella reaching nearly to the apex, a dense capillitium, and spores faintly spinulose and violet-brown in color, there are departures in different directions, but with connecting forms, finally terminating in a group of well marked centers which are considered as species, although intermediates may occasionally be seen in developments of *C. nigra*.

As the color becomes darker, there is resemblance to *C. Suksdorfii*; a more open capillitium, varying in degree, finally forms *C. laxa*; the tendency to form cylindrical sporangia finds its expression in species like *C. subcaespitosa* and *C. aequalis*; when the spores are smaller and more distinctly marked, the approach is to *C. pulchella*; the breaking of the columella into primary branches of the capillitium eventually forms *C. elegans*; and when the columella finally disappears, and the capillitium is attached directly to the top of the stalk, there is *C. extendens*. All forms mentioned are well advanced as distinct species, and are more or less common, except *C. extendens*. Much variation in shape, size and color will be found among the members of the group. *C. extendens* has been found but once, but the form is significant as ending a series of forms showing the disappearance of the columella through *C. elegans*.

2. **Comatricha Suksdorfii** Ellis & Everh. Bull. Washburn Lab. Nat. Hist. 1: 5. 1884. (N. Y. B. G. no. 5310, type.)

Comatricha pacifica Macbr.; Peck & Gilb. Am. Jour. Bot. 19: 139. 1932.

Plasmodium? Total height 2 to 8 mm. Sporangia scattered, cylindrical or globose, stalked, dark purplish black. Stalk about one half the total height, extending into the sporangium as a columella. Capillitium a dense network of flexuose black threads, springing from all parts of the columella. Spores brownish violet or purplish gray, spinulose, 9–12 μ diam.

TYPE LOCALITY: Washington.

HABITAT: On dead coniferous wood.

DISTRIBUTION: British Columbia, California, Colorado, Ontario, Oregon, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 123, figs. i, k, as *C. nigra*.

The type collection, made by W. N. Suksdorf in Washington, in September 1883, consists of cylindrical sporangia with a total height up to 8 mm., the stalks about one half the total height. Since then many developments with globose sporangia have been obtained from Colorado and Ontario, but all having the characteristic black color which is the important character separating the form from *C. nigra* and *C. aequalis*. A specimen of *C. pacifica*, from Prof. Macbride, in the Herbarium of the New York Botanical Garden, agrees in every respect with the type collection of *C. Suksdorfii* and is that species.

3. *Comatricha laxa* Rost. Mon. 201. 1874.

Badhamia penetralis Cooke & Ellis, *Grevillea* 5: 49. 1876.

Lamproderma Ellisianum Cooke, *Ann. Lyc. Nat. Hist. N. Y.* 11: 397. 1877.

Comatricha Ellisiana Cooke; Ellis & Everh. *N. Am. Fung. no. 2696.* 1891.
(*N. Y. B. G. no. 7628.*)

Comatricha Ellisii Morg. *Jour. Cinc. Soc. Nat. Hist.* 16: 133. 1894; Ellis & Everh. *N. Am. Fung. no. 3495.* 1896. (*N. Y. B. G. no. 11867.*)

Plasmodium watery white (Lister). Total height 1 to 3.5 mm. Sporangia globose, subglobose, or short-cylindrical, obtuse, scattered or gregarious. Stalk black, shining, often stout, 0.2 to 1 mm. high. Columella reaching nearly to the summit of the sporangium, narrowed upwards. Capillitium lax, the primary threads springing from all parts of the columella, at first straight or slightly curved, branching towards the surface to form a loose network of slender threads, either looped and anastomosing, or with numerous straight, free ends. Spores purplish gray or brown, minutely and closely spinulose, 7–13 μ diam.

Var. *rigida* Brândză, *Ann. Sc. Univ. Jassy* 11: 126. 1921.

Capillitium scanty, of rather rigid threads; columella often widely forking at the apex.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: *California, *Canal Zone, Colorado, Iowa, Kansas, Maine, New Jersey, New York, Ohio, Ontario, *Oregon, Pennsylvania; var. *rigida*, *Minnesota.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl. 124, figs. a–g.*

This is hardly more than a variety of *C. nigra*, but a useful center for forms with a more open capillitium. In the Herbarium of the New York Botanical Garden there is considerable material on pine boards used by Ellis for distribution as *N. Am. Fung. nos. 2696* and *3495*. It is apparently from several collections, and shows the variation in the capillitium and otherwise, as found usually in this center. There was no occasion to erect and maintain another species, as *C. Ellisii*, on these variations that are seen sometimes in the same colony. On one of the Long Island beaches, a few years back, there lay a large, weather beaten packing case made of pine boards. On this appeared each year fruitings of *C. nigra*, *C. elegans*, and *C. laxa*, sometimes together or intermingled. From such a series it is easy enough to pick out a small specimen that has the characters ascribed to *C. Ellisii*,

but they are not constant in different collections. *C. Ellisii* is merely one of the numerous phases grouped together under *C. laxa* as a center.

4. **Comatricha rubens** Lister, Mycetozaa 123. 1894. (N. Y. B. G. nos. 487, 752, 11376, authentic material.)

Plasmodium watery white (Lister). Total height 1 to 2 mm. Sporangia obovoid, ellipsoid, or subglobose, scattered, stalked, erect or inclined, 0.5 to 0.8 mm. long, 0.3 to 0.5 mm. broad, pinkish brown, shining below; sporangial wall evanescent above, membranous and persistent in the lower quarter, pinkish brown. Stalk setaceous, black, shining, 0.6 to 1.3 mm. long, rising from a circular, brown hypothallus. Columella reaching to about two thirds the height of the sporangium, branching at the apex. Capillitium of purplish brown threads, springing from all parts of the columella, broad at the base, more or less flexuose, anastomosing and branching at wide angles, often with flat expansions, gradually narrowing to the slender, straight, free ends; the persistent base of the sporangial wall connected with the lower part of the columella by capillitial threads with broad attachments. Spores pale lilac-brown, minutely spinulose, 7-8 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead leaves.

DISTRIBUTION: *Colorado, Maine, Massachusetts, New York, *Oregon, Pennsylvania, Quebec, Virginia.

ILLUSTRATION: Lister, Mycetozaa ed. 3. *pl.* 127, *figs.* d-f.

American collections agree perfectly with the above description of the English ones by Lister, except that as a rule the sporangia are a little smaller. The species forms small colonies, and is not rare in regions where intensive search is made. Its appearance in the field differs from *C. pulchella* and *C. tenerrima*, also pale forms, by the sporangial shape. The persistent base of the sporangial wall with its capillitial attachments is a constant feature.

5. **Comatricha lurida** Lister, Mycetozaa 119. 1894. (N. Y. B. G. nos. 11865, 11866, authentic material.)

Plasmodium watery white (Lister). Total height 1.25 mm. Sporangia globose or short-ovoid, erect, 0.5 mm. diam., scattered, stalked, purplish brown; sporangial wall evanescent. Stalk

setaceous, black, shining, 0.75 mm. long, rising from a circular, brown hypothallus. Columella cylindrical, reaching to half the height of the sporangium, dividing into stout branches at the apex, and continued into the capillitium. Capillitium dark, purplish brown throughout, spreading from the upper part of the columella in flexuose, anastomosing threads, with slender brown free ends. Spores spherical or subovoid, purplish gray, coarsely warted, 6–10 μ diam. (PLATE 3.)

TYPE LOCALITY: England.

HABITAT: On dead leaves.

DISTRIBUTION: New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 127, *figs.* a–c.

Two collections of this species have been made on Long Island, New York, having sporangia quite different from those of *C. rubens* from the same area; they are of about the same size but are globose and darker. The columella divides at the top into the primary branches of the capillitium. The latter has no attachments to the lower part of the columella, and the persistent lower part of the sporangial wall with its attachments to the capillitium is not present as it is in *C. rubens*. The spores are a little larger, darker, and more strongly marked than those of *C. rubens*, but not as much as in the English specimens. The specimens probably represent the American variation.

6. **Comatricha fimbriata** G. Lister & Cran; G. Lister, Jour. Bot. 55: 122. 1917.

Plasmodium colorless (Lister). Sporangia scattered, stalked, globose, blackish brown, 0.1 to 0.35 mm. diam. Stalk black, subulate, slender, straight or curved, 0.5 to 1 mm. high. Capillitium arising chiefly from the summit of a short, truncate columella, consisting of a scanty tuft of purplish brown threads, extremely slender at the base, either simple throughout, or forking below the clavate or irregularly expanded tips. Spores grayish purple, paler and smoother on one side, closely and minutely spinulose, 10–12 μ diam.

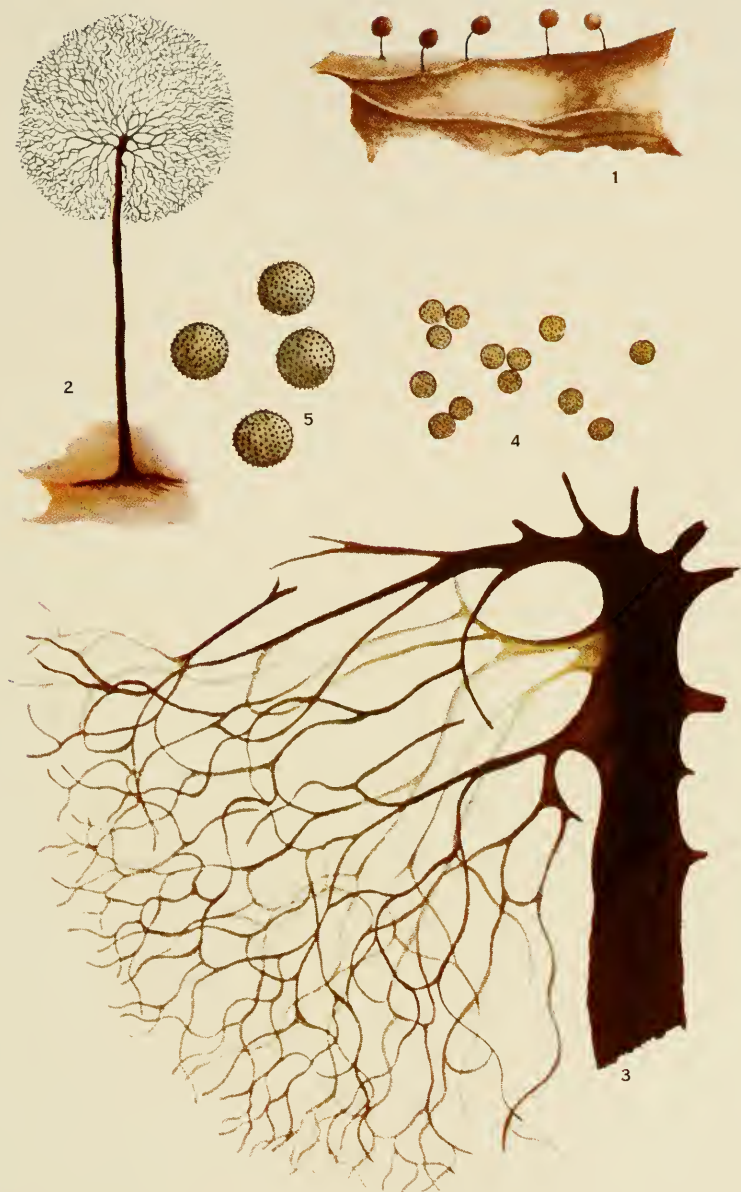
TYPE LOCALITY: England.

HABITAT: On dead wood, bark, and stems.

DISTRIBUTION: Iowa, Kansas, Massachusetts, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 210, *figs.* e'–i.

A very small, fragile species which has been obtained so far from North America only in moist chamber developments. The



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stalk in the lower part is somewhat like the stalk of *C. cornea*, showing inner strands.

7. **Comatricha elegans** (Racib.) Lister; G. Lister, Guide Brit. Mycet. ed. 3. 31. 1909.

Rostafinskia elegans Racib. Rozpr. Mat.-przyr. Akad. Umiej. Kraków 12: 78. 1884.

Plasmodium watery white (Lister). Sporangia gregarious or scattered, globose or subglobose, 0.2 to 0.6 mm. diam., purplish brown, stalked. Stalk black, slender, subulate, 0.6 to 1 mm. high. Columella short, dividing into a few straight, primary branches of the capillitium, or absent and the stalk dividing below the sporangium. Capillitium of branching threads forming towards the surface a loose tangle of slender, flexuose, anastomosing threads. Spores pale violet-brown, faintly spinulose, 8–10 μ diam. (PLATE 11, FIGS. 1, 2.)

Var. **pallens** G. Lister, Mycetozoa ed. 3. 144. 1925.

Spores pale reddish lilac in mass.

TYPE LOCALITY: Poland.

HABITAT: On dead wood.

DISTRIBUTION: California, Colorado, Georgia, Maine, Massachusetts, *New Brunswick, *New Jersey, New York, Ohio, Ontario, *Oregon, Pennsylvania, *Quebec, *South Carolina, *Virginia, *Washington; var. *pallens*, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 124, *figs.* h–n.

This species is practically the same as *C. nigra* except for the merging of the columella or stalk into the capillitium. This shows much variation in various collections, and sometimes in the same colony; and the size and color of the sporangia also vary. Nevertheless the species is well distinguished.

8. **Comatricha cornea** G. Lister & Cran; G. Lister, Jour. Bot. 55: 121. 1917.

Plasmodium colorless (Lister). Sporangia scattered or solitary, stalked, globose, dark purple brown, 0.1 to 0.2 mm. diam. Stalk subulate, slender, straight, 0.3 to 0.5 mm. high, dark brown above, brownish yellow below where it expands into a discoid hypothallus, tubular, translucent, with inner parallel fibres. Columella brown, reaching from one third to one half the height of the sporangium, with a small collar where it meets the stalk,

dividing above into several primary branches of the capillitium; these fork repeatedly and end at the surface in short, rigid, diverging branchlets. Spores violet-gray, distinctly spinulose, 8.5–9.5 μ diam.

TYPE LOCALITY: Scotland.

HABITAT: On bark and mosses.

DISTRIBUTION: Kansas.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 210, *figs.* a–e.

The Kansas specimens were obtained by Mr. Travis E. Brooks in moist chamber developments on walnut bark. The stalks are much longer than described originally, so the present description is written to conform to the Kansas material. The stalk is unusual, translucent, reddish brown at the top, shading to yellowish brown at the base, and tubular with an inner strand of parallel fibres. This is characteristic of the species.

9. **Comatricha extendens** Hagelstein, Mycologia 27: 374. 1935.
(N. Y. B. G. no. 1404, type.)

Plasmodium? Total height 2 to 4 mm. unexpanded. Sporangia gregarious, stalked, purplish brown, globose, 0.4 to 0.65 mm. diam.; sporangial wall firm, finally evanescent. Stalk subulate, slender, black, shining, from 4 to 6 times the size of the sporangial body, rising from a distinct hypothallus; the stalk either expanded at the top or splitting into several parts, as many as eight, which form the primary branches of the capillitium. Columella lacking or obsolete. Capillitium a tangled mass of anastomosing purplish brown threads springing directly from the stalk at the base of the sporangium; threads stouter at the base, becoming uniformly more slender, branched, somewhat looped or netted, but without a surface-net; capillitium more or less elastic, ultimately expanding into a cylindrical plume several times the size of the sporangial body. Spores brownish violet, minutely but distinctly spinulose, 8.5–10 μ diam. (PLATE 11, FIGS. 3, 4.)

TYPE LOCALITY: Long Island, New York.

HABITAT: On dead wood.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Hagelstein, Mycologia 27: *pl.* 34.

The type collection was made at Mitchell Field, Long Island. It was fairly large, in a fine state of maturity, and all the sporangia were uniform in the characters given. It seems to be the widest

digression from *C. nigra* with *C. elegans* as an intermediate center. At various times at the type locality were found connecting forms between the three species mentioned. *C. extendens* is so sharply defined, without a columella, and with an elastic capillitium expanding as in *Arcyria*, that it suggests a distinct genus. It is a *Comatricha*, however, and clearly related to *C. nigra*.

10. *Comatricha aequalis* Peck, Rept. N. Y. State Mus. 31: 42. 1879.

Comatricha nigra (Pers.) Schroet. var. *aequalis* (Peck) Sturg. Colo. Coll. Pub. Sc. Ser. 12: 34. 1907.

Plasmodium milk-white (Lister). Total height 4 to 9 mm. Sporangia closely gregarious, cylindrical, usually obtuse, curved, stalked, purplish brown. Stalk about half the total height. Columella reaching nearly to the summit of the sporangium. Capillitium a dense tangle of purplish brown threads springing from all parts of the columella, anastomosing and branching, and ending in free tips, usually pale. Spores violet-brown, minutely and faintly spinulose, 7–9 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: *Colorado, *Illinois, Minnesota, New Hampshire, New Mexico, New York, North Carolina, *Ohio, Ontario, Oregon, *Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 123, figs. l–n, as *C. nigra*.

This is practically the same as *C. nigra*, with similar capillitium and spores, differing only in the large, cylindrical sporangia. Many students have considered it as a variety of *C. nigra*, and with some reason, as it is not common, and occurs only occasionally where *C. nigra* is abundant. It is readily distinguished from *C. typhoides*, the only form it resembles in general appearance, by the spore-characters.

11. *Comatricha subcaespitosa* Peck, Rept. N. Y. State Mus. 43: 71. 1890.

Comatricha nigra (Pers.) Schroet. var. *subcaespitosa* (Peck) Lister, Mycetozoa ed. 3. 142. 1925.

Plasmodium? Total height about 2 mm., rarely larger or smaller. Sporangia closely gregarious, cylindrical, curved, usu-

ally acute, purplish brown. Stalk about one quarter the total height, black, continuing as a columella nearly to the summit. Capillitium a dense tangle of purplish brown threads, looped somewhat at the surface, and forming a more or less defined surface-net in the lower half. Spores somewhat pale violet-brown, distinctly and uniformly warted or spinulose, 6-8 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: Indiana, Iowa, Kansas, Maryland, New York, North Carolina, *Nova Scotia, Ontario, Pennsylvania, Quebec.

ILLUSTRATION: Macbr. & Martin, *Myxomycetes* pl. 12, figs. 295, 296.

This species often has large plasmodia forming thousands of sporangia over many feet of surface. I have seen one fruiting covering between 30 and 40 square feet. The sporangia are remarkably uniform in all characters in these developments. The form is not common, appearing spasmodically in a single or many developments in a particular region, and then without reappearance in years, but may be expected almost anywhere. More often, small colonies are found that differ somewhat from the description. The sporangia are more scattered, larger, up to 3 or 4 mm., and the spores also larger, up to 10 μ . These approach *C. aequalis*, to which as well as *C. nigra* the species is closely related, but with the surface-net in the lower half of the sporangium, showing a leaning to the genus *Stemonitis*. A slight inclination to form a surface-net at the base of the sporangium is seen occasionally in *C. nigra* and other species of this group.

12. *Comatricha typhoides* (Bull.) Rost. Versuch 7. 1873.

Trichia typhoides Bull. Herb. Fr. pl. 477, fig. 2. 1789; Bull. Champ. 119. 1791.

Plasmodium watery white (Lister). Total height 2 to 4 mm. Sporangia in loose clusters or scattered, stalked, cylindrical, obtuse, at first silvery-gray from the presence of the early evanescent sporangial wall, then lilac-brown. Stalk black, clothed with the silvery membranous continuation of the sporangial wall, about half the total height or sometimes less, rising from a well developed hypothallus. Columella reaching nearly to the summit of the sporangium, branching at the apex. Capillitium a close network of flexuose, pale brown threads, springing from all parts of the columella as stout branches, the ultimate branchlets more

slender, free or sometimes uniting to form an imperfect surface-net in the lower half. Spores pale lilac-brown, marked with 3 to 5 prominent, dark warts or clusters of warts on the hemisphere, otherwise smooth or faintly warted, 6–7 μ diam. (PLATE 15, FIG. 8.)

Var. *similis* Lister, Mycetozoa ed. 2. 158. 1911.

Similar to the typical form but the sporangial wall evanescent early and not apparent, and without the silvery sheath on the stalk; capillitium with an uneven surface-net below.

TYPE LOCALITY: France.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America; var. *similis* not so common.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 125, *figs.* a–c.

When the spores are observed in water under a cover glass, the dark warts will be seen more distinctly on the edges of the spores as they roll around; this character identifies all phases of the species, as it is not found in any other species of the genus *Comatricha*. Var. *similis* is well marked, and a constant form. From *C. subcaespitosa* the latter is distinguished by the longer stalks and the spore-characters.

13. *Comatricha pulchella* (Bab.) Rost. Mon. App. 27. 1876.

Stemonitis pulchella Bab.; Berk. Ann. Mag. Nat. Hist. 6: 431. 1841.

Plasmodium watery white (Lister). Total height 0.7 to 1.5 mm. Sporangia scattered, inversely obovoid or cylindrical, stalked, lilac or rufous brown; sporangial wall evanescent. Stalk black, 0.2 to 0.5 mm. high, rising from a circular, membranous hypothallus. Columella reaching nearly to the apex of the sporangium. Capillitium a network of flexuose, anastomosing, brown threads, springing from all parts of the columella, looped at the surface, with few ends. Spores pale lilac-brown, minutely but distinctly warted, 6–8 μ diam.

Var. *fusca* Lister, Jour. Bot. 35: 215. 1897.

Sporangia as in the typical form, but with more rigid, purplish brown capillitium and pale grayish brown spores.

Var. *gracilis* (Wingate) Lister, Mycetozoa ed. 2. 156. 1911.

Comatricha gracilis Wingate; Ellis & Everh. N. Am. Fung. no. 2094. 1888. (N. Y. B. G. no. 7603, type material.)

Sporangia narrowly cylindrical; capillitial threads usually uniting to form a close, uneven surface-net; spores pale violet-gray, faintly warted, 5-7 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead leaves, rarely on wood; var. *gracilis* on herbaceous stems.

DISTRIBUTION: Universally distributed in North America; varieties not rare.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 126, *figs.* a-e, i-l.

The typical form with pale, inversely obovoid sporangia is fairly common. Var. *fusca* usually has more cylindrical sporangia with a darker color. Var. *gracilis* is very close to *C. subcaespitosa*, but more narrowly cylindrical, and the stalks are longer, about one third of the total height. The habitat of var. *gracilis* is usually on herbaceous stalks, thus differing from *C. subcaespitosa*. The slight differences in the color of the spores are sometimes not noticeable. The species, as a whole, is related to *C. nigra*, differing in the paler capillitium of the typical form, and the paler, more strongly marked spores.

14. **Comatricha tenerrima** (Curt.) G. Lister, Guide Brit. Mycet. ed. 4. 39. 1919.

Stemonitis tenerrima Curt. Am. Jour. Sc. II. 6: 352. 1848.

Comatricha pulchella (Bab.) Rost. var. *tenerrima* (Curt.) Lister, Mycetozoa ed. 2. 156. 1911.

Plasmodium watery white (Lister). Sporangia scattered, stalked, ovoid or narrowly cylindrical, acute or obtuse, pale red, brownish pink, or lilac-pink, equal to or shorter than the slender black stalks; total height 1.5 to 2 mm. Columella slender, often reaching to the summit of the sporangium. Capillitium a network of slender, flexuose, pale red threads. Spores pale flesh-colored, minutely warted, 7-8 μ diam.

TYPE LOCALITY: South Carolina.

HABITAT: On herbaceous stalks.

DISTRIBUTION: *Antigua, *Pennsylvania, Quebec, *South Carolina.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 126, *figs.* f-h.

I have made two collections of this species in Quebec, and it is either rare, or often confused with *C. pulchella*, from which it differs only by the paler color and longer stalks. The emphasis laid on reddish colors in the description, which is copied from

Lister, is not borne out by the Quebec specimens or else the colors fade after maturity. The form is so close to *C. pulchella* that it would be better to accept it as a variety as Lister had it earlier.

15. **Comatricha irregularis** Rex, Proc. Acad. Nat. Sc. Phila. 1891: 393. 1891. (N. Y. B. G. nos. 12603, 12613, type or authentic material.)

Plasmodium white. Sporangia crowded, stalked, cylindrical, 2 to 8 mm. high, blackish brown. Stalks black, slender, 1 to 4 mm. high, rising from a membranous hypothallus. Columella straight or flexuose, reaching nearly to the apex of the sporangium. Capillitium a close or lax network of arched, purplish brown threads, becoming more slender towards the surface, and there forming an irregular net, or ending in numerous, colorless, free branchlets. Spores brownish purple, often paler on one side, closely spinulose, 7–10 μ diam.

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead wood.

DISTRIBUTION: Common in eastern continental North America; Colorado, Iowa, *Manitoba, Puerto Rico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 122, figs. f–i.

The pale character of the endings of the capillitium is often seen, sometimes extending far into the capillitium, so that it appears white when blown out. The capillitium with its pale ends, together with the crowded habit distinguish the form from cylindrical phases of *C. Suksdorfii*, another species with dark sporangia.

16. **Comatricha longa** Peck, Rept. N. Y. State Mus. 43: 70. 1890.

Plasmodium bright yellow (Lister). Sporangia densely clustered, forming fairly large colonies hanging in long tufts, stalked, narrowly cylindrical, elongate and slender, flexuose or drooping, 2 to 5 cm. long, black; sporangial wall evanescent. Stalks very slender, 1 to 3 mm. long, black, rising from a well-developed, membranous hypothallus. Columella continued nearly to the apex of the sporangium, tapering in thickness to very thin in the upper part, where it is wavy or zigzag. Capillitium a lax network of dark brown threads, the terminal branchlets extending outwards, rigid, free, forking at acute angles. Spores rather dark

grayish or brownish violet, 8–10 μ diam., spinulose, the spines forming a close reticulation.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: Common in eastern continental North America; *Iowa, Puerto Rico, *St. Jan, St. Thomas, *Wisconsin.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 122, *figs.* a–e.

The spores are very much like those of *Stemonitis fusca*. The long, drooping, narrow sporangia cannot be mistaken. There are occasional weak, small developments of smaller sporangia which resemble sporangia of *C. irregularis*, but the latter species has stouter and comparatively longer stalks, and the spores are not reticulate.

17. **Comatricha Rispaudii** Hagelstein, *Mycologia* 21: 297. 1929.
(N. Y. B. G. no. 1017A, type.)

Plasmodium? Sporangia sessile, cylindrical or clavate-cylindrical, clustered in dense groups of up to 30 or more, sometimes superimposed, violet-brown, 0.8 to 1.5 mm. high, 0.4 to 0.6 mm. thick; sporangial wall evanescent above, persisting at the base and frequently forming pseudo-cups which blend with the hypothallus. Columella dark brown, stout at the base but becoming slender, solid, sinuose and irregular, extending either to the apex or merging into the capillitium. The latter consists of branching and anastomosing brown threads, spreading from all parts of the columella, and generally coarsely meshed within. Spores pale violet-brown, 8–9 μ diam., reticulate with narrow, raised ridges, 0.5 μ high. (PLATE 11, FIGS. 5, 6; PLATE 12, FIG. 1.)

TYPE LOCALITY: Long Island, New York.

HABITAT: On dead leaves, in dryer portions of wet, wooded areas.

DISTRIBUTION: Florida, New Hampshire, New York, Pennsylvania, Virginia.

ILLUSTRATION: Hagelstein, *Mycologia* 21: *pl.* 26, *figs.* 1–3.

In habit, the species resembles the groups of clustered sporangia of *Diachea cylindrica* and *D. caespitosa*, but the color is different, the spores beautifully reticulate with raised bands, and it is a *Comatricha*. It is remarkably constant in characters and easily recognized. I have found it repeatedly on Long Island and in Pike County, Pennsylvania.

Genus 18. **ENERTHENEMA** Bowman, Trans. Linn. Soc. 16: 152. 1830.

Sporangia stalked; columella extending to the summit of the sporangium and expanding there as a dark, shining disc; capillitium springing from the disc and extending downward.

TYPE SPECIES: *Enerthenema elegans* Bowman.

Spores free.

Sporangia small, purplish brown or purplish black; apical disc small; spores minutely spinulose, 10–12 μ diam.

1. *E. papillatum*

Sporangia large, deep black; apical disc large; spores darker, coarsely spinose, 12–14 μ diam.

2. *E. melanospermum*

Spores in clusters.

3. *E. Berkeleyanum*

1. ***Enerthenema papillatum*** (Pers.) Rost. Mon. App. 28. 1876.

Stemonitis papillata Pers. Neues Mag. Bot. 1: 90. 1794.

Enerthenema elegans Bowman, Trans. Linn. Soc. 16: 152. 1830.

Plasmodium watery white (Lister). Total height 1 to 1.5 mm. Sporangia gregarious, stalked, globose, 0.5 to 0.7 mm. diam., purplish brown or purplish black, crowned with the small expanded apex of the columella; sporangial wall evanescent. Stalk cylindrical or tapering, black. Columella slender, cylindrical, from a conical base, traversing the sporangium and expanding on the surface into a black, membranous disc 0.1 to 0.2 mm. diam. Threads of the capillitium spreading downward from the expanded apex of the columella, long, slender, black, straight or flexuose, sparingly branched. Spores purplish brown or purplish gray, spinulose, 10–12 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Throughout the United States and Canada, not uncommon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 128, *figs.* a–e.

2. ***Enerthenema melanospermum*** Macbr. & Martin; Martin, Jour. Wash. Acad. Sc. 22: 91. 1932. (N. Y. B. G. nos. 7228, 12624, type material.)

Plasmodium? This species is similar to *E. papillatum* but more robust, deep black in color, with larger sporangia and a larger apical disc. The spores are darker, strongly spinose, and larger, 12–14 μ diam.

TYPE LOCALITY: Oregon.

HABITAT: On dead wood.

DISTRIBUTION: Oregon, *Washington.

ILLUSTRATION: Macbr. & Martin, *Myxomycetes pl. 13, figs. 307, 308.*

3. *Enerthenema Berkeleyanum* Rost. Mon. App. 29. 1876.

Enerthenema syncarpon Sturg. Colo. Coll. Pub. Sc. Ser. 12: 448. 1913.
(N. Y. B. G. no. 12622, type.)

Enerthenema papillatum (Pers.) Rost. var. *syncarpon* (Sturg.) G. Lister,
Mycetozoa ed. 3. 150. 1925.

Plasmodium? Similar to *E. papillatum* but usually a little smaller, darker, and with strongly spinose, somewhat darker spores, 12–14 μ diam., clustered in groups of four to twelve.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood and dressed lumber.

DISTRIBUTION: Colorado, Massachusetts, New Hampshire, New Jersey, New York, *South Carolina.

ILLUSTRATION: None published?

E. melanospermum and *E. Berkeleyanum* are closely related to *E. papillatum*. In the genus *Enerthenema* any other form must be similar to the type species as the generic characters are limited. The three species, nevertheless, are sharply defined.

Genus 19. **LAMPRODERMA** Rostafinski, Versuch 7. 1873.

Sporangia usually stalked, rarely sessile, globose or ellipsoid; sporangial wall membranous, somewhat persistent, shining with iridescent colors; stalk black; columella cylindrical or clavate, usually reaching to half or more than half the height of the sporangium; capillitium consisting of branched, anastomosing threads, radiating chiefly from the upper part of the columella.

TYPE SPECIES: *Physarum columbinum* Pers.

Spores spinulose, warted or nearly smooth (see also 8).

Columella dividing above into the few primary branches of the dark, flexuose capillitium.

1. *L. arcyronema*

Columella distinct; capillitium spreading from the upper part of the abruptly ending columella.

Sporangia iridescent.

Sporangia globose, usually iridescent brown; threads of capillitium dark with pale bases; spores 6.5–8 μ , distinctly warted.

2. *L. scintillans*

- Sporangia globose, blue or bronze; capillitium dark throughout; spores 10–12 μ , with large, scattered spines. 3. *L. muscorum*
- Sporangia globose or obovoid, more often iridescent blue or purple; capillitium usually purplish with pale tips; spores 11–14 μ . 4. *L. columbinum*
- Sporangia globose or obovoid, blue or brown; capillitium pale throughout or darker with pale tips; spores in typical examples 8–10 μ . 5. *L. violaceum*
- Sporangia silvery, spotted with black; capillitium pale. 6. *L. Gulielmae*
- Spores more or less reticulate.
- Spores reticulate with raised bands. 7. *L. cribrarioides*
- Spores marked with a close, imperfect reticulation of raised bands or rows of warts, or spinulose, or minutely warted all over. 8. *L. atrosporum*

1. **Lamproderma arcyronema** Rost. Mon. 208. 1874.

Comatricha Shimiekiana Macbr. Bull. Nat. Hist. S. U. Iowa 2: 380. 1893.
(N. Y. B. G. no. 9825, type material.)

Plasmodium watery white (Lister). Total height 1 to 2 mm. Sporangia gregarious, globose, stalked, erect, 0.4 to 0.6 mm. diam., steel-gray or bluish, iridescent; sporangial wall membranous, pale purple, falling away in large fragments, persistent as a collar at the base of the sporangium. Stalk subulate-setaceous, about 1 mm. high, black, shining. Columella slender, smooth, cylindrical, attaining about one third or one half the height of the sporangium, suddenly dividing at the apex into the few primary branches of the capillitium. Capillitium of purplish brown or black threads arising from the apex of the columella, at first stouter and branching, then more slender and anastomosing to form a close, dense network, with very short, free ends. Spores pale lilac-gray, faintly warted, 6–8 μ diam. (PLATE 16, FIG. 9.)

TYPE LOCALITY: Poland.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 129.

This species often forms large colonies, and is remarkably constant in all collections, so that there are no variations of any importance, and no approaches to other species of the genus. The densely netted, persistent capillitium is like that in the genus *Arcyria*, although not expanding. The divided columella is characteristic of the species.

2. **Lamproderma scintillans** (Berk. & Br.) Morg. Jour. Cin. Soc. Nat. Hist. 16: 131. 1894.

Stemonitis scintillans Berk. & Br. Jour. Linn. Soc. 15: 84. 1876.

Plasmodium watery white (Lister). Total height 1 to 1.5 mm. Sporangia scattered or gregarious, globose, stalked, erect, 0.3 to 0.5 mm. diam., usually brownish, reddish, or bronze, sometimes steel-blue, iridescent; sporangial wall delicately membranous, colorless, falling away in large fragments. Stalk setaceous, black, shining, rising from a purple-brown, circular hypothallus. Columella cylindrical, truncate, scarcely reaching to half the height of the sporangium. Capillitium of rigid threads, radiating from the apex of the columella, dichotomously branching and anastomosing, black or purple-brown, pale at the base, colored to the free extremities; the threads often connecting the apex of the columella with the somewhat persistent base of the sporangial wall are usually slender and colorless. Spores violet-gray, minutely warted, 6.5–8 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead leaves.

DISTRIBUTION: *California, Colorado, Iowa, Kansas, Minnesota, New Jersey, New York, *Ohio, Ontario, *Oregon, Pennsylvania, Quebec, Virginia.

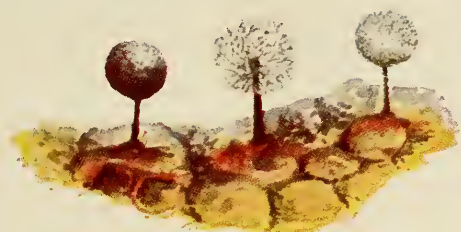
ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 130.

This species is not uncommon from June to September on dry leaves in moist places that are not too wet. From *L. columbinum*, it is distinguished in the field by the smaller sporangia, with usually a brownish or reddish iridescent color. From *L. violaceum*, to which it is related, it is separated by the microscopic characters of the capillitium, pale at the base, and the spores, which are usually smaller and distinctly marked by more separated warts. On Jones Beach, Long Island, are found very small sporangia, 0.2 mm. diam., on stalks 0.4 mm. high. The colonies are not rare, but small, seldom more than a dozen sporangia, developing on leaves and stems under bayberry bushes.

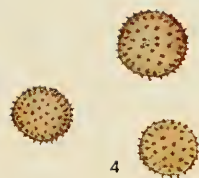
3. **Lamproderma muscorum** (Lév.) Hagelstein, Mycologia 27: 88. 1935. (N. Y. B. G. nos. 2608, 3193, 3465, authentic material, Hagelstein.)

Enerthenema muscorum Lév. Ann. Sci. Nat. IV. 20: 289. 1863.

Plasmodium? Total height 0.6 to 1 mm. Sporangia scattered, erect, stalked, globose, 0.3 to 0.5 mm. diam., blue or bronze,



1



4



2



3

LAMPRODERMA MUSCORUM

iridescent; sporangial wall thin, membranous, somewhat persistent at the base. Stalk subulate-setaceous, black, shining, about half the total height, rising from a circular, purplish brown hypothallus. Columella thick, tapering slightly to the obtuse end, extending half way into the sporangium. Capillitium dense, of rigid threads radiating in all directions from the apex of the columella, dichotomously forking and branching, purplish brown throughout from base to tips. Spores violet-brown, 10–12 μ diam., marked with large, sharp, scattered spines. (PLATE 4.)

TYPE LOCALITY: Colombia (New Granada).

HABITAT: On dead leaves.

DISTRIBUTION: New York, Pennsylvania.

ILLUSTRATION: Hagelstein, *Mycologia* 27: 87, figs. 1–3.

Resembles *L. scintillans*, but the stalks are shorter and stouter, the capillitium is dark throughout, not pale at the base, and the spores are larger and coarsely spinose.

4. *Lamproderma columbinum* (Pers.) Rost. Versuch 7. 1873.

Physarum columbinum Pers. Ann. Bot. Usteri 15: 5. 1795.

Lamproderma physaroides Rost. Mon. 202. 1874.

Plasmodium opaque white, rarely yellow (Lister). Total height 2 to 3 mm. Sporangia globose, ellipsoid, or obovoid, gregarious, stalked, erect, 0.5 to 1 mm. diam., purplish black with iridescent blue or purple reflections, or brassy; sporangial wall membranous, persistent, purplish in the lower part, occasionally mottled with darker shades. Stalk cylindrical, straight, 1.5 to 2 mm. high, purplish black, shining, longitudinally striate or rugose, rising from a dark purplish hypothallus. Columella cylindrical with a conical apex, or clavate, reaching to more than half the height of the sporangium. Capillitium dense, of brownish purple threads, radiating from the columella, sparingly forked and anastomosing, towards the surface branching and forming a delicate, nearly colorless network. Spores purple-gray, closely spinulose, 11–14 μ diam.

Var. **gracile** G. Lister, *Mycetozoa* ed. 3. 155. 1925.

Plasmodium watery white (Lister). Sporangia obovoid-cylindrical, obovoid, or subglobose, iridescent blue or purple; stalks 2 to 3 mm. long, slender, subulate, often curved.

TYPE LOCALITY: Europe.

HABITAT: On mosses, mossy stumps, logs, and rocks.

DISTRIBUTION: *British Columbia, Maine, Massachusetts, *Montana, New Hampshire, New York, North Carolina, Oregon, Pennsylvania, *South Carolina, Utah, *Washington, West Virginia.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 131, *figs.* a-g, k-m.

This species is common in wet areas along the Atlantic seaboard, forming small developments on tufts of moss, and mossy logs or stumps, each colony varying somewhat. It is very constant in the characters of the spores, but shows much variation in the shape of the sporangia, the stalk, the columella, and the capillitium. A number of varieties have been proposed on these variations, but only one, var. *gracile*, is known from North America. Most of the eastern material is that variety, but as it is usually associated with the typical form having short and straight stalks, it is hardly a distinct variety. The species is distinguished from *L. scintillans* by the usual brilliant, blue color, the larger size, and the characters of the spores. The capillitium occasionally springs from all parts of the columella.

5. *Lamproderma violaceum* (Fries) Rost. Versuch 7. 1873.

Stemonitis violacea Fries, Syst. Myc. 3: 162. 1829.

Plasmodium watery white, rarely yellow (Lister). Total height 0.6 to 1.5 mm. Sporangia stalked, subglobose, more or less flattened and umbilicate beneath, erect, scattered or gregarious, 0.4 to 0.9 mm. diam., shining with iridescent blue, violet, or bronze reflections; sporangial wall membranous, somewhat persistent, colorless or pale violet-brown, often sprinkled with small, scattered, slender, hyaline rods 50–100 μ long, which appear to be of a crystalloid nature. Stalk varying from very short to one and a half times the height of the sporangium, black, rising from a reddish brown membranous hypothallus. Columella one third to two thirds the height of the sporangium, cylindrical, obtuse, or sometimes narrowing to the apex. Capillitium of brown threads, or brown threads with pale extremities, or entirely pale throughout, springing from the upper part of the columella, branching and anastomosing to form a more or less dense network, becoming very slender towards the surface. Spores purplish gray, minutely spinulose, 8–10 μ diam.

Var. *Sauteri* (Rost.) Lister, Mycetoza 129. 1894.

Lamproderma Sauteri Rost. Mon. 205. 1874.

Sporangia globose or ovoid-globose; threads of the capillitium straight or wavy, brown; spores purple-brown, 11–15 μ diam., nearly smooth or spinulose.

Var. **Carestiae** (Ces. & DeNot.) Lister, Mycetozoa 130. 1894.

Stemonitis Carestiae Ces. & DeNot. Erb. Critt. Ital. no. 888. 1879.

Lamproderma Sauteri Rost. var. *Carestiae* (Ces. & DeNot.) Meylan, Bull. Soc. Vaud. Sc. Nat. 51: 264. 1917.

Lamproderma Carestiae (Ces. & DeNot.) Meylan, Bull. Soc. Vaud. Sc. Nat. 57: 368. 1932.

Sporangia globose or ovoid, nearly black, short-stalked or sessile on a dark, membranous hypothallus; capillitium of dark purple-brown threads with colorless tips, either flexuose and forming a dense network, or almost straight and branching at acute angles; spores purple-brown, closely spinulose or spinose, 9–20 μ diam.

TYPE LOCALITY: France.

HABITAT: On dead leaves and wood.

DISTRIBUTION: The typical form is common in the United States and Canada; Puerto Rico; var. *Sauteri*, California, *Colorado, Michigan, *Montana, Ontario, *Oregon, Washington; var. *Carestiae*, Colorado, Utah.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 132.

This species is notable for the large number of forms that surround it, all of which are clearly related, but differ more or less in some particulars. Forms like *L. Gulielmae*, *L. cribrarioides* and *L. atrosporum*, that have some prominent characters, constant in specimens from widely separated parts of the world, are entitled to specific separation. Others, which have only differences in size, shape, stalk, color of the capillitium, and spore characters, or various combinations thereof, seem to be more of the nature of variants. They are rarely found, or are confined to particular regions. In all my collecting experience I have never found a specimen that was not practically typical *L. violaceum*, and the typical form is common in the mountain areas I have visited. It has two phases. The sporangia of the early developments in July and August are somewhat small, usually brilliant blue, with a firm peridium, which is quite persistent. These fruitings are on leaves. Later, in October and on wood, is found the larger form, bronze or brown in color, and with a thin peridium which breaks away on maturity. Vars. *Sauteri* and *Carestiae* are not constant in different collections as seen in specimens here, and are con-

nected with the typical form by intermediate forms. In view of their scarcity in North America, it seems better to regard them as varieties until more abundant collections are found. In Pike County, Pennsylvania, I have made repeated collections of the form with long, slender, hyaline rods imbedded in the peridium. It has also been obtained from Ontario.

6. **Lamproderma Gulielmae** Meylan, Bull. Soc. Vaud. Sc. Nat. 52: 449. 1919.

Plasmodium translucent yellow (Brândză). Sporangia globose or obovoid, stalked, in loose clusters, 0.35 to 0.45 mm. diam., silvery or iridescent blue, spotted with black depressed patches corresponding to thickened purplish brown areas of the otherwise colorless sporangial wall. Stalk black, subulate, 0.5 to 1 mm. high. Capillitium consisting of pale brown or colorless threads radiating from the columella, and branching repeatedly at acute angles. Spores brownish purple, strongly spinulose, 12–15 μ diam. (PLATE 12, FIG. 2.)

TYPE LOCALITY: Switzerland.

HABITAT: On dead leaves and herbaceous stalks.

DISTRIBUTION: Colorado.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 215, *figs.* a–d.

Two collections were made by Dr. W. C. Sturgis in the Wet Mountain Valley of Colorado, in August 1914 (N. Y. B. G. *nos.* 11318, 11322), and are the only American collections known. The small, silvery gray sporangia with black spots on the peridia are well marked. The capillitium is pale, and the spores are strongly spinulose.

7. **Lamproderma cribrarioides** (Fries) R. E. Fries, Svensk Bot. Tidskr. 4: 259. 1911.

Stemonitis cribrarioides Fries, Syst. Myc. 3: 163. 1829.

Plasmodium? Sporangia scattered or clustered, globose, about 1 mm. diam., stalked or sessile, rarely forming plasmodiocarps, purple-brown, shining with iridescent colors; sporangial wall membranous, colorless above, purplish brown below. Stalk black, 0.1 to 0.5 mm. high. Columella cylindrical, reaching to half or two thirds the height of the sporangium, absent in the plasmodiocarp forms. Capillitium a network of pale or dark purplish brown, flexuose threads, stouter below, slender and

colorless at the tips. Spores dark purplish brown, 11–18 μ diam., regularly reticulate with narrow, raised bands, that form a net with from 8 to 24 meshes on the hemisphere, and show as a border 0.5–1.5 μ wide.

TYPE LOCALITY: Germany.

HABITAT: On herbaceous stalks (Colorado collection).

DISTRIBUTION: Colorado.

ILLUSTRATION: Macbr. & Martin, *Myxomycetes pl. 13, figs. 309, 310*.

The only American collection was by Dr. Fred J. Seaver, Curator of the New York Botanical Garden, associated with P. J. Swope, at Middle Boulder, Colorado, in July 1929. The collection is typical, with finely reticulate spores.

8. **Lamproderma atrosporum** Meylan, Bull. Soc. Vaud. Sc. Nat. 46: 51. 1910. (N. Y. B. G. nos. 7247, 8046, 11335, authentic material.)

Plasmodium black (Meylan). Sporangia scattered or clustered, subglobose or ovoid, stalked or sessile, glossy purple-black with silvery or iridescent reflections, 0.8 to 1.4 mm. diam.; sporangial wall purplish, at length breaking up into fragments. Stalk black, 0.1 to 1 mm. high, on a dark membranous hypothallus. Columella cylindrical or clavate, about half the height of the sporangium. Capillitium consisting of nearly black or purple-brown threads, branched and anastomosing, slightly flexuose or closely crisped, dark to the tips of the branchlets, which are often thickened and adhere to the sporangial wall. Spores brownish purple or purplish gray, 11–15 μ diam., either closely and minutely spinulose or marked with scattered spines, or more or less completely reticulate with rows of minute warts or raised bands.

TYPE LOCALITY: Switzerland.

HABITAT: On dead leaves, twigs, and stems.

DISTRIBUTION: California, *Oregon, Quebec, Utah.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl. 133, figs. f–i*.

Dr. C. L. Shear found this species in the Yosemite Valley of California in 1915. The spores are beautifully reticulate with spines. Another collection by Dr. J. W. Groves, at Burnet, Quebec, in 1939, has the spines more or less confluent, forming a broken reticulation of raised ridges accompanied by spines. In the Utah specimen, collected by S. J. Harkness in 1881, the spores are spinulose. These specimens illustrate the variation in the

characters of the spores, but in all three the capillitium is dark to the tips, which are expanded and attached to the sporangial wall. The latter is the important character on which the species is based. Var. *anglicum* and var. *debile* (N. Y. B. G. nos. 7238, 7242, authentic material), have so far been found only in England. They seem to be intermediate forms connecting the species with *L. cribarioides* and *L. Gulielmae*.

Genus 20. **CLASTODERMA** Blytt, Bot. Zeit. **38**: 343. 1880.

Sporangia stalked; columella very short; capillitium rising from the apex of the columella as solid, pale brown threads, repeatedly forking, sparingly anastomosing; sporangial wall dividing into membranous rounded or polygonal fragments, attached to one or several of the ultimate branches of the capillitium.

A SINGLE SPECIES.

1. **Clastoderma Debaryanum** Blytt, Bot. Zeit. **38**: 343. 1880.

Orthotricha microcephala Wing. Jour. Myc. **2**: 125. 1886.

Plasmodium watery white (Lister). Total height 0.5 to 1.25 mm. Sporangia gregarious, stalked, globose, 0.1 to 0.2 mm. diam., brown; sporangial wall membranous, persistent only in circular or polygonal plates attached to the ultimate branches of the capillitium. Stalk dark red with enclosed refuse matter, rough, tapering for three quarters of its length to a swollen mass, usually free from refuse, and then becoming abruptly more slender, thinner, and translucent. Columella short, dividing into the primary branches of the capillitium. Capillitium of pale brown threads, forking three or four times, sparingly anastomosing at the surface, the ultimate branchlets attached singly or several together to the persistent plates of the sporangial wall. Spores pale brownish violet, faintly warted, 8–10 μ diam.

TYPE LOCALITY: Norway.

HABITAT: On dead wood.

DISTRIBUTION: Florida, *Illinois, Iowa, *Maine, Massachusetts, New York, North Carolina, *Ohio, Ontario, Pennsylvania, Tennessee.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 135.

The peculiar stalk is a feature by which this species, although small, may be recognized in the field with a good lens. By trans-

mitted light it is seen to be yellow, translucent throughout, partially filled with refuse matter, and the distribution of the refuse makes the varied appearance seen by reflected light. The enlarged, swollen mass seems to be a part of the stalk, not an attachment, as sometimes it is seen between and separating the thicker and thinner sections. The species is not rare in eastern continental North America, and may be found almost anywhere by experienced collectors.

Genus 21. **ECHINOSTELIUM** de Bary; Rost. Versuch 7. 1873.

Sporangia stalked, very minute, about $50\ \mu$ diam., white; branches of the capillitium few, rising from the apex of a short columella.

A SINGLE SPECIES.

1. **Echinostelium minutum** de Bary; Rost. Mon. 215. 1874.

Plasmodium colorless (Lister). Sporangia scattered or gregarious, stalked, white, globose, $40\text{--}50\ \mu$ diam.; sporangial wall persistent at the base as a minute collar. Stalk slender, hyaline, with scanty pale refuse matter, 0.4 to 0.5 mm. high. Columella short, slender. Capillitium of a few arcuate threads, simple or sparingly branched and anastomosing, with free spine or hook-like branches. Spores colorless, smooth, $6\text{--}8\ \mu$ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Florida, Iowa, Kansas, Massachusetts, New York, Pennsylvania, Vermont, *West Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 128, figs. f-i.*

The smallest of the known *Mycetozoa*. The sporangia are often in fairly large colonies, and the white specks may be seen in the field with a good magnifier.

Genus 22. **MACBRIDEOLA** Gilbert, Univ. Ia. Stud. Nat. Hist. 16: 155. 1934.

Sporangia stipitate; stipe translucent, appearing hollow, extending into the sporangium as a columella; capillitium typically lacking, although divisions of the columella may be found in some sporangia; peridium membranous, translucent, evanescent or persistent; spores brown.

A SINGLE SPECIES.

The description is that of Gilbert. It seems to be an unnecessary genus. There is not a single broad character required for a genus, so that other forms may be included therein. The description is a combination of minor specific characters, and the two species proposed, which have only trifling differences, might well be included as a single species in either the genus *Comatricha* or the genus *Barbeyella*, which now have forms closely resembling them. *Barbeyella* is not represented by collections from North America. Little material of *Macbrideola* is available, as it appears the forms have been obtained only in moist chamber developments. The genus is retained tentatively, pending further study when more material is obtained, preferably in natural developments, which may show differences.

1. *Macbrideola scintillans* Gilb. Univ. Ia. Stud. Nat. Hist. 16: 156. 1934. (N. Y. B. G. no. 6880, type material.)

Macbrideola decapillata Gilb. Univ. Ia. Stud. Nat. Hist. 16: 158. 1934.

Plasmodium? Sporangia scattered, globose, dark brown or metallic bronze, 75–125 μ diam.; stipe tapering, translucent, appearing hollow, yellow at the base, brown above, continuing into the sporangium, 50–100 μ long; peridium thin, shining, translucent, tough, strongly attached to the columella; columella tapering, reaching the apex where it fuses with the peridium; capillitium lacking; spores globose, thick-walled, brown, marked with large warts irregular in shape and distribution, 8–9 μ diam.

TYPE LOCALITY: Iowa (moist chamber).

HABITAT: On bark of living trees.

DISTRIBUTION: Iowa, Kansas.

ILLUSTRATION: Gilb. Univ. Ia. Stud. Nat. Hist. 16: 157, fig. 2; 158, fig. 3.

The author writes in reference to *M. decapillata*, "the small size, long stipe and evanescent peridium set this form apart from *M. scintillans*." This is hardly sufficient to erect a separate species. The description of *M. decapillata* contains only minor differences, observed in almost every species of the *Mycetozoa*.

Family III. ELAEOMYXACEAE

Sporangia distinct, provided with a waxy or oily substance.

A SINGLE GENUS.

Genus 23. **ELAEOMYXA** Hagelstein, *Mycologia* **34**: 593. 1942.

Sporangia distinct, stalked or sessile, without lime; sporangial wall membranous; capillitium consisting of branching and anastomosing purplish threads; inclusions, granules or globules of an oily or waxy substance, present in the stalk, columella, sporangial wall, or capillitium.

TYPE SPECIES: *Diachea miyazakiensis* Emoto.

1. **Elaeomyxa miyazakiensis** (Emoto) Hagelstein, *Mycologia* **34**: 593. 1942.

Diachea miyazakiensis Emoto, *Proc. Imp. Acad. Tokyo* **11**: 444. 1935.

Plasmodium not observed. Total height 1 to 1.5 mm. Sporangia gregarious, cone-shaped, stalked, blue or iridescent violet; sporangial wall membranous, transparent, sometimes with pale orange oil granules. Stalk cylindrical, somewhat thicker in the middle, brownish black, 0.1 to 1 mm. long, about 0.05 mm. diam. Hypothallus not developed. Columella reaching to half the height of the sporangium, violet-brownish black, dividing into branches, without lime. Capillitium springing from the columella, of branching and anastomosing, dark violet-brown threads, colorless at the tips, and having at the axils oil-bearing nodules, 5–30 μ diam., pale orange or pale orange-red, containing many granules. Spores globose, dark violet-brown, warted, 7–10 μ diam.

TYPE LOCALITY: Japan.

HABITAT: On dead wood.

DISTRIBUTION: Ontario.

ILLUSTRATION: Emoto, *Proc. Imp. Acad. Tokyo* **11**: 444, *figs. 1–3*, as *Diachea miyazakiensis*.

The preceding is a translation of the German description of Emoto. He uses the German word for oil to explain the material in the sporangia and capillitium. Another species, so far unknown from North America, is described as having wax. Emoto may have used the word as synonymous with wax. In the Ontario specimens the substance is a solid at ordinary temperatures. The diameter of the stalk, given by Emoto as 0.05 mm., is clearly an error as it does not conform to his figure which shows a stout,

thick stalk. About 0.25 mm. diam. would coincide with the figure and agrees with the Ontario examples. The spores in the American material are 7-8 μ diam., clear violet by transmitted light, and the many reddish knots in the capillitium are prominent. In all other respects they agree with Emoto's description. The species has been collected repeatedly by Mr. Eli Davis and Mr. W. D. Sutton, near London, Ontario.

Family IV. AMAUROCHAETACEAE

Sporangia combined to form an aethalium. Capillitium of dark, purplish brown, irregular strands and threads, or of complex vesicles; without wax.

Schenella simplex Macbr. (Mycologia 3: 39. 1911), based on a single collection, might appropriately be placed in this family if conclusively proven to be a form of the *Mycetozoa*. The original description and figures are not impressive, and clearly indicate the author was uncertain.

Capillitium of irregularly branching threads; spores in mass black.

24. AMAUROCHAETE

Capillitium of horizontal threads, with many chambered vesicles; spores in mass purplish brown.

25. BREFELDIA

Genus 24. **AMAUROCHAETE** Rostafinski, Versuch 8. 1873.

Aethalium pulvinate, composed of elongate, closely, compacted, confluent sporangia; sporangial walls not developed within the aethalium; columellae black, rising from a dark, membranous hypothallus, irregularly branched and anastomosing, merging into the strands and threads of the capillitium. Spores, in mass, black.

TYPE SPECIES: *Reticularia atra* (Alb. & Schw.) Fries.

This genus is confined to forms with spores black in mass, or nearly so, and spinulose or warted, not reticulate. Forms approaching it in the capillitium, but with spores like those of members of the genus *Stemonitis*, are placed, as confluent varieties, with the appropriate species of the latter.

Capillitium of branches irregularly anastomosing.
Capillitium an elastic network of curved threads.

1. *A. fuliginosa*
2. *A. cribrosa*

1. **Amaurochaete fuliginosa** (Sow.) Macbr. N. A. Slime-Moulds
109. 1899.

Lycoperdon fuliginosum Sow. Engl. Fungi *pl.* 257. 1803.

Lycogala atrum Alb. & Schw. Consp. Fung. 83. 1805.

Reticularia atra (Alb. & Schw.) Fries, Syst. Myc. 3: 86. 1829.

Amaurochaete atra (Alb. & Schw.) Rost. Versuch 8. 1873.

Plasmodium cream-white (Lister). Aethalium pulvinate on a broad base, 1 to 8 cm. diam., rarely subglobose, 0.5 to 1 cm. diam., and attached to the habitat by a slender stalk-like strand of hypothallus, glossy purplish black; cortex divided by thinner lines into polygonal areolae, 0.4 to 0.8 mm. diam., representing the summits of the component sporangia. Columellae of black, rigid, flattened strands, forked and anastomosing, rising from a dark, purplish, membranous base. Capillitium of irregular, dark strands branching repeatedly at acute angles and anastomosing, the ultimate branchlets slender. Spores dark brownish purple at first, fading to paler or purplish gray, paler on one side, minutely spinulose, 11–14 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead coniferous wood.

DISTRIBUTION: Colorado, Maine, New Jersey, New York, *Ohio, *Ontario, *Oregon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 136, *figs.* a–c.

I have found this species twice in Maine and three times on Long Island, New York, yet it seems to be rarely collected. The spores vary occasionally from the sizes given and the color fades to lighter, so that these characters cannot be taken as absolutely determinative.

2. **Amaurochaete cribrosa** (Fries) Sturg. Mycologia 9: 328.
1917.

Lachnobolus cribrosus Fries, Syst. Orb. Veg. 1: 148. 1825.

Amaurochaete Tubulina Macbr. N. A. Slime-Moulds ed. 2. 150. 1922.

Plasmodium watery white (Lister). Aethalia subglobose or pulvinate, 1 to 4 cm. diam., glossy black, sessile, rarely stalked; sporangial walls represented by the polygonal areolae of the purplish, membranous cortex. Columellae numerous, less stout than in *A. fuliginosa*, branched and anastomosing, dividing above into the capillitium which forms an elastic network of dark, arcuate

threads, sometimes divided or lobed towards the surface of the aethalium to show the contours of the component sporangia. Spores black in mass, purplish gray by transmitted light, with a pale area of dehiscence, closely and minutely spinulose, 11–15 μ diam.

TYPE LOCALITY: Sweden.

HABITAT: On dead coniferous wood.

DISTRIBUTION: California, Massachusetts, *Oregon, *Pennsylvania, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 217, *figs.* a–c.

Macbride (*loc. cit.*) considers the form as agreeing with the description of *Stemonitis Tubulina* Alb. & Schw. (Consp. Fung. 102. 1805), but apparently the type, if still existent, has not been compared. Albertini and Schweinitz described the spore-mass color of *S. Tubulina* as brown, which would indicate a confluent phase of some species of *Stemonitis*. In view of the known errors and failings of the earlier students, it seems better to accept, at least for the present, the name of the form of Fries, which is generally accepted as representative. *A. cribrosa* is practically like *A. fuliginosa* in appearance and spores, but differs materially in the capillitium, which is an elastic network above the ragged columellae, instead of branching strands. So far as I know only five developments have been found in North America, the last by Miss E. E. Morse in Mt. Lassen National Park, California, in August 1928. Earlier gatherings were by Dr. A. P. D. Piguet, at Sharon, Massachusetts, in May 1910; Mr. Hugo Bilgram, at Lafayette, Pennsylvania, in May 1911; Prof. T. H. Macbride, on Mt. Ranier, Washington, in 1913; and it was reported by Peck and Gilbert from Oregon in August.

Genus 25. **BREFELDIA** Rostafinski, Versuch 8. 1873.

Aethalium pulvinate, consisting of subcylindrical, somewhat branched and confluent sporangia, rising from a base of spongy, barren tissue, which is continued among the lower portions of the sporangia in irregular folds; imperfect sporangial walls and central columellae sometimes present. Capillitium of numerous horizontal threads, uniting at the surface of the adjacent sporangia to form vesicles with many chambers.

A SINGLE SPECIES.

1. **Brefeldia maxima** (Fries) Rost. Versuch 9. 1873.

Reticularia maxima Fries, Syst. Orb. Veg. 1: 147. 1825.

Plasmodium cream-white. Aethalium large, pulvinate, 2 to 30 cm. or more across, 5 to 15 mm. thick, purplish brown, composed of elongate branching sporangia 0.3 to 0.5 mm. diam., extending upwards from the spongy basal tissue; distinct, rigid columellae often present. Capillitium consisting of numerous, dark threads radiating from the inner part of each sporangium, free from the columella; each thread expands at the surface of the sporangium into a vesicle of many chambers, which is continued into a corresponding radial thread of the adjoining sporangium; proximal ends of the threads connected in clusters of three or four by a fragile membrane; vesicles of firm texture, often containing a spore in several of the chambers, occasionally coalescing in lesser or greater numbers to form vertical scalariform strands. Spores purplish brown, minutely spinulose, 9–12 μ diam.

TYPE LOCALITY: Sweden.

HABITAT: On dead wood.

DISTRIBUTION: Iowa, Massachusetts, *Minnesota, New York, Ontario, *Oregon, *Pennsylvania, Quebec, *Wisconsin.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 136, figs. d–g.

The complexity of the capillitium has been analyzed and explained by Lister and by Macbride. It is a feature unknown in any other species of the *Mycetozoa*, and, with some of the spores in the vesicles, and the large, dark aethalium, makes it easy to recognize the form. It is not common, although I have found it four times in swampy lowlands of Long Island, New York. On two occasions the rising plasmodium was on living trees, three to six feet from the ground. Lister also mentions the wandering habit of the plasmodium. The plasmodia were infested with the eggs of insects, and the hatched larvae were later feeding on the spores. All specimens were found in the autumn, shortly before cold weather set in. The aethalia are loose and fragile, and do not last long in the open.

Order II. CRIBRARIALES

Spores variously colored, not violet-brown or purplish gray, except in *Licea minima*.

Suborder I. **DICTYDIINEAE**

Capillitium absent or not forming a system of uniform threads, except in *Alwisia*.

Family I. **CRIBRARIACEAE**

Sporangial wall membranous, studded with round, microscopic granules (plasmodic granules); the wall either continuous or forming a net in the upper part; capillitium and columella absent; spores usually 4–7 μ diam.

- | | |
|--|----------------|
| Sporangia sessile, closely compacted or in the form of an aethalium, the walls not forming nets in the upper part. | 26. LINDBLADIA |
| Sporangia stalked; sporangial wall with thickenings in the form of a delicate, persistent net usually expanded at the nodes. | 27. CRIBRARIA |
| Sporangia stalked; sporangial wall with thickenings in the form of nearly parallel ribs extending from the base to the apex, and connected by delicate transverse threads. | 28. DICTYDIUM |

Genus 26. **LINDBLADIA** Fries, Summa Veg. Scand. 449. 1849.

Sporangia either combined to form an aethalium or closely compacted, rarely free; sporangial wall membranous, studded with dark, plasmodic granules.

A SINGLE SPECIES.

1. **Lindbladia effusa** (Ehrenb.) Rost. Mon. 223. 1875.

Licea effusa Ehrenb. Sylv. Myc. Berol. 26. 1818.

Plasmodium brownish black (Lister). Sporangia cylindrical, convolute, combined to form a more or less complex, effused or pulvinate aethalium 1 to 25 cm. across, 2 to 10 mm. thick, either black with a cortex of imperfectly developed spores, or umber-brown and the surface formed by the convex summits of the component sporangia, each about 0.4 mm. diam.; hypothallus strongly developed, membranous, forming a more or less spongy tissue; sporangial walls entire or perforated, membranous, yellowish brown, studded with dark plasmodic granules grouped in clusters or forming irregular veins. Spores ochraceous brown, faintly warted, 4–6 μ diam.

Var. *simplex* Rex, Bot. Gaz. 17: 202. 1892.

Physarum caespitosum Peck, Rept. N. Y. State Mus. 26: 75. 1874. (N. Y. B. G. nos. 5486, 7971, 11254, type material.)

Perichaena caespitosa Peck, Rept. N. Y. State Mus. 31: 57. 1879.

Sporangia shortly cylindrical, closely compacted, sessile, usually in a single layer, rarely free and short-stalked.

TYPE LOCALITY: Germany.

HABITAT: On dead coniferous wood.

DISTRIBUTION: The typical form and var. *simplex* are widely distributed throughout the United States and Canada, and not uncommon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 137.

Some developments superficially resemble certain phases of *Tubifera ferruginosa*, but may be distinguished by the spores and plasmodic granules. Var. *simplex* is intermediate between the typical form and *Cribraria argillacea*, and connecting forms are found. *L. effusa* is often found nearby or associated with *C. argillacea*.

Genus 27. **CRIBRARIA** Persoon, Neues Mag. Bot. 1: 91. 1794.

Sporangia globose or piriform, stalked; sporangial wall either forming a cup in the lower half or reduced to a basal disc, continued above as a net of slender threads more or less expanded and thickened at the nodes, membranous and evanescent in the meshes of the net. Dark plasmodic granules present in the cup and nodes of the net.

TYPE SPECIES: *Cribraria rufescens* Pers.

The genus is a difficult one. A number of the species are so closely connected by numerous intermediate forms, that many of the collections are practically indeterminate, particularly if the material is in poor condition; many developments mature imperfectly; the colors for sporangia and spores, as given, are for fresh, perfect specimens, as the colors alter with age in many cases; and the size and arrangement of the plasmodic granules, while useful in diagnosis, are not always constant.

Sporangia ochraceous, yellow, or brown.

Cup and net present, but junction imperfectly defined in fresh material; nodes when present flattened.

Sporangial wall thickened below, persisting as a cup and merging gradually into a fragile, imperfect, irregularly meshed net.

1. *C. argillacea*

- Junction zone between cup and net broad, with numerous perforations merging gradually into the firm, distinct net; cup strongly ribbed; plasmodic granules 1-2 μ diam.
- Junction of cup and net more or less sharply defined. Nodes of net flattened, thickened, or inconspicuous.
- Plasmodic granules in typical examples large, 2-2.5 μ diam.; spores in mass yellowish brown.
- Cup distinct, toothed and occasionally perforated at the margin; spores evenly warted or nearly smooth.
- Similar to *C. piriformis* but spores irregularly warted.
- Plasmodic granules smaller than 2 μ diam.
- Cup distinct, toothed; net with well defined regular meshes; nodes prominent, flattened or thickened; spores golden yellow in mass.
- Cup well developed, dentate, with prominent intervening teeth extending into a loose, irregular net with very large meshes; nodes often inconspicuous.
- Sporangia minute; cup when present well defined; often without cup or nodes; spores ochraceous.
- Nodes of net always thickened, convex, angular or branching.
- Cup present or more or less obsolete, often irregular at the margin; nodes angular and branching; meshes of net close and regular; spores ochraceous.
- Similar to *C. intricata* but nodes convex or round.
- Similar to *C. intricata* but meshes of net larger; habitat on leaves.
- Cup always present and distinct, rim even and regular; stalk 4 to 10 times the height of the sporangium; spores reddish or brownish in mass.
- Cup wanting.
- Sporangia small, on long stalks; net extending to the top of the stalk or a small basal disc; nodes thickened and rounded; spores ochraceous in mass.
- Cup replaced by nine or more free ribs; nodes flattened.
- Sporangia red.
2. *C. macrocarpa*
3. *C. piriformis*
4. *C. dictyospora*
5. *C. aurantiaca*
6. *C. rufa*
7. *C. minutissima*
8. *C. intricata*
9. *C. tenella*
10. *C. laxa*
11. *C. languescens*
12. *C. microcarpa*
13. *C. splendens*
14. *C. ferruginea*

Sporangia purple or violet.

Sporangia purple, 2 to 2.5 mm. in total height; plasmodic granules 2-2.5 μ diam.; net irregular. 15. *C. purpurea*

Similar to *C. purpurea* but sporangia smaller and total height 0.7 to 1.7 mm.; net regular. 16. *C. elegans*

Sporangia violet, minute, less than 1 mm. total height; plasmodic granules 0.5-1 μ diam. 17. *C. violacea*

1. *Cribraria argillacea* Pers. Neues Mag. Bot. 1: 91. 1794.

Plasmodium lead-colored or purplish olive (Lister). Total height 0.75 to 1.5 mm. Sporangia crowded, globose, short-stalked or nearly sessile, 0.5 to 1.2 mm. diam., ochraceous or olivaceous; cup imperfectly defined; sporangial wall often persistent throughout, delicately membranous above, stouter towards the base, where it is strengthened by few, rather strong ribs, or reticulate all over with strongly or weakly thickened bands forming a net in the upper part with hardly expanded nodes, after the intervening thin membrane has vanished, or merely strands of the thickened portions; plasmodic granules about 1 μ diam. Stalk 0.1 to 0.8 mm. high, furrowed, dark brown, rising from a well-developed hypothallus. Spores ochraceous, nearly smooth, 5-6 μ diam. (PLATE 12, FIG. 3.)

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Not uncommon throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 138.

This species is distinguished from *Lindbladia effusa* var. *simplex* by the character of the sporangial wall. In *C. argillacea*, this is delicate in the upper part, forming eventually, by disappearance of the intervening membrane, a more or less defined net, often breaking and leaving persistent, thickened strands of the wall. The thickenings and ribs are seen as reticulations in an earlier stage. In some developments, the wall is nearly uniform in texture, and then resembles the wall of *L. effusa* var. *simplex* which is without net or strands. There are no disconcerting intermediates to confuse *C. argillacea* with any other species of the genus *Cribraria*.

2. *Cribraria macrocarpa* Schrad. Nov. Gen. Pl. 8. 1797.

Plasmodium slate-colored (Lister). Total height about 2 mm. Sporangia gregarious or scattered, stalked, globose or turbinate,

0.6 to 1 mm. diam., yellowish brown; cup brown with numerous dark brown longitudinal ribs, and a broad connective zone to the net, which has numerous perforations, and toothed and irregular where it merges into the net; nodes flattened, elongate, confluent and irregular in the lower part, branching and polygonal above; dark plasmodic granules in the ribs and nodes, 1–2 μ diam. Stalk 0.8 to 1 mm. high, thick, furrowed, dark brown. Spores ochraceous, nearly smooth, 4–6 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead coniferous wood.

DISTRIBUTION: Michigan, New Hampshire, New York, North Carolina, Ontario, Oregon, Pennsylvania, Quebec, *South Carolina, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 141, figs. a–d.*

This species is rare in North America, and collections are confined to mountainous regions at high altitudes. Forms intermediate with *C. intricata* are often found when the latter species is fruiting in abundance, sometimes mixed in the same development. These are usually paler in color, the connective zone is not so broad, and the nodes are thickened. They are nearer *C. intricata*, though approaching *C. macrocarpa*. The characteristic features of *C. macrocarpa* are the large, dark sporangia; the dark ribs of the cup; the broad zone between the cup and net, with its perforations; and the flattened, irregular nodes.

3. *Cribraria piriformis* Schrad. Nov. Gen. Pl. 4. 1797.

Cribraria atrofusca Martin & Lovejoy; Martin, Jour. Wash. Acad. Sc. 22: 92. 1932. (N. Y. B. G. no. 7122, cotype material.)

Plasmodium pale slate-color? (Lister). Total height 1 to 1.7 mm. Sporangia gregarious, turbinate or globose, stalked, 0.4 to 0.9 mm. diam.; spore-mass yellowish brown; cup brown, about one third the height of the sporangium, irregularly toothed and somewhat perforated at the margin, or equally toothed, studded with large, dark, round plasmodic granules 2–2.5 μ diam., arranged in broad lines radiating from the base or evenly distributed; nodes of the net varying in shape and size, flat, polygonal, triangular, elongate, or branching, often not expanded and convex, charged with dark plasmodic granules, and connected by yellowish or brown threads; net sometimes lax and incomplete, with free hooked ends between the threads. Stalk stout, 0.5 to 2.5

mm. high, dark brown. Spores ochraceous or brownish, faintly warted, 5–8 μ diam.

Var. *notabilis* Rex; Lister, Mycetozaa ed. 2. 182. 1911.

Sporangia globose; nodes convex and prominent, rounded or irregular, with slender connecting threads; stalks slender.

TYPE LOCALITY: Europe.

HABITAT: On dead coniferous wood.

DISTRIBUTION: California, Colorado, *Connecticut, *Iowa, Maine, New Hampshire, New York, *North Carolina, Ontario, *Oregon, Pennsylvania, *South Dakota, *Tennessee, *Virginia, *Washington, *Wyoming.

ILLUSTRATION: Lister, Mycetozaa ed. 3. *pl. 144*.

This species has been frequently reported from North America, but typical or representative examples are rare and confined to those from mountainous regions. It is connected with *C. aurantiaca* by intermediate forms, and, when the sporangia of the latter are piriform in shape, they have often been placed mistakenly with *C. piriformis*. The important differences are the large plasmodic granules in the cup and nodes of *C. piriformis*, and the darker, brownish color of the spores in mass. The granules vary in size, and are sometimes smaller, but are on an average twice the diameter of those of *C. aurantiaca*. Var. *notabilis* has very large, prominent nodes, when representative, but there are intermediate forms with smaller nodes that approach more nearly the typical form. *C. atrofusca* is almost typical *C. piriformis*. The large granules in the cup are arranged in narrow lines with clusters of granules between them to form a series of encircling lines. Variations in the arrangement of the granules are occasionally observed, even to the extent that they may be uniformly distributed, and are not regarded as of specific importance. Specimens collected by Dr. Brândză in Roumania, and regarded by him as *C. piriformis*, have the granules in a broad band at the margin of the calyculus.

4. *Cribraria dictyospora* Martin & Lovejoy; Martin, Jour. Wash. Acad. Sc. 22: 91. 1932. (N. Y. B. G. no. 7125, cotype material.)

Total height 1 to 2 mm. Sporangia gregarious, dark purplish brown, erect or slightly nodding, globose, 0.4 to 0.8 mm. diam.; calyculus occupying about one third of the spore-case, marked

with irregular, dark, granular rays, the margin toothed; net rather fine-meshed, the connecting threads narrow, the nodes flat and angular, not greatly thickened, densely filled with large, dark granules, making them appear black; free ends abundant, often branched, arising both from nodes and from connecting threads; stipe slender, two or three times the diameter of the sporangium, furrowed, light at the apex, otherwise dark. Spores ochraceous brown in mass, clear violet by transmitted light, globose or somewhat angular, minutely warted, and covered with a coarse and often imperfect reticulum of three to five meshes to the hemisphere, 8–8.8 μ , averaging 8.5 μ .

TYPE LOCALITY: Oregon.

HABITAT: On dead wood.

DISTRIBUTION: Oregon.

ILLUSTRATION: Martin, Jour. Wash. Acad. Sc. 22: 90, *figs. 8, 9*.

The above description is based upon the original of Martin & Lovejoy. An examination of the cotype material discloses that the form is practically *C. piriformis*, except for the spores, and is perhaps only an aberrant form of that species. The spores are not covered with a reticulum. They have faint spines or warts, irregularly arranged in patches or groups, and with intervening smooth areas which do not form a regular pattern. Similar spores are often met in many species of the *Mycetozoa*, but hitherto had not been reported in the genus *Cribraria*. Sometimes they appear in certain collections of a species while other specimens have spores without smooth areas. If it should be found that the condition is more general among the species of *Cribraria*, its value as a specific character would fall.

5. *Cribraria aurantiaca* Schrad. Nov. Gen. Pl. 5. 1797.

Cribraria vulgaris Schrad. Nov. Gen. Pl. 6. 1797.

Cribraria vulgaris Schrad. var. *aurantiaca* (Schrad.) Pers. Syn. Meth. Fung. 194. 1801.

Plasmodium green or slate-gray (Lister). Total height 1 to 2 mm. Sporangia gregarious, stalked, globose or sometimes turbinate, erect or nodding, 0.4 to 0.7 mm. diam.; spore-mass golden yellow; cup one third the height of the sporangium, pale brown or brown, irregularly and deeply toothed at the margin, often more regular, studded with round plasmodic granules 0.5–1 μ diam., arranged in close lines radiating from the base of the sporangium; nodes of the net flattened, broad, branching, and angular, or

narrow, the angles continued into the slender connecting threads, or thickened and convex, often with a few free rays. Stalk subulate, dark brown, two to four times the height of the sporangium or higher. Spores ochraceous by transmitted light, minutely warted, 5–6 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 142.

Lister (Mycetozoa ed. 3. 173. 1925), following Persoon, recognizes *C. vulgaris* with paler, flattened nodes as the species, and *C. aurantiaca* with dark, convex nodes as *C. vulgaris* var. *aurantiaca*. Under present rules of nomenclature *C. aurantiaca* must be accepted as the name, as the two forms are undoubtedly the same species. Schrader distinguished the two forms on nodes and color of the spores. Practically all American specimens have the golden yellow color of the spores in mass. The few that are paler have probably altered with age. Variation in the shape of the nodes is often seen in the same development and sometimes in the same sporangium. It is not considered of sufficient stability to warrant a distinct variety. The color of the calyculus and nodes depends much upon the number of plasmodic granules present, as it does in other species of the genus. Forms with thickened, convex or irregular nodes and a more regular net approach *C. tenella* or *C. intricata*, but may usually be distinguished by the spore-color which is ochraceous in the species named. The small size of the plasmodic granules in *C. aurantiaca* is an important character in separating it from other forms which it may resemble.

6. *Cribraria rufa* (Roth) Rost. Mon. 232. 1875.

Stemonitis rufa Roth, Tent. Fl. Germ. 1: 548. 1788.

Cribraria rufescens Pers. Neues Mag. Bot. 1: 91. 1794.

Plasmodium milk-white (Lister). Sporangia scattered, stalked, subglobose or turbinate, 0.5 to 0.7 mm. diam., reddish orange; cup one third the height of the sporangium, with a regularly toothed margin, more or less ribbed, the thicker ribs continued into the wide-meshed net; plasmodic granules hardly 1 μ diam.; nodes of the net hardly expanded, or narrow, triangular and flattened, connected by three or four firm threads. Stalk

cylindrical, the length of the sporangium or more, rugose, black. Spores yellowish, minutely warted, 5–8 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead coniferous wood.

DISTRIBUTION: *Montana, *Ohio, Ontario, Oregon, Pennsylvania, *Prince Edward Island, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 140, *figs.* a–c.

This species is distinguished by the usually firm and large meshes of the net and the reddish orange color. Its nearest neighbor is *C. minutissima*, but there is little comparison because of the minute size of the latter.

7. *Cribraria minutissima* Schw. Trans. Am. Phil. Soc. II. 4: 260. 1832.

Cribraria minima Berk. & Curt.; Berk. Grevillea 2: 67. 1873.

Cribraria microscopica Berk. & Curt.; Berk. Grevillea 2: 67. 1873.

Cribraria oregana Gilb.; Peck & Gilb. Am. Jour. Bot. 19: 142. 1932. (N. Y. B. G. no. 7127, type material.)

Plasmodium blackish blue (Lister). Total height 0.5 to 0.7 mm. Sporangia stalked, gregarious, globose, erect or inclined, 0.1 to 0.3 mm. diam., nut-brown; cup entirely wanting, or even at the margin and about half the height of the sporangium, or still higher and constricted below the rim, faintly striate longitudinally with lines of plasmodic granules about 1 μ diam.; nodes of the net not expanded, or narrow and flattened, connected by three to five slender threads. Stalk filiform, two to four times the height of the sporangium, brown. Spores ochraceous, minutely spinulose, or warted, 5–7 μ diam.

TYPE LOCALITY: North Carolina.

HABITAT: On dead coniferous wood.

DISTRIBUTION: Colorado, Indiana, *Iowa, Massachusetts, *Missouri, New Jersey, New York, North Carolina, Oregon, Pennsylvania, *South Carolina, *South Dakota, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 140, *figs.* d–h.

This minute species is usually found in the early months of the season when the more common *Cribrarias* appear in abundance. It is subject to considerable variation in the size and shape of the cup, and the nodes of the net are sometimes enlarged more prominently. The species compares in size with several other minute forms of *Cribraria*, but is readily recognized by sharp and clear characters. *C. oregana* is an abnormal form of

the present species with large, irregular spores and more pronounced nodes. A collection personally made in Sussex County, New Jersey, was on a rotten log almost completely immersed in the water of a swamp, and is identical with the type material of *C. oregana*. Such forms develop under adverse conditions of moisture.

8. ***Cribraria intricata*** Schrad. Nov. Gen. Pl. 7. 1797.

Plasmodium lead-colored or brownish black (Lister). Total height 1.5 to 3 mm. Sporangia gregarious, often forming large colonies, stalked, globose, nodding or erect, 0.5 to 0.7 mm. diam., ochraceous brown; cup one third the height of the sporangium, yellowish brown, studded with brown plasmodic granules 0.5–2 μ diam., arranged in close lines radiating from the base of the sporangium; margin toothed; net close, regular; nodes numerous, dark brown, thickened, prominent, polygonal, often branching, connected by five to eight very slender threads, and with many free rays. Stalk subulate, two to four times the height of the sporangium, dark brown. Spores ochraceous, nearly smooth or faintly warted, 5–6 μ diam. (PLATE 16, FIG. 10.)

Var. ***dictydioides*** (Cooke & Balf.) Lister, Mycetozoa 144. 1894.

Cribraria dictydioides Cooke & Balf.; Massee, Mon. 65. 1892. (N. Y. B. G. nos. 5394, 5395, type material.)

Cup more or less obsolete; nodes in the lower part of the net elongate and confluent, forming ribs converging to the apex of the stalk.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and usually abundant in North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 143, *figs.* a–e.

The conception that *C. intricata* is restricted to forms with double threads to the net is not accepted by the great majority of students. Such forms, if they exist, are generally regarded as anomalous. I have never seen any. Var. *dictydioides* is separated from typical *C. intricata* by the more or less obsolete condition of the cup; and both forms from *C. tenella* by the shape of the nodes. To distinguish them is often a matter of difficulty or personal opinion as there are no sharp lines. They merge into each other with all sorts of gradations, and a single colony may be

extremely variable. Phases that resemble *C. aurantiaca* or *C. macrocarpa* may usually be distinguished by the close and regular net, the nodes, and the ochraceous color. Var. *dictydioides* often has the net in the lower part replaced by ribs, somewhat as in *C. splendens*, but the latter appears more yellowish.

9. **Cribraria tenella** Schrad. Nov. Gen. Pl. 6. 1797.

Plasmodium brownish black (Lister). Sporangia closely resembling *C. intricata* in size, shape, color, and spores; cup one third the height of the sporangium, or more or less obsolete; net close and regular; nodes numerous, dark brown, rounded, rarely elongate, prominent, with few or no free rays, connected by three to six very slender threads.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common in the United States and Canada; not so common in the tropics.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 143, figs. f-i.

Differing from *C. intricata* only in the shape of the nodes of the net, the two forms are connected by many intermediates. Occasional phases of *C. tenella* with smaller sporangia, longer stalks, and deeper cups, appear like *C. languescens* superficially. *C. aurantiaca* is distinguished by its golden yellow spores. Occasional gatherings have ribs in the lower part of the net, but not as prominent as in *C. splendens*.

10. **Cribraria laxa** Hagelstein, Mycologia 21: 298. 1929. (N. Y. B. G. no. 1113, type.)

Plasmodium? Sporangia closely gregarious, stalked, globose, 0.5 to 0.7 mm. diam.; spore-mass ochraceous; cup dark brown, about one third the height of the sporangium, consisting of many dark brown ribs, joined near the top or connected by cross-ribs, and merging into the threads of the net, the ribs connected by a thin, partially evanescent membrane; net firm, regular, forming large triangular meshes, 0.1 mm. or more along the sides; nodes numerous, dark brown, prominent, rounded or branching, with few free rays, and connected by from five to eight slender, brown threads; plasmodic granules about 1 μ diam. Stalk dark brown, firm, usually erect, one or two times the height of the sporangium. Spores ochraceous, distinctly warted, 6-7 μ diam. (PLATE 12, FIG. 4.)

TYPE LOCALITY: Long Island, New York.

HABITAT: On dead leaves, in the dryer parts of wet areas.

DISTRIBUTION: New York, Pennsylvania, Virginia.

ILLUSTRATION: Hagelstein, *Mycologia* 21: pl. 26, figs. 4-6.

This handsome form is unique among the species of *Cribraria* because of its habitat on leaves with the plasmodium in the substratum of the soil. All other species of *Cribraria* are on wood. It somewhat resembles *C. intricata*, but the meshes of the net are much larger, from four to nine times, in area, than those of the latter species. It has been found repeatedly, in different years, at the type locality, and several times in Pike County, Pennsylvania. It is remarkably constant in all characters.

11. *Cribraria languescens* Rex, Proc. Acad. Nat. Sc. Phila. 1891: 394. 1891.

Cribraria cuprea Morg. Jour. Cin. Soc. Nat. Hist. 15: 142. 1893. (N. Y. B. G. nos. 5581, 12931, type material.)

Plasmodium red (Lister). Total height 2.5 to 3 mm. Sporangia scattered, stalked, often drooping, globose, 0.25 to 0.35 mm. diam., dull reddish or brownish; cup about one third the height of the sporangium, brown, shining, studded with brown plasmodic granules, 0.3-1.5 μ diam., arranged in close lines radiating from the apex of the stalk; margin slightly toothed; nodes of the net thickened, prominent, polygonal, connected by slender threads; meshes of the net triangular, with few free rays. Stalk long and slender, four to ten times the height of the sporangium, subulate, often sinuous or wavy; dark reddish brown. Spores dull reddish or brownish in mass, pale red by transmitted light, nearly smooth, 5-7 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: Dominica, *Iowa, Kansas, Massachusetts, *Missouri, New York, Ohio, Ontario, Pennsylvania, *Saint Croix, *South Carolina, *Washington, *Wyoming.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. pl. 145, figs. a-c.

This species is rare in North America, although widely distributed, and some of the records may be doubtful as long stalked phases of *C. tenella* are often confused with it. The important distinctions are the reddish or brownish spores and the usually smaller plasmodic granules. The spores, as in other species of

the genus *Cribraria*, have a tendency to alter in color. *C. cuprea* is a short-stalked phase of the species with more or less copper-colored spores. The typical form is quite variable in the color of the spores, so that a particular shade is hardly worthy of specific separation. Other differences are the usual ones to be expected in all species of *Cribraria*.

12. *Cribraria microcarpa* (Schrad.) Pers. Syn. Meth. Fung. 190. 1801.

Dictydium microcarpum Schrad. Nov. Gen. Pl. 13. 1797.

Cribraria tenella Schrad. var. *concinna* G. Lister, Mycetozoa ed. 3. 175. 1925. (N. Y. B. G. nos. 1260, 5397, 13017, authentic material.)

Plasmodium greenish or purplish black (Lister). Total height 0.7 to 2 mm. Sporangia gregarious, stalked, erect or nodding, globose, 0.1 to 0.4 mm. diam., ochraceous; cup wanting, except occasionally for a small basal disc; net close, regular; nodes of the net dark, prominent, thickened and rounded, charged with dark plasmodic granules 1–2 μ diam., and connected by five or six slender threads. Stalks slender, four to ten times the height of the sporangium, purplish brown. Spores pale ochraceous, faintly warted, 5–7 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Connecticut, *Dominica, Florida, Indiana, *Iowa, Massachusetts, *Missouri, *New Hampshire, New York, North Carolina, *Ohio, Ontario, Pennsylvania.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. *pl.* 145, *figs.* d–h (color confusing); Macbr. & Martin, Myxomycetes *pl.* 14, *figs.* 334, 335, 336.

Lister (Mycetozoa ed. 3. 177. 1925) describes *C. microcarpa* as a purplish red form with spores pale red in mass, which would place it with forms near *Cribraria purpurea*. *C. tenella* var. *concinna* was proposed on specimens from various places in North America, and described as differing from *C. microcarpa* in the yellow-brown color of the sporangia, and the smaller plasmodic granules. Portions of several of those collections are in the Herbarium of the New York Botanical Garden, as well as specimens of *C. microcarpa* determined by Miss Lister. Differences between all specimens here are imperceptible. It is possible that *C. microcarpa* in Europe represents a form different from that found in North America. The conception of American students,

generally, is that *C. microcarpa* represents a form somewhat like *C. tenella*, but smaller in size, on long stalks, without a cup, more or less rounded, thickened nodes, and ochraceous in color with ochraceous spores. Schrader's description seems to bear this out.

13. **Cribraria splendens** (Schrad.) Pers. Syn. Meth. Fung. 191. 1801.

Dictydium splendens Schrad. Nov. Gen. Pl. 14. 1797.

Plasmodium lead-colored (Lister). Sporangia scattered, globose, flattened beneath, stalked, erect or inclined, 0.3 to 0.6 mm. diam., pale yellow, or brown after the spores are discharged; sporangial wall consisting in the lower part of nine or more free ribs with little trace of a persistent cup, the ribs continued into a loose net with rather small meshes except between the ribs, and with small, flattened nodes which may be poorly developed; plasmodic granules minute and inconspicuous. Stalk slender, brown, three to five times the height of the sporangium. Spores yellow in mass, much paler by transmitted light, nearly smooth, 5-7 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead coniferous wood.

DISTRIBUTION: *Iowa, Maine, New Hampshire, New York, *Nova Scotia, *Ontario, Pennsylvania, Tennessee, *Washington, *West Indies, *Wyoming.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 141, figs. e-h.

This species is rare. We have found it on four occasions, and each time on very rotten wood in wet places. The developments are small, and appear in the field like poor phases of *C. intricata* var. *dictydioides*, because of the pale color and frequent collapse of the net due to the large spaces between the ribs in the lower part of the sporangium. The ribs constitute the important character. Occasionally, the nodes of the net approach those of *C. aurantiaca*, *C. intricata*, or *C. tenella*.

14. **Cribraria ferruginea** Meylan, Ann. Conserv. Bot. Genève 16: 319. 1913. (N. Y. B. G. no. 7133, authentic material.)

Plasmodium? Sporangia crowded on a membranous hypothallus, stalked, subglobose, contracted at the base, brick-orange to red, 0.8 to 1.5 mm. diam.; sporangial wall forming a weak, shallow cup with dark ribs merging above into the net, the nodes

of which are hardly expanded; plasmodic granules about $1\ \mu$ diam. Stalk firm and erect, dark brown, 0.5 to 1 mm. high. Spores reddish in mass, paler by transmitted light, minutely warted, $5-7\ \mu$ diam.

TYPE LOCALITY: Switzerland.

HABITAT: On dead coniferous wood.

DISTRIBUTION: *New Mexico, *Oregon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 219, figs. a-d.*

A handsome species rare in North America. It is one of two species known with a reddish color. The other, *C. rubiginosa* Fries, so far unknown from North America, has a much deeper calyculus, a short stout stalk, and a closer net.

15. *Cribraria purpurea* Schrad. Nov. Gen. Pl. 8. 1797.

Plasmodium scarlet? (Macbride). Total height 2 to 2.5 mm. Sporangia crowded or gregarious, erect or inclined, globose, about 1 mm. diam., reddish purple; cup about one third the height of the sporangium, deeply toothed at the margin; net irregular, with meshes of varying sizes; nodes flattened, expanded, angular, branching and irregular; plasmodic granules large, purple, $2-2.5\ \mu$ diam., densely distributed in the cup and nodes. Stalk purplish black, two or three times the height of the sporangium, rugged, furrowed. Spores purplish, faintly warted, $5-7\ \mu$ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Maine, *Massachusetts, *Montana, New York, Ontario, Oregon, Pennsylvania, *South Carolina, Tennessee, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 146, figs. a-c.*

This species is not common and is confined to higher altitudes in the mountains, where it sometimes forms large colonies. Occasional collections are close to *C. elegans*, having much smaller sporangia on long stalks, but the characteristic loose, irregularly meshed net of *C. purpurea*.

16. *Cribraria elegans* Berk. & Curt.; Berk. Grevillea 2: 67. 1873. (N. Y. B. G. no. 12923, type material.)

Plasmodium? Total height 0.7 to 1.7 mm. Sporangia gregarious, stalked, erect or inclined, globose, 0.3 to 0.5 mm. diam., reddish purple; cup about half the height of the sporangium, the

margin deeply toothed and perforated; net well developed, with small, regular meshes, and numerous flattened, expanded or branching nodes; cup and nodes thickly studded with purple plasmodic granules 2–2.5 μ diam. Stalk subulate, slender, nearly smooth, 0.6 to 1 mm. high, purplish black. Spores pale violet, nearly smooth, 5–7 μ diam.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood.

DISTRIBUTION: Indiana, Iowa, *Missouri, *New York, *Nova Scotia, Pennsylvania, South Carolina, *South Dakota, Tennessee, Virginia, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 146, figs. d–f.*

Closely related to *C. purpurea* and differing mainly in size. The presence of a more regular net will distinguish intermediate forms.

17. *Cribraria violacea* Rex, Proc. Acad. Nat. Sc. Phila. 1891: 393. 1891. (N. Y. B. G. no. 5583, type material.)

Plasmodium deep violet-black (Lister). Total height 0.5 to 1 mm. Sporangia gregarious or scattered, stalked, erect or nodding, globose or ellipsoid, 0.2 to 0.4 mm. diam., dark violet with a metallic sheen; cup shallow or up to two thirds the height of the sporangium, when it may be slightly constricted near the margin, which is scalloped with few short teeth, bluish violet; net very irregular, with slender threads connecting large, flattened, broadly expanded, angular nodes; cup and nodes with purple plasmodic granules 0.5–1 μ diam. Stalk slender, subulate, violet-black, two or three times the height of the sporangium. Spores lilac, minutely warted, 6–8 μ diam.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On dead wood and bark.

DISTRIBUTION: Antigua, Colorado, Florida, Illinois, Iowa, Kansas, New York, Ohio, Ontario, Pennsylvania, Puerto Rico.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 146, figs. g–l.*

This species is not rare and is sometimes found in large developments. It is somewhat of an exception in the order *Cribrariales*, as the spores in mass have a distinct brownish violet shade in many instances. A large series of collections made in Kansas by Mr. Travis E. Brooks, and close to the cotype locality, is remarkable for the variation shown. In some collections are sporangia up to 0.5 mm. diam. on relatively long stalks, and with

plasmodic granules $1.5\text{--}2\ \mu$ diam. The cups are very shallow, often almost obsolete. The larger sporangia approach *C. elegans*, but the violet tints are those of *C. violacea*.

Genus 28. **DICTYDIUM** Schrader, Nov. Gen. Pl. 11. 1797.

Sporangia stalked, globose; sporangial wall formed of numerous ribs extending from the base nearly to the apex, connected by slender, transverse threads, the intervening wall evanescent, or persistent as a shallow cup.

TYPE SPECIES: *Dictydium umbilicatum* Schrad.

1. **Dictydium cancellatum** (Batsch) Macbr. N. A. Slime-Moulds 172. 1899.

Mucor cancellatus Batsch, Elench. Fung. Contin. 2: 135. 1789.

Dictydium umbilicatum Schrad. Nov. Gen. Pl. 11. 1797.

Dictydium longipes Morg. Jour. Cin. Soc. Nat. Hist. 15: 143. 1893. (N. Y. B. G. no. 5265, type material.)

Plasmodium purple-black (Lister). Total height 1 to 2 mm. Sporangia gregarious, stalked, nodding, subglobose or depressed, often umbilicate above and sometimes below, brown or brownish purple, 0.5 to 0.7 mm. diam. Sporangial wall forming a net with nearly square meshes, composed of numerous rigid, longitudinal ribs, connected by slender, transverse threads, often breaking up into an irregular net at the top; calyculus usually rudimentary or lacking, sometimes well developed. Stalk subulate, bent or twisted at the slender top, dark brown or purplish brown, two to eight times the height of the sporangium. Spores pale reddish or purplish, $5\text{--}7\ \mu$ diam., nearly smooth, usually with one or more large, dark, plasmodic granules on the spore wall. (PLATE 12, FIG. 5.)

Var. **fuscum** Lister, Jour. Bot. 36: 120. 1898.

Sporangia nodding, smaller and browner than the type, bell-shaped or contracted at the base, with a well-defined cup or calyculus.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout the United States and Canada; Puerto Rico; var. *fuscum* not so common but widely spread.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 147.

Of all the described varieties of this species, var. *fuscum* is here regarded as the only one of sufficient importance to recognize. It is not rare, and may occur in any area, and is very constant in its characters so that even colonies which approach the typical form may be readily separated. The other varieties are extremely rare, only one or two authentic collections in each having been reported from North America. From examples of these varieties in the Herbarium of the New York Botanical Garden it appears that in those based on a more or less irregular net, the developments are abnormal, or have formed under unfavorable conditions of environment. Often, similar forms are found in otherwise normal colonies. Varieties based on length of stalk, shape of the sporangia and their color, or the development of the cup, are hardly worth recognition in this variable species, where such variations are common, but not constant or combined as in var. *fuscum*.

Family II. LICEACEAE

Sporangia scattered, sessile or stalked; sporangial wall cartilaginous or membranous; capillitium and columella wanting.

Sporangia sessile, subglobose or forming plasmodiocarps,
opening irregularly or by lobes.

29. LICEA

Sporangia stalked or sessile, opening by a membranous lid.

30. ORCADELLA

Genus 29. **LICEA** Schrader, Nov. Gen. Pl. 16. 1797.

Sporangia sessile, subglobose, hemispherical, or forming plasmodiocarps; sporangial wall cartilaginous or membranous; spores olive-brown or brownish yellow, lilac-brown, or nearly colorless; dehiscence irregular or by lobes.

TYPE SPECIES: *Licea pusilla* Schrad.

Sporangial wall cartilaginous.

Sporangia hemispherical, dehiscing in lobes; spores brown,
9-12 μ .

1. *L. minima*

Sporangia subglobose or bolster-shaped, dehiscing in lobes;
spores almost colorless, 8-10 μ .

2. *L. castanea*

Sporangia pulvinate, dehiscing in irregular lobes; spores
13-20 μ .

3. *L. pusilla*

Plasmodiocarps elongate, 1 to 6 mm. long, dehiscing irregularly.

4. *L. flexuosa*

Sporangial wall membranous.

Plasmodiocarps about 0.3 mm. long, 0.1 mm. wide, yellow, dehiscing by a longitudinal fissure.

5. *L. biforis*

Sporangia subglobose or ovoid, 0.2 to 0.5 mm. diam., olive-yellow or black.

6. *L. tenera*

1. *Licea minima* Fries, Syst. Myc. 3: 199. 1829.

Plasmodium drab, slate-colored, watery gray, or pale yellow (Lister). Sporangia scattered, subglobose or hemispherical, angular with prominent, shining ridges of dehiscence, 0.2 to 0.5 mm. diam., chestnut-brown or nearly black, dehiscing by several lobes; sporangial wall cartilaginous, dark brown, opaque with granular deposits, except the margins of the lobes which are usually dotted on the inner side with minute, peg-like warts 1–2 μ diam. Spores olivaceous brown or lilac-brown, spinulose, 9–12 μ diam., the wall thinner on one side.

TYPE LOCALITY: Europe

HABITAT: On dead coniferous wood.

DISTRIBUTION: Alabama, *Colorado, *Iowa, Kansas, Maine, Massachusetts, New Hampshire, New Jersey, New York, Ontario, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 148, figs. d–f.

The spores are sometimes violet-brown, an exception to the rule in the order *Cribrariales*. Specimens from Kansas show this nicely. The sporangia of the species vary much in size in the same development, and are usually dark, almost black. This makes it somewhat difficult to see the sporangia in the field if the wood is wet. The dehiscence-ridges are usually straight, but may be irregular in some sporangia of a colony, somewhat as in *L. pusilla*, a closely related species.

2. *Licea castanea* G. Lister, Jour. Bot. 49: 61. 1911.

Plasmodium? Sporangia scattered, sessile, subglobose, or forming bolster-shaped plasmodiocarps, 0.2 to 0.9 mm. long, 0.2 to 0.4 mm. broad, chestnut or pale brown, smooth or wrinkled; sporangial wall somewhat cartilaginous, nearly colorless or pale brown, overlaid by a more or less continuous layer of brown granular refuse matter, dehiscing along definite lines to form plates or lobes whose margins are often marked with a row of minute warts 1 μ diam. Spores in mass olive-yellow, almost colorless by transmitted light, smooth, 8–10 μ diam., the walls thinner on one side.

TYPE LOCALITY: Scotland.

HABITAT: On the inner, thin layers of bark.

DISTRIBUTION: New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 219, figs. e-g.*

This species was collected on two occasions on the inner layers of bark, from the same tree, associated with *L. biforis*. The brown color of the sporangia, and the colorless, almost smooth spores distinguish it from *L. minima*.

3. **Licea pusilla** Schrad. Nov. Gen. Pl. 19. 1797.

Plasmodium watery-drab, or dull yellowish (Lister). Sporangia scattered, sessile, hemispherical or pulvinate, 0.6 to 1 mm. diam., dark purple-brown, glossy on the inner side, dehiscing in irregular lobes; sporangial wall cartilaginous, chestnut-brown, often with deposits of dark refuse matter, the margins of the lobes usually crenate and undulate, dotted with prominent warts 1–2 μ diam. Spores olive-brown, 13–20 μ diam., closely warted, the wall thinner on one side.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 149, figs. a-c.*

This species is similar, superficially, to *L. minima*, differing in the much larger average size of the sporangia, and the much larger spores, which latter is the important character. It can be distinguished also by the appearance of the dehiscence ridges, which are usually crenate or undulate, although occasionally straight in some sporangia of a colony. The only collection here, personally made in Pike County, Pennsylvania, has spores 15–17 μ diam. Other records from North America are not included, as there are circumstances connected therewith which make the identifications doubtful.

4. **Licea flexuosa** Pers. Syn. Meth. Fung. 197. 1801.

Licea variabilis (?) Schrad. Nov. Gen. Pl. 18. 1797.

Plasmodium dull yellow or rose-colored (Lister). Sporangia scattered, pulvinate, depressed, more often forming straight, curved or branching plasmodiocarps, 1 to 6 mm. long, either yellowish brown and glossy, or dark brown and opaque when an outer layer of refuse matter is present; sporangial wall cartilaginous, translucent, pale purplish brown, usually more or less overlaid

with a thick, mottled layer of olive-brown refuse matter, dehiscing irregularly. Spores pale olive-brown, spinulose, with a thinner area of dehiscence, 11–14 μ diam., yellowish brown or dull olive in mass.

TYPE LOCALITY: Germany.

HABITAT: On dead coniferous wood.

DISTRIBUTION: Colorado, *Iowa, New York, *Nova Scotia, *Ohio, Ontario, Pennsylvania, *South Dakota, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 148, *figs.* a–c.

With little refuse on the wall this species is practically identical in appearance with *Dianema corticatum* or *Enteridium liceoides* (see *Enteridium olivaceum*), and is often associated with the former. *L. variabilis* Schrad. may be the present species, but may have been one of the others mentioned, as Schrader's description is not conclusive. Persoon's form is undoubtedly the species, so his name is used. The form is not at all rare when likely logs are watched until the fruiting period. I have found it repeatedly.

5. *Licea biforis* Morg. Jour. Cin. Soc. Nat. Hist. 15: 131. 1893.

Plasmodium watery white, then grayish (Lister). Sporangia scattered, minute, ellipsoid or fusiform, attached by the long base, 0.2 to 0.5 mm. long, 0.05 to 0.1 mm. broad, glossy yellowish brown, dehiscing along a thinner central ridge or depression; sporangial wall membranous, minutely papillose, almost colorless, with scanty, superficial deposits of discharged refuse matter. Spores globose or ellipsoid, the wall thinner on one side, 9–12 μ diam., smooth and almost colorless, ochraceous in mass.

TYPE LOCALITY: Ohio.

HABITAT: On dead bark.

DISTRIBUTION: Iowa, Kansas, New York, *Ohio, Ontario, Pennsylvania.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 149, *figs.* g–k.

The favorite habitat is on the inner layers of dead bark, where it often forms thousands of sporangia scattered over the different layers. It also develops on the outside of bark. The distribution stated is entirely out of proportion to the probabilities, as it must occur almost everywhere, but overlooked because of the small size and habitat. With good eyes the sporangia can be seen as yellow specks. The central longitudinal depressions along the elongate sporangia give them the appearance of date-stones.

6. *Licea tenera* Jahn, Ber. Deutsch. Bot. Ges. 36: 665. 1919.

Plasmodium? Sporangia solitary or in groups, sessile, subglobose or ovoid, 0.4 to 0.5 mm. diam., shining olive-yellow; sporangial wall a firm, pale olive or dull yellow membrane, hardly cartilaginous, minutely areolated from spore impressions, with scanty superficial deposits of refuse matter. Spores pale olive-yellow, minutely spinulose, 10–12 μ diam., the wall thinner on one side.

TYPE LOCALITY: Germany.

HABITAT: On dead wood and dung.

DISTRIBUTION: *Iowa, Kansas, Ontario, *Oregon.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3. pl. 219, figs. h–k; Jahn, Ber. Deutsch. Bot. Ges. 36: pl. 18, figs. 4–6.

The description is that of Miss Lister, which is not a literal translation of Jahn, and differs slightly but not materially. The species is based upon a dozen or so sporangia that appeared in a moist chamber development, and Prof. Jahn's description is therefore confined to the single specimen. The species is represented here by three specimens, two on wood from Kansas, and the other on dung from Brazil, developed in Ontario; and all in moist chambers. The determination of one of the Kansas specimens was confirmed by Prof. Jahn. The three specimens are similar, and do not agree with the descriptions, as the sporangia are minute, mainly about 0.1 mm. diam., and the walls are thickly coated with dark, refuse matter making them appear black. The spores are about 10 μ diam., spinulose but seem to have no pale or thin areas. The species is not well understood because of the limited number of collections so far reported. The conditions probably are the same as in many species with superficial deposits of lime or refuse matter. If the attachment to the wall is weak, and the conditions are too wet during the formation of sporangia, the lime or refuse matter will be washed from the walls, leaving them bare.

DOUBTFUL SPECIES:

Licea fimicola Dearn. & Bisby; Bisby, Buller & Dearn. Fungi Man. 52. 1929, is not included in this treatment of the genus *Licea*. The portion of the type development in the Herbarium of the New York Botanical Garden (no. 7647), kindly furnished by Dr. John Dearness, has but a single sporangium and insufficient for critical study. The form is unknown except from laboratory cultures made by the authors. Macbride

and Martin (Myxomycetes 227) have studied the type and another development, and report differences between the two sufficient to create doubts that the form belongs in the genus, although recognized by them. It may be a phase of one of the better known species of *Licea*, altered somewhat by methods of laboratory culturing, as such forms do occur. It is hoped that a natural fruiting from the field may be found, so that its position may be satisfactorily determined.

Genus 30. **ORCADELLA** Wingate, Proc. Acad. Nat. Sc. Phila. 1889: 280. 1889.

Hymenobolina Zukal, Oester. Bot. Zeitschr. 43: 133. 1893.

Kleistobolus Lippert, Verh. Zool.-Bot. Ges. Wien 44 (Abh.): 70. 1894.

Sporangia stalked or sessile, minute; sporangial wall opaque with granular deposits except in the upper part, where it forms a membranous lid; spores smooth.

TYPE SPECIES: *Orcadella operculata* Wing.

The members of this genus show a distinct advance in structure over those of *Licea* by the presence of a firm lid, which does not open or rupture until the spores are perfectly mature, and protects against premature dispersal. The highest development of the lid in form, attachment, and ornamentation, is seen in *Orcadella pusilla*.

Sporangia usually stalked.

1. *O. operculata*

Sporangia usually sessile.

Sporangia almost black.

2. *O. parasitica*

Sporangia brown.

3. *O. pusilla*

1. ***Orcadella operculata*** Wing. Proc. Acad. Nat. Sc. Phila. 1889: 280. 1889. (N. Y. B. G. nos. 6168, 6169, 7618, type material.)

Licea operculata (Wing.) Martin, Mycologia 34: 702. 1942.

Plasmodium dull orange (Minakata). Total height 0.4 to 0.9 mm. Sporangia scattered, usually stalked, rarely sessile, urn-shaped or subglobose, 0.1 to 0.3 mm. diam., brown or nearly black, with a convex, dull yellow, glossy lid; sporangial wall cartilaginous, opaque from deposits of refuse matter; lid membranous, minutely papillose. Stalk cylindrical, rough, furrowed, nearly black from dark refuse matter. Spores yellowish in mass, almost colorless by transmitted light, smooth, 8–11 μ diam.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On bark.

DISTRIBUTION: Iowa, *Maine, New Hampshire, Pennsylvania, *Vermont.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 149, *figs.* d-f.

All collections from North America have stalked sporangia; a sessile variety has been recorded from England. The form is so small, and concolorous with the habitat, that it is almost impossible to find it except accidentally along with a larger form.

2. *Orcadella parasitica* (Zukal) Hagelstein, *Mycologia* **34**: 258. 1942.

Hymenobolina parasitica Zukal, Oester. Bot. Zeitschr. **43**: 133. 1893. (N. Y. B. G. no. 5728, type material.)

Hymenobolina pedicellata Gilb. Univ. Ia. Stud. Nat. Hist. **16**: 153. 1934. (N. Y. B. G. no. 6885, type material.)

Licea parasitica (Zukal) Martin, *Mycologia* **34**: 702. 1942.

Licea pedicellata Gilb.; Martin, *Mycologia* **34**: 702. 1942.

Plasmodium rosy-red (Lister). Sporangia scattered, usually sessile, rarely stalked, subglobose, 0.05 to 0.2 mm. diam., grayish or black, opaque, rarely brownish and glossy when deposits of refuse matter are scanty, dehiscing by a well-defined lid or irregularly, the lid absent; lid smooth or areolated with prominent ridges; sporangial wall membranous, pale purplish, minutely papillose on the inner surface of the lid or throughout, usually invested with a thick layer of refuse matter in the lower part. Spores shining, brown in mass, grayish brown by transmitted light, smooth, with a paler area of dehiscence, 11-16 μ diam.

TYPE LOCALITY: Yugoslavia.

HABITAT: On bark.

DISTRIBUTION: Iowa, New York, Pennsylvania, *West Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 217, *figs.* h-k, as *Hymenobolina parasitica*.

Natural developments of this species were personally collected in New York and Pennsylvania, one of which consisted of a hundred or more sporangia closely scattered over dead bark and the mosses and lichens thereon. Presumably they came from a common plasmodium. The spores in this gathering are globose, distinctly grayish by transmitted light, measuring uniformly about 12 μ . The lids are absent occasionally, and the sporangia vary much in size. In moist chamber developments on wood from another New York locality, there are also sporangia seated

on bases protruding beyond the sporangia and iridescent at the edges. *Hymenobolina pedicellata*, developed in a moist chamber, has stalks, and seems to be a stalked phase of the species.

The species as described by Zukal has a somewhat different early life history from the other species of the *Mycetozoa*. The belief that each plasmodium produces but a single sporangium is not safely established, and is not borne out by the natural fruiting mentioned. Forms like *Cribraria violacea*, when cultured, will often form a single sporangium from a bit of plasmodium, yet naturally, will produce thousands of sporangia. In many species the plasmodium breaks up before fruiting, emerging in small particles, and forming single, widely separated sporangia, or small groups.

3. *Orcadella pusilla* (Lipp.) Hagelstein, *Mycologia* **34**: 258. 1942.

Kleistobolus pusillus Lipp. Verh. Zool.-Bot. Ges. Wien **44** (Abh.): 70. 1894.
Licea Kleistobolus Martin, *Mycologia* **34**: 702. 1942.

Plasmodium watery, blackish brown (Macbr. & Martin). Sporangia scattered, sessile, flattened above and below, with a flat or convex iridescent lid, depressed near and below the margin and readily separating, 0.04 to 0.15 mm. diam., brown; lid warted on the inner side, and with a few larger warts or processes; sporangial wall membranous, pale brown, warted at the margin, with superficial deposits of darker refuse matter. Spores brown in mass, pale brownish yellow by transmitted light, smooth, 8.5–11 μ diam.

TYPE LOCALITY: Austria.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, Iowa, New York, Pennsylvania.

ILLUSTRATION: Macbr. & Martin, *Myxomycetes pl.* 21, figs. 555–558, as *Kleistobolus pusillus*.

The lid, with its perfect setting and beautiful sculpture, is the most highly developed of any in the *Mycetozoa*. It undoubtedly performs an important part in the protection and dissemination of the spores, and for this purpose it is far advanced over the primitive manner of dehiscence in the genus *Licea*. A dozen or more natural developments of the species have been found personally, one of which consisted of thousands of sporangia. The sporangia are very small, but the glistening tops may be seen with

a hand-lens in the field, when a number of the sporangia are massed together.

Family III. TUBULINACEAE

Sporangia clustered, cylindrical or ellipsoid, stalked or sessile; sporangial wall membranous, pale rufous, without plasmodic granules; spores minutely reticulate, 4–7 μ diam.

Sporangia cylindrical, compacted, with or without a pseudo-columella.

31. TUBIFERA

Sporangia clustered, stalked, ellipsoid; capillitium a brush of tubular threads attached above and below to the sporangial wall.

32. ALWISIA

Genus 31. **TUBIFERA** Gmelin, Syst. Nat. 2: 1472. 1791.

Sporangia cylindrical, crowded on a common hypothallus.

TYPE SPECIES: *Stemonitis ferruginosa* Batsch.

There is little resemblance in this genus to the two preceding genera which have no supporting capillitial structure. In *T. ferruginosa* the tendency to form a rudimentary pseudo-capillitium is often seen in strands and threads from the sporangial walls; in *T. Casparyi* this is much more pronounced, and the threads are attached to a pseudo-columella. Forms have been found in *T. stipitata* that approach the genus *Alwisia*, where the capillitium is still further advanced.

Sporangia without pseudo-columellae.

Sporangia clustered on a broad hypothallus.

1. *T. ferruginosa*

Sporangia clustered on a stalk-like hypothallus.

2. *T. stipitata*

Sporangia with long pseudo-columellae connected by tubular strands to the sporangial walls.

3. *T. Casparyi*

1. **Tubifera ferruginosa** (Batsch) Gmel. Syst. Nat. 2: 1472. 1791.

Stemonitis ferruginosa Batsch, Elench. Fung. Contin. 1: 261. 1786.

Plasmodium watery-white, changing to red, and later brown. Sporangia densely crowded, cylindrical, angled by mutual pressure, often loosely clustered or nearly free, convex, conical or acuminate above, sometimes perforated, 3 mm. long, 0.4 mm. broad, light reddish brown or umber, glossy or iridescent, often seated on a common, spongy hypothallus, and forming brown

cushions 1 to 15 cm. long; sporangial wall membranous, pale rufous-brown, marked on the inner side with scattered warts or papillae, and often with hollow, pouch-like protuberances. Spores pale rufous-brown, closely and minutely reticulate over two thirds of the surface, the remaining part nearly smooth or marked with broken ridges, 5–8 μ diam. (PLATE 12, FIG. 6.)

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 150, *figs.* a–c.

The plasmodium often separates into many small portions forming numerous small clusters of sporangia connected only at the bases, and nearly free. The spongy hypothallus may be absent below these clusters, and is observed to best advantage in the large and high aethalia-like cushions, where it may be elevated above the wood with an empty space between, and the attachment of the aethalium at the edge. Frayed strands, as well as hollow processes, may be seen, sometimes in the sporangia. Rudimentary pseudo-columellae, occasionally present, connect the species with *T. Casparyi*. Altogether *T. ferruginosa* is a remarkable species, and deserves extensive collection and study in all its phases. It is common throughout the season.

2. *Tubifera stipitata* (Berk. & Rav.) Macbr. N. A. Slime-Moulds 157. 1899.

Licea stipitata Berk. & Rav.; Berk. & Curt. Proc. Am. Acad. Arts & Sc. 4: 125. 1859.

Plasmodium as in *T. ferruginosa*. Sporangia similar in size, shape, color, and spores to *T. ferruginosa*, but in small groups clustered on a dark brown spongy hypothallus, which has the form of a stout stalk, 2 to 5 mm. high. Spores usually more constant in size, about 5 μ diam., occasionally smaller.

TYPE LOCALITY: South Carolina.

HABITAT: On dead wood.

DISTRIBUTION: Bermuda, *Canal Zone, Florida, Jamaica, Kansas, *Missouri, New York, Ohio, *Ontario, Pennsylvania, *South Carolina, *South Dakota, *Wisconsin.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 150, *figs.* d–e.

Rarely found in any particular area, although its range appears to be conterminous with that of *T. ferruginosa*. In my twenty years of collecting activities, from upper Quebec to Florida, and in the West Indies, I have found it only eight times. It may be only a variant, produced occasionally from the plasmodium of *T. ferruginosa*, somewhat like similar forms found rarely in the genus *Fuligo*, and consisting of a small cluster of sporangia on a stalk-like strand from the hypothallus. A curious specimen, collected in Florida by Dr. Erdman West, has the usual groups of sporangia on stout stalks, and a number of single, ellipsoid sporangia on long, thin, dark stalks. Single sporangia have been reported before from Ceylon by Petch (Lister, Mycetozoa ed. 3. 188). These forms seem to connect the species with *Alwisia Bombarda*.

3. **Tubifera Casparyi** (Rost.) Macbr. N. A. Slime-Moulds 157. 1899.

Siphoptychium Casparyi Rost. Mon. App. 32. 1876.

Plasmodium white, with changes similar to those in *T. ferruginosa*. Sporangia closely compacted, resembling *T. ferruginosa* in shape, size, color, and spores, but usually in large aethalia-like cushions; sporangial wall connected with a long, central columella by numerous straight, tubular processes or threads. Spores usually 6-8 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Alabama, British Columbia, Delaware, *Iowa, Massachusetts, New Brunswick, New York, *Ohio, Ontario, Pennsylvania, Quebec, Vermont, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 150, figs. f-h.

The columellae and connecting processes are often absent or rudimentary in many sporangia of the pseudo-aethalium. The three species of the genus *Tubifera* are subject to the ravages of insects and the common slugs which feed upon the rising sporangia, and the spores. It is interesting to see how in the present species there is developing an internal structure which strengthens the sporangium, increases its defense against the attacks of enemies, and provides thereby more protection until the spores are mature.

Genus 32. **ALWISIA** Berkeley & Broome, Jour. Linn. Soc. 14: 86. 1873.

Sporangia clustered, stalked, ellipsoid; sporangial wall falling away in the upper half and exposing a stiff brush of capillitial threads.

A SINGLE SPECIES.

1. **Alwisia Bombarda** Berk. & Br. Jour. Linn. Soc. 14: 87. 1873.

Plasmodium watery white (Lister). Total height about 4 mm. Sporangia in clusters of four to eight, stalked, cylindrical-ellipsoid, 1 to 1.5 mm. high, 0.5 mm. broad, rufous brown, the outer sporangia of a cluster usually reflexed; sporangia opening by spreading lobes; sporangial wall membranous, evanescent above, persistent below, pale red, with minute scattered granules on the inner side, occasionally produced into small pouches. Stalks cylindrical, 2.5 mm. high, 0.15 mm. thick, adhering in clusters of four to twelve, brownish purple; when mounted in glycerine, orange-red, translucent. Capillitium consisting of slender, straight, and nearly simple tubular threads, 0.5 to 0.8 mm. long, 3–8 μ wide, attached above by slender points to the fugaceous apical sporangial wall, and also below to the interior of the cup-like base of the sporangium, where they often branch and anastomose; they may be interrupted by bulbous swellings 20–40 μ long, and are either smooth or closely studded with slender spines, 2–3 μ in length. Spores pale reddish brown, reticulate over two thirds their surface, 5–6 μ diam.

TYPE LOCALITY: Ceylon.

HABITAT: On dead wood.

DISTRIBUTION: Jamaica.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 151.

This species is represented here by a small portion of the gathering made by Lieut. W. Robinson, on Blue Mountain, Jamaica, which seems to be the only American collection. The form is connected with the genus *Tubifera* by specimens found in Ceylon and Florida as mentioned under *T. stipitata*. The capillitium is more highly developed, resembling slightly the capillitium in some forms of the suborder *Calonematineae*.

Family IV. RETICULARIACEAE

Sporangia closely compacted and usually forming an aethalium; sporangial walls without plasmodic granules, usually incomplete, perforated, or forming a spurious capillitium; true capillitium none, or in *Liceopsis* consisting of a few branching threads and strands.

Fructification always in aethalia.

Component sporangia columnar; sporangial walls incomplete, dome-shaped at the apex, continued toward the base in four to six straight threads.

33. DICTYDIAETHALIUM

Walls of the convolute, component sporangia perforated and forming a uniform tissue of interarching bands.

34. ENTERIDIUM

Walls of component sporangia incomplete and indefinite, forming plates and strands with numerous long threads.

35. RETICULARIA

Fructification usually of closely compacted, subglobose sporangia, sometimes forming aethalia; inner walls usually complete.

36. LICEOPSIS

Genus 33. **DICTYDIAETHALIUM** Rostafinski, Versuch 5. 1873.

Aethalium pulvinate, formed of erect, columnar sporangia; sporangial walls incomplete, dome-shaped at the apex, continued to the basal membrane in four to six straight threads; capillitium none.

A SINGLE SPECIES.

1. **Dictydiaethalium plumbeum** (Schum.) Rost. Versuch 5. 1873.

Fuligo plumbea Schum. Enum. Pl. Saell. 2: 193. 1803.

Plasmodium rose-red (Lister). Aethalium pulvinate, smooth, flattened, 1 to 10 cm. across, 0.5 to 1 mm. thick, olivaceous or ochraceous, areolated with the convex apices of the sporangia, usually surrounded by a white, membranous hypothallus; sporangia cylindrical, angled by mutual pressure, 0.5 to 1 mm. high, 0.2 mm. broad; sporangial wall ochraceous or yellow, persistent, and forming a flat or dome-shaped cap at the apex, sometimes dark with superficial deposits of refuse matter, continued down to the basal membrane in four to six straight threads, evanescent between the threads. Spores ochraceous or yellow in mass, pale

yellow by transmitted light, spinulose, 9–12 μ diam. (PLATE 13, FIG. 1.)

TYPE LOCALITY: Denmark.

HABITAT: On dead wood.

DISTRIBUTION: Throughout North America, and not uncommon.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 152.

Darker forms, lead-colored to nearly black, are occasionally found, and are due to the presence of refuse matter. Reddish forms, not rare, are due to incomplete maturity. The aethalia, particularly the larger ones, have a habit of splitting, with many cracks, on drying, eventually breaking into tufts of sporangia for better dispersal of the spores. Early developments are usually small, but later in the season, in October, they may be very large and of many aethalia.

Genus 34. **ENTERIDIUM** Ehrenberg, *Jahrb. Gewächsk.* 1 (2): 55. 1819.

Aethalium composed of confluent interwoven sporangia, their walls perforated with large openings; sporangia more or less evident; capillitium none.

TYPE SPECIES: *Enteridium olivaceum* Ehrenb.

Spores warted.

Aethalia usually 1 cm. diam. or more.

Aethalia 1 to 2 mm. diam.

Spores reticulate; aethalia large.

1. *E. olivaceum*

2. *E. minutum*

3. *E. Rozeanum*

1. **Enteridium olivaceum** Ehrenb. *Jahrb. Gewächsk.* 1 (2): 57. 1819.

Plasmodium rose-red (Lister). Aethalium pulvinate, depressed, 1 mm. to 3 cm. long, 1 to 3 mm. thick, smooth or rugulose, dark olive-brown, rarely dark bluish green, often glossy; sporangial walls yellow-olive, or dark green, membranous, perforated with wide openings forming a network or pseudo-capillitium with broad winged boundaries to the meshes. Spores in clusters of 6 to 20, sometimes free, pale olive or brown, thickened and warted on one side, 9–12 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: *California, New Hampshire, New Jersey, New York, *Oregon, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 153, *figs.* *a-c*.

I have found this species a dozen times or more in New Hampshire, New York, and Pennsylvania. Often, the developments consist of many aethalia, and in one such collection from Long Island, there were several small clusters of sporangia and a single sporangium. These have thin, iridescent walls which are complete, the capillitium is wanting, and the spores are clustered and the same as those of the adjoining aethalia. They illustrate in a marked degree the relationship of the sporangium to the aethalium, and that one has developed from the other. Separated, such sporangia are like forms in the genus *Licea*, but do not conform to any known species.

Enteridium liceoides G. Lister (Guide Brit. Mycet. ed. 4. 48. 1919) was formerly regarded as a variety of the present species. In the third edition of the Monograph (page 194) Miss Lister mentions an intermediate form gathered by Prof. Farlow at Chocorua, New Hampshire. Subsequently in correspondence she writes the spores are too pale-pink and too smooth for *E. liceoides*, and that it is almost surely *Dianema corticatum*. The two species are very close and difficult to separate in obscure specimens. *E. liceoides* has not been reported otherwise from North America. The spores in the species are brown or olivaceous.

2. **Enteridium minutum** Sturg. Mycologia 9: 329. 1917. (N. Y. B. G. no. 11314, type.)

Plasmodium? Aethalia rounded or elongate, pulvinate, pale umber in color, seated on a broad membranous base, 1.5 to 2 mm. diam.; wall wrinkled and usually marked with small, scattered pits, pale yellow, membranous. Walls of the component sporangia membranous, minutely roughened, perforated with round openings, the margins of which show many free threads; or reduced to irregular, anastomosing strands arising from the base of the aethalium, with membranous or net-like expansions at the angles and with many delicate, free, pointed ends. Spores pale yellow, usually united in twos or threes and ovoid or flattened on one side; when free, globose, very minutely spinulose, 9.5–10.5 μ diam. (PLATE 5.)

TYPE LOCALITY: Eldora Lake, Colorado.

HABITAT: On dead coniferous wood.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Sturgis, *Mycologia* 9: *pl.* 15.

The description is that of Dr. Sturgia in *Mycologia*. It is possibly a weak, aberrant phase of *Enteridium olivaceum*, but different somewhat in the inner structure and spores.

3. **Enteridium Rozeanum** Wing. Proc. Acad. Nat. Sc. Phila. 1889: 156. 1889.

Reticularia? *Rozeana* (?) Rost. Mon. App. 33. 1876.

Reticularia splendens Morg. Jour. Cin. Soc. Nat. Hist. 15: 137. 1893.

Enteridium splendens (Morg.) Macbr. N. A. Slime-Moulds 151. 1899.

Plasmodium watery white changing to flesh-color. Aethalia pulvinate, hemispherical, or subglobose, 5 mm. to 6 cm. diam., red or umber brown, shining, usually on a white, spreading hypothallus; cortex composed of the confluent tops of the component sporangia, often smooth, sometimes rough or perforated; sporangial walls within the aethalium perforated, forming a network of broad, membranous bands, or sometimes frayed into strands and slender threads as in *Reticularia*. Spores rusty brown, closely and evenly reticulate on two thirds of the surface, the remaining part faintly warted, 7-9 μ diam. (PLATE 16, FIG. 11.)

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead wood.

DISTRIBUTION: Throughout continental North America.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 153, *figs.* e-g.

The species is related to *Reticularia Lycoperdon*, and similar frayed strands and threads, as in that species, are often found, particularly in the lower part of the aethalium. The two forms also resemble each other superficially in certain phases. Doubtful specimens can be distinguished by lifting a part of the cortex, and if the inner, perforated bands are attached thereto, it is *E. Rozeanum*.

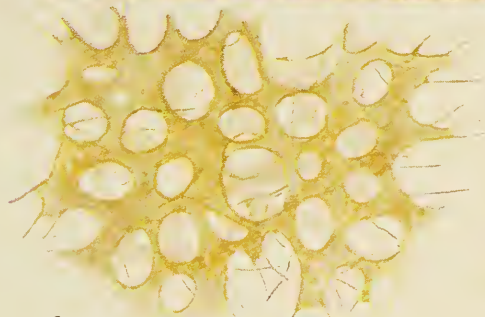
Genus 35. **RETICULARIA** Bulliard, Herb. Fr. *pl.* 326. 1786; Bulliard, Champ. 83. 1791.

Aethalium composed of numerous elongate, interwoven sporangia whose walls are partly evanescent, partly persistent, and form broad expansions and strands, dividing above into delicate capillitial-like threads; spores and threads rusty brown.

A SINGLE SPECIES.



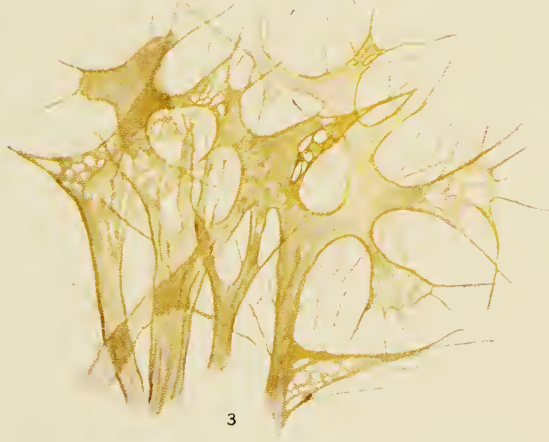
1



2



4



3



5

ENTERIDIUM MINUTUM

1. **Reticularia Lycoperdon** Bull. Herb. Fr. *pl.* 446, *fig.* 4. 1789;
Bull. Champ. 95. 1791.

Plasmodium cream-white (Lister). Aethalium pulvinate or subglobose, 5 mm. to 8 cm. diam., brownish copper-colored, or enclosed in a thin, smooth, silvery cortex, seated on a well-developed hypothallus of interwoven, membranous strands. Pseudo-capillitium consisting of persistent portions of the sporangial walls, forming irregular branching strands arising from the hypothallus, dividing above into numerous, slender, flattened and flexuose rusty brown threads. Spores free or adhering loosely in large clusters, somewhat turbinate from the clustering, rusty brown, thickened and closely reticulate on the rounded or exposed surface, the remaining part marked with scattered warts, 6–10 μ diam.

TYPE LOCALITY: France.

HABITAT: On dead wood.

DISTRIBUTION: Throughout North America, and fairly common.

ILLUSTRATION: Lister, *Mycetozoa* ed. 3. *pl.* 154, *figs.* a–c.

This species usually has small plasmodia forming a single aethalium. Occasionally, there may be as many as five or six large aethalia from a vigorous plasmodium, as happens also in the other aethalioid genera. The belief that a plasmodium yields but a single aethalium is disproved by long field experience. The silvery cortex is not always present, and the degenerate inner sporangial walls may be more developed, at times. Such forms may resemble *Enteridium Rozeanum*. The spores of *R. Lycoperdon* germinate very rapidly, requiring about 20 minutes in fresh material, so the species can be distinguished from *E. Rozeanum* with certainty by making the test, as the spores of the latter require a much longer time.

Genus 36. **LICEOPSIS** Torrend, Bull. Soc. Portug. Sc. Nat. 2: 63. 1908.

Sporangia closely compacted, sessile, rarely free or stalked, subglobose, with fragile membranous walls; capillitium consisting of slender, branching threads and strands with membranous expansions at the axils, or wanting.

A SINGLE SPECIES.

1. **Liceopsis lobata** (Lister) Torrend, Bull. Soc. Portug. Sc. Nat. 2: 63. 1908.

Reticularia lobata Lister, Mycetoza 161. 1894. (N. Y. B. G. no. 11285, authentic material.)

Plasmodium watery white (Lister). Sporangia closely clustered, usually sessile, angled by mutual pressure, rarely solitary or stalked, subglobose, 0.4 to 0.7 mm. diam., rusty brown, shining iridescent, sometimes confluent to form a flat or globose aethalium; sporangial walls membranous, smooth. Capillitium scanty, consisting of slender, rusty brown, branching and anastomosing threads and strands with thin, membranous expansions. Spores subglobose or turbinate, rusty brown, sharply and closely reticulate on two thirds of their surface, faintly and loosely reticulate on the remaining third, 6–10 μ diam.

TYPE LOCALITY: Essex, England.

HABITAT: On dead wood.

DISTRIBUTION: *Oregon, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 154, figs. d–f.

This species has been reported from two western states, and little is known about it from American gatherings. It is related to *Enteridium Rozeanum* and *Reticularia Lycoperdon*.

Family V. LYCOGALACEAE

Sporangia forming an aethalium; pseudo-capillitium consisting of smooth or wrinkled branching colorless tubes.

A SINGLE GENUS.

Genus 37. **LYCOGALA** Micheli; Adanson, Fam. Pl. 2: 7. 1763.

Aethalium subglobose or conical, with a cortex of two or more closely combined layers of different structure; the outer layer has large cell-like vesicles, which are either embedded or superficial, and is traversed by interlacing tubular threads; these pierce the homogeneous inner layer, and are continuous with the tubes of the pseudo-capillitium; the latter are gray or colorless, wrinkled or nearly smooth.

TYPE SPECIES: *Lycoperdon epidendrum* L.

Aethalia large, over 2 cm., cortex smooth or areolate.
Aethalia smaller, less than 2 cm., cortex warted.

Aethalia subglobose.

Aethalia conical.

1. *L. flavo-fuscum*

2. *L. epidendrum*

3. *L. conicum*

1. **Lycogala flavo-fuscum** (Ehrenb.) Rost. Versuch 3. 1873.

Diphtherium flavo-fuscum Ehrenb. Sylv. Myc. Berol. 27. 1818.

Lycogala repletum Morg. Jour. Cin. Soc. Nat. Hist. 18: 40. 1895.

Plasmodium white or pale pink (Lister). Aethalia usually solitary, occasionally in groups up to five, sessile, rounded, or piriform and short-stalked, 2 to 7 cm. diam., glossy, ochraceous or pale purplish brown, minutely areolate; cortex thick, of three layers; outer layer membranous, composed of interwoven barren sporangia; middle layer consisting of several layers of vesicles with ochraceous granular contents, 50–80 μ diam., bounded on the inner side by a network of tubes containing air; inner layer a pale brown, homogeneous membrane pierced by these tubes. Stalk a slender, colorless, more or less cylindrical strand of hypothallus, 1 to 2 cm. long. Pseudo-capillitium consisting of irregularly branching and anastomosing tubes, nearly colorless, smooth or somewhat wrinkled and papillose, 6–20 μ diam., with numerous wide expansions at the axils and with free, rounded ends. Spores in mass pale buff, when magnified colorless, minutely reticulate over the greater part of the surface, 5–6 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Widely distributed over the United States and Canada, but not common.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 155.

The aethalia may be expected at any time during the season, and in any place, but have the curious habit of not reappearing after that for years, so that collections in a particular area are apt to be rare. The plasmodium wanders, and the developments are sometimes on living trees up to fifteen feet above the ground. It may form a single aethalium, or several, or divide and form separated aethalia a few feet apart. The aethalia resemble the common puff-ball, but do not form the large colonies of the latter, nor is the peridium as tough. Occasionally large vesicles are seen among the spores.

2. **Lycogala epidendrum** (L.) Fries, Syst. Myc. 3: 80. 1829.

Lycoperdon epidendrum L. Sp. Plant. 1184. 1753.

Plasmodium coral-red, rarely white, cream-colored, or yellow (Lister). Aethalia crowded or scattered, sessile, subglobose, 3 to 15 mm. diam., pinkish gray, yellowish brown, olive-brown, or

nearly black, minutely warted; cortex varying in thickness, minutely warted with irregular superficial vesicles. Pseudocapillitium arising from the inner side of the cortex in the form of loosely branching and anastomosing thin-walled tubes, varying in thickness, 3–20 μ diam., usually marked with close transverse wrinkles; free branches numerous, clavate or rounded at the ends. Mass of spores pinkish gray or pink, becoming ochraceous with age, almost colorless by transmitted light, closely reticulate over the greater part of the surface, the remaining part marked with a loose reticulation or with short, raised lines and warts, 4–7 μ diam. (PLATE 16, FIG. 12.)

Var. **exiguum** (Morg.) Lister; Minakata, Bot. Mag. Tōkyō 27: (415). 1913.
Lycogala exiguum Morg. Jour. Cin. Soc. Nat. Hist. 15: 134. 1893.

Aethalia small, dark, 2 to 5 mm. diam., without chambered vesicles; otherwise as the typical form.

Var. **tessellatum** Lister; Penzig, Myx. Buit. 77. 1898.

Aethalia small, dark, 2 to 10 mm. diam.; superficial vesicles of the cortex dark, lobed, flattened, divided into numerous, polygonal chambers 20–50 μ diam., and one or two layers deep. (PLATE 13, FIG. 2.)

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant everywhere in North America; varieties not so common.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 156.

This species sometimes forms thousands of aethalia from a single plasmodium, and in such colonies are seen all sizes down to the small size of var. *exiguum*, which is no more than a dark variety. Dark sporangia are occasionally found up to 8 mm. diam., or more. Var. *tessellatum*, which resembles var. *exiguum* in the dark color, is sharply set off by the chambered vesicles, which may be observed in most cases by reflected light as a close punctuation. The two varieties are about evenly divided in specimens here, and are not rare.

3. *Lycogala conicum* Pers. Syn. Meth. Fung. 159. 1801.

Plasmodium rose-red or scarlet (Lister). Aethalia conical, sessile on a broad base, crowded or scattered, 1.5 to 3 mm. high, 0.8 to 1.5 mm. broad, sometimes subglobose, yellowish brown,

marked with dark, branching, superficial vesicles which form spots or a broken reticulation, chiefly on the upper part; cortex thin, of two closely combined layers; outer layer traversed by flattened tubes 2–10 μ broad, these either loosely interlacing or nearly parallel in a single series and separated by intervals of 2–20 μ ; tubes piercing the membranous inner layer and continuous with the pseudo-capillitium, the latter consisting of simple, rarely branching, olivaceous gray tubes 3 μ diam., or varying from 2–7 μ , faintly and minutely wrinkled, with clavate or obtuse ends. Spores yellowish gray or ochraceous, minutely reticulate over the greater part of the surface, 4–5 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: *Canal Zone, Florida, Indiana, *Missouri, Ohio, Pennsylvania, Virginia, *West Indies, *West Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 157.

This species is actually rare and not found often. The conical shape will usually distinguish the form, but when the aethalia are subglobose, they will resemble somewhat the smaller aethalia of *L. epidendrum*, and may be perplexing. Some of the aethalia may show an inclination to the conical shape, and the tops will usually show the patches, or imperfect reticulation, instead of warts. The species usually forms small developments in contrast to the large ones of *L. epidendrum*.

Suborder II. CALONEMATINEAE

Sporangia simple; capillitium always present, forming a system of uniform threads; spores yellow, red, or gray.

Family I. TRICHIACEAE

Capillitium consisting of tubular threads that are either free and then called elaters, or combined into an elastic network; thickenings in the form of spirals.

Capillitium abundant, consisting of free elaters with spiral thickenings.

38. TRICHIA

Capillitium scanty, consisting of free elaters with imperfect spiral thickenings; sporangia small, closely compacted or heaped.

39. OLIGONEMA

Similar to *Oligonema*, but the capillitium branching and anastomosing to form a network.

40. CALONEMA

Capillitium combined into a network, with spiral thickenings.

41. HEMITRICHIA

Genus 38. **TRICHIA** Haller, Hist. Stirp. Helv. 3: 114. 1768.

Sporangia stalked, sessile, or forming plasmodiocarps; sporangial wall membranous or cartilaginous; elaters free, pointed at each end, thickened with two to five spiral bands; spores reticulate or warted; in the former case the reticulation may be continuous or broken, and forms when seen in profile a border to the spore.

TYPE SPECIES: *Stemonitis Botrytis* Gmel.

Two longitudinal lines are often seen along the middle of the elaters. They signify little except to define the limits of the inner tube of the elater, and will vary in intensity depending on the mounting medium used. They are due to the difference in refractive index between what may be in the tube, and that of the material of which the elater is composed. On the elaters of some of the species there will be seen short striae between the spiral bands which appear to be slender ridges. They are placed completely around the elater and parallel. The elaters have spiral bands around them which appear in the field of the microscope as winding in a sinistral direction, that is, like the threads of a left-handed screw. A dextral winding is like that of the threads of a right-handed screw. The use of the words dextral and sinistral in a contrary sense is not correct when applied to an object as viewed from the outside. The species of the genus are subject to great variation, much of which is due to their sensitiveness to moisture and changes in temperature while developing. Nearly all of them appear in greatest abundance towards the end of the fruiting season, and are often affected by early frosts. The variations appear principally in the elaters of the capillitium, their length, breadth, branching, netting, terminals, regularity of the bands, and the presence of spines. They may also occur in the stalk, the sporangial wall, or even in the shape of the sporangia.

Spores more or less completely reticulate.

Elaters 6-8 μ wide; spores reticulate with narrow bands; border 2 μ wide; sporangia sessile.

1. *T. favoginea*

Elaters 4-6 μ wide; spores reticulate with narrow bands; border 1 μ wide; sporangia usually stalked, clustered.

2. *T. verrucosa*

Elaters 4-6 μ wide; spores reticulate with broad, pitted bands; border 0.5-1 μ wide; sporangia sessile.

3. *T. affinis*

Elaters 4-6 μ wide; spores with the reticulations more or less broken into shallow, pitted warts; border interrupted, 0.5 μ wide; sporangia sessile.

4. *T. persimilis*

- Elaters 4–6 μ wide; spores very closely reticulate; border almost none; sporangia sessile. 5. *T. scabra*
- Spores minutely warted (sometimes minutely reticulate in *T. decipiens*).
- Spirals of elaters two. 6. *T. varia*
- Spirals of elaters three or more.
- Elaters tapering shortly at the ends.
- Sporangia sessile; wall pale or dark brown, uniformly thickened with granular matter; spirals of elaters distinct or faint. 7. *T. contorta*
- Sporangia sessile; wall thick, black. 8. *T. alpina*
- Sporangia sessile; wall thin, without granular thickenings; spirals of elaters often faint. 9. *T. lutescens*
- Sporangia stalked; wall membranous, thickened in rounded areas with brown granular deposits; elaters spinose. 10. *T. erecta*
- Sporangia stalked; elaters smooth. 11. *T. subfusca*
- Elaters smooth, very gradually tapering at the ends; sporangia stalked.
- Stalk filled with spore-like cells. 12. *T. decipiens*
- Stalk brown, opaque, not filled with spore-like cells. 13. *T. Botrytis*
- Stalk red or brownish red, translucent when mounted. 14. *T. floriformis*

1. **Trichia favoginea** (Batsch) Pers. Neues Mag. Bot. 1: 90. 1794.

Lycoperdon favogineum Batsch, Elench. Fung. Contin. 1: 257. 1786.

Plasmodium white (Lister) or yellow (Macbride). Sporangia usually sessile, globose, obovoid, cylindrical, or clavate, crowded on a membranous hypothallus, 0.6 to 0.7 mm. broad, 0.7 to 1.9 mm. high, shining ochraceous yellow; mass of spores and capillitium orange-yellow; sporangial wall membranous, thickened with delicate, irregular striae. Capillitium consisting of long, cylindrical elaters 6–8 μ diam., smooth or with scattered spines, thickened with four or five spiral bands 1 μ wide, the intervals between them crossed by many slender ridges running parallel with the length of the elater; ends of the elaters conical, terminating in a smooth point, 3–8 μ long. Spores yellow, reticulate with narrow, high bands forming a net with three to five meshes to the hemisphere, 13–15 μ diam., including the border of 1.6–2 μ width. (PLATE 13, FIG. 3.)

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant in the United States and Canada; not so common in the tropics.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 159, *figs.* a, b.

Rarely, the sporangia have membranous stalks which may be up to 0.3 mm. high. They must not be confused with *T. verrucosa* as they have the sporangial walls, elaters, and spores of *T. favoginea*. This species, and the three following ones, constitute a group of related forms which are connected by many intermediates. Abnormal developments may have branched elaters or a netted capillitium like in the genus *Hemitrichia*. In cold weather developments, the spirals on the elaters may be replaced partially by rings. The descriptions apply therefore to the various centers around which the connecting forms are grouped, and which are usually constant in normal developments. The markings on the sporangial wall, the breadth of the elaters, and the height, pitting, and number of bands on the spores are important characters which must not be overlooked in separating the species.

2. ***Trichia verrucosa*** Berk. in Hooker f., *Fl. Tasm.* 2: 269. 1859.

Trichia superba Masee, *Jour. Roy. Micr. Soc.* 1889: 345. 1889.

Plasmodium white (Lister). Total height 2 to 4 mm. Sporangia stalked, rarely sessile, piriform or clavate, clustered or solitary, 1.4 mm. high, 0.8 mm. broad, ochraceous yellow; mass of elaters and spores golden yellow; sporangial wall membranous, minutely and closely papillose on the inner side, pale yellow, sometimes with an outer layer thickened by granular deposits. Stalks membranous, 1 to 2 mm. high, usually combined in clusters of three or four, rugose, yellowish brown or dark brown. Capillitium of long cylindrical elaters 4–6 μ wide, with short, conical ends, marked with three to five narrow spiral bands, smooth or with a few scattered spines; longitudinal striae distinct. Spores reticulate, with narrow, minutely pitted bands forming a network with about seven meshes to the hemisphere, 13–16 μ diam.; border 1 μ wide.

TYPE LOCALITY: Tasmania.

HABITAT: On dead wood.

DISTRIBUTION: *Dominica, *Mexico, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 161, *figs.* a, b.

This species sometimes forms sporangia that are short-stalked or entirely sessile, and crowded, appearing then like *T. favoginea*. Such forms are distinguished from the latter by the papillose character of the sporangial wall, the narrow elaters, and the spores with pitted bands, more meshes to the hemisphere, and narrower borders.

3. *Trichia affinis* de Bary; Fuckel, Symb. Myc. 336. 1870.

Trichia pulchella Rex, Proc. Acad. Nat. Sc. Phila. 1893: 366. 1893.

Plasmodium watery white (Lister). Sporangia clavate, obovoid or globose, sessile, usually crowded, often seated on a membranous hypothallus, 0.6 to 1 mm. diam., shining golden or ochraceous yellow; mass of elaters and spores bright yellow; sporangial wall membranous, pale yellow, marked with delicate irregular striae, rarely reticulate in a manner resembling fan-tracing. Capillitium consisting of long cylindrical elaters 4–6 μ diam., with conical, pointed ends, marked with four or five spiral bands, smooth, rarely studded with minute, scattered spines; longitudinal striae usually present. Spores reticulate with broad, rarely narrow, pitted bands, forming a more or less complete net with three to five meshes to the hemisphere, 13–15 μ diam.; border 0.5–1 μ wide.

TYPE LOCALITY: Austria.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 160, figs. c, d.

The form is intermediate between *T. favoginea* and *T. persimilis*. From the former it differs by the narrower elaters, and the low, broad, pitted bands on the spores, although there are connecting forms between the two. From *T. persimilis* it differs by the characters of the spores. Typical examples of *T. affinis* or *T. persimilis* are not common among the many collections of the two species from North America. In most of the specimens the bands on the spores are broken or interrupted in greater or lesser degree. This may be seen in the same colony, or even occasionally in the same sporangium. About half of the material of the two species leans nearer *T. affinis* and the other half towards *T. persimilis*, in typical examples of which the bands are broken up and replaced by irregular warts. The two species might well be united, as there are practically no differences except in the spores. *T. pulchella* is regarded by Lister as a phase of *T. affinis*.

4. ***Trichia persimilis*** Karst. Not. Sällsk. Fauna et Fl. Fenn. Förh. 9: 353. 1868.

Plasmodium watery white (Lister). Sporangia globose, obovoid, or clavate, usually crowded and seated on a common membranous hypothallus, 0.5 to 0.8 mm. diam., brownish yellow or golden yellow, shining; mass of capillitium and spores yellow; sporangial wall membranous, yellow, marked with delicate, stippled lines, or rows of minute warts. Capillitium of cylindrical elaters 4–6 μ diam., with about four closely set spiral bands usually studded with numerous, short, slender spines; ends of the elaters conical, acute, or with the spiral bands produced at the ends into two or three diverging points; longitudinal striae inconspicuous. Spores yellow, 11–14 μ diam., the reticulation broken or represented by irregular, pitted warts; border interrupted.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 160, *figs.* a, b.

In developments with typical or nearly typical spores, the sporangia are usually smaller and more inclined to be globose or irregularly so. As the spores approach *T. affinis*, the tendency is to form larger and more clavate or obovoid sporangia.

5. ***Trichia scabra*** Rost. Mon. 258. 1875.

Oligonema fulvum Morg. Jour. Cin. Soc. Nat. Hist. 16: 36. 1893.

Plasmodium watery white (Lister). Sporangia sessile, globose, usually crowded on a membranous hypothallus, 0.6 to 0.9 mm. diam., shining orange-yellow, olivaceous, or yellowish brown; sporangial wall membranous, yellow, marked with faint lines of minute warts or fan-like tracery. Capillitium and spores bright orange-yellow in mass. Elaters long, cylindrical, bright yellow, 4–6 μ diam., marked with four or five often somewhat irregular spiral bands, studded with spines or nearly smooth, the ends acutely conical, or with the bands produced at the ends in diverging points; longitudinal striae rarely evident. Spores yellow, minutely and closely reticulate with low bands forming a complete or fragmentary net with about forty meshes to the hemisphere, rarely irregularly warted, 9–12 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout continental North America.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 159, *figs.* c, d.

The developments appear late, after two thirds of the fruiting season has passed. There are few connecting forms with other species, which makes this species very constant as a rule. It can often be recognized in the field by its orange-yellow color. As in all the species of *Trichia*, occasional forms are found that depart in some respects, mainly in the markings on the elaters and spores. Lister has examined the type of *Oligonema fulvum*, and regards it as a form of the present species; it was based apparently upon a single gathering.

6. **Trichia varia** Pers. Neues Mag. Bot. 1: 90. 1794.

Plasmodium white (Lister). Sporangia globose, obovoid, or turbinate, 0.6 to 0.9 mm. diam., sessile, short-stalked, or forming short plasmodiocarps, crowded or scattered, ochraceous yellow or olivaceous, often forming large colonies; sporangial wall membranous, pale yellow, marked with ring-shaped or crescentic thickenings. Stalks 0.1 to 0.5 mm. high, thick, black, furrowed. Capillitium of cylindrical ochraceous yellow elaters 3–5 μ diam., tapering shortly at the ends and terminating in curved points, marked with two well-defined spiral bands which are more prominent on one side of the elater than on the other. Spores ochraceous yellow, minutely warted, 11–16 μ diam. (PLATE 16, FIG. 13.)

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 164, *figs.* a–c.

This species is clearly distinguished from every other one of the genus by the two spiral bands on the elaters, which are prominent, and more so on one side. Stalked forms are not rare in the latter part of the season when the species is fruiting in abundance, and occasionally sausage-shaped sporangia on stalks are found. The better developments are produced at that time, often olivaceous in color and with thin sporangial walls. The earlier fruitings are usually ochraceous and the sporangia have thicker walls. A

curious feature is that the form is often associated with *Hemitrichia Vesparium*.

7. *Trichia contorta* (Ditm.) Rost. Mon. 259. 1875.

Lycogala contortum Ditm. in Sturm, Deutsch. Fl. Pilze 1: 9. 1813.

Trichia reniformis Peck, Rept. N. Y. State Mus. 26: 76. 1874. (N. Y. B. G. no. 11168, type material.)

Trichia iowensis Macbr. Bull. Nat. Hist. S. U. Iowa 2: 133. 1892. (N. Y. B. G. no. 11190, authentic material.)

Trichia Macbridei M. E. Peck; Peck & Gilb. Am. Jour. Bot. 19: 145. 1932.

Plasmodium watery white (Lister). Sporangia crowded or scattered, subglobose, 0.5 to 0.8 mm. diam., sessile, often forming short, curved plasmodiocarps, rarely with a very short, black stalk, dull yellowish brown or dark reddish brown; sporangial wall membranous or cartilaginous, yellowish or reddish brown, charged with brown granular matter, rarely with deposits of angular crystals of lime, when the sporangia are gray. Capillitium of simple or branched elaters, with four or five often indistinct or rugged spiral bands 3–5 μ diam., the tips usually swollen and ending in a curved point, occasionally with scattered, long spines, yellow or yellowish brown. Spores yellow, minutely spinulose, 10–14 μ diam.

Var. *inconspicua* (Rost.) Lister, Mycetozoa 169. 1894.

Trichia inconspicua Rost. Mon. 259. 1875.

Trichia Andersoni Rex, Proc. Acad. Nat. Sc. Phila. 1891: 395. 1891. (N. Y. B. G. no. 6388, type material.)

Elaters regular, cylindrical; spiral bands distinct, close and regular.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 162, figs. a, b.

Var. *inconspicua* is far more abundant and more representative and might with reasons be made the typical form, as the latter is rare in good examples and has all the appearances of irregularity. The two are not distinct species, as they are connected by intermediate forms and all other departures are found equally in both. This species, like other members of the genus, is responsive to moisture and temperature and frequent aberrant developments are formed, rarely alike, some of which have been

proposed as distinct species. *T. iowensis* is unworthy even of varietal rank. It is based on the presence of scattered, long spines, but such spines are found occasionally on the elaters of the typical form, the var. *inconspicua*, and forms with lime on the peridium; the lime is not a specific character. *T. Macbridei*, from Oregon, reported by the author as collected in mid-winter, is apparently a phase of *T. contorta* with a combination of cold weather irregularities. A collection personally made at Mountain Lake, Virginia, in September, at an altitude of 4100 feet, has no capillitium, but there are spore-like bodies with short appendages that are spirally wound. The elaters of *T. contorta* are often branched. Forms in which the elaters are combined into a network are usually placed for convenience in the genus *Hemitrichia* as *H. Karstenii*. *T. lutescens* is closely related to *T. contorta*, but without granular deposits in the sporangial wall.

8. **Trichia alpina** (R. E. Fries) Meylan, Bull. Soc. Vaud. Sc. Nat. **53**: 460. 1921.

Trichia contorta (Ditm.) Rost. var. *alpina* R. E. Fries, Arkiv Bot. **6** (7): 5. 1906.

Trichia cascadiensis Gilb.; Peck & Gilb. Am. Jour. Bot. **19**: 145. 1932.

Plasmodium rich orange-red (Lister). Sporangia scattered or clustered, sessile, subglobose or forming long, straight or curved plasmodiocarps, 0.5 to 0.7 mm. diam., purple-black or black; sporangial wall cartilaginous, of two layers, the inner translucent olive or yellow, the outer chestnut or olive-brown, thickened externally with dense deposits of granular matter. Capillitium of bright yellow elaters 4–6 μ wide, marked with two to six regular or rugged and sometimes spinose spiral bands, and with shortly tapering pointed or truncate ends. Spores bright yellow in mass, globose or ovoid, minutely warted, 13–20 μ diam.

TYPE LOCALITY: Sweden.

HABITAT: On dead wood, twigs, leaves, and stems.

DISTRIBUTION: Maine, New Hampshire, Ontario, *Oregon, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 162, figs. c, d.

As seen from the description, and from Swiss and American gatherings, this species is very variable in the characters of the capillitium and spores, retaining, however, the rather large size and black color of the sporangia and plasmodiocarps, with the heavy deposits of dark granular matter. A specimen collected

in Maine agrees in almost every particular with the description of *T. cascadiensis*, but is regarded as merely one of the variations of *T. alpina*.

9. *Trichia lutescens* Lister, Jour. Bot. **35**: 216. 1897.

Plasmodium watery pink (Lister). Sporangia sessile, widely scattered or in small clusters, globose or bolster-shaped, 0.15 to 0.7 mm. diam., olivaceous yellow or yellow; sporangial wall membranous, yellow, entirely free from granular deposits, usually embossed with the impressions of the underlying spores. Capillitium consisting of short or long, simple or branching, pale yellow elaters 3–4.5 μ diam., marked with four or five distinct or faint spiral bands, either tapering or blunt and bulbous at the tips. Spores usually olivaceous in mass, or yellow, paler by transmitted light, closely warted or spinulose, 10–12 μ diam.

TYPE LOCALITY: Norway.

HABITAT: On dead wood.

DISTRIBUTION: California, Colorado, New Jersey, New York, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 161, figs. c–e*.

This species is allied to the variable *T. contorta*, but constant in the absence of dark, granular deposits in or on the sporangial wall. It has been rarely found in North America, probably due to the widely scattered habit. The eastern collections are all olivaceous in color with the mass of spores also olivaceous. The capillitium in European specimens is variable, as in nearly every species of the genus, with long or short elaters, simple, branched, or sometimes forming a network, and the breadth, markings, and terminals also vary. Species based on such variations are not valid, in my opinion.

10. *Trichia erecta* Rex, Proc. Acad. Nat. Sc. Phila. **1890**: 193. 1890. (N. Y. B. G. *nos. 6399, 6400, 7617, 11192*, type material.)

Plasmodium white (Lister). Total height 1 to 2 mm. Sporangia scattered, stalked, erect, often in clusters of two or three together, globose or turbinate, 0.5 to 0.7 mm. diam., bright yellow, mottled with well-defined brown, dark brown, or purplish red patches; sporangial wall membranous, pale yellow, densely charged with brown granular matter at the base of the sporangium

and in the dark patches. Stalk cylindrical, stout, 0.1 to 1 mm. high, 0.2 to 0.3 mm. thick, dark brown, opaque. Capillitium of bright yellow or orange elaters 3.5–4 μ diam., with short, tapering ends, marked with four close spiral bands, and studded with few or many spines. Spores bright yellow or orange in mass, minutely warted, 11–13 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: New York, North Carolina, Pennsylvania, Quebec, Tennessee, Virginia, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 158, *figs.* e–g.

This species appears to be confined principally to the mountains of eastern North America. It was rather common in the Laurentian mountains of Quebec in 1938, and in the Great Smoky Mountains of North Carolina and Tennessee in 1939. The mottled appearance of the sporangia, and the spinose elaters with short ends, distinguish it from other species of *Trichia*.

11. *Trichia subfusca* Rex, Proc. Acad. Nat. Sc. Phila. 1890: 192. 1890. (N. Y. B. G. *nos.* 6235, 7616, type material.)

Plasmodium chocolate-brown (Macbr. & Martin). Sporangia gregarious, solitary or united in pairs, stalked, subglobose or piri-form, 0.5 to 0.9 mm. diam., dull brown, yellowish or reddish brown; sporangial wall membranous, with more or less evenly distributed dark, granular deposits. Stalk dark brown or nearly black, erect, stout, furrowed, separated from the cavity of the sporangium by the inner layer of the sporangial wall. Capillitium consisting of bright yellow elaters 4–6 μ wide, marked with three or four prominent spiral bands, smooth and ending in short, slender, often curved tips. Spores yellow, minutely spinulose, 11–13 μ diam.

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: New Hampshire, New York, North Carolina, Pennsylvania, Quebec, Tennessee, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 163, *figs.* l–n.

Closely allied to *T. Botrytis*, this is distinguished by the elaters having short, tapering ends. It is usually found in the same places and at the same time with *T. erecta*, about the end of August.

12. **Trichia decipiens** (Pers.) Macbr. N. A. Slime-Moulds 218. 1899.

Arctia decipiens Pers. Ann. Bot. Usteri 15: 35. 1795.

Plasmodium rose-colored or white (Lister). Total height 1.5 to 3 mm. Sporangia stalked, rarely sessile, gregarious or crowded, turbinate, 0.6 to 0.8 mm. diam., shining olive or yellowish brown; sporangial wall yellow, membranous, of two layers; upper part of the wall often forming a cap of thinner texture which breaks up leaving a circular opening. Stalk cylindrical, furrowed, 0.1 to 1 mm. long, olive or dark brown, filled to the base with spore-like cells. Capillitium of simple or branched, smooth, olivaceous brown elaters 4.5–5.5 μ wide, marked with four or five spiral bands, gradually tapering into long, slender points. Spores yellowish brown in mass, either closely and often irregularly reticulate, or minutely warted, 9–12 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl. 158, figs. a–d.*

This species superficially resembles *Hemitrichia clavata*. It is distinguished from *T. Botrytis*, its nearest neighbor, by the stalks filled with spore-like cells.

13. **Trichia Botrytis** (Gmel.) Pers. Neues Mag. Bot. 1: 89. 1794.

Stemonitis Botrytis Gmel. Syst. Nat. 2: 1468. 1791.

Plasmodium purple-brown (Lister). Total height 1.5 to 5 mm. Sporangia stalked, piriform or turbinate, free or combined in small clusters, 0.6 to 0.8 mm. diam., yellowish olive, reddish brown, brown, or purple, often areolate with paler lines of dehiscence; sporangial wall of two layers, the outer charged with granular matter and continued into the stalk, the inner membranous, translucent, enclosing the spores. Stalks cylindrical, often adherent in clusters of two to eight, furrowed, red or purplish brown, consisting within of spongy tissue enclosing refuse matter. Capillitium of cylindrical yellowish brown elaters 4–5 μ diam., sometimes branched, gradually tapering to long slender points which are smooth at the tips, marked with three to five

flattened, or prominent lax and often rugged, spiral bands. Spores ochraceous yellow, minutely spinulose, 9–11 μ diam.

Var. **munda** Lister, Jour. Bot. 35: 216. 1897. (N. Y. B. G. no. 11661, authentic material.)

Elaters pale brown or yellowish brown, marked with close and regular spiral bands with long tapering points; spores yellow or brownish yellow.

Var. **flavicomma** Lister, Mycetozoa 172. 1894. (N. Y. B. G. no. 11650, authentic material.)

Sporangia minute, stalked, solitary, purplish brown with yellow lines of dehiscence; elaters and spores bright yellow.

TYPE LOCALITY: Germany.

HABITAT: On dead coniferous wood; var. *flavicomma* on leaves and plant stems.

DISTRIBUTION: The typical form is common in the United States and Canada; var. *munda*, not so common; var. *flavicomma*, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 163, figs. a–d, j, k.

Var. *munda* has the bands on the elaters close and regular, otherwise it is similar to the typical form. It bears about the same relation that var. *inconspicua* does to the typical form of *T. contorta*. Var. *flavicomma* is a minute form on short, stout stalks with yellow areolations, and is found on leaves and stems. Var. *cerifera* G. Lister has not been reported from North America. *T. Botrytis* is allied to *T. floriformis*, from which it is distinguished in the field by the more yellowish color of the capillitium and spores, and the usually smaller clusters of sporangia.

14. **Trichia floriformis** (Schw.) G. Lister, Jour. Bot. 57: 110. 1919.

Craterium floriforme Schw. Trans. Am. Phil. Soc. II. 4: 258. 1832.

Plasmodium purple-brown (Lister). Sporangia free, or often adhering in clusters of two to twenty, obovoid, subglobose, or cylindrical, brown often mottled with darker shades, purplish red or black; sporangial wall as in *T. Botrytis*. Stalks furrowed, bright or dark red, translucent and free from refuse matter, 1 to 2 mm. or more long, usually adhering in clusters and arising from a red hypothallus. Capillitium of pale brownish red elaters, marked with four to six spiral bands, ending in tapering points,

20–40 μ long. Spores brick-red in mass, pale orange-red by transmitted light, minutely warted, 10–12 μ diam. (PLATE 13, FIG. 4.)

TYPE LOCALITY: New York.

HABITAT: On dead wood.

DISTRIBUTION: California, Maine, Massachusetts, New Hampshire, New York, North Carolina, Ontario, *Oregon, Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 163, *figs.* e–i, as *T. Botrytis*.

This species is fairly common in many areas, and is usually in large colonies with many sporangia. It resembles *Hemitrichia Vesparium* in appearance, but is readily distinguished from that and all other species by the characters given.

Genus 39. **OLIGONEMA** Rostafinski, Mon. 291. 1875.

Sporangia small, yellow, clustered or heaped; capillitium usually scanty, of short or long threads with spiral markings obscure or wanting; spores reticulate.

TYPE SPECIES: *Trichia nitens* Lib.

The two members of the genus are allied to *Trichia favoginea*, *T. affinis*, and *T. persimilis*, differing principally in the absence of the continuous, spiral thickenings on the threads of the capillitium. When spiral windings are present, they are indistinct, or in the form of warts.

Sporangial wall smooth; spores irregularly reticulate.

1. *O. nitens*

Sporangial wall with minute granular thickenings; spores regularly reticulate.

2. *O. flavidum*

1. **Oligonema nitens** (Lib.) Rost. Mon. 291. 1875.

Trichia nitens Lib. Pl. Crypt. Ard. (Fasc. 3) no. 277. 1834.

Plasmodium watery white (Lister). Sporangia subglobose, sessile, heaped together for the most part in large clusters, 0.2 to 0.5 mm. diam., shining yellow or olivaceous yellow; sporangial wall membranous, yellow, smooth, except for scattered curved thickenings enclosing a thinner membrane. Capillitium usually of short, cylindrical, simple, branched, or ring-shaped, yellow threads 3–5 μ diam., with rounded or abruptly pointed ends, either smooth or with one to four irregular and indistinct sinistral markings, winding like the threads of a left-handed screw, occasionally marked with ring-shaped thickenings and scattered

spines. Spores yellow, 11–16 μ diam., reticulate with broad and pitted bands, or with narrow bands, forming an irregular net with a border 0.5–1.5 μ wide.

TYPE LOCALITY: Belgium.

HABITAT: On dead wood, twigs, straw, turf, etc., in wet places.

DISTRIBUTION: Throughout the United States and Canada, but not common.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 164, *figs.* d–f.

There are many intergrading forms, in capillitium and spores, between this species and *O. flavidum*. When those characters are obscure and difficult to differentiate, the character of the sporangial wall is usually conclusive. In *O. nitens* this is smooth, in *O. flavidum* it is marked with a close reticulation or fan-like lines of stippling. The sporangia of *O. nitens* are usually subglobose, those of *O. flavidum* larger, and obovoid, piriform, or even cylindrical, the shape depending much on mutual pressure.

2. **Oligonema flavidum** Peck, Rept. N. Y. State Mus. 31: 42. 1879.

Perichaena flavida Peck, Rept. N. Y. State Mus. 26: 76. 1874. (N. Y. B. G. nos. 7973, 12854, type material.)

Oligonema brevifilum Peck, Rept. N. Y. State Mus. 31: 42. 1879. (N. Y. B. G. nos. 7974, 12853, type material.)

Plasmodium watery white ? (Lister). Sporangia crowded, heaped, occasionally scattered, obovoid, piriform, cylindrical, or subglobose, 0.5 to 0.8 mm. high, 0.2 to 0.5 mm. broad, shining yellow; sporangial wall membranous, translucent yellow, marked with a close reticulation or with minute, close-set thickenings arranged in wavy or fan-like lines, which give the effect of delicate stippling. Capillitium scanty or fairly abundant, of short or long, simple or branched threads 3–5 μ diam., often showing irregular swellings, without distinct bands, but marked with close lines of minute warts that usually form irregular dextral spirals, winding like the threads of a right-handed screw. Spores yellow, 11–14 μ diam., regularly reticulate with narrow bands, which give a border 1 μ wide, and form a net with from three to five meshes across the hemisphere.

TYPE LOCALITY: New York.

HABITAT: On dead wood, twigs, straw, and turf, in wet places.

DISTRIBUTION: Fairly common throughout the United States and Canada.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 165, *figs.* *a-c*.

The species has a tendency to develop in dark, wet places, and may be sought under decaying logs with a moist base beneath. Both species of the genus show much variation in the length of the elaters, which are often branched.

Genus 40. **CALONEMA** Morgan, Jour. Cin. Soc. Nat. Hist. 16: 27. 1893.

Resembling *Oligonema* except that the threads of the capillitium are combined to form a network.

A SINGLE SPECIES.

1. **Calonema aureum** Morg. Jour. Cin. Soc. Nat. Hist. 16: 27. 1893. (N. Y. B. G. *no.* 11246, type material.)

Plasmodium? Sporangia sessile, clustered, subglobose, 0.3 to 0.6 mm. diam., shining yellow; sporangial wall membranous, yellow, translucent, marked with delicate lines of thickening forming an irregular net resembling fan-tracery, with thinner spots from which the lines radiate. Capillitium consisting of branching yellow threads 3–5 μ diam., more or less united to form a network, and marked with raised lines, or rows of minute warts arranged to form either an irregular reticulation, or irregular spirals which are usually dextral but may be sinistral; ring-shaped thickenings and scattered spines often present. Spores yellow, 13–15 μ diam., regularly reticulate with narrow raised bands, which give a border of 1–1.5 μ to the margin, and form a net showing five to six meshes across the hemisphere.

TYPE LOCALITY: Ohio.

HABITAT: On dead wood.

DISTRIBUTION: *Alabama, *Arkansas, Florida, *Illinois, *Maryland, *Minnesota, North Carolina, Ohio, *South Carolina, Tennessee, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 165, *figs.* *d-f*.

The form is practically the same as *Oligonema flavidum*, except that the capillitium is much branched and combined somewhat into a network varying in each collection. The spirals are not always dextral, but may be sinistral, sometimes both directions in a single sporangium. This may also be seen in the genus *Oligonema* as the direction depends on the arrangement of the individual warts. The spirals are not continuous thickenings as in

the genus *Trichia*. The spores are not reticulate like those of *Trichia favoginea*, as there are from three to five times as many meshes on the hemisphere; they are like those of *O. flavidum*. *C. aureum* is not a definite species but a variant from *O. flavidum*, which may be produced occasionally wherever the latter species is fruiting in abundance. The genus and species are retained merely for convenience.

Genus 41. **HEMITRICHIA** Rostafinski, Versuch 14. 1873.

Sporangia stalked or sessile; capillitium a more or less elastic network of branching threads, thickened with from two to six continuous, spiral bands, as in the genus *Trichia*; bands winding in a sinistral direction in all species except *H. leiocarpa*, where they are dextral.

TYPE SPECIES: *Trichia clavata* Pers.

Spores nearly smooth or minutely warted.

Capillitium red, spinose.

1. *H. Vesparium*

Capillitium yellow, yellowish brown, or yellowish gray.

Sporangia stalked.

Stalk solid.

2. *H. intorta*

Stalk hollow, filled with spore-like cells.

Stalk long or short; sporangia yellow; cup papillose; capillitium with five or six sinistral bands.

3. *H. clavata*

Stalk long; sporangia gray; cup smooth; spiral bands dextral.

4. *H. leiocarpa*

Stalk very short; sporangia sometimes sessile or nearly so, yellow without granular deposits; capillitium with one to three sinistral bands.

5. *H. abietina*

Sporangia sessile or forming plasmodiocarps; wall thickened with dark, granular deposits.

6. *H. Karstenii*

Spores reticulate.

7. *H. Serpula*

1. **Hemitrichia Vesparium** (Batsch) Macbr. N. A. Slime-Moulds 203. 1899.

Lycoperdon Vesparium Batsch, Elench. Fung. Contin. 1: 253. 1786.

Plasmodium purple-red (Lister). Total height 1.3 to 2.5 mm. Sporangia clavate or sub-cylindrical, stalked or sessile, combined in clusters or crowded, 1 to 1.3 mm. high, 0.5 to 0.7 mm. broad, glossy or shining, dark red, red-brown, or olive-black; sporangial wall of two layers, the outer continued into the stalk, the inner

enclosing the spores, orange-red. Stalks membranous, 0.2 to 1 mm. high, usually combined in clusters of from six to twelve, furrowed and rugose, red, not enclosing spore-like cells. Capillitium red or orange-red in mass, consisting of twisting, sparingly branched, orange-red, sinistrally winding threads 5-6 μ diam., with few pointed free ends, marked with three to five regular, spiral bands, and studded with numerous, scattered spines, 2-5 μ long, rarely nearly smooth. Spores pale orange-red, warted, 10-12 μ diam. (PLATE 13, FIG. 5.)

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common, and usually abundant, throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 166.

2. *Hemitrichia intorta* Lister, Mycetozoa 176. 1894. (N. Y. B. G. no. 12648, authentic material.)

Hemiarcyria intorta Lister, Jour. Bot. 29: 268. 1891.

Hemiarcyria longifila Rex, Proc. Acad. Nat. Sc. Phila. 1891: 396. 1891.

Plasmodium watery white (Lister). Total height 1 to 1.5 mm. Sporangia stalked, gregarious or scattered, turbinate, 0.3 to 0.7 mm. diam., shining orange-yellow; sporangial wall membranous above, thickened with granular deposits towards the base, which persists somewhat as a cup, the wall papillose on the inner side. Stalk thickened above and below, furrowed, 0.5 to 0.7 mm. long, 0.15 mm. thick in the middle, glossy purplish brown, opaque, without spore-like cells. Capillitium consisting of two or three long, orange-yellow threads, looped and attached at both ends to the base, sparingly connected by branches, and twisted throughout to form a dense, tangled mass; the threads marked with four or five closely set, sinistral spiral bands, sometimes connected by longitudinal striae, and densely spinulose. Spores yellow, minutely warted, 8-10 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead wood.

DISTRIBUTION: *Iowa, Massachusetts, Ohio, Ontario, *Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 172, *figs.* a, b.

An interesting species because of its peculiar capillitium, but extremely rare. The threads are up to 8 cm. or more long from

end to end, and profusely twisted, so that many long, twisted projections spread from the mass and appear as free ends. The species can be recognized with a hand-lens.

3. *Hemitrichia clavata* (Pers.) Rost. Versuch 14. 1873.

Trichia clavata Pers. Neues Mag. Bot. 1: 90. 1794.

Hemiarcyria stipitata Massee, Jour. Roy. Micr. Soc. 1889: 354. 1889.

Hemitrichia plumosa Morg. Jour. Cin. Soc. Nat. Hist. 16: 23. 1893. (N. Y. B. G. nos. 5969, 12159, type material.)

Hemiarcyria ablata Morg. Jour. Cin. Soc. Nat. Hist. 16: 24. 1893. (N. Y. B. G. no. 5962, type material.)

Hemiarcyria funalis Morg. Jour. Cin. Soc. Nat. Hist. 16: 26. 1893. (N. Y. B. G. no. 6674, type material.)

Hemiarcyria montana Morg. Jour. Cin. Soc. Nat. Hist. 18: 40. 1895.

Hemitrichia stipitata Massee; Macbr. N. A. Slime-Moulds 207. 1899.

Hemitrichia montana Morg.; Macbr. N. A. Slime-Moulds 208. 1899; Macbr. & Martin, Myxomycetes 298. 1934; Martin, Mycologia 34: 699. 1942. (N. Y. B. G. no. 13238, det. G. W. Martin.)

Plasmodium watery white or rose-red (Lister). Total height 1 to 3 mm. Sporangia stalked, gregarious or crowded, clavate or turbinate, 0.7 to 1.5 mm. high, shining ochraceous or olivaceous yellow, globose and nearly sessile in irregular developments; sporangial wall membranous, minutely papillose on the inner side, rarely reticulate, yellow, evanescent above, persistent below to form a more or less definite cup. Stalk cylindrical, 0.1 to 1.5 mm. long, furrowed or nearly even, olive, reddish brown, or nearly black, filled with spore-like cells. Capillitium an expanding network of yellowish olive, branched threads 5–6 μ diam., with or without free ends, marked with five or six well-defined close or lax sinistral, spiral bands, sometimes spinose in imperfect developments. Spores pale yellow, minutely warted, 7–9 μ diam. (PLATE 14, FIG. 1.)

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 167.

This species is subject to variation depending on moisture and temperature, and the attending factors of latitude and altitude. During the warm days of summer, a graceful form will develop with long, thin stalks, and small cups. It is illustrated by Lister on *pl.* 167, as *fig. f.* This is the common form from the tropics,

and was described by Massee, based on a specimen from Java, as *Hemiarcyria stipitata*. In the cooler months of autumn, the more robust forms with short, stout stalks and deep cups will be found and are usually regarded as typical. The phases are connected by intermediate forms. In late autumn and winter, if subjected to frosts, the sporangia may be sessile or nearly so, and the color, sporangial wall, capillitium, and spores may show alterations from their usual characters. Such developments are rarely alike, and vary depending on the period and locality. Morgan proposed four distinct species on abnormal forms, three of which are represented by type material here. Prof. G. W. Martin has kindly furnished a specimen collected in the vicinity of Mt. Rainier, Washington, and determined by him as *H. montana*. The four "species" of Morgan appear to have developed in frosty weather, and similar phases may be found almost anywhere during the late autumn or winter. I have studied *H. clavata* in the field for years, and examined particular logs periodically in order to note the different variations that occur as the season advances into the winter. All forms mentioned are only phases of *H. clavata*, in my opinion. The reader is referred to the Lister Monograph for further comments.

4. **Hemitrichia leiocarpa** (Cooke) Lister, Mycetozoa 177. 1894.

Hemiarcyria leiocarpa Cooke, Ann. Lyc. Nat. Hist. N. Y. 11: 405. 1877.

Plasmodium? Total height 1.5 mm. Sporangia scattered, stalked, obovoid, rarely subglobose, pale gray or ochraceous gray, 0.7 mm. diam.; sporangial wall evanescent above, persistent below as a cup, smooth or marked on the inside with short, scattered ridges, forming a broken reticulation, colorless, longitudinally plicate, minutely wrinkled transversely. Stalk 0.7 to 1 mm. long, 0.05 mm. thick, furrowed, ochraceous gray, containing spore-like cells. Capillitium a network of frequently branching, pale gray threads 2–5 μ thick, marked with three to five often prominent, dextral, spiral bands, either smooth or studded in many parts with numerous spines about 2 μ long; free ends subclavate, usually spinulose. Spores smooth, pale gray in mass, 6–8 μ diam.

TYPE LOCALITY: Maine.

HABITAT: On dead wood, mosses, and leaves.

DISTRIBUTION: *Maine, *Ontario, Pennsylvania.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 168, *figs.* a, b.

This species superficially resembles *Arcyria cinerea*, but is a *Hemitrichia*, as shown by a specimen collected by the late Mr. Hugo Bilgram near Philadelphia. It has prominent, continuous, spiral bands, that wind as thickenings around the threads in a dextral direction.

5. **Hemitrichia abietina** (Wigand) Lister, Mycetozoa ed. 2. 227. 1911.

Trichia abietina Wigand, Jahrb. Wiss. Bot. 3: 33. 1863.

Hemitrichia ovata Macbr. N. A. Slime-Moulds 202. 1899.

Plasmodium rose-red (Lister). Sporangia crowded or gregarious, short-stalked, rarely sessile, subglobose or turbinate, rarely short-cylindrical, 0.3 to 0.7 mm. diam., usually shining yellow, or ochraceous; sporangial wall membranous, thin, iridescent, yellow, almost smooth, usually evanescent above and forming a persistent cup below. Stalks ochraceous, 0.1 to 0.3 mm. long, filled with spore-like cells. Capillitium a tangle of flaccid, sparingly branched, ochraceous yellow threads 3-5 μ diam., marked with from one to three, slender, prominent bands forming irregular, loose, sinistral spirals, with few rounded or bulbous free ends. Spores yellow, minutely warted, 9-12 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: *California, Colorado, Maine, Massachusetts, New York, *Ohio, Ontario, Oregon, Pennsylvania, Quebec, Vermont, Virginia.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 168, *figs.* c-e.

This species is not rare and has been found repeatedly in areas where it is known to develop. In nearly all specimens here, the sporangia are stalked, and usually have three bands on the threads of the capillitium.

6. **Hemitrichia Karstenii** (Rost.) Lister, Mycetozoa 178. 1894.

Hemiarcyria Karstenii Rost. Mon. App. 41. 1876.

Hemiarcyria obscura Rex, Proc. Acad. Nat. Sc. Phila. 1891: 395. 1891.

Plasmodium watery white (Lister). Sporangia sessile, scattered, subglobose or forming elongate curved plasmodiocarps, 0.25 to 0.5 mm. broad, yellowish brown, red, or purplish brown;

sporangial wall membranous or cartilaginous, thickened with deposits of granular matter. Capillitium a loose network of branching, yellowish or reddish brown threads 3–5 μ diam., marked with three to five more or less distinct sinistral, spiral bands, rarely smooth, often with scattered ring-shaped thickenings and irregular expansions; free ends pointed or blunt. Spores yellow, minutely warted, 10–14 μ diam.

TYPE LOCALITY: Finland.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, *Montana, *Ontario, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 171.

This form is practically the same as *Trichia contorta*, showing similar variations, but with the threads of the capillitium combined into a network. Similar forms are found occasionally in other species of the genus *Trichia*. The present form, like *Calonema aureum*, is retained for convenience, as it has been reported frequently from Europe, although rarely from North America.

7. *Hemitrichia Serpula* (Scop.) Rost. Versuch 14. 1873.

Mucor Serpula Scop. Fl. Carn. ed. 2. 2: 493. 1772.

Plasmodium milky white, then yellow (Macbr. & Martin). Sporangia forming elongate, winding, branched plasmodiocarps, 0.4 to 0.6 mm. wide, usually uniting into a close net, golden yellow or brownish yellow, often seated on a reddish brown hypothallus; sporangial wall of two layers, the outer membranous or cartilaginous, yellow, or brownish yellow from deposits of refuse matter, the inner membranous, delicately marked with a network resembling fan-tracery. Capillitium an elastic tangle of twisted, sparingly branched, yellow or orange threads 5–6 μ diam., marked with three or four, rarely more, regular, sinistral, spiral bands, usually spinose, rarely smooth; longitudinal striae often distinct; free ends pointed. Spores yellow, reticulate with narrow bands forming a net with from nine to twelve meshes to the hemisphere, 10–12 μ diam.; border 0.5–1 μ wide. (PLATE 14, FIG. 2.)

TYPE LOCALITY: Austria.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 170, figs. a–c.

This conspicuous, common, abundant species needs no comment.

Family II. **ARCYRIACEAE**

Sporangia simple, stalked or sessile; capillitium a network of tubular threads branching at wide angles, smooth or ornamented with spines, warts, cog-like prominences or half-rings, usually abundant, sometimes scanty and of free threads in *Perichaena corticalis*.

Capillitium elastic; sporangia stalked, rarely sessile; sporangial wall evanescent above, persistent below as a cup.

42. **ARCYRIA**

Capillitium not elastic.

Sporangia sessile, heaped; sporangial wall single, persistent, papillose; capillitium closely warted.

43. **LACHNOBOLUS**

Sporangia sessile, rarely stalked; sporangial wall usually of two layers, at least at the base, the outer layer thickened with angular granules.

44. **PERICHAENA**

Genus 42. **ARCYRIA** Wiggers, Pr. Fl. Holsat. 109. 1780.

Sporangia stalked, sometimes sessile in *A. occidentalis*; sporangial wall evanescent above, persistent below as a membranous cup; stalk filled with spore-like cells; capillitium a more or less elastic network marked with spines, warts, cog-like prominences or half-rings, or with a broken reticulation; spores nearly smooth or faintly warted.

TYPE SPECIES: *Stemonitis incarnata* Pers.

Spores 9–11 μ diam.; sporangia red or yellow.

Sporangia usually red, ovoid or short-cylindrical; sporangial wall reticulate.

1. *A. ferruginea*

Sporangia yellow, clavate or piriform; sporangial wall papillose.

2. *A. vitellina*

Spores 6–8 μ diam.

Cup complete.

Capillitium firmly attached to the cup.

Sporangia white, gray or yellowish.

Sporangia cylindrical or ovoid, gray or yellowish; capillitium closely spinulose or warted.

3. *A. cinerea*

Sporangia globose, yellow; capillitium with spines arranged in an open spiral.

5. *A. pomiformis*

Sporangia globose, white, on slender stalks; cup about half the height of the sporangium; capillitium closely spinulose or warted, the warts usually arranged more or less in close, spiral lines.

6. *A. globosa*

- Sporangia red or reddish.
 Sporangia cylindrical or ovoid, flesh-colored; capillitium marked with a loose spiral of flat-topped cogs or spines. 4. *A. carnea*
- Sporangia red, subcylindrical or ovoid; capillitium marked with cogs and half-rings. 7. *A. denudata*
- Sporangia flesh-colored, cylindrical or ovoid, small; threads of the capillitium slender, marked with transverse ridges and minute spines. 8. *A. insignis*
- Capillitium centrally attached, almost or quite free from the cup.
- Network of mature capillitium expanding but not drooping.
- Sporangia red; capillitium marked with cogs and spines. 9. *A. incarnata*
- Sporangia copper-colored; capillitium marked with cogs, spines, and ridges, often arranged to form partial or complete spirals. 10. *A. stipata*
- Network of mature capillitium becoming much elongate and drooping.
- Sporangia yellow; sporangial wall evanescent above. 11. *A. nutans*
- Sporangia gray; sporangial wall evanescent above. 12. *A. magna*
- Sporangia red; sporangial wall persisting above as small plates attached to the capillitium. 13. *A. Oerstedtii*
- Sporangia yellowish green. 14. *A. virescens*
- Cup at length dividing nearly to the base into rounded lobes. 15. *A. occidentalis*

1. *Arcyria ferruginea* Sauter, Flora 24: 316. 1841.

Arcyria macrospora Peck, Rept. N. Y. State Mus. 34: 43. 1883. (N. Y. B. G. no. 12253, type material.)

Heterotrichia Gabriellae Massee, Mon. 140. 1892; Macbr. & Martin, Myxomycetes 275. 1934.

Arcyria nodulosa Macbr. N. A. Slime-Moulds ed. 2. 252. 1922; Macbr. & Martin, Myxomycetes 268. 1934.

Plasmodium rose-red or cream-colored (Lister). Total height 1 to 2 mm. Sporangia stalked, crowded, obovoid or short-cylindrical, 0.7 to 1.3 mm. high, 0.3 to 1 mm. broad, orange-red or red, rarely yellow; cup of sporangium even, shining, funnel-shaped or nearly flat, marked with round-meshed reticulation on

the inner side. Stalk cylindrical, 0.3 to 0.8 mm. long, red, rarely white, arising from a membranous hypothallus, filled with spore-like cells. Capillitium an elastic network of freely branching reddish or yellow threads 5–8 μ diam., usually massed, and connected with the tube of the stalk by one to three long basal threads which are about half the breadth of the others or less, and may be up to 10 mm. in length; threads triangular or oval in cross section, usually thicker on one side, and marked with transverse bars or reticulations arranged in a lax spiral, on the other two sides marked with a broken reticulation or with warts, often spinulose throughout; free ends with rounded or pointed tips are not infrequent. Spores pale red or ochraceous, faintly and closely warted, 9–12 μ diam. (PLATE 14, FIG. 3.)

TYPE LOCALITY: Austria.

HABITAT: On dead wood.

DISTRIBUTION: California, Colorado, *Indiana, Maine, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, *Nova Scotia, *Ohio, Ontario, *Oregon, Pennsylvania, Quebec, *South Carolina, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. pl. 173.

This species is subject to much variation in all respects. Two phases are usually seen among the American gatherings, a large one, and a smaller one which is more common, but they are connected by intermediate forms. The small phase was described by Peck as *A. macrospora*. The sporangia after appearing require nearly six days to mature properly, and are subject therefore to vagaries of the weather, which may affect them and cause variations in the capillitium such as free ends, bulbous thickenings, or spines. I have made many collections of the small phase in Pike County, Pennsylvania, and watched the development from the first appearance of the sporangia until maturity. The species fruits from May to November, and occasionally, parts of a colony will be yellow in color. *Heterotrichia Gabriellae* is regarded as an abnormal development of the small phase (see Mycologia 29: 393). *A. nodulosa*, described on a single collection from Pennsylvania, seems to be another one. The description of the latter reads like a description of one of the abnormal developments which have been affected by moisture or colder weather during the formation of the sporangia.

2. **Arcyria vitellina** Phill. Grevillea 5: 115. 1877. (N. Y. B. G. no. 5209, type material.)

Arcyria versicolor Phill. Grevillea 5: 115. 1877. (N. Y. B. G. no. 5207, type material.)

Plasmodium? Total height 2.5 to 3 mm. Sporangia short-stalked or sessile, gregarious or clustered, piriform or clavate, 1 to 2 mm. diam., more or less shining yellow or olivaceous yellow: sporangial wall membranous, persistent except at the apex, yellow, papillose on the inner side. Stalk 0.2 mm. long, yellowish brown, filled with spore-like cells, arising from a well-developed hypothallus. Capillitium an elastic network of freely branching threads 4–6 μ diam., triangular or oval in section, either uniformly spinulose and marked with broken reticulation, or with one side thickened and marked with transverse bars; threads arising from the tube of the stalk and not attached to the sporangial wall; free ends short-pointed. Spores yellow, smooth, 8–10 μ diam.

TYPE LOCALITY: California.

HABITAT: On dead wood.

DISTRIBUTION: California, Colorado, Ontario, Oregon, *South Dakota, Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 175, as *A. versicolor*.

A. vitellina and *A. versicolor* are the same, and were described by Phillips on the same page, but as the former came first it must be accepted as the name under present rules of nomenclature. The species is allied to the yellow phase of *A. ferruginea*.

3. **Arcyria cinerea** (Bull.) Pers. Syn. Meth. Fung. 184. 1801.

Trichia cinerea Bull. Herb. Fr. pl. 477, fig. 3. 1789; Bull. Champ. 120. 1791.

Plasmodium grayish white (Lister). Total height 0.8 to 4 mm. Sporangia stalked, gregarious or solitary, single or united in clusters of two to six, ovoid or cylindrical, more rarely globose, 0.5 to 0.8 mm. diam., pale gray, greenish or bluish gray, or yellowish; cup of the sporangium membranous, nearly smooth, minutely papillose or reticulate, plaited at the base, pale gray or yellowish. Stalk cylindrical, furrowed, 0.2 to 2 mm. long, 0.05 to 0.15 mm. thick, white, gray, or brown, filled with spore-like cells. Capillitium a close network of gray or yellowish gray threads, the upper and middle threads 2–4 μ diam., closely warted,

transversely banded or spinulose, the spines often stouter and larger on one side; threads composing the basal threads of the network 4–6 μ diam., either smooth, faintly warted or reticulate, with numerous attachments to the cup; the threads sometimes looped to form a more or less complete surface-net. Spores almost colorless, marked with a few scattered warts, 6–8 μ diam.

Var. *digitata* (Schw.) G. Lister, Mycetoza ed. 3. 232. 1925.

Stemonitis digitata Schw. Trans. Am. Phil. Soc. II, 4: 260. 1832.

Arcyria digitata (Schw.) Rost. Mon. 274. 1875.

Sporangia cylindrical, usually on long stalks, adhering in clusters of two to twelve or more.

TYPE LOCALITY: France.

HABITAT: On dead wood, twigs, or leaves.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 176, *figs.* a–e.

Var. *digitata* is hardly worth recognition as a variety, much less as a species. Free and clustered sporangia are found together in many collections and undoubtedly come from the same plasmodium. Similar conditions are found in *Hemitrichia Vesparium*, *Trichia Botrytis*, *T. floriformis*, and other species, where they are covered in a broader description. In other gatherings of *A. cinerea* the stalks do not adhere, but the sporangia are in small groups, the free stalks curved or bent and leaning to each other. *A. cinerea* is also very variable and there are many departures from the typical form, much of the variation depending on atmospheric changes.

4. *Arcyria carnea* G. Lister, Jour. Bot. 59: 92. 1921. (N. Y. B. G. no. 12242, authentic material.)

Arcyria cinerea (Bull.) Pers. var. *carnea* Lister, Mycetoza ed. 2. 236. 1911.

Arcyria carnea (?) Schum. Enum. Pl. Saell. 2: 213. 1803.

Plasmodium? Sporangia stalked, loosely clustered, ovoid or short-cylindrical, flesh-colored, 1.5 mm. high; cup marked with papillae or a broken reticulation, giving attachment to the capillitium. Stalks short, 0.2 to 0.4 mm. high. Capillitium a compact network of pale flesh-colored threads about 3.5 μ diam., marked with close-set prominences arranged in a loose spiral and appearing square-ended, notched, or hammer-shaped in profile; remainder of the thread either spinulose or marked with a broken reticu-

lation or occasionally with three or four faint, irregular, spiral lines; basal threads smoother and attached to the cup. Spores 6-8 μ diam., nearly smooth.

TYPE LOCALITY: England.

HABITAT: On dead wood.

DISTRIBUTION: New York, Pennsylvania, Quebec.

ILLUSTRATION: G. Lister, Jour. Bot. 59: pl. 558, figs. 2, 2a, 2b.

This species is not clearly marked with sufficient definite characters, and I doubt if anybody can understand it except the author. Miss Lister says in the original description that it may resemble in the field the robust forms of *A. insignis*. Three such specimens from the states reported have the capillitium firmly attached to the cup. The threads are broader than those of *A. insignis* and are marked with cogs or square-ended prominences. They are regarded as *A. carnea*, but similar markings are often seen in *A. denudata* or *A. incarnata*. Forms exactly like those regarded as *A. carnea*, except that the capillitium is centrally attached, I have placed with *A. incarnata*.

5. *Arcyria pomiformis* (Leers) Rost. Mon. 271. 1875.

Mucor pomiformis Leers, Fl. Herborn. 284. 1775.

Plasmodium white (Lister). Sporangia scattered or gregarious, stalked, subglobose or ovoid, 0.3 to 0.7 mm. diam., ochraceous yellow; cup plaited at the base, nearly smooth, faintly reticulate or papillose. Stalk slender, buff, 0.2 to 0.4 mm. high, filled with spore-like cells. Capillitium a loose, elastic network of yellowish threads about 3 μ diam., marked with transverse bands and spines arranged in an open spiral, nearly smooth elsewhere. Spores nearly colorless, 6-8 μ diam., marked with a few scattered warts.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 176, figs. f, f'.

This species is related to *A. cinerea* but may be distinguished by the uniformly yellowish color and more open capillitium. Yellow forms are not rare in *A. cinerea*, but those usually have a very close capillitium, and often a surface net. Var. *heterospora* G. Lister (Jour. Bot. 71: 221. 1933; N. Y. B. G. no. 8966, type material), from Japan, has not been reported from North America.

6. **Arcyria globosa** Schw. Schrift. Naturforsch. Ges. Leipzig 1: 64. 1822.

Lachnobolus globosus (Schw.) Rost. Mon. 283. 1875.

Plasmodium? Sporangia scattered or gregarious, stalked, globose, 0.3 to 0.6 mm. diam., usually white, pale yellow from fading, or brownish when stained; cup usually deep, occasionally shallow, membranous, smooth or papillose, often minutely wrinkled transversely. Stalk pale yellow or brown, slender, 0.2 to 0.5 mm. high, filled with spore-like cells. Capillitium a close and only slightly elastic network of colorless threads 2–4 μ diam., marked with warts or spines usually arranged along three or four dextral spiral lines, occasionally irregularly reticulate between the spines. Spores colorless, 6–8 μ diam., marked with a few scattered warts.

TYPE LOCALITY: North Carolina.

HABITAT: On fallen chestnut-burs of the preceding year, and leaves of the chestnut oak.

DISTRIBUTION: Eastern continental North America; formerly common but now rare.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 176, *figs.* g–i.

This species was very common formerly, often associated with *Craterium concinnum* on fallen chestnut-burs. I have found it several times in recent years at altitudes of 3,000 feet or more in the Appalachian range of mountains, where some chestnut trees have survived the blight until now. In 1942 I found it on two occasions on the dead leaves of the chestnut oak in eastern Pennsylvania. The habitat, white sporangia, and deep cups distinguish it from *A. cinerea* and *A. pomiformis*.

7. **Arcyria denudata** (L.) Wettst. Verh. Zool.-Bot. Ges. Wien 35 (Abh.): 535. 1886.

Clathrus denudatus L. Sp. Plant. 1179. 1753.

Plasmodium white (Lister). Total height 2 to 3 mm. Sporangia stalked, crowded or gregarious, ovoid or sub-cylindrical, 0.9 to 1.8 mm. high, 0.8 to 1 mm. broad, crimson, weathering to reddish brown or brown, rarely pale red; cup of sporangium membranous, firm, shining, plaited, smooth or marked with scattered papillae and faint broken reticulations on the inner side. Stalk cylindrical, 0.5 to 1 mm. high, 0.1 mm. thick, furrowed,

reddish brown, filled with spore-like cells. Capillitium a rather close, elastic network of flattened or terete pale red threads 2–5 μ diam., with thickenings in the form of prominent cogs or spines and half-rings arranged in a loose spiral; with many attachments to the cup and usually without free ends. Spores pale red, nearly smooth, marked with a few scattered warts, 6–8 μ diam. (PLATE 16, FIG. 14.)

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: Common and abundant throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 174.

This common species is also very variable and connected by intermediate forms with *A. incarnata*. Very small forms approach *A. insignis*.

8. *Arcyria insignis* Kalch. & Cooke; Kalch. Grevillea 10: 143. 1882.

Plasmodium watery white (Lister). Total height 0.5 to 1.5 mm. Sporangia stalked, gregarious, or clustered in small, scattered groups, ovoid or cylindrical, 0.3 to 0.4 mm. diam., flesh-colored or pink; cup of sporangium delicately membranous, plaited, nearly smooth or reticulate and spinulose. Stalk thickened upwards, furrowed, 0.2 to 0.4 mm. long, red, filled with spore-like cells. Capillitium a close, elastic network of pale pink, delicate threads 2–3 μ diam., usually with a few bulbous free ends, flattened, marked with transverse bands and short spines arranged in a lax spiral, closely and minutely spinulose or nearly smooth elsewhere. Spores almost colorless, nearly smooth, 6–8 μ diam.

Var. *dispersa* Hagelstein, Mycologia 21: 298. 1929. (N. Y. B. G. no. 1272, type.)

Sporangia solitary, scattered; otherwise as in the typical form. (PLATE 14, FIG. 4.)

TYPE LOCALITY: Africa, probably.

HABITAT: Usually on pithy stalks, occasionally on dead wood; var. *dispersa*, on dead leaves and stems.

DISTRIBUTION: *Canal Zone, *Indiana, Iowa, Kansas, Massachusetts, New Hampshire, New Jersey, New York, *Oregon, Pennsylvania, Quebec, *Washington; var. *dispersa*, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 181.

The variety *dispersa* has been found at three widely separated localities on Long Island, New York, on one occasion in great abundance on thousands of leaves of the scrub oak. Var. *major* G. Lister (Mycetozoa ed. 3. 236. 1925) may occur in North America, but is difficult to understand. Many collections, on wood, consisting of large sporangia in clusters 10 mm. or more across, have the color of *A. insignis*, but in the great majority, the capillitium is centrally attached, and such forms are undoubtedly *A. incarnata* irrespective of the markings on the capillitium. Among the others are several that have the capillitium firmly attached to the cup, and with cogs or square-ended prominences on the capillitium, exactly like those on the capillitium of an authentic specimen of *A. carnea*, and I have placed them with that form. Still others, with capillitium firmly attached, do not have the cogs, but the threads of the capillitium are not as narrow as those of *A. insignis* and those are placed with *A. denudata*. None of the forms referred to have the narrow threads. Critical separations on the markings of the capillitium are very unsatisfactory, as particular features are not sharply restricted to any of the four species mentioned. It might be better, perhaps, to divide all these obscure forms among *A. incarnata* and *A. denudata* on the attachment of the capillitium solely, abandoning thereby *A. insignis* var. *major* and *A. carnea*.

9. ***Arcyria incarnata*** Pers. Obs. Myc. 1: 58. 1796.

Stemonitis incarnata Pers.; Gmel. Syst. Nat. 2: 1467. 1791.

Plasmodium white (Lister). Sporangia stalked or nearly sessile, crowded, subcylindrical or ellipsoid, 1 to 1.5 mm. high, 0.6 mm. broad, pink; cup of sporangium membranous, even or plicate, spinulose. Stalk weak, 0.1 to 0.3 mm. long, flesh-colored, filled with spore-like cells. Capillitium a very loose, elastic, expanding network of pale pink threads 3–5 μ diam., sparingly and somewhat irregularly branched, with here and there broad, perforated or ring-like expansions, often swollen at the axils of the branches; thickenings in the form of sharp cogs, half-rings, or spines arranged in a loose spiral, and of minute scattered spinules; free ends more or less numerous, clavate or pointed, spinose. Spores pale pink, marked with a few scattered warts, 6–8 μ diam.

Var. ***fulgens*** Lister, Mycetozoa ed. 2. 242. 1911.

Sporangia crimson; stalks firm, dark reddish brown.

TYPE LOCALITY: Germany.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout the United States and Canada but not abundant; *West Indies; var. *fulgens*, not so common.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 177.

This species is related to *A. denudata* and is distinguished principally by the capillitium being almost free from the cup. There are frequent intermediate forms in which the capillitium is partially attached, and these must be separated by the other characters, such as the more expanding capillitium, the shorter stalk, and the more numerous free ends to the capillitium in *A. incarnata*. Var. *fulgens* is a constant form and not rare. The color of the capillitium and stalk is much darker than in the typical form.

10. *Arcyria stipata* (Schw.) Lister, Mycetozoa 189. 1894.

Leangium stipatum Schw. Trans. Am. Phil. Soc. II. 4: 258. 1832.

Hemitrichia stipata (Schw.) Macbr. N. A. Slime-Moulds 204. 1899.

Plasmodium? Total height 1 to 2 mm. Sporangia distinct but clustered, on long stalks, cylindrical with well-defined cups, copper-colored or deep brown; or, in vermiform masses of densely compacted and superimposed, cylindrical, contorted sporangia, with short stalks or nearly sessile, and poorly defined cups, reddish brown; sporangial wall irregularly evanescent above, persistent as a plaited or smooth cup, papillose or faintly reticulate near the rim. Stalk 0.1 to 1.5 mm. high, red-brown, dark brown, or nearly black, filled with spore-like cells. Capillitium a more or less elastic, expanding, loose network, the pale reddish threads 3–5 μ wide, marked with transverse ridges, warts, and spines, often arranged in quincunx to give the appearance of prominent spiral lines if not properly resolved by the microscope, but not like the continuous spiral thickenings seen in the genus *Hemitrichia*; the threads of the capillitium have many free, clavate ends and few attachments to the cup. Spores pale red, smooth with a few scattered warts, 6–9 μ diam.

TYPE LOCALITY: Pennsylvania.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 178.

The two phases of the sporangia have intermediate forms connecting them but are usually clearly distinguished. The species is also connected with *A. occidentalis* by forms with the general characters of *A. stipata*, but with deeper cups which may show occasionally a slight tendency to the petaloid dehiscence of *A. occidentalis*. The spirals on the threads of the capillitium of *A. stipata* are similar to those of other species of the genus, only often more prominent, and are not like those in the genus *Hemitrichia*.

11. *Arcyria nutans* (Bull.) Grev. Fl. Edin. 455. 1824.

Trichia nutans Bull. Herb. Fr. pl. 502, fig. 3. 1790; Bull. Champ. 122. 1791.

Plasmodium watery white (Lister). Sporangia stalked, clustered, cylindrical, when unexpanded 1.5 to 2 mm. high, 0.3 to 0.5 mm. broad, yellow or buff; cup of sporangium membranous, flaccid, reticulate and often spinulose on the inner side, interruptedly plicate. Stalk buff, short or elongate, weak, filled with spore-like cells. Capillitium an elastic network of pale yellow, terete or flattened threads 3–4 μ diam., expanding into a drooping column 8 to 12 mm. long, free from the cup or with few attachments; thickenings on the threads in the form of sharp spines and half-rings arranged in a loose spiral, and of scattered spinules and short lines of broken reticulation; free ends more or less numerous, clavate. Spores pale yellow, nearly smooth, marked with a few scattered warts, 6–8 μ diam. (PLATE 16, FIG. 15.)

TYPE LOCALITY: France.

HABITAT: On dead wood.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 179.

12. *Arcyria magna* Rex, Proc. Acad. Nat. Sc. Phila. 1893: 364. 1893. (N. Y. B. G. no. 5198, type material.)

Plasmodium? Sporangia stalked, clustered, cylindrical, when unexpanded 1.5 to 2 mm. high, 0.3 to 0.5 mm. broad, gray, often forming large developments; cup of sporangium funnel-shaped, membranous, flaccid, plicate, spinulose or papillose on the inner side. Stalk short or long, somewhat membranous and irregular, yellowish or brownish, filled with spore-like cells, and arising from a yellowish membranous hypothallus. Capillitium an elastic network of grayish threads 3–4 μ diam., expanding into a drooping column up to 12 mm. or more in length, free from the cup or with

few attachments; thickenings on the threads in the form of half-rings and numerous spines. Spores gray in mass, 6–8 μ diam., with a few scattered warts.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: On dead wood.

DISTRIBUTION: Florida, Iowa, Kansas, New York, *Oregon, Pennsylvania, *Wisconsin.

ILLUSTRATION: Macbr. & Martin, *Myxomycetes pl. 17, figs. 446–449*.

This form is practically the same as *A. nutans*, except that the color is gray, and strangely enough nearly all specimens turn to yellow throughout with long exposure to sunlight. Minor differences in the markings of the capillitium are of little importance, as they may be found in nearly every species of the genus. *A. magna* var. *rosea* was proposed by Rex on a roseate form which he regarded as a variety of *A. magna*. It has not been found again so far as I know. Lister found the roseate form to have fragments of the evanescent peridium attached to the capillitium and placed it with *A. Oerstedtii*, at the same time including the gray form. *A. magna* does not occur regularly in any particular area, appearing only now and then.

13. *Arcyria Oerstedtii* Rost. Mon. 278. 1875.

Plasmodium watery white (Lister). Sporangia stalked, clustered, cylindrical, curved, arising from a colorless membranous hypothallus, when unexpanded 0.6 to 1.5 mm. high, 0.3 to 0.5 mm. broad, dull crimson; sporangial wall evanescent above or persistent as a few, small, well-defined, rounded plates, which are papillose on the inner side, smooth on the margin, and attached to the capillitium; cup membranous, faintly reticulate, and marked with scattered papillae, the rim smooth. Stalks pale red, varying in length, usually short, weak, filled with spore-like cells. Capillitium an elastic network of pale reddish threads 3–5 μ diam., expanding into a long, drooping, cylindrical column; thickenings in the form of half-rings and sharp spines 1–3 μ long, arranged in a loose spiral, elsewhere marked with scattered spinules and often with four or five faint, irregular, spiral lines, some threads attached to the persistent plates of the sporangial wall, others to the cup; free ends with spinulose tips sometimes present. Spores pale reddish, nearly smooth, marked with a few scattered warts, 7–8 μ diam.

TYPE LOCALITY: Europe.

HABITAT: On dead wood.

DISTRIBUTION: *California, Colorado, Indiana, Louisiana, *Maine, Massachusetts, New York, Ontario, *Oregon, Pennsylvania, Quebec, *Washington.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 180.

The sporangia resemble those of *A. incarnata* var. *fulgens* in color and appearance and may be confused therewith, but the expanded capillitia are longer and more drooping. The important distinguishing characters are the persistent plates of the sporangial wall adhering to the capillitium, and the more numerous and usually larger spines on the threads.

14. *Arcyria virescens* G. Lister, Jour. Bot. 59: 252. 1921. (N. Y. B. G. no. 12845, authentic material.)

Plasmodium white (Lister). Sporangia crowded or clustered, often forming large colonies, stalked, cylindrical, yellowish green; cup of sporangium narrowly funnel-shaped, reticulate and spinose on the inner side. Stalks slender, straight or flexuose, dark olive-green, free or adhering in clusters of three to ten, 0.5 to 1.5 mm. long. Capillitium a loose elastic network of greenish or yellowish threads, free from the cup, and expanding into a column about 6 mm. long; threads 4–6 μ wide, marked with scattered groups of close-set, prominent, transverse ridges 3–5 μ high, arranged more or less in an open spiral, the remaining surface irregularly reticulate and roughened with delicate, often broad-based spines. Spores yellowish green in mass, 7–8 μ diam., smooth, except for a few scattered warts.

TYPE LOCALITY: Ceylon.

HABITAT: On dead wood.

DISTRIBUTION: *Iowa, *Oregon.

ILLUSTRATION: Lister, Mycetoza ed. 3. *pl.* 222.

This species resembles *A. nutans*. Aside from the American collections reported, it has not been found except in the tropics. I have not seen either of the American gatherings.

15. *Arcyria occidentalis* (Macbr.) Lister, Mycetoza ed. 2. 245. 1911.

Lachnobolus occidentalis Macbr. N. A. Slime-Moulds 188. 1899.

Lachnobolus incarnatus Macbr. Bull. Nat. Hist. S. U. Iowa 2: 126. 1892.

Plasmodium white, then rosy (Lister). Sporangia stalked, rarely sessile, crowded, often angled by mutual pressure, ovoid, ellipsoid, or irregular in shape, 0.6 to 1 mm. high, 0.4 to 0.6 mm. broad, ochraceous, yellowish or brownish; sporangial wall more or less evanescent above, persistent at the sides, dividing into four to six deep, rounded, membranous and papillose lobes. Stalk dark brown to nearly black, short, 0.1 to 0.4 mm. long, filled with spore-like cells. Capillitium a loose, slightly elastic network of yellowish or flesh-colored threads 3–5 μ diam., with few attachments to the sporangial wall, marked with spines, warts, and low transverse ridges, often arranged in an open spiral; free ends more or less numerous, clavate, papillose. Spores pale ochraceous, with a few scattered warts, 7–9 μ diam.

TYPE LOCALITY: Maine.

HABITAT: On dead wood.

DISTRIBUTION: *Iowa, Maine, *Manitoba, Maryland, Massachusetts, Michigan, *Missouri, *Nebraska, *New Hampshire, New York, Ontario, *Oregon, Pennsylvania, Quebec.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 192 (color too red).

The description is based on the large amount of material here, and differs materially from that of other authors. I have collected the species frequently from August to December, and observed the development of the sporangia from emergence of the plasmodium through all stages to maturity, which requires several days. The colors given are not due to fading. The form is clearly an *Arcyria* and allied to *A. stipata*, with which it is connected by intermediate forms, and with which it may be confused, unless the dehiscence in lobes is evident. The collections during cold weather, in the latter part of the season, vary in the character of the sporangial wall. The colonies then are usually small, of more globose sporangia on very short stalks or sessile. The wall is often more cartilaginous and firm throughout, dehiscing irregularly and without traces of the petaloid structure. In others, the wall is weaker at the top, and the lobes, while indistinct, are indicated by the rounded parts of the edge of dehiscence, the lower part of the wall persistent as a deep calyculus.

Genus 43. **LACHNOBOLUS** Fries, Fl. Scan. 356. 1837.

Sporangia sessile, clustered; sporangial wall single, membranous, somewhat persistent, not thickened with angular granules;

capillitium a loose, inelastic network of cylindrical threads with thickenings in the form of closely set warts.

A SINGLE SPECIES.

1. **Lachnobolus congestus** (Somm.) Lister, Mycetozoa ed. 2. 246. 1911.

Physarum congestum Somm. Fl. Lapp. 241. 1826.

Lachnobolus incarnatus Schroet. in Cohn, Krypt. Fl. Schles. 3 (1): 110. 1885.

Plasmodium white or rosy (Lister). Sporangia subglobose, sessile, clustered and heaped, 0.5 to 0.8 mm. diam., pale copper-colored when fresh, fading rapidly to dull ochraceous; sporangial wall membranous, firm, papillose, ochraceous or pinkish. Capillitium a network of freely branching, flaccid, pinkish or ochraceous threads, irregular in width varying from 2–8 μ diam., closely and equally studded with prominent warts, and attached at numerous points to the sporangial wall. Spores pale pink in mass, fading to ochraceous, faintly and minutely warted, with a few, scattered, stronger warts, 6–8 μ diam.

TYPE LOCALITY: Norway.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, *Iowa, New York, *Ohio, Ontario, *Oregon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 183.

A very rare species which may be found, however, by careful search. It forms small heaps of clustered sporangia which resemble *Oligonema nitens* in appearance but are dull ochraceous in color. It appeared twice on old sugar-bags that were used to cover young plants in my garden, and I have also collected it on two other occasions.

Genus 44. **PERICHAENA** Fries, Symb. Gast. 11. 1817.

Sporangia subglobose or irregular, sessile or forming plasmodiocarps, rarely short-stalked; sporangial wall usually of two layers, the outer thickened with angular granules which are exceptionally absent in the upper part, the inner usually membranous; capillitium of branching or simple, tubular, inelastic threads, spinose, minutely warted, or nearly smooth, usually marked with irregular constrictions; spores yellow or brown, minutely warted.

TYPE SPECIES: *Perichaena populina* Fries.

Fructification usually plasmodiocarpous.

Plasmodiocarps short, stout, curved or ring-shaped, dark brown.

1. *P. chrysosperma*

Plasmodiocarps long, slender, curved or net-like, yellow or pale brown.

2. *P. vermicularis*

Fructification sporangiate.

Sporangia sessile, subglobose, dark brown with deposits of refuse matter; dehiscence either by lobes or circumscissile.

3. *P. corticalis*

Sporangia sessile or stalked, small, globose, yellowish; deposits of refuse matter scanty or contracted into large, dark warts.

4. *P. minor*

Sporangia sessile, flattened and angular, dark brown with deposits of refuse matter; dehiscence circumscissile.

5. *P. depressa*

Sporangia stalked, minute, dark brown; on leaves.

6. *P. pedata*

1. **Perichaena chrysosperma** (Currey) Lister, Mycetozoa 196. 1894.

Ophiotheca chrysosperma Currey, Quart. Jour. Micr. Sc. 2: 240. 1854.

Ophiotheca Wrightii Berk. & Curt.; Berk. Jour. Linn. Soc. 10: 349. 1868.

Plasmodium pale brown, gray or pink (Lister). Sporangia scattered, sessile, rarely stalked, subglobose or forming curved or ring-shaped plasmodiocarps, 0.2 to 1 mm. diam., chestnut, red-brown, or blackish brown, dehiscing irregularly or the wall breaking up into areolae; sporangial wall of two layers; outer layer thickened with brown granular matter, which either forms a complete crust or is partially or completely obsolete; inner layer somewhat cartilaginous, pale yellowish, translucent, minutely and faintly papillose. Stalk when present, black, stout, cylindrical, 0.1 to 0.7 mm. high. Capillitium abundant, forming a loose network of sparingly branched, yellow threads 2-4 μ diam., irregularly constricted, studded with scattered spinules or curved spines 1-6 μ long. Spores yellowish in mass, paler by transmitted light, minutely warted, 9-10 μ diam., rarely 7-8 μ .

TYPE LOCALITY: England.

HABITAT: On dead wood and bark.

DISTRIBUTION: Throughout North America; not uncommon.

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 184.

This species forms small colonies, usually on the outer surface of dead bark. In the same development may appear subglobose sporangia and plasmodiocarps, either dehiscing by areolae or ir-

regularly, and with short or long spines on the capillitium. The brown covering of refuse matter may be partially or completely absent in some parts of a colony. This is seen in many other species, and is due to the particles washing away by moisture during formation of the fruiting bodies. In a collection made on Long Island, New York, a few of the sporangia have large, dark warts, similar to those on the wall of *P. minor* var. *pardina*. The species is connected by intermediate forms with the common phase of *P. corticalis*, which dehisces by lobes.

2. **Perichaena vermicularis** (Schw.) Rost. Mon. App. 34. 1876.

Physarum vermiculare Schw. Trans. Am. Phil. Soc. II. 4: 257. 1832.

Ophiotheca vermicularis (Schw.) Massee, Mon. 134. 1892.

Plasmodium watery white, yellowish white, or rose-red (Lister). Sporangia scattered, sessile, subglobose on a narrow base, 0.2 to 0.5 mm. diam., or more often forming slender, curved, netted or ring-shaped plasmodiocarps, ochraceous yellow, pale umber, or grayish; sporangial wall of two layers, the outer more or less charged with dark granules and occasionally with angular crystals of lime, closely combined with the membranous, papillose, inner layer; in some phases the outer layer is not distinguishable in the upper part of the sporangium. Capillitium a profuse network of sparingly branched yellow threads 2–4 μ diam., rough with minute scattered warts and irregular constrictions. Spores yellow, minutely warted, 10–15 μ diam.

TYPE LOCALITY: North Carolina.

HABITAT: On pithy stalks, plant stems, and bark.

DISTRIBUTION: Colorado, *Iowa, Kansas, New Jersey, New York, *North Carolina, Ohio, *Ontario, *Oregon, *Panama.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 187, *figs.* a–c.

This species is rarely collected by others, although probably common enough, as I have found it frequently on pithy stalks and stems. The yellow phase with net-like plasmodiocarps and minute spines or warts on the capillitium is readily identified. The darker forms, usually on bark, may have short, curved plasmodiocarps only, and are sometimes difficult to distinguish from phases of *P. chrysosperma* when the spines on the capillitium of the latter are short. They are somewhat intermediate, connecting the two species. Forms with lime on the outer wall are occasionally found.

3. *Perichaena corticalis* (Batsch) Rost. Mon. 293. 1875.

Lycoperdon corticale Batsch, Elench. Fung. 155. 1783.

Perichaena populina Fries, Symb. Gast. 12. 1817.

Perichaena marginata Schw. Trans. Am. Phil. Soc. II. 4: 258. 1832; Hagelstein, Mycologia 29: 401. 1937.

Perichaena ochrospora Peck, Rept. N. Y. State Mus. 54: 156. 1901. (N. Y. B. G. no. 7975, type material.)

Plasmodium watery gray (Lister). Sporangia crowded or scattered, subglobose, ellipsoid, or forming bolster-shaped plasmodiocarps, sessile on a broad or narrow base, rarely short-stalked, 0.2 to 1 mm. diam., dark purple, purplish brown, gray or white, dehiscing in broad, sinuose lobes, or horizontally with a convex lid; sporangial wall of two layers, the outer cartilaginous, yellowish brown, charged with brown granular matter, often intermixed with or replaced by crystals of lime forming a gray or white covering; inner wall membranous, usually closely combined with the outer. Capillitium often scanty or even lacking, consisting of long or short, branched or simple, yellow threads 1.5–4 μ diam., irregularly compressed, angled and constricted, minutely warted or marked with short spines and prominences, rarely smooth, either attached to the sporangial wall or free. Spores yellow, minutely and closely warted, 10–14 μ diam.

Var. *liceoides* (Rost.) Lister, Mycetozoa ed. 2. 251. 1911.

Perichaena liceoides Rost. Mon. 295. 1875.

Sporangia subglobose or bolster-shaped, shining iridescent yellow, brown, blue, or purplish, minute, 0.1 to 0.5 mm. diam., dehiscing irregularly; granular deposits of the outer translucent sporangial wall scanty or wanting; capillitium often scanty or none, rarely forming a network of nearly smooth threads; spores 10–15 μ diam.

TYPE LOCALITY: Germany.

HABITAT: On dead bark and wood.

DISTRIBUTION: Common throughout North America; var. *liceoides*, Florida, New York.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 186.

Occasional intermediate forms occur connecting this species with *P. chrysosperma* and *P. vermicularis*. The species often forms colonies with thousands of sporangia on the outside of bark, and in these the dehiscence is by broad lobes and not by lids. Sometimes when the lines of dehiscence are not clearly visible

the sporangia will resemble those of *Trichia contorta*. The smaller developments below bark have sporangia with usually more or less distinct lids. Numerous intermediate forms connect *P. corticalis* with *P. depressa* and these may be observed in many colonies. In all such forms the characters of the capillitium and spores are very variable, and critical separations cannot be made on them alone without considering the sporangial shape and wall. The yellow area of dehiscence seen in *P. depressa* is rarely, if ever, present in *P. corticalis*. It is possible that some of these intermediate forms are hybrids between various species of the genus. On a small log at Jericho, Long Island, were found the following forms, all in the same stage of perfect maturity; *P. chrysosperma*, *P. corticalis* and var. *liceoides*, *P. depressa*, *P. minor* and var. *pardina*, together with numerous other variations in size, shape and capillitium. *P. marginata* is a phase with crystalline lime on the wall. Such forms are frequent in this as well as other species of the genus *Perichaena*, and the presence of lime is of no importance as a specific character.

4. **Perichaena minor** (G. Lister) Hagelstein, *Mycologia* **35**: 130. 1943.

Hemitrichia minor G. Lister, *Jour. Bot.* **49**: 62. 1911; *Mycetozoa* ed. 3. 220. 1925; Macbr. & Martin, *Myxomycetes* 299. 1934.

Plasmodium watery cinnamon (Lister). Sporangia sessile or stalked, scattered or united in pairs, globose to subglobose, or forming curved plasmodiocarps, 0.2 to 0.5 mm. diam., dull yellow or yellowish brown; sporangial wall membranous, pale yellow, translucent, minutely papillose or marked with faint curved lines of thickening, and with scanty superficial deposits of refuse matter. Stalk when present black, cylindrical, enclosing dark refuse matter, 0.1 to 0.2 mm. high. Capillitium a loose network of yellowish threads 2.5–4 μ diam., irregularly constricted and with large, bulbous expansions; free ends few or many, often swollen; threads of the capillitium studded with numerous small spines, often arranged in quincunx, and presenting the appearance of diagonal lines when observed with insufficient numerical aperture. Spores pale yellow, faintly warted, 9–11 μ diam.

Var. **pardina** (Minakata) Hagelstein, *Mycologia* **35**: 131. 1943.

Hemitrichia minor G. Lister var. *pardina* Minakata; G. Lister, *Trans. Brit. Myc. Soc.* **5**: 82. 1915.

Sporangia and plasmodiocarps darker, thickly spotted with prominent, blackish brown warts composed of refuse matter; otherwise like the typical form.

TYPE LOCALITY: Japan.

HABITAT: On dead wood and bark, and on living trees.

DISTRIBUTION: *Iowa (culture), New York, *Ontario (culture).

ILLUSTRATION: Lister, Mycetozoa ed. 3. pl. 187, figs. d-f, as *Hemitrichia minor*.

As mentioned under *P. corticalis*, this species and its variety were found in fair abundance in association, on the same log, with many other forms of *Perichaena*. A few of the sporangia of *P. chrysosperma* present on that log also had the dark, prominent warts similar to those of *P. minor* var. *pardina*. Miss Lister (Mycetozoa ed. 3. 244. 1925) notes a similar association with *P. chrysosperma*, and with warts on the latter also, in a specimen from Japan. *P. minor* may be a hybrid between two of the forms present in those collections. It does not belong in the genus *Hemitrichia*, as the diagonal lines, either dextral or sinistral, are seen to be composed of small spines when properly resolved by the microscope. The markings on the capillitium are similar to those of *P. vermicularis*. Aside from the localities given the species and variety have been reported only from England.

5. *Perichaena depressa* Lib. Pl. Crypt. Ard. (Fasc. 4) no. 378. 1837.

Perichaena quadrata Macbr. N. A. Slime-Moulds 184. 1899; Hagelstein, Mycologia 29: 401. 1937.

Plasmodium milky white (Lister). Sporangia sessile, crowded, polygonal from mutual pressure, flattened or somewhat convex, sometimes arranged in chains, 0.3 to 1.5 mm. diam., red-brown, purple-brown, nearly black, or gray from the presence of superficial crystals of lime, dehiscing in a circumscissile manner, indicated by a narrow, yellow area along the line of dehiscence; lower part of the sporangial wall firm, persistent as a shallow base; wall consisting of two layers, the outer charged with brown, granular matter, often intermixed with crystals of lime, and contracting in the upper part of the sporangium at maturity, separating and curling away from the membranous inner layer, which encloses the spores and may persist for some time; the two layers often curl away together as a lid. Capillitium an abundant web

of slender, branched, yellow threads $1.5\text{--}2.5\ \mu$ diam., minutely warted or marked with regular close-set constrictions at intervals of $0.5\text{--}1\ \mu$, and with irregular expansions. Spores yellow, minutely warted, $8\text{--}12\ \mu$ diam. (PLATE 14, FIG. 5.)

TYPE LOCALITY: Belgium.

HABITAT: On dead wood and bark, occasionally on leaves.

DISTRIBUTION: Common throughout North America.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 189.

This species usually forms small developments. Typical sporangia are distinguished from *P. corticalis* by their larger size, flattened and polygonal shape, more abundant capillitium and smaller spores. There are many intermediate forms approaching *P. corticalis*. The yellow dehiscence area is usually a prominent feature of the species. *P. quadrata* is a phase of *P. depressa* with small, nearly quadrate sporangia, and somewhat elevated or convex lids, and is often seen among typical sporangia in one development. Forms with crystalline lime on the outer wall are frequent, as in *P. corticalis* and occasionally in *P. vermicularis*.

6. **Perichaena pedata** (A. & G. Lister) G. Lister, Jour. Bot. **75**: 326. 1937. (N. Y. B. G. no. 8964, authentic material.)

Perichaena variabilis Rost. var. *pedata* A. & G. Lister, Jour. Bot. **42**: 139. 1904.

Perichaena vermicularis (Schwein.) Rost. var. *pedata* Lister, Mycetozoa ed. 2. 253. 1911.

Plasmodium? Sporangia usually stalked, occasionally sessile or forming plasmodiocarps, minute, reddish brown; sporangial wall membranous, single, smooth or papillose, showing a tendency to break into areolae, clothed with granular refuse matter. Stalk black, 0.1 to 0.5 mm. high. Capillitium a flexuose network of pale yellow or brownish threads $2\text{--}2.5\ \mu$ diam., smooth or minutely warted and usually marked with close-set or irregular constrictions. Spores pale yellow, minutely warted, $9\text{--}10\ \mu$ diam.

TYPE LOCALITY: England.

HABITAT: On dead leaves.

DISTRIBUTION: *Pennsylvania, Quebec.

ILLUSTRATION: A. & G. Lister, Jour. Bot. **42**: *pl.* 459, *figs.* 3a, 3b, 4.

This little species was formerly placed with *P. vermicularis*, and later as a minute, stalked phase of *P. chrysosperma* (Lister, Mycetozoa ed. 3. 244. 1925). The Pennsylvania collection was

made by Mr. Hugo Bilgram at Philadelphia, and the Quebec one by Mr. Rispaud and me at Duchesnay. Otherwise the only reported gatherings are from England and Scotland, where it has been found frequently. The stalks and minute size are the only pronounced characters. There is nothing of importance in the wall, the capillitium, or the spores to distinguish it from other American species of the genus *Perichaena*. It seems to be constant in its habitat on dead leaves.

Family III. MARGARITACEAE

Sporangia usually sessile; sporangial wall single, rarely of two layers in *Dianema*, smooth, usually translucent; capillitium consisting of solid threads, either coiled and hair-like, or nearly straight and attached to the sporangial walls, simple or branching at acute angles.

- | | |
|---|------------------|
| Threads of the capillitium profuse, coiled. | 45. MARGARITA |
| Capillitium of nearly straight slender threads attached above and below to the sporangial wall. | 46. DIANEMA |
| Threads of the capillitium marked with spiral thickenings, stout below, penicillate and slender above, attached above and below to the sporangial wall. | 47. PROTOTRICHIA |

Genus 45. **MARGARITA** Lister, Mycetozoa 203. 1894.

Sporangia sessile; sporangial wall translucent; capillitium a profuse coil of hair-like, nearly simple, solid threads, with indistinct attachments to the sporangial wall.

A SINGLE SPECIES.

1. **Margarita metallica** (Berk.) Lister, Mycetozoa 203. 1894.

Physarum metallicum Berk. Mag. Zool. Bot. 1: 49. 1836.

Margarita pictoviana Moore, Trans. N. S. Inst. Sc. 12: 196. 1910.

Plasmodium watery white (Lister). Sporangia solitary or clustered, globose, sessile on a narrow base, 0.5 to 1 mm. diam., or pulvinate and forming plasmodiocarps, pearl-gray or copper-colored, shining iridescent; sporangial wall membranous, single, yellowish, translucent. Capillitium a profuse coil of very long, elastic, flexuose, solid, gray or yellowish threads 0.5–1 μ diam., increasing in some parts to 2 μ , scarcely branching in normal developments, with few attachments to the sporangial wall or almost free, marked with a very lax spiral band of minute spinules.

Spores in mass pale pinkish gray, becoming yellowish with age, nearly colorless by transmitted light, minutely warted, 8–13 μ diam.

TYPE LOCALITY: England.

HABITAT: On dead wood.

DISTRIBUTION: *California, Colorado, *Iowa, Kansas, New Hampshire, *New York, *Nova Scotia, Oregon, Pennsylvania, Quebec, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 196.

The species was found repeatedly in upper Quebec, near Lake St. John, in August 1938, but is not collected often. The developments range from sporangia to large, broad plasmodiocarps, the latter usually showing the primary sporangial formation. Varieties based on the plasmodiocarpous forms are hardly worth recognizing.

Genus 46. **DIANEMA** Rex, Proc. Acad. Nat. Sc. Phila. 1891: 397. 1891.

Sporangia sessile or forming plasmodiocarps; sporangial wall membranous or cartilaginous; capillitium consisting of nearly straight slender threads, attached above and below to the sporangial wall.

TYPE SPECIES: *Dianema Harveyi* Rex.

Sporangial wall membranous, translucent; spores free.

Threads of capillitium nearly simple, attached to the sporangial wall by short branches.

Threads of capillitium branching freely above.

Plasmodiocarps broad; threads of capillitium rigid, attached by acuminate extremities to the sporangial wall; spores reticulate.

Plasmodiocarps with cartilaginous walls; spores clustered.

1. *D. Harveyi*

2. *D. nivale*

3. *D. depressum*

4. *D. corticatum*

1. **Dianema Harveyi** Rex, Proc. Acad. Nat. Sc. Phila. 1891: 397. 1891.

Plasmodium white (Lister). Sporangia solitary or in small clusters, sessile, and subglobose, hemispherical, or cushion-shaped, flattened above, 0.5 to 2 mm. diam., 0.35 to 1 mm. high, sometimes elongate and bent into an irregular horseshoe shape, dull red or gold-bronze, shining; sporangial wall membranous, thin, translucent, pale purplish or olivaceous, marked with the persistent ends of the capillitium when the rest of the threads have

broken away. Capillitium of numerous slender, brownish yellow threads $1.5-2\ \mu$ diam., simple or sparingly branched and anastomosing, often dividing into slender branchlets at their origin or insertion, nearly parallel, straight or flexuose, running from the base to the upper part of the wall. Spores in mass brick-red, at length brownish yellow, pale yellow by transmitted light, minutely warted, $8-10\ \mu$ diam.

TYPE LOCALITY: Maine.

HABITAT: On dead wood.

DISTRIBUTION: Colorado, *Maine, Ontario.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 191, *figs.* a-c.

An exceedingly rare species. The original collection was made by F. L. Harvey in Maine, in 1889. It was found again by Dr. W. C. Sturgis in Colorado, in 1913, and the latest collection was by Mr. Eli Davis in Ontario, in 1939. No other records appear except from Great Britain. It should be searched for in higher latitudes and altitudes.

2. **Dianema nivale** (Meylan) G. Lister, Mycetozoa ed. 3. 254. 1925.

Lamprodermopsis nivalis Meylan, Bull. Soc. Vaud. Sc. Nat. 46: 56. 1910.

Dianema Andersonii (?) Morg.; Macbr. N. A. Slime-Moulds ed. 2. 239. 1922.

Plasmodium? Sporangia sessile or short-stalked, solitary or in small clusters, subglobose or pulvinate, 1 to 1.5 mm. diam., grayish pink, shining with iridescent green or coppery reflections; sporangial wall membranous, thin, translucent, pinkish gray. Stalk short, pale, enclosing granular matter, 0.1 to 1 mm.(?) high. Capillitium of abundant pinkish gray straight or flexuose threads radiating from the thickened floor of the sporangium, branching and anastomosing, attached by slender branchlets to the outer walls; stouter below, becoming very slender in the upper part. Spores in mass pale grayish pink, minutely and closely warted, $8-12\ \mu$ diam.

TYPE LOCALITY: Switzerland.

HABITAT: On dead wood, bark, twigs, and turf.

DISTRIBUTION: *British Columbia, *Washington (both as *D. Andersonii*).

ILLUSTRATION: None published?

Five colonies represent all the collections ever reported of the three forms here included. No author has seen fit to publish figures, and no material is readily available to make comparisons.

The descriptions indicate little on which to base three species in two genera, and the slight differences appear to be of the kind of variation seen in so many of the more common forms. Until more is known about these forms, it seems better to follow the lead of Miss Lister in regarding them all as probably one species.

3. **Dianema depressum** Lister, Mycetozoa 204. 1894. (N. Y. B. G. no. 11302, authentic material.)

Cornuvia depressa Lister, Jour. Bot. 29: 264. 1891.

Plasmodium white or rosy red (Lister). Sporangia solitary or clustered, forming sessile, flattened, pulvinate plasmodiocarps, 2 to 10 mm. wide, about 0.3 mm. thick, shining violet when immature, glossy and grayish brown when mature; sporangial wall membranous, smooth or minutely reticulate, translucent, yellowish or lilac-gray, marked on the inner side with the persistent ends of the capillitium when the rest of the threads have fallen away. Capillitium profuse, consisting of pale yellowish gray, straight, rigid, slender threads $0.5-2\ \mu$ thick, minutely papillose on one side, united into numerous small, pencil-like clusters, anastomosing above and below, the ends of the pencils attached to the sporangial wall by abruptly acuminate tips, at length breaking away in an elastic web. Spores in mass lilac-gray or drab, pale yellowish gray by transmitted light, closely reticulate over the greater part of the surface with raised bands forming a border $0.5-1\ \mu$ broad, the remaining part marked with broken or very loose reticulation, $6-9\ \mu$ diam.

TYPE LOCALITY: England.

HABITAT: On dead wood and sticks.

DISTRIBUTION: Colorado, *Oregon, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 190.

Another very rare species, with only three records from North America.

4. **Dianema corticatum** Lister, Mycetozoa 205. 1894. (N. Y. B. G. no. 11299, authentic material, Sande, Norway.)

Plasmodium pink (Lister). Sporangia either hemispherical, about 1 mm. diam., or, more often forming elongate, annular, or netted plasmodiocarps 3 to 30 mm. long, shining or opaque, chestnut or purplish brown; sporangial wall ochraceous olive, composed of two layers, the outer cartilaginous, densely granular,

the inner membranous. Capillitium somewhat scanty, often absent entirely, consisting of simple or acutely branching, slender, pale brown threads $0.5\text{--}1.5\ \mu$ diam., nearly smooth or marked with a single prominent spiral band, or for a short distance with three spiral bands, often with scattered bead-like thickenings; threads attached above and below by very slender attachments to the sporangial wall. Spores pale yellow by transmitted light, adhering in clusters of four to six, minutely warted on the outer side, irregular from pressure in the cluster, globose when separated and swollen, $10\text{--}12\ \mu$ diam.

TYPE LOCALITY: Sande, Norway.

HABITAT: On dead coniferous wood.

DISTRIBUTION: *Alberta, Colorado, *New Hampshire, Ontario, Oregon, Pennsylvania, *Quebec, *Washington.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 193.

This species is usually associated with *Licea flexuosa* and may resemble phases of the latter except for the clustered spores. A specimen collected by Dr. Morton E. Peck in Oregon is practically typical, with a fairly abundant capillitium. All specimens from Colorado, Ontario, and Pennsylvania have no capillitium, or at least it is so scanty that no threads were observed. The species also resembles superficially *Enteridium liceoides*, a form so far unknown from North America (see *Enteridium olivaceum*). The latter has the inner structure of an *Enteridium*, instead of threads, and the clustered spores are darker. In some collections of *D. corticatum* without capillitium, there may be seen minute protuberances on the inner side of the sporangial wall. In all specimens here, including those from Europe, the spores are pale yellow and the minute warts may often be observed on the edges. Miss Lister verified one of the Colorado specimens, calling attention to the absence of the capillitium and that occasional European specimens were similar. This is confirmed by the absence of the capillitium in some of the European specimens here.

Genus 47. **PROTOTRICHIA** Rostafinski, Mon. App. 38. 1876.

Sporangia sessile or stalked; capillitial threads arising from the base of the sporangium as stout strands marked with spiral thickenings, dividing above into pencils of slender branches attached by the tips to the upper part of the sporangial wall.

A SINGLE SPECIES.

1. **Prototrichia metallica** (Berk.) Masee, Jour. Roy. Micr. Soc. 1889: 350. 1889.

Trichia metallica Berk. in Hooker f., Fl. Tasm. 2: 268. 1859.

Trichia flagellifer Berk. & Br. Ann. Mag. Nat. Hist. III. 18: 56. 1866.

Plasmodium white (Lister). Sporangia crowded or scattered, subglobose, 0.5 to 1 mm. diam., sessile on a broad base, or short-stalked, rarely forming plasmodiocarps, brown or copper-colored, shining, iridescent; sporangial wall membranous, pale pinkish brown or glaucous, smooth, translucent, marked on the inner side with the slender, persistent ends of the threads of the capillitium. Stalk, when present, cylindrical, 0.1 to 0.4 mm. high, yellowish brown, enclosing dense granular matter. Capillitium arising from the base of the sporangium as numerous red or olive-brown, stout, solid threads, marked with two to four spiral bands, branching repeatedly above to form a pencil of slender branchlets attached by their extremities to the sporangial wall. Spores pink or pale pinkish brown, minutely warted, 9–12 μ diam.

TYPE LOCALITY: Tasmania.

HABITAT: On dead wood and bark.

DISTRIBUTION: *Alberta, *California, Colorado, North Carolina, *Washington, Wyoming.

ILLUSTRATION: Lister, Mycetozoa ed. 3. *pl.* 195.

This species appears to be fairly common in certain areas of the western mountains where active collecting has been pursued. My only personal collection came from the Great Smoky Mountains of North Carolina, at an altitude of 4,200 feet.

CONCLUSION

In the foregoing pages are described 285 species of the *Mycetozoa*, regarded as valid, and reported from North America. Of these, 269 are represented by specimens from North America in the Herbarium of the New York Botanical Garden, and of the latter 216 were personally studied and collected in the field from North Carolina to Lake St. John, in Quebec, with one or two exceptions, but often from many localities. All but three of the remaining species described are represented by specimens from other parts of the world. Numerous forms proposed and described as species by other students are treated synonymously or omitted. Rarely have they been found otherwise than by the original collector, and often many years ago. The great majority are based on abnormal, cold or wet weather, locational or seasonal forms, known to exist in many recognized species; trifling departures from typical characters, usual in nearly all species; imperfect observations and conceptions of characters with consequent incorrect descriptions; forms based merely on size, although size is not generally recognized as a distinguishing specific character; intermediate forms with a combination of minor characters of two related and known species; trifling differences, no more than varietal; limeless phases of calcareous forms; and forms of other groups proposed as species of the *Mycetozoa*. Proposed species of this nature indicate that the authors had insufficient field knowledge of the conditions affecting the development of the fruiting bodies, and lacked enough specimens from wide areas in order to understand thoroughly the great variation known to exist.

The entire number of species throughout the world is 318, regarded here as valid. There may be a few more among those described in recent years, but world conditions make it impossible to obtain authentic material for examination. A list is appended of the 33 additional species. Those preceded by an asterisk are in the Herbarium of the New York Botanical Garden, and double asterisks indicate the specimen is type or authentic material.

FOREIGN SPECIES NOT KNOWN FROM NORTH AMERICA

- ***Amaurochaete comata* G. Lister & Brândză
- Arcyria annulifera* Torrend
- Arcyria glauca* Lister
- Badhamia alpina* G. Lister
- ***Badhamia viridescens* Meylan
- ***Barbeyella minutissima* Meylan
- Cornuvia Serpula* (Wig.) Rost.
- Craterium rubronodum* G. Lister
- Cribraria rubiginosa* Fries
- Dianema repens* G. Lister & Cran
- Dictydium rutilum* G. Lister
- Diderma deplanatum* Fries
- Diderma lucidum* Berk. & Br.
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- ***Enteridium liceoides* G. Lister
- Erionema aureum* Penzig
- ***Hemitrichia chrysospora* Lister
- Hemitrichia imperialis* G. Lister
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- ***Lamproderma cristatum* Meylan
- Lamproderma echinulatum* (Berk.) Rost.
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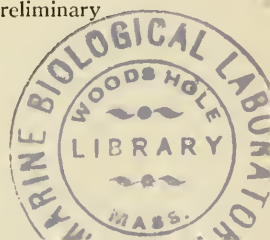
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EXPLANATION OF PLATES

The colored plates are from drawings made by the late Dr. William Codman Sturgis; the half-tone plates are from photographs made by the author. The general colors given for the black and white photographs are those of specimens used. They may be different in other collections of certain species. Variations from the colors are mentioned in the descriptions of species.

PLATE 1

The upper photograph shows a pile of short, decaying logs on an estate at Mill Neck, Long Island, from which many species were taken at different times. When such a pile is discovered, frequent visits should be made, and if fruiting bodies appear on the outside, the pile should be taken apart and every log carefully examined. Some species prefer a particular wood; others develop on the lower sides of logs; and others again are close to the ground or on leaves beneath or near the lower logs. It is a mistake to examine a wood-pile casually. It may hold a number of rare species and will repay a careful search.

The lower photograph shows the forest at Albertson, near Mineola, Long Island, with Mr. Rispaud at work on a stump. A dead tree, broken off and fallen like the one in the background sometimes has unusual forms near the top which cannot be seen from the ground while the tree is standing. We have broken down many dead trees in our experience. The stumps, together with surrounding mosses and leaves, are often prolific sources, particularly in wet areas.

PLATE 2

FIGS. 1-3. *Physarum megalosporum* (p. 62). FIG. 1, sporangia $\times 12$. FIG. 2, part of the capillitium with spores and showing typical lime-knots of the genus $\times 350$. FIG. 3, spores paler on one side $\times 750$.

FIGS. 4-6. *Didymium fulvum* (p. 132). FIG. 4, sporangia and plasmodiocarps $\times 12$. FIG. 5, part of the sporangial wall with capillitium and spores, and showing the characteristic lime-crystals of the genus $\times 350$. FIG. 6, spores paler on one side $\times 750$.

The drawing was made by Dr. W. C. Sturgis from the type material of the two species (N. Y. B. G. nos. 12805, 11338). The plate was reproduced in half-tone in *Mycologia* 9: pl. 14, 1917, but the magnifications given in the accompanying descriptions are not correct. The half-tone plate is smaller than the drawing, and it seems no corresponding adjustments were made in the magnifications, which were apparently intended for the drawing. Other slight errors in the magnifications have been corrected by comparison of the figures with the actual specimens.

PLATE 3

Comatricha lurida (p. 159). FIG. 1, a group of sporangia on a leaf $\times 6$. FIG. 2, a single sporangium with the capillitium free of spores $\times 55$. FIG. 3,

part of the columella with attached capillitium $\times 315$. FIG. 4, group of spores $\times 410$. FIG. 5, group of spores $\times 880$.

The drawing was made by Dr. W. C. Sturgis from authentic material collected in England and supplied by Mr. Arthur Lister (N. Y. B. G. no. 11866).

PLATE 4

Lamproderma muscorum (p. 172). FIG. 1, a group of sporangia on a leaf $\times 20$. FIG. 2, a single sporangium free of spores $\times 85$. FIG. 3, upper part of columella with capillitium $\times 250$. FIG. 4, group of spores $\times 750$.

The drawing was made by Dr. W. C. Sturgis from material collected by Mr. Joseph H. Rispaud and the author at Seventh Lake, Adirondack Mountains, New York (N. Y. B. G. no. 3465).

PLATE 5

Enteridium minutum (p. 217). FIG. 1, an aethalium on wood $\times 20$. FIGS. 2, 3, portions of the pseudo-capillitium $\times 350$. FIG. 4, group of spores $\times 350$. FIG. 5, group of spores $\times 750$.

The drawing was made by Dr. W. C. Sturgis from the type material (N. Y. B. G. no. 11314).

A similar plate was reproduced in half-tone in *Mycologia* 9: pl. 15, 1917, but the magnifications given in the accompanying description are not correct. The half-tone plate is smaller than the drawing, and it seems no corresponding adjustments were made in the magnifications, which were apparently intended for the drawing. Other slight errors in the magnifications have been corrected by comparison of the figures with the actual specimen.

PLATE 6

FIGS. 1, 2, one third natural size. Photographs of yellow plasmodia derived from sclerotium in the laboratory. Sclerotium is the inactive, hardened, resting stage of the plasmodium, into which it enters with the advent of cold weather, and remains until revived by warm rains. Sclerotium may be obtained during the winter months from very rotten logs with holes or large crevices where it often forms large masses, or beneath the logs. In the more solid logs the sclerotium may be thinly spread and not discernible. Suitable logs should be noted during the summer months by the indication of fruiting bodies, as many logs are barren. To obtain plasmodium from sclerotium, a flat dish with cover is prepared with several layers of neutral filter paper, which should be wetted and kept moist at all times. Rain or spring water is best, but tap water will do equally as well if not chlorinated. Ordinary room temperatures are sufficient. A small piece of the sclerotium is placed on the wet paper, and in three or four days the revived plasmodium will appear. It must then be fed to enable it to live and grow. Ordinary dried corn, ground in a small mill or mortar to a fine powder is a good food. It should be sprinkled sparingly over the paper with a fine sieve, and repeated every few days. In time the waste will foul and destroy the plasmodium unless removed by careful washing with a little water poured over it and then drained away. Many interesting observations may be made on the plasmodium and its animal-like

behavior. If the paper is placed only partly on the bottom of the dish the plasmodium will travel over the bare glass, and the dish may be placed on the microscope for observation of the circulation or rhythmic streaming of the protoplasm which pauses at short intervals and reverses the direction of its flow. If food is withdrawn, the plasmodium may eventually form fruiting bodies, but if dried too rapidly it will, more likely, pass again into sclerotium.

FIG. 3. *Badhamia magna* $\times 3$ (p. 20). Bluish sporangia on long, yellow stalks.

FIG. 4. *Badhamia gracilis* $\times 9$ (p. 24). Grayish white sporangia on yellowish stalks.

PLATE 7

FIG. 1. Spores of *Badhamia Dearnessii* $\times 700$ (p. 24). The spores are purplish brown and encircled by a narrow, pale band which is equally spinulose with the remainder of the spore.

FIG. 2. *Physarum sulphureum* $\times 9$ (p. 34). Sulphur-yellow sporangia on white or yellowish stalks.

FIG. 3. *Physarum polycephalum* $\times 9$ (p. 46). The phase with single sporangia, yellow fading to gray, on yellow stalks.

FIG. 4. *Physarum didermoides* $\times 6$ (p. 54). White sporangia on white, membranous stalks.

FIG. 5. *Physarum pezizoideum* $\times 9$ (p. 55). White sporangia on reddish stalks.

PLATE 8

FIG. 1. *Physarum compressum* $\times 9$ (p. 59). White sporangia on black or white stalks.

FIG. 2. *Physarum superbum* $\times 6$ (p. 65). Sessile plasmodiocarps, red or yellow.

FIG. 3. *Physarum gyrosum* $\times 6$ (p. 66). Sessile sporangia forming rosettes, pinkish or bluish gray.

FIG. 4. *Physarum virescens* $\times 6$ (p. 77). Sessile, greenish yellow sporangia in small clusters.

FIG. 5. *Physarella oblonga* $\times 9$ (p. 84). Olive-yellow or brown sporangia on reddish stalks, unopen; the sporangia open eventually disclosing spike-like processes on the inner side of the wall.

FIG. 6. *Cienkowskia reticulata* $\times 3$ (p. 85). The applanate, depressed phase which is more common in eastern North America than the terete, netted plasmodiocarps; color mottled with yellow or red.

PLATE 9

FIG. 1. *Craterium minutum* $\times 9$ (p. 86). The phase with long cylindrical sporangia; the color is brown on brown stalks. The common phase is funnel-shaped.

FIG. 2. *Diderma niveum* $\times 6$ (p. 99). Sessile, white sporangia with yellow inner walls and large yellow columellae.

FIG. 3. *Diderma Trevelyani* $\times 6$ (p. 104). Sessile reddish or brownish sporangia dehiscing by petaloid lobes.

FIG. 4. *Diderma floriforme* $\times 9$ (p. 105). Ochraceous brown sporangia with large columellae, and on similar colored stalks.

FIG. 5. *Diderma radiatum* $\times 6$ (p. 105). Sessile, brownish, mottled sporangia with large columellae.

PLATE 10

FIG. 1. *Didymium Sturgisii* $\times 6$ (p. 128). White, thinly effused plasmodiocarps.

FIG. 2. *Didymium crustaceum* $\times 6$ (p. 131). White sporangia on pale buff stalks; the outer fragile crust of lime-crystals is shown by two sporangia in the lower right hand corner of the figure.

FIG. 3. *Mucilago spongiosa* $\times 3$ (p. 134). An aethalium composed of more or less confluent sporangia, white in color.

FIG. 4. *Lepidoderma tigrinum* $\times 9$ (p. 135). Olive-gray sporangia with white, stellate, crystalline plates of lime on the outer surface, and on orange colored stalks.

FIG. 5. *Stemonitis confluens* $\times 9$ (p. 147). A small group of black sporangia, nearly sessile, and joined together by lateral extensions of the capillitium; on the extensions are small, black discs, the persistent remains of the otherwise evanescent sporangial walls.

PLATE 11

FIG. 1. *Comatracha elegans* $\times 100$ (p. 161). Capillitium free of spores and showing the columella dividing within the sporangium.

FIG. 2. *Comatracha elegans* $\times 100$ (p. 161). Capillitium free of spores and showing the columella dividing below the sporangium.

FIG. 3. *Comatracha extendens* $\times 10$ (p. 162). A group of purplish brown sporangia on long black stalks.

FIG. 4. *Comatracha extendens* $\times 50$ (p. 162). Capillitium free of spores, and showing the absence of a columella.

FIG. 5. *Comatracha Rispaudii* $\times 12$ (p. 168). A cluster of brown sporangia free of spores.

FIG. 6. *Comatracha Rispaudii* $\times 9$ (p. 168). A cluster of brown sporangia with spores intact.

PLATE 12

FIG. 1. *Comatracha Rispaudii* (p. 168). Spores of the species showing reticulation by raised ridges or bands $\times 450$.

FIG. 2. *Lamproderma Gulielmae* $\times 9$ (p. 176). Silvery gray sporangia on black stalks; the walls of the sporangia are spotted with black patches.

FIG. 3. *Cribraria argillacea* $\times 6$ (p. 189). A group of yellowish brown sporangia on dark brown stalks.

FIG. 4. *Cribraria laxa* $\times 9$ (p. 196). A group of yellowish brown sporangia on dark brown stalks; always on leaves.

FIG. 5. *Dictydium cancellatum* $\times 5$ (p. 202). A group of blown out, brown sporangia on slender, dark brown stalks.

FIG. 6. *Tubifera ferruginosa* $\times 3$ (p. 211). A group of nearly free, light brown sporangia. In other developments the tendency to form aethalia-like bodies is much more pronounced.

PLATE 13

FIG. 1. *Dictydiaethalium plumbeum* $\times 6$ (p. 215). The surface of an aethalium showing cracks which appear on complete dessication. The cracks reveal the component sporangia with traces of the threads hanging from the apex of each sporangium. The color of the aethalium is ochraceous yellow.

FIG. 2. *Lycogala epidendrum* var. *tessellatum* $\times 200$ (p. 222). Showing the chambered vesicles in the cortex. These are not present in the typical form nor in var. *exiguum*.

FIG. 3. *Trichia favoginea* $\times 6$ (p. 225). A group of sessile, yellow sporangia with yellow capillitium and spores.

FIG. 4. *Trichia floriformis* $\times 4$ (p. 235). A group of brownish red sporangia on dark stalks.

FIG. 5. *Hemitrichia Vesparium* $\times 6$ (p. 239). A group of red sporangia on red stalks.

PLATE 14

FIG. 1. *Hemitrichia clavata* $\times 6$ (p. 241). Yellow sporangia with yellow cups on dark, nearly black stalks.

FIG. 2. *Hemitrichia Serpula* $\times 6$ (p. 244). Sessile, net-like, yellow plasmodiocarps.

FIG. 3. *Arcyria ferruginea* $\times 9$ (p. 246). Red sporangia on short stalks. The long basal threads by which the capillitial mass is attached to the cup are clearly seen.

FIG. 4. *Arcyria insignis* var. *dispersa* $\times 15$ (p. 252). Solitary, pinkish sporangia as distinguished from the typical form where the sporangia are clustered in small groups.

FIG. 5. *Perichaena depressa* $\times 6$ (p. 264). Sessile, brownish sporangia. A yellow area of dehiscence makes the development, as a whole, appear yellow when viewed from a distance.

PLATE 15

FIG. 1. *Badhamia rubiginosa* $\times 4$ (p. 28). Brownish sporangia on similar colored stalks.

FIG. 2. *Physarum viride* $\times 10$ (p. 44). Yellow sporangia on gray stalks.

FIG. 3. *Fuligo intermedia* $\times 1$ (p. 80). An ecorticate aethalium, white in color, and showing the well developed layer of outer sporangia in place of a cortex.

FIG. 4. *Leocarpus fragilis* $\times 4$ (p. 91). Yellowish brown sporangia on membranous, yellowish stalks.

FIG. 5. *Diachea leucopodia* $\times 4$ (p. 109). Blue iridescent sporangia on white stalks.

FIG. 6. *Didymium squamulosum* $\times 4$ (p. 127). White sporangia and stalks.

FIG. 7. *Stemonitis axifera* $\times 3$ (p. 154). Rusty red sporangia on black stalks.

FIG. 8. *Comatricha typhoides* $\times 4$ (p. 164). Pale brown sporangia on black stalks. The sporangia are silvery gray at first due to the presence of a peridium which is soon evanescent,

PLATE 16

FIG. 9. *Lamproderma arcyronema* $\times 4$ (p. 171). Steel-gray before the peridium has broken away. After that the sporangia appear almost black with black stalks.

FIG. 10. *Cribraria intricata* $\times 6$ (p. 195). Ochraceous brown sporangia on dark brown stalks.

FIG. 11. *Enteridium Rozeanum* $\times 2$ (p. 218). A reddish brown aethalium on a white hypothallus.

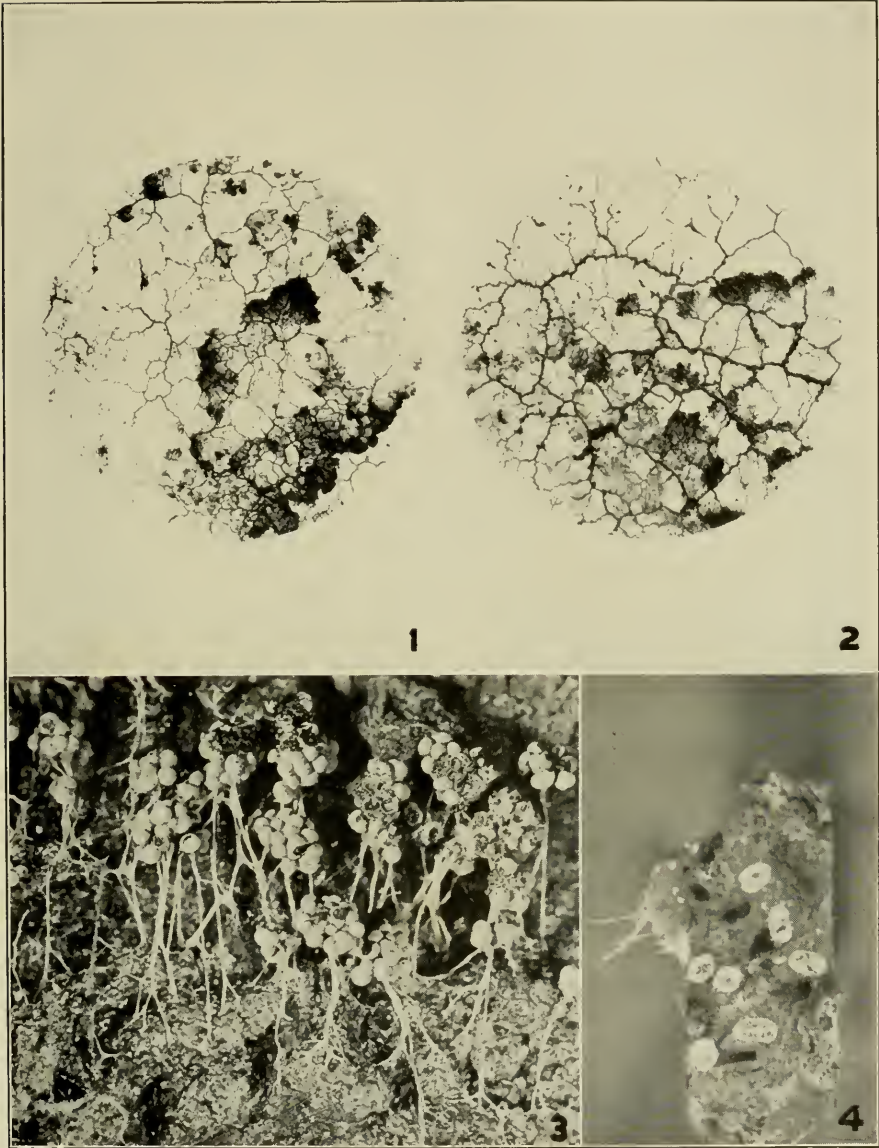
FIG. 12. *Lycogala epidendrum* $\times 1$ (p. 221). Olive-brown aethalia of the typical form.

FIG. 13. *Trichia varia* $\times 8$ (p. 229). Sessile, globose, yellow sporangia.

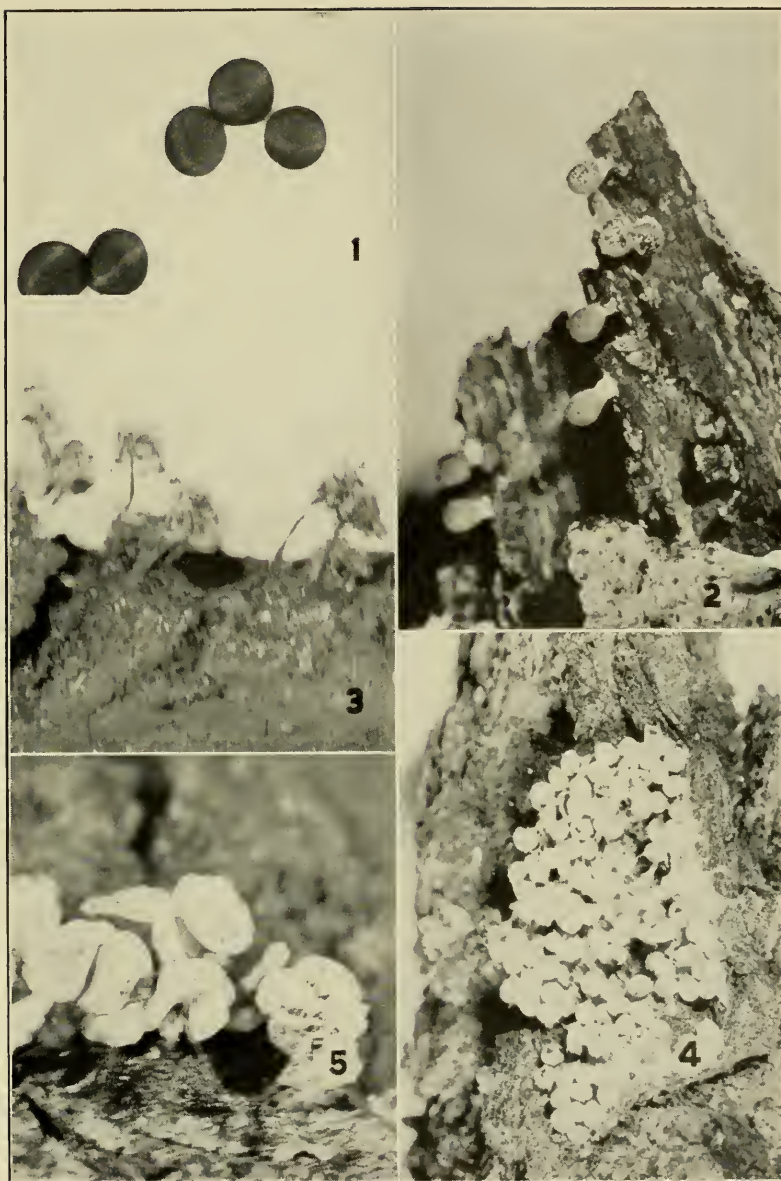
FIG. 14. *Arcyria denudata* $\times 4$ (p. 251). Red sporangia on reddish brown stalks.

FIG. 15. *Arcyria nutans* $\times \frac{7}{4}$ (p. 255). Long, drooping, yellow sporangia, nearly free from the cups, and on weak, yellowish stalks.

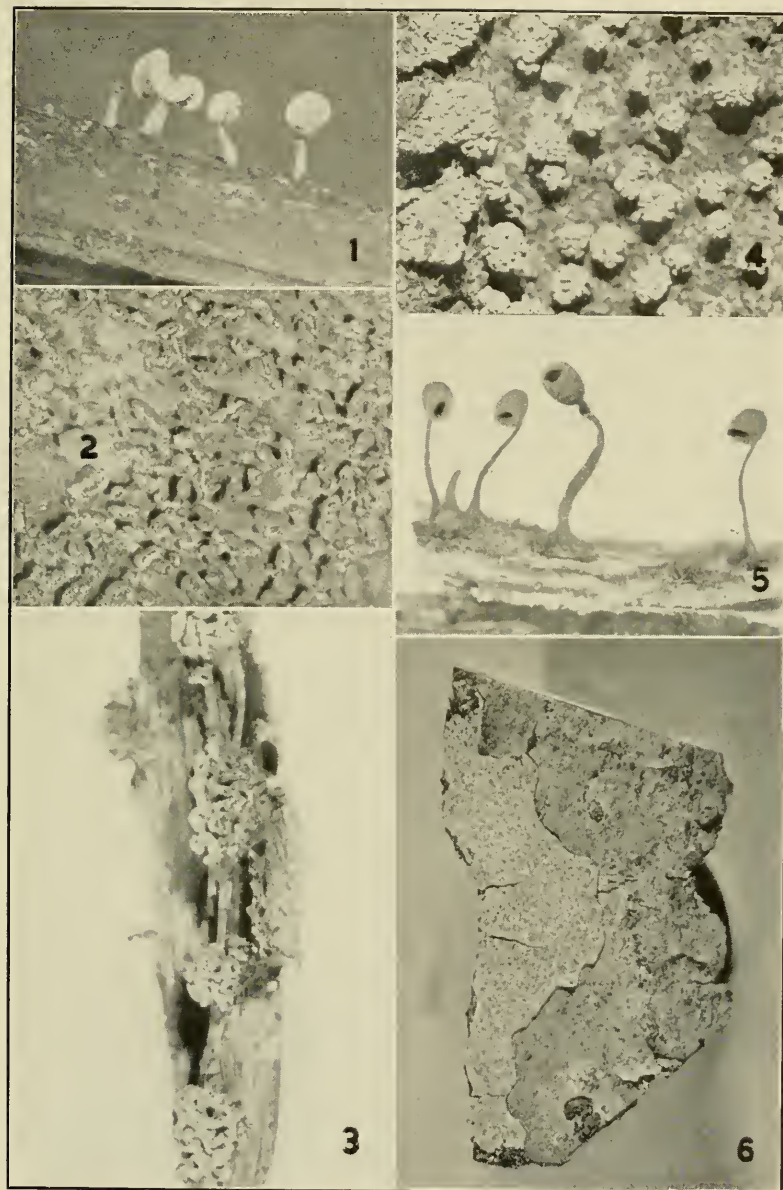
FIG. 16. *Ceratiomyxa fruticulosa* $\times 6$ (p. 13). White sporophores with spores on the outside.



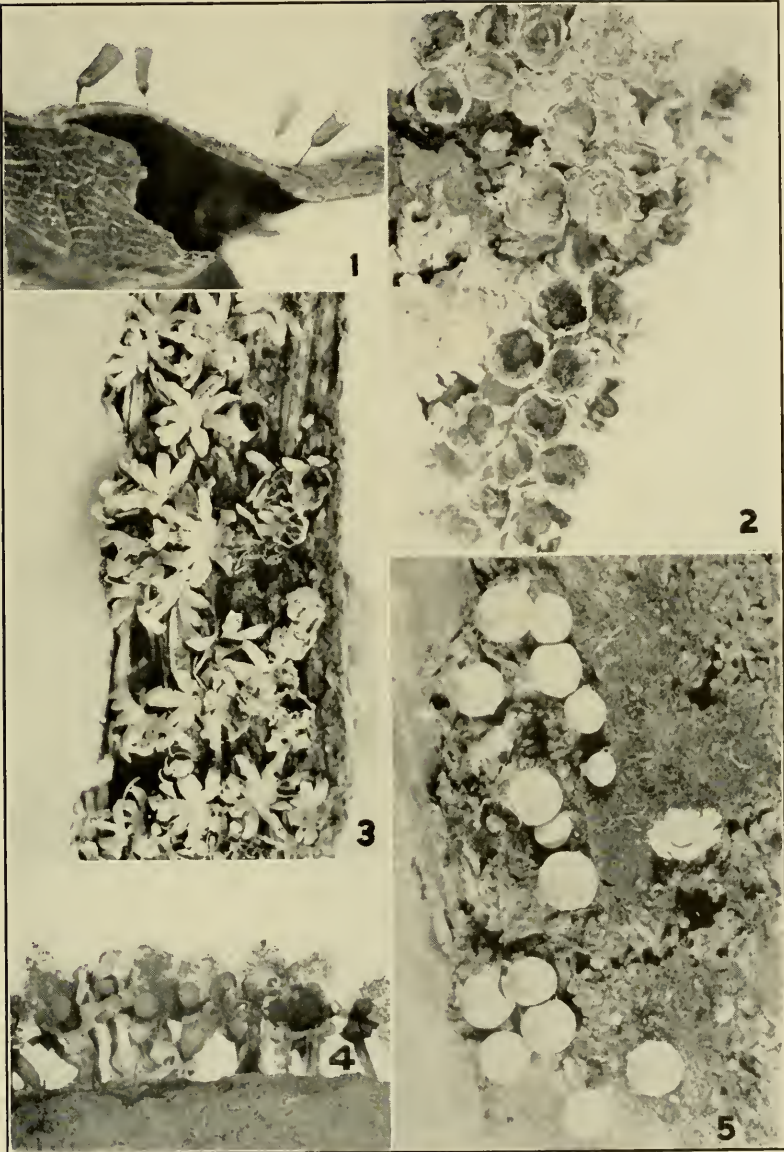
1, 2. PLASMODIUM
3. BADHAMIA MAGNA $\times 3$ 4. BADHAMIA GRACILIS $\times 9$



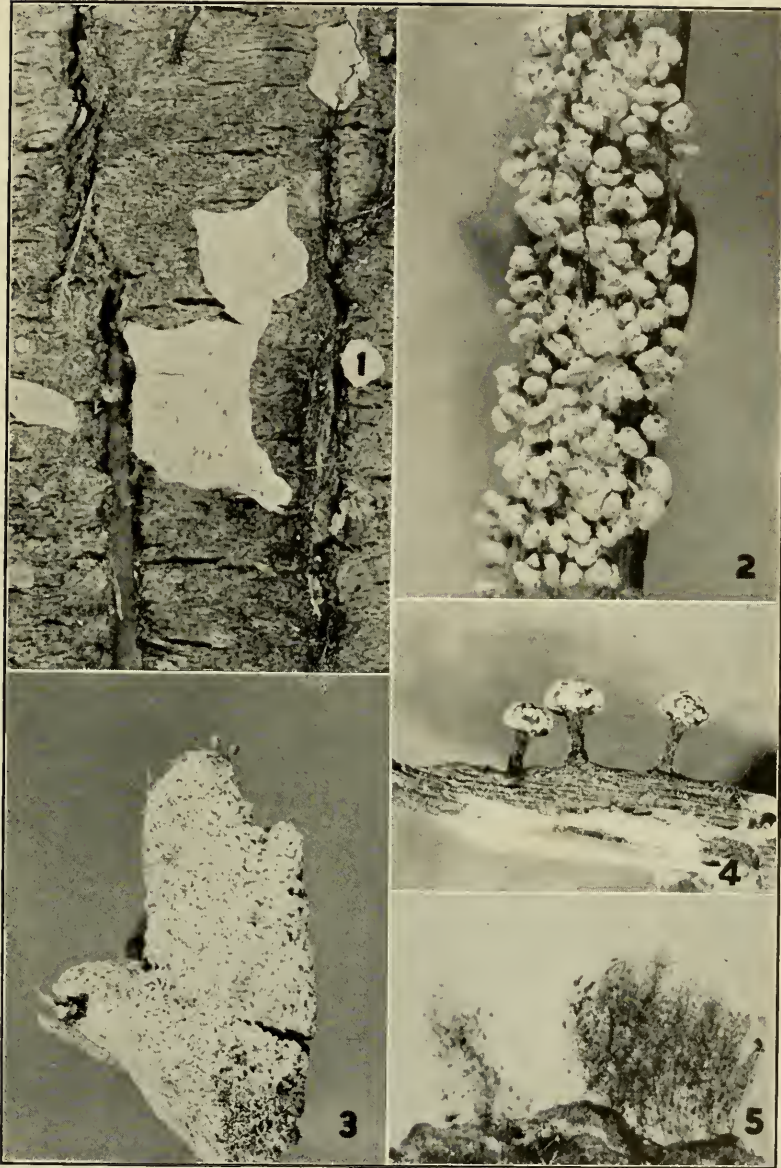
1. *BADHAMIA DEARNESSII*, SPORES $\times 700$
2. *PHYSARUM SULPHUREUM* $\times 9$
3. *PHYSARUM POLYCEPHALUM* $\times 9$
4. *PHYSARUM DIDERMOIDES* $\times 6$
5. *PHYSARUM PEZIZOIDEUM* $\times 9$



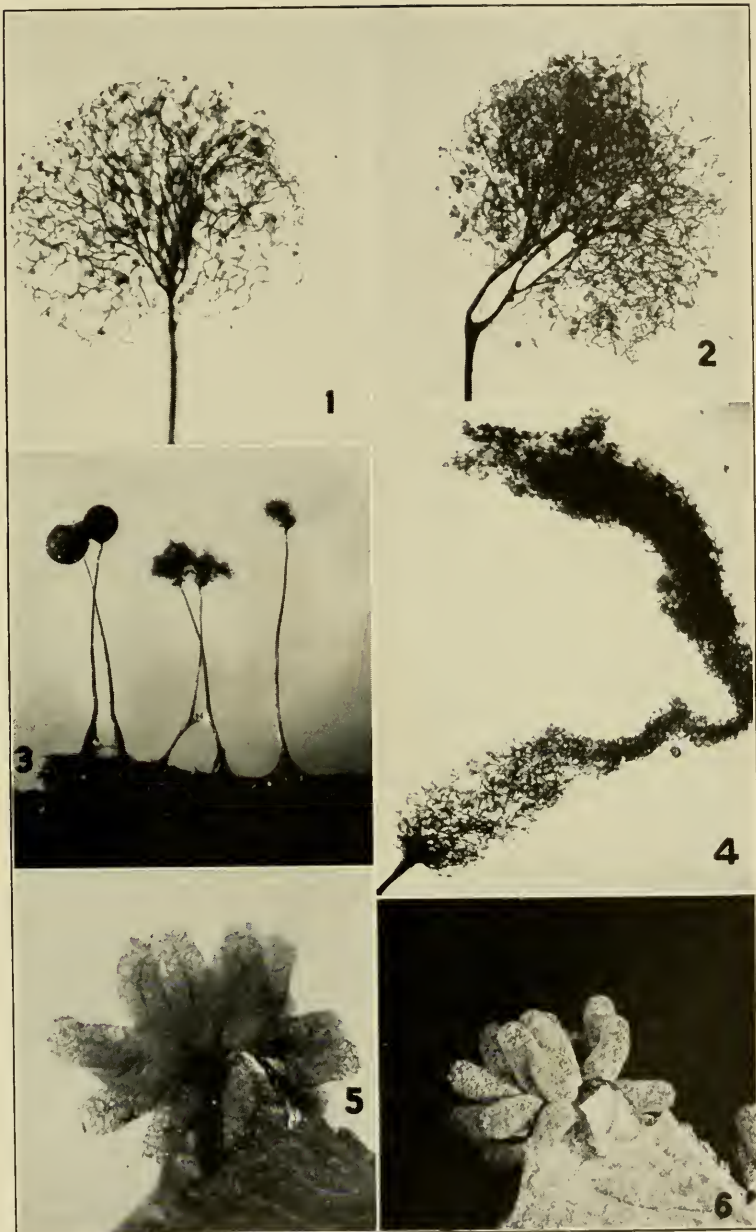
1. *PHYSARUM COMPRESSUM* $\times 19$
2. *PHYSARUM SUPERBUM* $\times 6$
3. *PHYSARUM GYROSUS* $\times 6$
4. *PHYSARUM VIRESCENS* $\times 6$
5. *PHYSARELLA OBLONGA* $\times 9$
6. *CIENKOWSKIA RETICULATA* $\times 3$



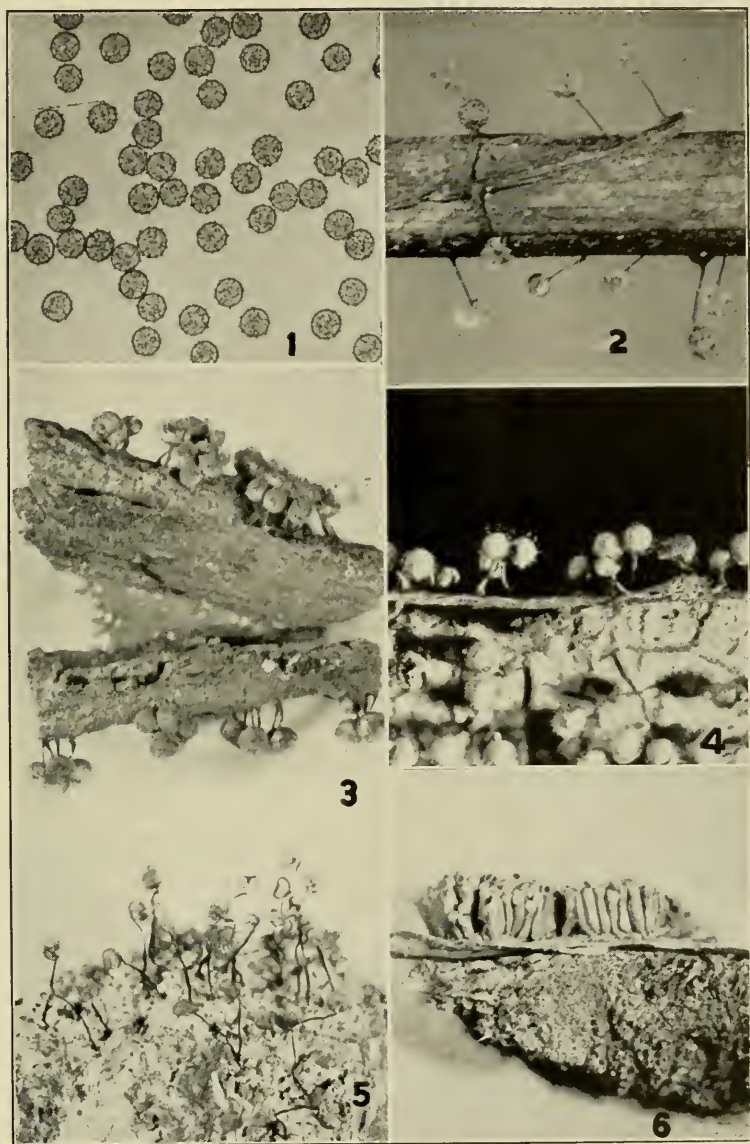
1. CRATERIUM MINUTUM $\times 9$
2. DIDERMA NIVEUM $\times 6$
3. DIDERMA TREVELYANI $\times 6$
4. DIDERMA FLORIFORME $\times 9$
5. DIDERMA RADIATUM $\times 6$



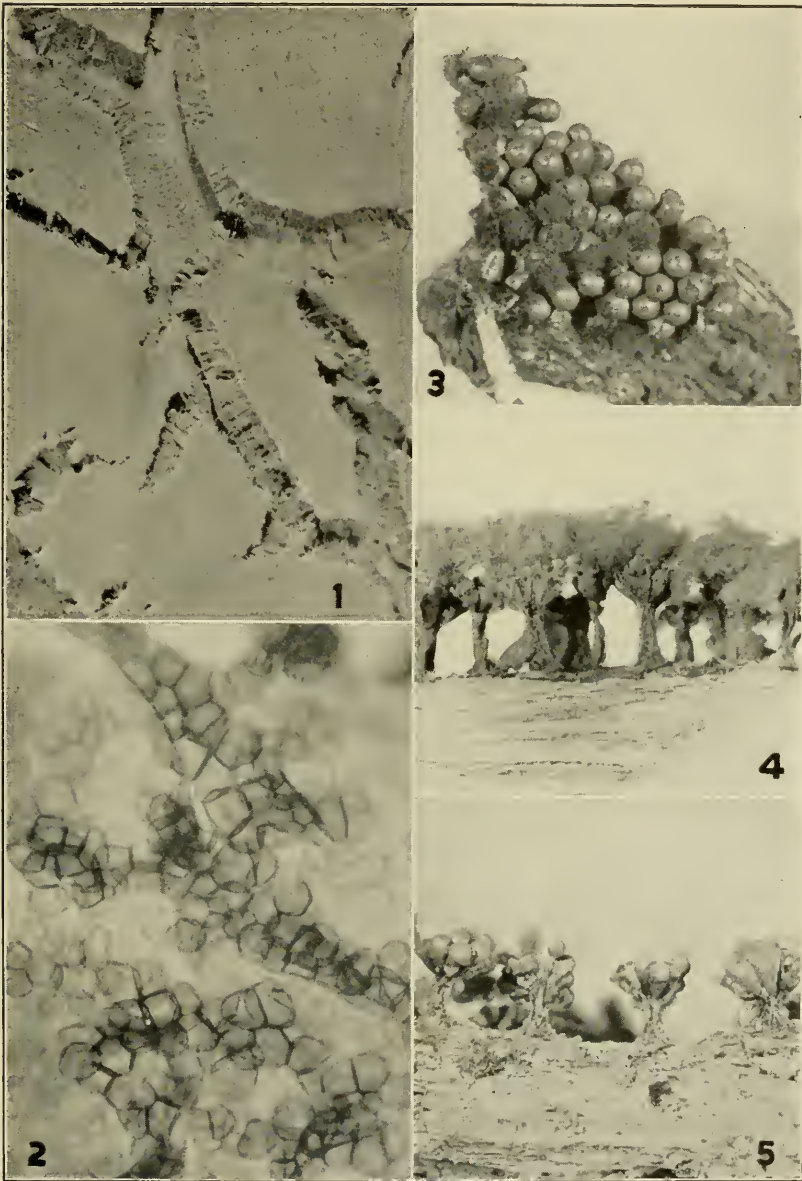
1. *DIDYMIUM STURGISII* $\times 6$
2. *DIDYMIUM CRUSTACEA* $\times 6$
3. *MUCILAGO SPONGIOSA* $\times 3$
4. *LEPIDODERMA TIGRINUM* $\times 9$
5. *STEMONITIS CONFLUENS* $\times 9$



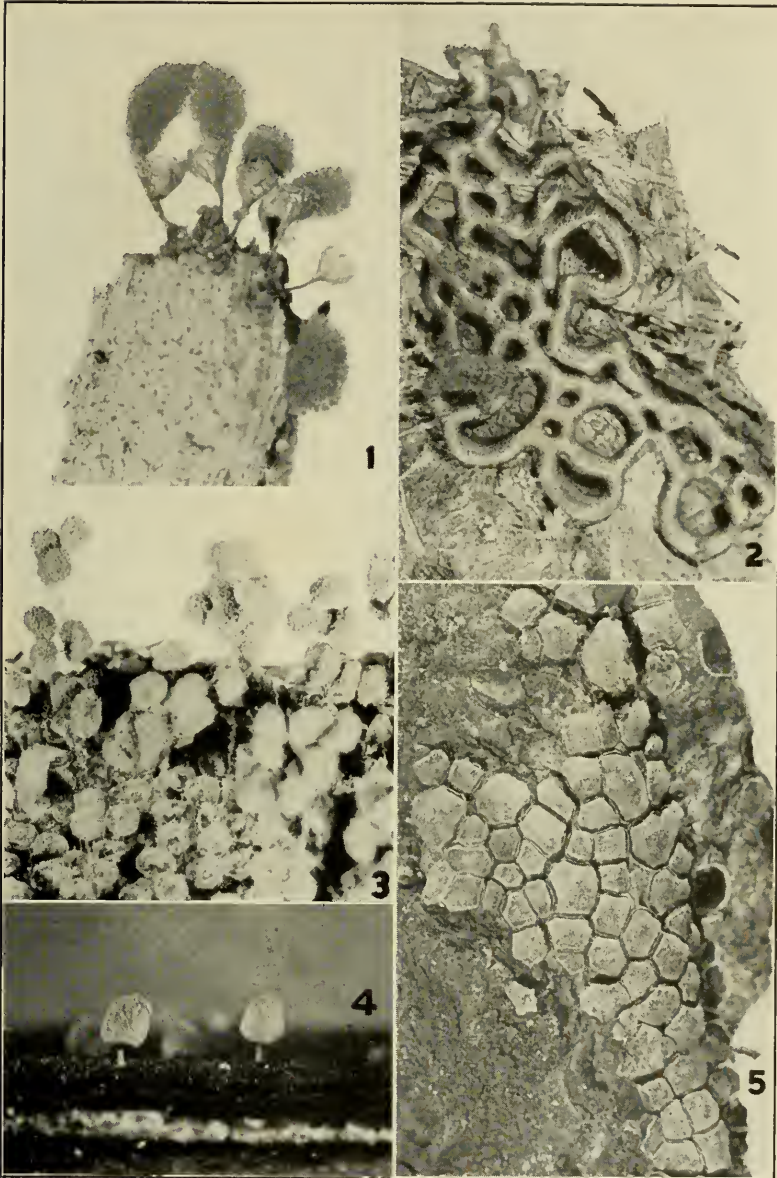
1, 2. *COMATRICH A ELEGANS* $\times 100$
3. *COMATRICH A EXTENDENS* $\times 10$
4. *COMATRICH A EXTENDENS* $\times 50$
5. *COMATRICH A RISPAUDII* $\times 12$
6. *COMATRICH A RISPAUDII* $\times 9$



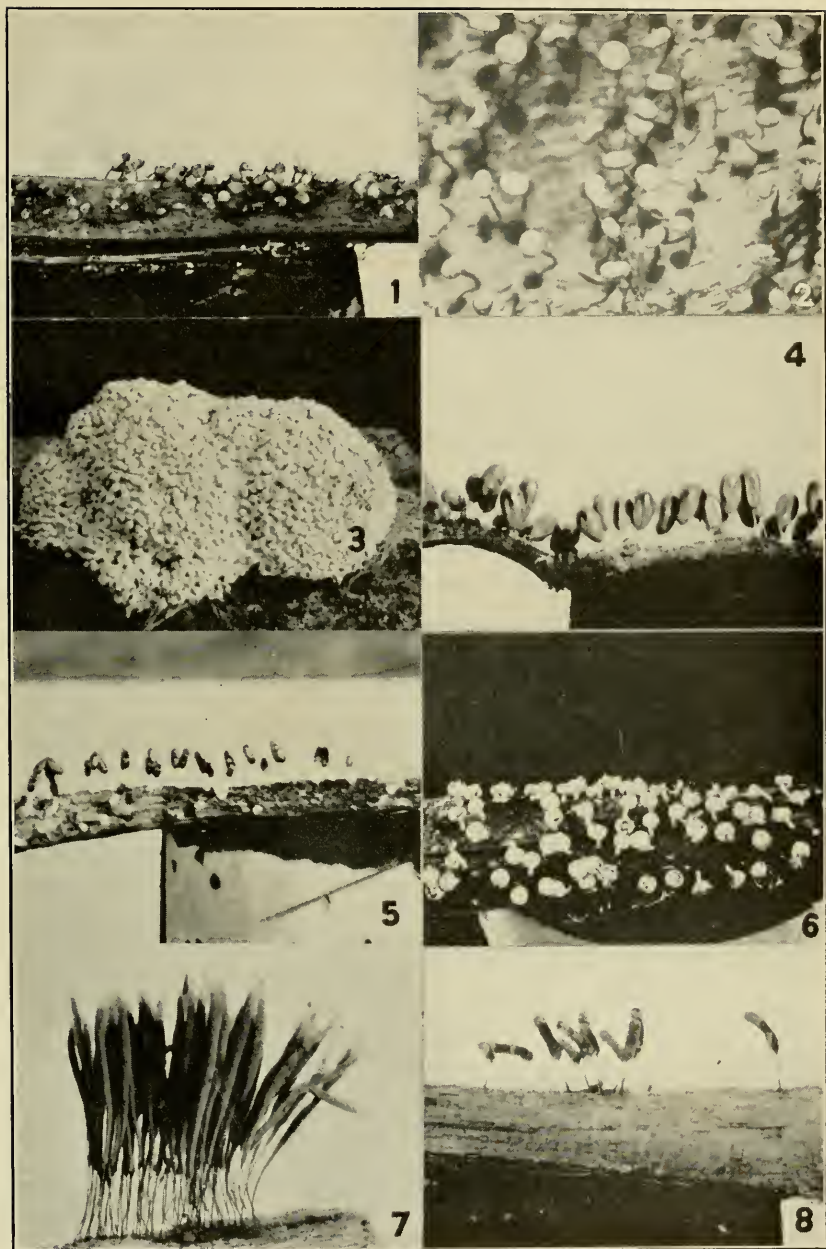
1. *COMATRICHA RISPAUDII*, SPORES $\times 450$
2. *LAMPRODERMA GULIELMAE* $\times 9$
3. *CRIBRARIA ARGILLACEA* $\times 6$
4. *CRIBRARIA LAXA* $\times 9$
5. *DICTYDIUM CANCELLATUM* $\times 5$
6. *TUBIFERA FERRUGINOSA* $\times 3$



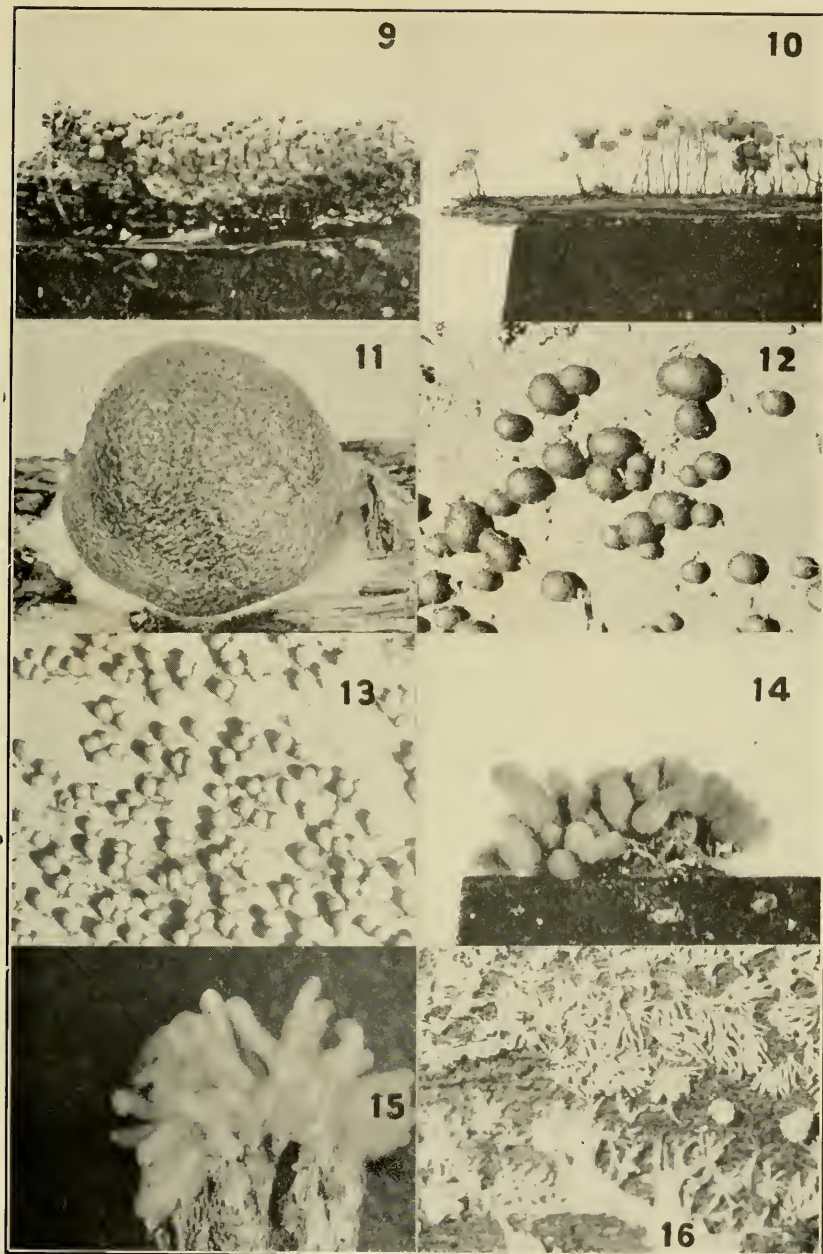
1. *Dictydiaethalium plumbeum* $\times 6$
2. *Lycogala epidendrum* var. *tessellatum* $\times 200$
3. *Trichia favoginea* $\times 6$
4. *Trichia floriformis* $\times 4$
5. *Hemitrichia vesparium* $\times 6$



1. *HEMITRICHIA CLAVATA* $\times 6$
2. *HEMITRICHIA SERPULA* $\times 6$
3. *ARCYRIA FERRUGINEA* $\times 9$
4. *ARCYRIA INSIGNIS* VAR. *DISPERSA* $\times 15$
5. *PERICHAENA DEPRESSA* $\times 6$



1. *BADHAMIA RUBIGINOSA* × 4
2. *PHYSARUM VIRIDE* × 10
3. *FULIGO INTERMEDIA* × 1
4. *LEOCARPUS FRAGILIS* × 4
5. *DIACHEA LEUCOPODIA* × 4
6. *DIDYMIUM SQUAMULOSUM* × 4
7. *STEMONITIS AXIFERA* × 3
8. *COMATRICHA TYPHOIDES* × 4



9. *LAMPRODERMA ARCYRIONEMA* $\times 4$
 10. *CRIBRARIA INTRICATA* $\times 6$
 11. *ENTERIDIUM ROZEANUM* $\times 2$
 12. *LYCOGALA EPIDENDRUM* $\times 1$
 13. *TRICHIA VARIA* $\times 8$
 14. *ARCYRIA DENUDATA* $\times 4$
 15. *ARCYRIA NUTANS* $\times 3$
 16. *CERATIOMYXA FRUTICULOSA* $\times 6$



