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A Taxonomic Study of the Coprophilous Ascomycetes of Southeastern Illinois

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A TAXONOMIC STUDY OF THE COPROPHILOUS ASCOMYCETES OF SOUTHEASTERN ILLINOIS

(TITLE)

BY

ALAN DOUGLAS PARKER

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INTRODUCTION

This taxonomic study has been primarily undertaken to gain a knowledge of the relative abundance and number of species of coprophilous ascomycetes, excluding the yeasts, in southeastern Illinois. The area encompassed in this study includes Coles, Cumberland, Clark, Douglas, Lawrence, and Richland Counties. In the course of this research over one hundred collections of various kinds of herbivore manure have been examined. Also included are two pellets from predatory birds. Previous knowledge of this group of fungi in Illinois has been restricted to a study conducted by Lane (1951), primarily from collections made in Champaign County.

The Ascomycetes are a large group of higher fungi. According to Ainsworth and Bisby (1954), there are approximately 1,700 genera and 15,000 species, while Bessey (1950) approximates the number of species to be 42,000. The distinguishing characteristic of all members of the class Ascomycetes is a sac-like cell called an ascus. The ascus contains ascospores, which are the product of karyogamy and meiosis within the ascus, and therefore are the perfect spore stage. Many ascomycetes also reproduce asexually, forming imperfect spores usually called conidia, although in yeasts and certain other groups they are sometimes designated as blastospores or oidia (arthrospores).

The taxonomy of the class Ascomycetes is based on morphological characters. The kind and color of ascocarp, the type of ascus, the arrangement of asci, and the characteristics of ascospores are important features used in the classification of this group of fungi.

The four kinds of ascocarps found in this class are the cleistothecium, a completely closed structure; the perithecium, generally a vase-shaped structure with an ostiole; the apothecium, an open, cup-shaped structure; and the ascostroma, a stroma which forms the wall of the ascocarp. Five major categories of ascomycetes are recognized according to the type of ascocarp and the arrangement of the asci within the ascocarp: those which bear naked asci with no ascocarp, the Hemiascomycetidae; those which produce scattered asci within a cleistothecium or perithecium, the Euascomycetidae, series Plectomycetes; those with asci arranged in a basal hymenium within a cleistothecium or a perithecium, the Euascomycetidae, series Pyrenomycetes: those with asci formed in a apothecium, the Euascomycetidae, series Discomycetes; and those with asci produced in an ascostroma, the Loculoascomycetidae.

The primary division of ascomycetes is according to ascus morphology. Two distinct ascus types are evident, the bitunicate ascus and the unitunicate ascus. All members of the subclass Loculoascomycetidae have bitunicate asci. The subclass Hemiascomycetidae has unitunicate asci, as do most members of the subclass Euascomycetidae. The few members of the

Euascomycetidae, the Patellariaceae, which possess bitunicate asci never form their asci in an ascostroma, but rather in an apothecium.

The bitunicate ascus has a wall composed of two distinct layers, the exoascus and the endoascus. The exoascus ruptures at the apex, allowing the endoascus to expand, forming a long cylindrical sac. Typically the ascospores are forcibly discharged through an elastic pore at the apex of the expanded endoascus. This pore is not distinct in the mature ascus prior to dehiscence, and lacks the variation in structure found in the majority of unitunicate asci (Luttrell, 1951).

The unitunicate ascus wall is composed of two thin, closely appressed layers, giving the impression of a single wall. The ascus wall may be relatively rigid, or in some instances it may be extensible. Ascospore release is accomplished by one of several mechanisms. The evanescent ascus dissolves or breaks down to release the ascospores. The asci in which forcible discharge of ascospores occurs have several apical mechanisms. In the large order Pezizales, the ascus opens by a lid, or operculum, which is forced open when the spores are discharged. Dennis (1968) described the ascus of the order Helotiales as having a simple apical pore, usually penetrating a somewhat thickened and conical portion of the ascus wall, and the ascus of the order Ostropales as often having a cap-like thickening at the tip. Luttrell (1951) assigned a representative genus to designate the dispersal

mechanism in those orders in which the ascospores are discharged through a split or an apical pore in the ascus. The Nectria type ascus usually lacks a distinct pore, and the spores are discharged through a weakened area in the ascus apex. The Erysiphe type ascus always lacks a distinct pore, and the asci burst as a result of a split in the ascus apex. In the Claviceps type, the ascus apex forms a thickened hemispherical cap penetrated by a fine pore. The Xylaria type has a thickened apex and a pore. The pore has a thickened annular ring surrounding it, giving the appearance of a crown in the apex of the ascus. The Diatrype and Endothia types both have an apical pore surrounded by a refractive ring (Luttrell, 1951).

The type of ascospores, number of spores per ascus, and to a lesser extent the color, ornamentation, size, and arrangement of spores are important characters used primarily in the separation of genera of ascomycetes. The spore types which occur in this group are the amerospore, a one-celled, rounded or ovoid spore; the didymospore, a two-celled spore; the phragmospore, a spore with two or more septa; the dictyospore, or muriform spore, with septa in two or more planes; and the scolecospore, a long, thin spore, with or without septa (Ainsworth and Bisby, 1954). The number of ascospores per ascus is typically eight, but the number may vary from one to over a thousand spores per ascus in certain species. The arrangement of ascospores is usually uniseriate or biseriate,

but inordinate and fasciculate arrangements occur in some genera. Spore color may range from hyaline to shades of purple, brown, or black. In some groups the ascospores are ornamented by granules, warts, spines, cracks, anastomosing striae, or reticulations. Ascospore size and ornamentation are important in the separation of species.

Coprophilous ascomycetes are a common group of fungi encountered on various kinds of herbivore dung. When properly treated, dung collected at any time of the year will provide representatives of this group abundantly. Some species appear very frequently and in large numbers, while others seem to be restricted in occurrence.

Coprophilous species are found in the orders Eurotiales and Microascales of the Plectomycetes, Chaetomiales and Sphaeriales of the Pyrenomycetes, Pezizales of the Discomycetes, and Pleosporales of the Loculoascomycetes. The Eurotiales produce scattered asci within cleistothecia, while the Microascales produce scattered asci within beaked perithecia, provided with definite ostioles. The Chaetomiales mostly form ostiolate perithecia with characteristic hairs originating from the perithecial wall. The asci are arranged in a basal hymenium and are evanescent. All members of the Sphaeriales have dark, globose or pear-shaped, ostiolate perithecia. The asci are arranged in a basal hymenium, and the ascospores are forcibly discharged at maturity. The Pezizales are characterized by operculate asci and the formation of apothecia. The

Pleosporales have asci which develop among pseudoparaphyses, either in a pseudothecium or a multiloculate stroma (Alexopoulos, 1962).

Coprophilous ascomycetes have a life cycle characteristic of their specialized habitat. The ascocarp, after developing on dung, releases the mature ascospores. The ascospores are found attached to or in close proximity with nearby vegetation, having either been forcibly discharged from the ascocarp or freed from the ascocarp and transmitted by insects, wind, or rain. The ascospores are consumed, along with vegetation, by a herbivore animal, passed through the digestive tract, and deposited with the dung. Germination of the ascospores occurs, and a vegetative mycelium develops on the dung. After a variable period of time the mycelium of homothallic species produces ascocarps, while in heterothallic species two compatible hyphae must be present to accomplish ascocarp formation. Once the ascocarp reaches maturity and releases ascospores, the life cycle is completed.

Coprophilous ascomycetes possess several adaptations to aid in their survival. The forcible discharge of ascospores helps to insure their removal from the dung and therefore increase the liklihood of being ingested by an animal. In those genera which have evanescent asci, the spores are probably transmitted by wind, rain or several of the large number of insects which frequent dung (Mohr, 1934). A number of genera in the orders Sphaeriales, Pezizales, and

Pleosporales have gelatinous appendages or sheaths attached to or surrounding the ascospores. This gelatinous material allows the ascospores to become attached to vegetation, thus helping to insure their consumption by animals. It is of interest to note that in the genus Ascobolus, which has coprophilous and non-coprophilous species, the gelatinous sheath is restricted to the coprophilous species, although it does not occur in all of them (Brummelen, 1967). Ascospore pigmentation may be of importance in spore survival. In the Ascoboloideae, it is thought by Brummelen (1967) that the layer of pigment surrounding the ascospores protects the spore contents against ultraviolet radiation when the spores are exposed.

LITERATURE REVIEW

The first taxonomic treatment to include coprophilous pyrenomycetes occurring in North America was done by Ellis and Everhart (1892). The authors described 11 coprophilous genera and 28 species. In the suborder Hypocreaceae, one species of Selinia was recognized, while in the suborder Perisporaceae, family Perisporieae, one species of Perisporium was treated. Four families of the suborder Sphaeriaceae were reported to have coprophilous representatives: one species of Wallrothiella in the family Cucurbitarieae; one species of Xylaria and three of Poronia in the family Xylarieae; one species of Chaetomium in the family Chaetomieae; six species of Sordaria, five of Podospora, two of Philocopra, two of Hypocopra, four of Sporormia, and one of Sporormiella in the family Sordarieae.

Griffiths (1901), in his treatment of the coprophilous members of the North American Sordariaceae, added many species; for he included 13 species of Sordaria, 29 of Pleurage (=Podospora), eight of Hypocopra, nine of Delitschia, 15 of Sporormia, and one of Sporormiella. Of these 78 species, 32 were newly described by Griffiths and 20 others were recorded in North America for the first time. In a later publication, Griffiths and Seaver (1910) treated the North American Fimetariaceae, a taxonomic category synonymous with the

Sordariaceae. Comparing with Griffiths' earlier paper, they cited two less species of Fimetaria (=Sordaria), two additional species of Pleurage, and the same number of species of Delitschia, Sporormia, and Sporormiella.

Stratton (1921), cataloging the Fimetariales of Ohio, reported coprophilous species of five genera, including four species of Chaetomium, six species of Fimetaria (=Sordaria), 14 species of Pleurage (=Podospora), two species of Delitschia, and six species of Sporormia. Included in this report were four newly described species.

Cain (1934) gave an extensive description of those coprophilous representatives found in Ontario of the very large and diverse order Sphaeriales, an order generally defined to include the Sordariaceae. Included were 42 species of Sordaria (as he treated it, this genus included species of both Sordaria and Podospora), five of Coniochaeta, five of Bombardia, one of Zygospermum, 13 of Delitschia, 25 of Sporormia, two of Pleophragmia, three of Hypocopra, 13 of Chaetomium, one of Phomatospora, one of Leptosphaeria, and one of Venturia. Of these 112 species, 27 were newly described by him. In addition, 34 species recorded from North America but not found in Ontario were listed. In a later study (Cain, 1957) restricted to the Hudson Bay area, 26 species of coprophilous ascomycetes were recorded.

Cain has recently published on a number of coprophilous genera of pyrenomycetes or allied groups, among which are

Gelasinospora (1950), Phaeotrichum (1956a), Tripterospora (1956b), Preussia (1961), and Podospora (1962). In addition, Cain and Farrow (1956) reported on Triangularia and Cain and Weresub (1957) on Sphaeronamella. A very complete treatment of the genus Posospora was presented by Mirza and Cain (1969). Semidelitschia, a new genus in the Sporormiaceae, was described by Cain and Luck-Allen (1969), while Apodospora, a new genus in the Sordariaceae, was named by Cain and Mirza (1970). The coprophilous members of the Pseudeurotiaceae were given attention by Malloch and Cain (1970). In a separate publication Malloch (1970) expressed the opinion that the genera Kernia and Lophotrichus belong in the Microascaceae, although Benjamin (1949), in his original description of Lophotrichus, placed it in the Chaetomiaceae. It is of interest to note that the type species of Lophotrichus was isolated by Benjamin on the University of Illinois campus.

The first North American treatment of the genus Chaetomium was done by Palliser (1910), who recognized 17 species, all of which were from North America and three being newly described. Chivers (1915) monographed the genera Chaetomium and Ascotricha, noting 28 species of Chaetomium, including two new species, 23 of which were reported from North America, and two species of Ascotricha, both from North America. Greathouse and Ames (1945) described three new species of Chaetomium from Tennessee, one of which is coprophilous. Skolko and Groves (1948, 1953) noted 47

species of Chaetomium while working on seed-borne fungi, three of these being new species. Ames (1949) reported nine new species of Chaetomium, four of which were isolated in North America. The family Chaetomiaceae was monographed by Ames (1961), and included 85 species of Chaetomium, 57 of which were from North America; six species of Ascotricha, three from North America; and three species of Lophotrichus, two from North America. Udagawa and Cain (1969) reported four new species of Chaetomium, while Wener and Cain (1970) reported one new species, all having been isolated in Canada.

One of first extensive listings of North American discomycetes was given by Morgan (1902) for the discomycetes of the Miami valley area of Ohio. Although no habitats were given, among the species listed which are consistantly coprophilous were two species of Ascobolus, one of Lasiobolus, one of Ryparobius, and one of Peziza. The first comprehensive publication dealing with discomycetes in North America was done in Iowa by Seaver (1905). This paper listed nine genera of coprophilous discomycetes in Iowa, including one species each of the genera Humaria (=Ascophanus), Peziza, Lachnea (=Patella), and Thecotheus, two species of Lasiobolus, five species of Ascophanus, three species of Ryparobius, six species of Ascobolus, and two species of Saccobolus. Seaver (1928) later published an enlarged and revised work on operculate discomycetes, covering much of North America. Of the coprophilous species reported were two species of Ascodesmis,

one species of Cubonia, nine species of Ascobolus, five species Saccobolus, 19 species of Ascophanus, three species of Streptotheca, five species of Ryparobius, one species of Thecotheus, two species of Lasiobolus, seven species of Patella, and two species of Peziza.

Recently several genera have been subjected to intensive study. In 1961 Obrist revised the genus Ascodesmis, while in 1964 Denison evaluated the species of the genus Cheilymenia (=Patella) for North America. In his world monograph of Ascobolus and Saccobolus, Brummelen (1967) listed a number of North American species.

Kimbrough (1966) treated species of the genera Thelebolus, Ryparobius, Ascozonus, Thecotheus, Lasiobolus, and Ascophanus. Kimbrough and Korf (1967), in a paper in which the tribe Theleboleae was proposed, described four new genera on the basis of combining and segregating existing genera: Iodophanus, for species of Ascophanus with iodine positive asci; Coprotus, for segments of Ascophanus and Ryparobius; Caccobius, for species intermediate to Ascozonus and Thelebolus; and Trichobolus, for setose members of Thelebolus. Later Kimbrough separately treated the genus Thecotheus (1969), while Cain and Kimbrough (1969) described a new genus Coprobolus, of the Theleboleae, and Kimbrough et al revised the genus Iodophanus (1969).

Very little research has been done concerning the coprophilous ascomycetes of Illinois. Graham (1933), in a short

paper dealing with the ecology of ascomycetes of the Chicago area of Illinois, mentioned one coprophilous discomycete, Peziza vesiculosa. Marks and Stover (1935) reported on fleshy ascomycetes from east-central Illinois; however, they reported no coprophilous species. The only paper dealing specifically with coprophilous ascomycetes in Illinois was Lane's (1951) unpublished report of the coprophilous pyrenomycetes in the Champaign area of Illinois. Reported were 11 species of Schizothecium (=Podospora), two species of Fimetaria (=Sordaria), one species of Coniochaeta, one species of Bombardia, two species of Delitschia, four species of Sporormia, one species of Lophotrichus, and five species of Chaetomium.

MATERIALS AND METHODS

All collections of dung made during this study were from Coles, Cumberland, Clark, Douglas, Lawrence, and Richland Counties of southeastern Illinois. An attempt was made in all counties to collect dung of both domestic and wild animals; however, fewer collections of the later are represented because of the difficulty in locating the excrement of wild animals. Collections from wild animals, primarily rabbit, coon, quail, and deer, were made by visiting areas which furnish suitable habitats for these animals. It was found that state parks, some of which practice wildlife management programs, provide good collecting areas. In addition, knowledge of game populations supplied by local hunters proved valuable. Dung of horse, cow, and sheep was collected from pastures, barn lots, and stables, while the cage droppings of domestic rabbit were utilized. Also included in this study are two pellets from predatory birds, although these animals are not herbivorous.

The majority of collections were made during the period of time from October, 1970, to April, 1971, although a few collections were obtained during the summer of 1970. The season of the year seemed not to have an effect on the abundance of ascomycetes that developed on the dung. Whenever

possible, fresh dung was selected to increase the likelihood of ungerminated spores being present. However, an abundance of ascomycetes was often obtained from partially weathered dung. Since most samples were taken during the colder months of the year, the lower temperature may have resulted in decreased spore germination prior to collection.

A garden trowel and paper sacks were used in collecting and transporting the dung samples. Most collections were immediately transferred to incubating containers at the laboratory; however, some samples were dried and, after several days, incubated. Cain (1934) and Brummelen (1967) both indicate that dung may be air dried and stored until needed. Brummelen (1967) reported a good development of ascomycetes, even after three or four months of dry storage.

All samples were incubated in one pint plastic freezer containers lined with two paper towels. The towels, which were moistened before placing the dung in the container, allowed for later addition of water, if needed, without disrupting the surface of the dung. Dried samples of dung were moistened after being placed in the container. Sufficient water was added to keep the manure continually moist, but no standing water was allowed in the containers. The method of Richardson and Watling (1968) was followed, who reported that free water does not allow the best development of ascomycetes.

At the beginning of this study, incubating samples were maintained at room temperature in a dark storeroom. This method yielded an abundance of some ascomycetes. However, during the major portion of this study the procedure recommended by Richardson and Watling (1968), in which incubation is carried out in daylight, was used. To accomplish this, samples were placed on a window ledge or in a lighted classroom.

An experiment was undertaken to determine if a noticable difference could be detected between incubation under light and dark conditions. Four pieces of horse manure were cut in half, one half of each piece being placed in a dark storeroom and the other half on a window ledge. The samples were examined weekly for six weeks. In general, for a piece of manure, the same species developed in light incubation as did in dark incubation. However, ascomycetes growing on those samples placed in the dark were approximately a week slower in appearance than those growing in window light.

Samples were examined with a dissecting scope at one week intervals after incubation. Sometimes a sample would become overgrown with the mycelium of deuteromycetes or phycomycetes by the end of one or two weeks. If this mycelium persisted and continued to obscure the surface of the dung, the sample was discarded. All sporocarps assignable to the Agaricales were removed from samples, because these fungi also interfere with examination. Samples were retained

for a maximum length of eight weeks, which was considered sufficient time for development of any ascomycetes that might be present.

The sequence of appearance of the various groups of ascomycetes followed a general pattern. Members of the Ascoboleae were the first to appear, usually within one or two weeks after incubation. Species of Chaetomium and Sordaria usually became evident after two or three weeks, while species of Podospora developed at various times, generally in three to six weeks. Other genera of ascomycetes were sporadic in appearance, occurring at various times from two to six weeks.

In the examination of incubating dung, some ascocarps are visible macroscopically, but many cannot be detected without magnification. Incubating samples were examined with a Bausch and Lomb BVB-73 Stero Zoom model binocular microscope having a magnification of 7x to 30x. Habit sketches and most ascocarp measurements were made with this microscope equipped with an ocular micrometer. Very small ascocarps were measured with the Zeiss microscope described below.

The ascocarps of all genera studied, except Chaetomium, were placed in a water mount for microscopic examination, and then crushed by applying pressure to the cover slip. Ascocarps of the genus Chaetomium, because of the numerous perithecial hairs, were first mounted in a drop of 70 per cent alcohol to prevent air bubbles, this being replaced by water. The

hairs, which are critical in species determination, were teased apart with two fine needles. Examination of large apothecia was accomplished by removing a thin, transverse slice of the ascocarp with a razor blade. All slides were examined with a Zeiss Standard GFL microscope, having 12.5x eyepieces, 10x, 25x, and 40x Acromat objectives, and a 100x Oil Neofluar objective. Spore measurements were made with an ocular micrometer, using the 100x oil immersion objective. Ascospore and ascus drawings were done using a tube-type camera lucida.

A number of publications dealing with the taxonomy of coprophilous ascomycetes were employed during this study. Species of Sporormia, Sordaria, and Bombardia were identified using Studies of Coprophilous Sphaeriales in Ontario (Cain, 1934) and The North American Sordariaceae (Griffiths, 1901). Identifications of collections of the genus Podospora were from the Revision of the Genus Podospora (Mirza and Cain, 1969). Species of Preussia were determined through use of Studies of Coprophilous Ascomycetes, VII, Preussia (Cain, 1961). Kernia brachytrica was identified from A New Species of Magnusia (Ames, 1937) and The Fungus Genus Kernia with the Description of a New Species (Seth, 1968). Members of the genus Chaetomium were determined from A Monograph of the Chaetomiaceae (Ames, 1961). The Genus Ascodesmis (Obrist, 1961) was used to identify Ascodesmis microscopica, while A World Monograph of the Genera Ascobolus and Saccobolus (Brummelen, 1967) was used to identify species of these

genera. Lasiobolus equinus was identified from A Key to the Fungi on Dung (Richardson and Watling, 1968).

In addition, the following publications were used for supplementary information: The Genera of Fungi (Clements and Shear, 1931), A Manual of the Soil Fungi (Gilman, 1957), The North American Pyrenomycetes (Ellis and Everhart, 1892), Danish Pyrenomycetes (Munk, 1957), The Fimetariales of Ohio (Stratton, 1921), North American Cup-Fungi (Operculate) (Seaver, 1928), A Monograph of the Genera Chaetomium and Ascotricha (Chivers, 1915), Notes on Seed-borne Fungi, V. Chaetomium species with dichotomously branched hairs (Skolko and Groves, 1948), Notes on Seed-borne Fungi. VII. Chaetomium (Skolko and Groves, 1953), Some new or noteworthy species of the Genus Chaetomium (Udagawa and Cain, 1969), Apodospora, a new genus in the Sordariaceae (Cain and Mirza, 1970), Semidelitschia, a new genus of the Sporormiaceae (Cain and Luck-Allen, 1969), Studies of Coprophilous Ascomycetes. IV. Tripterospora (Cain, 1956b), Studies of Coprophilous Ascomycetes. VIII. New Species of Podospora (Cain, 1962), Five New Genera in the Pseudeurotiaceae (Malloch and Cain, 1970), The Genus Cheilmenia in North America (Denison, 1964), North American Species of Thecotheus (Pezizeae, Pezizaceae) (Kimbrough, 1969), Iodophanus, the Pezizeae Segregation of Ascophanus (Pezizales) (Kimbrough et al, 1969).

Some of the species encountered during this study were isolated in pure culture to aid in identification. Species

of Chaetomium were isolated using a sterile needle with a minute block of agar at the tip. The agar block was applied to the cirrus of spores, then transferred to a plate of oatmeal agar. Species of Preussia, Sporormia, Kernia, and Bombardia were isolated through surface sterilization of ascocarps. The ascocarps were removed from the dung, washed in sterile water, immersed in Clorox bleach for lengths of time ranging from twenty seconds to two minutes, and transferred directly to plates of media. A species of Xylaria was also isolated by this method from sections of the stroma bearing perithecia. One species of Sporormia was isolated by removing asci from a pseudothecium crushed in sterile water, the asci being removed with a sterile needle and transferred to plates of media.

Most species formed ascocarps on either or both the oatmeal and horse manure agar. However, one species of Bombardia, which was isolated by surface sterilization, formed only mycelial growth on these two media. A method favored by G. W. Martin was employed in an attempt to induce perithecial formation in this isolate. Pieces of straw and corncob were placed in twenty-two millimeter test tubes containing one inch of water, and after sterilization pieces of mycelial innoculum were placed on the straw or corncob at water level. A thick mycelial growth resulted, but after twelve weeks no perithecial formation was observed.

Two media, oatmeal agar and horse manure agar, were used extensively in culture work. Oatmeal agar was prepared by sterilizing several flakes of instant oatmeal in a petri dish and then pouring a layer of one and one-half per cent water agar over the oatmeal. Horse manure agar was prepared by sterilizing horse manure mixed with water, filtering the product through several layers of cheesecloth, and combining 1000 millimeters of the filtrate with 12 grams of agar, followed by sterilization.

Stock cultures were made after an isolate was confirmed as axenic and ascocarps had developed. Subcultures of all isolates have been deposited in the culture collection of Eastern Illinois University.

SPECIES LIST AND COLLECTION DATA

The coprophilous ascomycetes identified during this study are listed below, arranged according to series, order, and family. The number of collections, including location, date, and type of manure, is given for each species. The occurrence of each species in the counties in which collections were made has been tabulated in Chart 1., while the frequency of appearance during this study is illustrated in Chart 2.

SUBCLASS EUASCOMYCETES - SERIES PYRENOMYCETES

ORDER SPHAERIALES

Family Sordariaceae

Sordaria Ces. and DeNot.

1. Sordaria fimicola (Rob.) Ces. and DeNot.

   Coles C., Charleston Twn. (Sect. 17, T12N, R9E), 4 Dec., 1970, horse manure.

   Coles C., Ashmore Twn., (Sect. 16, T13N, R10E), 7 Dec., 1970, horse manure.

   Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, cow manure.

   Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, horse manure.

   Cumberland C., Union Twn., 30 Dec., 1970, cow manure.

   Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 3 Feb., 1971, rabbit manure.

Coles C., East Oakland Twn., (Sect. 24, T14N, R11E), 2 Mar., 1971, horse manure.

Lawrence C., Petty Twn., (Sect. 25, T4N, R13W), 14 Mar., 1971, rabbit manure.

Lawrence C., Petty Twn., (Sect. 35, T4N, R13W), 5 Apr., 1971, deer manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Richland C., Olney Twn., Olney fair grounds, 3 May, 1971, horse manure.

This species is one of the most commonly encountered coprophilous ascomycetes in Illinois.

2. Sordaria humana (Fuck.) Winter

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, deer manure.

Cumberland C., Cottonwood Twn., (Sect. 27, T11N, R9E), 18 Oct., 1970, rabbit manure.

Lawrence C., Lawrence Twn., (Sect. 4, T3N, R12W), 4 July, 1970, tame rabbit manure.

Lawrence C., Lawrence Twn., (Sect. 4, %3N, R12W), 26 Feb., 1971, tame rabbit manure.

Podospora Cesati

1. Podospora anserina (Ces. in Rabenh.) Niessl

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 1 Dec., 1970, sheep manure.

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 16, T13N, R10E), 7 Dec., 1970, horse manure.

Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, sheep manure.

Cumberland C., Union Twn., 30 Dec., 1970, horse manure.

Lawrence C., Lawrence Twn., (Sect. 4, T3N, R12N), 4 July, 1970, tame rabbit manure.

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

2. Podospora appendiculata (Auersw.) Niessl

Lawrence C., Petty Twn., (Sect. 25, T4N, R13W), 14 Mar., 1971, rabbit manure.

3. Podospora communis (Speg.) Niessl

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 1 Dec., 1970, sheep manure.

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, horse manure.

Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, sheep manure.

Cumberland C., Union Twn., 30 Dec., 1970, sheep manure.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 2 Jan., 1971, horse manure.

Coles C., Pleasant Grove Twn., (Sect. 10, T11N, R9E), 21 Mar., 1971, horse manure.

4. Podospora curvicolla (Winter) Niessl

Cumberland C., Union Twn., (Sect. 8, T10N, R10E), 3 Oct., 1970, rabbit manure.

Cumberland C., Cottonwood Twn., (Sect. 27, T11N, R9E), 18 Oct., 1970, rabbit manure.

Coles C., Ashmore Twn., (Sect. 16, T13N, R10E), 7 Dec., 1970, horse manure.

Cumberland C., Cottonwood Twn., (Sect. 27, T11N, R9E), 30 Dec., 1970, rabbit manure.

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 3 Feb., 1971, rabbit manure.

Lawrence C., Christy Twn., (Sect. 3, T3N, R13W), 26 Feb., 1971, rabbit manure.

Douglas C., Sargent Twn., (Sect. 24, T14N, R11E), 2 Mar., 1971, rabbit manure.

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

Lawrence C., Petty Twn., (Sect. 25, T4N, R13W), 14 Mar., 1971, rabbit manure.

Coles C., Pleasant Grove Twn., (Sect. 21, T11N, R9E), 20 Mar., 1971, rabbit manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Richland C., Olney Twn., Olney fair grounds, 3 May, 1971, horse manure.

This is the most common species of Podospora encountered during this study, and probably represents the most common species in the state.

5. Podospora curvula (De Bary) Niessl

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, horse manure.

Clark C., Westfield Twn., (Sect. 25, T12N, R14W), 2 Jan., 1971, horse manure.

Clark C., Westfield Twn., (Sect. 23, T12N, R14W), 2 Jan., 1971, cow manure.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 5 Jan., 1971, horse manure.

6. Podospora decipiens (Winter) Niessl

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, cow manure.

Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, horse manure.

Clark C., Westfield Twn., (Sect. 25, T12N, R14W), 2 Jan., 1971, horse manure.

Coles C., Charleston Twn., pasture next to the Charleston sewage plant, 5 Mar., 1971, horse manure.

7. Podospora inaequalis (Cain) Cain

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

Udagawa and Cain (1969) describe this fungus as showing a tendency to grow on substrates other that dung. In the collection reported here, the perithecia were not produced directly upon the manure, but rather on straw litter mixed in with the manure.

8. Podospora pleiospora (Winter) Niessl

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

9. Podospora tetraspora (Winter) Cain

Cumberland C., Cottonwood Twn., (Sect. 27, T11N, R9E), 30 Dec., 1970, rabbit manure.

Lawrence C., Christy Twn., (Sect. 3, T3N, R13W), 26 Feb., 1971, rabbit manure.

Douglas C., Sargent Twn., (Sect. 36, T15N, R11E), 2 Mar., 1971, rabbit manure.

Lawrence C., Petty Twn., (Sect. 25, T4N, R13W), 26 Feb., 1971, rabbit manure.

Douglas C., Sargent Twn., (Sect. 36, T15N, R11E), 2 Mar., 1971, rabbit manure.

Lawrence C., Petty Twn., (Sect. 25, T4N, R13W), 14 Mar., 1971, rabbit manure.

Coles C., Pleasant Grove Twn., (Sect. 21, T11N, R9E), 20 Mar., 1971, rabbit manure.

10. Podospora vesticola (Berk. and Broome) Cain

Clark C., Westfield Twn., (Sect. 25, T12N, R14W); 2 Jan., 1971, horse manure.

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

Coles C., East Oakland Twn., (Sect. 24, T14N, R11E), 2 Mar., 1971, sheep manure.

Coles C., East Oakland Twn., (Sect. 14, T14N, R11E), 2 Mar., 1971, cow manure.

Coles C., Charleston Twn., pasture next to the Charleston sewage plant, 5 Mar., 1971, horse manure.

Coles C., Charleston Twn., Charleston fair grounds, 15 Mar., 1971, horse manure.

Bombardia Fries

1. Bombardia arachnoidea (Niessl) Cain

Clark C., Westfield Twn., (Sect. 25, T12N, R14W), 2 Jan., 1971, horse manure.

The collection reported here agrees with the description given by Cain (1934) for Bombardia arachnoidea (Niessl) Cain, due to the presence of long, brown perithecial hairs. Cain failed to give the spore size of this species, but Griffiths (1901) reported the spore size of Pleurage arachnoidea Niessl (=Bombardia arachnoidea (Niessl) Cain) as 17-20 x 6-11 u. However, the spores of the collection reported here have a slightly smaller length (15.5 x 8 u) than given by Griffiths. Since Bombardia arachnoidea is the only recognized species of this genus with long, brown perithecial hairs, the species reported in this present study has been assigned to the species Bombardia arachnoidea, despite the discrepancy in spore size.

Family Xylariaceae

Xylaria Hill ex Grev.

1. Xylaria sp.

Coles C., Pleasant Grove Twn., (Sect. 10, T11N, R9E), 21 Mar., 1971, horse manure.

The collection of Xylaria reported here consists of one black stroma 2.4 cm. tall, with a stalk 2 mm. in diameter and a clavate head 3 mm. in diameter, bearing numerous perithecia. The ascospores are ellipsoid, very slightly flattened on one side, light brown at maturity, containing 2-3 large oil drops, and measure 9.5-11 x 4.5-5 u. The only reference encountered during this study to a coprophilous species of Xylaria from North America was that of Ellis and Everhart (1892). They described

Xylaria pedunculata (Dicks.) Ellis and Everhart as being coprophilous, with a rather thick, dark brown stroma having a subglobose fertile head roughened by prominent perithecia, and with a spore size of 40 x 20 u. Dennis (1968) treats Xylaria pedunculata under the genus Podosordaria, describing the genus as having a small number of rather protuberant perithecia clustered in the subglobose tip of a small stalked stroma. He gives the ascospore size of Podosordaria pedunculata (S. F. Gray) Dennis as 40-60 x 20-30 u, and also recognizes two other species of Podosordaria, both having larger spores than the collection reported during this present study. Munk (1957), in his treatment of Danish pyrenomycetes, described one coprophilous species of Xylaria under the name Xylaria pedunculata Fr. It appears from the description given by Munk that he is dealing with an entirely different fungus than the Xylaria pedunculata of Ellis and Everhart and the Podosordaria pedunculata of Dennis. Munk describes Xylaria pedunculata as having a black, very small and slender stroma, a few mm. long and a few hundred microns thick, with one to a few prominent perithecia per stroma, and gives the spore size as 22-25 x 11-12 u. This worker has been unable to assign the collection of Xylaria reported here to any of the species described by Ellis and Everhart, Dennis, or Munk. The clavate stroma with numerous embedded perithecia, along with the smaller size of the ascospores, differs considerably from descriptions given by the above authors.

ORDER CHAETOMIALES

Family Chaetomiaceae

Chaetomium Kunze, ex Fries

1. Chaetomium aterrimum Ellis and Everhart

   Coles C., Mattoon Twn., Mattoon Junior High School, 26 Jan., 1971, waste material from a guinea pig cage.

   This species was isolated in pure culture from a collection made by Larry Dennis of Mattoon. Perithecia develop abundantly on oatmeal agar in two weeks.

2. Chaetomium bostrychodes Zopf

   Cumberland C., Union Twn., (Sect. 8, T10N, R10E), 3 Oct., 1970, rabbit manure.

Cumberland C., Union Twn., (Sect. 8, T10N, R10E), 30 Dec., 1970, coon manure.

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 3 Feb., 1971, rabbit manure.

Lawrence C., Lawrence Twn., (Sect. 21, T4N, R11W), 24 July, 1970, rabbit manure.

Coles C., Charleston Twn., south 9 th. street in Charleston, 20 Feb., 1971, rabbit manure.

Coles C., East Oakland Twn., (Sect. 14, T14N, R11E), 2 Mar., 1971, sheep manure.

Lawrence C., Petty Twn., (Sect. 25, T4N, R13W), 14 Mar., 1971, rabbit manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Isolated in pure culture from rabbit manure collected, 14 Mar., 1971. Perithecia form abundantly on oatmeal agar in two weeks.

3. Chaetomium caprinum Bainier

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, deer manure.

Coles C., Charleston Twn., Charleston fair grounds, 15 Mar., 1971, horse manure.

Isolated in pure culture from both of the above collections. Perithecia develop on oatmeal agar in two weeks.

4. Chaetomium cochliodes Palliser

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, cow manure.

Coles C., Charleston Twn., Charleston fair grounds, 15 Mar., 1971, horse manure.

Isolated in pure culture from cow manure collected 7 Dec., 1970. Perithecia develop abundantly on oatmeal agar in two weeks.

5. Chaetomium crispatum Fuck.

Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, cow manure.

Isolated in pure culture from the above collection. Perithecia develop slowly, in approximately 4 weeks, on oatmeal agar.

6. Chaetomium globosum Kunze, ex Fries

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, hawk or owl pellet.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 2 Jan., 1971, horse manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Isolated in pure culture from horse manure collected 5 May, 1971. Perithecia develop abundantly on oatmeal agar in two weeks.

7. Chaetomium murorum Corda

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, cow manure.

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

SUBCLASS EUASCOMYCETES - SERIES PLECTOMYCETES

ORDER PLECTASCALES

Family Tripterosporaceae

Tripterospora Cain

1. Tripterospora brevicaudata Cain

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 2 Jan., 1971, horse manure.

Isolated in pure culture from the above collection. Abundant ascocarps form on oatmeal agar.

2. Tripterospora longicaudata Cain

Coles C., Charleston Twn., Charleston fair grounds, 15 Mar., 1971, horse manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Isolated in pure culture from the above collection. Ascocarps form abundantly on oatmeal agar.

ORDER MICROASCALES

Family Microascaceae

Kernia Nieuwland

1. Kernia brachytricha (Ames) Benjamin

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 1 Dec., 1970, sheep manure.

Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, cow manure.

Cumberland C., Union Twn., 30 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 22, T13N, R10E), 2 Jan., 1971, cow manure.

Coles C., East Oakland Twn., (Sect. 14, T14N, R11E), 2 Mar., 1971, sheep manure.

Douglas C., Sargent Twn., (Sect. 36, T15N, R11E), 2 Mar., 1971, horse manure.

Coles C., East Oakland Twn., (Sect. 29, T14N, R14W), 2 Mar., 1971, horse manure.

Isolated in pure culture from cow manure collected 8 Dec., 1970. Cleistothecia form very abundantly on horse manure and oatmeal agar.

SUBCLASS EUASCOMYCETES - SERIES DISCOMYCETES

ORDER PEZIZALES

Family Pezizaceae

Lasiobolus Sacc.

1. Lasiobolus equinus (Mull. per Gray) Karst.

Coles C., Pleasant Grove Twn., (Sect. 10, T11N, R9E), 21 Mar., 1971, horse manure.

Iodophanus Korf

1. Iodophanus carneus (Pers. per Pers.) Korf

Coles C., Lafayette Twn., Bergner Acres, 8 Mar., 1970, hawk or owl pellet.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 5 Jan., 1971, horse manure.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 5 Jan., 1971, sheep manure.

Isolated in culture from the collection of 8 Mar., 1970. Very few apothecia form on oatmeal agar after four to six weeks, and this number decreases steadily with each transfer. All three collections of this species have been confirmed by Dr. James Kimbrough.

Family Ascobolaceae

Ascobolus Pers. per Hook.

1. Ascobolus albidus Crouan

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

Coles C., East Oakland Twn., (Sect. 24, T14N, R11N), 2 Mar., 1971, sheep manure.

Coles C., Charleston Twn., Charleston fair grounds, 15 Mar., 1971, horse manure.

2. Ascobolus amoenus Oud.

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, deer manure.

3. Ascobolus crenulatus P. Karst.

Lawrence C., Christy Twn., (Sect. 3, T3N, R13W), 26 Feb., 1971, coon manure.

4. Ascobolus furfuraceus Pers. per Hook.

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, deer manure.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 1 Dec., 1970, sheep manure.

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 16, T13N, R10E), 7 Dec., 1970, horse manure.

Coles C., Hutton Twn., (Sect. 15, T11N, R10E), 8 Dec., 1970, horse manure.

Cumberland C., Union Twn., 30 Dec., 1970, cow manure.

Cumberland C., Union Twn., (Sect. 8, T10N, R10E), 30 Dec., 1970, cow manure.

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

Coles C., East Oakland Twn., (Sect. 13, T14N, R11E), 2 Mar., 1971, cow manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

Richland C., Olney Twn., Olney fair grounds, 3 May, 1971, horse manure.

This species is one of the most commonly encountered coprophilous discomycetes in Illinois.

5. Ascobolus immersus Pers. per Pers.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 1 Dec., 1970, sheep manure.

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 16, T13N, R10E), 7 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, horse manure.

Coles C., Ashmore Twn., (Sect. 19, T13N, R10E), 7 Dec., 1970, cow manure.

Coles C., Charleston Twn., (Sect. 30, T12N, R9E), 22 July, 1970, horse manure.

Coles C., East Oakland Twn., (Sect. 14, T14N, R11E), 2 Mar., 1971, sheep manure.

Coles C., East Oakland Twn., (Sect. 24, T14N, R11E), 2 Mar., 1971, sheep manure.

Lawrence C., Petty Twn., (Sect. 35, T4N, R13W), 5 Apr., 1971, deer manure.

6. Ascobolus scatigenus (Berk.) Brumm.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 5 Jan., 1971, horse manure.

Ascodesmis Tiegh.

1. Ascodesmis sphaerospora Obrist

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, hawk or owl pellet.

Coles C., 23 July, 1970, rabbit manure.

Saccobolus Boud.

1. Saccobolus depauperatus (Berk. and Broome) E. C. Hansen

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Cumberland C., Union Twn., 8 Dec., 1970, horse manure.

Coles C., East Oakland Twn., (Sect. 24, T14N, R11E), 2 Mar., 1971, sheep manure.

Coles C., Charleston Twn., Charleston fair grounds, 5 May, 1971, horse manure.

2. Saccobolus glaber (Pers. per Pers.) Lamb.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 1 Dec., 1970, sheep manure.

Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 5 Jan., 1971, horse manure.

3. Saccobolus minimus Vel.

Richland C., Olney Twn., Olney fair grounds, 3 May, 1971, horse manure.

According to Brummelen (1967), this species has only been recorded once before in North America, by Thaxter in 1891.

SUBCLASS LOCULOASCOMYCETES

ORDER PLEOSPORALES

Family Sporormiaceae

Preussia Fuck.

1. Preussia funiculata (Preuss) Fuck.

   Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

   Isolated in pure culture from the above collection. Ascocarps develop in approximately three weeks. Abundance and size seems quite variable in culture.

2. Preussia fleischhakii (Auersw.) Cain

   Coles C., Charleston Twn., Charleston fair grounds, 15 Mar., 1971, horse manure.

   Isolated in pure culture from the above collection.

3. Preussia sp.

   Coles C., Charleston Twn., (Sect. 17, T12N, R9E), 2 Jan., 1971, horse manure.

   Isolated in pure culture from the above collection. The spore size of this isolate differs considerably from the sizes of the 11 species described by Cain (1961). Ascocarps form on oatmeal agar in approximately three weeks.

Sporormia DeNotaris

1. Sporormia australis Speg.

   Clark C., Westfield Twn., (Sect. 25, T12N, R14W), 2 Jan., 1971, horse manure.

2. Sporormia intermedia Auersw.

   Coles C., East Oakland Twn., (Sect. 14, T14N, R11E), 2 Mar., 1971, cow manure.

Isolated in pure culture from the above collection. Pseudothecia form abundantly on horse manure and oatmeal agar.

3. Sporormia leporina Niessl

Coles C., Charleston Twn., South 9 th. Street in charleston, 20 Feb., 1971, rabbit manure.

Isolated in pure culture from the above collection. Pseudothecia form quite abundantly on oatmeal agar.

4. Sporormia minima Auersw.

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 17 Oct., 1970, deer manure.

Coles C., Ashmore Twn., (Sect. 21, T13N, R10E), 3 Feb., 1971, rabbit manure.

Richland C., Olney Twn., Olney fair grounds, 26 Feb., 1971, horse manure.

Lawrence C., Petty Twn., (Sect. 35, T4N, R13W), 5 Apr., 1971, deer manure.

5. Sporormia kansensis Griff.

Coles C., Charleston Twn., Charleston fair grounds, 4 Dec., 1970, horse manure.

Clark C., Westfield Twn., (Sect. 25, T12N, R14W), 2 Jan., 1971, horse manure.

Isolated in pure culture from horse manure collected 4 Dec., 1970. Pseudothecia form very well on horse manure and oatmeal agar.

DISCUSSION

During this study 44 species of coprophilous ascomycetes in 14 genera have been recorded. Twenty-one of these species are pyrenomycetes, three are plectomycetes, eight are loculoascomycetes, and 12 are discomycetes. The occurrence of each of the 14 genera in North America, and specifically in Illinois, will be discussed.

In the genus Podospora Mirza and Cain (1969) reported 58 species occurring in North America. Lane (1951), in his study of the coprophilous pyrenomycetes of Illinois, recorded 11 species of Schizothecium, a synonym he used in preference to the name Podospora, which is regarded as the valid generic name by Mirza and Cain (1969). Of these 11 species, Lane proposed new name combinations for all but Schizothecium fimicolum Corda. Since Lane's work has remained unpublished these combinations are not valid; however, as an aid to a comparison with Lane's study, reference will be made to his combinations. Two of the species of Schizothecium (=Podospora) reported by Lane are doubtful members of the genus Podospora. Lane's Schizothecium zygosporum (Speg.) Lane is treated by Cain (1934) as Sordaria zygospora Speg. (in this publication, Cain placed all species of Podospora under the generic name Sordaria). However, Cain (1962) and Mirza and Cain (1969)

in papers dealing with the genus Podospora, make no mention of this species, even in their lists of synonyms. Lane's Schizothecium fimicolum Corda is recorded in Mirza and Cain (1969) as doubtful, for they indicate the description of the species is inadequate for determination and no specimen has been found. Those species reported by Lane and found in common with this study are Podospora anserina (Ces. in Rabenh.) Niessl (=Schizothecium anserinum (Ces.) Lane), Podospora vesticola (Berk. and Broome) Cain (=Schizothecium minutum (Fuck.) Lane), Podospora curvula (DeBary) Niessl (=Schizothecium curvulum (DeBary) Lane), Podospora communis (Speg.) Sacc. (=Schizothecium vestitum (Zopf.) Lane), Podospora decipiens (Winter) Niessl (=Schizothecium decipiens (Winter) Lane), and Podospora curvicolla (Winter) Niessl (=Schizothecium curvicollum (Winter) Lane). Lane found three species, Schizothecium taenioides (Griff.) Lane (=Podospora australis (Speg.) Niessl), Schizothecium pyriformis (Bayer) Lane (=Podospora pyriformis (Bayer) Cain), and Schizothecium similis (Hans.) Lane (=Podospora similis (Hans.) Niessl), which this worker did not encounter. Included in the species found during this study, but not reported by Lane, are four species of Podospora, P. appendiculata (Auersw.) Niessl, P. inaequalis (Cain) Cain, P. pleiospora (Winter) Niessl, and P. tetraspora (Winter) Cain.

In the genus Sordaria (in the restricted sense that the genus is recognized by Munk (1957)), Cain (1934) reported eight

species as occurring in North America, while Cain and Groves (1948) reported five species isolated from seeds, two of which have been subsequently recognized as species of Podospora. Lane (1951) listed two species from Illinois, Fimetaria fimicola (Rob.) Griff. and Seaver (=Sordaria fimicola (Rob.) Ces. and DeNot.) and Fimetaria humana (Fuck.) Griff. and Seaver (=Sordaria humana (Fuck.) Winter). The same two species were recorded during this study.

Five species of Bombardia were reported from North America by Cain (1934). Lane (1951), on the basis of the distinctive spore characteristics of this genus, reported an unidentified member of this genus from Illinois. One species was encountered during this present study and has been identified as Bombardia arachnoidea (Niessl) Cain.

The only comprehensive North American study of the genus Sporormia has been that of Cain (1934), in which 30 species are given. Lane (1951) recorded four of these from Illinois, Sporormia hurculea Ellis and Everhart, Sporormia australis Speg., Sporormia leporina Niessl, and Sporormia minima Auersw. In this present study, the latter three species were also identified, in addition to two species not encountered by Lane, Sporormia kansensis Griff. and Sporormia intermedia Auersw., making a total of five species of Sporormia.

Approximately 57 species of Chaetomium have been reported from North America (Ames, 1961, Udagawa and Cain, 1969), of which 30 are coprophilous, at least on occasion. Lane (1951)

reported Chaetomium caprinum Bainier, C. bostrychodes Zopf., C. cochliodes Palliser, C. globosum Kunze, and C. murorum Corda from Illinois. These five species were also recorded during this present study, along with two additional species, Chaetomium aterrimum Ellis and Everhart and Chaetomium crispatum Fuck.

Lane (1951) reported a total of four other species in three genera of pyrenomycetes which were not encountered during this study: Coniochaeta scatigena (Berk. and Broome) Cain, Delitschia didyma Auersw., Delitschia winteri Phill. and Plowr., and Lophotrichus ampullus Benjamin, the latter being isolated at the same location as Benjamin's type collection of this genus.

Three coprophilous species of plectomycetes, a group not included by Lane in his study of coprophilous fungi of Illinois, were recorded. In the genus Kernia three species have been reported from North America (Seth, 1968), and during this study one of these, Kernia brachytricha Ames, was identified several times. In his description of the recently named genus Tripterospora, Cain (1956b) reported three species from North America, and two of these, Tripterospora brevicaudata Cain and Tripterospora longicaudata Cain were recorded in this study. Although Tripterospora brevicaudata has not been described as coprophilous, for it has been reported from seeds and from a living branch of yellow birch, an isolate of this fungus was made and agreed

with all of the morphological characteristics of this species.

In the genus Preussia, better known under the name Perisporium, Cain (1961) reported four coprophilous species from North America. Two of these species, Preussia funiculata (Preuss.) Fuck. and Preussia fleischhakii (Auersw.) Cain, have been identified in this present study. In addition, an isolation of a third species has been made, but, as indicated in the listing of species, it does not agree with any of the 11 known species of this genus as given by Cain (1961).

Knowledge of the coprophilous discomycetes of North America is largely limited to the work of Seaver (1928), and to the recent work of Brummelen (1967) and Kimbrough (1966, 1967, 1969). Lane (1951) did not treat this large group in his study of the coprophilous fungi of Illinois. Twelve species in five genera of the discomycetes, order Pezizales, have been encountered in this present study. In the genus Ascodesmis, Obrist (1961) reported three species from North America, and one of these, Ascodesmis sphaerospora Obrist, was encountered in the course of this research of the coprophilous ascomycetes of southeastern Illinois. Three species of Lasiobolus have been recorded from North America (Kimbrough, 1966), and again one of these, Lasiobolus equinus (Mull. per Gray) Karst. was encountered. In his monograph, Brummelen (1967) reported 18 coprophilous species of Ascobolus and nine of Saccobolus from North America. The following six species of Ascobolus and three species of Saccobolus were

recorded during this current study: Ascobolus albidus Crouan, A. amoenus Oud., A. crenulatus P. Karst., A. furfuraceus Pers. per Hook., A. immersus Pers. per Pers., A. scatigenus (Berk.) Brumm., Saccobolus depauperatus (Berk. and Broome) E. C. Hansen, S. glaber (Pers. per Pers.) Lamb., and S. minimus Vel.. For the genus Iodophanus, Kimbrough et al (1969) reported four coprophilous species occurring in North America. Iodophanus carneus (Pers. per Pers.) Korf was found three times during this study, and all three of these collections have been verified by Dr. Kimbrough.

Any ascomycete appearing in six or more of the 105 collections of manure examined during this study has been considered to be common, while any species appearing only once has been regarded as rare. Among the pyrenomycetes, Podospora anserina, P. curvicolla, P. communis, P. vesticola, Sordaria fimicola, and Chaetomium bostrychodes are treated as common. Cain (1934) also reported these species, with the exception of Chaetomium bostrychodes, as being common and widely distributed in Ontario; however, Cain merely noted the species of Chaetomium identified during his study and made no reference to their distribution or frequency of occurrence. Lane (1951) also reported these same species as common in the vicinity of Urbana, Illinois, again with the exception of Chaetomium bostrychodes.

The pyrenomycetes encountered during this study whose occurrence has been considered rare are Podospora inaequalis,

P. appendiculata, P. pleiospora, Bombardia arachnoidea, Chaetomium aterrimum, and C. crispatum, plus an unidentified species of Xylaria. Cain (1934), however, treated Podospora appendiculata and Bombardia arachnoidea as common and Podospora pleiospora as not common, but did not report Podospora inaequalis, Chaetomium aterrimum and C. crispatum. Cain and Groves (1948) cited isolations of Podospora inaequalis from seeds from several locations in the United States, including Illinois. For Chaetomium crispatum, Chivers (1915) indicates this as a species frequently found on various substrata in New England. On the other hand, Ames (1961) lists only two other localities for this species, Virginia and Tennessee. In addition it should be noted that Skolko and Groves (1953) cite a collection from opossum dung from South Carolina and Abbott (1926) reports it from soil in Louisiana. For Chaetomium aterrimum Chivers (1915) lists only the type collection on damaged wheat from Kansas, and in addition Ames (1961) cites it from New England, Virginia, and Tennessee growing on rat, dog, and rabbit dung. None of the six species regarded as rare were reported by Lane in his study of Illinois coprophilous pyrenomycetes.

Of the eight loculoascomycetes encountered during this present study, none have been recorded as common, while six species are cited as rare. In the genus Sporormia, species falling in the rare category are Sporormia intermedia, S. australis, and S. leporina. In contrast, for Ontario Cain (1934) treated Sporormia intermedia and S. leporina as common and S. australis as not common, while in Illinois,

Lane (1951) reported Sporormia australis and S. leporina as occurring on occassion, and failed to report S. intermedia. In the genus Preussia, P. funiculata, P. fleischhakii, plus the unidentified isolate of the genus, are all considered rare. Cain (1961) has reported Preussia funiculata several times from Canada, while also reporting P. fleischhakii three times from the same area. Lane did not treat Preussia, since cleistocarpous genera were not included in his study.

Of the three species of plectomycetes isolated during this study, one, Kernia brachytricha, qualifies as common, while another, Tripterospora brevicaudata, is rare. Although there are no available references dealing with the distribution of the genus Kernia in North America, the rather frequent occurrence of Kernia brachytricha in this study suggests that it is probably common in states other than Illinois. In his recent description of the genus Tripterospora, Cain (1956b) reported T. brevicaudata as having been isolated twice from Canada and once from Connecticut, although not from dung.

Of the 12 discomycetes encountered during this present research, two are considered common, while five are recorded as rare. For the common species Ascobolus furfuraceus, Seaver (1928) indicates a distribution probably throughout North America, and Brummelen (1967) treats it as common in North America. For the second common species, Ascobolus immersus, Seaver suggests that it also probably occurs throughout

North America, and again, Brummelen (1967) considers it common in North America. Those species of discomycetes regarded as rare include Lasiobolus equinus, Saccobolus minimus, Ascobolus amoenus, A. scatigenus, and A. crenulatus. For Ascobolus amoenus, Seaver (1928) has given the distribution as New York to Iowa, but has not specifically referred to Illinois. For Ascobolus crenulatus he gives as the known distribution New York, and for Ascobolus scatigenus he gives in addition to New York, Porto Rico. For these three species, Brummelen (1967) has recorded several collections of each from North America, but again, none of these were from Illinois. Saccobolus minimus is not treated by Seaver (1928), and Brummelen (1967) gives only one report of this species from North America, that being a collection from Maine made by Thaxter in 1891. For the species Lasiobolus equinus, Seaver (1928) gives as the distribution in North America Massachusetts to South Carolina, North Dakota, Colorado, California, and the Bermuda Islands. Kimbrough and Korf (1967), in their analysis of the tribe Theleboleae, have cited numerous collections of Lasiobolus equinus from North America, but none were from Illinois.

For all species recorded more than three times during this study, a tabulation of the type of manure was made to determine if there was any correlation between a certain species of ascomycete and the manure of a certain kind of animal, but for most none was noted. However, in a few

species a consistency was observed, although possibly this may not be exhibited in further collections. In the five times Podospora tetraspora was observed, all observations were from wild rabbit manure. Of the 12 times Podospora curvicolla was obtained, eight identifications were from rabbit manure while four were from horse manure, suggesting an affinity toward rabbit manure. Sordaria humana was recorded in four collections, always from the manure of wild animals, three of these from rabbit and one from deer. Three of the species which were commonly encountered in this study showed a tendency toward domestic animal dung. Kernia brachytricha was reported ten times, Ascobolus furfuraceus 11 times, and Ascobolus immersus nine times; all of these reports having been made from cow, sheep, and horse manure.

The publications listed in the earlier portions of this paper have been examined for distribution records in North America of the species found during this study. On the basis of these records, and because of the lack of research on coprophilous ascomycetes in Illinois, several of the species found during this study are apparently state records for Illinois. The following 24 species are given as state records: Podospora appendiculata (Auersw.) Niessl, Podospora pleiospora (Winter) Niessl, Podospora tetraspora (Winter) Cain, Bombardia arachnoidea (Niessl) Cain, Chaetomium aterrimum Ellis and Everhart, Chaetomium crispatum Fuck., Preussia funiculata (Preuss) Fuck., Preussia fleischhakii (Auersw) Cain, Sporormia

intermedia Auersw., Sporormia kansensis Griff., Tripterospora brevicaudata Cain, Tripterospora longicaudata Cain, Kernia brachytricha (Ames) Benjamin, Lasiobolus equinus (Mull. per Gray) Karst., Iodophanus carneus (Pers. per Pers.) Korf, Ascobolus albidus Crouan, Ascobolus amoenus Oud., Ascobolus crenulatus P. Karst., Ascobolus furfuraceus Pers. per Hook., Ascobolus immersus Pers. per Pers., Ascodesmis sphaerospora Obrist, Saccobolus depauperatus (Berk. and Broome) E. C. Hansen, Saccobolus glaber (Pers. per Pers.) Lamb., Saccobolus minimus Vel.

SUMMARY

The coprophilous ascomycetes are very common fungi encountered on all types of herbivore dung. They appear at all seasons of the year, developing readily under laboratory conditions, and furnish a diversity of taxonomic groups for study.

This research has been primarily a taxonomic survey of the coprophilous ascomycetes of southeastern Illinois. One hundred and five samples of dung from various herbivore animals were incubated in the laboratory and examined periodically for ascomycetes.

As a result of this research, 44 species representing 14 genera of coprophilous ascomycetes were recorded for this region of Illinois, including ten species of Podospora, two of Sordaria, one of Bombardia, seven of Chaetomium, one of Xylaria, two of Tripterospora, one of Kernia, five of Sporormia, three of Preussia, one of Ascodesmis, three of Saccobolus, six of Ascobolus, one of Lasiobolus, and one of Iodophanus. Nine species were recorded in six or more collections and are therefore considered common, while 19 species were found only once and are regarded as rare. A total of 24 species are reported here as state records.

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KEY TO THE COPROPHILOUS ASCOMYCETES ENCOUNTERED DURING THIS STUDY

1. Ascocarp a perithecium, cleistothecium, or stroma..... 2

1. Ascocarp an apothecium..... 32

2. Ascocarp a perithecium..... 3

2. Ascocarp a cleistothecium or stroma..... 27

3. Perithecium covered with long, brown hairs, spores vermiform at maturity, or composed of one brown cell with a very long primary appendage..... *Bombardia arachnoidea*

3. Perithecia naked, or with various types of hairs, spores with or without gelatinous sheaths or appendages..... 4

4. Spores 4-celled, asci bitunicate (*Sporormia*)..... 23

4. Spores 1-celled..... 5

5. Perithecia covered with various types of prominent hairs, asci evansecent, spores without gelatinous material (*Chaetomium*)..... 6

5. Perithecia with or without hairs, spores with gelatinous sheaths or appendages..... 12

6. Terminal hairs wavy or undulate..... 7

6. Terminal hairs coiled or contorted..... 8

7. Terminal hairs with simple tips..... *Chaetomium globosum*

7. Terminal hairs with incurved tips..... *Chaetomium murorum*

8. Terminal hairs contorted, forming reverse loops near the tips..... *Chaetomium crispatum*

8. Terminal hairs coiled..... 9

9. Two types of coiled terminal hairs: (a.) stout, (b.) slender..... *Chaetomium cochliodes*

9. One type of coiled terminal hairs..... 10

10. Terminal hairs of approximately ten uniform coils..... *Chaetomium aterrimum*

10. Terminal hairs of 3-7 coils..... 11

11. Coiled hairs mixed with straight hairs, perithecia tall..... *Chaetomium caprinum*

11. All hairs coiled, perithecia subglobose to ovoid..... *Chaetomium bostrychodes*

12. Spores with a gelatinous sheath surrounding all but the germ pore, perithecia naked (*Sordaria*)..... 13

12. Spores with gelatinous appendages, perithecia with or without hairs (*Podospora*)..... 14

13. Spores ellipsoid, 19-23 x 11-12.5 u... *Sordaria fimicola*

13. Spores obovoid, 22-25 x 16-17.5 u..... *Sordaria humana*

14. Asci 4-spored..... 15

14. Asci 8-many spored..... 17

15. Spores flattened on one side, secondary appendages absent..... *Podospora inaequalis*

15. Spores ellipsoid, secondary appendages present..... 16

16. Spores 34-40 x 18-20 u, perithecia pyriform to subglobose..... *Podospora anserina*

16. Spores 19-22.5 x 11-13 u, perithecia elongate ovoid..... *Podospora tetraspora*

17. Asci more than 8-spored..... 18

17. Asci 8-spored..... 19

18. Asci 128-256 spored, neck of perithecium with a few tufts of long, agglutinated hairs..... *Podospora curvicolla*

18. Asci 32-spored, neck of perithecia with short papillar-like hairs *Podospora pleiospora*

19. Perithecia lacking agglutinated hairs..... 20

19. Perithecia with tufts of agglutinated hairs..... 22

20. Spores with 2 secondary appendages, perithecia ovoid, without a neck, upper portion covered with straight, scattered hairs..... Podospora appendiculata

20. Spores with more than 2 secondary appendages..... 21

21. Spores with a lyre shaped tuft of secondary appendages, and a skirt of secondary appendages at base of primary appendage..... Podospora decipiens

21. Spores with 4 secondary appendages at apex, and 4 secondary appendages at distal end of primary appendage ..... Podospora communis

22. Spores biseriate, 23-28 x 13-16 u ..... Podospora curvula

22. Spores uniseriate, 17-20 x 11-14 u ..... Podospora vesticola

23. Ascus contracted abruptly to form a short stipe..... 24

23. Ascus with an elongate stipe..... 26

24. Spores 28-32 x 5-6 u..... Sporormia minima

24. Spores larger..... 25

25. Spores 38-45 x 7.5-8.5 u..... Sporormia australis

25. Spores 48-58 x 9.5-11.5 u..... Sporormia intermedia

26. Spores 30-36 x 5.5-6.5 u..... Sporormia leporina

26. Spores 72-77 x 10-12 u..... Sporormia kansensis

27. Ascocarp a stalked stroma, with perithecia embedded in a club-shaped head..... Xylaria sp.

27. Ascocarp a cleistothecium..... 28

28. Cleistothecium black and shiny, with several appendages that are curled at the tips..... Kernia brachytricha

28. Cleistothecium without appendages..... 29

29. Spores 4-celled (*Preussia*)..... 30

29. Spores 1-celled, with hyaline primary appendage (*Tripterospora*)..... 31

30. Spores with obliquely transverse septa, ascus stipe elongate..... *Preussia funiculata*

30. Spores with transverse septa, ascus stipe very short..... *Preussia fleischhakii*

31. Hyaline appendage less than 5 u long..... *Tripterospora brevicaudata*

31. Hyaline appendage over 10 u long..... *Tripterospora longicaudata*

32. Apothecium with prominent hyaline hairs, spores 18-29 x 10-14 u.... *Lasiobolus equinus*

32. Apothecia without hairs..... 33

33. Spores globose, with reticulate markings, apothecia minute..... *Ascodesmis sphaerospora*

33. Spores not globose..... 34

34. Spores hyaline, with callose-pectic markings, 7.5-10.5 x 15-20 u, apothecia flesh colored..... *Iodophanus carneus*

34. Spores violet, purplish, or brownish..... 35

35. Spores firmly united in a cluster within ascus (*Saccobolus*)..... 36

35. Spores separate within ascus (*Ascobolus*)..... 38

36. Ascocarp white, spore clusters 28-37 x 10-13 u..... *Saccobolus depauperatus*

36. Ascocarp yellow..... 37

37. Spores 22-29 x 8.5-14.5 u, finely granular..... *Saccobolus glaber*

37. Spores 11.5-13.5 x 5.5-6.5 u, apothecia 0.1-0.2 mm. in diameter..... *Saccobolus minimus*

38. Spores very large, 58-71 x 28-36 u..... *Ascobolus immersus*

38. Spores smaller..... 39

39. Spores 29-38 x 14-18 u, episporium finely punctate or granular..... Ascobolus amoenus

39. Spore episporium with one to many fissures..... 40

40. Apothecia large, .5-3 cm. in diameter, brown colored with a lighter margin, spores 21.5-25.5 x 11.5-13 u..... Ascobolus scatigenus

40. Apothecia smaller, yellow or white..... 41

41. Apothecia white, spores 20-36 x 11-14 u..... Ascobolus albidus

41. Apothecia yellow..... 42

42. Spores 19-28 x 10-14 u..... Ascobolus furfuraceus

43. Spores 9.5-15 x 6-8 u..... Ascobolus crenulatus

Chart 1.

Tabulation of the species encountered in each of the six counties from which collections were made.

CHART 1.

	Coles	Clark	Cumberland	Douglas	Lawrence	Richland
Podospora anserina	X		X		X	X
Podospora appendiculata					X	
Podospora communis	X		X			
Podospora curvicolla	X		X	X	X	X
Podospora curvula	X	X				
Podospora decipiens	X	X				
Podospora inaequalis						X
Podospora pleiospora	X					
Podospora tetraspora	X		X	X	X	
Podospora vesticola	X	X				X
Sordaria fimicola	X		X		X	X
Sordaria humana	X		X		X	
Bombardia arachnoidea		X				
Chaetomium aterrimum	X					
Chaetomium bostrychodes	X		X		X	
Chaetomium caprinum	X					
Chaetomium cochliodes	X					
Chaetomium crispatum	X					

	Coles	Clark	Cumberland	Douglas	Lawrence	Richland
Chaetomium globosum	X					
Chaetomium murorum	X					X
Xylaria sp.	X					
Tripterospora brevicaudata	X					
Tripterospora longicaudata	X					
Kernia brachytricha	X		X	X		
Preussia fleischhakii	X					
Preussia funiculata						X
Preussia sp.	X					
Sporormia australis		X				
Sporormia intermedia	X					
Sporormia kansensis	X					
Sporormia leporina	X					
Sporormia minima	X				X	X
Ascodesmis sphaerospora	X					

	Coles	Clark	Cumberland	Douglas	Lawrence	Richland
Saccobolus depauperatus	X		X			
Saccobolus glaber	X					
Saccobolus minimus						X
Ascobolus albidus	X					X
Ascobolus amoenus	X					
Ascobolus crenulatus					X	
Ascobolus furfuraceus	X		X			X
Ascobolus immersus	X				X	
Ascobolus scatigenus	X					
Lasiobolus equinus	X					
Iodophanus carneus	X					

Chart 2.

Tabulation of the total number of collections from which each species was obtained.

CHART 2.

Number of collections.

	1	2	3	4	5	6	7	8	9	10	11	12
Podospora anserina	x	x	x	x	x	x	x					
Podospora appendiculata	x											
Podospora communis	x	x	x	x	x	x	x					
Podospora curvicolla	x	x	x	x	x	x	x	x	x	x	x	x
Podospora curvula	x	x	x	x	x							
Podospora decipiens	x	x	x	x								
Podospora inaequalis	x											
Podospora pleiospora	x											
Podospora tetraspora	x	x	x	x	x							
Podospora vesticola	x	x	x	x	x	x						
Sordaria fimicola	x	x	x	x	x	x	x	x	x	x	x	x
Sordaria humana	x	x	x	x								
Bombardia arachnoidea	x											
Chaetomium aterrimum	x											
Chaetomium bostrychodes	x	x	x	x	x	x	x	x				
Chaetomium caprinum	x	x										
Chaetomium cochlioides	x	x										
Chaetomium crispatum	x											
Chaetomium globosum	x	x	x									

Number of collections.

	1	2	3	4	5	6	7	8	9	10	11	12
Chaetomium murorum	x	x										
Xylaria sp.	x											
Tripterospora brevicaudata	x											
Tripterospora longicaudata	x	x										
Kernia brachytricha	x	x	x	x	x	x	x					
Preussia fleischhakii	x											
Preussia funiculata	x											
Preussia sp.	x											
Sporormia australis	x											
Sporormia intermedia	x											
Sporormia kansensis	x	x										
Sporormia leporina	x											
Sporormia minima	x	x	x	x								
Ascodesmis sphaerospora	x	x										
Saccobolus depauperatus	x	x	x	x								
Saccobolus glaber	x	x										

	Number of collections.											
	1	2	3	4	5	6	7	8	9	10	11	12
Saccobolus minimus	x											
Ascobolus albidus	x	x	x									
Ascobolus amoenus	x											
Ascobolus crenulatus	x											
Ascobolus furfuraceus	x	x	x	x	x	x	x	x	x	x	x	x
Ascobolus immersus	x	x	x	x	x	x	x	x	x			
Ascobolus scatigenus	x											
Lasiobolus equinus	x											
Iodophanus carneus	x	x	x									

PLATE 1.

Figs. 1-2. Podospora appendiculata. 1. Perithecium X70. 2. Ascospore X375.

Figs. 3-4. Podospora curvicolla. 3. Perithecium X100. 4. Ascospore X940.

Figs. 5-6. Podospora inaequalis. 5. Perithecium X230. 6. Ascospore X940.

Fig. 7. Podospora vesticola. Ascospore X940.

Fig. 8. Podospora communis. Ascospore X375.

Figs. 9-10. Podospora curvula. 9. Perithecium X60. 10. Ascospore X940.

Fig. 11. Podospora anserina. Ascospore X230.

Figs. 12-13. Podospora decipiens. 12. Ascospore X375. 13. Perithecium X70.

Fig. 14. Podospora tetraspora. Ascospore X940.

Fig. 15. Sordaria fimicola. Ascospore X940.

Fig. 16. Sordaria humana. Ascospore X940.

Figs. 17-18. Podospora pleiospora. 17. Ascospore X375. 18. Perithecium X60.

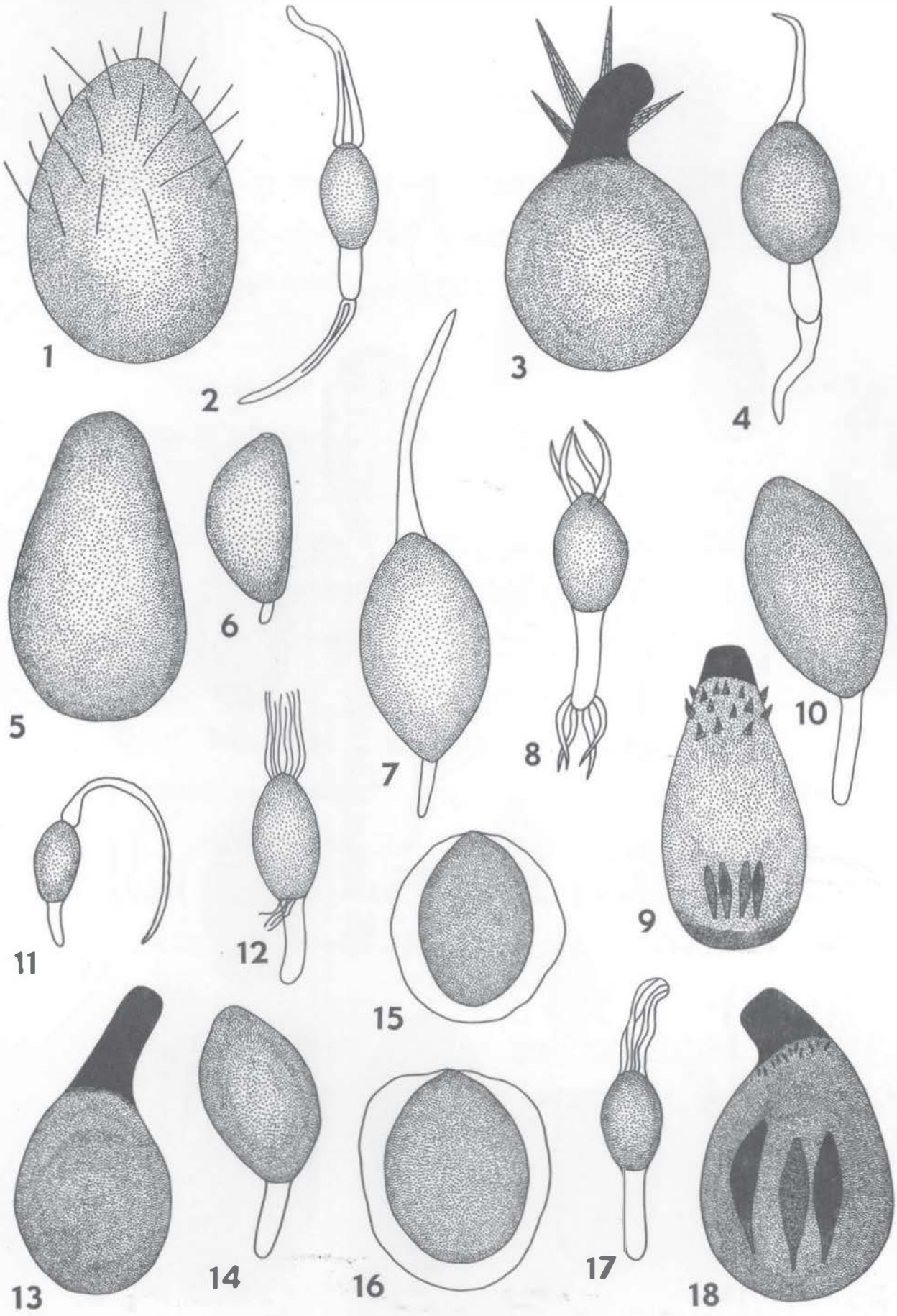
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PLATE 2.

Fig. 19. Saccobolus glaber. Ascospore packet X940.

Figs. 20-21. Saccobolus minimus. Ascospore packets X940.

Fig. 22. Saccobolus depauperatus. Ascospore packet X940.

Figs. 23-27. Ascobolus furfuraceus. 23. Ascus X375. 24. Ascospore X940. 25. Ascospore X940. 26-27. Paraphyses X940.

Fig 28. Ascobolus scatigenus. Ascospore X940.

Fig. 29. Ascobolus albidus. Ascospore X940.

Figs. 30-31. Ascobolus immersus. 30. Ascospore X230. 31. Apothecium X125.

Fig. 32. Ascodesmis sphaerospora. Ascospore X940.

Figs. 33-34. Ascobolus crenulatus. Ascospores X940.

Figs. 35-37. Iodophanus carneus. 35. Ascus X230. 36. Paraphysis X375. 37. Ascospore X940.

Figs. 38-39. Ascobolus amoenus. 38. Apothecium X150. 39. Ascospore X940.

Figs. 40-41. Lasiobolus equinus. 40. Ascospore X940. 41. Apothecium X100.

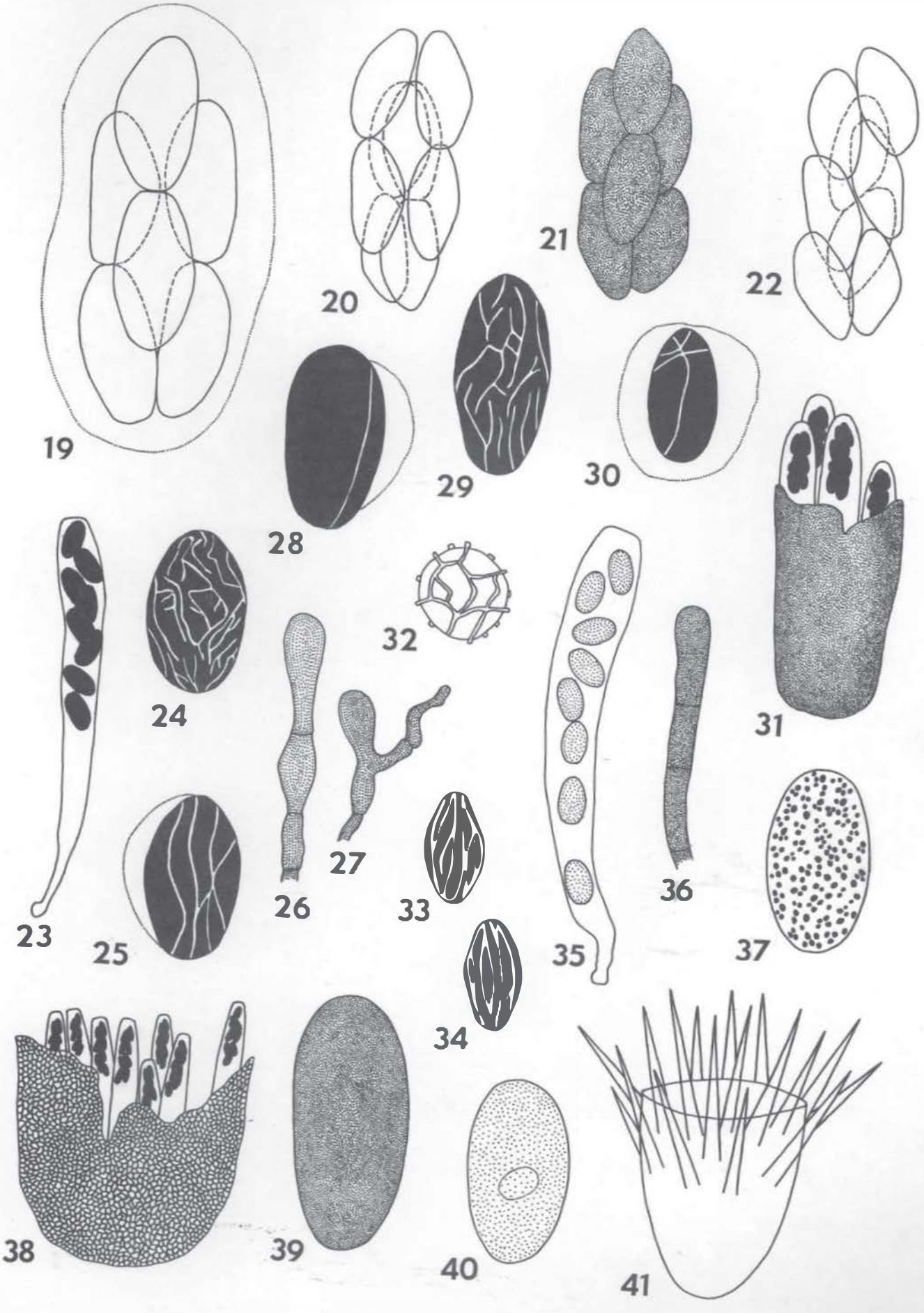
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PLATE 3.

Figs. 42-44. Xylaria sp. 42. Ascospores X940. 43. Stroma X4. 44. Ascus X375.

Fig. 45. Sporormia minima. Ascospore X940.

Fig. 46. Sporormia leporina. Ascospore X940.

Fig. 47. Preussia funiculata. Ascospore X940.

Fig. 48. Preussia fleischhakii. Ascospore X940.

Fig. 49. Sporormia kansensis. Ascospore X940.

Fig. 50. Preussia sp. Ascospore X940.

Figs. 51-52. Bombardia arachnoidea. 51. Mature ascospore X940. 52. Immature ascospore X940.

Fig. 53. Chaetomium murorum. Terminal hair X375.

Fig. 54. Chaetomium cochliodes. Terminal hair X375.

Fig. 55. Chaetomium globosum. Terminal hair X375.

Fig. 56. Chaetomium bostrychodes. Terminal hair X375.

Fig. 57. Sporormia australis. Ascospore X940.

Fig. 58. Trichterospora longicaudata. Ascospore X940.

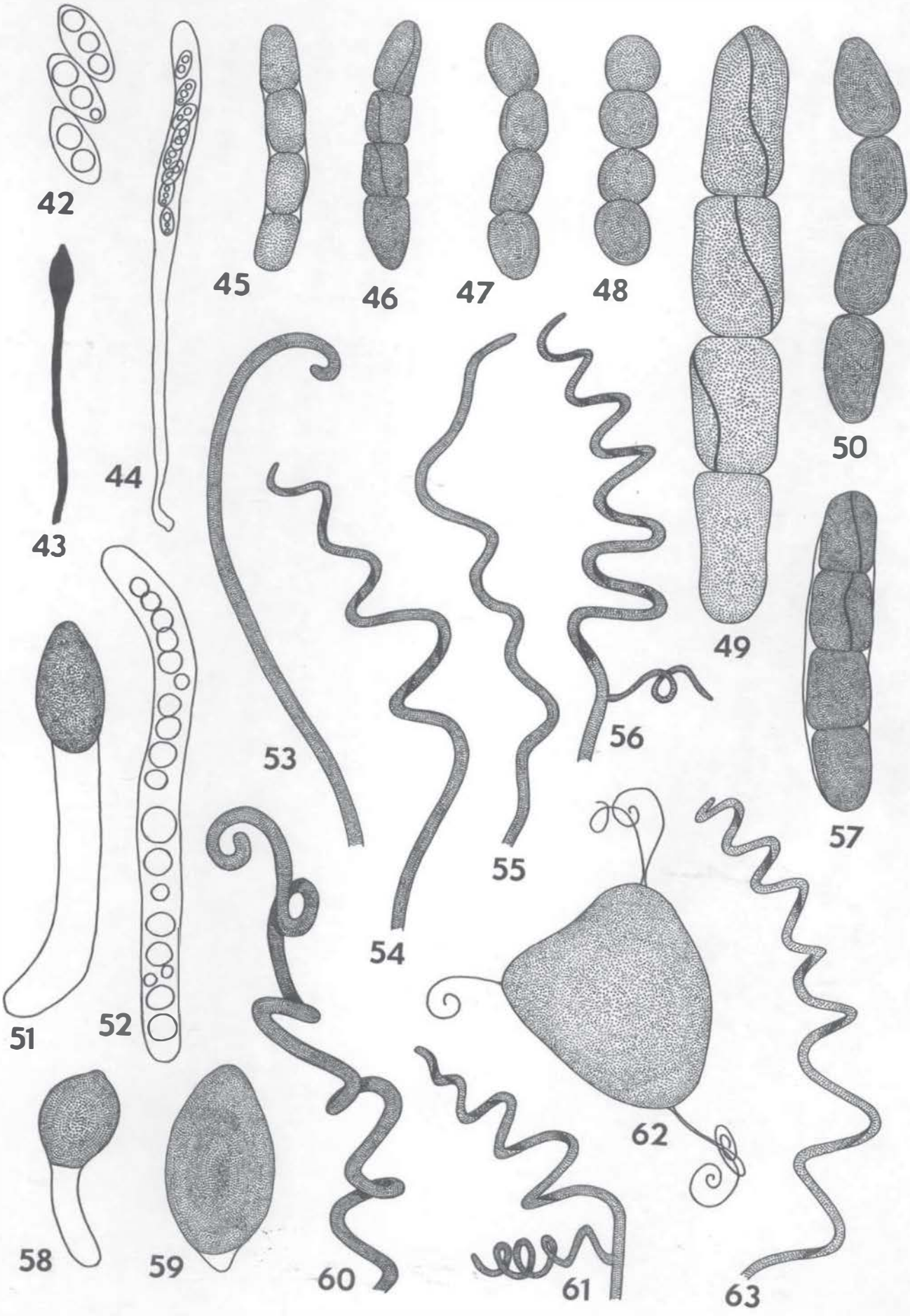
Fig. 59. Trichterospora brevicaudata. Ascospore X940.

Fig. 60. Chaetomium crispatum. Terminal hair X375.

Fig. 61. Chaetomium caprinum. Terminal hair X375.

Fig. 62. Kernia brachytricha. Cleistothecium X200.

Fig. 63. Chaetomium aterrimum. Terminal hair X375.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