A TAXONOMIC REVISION OF THE GENUS ARTHOPYRENIA MASSAL. S. LAT. (ASCOMYCETES) IN NORTH AMERICA

Dissertation for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY
RICHARD CLINTON HARRIS

1975

LIBRARY
Michigan State
University

This is to certify that the

thesis entitled

A TAXONOMIC REVISION OF THE GENUS
ARTHOPYRENIA MASSAL. S. LAT.
(ASCOMYCETES) IN NORTH AMERICA

presented by

RICHARD CLINTON HARRIS

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Botany

Henry A. Imshaug
Major professor

Date 3 July 1975

O-7639

BINDING BY
HOAG & SONS'
BOOK BINDERY INC.
LIBRARY BINDERS
SPRINGPORT, MICHIGAN

ABSTRACT

A TAXONOMIC REVISION OF THE GENUS ARTHOPYRENIA MASSAL. S. LAT. (ASCOMYCETES) IN NORTH AMERICA

By

Richard Clinton Harris

While studying large numbers of specimens of the pyrenolichen genus *Arthopyrenia* preparatory to a monograph of the North American species, it became clear that this was impossible without first clarifying familial and generic boundaries within the pyrenolichens. For this purpose a wide variety of additional material was examined and pertinent characters were recorded with drawings. These morphological studies, and chemical studies where relevant, have resulted in suggestions for minor reorganization of the families of pyrenolichens and in a drastic revision of generic boundaries. After a preliminary assessment of the taxonomic characters used, a key is given to the families and the genera included in them are listed. This is followed by a key to the genera of hyalodidymous and hyalophragmous pyrenolichens of North America (excluding Verrucariaceae). In the subsequent systematic section *Arthopyrenia* is redefined and many species are placed in segregate genera and combined with species described in other genera resulting in the following groupings: Pleosporaceae Wint. (*Arthopyrenia* Massal., *Mycoglaena* v. Höhn. and *Tomasellia* Massal.), Strigulaceae Fr. (*Acrocordia* Massal., *Anisomeridium* (Müll. Arg.) Choisy, *Pleurotrema* Müll. Arg., *Pyrenocollema* Reinke and *Strigula* Fr.) and Trypetheliaceae Eschw. (*Polymeridium* (Müll. Arg.) R. C. Harris and *Pseudopyrenula* Müll. Arg.).

Keys, short descriptions, discussions, illustrations and lists of exsiccati examined and specimens seen are provided for the 85 species included in the genera above. Distribution maps are provided for the more common species. A subsequent section contains keys and brief discussions for the North American species of other genera with colorless transversely septate spores not directly involved in the revision of *Arthopyrenia*: Pyrenulaceae Rabenh. (*Lithothelium* Müll. Arg. and *Plagiocarpa* R. C. Harris), Trichotheliaceae (Müll. Arg.) Bitt. & Schill. *in* Schill. (*Porina* Müll. Arg. and *Trichothelium* Müll. Arg.), Trypetheliaceae Eschw. (*Astrothelium* Eschw., *Trypethelium* Spreng. and an undescribed genus) and *Thelopsis* Nyl. whose familial position is uncetain. These genera contain 47 North American species, although many of them are left unnamed. Excluded taxa, the disposition of relevant names presently included in the North American lichen flora, and exsiccati examined are listed.

No new genera were described but one section is raised to the rank of genus, *Polymeridium* (Müll. Arg.) R. C. Harris. Fifteen new species are described: *Anisomeridium finkii*, *A. macrosporum*, *A. tuckeri*, *Arthopyrenia annulata*, *A. degelii*, *A. herrei*, *A. lyrata*, *A. minor*, *A. oblongens*, *A. taxodii*, *Mycoglaena wetmorei*, *Polymeridium exasperatum*, *Pyrenocollema imshaugii*, *Strigula connivens* and *S. hypothallina*. Two new names are provided to avoid creating homonyms: *Arthopyrenia confluens* for *Tomasellia leucostoma* Müll. Arg. and *Strigula americana* for *Arthopyrenia tenuis* R. C. Harris. Forty-six new combinations are proposed: *Acrocordia megalospora* (Fink) R. C. Harris, *Anisomeridium adnexum* (Müll. Arg.) R. C. Harris, *A. albisedum* (Nyl.) R. C. Harris, *A. ambiguum* (Zahlbr.) R. C. Harris, Anisomeridium biforme (Borr.) R. C. Harris, A. carinthiacum (J. Stein.) R. C. Harris, A. distans (Willey) R. C. Harris, A. feeanum (Müll. Arg.) R. C. Harris, A. leucochlorum (Müll. Arg.) R. C. Harris, A. sanfordense (Zahlbr.) R. C. Harris, A. subprostans (Nyl.) R. C. Harris, A. tamarindi (Fée) R. C. Harris, A. willeyanum (R. C. Harris) R. C. Harris, Arthopyrenia cedrina (Zahlbr.) R. C. Harris, A. plumbaria (Stizenb. in Hasse) R. C. Harris, Pleurotrema anacardii (Vain.) R. C. Harris, Polymeridium albidum (Müll. Arg.) R. C. Harris, P. catapastum (Nyl.) R. C. Harris, P. contendens (Nyl.) R. C. Harris, P. pleiomerellum (Müll. Arg.) R. C. Harris, P. quinqueseptatum (Nyl.) R. C. Harris, P. subcinereum (Nyl.) R. C. Harris, Porina heterospora (Fink in Hedr.) R. C. Harris, P. microspora (Fink in Hedr.) R. C. Harris, Pyrenocollema caesia (Nyl.) R. C. Harris, P. epigloea (Nyl.) R. C. Harris, P. halodytes (Nyl.) R. C. Harris, P. prospersella (Nyl.) R. C. Harris, P. saxicola (Massal.) R. C. Harris, P. tichothecioides (Arn.) R. C. Harris, Strigula affinis (Massal.) R. C. Harris, S. phaea (Ach.) R. C. Harris, S. stigmatella (Ach.) R. C. Harris, S. submuriformis (R. C. Harris) R. C. Harris, S. sychnogonioides (Nitschke in Rabenh.) R. C. Harris, S. taylori (Nyl.) R. C. Harris, S. viridiseda (Nyl.) R. C. Harris, S. wilsonii (Ridd.) R. C. Harris, Tomasellia americana (Minks ex Willey) R. C. Harris, T. californica (Zahlbr.) R. C. Harris, T. eschweileri (Müll. Arg.) R. C. Harris, T. lactea (Ach.) R. C. Harris, T. macularis (Minks ex Willey) R. C. Harris, T. sparsella (Nyl.) R. C. Harris and Trypethelium floridanum (Zahlbr. ex Choisy) R. C. Harris.

A TAXONOMIC REVISION OF THE GENUS

ARTHOPYRENIA MASSAL. S. LAT. (ASCOMYCETES) IN NORTH AMERICA

By

Richard Clinton Harris

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Botany and Plant Pathology

1975

ACKNOWLEDGEMENTS

Above all I would like to thank Dr. Henry Imshaug for his invaluable advice on nomenclatural and editorial problems. Special thanks go to Dr. Howard Crum and Dr. Rogers McVaugh for support, both spiritual and financial, during the past year which has made completion of this thesis possible. I would also like to thank the curators and institutions from which material was borrowed, especially Peter James, British Museum, for the loan of Acharian specimens, O. Vitikainen, Helsinki, for his help with Nylander types and Dr. Shirley Tucker, Louisiana State University, for lending me her very interesting unidentified personal collections. Finally, I wish to thank W. R. Buck for helping with some of the typing.

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

This study was begun with the intention of monographing the genus *Arthopyrenia* in North America. After several years of study it became clear that *Arthopyrenia* was not a single genus. This view was strongly supported by the developmental studies of Janex-Favre (1971) which indicated that some of the species included in the genus belong to very different groups of Ascomycetes. As a result it became necessary to define the genera involved before any monographic studies could be attempted. Thus the direction of my study was modified to provide a foundation on which future monographic studies may be constructed. Since definitions of generic limits require a knowledge of related genera, the study was broadened to include the other genera of pyrenolichens with hyaline spores. The preliminary results of these supplementary investigations are presented in the form of keys to provide a context for the dismemberment of *Arthopyrenia*. They also provide a rather comprehensive manual by which the more common pyrenolichens with colorless, transversely septate spores may be identified. Ultimately I ended up making some preliminary studies in almost all of the genera of pyrenolichens (mostly excluding the Verrucariaceae). This has meant almost ten years of work and examination of approximately 7000 specimens. The tentative results of this overview are embodied in a suggested reorganization of the families of pyrenolichens.

This paper is in no way intended to be final or complete. It is intended to place my ideas on the systematics of the pyrenolichens before the scientific community to serve as a basis for discussion. Nor is it complete in its coverage of the species of *Arthopyrenia* s. lat. in North America. Specimens from several large herbaria remain to be

studied. Also a number of presumed new species have not been included since they are represented by only one or two collections. I feel that this is justified since I hope to go on from this starting point to monograph each of the segregate genera separately. Also the probability of these rare species being encountered is very low. Undoubtedly there will be some changes in specific names in the future as I have not examined the types of a large number of tropical American species (Brazil especially has many species in common with the southern United States). Thus at the familial and generic levels this study is intended to serve as a foundation for future work, but at the specific level it is best described as a progress report.

Arthopyrenia, as a genus, has in the past been defined mainly by three characters, perithecial ascocarp, colorless transversely septate spores and branched paraphyses which are usually persistent. It has grown by a process of accretion to an unwieldy size of c. 300 species. This alone might lead one to suspect the naturalness of the genus. That the unnaturalness of this assemblage was in part realized by earlier workers seems to be indicated by the often extensive generic synonymies. Thus I am not so much in the position of creating new genera but in one of redefining already published taxa. Keissler (1936-38) made a beginning in separating out the species associated with blue-green algae. Riedl (1962) has tried to reduce the size of the genus by dividing it on the basis of spore septation. Recent European workers have re-established *Acrocordia* (Vězda. 1968; Poelt, 1969). Vězda (1968) has very clearly pointed out the need for segregate genera from *Arthopyrenia*.

In establishing these segregate genera I have taken as a first principle that they should be as homogeneous as possible. I have retained in *Arthopyrenia* any species whose position is in doubt. Thus *Arthopyrenia* itself is still somewhat heterogeneous. I suspect further work may lead to the segregation of at least one additional genus (*Arthopyrenia bifera* group). The splitting up of *Arthopyrenia* has resulted in a very large number of name changes, however I feel that these are fully justified by the distinctness and homogeneity of the segregates.

The terminology used here is essentially that used in Harris (1973). Any modifications or additional terms are included in the discussions of the appropriate structures in the section on taxonomic characters. Since the pyrenolichens include ascolocular, semi-ascohymenial and ascohymenial members, I have chosen to use a single relatively neutral set of terms throughout rather than changing with each group even though some precision is lost. In discussing ascus types and ascocarp types I follow the terminology of Chadefaud (1973) and Janex-Favre (1971), mostly translated into English but occasionally left in the original French where this seems appropriate. Spore shapes are described in terms of plane figures based on an optical section.

Although this study was primarily centered on North America north of Mexico, a considerable amount of European, West Indian and South American material was examined. For common European species or where it has otherwise seemed useful some species not occurring in North America have been included. Species with only a few collections from North America have not been mapped nor have those whose distribution is essentially unchanged from that shown in Harris (1973). In the case of very common species only selected specimens have been cited.

The abbreviations for journal titles have been taken from Lawrence *et al.* (1968), those of exsiccati from Lynge (1920-22, 1939) or follow the pattern of these works. Acronyms for herbaria in specimen citations are the standard ones of Lanjouw & Stafleu (1964). Herbaria of special significance kept separately from the general collections are indicated by the acronym of the institution plus the abbreviated name of the original owner of the collection. In the case of the Tuckerman and Nylander herbaria a sheet or specimen number is also included to facilitate location of the specimens. Specimens have been seen from the following herbaria: CAN, FH, G, H, LD, LSU, M, MICH, MSC, OSC, PC, S, TUR, UMBS, UPS, US, US *ex* MO, W & WIS.

II. METHODS

The methods of study used were mainly those outlined in Harris (1973). The only major change was that the critical characters have been recorded in drawings for the majortity of specimens examined using a Wild drawing tube. This procedure, although very tedious and time consuming, has a number of very definite benefits. It provides a permanent record of a collection's characteristics and greatly reduces the necessity for re-examination with consequent destruction of additional material. This is most important in preserving material for future study in these groups where a type collection may consist of only a few tiny perithecia. Secondly it forces one to examine each specimen very closely. These advantages are obvious. More important, however, is that the large amount of time necessarily spent at the microscope provides the time to consider each specimen and its relations to other specimens very carefully. As a result of this procedure my taxonomic concepts evolved through the relating of specimens to a few common species for which I had abundant material. These species thus served as nuclei around which the segregate genera have formed. The collections were not actually completely sorted into species until late in the study. Finally, these camera lucida drawings have been directly utilized for the illustrations, either by direct tracings in the case of the asci and ascocarp cross sections or by tracings with a pantograph in order to enlarge them in the case of the ascospores and conidia.

A minor change in method is the increased use of two stains. Phloxine (1-2 percent in water) mixed with 15-20 percent aqueous

potassium hydroxide (KOH) was used to stain thin sections of the thallus, especially in old herbarium specimens, to check the presence or absence of algae. The contents of the algal cells usually stain more heavily than the surrounding bark cells. Additional contrast between bark and algal cells may be obtained by washing with KOH. Chlorazol Black (1-2 percent in water) mixed with KOH on a microscope slide immediately before use has proved to be the most satisfactory stain for the chitinoid ring in the ascus tip of *Porina* and *Trichothelium*.

III. TAXONOMIC CHARACTERS

A. Thallus

In the majority of the Pleosporaceae and Strigulaceae the thallus is mostly just a lighter blotch on the surface of the substrate and provides little or no information of taxonomic value. In some species of *Strigula*, especially the foliicolous ones, the growth habit, color, presence of punctation and presence of hypothallus are useful in distinguishing species. In the Pyrenulaceae, Trichotheliaceae and Trypetheliaceae the thallus may provide as much taxonomic information as the characters of the ascocarp, asci and spores. There is considerable variation in such characters as texture, color, pruinosity, punctation and crystalline inclusions. In *Porina* there are even some species which produce isidia. Interestingly enough pyrenolichens seem not to produce soredia. The only instance I am aware of is *Normandina pulchella* (Borr.) Nyl.

B. Phycobiont

Among the pyrenolichens there seems to me to be a high correlation between the nature of the phycobiont and mycological characters at the familial level or occasionally even at the generic or specific level. Those genera which I consider to belong in the Pleosporaceae have only a very few species which seem to be associated with *Trentepohlia*, the majority are non-lichenized. Ahmadjian (1958, 1967) has reported six genera of the Chlorophyceae (but not *Trentepohlia*) and one of the Xanthophyceae from various members of the Verrucariaceae. The Strigulaceae, Trypetheliaceae and Trichotheliaceae are associated with

Trentepohlia with a few exceptions. Foliicolous species of _Strigula_ are associated with _Cephaleuros_, while those of _Porina_ are associated with _Phycopeltis_. A few species in the Strigulaceae and Trypetheliaceae seem to be non-lichenized. However, this is not certain since they are tropical species known from very few collections, often in poor condition. It is quite possible that _Trentepohlia_ could be found in fresh material. A few species in the Strigulaceae are associated with various blue-green algae. They have been placed in a single genus which is distinct on mycological grounds as well. They seem to represent an evolutionary line line adapted to aquatic and semi-aquatic habitats. It could be possible that this association with blue-green algae is part of the adaptation. There are, however, a few semi-aquatic species of _Anisomeridium_ associated with _Trentepohlia_.

C. Ascocarp

The ascocarp and associated modifications of the thallus are of relatively little use at the generic and specific levels in the Pleosporaceae and Strigulaceae. In the past much has been made of whether the carbonized wall layer is continuous beneath the ascocarp or not. A given species may have a definite tendency in this regard but it is subject to considerable modification due to the nature of the substrate, age, and amount of erosion of the upper layers of thallus and bark. Ascocarp size and shape are of some use but are often quite variable within a species. The amount the ascocarp is immersed in the substrate or covered by the thallus is occasionally useful but is also subject to environmental modification. Although the above characters are comparatively easily observed, I have tended to avoid using them in keys due to their variability.

Obvious exceptions to the above are when the position of the ostiole is eccentric or lateral (parathelioid ascocarp), when two or more ascocarps are joined by the fusion of their ostiolar necks (astrothelioid ascocarp) or when fusion is even more complete so that a compound ascocarp is formed with the ostioles separate (mycoporoid ascocarp) or joined (astrothelioid ascocarp). The parathelioid and astrothelioid types are lacking in the Pleosporaceae and Trichotheliaceae, rare in the Strigulaceae, but fairly common in the Pyrenulaceae and Trypetheliaceae. These two types of ascocarps have been used in the past to define families (Zahlbruckner, 1926) but it is clear that such families are unnatural and the genera involved are better placed with their erect ostioled relatives.

The color of the outer layers of the ascocarp wall is more or less uniformly brown to brownish black in the majority of the pyrenolichens but species of _Mycoglaena_, _Porina_ and _Thelopsis_ provide notable exceptions. The color in these may be blue green, yellowish to reddish, pallid or even colorless. The color of the ascocarp is taxonomically important in these genera.

Although only a few species have been studied it seems as if the manner in which the ascocarp develops may be distinctive at the familial level (Janex-Favre, 1971). _Arthopyrenia_ s. str. has typical ascolocular development as one would expect in a member of the Pleosporaceae. Members of the Verrucariaceae (except _Dermatocarpon_) have a developmental type combining features of both ascolocular and ascohymenial ascocarps. Chadefaud (1973) has referred to them as semi-ascohymenial. _Dermatocarpon_ is wholly ascohymenial (Janex-Favre, 1971). _Acrocordia conoidea_ and _Pyrenocollema halodytes_, both in the Strigulaceae, have

ascohymenial development but lack any ostiolar apparatus. Janex-Favre refers to these as perithecioid ascocarps. Pyrenula nitida and her Porina sp. are also ascohymenial but with an ostiolar apparatus with periphyses and are indicated as possibly more closely related to primitive discomycetes than to the non-lichenized ascohymenial pyrenomycetes (Janex-Favre, 1971).

I have previously used the terms involucrellum and exciple (Harris, 1973). The work of Janex-Favre has shown that the situation is more complex, but I feel that the terms are still useful. The involucrellum is the primary envelope which involves the thallus and bark in its outer layers as in Pyrenula nitida and her Porina sp. Or perhaps, as in Acrocordia conoidea and Pyrenocollema halodytes, the thalline envelope could be considered to be equivalent to the involucrellum. In fact these two envelopes may be different expressions of the same structure. The involucrellum could also be regarded, in my opinion, as a very much reduced pseudostroma since it contains bark and algal cells. The exciple would then usually be either the secondary envelope and/or the carpocentral envelope.

The involucrellum, carbonized or not, often contains colorless crystals (Pyrenulaceae, Trichotheliaceae and Trypetheliaceae). In the Pyrenulaceae crystals are most often produced in and around the ostiolar apparatus or in the ascocarp wall. Production of crystals, although occasionally variable, seems on the whole to be a reliable specific character.

The well developed ostiolar apparatus in the Pyrenulaceae seems to me to be of biological significance. In many species, especially those with parathelioid and astrothelioid ascocarps, the ostiolar apparatus

is large and heavily gelatinized and in fact may control spore liberation from the ascocarp. When wet the diameter of the canal through it seems less than the diameter of the spores. This combined with the fact that the neck of some ascocarps is several times longer than the asci leads me to speculate that the spores are released within the ascocarp. Granted that the bitunicate asci of this group are extensible, but not only would they have to extend several times their own initial length [and none of the illustrations by Swinscow (1966) or Morgan-Jones (1972) show any great amount of extension], they would have to force their way through the narrow canal of the ostiolar apparatus. The hymenium contains much gelatinous material and the secondary envelope is free from the primary envelope except at the tip and contracts and expands with changes in moisture. Perhaps the pressure developed in these changes expels the spores. However I suspect that the final impetus which liberates the spore is given by the ostiolar apparatus wich pops it out in the same way a bean squeezed between two fingers may be shot some distance. Thus it seems possible that in the Pyrenulaceae the ascocarp has taken over the function of the ascus in spore liberation. Indeed it seems to be one of the characters which help differentiate the Pyrenulaceae from the Trypetheliaceae, since in the former the secondary envelope commonly separates from the primary envelope, I have never observed this phenomenon in the latter. Nor have I observed any well developed ostiolar apparatus in the Trypetheliaceae.

As indicated in the section on lichen substances, various pigments are not uncommonly deposited within the outer layers of the involucrellum or pseudostroma in the Pyrenulaceae, Trichotheliaceae and Trypetheliaceae.

In the Trypetheliaceae and to a lesser extent in the Pyrenulaceae the ascocarps may be aggregated into small or large groups within psuedostromata. These pseudostromata may be little different from the surrounding thallus, e.g., Trypethelium virens, or may form warts much different from the thallus, e.g., Trypethelium eluteriae or Laurera spp. As a result species in the Trypetheliaceae can often be identified with the dissecting microscope alone, whereas in other pyrenolichen families spores and even conidia are required for a positive identification.

D. Hymenium

The hymenium consists of interascal threads of various sorts and the asci, often surrounded by abundant gelatinous material. I have decided to follow Poelt (1974) in using paraphyses as a neutral term for the interascal threads. More precisely however those in ascolocular ascocarps, e.g., Arthopyrenia s. str., are pseudoparaphyses. Those associated with ascohymenial ascocarps, e.g., Acrocordia, are true paraphyses (Janex-Favre, 1971). Members of the Verrucariaceae have both pseudoparaphyses and true paraphyses or only pseudoparaphyses.

The amount of branching and anastomosing of the paraphyses is generally a useful character, although not one which lends itself to easy description or illustration. In some species of Arthopyrenia and all of those of Tomasellia the paraphyses are quite broad, much branched and consist of short cells so that the hymenium appears cellular. In the Verrucariaceae the paraphyses are lacking or very soon disappear. In the remaining pyrenolichens the paraphyses are slender and thread-like with relatively long cells. In Strigula there is very little branching and this is helpful in recognizing members of this genus.

The paraphyses in members of the Trichotheliaceae are essentially unbranched although an occasional dichotomy may be found. In the Trypetheliaceae on the other hand it is quite the opposite since the regular net-like branching and anastomosing seems to characterize the family.

The gelatin surrounding the paraphyses and asci often reacts with iodine, giving blue green, sordid or orangish colors. As far as I know all of the members of the Verrucariaceae exhibit this reaction. A sizeable percentage of the Pyrenulaceae react as do a small number of the Pleosporaceae. This seems to be a useful character in recognizing species in these families. The Strigulaceae, Trichotheliaceae and Trypetheliaceae have not yet been found to have any hymenial reactions with iodine.

In addition to the gelatinous matrix the hymenium may contain other substances dispersed through it. The presence of these substances appears to be a good specific character in most cases. In the Pyrenulaceae they are usually in the form of small oil-like droplets. In the Trypetheliaceae, at least in herbarium specimens, they in the form of colorless amorphous granules which liquify on addition of KOH. This difference between the types of materials inspersing the hymenium seems to be quite reliable in distinguishing the two families. The other families of pyrenolichens may have a few oil-like droplets in the hymenium, they are never abundant enough or variable enough to provide any taxonomic information.

In Psuedopyrenula the outer layer of the hymenium contains a yellowish pigment which turns red in KOH. The amount present is often variable and thus difficult to detect in some cases. An attempt to correlate the presence or absence of this pigment with spore size led

to chaos. More study is required to assess the taxonomic worth of this pigment. Temporarily I do not attach much importance to the pigment at the species level, although its presence is diagnostic for the genus.

E. Asci

With few exceptions the fundamental ascus type of the pyrenolichens has been found to be the bitunicate type (Richardson & Morgan-Jones, 1964; Swinscow, 1965b, 1966, 1967; Morgan-Jones & Swinscow, 1965; Vězda, 1968; Janex-Favre, 1971; Morgan-Jones, 1972). In those most closely studied they have proved to be bitunicate-nassascé (Janex-Favre, 1971). Thus the asci have an exoascus and endoascus which are not permanently fused together and the ocular chamber contains a nassé [see Chadefaud (1973) for a summary of ascus types]. In the process of spore liberation the more fragile exoascus ruptures and the endoascus increases in length and releases the spores. A number of illustrations in the papers referred to above show the exoascus breaking some distance from the tip of the ascus leaving a thimble-shaped cap of exoascus on the extended endoascus. This troubles me somewhat, since if the spores are to be released through a pore or break in the tip of the endoascus, this cap would almost surely interfere. In the perithecial type of ascocarp I can visualize no ready mechanism for the endoascus to rid itself of this cap. The only obvious method would be for it to be carried away by the discharge of the spores, but that would surely reduce the distance which the spores could be discharged. I have never observed any such thimble-shaped caps left in the hymenium. Another possibility is that the endoascus simply disintegrates releasing the spores within the ascocarp and then the spores are released from the ascocarp by some means

other than active discharge from the ascus. In the Pyrenulaceae there are some indications that this what happens (see under discussion of ascocarp). In view of the difficulties which an exoascus cap might present to spore release it seems to me more probable that the brittle exoascus has been broken in an unnatural manner in the process of preparing the material for study. This, of course, would not change the interpretation that these asci are bitunicate.

In the Trichotheliaceae the ascus seems to be fundamentally distinct from those previously discussed. Janex-Favre (1971) has interpreted the ascus in a species of _Porina_ as being of the archeascé type, lacking a nassé, but bitunicate with the endoascus reduced mainly to the apical dome. Janex-Favre also reports a raised ring-like thickening at the tip of the exoascus. I have examined many species of _Porina_ and two of _Trichothelium_ and have seen no indications that the ascus is functionally bitunicate. There is, however, in most species a very distinct ring in the tip of the ascus. It is often visible without staining due to its refractive properties differing from those of the surrounding asucs wall. It can readily be stained with Congo Red or Chlorazol Black and thus is of the chitinoid type. Janex-Favre (1971, f. 51,C, D) illustrates it as being raised and thicker than the rest of the outer layer of the exoascus. As far as I am able to determine it is flush with the rest of the exoascus and included within it (or if the exoascus were interpreted as being very thin, perhaps in the outermost layer of the endoascus). Since it does seem to be part of the exoascus it is not an apical ring in the sense of Chadefaud and his students, as the latter structure is a part of the endoascus. It is very similar to the upper chitinoid ring I have seen in the ascus apex of _Nectria_

episphaeria (Tode _ex_ Fr.) Fr. The lower ring is clearly part of the endoascus but the upper seems to occupy a position like that in _Porina_. It differs in being broader. It is possible that the _Porina_ type of ascus could be derived from that of _Nectria episphaeria_ by reduction of the endoascus and loss of the lower ring. This possibility taken together with the spore type and the tendency for _Porina_ to have brightly colored ascocarps, as in the Nectriales, tempts me to wonder if perhaps the Trichotheliaceae might not have its origins in the Nectriales. If this were true then the Trichotheliaceae would seem to be only distantly related to the other pyrenolichens. Janex-Favre (1971) described the ascocarp development of _Porina_ as being very similar to that of _Pyrenula_ which would argue against a relationship with the Nectriales. However it seems to be a possibility which should be investigated.

Some species of _Microglaena_ and _Thrombium epigaeum_ have an amyloid apical ring. Species of _Microglaena_ have been shown to have bitunicate asci (Morgan-Jones & Swinscow, 1965). Thus the asci would seem to be of the archeascé type with an amyloid ring and bitunicate dehiscence.

A fourth type of ascus is found in _Thelopsis_ and _Belonia_. The asci are very thin walled, more or less as in _Porina_, but lacking a chitinoid ring in the ascus apex. The hymenial gelatin reacts with iodine which also seems to indicate their removal from the Trichotheliaceae.

Thus the bulk of the pyrenolichens, Pleosporaceae, Pyrenulaceae, Strigulaceae and Trypetheliaceae have the same basic ascus type. There seem to be a few smaller groups which may in part be defined by ascus type. These are the Trichotheliaceae plus two groups of uncertain position.

Within the larger groups the asci are useful in defining genera and species. The Trypetheliaceae are largely characterized by asci with broad, shallow ocular chambers. The long cylindrical asci with an almost subglobose ocular chamber are diagnostic for the genus _Acrocordia_. Ascus shape is often useful. Typical pleosporoid asci, swollen at the base, are almost entirely confined to _Arthopyrenia_ s. str. and _Tomasellia_. Within _Arthopyrenia_ there is a transition from this type (_A. fraxini_, _A. punctiformis_) to nearly cylindrical asci (_A. lapponina_). The long flexuous ascus base found in most species of _Pyrenocollema_ is more or less diagnostic for the genus. Ascus size may occasionally be useful in separating closely related species but as a general rule it is related to spore size. Thus ascus size is not included in the descriptions unless it is genuinely useful in distinguishing species.

F. Ascospores

Without any doubt, although it means much tedious microscopic work, the ascospores provide many of the most reliable characters for identifying and classifying taxa of the pyrenolichens. They have been one of the most important characters used in the formation of genera (Zahlbruckner, 1926), based primarily on color, septation and wall thickenings. This dependence on spore characters to the exclusion of others has in some cases led to fairly natural groupings, e.g., _Pyrenula_, but in others to largely unnatural assemblages, e.g., _Arthopyrenia_ s. lat. When assigning a pyrenolichen to a genus one must weigh all available data. A case in point is _Plagiocarpa hyalospora_ which has colorless spores with very little wall thickening. On the basis of this type of spore one would not associate the species with _Pyrenula_. However it has the same type of ascocarp, hymenium and conidia which are particular to Pyrenula and related genera. Further the species is included in the same genus with brown spored species on the basis of an unusual ascocarp type and a unique ascus type.

In addition to the spore characters mentioned above, size and shape are useful at various levels. It is interesting to note that the larger spores are found in lichenized genera, especially Acrocordia and Anisomeridium. The non-lichenized genera Arthopyrenia and Tomasellia tend to have rather small spores mostly less than 25 µ in length. The number of spores in an ascus is usually eight although one or two often do not develop. A regular decrease in spore number is found in many genera but seems of no significance above the specific level. It is usually accompanied by an increase in spore size. Polyspory is very rare in the pyrenolichens (Thelopsis), and apparently lacking in the main families. However, the separation of the spores into two part spores while still in the ascus (Strigula) gives rise to a kind of polyspory different from the usual sort.

In the smaller spored species the only layers of the spore wall (Chadefaud, 1969) which are readily discernible are the perisporal formation (ectospore + perispore) and the episporal formation (exospore + epispore). In the Pyrenulaceae and Trypetheliaceae the endosporal formation (mesospore + endospore) is very well developed and is in part diagnostic of these families. In fact the endospore is so well developed that Morgan-Jones (1972, 1973) has interpreted this structure as forming endoascosporic cells or endospores which could possibly be set free to act as secondary diaspores. I personally doubt that this happens. I have examined hundreds of specimens of members of these

and never seen these endospores released in the manner illustrated by Morgan-Jones. The endospore layer can be partially freed from the mesospore but only with considerable difficulty and not in all species. In a number of species of Pyrenula I have found spores germinated in the hymenium in the manner illustrated by Pyatt (1974) by a germ tube at either end of the spore. Some species of Anthracothecium and Parmentaria have muriform spores sufficently large that the spores can be collected from the bark on to which they have been expelled. Such spores are often found to have begun germination by means of numerous germ tubes over the entire surface of the spore. One species of Parmentaria in addition to producing germ tubes was found to produce internally a layer of conidiophores with conidia similar to those found in normal pycnidia on the thallus. This suggests that the microconidia, at least in this instance, function as asexual diaspores.

In order to simlify Chadefaud's terminology somewhat, I will refer to the perisporal formation by its most obvious layer, the perispore. In the past I and others have referred to the wall thickenings in the spores of the Pyrenulaceae and Trypetheliaceae as endospore. It seems clear that it is mainly the mesospore which is thickened (Rudolph & Giesy, 1966; Chadefaud, 1969; Janex-Favre, 1971). It seems wise to make this distinction since the mesospore layer and the endospore layer are often different in color and texture.

The perispore is often rather gelatinous and may swell considerably in water or KOH. In some groups, however, it seems to be very reduced or perhaps absent, at least it is not readily discernable. Thus the degree of development of the perispore seems taxonomically useful.

A number of scattered species and even an entire genus (Acrocordia) have spores with ornamented walls. The ornamentation seems in most cases to consist of granules trapped between the exospore and perispore or perhaps projections from the exospore. Another type seems to consist of small holes in the perispore layer, which when stained, look rather like the granular type of ornamentation. The presence anf type of ornamentation is often of considerable taxonomic value.

G. Microconidia

Conidia, both microconidia and macroconidia, have proved to be extremely useful at all levels of classification. Although all are apparently of the same basic type with simple conidiophores, there is considerable variation in shape and size. The microconidia could also be termed spermatia. The pycnidia producing them are most commonly found at the margin of the thallus, often in areas without mature ascocarps, and they can be found in the majority of specimens. Their location and rather consistent presence suggest that they might be functional spermatia. In species also producing macroconidia both types are found on the same thallus. Occasionally a pycnidium is found producing both microconidia and macroconidia.

The pycnidia in most species are more or less globose with a simple chamber but in the Trypetheliaceae the surface area producing conidia may be increased by folding.

In some ways it is unfortunate that the microconidia are so useful. The botanist with only a few specimens to determine is not likely to make the often tedious search for pycnidia, but often microconidia are the most satisfactory character to provide a determination.

H. Macroconidia

Macroconidia are produced in pycnidia similar to those producing microconidia but which are usually somewhat larger. The conidia are produced singly at the tip of staff shaped conidiophores. They probably serve as asexual diaspores.

Macroconidia are known with certainty in the colorless spored pyrenolichens only from two genera, *Anisomeridium* and *Strigula*, both in the Strigulaceae. In *Anisomeridium* they are non-septate and resemble large versions of the microconidia. In *Strigula* the macroconidia are apparently patterned on the ascospores and have as many cells as the ascospores with the exception of *Strigula complanata* which has more. In *Anisomeridium* macroconidia have been found in relatively few species while they are known from all species of *Strigula* except *S. sychnogonioides*.

The macroconidia are taxonomically most useful at the generic level. Some of the small spored species of *Anisomeridium* and *Strigula* are superficially very similar but are easily distinguished if macroconidia can be found.

I. Lichen Substances

Lichen substances, although rarely present, are very useful taxonomically primarily at the specific level. They are not as widespread and varied in the pyrenolichens as in many other groups of lichens. The non-lichenized genera belonging to the Pleosporaceae, as expected, have not been found to produce any lichen substances. In the Verrucariaceae I have found zeorin in *Normandina*. Lichexanthone seems not

uncommon in the Pyrenulaceae and Trypetheliaceae and occurs in a single genus of the Strigulaceae (Anisomeridium). Anthraquinones, commonly parietin, are found in a number of the Pyrenulaceae and Trypetheliaceae and in one species of the genus Anisomeridium. They are often present in the thallus, over the entire surface as in Pyrenula cerina and Trypethelium aeneum, or may occur only over the ascocarps as in Astrothelium or in only a small area around the ostiole as in Anisomeridium. Anthraquinone-like pigments may also be present inside the ascocarp wall as in Pyrenula nitida and Pseudopyrenula spp. The pseudostromata in members of the Trypetheliaceae often contain layers of anthraquinone pigments. The Pyrenulaceae and Trypetheliaceae also produce a variety of pigments of an unknown nature, usually in relation to the ascocarps. The oddest case, perhaps, is in a few species of Pyrenula and one of Campylothelium where the mouth of the ostiole (but not the surrounding thallus) is pigmented. As indicated above these various lichen substances are useful at the specific level and when their distribution is fully known may have implications at higher levels.

IV. A SUGGESTED REORGANIZATION OF THE FAMILIES OF PYRENOLICHENS

Since my ideas on the number and composition of the families of pyrenolichens do not coincide exactly with any previous treatments (Zahlbruckner, 1926; Hale & Culberson, 1970; Poelt, 1974), I have summed up their definitions in the key below and their tentative composition in a list following the key. A few of the more interesting problems are discussed at the end of this section.

1. Paraphyses gelatinized; hymenial gelatin IKI+ pink orange, orange red or bluish; periphyses usually present; microconidia elliptical, oblong or cylindrical; macroconidia not known; almost all species growing on on rock or soil .... Verrucariaceae

1. Paraphyses usually persistent (if gelatinizing, then hymenial gelatin IKI-); hymenial gelatin IKI- or IKI+; periphyses rarely present; microconidia various; macroconidia present in some genera; more commonly on substrates other than rock and soil 2

2. Ascus tip thin with a chitinoid ring in the tip of the exoascus (ring not evident in <u>Clathroporina</u> and some large spores species of <u>Porina</u>); ascocarp wall often brightly colored; paraphyses unbranched; hymenial gelatin IKI-; microconidia elliptical, oblong or rod-shaped; macroconidia not known .... Trichotheliaceae

2. Ascus tip lacking a chitinoid ring in the exoascus 3

3. Ascus with amyloid apical apparatus .... Microglaena pr. p. & Thrombium

3. Ascus lacking amyloid apical apparatus 4

4. Spore wall thickened or if spores muriform and without obviously thickened walls, then with well developed thallus, ascocarp type and chemical characters of Pyrenula or Trypethelium 5

4. Spore wall not thickened; thallus mostly not well developed 6

5. Microconidia filiform; hymenial gelatin commonly IKI+; spores mostly some shade of brown, rarely colorless, IKI-; ascocarps rarely aggregated and included in a psuedostroma (trypethelioid); macroconidia known in one genus (Eopyrenula) .... Pyrenulaceae

5. Microconidia rod-shaped; hymenial gelatin IKI-; spores mostly colorless, rarely brown, occasionally IKI+ violet; ascocarps often aggregated and included in a pseudostroma; macroconidia not known .... Trypetheliaceae

6. Ascus not thickened at the tip; hymenial gelatin or ascus sheath commonly IKI+; periphyses present or not .... Thelopsis & Belonia

6. Ascus thickened at the tip; hymenial gelatin mostly IKI-; periphyses absent 7

7. Microconidia relatively broad, orbicular, elliptical or oblong; macroconidia present in two genera; hymenial gelatine IKI-; spores colorless; almost all species lichenized; growing on a wide variety of substrates ... . Strigulaceae

7. Microconidia narrower, short to long rods or rarely filiform; macroconidia not known; hymenial gelatin mostly IKI-, rarely IKI+; spores colorless or brown; mostly non-lichenized; more or less restricted to bark and wood .... Pleosporaceae

Composition of the families of pyrenolichens

PLEOSPORACEAE

Arthopyrenia
Blastodesmia
Leptorhaphis
Microthelia
Mycomicrothelia?
Mycoglaena?
Mycoporum
Polyblastiopsis
Sporoschizon
Tomasellia

PYRENULACEAE

Anthracothecium
Bottaria
Eopyrenula
Lithothelium
Melanotheca
Microglaena s. str.
Parathelium
Parmentaria
Plagiocarpa
Pleurotheliopsis
Pyrenastrum
Pyrenula

STRIGULACEAE

Acrocordia
Anisomeridium
Monoblastia
Pleurotrema
Pyrenocollema
Strigula

TRICHOTHELIACEAE

Clathroporina
Porina
Trichothelium

TRYPETHELIACEAE

Astrothelium
Campylothelium
Cryptothelium
Laurera
Polymeridium
Pseudopyrenula
Trypethelium

VERRUCARIACEAE	GENERA OF UNCERTAIN POSITION WHICH MAY CONSTITUTE SEPARATE FAMILIES
As in Poelt (1974) with the addition of	1) Belonia, Thelopsis
Microtheliopsis Normandina Psoroglaena	2) Microglaena pr. p., Thrombium 3) Aspidothelium?, Phyllobathelium

In addition to the discussion of each family in the taxonomic section I will mention a few of the more interesting problems here. As indicated in Harris (1973) Microglaena is heterogeneous. The type species, M. modesta (Nyl.) A.L. Sm., does not have the amyloid ring found in some of the other species. I have recently located microconidia in several species including M. modesta and M. hassei Zahlbr. and they are filiform as in Pyrenula. In Microglaena hassei, which also lacks an amyloid ring, the spores are brown which also suggests the Pyrenulaceae. Therefore I feel that Microglaena s. str. can be tentatively assigned to the Pyrenulaceae. The species of Microglaena with an amyloid ring require a new generic name. They are probably related to Thrombium epigaeum which also has this feature. Vězda (1968) has also reported an amyloid apical apparatus in Geisleria. I have examined a number of specimens of the type species, G. sychnogonioides Nitschke, including the type collection, and have not been able to detect an amyloid ring with either IKI or Melzer's reagent.

The Laureraceae Vězda ad int. (Poelt, 1974), created for genera with muriform spores with thin spore walls, is I feel unnatural. There seems to be a tendency for the reduction and loss of mesospore thickening in the evolution of muriform spores from septate spores with thickened mesospore. In Anthracothecium and Parmentaria there are several species which lack the characteristic thick spore walls. Also in the Trypetheliaceae there are several species with submuriform spores which connect Trypethelium and Laurera. Thus I feel that the genera placed in the Laureraceae are better assigned to either the Pyrenulaceae or Trypetheliaceae with the exception of Phyllobathelium of whose position I am unsure.

Vězda (1968) has suggested that perhaps Thelopsis should be included in the Thelotremataceae. The genus seems to me to be out of place in that family but I do not have enough evidence to suggest any other placement. Thelopsis seems to me to be closely related to Belonia, previously included by Vězda (1968) in the Porinaceae (= Trichotheliaceae), but seems to be excluded from that family on the basis of ascus type and hymenial reaction with iodine. Not all members of the Trichotheliaceae possess the chitinoid ring in the ascus tip. It is lacking in Clathroporina and in some species of Porina. However the similarity of thallus and ascocarp type taken together with a series of submuriform spored species linking Clathroporina to Porina leaves no doubt that they are closely related.

The Pyrenulaceae and Trypetheliaceae show a considerable number of parallel trends, astrothelioid and parathelioid ascocarps, inclusion of ascocarps in pseudostromata, production of lichexanthone and various pigments, thickened mesospore wall, well developed endospore in many species and similar ecology and distribution. Thus it is possible that the families could be combined. However for the time being I feel that the two families can be maintained on the basis of the differences in spore type (color and shape of lumina), paraphysis type, iodine reactions in the hymenium and possibly in the method of spore liberation.

Although Poelt (1974) lists Normandina among genera of uncertain position, I feel it is clearly a member of the Verrucariaceae. The systematic position will be discussed in detail in another paper (Harris & Weber, in preparation).

V. SYSTEMATIC SECTION

A. A key to the genera of hyalodidymous and hyalophragmous pyrenolichens of North America

1. Paraphyses gelatinized; hymenial gelatin IKI+ pinkish orange, orange red or bluish; almost always growing on rock .... Verrucariaceae (not treated further)
1. Paraphyses persistent (or if gelatinizing, then hymenial gelatin IKI- and not growing on rock); growing on bark, old wood, leaves, bryophytes and rock 2

2. Growing on leaves 3
2. Growing on some other substrate 4

3. Asci thickened at the tip, lacking a chitinoid ring at the tip of the exoascus; paraphyses sparsely branched .... Strigula
3. Asci not thickened at the tip, with a chitinoid ring at the tip of the exoascus; paraphyses unbranched .... Porina

4. Ascocarp with stiff black hairs; ascus with a chitinoid ring at the tip of the exoascus .... Trichothelium
4. Ascocarp smooth, without hairs 5

5. Ascocarp with more than one chamber; ostioles separate or united 6
5. Ascocarp with only one chamber (ascocarps may be aggregated within a pseudostroma, but not fused into a compound ascocarp 9

6. Ostioles separate .... Tomasellia

6. Ostioles united in a common disk or into a common opening 7

7. Paraphyses mostly unbranched; hymenial gelatin IKI+ blue green becoming orangish .... Lithothelium

7. Paraphyses branched and anastomosed; hymenial gelatin IKI- 8

8. Spores with 4 or more cells; ascocarp very carbonaceous and hard, often pigmented outside .... Astrothelium

8. Spores with 2 cells, small, 8-12 x 3-4 µ; ascocarp not carbonaceous, rather soft .... Strigula

9. Ostioles eccentric or lateral 10

9. Ostioles erect 12

10. Paraphyses mostly unbranched; hymenial gelatin IKI+ blue green becoming orangish; microconidia filiform .... Plagiocarpa

10. Paraphyses branched and anastomosed; hymenial gelatin IKI-; microconidia rod-shaped 11

11. Spores IKI-; mesospore not thickened .... Pleurotrema

11. Spores IKI+ violet; mesospore thickened from the beginning .... Unnamed genus of Trypetheliaceae

12. Ascocarp wall blue green, HNO_3+ reddish 13

12. Ascocarp wall some other color 14

13. Asci thin tipped with a chitinoid ring at the apex of the exoascus; paraphyses unbranched .... Porina

13. Asci relatively thick tipped, lacking a chitinoid ring; paraphyses branched .... Mycoglaena

14. Asci with more than eight spores, thin tipped; hymenial gelatin or ascus sheath IKI+ .... Thelopsis

14. Asci with eight or fewer spores 15

15. Spores long cylindrical to filiform 16

15. Spores fusiform to oval 18

16. Paraphyses branched and anastomosed; ascus tip often appearing truncated; ascocarps simple or multilocular .... Leptorhaphis s. lat.

16. Paraphyses mostly unbranched 17

17. Ascus with chitinoid ring at the tip of the exoascus ...... Porina

17. Ascus tip lacking a chitinoid ring .... Belonia*

18. Mesospore thickened from the beginning; spore lumina rounded or angular 19

18. Mesospore not thickened except in old age; lumina cylindrical 20

---

* The only species of Belonia known from North America, B. americana Fink in Hedr., is a non-lichenized fungus belonging to the Ostropaceae. Thus the genus should be removed from the North American flora. Details will be published in Harris (1975).

19. Thallus well developed, usually cartilaginous and shiny; ascocarps mostly clustered in pseudostromata, but scattered singly in some species .... Trypethelium

19. Thallus poorly developed, never cartilaginous, rarely non-lichenized; ascocarps never clustered within pseudostromata .... Pseudopyrenula

20. Phycobiont a blue-green alga, blue-green, purplish or yellowish brown in color; mostly on calcareous rock, aquatic or in moist situations .... Pyrenocollema

20. Phycobiont a green alga, usually Trentepohlia, or non-lichenized; mostly on bark and old wood but also on rock and soil, rarely aquatic 21

21. Asci with a chitinoid ring at the tip of the exoascus; paraphyses not branched .... Porina

21. Asci lacking a chitinoid ring; paraphyses branched and anastomosed except in Strigula 22

22. Paraphyses mostly with only a few branches; macroconidia commonly present, septate, fusiform, cylindrical or rarely filiform; asci usually cylindrical; spores often uniseriate .... Strigula

22. Paraphyses branched and anastomosed; macroconidia rarely produced, non-septate when present; asci often broader at one end; spores uniseriate or not ... 23

23. Spores oval to elliptic; spore wall ornamented with small granules, uniseriate .... Acrocordia

23. Spores fusiform to ovate, most commonly with one half of the spore shorter and/or narrower than the other, if oval then not ornamented and uniseriate; often biseriate or irregularly arranged in the ascus 24

24. Microconidia globose to elliptical; spores 2(-4)-celled, septum eccentric; Trentepohlia always present .... Anisomeridium

24. Microconidia short or long rods, rarely filiform; spores 2-many-celled, septum eccentric or not; often non-lichenized 25

25. Paraphyses rather loosely and reticulately branched; hymenium often inspersed; lichenized or not; spores 4-many-celled, endospore gradually filling lumen in age, not becoming brownish or ornamented .... Polymeridium

25. Paraphyses thick, short celled and appearing almost parenchyma-like to slender and thread-like or gelatinizing, but not loosely and regularly reticulate; very rarely lichenized; endospore not filling spore lumen in age, but spore wall may become brownish, thickened and ornamented in age 26

26. Spores 2-celled, breaking into part spores at maturity .... Sporoschizon

26. Spores 2-many-celled, not breaking into part spores at maturity .... Arthopyrenia

B. PLEOSPORACEAE Wint.

Rabenh. Kryptog.-Fl. 1(2): 405. 1885. Holotype: Pleospora Rabenh.

Mycoporaceae Zahlbr., Nat. Pflanzenfam. 1(1*): 77. 1903. Holotype: Mycoporum Flot. ex Nyl.

Arthopyreniaceae W. Wats., New Phytol. 28: 107. 1929. Holotype: Arthopyrenia Massal.

Thallus mostly indicated by modification of the substrate, rarely forming a superficial subicular layer of hyphae or in one case, epilithic. A few species constantly or occasionally associated with Trentepohlia, but most are probably saprophytic or possibly even parasitic.

Ascocarps ascolocular in the two species studied by Janex-Favre (1971). Ascocarps simple or compound, when compound each locule with its own ostiole. Ostioles erect or rarely eccentric in a few species provisionally included here. Interascal filaments in the species studied by Janex-Favre (1971) are pseudoparaphyses. Pseudoparaphyses branched and anastomosed, thick and irregular with short cells to slender and regular with relatively long cells, often somewhat gelatinized or rarely completely so. Asci bitunicate (Richardson & Morgan-Jones, 1964), bitunicate-nassascé (Janex-Favre, 1971), often broadest at the base (Pleosporales type, Janex-Favre, 1971). Spores colorless or brown, 2-celled to muriform, usually 8/ascus but rarely 2-4/ascus; spore wall granular ornamented from the beginning in some, becoming so in old age in a number; perispore usuall well developed.

Microconidia thin, rod-like, linear or filiform.

The above synonymy and diagnosis of the Pleosporaceae are not intended to be comprehensive but only to include the taxa which have been previously considered to be lichens. A few do indeed seem to be lichenized but many are found only on smooth, thin bark where the hyphae might well be able to invade living tissues and I suspect that they are parasitic, at least in part.

The species which I consider to be primitive are easily recognized as members of this family by their ovate, thick tipped asci and coarse, almost parenchyma-like paraphyses. More advanced species approach members of the Strigulaceae or Trypetheliaceae on the basis of microconidial type, lack of mesospore thickening at any stage, hymenial type and absence of _Trentepohlia_.

Arthopyrenia and _Tomasellia_ seem to be very closely related but perhaps _Mycoglaena_ should be included in some other family. However, due to my lack of knowledge of the families of non-lichenized pyrenomycetes, _Mycoglaena_ is placed in the Pleosporaceae more or less by default.

It seems noteworthy that the parathelioid and astrothelioid type of ascocarp is lacking in the Pleosporaceae and is confined to the lichenized pyrenomycetes, whereas the _Tomasellia_ type of ascocarp is lacking in the lichenized families. Also, there is no development of pseudostromata as in the Trypetheliaceae or Pyrenulaceae.

1. _ARTHOPYRENIA_ Massal.

Ricerch. Auton. Lich. 165. 1852. Lectotype (Riedl, 1962): _Verrucaria rhyponta_ Ach.

Mycarthopyrenia Keissl., Ann. Naturhist. Hofmus. Wien 34: 17. 1921. Holotype: _M. sorbi_ Keissl.

Ciferriolichen Tomas. _in_ Tomas. & Cif., Arch. Bot. (Forlì) 28: 4. 1952. ≡ _Mycociferria_ Tomas. _in_ Cif. & Tomas., Ist. Bot. Reale Univ.

Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 28, 56. 1953. Holotype: Arthopyrenia lapponina Anzi.

Jatteolichen Tomas. & Cif., Arch. Bot. (Forlì) 28: 6. 1952. ≡Jatteomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 34, 61. 1953. Holotype: Verrucaria pyrenastrella Nyl.

Santessoniolichen Tomas. & Cif., Arch. Bot. (Forlì) 28: 5. 1952. ≡Santessoniomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 29, 57. 1953. Holotype: S. punctiformis ("Fr.") sensu Jatta [sic].

Giacominia Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 29, 57. 1953. Holotype: Arthopyrenia parolinii Beltram.

Mycoarthopyrenia Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 29, 57. 1953. hom. illeg. Holotype: Verrucaria analeptella Nyl.

Thallus endophloeodal, indicated by discoloration of the substrate, usually whitish or grayish, rarely darker, in a few species consisting of an epiphloeodal dark brown subicular layer of hyphae, or epilithic in a single species. Phycobiont, when present, Trentepohlia.

Ascocarp with brown to blackish wall, usually lacking below. Ostiole erect or rarely eccentric. Paraphyses thick and irregular with short cells, often appearing almost parenchyma-like to slender and regular with relatively long cells, sometimes partially gelatinized, rarely completely so. Asci various, ovate to narrowly ovate, narrowly elliptical, narrowly obovate or cylindrical; tip often thickened, with or without an obvious ocular chamber. Spores typically 8/ascus, often fewer due to random abortion, rarely 2-4/ascus, mostly 2-4-celled but up to 8-celled, constricted at the septa; spore wall ornamented from the beginning in a few species, becoming ornamented in old age in a number; perispore usually evident, frequently well developed.

Microconidia commonly rod-like or linear, rarely filiform.

Habitat mostly on bark, often smooth, young bark, less commonly on ecorticate wood and on rock in a single species.

The typification of _Arthopyrenia_ is a difficult problem which is complicated by the fact that _Lichen analeptus_ Ach. (_Arthopyrenia analepta_ (Ach.) Massal.) is a superfluous name for _Verrucaria olivacea_ Pers. (= _Porina olivacea_ (Pers.) A. L. Sm.). Thus genera which have been typified with _A. analepta_ are nomenclatural synonyms of _Porina_. This includes _Pyrenillium_ Clem. and _Arthopyreniomyces_ Cif. & Tomas., as well as _Leiophloea_ (Ach.) S. Gray if Riedl's (1962) lectotype is accepted. The earliest typification of _Arthopyrenia_ was with _A. analepta_ by Th. Fries in 1861. This species was also chosen by Fink in 1910. However, acceptance of this priority would lead to the synonymization of _Arthopyrenia_ with _Porina_, which certainly was not intended by either Th. Fries or Fink who could not anticipate the results of future nomenclatural rules. Thus, I feel that this is exactly the sort of situation covered by Par. 4.f. of the Guide for the Determination of Types (Stafleu, et al., 1972) and that the earliest lectotypification should not be accepted. Clements (1909) chose _A. pyrenuloides_ (Fée) Müll. Arg. as the type, but this was not one of the original species. Thus, Riedl's (1962) lectotype, _A. rhyponta_, has priority and must be accepted. In a similar manner one could reject Riedl's typification of _Leiophloea_, but I leave that to others since I have no interest in resurrecting the genus.

Leiophloea has no history of usage and its synonymization with Porina is of little significance. Also, it leaves Arthopyrenia as the oldest name for the genus as treated here, including species with 2-celled and multi-celled spores.

The genus Arthopyrenia in the sense which I accept it is primarily non-lichenized although there are some exceptions. The bulk of the lichenized species are those whose position is unclear to me at this time and remain in Arthopyrenia by default. Others, a very few, seem to be lichenized species of Arthopyrenia in the strict sense. The most interesting of these is the West Coast population of A. padi which is consistently associated with Trentepohlia, while collections from the rest of its extensive range seem to be non-lichenized. Another is the maritime species A. herrei which has a well developed thallus remininscent of Pyrenocollema but on the basis of mycological characters seems to belong in Arthopyrenia. Of course, it is possible that it is a parasymbiont on another sterile lichen.

In addition to the absence of Trentepohlia, the genus tends to be marked by the thin microconidia which range from short and rod-like to filiform. Many of the species have asci which are broadest at the base, a character which is relatively rare in the lichenized genera. However, in the more advanced species the asci become cylindrical or broader at the tip. This change in ascus type is more or less correlated with the paraphysis type which in the more primitive species is thick, irregular and short celled becoming slender and thread-like in the more advanced ones. The spores are initially hyaline but in many species very old spores become tinted and ornamented. The perispore is often well developed. These characters taken together have been used to define

Arthopyrenia in a rather broad sense. The genus could be divided further as Riedl (1962) has done by separating species with 2-celled spores from those with 4- or more celled spores. As I indicated in 1973, I feel that this is artificial, separating closely related species as *A. lapponina* from *A. cerasi* and *A. padi* from the *A. persoonii* group. A more natural method would be to recognize two genera based on asci, paraphyses and microconidia, one centering around *A. padi*, the other around *A. lapponina*. This would separate the species I consider to be primitive from the ones I consider more advanced. However, the distinction is not sharp since a few species, such a *A. fraxini* and *A. antecellens*, are rather intermediate and, therefore, I prefer to maintain a single genus. The separation of *Arthopyrenia* from *Tomasellia* and *Polymeridium* is discussed under the latter genera.

1. Spores 4-celled 2
1. Spores 2-celled, rarely 4-celled in old age 5

    2. Thallus dark brown; hyphae thick, epiphloeodal; spores 17-20 x 5.5-7 µ .... [*A. rhyponta*]
    2. Thallus whitish, grayish or little different from the surrounding bark 3

3. Ascocarp immersed, the tip surrounded by a broad, thin shield often confluent with other shields; ostiole often surrounded by a whitish ring; spores 17-22 x 6-8 µ; microconidia 6-9 x 1 µ .... *A. confluens*
3. Ascocarp without a broad, thin shield, not confluent; ostiole without a whitish ring 4

4. Asci ovate; spores 17-21 x 5-6 µ .... *A. atomarioides*

4. Asci narrowly ovate to cylindrical, 60-90 x 17-20 µ; spores 17-23 x 6-7.5 µ .. .. [*A. cerasi*]

5. Spore wall constricted in the middle of one or both cells or mesospore thickened as if additional septa were forming, becoming 4-celled in old age 6

5. Spore wall not constricted in the middle of the cells; mesospore not thickened 11

6. Spore wall ornamented; mesospore often forming a ring cutting off a subchamber; North Carolina to Florida and Texas (*A. bifera* group) 7

6. Spore wall not ornamented; no subchamber partially cut off; West Virginia and Tennessee to Newfoundland or western 9

7. Spores 2/ascus, 37-48 x 15-16 µ; ostiole occasionally eccentric .... *A. bifera*

7. Spores 4-8/ascus 8

8. Spore wall with a flat-topped, ring-like ridge within each cell which in old age forms a complete septum; spores 27-37 x 10-12 µ .... *A. annulata*

8. Spore wall usually not thickened, merely constricted at the middle of each cell; spores very rarely 4-celled in old age, 18-30 x 6.5-9.5(-12) µ .... *A. lyrata*

9. Spores 12-15(-18) x 4-5 µ; constrictions rather weak .... *A. degelii*

9. Spores larger, (13-)15-26 x 4.5-9 µ; wall rather strongly constricted 10

10. Spores with both ends rounded, upper cell usually somewhat larger, 18-22 x 7-8(-9) µ; asci mostly elliptical or obovate, 60-80 x 17-22 µ .... *A. cinereopruinosa*

10. Spores with one or both ends pointed, cells approximately equal, (13-)15-20 x 4.5-6.5(-7.5) µ; asci mostly narrowly elliptical, narrowly ovate or narrowly obovate, 75-110 x 12-18 µ .... *A. plumbaria*

11. Thallus well developed, brown, epilithic; spores 14-19 x 4.5-5.5 µ .... *A. herrei*

11. Thallus poorly developed, endophloeodal 12

12. Paraphyses completely or almost completely gelatinized; spores (12-)15-22 x 4.5-6 µ; asci ovate to narrowly ovate, 35-50 x 15-20 µ .... *A. salicis*

12. Paraphyses persistent, occasionally somewhat gelatinized or embedded in much gelatin but not disappearing 13

13. Spores ovate, length/width ratio 1.5:1-2:1, cells markedly unequal, 13-15 x 7-8(-10) µ .... *A. oblongens*

13. Spores narrowly ovate or narrowly elliptical, length/width ratio 2.5:1 or greater 14

14. Asci cylindrical, narrowly elliptical or narrowly obovate 15

14. Asci narrowly ovate, broadest below the middle 19

15. Spores mostly less than 23 µ long and 7.5 µ wide 16

15. Spores mostly more than 20 µ long and 7 µ wide 18

16. Spores 12-17 x 4-5.5 µ .... *A. minor*

16. Spores 15-23 x 5-7.5 µ 17

17. Spores 15-22 x 5.5-7.5 µ; ascocarp wall not extended outward into a broad shield; Massachusetts and Europe .... *A. lapponina*

17. Spores 17-23 x 5-7 µ; ascocarp wall extended outward forming a broad shield; Florida and the West Indies .. *A. planorbis*

18. Ascocarp immersed, tip surrounded by a broad, thin hyphal ring; spores 20-28(-32) x 6-8(-9.5) µ; on *Taxodium* .... *A. taxodii*

18. Ascocarp superficial, hemispherical, no hyphal ring present; spores 20-30 x 7-9.5(-11) µ; on a wide variety of smooth, thin barks .... *A. cinchonae*

19. Spores larger, (21-)25-40 µ in length 20

19. Spores smaller, 25 µ or less in length 22

20. Spores broader, (25-)28-40 x 8-12(-14) µ, becoming 4-celled, brownish and ornamented with age .... *A. antecellens*

20. Spores narrower, 6-8 µ in width, not obviously becoming 4-celled, brownish and ornamented 21

21. Ascocarps subglobose, immersed, 0.1-0.15 mm in diameter; spores 21-33 x 6-7.5 µ; Florida and Alabama .... *A. cedrina*

21. Ascocarps flattened, superficial, 0.4-0.6 mm in diameter;

spores 25-32 x 6-8 µ; Maine .... *A. megalospora*

22. Spores larger, 19-25 x 5.5-7.5 µ; ascocarps hemispherical or flattened, 0.3-0.5 mm in diameter; northeastern United States and Europe .... *A. fraxini*

22. Spores smaller, 15-22 x 4-5.5 µ 23

23. Asci slender, 55-70 x 12-16 µ; Florida and Alabama .... *A. atractospora*

23. Asci shorter and stouter, 30-60 x 15-24 µ; spores 15-20 x 4.5-5.5(-6.5) µ; widespread northward, Maine to British Columbia .... *A. padi*

Arthopyrenia antecellens (Nyl.) Arn.

Flora 53: 485. 1870. *Verrucaria antecellens* Nyl., Flora 49: 86. 1866. *Mycoporopsis antecellens* (Nyl.) Riedl, Sydowia 15: 268. 1962 *comb. inval.* Holotype: England, Sussex, Tilgate Forest, *Larbalestier 77* (H-NYL 767).

Pyrenula zwackhii Hepp, Fl. Eur. 954. 1867. Type collection: Germany, near Heidelberg, *Zwackh*. Isotypes in FH & FH-TUCK 4066.

Ascocarps superficial, hemispherical to flattened, 0.3-0.6 mm in diameter; ascocarp wall brown, not heavily carbonized, lacking below. Paraphyses thick, up to 3 µ, somewhat irregular. Asci ovate to narrowly ovate, (65-)80-105 x (20-)27-35(-40) µ. Spores irregularly arranged, narrowly ovate, 2-celled, becoming 4-celled, brownish and ornamented in old age; perispore usually not obvious; (25-)28-40 x 8-12(-14) µ.

Microconidia short, rod-like, 3-4 x 1 µ.

Habitat on smooth bark.

Zahlbruckner (1921-22) incorrectly placed Pyrenula zwackhii as a synonym of Thelidium zwackhii (Hepp) Massal. based on Sagedia zwackhii Hepp, a different independently published species.

Arthopyrenia antecellens has not previously been reported from North America, but it is easily recognized by its large spores and ovate asci. It seems nearest to the A. padi group but the paraphyses are somewhat intermediate with those of the A. lapponina group. Based on specimens which I have verified, A. antecellens has a rather oceanic distribution both in North America and Europe.

Illustrations: Figs. 1-6.

Exsiccati examined: Hepp 954 (FH, FH-TUCK 4066).

Specimens seen: Canada. BRITISH COLUMBIA: Queen Charlotte Islands, Graham Is., Brodo 11603, 12901a (CAN), Lyell Is., Brodo 11922 (CAN, MSC). NEWFOUNDLAND: Bay of Islands, Lark Harbour, 1887 Waghorne 572 (MICH, US ex MO).

United States. MAINE: Sagadahoc County, near Brunswick, 3.XI.1939 Degelius (US, US ex MO). NORTH CAROLINA: Haywood County, Blue Ridge Parkway lookout at Graveyard Fields, Harris 3397-A (MSC). OREGON: sine loc., 1871 Hall (FH-TUCK 4048). WASHINGTON: Jefferson County, 5 mi E of Lake Quinault, Tucker 8365 (LSU).

Arthopyrenia atomarioides Müll. Arg.

Bot. Jahrb. Syst. 6: 406. 1885. Holotype: Cuba, Wright Verr. Cub. II: 629 (G).

Verrucaria subpunctiformis Nyl., Lich. Ins. Guineens. 51. 1889.

Arthopyrenia floridana Zahlbr., Cat. Lich. Univ. 1: 332. 1922 ut nom.

nov. Type collection?: Florida, Ft. George, 1887 Calkins. Isotypes? in FH, MICH, US & US ex MO.

Ascocarps superficial or partly immersed, hemispherical, 0.1-0.2 mm in diameter; ascocarp wall brown, lacking below. Paraphyses thick and irregular, somewhat gelatinized. Asci ovate, 35-50 x 18-22 µ. Spores irregularly arranged, narrowly ovate, soon 4-celled, a few becoming 6-celled; perispore not obvious; 17-21 x 5-6 µ.

Habitat on smooth bark.

Arthopyrenia atomarioides can be recognized by its small ascocarps, asci and 4-celled spores. Nylander credited the type collection to Eckfeldt, but I have seen no North American material except the single Calkins collection which is uniformly mixed with *Tomasellia lactea*.

Illustrations: Figs. 7-11.

Arthopyrenia atractospora Zahlbr.

Ann. Mycol. 33: 33. 1935. Holotype: Florida, Sanford, VII.1928 Rapp 137 (W).

Ascocarps immersed, subglobose, c. 0.2 mm in diameter. Paraphyses somewhat gelatinized. Asci narrowly ovate, wall strongly thickened in the tip, 55-70 x 12-16 µ. Spores irregularly arranged, narrowly ovate, 2-celled, lower cell often somewhat longer and narrower; perispore not obvious; 16-22 x 4-5 µ.

Microconidia rod-like, 4-5 x 1 µ.

Habitat on bark.

Arthopyrenia atractospora is characterized by slender asci with the tip strongly thickened and by its slender spores. It is known from

only two collections.

Illustrations: Figs. 12-15.

Specimens seen: United States. ALABAMA: Baldwin County, Yupon Point, 1.III.1925 Evans 210 (MICH). FLORIDA: Seminole County, Sanford, VII.1928 Rapp 137 (W).

Arthopyrenia cedrina (Zahlbr.) R. C. Harris stat. nov.

Arthopyrenia sanfordensis var. *cedrina* Zahlbr., Ann. Mycol. 33: 33. 1935. Holotype: Florida, Sanford, X.1922 Rapp 135 (W).

Thallus endophloeodal, *Trentepohlia* present.

Ascocarps semi-immersed, subglobose, c. 0.15 mm in diameter. Paraphyses thick, up to 3 µ in width, irregular, somewhat gelatinized. Asci narrowly ovate, 60-90 x 20-25 µ. Spores irregularly arranged, narrowly ovate, 2-celled; perispore thin; 21-33 x 6-7.5 µ.

Microconidia short, rod-like, c. 3 x 1 µ.

Habitat on bark.

Arthopyrenia cedrina is not closely related to *A. sanfordensis* which is a member of the genus *Anisomeridium*. *Arthopyrenia cedrina* is quite similar in paraphyses, asci and spores to *A. fraxini* but differs by its small subglobose ascocarps and thinner perispore. *Trentepohlia* is present in both of the known collections.

Illustrations: Figs. 16-19.

Specimens seen: United States. ALABAMA: Baldwin County, Volanta, 9.III.1925 Evans 258 (MICH). FLORIDA: Seminole County, Sanford, X.1922 Rapp 135 (W).

Arthopyrenia cerasi (Schrad.) Massal.

Ricerch. Auton. Lich. 167, f. 332. 1852. Verrucaria cerasi Schrad., Ann. Bot. (Usteri) 22: 86. 1797. Type collection not seen.

Ascocarps superficial, hemispherical to flattened, (0.2-)0.4-0.5 mm in diameter; ascocarp wall lacking below. Paraphyses slender, regular and thread-like. Asci narrowly ovate to narrowly elliptic, rarely narrowly obovate, 60-90 x 17-20 µ. Spores biseriate to irregularly arranged, narrowly ovate, 4-celled; perispore often rather thick; 17-23 x 6-7.5 µ (excl. perispore).

Microconidia linear, 10-13 x 1 µ.

Habitat on smooth bark.

Arthopyrenia cerasi seems to me to be rather closely related to A. lapponina, differing in having 4-celled spores. Although reported from North America, I have not been able to verify any specimens of it and it should be deleted from the North American flora.

Illustrations: Figs. 20-23.

Exsiccati examined: Anzi Ven. 130 (FH-TUCK 4077); Harm. Loth. 450 (FH); Hepp 457 (FH, FH-TUCK 4081); Malbr. 400 (MSC); Mass. 106 (FH-TUCK 4081), 219 (FH-TUCK 4083); Norrl. 393 (MSC); Nyl. Pyr. 50 (FH-TUCK 4081); Rab. 145 (MICH, FH-TUCK 4082); Samp. 22 (MSC).

Arthopyrenia cinchonae (Ach.) Müll. Arg.

Flora 66: 287. 1883. Verrucaria cinchonae Ach., Synops. Lich. 90. 1814. Holotype: America, on Cinchona officinalis (H-ACH).

Verrucaria prostans Mont., Ann. Sci. Nat. Bot., ser. 2, 19: 53. 1843. Holotype: French Guiana, Leprieur 215 (PC-MONT).

Verrucaria alboatra var. detergens Nyl., Flora 52: 125. 1869.

Type collection: Brazil, near Rio de Janeiro, Glaziou 1915. Isotype in M.

Ascocarps superficial, hemispherical to flattened, 0.4-0.6 mm in diameter; ascocarp wall lacking below. Paraphyses slender, regular and thread-like. Asci mostly narrowly obovate, rarely almost cylindrical; ocular chamber mostly not evident; (85-)100-125 x 17-22 μ. Spores biseriate, subbiseriate or almost uniseriate, occasionally only 4/ascus, narrowly ovate, 2-celled, lower cell occasionally slightly constricted in the middle; perispore well developed; 20-30 x 7-9.5(-11) μ.

Microconidia rod-like, 4-5 x 1 μ.

Habitat on smooth bark.

Arthopyrenia cinchonae can be recognized by the rather large ascocarps, asci and spores. However, it has commonly been confused with *A. lyrata*, which has more nearly cylindrical asci, not broadening to the tip, ornamented spores with one or both cells constricted near the middle, longer microconidia and is always associated with *Trentepohlia*.

Arthopyrenia cinchonae is widespread and often very abundant in the southeastern United States occurring as far north as New Jersey. Of all the pyrenolichens it most truely deserves the title of "weed". It is also known from Brazil, French Guiana, Mexico and the West Indies (Bahamas, Bermuda, Cuba, Dominica, and Puerto Rico).

Illustrations: Figs. 24-30. Distribution: Fig. 406.

Exsiccati examined: Rel. Tuck. 130 (FH, MICH, MSC, US).

Selected specimens seen: United States. ALABAMA: Baldwin County, Volanta, 20.III.1925 Evans 316 (MICH); Cleburne County, N of Heflin, Harris 1328-A, 1338-A, 1392, 1406, 1407-A, 1425 (MSC); Lawrence County, Moulton, 1874 Peters (FH-TUCK 4025). FLORIDA: Alachua County,

Gainesville, IV.1915 Nelson 274 (FH); Baker County, Osceola Nat. Forest, Harris 3127, 3129-B (MSC); Dade County, Everglades Nat. Park, between Mahogany Hammock and Pa-hay-okee Overlook, Harris 2916-C, 2946-C, 2966-A, 2968-A (MSC), near Pa-hay-okee Overlook, Harris 2717-A, 2718, 2729, 2741-A, 2742, 2753-B, 2757-A, 2763, 2765-B, 2795-A, 2829-B, 2836-B (MSC), near Pinelands Trail Area, Harris 2879-A, 2884-A, 2897-B, 2898-B, 2905-B, 2911-E, 2986-E, 2988-A, 3017 (MSC), W. Palm Beach, 1897 Thaxter 50 (FH); Duval County, Bayard, IV.1910 Bussey (FH, US), Jacksonville, Calkins (FH, MICH, US); Flagler County, Flagler St. Park, Harris 2481-A, 2485-C, 2502-A (MSC); Franklin County, W of St. Teresa, Harris 1741-E (MSC); Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, Harris 1456-B, 1583-D, 1785 (MSC); Marion County, Ocala Nat. Forest, S of Long Pond, Harris 1803-A (MSC), NW of Big Bass Lake, Harris 2052-A, 2054, 2060-A (MSC); Sarasota County, Myakka River St. Park, Harris 2586, 2623-A (MSC); Seminole County, Sanford, V.1908 Rapp (FH), 11.IV.1914 Rapp (FH); St. Johns County, Six Mile Creek, Calkins (FH, MICH, MSC, US); Volusia County, Daytona [= Daytona Beach], 1898 Thaxter 350 (MICH); Wakulla County, St. Marks Nat. Wildlife Refuge, Harris 1733-B (MSC). KENTUCKY: McCreary County, SW of Corbin, Harris 1163-A (MSC). LOUISIANA: E. Feliciana Parish, Felixville, Tucker 7762-A (LSU); Iberia Parish, Avery Is., II.1915 McIllenny (FH-RIDD); St. Landry Parish, Grand Coteau, 6.VI.1894 Langlois (US); St. Martin Parish, Breaux Bridge, 12.XII.1893 Langlois (US), St. Martinville, 8.VII.1892 Langlois (US); St. Tammany Parish, Covington, 16.IV.1894 Langlois 940 (US), near Tallisheek, Tucker 10302 (LSU); Washington Parish, E. of Mount Hermon, Tucker 10255 (LSU). NEW JERSEY: Atlantic County, Atlantic City, 12.VIII.1887 Green (MICH); Camden County, Atco,

1882 Eckfeldt (CAN). SOUTH CAROLINA: County unknown, Santee Canal, 1857 Ravenel (FH,MICH, MSC, US); Aiken County, Aiken, Ravenel (FH); Berkeley County, Francis Marion Nat. Forest, Bonneau Campground, Harris 3157-A (MSC), Guilliard Lake Campground, Harris 3211-A (MSC); Pickens County, Mt. Pinnacle, 10.VII.1886 Green (US). TENNESSEE: Wilson County, Cedars of Lebanon St. Park, Harris 1318-A (MSC). TEXAS: sine loc., Hall (US).

Arthopyrenia cinereopruinosa (Schaer.) Massal.

Symmict. Lich. 117. 1855. Verrucaria cinereopruinosa Schaer., Lich. Helvet. Spicil., sect. 6: 343. 1836. Type collection not seen.

Pyrenula punctiformis var. cinereopruinosa f. hederae Hepp, Flecht. Eur. 105. 1853. Type collection: Switzerland, Zürich, Hepp. Isotypes in FH & FH-TUCK 4073.

Pyrenula punctiformis var. cinereopruinosa f. pinicola Hepp, Flecht. Eur. 106. 1853. Arthopyrenia pinicola (Hepp) Massal., Symmict. Lich. 118. 1855. Type collection: Switzerland, Zürich, Hepp. Isotypes in FH & FH-TUCK 4073.

Arthopyrenia stigmatella var. elabens Massal., Symmict. Lich. 120. 1855. Type collection: Mass. 202, Italy, "ad truncos pinorum in Prov. Patavinia (Rua)". Isotypes in FH & FH-TUCK 4077.

Pyrenula punctiformis var. cinereopruinosa f. buxicola Hepp ex Rabenh., Lich. Eur. 630. 1862. nom. inval. sin. descr.

Arthopyrenia fallax var. conspurcata J. Stein. in Beck & Zahlbr., Ann. Naturhist. Hofmus. Wien 12: 94. 1898. Type collection: Krypt. Vind. 269, Austria, Carinthia, woods below castle Hornstein near Klagenfurt, J. Steiner. Isotype in US.

Arthopyrenia ligustri Britz., Hedwigia (Beibl.): (37). 1904. hom. illeg. Syntype collection: Britz. 385, Germany, Augsburg, westliche Hugelzug, Britzelmayer. Isotype in US ex MO.

Ascocarps superficial to semi-immersed, hemisphereical to flattened, 0.2–0.3(-0.4) mm in diameter; ascocarp wall lacking below. Paraphyses slender, regular and thread-like. Asci mostly elliptical or obovate, rarely narrowly so, 60-80 x 17-22 µ. Spores irregularly arranged, narrowly ovate to narrowly elliptical, 2-celled, one or both cells somewhat constricted near the middle, upper cell often broader and longer, rarely becoming 4-celled; perispore usually well developed; 18–22 x 7-8(-9) µ.

Microconidia linear, 10-12 x 1 µ.

Habitat on smooth bark.

The transfer of Verrucaria cinereopruinosa to Arthopyrenia was attributed by Zahlbruckner (1921-22) to Körber, but it seems fairly clear that Massalongo's publication was earlier.

Arthopyrenia cinereopruinosa seems fairly closely related to A. lapponina but differs in that the spore cells are constricted in the middle. Arthopyrenia plumbaria is very closely related to A. cinereopruinosa and is distinguished by its more slender asci and spores and in having rather pointed spores. Arthopyrenia cinereopruinosa is common in Europe but apparently rare in North America where its distribution seems to be oceanic.

Illustrations: Figs. 31-35.

Exsiccati examined: Anzi Ven. 129 (FH-TUCK 4077); Arn. 1262, 1740 (MICH); Arn. Mon. 420, 449 (MICH); Britz. 51, 385, 386 pr. p. (US ex MO); Desm. ed. II, ser. II: 598 (FH); Erb. II: 419 (FH);

Hepp 105, 106, 455 (FH, FH-TUCK 4073), 107 (FH, FH-TUCK 4076), 456 (FH-TUCK 4066); Krypt. Vind. 269 (US); Leight. 197 (FH, US); Malbr. 199 (MSC); Mass. 197, 199, 200, 203 (FH-TUCK 4077), 198, 201 (FH), 202 (FH, FH-TUCK 4077); Moug. 364 pr. p. (FH-TUCK 4069); Rab. 328, 630, 659 (MICH, FH-TUCK 4073, 4076); Schaer. 287 pr. p. (FH-TUCK 4072); Trev. 29, 41, 42, 43 (FH).

Specimens seen: Canada. NEWFOUNDLAND: Bay of Islands, John's Beach, Waghorne 367 (US ex MO), Middle Arm, Waghorne 463 (MICH).

United States. CALIFORNIA: Santa Cruz County, Stevens Creek Canyon, 24.XI.1906 Herre (FH). OREGON: County unknown, Upper Willamette Valley, Sipe 716 (MICH). VERMONT: Addison County, Goshen, 8. III.1925 Dutton 2312 (FH).

Arthopyrenia confluens R. C. Harris nom. nov.

Tomasellia (s. Oligomeris) leucostoma Müll. Arg., Flora 68: 257. 1885. (non Arthopyrenia leucostoma (Fée) Massal., Ricerch. Auton. Lich. 170. 1852). Holotype: "in Cort. Cascarillae ex hb. Hampe, 1877". (G).

Ascocarps solitary or grouped, immersed, hymenium pyriform to hemispherical, 0.1-0.2 mm in diameter; ascocarp wall poorly developed, lacking below; tip of ascocarp surrounded by a broad, thin, black ring, 0.2-0.3 mm in width, often confluent with the rings of other ascocarps forming groups of 2-10 ascocarps. Ostiole often depressed, surrounded by a whitish ring. Paraphyses slender, regular and thread-like. Asci mostly narrowly ovate, rarely almost cylindrical, 60-105 x 16-26 µ. Spores irregularly arranged to biseriate, narrowly ovate to narrowly elliptical, 4-celled; perispore well developed; 17-22 x 6-8 µ.

Microconidia linear, 6-9 x 1 µ.

Habitat on bark.

Although _A. confluens_ at first glance has the appearance of a _Tomasellia_, the structure of the ascocarp is not truely compound as in that genus. Numerous solitary, simple ascocarps can be found and the groups are formed by the fusion of the thin ring-like shields surrounding the tips of the ascocarps. Also the slender thread-like paraphyses would exclude this species from _Tomasellia_. _Arthopyrenia confluens_ has been found in southern Florida and the Bahamas.

Illustrations: Figs. 36-39.

Specimens seen: United States. FLORIDA: County unknown, Constant Springs, XII.1880 _Hitchcock_ (US ex MO); Monroe County, Key West, I.1898 _Thaxter 122_ (MICH, MSC), II.1898 _Thaxter 301_, _324a_ (MICH).

Arthopyrenia degelii R. C. Harris sp. nov.

Arthopyrenia ascis sat parvis, 48-60 x 11-13 μ et sporis parvis, bilocularibus cum uno vel ambis cellulis in medio constrictis, 12-15 x 4-5 μ.

Holotype: Tennessee, Great Smoky Mountains, Cherokee Orchard, 11.IX.1939 _Degelius_ (US). Isotypes in FH & US ex MO.

Ascocarps superficial, hemispherical to flattened, 0.3-0.5 mm in diameter; ascocarp wall lacking below. Paraphyses thread-like, regular, up to 2 μ in width. Asci narrowly elliptical, 48-60 x 11-13 μ. Spores biseriate to subbiseriate, narrowly elliptical, 2-celled, one or both cells constricted near the middle; perispore thin; 12-15(-18) x 4-5 μ.

Microconidia rod-like, 6-8 x 1.5 μ.

Habitat on smooth bark, possibly always _Hamamelis_.

The type of paraphyses and spores shown by _A. degelii_ would seem to place it near _A. cinereopruinosa_. The constriction of the spore cells is often slight and the species could be confused with _A. minor_, but the broader microconidia of the former along with the differences in geography and substrate help to separate them if the constrictions are overlooked. _Arthopyrenia degelii_ has been most frequently collected in West Virginia but is also known from Tennessee and Massachusetts.

Illustrations: Figs. 40-43.

Specimens seen: United States. MASSACHUSETTS: Bristol County, New Bedford, _Willey_ (US). TENNESSEE: Sevier County, Cherokee Orchard, 11.IX.1939 _Degelius_ (FH, US, US ex MO). WEST VIRGINIA: _sine loc._, _Calkins_ (FH); County unknown, Benaverti, 31.XII.1880, coll. unknown _799_ (MSC); Fayette County, _sine loc._, 1893 _Nuttall 85_ (FH, MICH); Greenbrier County, Greenbrier Run, 1.VI.1880 [_Faxon?_] (FH); Taylor County, Grafton, 17.XII.1880 coll. unknown (MSC).

Arthopyrenia fraxini Massal.

Ricerch. Auton. Lich. 167, f. 333. 1852. Type collection not seen.

Ascocarps superficial, hemispherical to flattened, 0.3-0.5 mm in diameter; ascocarp wall lacking below. Paraphyses quite slender, but rather irregular and tending to gelatinize. Asci ovate to narrowly ovate, 60-90 x 16-25(-30) µ. Spores irregularly arranged, narrowly ovate, rarely narrowly elliptical, 2-celled; perispore often rather thick; 19-25 x 5.5-7.5 µ.

Microconidia rod-like, 4-5 x 1 µ.

Habitat on smooth bark, most often on young bark of _Fraxinus_.

The spores of _A. fraxini_ approach those of _A. lapponina_ in size and shape, but the former has ovate asci, shorter macroconidia and less regular paraphyses. Arthopyrenia megalospora may be a large form of this species and is discussed further under that species. It is largely the shape of the asci and the small microconidia which are diagnostic for A. fraxini.

Illustrations: Figs. 44-48; Harris (1973), figs. 8-9. Distribution: Fig. 407.

Exsiccati examined: Anzi It. 385 (FH-TUCK 4071); Fellm. 222 (FH-TUCK 4072); Fr. 242 (FH-TUCK 4067); Hepp 453 (FH pr. p., FH-TUCK 4066); Krypt. Vind. 268b (FH), 1523 (US); Mass. 184 pr. p. (FH-TUCK 4078), 298A, B, 299 (FH-TUCK 4070); Merr. I: 281 (US), II: 20 (MICH, MSC, US, US ex MO, WIS); Rab. 146 (MICH, FH-TUCK 4071), 658 (MICH, FH-TUCK 4078).

Additional specimens seen (not cited in Harris, 1973): United States. MAINE: Knox County, Rockport, 20.IV.1910 Merrill (FH). MINNESOTA: Chicago County, N shore of Clear Lake, Tucker 1529-B (LSU). VERMONT: Addison County, Goshen, 3.III.1926 Dutton 2454 (FH).

Arthopyrenia herrei R. C. Harris sp. nov.

Arthopyrenia thallo epilithico, fusco et gelatinoso, ascis gracilibus, 65-85 x 12-15(-20) μ et sporis parvis bilocularibus, 14-19 x 4.5-5.5 μ.

Holotype: California, San Francisco County, San Francisco, Point Lobos, 19.VII.1906 Herre 889 (FH). Isotypes in FH, MICH & US.

Thallus well developed, epilithic, brown to dark brown, gelatinous when wet. Phycobiont apparently Trentepohlia.

Ascocarps very numerous, semi-immersed, subglobose, 0.2-0.3 mm in diameter; ascocarp wall lacking below. Paraphyses thread-like but rather irregular and short celled, up to 2.5-3 µ in width. Asci narrowly ovate to cylindrical; wall strongly thickened at the apex; 65-85 x 12-15(-20) µ. Spores irregularly arranged, narrowly ovate, 2-celled; perispore not obvious; 14-19 x 4.5-5.5 µ.

Microconidia rod-like, 4-5 x 1 µ.

Habitat on maritime rock (sandstone).

Although A. herrei is known from only a single collection, there is ample material and it is a most unusual species. As a rule the genus Arthopyrenia is corticolous and non-lichenized, while A. herrei is saxicolous and has a well developed thallus. It is possible that it is a parasymbiont on an otherwise sterile lichen thallus, but without additional material the problem cannot be resolved.

Illustrations: Figs. 49-52.

Arthopyrenia lapponina Anzi

Comment. Soc. Crittogam. Ital. 2: 25. 1864. Type collection: Anzi Lang. 347, Italy, Bormio, Anzi. Isotype in FH-TUCK 4084.

Verrucaria epidermidis var. fallax Nyl., Bot. Notiser 1852: 178, pl. 1, f. 12b. 1852. Verrucaria fallax (Nyl.) Nyl., Flora 55: 363. 1872. Arthopyrenia fallax (Nyl.) Arn., Verhandl. Zool.-Bot. Ges. Wien 23: 505. 1873. Leiophloea fallax (Nyl.) Riedl, Sydowia 23: 234. 1971. Holotype: Finland, Holmia, Nylander (H-NYL 955).

Pyrenula punctiformis var. fallax f. betulae Hepp, Flecht. Eur. 452. 1857. Type collection: Switzerland, Zürich, Hepp. Isotype in FH.

Arthopyrenia fallax f. crategina J. Stein. in Zahlbr., Ann. Naturhist. Hofmus. Wien 24: 283. 1911. Type collection: Krypt. Vind.

1763a, Yugoslavia, "ad litus meridionalis lacus "Veldeser See", Steiner. Isotypes in FH & US.

Ascocarps superficial, hemispherical to flattened, 0.3-0.6 mm in diameter; ascocarp wall lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical, 75-90(-110) x 15-23 µ. Spores biseriate to subbiseriate, narrowly ovate, 2-celled; perispore well developed; 15-22 x 5.5-7.5 µ.

Microconidia linear, 7-10 x 1 µ.

Habitat on smooth bark.

It is somewhat unfortunate that such a well known name as *A. fallax* should be superseded but it probably is just as well since the name is among the most misused names. *Arthopyrenia lapponina* is characterized by the large ascocarps, slender paraphyses, narrowly elliptical asci and medium length microconidia. The species is common in Europe but is known from North America in the typical form by only a single collection. There is a small handful of collections which differ slightly from *A. lapponina* but they have not been treated.

Illustrations: Figs. 53-59; Richardson & Morgan-Jones (1964), fig. 1.

Exsiccati examined: Anzi Lang. 347 (FH-TUCK 4084); Claud. 50 (FH); Erb. II: 930 (US ex MO); Fellm. 221 (FH-TUCK 4072); Fr. 244 pr. p. (FH-TUCK 4067); Harm. 220 (FH); Hepp 450 (FH, FH-TUCK 4080), 451 (FH, FH-TUCK 4066), 452 (FH), 453 pr. p. (FH); Krypt. Vind. 268a (FH,US), 1763a (FH, US), 1763b (MSC); Malbr. 99 (MSC); Mass. 185, 186 (FH-TUCK 4071); Moug. 364 pr. p (FH-TUCK 4069); Nyl. Par. 148 (FH-TUCK 4068); Rel. Suz. 6 (MSC); Schaer. 287 (FH-TUCK 4072); Stenh. 89 (FH-TUCK 4067, MICH, US).

Specimens seen: United States. NEW HAMPSHIRE: County unknown, Shelburne Lake, Gentian Point, 1886 [Farlow] (FH).

Arthopyrenia megalospora Lönnr.

Flora 41: 634. 1858. Lectotype collection: Fr. 244, Sweden. Isolectotype in FH-TUCK 4067.

Ascocarp flattened, orbicular to elliptical in outline, 0.4-0.6 mm in diameter or length, sometimes less in width. Paraphyses slender but rather irregular and somewhat gelatinized. Asci narrowly ovate, 85-100 x 24-27 μ. Spores irregularly arranged, narrowly ovate, 2-celled; perispore well developed; 25-32 x 6-8 μ.

Microconidia rod-like, c. 5 x 1 μ.

Habitat on smooth bark.

As Keissler (1936-38) has pointed out the two numbers of Fries' exsiccatus cited by Lönnroth were reversed in the original publication, but it is clear that he meant var. α to apply to Fr. 244 and var. β to apply to Fr. 242. The situation is further complicated since Fr. 244 is a mixed collection of A. megalospora and A. lapponina. Apparently the collection examined by Keissler contained only A. lapponina and he therefore abandoned A. megalospora. However since there is material which clearly fits Lönnroth's description, the name should be retained. Fries 242 (var. β) is A. fraxini.

Arthopyrenia megalospora is very similar to A. fraxini, differing only by larger asci and spores. It is possible that further study may reveal that the two taxa are in fact extremes of the same species. Material assigned to this species comes from Maine and Europe (Sweden and England).

Illustrations: Figs. 60-64.

Exsiccati examined: Fr. 244 pr. p. (FH-TUCK 4067).

Specimens seen: United States. MAINE: Knox County, Warren, summit of Mt. Pleasant, 20.X.1912 Merrill (FH).

Arthopyrenia minor R. C. Harris sp. nov.

Arthopyrenia sporis parvis, anguste ovatis, 12-15 x 4-4.5 µ et ascis gracilibus, anguste ellipticis vel cylindraceis, 71-89 x 13-14 µ.

Holotype: Florida, Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, Harris 1545 (MSC). Isotype in H.

Ascocarps hemispherical to subglobose, superficial to semi-immersed, 0.25-0.5 mm in diameter; ascocarp wall thinner or lacking below. Paraphyses slender, regular and thread-like. Asci slender, narrowly elliptical to cylindricla, ocular chamber usually distinct, (50-)60-90 x (9-)12-14 µ. Spores subbiseriate, narrowly ovate, 2-celled; perispore thin; 12-17 x 4-5.5 µ.

Microconidia rod-like, 4-7 x 1 µ.

Habitat on bark.

Arthopyrenia minor is not a very distinctive species. It differs from the majority of the American species by its smaller asci and spores. It differs from A. degelii, which also has small spores, in showing no signs of any constriction of the spore cells. Arthopyrenia minor seems to be restricted to Florida, Louisiana and Texas.

Illustrations: Figs. 65-68.

Specimens seen: United States. FLORIDA: sine loc., Eckfeldt (US); Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, Harris 1498, 1545 (MSC). LOUISIANA: Lafayette/St. Martin

Parish, Bayoue Tortue, 15.IV.1895 Langlois (US); St. Landry Parish, Grand Coteau, 6.VI.1894 Langlois (US). TEXAS: *sine loc.*, Hall (US).

Arthopyrenia oblongens Zahlbr. *ex* R. C. Harris sp. nov.

Species distincta sporis ovatis, bilocularibus, cellulis insigniter inaequalibus, 13-15 x 7-8 µ.

Holotype: Florida, Sanford, IV.1930 Rapp (MICH). Isotype in LD.

Ascocarps immersed, hymenium subglobose, 0.2-0.3 mm in diameter; ascocarp wall extended outward above forming an elongate shield, c. 0.3-0.5 x 0.7-1.0 mm, thinner or lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical to cylindrical, 75-110 x 14-16 µ. Spores uniseriate to subbiseriate, ovate, 2-celled, the cells markedly unequal with the lower narrower and shorter; perispore not obvious; 13-15 x 7-8(-10) µ.

Microconidia linear, 8-10 x 1 µ.

Habitat on bark, both known collections on *Andromeda* (probably = *Lyonia*).

The broad spores with unequal cells of this species would at first suggest the genus *Anisomeridium*, but the linear microconidia and absence of *Trentepohlia* lead me to place it in *Arthopyrenia*, especially since microconidial shape seems to be a more stable character than spore shape.

Illustrations: Figs. 69-72.

Specimens seen: United States. Florida: Seminole County, Sanford, 28.VI.1928 Rapp 709 (MICH), IV.1930 Rapp (MICH, LD).

<u>Arthopyrenia</u> <u>padi</u> Rabenh.

Lich. Eur., fasc. 14, 390. 1858. Type collection: "An Prunus Padus bei Hermsdorf in Bilaer Grunde in der sächse Schweiz". Isotype in MICH.

Ascocarps superficial, flattened to hemispherical, 0.1-0.3 mm in diameter; ascocarp wall lacking below. Paraphyses thick, up to 2-4 µ in width, irregular, with short cells and often appearing rather parenchyma-like, occasionally somewhat gelatinized. Asci ovate to narrowly ovate, rarely narrowly elliptical, 2-celled, rarely 4-celled in old age; perispore thin; 15-20 x 4.5-5.5(-6.5) µ.

Microconidia short, rod-like, 3-4 x 1 µ.

Habitat on smooth bark.

In 1973 I treated this species under the name <u>A.</u> <u>punctiformis</u> Massal., mainly because I had no other name for it and the name had been commonly used in this sense. However, since so much confusion and misinterpretation surrounds <u>A.</u> <u>punctiformis</u>, since I have not seen the type and since <u>A.</u> <u>padi</u> is almost as old a name and is typifiable, I have chosen to adopt <u>A.</u> <u>padi</u>. Further the European concept of <u>A.</u> <u>punctiformis</u> s. lat. (including <u>A.</u> <u>analepta</u> Auct. and <u>A.</u> <u>atomaria</u> Auct.) encompasses what I believe to be two distinct species, <u>A.</u> <u>padi</u> and <u>A.</u> <u>salicis</u>. <u>Arthopyrenia</u> <u>padi</u> differs from <u>A.</u> <u>salicis</u> in having persistent, or mostly so, paraphyses and in having generally longer and narrower spores. There are some specimens which are intermediate in one or the other of these characters and their assignment to a species is somewhat arbitrary. As a general rule I have used the gelatinization of the paraphyses as the deciding character. Others may wish to do otherwise.

I take a very broad view of _A. padi_, since to do otherwise would result in the recognition of numerous, barely distinguishable populations as microspecies. One of the more distinctive populations is the one occurring on the West Coast. The asci and spores are somewhat larger than normal for other regions and _Trentepohlia_ is present in the thallus. However I am not inclined to give this population any taxonomic recognition.

Arthopyrenia padi is broadly distributed in temparate regions, including both Northern and Southern Hemispheres. In North America it is the only species which is more or less uniformly distributed from coast to coast in the northern states.

Illustrations: Figs. 73-79; Harris (1973), figs. 9-10; Richardson & Morgan-Jones (1964), fig. 2; Vězda (1968), fig. 8. Distribution: fig. 408.

Exsiccati examined: Britz. 185 (US ex MO), 218 (MICH, US ex MO), 386 pr. p., 388 (US ex MO); Fr. 243 (FH-TUCK 4088); Kern. 2774 (US ex MO); Krypt. Vind. 468b (US), 1523 (FH), 1763b (US); Lich. Colo. 67 (MICH, MSC); Moug. 557 (MSC); Pišut 77 (MSC); Rab. 390 (MICH), 476 (FH-TUCK 4070); Stenh. 180 (FH, FH-TUCK 4067, MICH, US).

Selected specimens seen: Canada. BRITISH COLUMBIA: Queen Charlotte Islands, Graham Is., _Brodo 11620_, _11650_, _12915_ (CAN), Murchison Is., _Brodo 11846_ (CAN). ONTARIO: Carleton County, Ottawa, 30.IV.1897 _Macoun 462_ (CAN, FH, US).

United States. ARIZONA: Cochise County, Barfoot Park, _Weber & Awasthi_ (MICH, MSC). CALIFORNIA: San Diego County, San Diego, 1883 _Orcutt 98_ (US). CONNECTICUT: Middlesex County, Killingworth, 1876 _Hall_ (FH). IOWA: Franklin County, Beeds Lake St. Park, _Wetmore 17489_,

17496 (MIN). MAINE: Hancock County, Mt. Desert Is., Salisbury Cove, 2.VIII.1922 Plitt 108 (MICH, US). MASSACHUSETTS: Bristol County, New Bedford, Willey (US); Essex County, Magnolia, IV.1896 [Farlow] (FH); Middlesex County, Newton, IV.1893 Farlow (FH). MICHIGAN: Alger County, E of Kingston Lake, Harris 661 (MSC), Laughing Whitefish Point, Lowe 1929 (FH, MICH); Charlevoix County, Beaver Is., Imshaug 27485 (MSC); Keweenaw County, Isle Royale, Angleworm Lake, Mc Farlin & Brown 580a (FH, MICH). MINNESOTA: County unknown, Minneapolis, 1896 Fink 35 (MICH). NEW YORK: Suffolk County, Gardiner's Is., Brodo 2375 (MSC). SOUTH DAKOTA: Custer County, 3 mi E of Sylvan Lake, Wetmore 7371 (MSC); Lawrence County, Terry Peak, Wetmore 9349 (CAN, MSC, WIS); Meade County, 10 mi E of Lead, Wetmore 10524 (MSC). WASHINGTON: Jefferson County, along Hoh River, Tucker 8311 (LSU); Pierce County, c. 15 mi W of Chinook Pass, Furlow 291 (MSC).

Arthopyrenia planorbis (Ach.) Müll. Arg.

Mém. Soc. Phys. Genève 30: 27. 1888. *Verrucaria planorbis* Ach., Synops. Lich. 92. 1814. Holotype: "in America ad Crotonis Cascarillae". (H-ACH).

Arthopyrenia fallacior Müll. Arg., Bot. Jahrb. Syst. 6: 404. 1885. Type collection: Cuba, Wright Verr. Cub. 129. Isotype in US.

Arthopyrenia planior Müll. Arg., Bot. Jahrb. Syst. 6: 404. 1885. Syntype collection: Cuba, Wright Verr. Cub. 627b. Isosyntype in US.

Arthopyrenia planorbiculata Müll. Arg., Bot. Jahrb. Syst. 6: 405. 1885. Type collection: Cuba, Wright Verr. Cub. 64. Isotype in US.

Ascocarp semi-immersed to superficial, flattened to hemispherical, hymenium mostly pyriform to subglobose, c. 0.2 mm in diameter; ascocarp wall usually extended outwards above forming a broad shield up to 1 mm in diameter, lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical, 55-100 x 12-17(-20) µ. Spores subbiseriate to biseriate, narrowly ovate, 2-celled, rarely 4-celled; perispore thin; 17-23 x 5-7 µ.

Microconidia filiform, usually curved, 20-27 x 1 µ.

Habitat on bark.

Arthopyrenia planorbis is characterized by the broad shield formed by the ascocarp wall and by the filiform microconidia. At first I was inclined to recognize *A. planorbiculata* (including *A. planior*) as a separate species on the basis of smaller spores and longer microconidia, but the amount of overlap in both characters has finally led me to synonymize them. *Arthopyrenia planorbis* occurs in southernmost Florida and the West Indies (Bahamas, Cuba, Dominican Republic, Grand Cayman, Jamaica and Puerto Rico).

Illustrations: Figs. 80-87. Distribution: Fig. 409.

Specimens seen: United States. FLORIDA: Dade County, Coconut Grove, 1898 *Thaxter 275* (FH), Everglades Nat. Park, SW of Pineland Trail Area, *Harris 2890* (MSC), Lemon City, Simpson's Hammock, 22.II.1917 *Safford 1753b* (US); Monroe County, Big Pine Key, *Hale 36816* (US), No Name Key, *Hale 36942* (US).

Arthopyrenia plumbaria (Stizenb. *in* Hasse) R. C. Harris comb. nov.

Verrucaria plumbaria Stizenb. *in* Hasse, Erythrea 3: 44. 1895. *Porina plumbaria* (Stizenb. *in* Hasse) Hasse, Contr. U. S. Natl. Herb. 17: 12. 1913. Type collection not seen.

Pyrenula herrei Fink in Hedrick, Mycologia 25: 309. 1933. Holotype: California, Santa Cruz Peninsula, Herre (MICH, Fink hb. 13,044).

Ascocarps superficial to slightly immersed, hemispherical, 0.3-0.4(-0.5) mm in diameter; ascocarp wall thinner or lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical, narrowly ovate or narrowly obovate, 75-110 x 12-18 μ. Spores uniseriate to biseriate, narrowly elliptical to narrowly ovate with one or both ends pointed, 2-celled, rarely 4-celled in old age, cells approximately equal in size, cells constricted near the middle or rarely two constrictions per cell; perispore well developed; (13-)15-20 x 4.5-6.5 μ.

Microconidia linear, 10-12(-15) x 1 μ.

Habitat on smooth bark.

Arthopyrenia plumbaria is easily recognized by the spores with constricted spore cells. It is closely related to A. cinereopruinosa but differs in its more slender spores with equal cells and pointed ends and in longer and more slender asci. Misdeterminations of this species account for the vast majority of the Arthopyrenia reports from the West Coast. Arthopyrenia plumbaria ranges from California to British Columbia but never very far inland. It seems to be common.

Illustrations: Figs. 88-92. Distribution: Fig. 410.

Selected specimens seen: Canada. BRITISH COLUMBIA: Queen Charlotte Islands, Graham Is., Brodo 10163 (CAN, MSC), Moresby Is., Brodo 10763, 12884 (CAN); Vancouver Island, Sidney, 19.VII.1914 Macoun (CAN, FH).

United States. CALIFORNIA: Los Angeles County, Catalina Is., IX.1912 Hasse (ABSL, FH, US), Santa Monica Mtns., Sullivans Canyon, VII.1913 Hasse (FH), Topanga Canyon, VII.1914 Hasse (FH); Napa County, 2 mi W of Lake Berryessa, Tucker 6421-B (LSU); Santa Clara County, Santa Cruz Mtns., Los Gatos, 29.XI.1907 Herre 1175 (ABSL, FH, US), Saratoga, Toyon Lodge, 31.V.1945 Herre (MICH); Santa Cruz County, Santa Cruz Peninsula, Herre (MICH). OREGON: Benton County, Adair Tract St. Forest, Pike 3041 (OSC), Corvallis, II.1931 Plitt (US). WASHINGTON: Jefferson County, along Hoh River, Tucker 8311 (LSU).

Arthopyrenia rhyponta (Ach.) Massal.

Ricerch. Auton. Lich. 166, f. 329. 1852. *Verrucaria rhyponta* Ach., Kongl. Vetensk. Akad. Nya Handl. 30: 150. 1809. Type collection: Sweden, coll. unknown. Isotype? in BM-ACH 289.

Thallus brown to blackish, epiphloeodal, consisting of thick dark brown hyphae.

Ascocarps more or less immersed in the thallus, hemisphereical, 0.2-0.3 mm in diameter. Paraphyses thick, irregular with short cells, often mostly gelatinized. Asci narrowly ovate, 40-75 x 15-20 µ. Spores irregularly arranged, narrowly ovate, 4-celled; perispore thin; 17-20 x 5.5-7 µ.

Microconidia rod-like, 4-5 x 1 µ.

Arthopyrenia rhyponta is distinguished by its dark brown thallus and 4-celled spores. It seems somewhat related to *A. padi*. It has been reported from North America, but I have not been able to verify any specimens of it and it should be deleted from the North American flora.

Illustrations: Figs. 93-96.

Exsiccati examined: Anzi Lang. 471 (FH-TUCK 4088); Anzi Ven. 121

(FH-TUCK 4088); Kern. 3136 (FH, US ex MO); Krypt. Vind. 1021 (FH); Moug. 557 (FH-TUCK 4087).

Arthopyrenia salicis Massal.

Ricerch. Auton. Lich. 169, f. 336. 1852. Type collection not seen.

Ascocarps superficial, hemispherical to flattened, 0.15-0.25(-0.3) mm in diameter; ascocarp wall lacking below. Paraphyses more or less completely gelatinized; gelatin occasionally IKI+ pale violet. Asci ovate to narrowly ovate, 35-50 x 15-20 µ. Spores irregularly arranged, narrowly ovate, mostly with rather blunt ends, 2-celled; perispore thin; (12-)15-22 x 4.5-6 µ.

Microconidia short, narrowly elliptical, 2-3 x 1 µ.

Habitat on smooth bark.

Arthopyrenia salicis is recognized by its gelatinized paraphyses, small, usually ovate, asci and rather small spores which are somewhat broader in proportion to length than those of the rather similar A. padi. The relation of these two species is discussed further under the latter. Arthopyrenia salicis is common in Europe but rare in North America and has not been previously reported.

Illustrations: Figs. 97-100.

Exsiccati examined: Erb. II: 120 (FH); Kern. 3534 (FH, US ex MO); Krypt. Vind. 468 (FH, US), 468c (FH); Leight. 288 (FH), 344 (FH, US); Mass. 127 (FH-TUCK 4085), 201 (FH-TUCK 4077); Norrl. 149 (FH-TUCK 4068, MSC); Rab. 203 (MICH), 629 (FH-TUCK 4070, MICH), 943 (MICH).

Specimens seen: United States. ALABAMA: Cleburne County, N of Heflin, Harris 1348 (MSC). LOUISIANA: St. Helena Parish, NE of

Grangeville, _Tucker 10165_ (LSU). MASSACHUSETTS: Bristol County, New Bedford, 1883 _Willey_ (FH).

Arthopyrenia taxodii R. C. Harris sp. nov.

Arthopyrenia ascocarpis immersis clypeo lato, ascis cylindraceis, 105-130 x 15-20 µ et microconidiis linearibus, 7-8 x 1 µ.

Holotype: Texas, Houston, 1869 _Ravenel 60_ (FH-TUCK 4022). Isotypes in FH, MICH & US.

Ascocarps immersed, hymenium pyriform, 0.2-0.3 mm in diameter; tip of ascocarp surrounded by a broad, thin black ring; ascocarp wall poorly developed, lacking below. Paraphyses slender and regular. Asci cylindrical, 100-130 x 14-20 µ. Spores subbiseriate, often almost uniseriate, narrowly ovate to narrowly elliptical, 20-28(-32) x 6-8(-9.5) µ.

Microconidia linear, 7-8 x 1 µ.

Habitat on soft bark of _Taxodium_.

Arthopyrenia taxodii is distinctive in its substrate preference, since as a whole the genus _Arthopyrenia_ occurs on thin smooth barks. The spores are reminiscent of _A. cinchonae_, but the asci are more cylindrical and the ascocarp is immersed and the ostiole is surrounded by a broad hyphal ring. The species is known only from Texas and Florida.

Illustrations: Figs. 101-104.

Specimens seen: United States. FLORIDA: County unknown, Upsala, 5.XI.1932 _Rapp_ (MICH); Duval County, Jacksonville, [_Calkins_?] (MICH). TEXAS: Harris County, Houston, 1869 _Ravenel 60_ (FH, FH-TUCK 4022, MICH, US).

2. ARTHOPYRENIA BIFERA GROUP

This group, although placed in Arthopyrenia, is kept separate since the species included seem to be more closely related to one another than to the rest of the genus. Their 2-celled spores tend to have the spore wall slightly thickened forming a partial subdivision of the spore lumen. Ultimately these thickenings form additional septa giving rise to 4-celled spores. The spore wall is usually strongly ornamented and the perispore is usually quite thick. There is also a tendency for reduction in spore number and even in those which normally have 8 spores per ascus occasional collections are found with four. Two of the species placed here have a strong tendency for the ostiole to be eccentric. The microconidia are linear. Several of the species seem to be consistently associated with Trentepohlia. All of them are tropical or subtropical in distribution.

Many of the above characters are anomalous in Arthopyrenia and are rather more suggestive of the Trypetheliaceae. At the present time my understanding of this group of species is not sufficiently great that I wish to take any major action in regard to them. It is possible that they might be included in Polymeridium or constitute a new genus related to it or, perhaps, a new genus of the Pleosporaceae. Hopefully further investigations of tropical pyrenolichens will bring to light the connecting links needed to clarify the position of this group.

In addition to the species treated here, the group includes two West Indian species, A. porospora Vain. from Dominica and an undescribed species from Jamaica with eccentric ostioles and two spores per ascus.

<u>Arthopyrenia</u> <u>annulata</u> R. C. Harris sp. nov.

Species distintissima sporis bilocularibus, cellulis intra annulo elevato, vel tarde 4-locularibus, asperis, 27-37 x 10-12 µ.

Holotype: Florida, Upper Matecumbe Key, 13.XII.1919 <u>Britton</u> & <u>Britton</u> <u>846</u> (FH-RIDD).

Ascocarps immersed, hymenium flattened hemispherical, (0.2-)0.3-0.4 mm in diameter; tip of ascocarp surrounded by a broad, thin hyphal ring; ascocarp wall thin, lacking below. Paraphyses slender, regular and thread-like. Asci narrowly obovate, (80-)105-125 x 25-30 µ. Spores 4-8/ascus, irregularly arranged, narrowly elliptical to narrowly ovate, 2-celled, each cell partially subdivided by a flat topped ring-like thickening of the wall, becoming 4-celled; spore wall strongly granular ornamented; perispore thick, up to 2 µ; 27-37 x 10-12 µ (excluding perispore).

Microconidia linear, 6-8 x 1 µ.

Habitat on bark.

This species is unique in the peculiar ring-like thickenings around the inside of the spore wall which eventually become septa dividing the spore into four cells. The ascocarp type and strongly ornamented spores are also distinctive. In addition to the type collection from Florida, the species is known from the Bahamas and the West Indies.

Illustrations: Figs. 105-108.

Specimens seen: United States. FLORIDA: Monroe County, Upper Matecumbe Key, 13.XII.1919 <u>Britton</u> & <u>Britton</u> <u>846</u> (FH-RIDD).

West Indies. BAHAMAS: New Providence, 9.XII.1918 <u>Brace</u> <u>9759</u>

(FH-RIDD). CUBA: Isle of Pines, Vivijagua, Britton & Wilson 15596 (FH-RIDD). PUERTO RICO: Mayagüez District, Yauco, 29.XII.1915 Fink 1482 (US).

Arthopyrenia bifera Zahlbr.

Ann. Mycol. 33: 34. 1935. Holotype: Florida, Sanford, 27.IV.1929 Rapp 80 [86 in orig.] (W).

Thallus poorly developed but *Trentepohlia* usually detectable.

Ascocarps mostly immersed, subglobose to hemispherical, 0.2-0.4 mm in diameter; ascocarp wall thinner or lacking below. Ostiole often rather eccentric. Paraphyses slender, regular and thread-like. Asci narrowly elliptical to elliptical, 75-105(-120) x (20-)25-35 µ. Spores 2/ascus, narrowly elliptical, 2-celled, with a slightly thickened area of the wall outlining a smaller subchamber, ultimately becoming 4-celled; spore wall strongly granular ornamented; perispore well developed; 37-48 x 15-16 µ (excluding perispore).

Microconidia rod-like to linear, 5-10 x 1 µ.

Habitat on bark.

The asci with only two spores, the peculiar thickenings of the spore wall and the strong ornamentation of the spore wall make A. *bifera* one of the most distinctive pyrenolichens. It is common in Florida and also known from Alabama, Louisiana and Texas.

Illustrations: Figs. 109-113. Distribution: Fig. 411.

Specimens seen: United States. ALABAMA: *sine loc.*, Wilson (FH-TUCK 4042); Baldwin County, Volanta, 21.II.1925 Evans 168 (MICH). FLORIDA: Dade County, Everglades Nat. Park, near Pa-hay-okee Overlook, Harris 2744-B, 2749, 2751, 2757-B, 2826-G, 2829-E, 2916-B, 2947-B, 2968-B, 2971-B (MSC), N of Paurotis Pond, Harris 2672-B (MSC), SW of Pineland Trail Area, Harris 2875-C, 2882-B (MSC); Liberty County, Apalachicola Nat. Forest, Porter Lake Picnic Area, Harris 1637 (MSC), Whitehead Lake Campground, Harris 1471-A, 1486, 1490, 1575-A, 1717 (MSC); Orange County, Camp Wewa, Schallert (F); Seminole County, Sanford, 27.IV.1929 Rapp 80 (W). LOUISIANA: St. Tammany Parish, Abita, 30.VII.1898 Langlois (US). TEXAS: *sine loc.*, Calkins (US).

Arthopyrenia lyrata R. C. Harris sp. nov.

Species distincta sporis bilocularibus cum uno vel ambis cellulis in medio parum constrictis, asperis, 21-29 x 8.5-10 μ, microconidiis linearibus, 6.5-9 x 1 μ et algis ad *Trentepohliam* pertinentibus.

Holotype: Merr. II: 38, Florida, Daytona, 18.II.1911 Merrill (MSC). Isotypes in MICH, US, US ex MO.

Ascocarps semi-immersed, less commonly immersed or superficial, hemispherical, 0.3-0.5 mm in diameter; ascocarp wall usually lacking below. Paraphyses slender, regular and thread-like. Asci narrowly elliptical to elliptical, usually with a distinct ocular chamber; 75-120(-130) x 20-30 μ. Spores irregularly arranged to biseriate, narrowly elliptical or narrowly ovate, 2-celled, with one or both cells weakly constricted near the middle, rarely becoming 4-celled; spore wall granular ornamented; perispore well developed; 18-30 x 6.5-9.5(-12) μ (excluding perispore).

Microconidia linear, 6-9 x 1 μ.

Arthopyrenia lyrata has been previously confused with *A. cinchonae* but can be separated from it and other similar species by the ornamented spores, constricted spore cells and the presence of Trentepohlia. Arthopyrenia lyrata is almost as uiquitous in the southeastern United States as A. cinchonae and known from Alabama, Florida, Louisiana, North Carolina, Texas and Mexico.

Illustrations: Figs. 114-118. Distribution: Fig. 412.

Exsiccati examined: Cum. I: 180 (CAN, MSC, US, US ex MO); Cum. II: 110 (MICH, FH-RIDD); Merr. II: 38 (MICH, MSC, US, US ex MO).

Selected specimens seen: United States. ALABAMA: Baldwin County, Fairhope, 26.V.1925 Evans 456 (MICH); Mobile County, Mobile, 7.X.1870 Mohr (US). FLORIDA: Dade County, Everglades Nat. Park, N of Paurotis Pond, Harris 2663-A, 2686-C (MSC); Duval County, Jacksonville, Calkins (MICH); Monroe County, Key West, II.1898 Thaxter 361 (MICH); Sarasota County, Myakka River St. Park, Harris 2584-D (MSC); Seminole County, Sanford, XI.1910 Rapp 37 (FH); Volusia County, Daytona [= Daytona Beach], 18.II.1911 Merrill (MICH, MSC, US, US ex MO), 1898 Thaxter 55 (FH), 337, 338 (MICH). LOUISIANA: E. Baton Rouge Parish, 1.5 mi S of Baton Rouge, Tucker 8846-A (LSU); Iberia Parish, Avery Is., II.1915 McIllenny (FH-RIDD); Sabine Parish, 3.5 mi N of Hornbeck, Tucker 7026 (LSU); St. Landry Parish, St. Leo, 21.III.1895 Langlois (US); St. Martin Parish, St. Martinville, 26.III.1894 Langlois (US); W. Feliciana Parish, Tunica Hills, Tucker 8417 (LSU). NORTH CAROLINA: Polk County, Tryon, 24.VI.1893 Green (CAN, FH-RIDD, MICH, MSC, US, US ex MO). TEXAS: Aransas/San Patricio County, Aransas Pass, 9.V.1913 Orcutt (ABSL, FH, MICH); Brazos County, 5 mi E of Bryan, Darrow 4842 (US); Burnet County, on St. Road 1604 4 mi W of old Blanco Rd., Fox T-44 (US); Cameron County, 2 mi W of Boca Chica, F. Brodo 26H (CAN), NE of Brownsville, Runyon 4144a (US ex MO); Kenedy County, 10 mi S of Armstrong, F. Brodo

2B (CAN); Nueces County, Corpus Christi, 1869 Ravenel 86 (US); San Jacinto County, Little Thicket Sanctuary, 25.VIII.1967 Arnold (CAN).

3. MYCOGLAENA v. Höhn.

Sitzungsber. Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl., Abt. 1. 188: 1210. 1909. Holotype: *Verrucaria subcoerulescens* Nyl.

?*Arthopyreniella* J. Stein. *in* Zahlbr., Ann. Naturhist. Hofmus. 24: 284. 1911. ≡*Bertossia* Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 29, 56. 1953. Holotype: *Arthopyrenia cinersescens* Massal. (see Harris, 1973).

Ascocarps flattened, superficial; ascocarp wall green or greenish black, HNO_3+ reddish, lacking below. Hymenial gelatin IKI-. Paraphyses often rather thick, only slightly branched to branched and anastomosed. Asci cylindrical, often with truncate apex, usually with a small ocular chamber. Spores colorless, 2-celled to muriform; perispore not evident.

Microconidia rod-like

Habitat on smooth bark, especially *Myrica* and *Quercus*.

For a discussion of the circumsription of this genus see Harris (1973). The color of the ascocarp wall and the usually truncate tipped asci are diagnostic for the genus. Detailed comments and specimen citations (except for *M. wetmorei*) should be sought in Harris (1973).

1. Spores 2-celled, 17-23 x 6-8 µ .... *M. wetmorei*
1. Spores 4-celled to submuriform 2

    2. Spores with 4-6(-7) cells, two or more cells longitudinally septate, 18-26 x (7-)8-10 µ .... *M. meridionalis*

2. Spores mostly with only 4-6 cells, rarely a single cell longitudinally septate 3

3. Spores pointed at both ends, 4-celled, one of the median cells enlarged, 18-23 x 6-8 µ; on Myrica, rarely on Abies .... M. myricae

3. Spores with more rounded ends, 4-6-celled, cells all approximately equal, 18-30 x (5-)6-8(-9) µ; on Quercus .... M. quercicola

Mycoglaena meridionalis (Zahlbr.) Szat. in Degen Fl. Velebitica 3: 310. 1938. Polyblastiopsis meridionalis Zahlbr., Ann. Naturhist. Hofmus. 23: 223. 1909. Type collection: Krypt. Vind. 1646, "Hungaria: ad ramulos Fraxini orni in Valle "Skurinjatal" prope Fiume, Schuler". Isotypes in FH & US.

Arthopyrenia peranomala Zahlbr., Ann. Mycol. 7: 472. 1909. Holotype: Albania, Boschoholz im Ragusaner Hafen zum Verhaus ausgeschiffts, 18.X.1907 Latzel 589C (W).

Spores ovate to elliptical, submuriform, 3-5(-6) transverse septa, 1-5 cells with 1(-2) longitudinal septa, 18-26 x (7-)8-10 µ.

Illustrations: Figs 119-125; Harris (1973), fig. 32.

Exsiccati examined: Krypt. Vind. 1646 (FH, US); Mass. 43 (FH-TUCK 4084); Merr. II: 93 (MICH, MSC, US, US ex MO).

Additional specimens seen (not cited in Harris, 1973): United States. CONNECTICUT: Litchfield County, Ellsworth, 27.VIII.1884 Green (US).

Mycoglaena myricae (Nyl.) R. C. Harris

Michigan Bot. 12: 29. 1973. Verrucaria myricae Nyl., Flora 52: 297. 1869. Holotype: France, Brest, 1868 Crouan (H-NYL 799).

Verrucaria epidermidis var. aeruginella Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 8: 173. 1866. Holotype: Finland, Kola, 1863 Fellman (H-NYL 800).

Verrucaria fallacissima Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 8: 173. 1866. Holotype: Finland, Kola, 1861 Fellman (H) nom. illeg.

Spores narrowly ovate with rather pointed ends, 4-celled, one of the median cells swollen, 18-23 x 6-8 µ.

The specimen on which Nylander based Verrucaria fallacissima is one of M. myricae. However he included Verrucaria frankliniana Leight. [= Polyblastiopsis fallaciosa (Arn.) Zahlbr.] in synonymy and thus V. fallacissima is a superfluous name. Unfortunately Vainio (1921) based his concept of Mycoglaena fallaciosa (Arn.) Vain. on this same specimen. This has led to some confusion in regards to the interpretation of Polyblastiopsis fallaciosa (Riedl, 1971). No additional American material has been seen.

Illustrations: Figs. 126-130; Harris (1973), fig. 33.

Exsiccati examined: Krypt. Vind. 861 (FH), 3477 (US); Magn. 127 (FH); Mig. 100 (MICH, MSC); Zw. 1197 (MICH).

Mycoglaena quercicola R. C. Harris

Michigan Bot. 12: 30. 1973. Holotype: Iowa, Bremer County, 1895 Fink (US). Isotypes in CAN & US.

Spores narrowly elliptical to narrowly ovate, 4-6-celled, cells approximately equal in size, occasionally with one cell longitudinally septate, 18-30 x (5-)6-8(-9) μ.

Illustrations: Figs. 131-134; Harris (1973), fig. 34.

Exsiccati examined: Cum. I: 249 (CAN, MICH, MSC, US, US ex MO, WIS); II: 189 (ABSL, FH-RIDD, MICH, MSC, US).

Additional specimens seen (not cited in Harris, 1973): United States. MISSOURI: Saline County, Emma, 19.VI.1900 Demetrio (MICH).

Mycoglaena wetmorei R. C. Harris sp. nov.

Mycoglaena sporis bilocularibus, 17-23 x 6-8 μ.

Holotype: Texas, Brewster County, Big Bend Nat. Park, N slope of Emory Peak, 6300 ft., Wetmore 19648-B (MIN).

Thallus indicated by a lighter area on the bark, no algae seen.

Ascocarps flattened, orbicular, c. 0.3 mm in diameter, occasionally depressed in the center. Paraphyses little branched, rather thick, c. 2 μ, with scattered swollen cells, almost moniliform in places. Asci cylindrical or narrowly ovate, 70-90 x 12-15 μ. Spores narrowly ovate, 2-celled, very rarely 4-celled, upper cell broader than the lower; perispore not obvious; 17-23 x 6-8 μ.

Although this species is known only from the type collection, I felt it should be described since it is the first 2-celled Mycoglaena to come to my attention. Among the ten or so ascocarps examined a single 4-celled spore was seen.

Illustrations: Figs. 135-137.

4. TOMASELLIA Massal.

Flora 39: 283. 1856. ≡*Tomaselliomyces* Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 35, 62. 1953. Holotype: *Arthopyrenia arthonioides* Massal.

Athrismidium Trev., Consp. Verruc. 15. 1860. Lectotype: *Arthonia gelatinosa* Chev.

Beckhausia Hampe ex Körb., Parerga Lich. 396. 1865. *nom. inval. in synon.* Holotype: *B. nitida* Hampe *ex* Körb. (= *Tomasellia gelatinosa*).

Mycoporellum Müll. Arg., Rev. Mycol. (Toulouse) 6: 14. 1884. Lectotype (Riedl, 1962): *Mycoporum sparsellum* Nyl.

Mycoporopsis Müll. Arg., Flora 68: 514. 1885. Lectotype (Riedl, 1962): *Mycoporum sorenocarpum* Knight

Chlorodothis Clem., Genera of Fungi 50. 1909. Holotype: *Mycoporellum lahmii* Müll. Arg.

Nothostroma Clem., Genera of Fungi 50. 1909. Holotype: *Mycoporopsis roseola* Müll. Arg.

Sciodothis Clem., Genera of Fungi 50. 1909. Holotype: *Mycoporopsis leucoplaca* Müll. Arg.

Thallus indicated by discoloration of substrate, whitish, grayish or brownish, rarely dark brown, non-lichenized.

Ascocarps flattened, orbicular, elliptical or irregular in outline, compound with few to many chambers, each chamber with an ostiole; chambers separated by colorless or partially carbonized tissue. Hymenial gelatin IKI-. Paraphyses with short, rather irregular cells, often appearing rather parenchyma-like. Asci mostly narrowly ovate or ovate, occasionally narrowly elliptical or elliptical, ocular chamber mostly

not evident. Spores colorless when young, mostly becoming tinted yellow brown in age, mostly irregularly arranged, narrowly ovate or ovate, 2-4-celled, usually constricted at the septa; perispore usually evident, thin to moderately thick; spore wall in most species becoming strongly granular ornamented in old age.

Microconidia rod-like.

Habitat on bark, usually smooth young bark, rarely on ecorticate wood or palmetto petioles.

Tomasellia was related by Massalongo (1856) to genera in the Trypetheliaceae. This was reinforced by Trevisan (1861) who created a separate section of the family for Tomasellia s. lat. Zahlbruckner (1926) and Keissler (1936-38) maintained this disposition of the genus. However, as Müller & von Arx (1962) and Vězda (1968) pointed out, Tomasellia is closely related to Arthopyrenia and has no relationship to the Trypetheliaceae but is a member of the Pleosporaceae (Müller & von Arx, 1962). Further, study of Tomasellia in relation to Mycoporellum and Mycoporopsis has led me to the conclusion that all three are congeneric. They all have the same type of ascocarps, paraphyses and asci. With the exception of T. arthonioides and T. sparsella, all their species known to me have spores which sooner or later become 4-celled and pale yellow brown with an ornamented spore wall. Tomasellia, in my mind, is separated from such species of Arthopyrenia as A. padi, A. rhyponta and the A. persoonii group only by having more than one chamber in the ascocarp. Riedl (1962) separates Mycoporellum and Mycoporopsis from Arthopyrenia by whether the spores become colored or not. I have seen occasional colored spores in most of the common species of Arthopyrenia. I personally find that if one wishes to recognize separate genera, it is much simpler and more useful to do so on the basis of ascocarp structure rather than on the color of the spores in old age. Thus Tomasellia is somewhat artificial but, since the group is homogeneous and its recognition reduces the unwieldy size of Arthopyrenia, I feel justified in recognizing the genus.

The maintenance of separate genera for 2-celled and 4-celled spored species also seems unwarranted as I have found a few 4-celled spores in most of the species previously considered 2-celled. The only species which consistently have only 2-celled spores are T. arthonioides and T. sparsella. Thus if one wishes to recognize separate genera on the basis of spore septation, Tomasellia would be the correct name for species with 2-celled spores and Athrismidium for those becoming 4-celled (Athrismidium had two original species but one was included with a question mark so that Arthonia gelatinosa is made the lectotype). I feel that such a distinction is unecessary and prefer to recognize only a single genus.

There is a rather interesting problem relating to the recognition of species within Tomasellia. My species concepts are broader than those of Riedl (1962, 1963) and are based primarily on spore characters. In some species 4-celled spores develop very early and the majority of the spores are 4-celled. In others 4-celled spores develop very late and then only in small numbers. For all practical purposes T. gelatinosa differs from T. lactea and T. californica from T. eschweileri only in the time at which the spores become 4-celled. I cannot help wondering if this might not be under simple genetic control. If this were true I think one might be justified in treating them as forms of a single species. However since there is no direct evidence to hand, I provisionally maintain them as separate species.

Taken as a whole *Tomasellia* seems to be highly oceanic in distribution with only a few collections of a few species occurring in continental areas.

1. Spores very soon 4-celled 2
1. Spores 2-3- or tardily 4-celled 4

   2. Spores 15-17 x 4-5.5 µ .... *T. americana*
   2. Spores 17 µ or more in length and 5.5 µ or more in width 3

3. Spores 17-22 x 5.5-7 µ .... *T. californica*
3. Spores 20-28 x 7-8 µ .... *T. gelatinosa*

   4. Spores constantly 3-celled .... *T. macularis*
   4. Spores mostly 2-celled, often tardily 4-celled 5

5. Spores small, constantly 2-celled, 12-15 x 4.5-5 µ .... [*T. arthonioides*]
5. Spores larger, over 17 µ in length 6

   6. Spores 1.5-2.5 times longer than broad, 17-22(-25) x 7.5-10 µ .... *T. sparsella*
   6. Spores 2.5-4 times longer than broad, 17-27 x 5-8 µ 7

7. Spores 20-27 x 6.5-8 µ .... *T. lactea*
7. Spores 17-20(-22) x 5-6(-7) µ .... *T. eschweileri*

Tomasellia americana (Minks ex Willey) R. C. Harris comb. nov.

Cyrtidula americana Minks ex Willey, Enum. Lich. New Bedford 33. 1892. Syntype collection: Massachusetts, New Bedford, Willey. Isosyntype in MICH.

Ascocarps orbicular to elliptical, 0.25-0.7 mm in diameter or length, occasionally somewhat less in width, 0.05-0.1 mmin height, with few to many locules. Asci ovate to narrowly ovate or narrowly elliptical, 35-60 x 14-18 µ. Spores irregularly arranged, narrowly ovate, mostly 4-celled; perispore thin; 15-17 x 4-5.5 µ.

Habitat on smooth bark of Cornus, Hamamelis, Prunus and Vitex.

Tomasellia americana has the smallest spores of any of the species with 4-celled spores. It is known from only a few collections from Massachusetts and one from Yugoslavia.

Illustrations: Figs. 138-140.

Exsiccati examined: Vězda Sel. 701 (US).

Specimens seen: United States. MASSACHUSETTS: Bristol County, New Bedford, Willey (MICH), Willey 742 (FH-TUCK 3734, 3735), Willey 857 (FH-TUCK 3731).

Tomasellia arthonioides (Massal.) Massal.

Flora 39: 283. 1856. Arthopyrenia arthonioides Massal., Ricerch. Auton. Lich. 169, f. 339. 1852. Type collection not seen.

Ascocarps orbicular, 0.9-2.0 mm in diameter, 0.05-0.1 mm in height, mostly with many locules. Asci narrowly ovate to narrowly elliptical, 45-70 x 13-15 µ. Spores irregularly arranged to subbiseriate, narrowly ovate, 2-celled, lower cell narrower and longer; perispore not

evident; 12-15 x 4.5-5 μ.

Microconidia rod-like, 3-5 x 1 μ.

Habitat on smooth bark, especially young Fraxinus.

Tomasellia arthonioides is included since it is the type species of the genus. It has not yet been found in North America.

Illustrations: Figs. 141-144; Vězda (1968), fig. 10.

Tomasellia californica (Zahlbr.) R. C. Harris comb. nov.

Mycoporellum californicum Zahlbr., Ann. Mycol. 10: 363. 1912.

Mycoporopsis californica (Zahlbr.) Riedl, Sydowia 16: 216. 1963.

Type collection: California, Santa Monica Mtns., Hasse 1003. Isotype in FH.

Ascocarps orbicular, elliptical or irregular in outline, 0.3-0.7 mm in diameter or length, often c. 0.1 mm less in width, 0.05-0.1 mm in height, with few to many locules. Asci mostly ovate or elliptical, less commonly narrowly ovate or narrowly elliptical, 45-60 x (15-)20-27 μ. Spores irregularly arranged, narrowly ovate, mostly 4-celled; perispore thin; 17-22 x 5.5-7 μ.

Habitat on smooth bark.

Tomasellia californica has about the same spore size as T. eschweileri but the latter has predominantly 2-celled spores. With the exception of a single collection from Texas, T. californica is known only from California and Hawaii.

Illustrations: Figs. 145-149; Richardson & Morgan-Jones (1964), fig. 7.

Exsiccati examined: Merr. I: 156 (FH, US).

Specimens seen: United States. CALIFORNIA: Los Angeles County, Catalina Island, IV.1915 Hasse (FH), Santa Monica Canyon, V.1914 Hasse (FH), VII.1914 Hasse (FH), Santa Monica Mtns., 1906 Hasse (FH), 1913 Hasse (FH), III.1915 Hasse (FH, US). HAWAII: Oahu, Punchbowl, 25.II.1895 Heller (FH), 1.IV.1895 Heller 2051 (FH, MSC). TEXAS: Dallas County, Dallas, 1879 [Hall] (FH-TUCK 3734).

Tomasellia eschweileri (Müll. Arg.) R. C. Harris comb. nov.

Mycoporellum eschweileri Müll. Arg., Flora 71: 526. 1888.

Holotype: Brazil, Bahia (G).

Ascocarps orbicular to irregular, 0.3-0.6(-0.8) mm in diameter or length, often somewhat less in width, 0.06-0.12 mm in height , with few to many locules. Asci narrowly ovate, 42-65 x 20-23(-26) µ. Spores irregularly arranged, narrowly ovate, mostly 2-celled, a few becoming 4-celled; perispore thin; 17-20 x 5-6(-7) µ.

Microconidia rod-like, 4-5 x 1 µ.

Habitat on bark and rarely on palmetto petioles.

The spore size of *T. eschweileri* overlaps that of *T. lactea* and occasional collections are difficult to place. It differs from *T. californica* in spore septation. The Iowa and Minnesota collections differ in that the spore wall is very thin and the spores tend to collapse, but I am not inclined to recognize them as a separate taxon on this basis. They were included in Harris (1973) as *Mycoporellum* sp. *Tomasellia eschweileri* has been collected in the southeastern United States, the Hawaiian Islands, Brazil and the West Indies (Cuba, Grand Cayman, Haiti, Jamaica, Puerto Rico, Martinique and St. Lucia). It has not been reported from North America previously.

Illustrations: Figs. 150-155. Distribution: Fig. 413.

Exsiccati examined: Merr. I: 156 (CAN, FH-RIDD, US).

Specimens seen: United States. ALABAMA: Baldwin County, Fish River, 21.III.1925 Evans 324 (MICH). FLORIDA: Dade County, Everglades Nat. Park, near Pa-hay-okee Overlook, Harris 2730-B, 2815-C, 2840-B (MSC), near Pineland Trail Area, Harris 2888-B, 2889-A, 2911-F (MSC); Duval County, Jacksonville, Calkins (FH, US); Flagler County, Flagler St. Park, Harris 2500-B, 2502-B (MSC); Sarasota County, Myakka River St. Park, Harris 2663-C (MSC); Seminole County, Sanford, 5.VI.1915 Rapp 214 (FH); Volusia County, Tomoka St. Park, Harris 2319 (MSC). HAWAII: Oahu, Punchbowl, 25.III.1895 Heller (FH), 1.IV.1895 Heller (CAN, FH-RIDD, US, US ex MO). IOWA: Bremer County, VIII.1895 Fink (MICH). KENTUCKY: Rockcastle County, Conway, 8.IV.1927 Fink (MICH). LOUISIANA: St. Martin Parish, 1889 Langlois 957 (US). MINNESOTA: Blue Earth County, Mankato, 24.VI.1899 Fink 90 (MIN). TEXAS: Cameron County, 2 mi N of Olmito, Runyon 3814 (US ex MO).

Tomasellia gelatinosa (Chev.) Zahlbr.

Cat. Lich. Univ. 1: 474. 1922. *Arthonia gelatinosa* Chev., J. Phys. Chim. Hist. Nat. Arts 94: 54. 1822. Type collection not seen.

Ascocarps orbicular, 0.4-1.0 mm in diameter, 0.07-0.15 mm in height, mostly with numerous locules. Asci ovate to almost elliptical, 50-85 x 24-30 µ. Spores irregularly arranged, narrowly ovate, mostly 4-celled; perispore thin; 20-28 x 7-8 µ.

Habitat on smooth bark.

Tomasellia gelatinosa differs from *T. lactea* in having predominantly

4-celled spores and from T. californica by larger spores, although there is some overlap in spore size. Tomasellia gelatinosa has not previously been reported from North America.

Illustrations: Figs. 156-159.

Exsiccati examined: Magn. 377 (US); Malbr. 250 (MSC); Rab. 780 (FH-TUCK 3734); Trev. 54 (FH).

Specimens seen: Canada. NEWFOUNDLAND: Bay of Islands, Lark Harbour, 19.III.1887 Waghorne 576 (US ex MO).

United States. MAINE: Knox County, Rockland, 15.IV.1910 Merrill (FH).

Tomasellia lactea (Ach.) R. C. Harris comb. nov.

Verrucaria stigmatella var. lactea Ach., Lich. Univ. 277. 1810. Verrucaria lactea (Ach.) Eschw. in Martius, Fl. Brasil. 1: 126. 1833. Mycoporellum lacteum (Ach.) Zahlbr., Cat. Lich. Univ. 1: 554. 1922. Type collection: "India Occid., Swartz". Isotypes in BM-ACH & UPS.

Mycoporopsis leucoplaca Müll. Arg., Flora 69: 316. 1886. Mycoporellum leucoplacum (Müll. Arg.) Zahlbr., Nat. Pflanzenfam. 1(1*): 78. 1903. Type collection: Brazil, Minas Geraes, Glaziou. Isotypes in FH, FH-TAYL 118 & US.

Mycoporellum hassei Zahlbr. in Hasse, Bryologist 15: 46. 1912. Holotype: California, Catalina Island, near Avalon, Hasse 1321 (W). Isotypes in FH.

Mycoporellum deserticola Fink in Hedrick, Mycologia 22: 248. 1930. Mycoporopsis deserticola (Fink in Hedr.) Riedl, Sydowia 16: 218. 1963. Holotype: Puerto Rico, Yauco, 1.I.1916 Fink 1688 (MICH).

Ascocarps orbicular, elliptical or irregular, 0.3-0.6 mm in diameter or length, often less in width, 0.09-0.13 mm in height, with few to many locules. Asci ovate to elliptical or narrowly ovate to narrowly elliptical, 50-75(-100) x 20-27(-30) µ. Spores irregularly arranged, narrowly ovate, mostly 2-celled but a few 4-celled; perispore thin to moderately thick; 20-27 x 6.5-8 µ.

Microconidia rod-like, 4-5 x 1 µ.

Habitat on bark and wood.

Riedl (1962) excluded this species since the specimen in Helsinki was apparently a poorly developed Arthopyrenia. However other isotypes contain well developed material of this species. Mycoporellum difforme (Minks in Willey) Fink was described from Massachusetts, but I have not been able to examine the original material. I presume from Riedl's (1962) description that it will prove to be identical with T. lactea. The original material of Mycoporopsis leucoplaca has asci larger than seem normal for T. lactea but agrees in its other characters, so I have tentatively placed it in synonymy.

Tomasellia lactea is the most widely distributed species in the genus. In North America it occurs from Massachusetts to Texas and in California. It is also known to me from Brazil, Puerto Rico and in Europe from England, Ireland and Tenerife.

Illustration: Figs. 160-166. Distribution: Fig. 414.

Exsiccati examined: Rel. Hasse 113 (FH).

Specimens seen: United States. ALABAMA: Baldwin County, Bailey's Beach, 8.III.1925 Evans 245 (MICH). CALIFORNIA: Los Angeles County, Catalina Island, V.1911 Hasse (FH), 1912 Hasse (US), beach S of Avalon, V.1911 Hasse (FH, W), near "Clifton by the Sea," XII.1907 Hasse (FH),

Santa Monica Mtns., Hasse (MICH); San Diego County, San Diego, III.1885 Farlow (FH, MICH). FLORIDA: Dade County, Everglades Nat. Park, between Mahagony Hammock and Pa-hay-okee Overlook, Harris 2916-A (MSC), near Pa-hay-okee Overlook, Harris 2744-A, 2757-D, 2762, 2813-B, 2829-F (MSC), near Pineland Trail Area, Harris 2875-B, 2896-B, 2898-A (MSC); Duval County, Ft. George Island, Calkins (MSC), Jacksonville, Calkins (FH); Flagler County, Flagler St. Park, Harris 2478-A, 2486-A (MSC); Liberty County, Apalachicola Nat. Forest, Whitehead Lake campground, Harris 1448, 1488 (MSC); Seminole County, Sanford, 27.IV.1914 Rapp 500 (FH), 5.V.1914 Rapp 13 (FH), V.1919 Rapp (US). MASSACHUSETTS: Bristol County, New Bedford, 1881 Willey 850d (FH-TUCK 3731). SOUTH CAROLINA: Berkeley County, Francis Marion Nat. Forest, Guilliard Lake campground, Harris 3166 (MSC);Charleston County, near Charleston, Ravenel 347 (FH-TUCK 4050).

Tomasellia macularis (Minks ex Willey) R. C. Harris comb. nov.

Cyrtidula macularis Minks ex Willey, Enum. Lich. New Bedford 33. 1892. Syntype collection: Massachusetts, New Bedford, Willey. Isosyntype in MICH.

Ascocarps orbicular to elongated and irregular, 0.4-0.6 mm in diameter to 1.2 mm long and 0.4 mm wide, 0.07-0.12 mm in height, with few to many locules. Asci ovate to elliptical, 45-65 x 27-33 μ. Spores irregularly arranged, narrowly ovate to ovate, 3-celled, upper cell the largest; perispore moderately thick, 22-26 x 8-12 μ.

Habitat on smooth bark of Hamamelis, Pinus and Prunus.

Tomasellia macularis is quite unusual in that the spores are 3-celled. A few 3-celled spores may be found in other species but they are transitional to 4-celled spores. No 4-celled spores have been found

in _T. macularis_.

Illustration: Figs. 167-169.

Specimens seen: United States. MASSACHUSETTS: Bristol County, New Bedford, 1881 _Willey 850a_, _850c_ (FH-TUCK 3731), 1885 _Willey 972_ (FH-TUCK 3735).

Tomasellia sparsella (Nyl.) R. C. Harris comb. nov.

Mycoporum sparsellum Nyl., Ann. Sci. Nat. Bot. ser. 5, 7: 343. 1867. _Mycoporellum sparsellum_ (Nyl.) Müll. Arg., Rev. Mycol. (Toulouse) 4: 14. 1884. Lectotype: Columbia, Monte del Morro, _Lindig_ (H-NYL 4292).

Ascocarps orbicular, elliptical or irregular in outline, 0.4-0.6 mm in diameter or length, often somewhat less in width, 0.08-0.2 mm in height, with relatively few locules (up to c. 15). Asci ovate or elliptical, 55-85 x 24-35 µ. Spores irregularly arranged, ovate, 2-celled; perispore thin; 17-22(-25) x 7.5-10 µ.

Microconidia rod-like, 4-5 x 1 µ.

Tomasellia sparsella is distinguished by its relatively short but broad spores which are ovate (length/width ratio 2-2.5:1) rather than narrowly ovate (length/width ratio 2.5-4:1) as in the rest of the species treated. It is known only from Florida in North America but also has been found in Columbia, Guatemala and the West Indes (Cuba, Dominica, Grand Cayman and Jamaica).

Illustration: Figs. 170-173. Distribution: Fig. 415.

Specimens seen: United States. FLORIDA: Dade County, Everglades Nat. Park, between Mahagony Hammock and Pa-hay-okee Overlook, _Harris 2959_ (MSC), near Pa-hay-okee Overlook, _Harris 2799_, _2815-A_, _2820_ (MSC), near Pineland Trail Area, _Harris 2911-G_ (MSC); Flagler County, Flagler

St. Park, Harris 2484-B (MSC); Marion County, Ocala Nat. Forest, S of Long Pond, Harris 1819 (MSC); Seminole County, Sanford, Rapp (MICH), I.1912 Rapp (FH, US), 25.V.1914 Rapp (FH).

C. STRIGULACEAE Fr.

Syst. Orb. Veg. 1: 110. 1825. Holotype: *Strigula* Fr.

Xanthopyreniaceae Zahlbr., Nat. Pflanzenfam., ed. 2, 8: 91. 1926. Holotype: *Xanthopyrenia* Bachm.

Monoblastiaceae W. Wats., New Phytol. 28: 106. 1929. Holotype: *Monoblastia* Ridd.

Pleurotremataceae W. Wats., New Phytol. 28: 112. 1929. Holotype: *Pleurotrema* Müll. Arg.

Acrocordiaceae Oxn., Flora Lishainikiv Ukraini 1: 144. 1956. *nom. inval. descr. ross.*

Thallus usually well developed, mostly within the substrate but occasionally mostly superficial, subcuticular in the foliicolous species. Most species associated with *Trentepohlia*, foliicolous species with *Cephaleuros*, species of *Pyrenocollema* with various blue-green algae.

Ascocarp perithecioid lacking an ostiolar apparatus in the two species studied by Janex-Favre (1971), unknown for the rest but presumably similar. Ascocarps not fused by their necks except in *Strigula connivens*. Ostiole erect in all except *Pleurotrema*, *Monoblastia palmicola* and *Anisomeridium macrosporum*. Interascal filaments in the species studied by Janex-Favre (1971) were found to be true paraphyses. Paraphyses slender, thread-like, branched and anastomosed in most, only sparsely so in *Strigula*. Asci bitunicate (Richardson & Morgan-Jones, 1964; Swinscow, 1965b, 1967), nassascé (Magne, 1946), bitunicate-

nassascé (Janex-Favre, 1971). Spores colorless, transversely septate (submuriform in Strigula submuriformis, simple in Monoblastia palmicola), eight per ascus (except for random abortion), occasionally dividing into two part spores before or after release from the ascus, mostly without a well developed perispore, with granular ornamentation in Acrocordia, commonly in Pleurotrema, rarely in Anisomeridium.

Microconidia orbicular, elliptical or oblong.

Macroconidia known for most species of Strigula and some of Anisomeridium, cylindrical or fusiform and transversely septate in Strigula, orbicular, elliptical or rarely cylindrical and non-septate in Anisomeridium.

Lichen substances generally lacking except for a few species of Anisomeridium which produce lichexanthone and one or more anthraquinones in one species.

Habitats include bark, wood, leaves, bryophytes, rock and soil, occasionally aquatic.

The six genera of the Strigulaceae contain the bulk of the species removed from Arthopyrenia, some wrongly placed in Porina and Thelidium, and even one from the Collemataceae. The genera are united on the basis of an aggregation of characters rather than any one outstanding feature. These include similar ascocarp type and development (as far as is known), generally similar asci and paraphyses and similar type of spores and microconidia. It is of interest to note that the spores show relatively little variation in comparison to the other families of pyrenolichens. No members have yet been found with truely muriform spores, acicular spores or an increased or decreased number of spores in the ascus. There is also little variation in the form of the ascocarp. Parathelioid

and astrothelioid types are rare and no instances of aggregation within a pseudostroma are known, while these types are common in the Pyrenulaceae and Trypetheliaceae. Although the Strigulaceae may be lacking in morphological versatility it is ecologically very versatile. The only other pyrenolichen family capable of living in such a variety of habitats is the Trichotheliaceae. The Pyrenulaceae (except Lithothelium) and Trypetheliaceae are exclusively corticolous. Although a number of species are tropical in distribution the Strigulaceae seem less exclusively tropical than the Pyrenulaceae, Trichotheliaceae and Trypetheliaceae. The Strigulaceae do not seem to me to be closely related to any of the other pyrenolichen families.

1. ACROCORDIA Massal.

Geneac. Lich. 17. 1854. Lectotype (Th. Fr., 1861): Lichen gemmatus Ach.

Acrocordiomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 26, 56. 1953. Holotype: Verrucaria conoidea Fr.

Thallus well developed, mostly endophloeodal or endolithic. Phycobiont Trentepohlia.

Ascocarp with outer layers of wall brown to brown black, occasionally almost colorless in deeply embedded ascocarps. Ostiole erect or sometimes eccentric. Paraphyses slender, rather loosely branched and anastomosed forming a rather regular network. Asci cylindrical with a hemispherical to almost subglobose ocular chamber which is capped by a layer which is clearly distinct when stained (meniscus of Janex-Favre, 1971). Spores eight in the ascus, uniseriate, oblong to elliptical;

spore wall with granular ornamentation on the epispore (apparently included in the perispore), perispore and granules disappearing in KOH.

Microconidia elliptical to oblong.

Habitat on bark, old wood and rock.

Acrocordia is a genus easily recognized by its distinctive ascus and spore type. At present I would include only seven species, A. cavata, A. conoidea, A. gemmata (Ach.) Massal., A. megalospora, A. salweyi (leight.) A. L. Sm., Arthopyrenia subglobosa Vězda and possibly Acrocordia macrospora Massal.

The distribution of the species is of some interest. Acrocordia gemmata, macrospora, salweyi and subglobosa are strictly European. Acrocordia gemmata has already been excluded from the North American flora and all of the previous records of A. conoidea examined have turned out to be either Verrucaria spp. or Thelidium spp. Thus A. conoidea is European with the exception of one collection from Chile (Juan Fernandez Is.) and another in North America (Michigan). Acrocordia megalospora is restricted to eastern North America. Therefore the only widespread species is A. cavata, occurring in both Europe and North America. No specimens of this genus have been verified from the tropics nor, with a single exception, from the Southern Hemisphere. Acrocordia is rather unique among the pyrenolichens in having an almost entirely North Temperate distribution.

1. Growing on calcareous rock; spores 13-17 x 7-8.5 μ .... A. conoidea
1. Growing on bark 2

2. Spores 33-48(-60) x 15-23 µ .... _A. megalospora_

2. Spores 11-17 x 6-9.5 µ .... _A. cavata_

Acrocordia cavata (Ach.) R. C. Harris _in_ Vězda

Lich. Sel. 1229. 1974. _Verrucaria cavata_ Ach., Syn. Lich. 91. 1814. _Arthopyrenia cavata_ (Ach.) R. C. Harris, Michigan Bot. 12: 11. 1973. Holotype: Switzerland, [Schleicher?] 442a (H-ACH).

Ascocarps 0.3-0.5 mm in diameter. Asci 80-115 x 9-10 µ. Spores 11-17 x 6-9.5 µ; spore wall with minute granular ornamentation.

Microconidia oblong, 3-6 x 1-2 µ.

The relationship of _A. cavata_ to other species in the genus is discussed in Harris (1973). European specimens have been verified from England, France, Germany, Sweden and Switzerland. The range in eastern North America has been extended significantly by a collection of this species from South Carolina.

Illustrations: Figs. 174-178; Harris (1973), fig. 4. Distribution: Fig. 416.

Exsiccati examined: Fr. 274 (MSC); Krypt. Vind. 2152 (FH, US); Malbr. 398 (MSC); Rab. 89 (FH-TUCK 4062); Vězda Sel. 1229.

Additional specimens seen (not cited in Harris, 1973): United States. MICHIGAN: Baraga County, NE of Sidnaw, _Harris 7827_, _7878_ (MSC); Keweenaw County, Isle Royale, Conglomerate Bay, _Wetmore 4214_ (MSC) [sub _Bacidia rubella_]. SOUTH CAROLINA: Berkeley County, Francis Marion Nat. Forest, Guilliard Lake Campground, _Harris 3193-B_ (MSC).

Acrocordia conoidea (Fr.) Körb.

Syst. Lich. Germ. 358. 1855. *Verrucaria conoidea* Fr., Lichenogr. Europ. Reform. 432. 1831. Type collection not seen.

Ascocarps 0.6-0.8 mm in diameter. Asci 120-140 x 9-11 µ. Spores 13-17 x 7-8.5 µ; spore wall with minute granular ornamentation. (In part from Vĕzda, 1961).

Microconidia oblong to elliptical, 3-4 x 1.5-2 µ.

Habitat on calcareous rock.

The spore measurements of the sole North American collection compare very closely with those given by Vĕzda (1961) for var. *conoidea*. However the range he gives seems somewhat low based on the comparatively few specimens I have studied (15). The ascocarps are also slightly smaller and less spreading at the base than in European material, but the wall is not as incurved at the base as in var. *suzae* Vĕzda.

Acrocordia conoidea is currently known in North America only from Michigan. All other North American collections under this name seen by me have proved to belong to either *Thelidium* or *Verrucaria*. The Michigan collection grew on a limestone boulder at the edge of Lake Huron, certainly wetted by waves in rough weather.

Illustrations: Figs. 179-182; Vĕzda (1961), figs. 1-4; (1968), fig. 31.

Exsiccati examined: Krypt. Vind. 376 (FH, US); Leight. 31 (US); Malbr. 397 (MSC); Pišut 151 (MSC); Rab. 598 (US); Vĕzda Bohem. 62 (MSC).

Specimen seen: United States. MICHIGAN: Mackinaw County, shore of Lake Huron at Bush Bay, *Harris 9474* (MICH).

Acrocordia _megalospora_ (Fink) R. C. Harris comb. nov.

Pyrenula _megalospora_ Fink, Minnesota Bot. Stud. 2: 329. 1899. _Arthopyrenia_ _macrospora_ Fink, Contr. U.S. Natl. Herb. 14: 237. 1910 _ut_ _nom._ _nov._, _hom._ _illeg._ (_non_ _A._ _macrospora_ J. Stein., Ann. Naturhist. Hofmus. 23: 109. 1909). _Arthopyrenia_ _finkii_ Zahlbr., Cat. Lich. Univ. 1: 306. 1921. _ut_ _nom._ _nov._ Lectotype (Harris, 1973): Minnesota, Mankato, _Fink_ _209_ (MICH). Isolectotype in MIN.

Ascocarps 0.5-1.0 mm in diameter. Ostiole often at the end of a short neck, often displaced from the vertical. Asci 150-250 x 15-25 µ. Spores 33-48(-60) x 15-23 µ; spore wall granular ornamented; perispore rather thick.

Microconidia elliptical, 4-5 x 2 µ.

The transfer of Fink's original name was blocked in _Arthopyrenia_ by the existence of an earlier homonym, but there is no such obstacle in _Acrocordia_. Further discussion of this species can be found in Harris (1973).

Illustrations: Figs. 183-186; Harris (1973), fig. 6.

Distribution: Harris (1973), fig. 59.

Additional specimens seen (not cited in Harris, 1973): United States. MAINE: Knox County, Rockland, 1.IX.1910 _Merrill_ (FH). MARYLAND: Baltimore County, The Caves, 1.III.1910 _Plitt_ _317_ (US), Catonsville, 14.I.1911 _Plitt_ _402_ (US), Muby Rd., 22.XII.1906 _Plitt_ _119a_ (US), Union Dam, 12.IX.1907 _Plitt_ _208_ (FH, US). MASSACHUSETTS: Bristol County, New Bedford, _Willey_ (FH-TUCK 4025, US); Hampshire County, Amherst, 1857 _Tuckerman_ (FH-TUCK 4024); Middlesex County, Cambridge, 1852 _Tuckerman_ (FH-TUCK 4024), Newton, _Farlow_ _46_ (FH-TUCK

4047), Pepperell, VII.1909 Riddle (FH-RIDD); Norfolk County, Weymouth, XI.1852 Tuckerman (FH-TUCK 4024). MICHIGAN: Jackson County, Race Rd. E of Jackson, Harris 9759 (MICH). PENNSYLVANIA: Huntingdon County, Penn. State College Nature Camp, Thomson 1789 (Thomson). VIRGINIA: Page County, Little Stony Man, Imshaug 38670-B (MSC).

2. ANISOMERIDIUM (Müll. Arg.) Choisy

Icon. Lich. Univ., fasc. 3 (sine pagin.). 1928. *Arthopyrenia* sect. *Anisomeridium* Müll. Arg., Flora 66: 290. 1883. Lectotype (Riedl, 1963): *Arthopyrenia xylogena* Müll. Arg.

Lembidium Körb., Syst. Lich. Germ. 358. 1855 *nom. rejic.* [*non Lembidium* Mitt., 1867 (Hepaticae)]. Holotype: *Lembidium polycarpum* Körb. (= *Anisomeridium biforme*).

Thallus whitish or grayish, endophloeodal or less commonly epilithic or endolithic. Phycobiont *Trentepohlia*.

Ascocarps variable in size and shape, immersed or superficial; outer layer of ascocarp wall dark brown or blackish, often lacking below. Hymenial gelatin IKI-. Paraphyses thread-like, branched and anastomosed. Asci mostly cylindrical or dactyloid, less commonly narrowly elliptical, narrowly ovate or narrowly obovate to ovate or obovate; normally with a small ocular chamber. Spores uniseriate, biseriate or irregularly arranged, broadly elliptical, broadly ovate to narrowly ovate or subcylindrical, mostly 2-celled, rarely 3-4-celled; cells mostly unequal, often markedly so, lower cell shorter and narrower than upper; spore wall quite thick, up to 2 μ; perispore usually not distinguish able; without ornamentation except in *A. adnexum*.

Microconidia orbicular, elliptical or narrowly elliptical.

Macroconidia simple, orbicular or elliptical.

Lichen substances: Lichexanthone in several species, antraquinone pigments in *A. macrospora*.

Choisy's use of *Anisomeridium* as a genus is found in a key without any indication of basionym or species included. It seems clear from the context that he meant it as a genus and that he was dealing with the sections of *Arthopyrenia* as recognized by Zahlbruckner (1921-22, 1926). *Acrocordia* and *Anisomeridium* were given generic status by Choisy while he retained the other sections in *Arthopyrenia*. Thus, even though there is no specific reference to Müller's section, I feel fully justified in treating Choisy's name as a change of status rather than a new genus.

Anisomeridium is to some extent composed of species which do not fit into any of the other genera of the Strigulaceae. In spite of this *Anisomeridium* seems to be a natural grouping. The orbicular microconidia, simple macroconidia and presence of lichexanthone are diagnostic. The tendency for the spore cells to be unequal in length and width is also characteristic. The spore cells may be unequal in other genera of pyrenolichens but in most cases the lower cell although narrower is usually as long or longer than the upper. In *Anisomeridium* the lower cell is usually the shorter. The genus most likely to be confused with *Anisomeridium* is *Strigula*, but the almost unbranched paraphyses in the latter distinguishes them rather easily. *Anisomeridium* is separated from *Acrocordia* by the ascus and spore type and from *Pyrenocollema* by the phycobiont and spore type.

Anisomeridium has its greatest diversity in subtropical regions. *Anisomeridium biforme* is the most widely distributed species, growing in temperate to tropical areas in both hemispheres. Of the other species known to me only _A. carinthiacum_ is found in both Europe and North America. All the rest are American.

1. Growing on rock 2
1. Growing on bark or wood 4

2. Spores becoming 4-celled, 16-22 x 6.5-8 µ; not aquatic .... _A. distans_
2. Spores remaining 2-celled 3

3. Spores (11-)13-18 x 5.5-7 µ; more-or-less aquatic on non-calcareous rock; northeastern U. S. .... _A. carinthiacum_
3. Spores 20-25 x 6.5-8.5 µ; on limestone, not aquatic; southern Florida and West Indies .... _A. finkii_

4. Thallus UV+ yellow (lichexanthone) or rarely UV- in _A. ambiguum_ 5
4. Thallus UV- 7

5. Spores small, (12-)15-20 x 5-6.5 µ; macroconidia cylindrical, 7.5-12 x 2-2.5 µ .... _A. tuckeri_
5. Spores larger, over 25 µ long; macroconidia orbicular to elliptical 6

6. Spores 37-52 x 12-20 µ; orange pigment around ostiole KOH+ purple; macroconidia elliptical, 30-45 x 15-20 µ .. .. _A. macrosporum_
6. Spores 24-33 x (8-)9-13 µ; macroconidia suborbicular to broadly elliptical, 15-21 x 10-15 µ .... _A. ambiguum_

7. Spore wall ornamented; spores broadly ovate, 25-33 x 15-18 µ; spore cells strongly unequal .... *A. adnexum*

7. Spore wall smooth 8

8. Spores small, 9-13 x 4-5 µ .... *A. albisedum*

8. Spores larger, over 10 µ in length 9

9. Spores becoming 4-celled, 14-20 x 4.5-6 µ; microconidia elliptical; mainly northern (as far south as North Carolina) ... . *A. willeyanum*

9. Spores remaining 2-celled; microconidia mostly orbicular (elliptical in *A. subprostans*); mostly in the coastal plain (*A. leucochlorum* as far inland as southern Ohio and Illinois) 10

10. Asci slender, cylindrical or dactyloid 11

10. Asci ovate or obovate to narrowly ovate or narrowly obovate 13

11. Spores broadly elliptical to ovate, rarely narrowly ovate, 10-18 x 4.5-7.5 µ; common on both coasts, rarer in the South .... *A. biforme*

11. Spores slender, narrowly ovate to almost cylindrical (often slightly bent in *A. tamarindi*); coastal plain and West Indes 12

12. Microconidia elliptical; macroconidia not known; spores 12-18(-21) x 4.5-6.5 µ, not bent .... *A. subprostans*

12. Microconidia orbicular; macroconidia elliptical, 4-7 x 2.5-3.5 µ; spores 15-22(-24) x 4-5.5(-6) µ, often slightly bent .... *A. tamarindi*

13. Spores 12-18 x 5-7.5 µ; ascus wall thin and even; macroconidia globose .... *A. leucochlorum*

13. Spores larger, 15-22 x 5.5-8.5 µ 14

14. Ascus wall thick, thickened unevenly; spores 15-22 x 6.5-8.5 µ .... *A. feeanum*

14. Ascus wall relatively thin and even; spores 18-22 x 5.5-7 µ .... *A. sanfordense*

Anisomeridium adnexum (Müll. Arg.) R. C. Harris comb. nov.

Arthopyrenia adnexa Müll. Arg., Flora 66: 304. 1883. (*adnaex err. typ.*). *Leiophloea adnexa* Riedl, Sydowia 16: 266. 1963. Lectotype: Brazil, Apiahy, *Puiggari 240* (G).

Asci ovate. Spores irregularly arranged, ovate; cells markedly unequal; 25-33 x 15-18 µ; spore wall strongly ornamented.

Microconidia orbicular, c. 2 µ in diameter.

The collection chosen as the lectotype is the one which Riedl (1963) has discussed in some detail. The syntype from Rio de Janeiro is another species of *Anisomeridium*. *Anisomeridium adnexum* has not been found in North America.

Illustration: Figs. 187-190.

Specimens seen: Brazil, Apiahy, *Puiggari 240*, *1007* (G).

Anisomeridium albisedum (Nyl.) R. C. Harris comb. nov.

Verrucaria viridiseda f. _albiseda_ Nyl., Lich. Japon. 108. 1890. _Porina viridiseda_ f. _albiseda_ (Nyl.) Zahlbr., Cat. Lich. Univ. 1: 409. 1922. Lectotype: Florida, _Calkins_ (H-NYL 717). Isolectotypes in MICH? and US.

Thallus whitish, endophloeodal.

Ascocarps hemispherical to subglobose, small, 0.2-0.3(-0.4) mm in diameter. Asci cylindrical, occasionally slightly broader toward the base, 50-75(-85) µ in length. Spores nearly uniseriate to subbiseriate, narrowly ovate, slightly constricted at the septum, 9-13 x 4-5 µ.

Microconidia narrowly elliptical to rectangular, 3.5-4.5 x 1.2-2 µ.

Habitat on bark, usually _Quercus_ but once on _Myrica_.

The other syntype of _V. viridiseda_ f. _albideda_ (H-NYL 718) is _Strigula phaea_. _Anisomeridium albisedum_ is the smallest spored species in the genus. _Strigula phaea_ has spores similar in size and shape, but differs in having a darker thallus, unbranched paraphyses and 2-celled macroconidia. _Anisomeridium albisedum_ is known only from northern and central Florida.

Illustrations: Figs. 191-194.

Specimens seen: United States. FLORIDA: _sine loc._, _Calkins_ (FH, H-NYL, MICH, US); County unknown, Livezey's Creek, _Calkins_ (MICH); Duval County, Jacksonville, _Calkins_ (FH, MICH, MSC); Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, _Harris 1549_ (MSC); Seminole County, Sanford, X.1910 _Rapp_ (FH), 31.IX.1912 _Rapp_ (FH).

Anisomeridium ambiguum (Zahlbr.) R. C. Harris comb. nov.

Arthopyrenia (_Acrocordia_) _ambigua_ Zahlbr., Ann. Mycol. 33: 35. 1935. Lectotype: Florida, Sanford, V.1923 _Rapp 142_ (W, middle piece of three on card).

Thallus whitish or grayish, UV+ yellow (lichexanthone) or rarely UV-.

Ascocarps immersed, hymenium ovate; ascocarp wall usually thick above and extending outward to form a shield, thin or lacking below. Asci cylindrical. Spores nearly uniseriate, ovate to narrowly ovate, ends often somewhat pointed, slightly constricted at the septum, 24-33 x (8-)9-13 µ.

Microconidia elliptical to narrowly elliptical, 3-4 x 1.5-2 µ.

Macroconidia suborbicular to broadly elliptical, 15-21 x 10-15 µ.

Habitat on soft bark of a variety of trees.

The middle piece on the card is designated as the lectotype since it seems to be the piece studied by Zahlbruckner. However, it is the only specimen I have seen which I have seen which lacks lichexanthone. It is identical to lichexanthone containing specimens in all other respects. The two syntypes on the card do contain lichexanthone.

Anisomeridium ambiguum is one of three closely related species having similar spores, asci and chemistry. _Anisomeridium tuckeri_ has smaller spores and _A. macrosporum_ larger. _Anisomeridium ambiguum_ occurs in northwestern Florida and Jamaica.

Illustrations: Figs. 195-199.

Specimens seen: United States. FLORIDA: Putnam County, Oklawaha River at Fla. Hwy 19, _Harris 2200_ (MSC); Seminole County, Sanford, 10.V.1915 _Rapp 167_ (ABSL, US), V.1923 _Rapp 142_ (W), Sanford, Robinson Spring, 11.III.1915 _Rapp 107_ (US); Volusia County, Daytona [=Daytona Beach], I.1898 _Thaxter 15_ (FH).

West Indies. JAMAICA: Clarendon Parish, N slope of Portland Ridge, _Imshaug 13264_ (MSC).

Anisomeridium _biforme_ R. C. Harris comb. nov.

Verrucaria _biformis_ Borr. _in_ Hook. & Sowerby, Suppl. Engl. Bot. 1: pl. 2617, f. 1. 1831. _Arthopyrenia_ _biformis_ (Borr.) Massal., Framm. Lich. 26. 1855. Type collection not seen.

Arthopyrenia _brachyspora_ Müll. Arg., Nuovo Giorn. Bot. Ital. 21: 52. 1889. Holotype: Argentina, Isla de los Esados, 1888 _Spegazzini_ (G).

Arthopyrenia _parvula_ Zahlbr., Beih. Bot. Centralbl. 13: 149. 1902. _Leiophloea_ _parvula_ (Zahlbr.) Riedl, Sydowia 16: 269. 1963. Type collection: California, Santa Monica Mtns., Malibu Canyon, VIII.1898 _Hasse_ _759_. Isotypes in ABSL, FH & US.

Arthopyrenia _amaura_ Zahlbr. _in_ Handel-Mazzetti, Symbol. Sinic. 3: 19. 1930. Type collection: China, Hunan Province, near Tschangscha, 10.XII.1917 _Handel-Mazzetti_ _11426_. Isotype in US.

Ascocarps hemispherical to globose, immersed or emergent, 0.3-0.6 mm in diameter. Asci dactyloid to cylindrical, 65-130 x 10-15 µ. Spores subbiseriate to uniseriate, narrowly ovate to elliptical, sometimes slightly constricted at the septum, 10-17 x 5-8 µ.

Microconidia orbicular, 2-3 µ in diameter.

Macroconidia relatively rare, orbicular to elliptical or ovate, 3-5 µ in diameter or 3.5-5 x 2.5-3 µ.

Habitat on bark or old wood.

Although I have not seen the original material of this species, I have seen several specimens collected and determined by Borrer. _Anisomeridium_ _biforme_ is apparently cosmopolitan in its distribution. In addition to numerous collections from Europe and North America I have verified collections from Asia (China and India), New Zealand (Campbell Is.), Bermuda, the West Indies and southern South America (Falkland Is., Isla de los Estados). As would be expected there is some variation in the spores from region to region. The most strikingly different population is the one in eastern North America in which the spores are almost always elliptical and uniseriately arranged in the ascus. This has caused it to be confused with various _Acrocordia_ species but the lack of any ornamentation of the spores removes it from that genus. However this type of spore is found occasionally in the southeastern United States/West Indian and the western North American populations. The southeastern/West Indian population has the smallest asci. _Anisomeridium biforme_ in North America is mainly coastal with relatively few inland stations. One wonders if the gap in its distribution between Maryland and Florida is real or artificial.

Illustrations: Figs. 200-207; Harris (1973), figs. 2-3. Richardson & Morgan-Jones (1964), fig. 4. Distribution: Fig. 417.

Exsiccati examined: Anxi Ven. 132 (FH-TUCK 4062); Desm. ed. II, ser. II: 400 (FH); Hepp 953 (FH, FH-TUCK 4065); Krypt. Vind. 375 (FH, US); Leight. 100 (FH, FH-TUCK 4064, US); Merr. I: 147 (CAN, FH, FH-RIDD, MICH, US); Merr. I: 164 (CAN, FH, FH-RIDD, MICH, US); Nyl. Par. 91 (FH-TUCK 4065); Nyl. Par. 92 (FH-TUCK 4065); Rab. 483 (FH-TUCK 4065, MICH); Rel. Hasse 79 (FH); Zahl. 190 (MICH, W).

Selected specimens seen: Canada. BRITISH COLUMBIA: Vancouver Island, Sidney, 19.XI.1912 _Macoun_ (FH), Victoria, 28.IV.1914 _Macoun 314_ FH).

United States. CALIFORNIA: Los Angeles County, Malibu Canyon, VIII.1898 _Hasse 759_ (ABSL, FH, US), Santa Catalina Island, IX.1912

Hasse (ABSL, FH), Santa Monica Canyon, VI.1914 Hasse (FH); Orange County, Laguna Creek, 1.I.1908 Herre 1240 (FH), near Newport, 1911 Hasse (US); Santa Cruz County, Santa Cruz Peninsula, Hasse (MICH). FLORIDA: Dade County, Everglades Nat. Park, S of Pa-hay-okee Overlook, Harris 2730-A, 2826-E (MSC); Liberty County, Apalachicola Nat. Forest, Porter Lake Picnic Area, Harris 1634 (MSC); Palm Beach County, W. Palm Beach, Thaxter 97 (MICH); Seminole County, Sanford, I.1909 Rapp (FH), 4.II.1914 Rapp (FH). ILLINOIS: Cook County, Calkins (FH, MICH, Thomson, US, US ex MO). KENTUCKY: McCreary County, SW of Corbin, Harris 1253 (MSC). LOUISIANA: E. Baton Rouge Parish, S of Baton Rouge, Tucker 7403-B, 8846, 8846-B (LSU); Lafayette Parish, Lafayette, Tucker 7164 (LSU); Plaquemines Parish, Pointe-à-la-Hache, 23.XII.1885 Langlois 796 (US). MAINE: Hancock County, Mt. Desert Island, Salisbury Cove, 10.VIII.1932 Plitt (US); Knox County, Rockland, 10.X.1909 Merrill (CAN, FH, FH-RIDD, MICH, US), Thomaston, 24.VII.1910 Merrill (CAN, FH, FH-RIDD, MICH, US), Warren, 21.VIII.1909 Plitt 335 (FH, US). MARYLAND: Anne Arundel County, road to Elvaton, 11.VI.1910 Plitt 253 (FH, US); Baltimore County, road to Perry Hall, 7.VI.1910 Plitt 261a (FH, US). MASSACHUSETTS: Barnstable County, Chatham, Brodo 4396 (CAN, US); Bristol County, New Bedford, Willey (US); Middlesex County, Concord, 1863 Mann (FH-TUCK 4024, US); Plymouth County, Wareham, 1919 Robbins (FH); Suffolk County, Waverly, 11.X.1894 Burt (FH); Worchester County, S. Milford, XI.1852 Tuckerman 74 (FH-TUCK 4024). MICHIGAN: Washtenaw County, NW of Crooked Lake, Harris 869 (MSC). NEW HAMPSHIRE: White Mtns., Tuckerman (FH-TUCK 4024). NEW JERSEY: sine loc., 1876 Austin 662 (FH-TUCK 4025). OREGON: County unknown, sea coast, 2.XI.1881 Pringle 8 (FH, US). PENNSYLVANIA: Pike County, Bushkill Falls, 28.IV.1940 Nearing (WIS). WASHINGTON: San Jaun County, Friday Harbor, 28.VI.1906 Fink 40 (MICH).

Anisomeridium carinthiacum (J. Stein.) R. C. Harris comb. nov.

Arthopyrenia carinthiaca J. Stein., Oesterr. Bot. Z. 63: 335. 1913. ("carintiaca", corr. Zahlbr., 1921). Lectotype not selected. Isosyntype: Austria, near Klagenfurt, Steiner (US ex MO).

Arthopyrenia dimidiata Fink in Hedrick, Mycologia 25: 306. 1934. Holotype: Connecticut, near Ellsworth, 1895 Green (MICH, hb. Fink 15,469).

Thallus epilithic, whitish, greenish or tan; black hypothallus not evident in some pecimens to dominant in others.

Ascocarps hemispherical to subglobose, semi-immersed, 0.2-0.3 mm in diameter. Asci narrowly elliptical to narrowly obovate; ascus wall thickened at tip; 50-60 x 13-17 µ. Spores irregularly arranged, ovate to almost elliptical, (11-)13-18 x 5.5-7 µ.

Microconidia narrowly elliptical, 4-5 x 1.5-2 µ.

Habitat on non-calcareous rock along streams, probably occasionally inundated.

This species is unusual in its habitat and in the variability of its hypothallus. There is no evident hypothallus in any other species of Anisomeridium. In the Michigan collections the lichenized thallus is often restricted to isolated patches surrounded by black hypothallus. The hypothallus is present but not well developed in the isosyntype of A. carinthiacum and is apparently lacking in the Connecticut collections. The semi-aquatic habitat suggests Pyrenocollema, but the phycobiont, asci and spores are not characteristic of that genus but rather of Anisomeridium.

Illustrations: Figs. 208-212.

Specimens seen: United States. CONNECTICUT: Litchfield County, Aton Forest, Hale 137 (US), Ellsworth, 1895 Green (MICH). MICHIGAN: Delta County, NE of Rapid River, Harris 4202-B, 4210-A (MSC).

Anisomeridium distans (Willey) R. C. Harris comb. nov.

Verrucaria distans Willey, Enum. Lich. New Bedford 38. 1892. Arthopyrenia distans (Willey) Zahlbr., Cat. Lich. Univ. 1: 276. 1921. Type collection: Massachusetts, New Bedford, head of Purchase St., 1866 Willey. Isotype in MICH.

Thallus epilithic, whitish to brownish, thin.

Ascocarps subglobose, 0.1-0.3 mm in diameter. Asci narrowly elliptical or narrowly obovate, c. 70-80 x 15-18 µ. Spores irregularly arranged, narrowly ovate to narrowly elliptical, 2-4-celled, not constricted at the septa, 16-22 x 6.5-8 µ.

Microconidia narrowly elliptical, 4-5 x 1.5-2 µ.

Macroconidia elliptical, 5-5.5 x 2.5-3 µ.

Habitat on moist rocks but apparently not aquatic.

Anisomeridium distans is unusual in the genus in that it grows on rock and has 4-celled spores. The phycobiont is hard to determine with certainty. Trentepohlia is present in both collections but another alga, probably a blue-green, is also present.

Illustrations: Figs. 213-218.

Specimens seen: United States. MASSACHUSETTS: Bristol County, New Bedford, 1866 Willey (MICH). OHIO: Coshocton County, near Coshocton, Moldenke 14399 (Us ex MO).

Anisomeridium feeanum (Müll. Arg.) R. C. Harris comb. nov.

Arthopyrenia feeana Müll. Arg., Mém. Soc. Phys. Hist. Genève 30: 28. 1888. Holotype: [West Indies] on Croton cascarilla (G).

Ascocarp hemispherical to subglobose, semi-immersed to immersed; ascocarp wall sometimes extended outwards above to form a shield, thin or lacking below. Asci narrowly obovate or rarely narrowly elliptical, 60-80 x 13-20 µ. Spores irregularly arranged, ovate, lower cell markedly shorter, occasionally slightly consticted at the septum, 15-22 x 6.5-8.5 µ.

Microconidia in one collection (Thaxter 29) orbicular, c. 2.5 µ in diameter, in another (Harris 1306) elliptical, c. 3 x 1.5-2 µ.

Macroconidia elliptical, 5-6 x 2.5-3.5 µ.

Habitat on various barks.

Anisomeridium feeanum is very close to A. biforme and along with A. leucochlorum and A. sanfordense forms an intergrading group of species which are maintained as distinct on a provisional basis. Specimens tentatively identified with A. feeanum come from Tennessee, Florida, the West Indies and Hong Kong.

Illustrations: Figs. 219-224.

Specimens seen: United States. FLORIDA: Dade County, Coconut Grove, 1898 Thaxter 29 (FH); Volusia County, Daytona Beach, Thaxter (MICH). TENNESSEE: Wilson County, Cedars of Lebanon St. Park, Harris 1306 (MSC).

Anisomeridium finkii R. C. Harris sp. nov.

Anisomeridium ascocarpis in saxo calcareo immersis, sporis 20-24 x 6.5-8.5 µ et microconidiis ellipticis, 3-5 x 1.5 µ.

Holotype: Puerto Rico, Arecibo District, Manatí, 12.I.1916 Fink 2052 (US). Isotype in FH.

Thallus endolithic, whitish.

Ascocarps immersed in Puerto Rican specimens, emergent in Florida specimens, subglobose or with upper part of ascocarp wall extended outward to form a shield; ascocarp wall thinner below. Paraphyses branched and anasomosed, embedded in abundant hymenial gelatin. Asci cylindrical, thickened at the tip with a small ocular chamber, 105-125 x 15-18 µ. Spores subbiseriate, narrowly ovate, lower cell usually shorter, 20-25 x 6.5-8.5 U.

Microconidia elliptical, 3-5 x 1-1.5 µ.

Habitat on calcareous rock.

The collection in US was designated as the holotype since the one in Fink's herbarium contained only a discocarpous lichen associated with a blue-green alga. The material was named *Thelidium immersum* by Merrill. The other saxicolous species of *Anisomeridium* grow on non-calcareous rock and are temperate in distribution.

Illustrations: Figs. 225-229.

Specimens seen: United States. FLORIDA: Dade County, Coconut Grove, XII.1897 Thaxter (MICH).

West Indies. PUERTO RICO: Arecibo District, Manatí, 12.I.1916 Fink 2052 (FH, US); Mayagüez District, Yauco, 20.XII.1915 Fink 1562 (FH).

Anisomeridium leucochlorum (Müll. Arg.) R. C. Harris comb. nov.

Arthopyrenia leucochlora Müll. Arg., Flora 66: 287. 1883.

Type collection: Massachusetts, New Bedford, Willey. Isotype? in US and MICH.

Ascocarps often immersed, hemispherical to subglobose, ascocarp wall lacking below, 0.2-0.3 mm in diameter. Asci narrowly obovate, ascus wall rather uniform, c. 1.5-3 µ thick, 53-72(-77) x 12-17(-20) µ. Spores irregularly arranged, narrowly ovate to ovate, 12-18 x 5-7.5 µ.

Microconidia orbicular, 2-2.5 µ in diameter.

Macroconidia orbicular, often slightly tinted, 2.5-4 µ in diameter.

Habitat on bark.

This species is maintained with some hesitation, since it is virtually identical to *A. biforme* in most respects. It differs in the size and shape of the ascus and in the spore arrangement. It is possible that the material placed here represents an extreme form of *A. biforme*, and it is often difficult to place some specimens with certainty.

There are a number of specimens named "*Pyrenula leucochlora*" by Willey, but only one, on maple, fits Müller's description of the thallus which is rather peculiar and seems to me to be the result of a foreign thallus overgrowing the *Anisomeridium*. All the other specimens seen have a typical endophloeodal thallus. The other specimens collected by Willey are all *A. willeyanum*.

Illustrations: Figs. 230-235.

Specimens seen: United States. CONNECTICUT: Middlesex County, Old Saybrook, Evans & Musch 777 (FH). ILLINOIS: sine loc., Wolf (MICH, US); Menard County, Athens, Hall (MICH). MASSACHUSETTS: Bristol County, New Bedford, Willey (MICH, US, US ex MO). OHIO: Oxford County, Sloat's Hill, 17.IV.1927 Fink (MICH).

Anisomeridium macrosporum R. C. Harris sp. nov.

Species distinctissima thallo UV+ aureo (lichexanthone), ostiolis eccentricis pigmento aurantiaco circumdatis et sporis magnis, 39-53x 12-15 µ.

Holotype: Florida, Dade County, Everglades Nat. Park, NE of Pa-hay-okee Overlook, Harris 2791-A (MSC). Isotypes in BM, H, TNS, US, Vězda.

Thallus white, UV+ yellow (lichexanthone).

Ascocarps mostly immersed, hemispherical to subglobose, 0.5-0.8 mm in diameter, ascocarp wall often extended outwards above to form a shield, thinner or lacking below; ostioles mostly eccentric, surrounded by a small ring of orange pigment which is KOH+ purple. Asci cylindrical with a distinct ocular chamber, 150-200 x 20-30 µ. Spores subbiseriate to biseriate, narrowly ovate, often with rather pointed ends, lower cell markedly shorter, 37-52 x 12-20 µ.

Microconidia elliptical, 2.5-4 x 1.2-2 µ.

Macroconidia elliptical, 30-45 x 15-20 µ.

Habitat on bark, including Taxodium.

This remarkable species is known only from a single small region of the Everglades National Park but it is rather abundant there.

Illustrations: Figs. 236-241.

Specimens seen: United States. FLORIDA: Dade County, Everglades Nat. Park, NE of Pa-hay-okee Overlook, Harris 2785, 2791-A, 2810, 2813-A, 2829-C (MSC).

Anisomeridium sanfordense (Zahlbr.) R. C. Harris comb. nov.

Arthopyrenia (Mesopyrenia) sanfordensis Zahlbr., Ann. Mycol. 33: 33.

1935. Holotype: Florida, Sanford, IV.1932 Rapp 134 ("139" in original description), (W).

Ascocarps small, subglobose, 0.15-0.2 mm in diameter. Asci obovate, 50-63 x 16-23 µ; ascocarp wall rather thin, 1-2 µ thick. Spores irregularly arranged, narrowly ovate with rather pointed ends, 18-22 x 5.5-7 µ.

Microconidia orbicular, c. 2 µ in diameter.

Habitat on bark (*Diospyros*).

Anisomeridium sanfordense is little different from *A. leucochlorum*, having broader asci and longer spores. It is known only from the type collection.

Illustrations: Figs. 242-245.

Anisomeridium subprostans (Nyl.) R. C. Harris comb. nov.

Verrucaria subprostans Nyl., Expos. Syn. Pyrenoc. 56. 1858.

Arthopyrenia subprostans (Nyl.) Müll. Arg., Flora 66: 317. 1883.

Holotype: South Carolina, Ravenel (H-NYL Pm. 7378). Isotype in US.

Ascocarps hemispherical to subglobose, 0.3-0.5(-0.6) mm in diameter, ascocarp wall thinner or lacking below. Asci dactyloid to cylindrical, 75-125 x 9-12 µ. Spores uniseriate to biseriate, narrowly ovate, often with rather pointed ends, slightly constricted at the septum, 12-18(-21) x 4.5-6.5 µ.

Microconidia narrowly elliptical to elliptical, 2.5-4 x 1.2-2 µ.

Macroconidia elliptical, 6-6 x 2.5-5 µ.

Habitat on bark, especially *Taxodium*.

Nylander in his original description indicated the type as coming from Texas. However, the specimen cited above bears notes in Nylander's handwriting which agree with the published description. As far as I

know the species is not found in Texas.

Anisomeridium subprostans differs from the closely related *A. biforme* and *A. tamarindi* by its elliptical microconidia and its spore shape.

Illustrations: Figs. 246-250.

Specimens seen: United States. FLORIDA: Monroe County, Big Pine Key, 14.IV.1921 *Kelly* (US). LOUISIANA: Parish unknown, Bayou Millieu, 26.X.1896 *Langlois* (US). SOUTH CAROLINA: *sine loc.*, *Ravenel* (H-NYL, US).

West Indies. PUERTO RICO: San Juan District, Rio Piedras, 1.XII.1915 *Fink 536* (MICH, US).

Anisomeridium tamarindi (Fée) R. C. Harris comb. nov.

Verrucaria tamarindi Fée, Suppl. Essai Crypt. Ecorc. Off. 85. 1837.
Porina tamarindi (Fée) Müll. Arg., Mém. Soc. Phys. Genève 30: 24. 1888.
Lectotype: "ad cortices Tamarindi officinalis L. Antillarum" (Guadeloupe *fid.* Fée, *loc. cit.* p. 165) (G). Isolectotypes in G and H-NYL 748.

Ascocarps immersed, hemispherical, 0.4-0.6 mm in diameter; ascocarp wall forming a shield, lacking below. Asci dactyloid to cylindrical, 75-110 x 10-12 μ. Spores uniseriate to biseriate, narrowly ovate to ovate, longer spores often somewhat bent, 15-22(-24) x 4.5-5.5(-6) μ.

Microconidia orbicular, c. 2 μ in diameter.

Macroconidia elliptical, 4-7 x 2.5-3.5 μ.

Habitat on bark, in the West Indies often on coconut palm.

Anisomeridium tamarindi differs from *A. biforme* by longer, narrower, often bent spores and by elliptical macroconidia. The spores in some collections of *A. tamarindi* approach those of *A. subprostans* which has elliptical microconidia. *Anisomeridium tamarindi* is not uncommon in Florida and Louisiana. It also occurs in the Bahamas and the West Indies

(Bequia, Cuba, Dominica, Grand Cayman, Guadeloupe, St. Vincent and Trinidad).

Illustrations: Figs. 251-256. Distribution: Fig. 418.

Specimens seen: United States. FLORIDA: County unknown, Pumpkin Key, IV.1921 Kelly 89, 148 (MICH); Dade County, Coconut Grove, 1898 Thaxter 313 (MICH), Everglades Nat. Park, NE of Pa-hay-okee Overlook, Harris 2791-B (MSC); Monroe County, Key West, II.1898 Thaxter 324c (MICH); Palm Beach County, Palm Beach, 1898 Thaxter 18 (FH); Volusia County, Tomoka St. Park, Harris 2280 (MSC). LOUISIANA: E. Baton Rouge Parish, Baton Rouge, Tucker 9129 (LSU); St. Martin's Parish, Bois Charmant, 27.VI.1895 Langlois (US).

Anisomeridium tuckeri R. C. Harris sp. nov.

Sat similis *A. ambigui* sed sporis minoribus, 15-20 x 5-6 μ et macroconidiis cylindricis, 7.5-12 x 2-2.5 μ.

Holotype: Louisiana, E. Baton Rouge Parish, Baton Rouge, LSU property off Essen Lane, Tucker 10003 (LSU).

Thallus gray or whitish, UV+ yellow (lichexanthone).

Ascocarps mostly immersed, hemispherical, 0.5-0.6 mm in diameter; ascocarp wall often extending outward above to form a shield, lacking below. Asci cylindrical, 90-115 x 10-12 μ. Spores uniseriate to subbiseriate, narrowly ovate, slightly constricted at the septum, (12-)15-20 x 5-6.5 μ.

Microconidia elliptical to suborbicular, 2.5-3 x 1.5-2 μ.

Macroconidia cylindrical, 7.5-12 x 2-2.5 μ.

Habitat on various barks.

This interesting species is named for Dr. Shirley Tucker whose diligent collecting has brought to light many novel pyrenolichens. The presence of lichexanthone and the spore shape relate A. tuckeri to A. ambiguum and A. macrosporum. While all the other species of the genus have orbicular to elliptical macroconidia, A. tuckeri is unique in having cylindrical macroconidia.

Illustrations: Figs. 257-261. Distribution: Fig. 419.

Specimens seen: United States. FLORIDA: Putnam County, Oklawaha River at Fla. Hwy. 19, Harris 2266 (MSC); Seminole County, Sanford, 19.V.1919 Rapp (FH), VII.1920 Rapp 626 (FH, MICH). LOUISIANA: E. Baton Rouge Parish, Baton Rouge, Tucker 10003 (LSU); Livingston Parish, 3 mi S of Livington, Tucker 7357 (LSU); St. James Parish, near Frenier, Koch 7068 (CAN); St. Martin Parish, Duchamps, 26.IX.1894 Langlois (US).

Anisomeridium willeyanum (R. C. Harris) R. C. Harris comb. nov.

Arthopyrenia willeyana R. C. Harris, Michigan Bot. 12: 16. 1973. Holotype: Michigan, Iosco County, N of Tawas City, Harris 818 (MSC). Isotypes in B, BM, CAN, COLO, Duke, H, Harris, LD, MIN, S, TNS, UPS, US, Vězda & WIS.

See Harris (1973) for a detailed description. Anisomeridium willeyanum is distinguished by its small, rather shiny ascocarps, narrowly ovate spores which often become 4-celled and elliptical microconidia. The known range of the species has been extended southward by a collection from Alabama. Two collections by Sandstede in Germany constitute the first records for Europe.

Illustrations: Figs. 262-265; Harris (1973), figs. 16-17. Distribution: Fig. 420.

Additional specimens seen (not cited in Harris, 1973): United

States. ALABAMA: Cleburne County, N of Heflin, Harris 1330 (MSC). CONNECTICUT: Litchfield County, Aton Forest, Hale 129 (US). DELAWARE: Sussex County, 5 mi W of Georgetown, Brodo 9542 (CAN, MSC). ILLINOIS: Cook County, Calkins (MICH). KENTUCKY: McCreary County, SW of Corbin, Harris 1192 (MSC). MAINE: Waldo County, Freedom, Parlin 7534 (FH). MASSACHUSETTS: Bristol County, Fairhaven, 1876 Willey (US), New Bedford, Willey (FH-TUCK 4024, 4051, US); Middlesex County, Concord, 1863 Mann (FH-TUCK 4024), Wayland, IX.1909 Riddle 748 (FH-RIDD);Suffolk County, Newton, (Farlow) (FH). MICHIGAN: Baraga County, 5 mi NE of Sidnaw, Harris 7839 (MSC); Jackson County, E of Leeke Lake, Harris 7712 (MSC); Lenawee County, Bean Creek at Lime Creek Rd., Harris 7695, 7699 (MSC); Mackinac County, 8 mi E of Naubinway, Harris 9627 (UMBS); Newaygo County, ENE of White Cloud, Harris 7761, 8162 (MSC). MISSOURI: Saline County, Davis Creek-Bottom, 12.VIII.1896 Demetrio (FH). NEW JERSEY: sine loc., 1876 Austin 663 (FH-TUCK 4025). NEW YORK: Madison County, Bridgeport, 7.II.1959 Brodo (CAN); Saratoga/Washington County, Hudson Falls, IX.1919 Burnham (MICH); Suffolk County, Long Island, Brodo 3176 (CAN, MSC). NORTH CAROLINA: Transylvania County, Lookout over John Rock, Harris 3360 (MSC). OHIO: Lake County, Painesville, 8.X.1915 Fink 691 (MICH). PENNSYLVANIA: Clarion County, near Cooksburg, Brodo 5529 (CAN); Huntingdon County, Penn. St. Nature Camp, Thomson 1798 (Thomson). RHODE ISLAND: sine loc., Bennett (MICH). TENNESSEE: Wilson County, Cedars of Lebanon St. Park, Harris 1304-C (MSC). VIRGINIA: Madison County, Stony Man, Imshaug 38551, 38569 (MSC); Page County, Big Meadows, Brodo 9381, 9410 (CAN), 9382 (CAN, MIN), Wetmore 15299 (MIN). WEST VIRGINIA: Randolph County, Gaudineer Scenic Area, Harris 5974, 5977 (MSC).

3. PLEUROTREMA Müll. Arg.

Bot. Jahrb. Syst. 6: 388. 1885. Lectotype (Clements, 1909): Parathelium polysemum Nyl. ≡Pleurotrematomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 14: 6. 1957. Holotype: Parathelium polysemum Nyl.

Ditremis Clem., Genera of Fungi 41. 1909. Holotype: Pleurotrema inspersum Müll. Arg.

Thallus whitish, cream color or grayish, endophloeodal. Phycobiont Trentepohlia or apparently non-lichenized.

Ascocarps flattened, broadly elliptical or orbicular in outline, mostly not much immersed; ascocarp wall brownish to blackish, thinner or lacking below. Ostiole eccentric to lateral, occasionally at the end of a short projecting neck. Hymenial gelatin IKI-. Paraphyses thread-like, branched and anastomosed. Asci cylindrical with a small ocular chamber. Spores uniseriate, rarely biseriate, ovate to narrowly ovate, often with somewhat pointed ends, 2-celled, cells mostly approximately equal, usually constricted at the septum; spore wall usually granular ornamented, at least in age; perispore thin, often not discernable.

Microconidia narrowly elliptical to elliptical.

Habitat on bark.

Clements (1909) chose P. polysemum (Nyl.) Müll. Arg. as the type of the genus. However, at this time I do not know whether Müller ever saw a specimen of this species or whether he made the transfer solely on the basis of Nylander's description. If Müller had not seen any material of P. polysemum, I would recommend that P. inspersum should be the lectotype of Pleurotrema. The choice of lectotype is of considerable importance since I do not believe P. polysemum and P. inspersum to be congeneric. The bulk of the species previously described belong with P. inspersum and retypification, if possible, would avoid a number of name changes. If Müller did have material of P. polysemum available when he described Pleurotrema, then the correct name for the genus as accepted here is Ditremis, since in that case there would seem to be no basis for overturning Clement's lectotypification.

In addition to the eccentric ostiole, Pleurotrema can be distinguished by its cylindrical asci, uniseriate spores, spore shape and usually ornamented spores. All of the known species are tropical or subtropical in distribution. The genus has not been previously reported from North America and is represented by only a single collection.

A few additional species with parathelioid ascocarps belonging to other genera have been included in the key to avoid confusion.

1. Spores 2/ascus; ostioles mostly upright but more or less eccentric in some collections .... Arthopyrenia bifera

1. Spores 8/ascus 2

 2. Thallus UV+ yellow 3

 2. Thallus UV- 4

3. Spores 2-celled, 30-45 x 15-20 µ; spore wall not ornamented; orange pigment around ostiole .... Anisomeridium macrosporum

Spores 4-celled, 28-36 x 9-12 µ; spore wall ornamented

.... _Polymeridium exasperatum_

4. Spores 4-celled .... _Polymeridium exasperatum_

4. Spores 2-celled 5

Spores 17-25(-30) x 5.5-7.5 µ .... _Pleurotrema anacardii_

Spores 25-40 x 8-10 µ .... [_Pleurotrema inspersum_]

eurotrema anacardii (Vain.) R. C. Harris comb. nov.

Arthopyrenia (_Acrocordia_) _anacardii_ Vain., Hedwigia 38(Beibl.):
8). 1899. Holotype: Guadeloupe, Basse-Terre, _Duss 498_ (TUR).

Thallus whitish or cream color. _Trentepohlia_ present.
Ascocarps flattened, elliptical, ovate or circular in outline, long
s oriented toward the ostiole or perpendicular to it, 0.4-0.7 mm
g and usually 0.05-0.1 mm less in width. Asci cylindrical, 110-170
)-15 µ. Spores uniseriate, rarely biseriate, narrowly ovate, ends
en rather pointed; spore wall of older spores granular ornamented;
5(-30) x 5.5-7.5 µ.

Microconidia elliptical to narrowly elliptical, 2-4.5 x 1.2-2 µ.

Habitat on bark.

Pleurotrema anacardii is rather similar to _P. inspersum_ but is
ler in all respects. In North America it is found only in southern-
Florida.

Illustrations: Figs. 266-269.

Specimens seen: United States. FLORIDA: Monroe County, Umbrella
, 8.IV.1916 _Small 7598_ (FH-RIDD, US).

West Indies. CUBA: sine loc., Wright (MSC ex G). PUERTO RICO: sine loc., Seaver (MICH). ST. LUCIA: Quarter of Soufrière, summit area of Gros Piton, Imshaug 30198, 30210 (MSC).

Pleurotrema inspersum Müll. Arg.

Bot. Jahrb. Syst. 6: 389. 1885. Type collection: Cuba, Wright Verr. Cub. 123. Isotypes in FH-TUCK 3948 & US.

Didymella labiata Vain., Hedwigia 38(Beibl.): (258). 1899. Holotype: Guadeloupe, Basse-Terre, Duss 503 (TUR).

Ascocarps flattened, mostly ovate in outline, the long axis oriented toward the ostiole, 0.5-0.6 mm long, 0.1-0.2 mm less in width. Asci cylindrical, 180-215 x 15-20 µ. Spores uniseriate, narrowly ovate; spore wall ornamented, especially in older spores; 25-40 x 8-10 µ.

Pleurotrema inspersum has not been collected in North America. I have verified specimens from Cuba, Guadeloupe and St. Lucia.

Illustrations: Figs. 270-272; Vězda (1968), fig. 32.

4. PYRENOCOLLEMA Reinke

Jahrb. Wiss. Bot. 28: 461. 1895. Holotype: P. tremelloides Reinke (= P. epigloea).

Xanthopyrenia Bachm., Nov. Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 105: 65. 1919. Holotype: Arthopyrenia tichothecioides Arn.

Pseudarthopyrenia Keissl., Revue Bryol. Lichénol. 8: 32. 1935. Holotype: Verrucaria caesia Nyl.

Thallus often well developed and epilithic, subfoliose in one species, or poorly developed and mostly within the substrate. Phycobionts include a variety of blue-green algae, including Hyella, Nostoc and some Gleocapsa-like algae.

Ascocarps usually rather small, 0.2-0.5 mm in diameter. Ascocarp wall brown, flexible when wet except in P. halodytes which has a carbonized thalline envelope. Paraphyses rather sparse, branched and anastomosed, embedded in an abundant gelatinous matrix. Asci mostly ovate or obovate, occasionally almost cylindrical, with a long flexuous base especially when young. Spores ovate with truncate ends to narrowly ovate, upper cell usually broader and shorter, usually constricted at the septum. Spore wall thin and the spores often collapsing, rarely with a thin perispore. Spore contents often weakly orangish in IKI.

Microconidia elliptical to oblong.

Habitat on rock, mostly calcareous, and barnacles; marine, fresh water aquatics or in other moist situations.

Pyrenocollema is a most remarkable genus, especially for the wide variety of blue-green phycobionts and its preference for wet habitats. Reinke, Bachmann and Keissler erected their genera mainly on the basis of the type of algal associate but the combined genus is also distinctive on mycological grounds. The spore shape, thin spore wall, IKI+ orangish spore contents and the rather long, often flexuous ascus base are diagnostic for the genus. With the exception of P. halodytes, I am acquainted with the species of the genus from only a handful of specimens. This has made interpretation difficult. Pyrenocollema epigloea, imshaugii and prospersella are virtually indistinguishable on the basis of mycological characters and are separated on the basis of thallus, phycobiont and habitat characters. Swinscow (1965b) has taken a different point of view and included collections with differing phycobionts in *P. caesia*. Problems of this sort point up how little is really known of the biology of these organisms. Before any final taxonomy can be attempted more ecological data must be obtained and, if possible, isolation of the phycobionts should be attempted.

Of the previously described species included in *Pyrenocollema*, it is clear from the descriptions that *P. minutulum* (Born.) Puym. and *P. neozelandicum* Zahlbr. are discolichens. *Pyrenocollema aquensis* Crozals & Dughi would seem to be excluded from the genus due to its lack of paraphyses, lack of long ascus base and by the pointed spores. Also in addition to the species included in the key, it seems likely from Swinscow's (1967a, 1970) descriptions that *Arthopyrenia stronianensis* and *A. monensis* (Wheld.) Zahlbr. will prove to be members of this genus.

1. Marine, in tidal or spray zone 2
1. Fresh water aquatics, semi-aquatics or on rock in moist places 3

 2. Thallus thin, inconspicuous; algal cells small, up to 12 µ in diameter (Swinscow); spores 12-20(-23) x 5-8(-10) µ .... *P. halodytes*
 2. Thallus thick, gelatinous when wet, conspicuous; algal cells large, up to 25 µ in diameter; spores 14-18 x 7-9 µ .... *P. imshaugii*

3. Phycobiont a subfoliose species of *Nostoc*; thallus similar to that of *Collema*; spores 18-21 x 8-9.5 µ .... [*P. epigloea*]

3. Phycobiont not *Nostoc*; thallus crustose 4

4. Algae blue-green in color 5

4. Algae yellow-brown to brown due to colored sheath (*Gleocapsa*-like) 6

5. Spores 25-30 x 10-12.5 µ .... [*P. caesia*]

5. Spores 17-23 x 8-11 µ .... *P. prospersella*

6. Spores with a thin perispore, 20-25 x 5-7 µ ..... [*P. saxicola*]

6. Spores lacking an obvious perispore, (18-)20-27 x 8-11 µ .... *P. tichothecioides*

Pyrenocollema caesia (Nyl.) R. C. Harris comb. nov.

Verrucaria caesia Nyl., Bot. Not. 1853: 162. 1853. *Arthopyrenia caesia* (Nyl.) Zahlbr., Cat. Lich. Univ. 1: 330. 1922. Type collection not seen.

Thallus grayish to brownish, continuous, rimose or of separated granules. Phycobiont with blue-green colored cells in groups surrounded by a sheath.

Ascocarps mostly emergent. Asci obovate. Spores 25-30 x 10-12.5 µ.

Habitat on limestone.

My concept of this species is based on a single specimen plus the description by Swinscow (1965b). It differs from *P. prospersella* in having larger spores. However Swinscow places the lower limit of spore length in *P. caesia* at 20 µ which would overlap *P. prospersella*. In the limited material I have examined there is no overlap and I recognize two species, at least temporarily. *Pyrenocollema caesia* is similar to

P. tichothecioides in spore size but differs in phycobiont. Pyrenocollema caesia has not been found in North America.

Illustrations: Figs. 273-274; Swinscow (1965b), fig. 8.

Specimen seen: France. VAR: Cap Brun, I.1923 Crozals (US ex MO).

Pyrenocollema epigloea (Nyl.) R. C. Harris comb. nov.

Verrucaria epigloea Nyl., Flora 69: 464. 1886. Arthopyrenia epigloea (Nyl.) Zahlbr., Cat. Lich. Univ. 1: 279. 1921. Pyrenocollema tremelloides Reinke, Jahrb. wiss. Bot. 28: 461. 1895. Type collection: Lojk. Univ. 249, "Supra Nostoc saxa dolomitica incolens inundata fluminis Narenta in Herzegovinia (Lojka)." fide Nyl. Isotype in MICH.

Thallus blackish, subfoliose, very similar to a primitive Collema, habit determined by the Nostoc phycobiont.

Ascocarps immersed in the thallus. Asci narrowly obovate. Spores 18-21 x 8-9.5 μ

Microconidia elliptical, c. 3 x 1.2 μ.

Pyrenocollema epigloea is known only from the type collection. It is not completely clear whether the last two numbers of Lojka's Lichenotheca Universalis (249 & 250) were ever officially distributed. Reinke's specimens had only the number without any data (Reinke, 1895). The specimen in MICH has a handwritten label naming it as Verrucaria epigloea and giving an abbreviated version of the collection data quoted from Nylander above.

The discovery that the mycobiont of P. epigloea was congeneric with that of P. halodytes and related species was most startling to me. The thallus would indeed lead one to place P. epigloea in the

Collemataceae. However, if I were presented only with the ascocarp and its contents I would be virtually unable to distinguish them from those of P. imshaugii or P. prospersella. The microconidia are very similar but slightly larger in the last two species. Thus I am not at all hesitant in uniting P. epigloea with the crustose species.

Keissler (1936-38) suggested that this species was a parasite on the Nostoc, but in view of the constant association of the other species of the genus with blue-green algae and its similarities to other members of the Strigulaceae, I feel it is best treated as a true pyrenolichen with an extraordinary phycobiont. The name Pyrenocollema at first seems somewhat inappropriate but since the genus consists of pyreno-lichens with blue-green phycobionts it is actually quite a descriptive name.

Illustrations: Figs. 275-278; Reinke (1895), fig. 179.

Pyrenocollema halodytes (Nyl.) R. C. Harris comb. nov.

Verrucaria halodytes Nyl., Mém. Soc. Sci. Nat. Cherbourg 5: 142. 1875. Arthopyrenia halodytes (Nyl.) Arn., Ber. Bayer. Bot. Ges. 1, suppl.: 121. 1891. Type collection not seen.

Verrucaria consequella Nyl., Sert. Lich. Labuan & Singap. 43. 1891. Arthopyrenia consequella (Nyl.) Zahlbr., Cat. Lich. Univ. 1: 276. 1921. Holotype: Massachusetts, Weymouth, 1890 Willey (H-NYL 984).

For additional synonymy see Swinscow (1965a).

Thallus usually immersed when on limestone or barnacles, epilithic, thin, brown and shiny when on non-calcareous rock. Phycobiont Hyella (Swinscow, 1965a).

Ascocarps emergent or immersed. Asci variable, slightly ovate, nearly cylindrical or slightly obovate. Spores 12-20(-23) x 5-8(-10) µ.

Microconidia elliptical, 2-3 x 1.2-2 µ.

Habitat on rocks, calcareous or not and barnacles in the inter-tidal zone.

This species is most easily recognized by its habitat. *Pyrenocollema imshaugii* is also marine but has a much thicker thallus with larger algae and slightly larger microconidia.

This is certainly the most common and widespread member of the genus. Not unexpectedly there is some variation. The majority of the collections from California have larger spores than those from the East Coast or the majority of European specimens. The range is, however, essentially continuous and some European specimens have equally large spores. Thus it seems unprofitable to give taxonomic recognition to the Californian population.

The distribution of *P. halodytes* is essentially cosmopolitan, being absent only on tropical shores (Santesson, 1939). Most of the eastern records are contained in a thesis by R. M. Taylor (Michigan State University) on the ecology of marine lichens and will not be repeated here.

Illustrations: Figs. 279-283; Swinscow (1965a), figs. 1-2. Distribution: Fig. 421.

Exsiccati examined: Krypt. Vind. 469 (US), 469b (FH, US); Magn. 242 (MSC); Mig. 24 (MICH, MSC), 74 (MICH, MSC); Vězda Sel. 130 (MSC).

Specimens seen: United States. CALIFORNIA: Humboldt County, Trinidad, *Parks* (MSC); Los Angeles County, Santa Catalina Island, *Weber & Santesson L-42155* (FH); Monterey County, Carmel, Pt. Lobos, 10.IX.1932

Bonar (FH, MICH, US, US ex MO); San Francisco County, San Francisco, Cliff House, 11.III.1935 Bonar (FH, MICH), Land's End, I.1921 Gardener (FH, MICH, US, US ex MO), 21.VIII.1932 Bonar (FH, MICH, MSC, US). MAINE: County unknown, Wood. Island near Brunswick, 28.VIII.1939 Degelius (US); Hancock County, Mt. Desert Island, 31.VII.1922 Plitt 134 (US); Sagadahoc County Cundys Harbor, 28.VIII.1939 Degelius (US). MASSACHUSETTS: Essex County, Magnolia, VIII.1903 [Farlow] (FH, MICH, MSC); Norfolk County, Weymouth, Willey (H-NYL, MICH). RHODE ISLAND: Newport County, S of Newport, Wetmore 12317 (CAN, MIN). WASHINGTON: Clallam County, Crescent Beach, Pike 917 (OSC).

Pyrenocollema imshaugii R. C. Harris sp. nov.

P. halodyti sat similis quoad characteres fungi sed differt thallo crassiore cum cellulis algarum majoribus, usque 25 µ diam. et microconidiis parum majoribus, 3-4 x 1.2-2 µ.

Holotype: California, Mendocino County, Point Arena, on coastal rocks near lighthouse, Imshaug 17678 (MSC). Isotype in H.

Thallus thick, c. 0.1-0.2 mm, olivaceous to dark brown, shiny, somewhat translucent even when dry, more so when wet. Phycobiont a blue-green alga, blue gray in color with cells of varying size up to 25 µ in diameter, cells weakly arranged into vertical rows.

Ascocarps subglobose, immersed, becoming emergent, black, 0.2-0.3 mm in diameter. Ascocarp wall carbonized below. Asci narrowly elliptical to narrowly obovate, c. 80-85 x 17-22 µ. Spores 14-18 x 7-9 µ.

Microconidia elliptical, 3-4 x 1.2-2 µ.

Habitat on non-calcareous rock in the intertidal zone? (barnacles on the same piece of rock).

I had at first thought _P. imshaugii_ to be no more than an odd form of _P. halodytes_ but the distinctive thallus, phycobiont not _Hyella_ and the slight difference in microconidial size seem to warrent recognition at the species level. The species is known only from the type locality.

Illustrations: Figs. 284-288.

Specimens seen: United States. CALIFORNIA: Mendocino County, Point Arena, _Imshaug 17677_ (MSC), _17678_ (H, MSC).

Pyrenocollema prospersella (Nyl.) R. C. Harris comb. nov.

Verrucaria prospersella Nyl., Lich. Japon. 108. 1890. _Arthopyrenia prospersella_ (Nyl.) Zahlbr., Cat. Lich. Univ. 1: 288. 1921. Holotype: Illinois, Cook County, 10 mi from Chicago, _Calkins_ (H-NYL 991).

Thallus gray, continuous to rimose, epilithic. Phycobiont with cells blue green in color, in small groups but without an obvious sheath.

Ascocarps globos, 0.2-0.25 mm in diameter. Asci slightly ovate to elliptical. Spores 17-23 x 8-11 µ.

Microconidia elliptical, 3.5-4 x 1.5-2 µ.

Habitat on calcareous rocks, possibly more or less aquatic.

Pyrenocollema prospersella is externally similar to _P. caesia_ but differs in havin smaller spores. It is known from a Belgian collection in addition to the type locality.

Illustrations: Figs. 289-292.

Specimens seen: United States. ILLINOIS: Cook County, _Calkins_ (FH, MICH, MSC), 10 mi from Chicago, _Calkins_ (H-NYL 991).

Pyrenocollema saxicola (Massal.) R. C. Harris comb. nov.

Arthopyrenia saxicola Massal., Symmict. Lich. 107. 1855. *Leiophloea saxicola* (Massal.) Riedl, Sydowia 23: 234. 1971. Type collection not seen.

Thallus mostly epilithic, brown to blackish, appearing speckled due to uneven distribution of algae. Phycobiont yellow brown in color, *Gleocapsa*-like.

Ascocarps globose, partially immersed in rock, c. 0.2 mm in diameter. Spores narrowly elliptic, narrowly ovate, elliptic or ovate, with rather blunt ends, 20-25 x 5-7 μ, with a thin perispore.

This species is distinctive in the *Gleocapsa*-like phycobiont and in the spores which are longer in proportion to width than is usual in the genus. I have seen specimens from England and Switzerland but not from North America.

Illustrations: Figs. 293-295.

Pyrenocollema tichothecioides (Arn.) R. C. Harris comb. nov.

Arthopyrenia tichothecioides Arn., Flora 52: 268, pl. 8, f. 6. 1869. *Xanthopyrenia tichothecioides* (Arn.) Bacm., Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 105: 65. 1919. Type collection not seen.

Thallus yellow brown to dark brown, epilithic, in drier situations consisting of dispersed groups of algae, rimose to continuous and somewhat gelatinous in moister or aquatic habitats. Phycobiont yellow brown in color, *Gleocapsa*-like.

Ascocarps globose, immersed in rock or superficial, 0.2-0.25 mm in diameter. Asci narrowly ovate, narrowly obovate to ovate, elliptic or obovate. Spores (18-)20-27 x 8-11 µ.

Microconidia elliptic to oblong, 3-5 x 1.2-1.5 µ.

Habitat on calcareous rock in moist to aquatic situations.

Pyrenocollema tichothecioides is distinguished from P. caesia by the associated alga, from the rest of the genus by its larger spores. The aspect of the thallus is markedly different between drier and wetter habitats. Possibly more than one species is involved. The aquatic forms may prove to be referable to Arthopyrenia strontianensis Swinsc. The European specimens examined (Yugoslavia and France) seem to be from drier habitats. One of the Michigan collections (1080-A) is from a lake shore (but not aquatic, associated with Verrucaria muralis Ach.). The other Michigan collections were aquatic.

Illustrations: Figs. 296-300.

Exsiccati examined: Krypt. Vind. 1356 (US).

Specimens seen: United States. MICHIGAN: Mackinac County, shore of Lake Huron W of Hessel, Harris 1080-A (MSC); Menominee County, N of Cedar River, Harris 731-C, 749 (MSC).

Mexico. State unknown: Villas Cardinas, XI.1910 Orcutt 166 (FH).

5. STRIGULA Fr.

Syst. Myc. 2: 535. 1823. Lectotype (Santesson, 1952): S. smaragdula Fr. (= S. elegans (Fée) Müll. Arg.

Geisleria Nitschke in Rabenh., Lich. Eur. 574. 1861. Holotype: G. sychnogonioides Nitschke in Rabenh.

Raciboskiella v. Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1. ser. 1, 118: 1176. 1909. Holotype: Clypeolum talaumae Racib. (= R. janeirensis (Müll. Arg.) Sant.).

Geisleriomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 31, 59. 1953 _nom. illeg._ Holotype: _G. sychnogonioides_ Cif. & Tomas.

Sagediomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 30, 57. 1953. Holotype: _S. affinis_ Cif. & Tomas.

Strigulomyces Cif. & Tomas., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti, ser. 5, 10: 34, 61. 1953. _nom. illeg._ Holotype: _S. elegans_ Cif. & Tomas.

See Santesson (1952) for additional synonymy.

Thallus whitish, grayish or greenish to dark green or brown, rarely punctate, endophloeodal, epiphloeodal, epiphyllous and subcuticular or endolithic; black hypothallus present in a few species. Phycobiont _Trentepohlia_ or _Cephaleuros_.

Ascocarps mostly hemispherical, less commonly subglobose, immersed or superficial; outer layer of the wall dark brown to blackish, often lacking below or occasionally when the ascocarps are immersed the wall may be colorless except for the exposed tip. Hymenial gelatin IKI-. Paraphyses thread-like, unbranched or occasionally dichotomously branched above or rarely somewhat branched and anastomosed above. Asci cylindrical to narrowly elliptical, rarely narrowly ovate; often with a small ocular chamber. Spores commonly uniseriate, occasionally sub-biseriate to biseriate, rarely irregularly arranged, mostly narrowly ovate, less commonly ovate or elliptical, commonly 2-celled but some species 4-8-celled and one submuriform; cells in 2-celled species often slightly unequal with the lower cell shorter and narrower; spore wall not ornamented; perispore not distinguishable.

Microconidia narrowly elliptical to elliptical.

Macroconidia common, present in most collections, narrowly elliptical or rarely filiform, usually with as many cells as the ascospores, rarely more.

The realization that Strigula encompasses many non-foliicolous species was a very slow process for me, but the conclusion seems inescapable. The foliicolous and non-foliicolous species share a number of unique characters, septate macroconidia, almost unbranched paraphyses, spores separating into part spores, punctation of the thallus and presence of a black hypothallus. Also the general shape of the ascocarps, asci, spores and microconidia is very similar. Vězda (in litt.) has indicated some reluctance to merge the non-foliicolous species with the foliicolous ones since the latter have a distinctive subcuticular thallus. However, the Cephaleuros phycobiont is also subcuticular in the free living state (Printz, 1940). Therefore, in my opinion, the subcuticular thallus of the foliicolous species of Strigula is merely a result of the association with Cephaleuros and should not be considered when delimiting genera. The combined taxon seems to me to be a very natural one adapted to a wide variety of substrates and climates. Strigula seems to be mainly subtropical or tropical although a number of species occur in temperate areas of the Northern Hemisphere. I have not seen any specimens of non-foliicolous species from the Southern Hemisphere.

1. Growing on leaves (modified from Santesson, 1952) 2
1. Growing on bark, wood, mosses, soil or rock 4

2. Spores 4-celled, rarely 2-celled, fusiform to almost bacillar, (12-)15-24 x 3.5-6 µ; ascocarps 0.1-0.2 mm in diameter .... _S. complanata_

2. Spores 2-celled, rarely 4-celled 3

3. Spores elliptical, breaking into two part spores, 8-10(-12) x (2-)2.5-3 µ; ascocarps 0.4-0.6 mm in diameter .... _S. nitidula_

3. Spores fusiform, not breaking into part spores, 14-22(-24) x 4-5.5 µ; ascocarps 0.25-0.4 mm in diameter .... _S. elegans_

4. Growing on rock or soil 5

4. Growing on bark, wood or mosses on bark 8

5. Spores 4-celled 6

5. Spores 2-celled 7

6. Spores 15-21 x 4.5-7 µ; on limestone or mortar ..... _S. affinis_

6. Spores larger, 18-30(-35) x 7-10 µ; on soil .... [_S. sychnogonioides_]

7. Spores 12-15 x 4.5-5.5 µ .... _S. viridiseda_

7. Spores larger, 14-20 x 4.5-6 µ .... _S. wilsonii_

8. Spores 4-8-celled or submuriform 9

8. Spores 2-celled 11

9. Spores 4-celled, 15-21 x 4.5-7 µ .... _S. affinis_

9. Spores 6-8-celled or submuriform 10

10. Spores often submuriform, 20-27 x 6-7.5 µ; growing on bark .... *S. submuriformis*

10. Spores never submuriform, 24-42 x 5-7.5 µ; on bryophytes, less commonly directly on bark .... *S. stigmatella*

11. Ascocarp compound, with 2-3 chambers sharing a common ostiole; spores small, 7-10(-12) x 3-4.5 µ .... *S. connivens*

11. Ascocarp simple, with only a single chamber 12

12. Thallus with small white dots; black hypothallus present; spores 17-22 x 5-6 µ .... *S. hypothallina*

12. Thallus not dotted; hypothallus lacking 13

13. Asci narrowly ovate; spores usually breaking into two part spores, 21-32 x 4-5.5(-7) µ .... [*S. taylori*]

13. Asci cylindrical to narrowly elliptical; spores not breaking into part spores 14

14. Spores small, 9-11(-13) x 2.5-4 µ, ends usually rounded with upper cell often broader than lower ... *S. phaea*

14. Spores larger, 12-25 x 4-5.5 µ, usually with rather pointed ends, cells not much different in width 15

15. Spores 12-17 x 4.5-5 µ .... *S. viridiseda*

15. Spores 16-25 x 4-5.5 µ .... *S. americana*

Strigula affinis (Massal.) R. C. Harris comb. nov.

Sagedia affinis Massal., Memor. Lichenogr. 138, f. 169. 1853.

Porina affinis (Massal.) Zahlbr., Oesterr. Bot. Z. 51: 277. 1901.

Arthopyrenia affinis (Massal.) Boist., Nouv. Flore Lich. 2: 278. 1903. Type collection not seen.

Geisleria jamesii Swinsc., Lichenologist 3: 420. 1967. Holotype: England, Dorset, Brownsea Island, XI.1964 James (BM).

Ascocarps hemispherical to subglobose, 0.1-0.4 mm in diameter; ascocarp wall sometimes extended outward above, often lacking below. Asci narrowly elliptical to cylindrical, 60-100 x 10-15 µ. Spores subbiseriate to biseriate, narrowly ovate to narrowly elliptical, 4-celled, slightly constricted at the septa, 15-21 x 4.5-7 µ.

Microconidia narrowly elliptical to elliptical, 2.5-4 x 1-1.7 µ.

Macroconidia narrowly elliptical, 4-celled, 12-17(-20) x 3-5 µ.

Habitat on bark or rarely on calcareous rock or mortar.

In 1973 I carelessly overlooked Boistel's earlier transfer of this species to Arthopyrenia and made an unnecessary transfer. I can see no differences between Geisleria jamesii and S. affinis except substrate. The collection from Haiti is on limestone and has slightly broader spores and longer macroconidia than usual.

Illustrations: Figs. 301-308; Harris (1973), fig. 1; Swinscow (1962), fig. 13, (1967b), figs. 2-4.

Exsiccati examined: Hepp 458 (FH); Mass. 350 (FH); Rab. 561 (MICH).

Specimens seen: Canada. ONTARIO: Carleton County, Ottawa, 12.IV.1895 Macoun (FH).

United States. LOUISIANA: E. Baton Rouge Parish, Baton Rouge, Tucker 9056-A (MSC).

West Indies. HAITI: Department de l'Ouest, N of Foret des Pins, Wetmore 2903 (MSC).

Strigula americana R. C. Harris nom. nov.

Arthopyrenia tenuis R. C. Harris, Michigan Bot. 12: 16. 1973. (non Strigula tenuis Müll. Arg., Flora 68: 344. 1885.). Holotype: Iowa, Fayette County, 1896 Fink (MSC). Isotypes in FH, MICH, MIN & US.

Ascocarps hemispherical or somewhat conical, 0.3-0.5 mm in diameter; ascocarp wall thinner or lacking below. Asci cylindrical, 70-135 x 8-12 µ. Spores uniseriate to biseriate, narrowly ovate with pointed ends, occasionally slightly bent, 2-celled, slightly constricted at the septum, 16-25 x 4.5-5.5 µ.

Microconidia narrowly elliptical to elliptical, 3-5 x 1.2-2 µ.

Macroconidia narrowly elliptical, 2-celled, 12-20 x 3-4.5 µ.

Habitat on bark.

Strigula americana is closely related to S. viridiseda but differs in having larger spores. However in the southeastern United States where their ranges overlap a number of collections have spores intermediate in size. They have been assigned to S. americana. I previously thought this species to have a rather northern distribution but it turns out to be fairly common in Florida and Louisiana.

Illustrations: Figs. 309-314; Harris (1973), figs. 13-15. Distribution: Fig. 422.

Additional specimens seen (not cited in Harris, 1973): United States. ALABAMA: Cleburne County, N of Heflin, Harris 1403 (MSC). FLORIDA: Dade County, Coconut Grove, 1898 Thaxter 275 (FH), 282 (MICH); Duval County, Jacksonville, Calkins (MICH); Jackson County, Florida Caverns St. Park, Harris 1597 (MSC); Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, Harris 1519 (MSC); Marion County, Eton Creek at Fla. Hwy. 314, Harris 2405 (MSC); Seminole County, Sanford, I.1924 Rapp 177 (MICH). LOUISIANA: E. Baton Rouge Parish, Baton Rouge, Tucker 9035 (LSU); St. Martin Parish, Duchamps, 26.IX.1894 Langlois (US), John Durand's, 2.I.1894 Langlois 913 (US). NEW JERSEY: Bergen County, Closter, 1877 Austin 747 (FH-TUCK 4049), 752 (FH-TUCK 4048). SOUTH CAROLINA: Berkeley County, Guilliard Lake Campground, Harris 3193-A (MSC).

Strigula complanata (Fée) Mont.

Hist. Cuba [Sagra] Bot. Pl. Cell. 140. 1842. Phyllocharis complanata Fée, Essai Crypt. Ecorc. Off. XCIV, XCIX, pl. 2, f. 3. 1824. Type collection not seen.

See Santesson (1952) for synonymy and description.

Strigula complanata in the United States is often sterile or producing only pycnidia. It is easily recognized by its 4-celled spores or by the filifrom conidia.

Illustrations: Fig. 315. Distribution: Fig. 423.

Specimens seen (not cited by Santesson, 1952): United States. FLORIDA: Jackson County, Florida Caverns St. Park, Harris 1598 (MSC). LOUISIANA: E. Baton Rouge Parish, Baton Rouge, Tucker 8841, 9063 (MSC); Livingston Parish, 23.IX.1968 Exner (MSC).

Strigula connivens R. C. Harris sp. nov.

Species generis unica ascocarpis compositis, 2-3 loculis cum ostiolo unico et sporis 7-10(-12) x 3-4.5 µ.

Holotype: Florida, Dade County, Cutler, 1898 Thaxter 19 (MSC).

Thallus greenish gray, well developed, endophloeodal.

Ascocarps compound, usually with two chambers, occasionally three, rarely simple, 0.3-0.4 mm long, somewhat less in width; chambers connected above, sharing a single ostiole; ascocarp wall thinner or lacking below. Asci narrowly elliptical, 45-50 x 7-8 µ. Spores subbiseriate to biseriate, narrowly ovate, 2-celled, slightly constricted at the septum, 7-10(-12) x 3-4.5 µ.

Microconidia narrowly elliptical to elliptical, 2.5-4 x 1.5-2 µ.

Macroconidia narrowly elliptical, 2-celled, 6.5-7.5 x 2-3 µ.

Habitat on bark.

This is the only species known from the Strigulaceae with astrothelioid ascocarp structure. In all other respects it is a typical *Strigula*. Normally I would not describe a species on the basis of so little material, but I feel it is necessary to round out the circumscription of *Strigula*.

Illustrations: Figs. 316-320.

Specimens seen: United States. FLORIDA: County unknown, Snapper Hammock, 11.XII.1919 *Britton* & *Britton* *806* (FH-RIDD); Dade County, Cutler, 1898 *Thaxter* *17a* (MICH), *19* (MSC).

Strigula *elegans* (Fée) Müll. Arg.

Linnaea 43: 41. 1880. *Phyllocharis* *elegans* Fée, Essai Crypt. Ecorc. Off. XCIV, C, pl. 2, f. 7. 1824. Type collection not seen.

See Santesson (1952) for synonmy and description.

Strigula *elegans* is distinguished from *S.* *complanata* by its 2-celled spores and from *S.* *nitidula* by larger spores which do not break up into part spores. Many of the specimens cited below were determined by Santesson after the publication of his work on foliicolous lichens.

Illustrations: Fig. 321-322; Vězda (1968), fig. 29.

Distribution: Fig. 424.

Specimens seen (not cited in Santesson, 1952): United States. FLORIDA: Alachua County, Gainesville, III.1924 Burger (MICH), 21.X.1907 Hampton (MICH), 20.VI.1922 O'Byrne (MICH); Dade County, Coconut Grove, I.1898 Thaxter N1 (MICH, MSC), 397, 406, 409, 427 (MICH), Cutler, IX.1897 Thaxter 414 (MICH); Jackson County, Florida Caverns St. Park, Harris 1600 (MSC); Lake County, Eustis, Thaxter (MICH, MSC); Marion County, Ocala, X.1897 Thaxter (MICH, MSC), Ocala Nat. Forest, Hughes Island, Harris 2000 (MSC); Orange County, Plymouth, 1914 Grossenbacker (MICH); Palm Beach County, Palm Beach, Thaxter (MICH); Putnam County, Oklawaha River at Fla. Hwy. 19, Harris 2260 (MSC); Volusia County, Daytona [= Daytona Beach], 1898 Thaxter 422 (MICH). LOUISIANA: W. Feliciana Parish, Tunica Hills, Koch 7743 (MSC); Livingston Parish, Denham Springs, 30.V.1968 Evans (MICH, MSC).

Strigula hypothallina R. C. Harris sp. nov.

Strigula thallo nitido, albo-punctato, infra cum hypothallo nigro et sporis bicellularis, 17-22 x 5-6 μ.

Holotype: South Carolina, Berkeley County, Francis Marion Nat. Forest, Guilliard Lake Campground, Harris 3201-A (MSC).

Thallus light brown, shiny, with scattered white punctae, underlain by a black hypothallus which is visible at the margins of the thallus.

Ascocarps flattened to hemispherical, immersed, 0.5-0.8 mm in diameter, 0.2 mm in height; ascocarp wall sometimes indistinguishable from the hypothallus, lacking below. Asci cylindrical, 90-120 x 9-10 µ. Spores uniseriate, narrowly ovate, with rather pointed ends, 2-celled, slightly constricted at the septum, 17-22 x 5-6 µ.

Habitat on bark (*Ilex*).

Although this species is known from only a single collection, I venture to describe it since it helps to link the non-foliicolous and foliicolous species and to reinforce the concept that they constitute a single genus. *Strigula nemathora* Mont. has a similarly punctate thallus and *S. subtilissima* (Fée) Müll. Arg., *S. maculata* (Cooke & Massee) Sant. and *S. melanobapha* (Kremp.) Sant. have a well developed hypothallus.

Illustrations: Figs. 323-325.

Strigula nitidula Mont.

Hist. Cuba [Sagra] Bot. Pl. Cell. 139. 1842. Type collection not seen. See Santesson (1952) for synonymy and description.

This is the only foliicolous *Strigula* known from the United States in which the spores separate into two part spores. The species is new to the United States flora and the single collection is on *Magnolia* leaves.

Illustrations: Figs. 326-327; Vězda (1968), fig. 28.

Specimen seen: United States. FLORIDA: Seminole County, Oviedo, XI.1922 *Rapp* (MICH).

Strigula phaea (Ach.) R. C. Harris comb. nov.

Verrucaria phaea Ach., Synops. Lich. 88. 1814. *Porina phaea* (Ach.)

Müll. Arg., Flora 68: 261. 1885. Holotype: "India Occid. ad corticem Cinchonae?" (H-ACH). Isotype in S.

Porina cineriseda Müll. Arg., Bot. Jahrb. Syst. 6: 402. 1885. Verrucaria cineriseda Nyl., Flora 59: 364. 1876. nom. nud. Holotype: Cuba, Wright Verr. Cub. 10 (G).

Pyrenula virella Merr., Lich. Exs., ser. 1, 289. s. d. nom. nud., Acrocordia virella Merr., Lich. Exs., ser. 2, 5. 1925. nom. nud. Arthopyrenia virella (Merr.) Zahlbr., Krypt. Exs. Vindob. fasc. 32, 3141. 1933. nom. nud.

Thallus light green to dark green or dark olive or brown, at least in part epiphloeodal.

Ascocarps hemispherical or conical, 0.2-0.3 mm in diameter; ascocarp wall usually thinner or lacking below. Asci narrowly elliptical to dactyloid, 40-55(-65) x 5-8 µ. Spores uniseriate to biseriate, narrowly ovate or narrowly elliptical, 2-celled, slightly constricted at the septum, 9-11(-13) x 2.5-4 µ.

Microconidia elliptical 2.5-4.5 x 1.2-2 µ.

Macroconidia narrowly elliptical, 2-celled, 6.5-10 x 2-3.5 µ.

Habitat on bark.

This species can often be recognized by its dark colored, usually epiphloeodal thallus. Its small spores are also distinctive.

Illustrations: Figs. 328-336. Distribution: Fig. 425.

Exsiccati examined: Krypt. Vind. 3141 (US); Merr. I: 289 (US); Merr. II: 5 (MICH, MSC, US, US ex MO).

Specimens seen: United States. FLORIDA: sine loc., Calkins (MSC); Duval County, Jacksonville, Calkins (US); Putnam County, Oklawaha River at Fla. Hwy. 19, Harris 2217-D (MSC); Seminole County, Sanford, X.1907

Rapp (MICH, MSC, US, US ex MO), 3.IV.1914 Rapp (FH), XII.1914 Rapp 98 (FH), III.1916 Rapp (MICH, US), V.1927 Rapp (FH), Selman & Ridge (US). GEORGIA: McIntosh County, Darien, Ravenel 647 (FH-TUCK 4049).

West Indies. BERMUDA: Somerville, 17.I.1916 Hervey (MICH). JAMAICA: Parish of Trelawny, Barbecue Bottom, Imshaug 16064 (MSC). PUERTO RICO: San Juan District, Rio Piedras, 18.I.1916 Fink 2171 (FH, MICH).

Strigula stigmatella (Ach.) R. C. Harris comb. nov.

Lichen stigmatellus Ach., Lich. Suec. Prodr. 15. 1798. Lectotype: Germany, *Persoon* (H-ACH).

Verrucaria cinerea Pers., Ann. Bot. (Usteri) 7: 28, pl. 3, f. 6A. 1794. *nom. illeg.* (*non* Humbolt, Flora Friburg. Specim. 44. 1793). Isotype? in H-ACH.

Sagedia faginea Schaer., Enum. Crit. Lich. Europ. 208. 1850. *Porina faginea* (Schaer.) Arn., Flora 68: 166. 1885. *Arthopyrenia faginea* (Schaer.) Swinsc., Lichenologist 3: 72. 1965. Type collection not seen.

Thallus whitish to green, endophloeodal or epiphloeodal.

Ascocarps subglobose to hemispherical, immersed or emergent, 0.2-0.4 mm in diameter; ascocarp wall brown above or almost entirely colorless in immersed ascocarps. Asci cylindrical, 80-110 x 13-15 μ. Spores biseriate or subbiseriate, narrowly ovate with pointed ends, 8-celled, slightly constricted at the septa, especially the middle one, 24-42 x 5-7.5 μ.

Macroconidia narrowly elliptical, 23-30 x 3.5-5 μ.

Habitat on bark and mosses, in Michigan usually on *Thuja*.

Henry Imshaug reports that he could find no Swedish collection of *Lichen stigmatellus* in Helsinki. However, specimens from Persoon and Schrader were present. Both were cited in the original description. Schrader's specimen apparently bears only macroconidia, while Persoon's has both ascospores and macroconidia. Therefore, Persoon's specimen is designated as the lectotype. Material of this species in the Acharian collection at the British Museum (284-287) is a mixture of *S. stigmatella* (macroconidia only) and *Pyrenula coryli*.

Strigula stigmatella is recognized by its 8-celled spores larger than those of *S. submuriformis* with which it could be confused. The species is apparently rather common in Michigan *Thuja* swamps.

Illustrations: Figs. 337-341; Harris (1973), fig. 5; Swinscow (1962), fig. 13; Vězda (1968), fig. 27.

Exsiccati examined: Hepp 464, 708 (FH); Krypt. Vind. 180 (FH, US); Lojk. Univ. 199 (FH-TUCK 4074); Rab. 579 (FH), 623 (MICH).

Additional specimens seen (not cited in Harris, 1973): United States. MICHIGAN: Baraga County, NE of Sidnaw, *Harris 7828*, *7830*, *7831*, *7866*, *7977*, *7978* (MSC); Cheboygan County, E of Pine Grove campground, *Harris 7810* (MSC); Oscoda County, S of Mio, *Harris 8289*, *8364*, *8371* (MSC).

Strigula submuriformis (R. C. Harris) R. C. Harris comb. nov.

Arthopyrenia submuriformis R. C. Harris, Michigan Bot. 12: 15. 1973. Holotype: Pennsylvania, West Chester, VII.1898 *Windle* (MSC). Isotypes in CAN, MICH & US as Cum. I: 299; in FH, FH-RIDD, MICH & MSC as Cum. II: 250.

See Harris (1973) for description and discussion. _Strigula submuriformis_ is easily recognized by its 5-7 transversely septate spores, usually with 1 or 2 cells longitudinally septate. I have seen no additional material since 1973.

Illustrations: Figs. 342-345; Harris (1973), figs. 11-12.

Strigula sychnogonioides (Nitschke _in_ Rabenh.) R. C. Harris comb. nov.

Geisleria sychnogonioides Nitschke _in_ Rabenh., Lich. Eur. 574. 1861. Type collection: "an Erdwallen des Schiessplatzes bei Münster..." Isotypes in BM & MICH.

See Vězda (1970) for description and discussion. The species is distinctive in being terricolous and in having rather large 4-celled spores. I have examined as many specimens as possible in hopes of finding conidia to confirm its position in _Strigula_. I have not been able to find either micro- or macroconidia, but even so I feel the species can be included in _Strigula_ on the basis of ascocarp, ascus and spore characters. _Strigula sychnogonioides_ is not known from North America.

Illustrations: Figs. 346-348; Swinscow (1967b), figs. 1-2, Vězda (1968), fig. 2.

Exsiccati examined: Rab. 574 (BM, MICH); Vězda Sel. 577 (US).

Strigula taylori (Carroll _ex_ Nyl.) R. C. Harris comb. nov.

Verrucaria taylori Carroll _ex_ Nyl., Expos. Syn. Pyrenoc. 82. 1858. Mém. Soc. Sci. Nat. Cherbourg 5: 337. 1857. _nom. nud._ _Arthopyrenia taylori_ (Carroll _ex_ Nyl.) Mudd, Manual Brit. Lich. 302. 1861. _Porina taylori_ (Carroll _ex_ Nyl.) Swinsc., Lichenologist 2: 169. 1963. Type collection?: Ireland, Cork, Dunscombe's Wood, 12.VIII.1856 Carroll. Isotypes in BM *ex* Kew.

See Swinscow (1963) for description and discussion. The asci tend to be more ovate than in other species of *Strigula*. The separation of the spores into two part spores at maturity is found otherwise only in some foliicolous species. *Strigula taylori* has not been found in North America.

Illustrations: Figs. 349-353; Swinscow (1963), fig. 2.

Strigula viridiseda (Nyl.) R. C. Harris comb. nov.

Verrucaria viridiseda Nyl., Expos. Syn. Pyrenoc. 55. 1858. *Porina viridiseda* (Nyl.) Zahlbr., Cat. Lich. Univ. 1: 409. 1922. Holotype: "Guyana gallica, *Melinon*" (H-NYL 719).

Verrucaria bermudana Tuck. *ex* Nyl., Sert. Lich. Trop. 43. 1891. *Thelidium bermudanum* (Tuck. *ex* Nyl.) Ridd., Bull. Torrey Bot. Club 43: 146. 1916. Holotype: Bermuda, Walsingham, *Farlow 31* (H-NYL 985). Isotypes in FH & FH-TUCK.

Thallus whitish to light green, endophloeodal or endolithic.

Ascocarps hemispherical to subglobose, immersed or emergent, 0.25-0.5 mm in diameter. Asci cylindrical, 65-105 x 6-10 µ. Spores mostly uniseriate, less often subbiseriate, narrowly ovate with somewhat pointed ends, 2-celled, slightly constricted at the septum, 12-17 x 4.5-5 µ.

Microconidia elliptical to narrowly elliptical, 2.5-4 x 1.2-2 µ.

Macroconidia narrowly elliptical to elliptical, 2-celled, 10-13(-15) x 2.5-4.5 µ.

Habitat on bark, calcareous rock or shell.

The type of _Verrucaria bermudana_ is on rock, but I can find no other characters separating it from _S. viridiseda_. _Strigula viridiseda_ is closely related to and intergrades with _S. americana_ and _S. wilsonii_ both of which have larger spores. Collections with spores somewhat intermediate in size occur and if on bark have been refered to _S. americana_, if on rock to _S. wilsonii_.

Strigula viridiseda occurs in the southeastern United States and is apparently widespread in the West Indies (Bermuda, Dominican Republic, Jamaica, Puerto Rico and Trinidad). Thaxter's collections are on an old conch shell, the rest are on bark.

Illustrations: Figs. 354-359. Distribution: Fig. 426.

Specimens seen: United States. ALABAMA: Cleburne County, N of Heflin, _Harris 1321_, _1336_ (MSC). FLORIDA: Dade County, Coconut Grove, XII.1897 _Thaxter 400_ (MSC), _402_, _414_ (MICH); Seminole County, Sanford, 4.II.1914 _Rapp_ (FH, US), XII.1915 _Rapp_ (US), 25.V.1921 _Rapp 177_ (FH, MICH, US). LOUISIANA: Parish unknown, near New Orleans, _Langlois_ (MICH).

Strigula wilsonii (Ridd.) R. C. Harris comb. nov.

Porina wilsonii Ridd. _in_ Brit. & Millsp., Bahama Fl. 523. 1920. Holotype: Cuba, Isle of Pines, Caleta Cocodrilos, _N. Britton_, _Wilson & Leon 15288_ (FH-RIDD).

Porina subprospersella Vain., Mycologia 21: 39. 1929. Type collection: Puerto Rico, Yauco, 28.XII.1915 _Fink 1398_. Isotype in MICH.

Porina vainii Fink _in_ Hedrick, Mycologia 22: 247. 1930. Holotype: Puerto Rico, near Yauco, 28.XII.1915 _Fink 1431_ (MICH). Isotype in FH.

Thallus white to greenish, endolithic.

Ascocarps mostly immersed, subglobose or more less conical; ascocarp wall well developed above and lacking below, or reduced to a small ring around the ostiole of deeply immersed ascocarps. Asci cylindrical, 90-130(-160) x 7-12 µ. Spores uniseriate, narrowly ovate, sometimes with rather pointed ends, 2-celled, slightly constricted at the septum, 14-20 x 4.5-6 µ.

Microconidia narrowly elliptical to elliptical, 4-5 x 1.2-2 µ.

Macroconidia narrowly elliptical to elliptical, 2-celled, 10-13(-17) x 3-4.5 µ.

Habitat on calcareous rock.

Strigula wilsonii is very close to being a saxicolous form of *S. americana*, but the spores are in general shorter and broader in the former. It also intergrades to some extent with the saxicolous forms of *S. viridiseda* and occasional collections may be hard to place. *Strigula wilsonii* is apparently very common in Puerto Rico and is also known from Bermuda, Cuba and Trinidad. In the United States it is restricted to southernmost Florida.

Illustrations: Figs. 360-366. Distribution: Fig. 427.

Specimens seen: United States. FLORIDA: Dade County, Coconut Grove, XII.1897 *Thaxter* (MICH, MSC); Monroe County, Key West, II.1898 *Thaxter* (MICH).

D. TRYPETHELIACEAE

Syst. Lich. 17. 1824. Holotype: *Trypethelium* Spreng. *nom. cons.*

Astrotheliaceae Zahlbr., Nat. Pflanzenfam. 1(1*): 72. 1903. Holotype: *Astrothelium* Eschw.

Cryptotheliaceae W. Wats., New Phytol. 28: 113. 1929. Holotype: _Cryptothelium_ Massal.

Hyalophragmiaceae Räs., Acta Bot. Fenn. 33: 9, 23, 74. 1943. _nom. inval. descr. germ._ Lectotype (Cooke & Hawksworth, 1970): _Pseudopyrenula_ Müll. Arg.

Laureraceae Vězda _ex_ Poelt _in_ Ahmadjian & Hale, The Lichens 609. 1974. _nom. inval. descr. eng._

Thallus mostly well developed, semi-endophloeodal, with a cortex-like upper layer of compacted hyphae and bark cells, sometimes with extensive deposits of crystals or pigment granules beneath the algal layer. Phycobiont _Trentepohlia_ or in a few cases non-lichenized.

Ascocarps commonly simple, grouped and immersed in a pseudostroma which may be differently colored from the thallus or may contain crystals or pigment granules, sometimes ascocarps solitary, immersed or superficial; less commonly with compound ascocarps possessing several hymenia sharing a common ostiole. Ostioles mostly erect, occasionally eccentric or lateral. Hymenium commonly containing granules of an unknown substance; hymenial gelatin IKI-. Paraphyses branched and anastomosed, often in a regular and reticulate manner. Asci bitunicate (Morgan-Jones, 1972), often with a broad, shallow ocular chamber. Spores mostly colorless, very rarely brownish, 4-celled to muriform, commonly eight/ascus but occasionally four or two/ascus; mesospore thickened, rarely remaining unthickened, rarely IKI+ violet; perispore present, occasionally rather thick; a few species with granular ornamentation.

Microconidia rod-like.

Lichen substances: lichexanthone sporadically in most genera and numerous pigments, including anthraquinone pigments such as parietin (Santesson, 1970).

Habitat on bark and perhaps occasionally on ecorticate wood.

The most characteristic feature of the Trypetheliaceae is the colorless spores with thickened mesospore. The few brownish spored species known to me have been placed in this family on the basis of thallus and ascocarp morphology. Polymeridium lacks mesospore thickening and a well developed thallus but seems best placed in the Trypetheliaceae on the basis of hymenial, microconidial and chemical characters, i.e. inspersed hymenia of the same type as Trypethelium, rod-shaped microconidia and the presence of lichexanthone in some species. The same type of poorly developed thallus is found in Pseudopyrenula which does have the typical mesospore thickening.

The Trypetheliaceae are almost entirely subtropical and tropical in distribution with only a single species Trypethelium virens reaching southern Canada. In comparison with the Strigulaceae and Trichotheliaceae the range of substrates is very limited.

Astrothelium and Trypethelium are treated briefly in Appendix A. Pseudopyrenula is included here with Polymeridium since the single North American species has previously been misidentified as various species of Arthopyrenia and also to provide some context for the understanding of Polymeridium.

1. POLYMERIDIUM (Müll. Arg.) R. C. Harris stat. nov.

Arthopyrenia sect. Polymeridium Müll. Arg., Flora 46: 317. 1883.

Lectotype (Riedl, 1962): Verrucaria contendens Nyl.

Thallus whitish, endophloeodal, not differentiated into layers as in *Trypethelium*.

Ascocarps flattened, hemispherical or subglobose, immersed or superficial; outer layer of ascocarp wall brown to blackish, often lacking below. Hymenium inspersed with amorphous granules or not. Asci cylindrical to narrowly elliptical or narrowly ovate, with a small, shallow ocular chamber. Spores biseriate or irregularly arranged, narrowly ovate or narrowly elliptical, 4-10-celled, cells approximately equal, slightly constricted at the septa; spore wall mostly not ornamented; perispore visible, occasionally rather thick, up to 2 µ.

Microconidia rod-like, 5-12 x 1 µ.

Lichen substances: Lichexanthone in the thallus of several species.

Polymeridium seems to me to be closely related to *Pseudopyrenula*, with which it has been confused in the past. The main feature separating them is the lack of mesospore thickening in *Polymeridium*. Also in *Polymeridium* the paraphyses tend to be less regularly reticulate, the ascocarps tend to be smaller, more immersed and have a less heavily carbonized wall.

It is possible that some of the species placed in *Polymeridium* belong in the genus *Arthopyrenia*. Many species previously included in the sect. *Polymeridium* clearly have their nearest relatives in *Arthopyrenia* and are placed there, e.g., *A. atomarioides* and *A. cerasi*. If *Trentepohlia* is not evident, the hymenium uninspersed, etc., the decision as to the correct genus is difficult. In these cases the nature of the old spores has proved useful. In *Polymeridium* the lumen becomes almost filled with additional layers of spore wall and the spores do not become tinted. In *Arthopyrenia* additional wall layers are not usually added with age and the spores often become tinted and ornamented in extreme old age.

As presently circumscribed *Polymeridium* does not include any species with 2-celled spores. It is possible that the species with 2-celled spores now included in the *Arthopyrenia bifera* group should actually be included in *Polymeridium*. Their spores tend to have some mesospore thickening, the microconidia are of the same type and they are often asscociated with *Trentepohlia*. However, my knowledge of the group is not such that I wish to make a decision at this time.

1. Thallus UV+ yellow; spores 4-celled 2
1. Thallus UV-; spores 4-10-celled 3

    2. Spores smooth, 24-33 x 8-10 µ; perispore thin .... *P. catapastum*
    2. Spores ornamented, 28-36 x 9-12 µ; perispore thick .... *P. exasperatum*

3. Spores 4-celled 4
3. Spores more than 4-celled 7

    4. Hymenium inspersed; spores 14-17 x 5-6 µ .... *P. contendens*
    4. Hymenium not inspersed 5

5. Spores large, 28-36 x 9-12 µ, ornamented; perispore thick .... *P. exasperatum*
5. Spores smaller, less than 25 µ long, not ornamented 6

6. Spores 17-20(-22) x 5-6.5(-7) µ; asci 70-85 µ long; perispore thin .... *P. subcinereum*

6. Spores 20-25 x 6-7.5 µ; asci 90-125 µ long; perispore well developed .... *P. albidum*

7. Spores 6-8-celled, 18-27 x 5.5-7 µ .... *P. quinqueseptatum*

7. Spores 8-10-celled, 27-35 x 7-8 µ .... *P. pleiomerellum*

Polymeridium albidum (Müll. Arg.) R. C. Harris comb. nov.

Arthopyrenia albida Müll. Arg., Flora 67: 664. 1884. Lectotype: Brazil, Cayeté, *Martius* (M).

Ascocarps subglobose, immersed or emergent, 0.3-0.4 mm in diameter. Hymenium not inspersed. Asci narrowly elliptical, 90-125 x 16-22 µ. Spores biseriate, narrowly ovate, 4-celled; perispore well developed; 20-25 x 6-7.5 µ (excluding perispore).

Microconidia linear, 9-10 x 1 µ.

Habitat on bark and petiole of palmetto.

Polymeridium albidum is very similar to *P. subcinereum*, differing slightly in spore and ascus size. I have seen very few specimens of either and it is possible that additional material might bridge the gap.

Illustrations: Figs. 367-371.

Specimens seen: United States. FLORIDA: Dade County, Everglades Nat. Park, SW of Pineland Trail Area, *Harris 2889-A* (MSC). TEXAS: *sine data* (MICH).

Polymeridium catapastum (Nyl.) R. C. Harris comb. nov.

Verrucaria catapasta Nyl., Acta Soc. Sci. Fenn. 7: 488. 1863.

Arthopyrenia catapasta (Nyl.) Müll. Arg., Flora 66: 318. 1883. Type collection: Colombia, Bogota, Tequendama, 2600 m, Lindig 2869. Isotype in FH-TUCK 4086.

Pyrenastrum album, verrucarioides Eschw. in Martius, Flora Brasil. 1: 147. 1833. Arthopyrenia tumida Müll. Arg., Flora 67: 669. 1884. Lectotype: Brazil, near Bahia, Martius (G).

Thallus white, usually well developed, UV+ yellow (lichexanthone).

Ascocarps subglobose to hemispherical, mostly immersed, 0.3-0.5 mm in diameter; ascocarp wall often lacking below. Hymenium not inspersed. Asci narrowly elliptical or elliptical, 80-130 x 20-25 µ. Spores irregularly arranged or less often biseriate, narrowly elliptical or narrowly ovate, 4-celled; perispore relatively thin; 24-33 x 8-10 µ (excluding perispore).

Microconidia rod-like, 6-8 x 1 µ.

Habitat on bark, in Florida especially on Quercus.

This is the only North American species of Polymeridium which regularly produces large amounts of lichexanthone in the thallus. Polymeridium exasperatum may produce small amounts, but it is easily distinguished by longer microconidia, ornamented spore wall and thicker perispore. Polymeridium catapastum is very abundant locally in central Florida. It is also known from Alabama, the Bahamas, Cuba, Grand Cayman and Colombia.

Illustrations: Figs. 372-378. Distribution: Fig. 428.

Specimens seen: United States. ALABAMA: Baldwin County, Rock Creek, 27.II.1925 Evans 190 (MICH). FLORIDA: Dade County, junction of Hwys. 31 & 74, IV.1970 Hale (US); Lake County, Eustis, 1898 Thaxter 339

(MICH); Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, Harris 1449, 1464, 1472 (MSC); Marion County, Ocala Nat. Forest, NW of Big Bass Lake, Harris 2050-B, 2051 (MSC), Hopkins Prairie, Harris 2427-A, 2429-B, 2443, 2447, 2466-B, 2473-A (MSC), Hughes Island, Harris 1999, 2034, 2044 (MSC), S of Long Pond, Harris 1802-B, 1820, 1823, 1828, 1835, 1842-B, 1843, 1866, 1867, 1870, 2325, 2329-A, 2333, 2353 (MSC), Pats Island, Harris 2068, 2082, 2113 (MSC); Seminole County, Sanford, 4.X.1904 Rapp (FH), I.1910 Rapp (FH), 15.X.1912 Rapp (FH); Volusia County, Tomoka St. Park, Harris 2314, 2321 (MSC).

Polymeridium contendens (Nyl.) R. C. Harris comb. nov.

Verrucaria contendens Nyl., Acta Soc. Sci Fenn. 7: 492. 1863.

Arthopyrenia contendens (Nyl.) Müll. Arg., Flora 66: 317. 1883.

Holotype: Colombia, San Antonio, Lindig 2877 (H-NYL 7331).

Ascocarps hemispherical, semi-immersed, c. 0.3 mm in diameter. Hymenium heavily inspersed. Asci narrowly elliptical, 70-90 x 14-15 µ. Spores subbiseriate, narrowly elliptical or narrowly ovate, 4-celled; perispore very thin; 14-17 x 5-6 µ.

The heavily inspersed hymenium and small spores characterize this rare species. Nylander in his original description cited Lindig 2877 as being from La Mesa but the specimen of this number in Nylander's herbarium is labelled "San Antonio".

Illustrations: Figs. 379-382.

Specimen seen: United States. FLORIDA: Sarasota County, Myakka River St. Park, Harris 2642 (MSC).

<u>Polymeridium</u> <u>exasperatum</u> R. C. Harris sp. nov.

Sat similis <u>P</u>. <u>catapasti</u> sed differt sporis exasperatis, perisporio crassiore, usque 2 µ, et microconidiis longioribus, 9-12 x 1 µ.

Holotype: Florida, Dade County, Everglades Nat. Park, NE of Pa-hay-okee Overlook, <u>Harris</u> <u>2829-A</u> (MSC). Isotype in H.

Thallus whitish, UV- or patchily UV+ yellowish (lichexanthone?). <u>Trentepohlia</u> present or absent.

Ascocarps hemispherical to subglobose, mostly immersed, 0.4-0.6 mm in diameter; ascocarp wall occasionally extending outward above, thinner or lacking below. Ostiole often somewhat eccentric. Hymenium not inspersed. Asci narrowly elliptical, with a small ocular chamber, 140-160 x 20-28 µ. Spores biseriate to almost uniseriate, narrowly elliptical to narrowly ovate, 4-celled; spore wall granular ornamented; perispore thick, up to 2 µ; 28-36 x 9-12 µ (excluding perispore).

Microconidia linear, 9-12 x 1 µ.

<u>Polymeridium</u> <u>exasperatum</u> is the only species in the genus with ornamented spores. The variable presence of lichexanthone and the size and shape of the spores is very similar to <u>P</u>. <u>catapastum</u>. It is easily distinguished, however, by the features noted in the diagnosis as well as by the tendency for the ostiole to be eccentric and by larger asci. It is known only from southernmost Florida.

Illustrations: Figs. 383-386.

Specimens seen: United States. FLORIDA: Dade County, Everglades Nat. Park, NE of Pa-hay-okee Overlook, <u>Harris</u> <u>2814-B</u>, <u>2829-A</u>, <u>2836-C</u> (MSC); Monroe County, Key West, I.1898 <u>Thaxter</u> <u>122</u> (MICH).

Polymeridium _pleiomerellum_ (Müll. Arg.) R. C. Harris comb. nov.

Arthopyrenia _pleiomerella_ Müll. Arg., Bot. Jahrb. Syst. 6: 406. 1885. Type collection not seen.

Thallus whitish, endophloeodal. _Trentepohlia_ apparently absent in many collections.

Ascocarps hemispherical, mostly superficial but occasionally immersed, 0.3-0.6 mm in diameter; ascocarp wall lacking below. Hymenium heavily inspersed. Asci narrowly elliptical or narrowly obovate, (80-)100-120(-130) x 20-25 μ. Spores subbiseriate to irregularly arranged, narrowly elliptical to narrowly ovate, 8-10-celled; perispore usually well developed; 27-35 x 7-8 μ (excluding perispore).

Microconidia linear, 7-11 x 1 μ.

Habitat on smooth barks.

The spore size given by Müller in his original description is somewhat smaller than in the material I have seen but the number of cells agrees. The name is therefore used provisionally. _Polymeridium_ _pleiomerellum_ intergrades with _P._ _quinqueseptatum_, especially in southern Florida where both occur. Typical _P._ _pleiomerellum_ is 9-10-celled but also commonly 8-celled while _P._ _quinqueseptatum_ is 6-7-celled ranging up to 8-celled and rarely 9-celled. In southern Florida many collections are 7-8(-9)-celled and I have more or less arbitrarily separated them on the basis of spore length (longer or shorter than 27 μ). Material determined as _P._ _pleiomerellum_ is confined to southern Florida, Mexico and the West Indies while _P._ _quinqueseptatum_ ranges more widely on the Coastal Plain.

Illustrations: Figs. 388-391.

Specimens seen: United States. FLORIDA: Dade County, Everglades Nat. Park, near Pineland Trail Area, _Harris_ _2875-A_, _2883-D_, _2887_, _2896-A_, _2900_, _2908_, _2911-C_, _2986-F_ (MSC).

Mexico. GUERRERO: near Cruz Grande, _Graham_ _1219-B_ (MSC).

West Indies. JAMAICA: Parish of St. Andrew, summit of Long Mtn., _Imshaug_ _13487_, _13505-B_, _13507_, _13515-A_ (MSC). PUERTO RICO: Mayagüez District, Yauco, 29.XII.1915 _Fink_ _1512_ (FH).

Polymeridium _quinqueseptatum_ (Nyl.) R. C. Harris comb. nov.

Verrucaria _quinqueseptata_ Nyl., Expos. Syn. Pyrenoc. 58. 1858. _Arthopyrenia_ _quinqueseptata_ (Nyl.) Müll. Arg., Flora 68: 326. 1885. Holotype: South Carolina, _Ravenel_ (H-NYL 591).

Arthopyrenia _comparatula_ Müll. Arg., Jahrb. Bot. Syst. 6: 406. 1885. Holotype: Cuba, Wright Verr. Cub. 152 (G).

Thallus whitish. _Trentepohlia_ present or apparently absent.

Ascocarps hemispherical, superficial, 0.25-0.5(-0.6) mm in diameter; ascocarp wall usually lacking below. Hymenium inspersed. Asci narrowly elliptical to narrowly ovate, (65-)75-90 x (15-)18-21 µ. Spores narrowly ovate, 6-8(-9)-celled; perispore thin; 18-27 x 5.5-7 µ (excluding perispore).

Microconida linear 9-12 x 1 µ.

Habitat on smooth barks.

The distinction between this species and _P._ _pleiomerellum_ is discussed under the latter. _Polymeridium_ _quinqueseptatum_ is less tropical in distribution than most of the other species in the genus ranging from South Carolina to Texas and south to southern Florida but is apparently absent from the West Indies.

Illustrations: Figs. 392-395. Distribution: Fig. 429.

Specimens seen: United States. ALABAMA: Baldwin County, Volanta, 9.III.1925 Evans 262 (MICH); Lawrence County, Moulton, 1860 Beaumont 168, 228 (FH-TUCK 4023). FLORIDA: Baker County, Osceola Nat. Forest, Harris 3128-C (MSC); Dade County, Everglades Nat. Park, S of Pa-hay-okee Overlook, Harris 2745-D (MSC), SW of Pineland Trail Area, Harris 2879-B, 2911-B (MSC); Duval County, Jacksonville, Calkins (FH, US); Flagler County, Flagler St. Park, Harris 2478-C (MSC); Liberty County, Apalachacola Nat. Forest, Whitehead Lake Campground, Harris 1456-A, 1557, 1575-B, 1576, 1726 (MSC); Marion County, Ocala Nat. Forest, S of Long Pond, Harris 2345-A (MSC), Pats Island, Harris 2094-A (MSC); Monroe County, Key West, II.1898 Thaxter 299, 301, 361 (MICH); St. Johns County, Six Mile Creek, Calkins (FH); Seminole County, Sanford, IV.1908 Rapp (FH). LOUISIANA: E. Feliciana Parish, Felixville, Tucker 7762 (MSC); St. Tammany Parish, Covington, 16.IV.1894 Langlois (US); Vernon Parish, Kisatchie Nat. Forest, Fort Polk, Tucker 7875 (LSU). SOUTH CAROLINA: County unknown, Santee Canal, 1857 Ravenel (FH, FH-TUCK 4023, MICH, MSC, US); Berkeley County, Francis Marion Nat. Forest, Guilliard Lake Campground, Harris 3175-B (MSC). TEXAS: Harris County, Houston, coll. unknown (FH-TUCK 4023).

Polymeridium subcinereum (Nyl.) R. C. Harris comb. nov.

Verrucaria subcinerea Nyl., Expos. Syn. Pyrenoc. 37. 1858. Arthopyrenia subcinerea (Nyl.) Müll. Arg., Flora 64: 318. 1883. Holotype: Texas, 1850 Wright (H-NYL 1529). Isotypes in FH-TUCK 4022 & US.

Arthopyrenia subimitans Müll. Arg., Bull. Soc. Bot. Belg. 32: 169.

1893. Type collection: Costa Rica, Boruca, Pittier 6287. Isotype in US.

Ascocarps hemispherical or flattened, semi-immersed, 0.3-0.5 mm in diameter. Hymenium not inspersed. Asci narrowly elliptical, 70-85 x 15-22 µ. Spores biseriate or subbiseriate, narrowly elliptical to narrowly ovate, 4-celled; perispore thin; 17-20(-22) x 5-6.5(-7) µ.

Microconidia rod-like, 5-7 x 1 µ.

This species is very similar to *P. albidum* but has smaller spores and asci. It is known from Florida, Texas and Costa Rica.

Illustrations: Figs. 396-399.

Specimens seen: United States. FLORIDA: Orange County, Rock Springs, 6.V.1921 Kelly 89A (US). TEXAS: County unknown, thickets of the Blanco, 1850 Wright 85 (US); Hidalgo County ?, valley of the Rio Grande below Donna, Wright (FH-TUCK 4023).

2. PSEUDOPYRENULA Müll. Arg.

Flora 66: 247. 1883. Lectotype (Clements, 1909): *Verrucaria diluta* Fée.

Plagiotrema Müll. Arg., Bot. Jahrb. Syst. 6: 387. 1885. Holotype: *P. cubanum* Müll. Arg.

Thallus whitish, endophloeodal, not differentiated into layers as in *Trypethelium*. Phycobiont *Trentepohlia*, but some species apparently not lichenized.

Ascocarps flattened, hemispherical or subglobose, mostly superficial, rarely immersed; ascocarp wall carbonaceous, often very hard and brittle, often extended outward at the base, often lacking below. Hymenium often inspersed with amorphous granules. Paraphyses branched and anastomosed, often quite regularly and reticulately. Asci cylindrical or narrowly elliptical, often with a broad, shallow ocular chamber. Spores elliptical to narrowly elliptical, 4-celled; mesospore thickened so that the lumina are angular or rounded in optical section; spore wall not ornamented; perispore thin.

Microconidia rod-like.

Lichen substances: Lichexanthone in one species and a yellowish pigment, KOH+ red, in the hymenia of several species.

Pseudopyrenula is distinguished from *Trypethelium* mainly on the basis of thallus and ascocarp characters. The thallus of *Pseudopyrenula* does not have a cortex-like upper layer and the ascocarps are superficial and often rather flattened. In *Trypethelium* the ascocarps are immersed, either singlely in the thallus or grouped within pseudostromata. The distinction of *Pseudopyrenula* from *Polymeridium* is discussed under the latter genus.

There is only a single species of *Pseudopyrenula* in North America. The previous reports of *P. pupula* (Ach.) Müll. Arg. were based on misidentified specimens of *Trypethelium floridanum*.

Pseudopyrenula subgregaria Müll. Arg.

Bot. Jahrb. Syst. 6: 408. 1885. Holotype: Cuba, Wright Verr. Cub. 80 (G). Isotype in US.

Pseudopyrenula confluens Merr. *in* Hedrick, Mycologia 22: 247. 1930. Holotype: Puerto Rico, near Aibonito, 4.I.1916 *Fink 1856* (MICH). Isotype in FH.

Thallus whitish, endophloeodal, Trentepohlia present or not.

Ascocarps flattened to hemispherical, rarely subglobose, often somewhat aggregated in irregular groups or rows, 0.3-0.7 mm in diameter; ascocarp wall often exteneded outward at the base, thinner or lacking below. Hymenium inspersed with amorphous granules and with a yellowish pigment, KOH+ red, pigment rarely lacking. Asci narrowly elliptical, 75-95(-120) x 15-20 µ. Spores 20-27 x 6-8 µ.

Microconidia rod-like, 5-8 x 1 µ.

Habitat on bark and old wood.

In general species in the genus Pseudopyrenula do not seem to me at this time to be very distinct. There is considerable intergradation in spore size and the presence or absence of the yellowish hymenial pigment does not seem to correlate with other characters. Pseudopyrenula subgregaria has the smallest spores in the genus and the presence of the pigment is quite constant so that it is perhaps a little better defined than most. It is apparently rather common in Florida and the West Indies (Cuba, Dominica, Dominican Republic, Grand Cayman, Jamaica and Puerto Rico) and represented from Louisiana and Costa Rica by single collections.

Illustrations: Figs. 400-405. Distribution: Fig. 430.

Specimens seen: United States. FLORIDA: sine loc., Shockley (US); Dade County, Everglades Nat. Park, near Mahogany Hammock, Harris 2929-C (MSC), S of Pa-hay-okee Overlook, Harris 2719-H, 2741-B (MSC), near Pineland Trail Area, Harris 2891, 2906, 3016, 3018 (MSC); Liberty County, Apalachicola Nat. Forest, Whitehead Lake Campground, Harris 1499, 1515, 1521 (MSC), Porter Lake Picnic Area, Harris 1689 (MSC). LOUISIANA: E. Baton Rouge Parish, Baton Rouge, Tucker 10005 (LSU).

VI. SOME ADDITIONAL HYALINE SPORED PYRENOLICHENS

In order to provide some sort of preliminary manual for the transversely septate, colorless spored pyrenolichens (excluding the Verrucariaceae) this appendix contains keys, nomenclatural citations and brief statements of diagnostic characters and distribution. All of the species known to me from the United States are included with the exception of *Porina*, where a few rare species found only in southernmost Florida have been omitted.

In this appendix *cf.* is used to indicate an identification based almost entirely on the literature without examination of authentic material, while *aff.* is used to indicate an unnamed species which seems very closely related to a well known species and is only tentatively maintained as a separate species.

A. PYRENULACEAE Rabenh.

Kryptog.-Fl. von Sachsen 2: 42. 1870. Holotype: *Pyrenula* Ach.

Paratheliaceae Zahlbr., Nat. Pflanzenfam. 1(1*): 71. 1903. Holotype: *Parathelium* Nyl.

Gleophragmiaceae Räs., Acta Bot. Fenn. 33: 9, 22, 72. 1943. *nom. inval. descr. germ.* Lectotype (Cooke & Hawksworth, 1970): *Mycopyrenula* Vain.

Gloenodictyaceae Räs., Acta Bot. Fenn. 33: 9, 22, 73. 1943. *nom. inval. descr. germ.* Lectotype (Cooke & Hawksworth, 1970): *Bottaria* Massal.

Microglaenaceae Serv., Česk. Lišejníky Čeledi Verruc. 17. 1954. Holotype: *Microglaena* Körb.

Cooke & Hawksworth (1970) attribute the first publication of the name Pyrenulaceae to Zahlbruckner (1903-7), but a superficial search has turned up an earlier usage by Rabenhorst and a more exhaustive search might reveal even earlier ones.

Although the Pyrenulaceae is mainly comprised of brown spored species, there are a few with colorless spores. They are included in the Pyrenulaceae on the basis of ascocarp structure, hymenial characters and type of microconidia.

1. LITHOTHELIUM Müll. Arg.

Bot. Jahrb. Syst. 6: 386. 1885. Holotype: *L. cubanum* Müll. Arg.

A compound ascocarp containing several hymenia sharing a single ostiole, inspersed hymenium, hymenial gelatin IKI+ bluish to orangish and filiform microconidia are diagnostic for *Lithothelium*.

Lithothelium cubanum Müll. Arg.

Bot. Jahrb. Syst. 6: 386. 1885. Type collection: Cuba, Wright Verr. Cub. II: 612. Isotype in FH-TUCK 3982.

Verrucaria falklandica Nyl., Lich. Fueg. & Patagon. 22. 1888. Holotype: "Insula Falkland, calcicola, Rabenhorst fil." (H-NYL 1274).

Porina (sect. *Sagedia*) *macrocarpa* Ridd. *in* Brit. & Millsp., Bahama Fl. 523. 1920. Type collection not seen.

Lithothelium violascens Malme, Ark. Bot. 19(1): 16. 1924. Type collection: Malme Austroam. 25, Paraguay, Colonia Risso pr. Rio Apa, *Malme*. Isotype in MSC.

The ascocarp wall is usually rather purplish in this species, which led Malme to name it "violascens". Lithothelium has not yet been found in North America but its rather broad subtropical distribution suggests that it might well occur on limestone in southern Florida. The Falkland Island locality seems somewhat doubtful.

2. PLAGIOCARPA R. C. Harris

Michigan Bot. 12: 34. 1973. Holotype: P. septemseptata R. C. Harris.

See Harris (1973) for description and discussion.

Plagiocarpa hyalospora (Nyl.) R. C. Harris

Michigan Bot. 12: 34. 1973. Verrucaria hyalospora Nyl., Mém. Soc. Acad. Maine Loire 4: 48. 1858. Holotype: New England (H-NYL 1251).

See Harris (1973) for description and discussion.

In addition to the widespread P. hyalospora there are two other colorless spored species which are very similar. They differ from P. hyalospora in having Pyrenula type asci, lacking the very distinctive ocular chamber unique to Plagiocarpa. Their distribution is more tropical but they agree with Plagiocarpa in all other respects. At the present time I do not wish to describe them in Plagiocarpa or create a new genus for them. The two species differ in spore size. The smaller spored species (17-20 x 7-10 μ) is known from a few collections from Louisiana and one from the West Indies (St. Lucia). The larger (23-29 x 10-12.5 μ) is mixed with the original material of Anisomeridium tamarindi (G) and probably comes from Guadeloupe.

B. TRICHOTHELIACEAE (Müll. Arg.) Bitt. & Schill. in Schill Hedwigia 67: 273. 1927. Pyrenulae subtr. Trichotheliae Müll. Arg., Bot. Jahrb. Syst. 6: 418. 1885. Holotype: Trichothelium Müll. Arg.

Porinaceae W. Wats., New Phytol. 28: 108. 1929. Holotype: Porina Müll. Arg.

Gloenoblastiaceae Räs., Acta Bot. Fenn. 33: 9, 22, 74. 1943. nom. inval. diagn. germ. Lectotype (Cooke & Hawksworth, 1970): Stereochlamys Müll. Arg.

The Trichotheliaceae seem to form a homogeneous unit if one accepts the definition proposed in this work. The asci are characteristically rather truncate, the ascus tip is little thickened and most species have a chitinoid ring in the apex of the exoascus. Other aids to recognizing the family are the unbranched paraphyses, spores mostly multiseptate, ascocarp wall often some color other than brown black and abundant colorless crystals in the thallus, especially around the ascocarp. The bulk of the family is subtropical or tropical. The majority of the species are corticolous, but some species grow on rock, mosses or leaves.

1. PORINA Müll. Arg.

Flora 66: 320. 1883. nom. cons. Lectotype: P. nucula Ach.

Pseudosagedia (Müll. Arg.) Choisy, Bull. Mens. Soc. Linn. Lyon. 18: 107. 1949. Arthopyrenia sect. Pseudosagedia Müll. Arg., Mém. Soc. Phys. Gèneve 16: 428. 1862. Type not selected but all original species have been referred to Porina.

Porina is one of the largest genera of pyrenolichens in North America, but many of the species are rare. The genus presents a number of taxonomic problems which will require considerable additional study. *Porina* is most diverse in Florida, thus it is probable that some of the unnamed species will prove to have been described in other regions of tropical America.

1. Growing on leaves (after Santesson, 1952) 2
1. Growing on bark, wood, mosses or rock 4

2. Spores 8-celled, 24-31 x 3-4 µ; ascocarps reddish brown, constricted at the base .... *P. octomera*
2. Spores 4-6-celled; ascocarps black with a thin or thick thallus covering 3

3. Spores 4-celled, 18-25 x 4-5 µ; thallus covering more or less thick, ascocarp thus similar in color to thallus .... *P. thaxteri*
3. Spores 6-celled, 20-28 x 3.5-4.5 µ; ascocarps blackish to grayish, with a thin thallus covering .... *P. nitidula*

4. Spores 4-celled 5
4. Spores more than 4-celled 12

5. Involucrellum black (lacking reddish tints even in section) 6
5. Involucrellum orange red to reddish black (if necessary examine a thin section) 8

6. Growing on bark; spores 16-24 x 4.5-5 µ .... *P. carpinea*

6. Growing on rock 7

7. Microconidia oblong, 2-3 µ long; spores 18-25 x 4.5-5 µ .... *P. chlorotica*

7. Microconidia cylindrical, 5-10 µ long; spores 18-25 x 5.5-7 µ .... *P.* aff. *chlorotica*

8. Growing on bark or on mosses and plant remains 9

8. Growing on rock 11

9. Growing on bryophytes and plant remains; involucrellum purplish red in section; spores 25-40 x 4-6 µ (Swinscow, 1962) .... *P. mamillosa*

9. Growing on bark; involucrellum orange red to yellowish in section 10

10. Microconidia oblong, 2-3 µ long; spores 16-23 x 3-5 µ (Swinscow, 1962) .... *P. leptalea*

10. Microconidia cylindrical, c. 5 µ long; spores 17-23 x 4.5-5.5 µ .... *P. microspora*

11. Spores 20-30(-40) x 5-8 µ (Swinscow, 1962); microconidia elliptical with pointed ends, c. 1.5 µ broad .... *P. lectissima*

11. Spores 15-19 x 4.5-6 µ; microconidia oblong 1 µ or less broad .... *P.* aff. *lectissima*

12. Ascocarp wall green; involucrellum absent; spores 7-9-celled, 28-38 x 6.5-9 µ .... _Porina_ sp. 1

12. Ascocarp wall or involucrellum yellowish, reddish, brown or black 13

13. Involucrellum or ascocarp wall pink, yellowish or reddish, sometimes darker colored around the ostiole 14

13. Involucrellum or ascocarp wall dark brown to black 23

14. Growing on rock; ascocarps pinkish orange, lacking involucrellum; spores 9-15-celled, 55-75 x 7.5-9 µ .... _Porina_ sp. 2

14. Growing on bark 15

15. Thallus shiny, thin and fragile, with a definite black hypothallus, often becoming detached from the substrate; ostiole usually surrounded by a dark ring 16

15. Thallus dull, without evident hypothallus and never becoming detached from the substrate; ostiole not normally surrounded by a dark ring 18

16. Thallus with scattered cylindrical isidia; spores 8-celled, 30-50 x 5-7.5 µ .... _Porina_ sp. 3

16. Thallus lacking isidia 17

17. Spores 35-50 x 5-7.5 µ, 8-celled .... _P._ cf. _tetracerae_

17. Spores 42-55 x 8-9.5 µ, 8-celled .... _P._ _subpungens_

18. Thallus covered with simple to coralloid isidia; ascocarps immersed, flesh-colored; spores 9-18-celled, 65-110 x 7.5-12 µ .... *Porina* sp. 4

18. Thallus not isidiate 19

19. Spores dactyloid, much narrower at one end 20

19. Spores narrowly elliptical or narrowly ovate 21

20. Spores 11-15-celled, 75-125 x 10-15 µ; involucrellum filled with crystals .... *P. heterospora*

20. Spores 8-celled, 37-42 x 7-8 µ; involucrellum not filled with crystals .... *Porina* sp. 5

21. Spores 35-60 x 7.5-10 µ .... *P.* aff. *nucula*

21. Spores mostly over 10 µ in width 22

22. Spores 45-55 x 10-14 µ .... *P. nucula*

22. Spores 55-80 x 10-13 µ .... *Porina* sp. 6

23. Growing on rock 24

23. Growing on bark 26

24. Spores 33-40 x 6.5-8(-10) µ, 8(-12)-celled, cylindrical to narrowly ovate .... *Porina* sp. 7

24. Spores 6.5 µ or less in width 25

25. Spores cylindrical, 30-47 x 4.5-6 µ, 8(-14)-celled ... *Porina* sp. 8

25. Spores dactyloid, tapering to a long tail, 45-60 x 5-6 µ, 8(-13)-celled .... *Porina* sp. 9

26. Spores filiform, 100-140 x 3-5 µ, up to 21-celled .... *P. raphidosperma*

26. Spores 90 µ or less in length 27

27. Spores 8(rarely -10)-celled, narrowly ovate, 30-50 x 5-7.5 µ .... *P. cestrensis*

27. Spores (8-)10-18-celled, cylindrical, dactyloid or linear, mostly narrower at one end in the larger spored forms, if only 8-celled, then the spores cylindrical, 40-9- x 3-7(-7.5) µ .... see discussion of *P. cestrensis*

Porina carpinea (Pers. *ex* Ach.) Zahlbr.

in Engler & Prantl, Natürl. Pflanzenfam. 1(1*): 66. 1903. *Verrucaria carpinea* Pers. *ex* Ach., Meth. Lich. 120. 1803. Type collection not seen.

The small black ascocarps, 4-celled spores and corticolous habitat are diagnostic. Specimens have been verified from British Columbia, Florida and Texas.

Porina cestrensis (Tuck. *ex* Michener) Müll. Arg.

Flora 64: 338. 1883. *Verrucaria cestrensis* Tuck. *ex* Michener *in* W. Darl., Fl. Cest. ed. 3. 452. 1853. Lectotype(?): Pennsylvania, Chester, *Michener 204* (FH-TUCK 3986).

Porina cestrensis var. *platyspora* Fink *in* Hedrick, Mycologia 25: 308. 1933. Holotype: Indiana, near Scipio, 8.II.1909 (MICH, hb. Fink 8,889).

Porina cestrensis is one of the commonest species in eastern North America. Unfortunately it is involved in one of the worst taxonomic problems in the genus. A majority of collections have uniformly 8-celled, narrowly ovate spores, but a sizable number of collections have spores which range, in different collections, from 8-celled and cylindrical to linear, often with one end narrowed, and up to 18-celled. There do not seem to be any immediately obvious discontinuities in this continuum although the various spore forms encompass a range of variation not normally included in a single species. Swinscow (1962) includes narrowly ovate and cylindrical spored forms as varieties of a single species. Thus one might include the 8-celled cylindrical spored forms in *P. cestrensis* proper. Some of the longest spores begin to approach the very long filiform spores of *P. rhaphidosperma*. I am tempted to speculate that the considerable number of specimens intermediate between *P. cestrensis* and *P. rhaphidosperma* represent a hybrid swarm. This would account for the lack of discontinuities and the extraordinary variation in spore size, shape and septation. *Porina hibernica* James & Swinsc., which is apparently a distinct species in Europe, represents the upper end of the range of this swarm. *Porina olivacea* (Pers.) A. L. Sm. is the European vicariant of *P. cestrensis* and differs only in slightly smaller spores.

Porina cestrensis and its variants range from Massachusetts to Ohio south to Florida and eastern Texas.

Porina chlorotica (Ach.) Müll. Arg.

Revue Mycol. (Toulouse) 6: 20. 1884. *Verrucaria chlorotica* Ach., Lich. Univ. 283. 1810. Type collection not seen.

This is the saxicolous form of *P. carpinea*, both having black ascocarps and 4-celled spores. It is known in North America only from

Massachusetts.

Porina aff. *chlorotica*

This is a marine or maritime species found so far only in British Columbia and Alaska. I had originally included the western population in *P. chlorotica* but the broader spores and longer microconidia suggest it should be recognized as a separate species.

Porina heterospora (Fink *in* Hedrick) R. C. Harris stat. nov.

Porina nucula var. *heterospora* Fink *in* Hedrick, Mycologia 25: 308. 1933. Holotype: Florida, *Calkins* (MICH, hb. Fink 15,512).

Although clearly related to *P. nucula*, the spores are many times longer and differently shaped. Swinscow's (1962) description of *P. nucula* seems to be based, at least in part, on specimens of this species. *Porina heterospora* is common in the southern part of the Coastal Plain.

Porina lectissima (Fr.) Zahlbr.

in Engler & Prantl, Natürl. Pflanzenfam. 1(1*): 66. 1903. *Segestria lectissima* Fr., Syst. Orb. Veget. 287. 1825. Type collection not seen.

This species is recognized by its reddish ascocarp, 4-celled spores and saxicolous habitat. The only verified specimen from North America is from New Hampshire.

Porina aff. *lectissima*

Just as in *P. chlorotica*, the western population seems sufficiently different from eastern North American and European material to warrant recognition. The spores are smaller and the microconidia narrower. It is represented by a single specimen from California.

Porina leptalea (Dur. & Mont.) A. L. Sm.

Monogr. Brit. Lich. 2: 333. 1911. Biatora leptalea Dur. & Mont., in Dur., Fl. d'Alger., Crypt. 1: 268. 1846-9. Type collection not seen.

Porina leptalea is related to P. lectissima but has smaller spores and grows on bark. It is distinguished from P. microspora mainly by its microconidia. New to North America, it is so far known only from Florida.

Porina mamillosa (Th. Fr.) Vain.

Acta Soc. Fauna Fl. Fenn. 49: 176. 1922. Segestria mamillosa Th. Fr., Lich. Arctoi 262. 1860.

This species is readily distinguished by its substrate, 4-celled spores and purplish-red involucrellum. It has been reported by Anderson (1967) from alpine areas of Colorado.

Porina microspora (Fink in Hedrick) R. C. Harris stat. nov.

Porina olivacea var. microspora Fink in Hedrick, Mycologia 25: 308. 1933. Holotype: New Hampshire, Chocorua, Lonely Lake, VIII.1918 Farlow (MICH, hb. Fink 11,559). Isotypes in FH, FH-RIDD and MICH.

Fink, failing to notice the reddish tints in the involucrellum, thought his species to be a variety of P. olivacea. It is questionably distinct from P. leptalea which has shorter microconidia and brighter reddish ascocarps. In other genera with which I am better acquainted, this sort of difference in the microconidia is often significant, thus

I am recognizing the species, at least until I have had more experience with the genus Porina. Porina microspora is known only from the type collection.

Porina nitidula Müll. Arg.

Flora 66: 336. 1883. Type collection not seen.

See Santesson (1952) for description and distingushing characters. Porina nitidula is new to North America and was collected in Dade County, Florida by Roland Thaxter.

Porina nucula Ach.

Syn. Lich. 112. 1814. Lectotype: Africa, Guinea (H-ACH).

I am indebted to Henry Imshaug for a preparation from the Acharian specimen and to Mason Hale for a photograph of it. Porina nucula has not been generally correctly interpreted. A number of closely related species have the same thallus and ascocarp type and specific identification depends on spore characters. The thallus is generally warted or rugose and contains numerous colorless crystals; the upper part of the ascocarp is yellowish to reddish, occasionally almost black around the ostiole, and the involucrellum also contains numerous crystals. Porina nucula is distinguished by its narrowly elliptic, 8-celled spores which are 10 µ or more in width. It is relatively rare in North America, known from Florida and South Carolina. I have also verified a specimen from the West Indies (St. Thomas). Brodo's (1968) report is all Porina sp. 4.

Porina aff. nucula

This taxon differs from P. nucula by its consistently narrower spores. Further study is needed to determine at what taxonomic rank it would be best recognized. It is rather common in the southern part of the Coastal Plain.

Porina octomera (Müll. Arg.) Schill.

Hedwigia 67: 274. 1927. Phylloporina octomera Müll. Arg., Flora 73: 198. 1890. Type collection not seen.

See Santesson (1952) for description and distinguishing characters. Porina octomera is new to North America. It has only been collected once in Dade County, Florida by Thaxter.

Porina rhaphidosperma Müll. Arg.

Hedwigia 34: 35. 1895. Type collection: Massachusetts, on hemlock, Willey. Isotypes in FH-TUCK 3988 and US.

This species is immediately recognizable by its filiform spores. For a discussion of the relationship of this species with the P. cestrensis-complex, see under that species. Apparently not common, verified specimens come from Florida, Kentucky and Massachusetts.

Porina subpungens Malme

Ark. Bot. 23A(1): 17. 1929. Isosyntype: Paraguay, Colonia Risso, 16.X.1893 Malme (MSC).

The identification of P. subpungens from Florida is somewhat tentative since the spores in the isosyntype are slightly broader, but the specimens are otherwise identical. The shiny thallus, black hypothallus and relatively broad spores characterize the species. Porina subpungens has not previously been reported from North America.

Porina cfr. tetracerae (Afz. ex Ach.) Müll. Arg.

Bot. Jahrb. Syst. 6: 401. 1885. Verrucaria tetracerae Afz. ex Ach., Meth. Lich. 121. 1803. Lectotype: Africa, Sierra Leone, ad corticem Tetracerae, Afzelius (H-ACH).

Tentative recognition of this species in North America is based on a preparation from the Acharian specimen by Dr. Imshaug and on Malme's (1929) discussion of its relationship to P. subpungens, from which it differs by its narrower spores. I have examined several specimens from southern Florida and one from Puerto Rico.

Porina thaxteri Sant.

Symb. Bot. Upsal. 12(1): 218. 1952. Type collection not seen.

See Santesson (1952) for description and distinguishing characters. ɔrina thaxteri was described from Florida.

ːina sp. 1

Unique among North American Porinas due to the green or blue-green ɔr of the ascocarp. It has been collected in two localities in hern Florida.

a sp. 2

This species is related to P. lectissima by the color of its ascocarps and saxicolous habitat. It differs in having larger, multiseptate spores. It is known from a single collection by Tuckermann from the White Mountains of New Hampshire.

Porina sp. 3

One of two isidiate species in North America, it seems from Malme's (1929) description closely related to _P. conspersa_ Malme, differing by 8-celled, slightly smaller spores. It has been found several times in southern Florida.

Porina sp. 4

The thallus is often so densely isidiate as to appear granulose, which along with the palid ascocarps and large spores make this species unique. It seems to have the same type of thallus as _P. coralloidea_ James but differs in ascocarp color and spores. It has been found only on Long Island, New York, and was reported by Brodo (1968) as _P. nucula_.

Porina sp. 5

The spores of this species closely resemble those of _P. cestrensis_, but it differs from that species in its reddish ascocarps (orange-yellow in section). It is known from a single collection by Calkins in Tennessee.

Porina sp. 6

Very similar to _P. nucula_ externally, but it differs in having larger, more pointed spores. It occurs rarely in central Florida.

Porina sp. 7, sp. 8 and sp. 9

These three taxa are all related to _P. guentheri_ (Flot.) Zahlbr. The spores of _P. guentheri_ are 8-celled while the North American material is variable with some spores 8-celled but ranging up to 12-14-celled. They show the same sort of variation treated by Swinscow (1963) as varieties of _P. guentheri_ and, perhaps, should be treated as such. All are known from only one or two collections from New England.

2. TRICHOTHELIUM Müll. Arg.

Bot. Jahrb. Syst. 6: 418. 1885. Holotype: _Trichothelium epiphyllum_ Müll. Arg.

For additional synonymy and description see Santesson (1952). The asci of both _T. epiphyllum_ and _T. horridulum_ have chitinoid rings in the tip closely linking the genus with _Porina_.

Trichothelium horridulum (Müll. Arg.) Sant.

Symb. Bot. Upsal. 12(1): 278. 1952. _Stereochlamys horridula_ Müll. Arg., Flora 68: 344. 1885. Type collection not seen.

See Santesson (1952) for description and distinguishing characters. Previously known only from Brazil, it was collected by Thaxter in Marion County, Florida.

C. TRYPETHELIACEAE Eschw.

See pages 148-149 for synonymy and diagnosis.

1. ASTROTHELIUM Eschw.

Syst. Lich. 18. 1824. Lectotype (Massalongo, 1860): A. conicum Eschw.

≡Heufleria Trev., Spighe e Paglie 19. 1853. Holotype: A. conicum Eschw.

The genus Astrothelium was based on two syntypes, A. conicum and A. isabellinum. Trevisan (1853) created a new genus Heufleria with only a single species, Astrothelium conicum, but apparently made no mention of A. isabellinum. The present day rules of nomenclature recommend that the remaining species, A. isabellinum, should be the lectotype of Astrothelium. However, Massalongo in 1860 was under no such constraints and his explicit lectotypification of Astrothelium with A. conicum has priority as far as I know. Nor, since Trevisan did not mention A. isabellinum, does his creation of Heufleria constitute a schizotype (Korf & Rogers, 1967). In 1973 Imshaug was unable to locate either of the type specimens involved although others of Eschweiler's types were found. Thus the application of the names is still somewhat uncertain and it may eventually be necessary to designate neotypes for them.

Astrothelium differs from Trypethelium in having a multichambered ascocarp with a single common ostiole. In the Pyrenulaceae this type of ascocarp apparently results from the fusion of several ascocarps. It is possible that in Astrothelium a compound ascocarp results from invaginations of the wall within a single ascocarp. The ascocarps of Trypethelium ochroleucum are often found partially divided into chambers in a manner suggestive of Astrothelium. Also it seems to me that various species of Astrothelium are more closely related to species of Trypethelium than to each other. This suggests that the two genera could be merged, however, further study is necessary before any final decision.

The three species of Astrothelium occurring in North America are closely related and have the stromata pigmented orange outside, at least at the tip. Thin layer chromatography has shown that the major pigment responsible is parietin. The species in this group are separated by spore size and presence or absence of lichexanthone. The genus is not included in Hale & Culberson (1970) but A. ochrothelizum was reported by Herre (1942).

1. Thallus UV-, usually greenish or olivaceous, shiny; spores 23-30(-32) x 8-10(-12) µ .... A. cinnamomeum
1. Thallus UV+ yellow (lichexanthone), pale tan, usually pruinose 2

    2. Spores 21-28 x 7-9(-10) µ .... A. ochrothelizum
    2. Spores (26-)28-35(-39) x 10-13 µ .... A. versicolor

Astrothelium cinnamomeum (Eschw.) Müll. Arg.

Flora 68: 270. 1884. Pyrenastrum cinnamomeum Eschw. in Mart., Icon. Pl. Crypt. 18, pl. 9, f. 1. 1828. Holotype: Brazil, prope Caitetė (M).

Astrothelium minus Müll. Arg., Bot. Jahrb. Syst. 6: 382. 1885. Type collection: Cuba, Wright Verr. Cub. 235. Isotypes in FH-TUCK 3982 & US.

Astrothelium minus var. nigratum Müll. Arg., Bot. Jahrb. Syst. 6: 382. 1885. Type collection: Cuba, Wright Verr. Cub. II. 638. Isotype in FH-TUCK 3982.

The small spores and rather shiny thallus lacking lichexanthone characterize the species. I have verified three collections from northern Florida, as well as collections from Brazil, Cuba, French Guiana, Tobago and Trinidad.

Astrothelium ochrothelizum Müll. Arg.

Bot. Jahrb. Syst. 6: 382. 1885. Type collection: Cuba, Wright Verr. Cub. 144. Isotype in FH-TUCK 3982.

Astrothelium conicum var. pallidum Müll. Arg., Bot. Jahrb. Syst. 6: 382. 1885. Lectotype collection: Wright Verr. Cub. 605. Isolectotypes in FH-TUCK 3981 & US.

This species has the smallest spores of those containing lichexanthone. It is represented in North America by three collections made in Florida by Rapp. It also occurs in Cuba and French Guiana.

Astrothelium versicolor Müll. Arg.

Flora 71: 495. 1888. Holotype: Puerto Rico, Sintensis 6 (G).

This species is distinguished from A. ochrothelizum, which also roduces lichexanthone, by its larger spores. It is known to me from lorida and also British Guiana, French Guiana and Puerto Rico.

2. TRYPETHELIUM Spreng.

Anleitung Kenntn. Gewächse 3: 350. 1804. *nom. cons.* (*syn. prius Bathelium* Ach., Meth. Lich. 111. 1803). Holotype: *T. eluteriae* Spreng.

Trypethelium seems to me to be distingushed from *Pseudopyrenula* mainly by thallus characters. *Trypethelium* has a very well developed thallus with a cortex-like upper layer. The thallus of *Pseudopyrenula* lacks any such layer and may possibly be occasionally non-lichenized. Also the ascocarp in *Pseudopyrenula* is flattened or conical and is not immersed in a pseudostroma or in the thallus. Thus I feel a number of species, such as *P. calospora* Müll. Arg. and *P. papulosa* (Nyl.) Müll. Arg., placed in *Pseudopyrenula* on the basis of having scattered ascocarps not aggregated in a pseudostroma should be transferred to *Trypethelium*.

At one time I separated species of *Trypethelium* on the basis of whether they had an inspersed hymenium and lacked crystals in the ascocarp wall or whether they had an uninspersed hymenium and crystals were present in the wall. While most collections belong to one type or the other, I have found a few collections of *T. ochroleucum* which have both an inspersed hymenium and a few crystals in the ascocarp wall. These two types are also found in *T. aeneum*, *T. ochroleucum* and *Trypethelium* sp. 1. In the Pyrenulaceae the presence of oily substances in the hymenium seems to be useful, but in view of the intermediates and the parallel occurence in several species I feel it should not be stressed in these cases in the Trypetheliaceae. I wonder if the oily substances in the hymenium and the crystals in the ascocarp wall might not be different expressions of the same metabolic pathway.

1. Thallus entirely or partly orange pigmented, KOH+ purple; spores 21-28 x 8-9.5 µ .... *T. aeneum*

1. Thallus not orange pigmented, KOH- 2

 2. Pseudostroma pigmented pale yellow to orangish within .. 3

 2. Pseudostroma not pigmented within 4

3. Spores 4-celled, 18-28 x 6-9 µ (Johnson, 1959); pseudostromata irregular, brownish, not constricted at the base, pigment KOH- .... *T. mastoideum*

3. Spores up to 12-celled, 40-50 x 9-12 µ; pseudostromata often concolorous with the thallus (may become brownish or yellowish in age), cushion-shaped and often constricted at the base, pigment KOH+ purple .... *T. eluteriae*

 4. Thallus UV+ yellow (lichexanthone), usually appearing pruinose; ascocarp often incompletely divided into separate chambers (similar to *Astrothelium*); spores 4-celled, 20-25 x 7.5-10 µ .... *T. ochroleucum*

 4. Thallus UV- 5

5. Ascocarps not immersed in thallus or pseudostromata, black with whitish indented area around ostiole; spores 4-celled, 20-26 x 6-8 µ (Johnson, 1959) .... *T. tropicum*

5. Ascocarp immersed in thallus or pseudostromata 6

 6. Spores 4-celled 7

 6. Spores up to 12-celled 8

7. Spores large, 35-43 x 12-15 μ; thallus usually yellowish or yellowish green; cortex-like layer of thallus extending beneath the ascocarp .... *T. floridanum*

7. Spores smaller, 20-27 x (7-)8-10 μ; thallus usually greenish to brownish; cortex-like layer of thallus not extending beneath ascocarp; ascocarp wall often little carbonized .... *Trypethelium* sp. 1

8. Spores up to 12-celled, 38-52 x 7-10 μ (Johnson, 1959); thallus well developed or not, lacking any obvious layer of whitish crystals .... *T. virens*

8. Spores 6-7-celled, 39-45 x 10-12 μ; thallus well developed, with a layer of whitish crystals . *Trypethelium* sp. 2

Trypethelium aeneum (Eschw.) Zahlbr.

in Engler & Prantl, Natürl. Pflanzenfam. 1(1*): 70. 1903.
Verrucaria aenea Eschw. *in* Mart., Icon. Pl. Cryptog. 2: 15, pl. 8, f. 3. 1828. Holotype: Brazil, Cayeté, *Martius* (M).

This species, like *Pyrenula cerina* Eschw. and some species of *Anthracothecium*, produces parietin in the upper layers of the thallus. The thallus may be completely orange but is often greenish with just a few orangish patches. It is not uncommon in Florida and I have also seen specimens from Brazil and Guatemala.

Trypethelium eluteriae Spreng.

Anleitung Kenntn. Gewächse 3: 351. 1804. Type collection not seen.

The pseudostromata filled with anthraquinone crystals (mainly parietin) and the multilocular spores are diagnostic. Trypethelium eluteriae is common in Florida, especially southward, and is less common in Louisiana. I have also examined specimens from Mexico, the West Indies, Brazil, Java and Australia.

Trypethelium floridanum (Zahlbr. ex Choisy) R. C. Harris comb. nov.

Astrothelium floridanum Zahlbr. ex Choisy, Icon. Lich. Univ. pl. 5. 1928. Zahlbr. Lich. Rar. Exs. 241. 1927. nom. nud. Type collection: (Zahlbr. Lich. Rar. 241) Florida, Miami, Plitt. Isotype in MICH.

Although Zahlbruckner never validly published Astrothelium floridanum, I accept Choisy's illustration, which shows ascocarp cross-section, ascus, paraphyses and spores with labels and scale, as valid publication. All of the North American records of Pseudopyrenula pupula are misidentifications and are referable to this species. The ascocarps are usually rather scattered and not aggregated into pseudostromata. The yellowish thallus and white ring around the ostiole characterize the T. annulare group to which T. floridanum belongs, as does the continuation of the cortex-like layer below the ascocarp. Although T. floridanum closely resembles Fée's figure of T. annulare, Müller (1888) reports larger spores (50-70 x 16-25 μ) in Fée's material. Trypethelium floridanum is rather common in Florida and a collection from British Honduras apparently belongs here also.

Trypethelium mastoideum (Ach.) Ach.

Lich. Univers. 307, pl. 4, f. 9. 1810. Bathelium mastoideum Ach., Meth. Lich. 111. 1803. Type collection not seen.

Trypethelium scoria Fée, Essai Crypt. Écorc. Off. 69. 1824. Original material: "in America ad corticem Crotonis Cascarillae (G).

The pseudostromata of T. mastoideum are only slightly raised, brownish outside and pale yellow within. This is one of the most common species of Trypethelium in North America. It ranges from Virginia and Kentucky to Oklahoma and southward to Florida and Texas. Specimens have also been seen from Mexico and Cuba.

Trypethelium ochroleucum (Eschw.) Nyl.

Flora 52: 126. 1869. Verrucaria ochroleuca Eschw. in Mart., Icon. Pl. Cryptog. 2: 16, pl. 8, f. 3-4. 1828. Lectotype: Brazil, Cayeté, Martius (M, with holotype of T. aeneum).

Trypethelium pallescens Fée, Ann. Sci. Nat. 23: 440, pl. 13, f. 3, A-C. 1831. Lectotype (Müll. Arg., 1888): "Surinam ad corticem arboris ignotae" (G). Isolectotype in G.

Trypethelium erubescens Kunze ex Fée, Ann. Sci. Nat. 23: 441, pl. 14, f. 1. 1831. Lectotype: "Surinam ad corticem arboris ignotae" (G, with isolectotype of T. pallescens).

Pseudopyrenula portoricensis Hedrick, Mycologia 22: 248. 1930. Holotype: Puerto Rico, near Mayaguez, Fink 1025 (MICH).

This is the only species of Trypethelium in North America which produces lichexanthone. This very common species ranges from Tennessee to Florida and Texas, also widespread in the West Indies and known to me from Brazil and Paraguay.

Trypethelium virens Tuck. *ex* Michen.

in W. Darl., Fl. Cest. ed. 3. 453. 1853. Type collection not seen.

Trypethelium exocanthum Tuck. *ex* Nyl., Ann. Sci. Nat. Bot., ser. 4, 20: 258. 1863. Holotype: Louisiana, *Hale* (H-NYL 177).

See Harris (1973) for description.

I previously attributed this species to Tuckerman, but Darlington's footnote on page 431 makes it clear that Michener supplied the section on lichens. Also, on rereading, the descriptions seem different in style from Tuckerman's.

Trypethelium virens is common throughout the eastern United States and has not been found elsewhere as yet. In the northernmost part of its range it often produces only pycnidia.

Trypethelium sp. 1

The rather widely scattered, immersed ascocarps and brownish or greenish thallus distinguish this species. Malme distributed material of this species as *T. catervarium* (Fée) Tuck. (Malme Austroam. 30). However, I have examined the original material of *T. catervarium* and it is a depauperate specimen of *Astrothelium variolosum* (Ach.) Müll. Arg. Müller (1888) acknowledged the poor condition of the specimen but chose to use the name anyway. He cited a number of synonyms, but I have not yet had a chance to examine their types. I have seen specimens from Florida, Texas, the West Indies and Brazil.

Trypethelium sp. 2

Superficially this species is similar to *T. annulare* but differs in the spores, the lack of the cortex-like layer below the ascocarp and the presence of a layer of whitish crystals in the thallus. It is known from a single collection in Florida by Rapp.

3. UNDESCRIBED GENUS WITH PARATHELIOID ASCOCARPS

This genus is analogous to *Campylothelium* but with the spores only transversely septate instead of muriform. Parts of the spore wall are IKI+ violet. This reaction is found sporadically in other members of the Trypetheliaceae, especially *Laurera*. The rather large (44-57 x 11-14 μ), 8-celled spores might lead to confusion with *Trypethelium virens*, if the eccentric ostiole is not noticed. I have seen one collection each from Louisiana and North Carolina.

D. FAMILY UNCERTAIN

1. THELOPSIS Nyl.

Mém. Soc. Sci. Nat. Cherbourg 3: 194. 1855. *nom. cons.* (*syn. prius* *Sychnogonia* Körb., Syst. Lich. Germ. 332. 1855.). Holotype: *T. rubella* Nyl.

See Vězda (1968) for descriptions and synonymies. *Thelopsis* is the only North American genus of pyrenolichens with multisporous asci. The key is modified from Vězda (1968).

1. Ascocarp remaining covered by the thallus; spores 2-celled, 12-15 x 5-8 µ .... T. isiaca
1. Ascocarp more or less free from the thallus; spores 4-celled or submuriform 2
   2. Growing on mosses or plant remains; ascocarps black and roughened; spores 4-celled, 11-20 x 4-7 µ .... T. melathelia
   2. Growing on bark; ascocarps reddish 3
3. Spores 4-6-celled, 12-18(-21) x 5-6 µ .... T. rubella
3. Spores submuriform with 3 transverse septa and 1-4 longitudinal septa, 9-14 x 5-7 µ .... T. inordinata

Thelopsis inordinata Nyl.

Flora 50: 9. 1867. Type collection not seen.

This species, recognized by its submuriform spores and reddish ascocarps, was previously known only from the type collection (Vězda, 1968). I have seen one collection each from Tennessee and Louisiana.

Thelopsis isiaca Stizenb.

Ber. Thätigk. St. Gallishen Naturwiss. Ges. 1893-94: 262. 1895. Type collection not seen.

The whitish or slightly yellowish immersed ascocarps distinguish T. isiaca. It is known from California.

Thelopsis melathelia Nyl.

Flora 47: 358. 1864. Type collection not seen.

Thelopsis melathelia is the only species in the genus growing on mosses and detritus. The species has not been previously reported from North America and the single collection by Lowe from Isle Royale, Michigan, is typical of the species.

Thelopsis rubella Nyl.

Mém. Soc. Sci. Nat. Cherbourg 3: 200. 1855. Type collection not seen.

Thelopsis rubella normally has only 4-celled spores. The single North American collection from Texas differs in that many of the spores become 6-celled. However, it is otherwise identical to European collections of *T. rubella*. The species is new to North America.

VII. EXCLUDED TAXA

A. Excluded Generic Names

Celothelium Massal., Atti R. Ist. Venet., ser. 3, 5: 331. 1860.

This genus is treated as a synonym of *Tomasellia* by Zahlbruckner (1921-22). Since I have not been able to examine material of the type species I do not wish to comment on its disposition.

Inoderma (Ach.) S. F. Gray, A Natural Arrang. Brit. Plants 1: 498. 1821.
Verrucaria subg. *Inoderma* Ach., Lich. Univ. 294. 1810.

Although referred in part in Ainsworth (1971) to *Arthopyrenia*, it has been lectotypified by Choisy (1954) with *Verrucaria epigaea* Ach. and therefore is a synonym of *Thrombium*.

Leiophloea (Ach.) S. F. Gray, A Natural Arrang. Brit. Plants 1: 495. 1821.
Verrucaria subg. *Leiophloeia* Ach., Meth. Lich. Suppl. 24. 1803.

As currently lectotypified (Riedl, 1962), *Leiophloea* is a nomenclatural synonym of *Porina* (see discussion, p. 37).

Magmopsis Nyl., Flora 58: 102. 1878.

Although listed by Zahlbruckner (1921-22) as a questionable synonym of *Arthopyrenia*, Nylander related it to the Pyrenopsidaceae in his original description and Willey (1892) transferred the type species (*M. pertenella* Nyl.) to *Pyrenopsis* where Zahlbruckner retained it. I have seen no material.

Mesopyrenia Choisy, Bull. Soc. Bot. France 78: 456. 1931.

There is no indication whether this is an elevation in rank of Arthopyrenia sect. Mesopyrenia Müll. Arg. or whether it is a new genus with a generico-specific description. In either case I am unable to place the name at this time.

Prototylium Choisy, Icon. Lich. Univ., fasc. 2, pl. 25. 1929? (drawn 5 Nov. 1928).

Apparently intended as a genus similar to Pseudopyrenula except that the conidia were ovate rather than rod-like. Since no species were included I am unable to place the genus.

Pseudopyrenia Keissl.

This name is listed in Ainsworth (1971) as a synonym of Arthopyrenia and presumably is a typographic error for Pseudarthopyrenia Keissl. (= Pyrenocollema).

Pyrenillium Clem, Genera of Fungi 41. 1909.

Under the present nomenclatural rules concerning superfluous names (Stafleu et al., 1972), Pyrenillium is a synonym of Porina (see discussion, p. 37).

Syngenosorus Trev., Conspect. Verruc. 15. 1860.

Zahlbruckner lists this genus as a synonym of Tomasellia. There were two species originally included in the genus, but one was with a question mark. The unquestioned species (and logical lectotype), S. arthoniellus (Nyl.) Trev. [Melanotheca arthoniella Nyl.] has muriform spores (Riedl, 1962) and thus cannot be referred to *Tomasellia*.

Trichotrema Clem., Genera of Fungi 41. 1909.

This genus is placed in synonymy with *Pleurotrema* in Zahlbruckner (1921-22). It is unknown to me but would seem to be excluded from my concept of *Pleurotrema* by the long acicular spores and is perhaps better placed in or near *Leptorhaphis*.

B. Excluded Species Names

Arthopyrenia rappii Zahlbr., Ann. Mycol. 33: 34. 1935.

The type specimen was not available.

Leiophloea clypeata Riedl, Sydowia 16: 267. 1963.

The type specimen was not available.

Mycoporellum epistigmellum Nyl. in Hasse, Lich. Calif. ed. 2, Addenda. 1898.

This species is a lichen parasite and synonymous with *Pharcidia dispersa* (Lahm) Wint. according to Keissler (1930).

VIII. DISPOSITION OF THE PYRENOLICHEN NAMES INCLUDED IN HALE AND CULBERSON (1970) ACCORDING TO THE TREATMENT IN THIS WORK

ARTHOPYRENIA

atractospora Zahlbr.	
alba (Schrad.) Zahlbr.	excluded as misidentifications
ambigua Zahlbr.	= Anisomeridium
analepta (Ach.) Mass.	mostly = Arthopyrenia padi
analeptella (Nyl.) Arn.	excluded as misidentifications
bifera Zahlbr.	
cerasi (Schrad.) Mass.	excluded as misidentifications
cinchonae (Ach.) Müll. Arg.	
cinereopruinosa (Schaer.) Massal.	
conformis (Nyl.) Müll. Arg.	= Anisomeridium biforme ?
conoidea (Fr.) Zahlbr.	= Acrocordia
dimidiata Fink	= Anisomeridium carinthiacum
distans (Will.) Zahlbr.	= Anisomeridium
epidermidis (DC.) Mass.	excluded, see Harris (1973)
fallax (Nyl.) Arn.	= Arthopyrenia lapponina
finkii Zahlbr.	= Acrocordia megalospora
gemmata (Ach.) Mass.	excluded as misidentifications
halodytes (Nyl.) Arn.	= Pyrenocollema
hyalospora (Nyl.) Fink	= Plagiocarpa
leucochlora Müll. Arg.	= Anisomeridium
macrocarpa (Körb.) Zahlbr.	excluded as misidentifications

parvula Zahlbr.	= Anisomeridium biforme
pinicola (Hepp) Mass.	= Arthopyrenia cinereopruinosa
prospersella (Nyl.) Zahlbr.	= Pyrenocollema
punctiformis auct.	= Arthopyrenia padi
quinqueseptata (Nyl.) Fink	= Polymeridium
rappi Zahlbr.	?, type not available
rhyponta (Ach.) Mass.	excluded as misidentifications
sanfordensis Zahlbr.	= Anisomeridium
sphaeroides auct.	= Acrocordia cavata
sublitoralis (Leight.) Arn.	= Pyrenocollema halodytes
subpunctiformis Nyl.	= Arthopyrenia atomarioides

MYCOPORELLUM

californicum Zahlbr.	= Tomasellia
difforme (Minks) Fink	?. type not found
hassei Zahlbr.	= Tomasellia lactea
sparsellum (Nyl.) Müll. Arg.	= Tomasellia

PORINA

carpinea (Pers.) Zahlbr.	
cestrensis (Michen.) Müll. Arg.	
chlorotica (Ach.) Müll. Arg.	
cinerea (Pers.) Zahlbr.	excluded as misidentifications
hibernica P. James & Swinsc.	
lectissima (Fr.) Zahlbr.	
mamillosa (Th. Fr.) Vain.	
mastoidea (Ach.) Müll. Arg.	excluded as misidentifications

nucula Ach.	
olivacea (Pers.) A. L. Sm.	excluded as misidentifications
plumbaria (Stizenb.) Hasse	= *Arthopyrenia*
rhaphidosperma Müll. Arg.	
salicina Müll. Arg.	?, type not seen
subcinerea (Nyl.) Zahlbr.	= *Polymeridium*
thaxteri Sant.	
viridiseda (Nyl.) Zahlbr.	= *Strigula*

PSEUDOPYRENULA

pupula (Ach.) Müll. Arg.	N. Amer. records = *Trypethelium floridanum*

PYRENULA

herrei Fink	= *Arthopyrenia plumbaria*

THELOPSIS

isiaca Stizenb.	
subporinella Nyl.	= *T. isiaca*, fid. Vězda (1969)

TRYPETHELIUM

aeneum (Eschw.) Zahlbr.	
catervarium (Fée) Tuck.	N. Amer. records = *Trypethelium* sp.
eluteriae Spreng.	
exocanthum Tuck.	= *T. virens*
mastoideum Ach.	
ochroleucum (Eschw.) Nyl.	
scorites Tuck.	?, type not seen

tropicum (Ach.) Müll. Arg.

virens Tuck. _ex_ Michen.

IX. ALPHABETICAL LIST OF EXSICCATI EXAMINED

Anzi It. 385	Arthopyrenia fraxini
Anzi Lang. 347	Arthopyrenia lapponina
471	Arthopyrenia rhyponta
Anzi Ven. 121	Arthopyrenia rhyponta
129	Arthopyrenia cinereopruinosa
130	Arthopyrenia cerasi
132	Anisomeridium biforme
Arn. 1262	Arthopyrenia cinereopruinosa
1573	Tomasellia arthonioides
Arn. Mon. 420	Arthopyrenia cinereopruinosa
449	" "
Britz. 51	Arthopyrenia cinereopruinosa
185	Arthopyrenia padi
218	" "
385	Arthopyrenia cinereopruinosa
386	" " , A. padi
388	Arthopyrenia padi
Claud. 50	Arthopyrenia lapponina
Cum. I: 180	Arthopyrenia lyrata
249	Mycoglaena quercicola
II: 110	Arthopyrenia lyrata
189	Mycoglaena quercicola
Desm. ser. II. ed. II. 400	Anisomeridium biforme
Erb. II: 120	Arthopyrenia salicis
930	Arthopyrenia lapponina
Fellm. 221	Arthopyrenia lapponina
222	Arthopyrenia fraxini
Fr. 242	Arthopyrenia fraxini
243	Arthopyrenia padi
244	Arthopyrenia lapponina, A. megalospora
274	Acrocordia conoidea
Harm. Loth. 450	Arthopyrenia cerasi

Hepp 105-107	Arthopyrenia cinereopruinosa
450-452	Arthopyrenia lapponina
453	Arthopyrenia fraxini, A. lapponina
455-456	Arthopyrenia cinereopruinosa
457	Arthopyrenia cerasi
458	Strigula affinis
464	Strigula stigmatella
953	Anisomeridium biforme
954	Arthopyrenia antecellens
Kern. 2774	Arthopyrenia padi
3136	Arthopyrenia rhyponta
3534	Arthopyrenia salicis
Krypt. Vind. 68, 68b	Tomasellia arthonioides
180	Strigula stigmatella
268a	Arthopyrenia lapponina
268b	Arthopyrenia fraxini
269	Arthopyrenia cinereopruinosa
375	Anisomeridium biforme
468	Arthopyrenia salicis
468b	Arthopyrenia padi
468c	Arthopyrenia salicis
469, 469b	Pyrenocollema halodytes
861	Mycoglaena myricae
1021	Arthopyrenia rhyponta
1356	Pyrenocollema tichothecioides
1523	Arthopyrenia padi
1646	Mycoglaena meridionalis
1763a, b	Arthopyrenia lapponina
2152	Acrocordia cavata
3141	Strigula phaea
3477	Mycoglaena myricae
Leight. 31	Acrocordia conoidea
100	Anisomeridium biforme
197	Arthopyrenia cinereopruinosa
288	Arthopyrenia salicis
344	" "
Lich. Colo. 67	Arthopyrenia padi
Lojk. Univ. 199	Strigula stigmatella
279	Pyrenocollema epigloea
Magn. 127	Mycoglaena myricae
242	Pyrenocollema halodytes
377	Tomasellia gelatinosa
Malbr. 97	Arthopyrenia lapponina
199	Arthopyrenia cinereopruinosa
250	Tomasellia gelatinosa
397	Acrocordia conoidea

Malbr. 398	Acrocordia cavata
400	Arthopyrenia cerasi
Mass. 43	Mycoglaena meridionalis
106	Arthopyrenia cerasi
127	Arthopyrenia salicis
184	Arthopyrenia fraxini
185-186	Arthopyrenia lapponina
197-200	Arthopyrenia cinereopruinosa
201	" " , A. salicis
202-203	" "
219	Arthopyrenia cerasi
298A, B	Arthopyrenia fraxini
299	" "
350	Strigula affinis
Merr. I: 147	Anisomeridium biforme
156	Tomasellia californica, T. eschweileri
164	Anisomeridium biforme
281	Arthopyrenia fraxini
289	Strigula phaea
II: 5	" "
20	Arthopyrenia fraxini
38	Arthopyrenia lyrata
93	Mycoglaena meridionalis
Mig. 24	Pyrenocollema halodytes
74	" "
100	Mycoglaena myricae
Moug. 364	Arthopyrenia cinereopruinosa, A. lapponina
557	Arthopyrenia rhyponta, Arthopyrenia padi
Norrl. 149	Arthopyrenia salicis
393	Arthopyrenia cerasi
Nyl. Par. 91	Anisomeridium biforme
148	Arthopyrenia lapponina
Nyl. Pyr. 50	Arthopyrenia cerasi
Pišut 77	Arthopyrenia padi
151	Acrocordia conoidea
Rab. 89	Acrocordia cavata
145	Arthopyrenia cerasi
146	Arthopyrenia fraxini
203	Arthopyrenia salicis
390	Arthopyrenia padi
476	" "
483	Anisomeridium biforme
561	Strigula affinis

Rab. 574	Strigula sychnogonioides
579	Strigula stigmatella
598	Acrocordia conoidea
623	Strigula stigmatella
630	Arthopyrenia cinereopruinosa
658	Arthopyrenia fraxini
659	Arthopyrenia cinereopruinosa
704	Tomasellia arthonioides
780	Tomasellia gelatinosa
943	Arthopyrenia salicis
Rel. Hasse 79	Anisomeridium biforme
113	Tomasellia lactea
Rel. Suza 6	Arthopyrenia lapponina
9	Tomasellia arthonioides
Rel. Tuck. 130	Arthopyrenia cinchonae
Samp. 22	Arthopyrenia cerasi
Schaer. 287	Arthopyrenia cinereopruinosa, A. lapponina
Stenh. 89	Arthopyrenia lapponina
180	Arthopyrenia padi
Suza 122	Tomasellia arthonioides
Trev. 29	Arthopyrenia cinereopruinosa
41-43	" "
54	Tomasellia gelatinosa
Vězda Bohem. 62	Acrocordia conoidea
Vězda Sel. 130	Pyrenocollema halodytes
577	Strigula sychnogonioides
1229	Acrocordia cavata
Zahl. 190	Anisomeridium biforme
241	Trypethelium floridanum
Zw. 815	Tomasellia arthonioides
1197	Mycoglaena myricae

LITERATURE CITED

X. LITERATURE CITED

Ahmadjian, V. 1958. A guide for the identification of algae occurring as lichen symbionts. Bot. Not. 111: 632-644.

____________. 1967. A guide to the algae occurring as lichen symbionts. Phycologia 6: 127-160.

Ainsworth, G. C. 1971. Ainsworth & Bisby's Dictionary of Fungi. Commonwealth Mycological Institute, Kew. 663 pp.

Anderson, R. A. 1967. Additions to the lichen flora of North America - II. Bryologist 70: 339-343.

Brodo, I. M. 1968. The lichens of Long Island, New York: A vegetational and floristic analysis. New York State Mus. & Sci. Serv. Bull. 410, 330 pp.

Chadefaud, M. 1969. Une interprétation de la paroi des ascospores septées, notamment celles des Aglaospora et des Pleospora. Bull. Soc. Mycol. France 85: 145-157.

____________. 1973. Les asques et la systematique des Ascomycètes. Bull. Soc. Mycol. France 89: 127-170.

Choisy, M. 1954. La nomenclature générique des Endocarpaceae, Lichens Ascomycètes. Bull. Soc. Mycol. France 70: 162-181.

Clements, F. E. 1909. The Genera of Fungi. H. W. Wilson Co., Minneapolis. 227 pp.

Cooke, W. B. & D. L. Hawksworth. 1970. A preliminary list of the families proposed for fungi. Mycol. Papers 121, 86 pp.

Fink, B. 1910. The lichens of Minnesota. Contr. U. S. Natl. Mus. 14(1): 1-269.

Fries, T. 1861. Genera Heterolichenum europaea recognita. Edquist, Upsala. 116 pp.

Hale, M. E. & W. L. Culberson. 1970. A fourth checklist of the lichens of the continental United States and Canada. Bryologist 73: 499-543.

Harris, R. C. 1973. The corticolous pyrenolichens of the Great Lakes region. Michigan Bot. 12: 3-68.

Harris, R. C. 1975. Belonia, Scoliocarpon and Robergea. Contr. Univ. Michigan Herb. 11(2). [in press]

Herre, A. 1942. Some noteworthy lichens from Florida. Bryologist 45: 180.

Janex-Favre, M. C. 1971. Recherches sur l'ontogénie, l'organisation et les asques de quelques Pyrénolichens. Rev. Bryol. Lichénol. 37: 428-649.

Johnson, G. T. 1959. The Trypetheliaceae of Mississippi. Mycologia 51: 741-750.

Keissler, K. 1930. Die Flechtenparasiten. In L. Rabenhorst, Kryptogamen-Flora 8: 1-712.

___________. 1936-1938. Pyrenulaceae bis Mycoporaceae, Coniocarpineae. In L. Rabenhorst, Kryptogamen-Flora. 9(1 Abt., 2 Teil): 1-846.

Korf, R. P. & J. K. Rogers. 1967. A new term, the schizotype, and the concept of implicit typification. Taxon 16: 19-23.

Lanjouw, J. & F. A. Stafleu. 1964. Index Herbariorum. Regnum Vagatabile 31, 251 pp.

Lawrence, G. et al. 1968. Botanico-Periodicum-Huntianum. Hunt Botanical Library, Pittsburgh. 1063 pp.

Lynge, B. 1920-1922. Index specierum et varietatum lichenum quae collectionibus "Lichenes exsiccati" distibutae sunt. Pars II. Nyt Mag. Naturvidensk. 57-60: 1-316.

___________. 1939. Index collectionum "Lichenes exsiccati" Suppl. I. Nyt Mag. Naturvidensk. 79: 233-323.

Magne, F. 1946. Anatomie et morphologie comparées des asques de quelques Lichens. Rev. Bryol. Lichénol. 15: 204-209.

Malme, G. O. 1929. Porinae et Phylloporinae in Itinere Regnelliano primo collectae. Ark. Bot. 23A(1): 1-37.

Massalongo, A. B. 1856. Genera Lichenum aliquot nova. Flora 39: 281-286.

___________. 1860. Esame comparativo di alcune generi di licheni. Atti R. Ist. Venet., Sci. Lett. ed Arti, ser. 3, 5: 247-276, 313-337.

Morgan-Jones, G. 1972. Studies on lichen asci. II. Further examples of the bitunicate type. Lichenologist 5: 275-282.

Morgan-Jones, G. 1973. Endoascosporic cells in three pyrenocarpous lichen genera. Canad. J. Bot. 51: 493-495.

__________, & T. D. V. Swinscow. 1965. On the genus Microglaena Körb. Lichenologist 3: 42-54.

Müller, E. & J. A. von Arx. 1962. Die Gattungen der didymosporen Pyrenomyceten. Beitr. Kryptogamenfl. Schweiz 11(2): 1-922.

Müller, J. 1888. Pyrenocarpeae Feeanae. Mém. Soc. Phys. Genève 30(3): 1-45.

Poelt, J. 1969. Bestimmungschlüssel Europäischer Flechten. Cramer, Lehre. 757 pp.

__________. 1974. Classification. Appendix A, p. 599-632. In Ahmadjian, V. & M. E. Hale, [eds.]. The Lichens. Academic Press, New York & London.

Printz, H. 1940. Trentepohliaceae. Nytt Mag. Naturvidensk. 80: 137-210.

Pyatt, F. B. 1974. Lichen Propagules, p. 117-145. In Ahmadjian, V. & M. E. Hale, [eds.]. The Lichens. Academic Press, New York & London.

Richardson, D. H. S. & G. Morgan-Jones. 1964. Studies on lichen asci. I. The bitunicate type. Lichenologist 3: 72-83.

Riedl, H. 1962. Die Arten der Gattung Mycoporellum Müll. Arg. sensu Zahlbr. Catal., nebst Bemerkungen zum System dothidealer Flechten. Sydowia 15: 257-287.

__________. 1963. Die Arten der Gattung Mycoporellum .... II. Sydowia 16: 215-234.

__________. 1971. Zur Kenntnis von Polyblastiopsis Zahlbr. und Mycoglaena v. Höhn. Oesterr. Bot. Z. 119: 41-67.

Rudolph, E. & R. M. Giesy. 1966. Electron microscope studies of lichen reproductive structures in Physcia aipolia. Mycologia 58: 786-796.

Santesson, J. 1970. Some occurrences of the anthraquinone parietin in lichens. Phytochemistry 9: 1565-1567.

Santesson, R. 1939. Amphibious Pyrenolichens I. Ark. Bot. 29A(10): 1-67.

__________. 1952. Foliicolous lichens I. Symbol. Bot. Upsal. 12(1): 1-590.

Stafleu, F. A. et al. 1972. International Botanical Code of Nomenclature. Regnum Vegetabile 82, 426 pp.

Swinscow, T. D. V. 1962. Pyrenocarpous lichens: 3 The genus Porina in the British Isles. Lichenologist 2: 6-56.

____________. 1963. Pyrenocarpous lichens: 5 A further Porina species. Lichenologist 2: 169-171.

____________. 1965a. Pyrenocarpous lichens: 8 The marine species of Arthopyrenia in the British Isles. Lichenologist 3: 55-64.

____________. 1965b. Pyrenocarpous lichens: 9 Notes on various species. Lichenologist 3: 72-85.

____________. 1966. Lichens with bitunicate asci. Nature 210: 852-853.

____________. 1967a. Pyrenocarpous lichens: 11 A new species of Arthopyrenia. Lichenologist 3: 415-417.

____________. 1967b. Pyrenocarpous lichens: 12 The genus Geisleria Nitschke. Lichenologist 3: 418-422.

____________. 1970. Pyrenocarpous lichens: 14 Arthopyrenia Massal. sect. Acrocordia (Massal.) Müll. Arg. in the British Isles. Lichenologist 4: 218-233.

Trevisan, V. 1853. Caratteri essenziali di didoci nuovi generi di Licheni. Spighe e Paglie, p. 1-20.

____________. 1861. Synopsis generum Trypethelinarum. Flora 44: 17-26.

Vainio, E. 1921. Lichenographia Fennica I. Pyrenolichenes. Acta Soc. Faun. Fl. Fenn. 49(2): 1-274.

Vězda, A. 1961. Der Formenkreis der Arthopyrenia conoidea (Fr.) Zahlbr. in Tschechoslowakei. Čas. Slez. Mus., ser. A, Hist. Nat. 10: 131-138.

____________. 1968. Taxonomische Revision der Gattung Thelopsis Nyl. Folia Geobot. Phytotax. 3: 363-406.

____________. 1970. Neue oder wenig bekannte Flechten in der Tschechoslowakei. I. Folia Geobot. Phytotax. 5: 307-337.

Willey, H. 1892. Enumeration of the Lichens found in New Bedford, Massachusetts and its vicinity from 1862-1892. Anthony & Sons, New Bedford. 39 pp.

Zahlbruckner, A. 1903-1907. Lichenes (Flechten). B. Spezieller Teil. In Engler, A. & K. Prantl. Die Natürlichen Pflanzenfamilien 1(1*): 49-249. Engelmann, Leipzig.

Zahlbruckner, A. 1921-1922. Catalogus Lichenum Universalis. Vol. 1. Gebrüder Borntraeger, Leipzig. 696 pp.

____________. 1926. Lichenes (Flechten). B. Spezieller Teil. In Engler, A. & K. Prantl, Die Natürlichen Pflanzenfamilien, ed. 2, 8: 61-270. Engelmann, Leipzig.

INDEX TO TAXA

XI. INDEX TO TAXA

FIGURES

Figures 1-6. *Arthopyrenia antecellens* (Nyl.) Arn.

England, *Larbalestier 77* (H-NYL 767) [holotype]. 1. Spores. 2. Microconidia. 3. Ascus.*

British Columbia, *Brodo 11603* (CAN). 4. Spores. 5. Cross section of ascocarp. 6. Ascus.

Figures 7-11. *Arthopyrenia atomarioides* Müll. Arg.

Cuba, Wright Verr. Cub. II: 629 (G) [holotype]. 7. Spores. 8. Ascus.

Florida, 1887 *Calkins* (MICH) [isotype of *Verrucaria subpunctiformis* Nyl.]. 9. Spores. 10. Ascus. 11. Cross section of ascocarp.

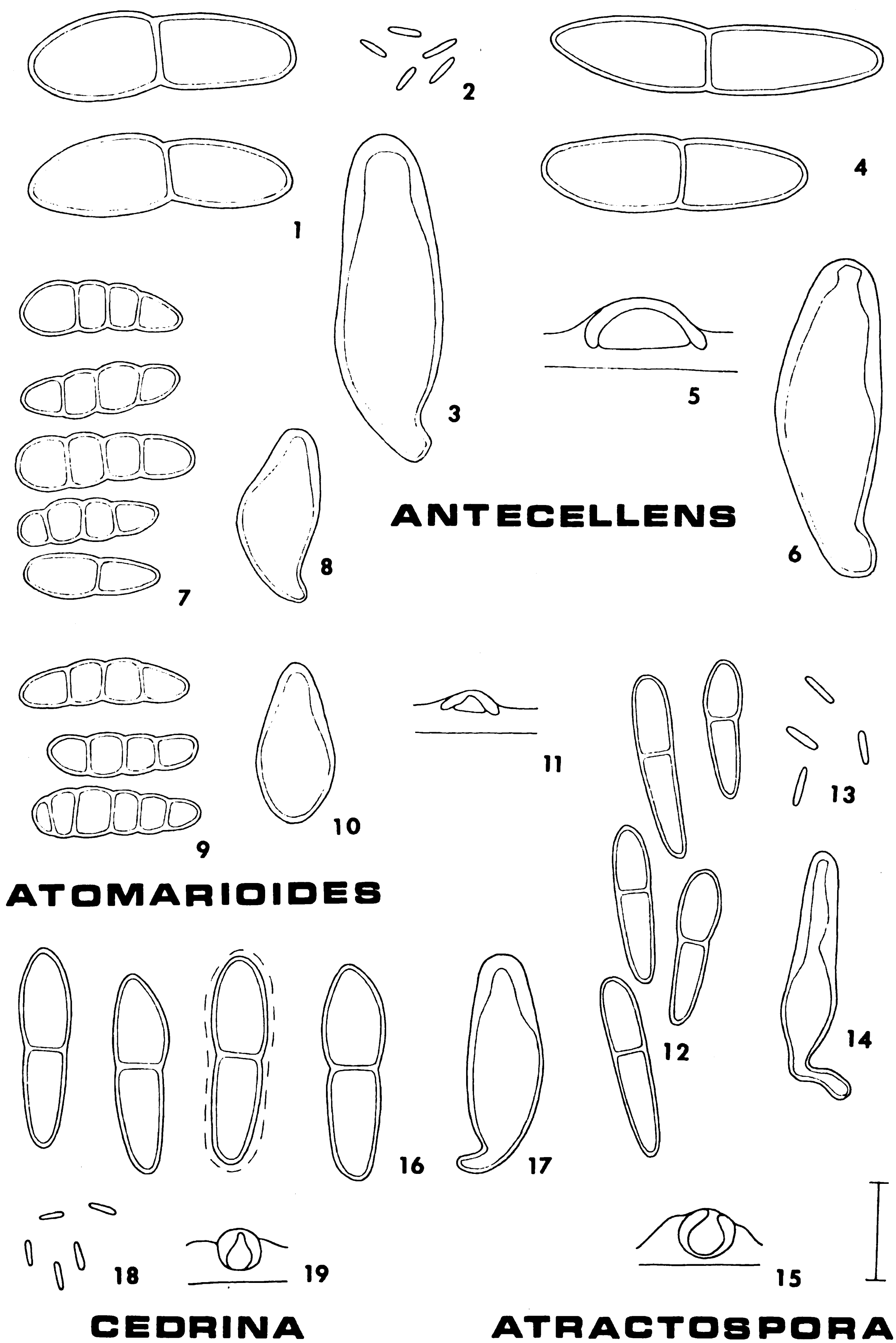
Figures 12-15. *Arthopyrenia atractospora* Zahlbr.

Florida, *Rapp 137* (W) [holotype]. 12. Spores. 13. Microconidia. 14. Ascus. 15. Cross section of ascocarp.

Figures 16-19. *Arthopyrenia cedrina* (Zahlbr.) R. C. Harris

Florida, *Rapp 135* (W) [holotype]. 16. Spores. 17. Ascus. 18. Microconidia. 19. Cross section of ascocarp.

* Scale bar represents 10 µ for spores, 25 µ for the asci and 250 µ for the ascocarp cross section.


1
2
3
4
5
6
7
8
ANTECELLENS
9
10
11
12
13
14
ATOMARIOIDES
15
16
17
18
19
CEDRINA
ATRACTOSPORA

Figures 20-23. Arthopyrenia cerasi (Schrad.) Massal.

France, collector unknown (MSC). 20. Spores. 21. Microconidia. 22. Ascus. 23. Cross section of ascocarp.

Figures 24-30. Arthopyrenia cinchonae (Ach.) Müll. Arg.

French Guiana, Leprieur 215 (P-MONT) [holotype of Verrucaria prostans Mont.]. 24. Spores. 25. Microconidia. 26. Cross section of ascocarp. 27. Ascus.

Florida, Harris 2054 (MSC). 28. Spores.

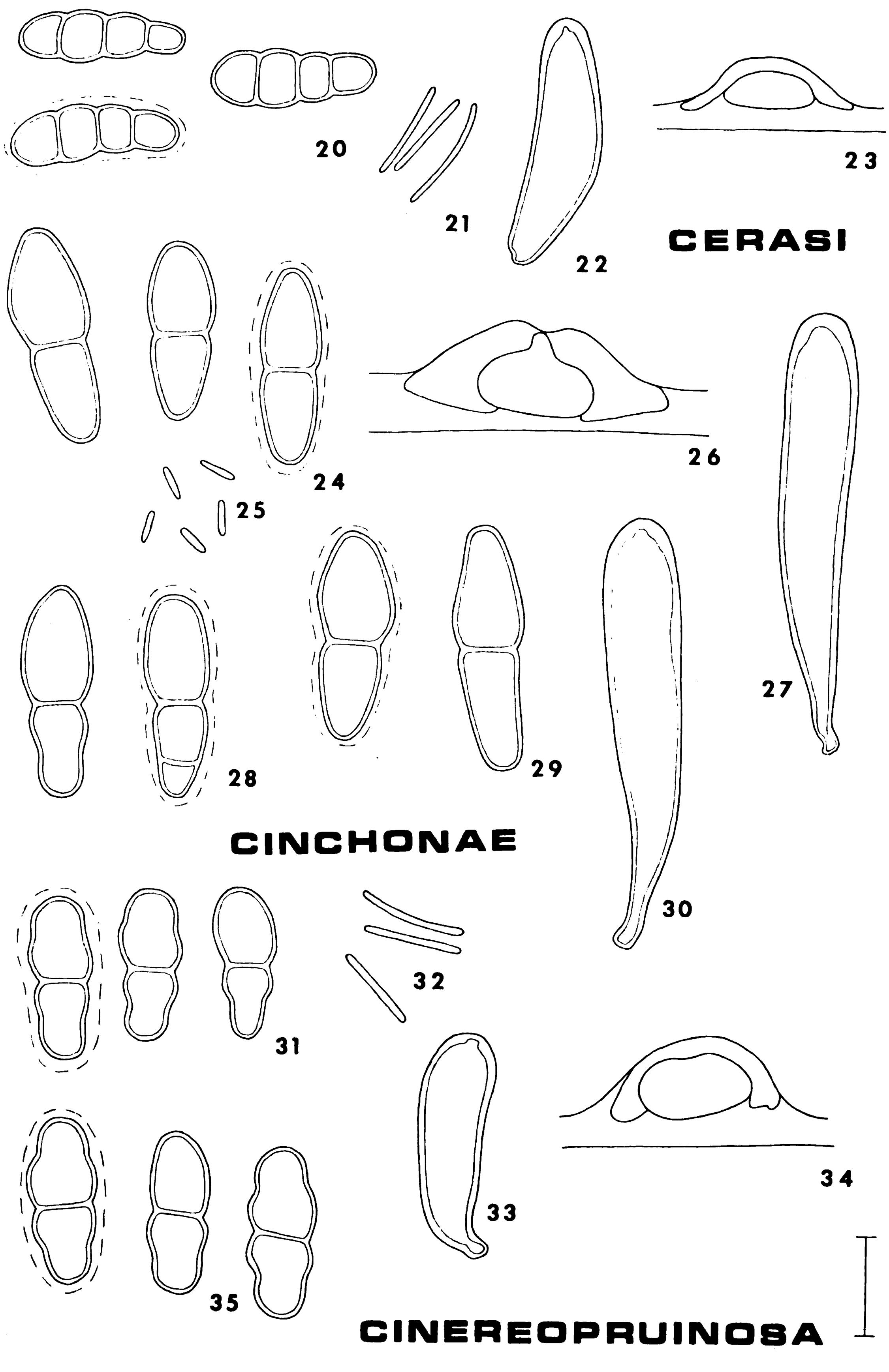
Puerto Rico, Britton et al. 4183 (MICH). 29. Spores.

Florida, Calkins (US). 30. Ascus.

Figures 31-35. Arthopyrenia cinereopruinosa (Schaer.) Massal.

England, Leight. 197 (FH). 31. Spores. 32. Microconidia. 33. Ascus. 34. Cross section of ascocarp.

Newfoundland, Waghorne 367 (US ex MO). 35. Spores.


20
21
22
23
CERASI
24
25
26
27
28
29
30
CINCHONAE
31
32
33
34
35
CINEREOPRUINOSA

Figures 36-39. Arthopyrenia confluens R. C. Harris

"In Cort. Cascarillae ex hb. Hampe, 1877" (G) [holotype of Tomasellia leucostoma Müll. Arg.]. 36. Spores. 37. Microconidia. 38. Cross section of a group of ascocarps. 39. Ascus.

Figures 40-43. Arthopyrenia degelii R. C. Harris

Tennessee, 11.IX.1939 Degelius (US ex MO) [isotype]. 40. Spores. (US) [holotype]. 41. Asci. 42. Spores. 43. Cross section of ascocarp.

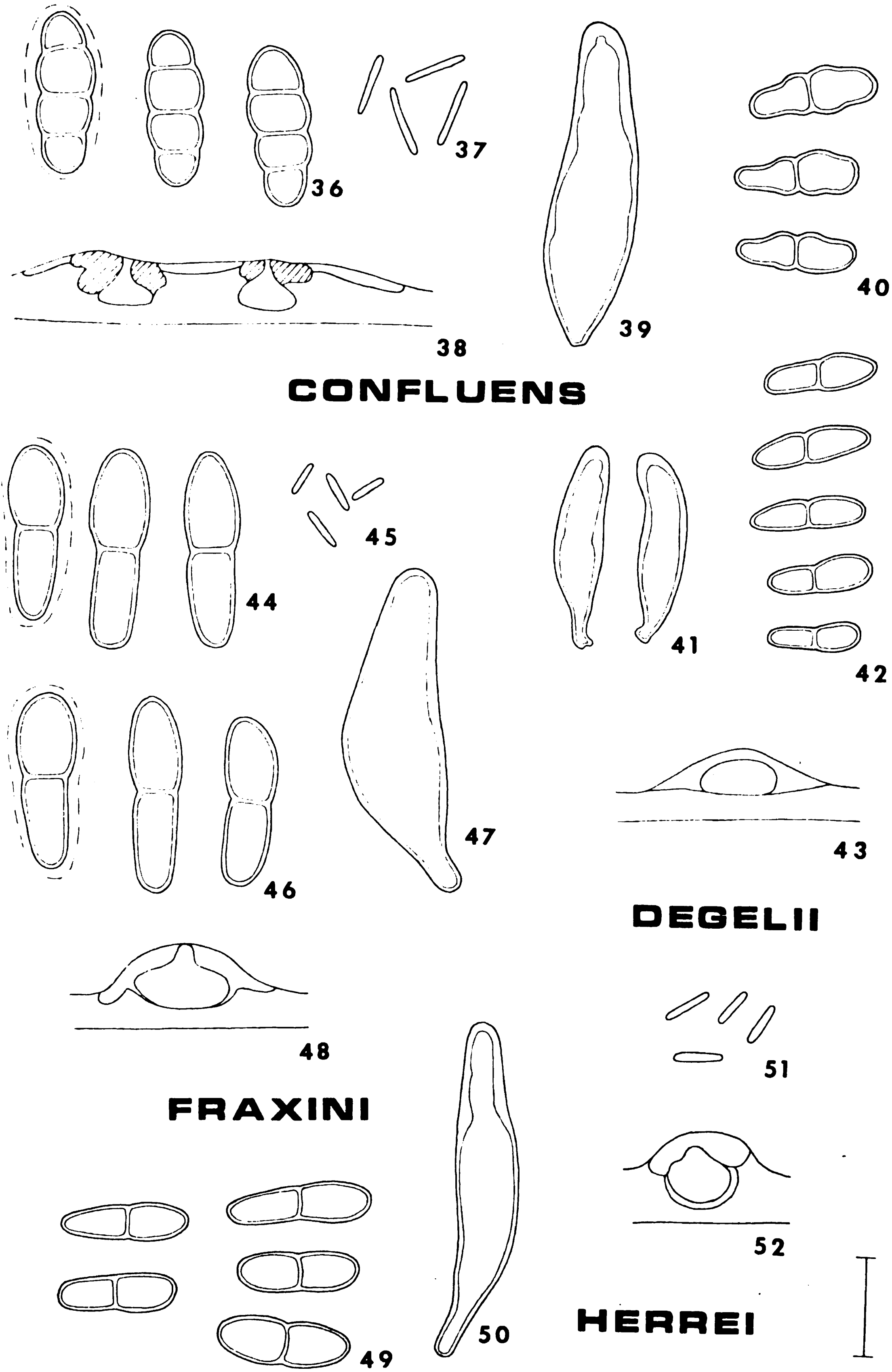
Figures 44-48. Arthopyrenia fraxini Massal.

Italy, ex hb. Massalongo (FH). 44. Spores.

Maine, 20.IV.1910 Merrill (FH). 45. Microconidia. 46. Spores. 47. Ascus. 48. Cross section of ascocarp.

Figures 49-52. Arthopyrenia herrei R. C. Harris

California, Herre 889 (FH) [holotype]. 49. Spores. 50. Ascus. 51. Microconidia. 52. Cross section of ascocarp.


36
37
38
39
40
CONFLUENS
41
42
43
44
45
46
47
DEGELII
48
FRAXINI
49
50
51
52
HERREI

Figures 53-59. Arthopyrenia lapponina Anzi

Italy, Anzi Lang. 347 (FH-TUCK 4084) [isotype]. 53. Spores. 54. Microconidia. 55. Cross section of ascocarp. 56. Ascus.

New Hampshire, 1886 [Farlow] (FH). 57. Spores.

Finland, 1852 Nylander (H-NYL 955) [holotype of Arthopyrenia epidermidis var. fallax Nyl.]. 58. Spores. 59. Ascus.

Figures 60-64. Arthopyrenia megalospora Lönnr.

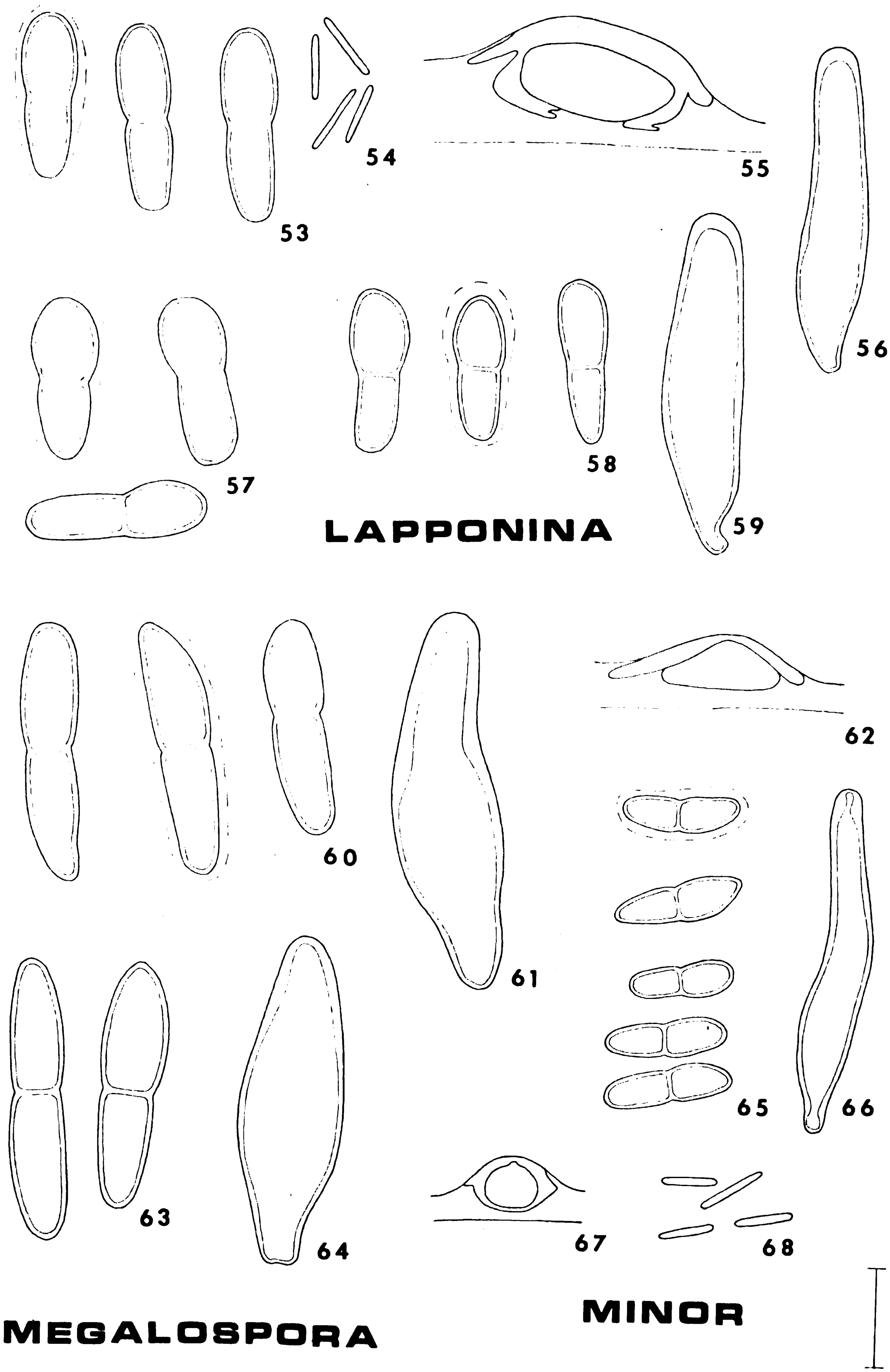
Maine, 20.X.1912 Merrill (FH). 60. Spores. 61. Ascus. 62. Cross section of ascocarp.

Sweden, Fr. 244 (FH-TUCK 4067) [isotype]. 63. Spores. 64. Ascus.

Figures 65-68. Arthopyrenia minor R. C. Harris

Florida, Harris 1545 (MSC) [holotype]. 65. Spores. 66. Ascus. 67. Cross section of ascocarp.

Louisiana, 6.VI.1894 Langlois (US). 68. Microconidia.


54
55
53
56
57
58
59
LAPPONINA
60
61
62
63
64
65
66
67
68
MEGALOSPORA
MINOR

Figures 69-72. Arthopyrenia oblongens Zahlbr. ex R. C. Harris

Florida, IV.1930 Rapp (MICH) [holotype]. 69. Spores. 70. Ascus. 71. Cross section of ascocarp. 72. Microconidia.

Figures 73-79. Arthopyrenia padi Rabenh.

British Columbia, Brodo 12915 (CAN). 73. Ascus. 74. Spores.

Switzerland, Rab. 390 (MICH) [isotype]. 75. Spores. 76. Asci. 77. Cross section of ascocarp. 78. Microconidia.

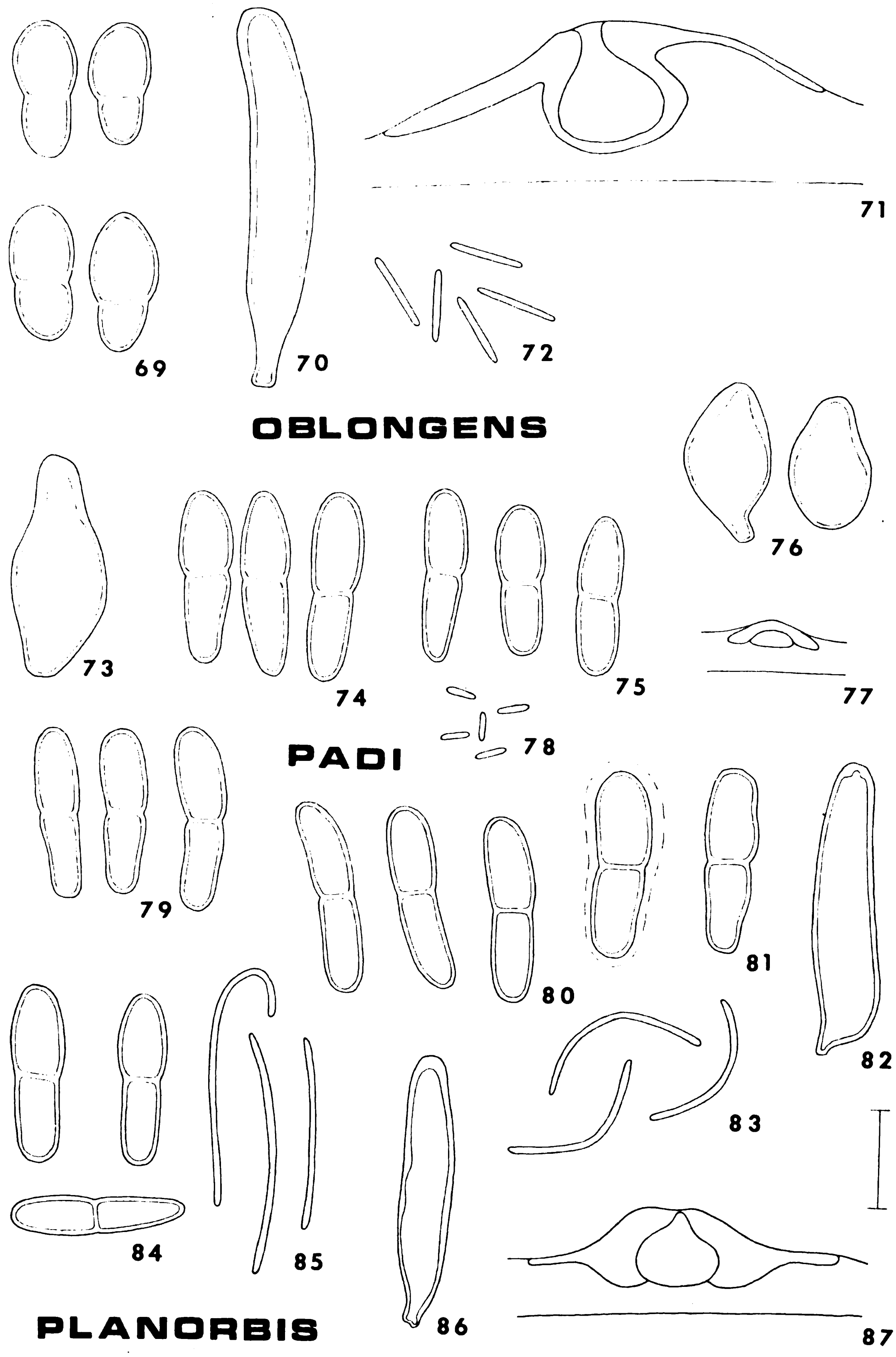
Maine, Plitt 108 (MICH). 79. Spores.

Figures 80-87. Arthopyrenia planorbis (Ach.) Müll. Arg.

"In America ad Crotonis Cascarillae" (H-ACH) [holotype]. 80. Spores.

Florida, Hale 36942 (US). 81. Spores. 82. Ascus. 83. Microconidia.

Cuba, Wright Verr. Cub. 405 (US) [isotype of Arthopyrenia planorbiculata Müll. Arg.]. 84. Spores. 85. Microconidia. 86. Ascus. 87. Cross section of ascocarp.


69
70
71
72
OBLONGENS
73
74
75
76
77
PADI
78
79
80
81
82
83
84
85
86
87
PLANORBIS

Figures 88-92. Arthopyrenia plumbaria (Stizenb. in Hasse) R. C. Harris

California, Herre 493 (FH). 88. Spores. IX.1912 Hasse (FH). 89. Microconidia. 90. Spores. 91. Cross section of ascocarp. 92. Ascus.

Figures 93-96. Arthopyrenia rhyponta (Ach.) Massal.

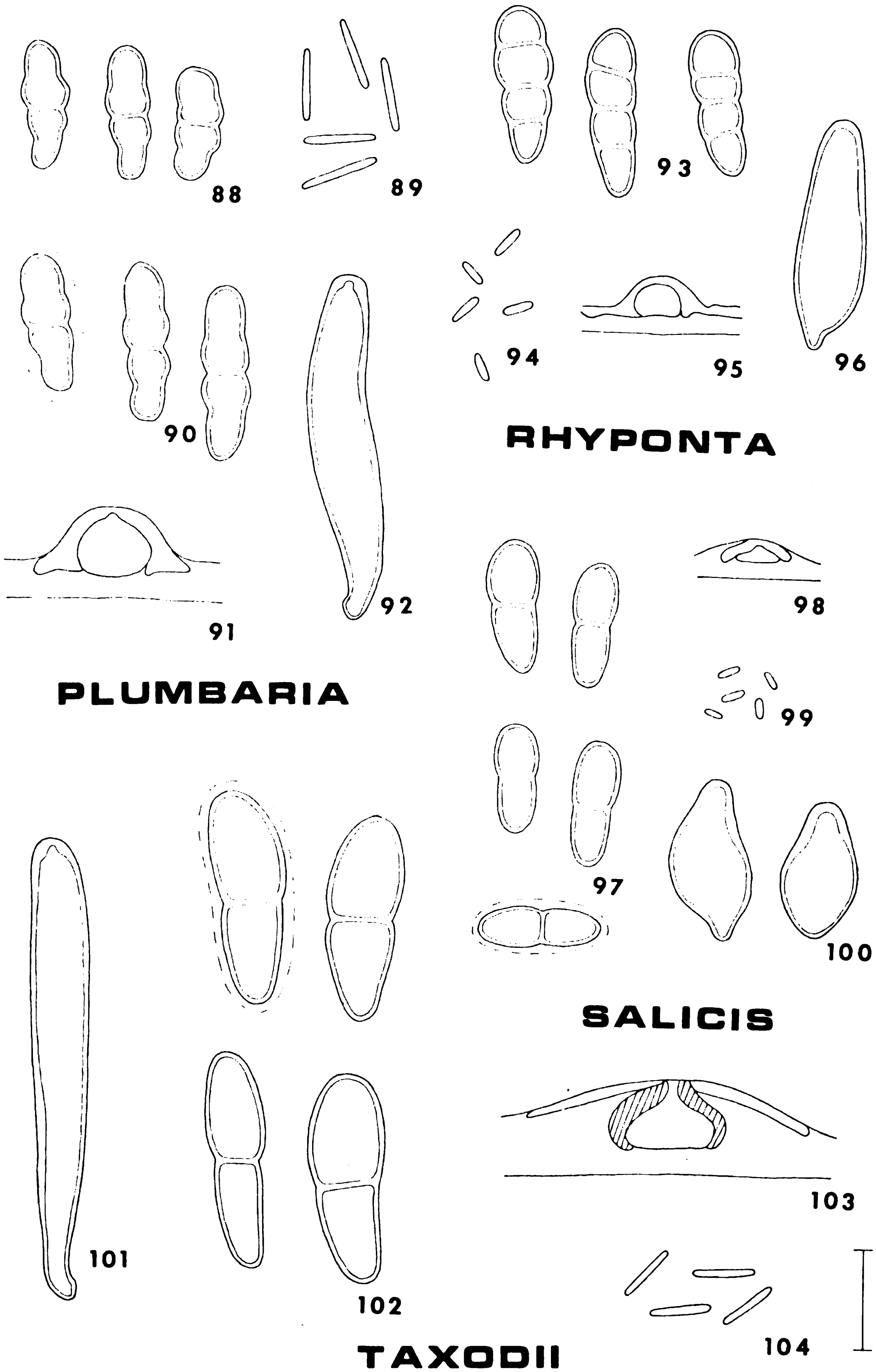
Sweden, collector unknown (BM-ACH 289) [isotype?]. 93. Spores. 94. Microconidia. 95. Cross section of ascocarp. 96. Ascus.

Figures 97-100. Arthopyrenia salicis Massal.

Italy, Mass. 127 (FH-TUCK 4085). 97. Spores. 98. Cross section of ascocarp. 99. Microconidia. 100. Asci.

Figures 101-104. Arthopyrenia taxodii R. C. Harris

Texas, Ravenel 60 (FH-TUCK 4022) [holotype]. 101. Ascus. 102. Spores. 103. Cross section of ascocarp. 104. Microconidia.

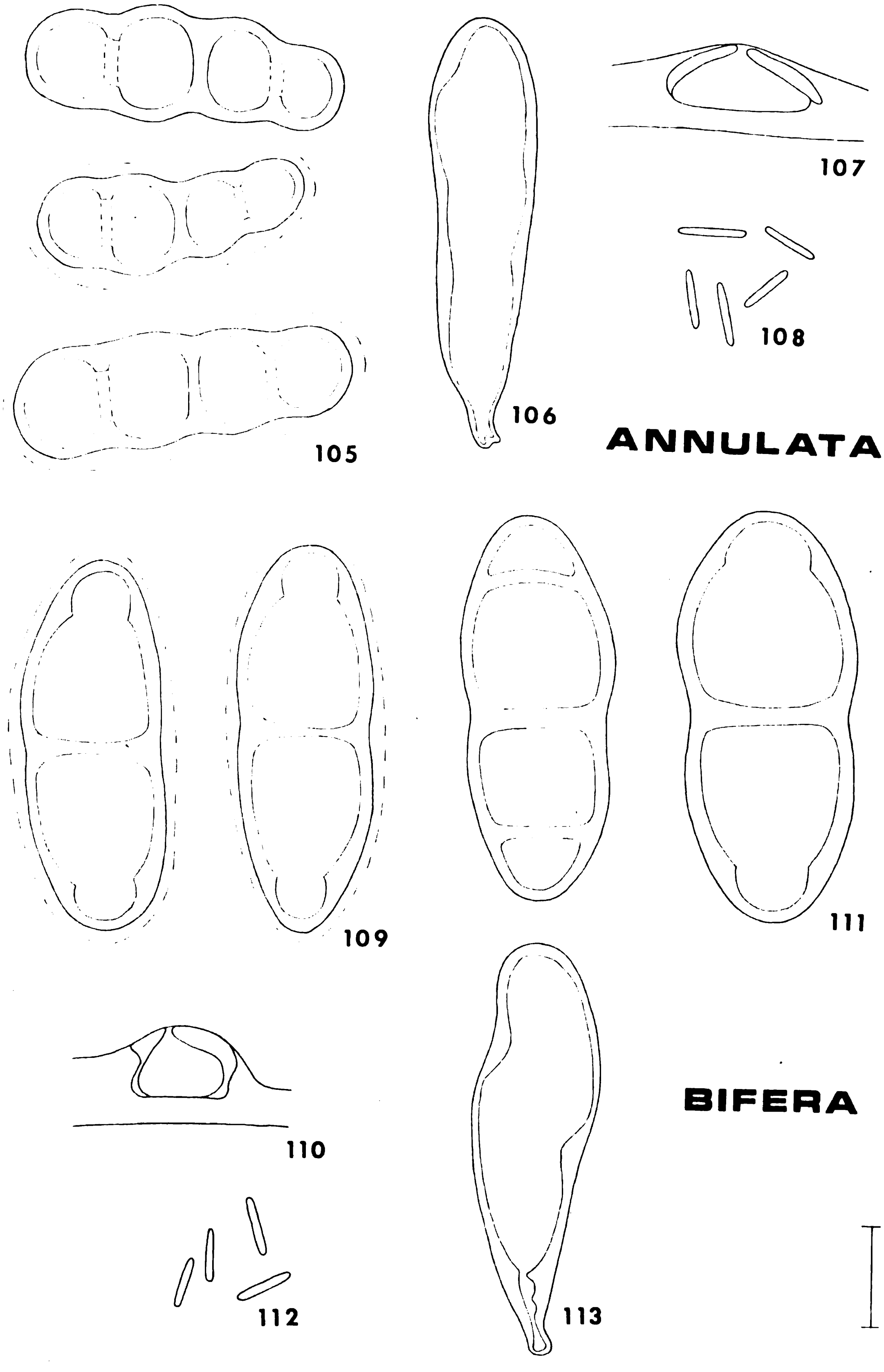

88
89
93
94
95
96
90
92
91
RHYPONTA
PLUMBARIA
98
99
97
100
SALICIS
101
102
103
104
TAXODII

Figures 105-108. Arthopyrenia annulata R. C. Harris

Florida, Britton & Britton 846 (FH-RIDD) [holotype]. 105. Spores. 106. Ascus. 107. Cross section of ascocarp.

Figures 109-113. Arthopyrenia bifera Zahlbr.

Florida, Rapp 80 (W) [holotype]. 109. Spores. 110. Cross section of ascocarp. Harris 1637 (MSC). 111. Spores. 112. Microconidia. 113. Ascus.


105
106
107
108
ANNULATA
109
111
110
BIFERA
112
113

Figures 114-118. Arthopyrenia lyrata R. C. Harris

Florida, Merr. II: 38 (MSC) [holotype]. 114. Microconidia. 115. Ascus. 116. Spores. 117. Cross section of ascocarp.

Louisiana, Tucker 7026 (LSU). 118. Spores.

Figures 119-125. Mycoglaena meridionalis (Zahlbr.) Szat.

Italy, Mass. 43 (FH-TUCK 4084). 119. Spores. 120. Microconidia. 121. Ascus.

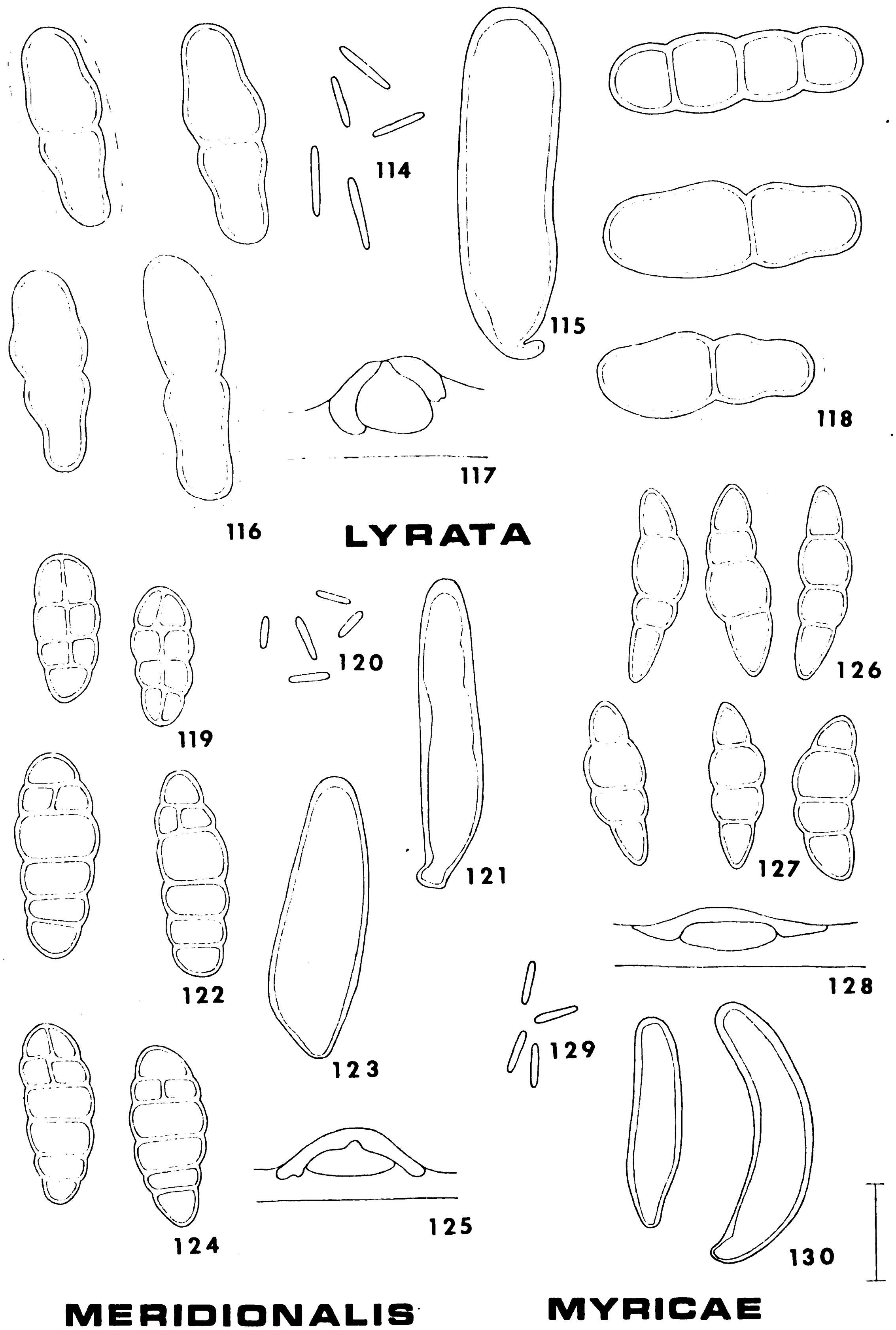
Albania, Latzel 589c (W) [holotype of Arthopyrenia peranomala Zahlbr.]. 122. Spores.

Yugoslavia, Krypt. Vind. 1646 (US) [isotype]. 123. Ascus. 124. Spores. 125. Cross section of ascocarp.

Figures 126-130. Mycoglaena myricae (Nyl.) R. C. Harris

Michigan, Harris 7652 (MSC). 126. Spores.

Finland, 1861 Fellman (H) [holotype of Verrucaria fallacissima Nyl.]. 127. Spores. 128. Cross section of ascocarp. 129. Microconidia. 130. Asci.


114
115
116
117
118
LYRATA
119
120
121
122
123
124
125
126
127
128
129
130
MERIDIONALIS
MYRICAE

Figures 131-134. Mycoglaena quercicola R. C. Harris

Iowa, 1895 Fink (US) [holotype]. 131. Spores. 132. Microconidia. 133. Cross section of ascocarp. 134. Ascus.

Figures 135-137. Mycoglaena wetmorei R. C. Harris

Texas, Wetmore 19648-B (MIN) [holotype]. 135. Spores. 136. Asci. 137. Cross section of ascocarp.

Figures 138-140. Tomasellia americana (Minks ex Willey) R. C. Harris

Massachusetts, Willey 742 (FH-TUCK 3735). 138. Spores. 139. Asci. 140. Cross section of ascocarp.

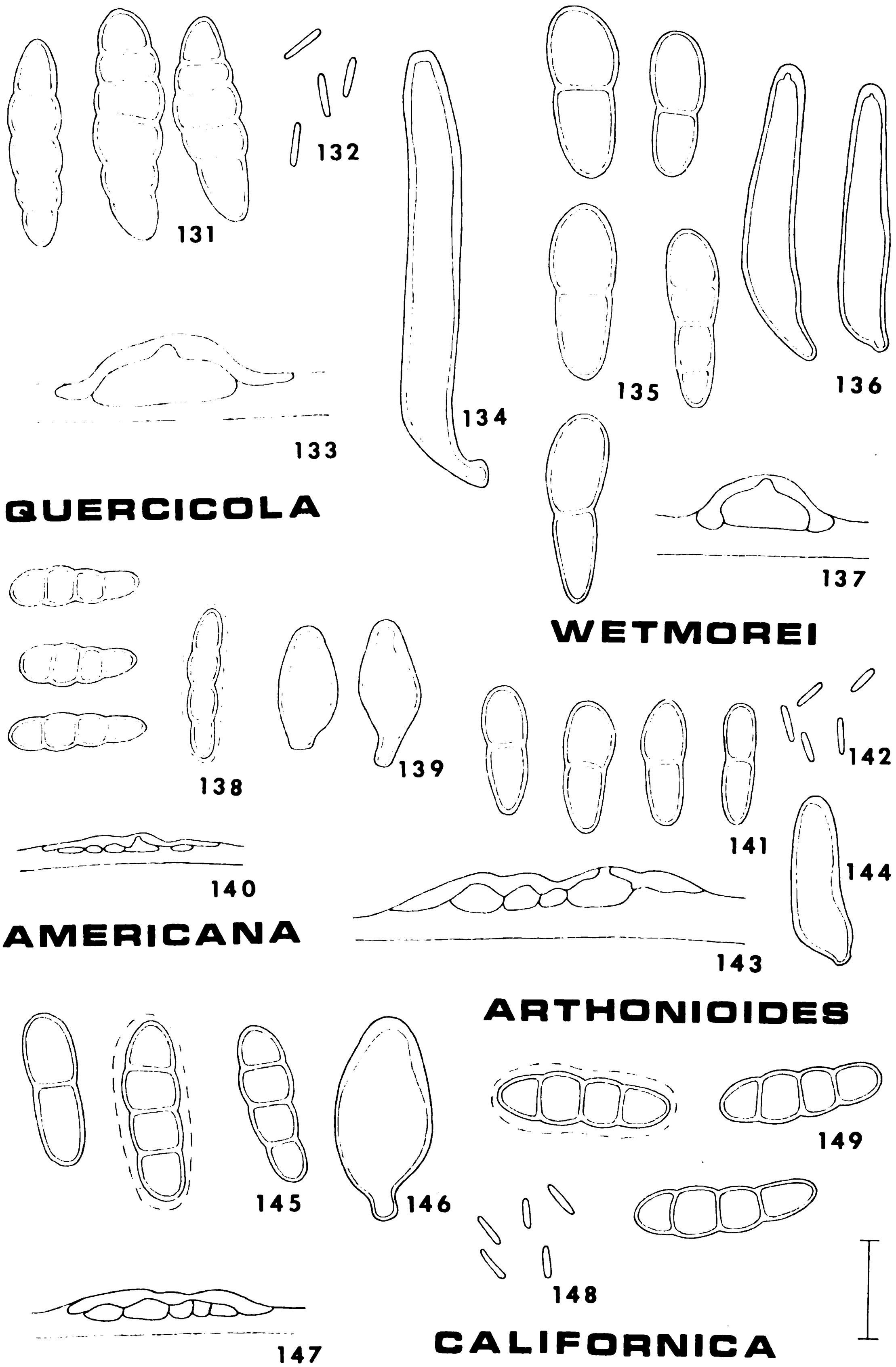
Figures 141-144. Tomasellia arthonioides (Massal.) Massal.

Bulgaria, 29.V.1929 Szatala (US). 141. Spores. 142. Microconidia. 143. Cross section of ascocarp. 144. Ascus.

Figures 145-149. Tomasellia californica (Zahlbr.) R. C. Harris

California, Hasse 1003 (W) [holotype]. 145. Spores. (FH) [isotype]. 146. Ascus. 147. Cross section of ascocarp. 148. Microconidia.

Hawaiian Islands, Heller 2051 (MSC). 149. Spores.



131
132
133
134
135
136
137
QUERCICOLA
WETMOREI
138
139
140
141
142
143
144
AMERICANA
ARTHONIOIDES
145
146
147
148
149
CALIFORNICA

Figures 150-155. Tomasellia eschweileri (Müll. Arg.) R. C. Harris

Brazil, Collector unknown (MSC) [fragment of holotype].

150. Spores. 151. Ascus.

Iowa, VIII.1895 Fink (MICH). 152. Spores.

Florida, Harris 2502-B (MSC). 153. Microconidia. 154. Ascus.

155. Cross section of ascocarp.

Figures 156-159. Tomasellia gelatinosa (Chev.) Zahlbr.

France, Collector unknown (MSC). 156. Spores.

Maine, 15.IV.1910 Merrill (FH). 157. Cross section of ascocarp.

158. Ascus. 159. Spores.

Figures 160-166. Tomasellia lactea (Ach.) R. C. Harris

West Indies, Swartz (UPS) [isotype]. 160. Spores. 161. Ascus.

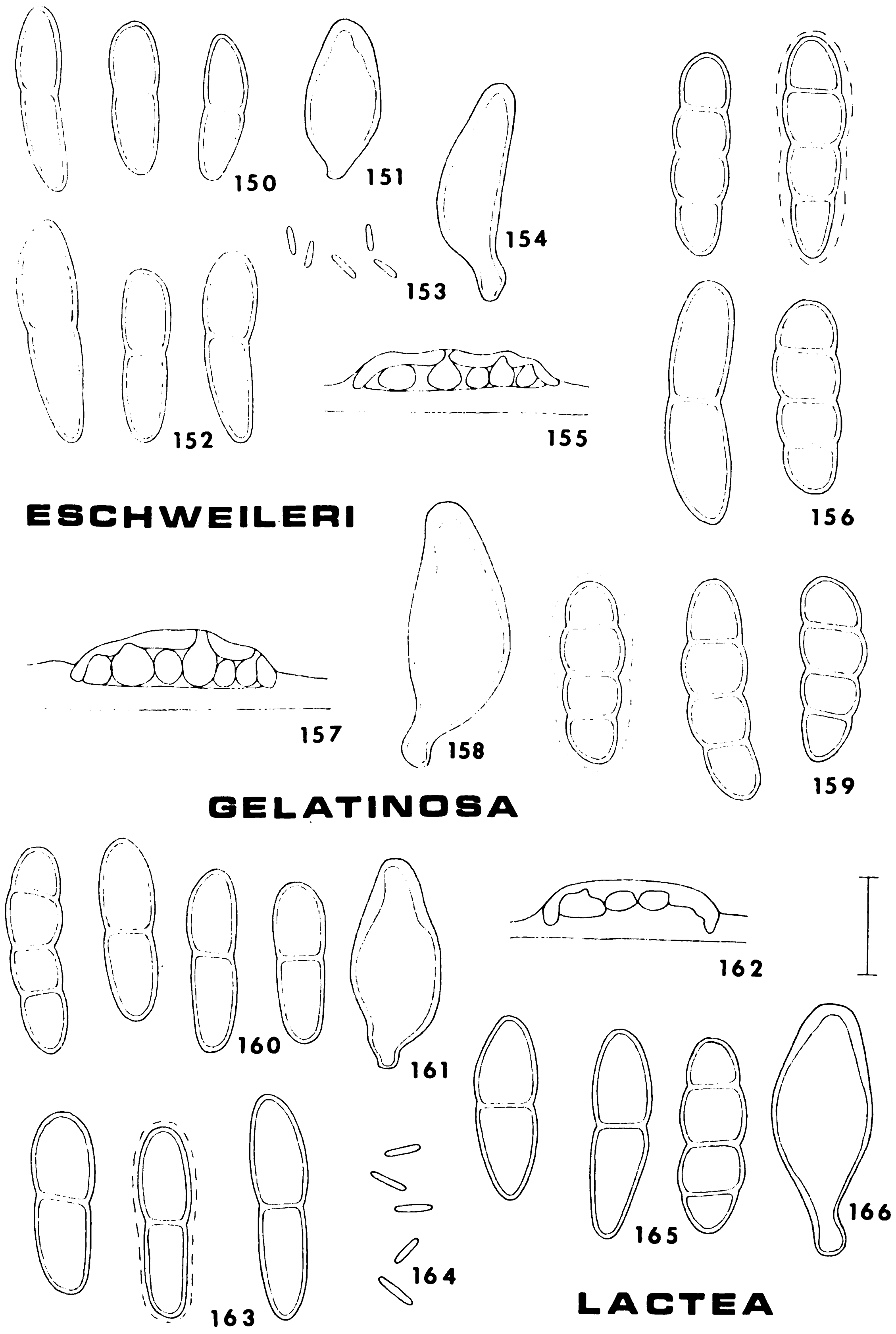
162. Cross section of ascocarp.

California, Hasse 1321 (W) [holotype of Mycoporellum hassei Zahlbr.]. 163. Spores.

Florida, Harris 2916-A (MSC). 164. Microconidia.

Brazil, Glaziou (US) [isotype of Mycoporopsis leucoplaca Müll. Arg.].

165. Spores. 166. Ascus.


150
151
154
153
152
155
156
ESCHWEILERI
157
158
159
GELATINOSA
160
161
162
163
164
165
166
LACTEA

Figures 167-169. Tomasellia macularis (Minks ex Willey) R. C. Harris

Massachusetts, Willey 850c (FH-TUCK 3731). 167. Spores.
168. Cross section of ascocarp. 169. Ascus.

Figures 170-173. Tomasellia sparsella (Nyl.) R. C. Harris

Columbia, Lindig 1863 (H-NYL 4292) [holotype]. 170. Spores.
171. Ascus. 172. Cross section of ascocarp.

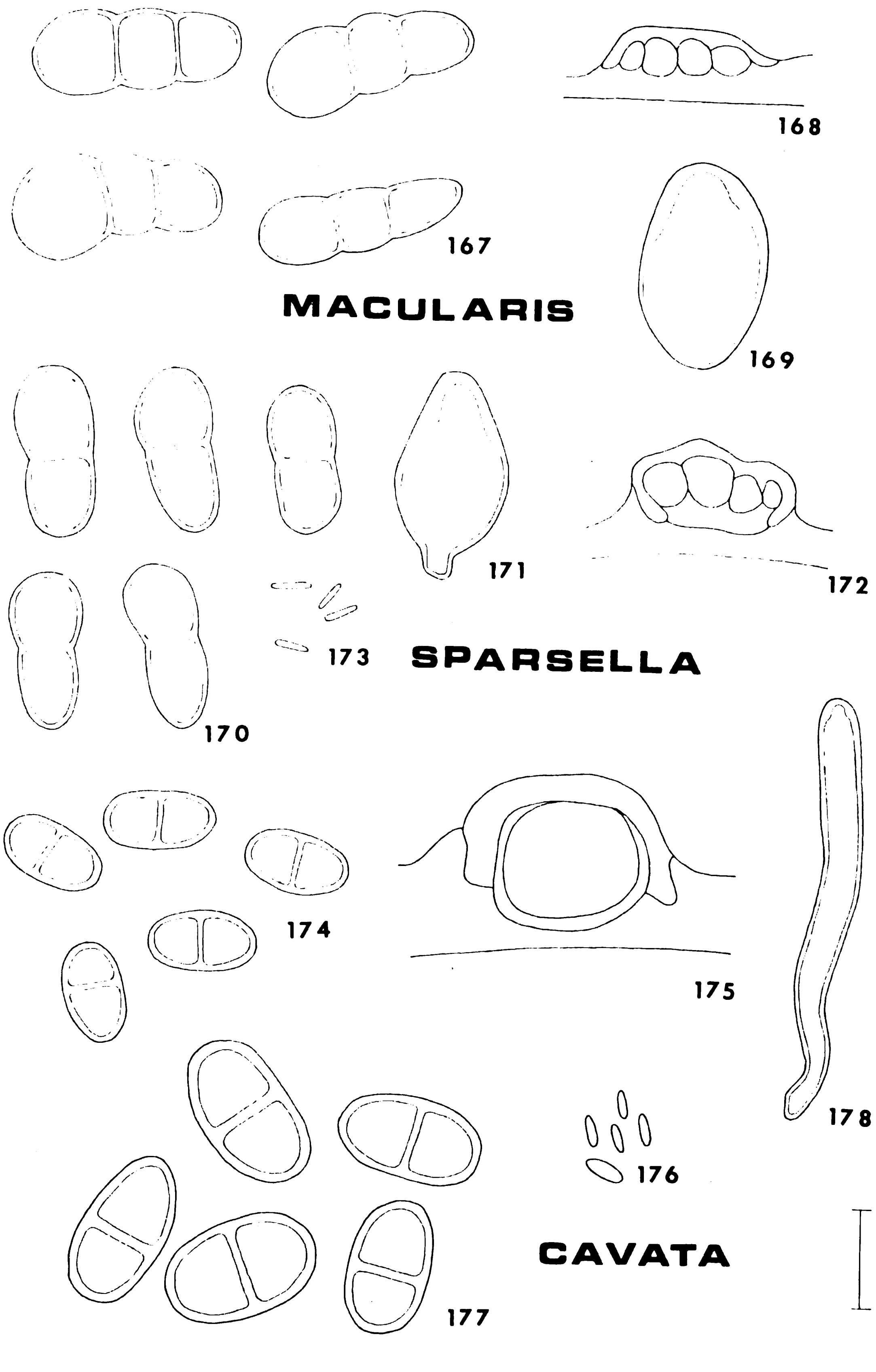
Florida, Harris 2799 (MSC). 173. Microconidia.

Figures 174-178. Acrocordia cavata (Ach.) R. C. Harris in Vězda

Switzerland, [Schleicher?] 442a (H-ACH) [holotype].
174. Spores.

North Carolina, Harris 3193-B (MSC). 175. Cross section of ascocarp. 176. Microconidia. 177. Spores.

Maine, 23.VIII.1911 Merrill (FH). 178. Ascus.

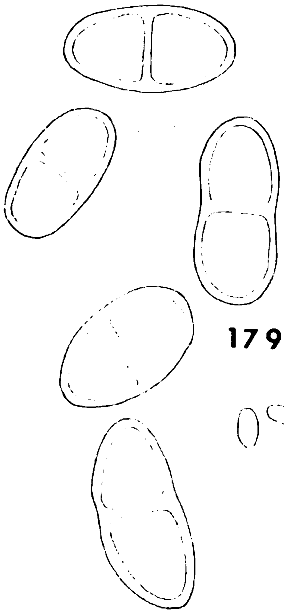

168
167
MACULARIS
169
171
172
173
SPARSELLA
170
174
175
178
176
CAVATA
177

Figures 179-182. Acrocordia conoidea (Fr.) Körb.

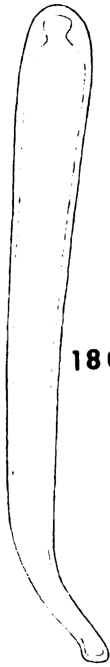
Michigan, Harris 9474 (MICH). 179. Spores. 180. Ascus. 181. Cross section of ascocarp. 182. Microconidia.

Figures 183-186. Acrocordia megalospora (Fink) R. C. Harris

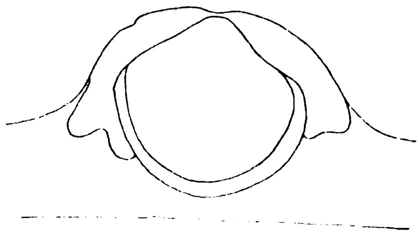
Minnesota, Fink 209 (MIN) [isolectotype]. 183. Spores. 184. Ascus (half normal magnification). 185. Microconidia. 186. Cross section of ascocarp.



179



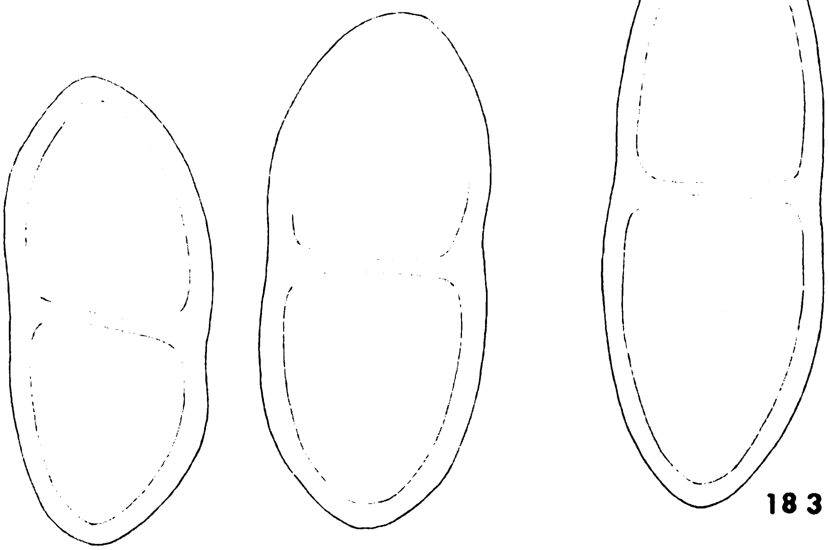
180



181

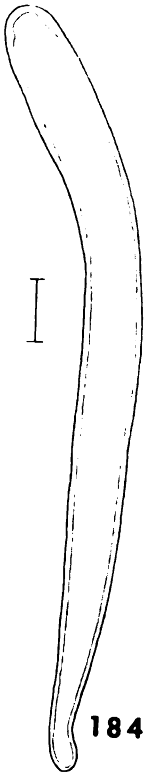
182

CONOIDEA

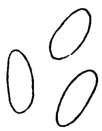


183

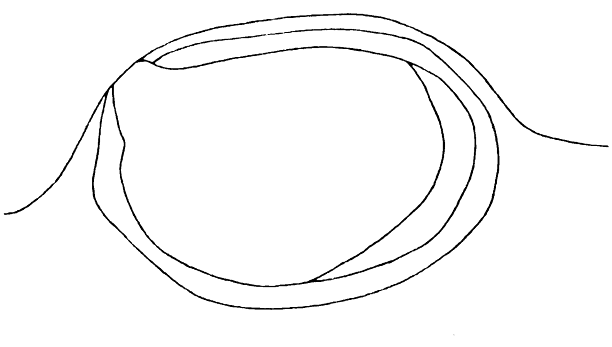
MEGALOSPORA



184



185



186

Figures 187-190. Anisomeridium adnexum (Müll. Arg.) R. C. Harris

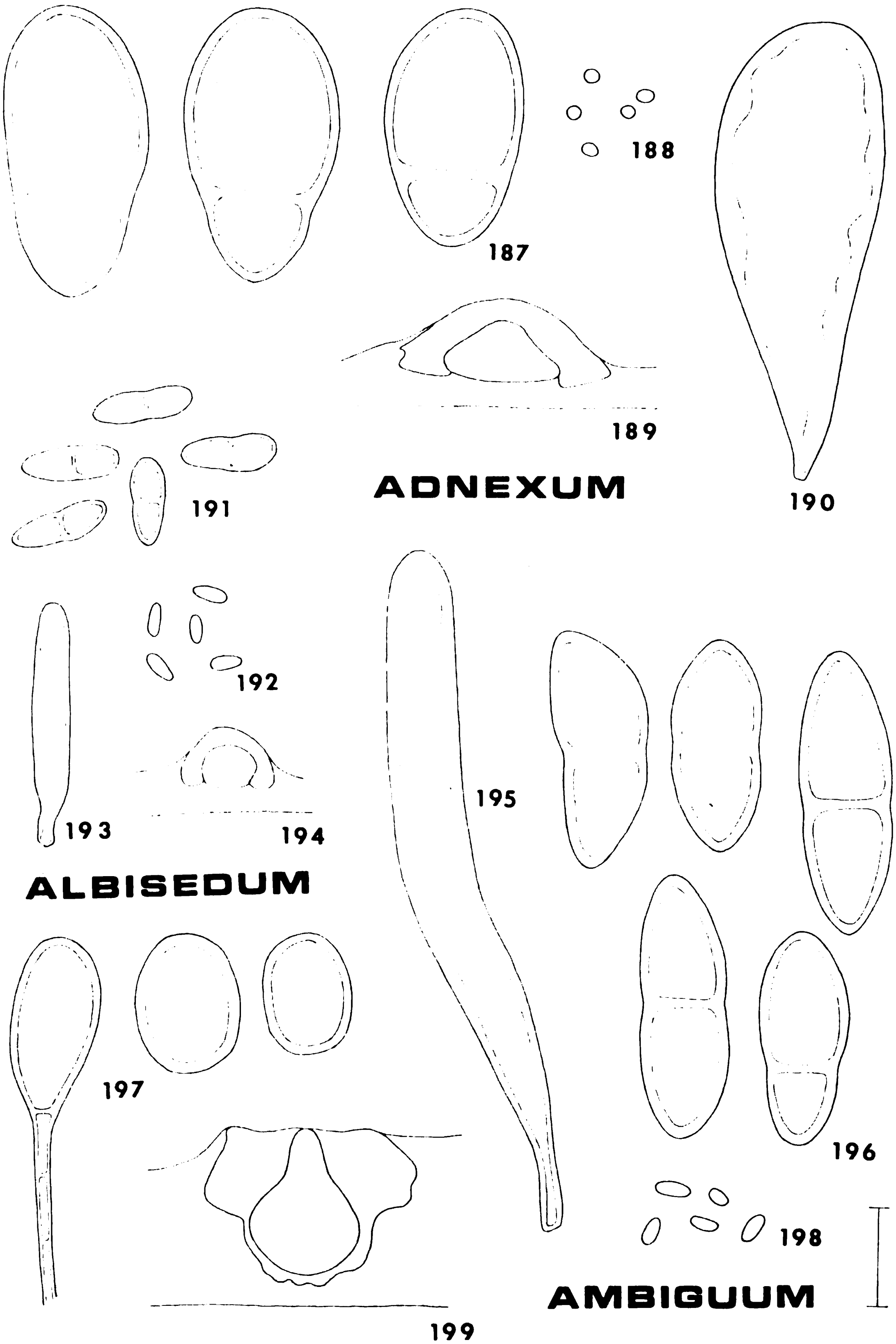
Brazil, Puiggari 240 (G) [lectotype]. 187. Spores. 188. Microconidia. 189. Cross section of ascocarp. 190. Ascus.

Figures 191-194. Anisomeridium albisedum (Nyl.) R. C. Harris

Florida, Calkins (H-NYL 717) [lectotype]. 191. Spores. 192. Microconidia. 193. Ascus. 194. Cross section of ascocarp.

195-199. Anisomeridium ambiguum (Zahlbr.) R. C. Harris

Florida, Rapp 142 (W) [lectotype]. 195. Ascus. 196. Spores. Harris 2200 (MSC). 197. Macroconidia. 198. Microconidia. 199. Cross section of ascocarp.


188
187
189
190
191
ADNEXUM
192
193
194
195
ALBISEDUM
196
197
198
199
AMBIGUUM

Figures 200-207. Anisomeridium biforme (Borr.) R. C. Harris

California, Hasse 759 (FH) [isotype of Arthopyrenia parvula Zahlbr.]. 200. Spores. 201. Microconidia. 202. Ascus.

Massachusetts, 1921 Robbins (FH). 203. Spores. 204. Cross section of ascocarp. 205. Ascus.

British Columbia, Macoun 34 (FH). 206. Macroconidia.

England, Mudd (US). 207. Spores.

Figures 208-212. Anisomeridium carinthiacum (J. Stein.) R. C. Harris

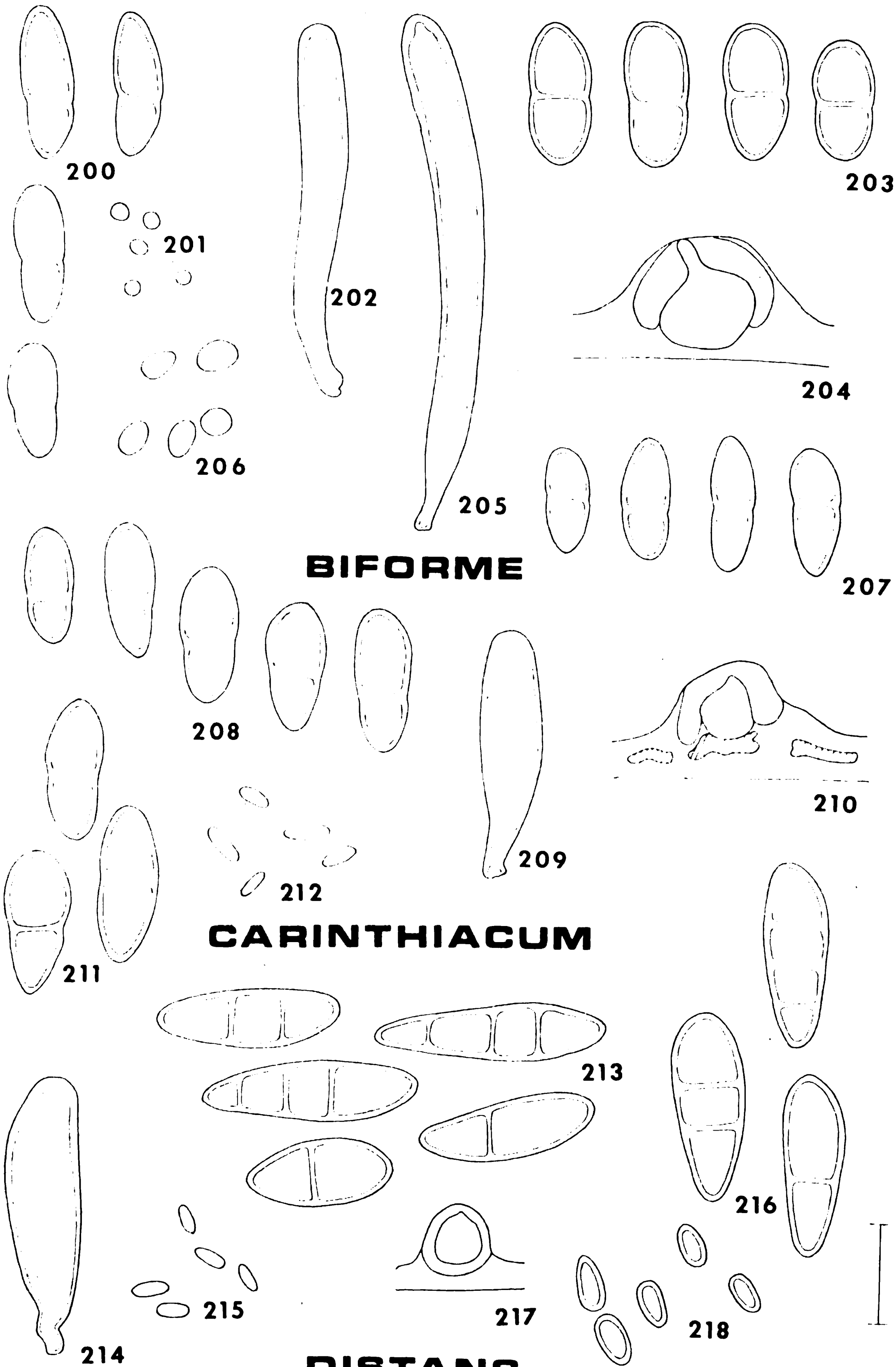
Austria, Steiner (US ex MO) [isosyntype]. 208. Spores. 209. Ascus. 210. Cross section of ascocarp.

Connecticut, 1895 Green (MICH) [holotype of Arthopyrenia dimidiata Fink ex Hedr.]. 211. Spores. 212. Microconidia.

Figures 213-218. Anisomeridium distans (Willey) R. C. Harris

Massachusetts, Willey (MICH) [isotype]. 213. Spores. 214. Ascus. 215. Microconidia.

Ohio, Moldenke 14399 (US ex MO). 216. Spores. 217. Cross section of ascocarp. 218. Macroconidia.



200
201
202
203
204
205
206
207
BIFORME
208
209
210
211
212
CARINTHIACUM
213
214
215
216
217
218
DISTANS

Figures 219-224. _Anisomeridium feeanum_ (Müll. Arg.) R. C. Harris [West Indies] (G) [holotype]. 219. Spores. 220. Ascus. 221. Cross section of ascocarp. 222. Microconidia.

Florida, _Thaxter 29_ (FH). 223. Spores. 224. Ascus.

Figures 225-229. _Anisomeridium finkii_ R. C. Harris

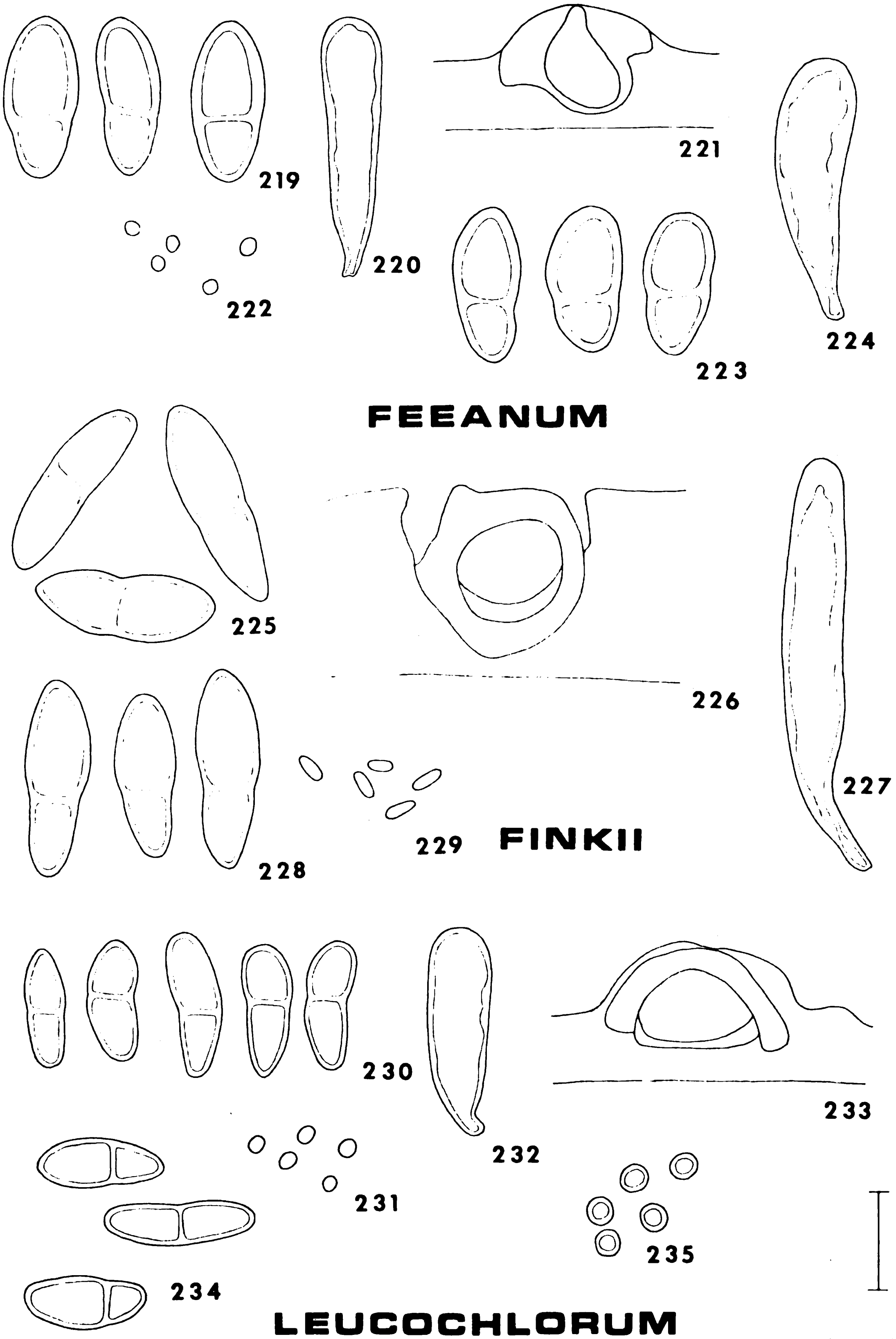
Puerto Rico, _Fink 2052_ (US) [holotype]. 225. Spores. 226. Cross section of ascocarp. 227. Ascus.

Florida, XII.1897 _Thaxter_ (MICH). 228. Spores. 229. Microconidia.

Figures 230-235. _Anisomeridium leucochlorum_ (Müll. Arg.) R. C. Harris

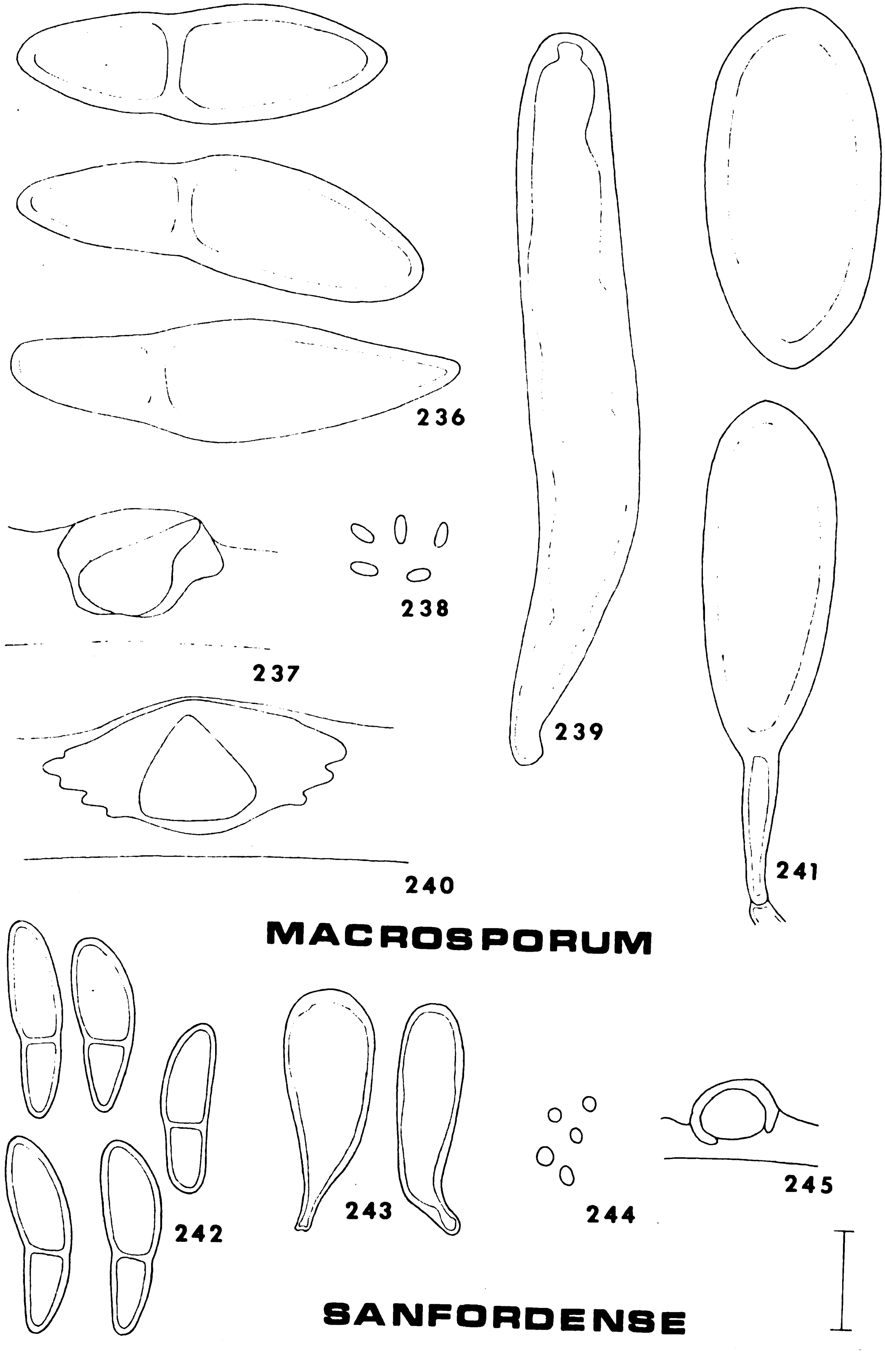
Massachusetts, _Willey_ (US) [isotype]. 230.spores. 231. Micro-_conidia_. 232. Ascus. 233. Cross section of ascocarp.

Illinois, _Wolf_ (US). 234. Spores. 235. Macroconidia.


219
220
221
222
223
224
FEEANUM
225
226
227
228
229
FINKII
230
231
232
233
234
235
LEUCOCHLORUM

Figures 236-241. *Anisomeridium macrosporum* R. C. Harris Florida, *Harris 2791-A* (MSC) [holotype]. 236. Spores. 237. Longitudinal section of ascocarp. 238. Microconidia. 239. Ascus. *Harris 2785* (MSC). 240. Cross section of ascocarp. *Harris 2829-C* (MSC). 241. Macroconidia.

Figures 242-245. *Anisomeridium sanfordense* (Zahlbr.) R. C. Harris Florida, *Rapp 134* (W) [holotype]. 242. Spores. 243. Ascus. 244. Microconidia. 245. Cross section of ascocarp.


236
238
237
239
240
241
MACROSPORUM
242
243
244
245
SANFORDENSE

Figures 246-250. Anisomeridium subprostans (Nyl.) R. C. Harris

South Carolina, Ravenel (H-NYL 7378) [holotype]. 246. Spores. 247. Ascus. 248. Cross section of ascocarp. 249. Microconidia.

Louisiana, 26.X.1896 Langlois (US). 250. Macroconidia.

Figures 251-256. Anisomeridium tamarindi (Fée) R. C. Harris

Guadeloupe (G) [lectotype]. 251. Spores. 252. Ascus. (G) [isolectotype]. 253. Cross section of ascocarp. 254. Ascus.

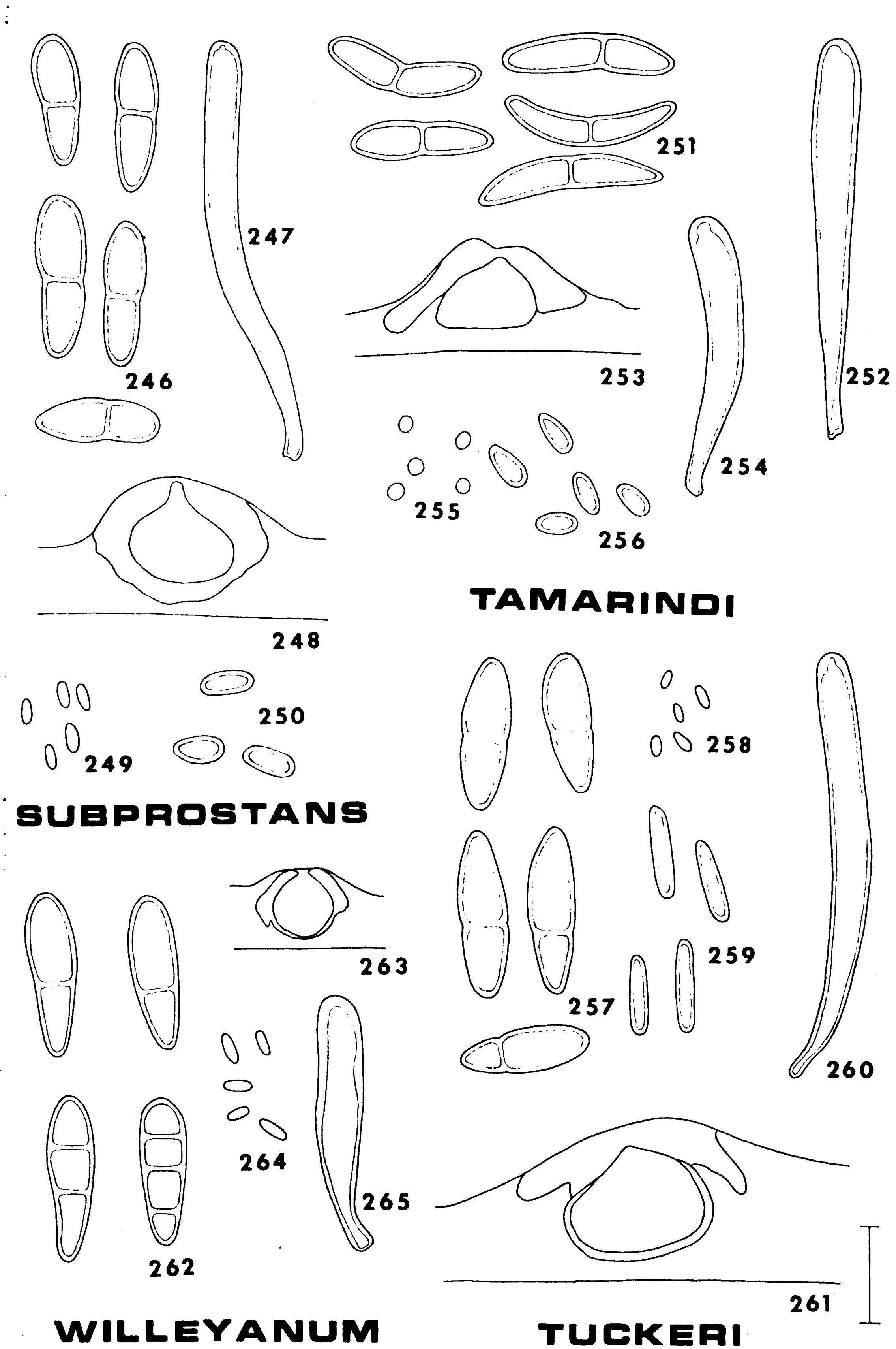
Florida, Thaxter 313 (MICH). 255. Microconidia. 256. Macroconidia.

Figures 257-261. Anisomeridium tuckeri R. C. Harris

Louisiana, Tucker 10003 (LSU) [holotype]. 257. Spores. 258. Microconidia. 259. Macroconidia. 260. Ascus. 261. Cross section of ascocarp.

Figures 262-265. Anisomeridium willeyanum (R. C. Harris) R. C. Harris

Michigan, Harris 818 (MSC) [holotype]. 262. Spores. 263. Cross section of ascocarp. 264. Microconidia. 265. Ascus.


246
247
248
249
250
SUBPROSTANS
251
252
253
254
255
256
TAMARINDI
257
258
259
260
261
TUCKERI
262
263
264
265
WILLEYANUM

Figures 266-269. Pleurotrema anacardii (Vain.) R. C. Harris

Guadeloupe, Duss 498 (TUR) [holotype]. 266. Ascus. 267. Longitudinal section of ascocarp. 268. Spores.

Florida, Small 7598 (US). 269. Spores.

Figures 270-272. Pleurotrema inspersum Müll. Arg.

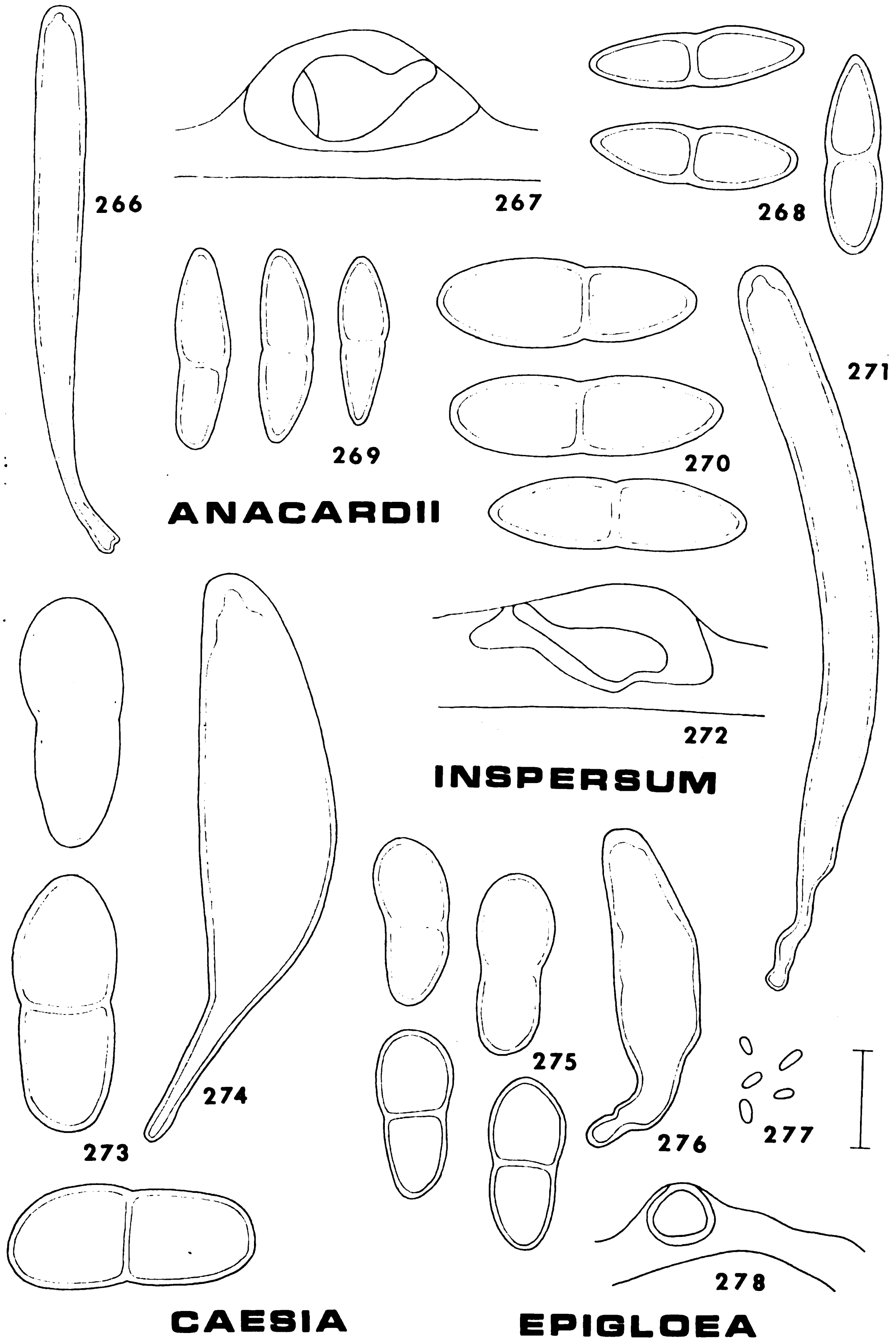
Cuba, Wright Verr. Cub. 123 (US) [isotype]. 270. Spores. 271. Ascus. 272. Longitudinal section of ascocarp.

Figures 273-274. Pyrenocollema caesia (Nyl.) R. C. Harris

France, I.1923 Crozals (US ex MO). 273. Spores. 274. Ascus.

Figures 275-278. Pyrenocollema epigloea (Nyl.) R. C. Harris

Yugoslavia, Lojk. Univ. 249 (MICH) [isotype]. 275. Spores. 276. Ascus. 277. Microconidia. 278. Cross section of ascocarp.


266
267
268
269
270
271
ANACARDII
272
INSPERSUM
273
274
275
276
277
278
CAESIA
EPIGLOEA

Figures 279-283. Pyrenocollema halodytes (Nyl.) R. C. Harris

Massachusetts, 1890 Willey (H-NYL 984) [holotype of Verrucaria consequella Nyl.]. 279. Spores. 280. Asci. 281. Microconidia.

Rhode Island, 31.VIII.1963 Wetmore (CAN). 282. Cross section of ascocarp.

California, Bonar (FH) [isotype of Didymella conchae Bonar?]. 283. Spores.

Figures 284-288. Pyrenocollema imshaugii R. C. Harris

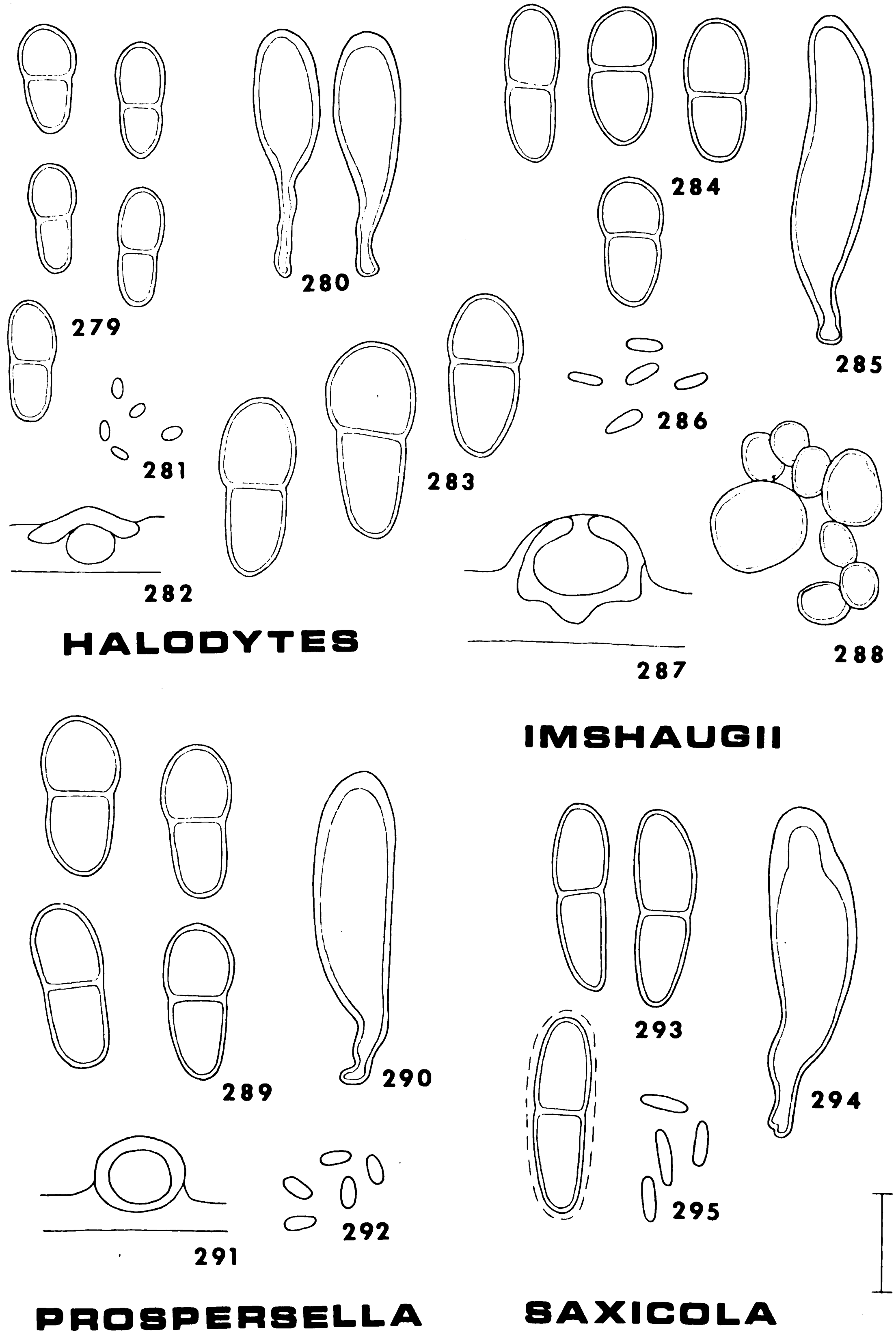
California, Imshaug 17678 (MSC). 284. Spores. 285. Ascus. 286. Microconidia. 287. Cross section of ascocarp. 288. Symbiotic algae.

Figures 289-292. Pyrenocollema prospersella (Nyl.) R. C. Harris

Illinois, Calkins (H-NYL 991) [holotype]. 289. Spores. 290. Ascus. 291. Cross section of ascocarp. (MICH). 292. Microconidia.

Figures 293-295. Pyrenocollema saxicola (Massal.) R. C. Harris

Switzerland, collector unknown (FH). 293. Spores. 294. Ascus. 295. Microconidia.



284
279
280
285
286
281
283
282
288
287
HALODYTES
IMSHAUGII
289
290
293
294
295
292
291
PROSPERSELLA
SAXICOLA

Figures 296-300. Pyrenocollema tichothecioides (Arn.) R. C. Harris

Yugoslavia, Krypt. Vind. 1356 (US). 296. Spores. 297. Microconidia. 298. Ascus.

Michigan, Harris 731-C (MSC). 299. Spores. 300. Cross section of ascocarp.

Figures 301-308. Strigula affinis (Massal.) R. C. Harris

England, XI.1964 James (BM) [holotype of Geisleria jamesii Swinsc.]. 301. Spores. 302. Macroconidia.

Louisiana, Tucker 9056-A (MSC). 303. Spores. 304. Microconidia.

Haiti, Wetmore 2903 (MSC). 305. Spores. 306. Macroconidia.

Austria, Rab. 561 (MICH). 307. Cross section of ascocarp. 308. Ascus.

Figures 309-314. Strigula americana R. C. Harris

Iowa, 1896 Fink (MSC) [holotype of Arthopyrenia tenuis R. C. Harris]. 309. Spores. 310. Microconidia. 311. Macroconidia. (MIN) [isotype]. 312. Cross section of ascocarp.

Louisiana, Tucker 9035 (LSU). 313. Ascus.

Florida, Harris 2405 (MSC). 314. Spores.

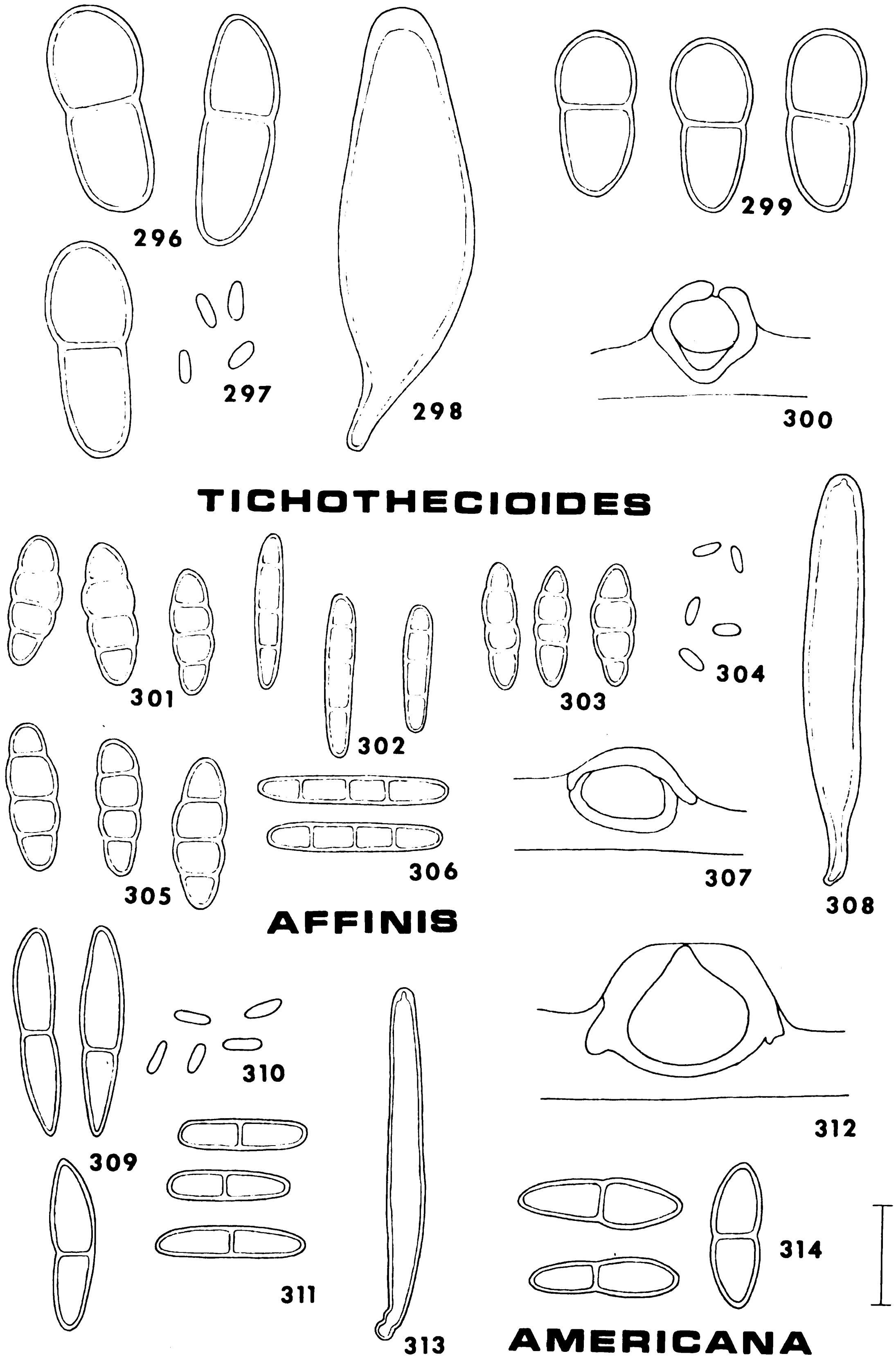

296
297
298
299
300
TICHOTHECIOIDES
301
302
303
304
305
306
307
308
AFFINIS
309
310
311
312
313
314
AMERICANA

Figure 315. Strigula complanata (Fée) Mont.

Florida, Harris 1598 (MSC). 315. Spores.

Figures 316-320. Strigula connivens R. C. Harris

Florida, Thaxter 19 (MICH) [holotype]. 316. Spores. 317. Asci. 318. Microconidia. 319. Macroconidia. 320. Cross section of joined ascocarps.

Figures 321-322. Strigula elegans (Fée) Müll. Arg.

Florida, Thaxter 427 (MICH). 321. Spores.

Cuba, Ekman L-131 (MSC). 322. Macroconidia.

Figures 323-325. Strigula hypothallina R. C. Harris

Florida, Harris 3201-A (MSC) [holotype]. 323. Spores. 324. Cross section of ascocarp. 325. Ascus.

Figures 326-327. Strigula nitidula Mont.

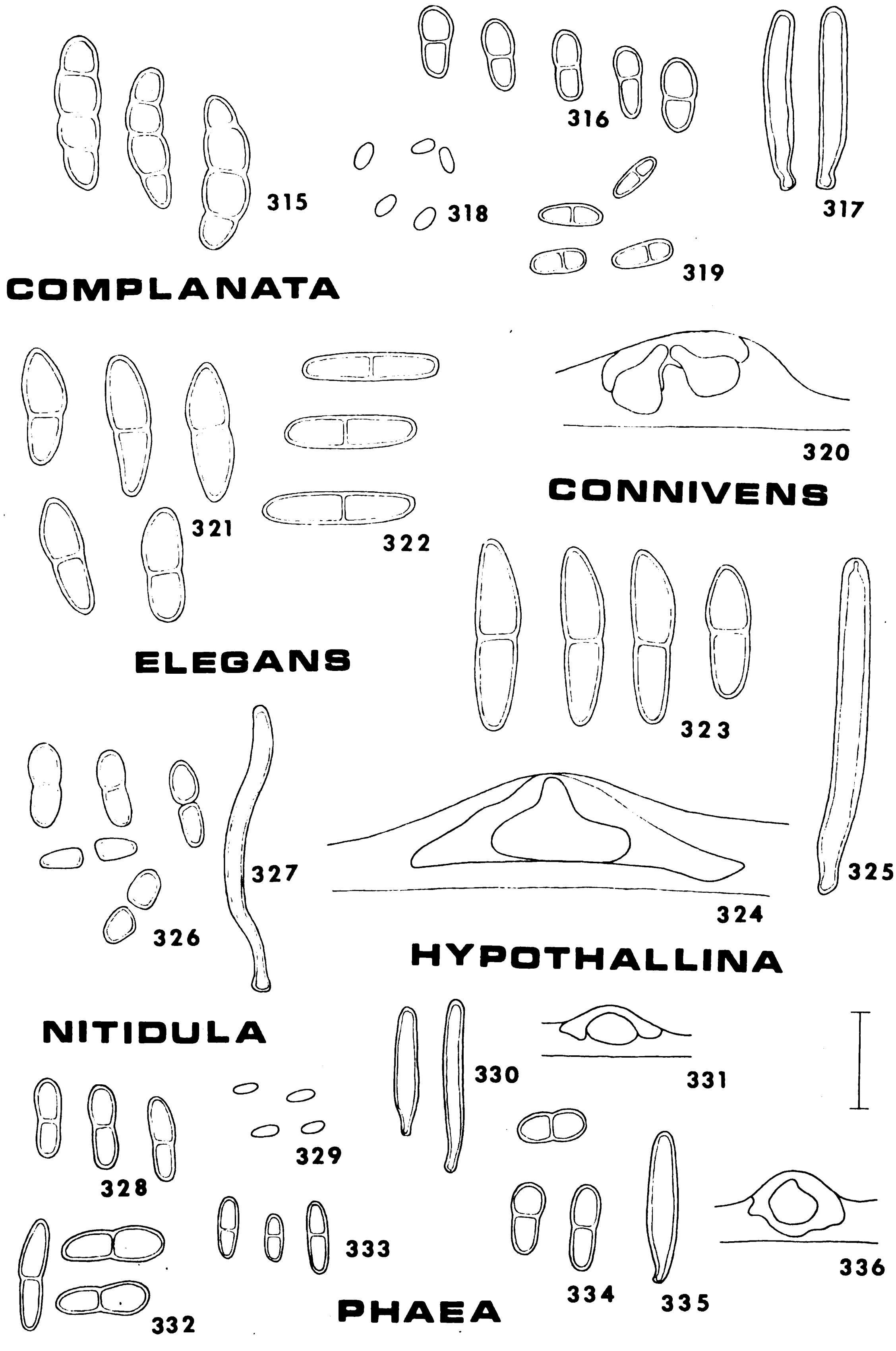
Florida, XI.1922 Rapp (MICH). 326. Spores. 327. Ascus.

Figures 328-336. Strigula phaea (Ach.) R. C. Harris

West Indies, coll. unknown (S) [isotype]. 328. Spores. 329. Microconidia. 330. Asci. 331. Cross section of ascocarp.

Cuba, Wright Verr. Cub. 10 (MSC) [fragment of holotype of Porina cineriseda Müll. Arg.]. 332. Spores. 333. Macroconidia.

Florida, Calkins (H-NYL 718) [syntype of Verrucaria viridiseda f. albiseda Nyl.]. 334. Spores. 335. Ascus. 336. Cross section of ascocarp.


315
316
317
318
319
COMPLANATA
320
CONNIVENS
321
322
ELEGANS
323
324
325
326
327
HYPOTHALLINA
NITIDULA
328
329
330
331
332
333
334
335
336
PHAEA

Figures 337-341. *Strigula stigmatella* (Ach.) R. C. Harris

Germany, *Persoon* (H-ACH) [lectotype]. 337. Spores. 338. Macroconidia.

Michigan, *Harris 7534* (MSC). 339. Ascus. *Harris 6052* (MSC). 340. Spores. *Harris 7447* (MSC). 341. Cross section of ascocarp.

Figures 342-345. *Strigula submuriformis* (R. C. Harris) R. C. Harris

Pennsylvania, Cum. I. 299. (MSC) [holotype]. 342. Spores. 343. Cross section of ascocarp. 344. Ascus.

Minnesota, *Fink 71* (MIN). 345. Macroconidia.

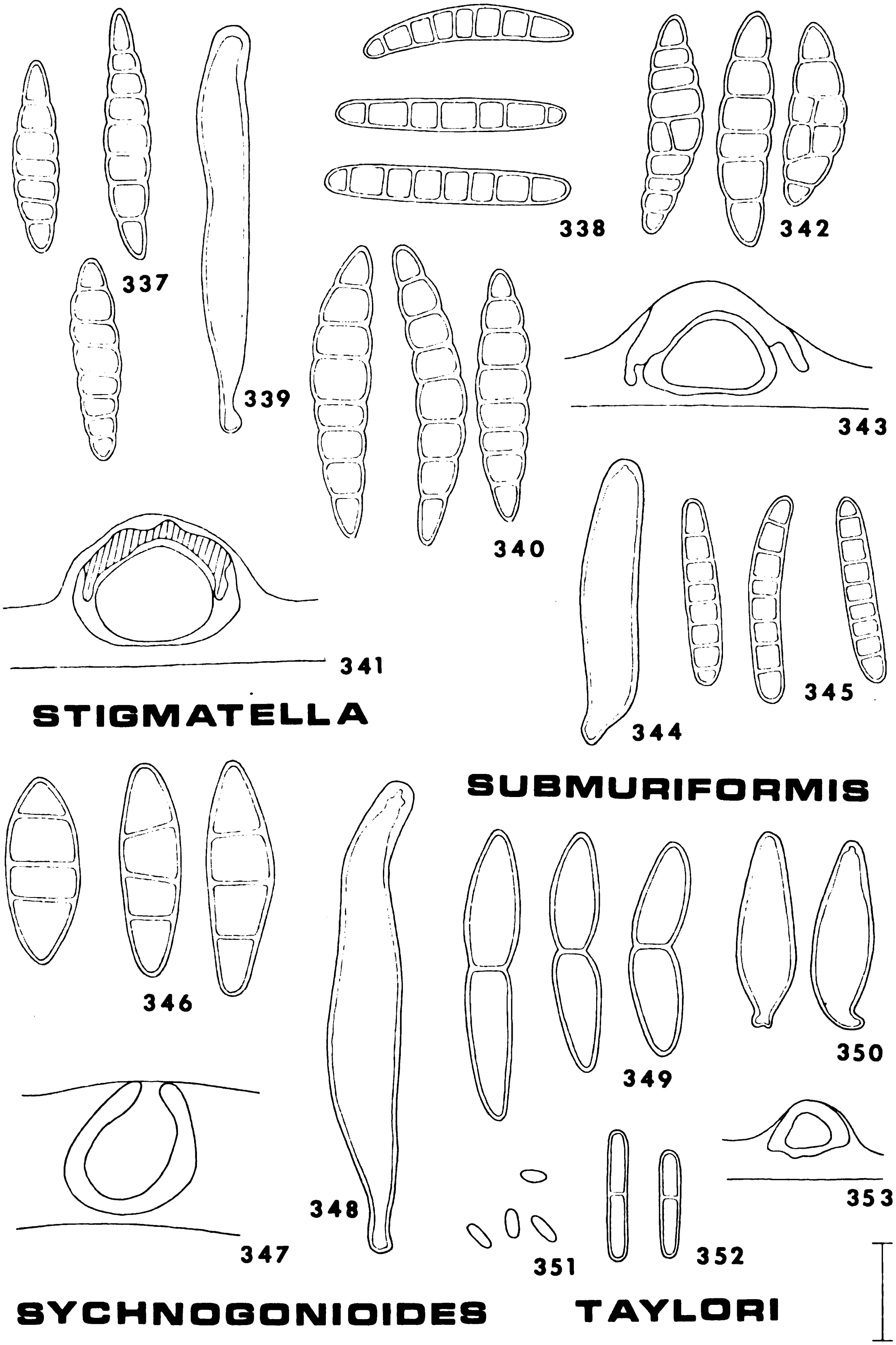
Figures 346-348. *Strigula sychnogonioides* (Nitschke) R. C. Harris

Germany, Rab. 574 (MICH) [isotype]. 346. Spores.

Switzerland, *Hepp 938* (BM). 347. Cross section of ascocarp. 348. Ascus.

Figures 349-353. *Strigula taylori* (Nyl.) R. C. Harris

Ireland, *Carroll* (BM). 349. Spores. 350. Asci. 351. Microconidia. 352. Macroconidia. 353. Cross section of ascocarp.


337
338
339
340
341
342
343
344
345
STIGMATELLA
SUBMURIFORMIS
346
347
348
349
350
351
352
353
SYCHNOGONIOIDES
TAYLORI

Figures 354-359. Strigula viridiseda (Nyl.) R. C. Harris

French Guiana, Melinon (H-NYL 719) [holotype]. 354. Spores. 355/ Ascus. 356. Cross section of ascocarp. 357. Microconidia.

Bermuda, Farlow (H-NYL 985) [holotype of Verrucaria bermudana Nyl.]. 358. Spores. 359. Macroconidia.

Figures 360-366. Strigula wilsonii (Ridd.) R. C. Harris

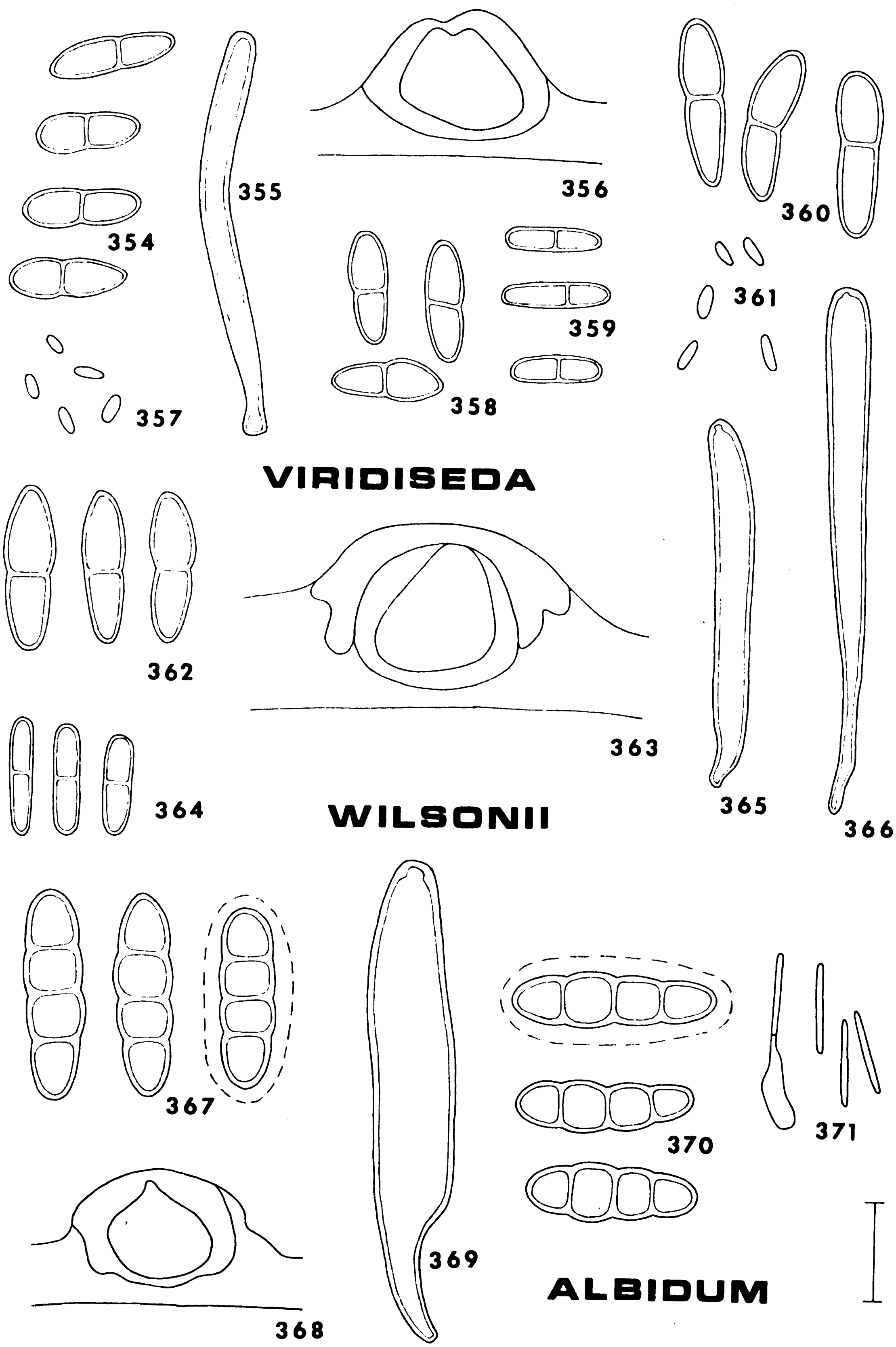
Cuba, Britton et al. 15288 (FH-RIDD) [holotype]. 360. Spores. 361. Microconidia.

Puerto Rico, Fink 1431 (MICH) [holotype of Porina vainii Fink in Hedr.]. 362. Spores. 363. Cross section of ascocarp. 364. Macroconidia. 365. Ascus. (FH) [isotype]. 366. Ascus.

Figures 367-371. Polymeridium albidum (Müll. Arg.) R. C. Harris

Brazil, Martius (M) [holotype]. 367. Spores. 368. Cross section of ascocarp. 369. Ascus.

Florida, Harris 2889-A (MSC). 370. Spores. 371. Microconidia.



354
355
356
357
358
359
360
361
VIRIDISEDA
362
363
364
365
366
WILSONII
367
368
369
370
371
ALBIDUM

Figures 372-378. Polymeridium catapastum (Nyl.) R. C. Harris

Colombia, Lindig 2869 (FH-TUCK 4086) [holotype]. 372. Spores. 373. Ascus.

Florida, Harris 2429-B (MSC). 374. Cross section of ascocarp. 375. Old spore. 376. Ascus. Harris 1472 (MSC). 377. Spores. 378. Microconidia.

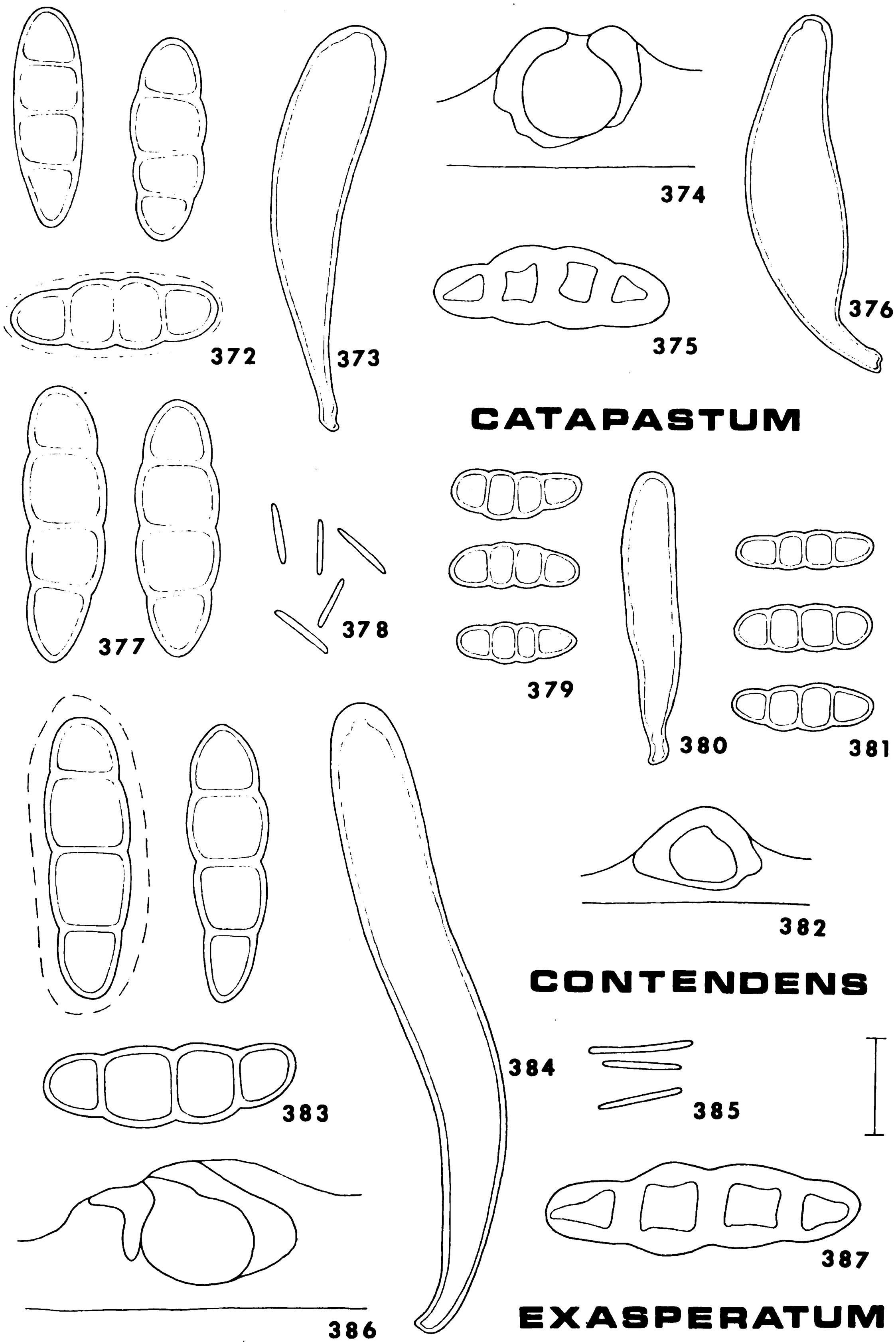
Figures 379-382. Polymeridium contendens (Nyl.) R. C. Harris

Florida, Harris 2642 (MSC). 379. Spores.

Colombia, Lindig 2877 (H-NYL 7331) [holotype]. 380. Ascus. 381. Spores. 382. Cross section of ascocarp.

Figures 383-387. Polymeridium exasperatum R. C. Harris

Florida, Harris 2829-A (MSC) [holotype]. 383. Spores. 384. Ascus. 385. Microconidia. 386. Longitudinal section of ascocarp. Harris 2814-B (MSC). 387. Old spore.


372
373
374
375
376
CATAPASTUM
377
378
379
380
381
382
CONTENDENS
383
384
385
386
387
EXASPERATUM

Figures 388-391. Polymeridium pleiomerellum (Müll. Arg.) R. C. Harris

Florida, Harris 2900 (MSC). 388. Spores. 389. Cross section of ascocarp. 390. Ascus. 391. Microconidia.

Figures 392-395. Polymeridium quinqueseptatum (Nyl.) R. C. Harris

South Carolina, Ravenel (H-NYL 591) [holotype]. 392. Spores. 393. Ascus. 394. Microconidia. 395. Cross section of ascocarp.

Figures 396-399. Polymeridium subcinereum (Nyl.) R. C. Harris

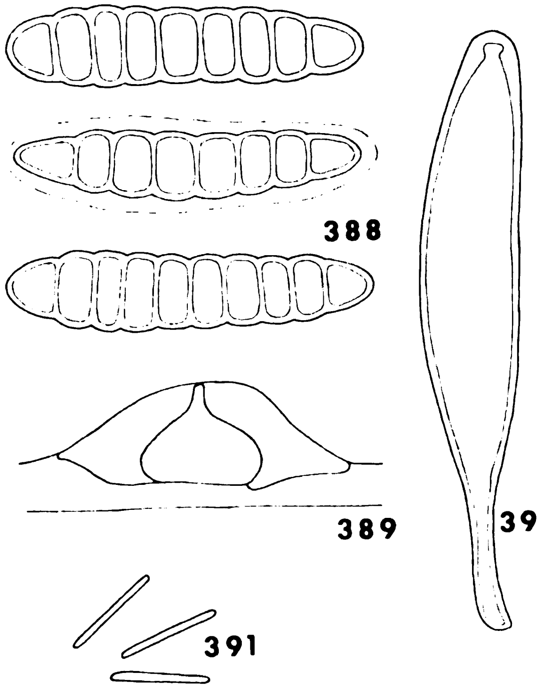
Texas, Wright 85 (H-NYL 1529) [holotype]. 396. Spores. 397. Microconidia. 398. Cross section of ascus. (FH-TUCK 4022) [isotype]. 399. Ascus.

Figures 400-405. Pseudopyrenula subgregaria Müll. Arg.

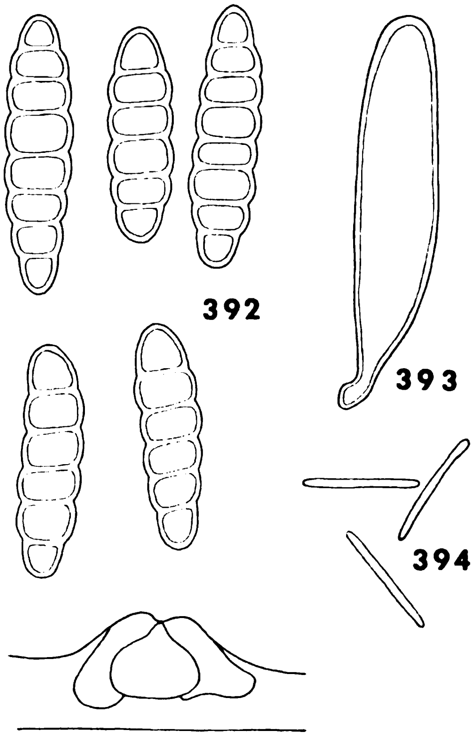
Cuba, Wright Verr. Cub. 80 (US) [isotype]. 400. Cross section of ascocarp. 401. Spores. 402. Ascus.

Florida, Harris 1521 (MSC). 403. Ascus. 404. Spores.

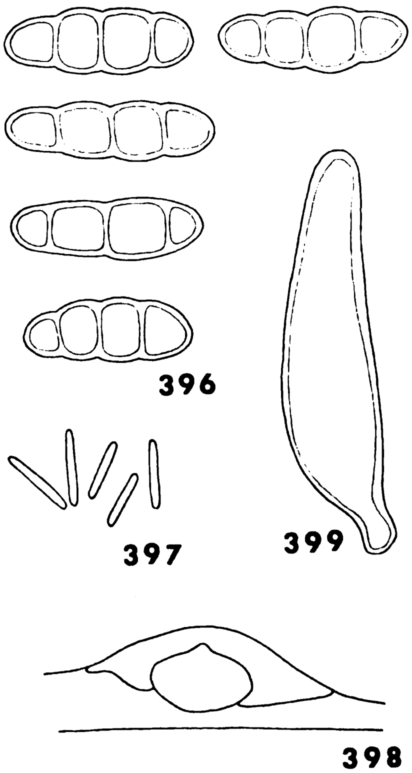
Louisiana, Tucker 10005 (LSU). 405. Microconidia.



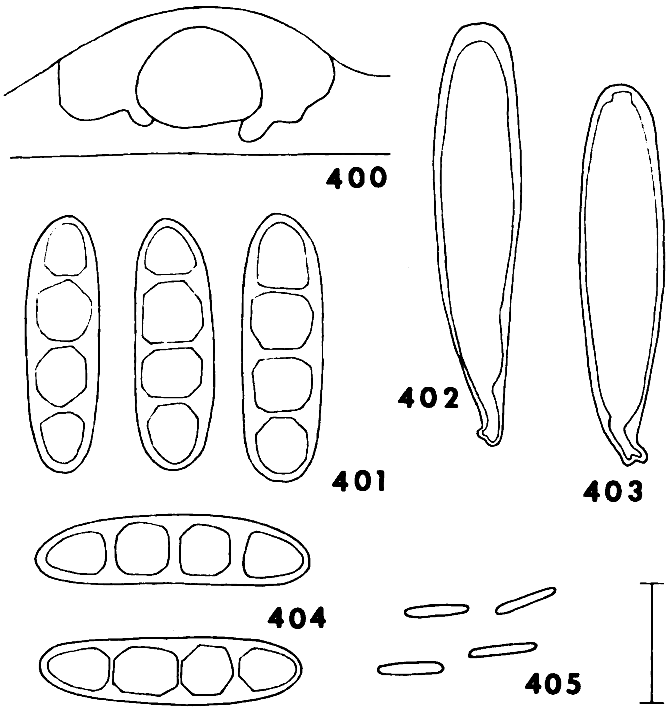
PLEIOMERELLUM



QUINQUESEPTATUM



SUBCINEREUM



SUBGREGARIA

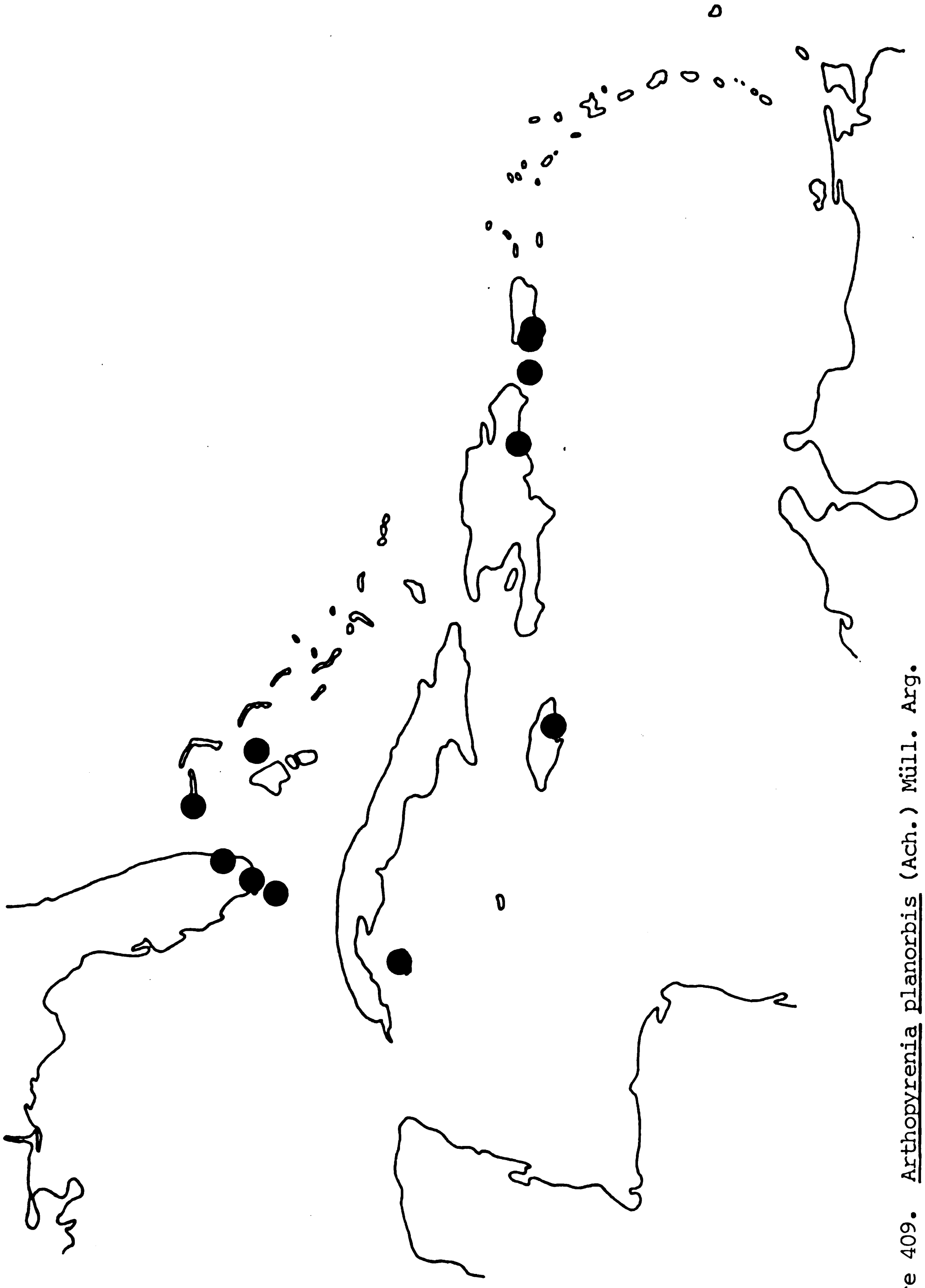


Figure 409. *Arthopyrenia planorbis* (Ach.) Müll. Arg.

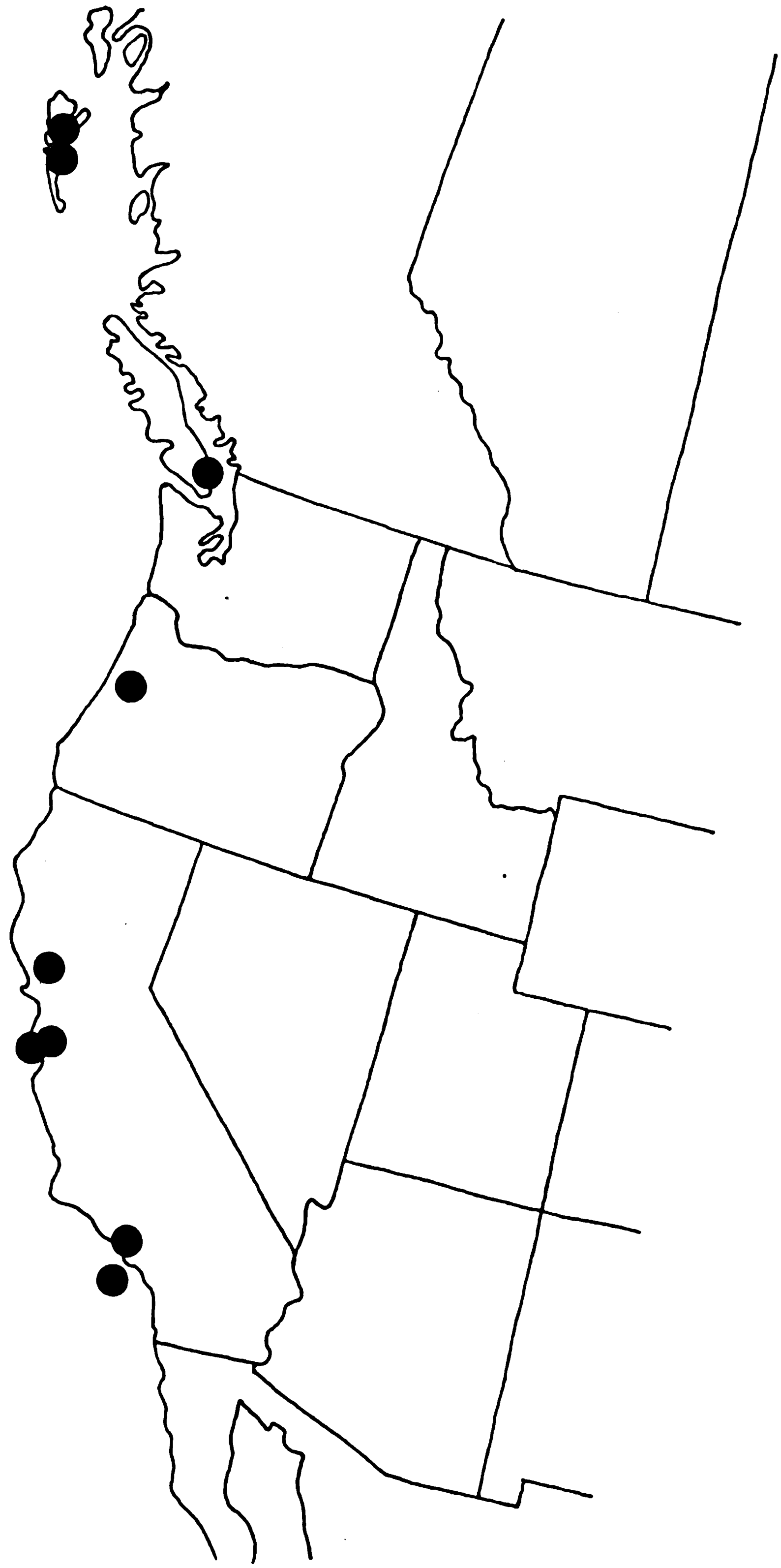


Figure 410. <u>Arthopyrenia plumbaria</u> (Stizenb. in Hasse) R. C. Harris

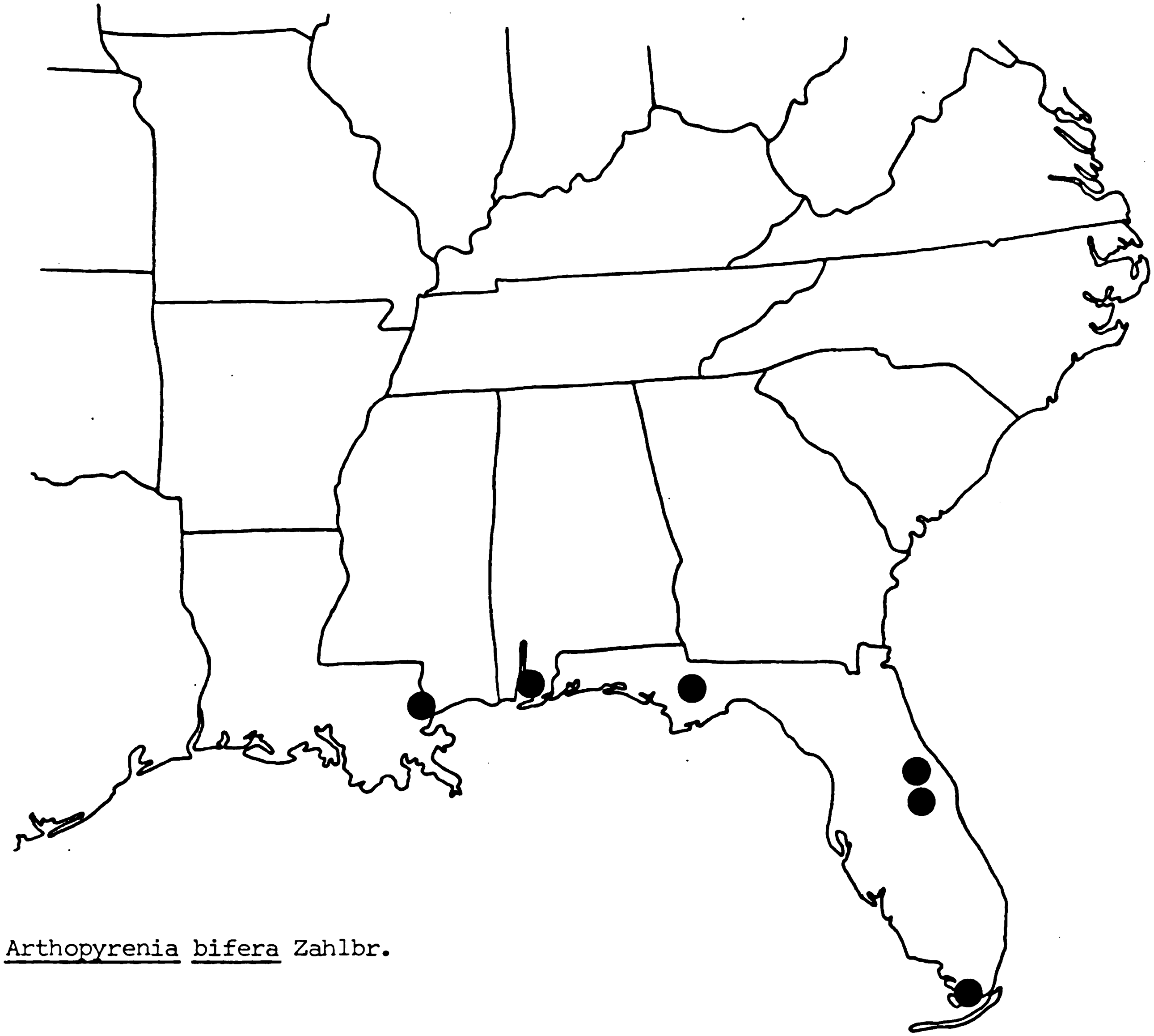


Figure 411. Arthopyrenia bifera Zahlbr.

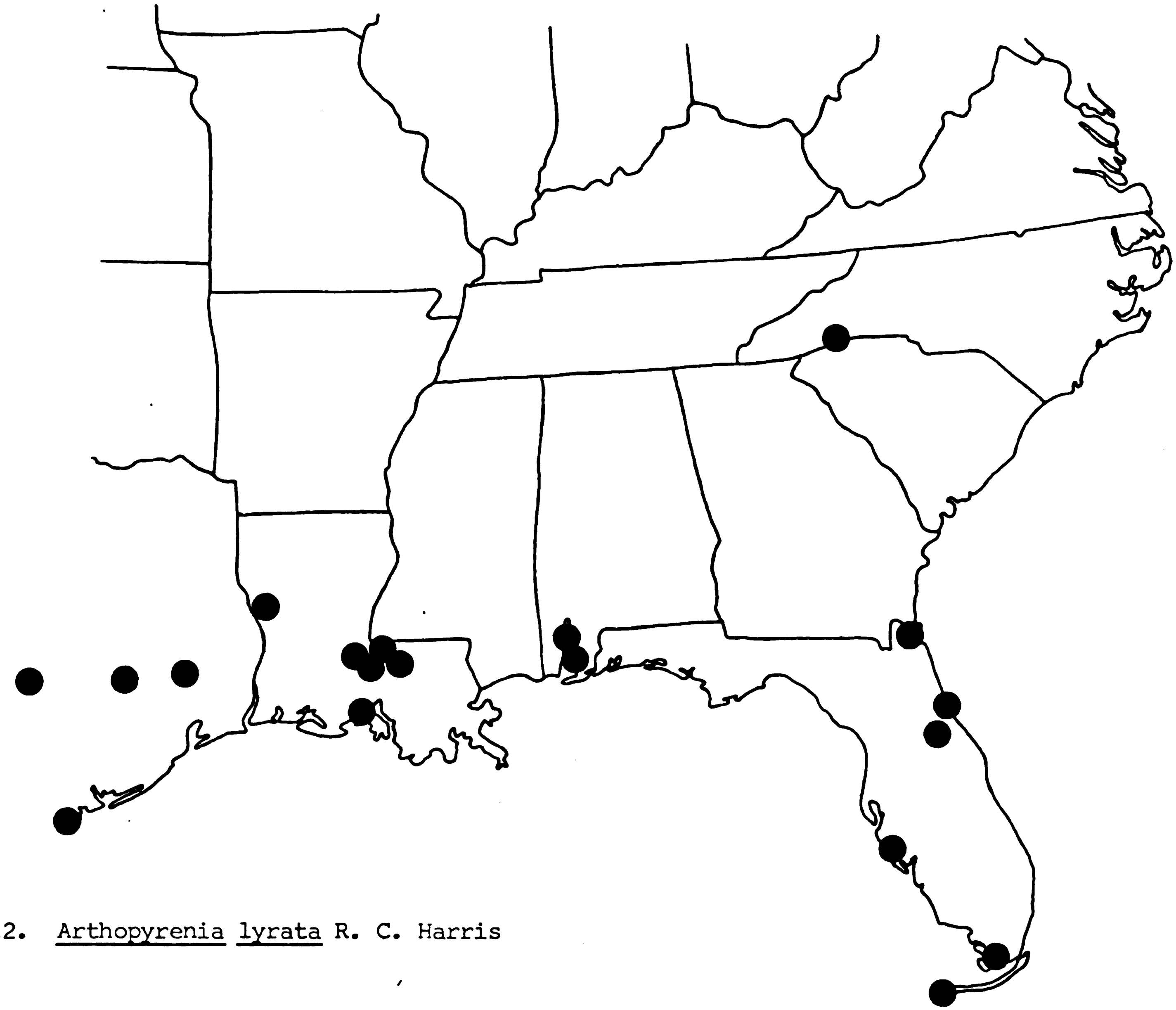


Figure 412. Arthopyrenia lyrata R. C. Harris

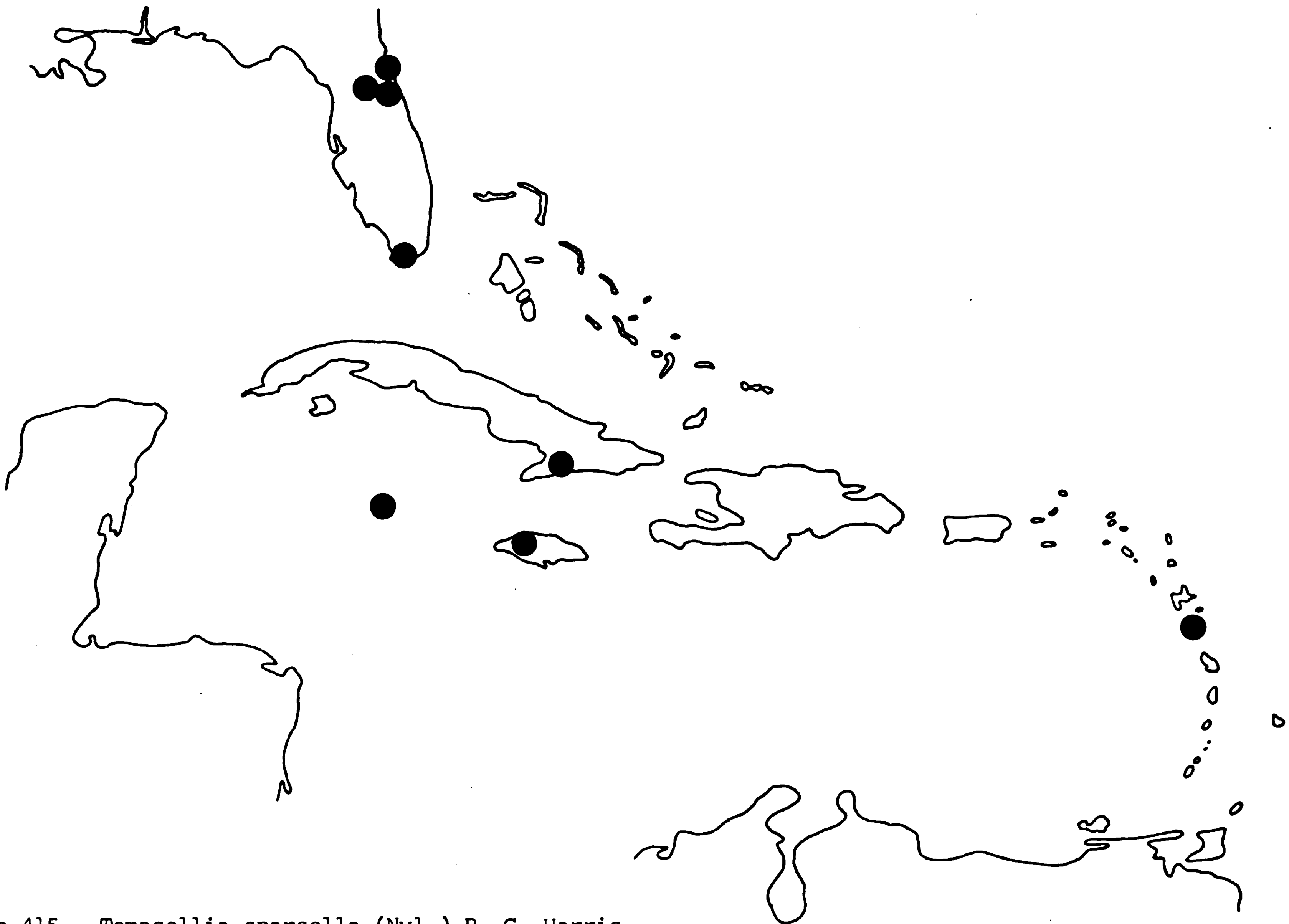


Figure 415. Tomasellia sparsella (Nyl.) R. C. Harris

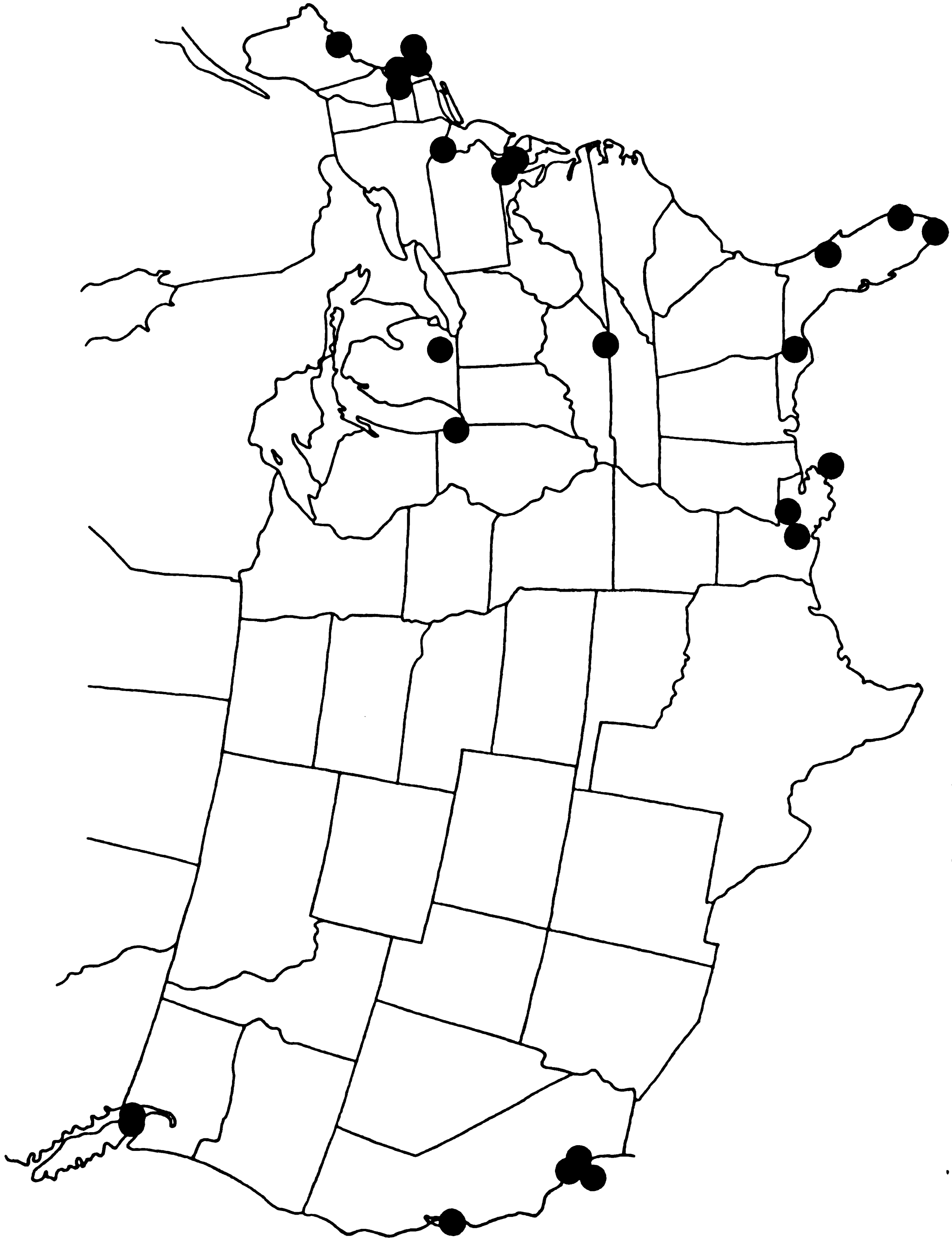


Figure 417. Anisomeridium biforme (Borr.) R. C. Harris

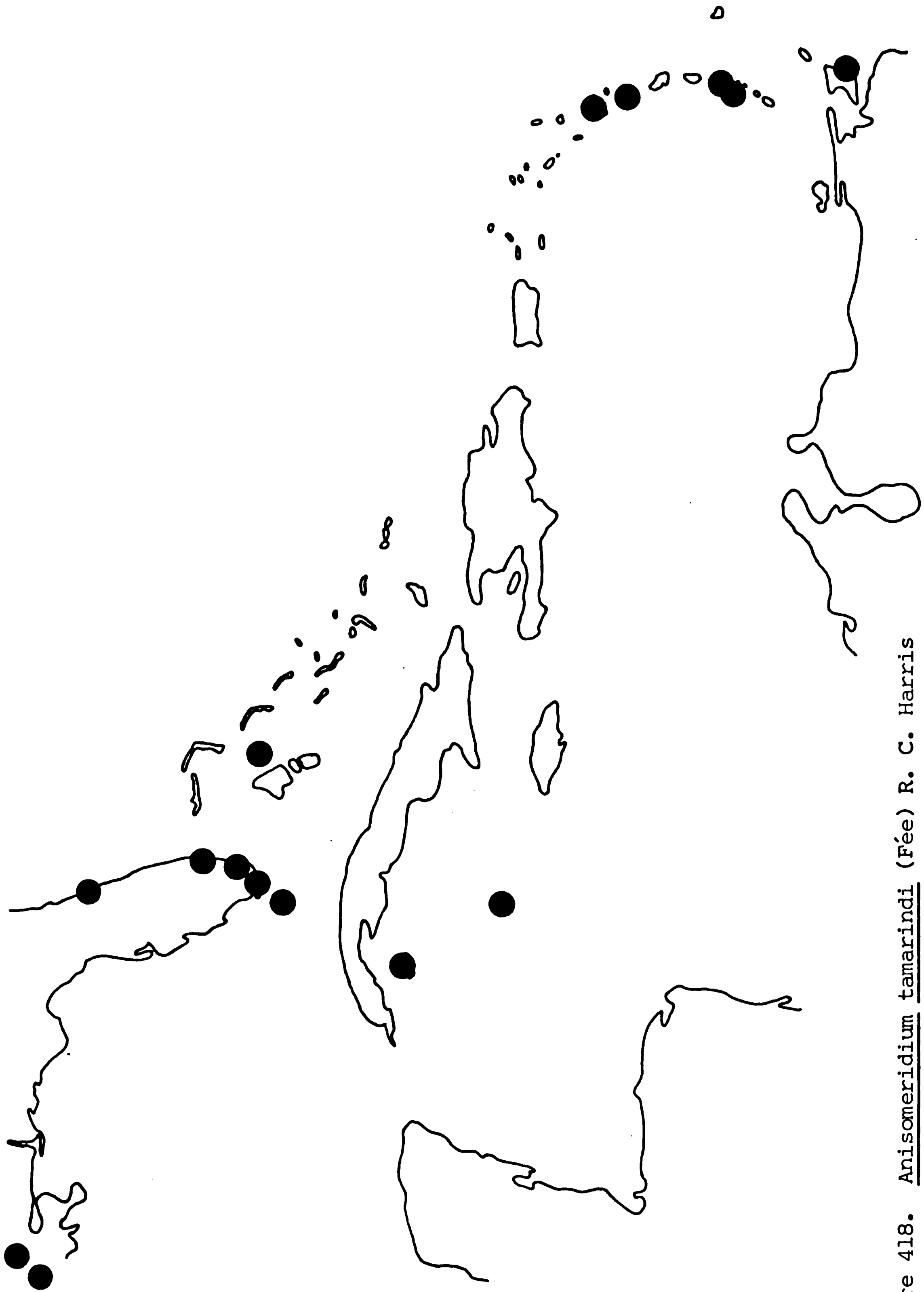


Figure 418. Anisomeridium tamarindi (Fée) R. C. Harris

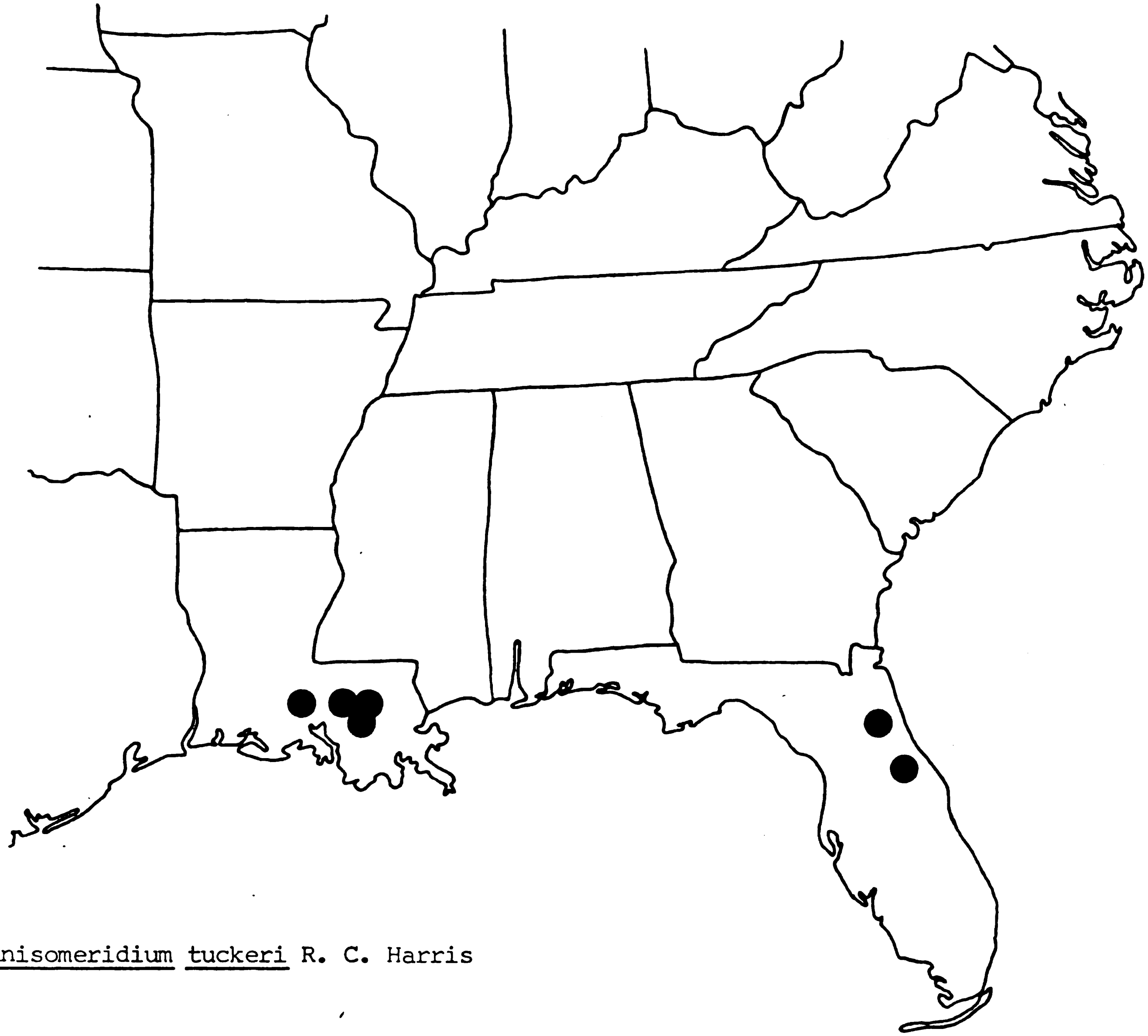


Figure 419. Anisomeridium tuckeri R. C. Harris

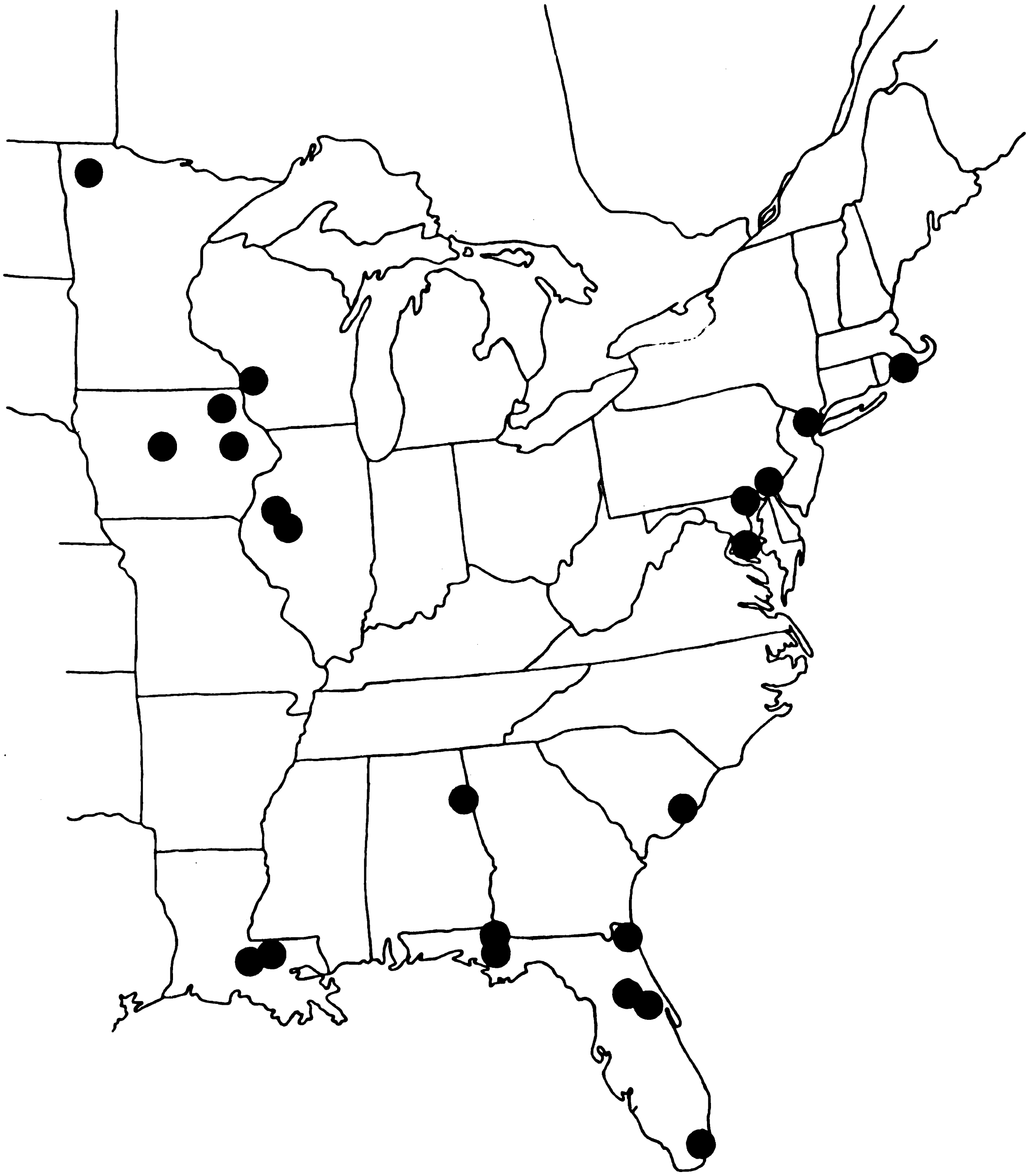


Figure 422. <u>Strigula americana</u> R. C. Harris

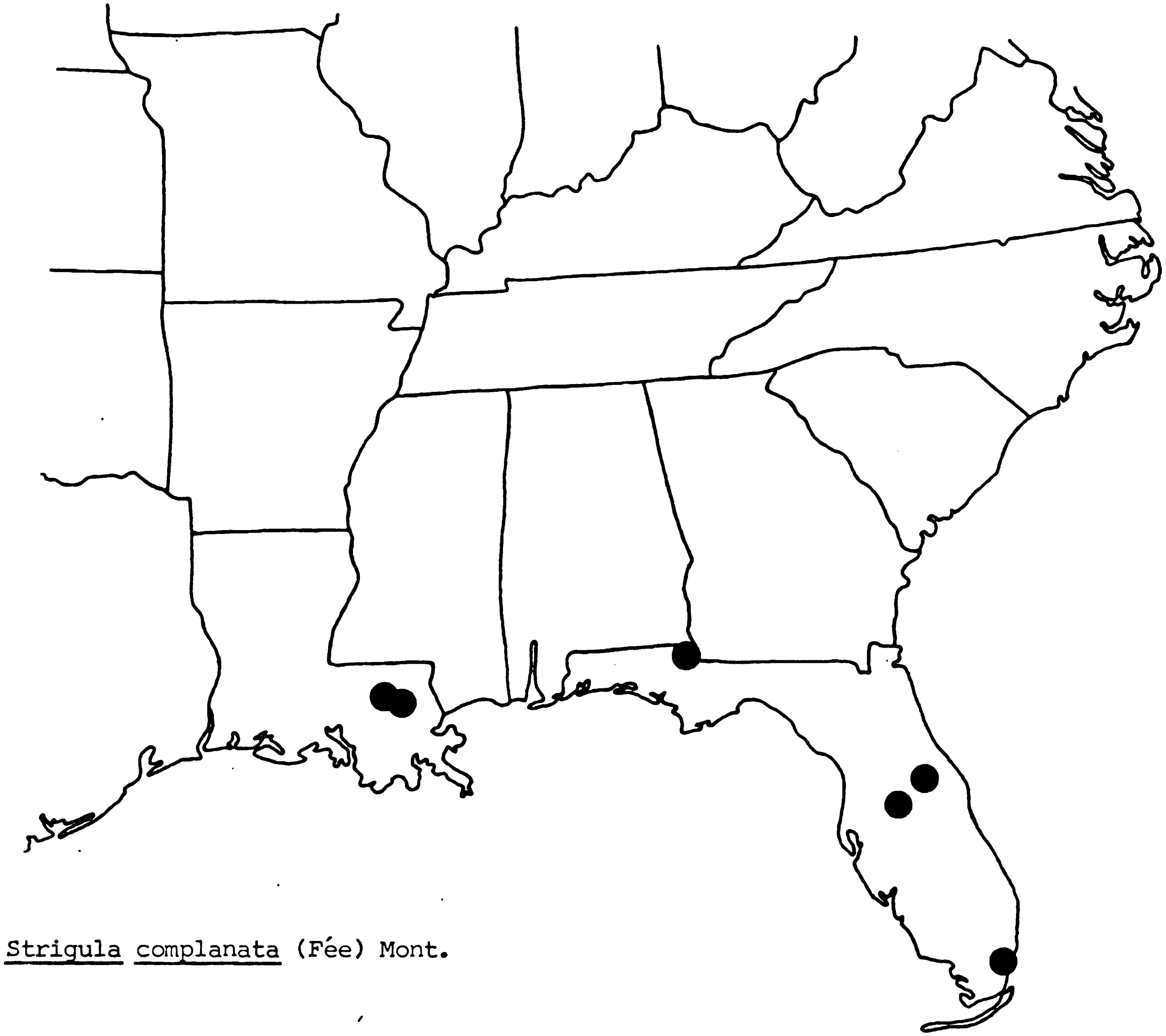


Figure 423. Strigula complanata (Fée) Mont.

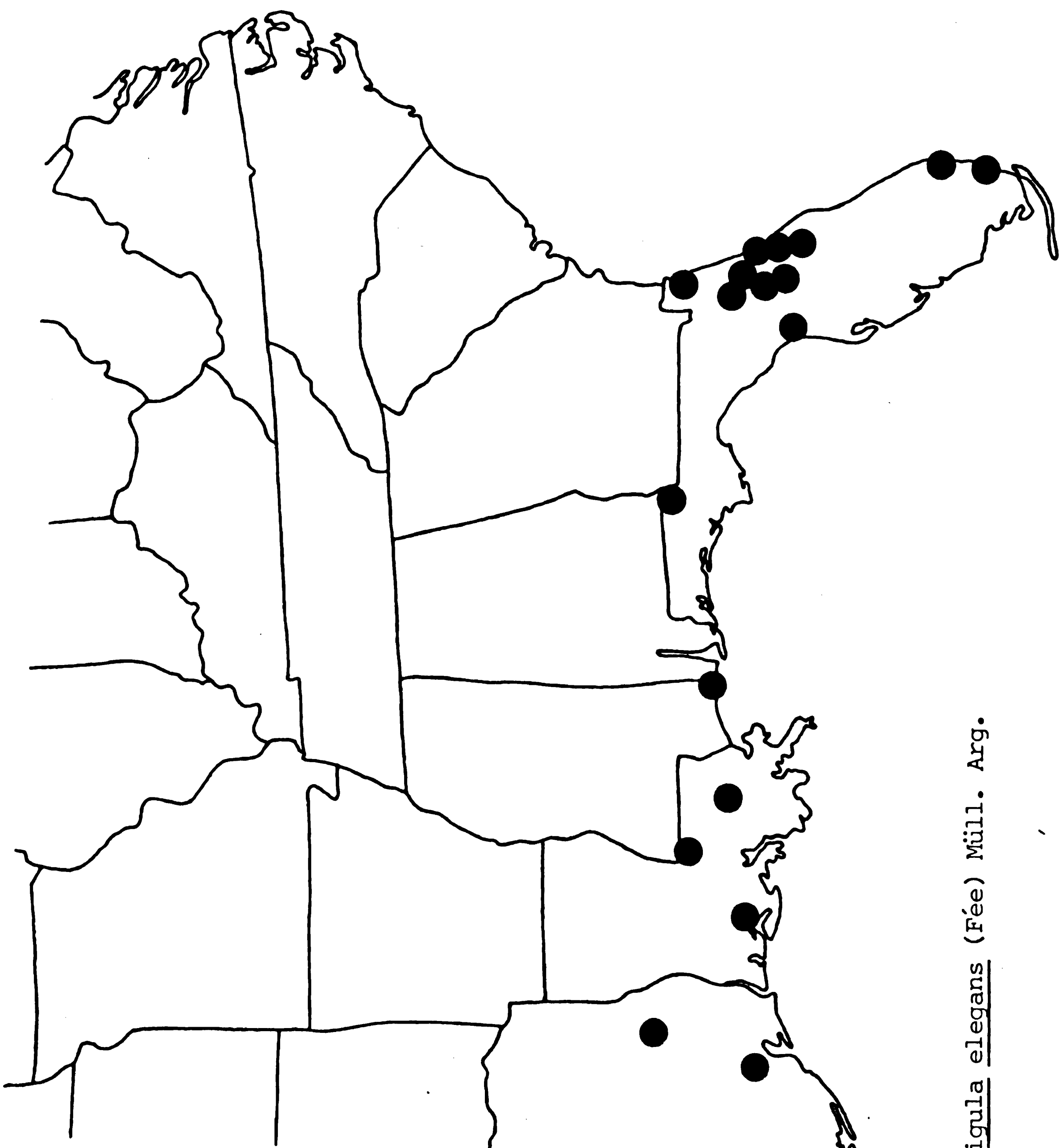


Figure 424. Strigula elegans (Fée) Müll. Arg.

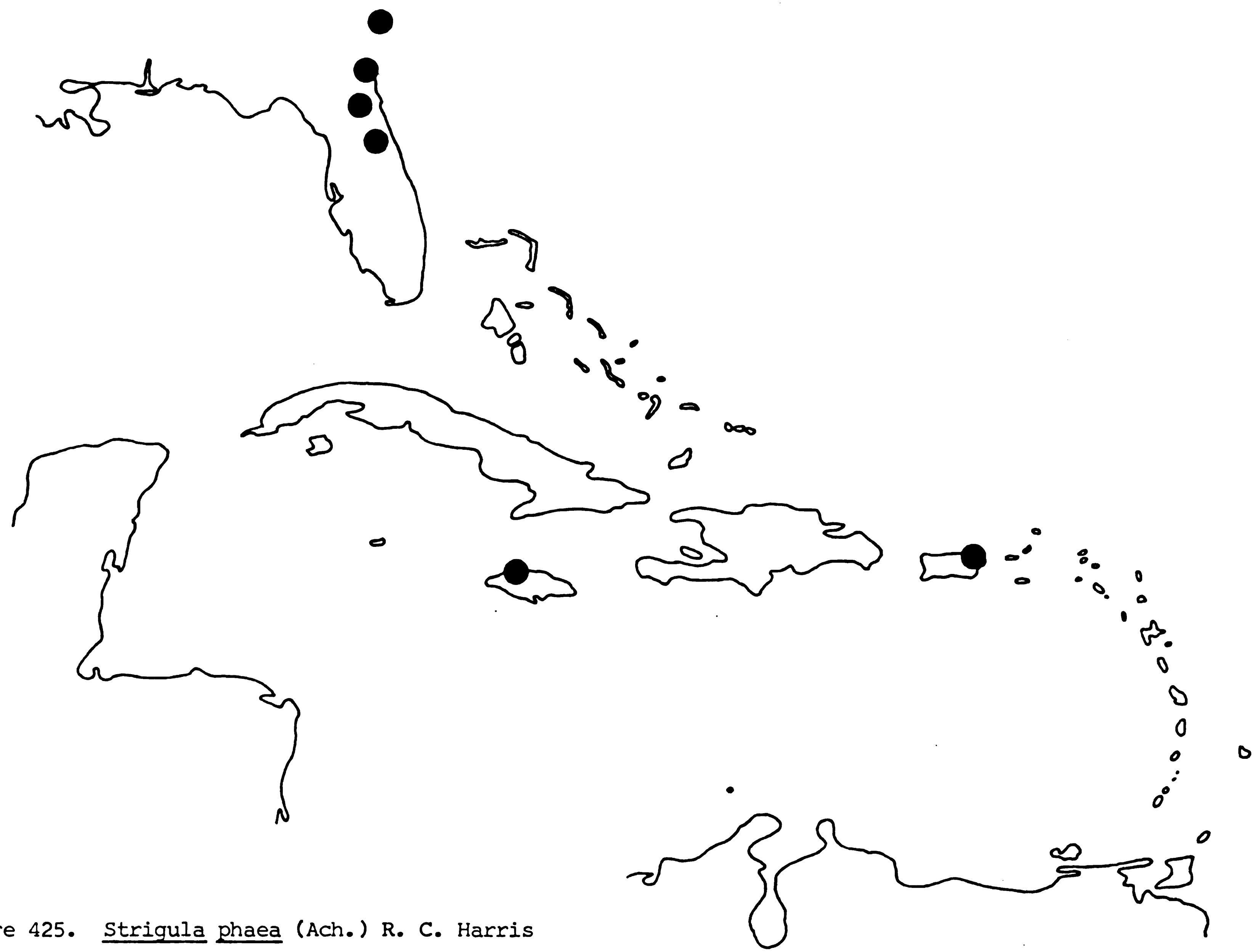


Figure 425. <u>Strigula phaea</u> (Ach.) R. C. Harris

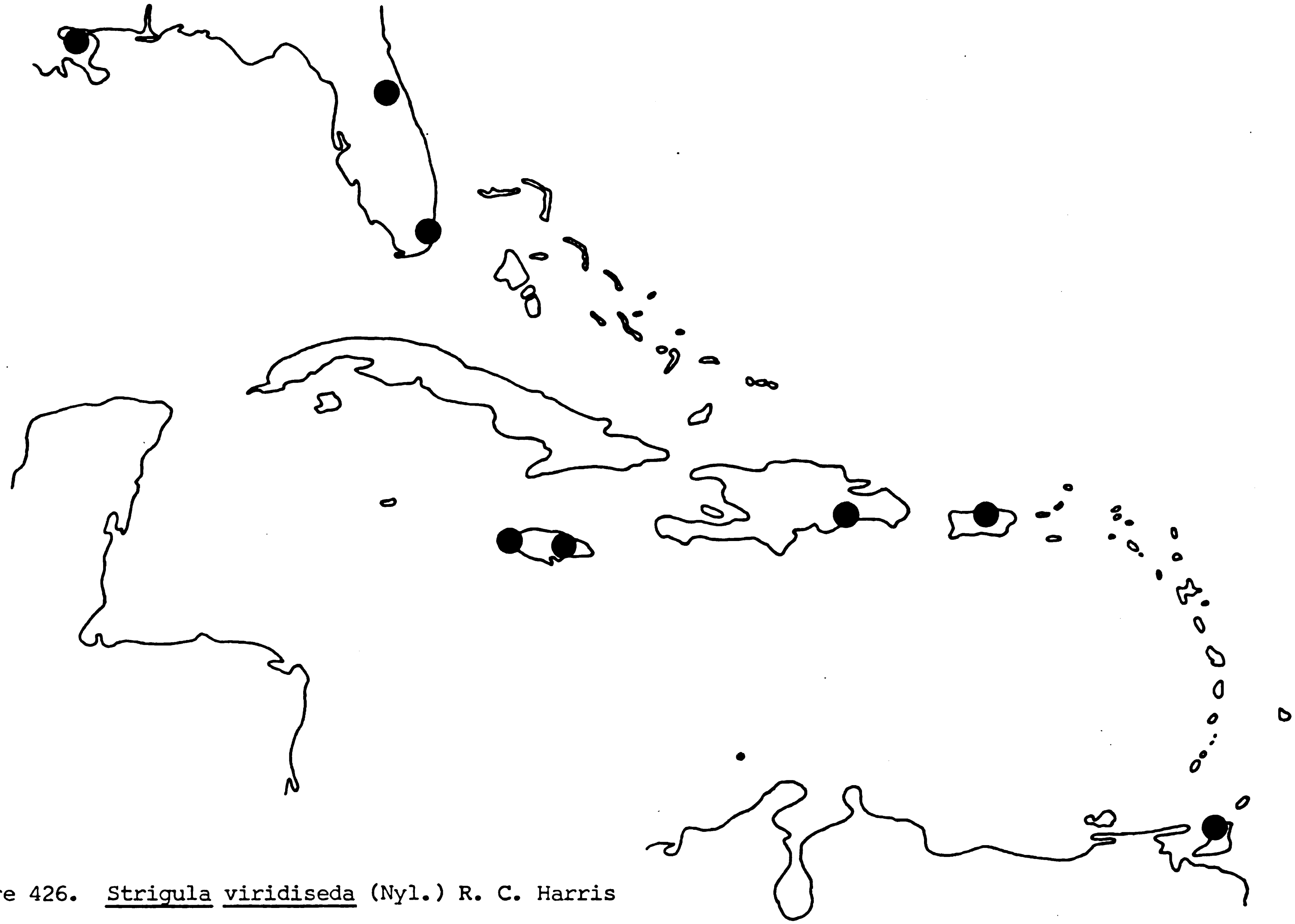


Figure 426. <u>Strigula</u> <u>viridiseda</u> (Nyl.) R. C. Harris

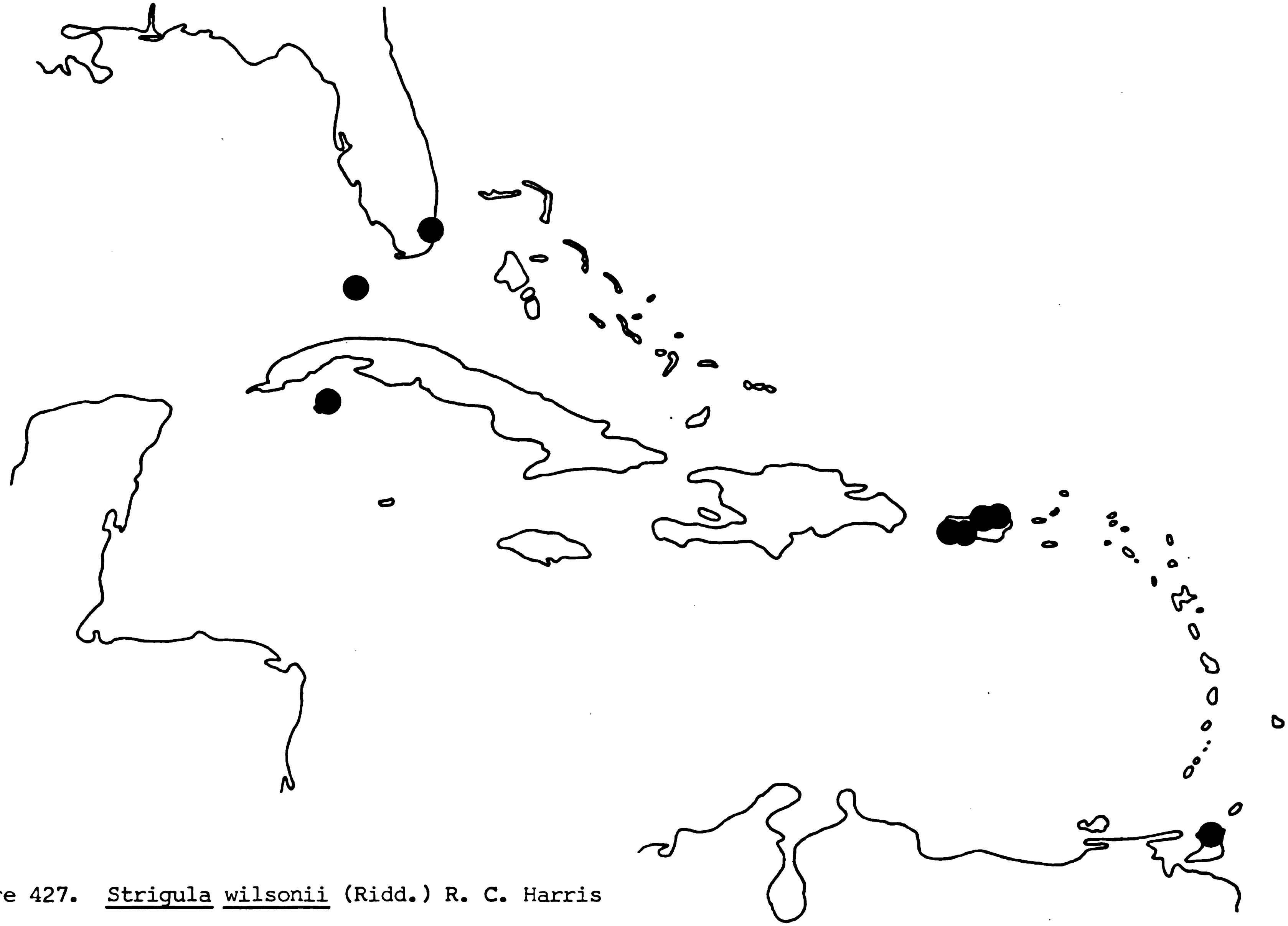


Figure 427. <u>Strigula</u> <u>wilsonii</u> (Ridd.) R. C. Harris

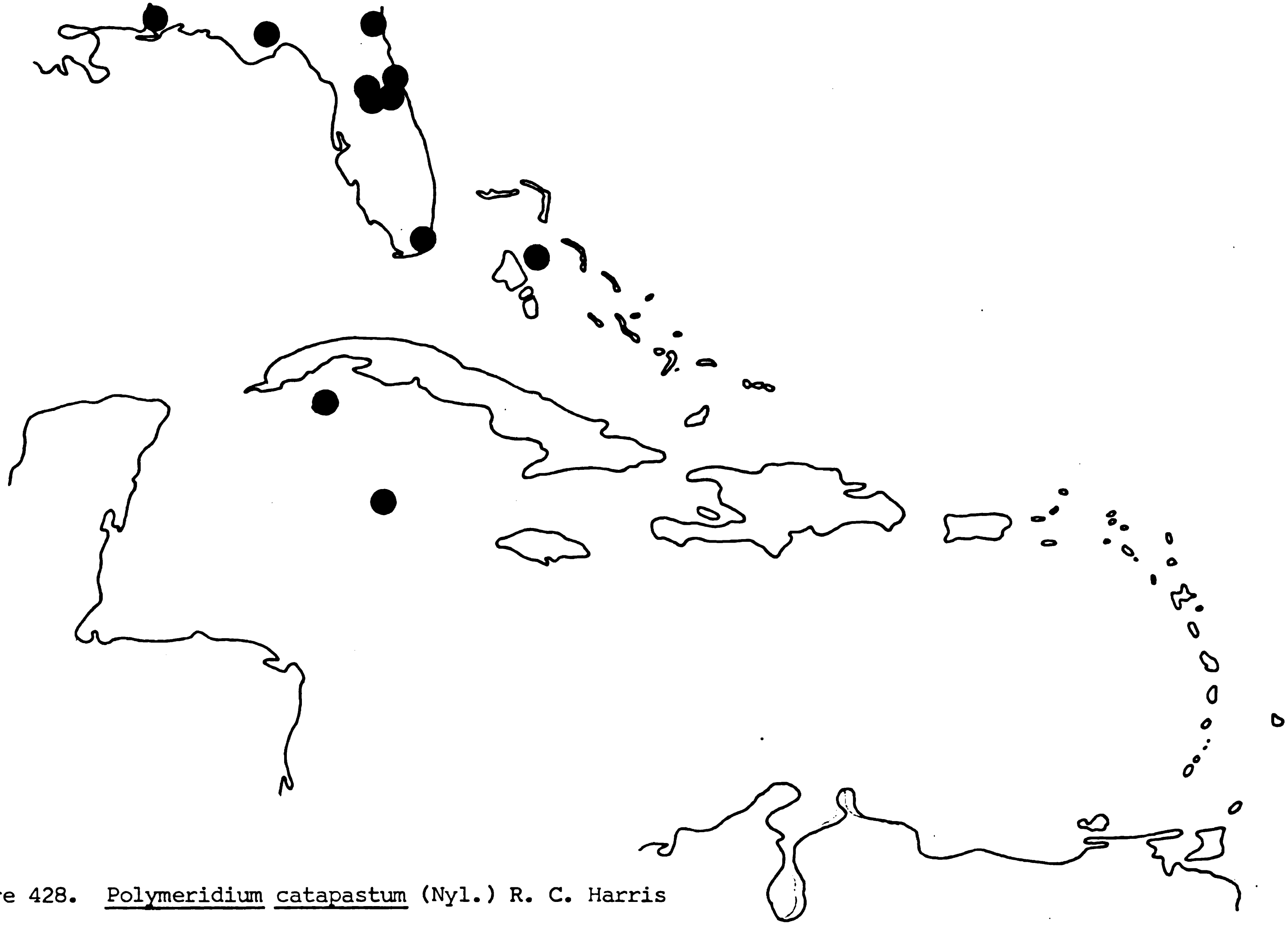


Figure 428. <u>Polymeridium</u> <u>catapastum</u> (Nyl.) R. C. Harris

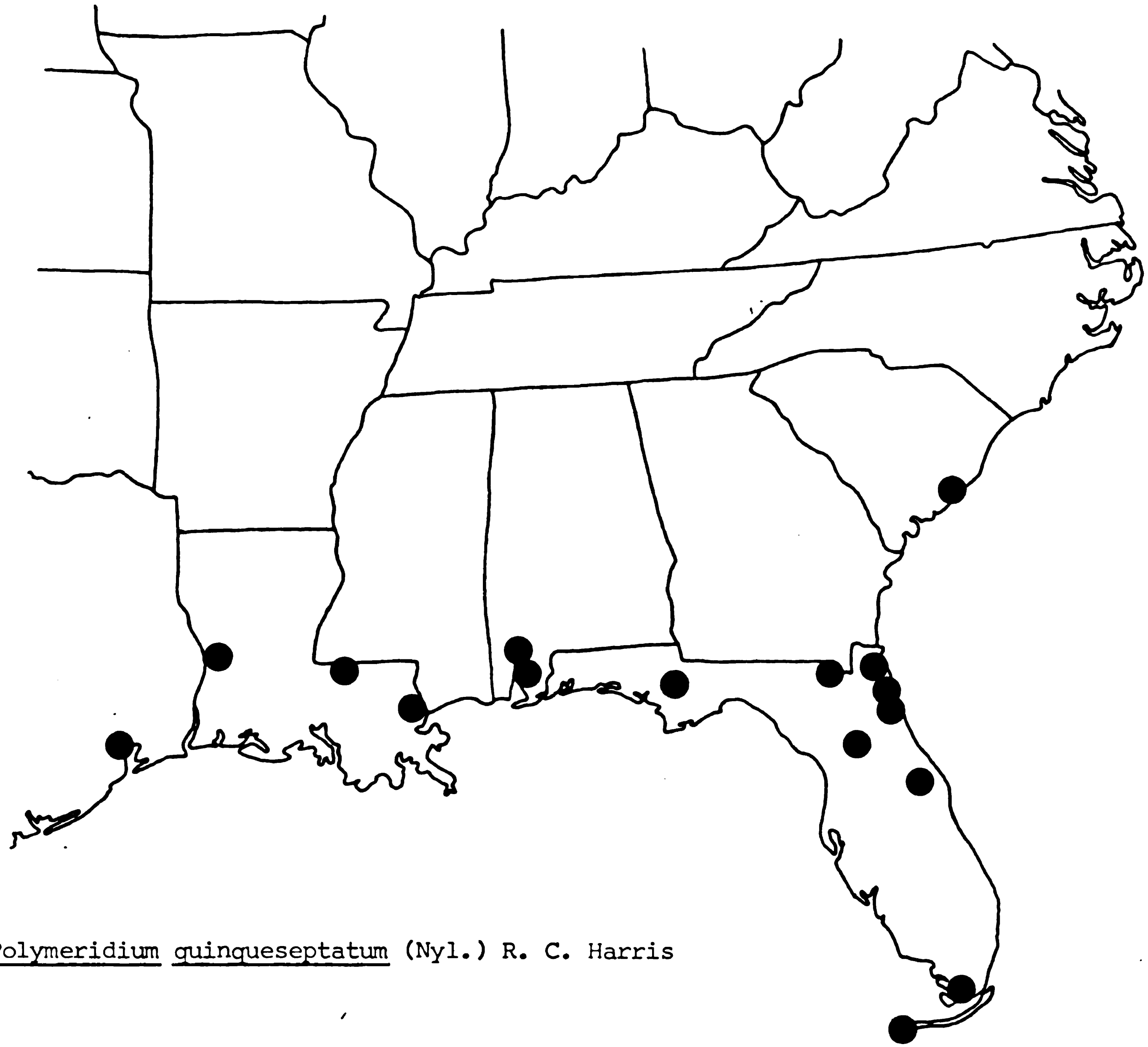


Figure 429. <u>Polymeridium</u> <u>quinqueseptatum</u> (Nyl.) R. C. Harris

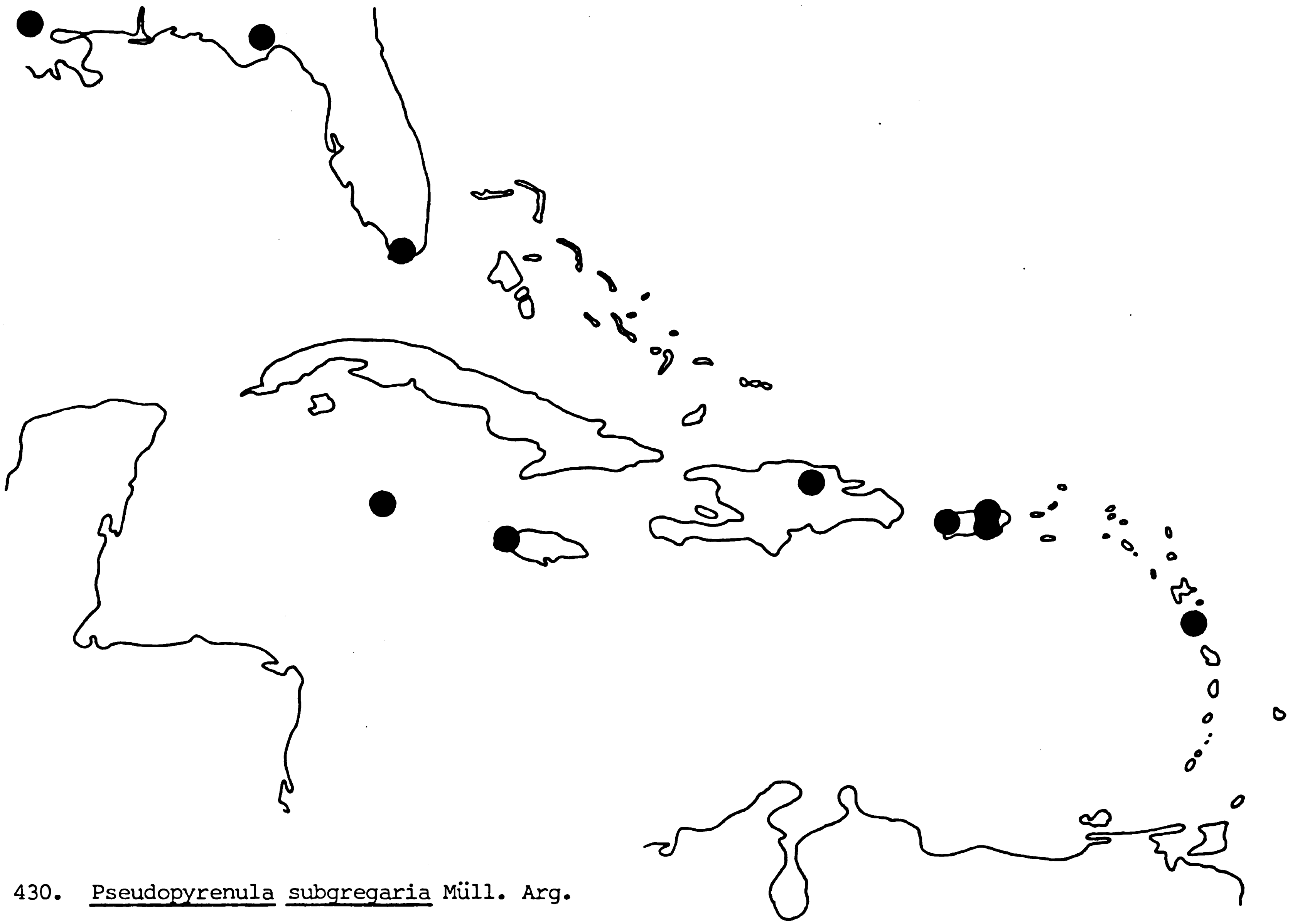


Figure 430. Pseudopyrenula subgregaria Müll. Arg.

MICHIGAN STATE UNIVERSITY LIBRARIES
3 1293 03084 9313