1973

An Illustrated Guide for the Identification of Genera and Species of Filamentous Aquatic Phycomycetous Fungi from Illinois

Sharon Kay Reed
Eastern Illinois University

PAPER CERTIFICATE #2

TO: Graduate Degree Candidates who have written formal theses.

SUBJECT: Permission to reproduce theses.

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

Please sign one of the following statements:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

_____ _____

Date Author

I respectfully request Booth Library of Eastern Illinois University not allow my thesis be reproduced because the paper is to be copyrighted and incorporated into a formal bound publication for classroom use in the near future.

June 29, 1973 _____

Date Author

pdm

AN ILLUSTRATED GUIDE FOR THE IDENTIFICATION OF GENERA AND SPECIES OF FILAMENTOUS AQUATIC PHYCOMYCETOUS FUNGI FROM ILLINOIS

(TITLE)

BY

SHARON KAY REED

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF SCIENCE

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1973
YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

6/29/73
DATE

ADVISER

6/29/73
DATE

DEPARTMENT HEAD

Acknowledgment

The artist wishes to express her utmost appreciation to her adviser, Dr. William W. Scott, for his continual interest, encouragement, and faith in this project throughout her graduate degree work, especially in the preparation of this paper. Her deepest gratitude to Dr. Leonard Durham for his advice and counsel during her entire graduate program. Thanks are also extended to Dr. John Ebinger, Dr. Wesley Whiteside and Dr. Steven A. Becker, members of her graduate committee for their support in completing this degree. Further recognition belongs to the students and staff of the Botany and Zoology Departments, Eastern Illinois University, and to Ms. Alice Boatright, Zoology departmental artist, University of Illinois, for their friendship and encouragement.

Special thanks to Mrs. Brenda Lewis for her patience and assistance in the preparation and typing of this paper as well as her constant friendship and encouragement. She would finally like to acknowledge Mrs. Lou Ann Wilson and Mr. Ron Butler for helping proofread and assemble the final copies of this paper.

LIST OF FUGURES

AN ILLUSTRATED GUIDE FOR THE IDENTIFICATION OF GENERA AND SPECIES OF FILAMENTOUS AQUATIC PHYCOMYCETOUS FUNGI FROM ILLINOIS

INTRODUCTION

The term "fungi", in its broadest sense, may be used to describe all non-green members of the plant kingdom other than a few colorless species of algae, mosses, liverworts, and higher plants. Since these organisms have in common only the absence of photosynthetic pigments and since they differ in many important morphological, cytological, and physiological characteristics, it has become practice to include the "fungi" in three separate Divisions. These major divisions of the plant kingdom are: 1) the Schizomycophyta including the bacteria and related organisms, 2) the Myxomycophyta including the several different groups of slime molds, and 3) the Eumycophyta or true fungi. In the restricted sense then, and as used herein, the term "fungi" is limited to those organisms included among the Eumycophyta.

The Eumycophyta in turn may be subdivided into a number of natural classes. In accordance with our present system of classification these are: 1) Chytridiomycetes, 2) Hyphochytridiomycetes, 3) Oomycetes, 4) Plasmodiophoromycetes, 5) Zygomycetes, 6) Trichomycetes, 7) Ascomycetes, 8) Basidiomycetes, and 9) Deuteromycetes or Fungi Imperfecti. In older systems of classification the first six of the above classes were all included in a single class, the

Phycomycetes, a group that has in common only a simple, non-septate, multinucleate type of plant body. Since the phycomycetous fungi have so little in common and since including such a heterogeneous group of organisms in a single class tends to obscure some very important differences between them, the separation of these fungi into six distinct classes has received wide acceptance. The nine classes of true fungi listed above are distinguished from one another largely upon details of sexual reproduction and the nature of the flagellated spore, if present.

The Chytridiomycetes and Oomycetes are typically aquatic fungi although in each class there are numerous species that inhabit moist soil from which they may be readily isolated. The truly aquatic fungi are well adapted to their environment since all produce motile cells, zoospores and/or gametes, equipped with one or two flagella. The Chytridiomycetes are unique in that all species produce uniflagellate zoospores and gametes. The single flagellum is of the whiplash type and is posteriorly attached. Most chytrids are unicellular although there are a few species which develop a filamentous type of thallus. Only those species with filamentous thalli will be considered herein. Most chytrids are isogamous, reproducing sexually by the fusion of identical motile gametes. A few species, however, and particularly the filamentous members of the Chytridiomycetes are heterogamous, reproducing sexually by the fusion of gametes that are distinctly male or female. Only the filamentous chytrids belonging to the genera Allomyces, Monoblepharis, and Monoblepharella will be treated herein.

The Hyphochytridiomycetes, a small group of unicellular species, closely resemble the chytrids in their life cycles and body forms. They are unique, however, in the formation of zoospores that are anteriorly uniflagellate. The single flagellum is of the tinsel type provided with numerous lateral hair-like fibrils. Since there are no known filamentous hyphochytrids, no further consideration will be given to this group of aquatic fungi.

The Plasmodiophoromycetes, sometimes called the parasitic slime molds, are all obligate parasites of aquatic vascular plants, algae, or other phycomycetous fungi. Their inclusion among the classes of phycomycetous fungi is now accepted on the basis of their phycomycetous life cycles and type of zoospore. Most of these fungi form zoosporangial stages that are typically phycomycetous and zoospores that are unequally biflagellate. Both flagella are of the whip-lash type and are anteriorly attached; the longer flagellum directed posteriorly and trailing behind, the shorter flagellum directed forward when the spore is in motion. Since there are no filamentous species among the plasmodiophoraceous fungi, no further consideration will be given to this group of fungi.

The Oomycetes are unique in that all species produce equally biflagellate zoospores. The two flagella, one of the whip-lash type and one of the tinsel type, are attached either anteriorly or laterally. Most species are filamentous although a number of the more primitive Oomycetes are unicellular and resemble the chytrids in their form and structure. Only those aquatic species

with filamentous thalli will be considered herein. All members of the Oomycetes are oogamous. Sexual reproduction involves the fusion of a male gametangium or antheridium with a female gametangium or oogonium, the latter containing one to several eggs. Motile gametes are absent among the Oomycetes.

The Zygomycetes, a group of aplanetic phycomycetous fungi; and the so-called "higher fungi" belonging to the Ascomycetes, Basidiomycetes, and Deuteromycetes (Fungi Imperfecti) are typically terrestrial fungi and are strictly non-zoosporic. In each of these classes, however, at least a few species are known to occur, not uncommonly, as adventitious inhabitants of the aquatic environment. One group of Fungi Imperfecti commonly referred to as the "aquatic Hyphomycetes", is of particular interest to students of mycology. These bizarre filamentous fungi complete their entire life cycles submerged, growing in the vascular tissues of decomposing plant debris. They reproduce asexually by the formation of highly-modified, many-armed conidia of various types. Such non-motile asexual spores show a high degree of adaptation to an aquatic mode of existence. Since the fungi mentioned above are strictly non-zoosporic no further consideration will be given herein to these groups.

The Trichomycetes are simple, filamentous, phycomycete-like organisms of uncertain affinities. These little-known fungi are always found associated with various aquatic arthropods, their filamentous thalli attached to the exterior or in the digestive tract of the living hosts. Species of Trichomycetes will not be

considered herein.

In the strict sense, the term "water mold" is used to refer only to those filamentous Oomycetes included in the order Saprolegniales. The Oomycetes, in addition, include the orders Leptomitales and Peronosporales, many species of which are filamentous and zoosporic, and are frequently found in the same habitats as saprolegniaceous species. The Leptomitales closely resemble the Saprolegniales in the general development and appearance of the thallus and the diplanetic (dimorphic) nature of the zoospores. They differ, however, in the formation of regularly constricted hyphae and pedicellate reproductive structures, characteristics that are diagnostic for all leptomitaceous fungi. These fungi, with the exception of the genus Apodachlyella, form oogonia with a single oospore and the contents of the oogonium are clearly differentiated into ooplasm and periplasm. The latter characteristic is shared by the Peronosporales to which the leptomitaceous fungi are also related. The Peronosporales may be regarded as the "amphibians" of the fungus world; many species are strictly terrestrial and tend toward a parasitic mode of existence; other species are strictly aquatic and these may be parasitic or saprophytic; still other species, normally terrestrial and non-zoosporic, will behave as zoosporic species when exposed to an aquatic environment. The Peronosporales are unique in that the zoospores are cleaved out within a delicate evanescent vesicle formed at the mouth of the zoosporangium or if formed within the zoosporangium discharged into the vesicle prior to release. The frenzied milling

about of the zoospores within the vesicle is diagnostic for the peronosporaceous fungi.

In the broad sense and as the term is used here the water molds to be considered herein include not only the Saprolegniales but also the filamentous Leptomitales (including the genera Leptomitus, Apodachlya, and Apodachlyella), the aquatic Peronosporales (including the genera Pythium, Pythiogeton, Phytophthora, and Zoophagus), and those filamentous chytridiaceous fungi belonging to the genera Allomyces, Monoblepharis, and Monoblepharella.

Although the vegetative features of mycelial and zoosporangial development are generally regarded as too variable for use in specific taxonomic studies, it is precisely these features that are used to distinguish and separate the various genera of aquatic filamentous phycomycetous fungi. The following key with accompanying figures may be used to distinguish the genera and species of those aquatic filamentous Oomycetes known to occur in Illinois. All other aquatic filamentous phycomycetous fungi from Illinois are considered as an addendum to this paper.

Key to the Genera of Aquatic Filamentous Oomycetes from Illinois

1. Primary zoospores liberated from the zoosporangium to swim actively away without prior encystment (as in Pythiopsis or Saprolegnia) 2

1. Primary zoospores liberated from the zoosporangium to encyst at the orifice (as in Achlya); or primary zoospores encysting within the zoosporangium prior to liberation (as in Dictyuchus) 4

2. Primary zoospores liberated from the zoosporangium to swim actively away without prior encystment, later to settle down and to germinate directly to form hyphae; zoosporangia tending to be more spherical than elongate (fig. 1) . . . . . Pythiopsis

2. Primary zoospores liberated from the zoosporangium to swim actively away without prior encystment, later to encyst, the cysts germinating to give rise to secondary zoospores; zoosporangia elongate (figs. 10, 23) 3

3. Zoosporangia differentiated from and of greater diameter than the subtending hyphae; zoospores formed in more than one row in the zoosporangium (fig. 10) . . . . . Saprolegnia

3. Zoosporangia undifferentiated from and of the same diameter as the subtending hyphae; zoospores formed in a single row in the zoosporangium (fig. 23) . . . . . Leptolegnia

4. Primary zoospores liberated from the zoosporangium to encyst at the orifice (figs. 26, 33) later germinating to give rise to secondary zoospores 5

4. Primary zoospores encysting within the zoosporangium prior to liberation, later to germinate directly by germ tubes through the wall of the zoosporangium (fig. 71) or by the formation of secondary zoospores that escape through the wall of the zoosporangium (fig. 79) or by the formation of secondary zoospores that escape following the deliquescence of the zoosporangial wall (fig. 73). 7

5. Zoosporangia undifferentiated from and of the same diameter as the subtending hyphae; primary zoospores formed in a single row in the zoosporangium (fig. 26). . . . . Aphanomyces

5. Zoosporangia differentiated from and of greater diameter than the subtending hyphae; primary zoospores formed in more than one row in the zoosporangium (figs. 33, 68) 6

6. All of the primary zoospores encysting in a spherical clump at the mouth of the zoosporangium (fig. 33) . . . . . Achlya

6. Some of the primary zoospores encysting in an irregular clump at the mouth of the zoosporangium; some of the primary zoospores swimming actively away later to encyst (fig. 68) . . . . . Protoachlya

7. Oogonium containing more than one egg (fig. 72, 74) 8

7. Oogonium containing a single egg (fig. 80). 10

8. Encysted primary zoospores germinating directly by germ tubes which penetrate the zoosporangial wall (fig. 71). . . . . Aplanes

8. Encysted primary zoospores germinating by the formation of motile secondary zoospores (figs. 73, 79) 9

9. Encysted primary zoospores liberated by the deliquescence of the entire zoosporangial wall (fig. 73) . . . . . Thraustotheca

9. Encysted primary zoospores liberated by the deliquescence of only the apical portion of the zoosporangial wall (fig. 77) . . . . . Calyptralegnia

10. Mycelium consisting of well-developed, branched hyphae; secondary zoospores emerging through the zoosporangial wall leaving behind a network of primary zoospore cyst walls (figs. 79) . . . . . Dictyuchus

10. Mycelium consisting of depauperate, sparingly branched hyphae; primary zoospore cysts liberated by the deliquescence of the zoosporangial wall to float free prior to the emergence of motile secondary zoospores (fig. 90) or motile secondary zoospore stage entirely lacking (fig. 99) 11

11. Encysted primary zoospores formed in more than one row in the zoosporangium (fig. 93) . . . . . Brevilegnia

11. Encysted primary zoospores formed in a single row in the zoosporangium (fig. 99) . . . . . Geolegnia

Genus: Pythiopsis de Bary

Bot. Zeitung, 46: 609. 1888.

The genus Pythiopsis was established to include a small group of water molds of unique characteristics and of infrequent occurrence. Isolates of Pythiopsis produce zoospores of the primary type only. These are formed in zoosporangia that are short and plump, tending to be more spherical than elongate, and are usually provided with a distinct apical papillae. Secondary zoosporangia develop on short lateral stalks from below and tend to form in clusters. Zoospore discharge is saprolegnoid; the primary zoospores swim actively, encyst, and germinate to produce a mycelium (fig. 1). This condition is said to be monoplanetic (monomorphic) in contrast to the diplanetic (dimorphic) condition found for example, in species of Saprolegnia. Isolates of Pythiopsis produce gemmae in abundance and often in chains. These resemble zoosporangia in appearance and may function as zoosporangia after a period of dormancy. Most isolates of Pythiopsis produce oogonia in culture without difficulty. When immature, the oogonia resemble the zoosporangia and gemmae in shape and size being typically spherical to pyriform. At maturity, the oogonia contain a single (rarely 2-3) eccentric oospore. The antheridia are short and thick, typically androgynous (rarely diclinous) and originate close to the oogonium (fig. 2).

Pythiopsis cymosa de Bary

Bot. Zeitung, 46: 631. 1888.

Fig. 1. Filaments of *Pythiopsis cymosa* bearing zoosporangia. Note that the zoosporangia are spherical and that only primary zoospores are formed, these encysting later to germinate directly to form hyphae.

Fig. 2. Oogonia and antheridia of *Pythiopsis cymosa*. Note that the oogonial wall is unpitted and sparsely ornamented; that the single subeccentric oospore nearly fills the oogonium; and that the short, stout, androgynous antheridial branches originate near the base of the oogonium.

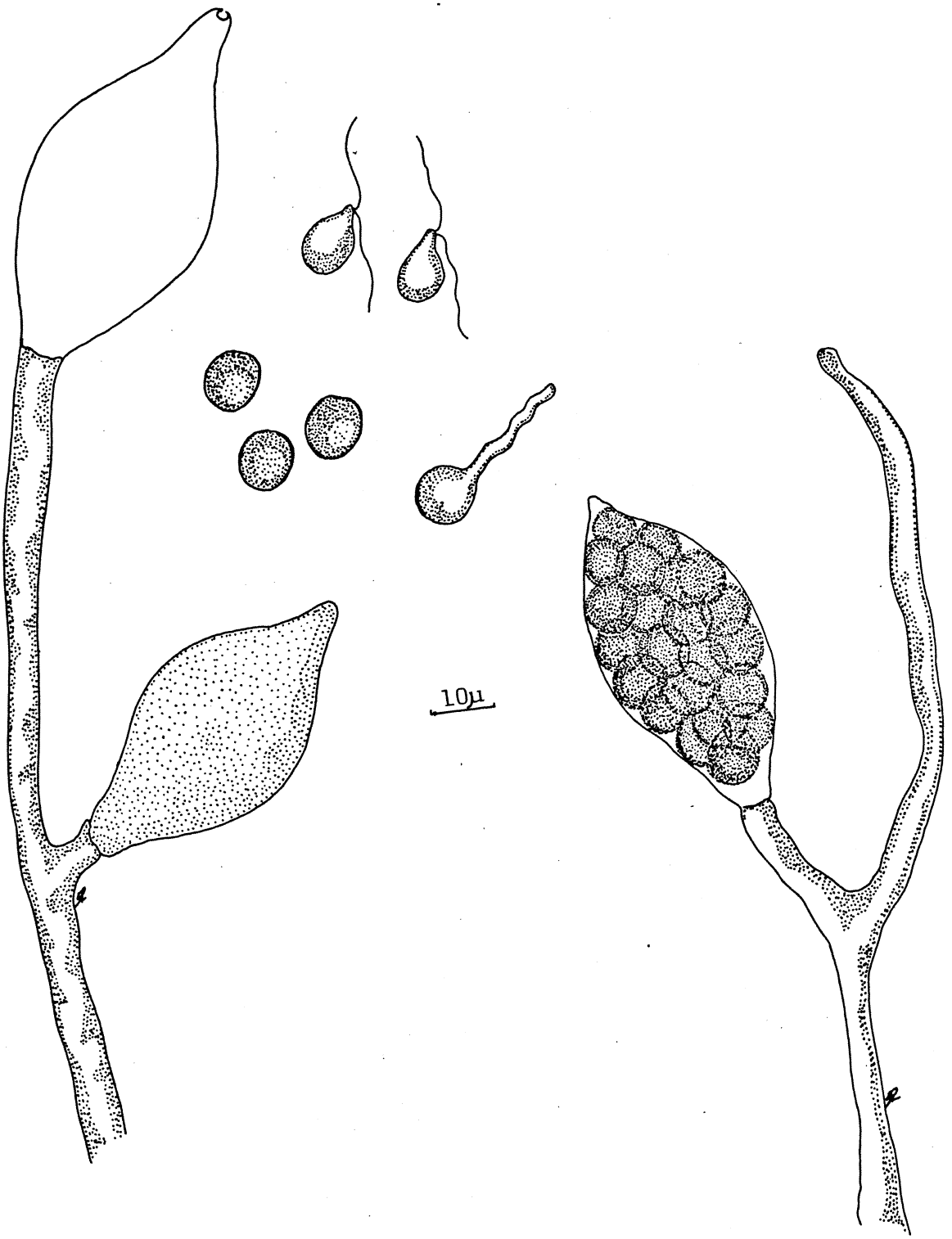

Fig. 1

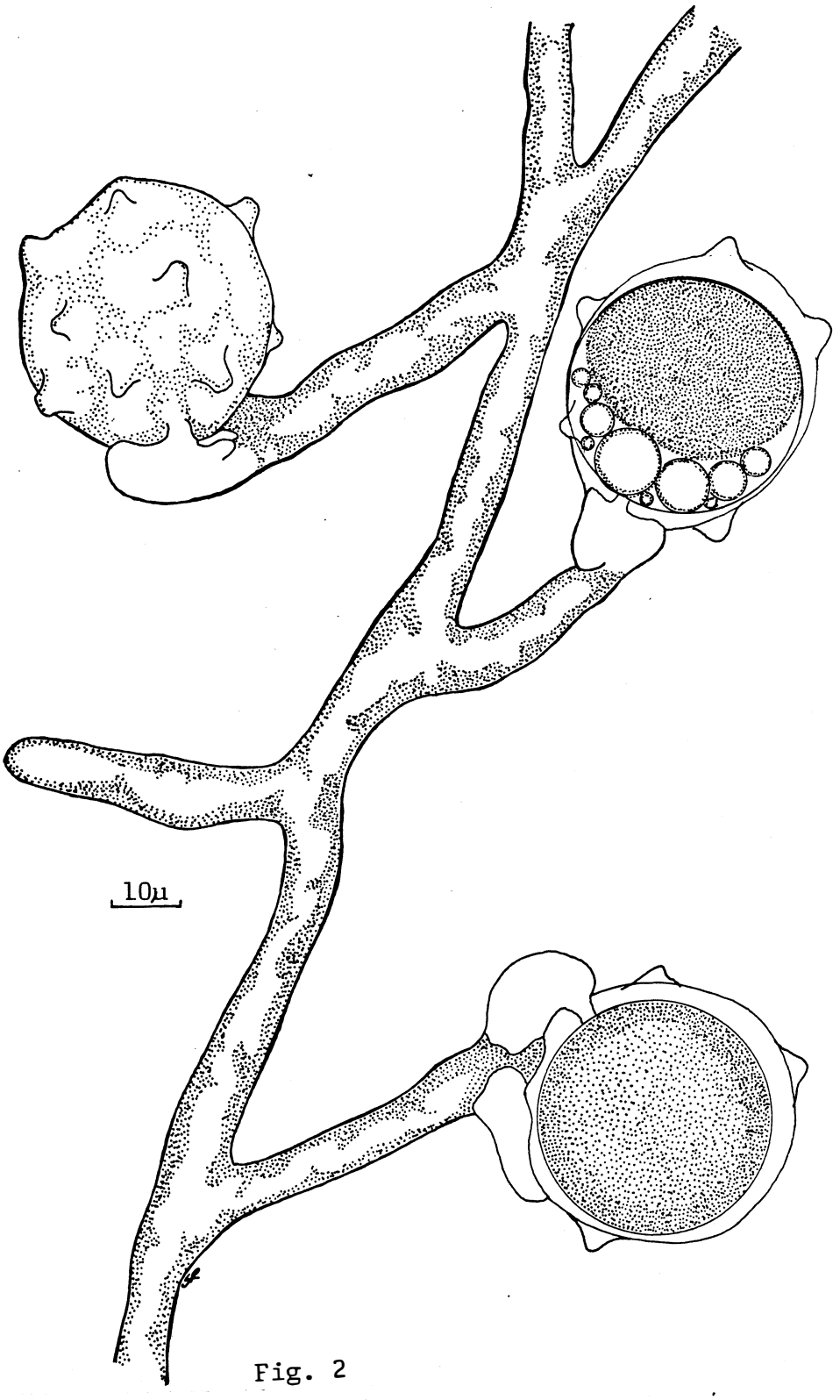

Fig. 2

Genus: Saprolegnia C. G. Nees

Nova Acta Acad. Leop.-Carol., 11: 513. 1813.

The genus Saprolegnia, comprising more than fifty reported taxa, is a relatively large but well-known group of water molds. Most isolates of Saprolegnia are readily recognized by the size, shape, and method of renewal of the zoosporangium; and by the type of zoospore discharge exhibited. The zoosporangia are usually terminal and of greater diameter than the subtending hyphae; are usually clavate, cylindrical, or filiform in shape; and are usually renewed by internal proliferation (fig. 10). Although zoosporangial renewal by internal proliferation is extremely common throughout the genus and may be used as a diagnostic characteristic, zoosporangial renewal by cymose branching and/or by basipetalous succession is relatively frequent in certain species, and in all species these variations are enhanced by unfavorable cultural conditions. Zoosporangial renewal by sympodial branching is not commonly encountered among species of Saprolegnia. The typical method of zoospore discharge in the genus Saprolegnia is termed saprolegnoid and involves the rapid emergence of the primary zoospores one by one through one terminal exit pore (rarely more than one and rarely through a lateral pore). The primary zoospores swim actively away from the zoosporangium and after a period of motility they encyst. In most species, particularly under unfavorable cultural conditions, zoospore discharge may be aplanoid or dictyoid. Following a relatively short period of rest from the primary zoospore cysts

emerge laterally biflagellate secondary zoospores. These swim actively, later encyst and give rise to vegetative hyphae.

Most species of Saprolegnia form gemmae (chlamydospores), modified thick-walled segments of the hyphae in which there occurs a dense accumulation of protoplasm. Gemmae may occur normally or in response to unfavorable cultural conditions. These resistant bodies may germinate directly into a new mycelium or may function as a zoosporangium or, less frequently, as an oogonium.

Although the vegetative and asexual characteristics mentioned above are useful in deciding if an unknown isolate under observation belongs to the genus Saprolegnia or not, these characteristics are not dependable taxonomic features at the species level. The separation and identification of species of Saprolegnia, as in other genera of water molds, depends upon a combination of characters associated with the male and female reproductive organs. These include the number and type of oospore, oogonial wall ornamentation and pitting, oogonial shape and position, antheridial branch origin, length and appearance of the oogonial stalk, and the size of oogonia and oospores.

The generic concepts of Saprolegnia, as now understood, have been expanded to include those species which formerly belonged to the genus Isoachlya (Seymour, 1970). The genus Isoachlya was characterized and distinguished by the presence of cymose branching as in Achlya and/or internal proliferation as in Saprolegnia, as the mode of formation of secondary

zoosporangia, coupled with dimorphic zoospores swimming as in Saprolegnia. Since cymose branching as a mode of zoosporangial renewal is an accepted characteristic in several species of Saprolegnia, there is no justification for the separation of these genera. The generic name Isoachlya no longer has any taxonomic significance and those species formerly referred to that genus are regarded herein as members of the genus Saprolegnia.

Key to the Illinois Species of *Saprolegnia*

1. Oogonial walls ornamented. 2
1. Oogonial walls smooth, never ornamented. 3
   2. Oogonial walls densely papillate (fig. 3). . . . . *S. asterophora*
   2. Oogonial walls sparsely and irregularly papillate (fig. 4) . . . . . *S. subterranea*
3. Oospores eccentric or subeccentric 4
3. Oospores centric or subcentric 5
   4. Oospores mostly more than 3 per oogonium; antheridial branches mostly diclinous; zoospores variable in size (fig. 5, 6). . . . . *S. anisospora*
   4. Oospores mostly less than 3 per oogonium; antheridia absent; zoospores uniform in size (fig. 7) . . . . . *S. eccentrica*
5. Oospores mostly more than 3 per oogonium 6
5. Oospores mostly less than 3 per oogonium 14
   6. Antheridia strictly hypogynous (fig. 8). . . . . *S. hypogyna*
   6. Antheridia monoclinous and/or androgynous, and/or diclinous, and/or completely lacking 7
7. Oogonial wall conspicuously thickened and pitted (fig. 9). . . . . *S. turfosa*
7. Oogonial wall relatively thin; pitted or unpitted. 8
   8. Antheridia completely lacking or present in variable numbers; oogonial wall conspicuously pitted (fig. 11, 12, 13). . . . . *S. ferax*

8. Antheridia usually present; oogonial wall pitted or unpitted 9

9. Oospores subcentric; antheridial branches mostly diclinous; oogonial wall unpitted (fig. 15) . . . . . S. parasitica

9. Oospores centric; antheridial branches variable; oogonial wall pitted or unpitted. 10

10. Antheridial branches mostly diclinous, rarely monoclinous or androgynous 11

10. Antheridial branches mostly monoclinous or androgynous rarely diclinous. 12

11. Antheridial branches mostly diclinous, persistent; oospores of equal size (fig. 16). . . . . S. diclina

11. Antheridial branches always diclinous, not persistent; oospores of variable size (fig. 17). . . . . S. toruloides

12. Oogonial wall sparsely but conspicuously pitted; oospores relatively large (av. 32 μ in diam.) (fig. 18). . . . . S. litoralis

12. Oogonial wall abundantly and conspicuously pitted; oospores relatively small (av. 22-25 μ in diam.) 13

13. Antheridial branches contorted, irregular, and glomerate; hyphal branches clustered and contorted (fig. 19). . . . . S. glomerata

13. Antheridial branches not contorted or irregular or glomerata; hyphal branches not clustered or contorted (figs. 12, 13). . . . . S. ferax

14. Antheridia present. 15

14. Antheridia absent (fig. 20) . . . . . S. unispora

15. Antheridial branches mostly monoclinous; oogonial stalks simple (fig. 21) . . . . . S. megasperma

15. Antheridial branches mostly androgynous; oogonial stalks frequently branched (fig. 22). . . . . S. subterranea

Saprolegnia asterophora de Bary

Jahrb. wiss. Bot., 2: 189. 1860.

Fig. 3. Oogonia and antheridia of Saprolegnia asterophora. Note the densely papillate nature of the oogonial wall and the subeccentric oospores.

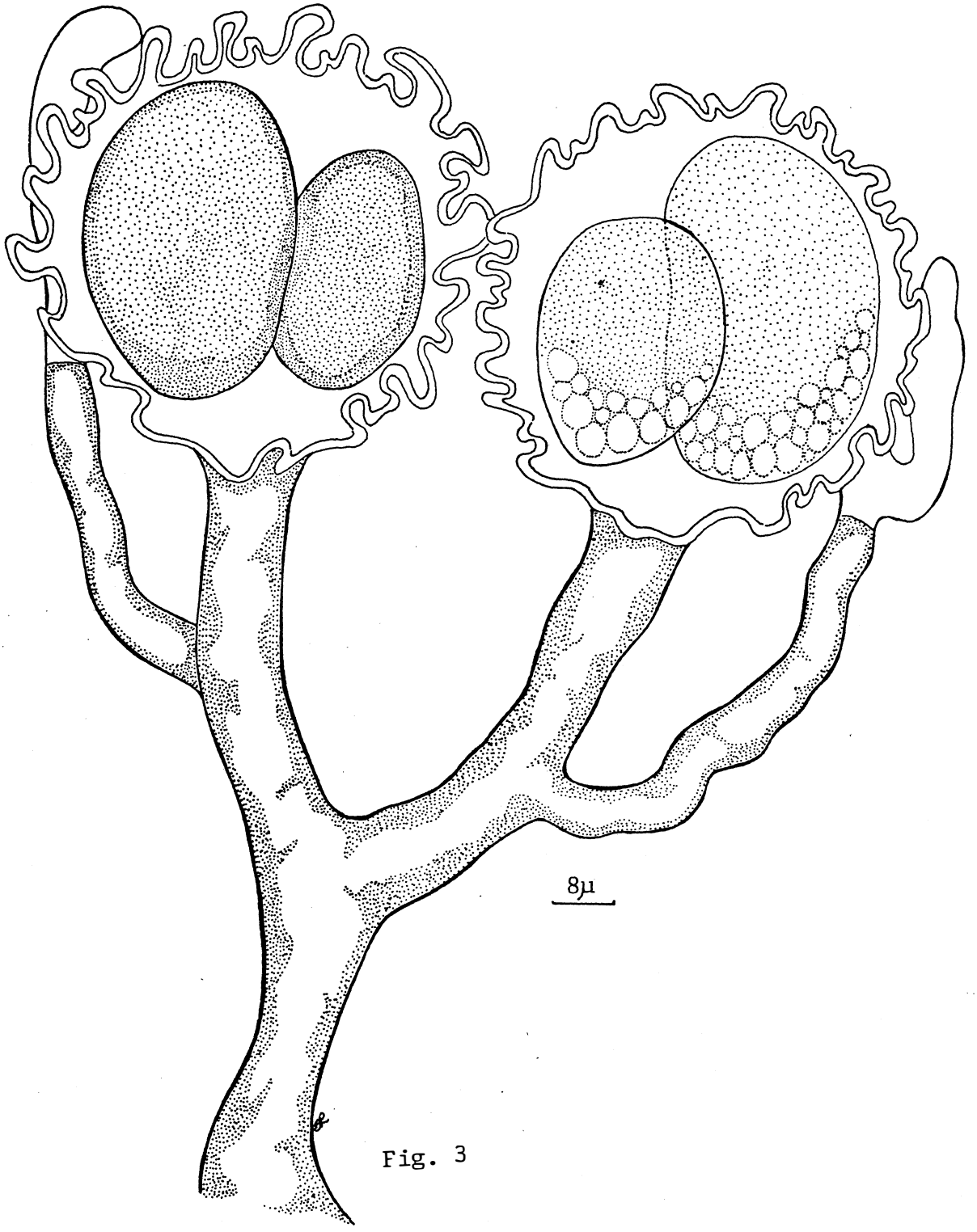

Fig. 3

Saprolegnia subterranea (Dissmann) Seymour

Nova Hedwigia, 19: 59. 1970.

Fig. 4. Oogonia and antheridia of Saprolegnia subterranea. Note the sparsely papillate nature of the oogonial walls. In most isolates only a few oogonia exhibit this character.

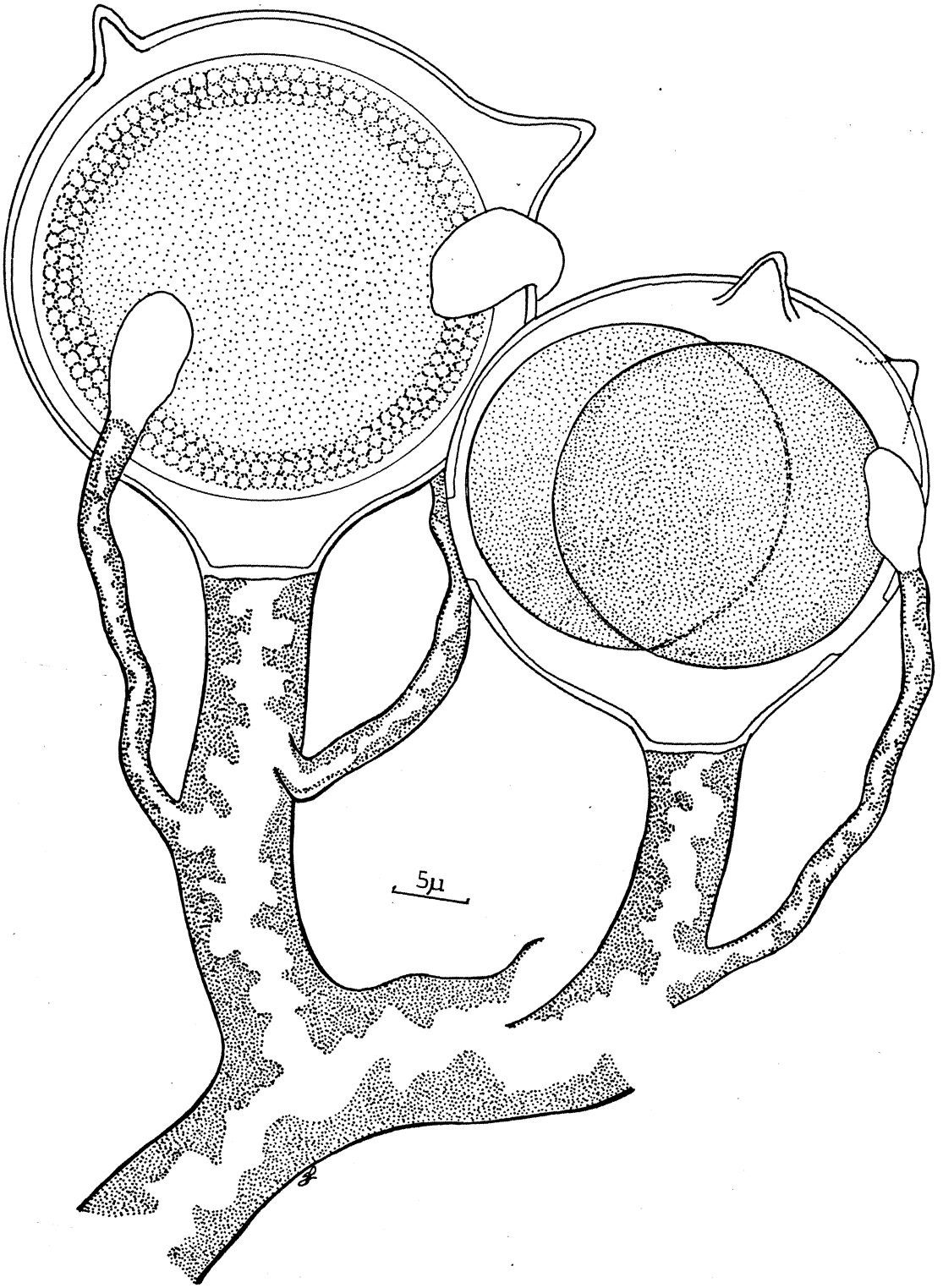

Fig. 4

Saprolegnia anisospora de Bary

Bot. Zeitung, 46: 619. 1888.

Fig. 5. Filaments of Saprolegnia anisospora bearing zoosporangia. Note that zoosporangial renewal may occur by internal proliferation or by cymose branching, and that the primary zoospores are variable in size.

Fig. 6. Oogonia and antheridia of Saprolegnia anisospora. Note that the oospores are eccentric and occur more than 3 per oogonium, and that the antheridial branches are mostly diclinous.

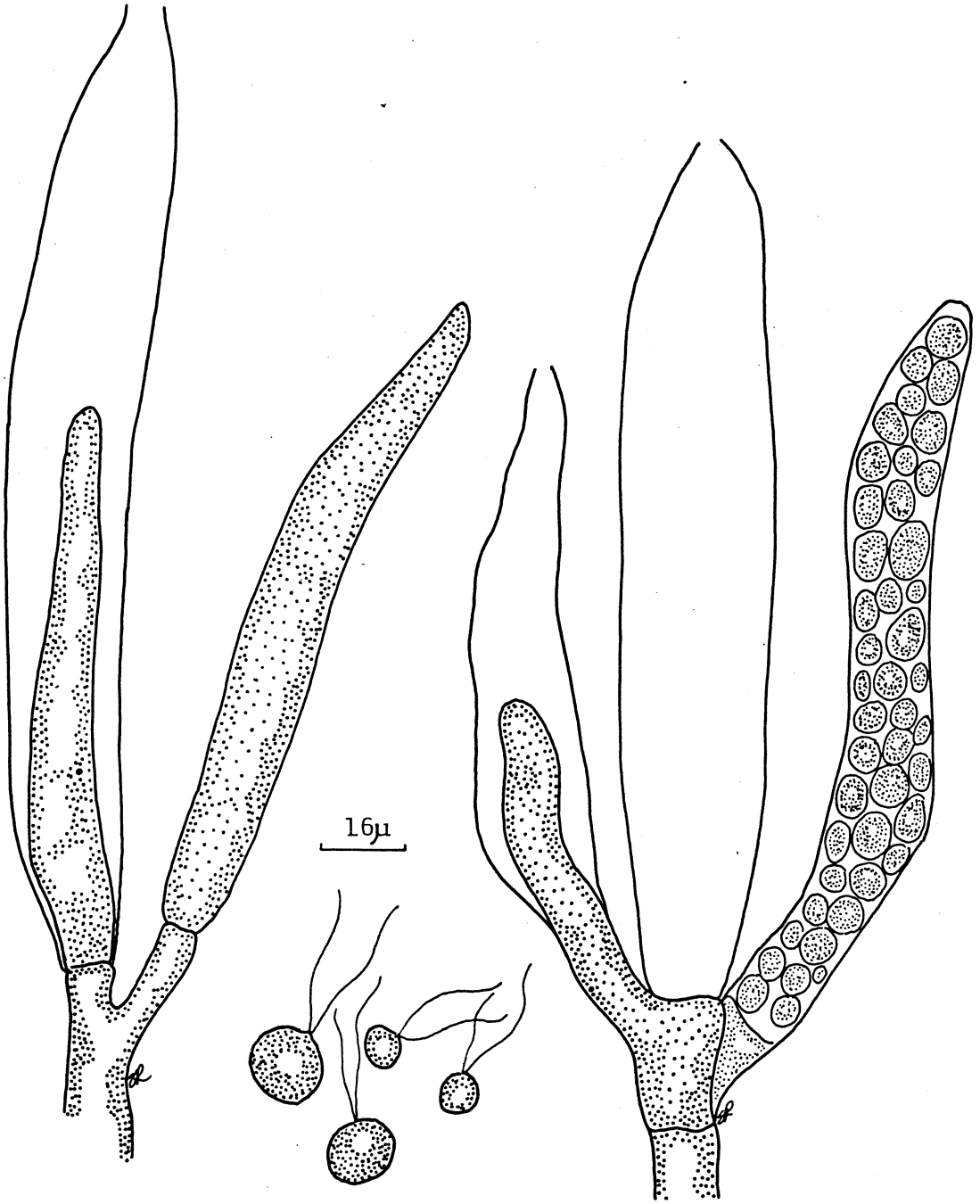

Fig. 5

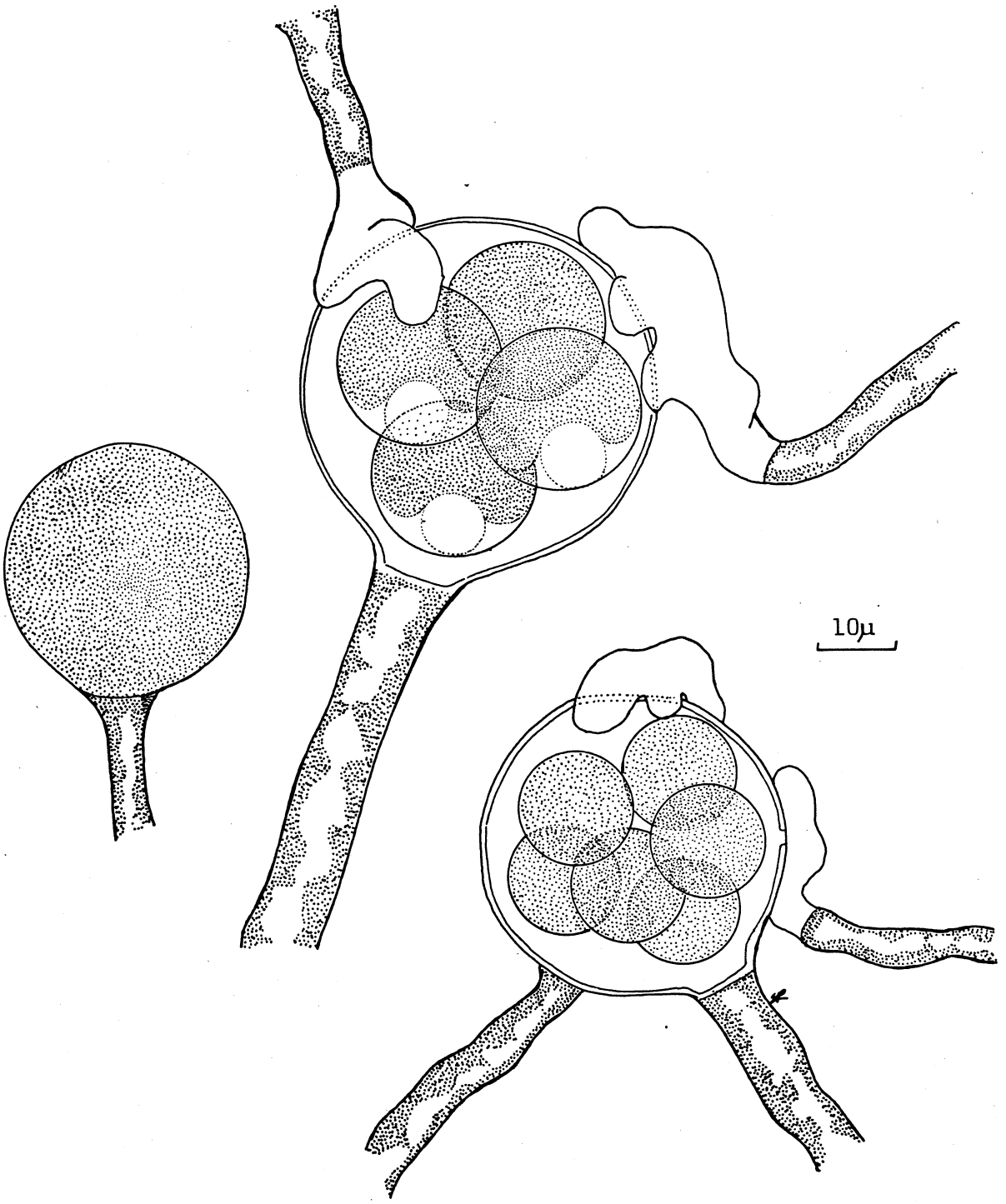

Fig. 6

Saprolegnia eccentrica (Coker) Seymour

Nova Hedwigia, 19: 53. 1970.

Fig. 7. Oogonia of Saprolegnia eccentrica. Note that the oospores are eccentric and are few in number, and that the antheridia are entirely absent.

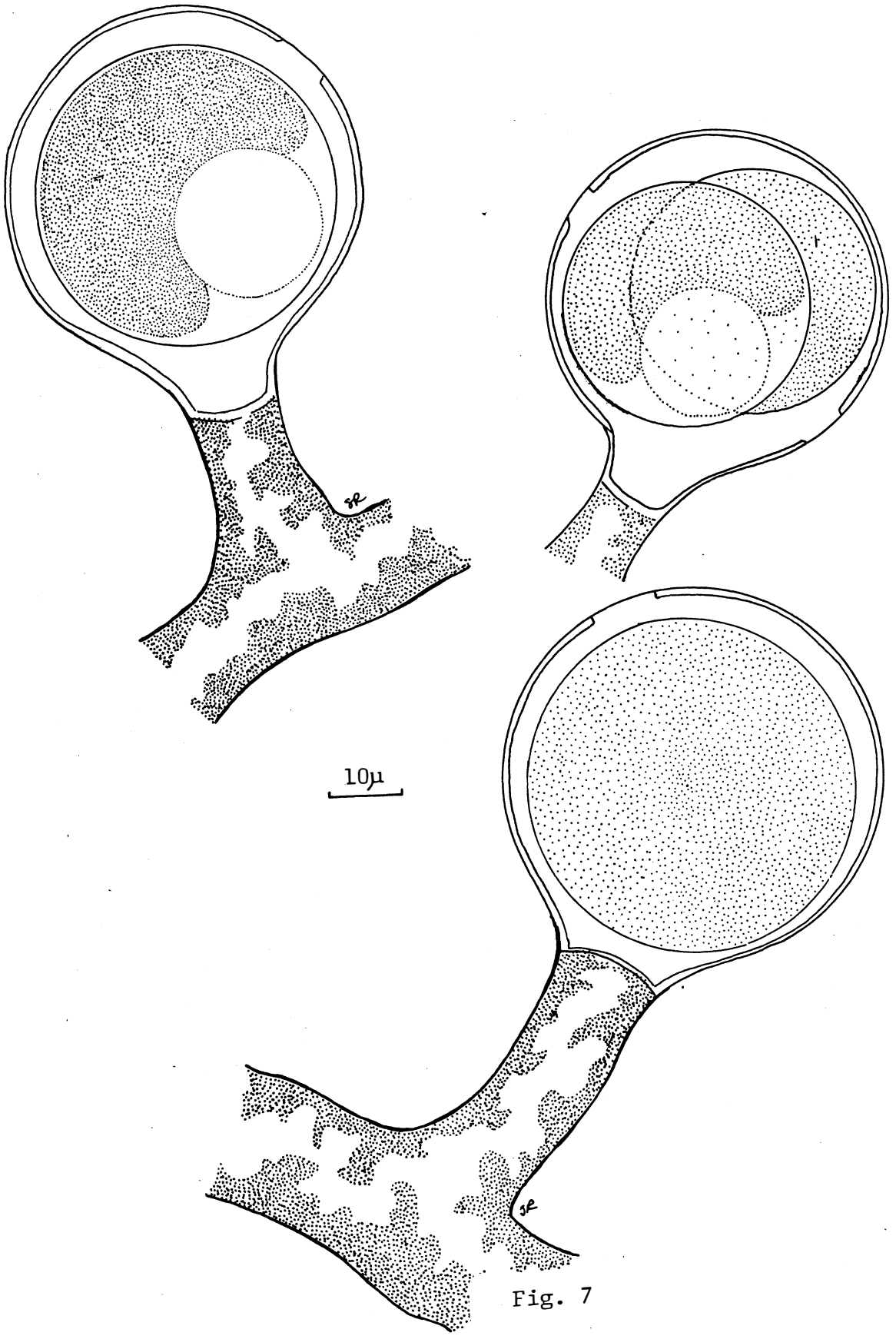

Fig. 7

Saprolegnia hypogyna (Pringsheim) de Bary

Bot. Zeitung, 41: 56. 1883.

Fig. 8. Oogonia and antheridia of Saprolegnia hypogyna. Note that the oospores are centric and numerous, the conspicuously pitted oogonia are borne on relatively long oogonial stalks, and that the antheridial cells are entirely hypogynous.

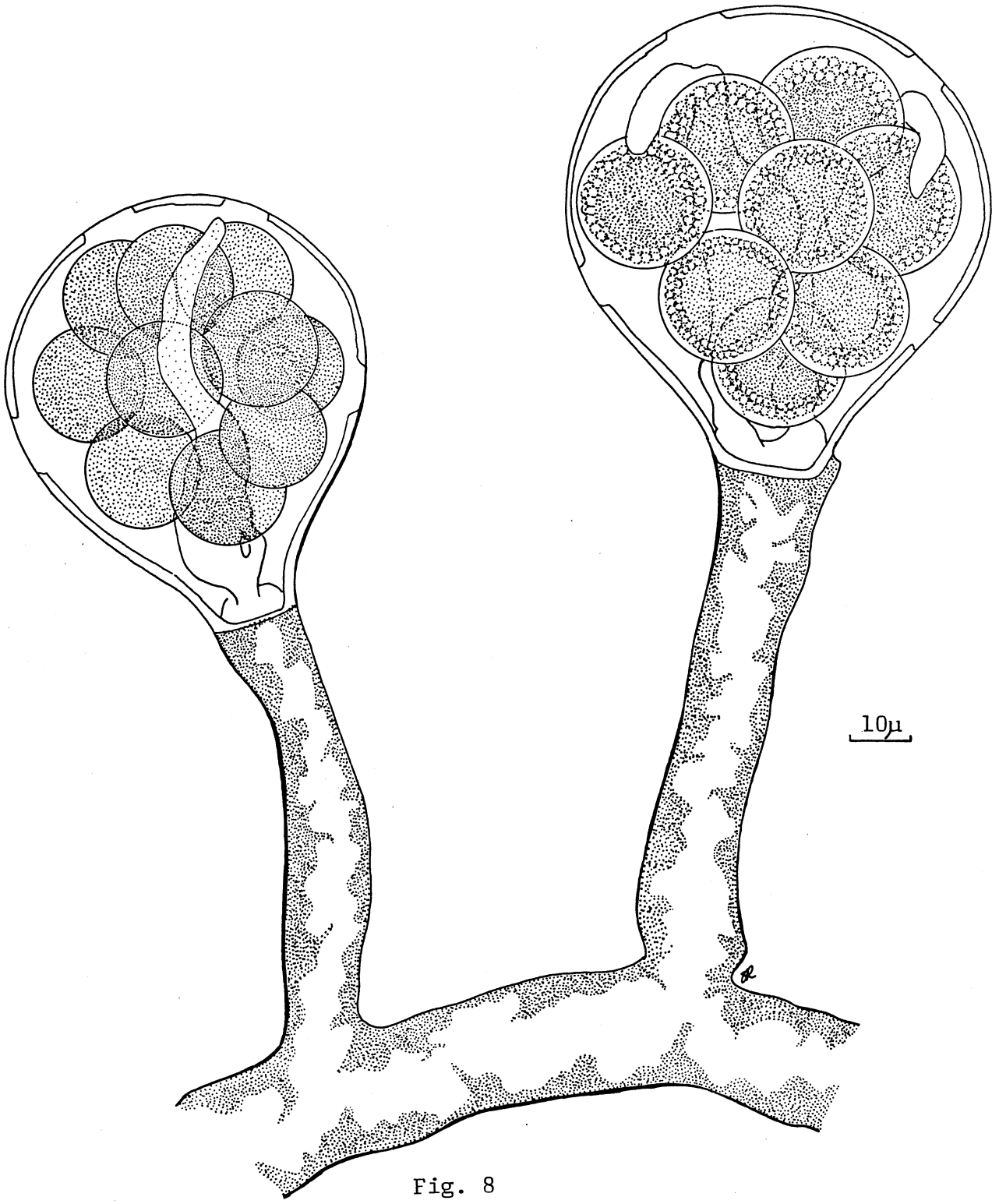

Fig. 8

Saprolegnia turfosa (Minden) Gaumann

Botaniska Notiser, 1918-19: 154. 1918.

Fig. 9. Oogonia and antheridia of Saprolegnia turfosa. Note that the oospores are centric and numerous, that the large conspicuously pitted oogonia have greatly thickened walls and are borne on relatively short stalks, and that the short antheridial branches are mostly of androgynous origin.

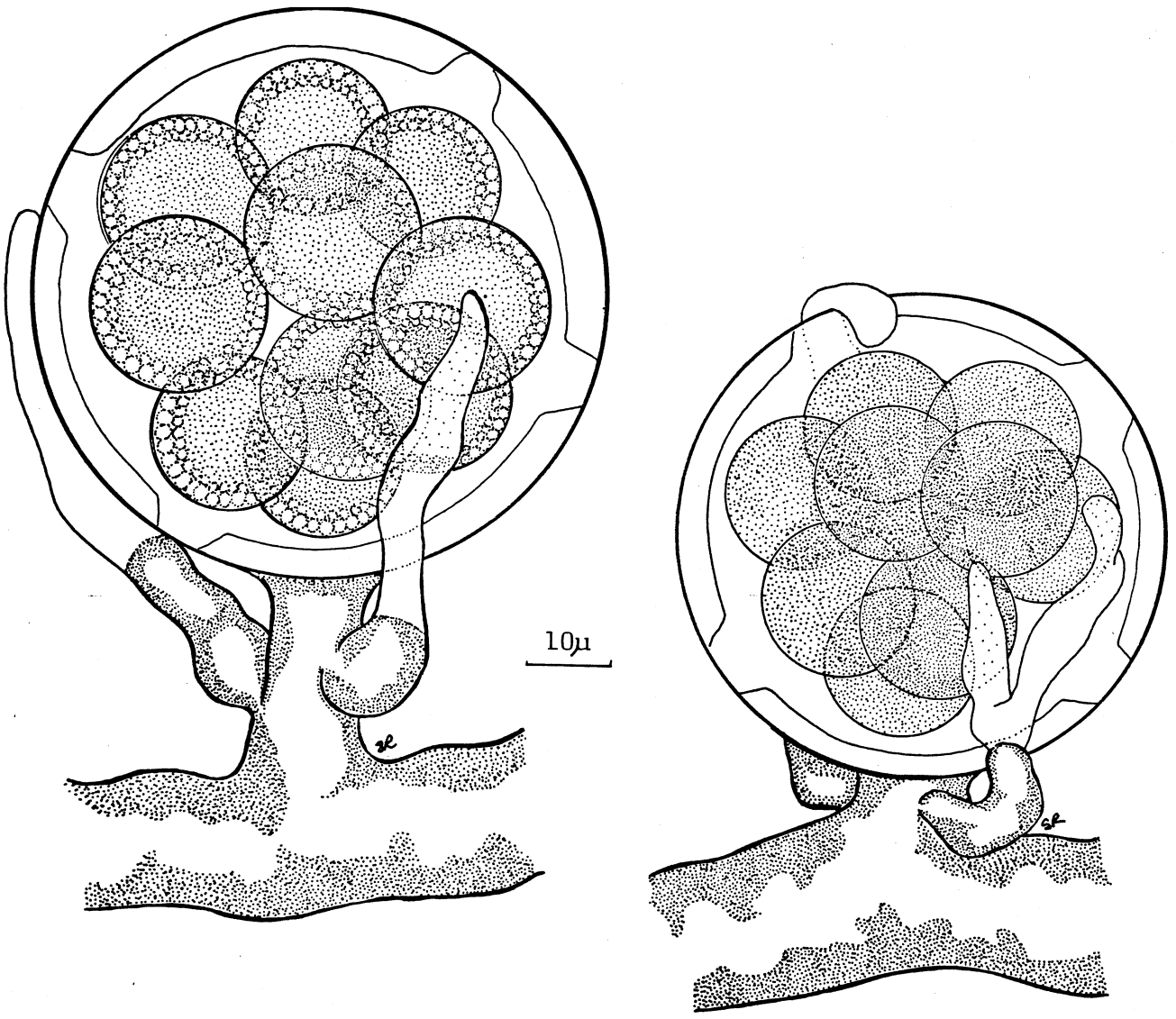

Fig. 9

Saprolegnia ferax (Gruith.) Thuret

Ann. Sci. Nat. Bot., Ser. III, 14: 214. 1850.

Fig. 10. Filaments of Saprolegnia ferax bearing zoosporangia. Note that the differentiated zoosporangia are elongate with the primary zoospores formed in several rows and that the zoosporangia are renewed by internal proliferation.

Fig. 11. Oogonia of Saprolegnia ferax. Note that the oospores are centric and numerous, that the oogonial wall is conspicuously pitted, and that antheridia are entirely absent or present on less than 10% of the oogonia.

Fig. 12. Oogonia and antheridia of Saprolegnia ferax (Syn. S. mixta). Note that antheridia occur on about 50% of the oogonia.

Fig. 13. Oogonia and antheridia of Saprolegnia ferax (Syn. S. monoica). Note that the antheridia occur on nearly all of the oogonia.

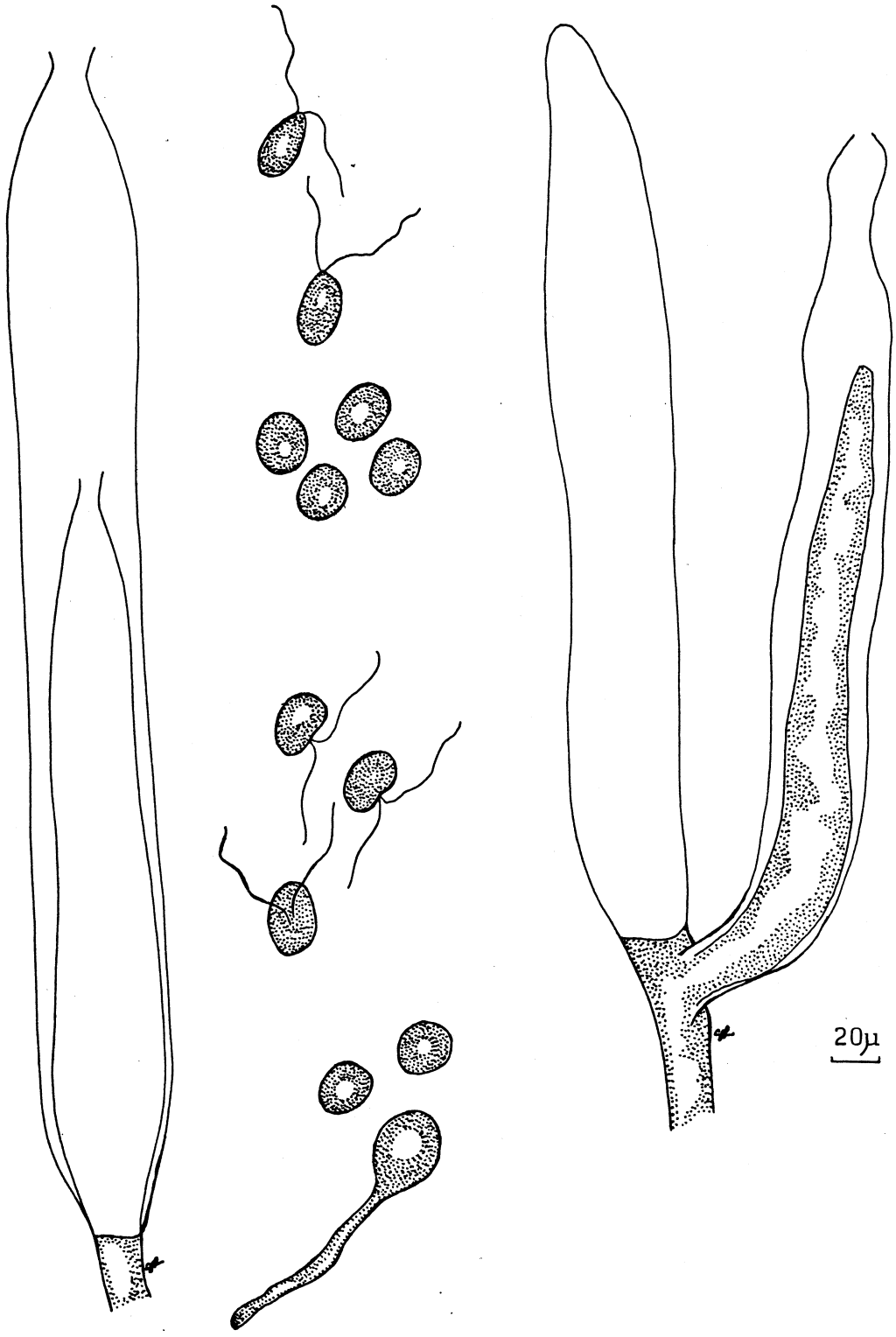

Fig. 10

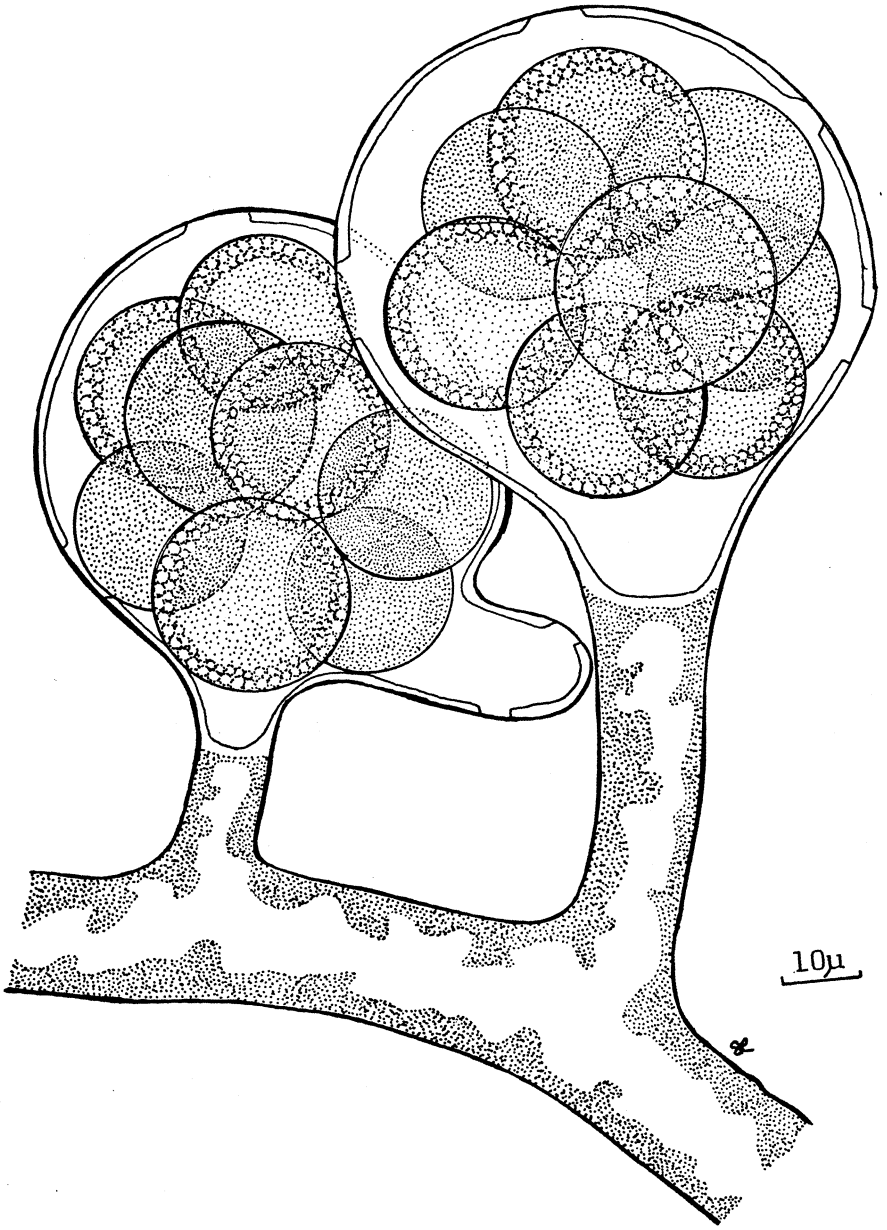

Fig. 11

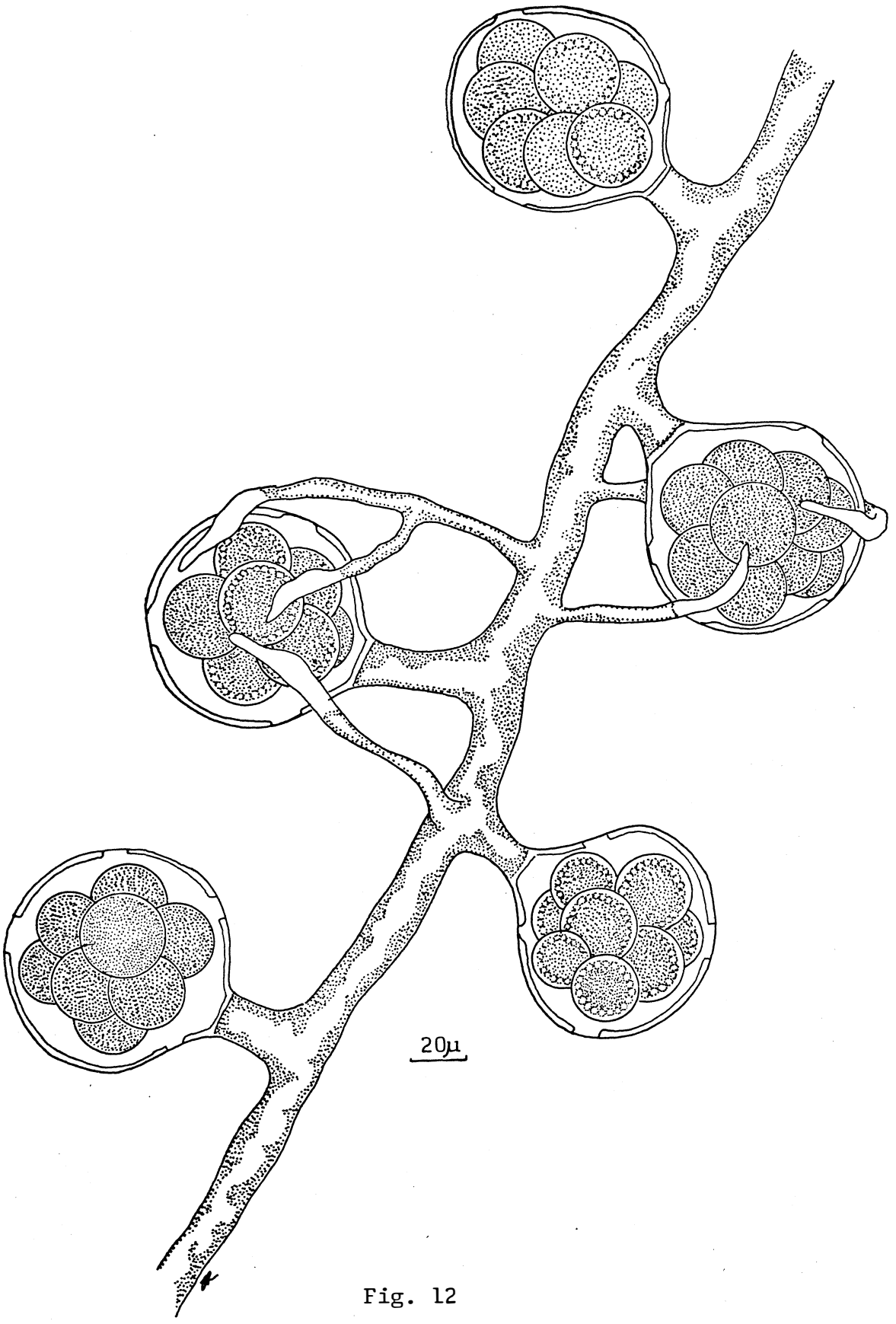

Fig. 12

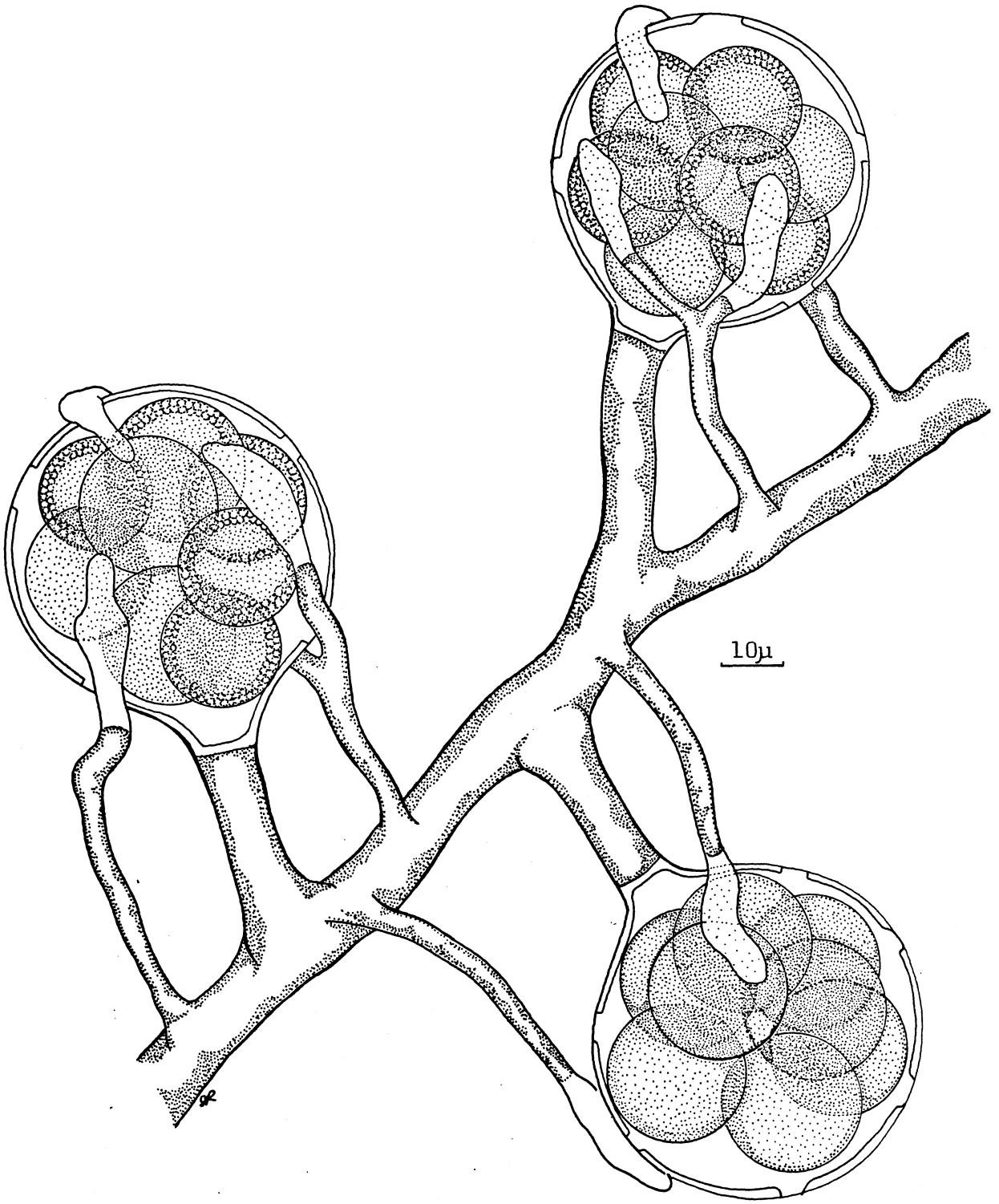

Fig. 13

Saprolegnia parasitica Coker

Saprolegniaceae, p. 57. 1923.

Fig. 14. Filaments of Saprolegnia parasitica bearing zoosporangia. Note that zoosporangial renewal may occur by internal proliferation or laterally in basipetalous succession.

Fig. 15. Oogonia and antheridia of Saprolegnia parasitica. Note that the numerous oospores are subcentric, that the oogonial wall is unpitted, and that the antheridia branches are mostly diclinous.

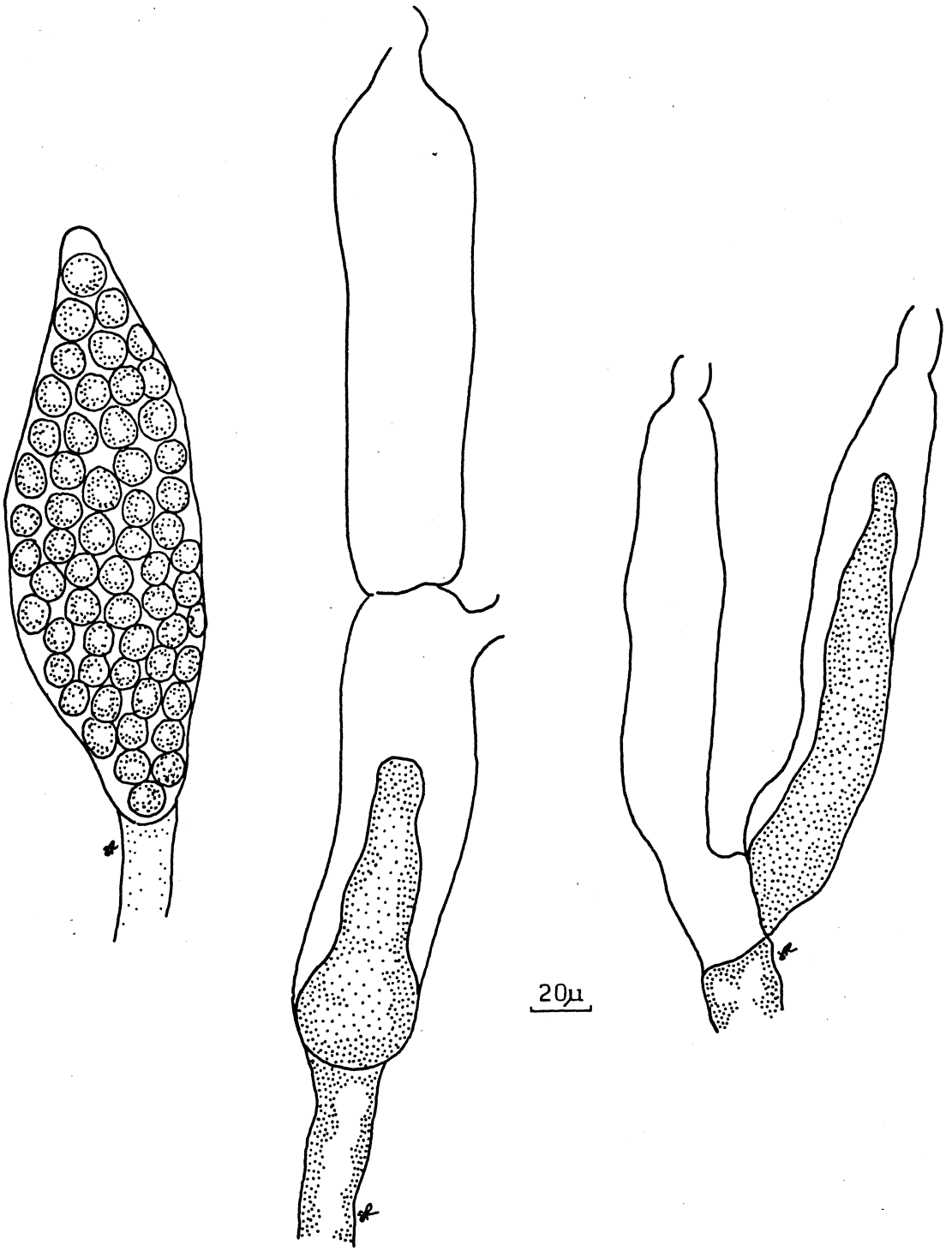

Fig. 14

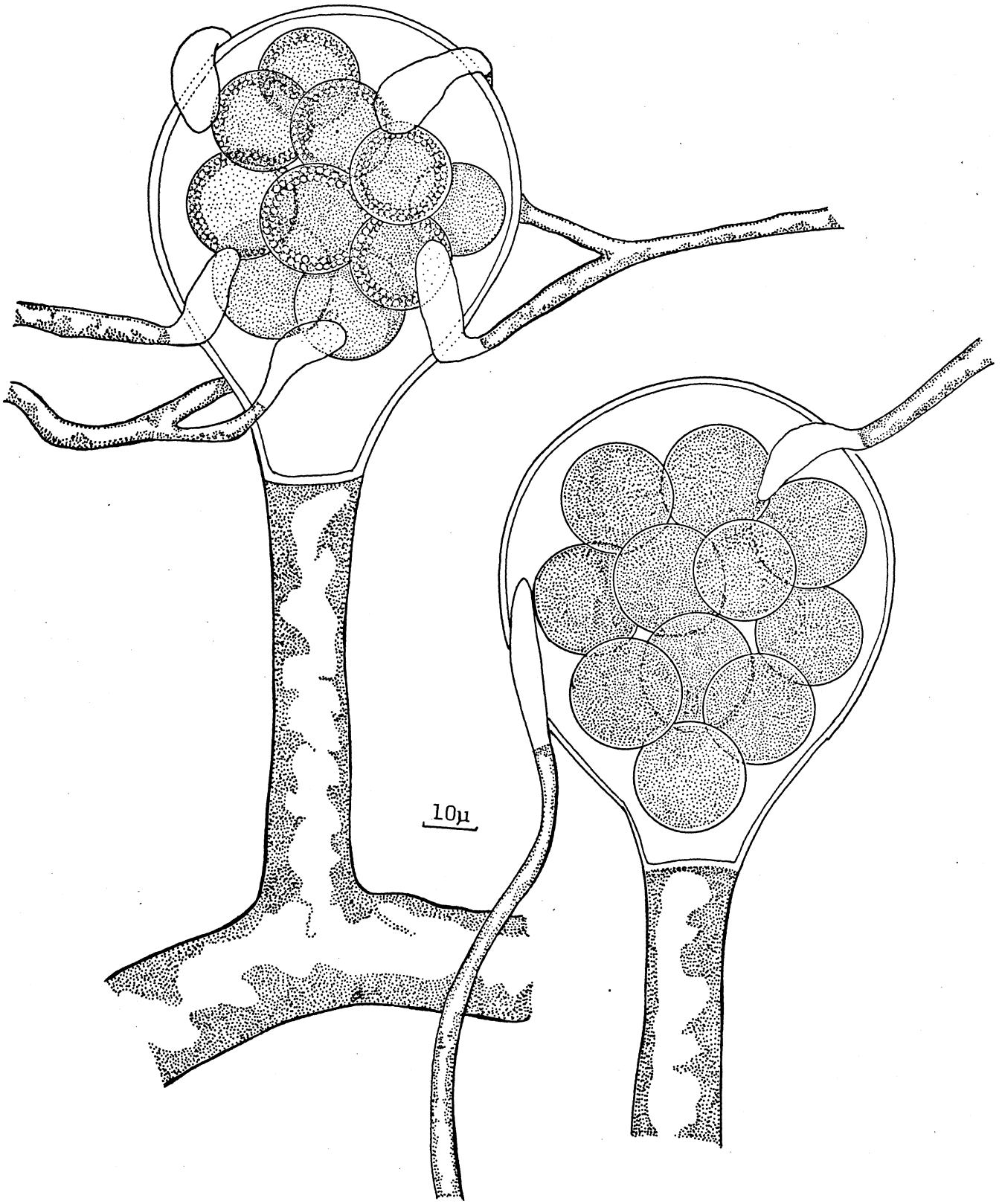

Fig. 15

Saprolegnia diclina Humphrey

Trans. Amer. Phil. Soc., 17: 109. 1893.

Fig. 16. Oogonia and antheridia of Saprolegnia diclina. Note that the numerous oospores are centric, that the oogonial wall is unpitted, and that the antheridial branches are mostly diclinous

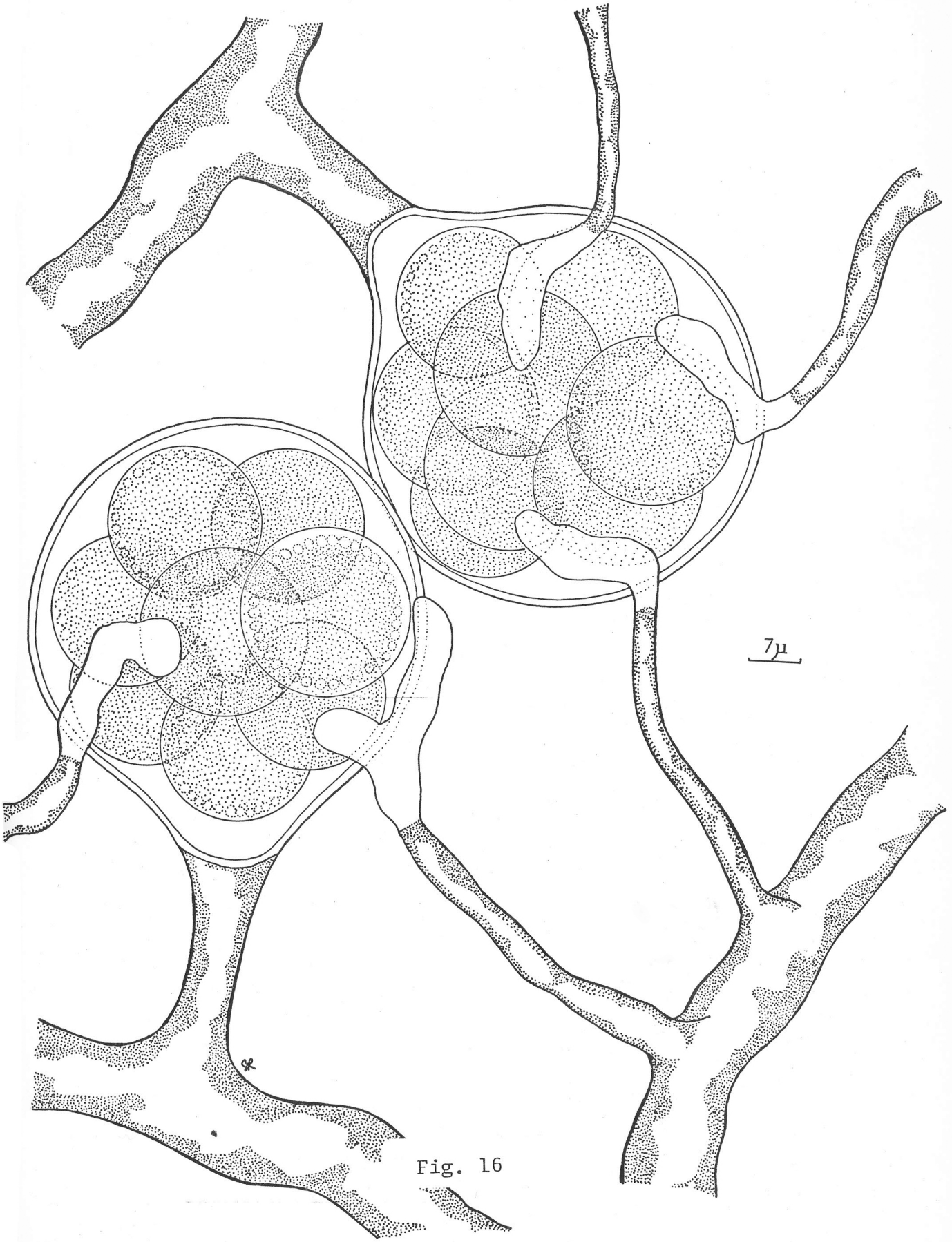

Fig. 16

Saprolegnia toruloides (Kauffman and Coker) comb. nov.

(Syn. Isoachlya toruloides Kauffman and Coker)

Amer. J. Bot., 8: 231. 1921.

Fig. 17. Oogonia and antheridia of Saprolegnia toruloides. Note that the oospores are centric and variable in size; and that the delicate antheridial branches are diclinous and are not persistent.

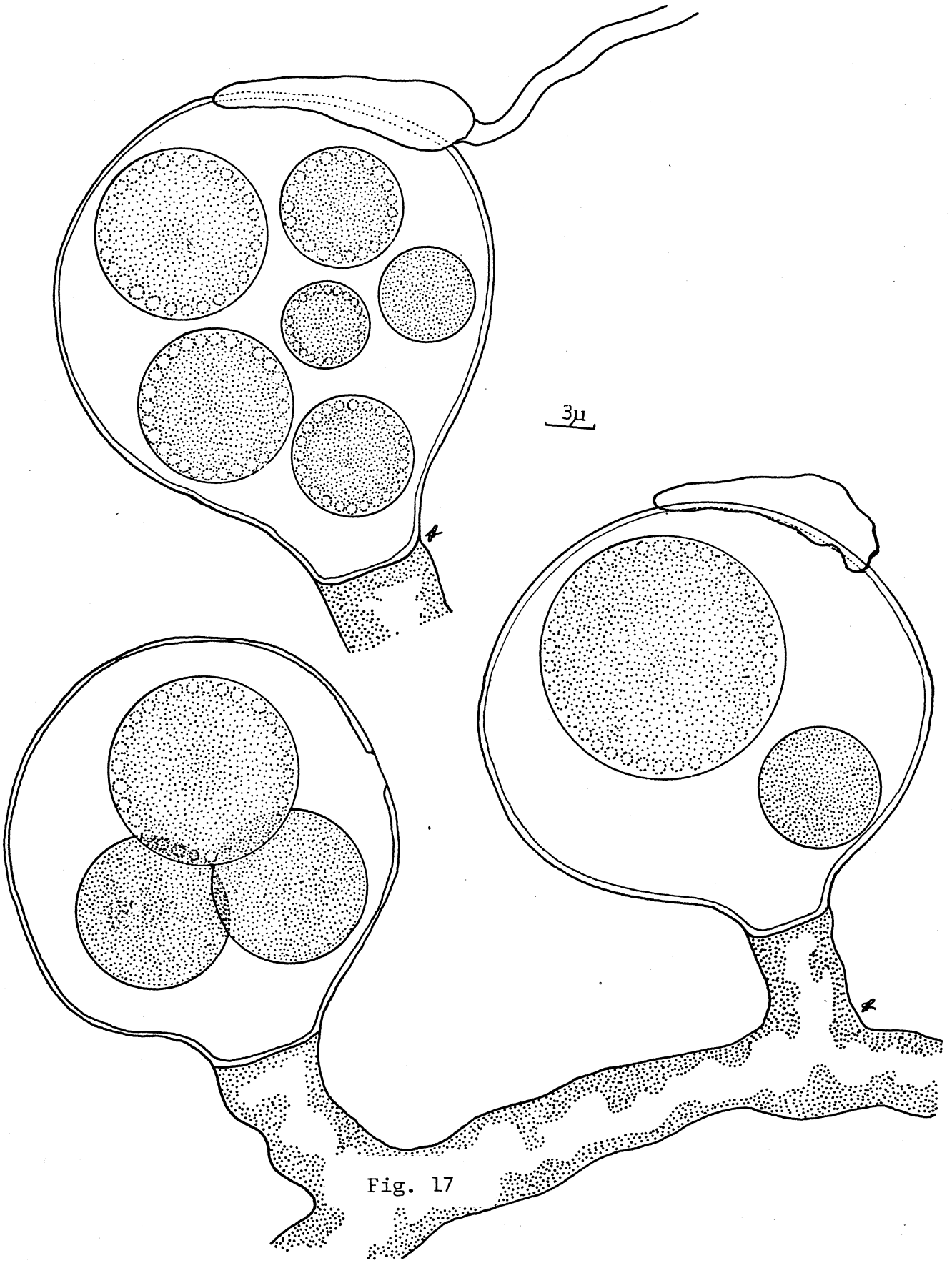

Fig. 17

Saprolegnia litoralis Coker

Saprolegniaceae, p. 54. 1923.

Fig. 18. Oogonia and antheridia of Saprolegnia litoralis. Note that the oospores are centric and relatively large, that the oogonial wall is sparsely but conspicuously pitted, and that the antheridial branches are mostly androgynous.

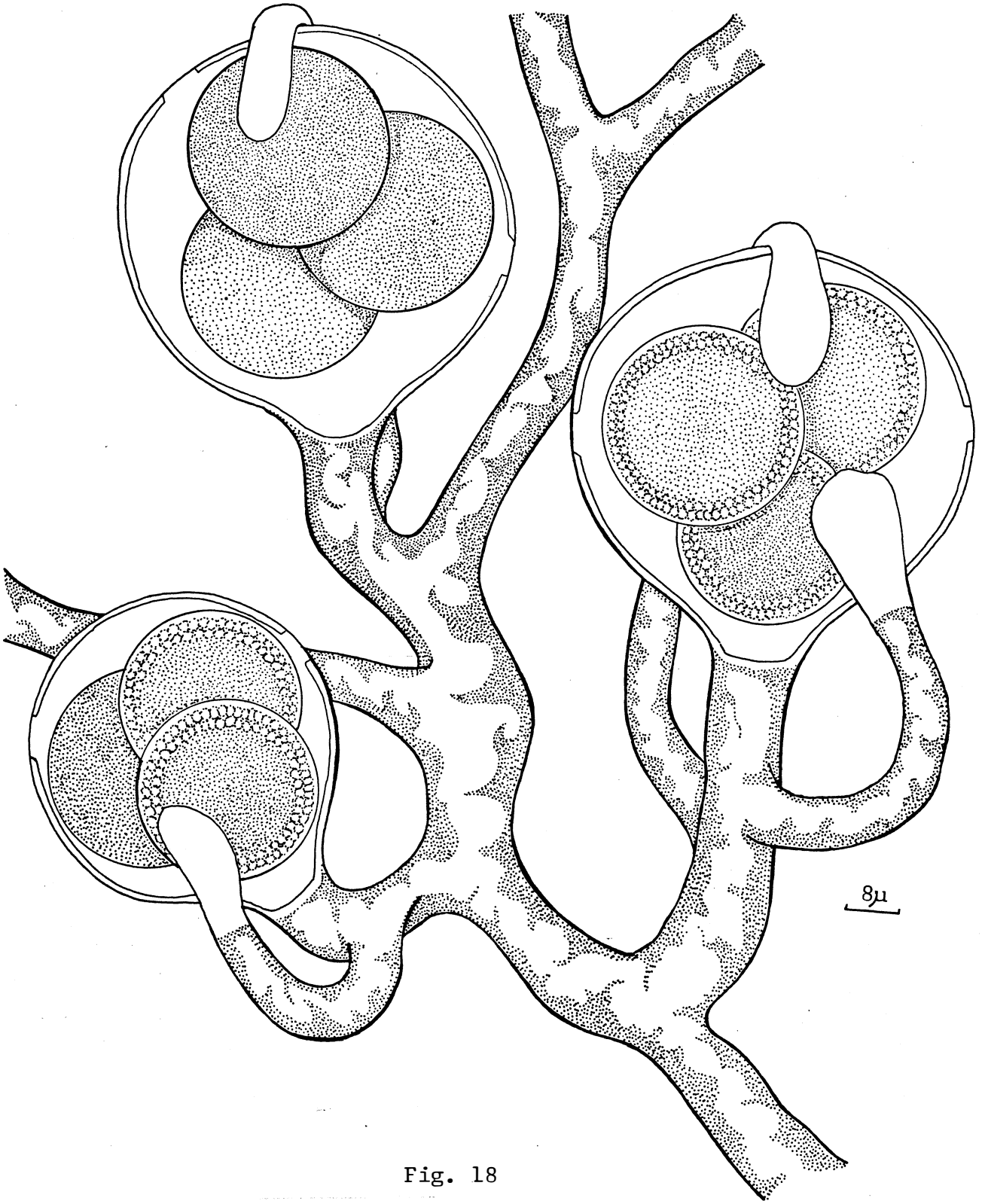

Fig. 18

Saprolegnia glomerata (Tiesenhausen) Lund

Kgl. Danske Vidensk. Selsk. Skrift., Naturv. Math., Afd. IX, 6: 14. 1934.

Fig. 19. Oogonia and antheridia of Saprolegnia glomerata. Note that the oospores are centric and relatively small, that the oogonial wall is abundantly and conspicuously pitted, and that the antheridial branches are mostly androgynous or monoclinous and are irregularly contorted and clustered.

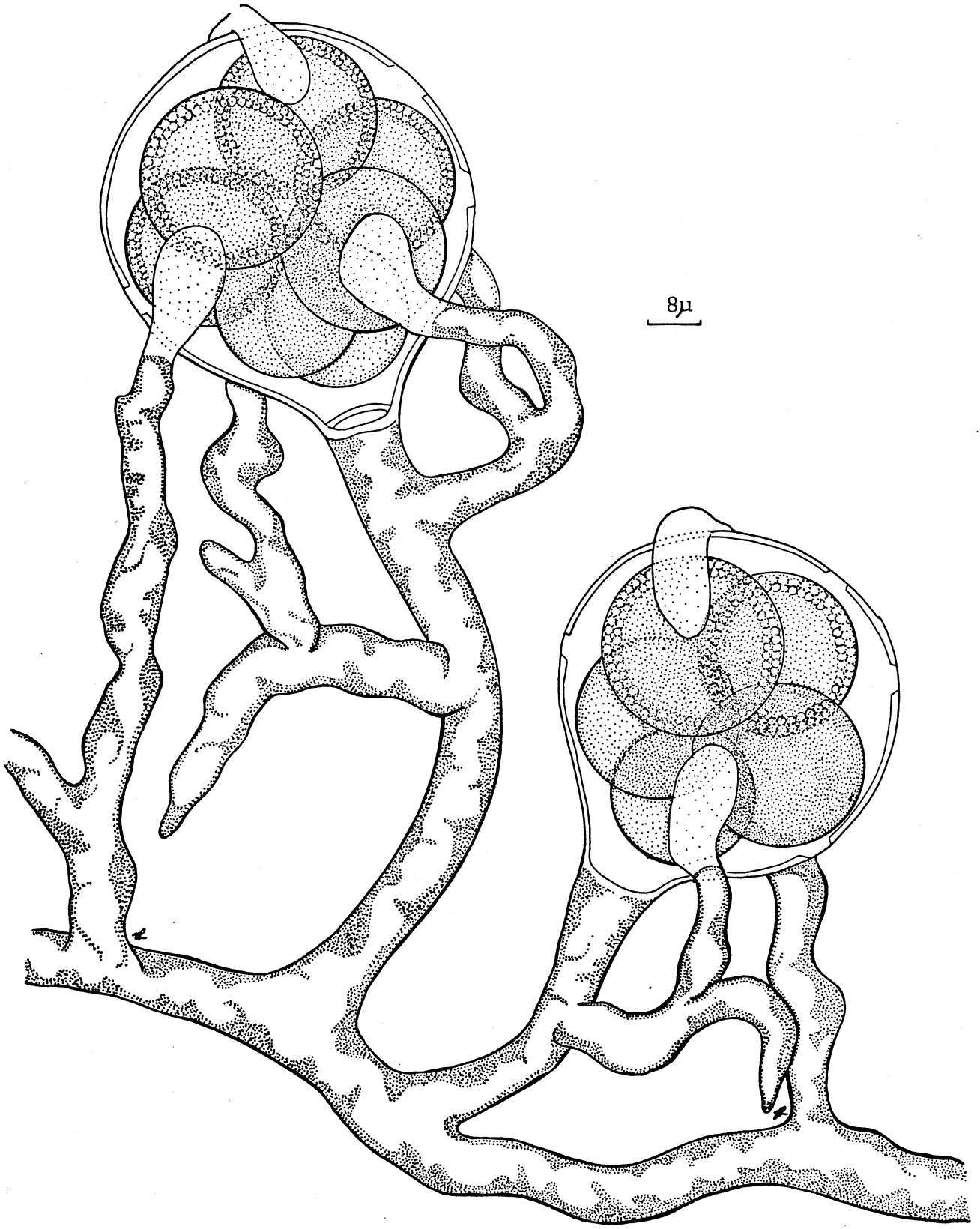

Fig. 19

Saprolegnia unispora (Coker and Couch) Seymour

Nova Hedwigia, 19: 57. 1970.

Fig. 20. Oogonia of Saprolegnia unispora. Note that the oospores are subcentric (rarely centric) and few in number and that antheridia are entirely absent.

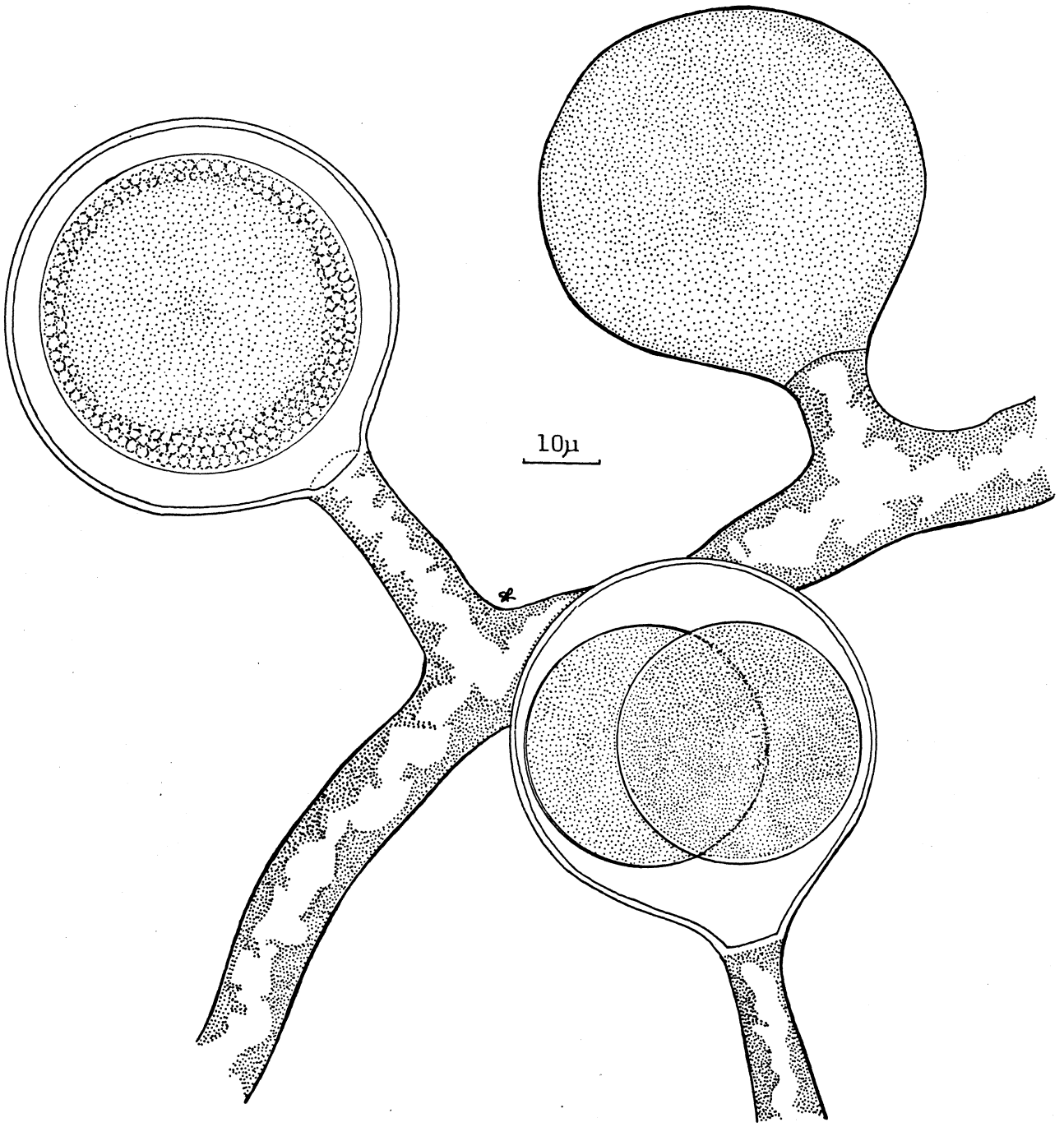

Fig. 20

Saprolegnia megasperma Coker

Saprolegniaceae, p. 56. 1923.

Fig. 21. Oogonia and antheridia of Saprolegnia megasperma. Note that the oospores are subcentric and few in number, that the oogonial stalks are simple and unbranched, and that the antheridial branches are mostly monoclinous.

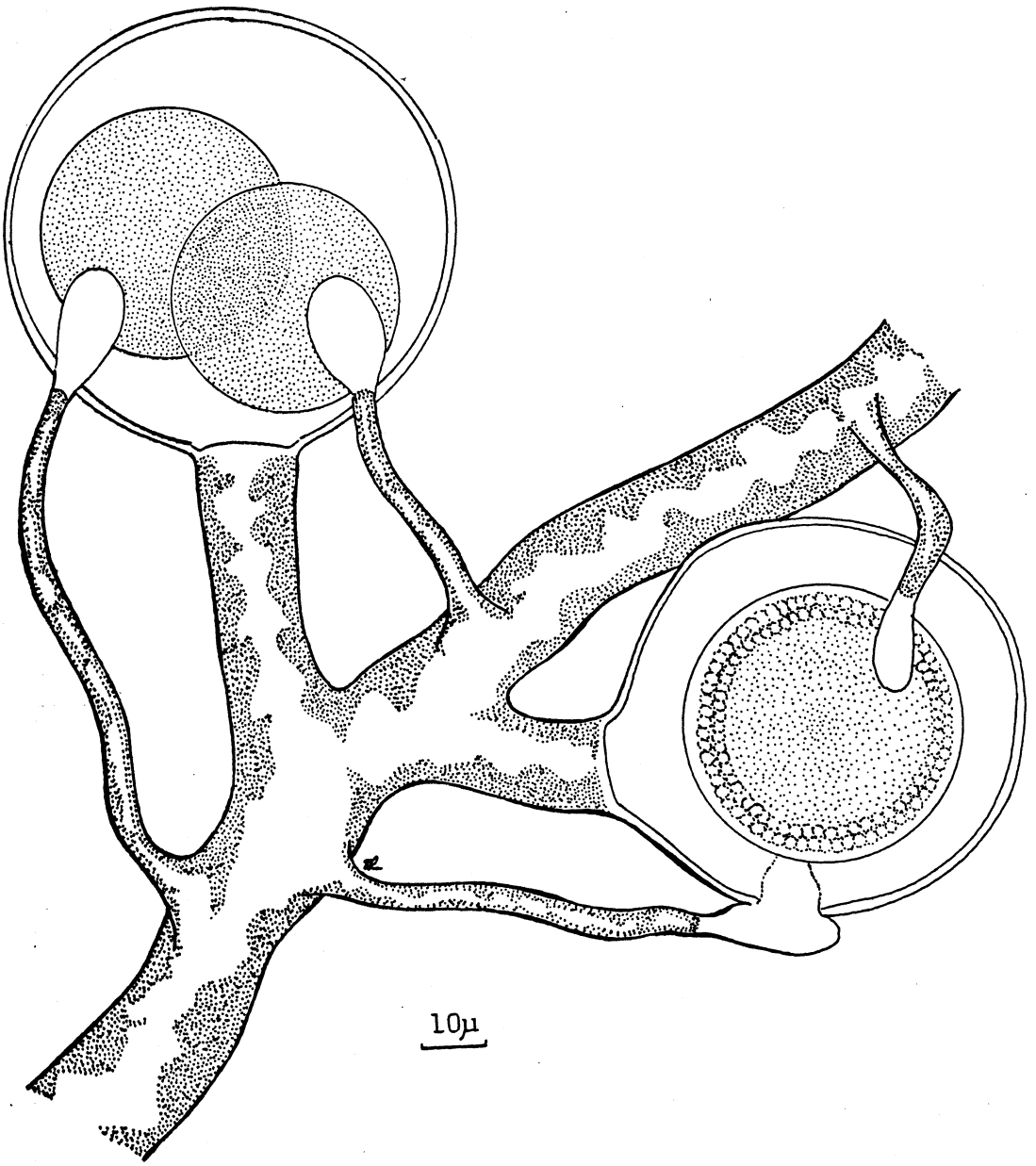

Fig. 21

Saprolegnia subterranea (Dissmann) Seymour

Nova Hedwigia, 19: 59. 1970.

Fig. 22. Oogonia and antheridia of Saprolegnia subterranea. Note that the oogonium is smooth-walled, that the oospores are few in number and mostly subcentric (rarely centric), and that the antheridial branches are mostly androgynous. In some isolates of S. subterranea the oogonial wall may be sparsely papillate (see fig. 5).

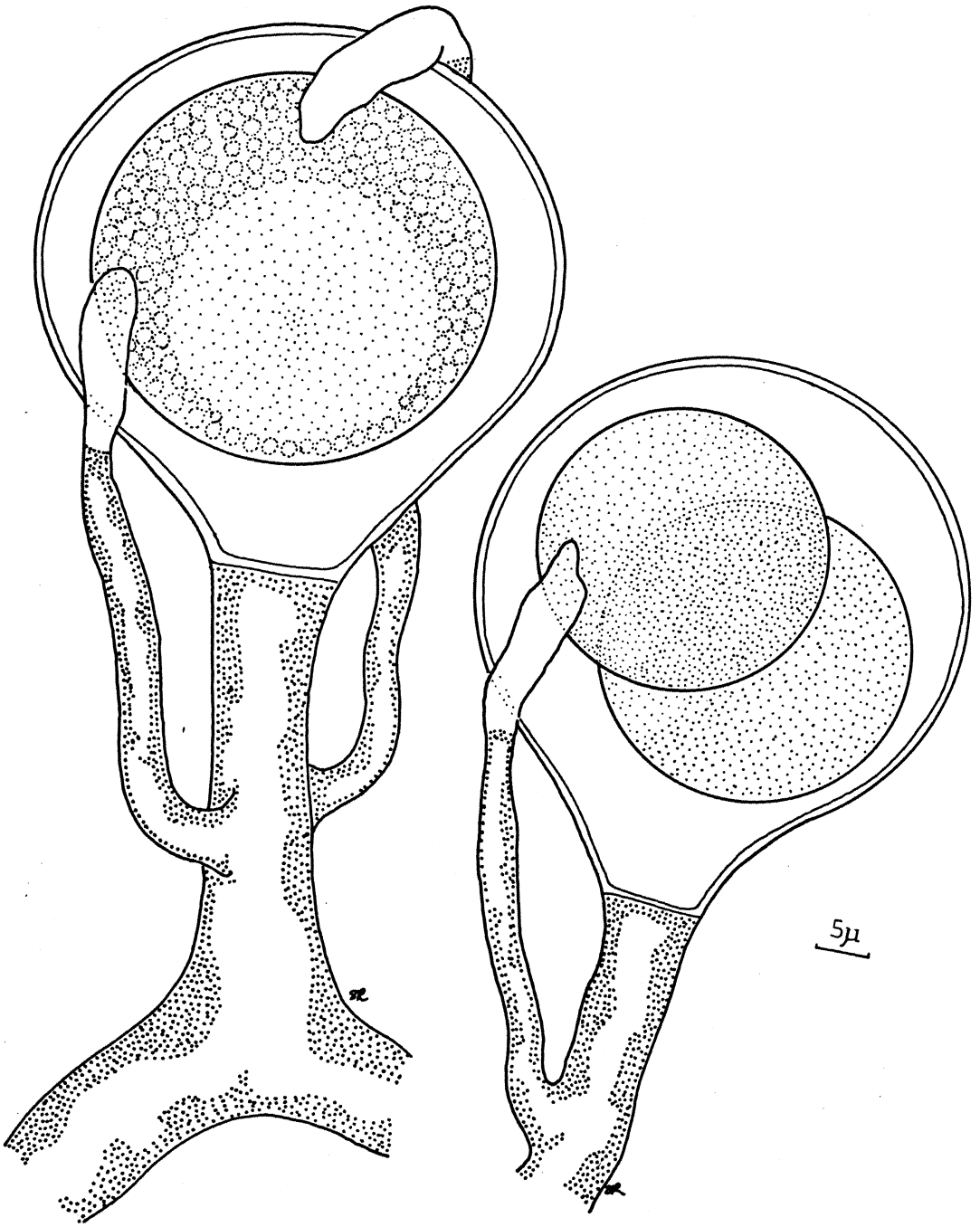

Fig. 22

Genus: Leptolegnia de Bary

Bot. Zeitung, 46: 609. 1880.

The genus Leptolegnia bears the same relationship to Saprolegnia as does the genus Aphanomyces to Achlya. Isolates of Leptolegnia develop an extensive mycelium composed of delicate and sparingly branched hyphae bearing terminal zoosporangia that are long, cylindrical, and of the same diameter as the subtending hyphae. The primary zoospores are formed in a single row (uniseriate) in contrast to the multiseriate condition observed in species of Saprolegnia (fig. 23). Zoospore discharge in Leptolegnia is saprolegnoid, the primary zoospores are elongate upon emergence but soon assume a pip-shaped form to swim actively, later encysting and giving rise to laterally biflagellate secondary zoospores as in Saprolegnia. Zoosporangial renewal may be by internal proliferation. Gemmae are entirely lacking among isolates of Leptolegnia. In contrast to the many-spored oogonia typical of most species of Saprolegnia, these isolates form oogonia each with a single, eccentric oospore that completely or nearly fills the oogonium (fig. 24).

Key to the Illinois Species of *Leptolegnia*

1. Oogonia relatively small; oogonial walls nearly smooth; antheridial branches diclinous (fig. 24) . . . . . *L. caudata*

1. Oogonia relatively large; oogonial wall with conspicuous warts and projections; antheridia absent (fig. 25) . . . . . *L. subterranea*

Leptolegnia caudata de Bary

Bot. Zeitung, 46: 631. 1888.

Fig. 23. Filaments of Leptolegnia caudata bearing zoosporangia. Note that the undifferentiated zoosporangia are elongate with the primary zoospores formed in a single row.

Fig. 24. Oogonia and antheridia of Leptolegnia caudata. Note that the oogonial walls are unpitted and smooth but with a few beak-like projections, and that the antheridial branches are strictly diclinous.

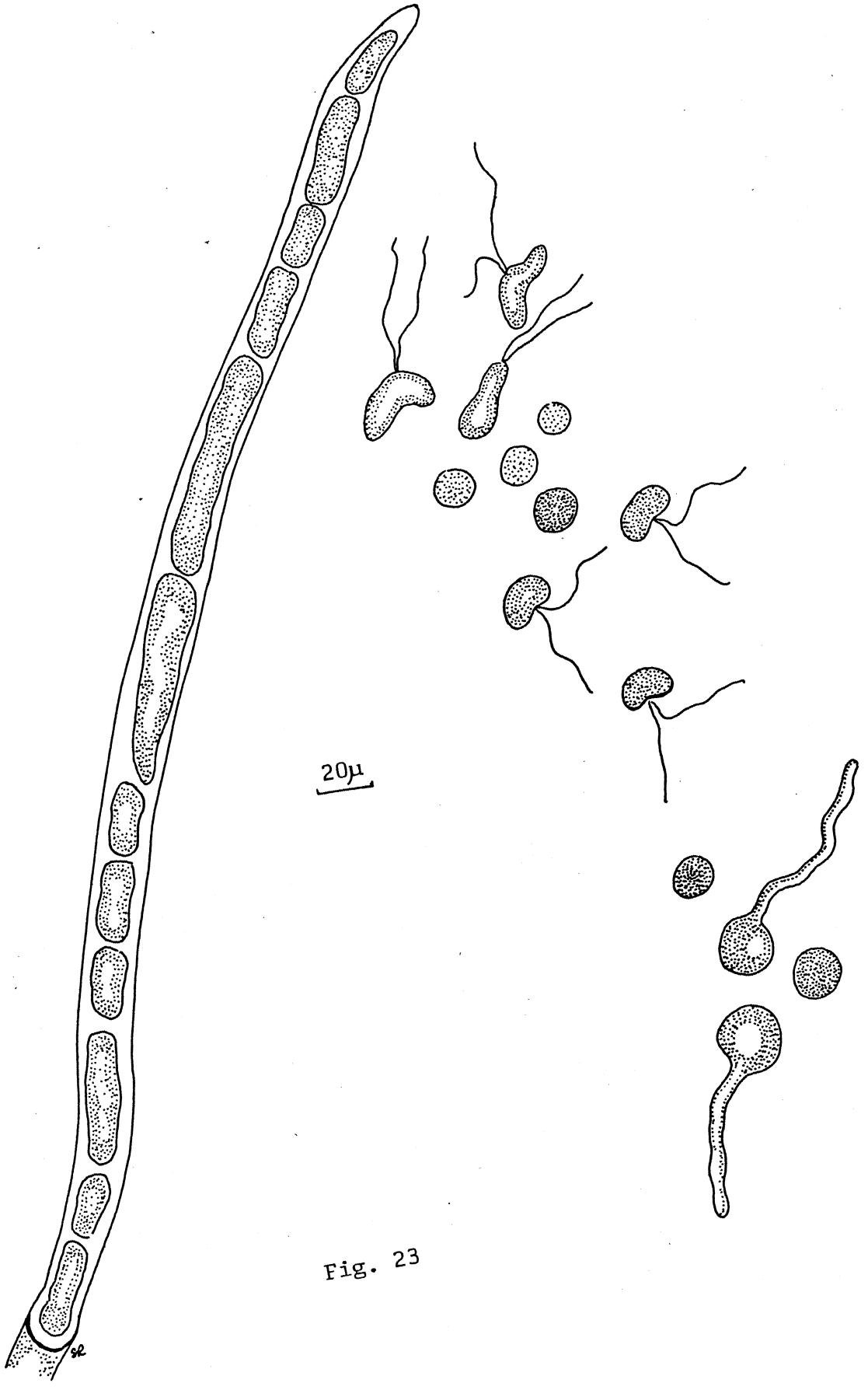

Fig. 23

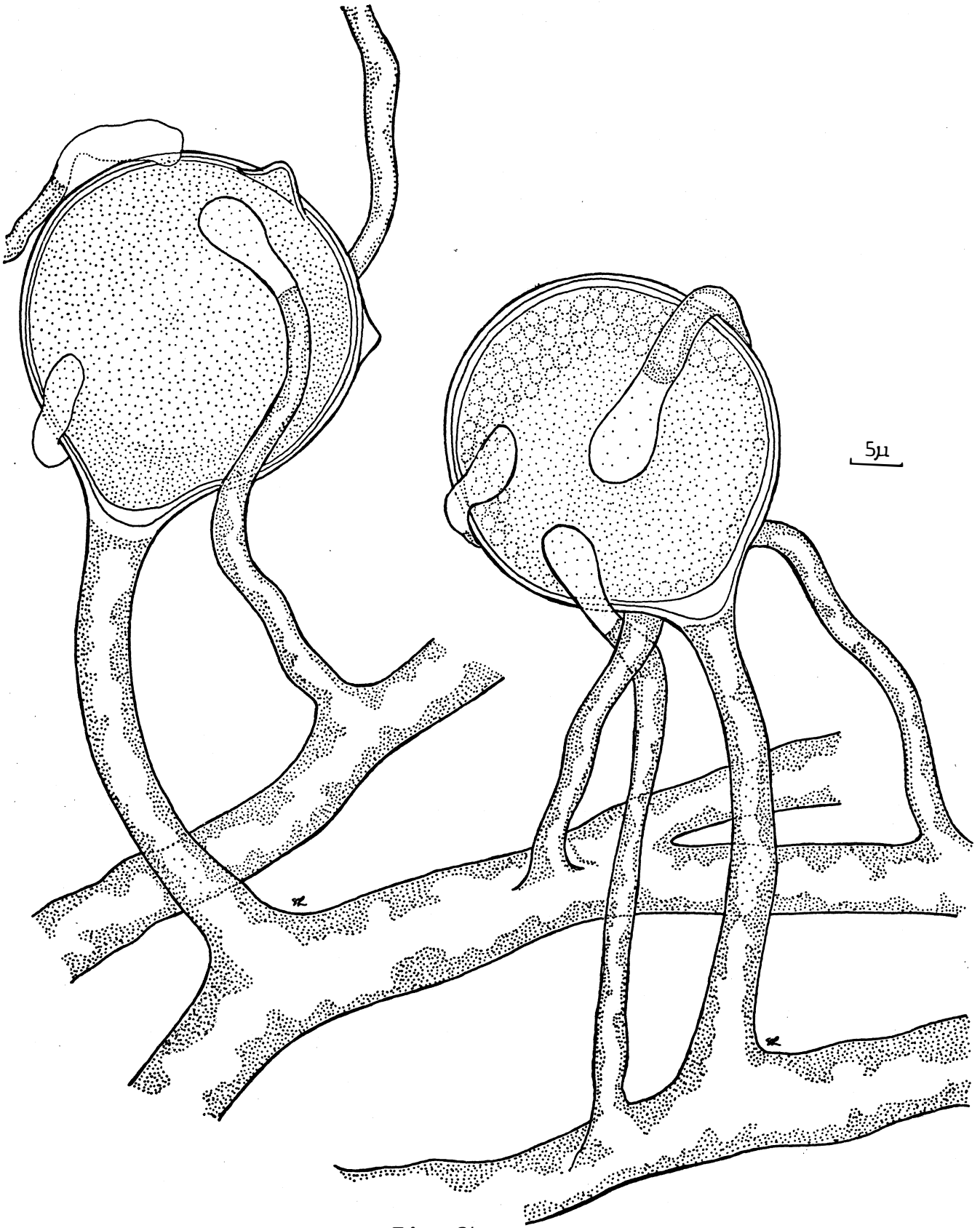

Fig. 24

Leptolegnia subterranea Coker and Harvey

Jour. Elisha Mitch. Sci. Soc., 41: 158. 1925.

Fig. 25. Oogonia and antheridia of *Leptolegnia subterranea*. Note that the oogonia walls are conspicuously ornamented, and that antheridia are entirely absent.

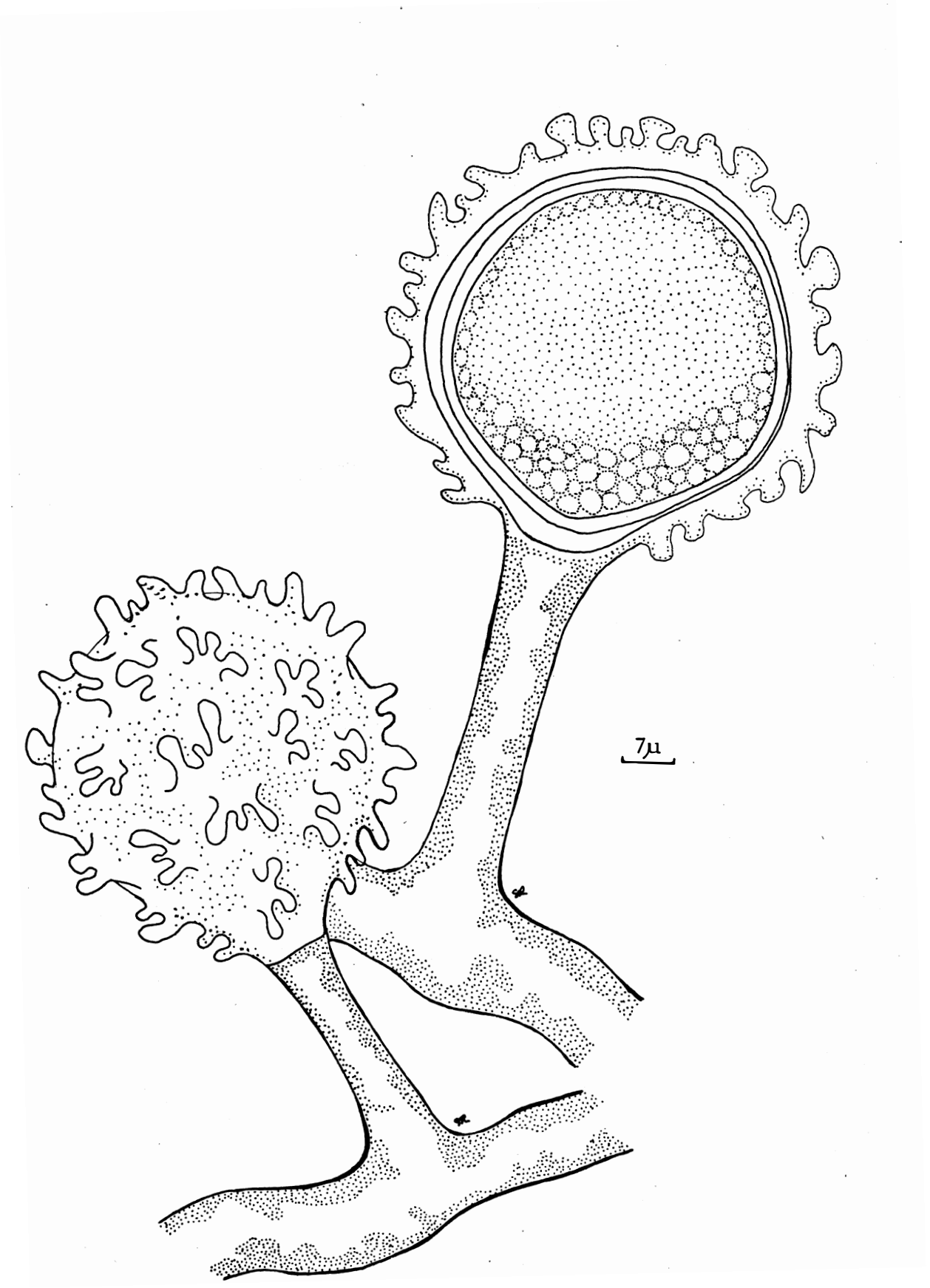

Fig. 25

Genus: Aphanomyces de Bary

Jahrb. wiss. Bot., 2: 178. 1860.

The genus Aphanomyces, comprising some 30 reported species, bears the same relationship to Achlya as does the genus Leptolegnia to Saprolegnia. Isolates of Aphanomyces develop an extensive mycelium composed of delicate and sparingly branched hyphae bearing terminal zoosporangia that are long, cylindrical, and of the same diameter as the subtending hyphae. The primary zoospores are formed in a single row (uniseriate) in contrast to the multiseriate condition characteristic of species of Achlya. Zoospore discharge in species of Aphanomyces is achlyoid and zoosporangial renewal occurs but rarely by sympodial branching, never by internal proliferation (fig. 26). The encysted primary zoospores give rise to secondary zoospores; these swim actively, encyst, later to germinate forming hyphae. The emergence of the secondary zoospores leaves behind a cluster of "ghosts" at the month of zoosporangia, these representing the persistent cell walls of the primary zoospore cysts, a feature unique to this genus and to species of Achlya. Gemmae are generally lacking among isolates of Aphanomyces. In contrast to the many-spored oogonia typical of most species of Achlya, these isolates form oogonia each with a single oospore (rarely 2) that does not completely fill the oogonium (figs. 27-32).

Key to the Illinois Species of *Aphanomyces*

1. Oogonial walls smooth. 2
1. Oogonial walls irregular or undulate or ornamented 3
   2. Antheridial branches not coiling (fig. 27) . . . . . *A. laevis*
   2. Antheridial branches coiling about the oogonial stalk and subtending hyphae (fig. 28). . . . . *A. helicoides*
3. Oogonial wall irregular or undulate or ornamented with relatively short papillae or spines (figs. 29, 30) . . . . . *A. scaber*
3. Oogonial wall ornamented with relatively long papillae or spines 4
   4. Oogonia up to 32 u in diameter with blunt, conical projections 6-7 u in length; usually saprophytic (fig. 31). . . . . *A. stellatus*
   4. Oogonia up to 22 u in diameter with sharp-pointed spines 7-8 u in length; usually parasitic in *Achlya* (fig. 32) . . . . . *A. parasiticus*

Aphanomyces laevis de Bary

Jahrb. wiss. Bot., 2: 179. 1860.

Fig. 26. Filaments of Aphanomyces laevis bearing zoosporangia. Note that the zoosporangia are undifferentiated from the vegetative hyphae, that the zoospores are formed in a single row in the zoosporangium and upon discharge encyst immediately at the mouth of the zoosporangium.

Fig. 27. Oogonia and antheridia of Aphanomyces laevis. Note that the oogonial wall is entirely smooth and that the antheridial branches do not coil.

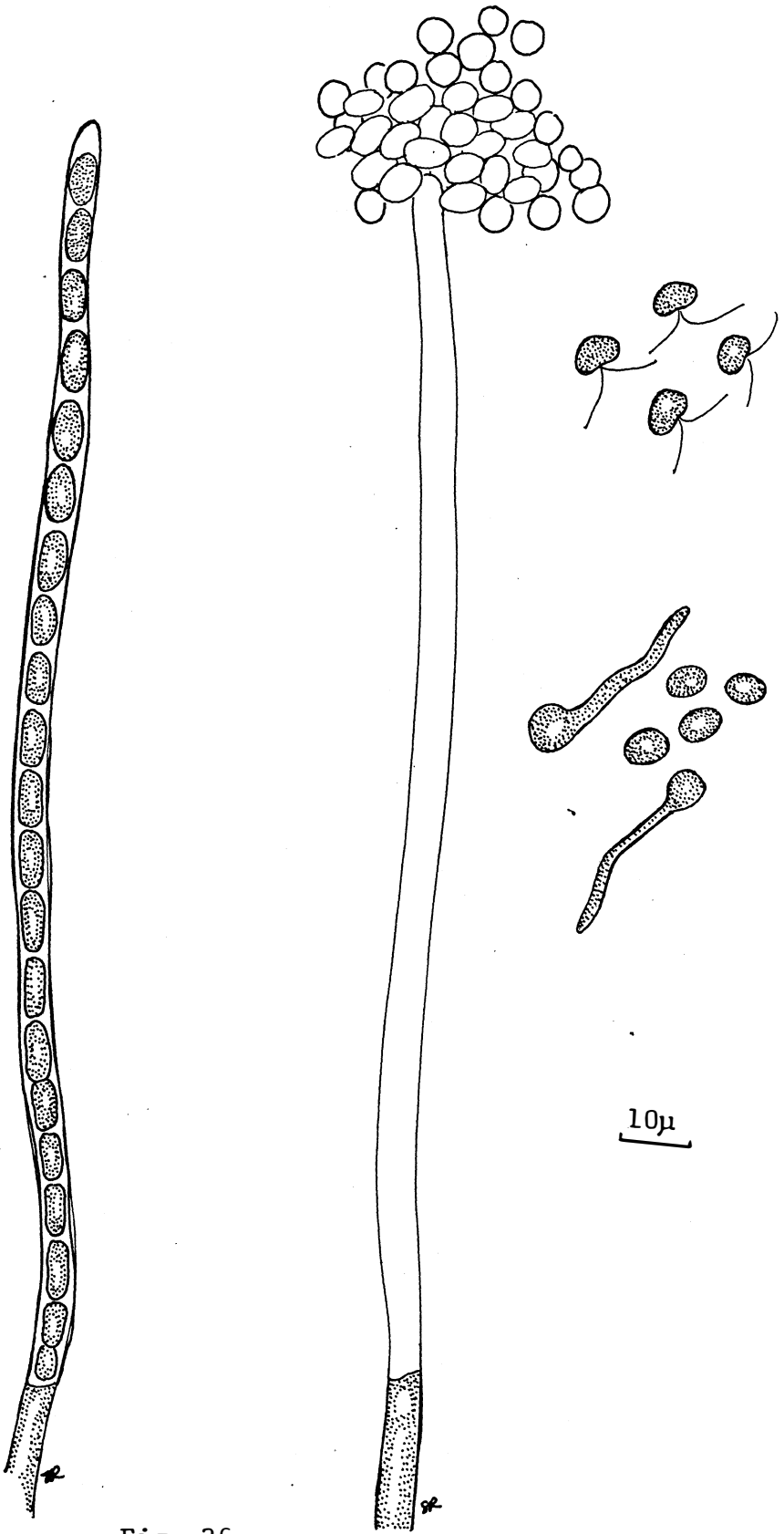

Fig. 26

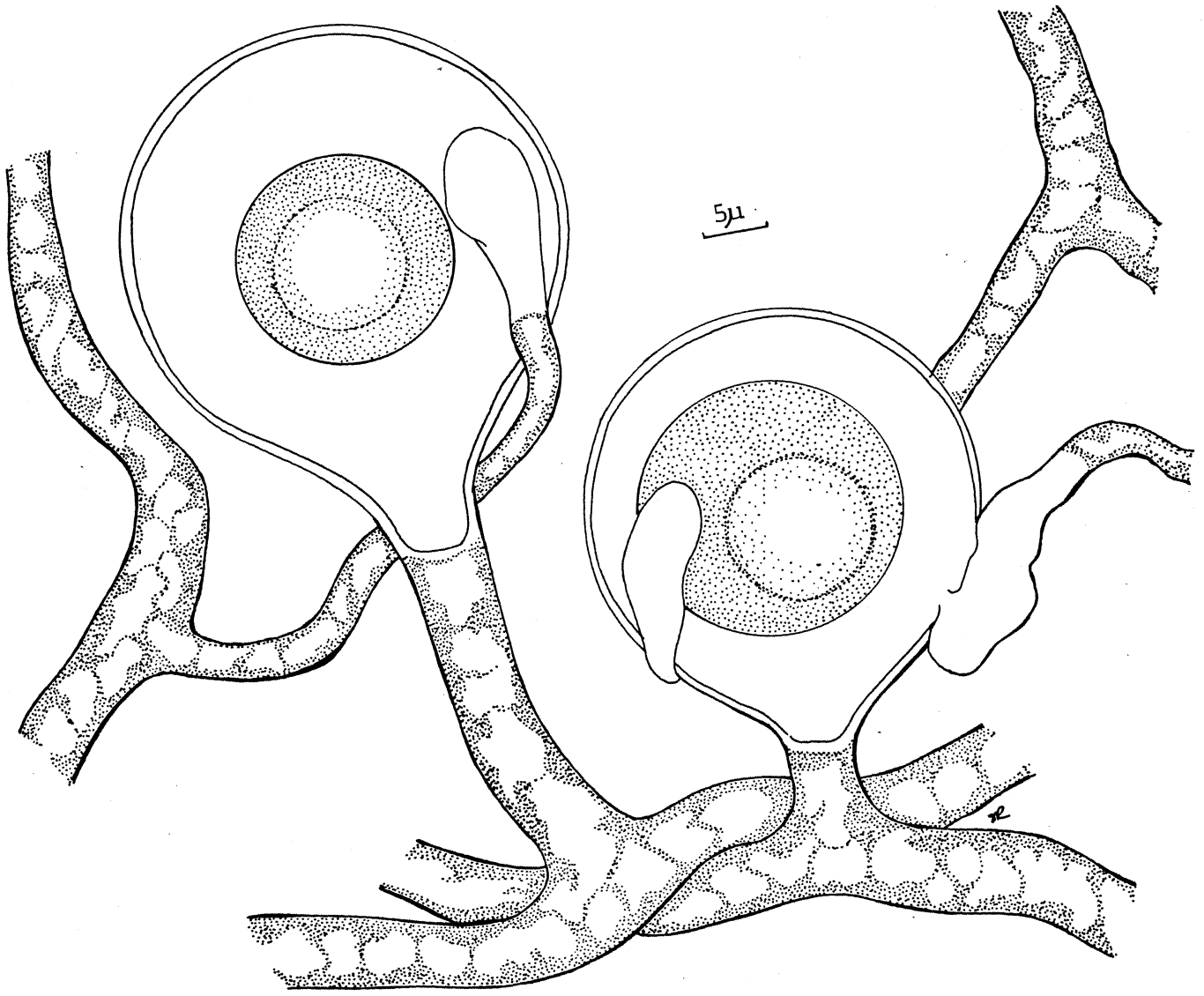

Fig. 27

Aphanomyces helicoides von Minden

Kryptogamenfl. Mark Brandenburg, 5: 559. 1915.

Fig. 28. Oogonia and antheridia of Aphanomyces helicoides. Note that the oogonial wall is smooth and that the antheridial branches coil about the oogonial stalk and subtending hyphae.

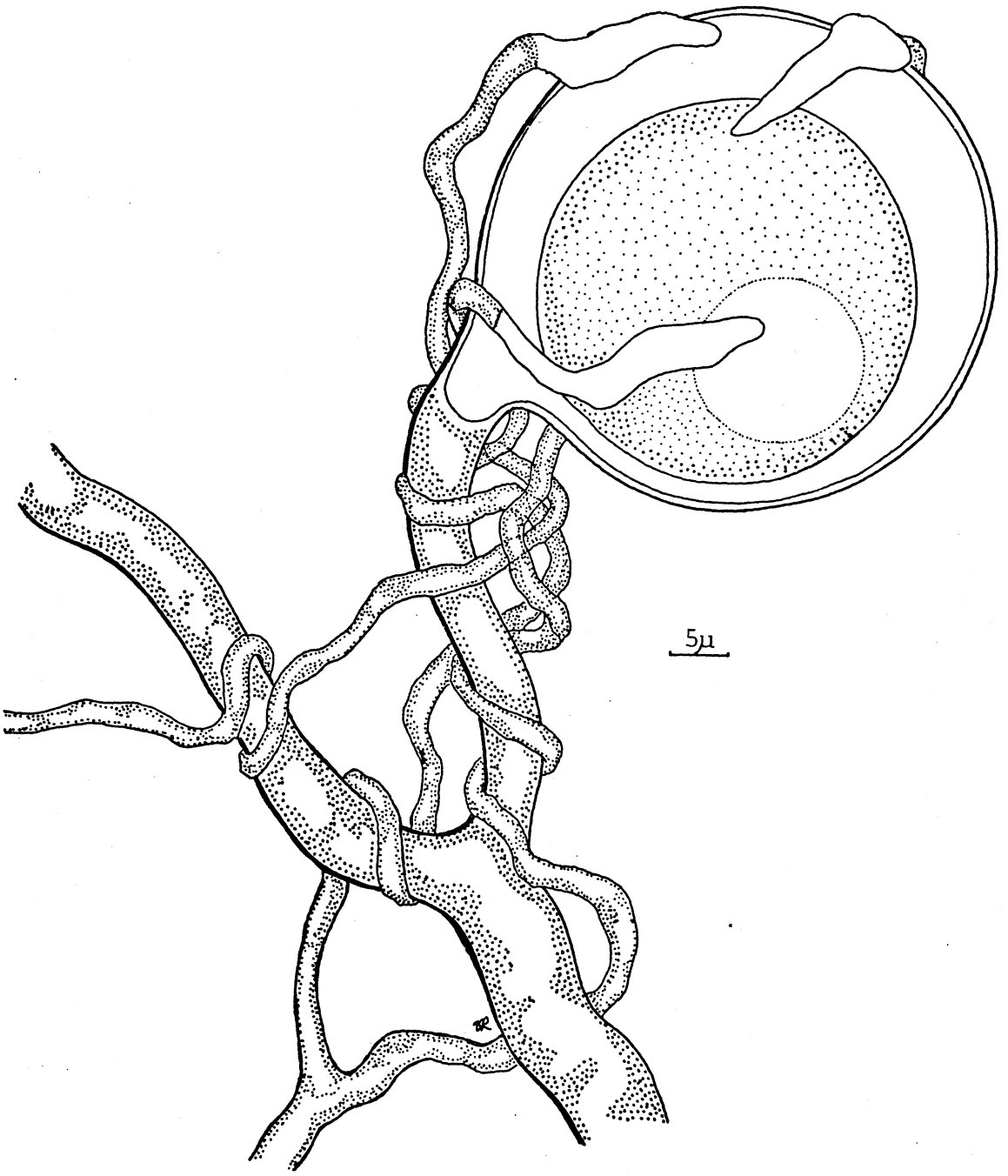

Fig. 28

Aphanomyces scaber de Bary

Jahrb. wiss. Bot., 2: 178. 1860.

Fig. 29. Oogonia and antheridia of Aphanomyces scaber. Note that the oogonial walls are ornamented with spines. In some isolates the oogonial walls may be papillate, tuberculate, or merely irregularly roughened.

Fig. 30. Oogonia and antheridia of Aphanomyces scaber (Syn A. irregulare). Note that the oogonial walls are irregularly roughened.

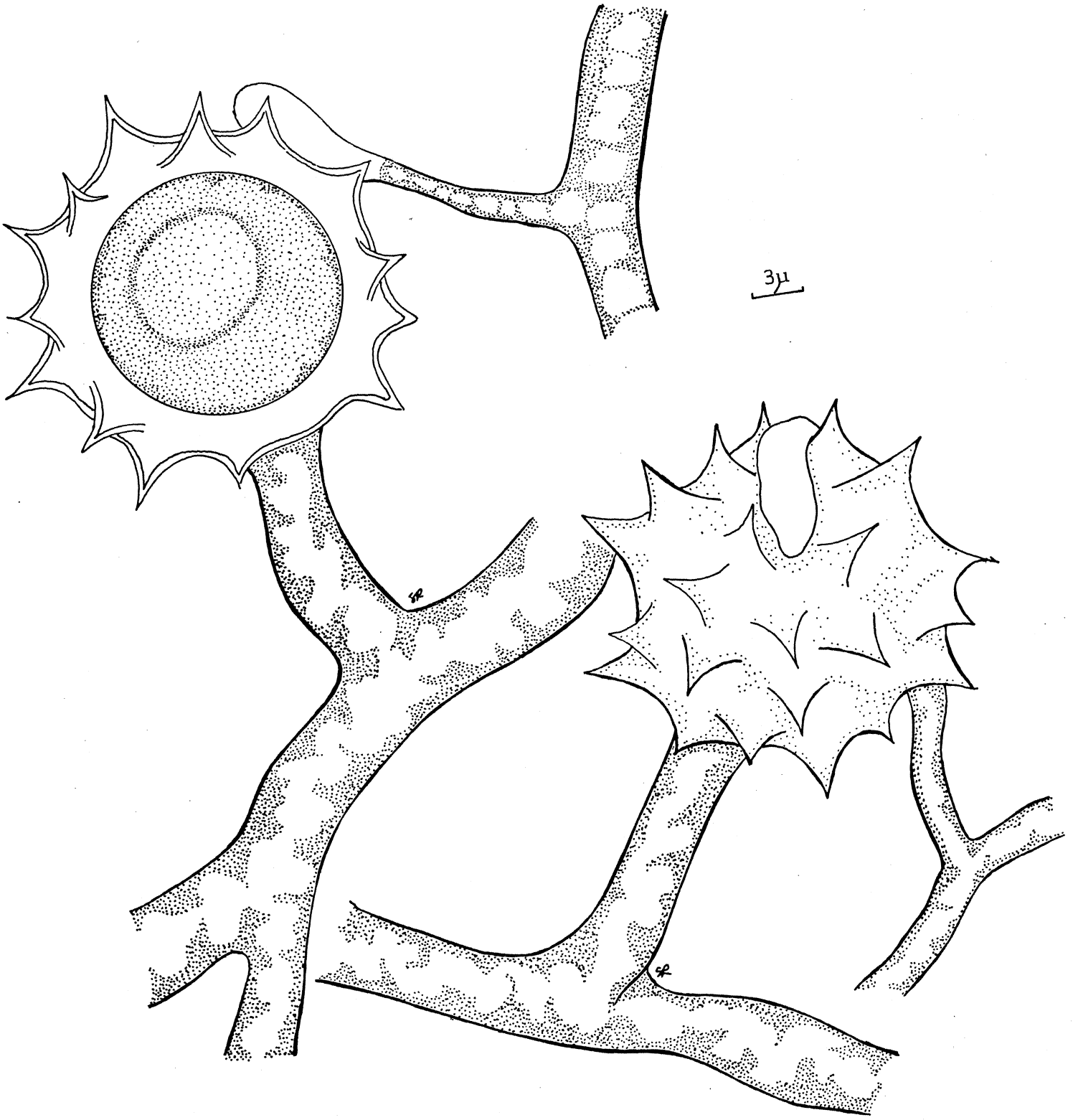

Fig. 29

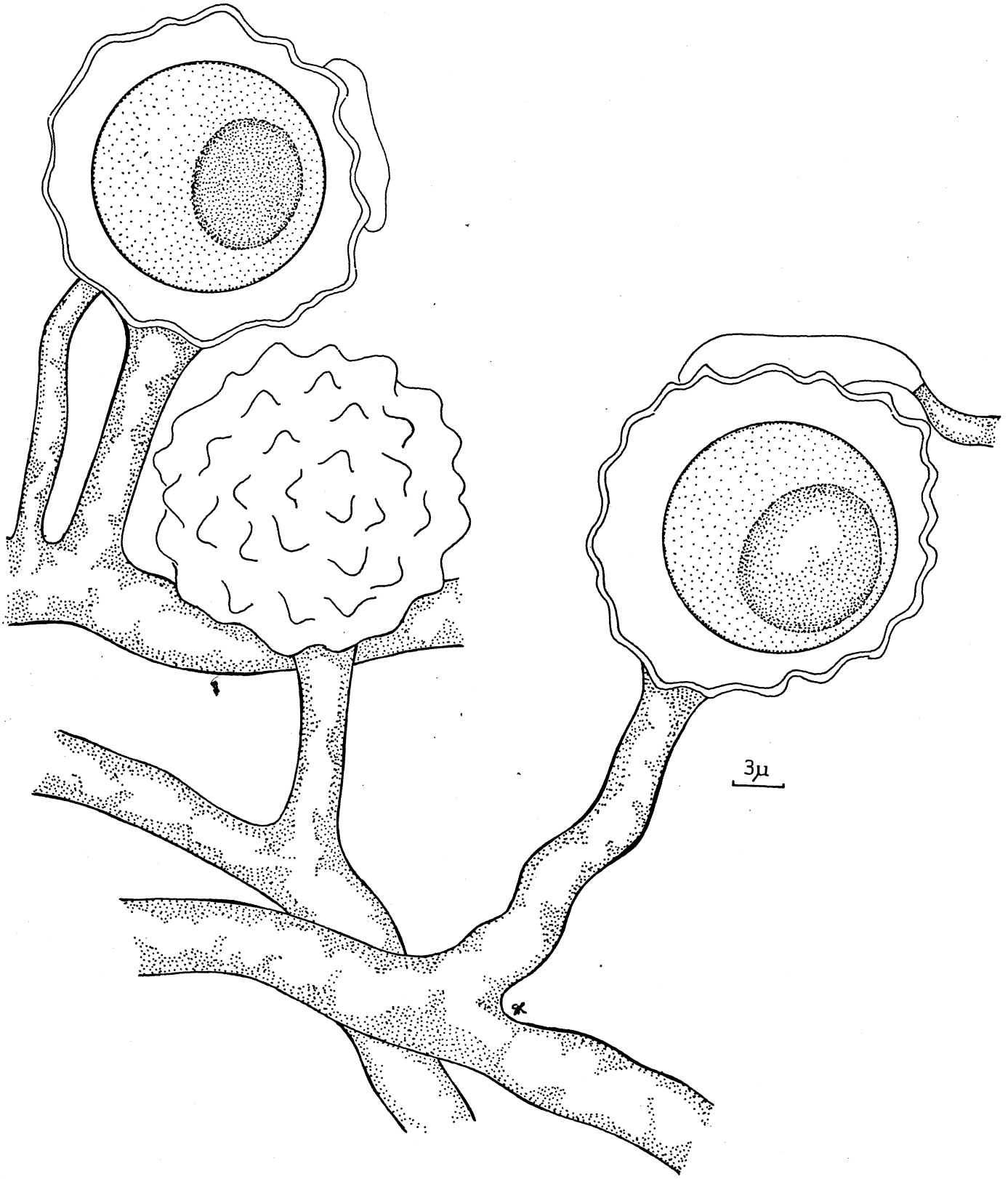

Fig. 30

Aphanomyces stellatus de Bary

Jahrb. wiss. Bot., 2: 178. 1860.

Fig. 31. Oogonia and antheridia of *Aphanomyces stellatus*. Note that the oogonial walls are ornamented with bluntly conical projections.

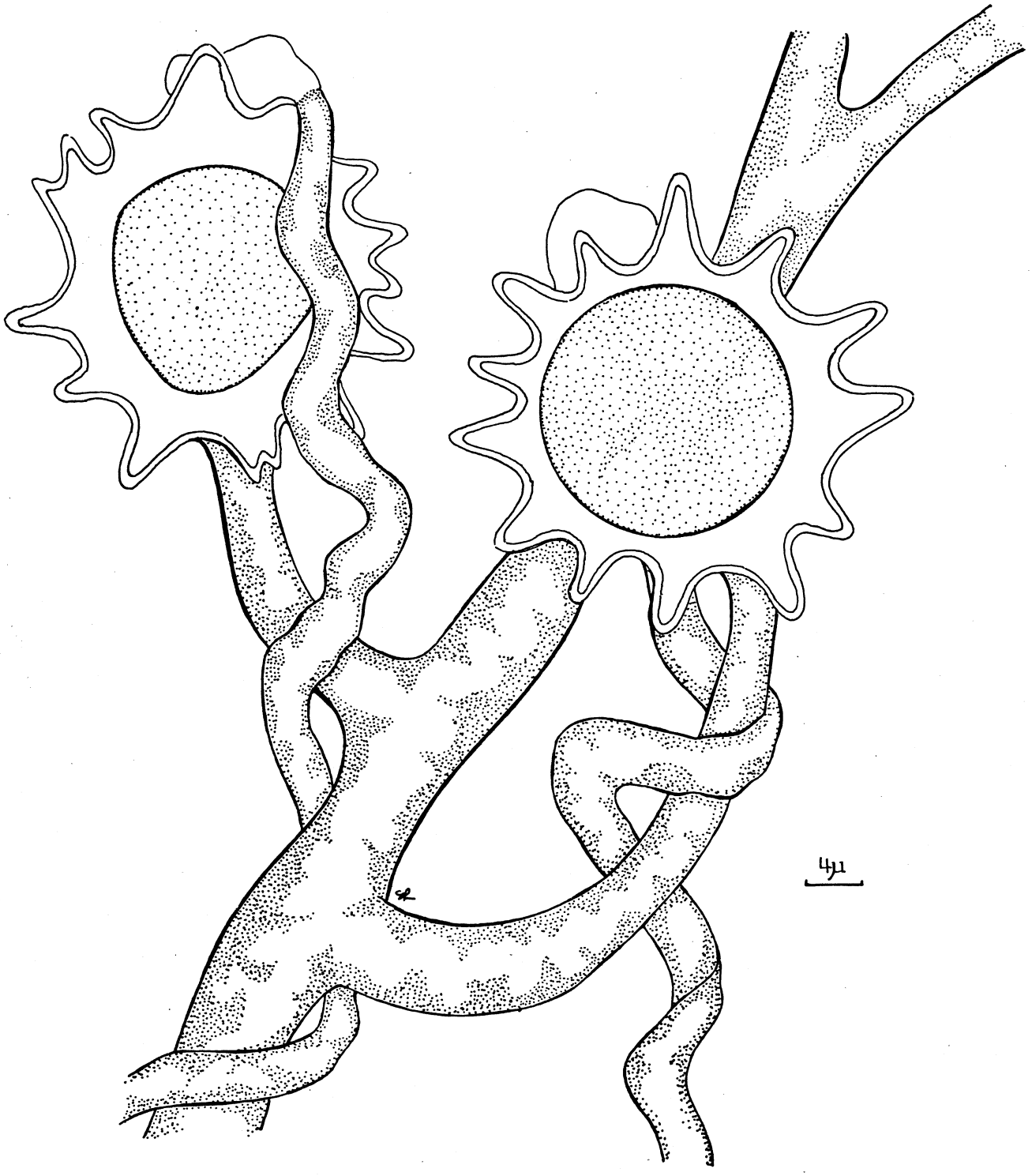

Fig. 31

Aphanomyces parasiticus Coker

Saprolegniaceae, p. 165. 1923.

Fig. 32. Oogonia and antheridia of Aphanomyces parasiticus. Note that the oogonia are formed within the host cell and that the oogonial walls are ornamented with sharp-pointed spines.

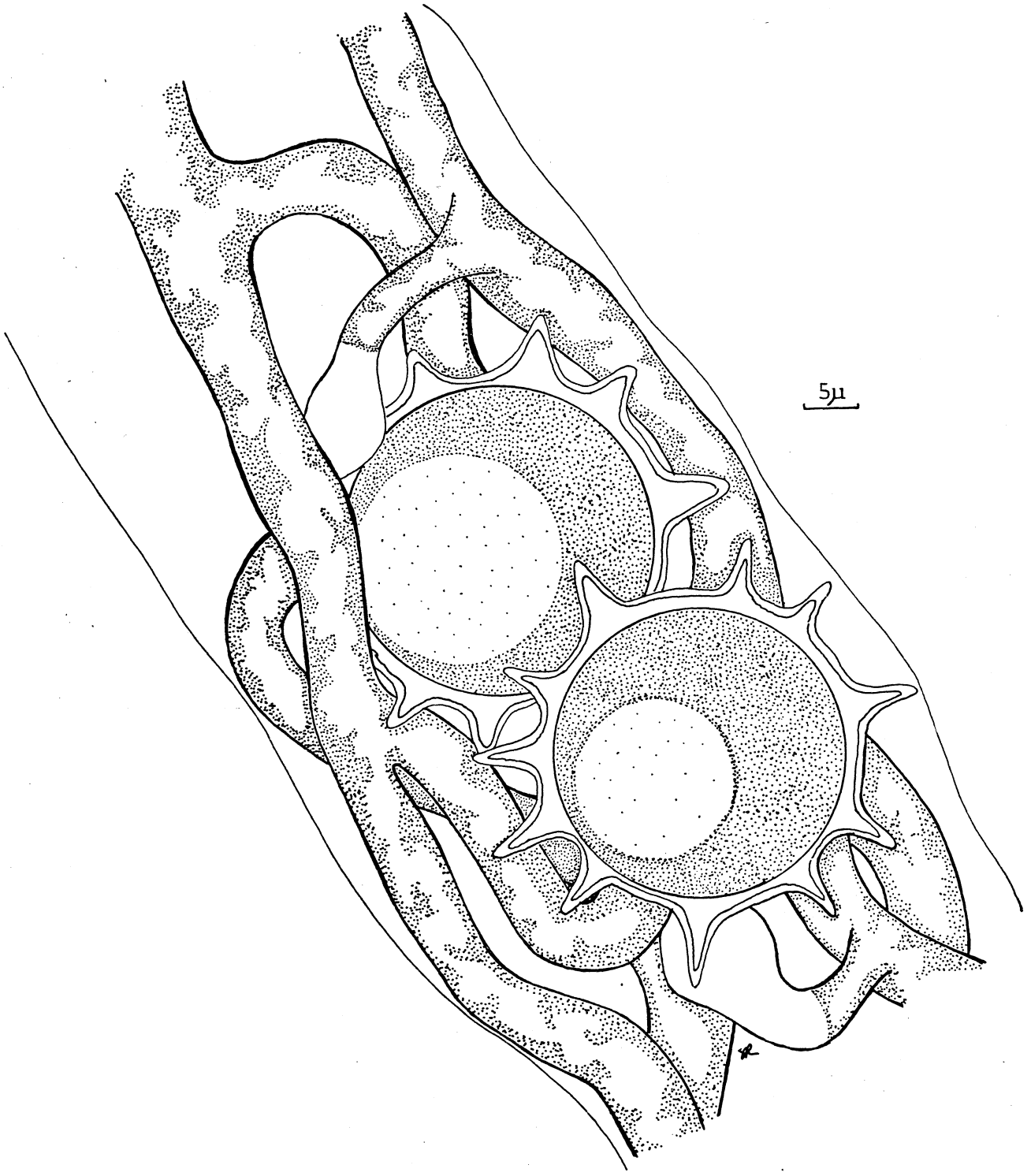

Fig. 32

Genus: Achlya C. G. Nees

Nova Acta Acad. Leop.-Carol., 11: 514. 1823.

The genus Achlya, comprising more than one hundred species and varieties, is the largest and probably the best known genus of the water molds. Most isolates of Achlya are readily recognized by the size, shape, and renewal of the zoosporangia; and by the type of zoospore discharge exhibited. The zoosporangia are usually terminal and of greater diameter than the subtending hyphae; are usually clavate, naviculate, or fusiform in shape; and are renewed by sympodial branching (fig. 33). In some species zoosporangia are formed in basipetalous succession and in a few other species zoosporangia may be formed in terminal clusters by cymose branching. The typical method of zoospore discharge in the genus Achlya is termed achlyoid and involves the immediate encystment of the primary zoospores in a hollow mass at the mouth of the zoosporangium. Observation of the encysted zoospore mass at the orifice of the differentiated zoosporangium; or of the "ghosts," the empty primary zoospore cysts left behind following the emergence of the secondary zoospore, is diagnostic for the genus Achlya. In a few species, and in most species under abnormal environmental conditions, zoospore discharge may be aplanoid, thraustothecoid, or dictyoid. The secondary zoospores swim actively, later encyst, and upon germination develop into vegetative hyphae. Gemmae may or may not be present.

In general the following characteristics are essential for the separation and identification of species of Achlya: oospore type, oogonial wall ornamentation and pitting, oogonial shape

and position, antheridial-branch origin, length and appearance of the oogonial stalk, and oogonium and oospore size. Of primary importance in species identification is the type of mature oospore formed, whether centric, subcentric, or eccentric. A centric oospore is one which at maturity contains one or two peripheral layers of small oil droplets completely surrounding the central ooplasm (fig. 39). A subcentric oospore is one which at maturity contains a single layer of small oil droplets on one side of the ooplasm and two or three layers of oil droplets on the opposite side, or with the single layer of oil droplets not formed thus exhibiting a lunate grouping of droplets, or with a single layer of small oil droplets located eccentrically to the oospore wall (fig. 40). An eccentric oospore is one which at maturity contains a single large oil globule located on one side of the oospore and not entirely enclosed by the ooplasm (fig. 37).

As in most genera of water molds, isolates of Achlya may fail to form sexual structures even after prolonged growth in culture and despite the use of various methods to induce the formation of sex organs. Such isolates may be male or female strains of a dioecious species and may be readily identified following cross-cultural studies. It may be assumed that all other non-fruiting isolates will fail to form sex organs under the cultural conditions employed or that such isolates have lost entirely the ability to reproduce sexually. All non-fruiting isolates may be referred to as Achlya sp.

Key to the Illinois Species of *Achlya*

1. Oogonial wall smooth, not conspicuously ornamented 2
1. Oogonial wall conspicuously ornamented 1

2. Mycelium heterothallic 3
2. Mycelium homothallic 4

3. Spherical, thick-walled gemmae produced on both male and female thalli; oospores rarely maturing (figs. 34, 35) . . . . . *A. bisexualis*
3. Spherical, thick-walled gemmae entirely absent; oospores usually maturing (fig. 36) . . . . . *A. ambisexualis*

4. Antheridial branches usually lacking (fig. 38) . . . . . *Achlya caroliniana*
4. Antheridial branches usually present 5

5. Oogonia and antheridia borne on the same hyphae (monoclinous or androgynous) 6
5. Oogonia and antheridia borne on different hyphae (diclinous) 12

6. Oospores centric or subcentric 7
6. Oospores eccentric 9

7. Oospores centric; oogonial wall pitted only under point of antheridial attachment, inner surface occasionally irregular (fig. 39) . . . . . *A. racemosa*
7. Oospores subcentric; oogonial wall unpitted or pitted only under point of antheridial attachment, inner surface smooth or irregular 8

8. Oogonia usually spherical or pyriform and mostly apiculate (fig. 40) . . . . . *A. apiculata*

8. Oogonia mostly pyriform and not apiculate (fig. 41). . . . . A. polyandra

9. Oospores mostly 1-2 per oogonium; oogonial stalks frequently recurved (fig. 42) . . . . . A. orion

9. Oospores usually more than 2 per oogonium; oogonial stalks not recurved 10

10. Oogonial wall unpitted, smooth; antheridial branches strictly monoclinous (fig. 43). . . . . A. debaryana

10. Oogonial wall pitted, smooth; antheridial branches usually monoclinous 11

11. Oospheres usually maturing; oospores small and numerous, filling the oogonium; oogonia conspicuously pitted, short-stalked; antheridial branches monoclinous, short, of near by origin (fig. 44). . . . . A. americana

11. Oospheres rarely maturing; oospores small and numerous not filling the oogonium; oogonia pitted under point of antheridial attachment, stalks long; antheridial branches monoclinous and androgynous (fig. 45). . . . . A. conspicua

12. Oospores subcentric, numerous small and infrequently maturing, not filling the oogonium (fig. 46). . . . . A. oblongata

12. Oospores eccentric, maturing or not, variable in size and number, and filling the oogonium or not 13

13. Primary (first-formed) zoosporangia discharge as in Thraustotheca (fig. 47). . . . . A. dubia

13. Primary zoosporangial discharge never thraustothecoid. 14

14. Oogonia usually lobed, hemispherical or otherwise irregular in shape (fig. 49). . . . . A. intricata

14. Oogonia usually spherical or pyriform 15

15. Antheridial branches coiling closely about the hyphae which may or may not bear oogonia (fig. 50). . . . . A. proliferoides

15. Antheridial branches not coiling about the hyphae. 16

16. Vegetative hyphae provided with numerous conspicuously inflated lateral swellings (fig. 51). . . . . A. diffusa

16. Hyphal swellings entirely absent. 17

17. Oospheres usually not maturing; oospores not filling the oogonium (fig. 53) . . . . . A. flagellata

17. Oospheres usually maturing; oospores filling the oogonium. 18

18. Oospores few in number, mostly 1-2 (fig. 55). . . . . A. rodriqueziana

18. Oospores numerous, mostly 2-10. 19

19. Antheridial branches strictly diclinous, irregular, contorted, profusely branched, wrapping about the oogonium and oogonial stalk (fig. 56). . . . . A. prolifera

19. Antheridial branches usually diclinous, occasionally monoclinous, simple or branched, not contorted or wrapping about oogonium 20

20. Antheridial branches usually diclinous, occasionally remotely monoclinous, simple or sparingly branched, always attached to the oogonium (fig. 57) . . . . . A. klebsiana

20. Antheridial branches usually diclinous, occasionally monoclinous, branched, and frequently not attached to the oogonium (fig. 54). . . . . A. flagellata

21. Oospores centric or subcentric 22

21. Oospores eccentric 27

22. Oospores centric. 23

22. Oospores subcentric 26

23. Oogonial wall pitted only under point of antheridial attachment, antheridial branches mostly androgynous (fig. 58). . . . . A. colorata

23. Oogonial wall unpitted, antheridial branches absent or when present mostly monoclinous 24

24. Oogonial stalks generally coiled; antheridia absent or, if present, of monoclinous origin (fig. 59) . . . . . A. spiracaulis

24. Oogonial stalks not generally coiled; antheridia usually present and generally of monoclinous origin 25

25. Oogonial wall densely ornamented (fig. 60) . . . . . A. papillosa

25. Oogonial wall smooth or but sparsely ornamented (fig. 61). . . . . A. oligacantha

26. Oogonial wall unpitted with mammiform ornamentations, oogonia mostly terminal or lateral (fig. 62). . . . . A. radiosa

26. Oogonial wall pitted with papillate ornamentations, oogonia mostly intercalary (fig. 63). . . . . A. treleaseana

27. Oogonial wall provided with truncate projections 28

27. Oogonial wall provided with papillate, tuberculate, or variously shaped projections, not truncate 29

28. Oogonia relatively large (up to 65 μ in diameter), projections always truncate up 20 μ in length, antheridial branches simple or sparsely branched and mostly androgynous (fig. 64). . . . . A. recurva

28. Oogonia relatively small (up to 50 μ in diameter), projections mostly truncate (but often with rounded tips) up to 10 μ in length, antheridial branches profusely branched and mostly monoclinous (fig. 65) . . . . . Achlya 478

29. Oospores single; oogonial stalks much-branched and contorted; antheridia usually absent, when present of androgynous or monoclinous origin (fig. 66). . . . . A. glomerata

29. Oospores numerous; oogonial stalks simple or once-branched; antheridia usually absent, when present of monoclinous or diclinous origin (fig. 67) . . . . . A. crenulata

Achlya flagellata Coker

Saprolegniaceae, p. 116. 1923.

Fig. 33. Filaments of Achlya flagellata bearing zoosporangia. Note that the zoosporangia are of greater diameter than the subtending hyphae, that the primary zoospores are formed in several rows within the zoosporangium, and that upon emergence the primary zoospores encyst in a clump at the mouth of the zoosporangia. Note also that the zoosporangia are renewed by sympodial branching.

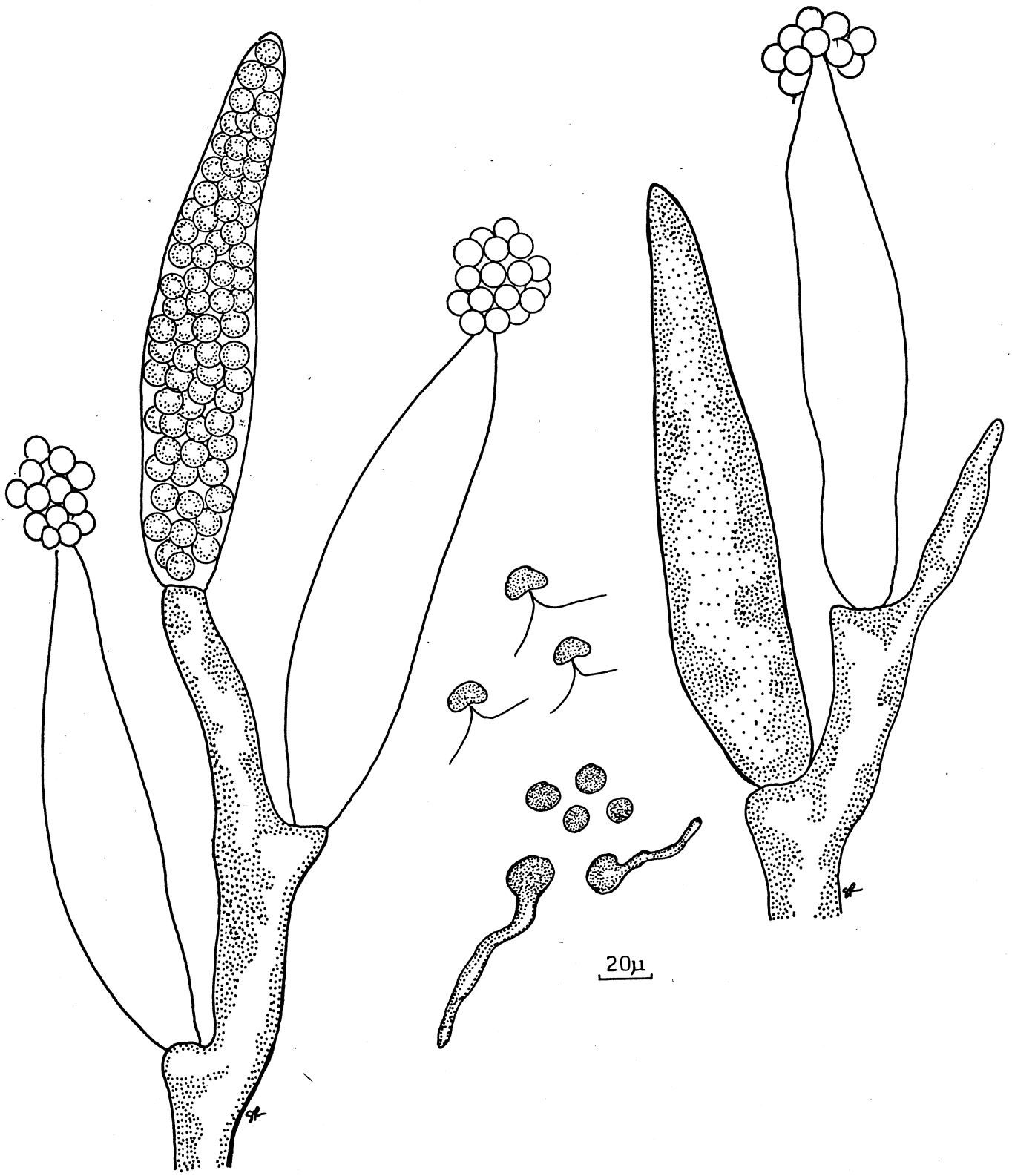

Fig. 33

Achlya bisexualis Coker and A. Couch

Jour. Elisha Mitch. Sci. Soc., 42: 207. 1927.

Fig. 34. Filaments of Achlya bisexualis bearing zoosporangia and gemmae. Note that the gemmae are spherical, thick-walled, and often formed in chains.

Fig. 35. Oogonia and antheridia of Achlya bisexualis. Note that the oospores are eccentric, that few oospores mature, and that these do not fill the oogonium. Note also that the oogonial wall is smooth and is pitted only under the point of antheridial attachment, and that the antheridial branches are long, much-branched, irregular, and tend to envelope the oogonium.

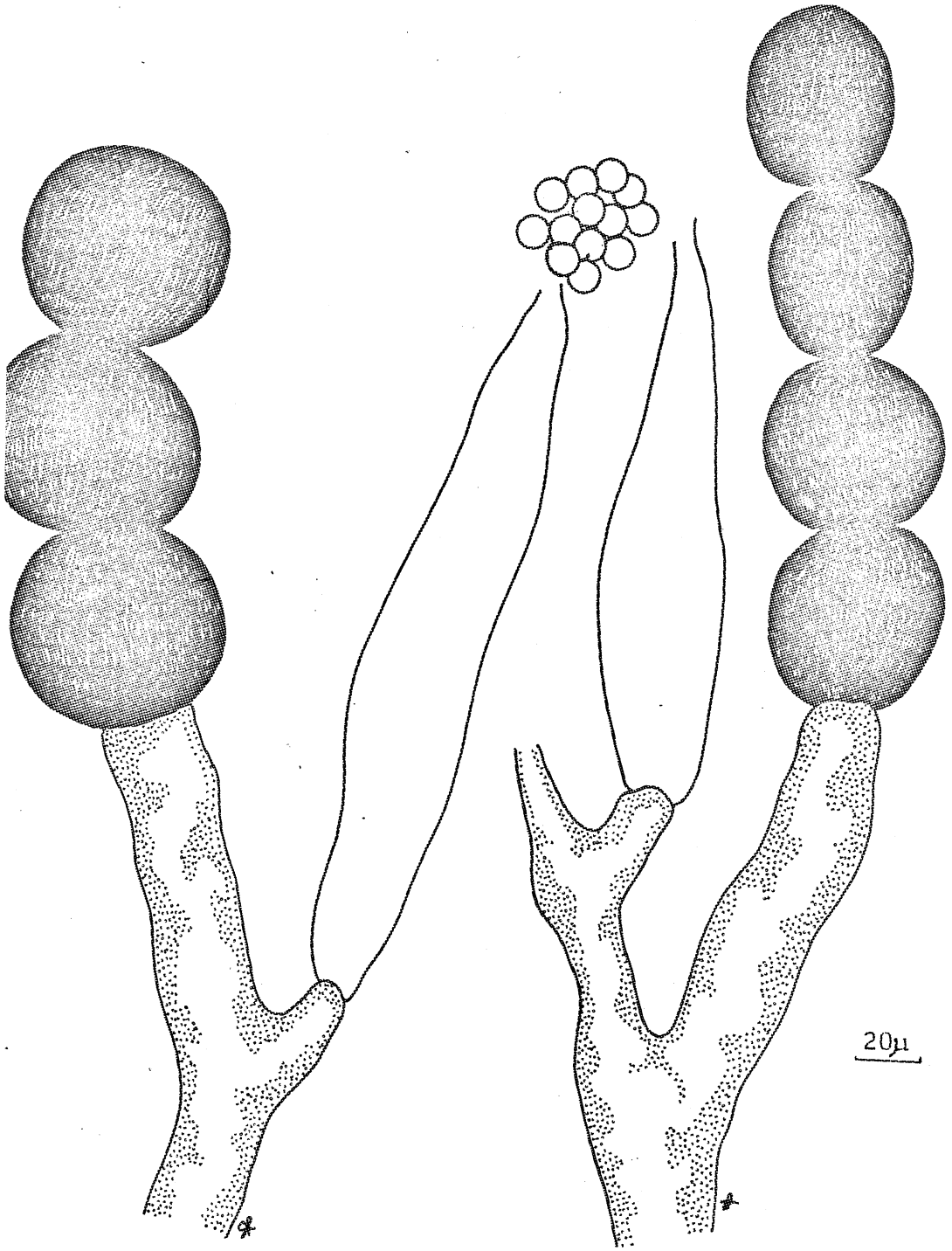

Fig. 34

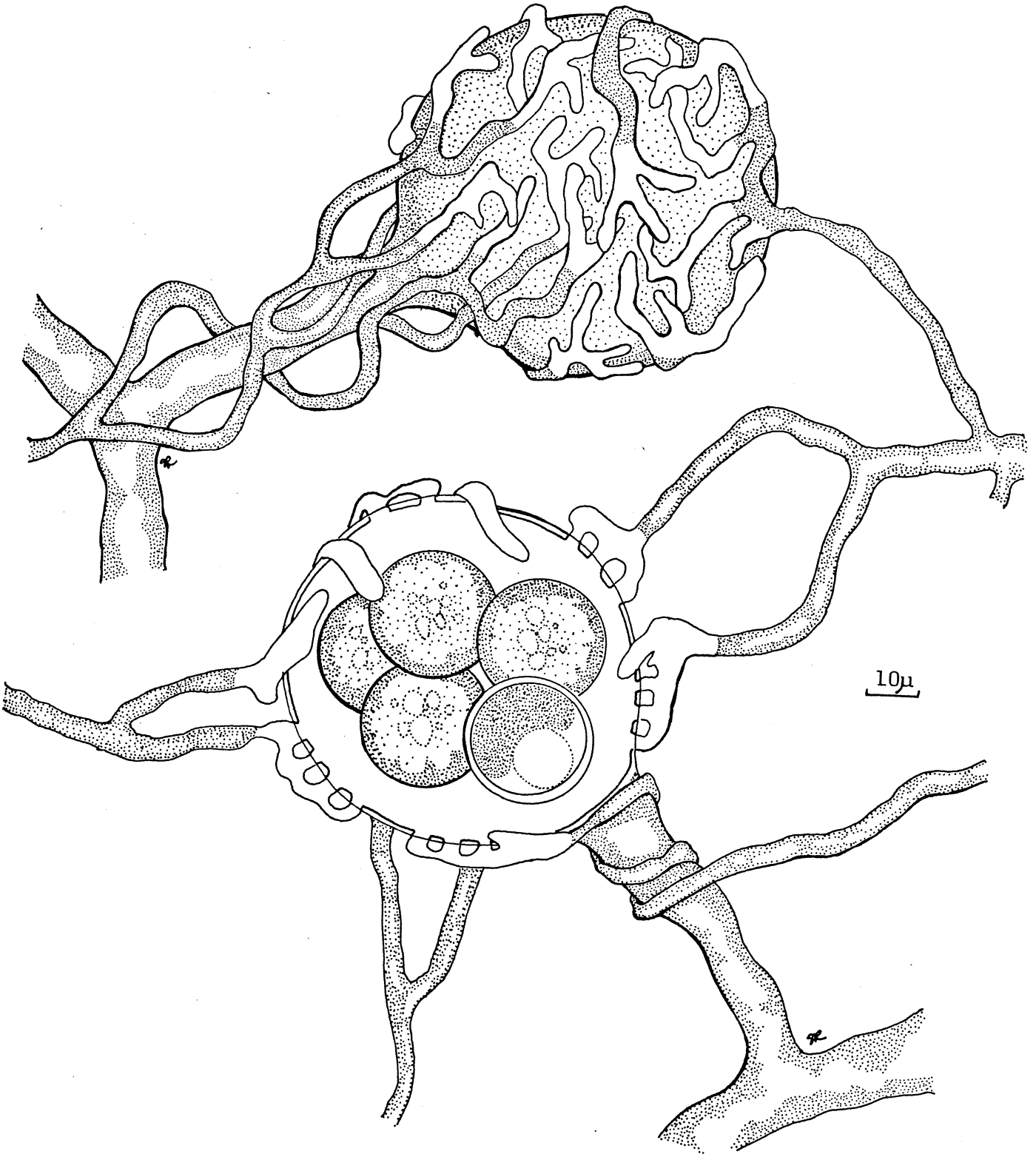

Fig. 35

Achlya ambisexualis J. R. Raper

Amer. J. Bot. 26: 639. 1939.

Fig. 36. Filaments of Achlya ambisexualis bearing zoosporangia and gemmae. Note that the gemmae are filiform or fusiform, and often disarticulate.

Fig. 37. Oogonia and antheridia of Achlya ambisexualis. Note that the oospores are eccentric, that the oospores are mostly mature and fill the oogonium. Note also that the oogonial wall is smooth and pitted only under the point of antheridial attachment; and that the antheridial branches are long, much branched, and tend to envelope the oogonium.

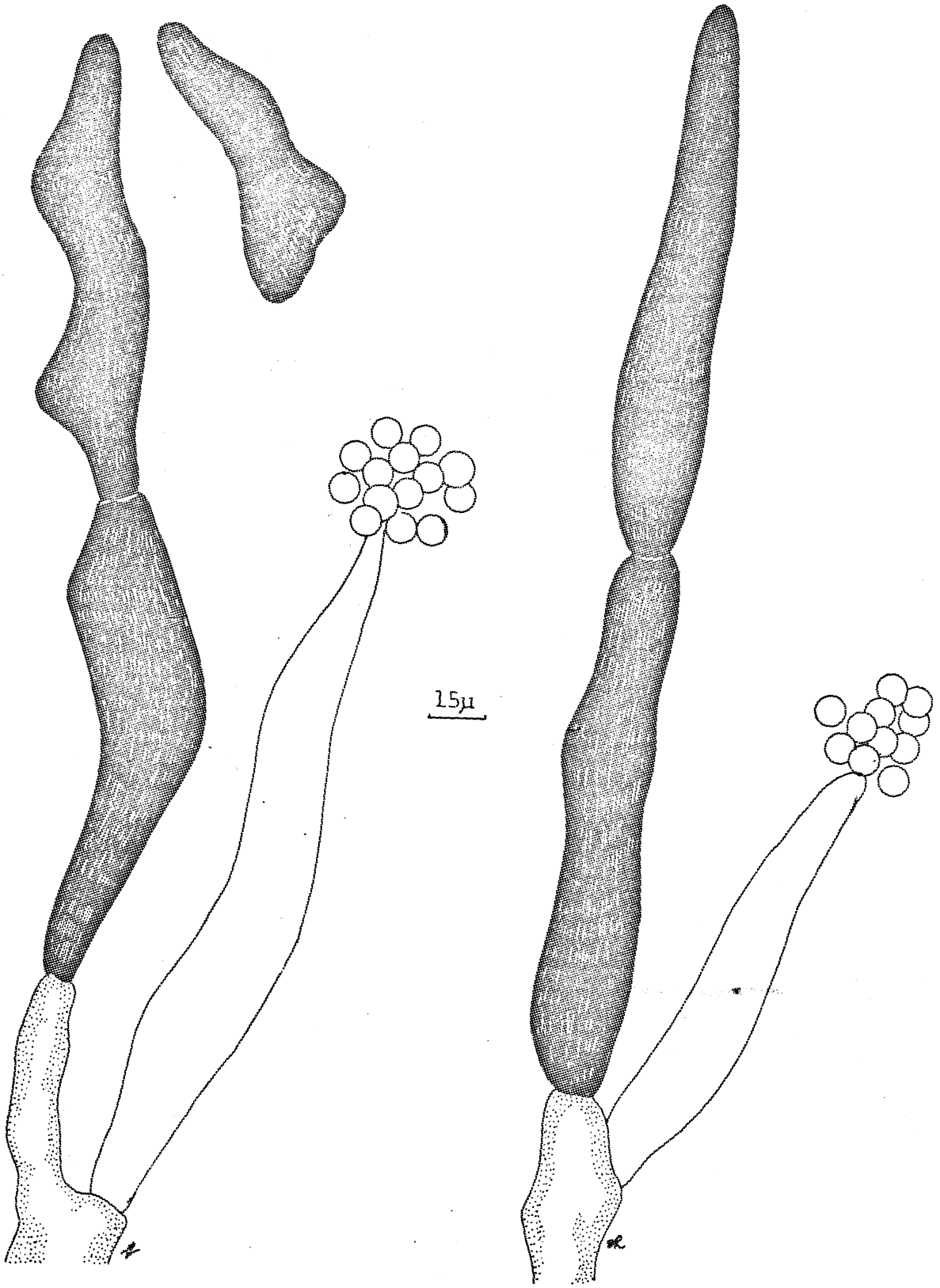

Fig. 36

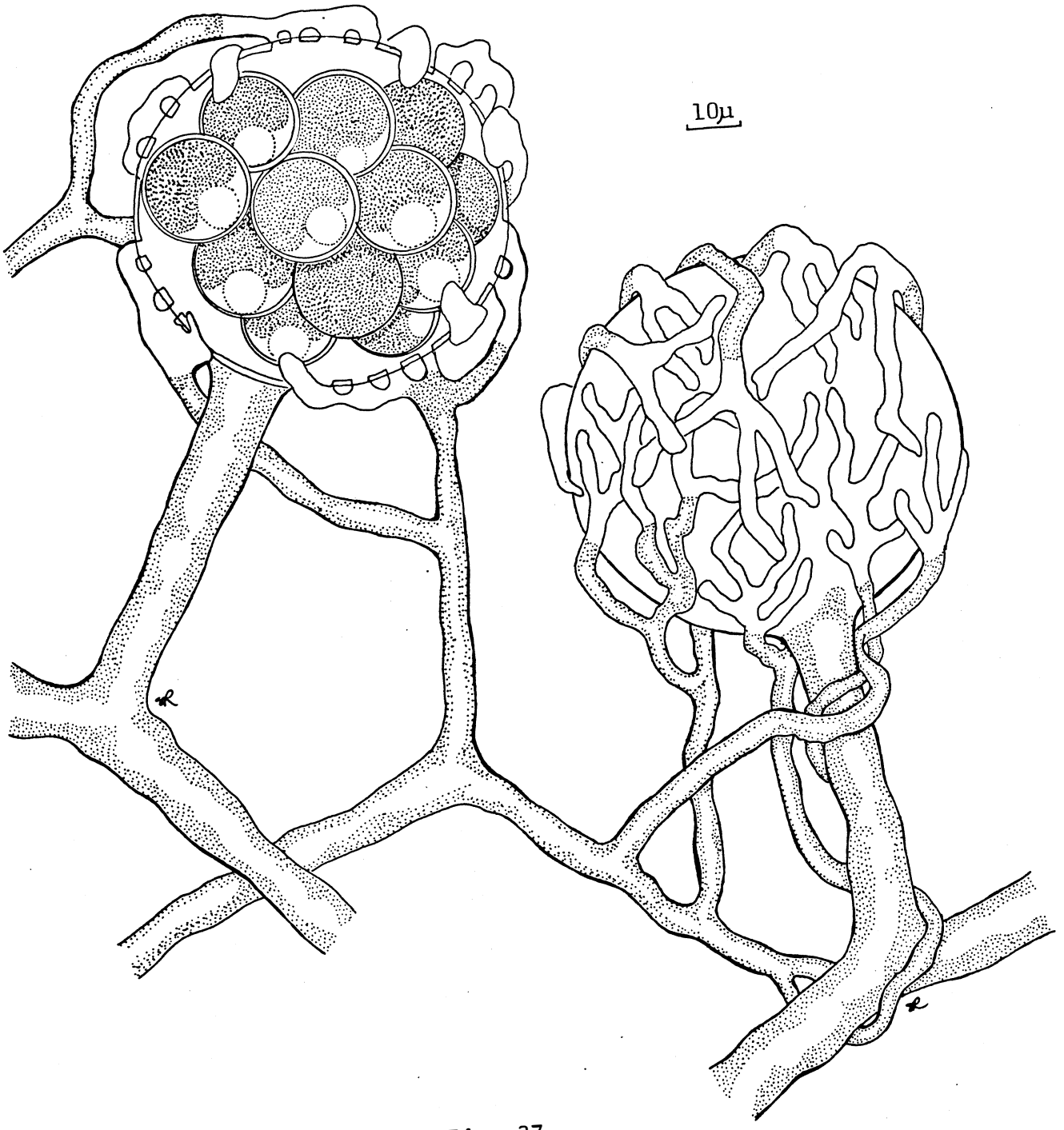

Fig. 37

Achlya caroliniana Coker

Bot. Gaz., 50: 381. 1919.

Fig. 38. Oogonia of Achlya caroliniana. Note that the oospores are eccentric, the oogonial wall smooth and unpitted, and that antheridia are entirely absent.

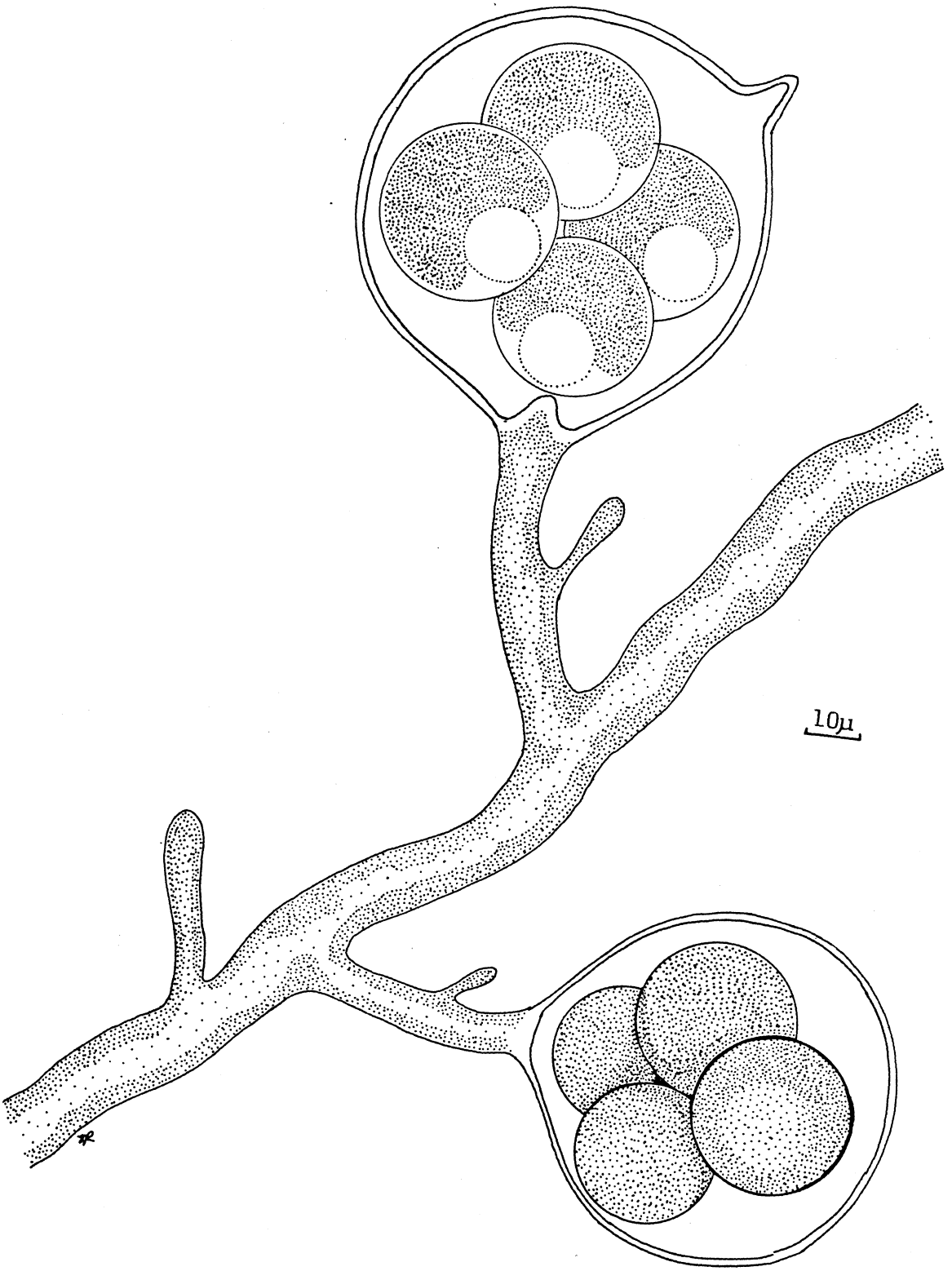

Fig. 38

Achlya racemosa Hildebrand

Jahrb. wiss. Bot., 6: 249. 1867-68.

Fig. 39. Oogonia and antheridia of Achlya racemosa. Note that the oospores are centric, that the oogonial wall is smooth and pitted only under the point of antheridial attachment, and that the antheridial branches are mostly androgynous.

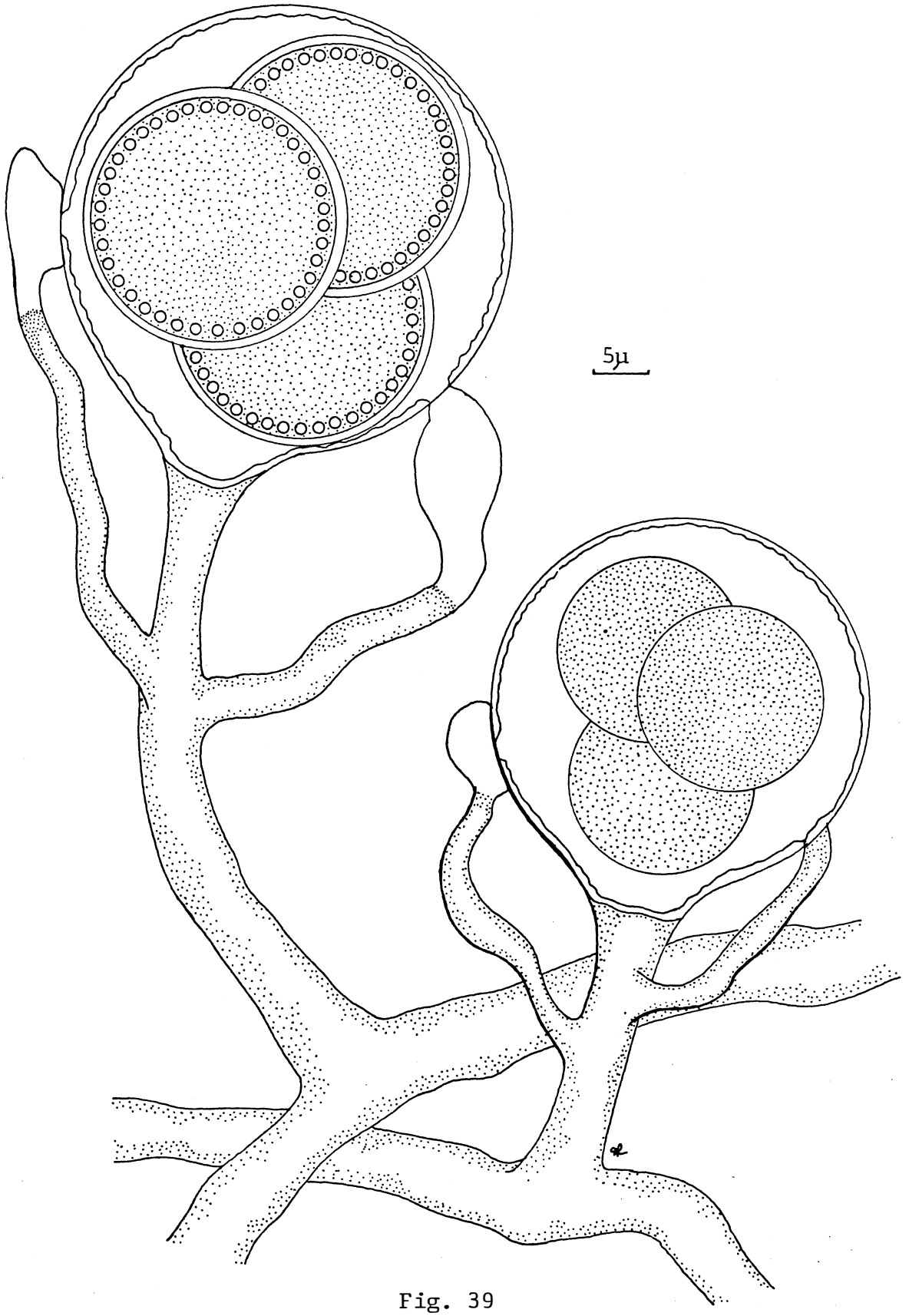

Fig. 39

Achlya apiculata de Bary

Bot. Zeitung, 46: 635. 1888.

Fig. 40. Oogonia and antheridia of Achlya apiculata. Note that the oospores are subcentric, that the smooth-walled oogonium is borne on a short stalk and is apiculate, and that the antheridial branches are mostly monoclinous.

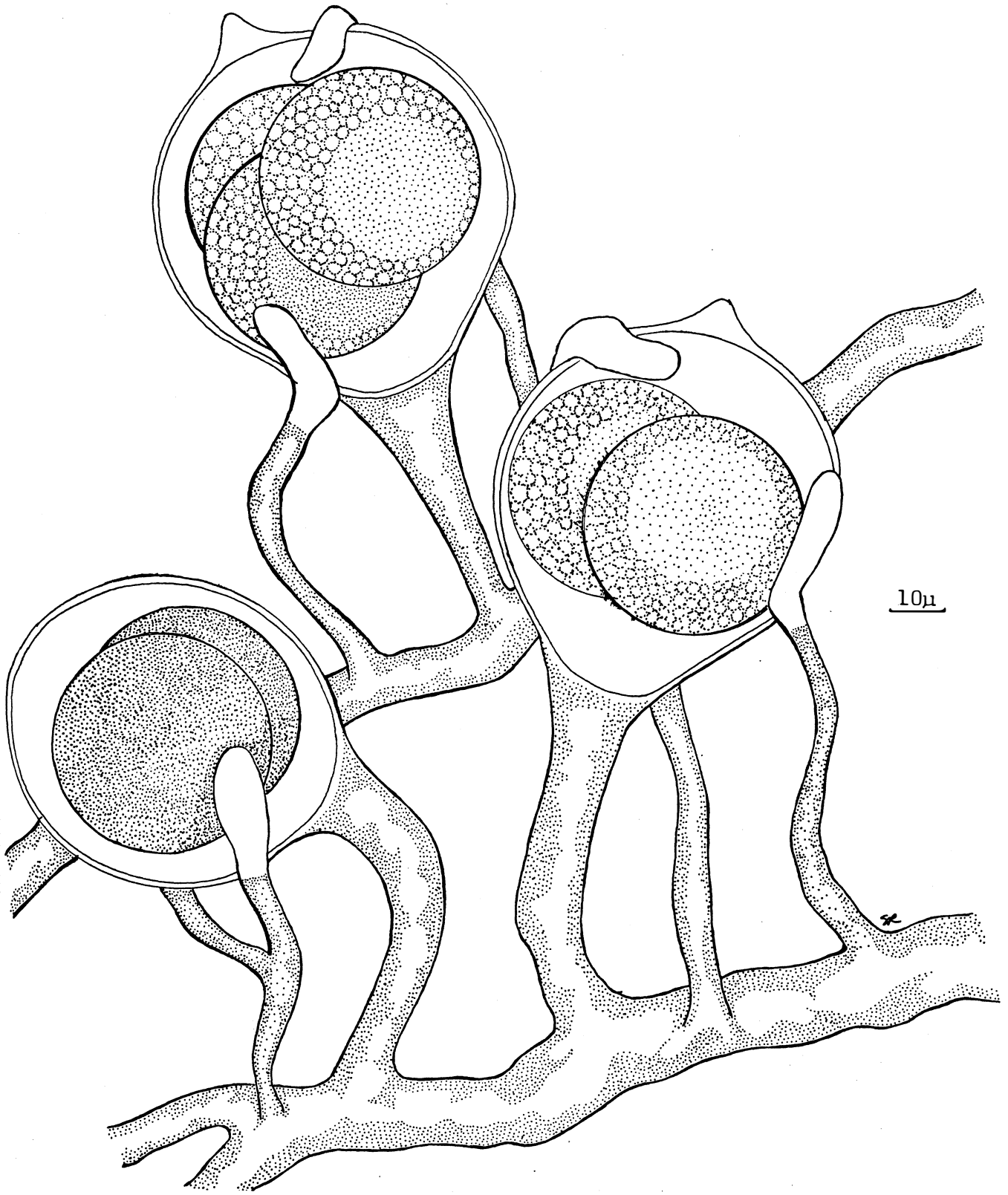

Fig. 40

Achlya polyandra Hildebrand

Jahrb. wiss. Bot., 6: 258. 1867-68.

Fig. 41. Oogonia and antheridia of Achlya polyandra. Note that the oospores are subcentric, that the smooth-walled oogonium is borne on a long stalk and is not apiculate, and that the antheridial branches are mostly androgynous.

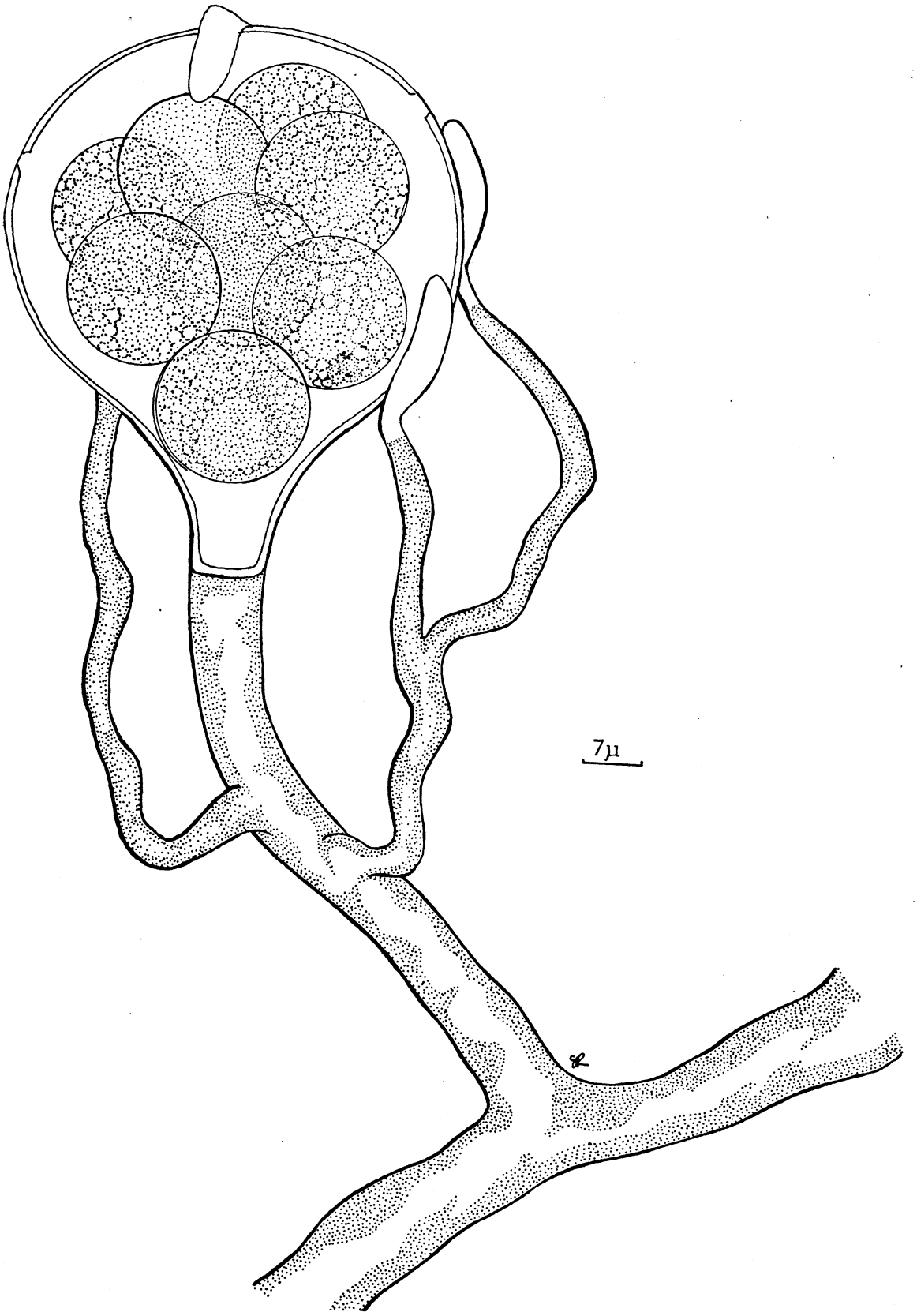

Fig. 41

Achlya orion Coker and Couch

Saprolegniaceae, p. 112. 1923.

Fig. 42. Oogonia and antheridia of Achlya orion. Note that the oospores are eccentric and few in number, that the smooth-wall oogonia are distinctively pendant, and that the antheridia are mostly androgynous.

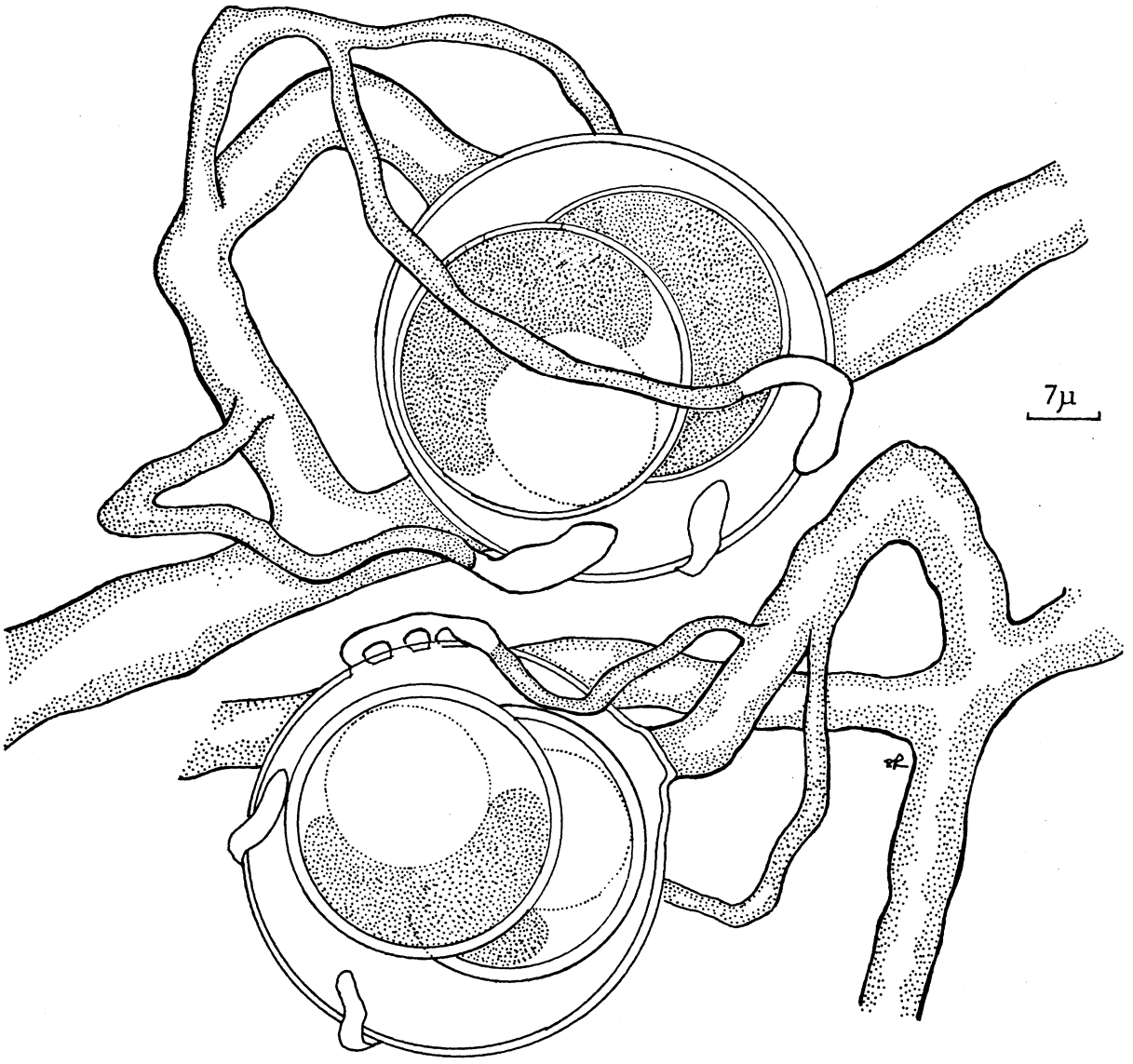

Fig. 42

Achlya debaryana Humphrey

Trans. Amer. Phil. Soc., 17: 117. 1893.

Fig. 43. Oogonia and antheridia of Achlya debaryana. Note that the oospores are eccentric and numerous, that the short-stalked oogonia are smooth-walled and unpitted, and that the antheridial branches are monoclinous and are mostly of remote origin.

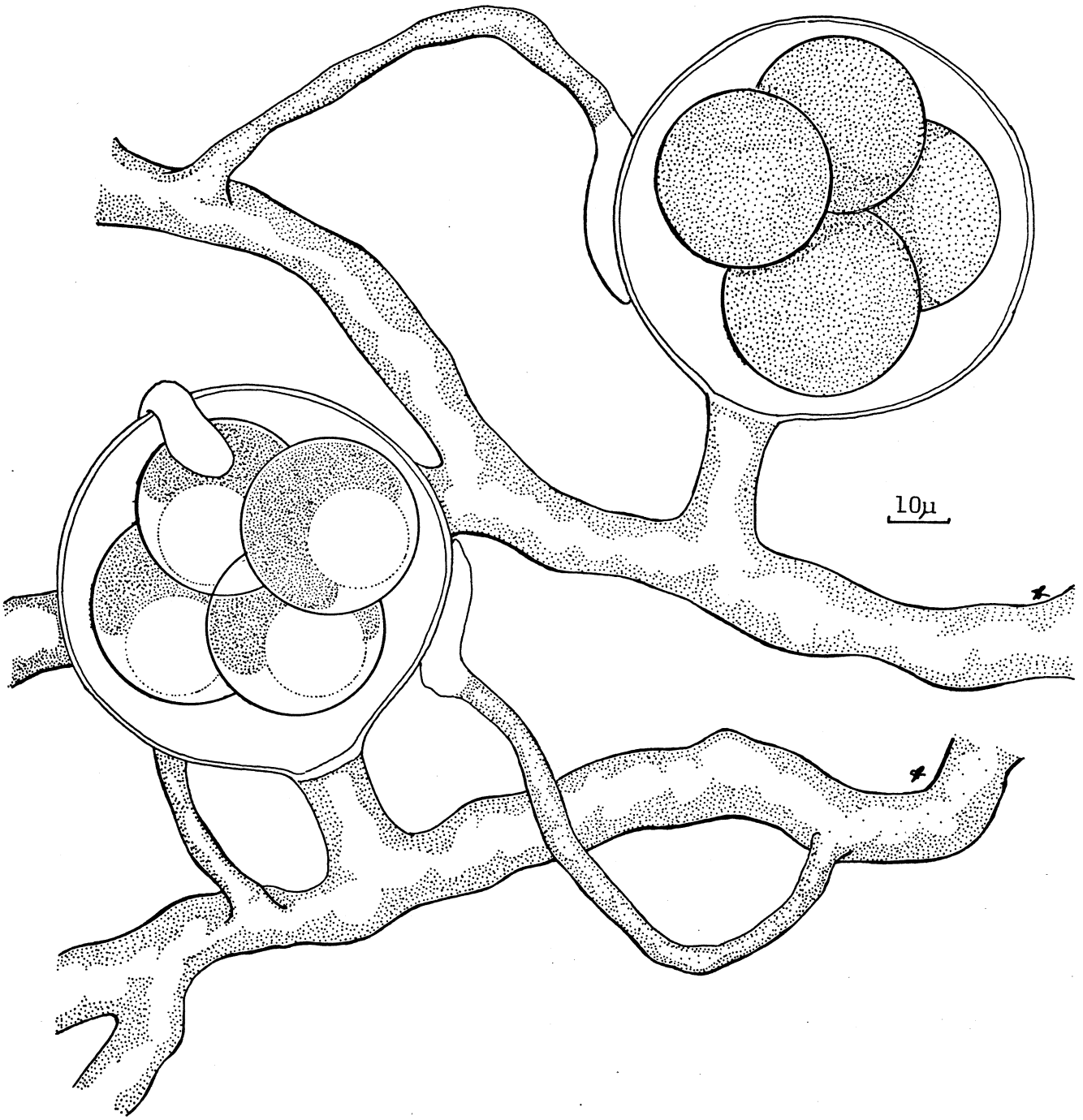

Fig. 43

Achlya americana Humphrey

Trans. Amer. Phil. Soc., 17: 116. 1893.

Fig. 44. Oogonia and antheridia of Achlya americana. Note that the numerous small oospores are eccentric, mature, and fill the oogonium; that the short-stalked oogonia are smooth-walled and conspicuously pitted; and that the antheridial branches are closely monoclinous.

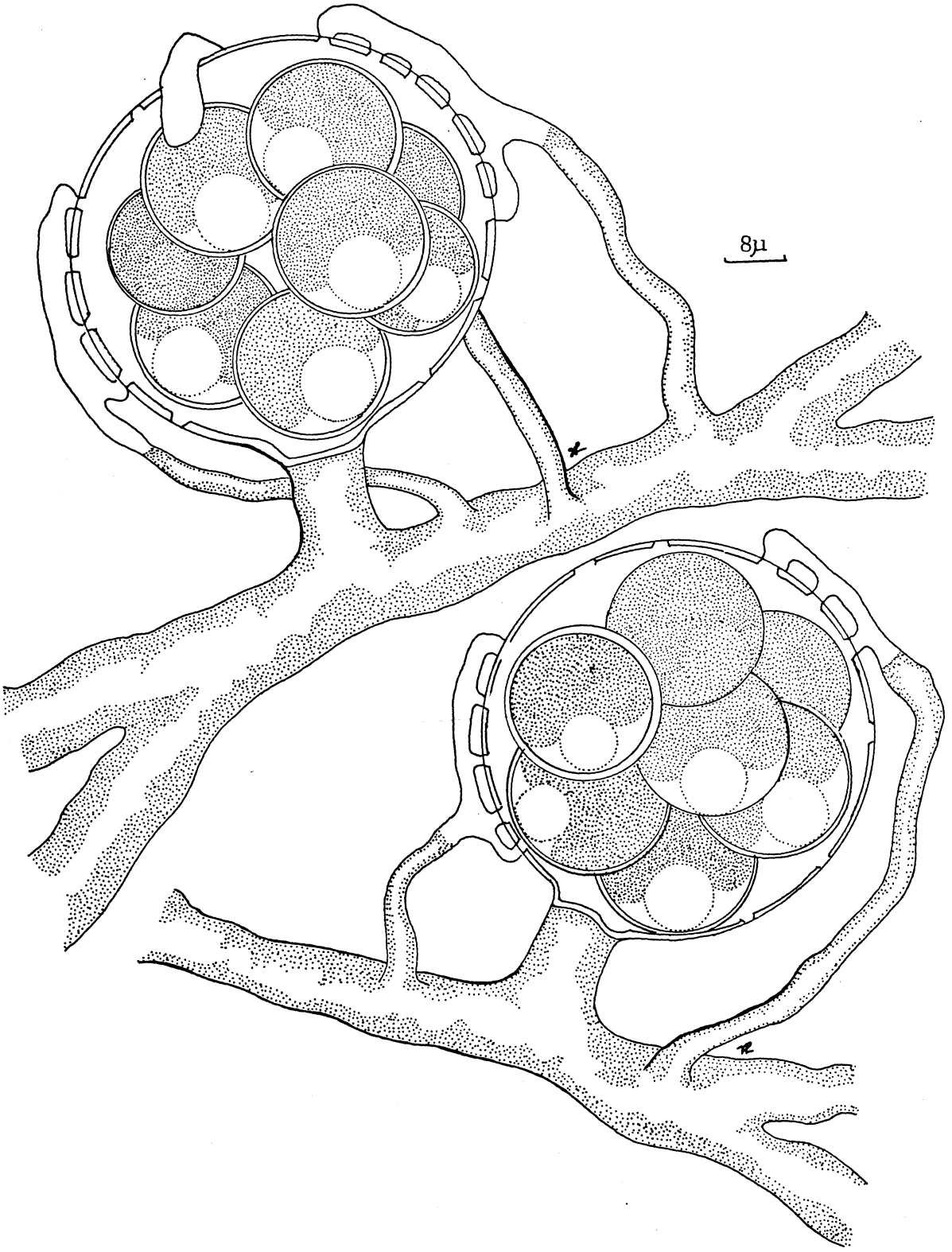

Fig. 44

Achlya conspicua Coker

Saprolegniaceae, p. 131. 1923.

Fig. 45. Oogonia and antheridia of Achlya conspicua. Note that the numerous small oospores are eccentric but rarely mature and do not fill the oogonium; that the usually long-stalked oogonia are smooth-walled and pitted only under the point of antheridial attachment; and that the antheridial branches are monoclinous or androgynous.

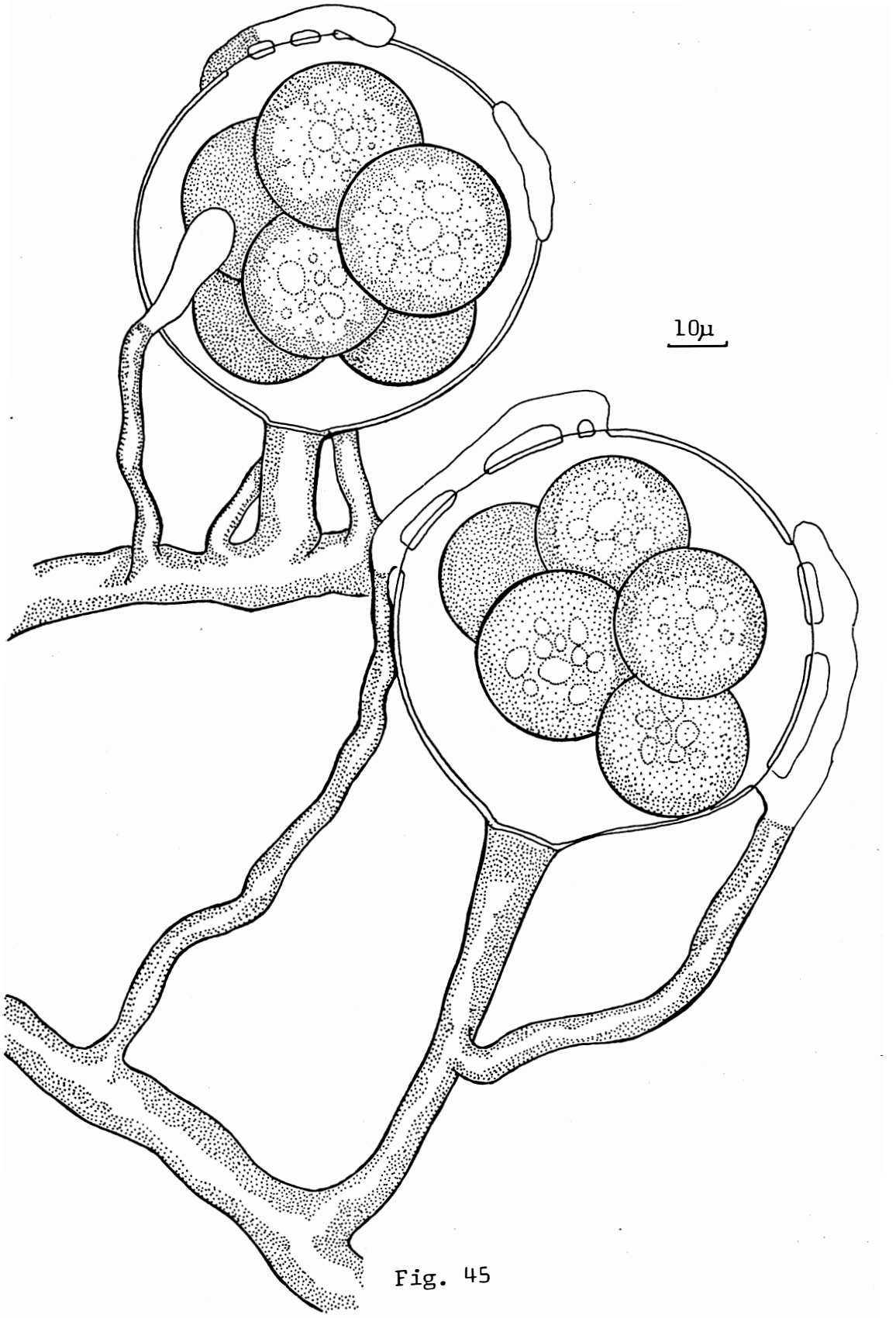

Fig. 45

Achlya oblongata de Bary

Bot. Zeitung, 46: 646. 1888.

Fig. 46. Oogonia and antheridia of Achlya oblongata. Note that the oospores are subcentric, small and numerous, and not filling the oogonium; and that the antheridial branches are strictly diclinous.

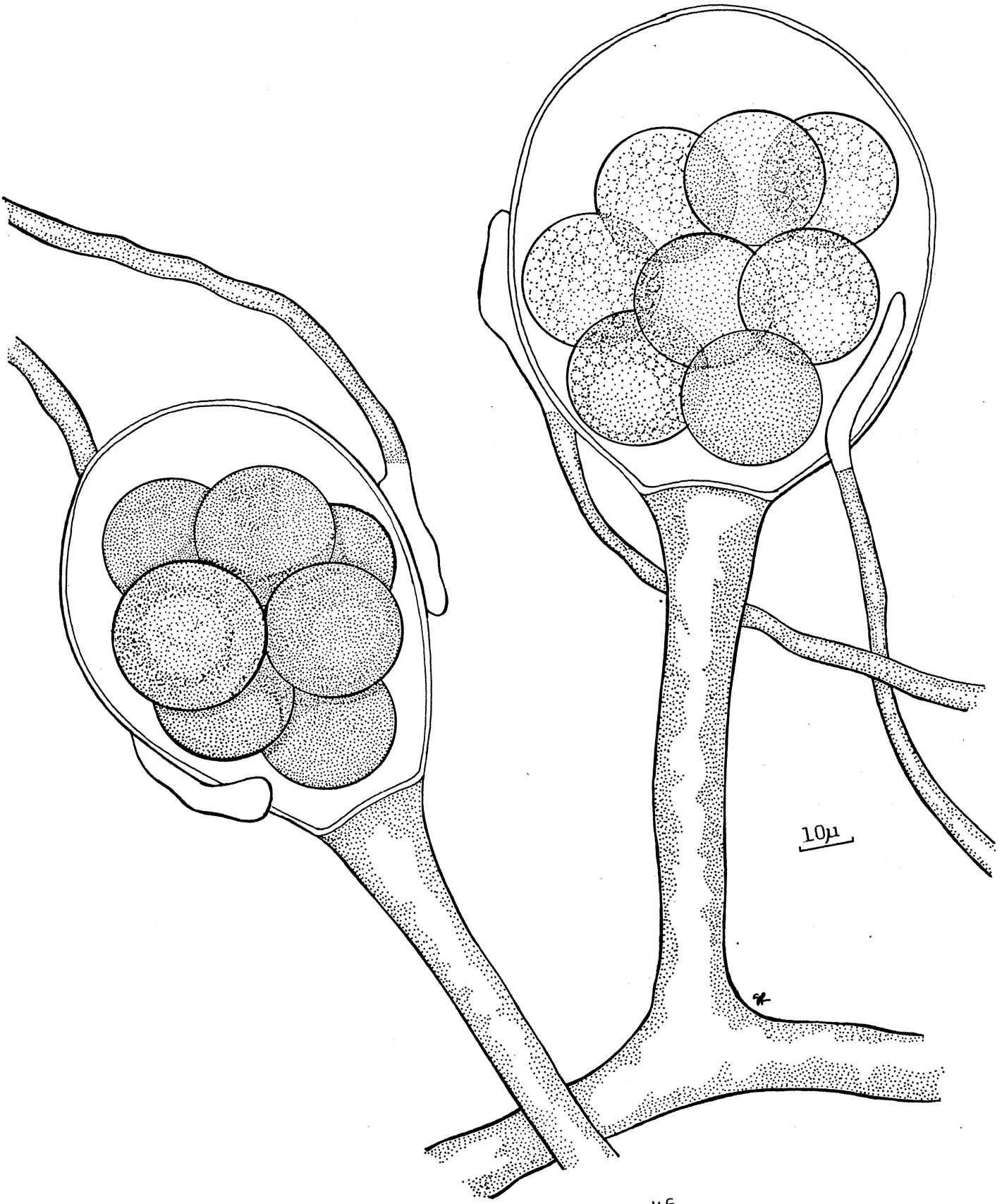

Fig. 46

Achlya dubia Coker

Saprolegniaceae, p. 135. 1923.

Fig. 47. Filaments of Achlya dubia bearing zoosporangia. Note that the first-formed zoosporangia are thraustothecoid and that the secondary zoosporangia are typically achlyoid.

Fig. 48. Oogonia and antheridia of Achlya dubia. Note that the oospores are eccentric, few in number, and do not usually fill the oogonium; that the oogonial wall is smooth and pitted; and that the antheridial branches are mostly diclinous.

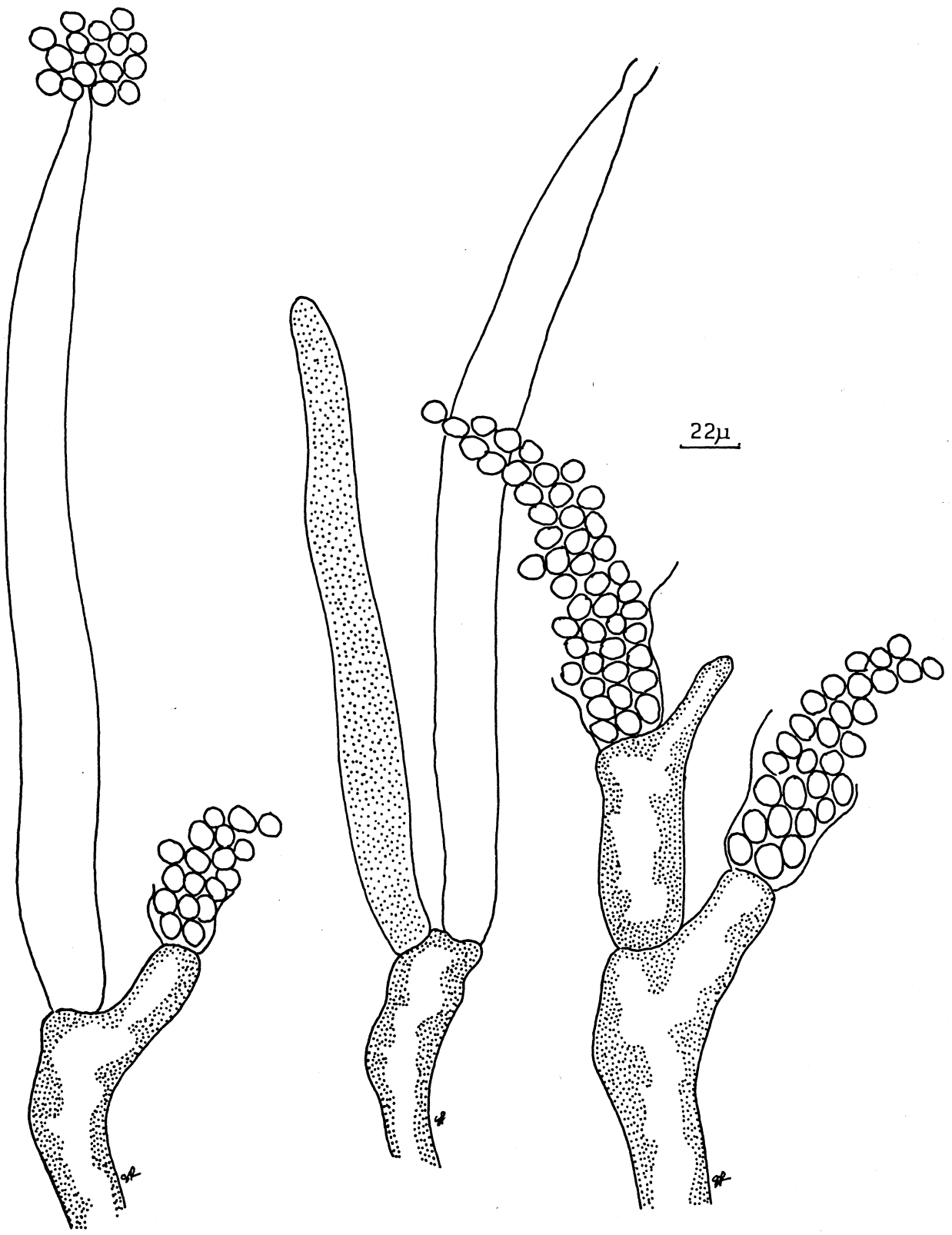

Fig. 47

Achlya intricata Beneke

Jour. Elisha Mitch. Sci. Soc., 64: 261. 1948.

Fig. 49. Oogonia and antheridia of Achlya intricata. Note that the oospores are eccentric, that the lobed and irregularly shaped oogonia are smooth-walled, and that the delicate antheridial branches are diclinous and are much-branched, irregular, and tend to wrap about the oogonium and attendant hyphae.

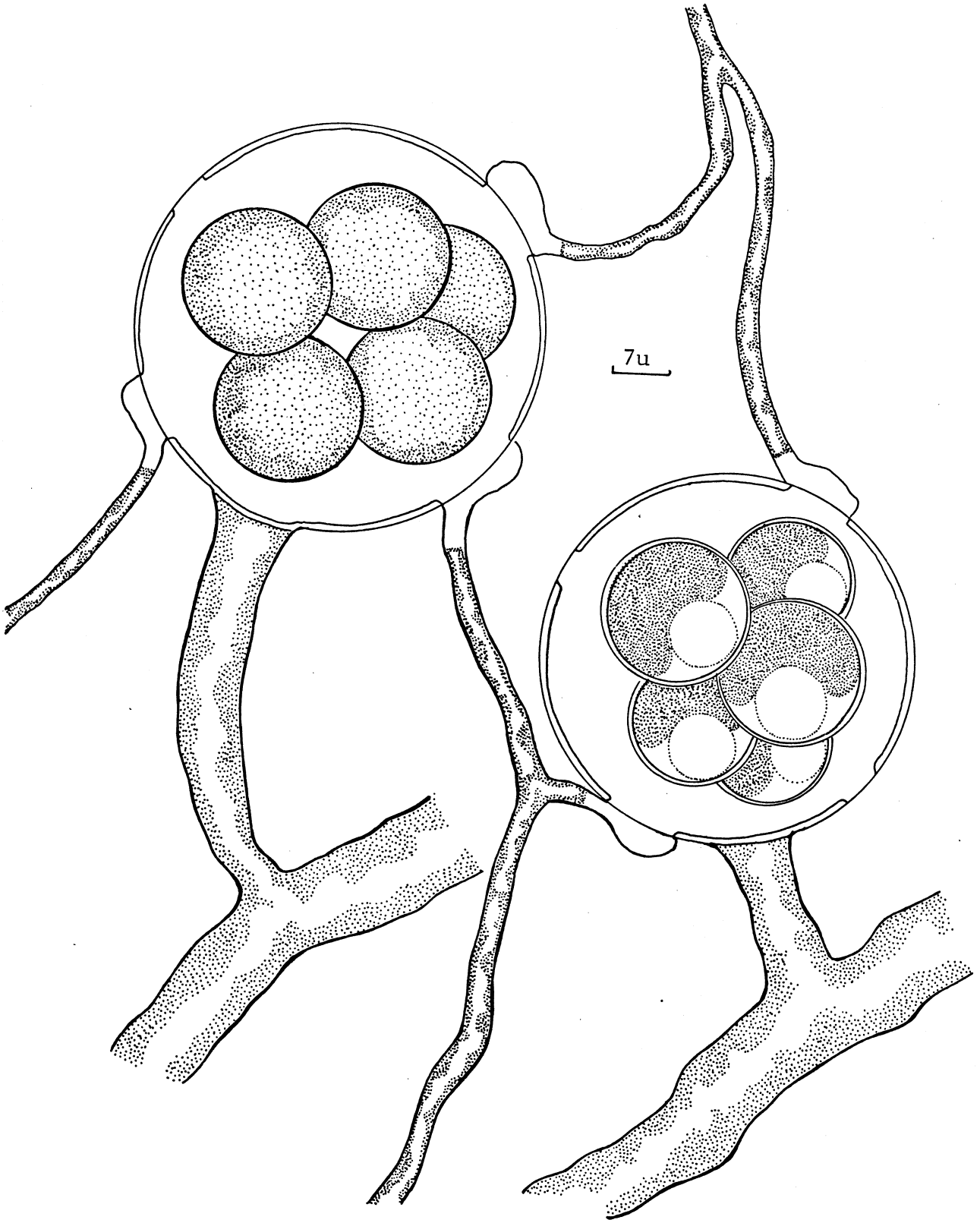

Fig. 48

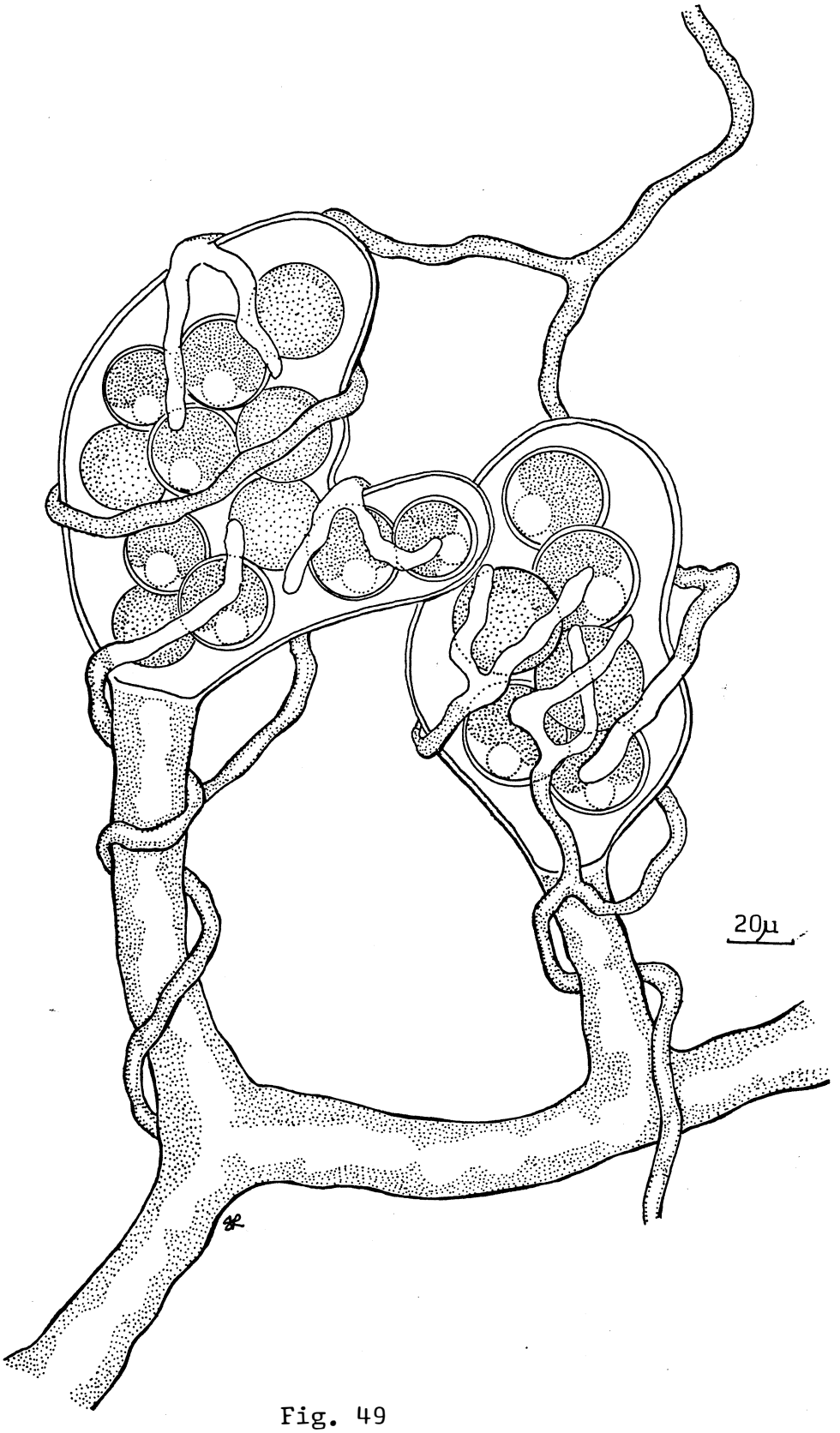

Fig. 49

Achlya proliferoides Coker

Saprolegniaceae, p. 115. 1923.

Fig. 50. Oogonia and antheridia of Achlya proliferoides. Note that the oospores are eccentric, that the spherical oogonia are smooth-walled, and that the diclinous antheridia tend to coil about the vegetative hyphae and about the oogonial stalk.

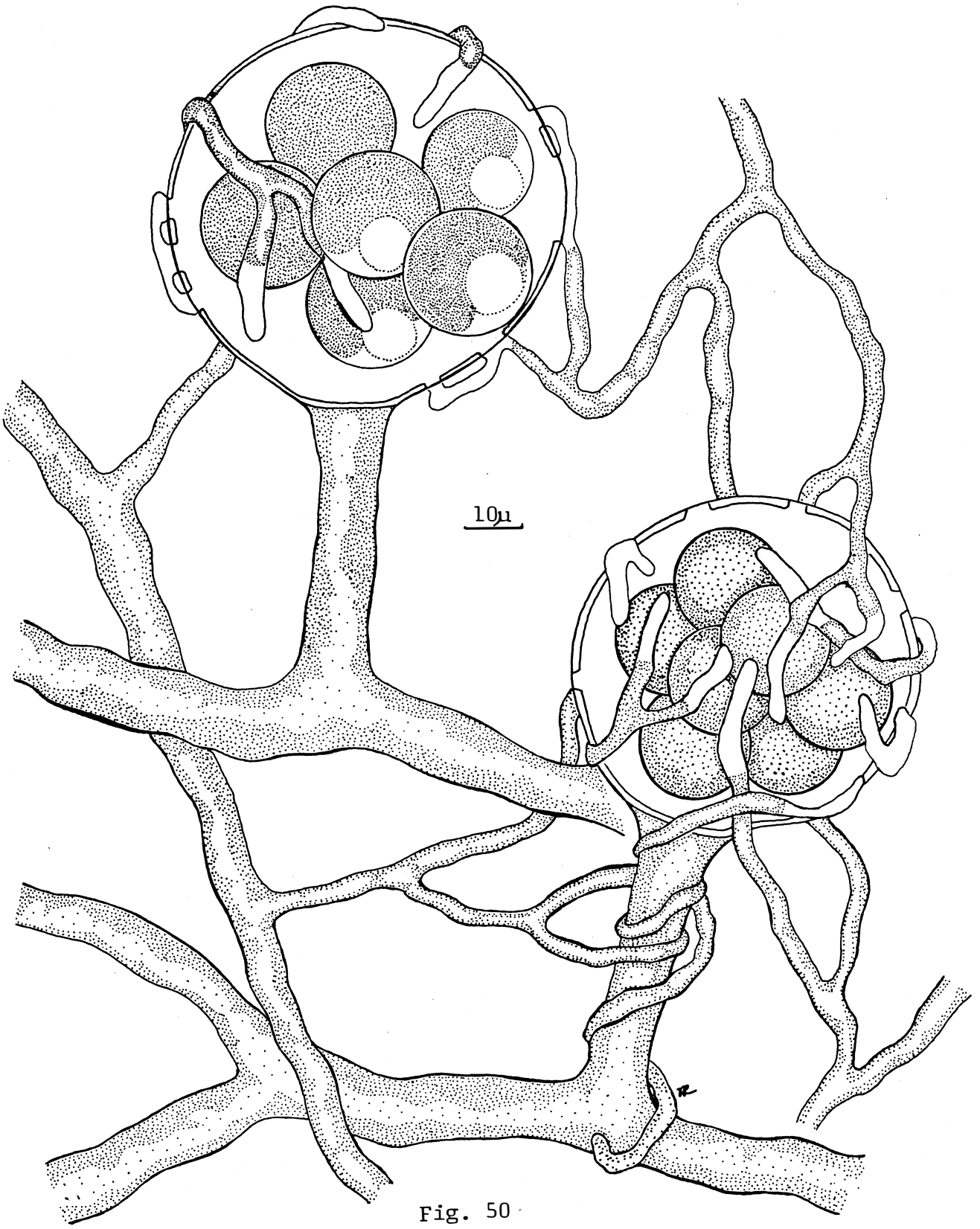

Fig. 50

Achlya diffusa (Harvey) Johnson

The Genus Achlya, p. 64. 1956.

Fig. 51. Filaments of Achlya diffusa bearing zoosporangia and lateral hyphal swellings. Note the singular inflated "balloon-like" swellings borne on short lateral branches.

Fig. 52. Oogonia and antheridia of Achlya diffusa. Note that the oospores are eccentric and frequently abort, that the spherical oogonium is smooth-walled, and that the antheridial branches are mostly diclinous.

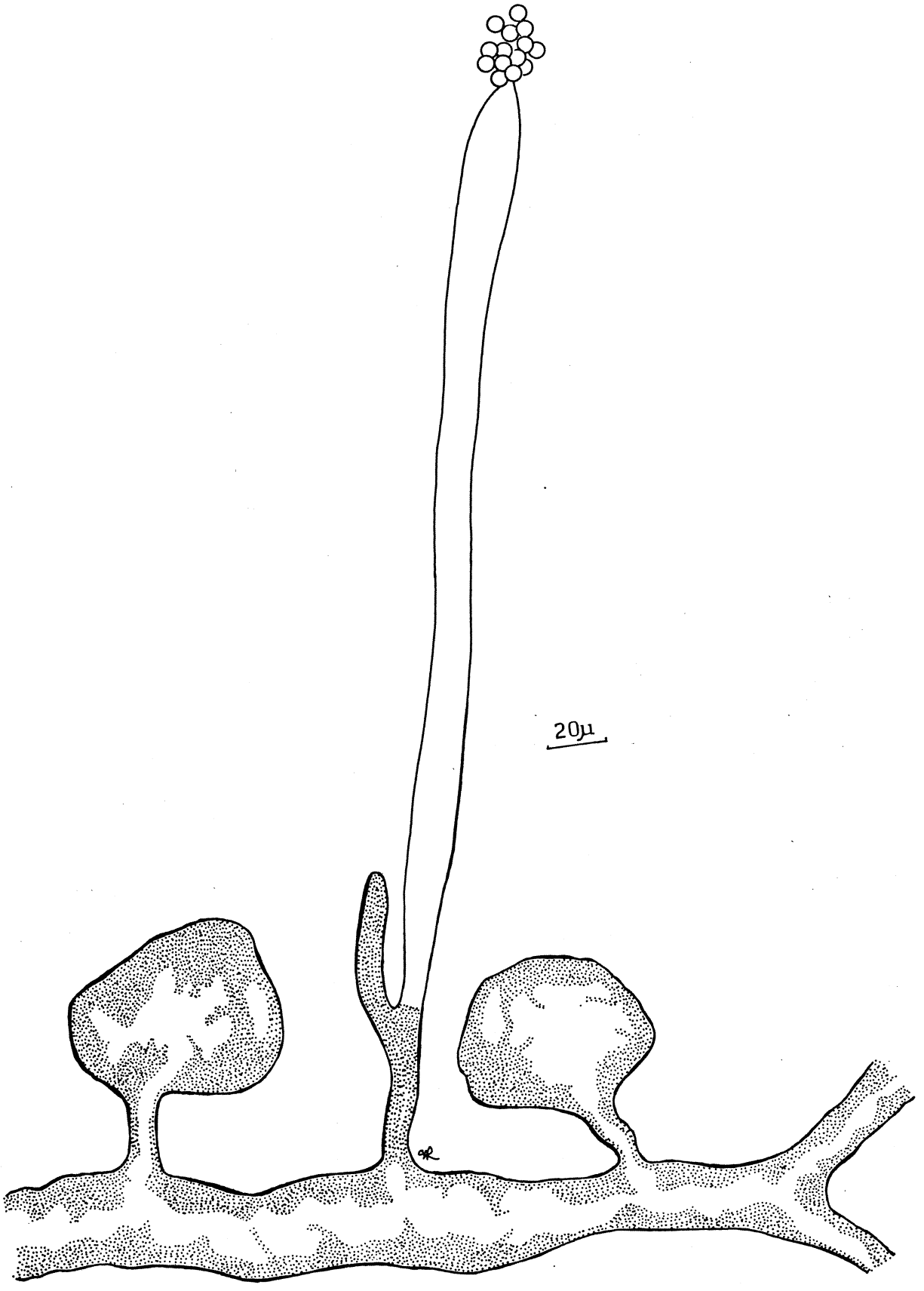

Fig. 51

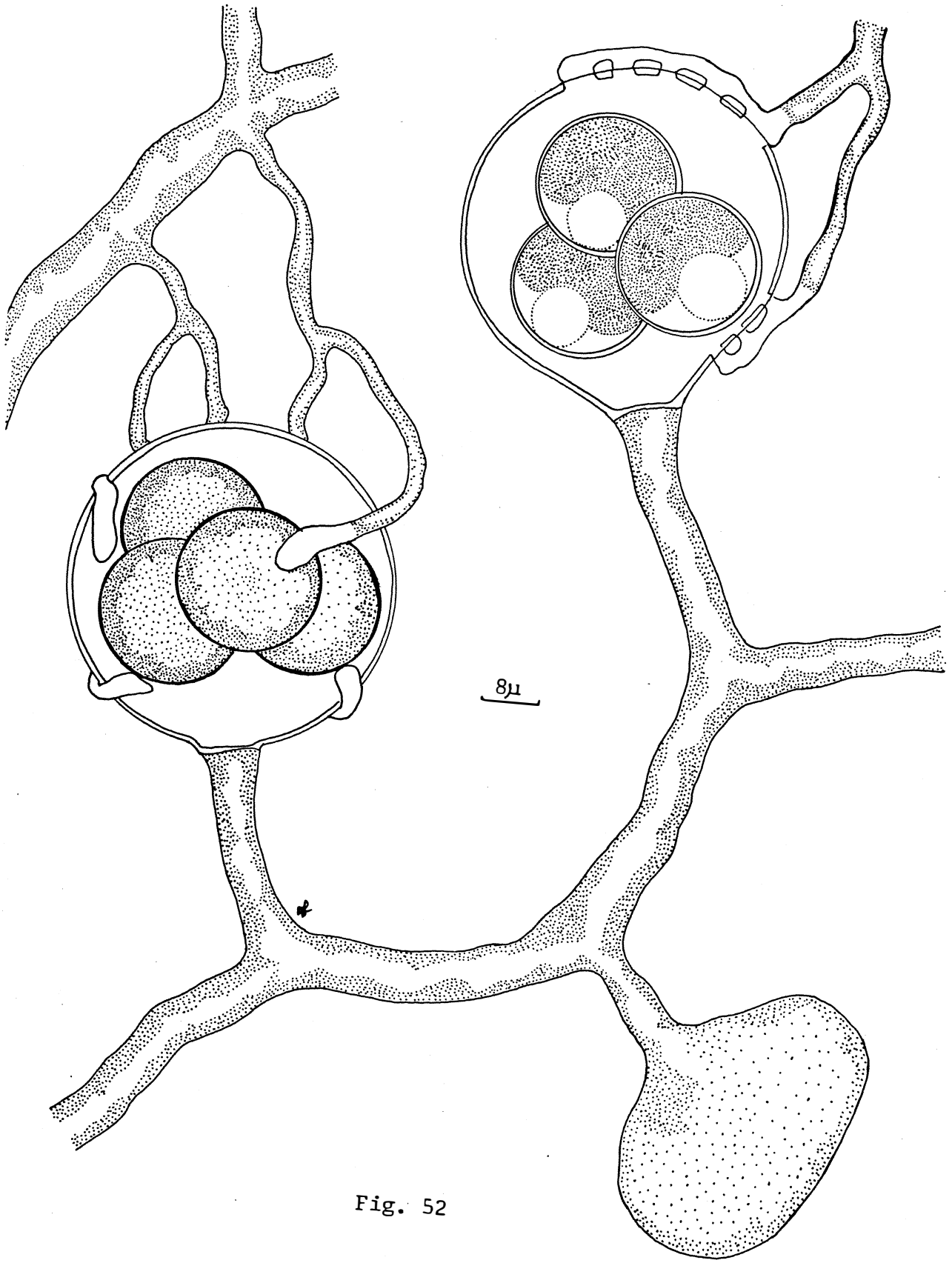

Fig. 52

Achlya flagellata Coker

Saprolegniaceae, p. 116. 1923.

Fig. 53. Oogonia and antheridia of Achlya flagellata (Syn. A. imperfecta). Note that the oospores are eccentric, that the oospores frequently fail to mature and do not fill the oogonium, and that the short and sparingly branched antheridial branches are mostly diclinous, but occasionally androgynous.

Fig. 54. Oogonia and antheridia of Achlya flagellata. Note that the oospores are eccentric and that the oospheres usually mature filling the oogonium, and that the relatively long and profusely branched antheridial branches are strictly diclinous.

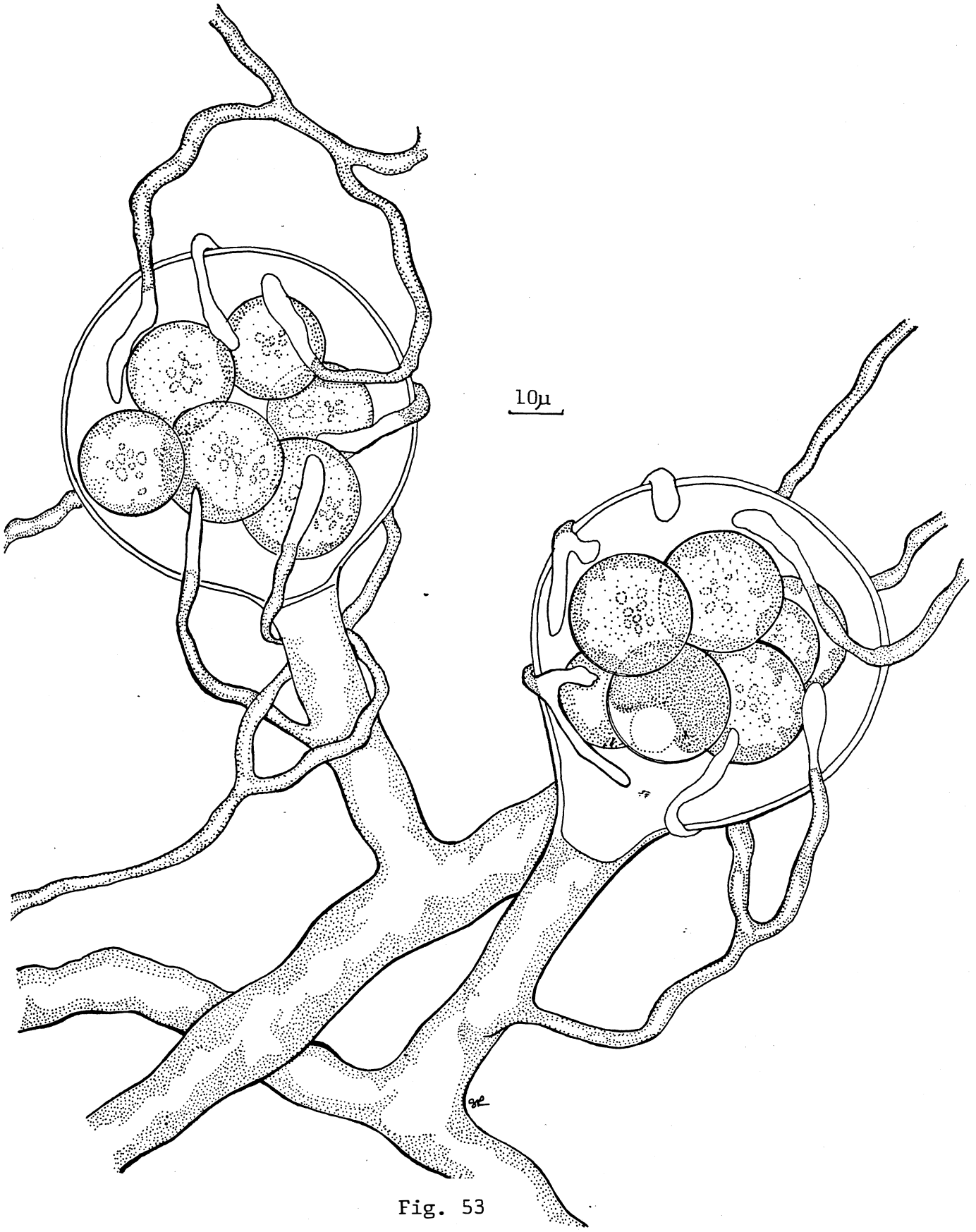

Fig. 53

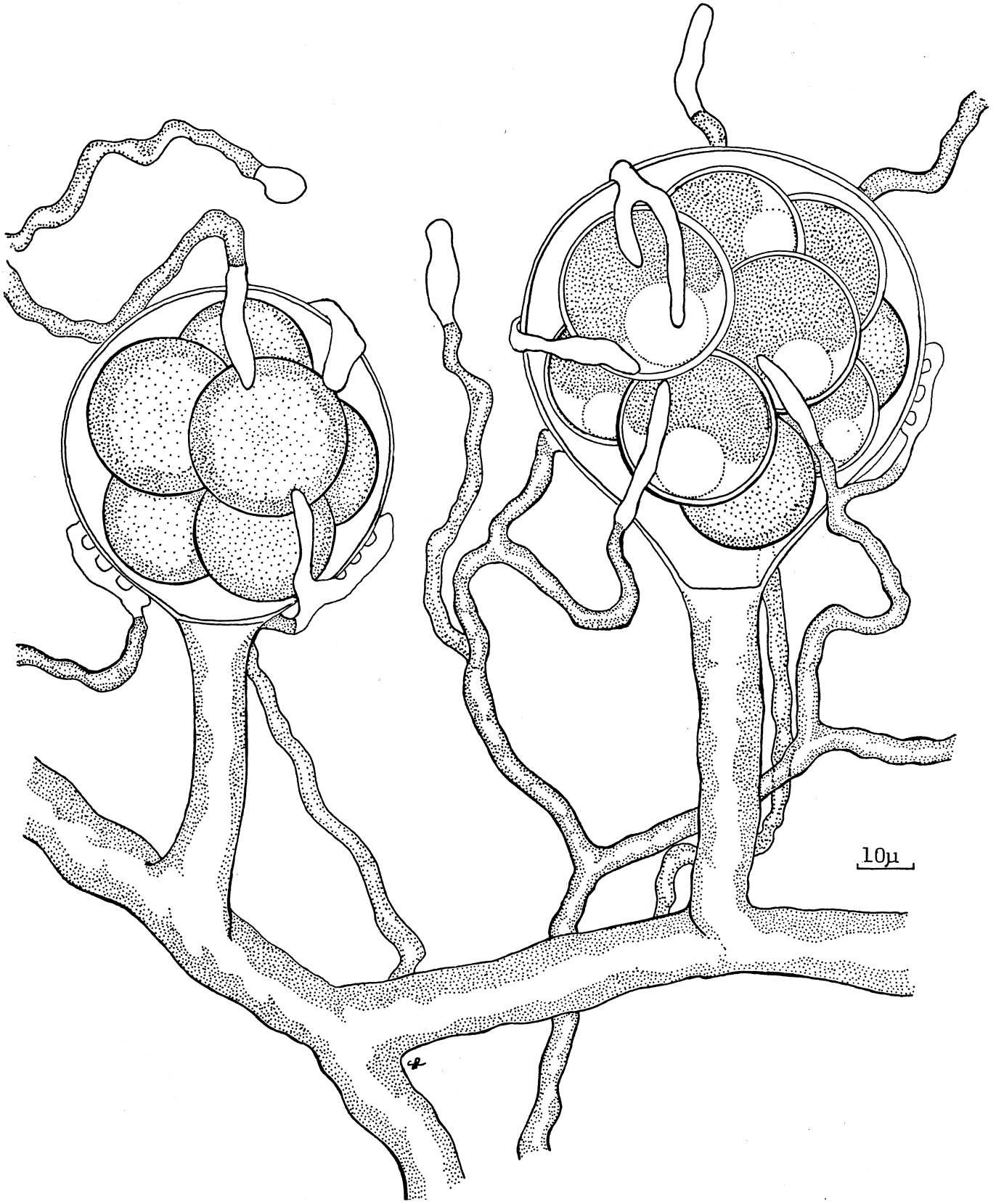

Fig. 54

Achlya rodriqueziana F. T. Wolf

Mycologia, 33: 274. 1941.

Fig. 55. Oogonia and antheridia of Achlya rodriqueziana. Note that the oospores are eccentric and few in number, and that the oospheres frequently fail to mature. Note also that the oogonium is smooth-walled and that the antheridial branches are mostly diclinous.

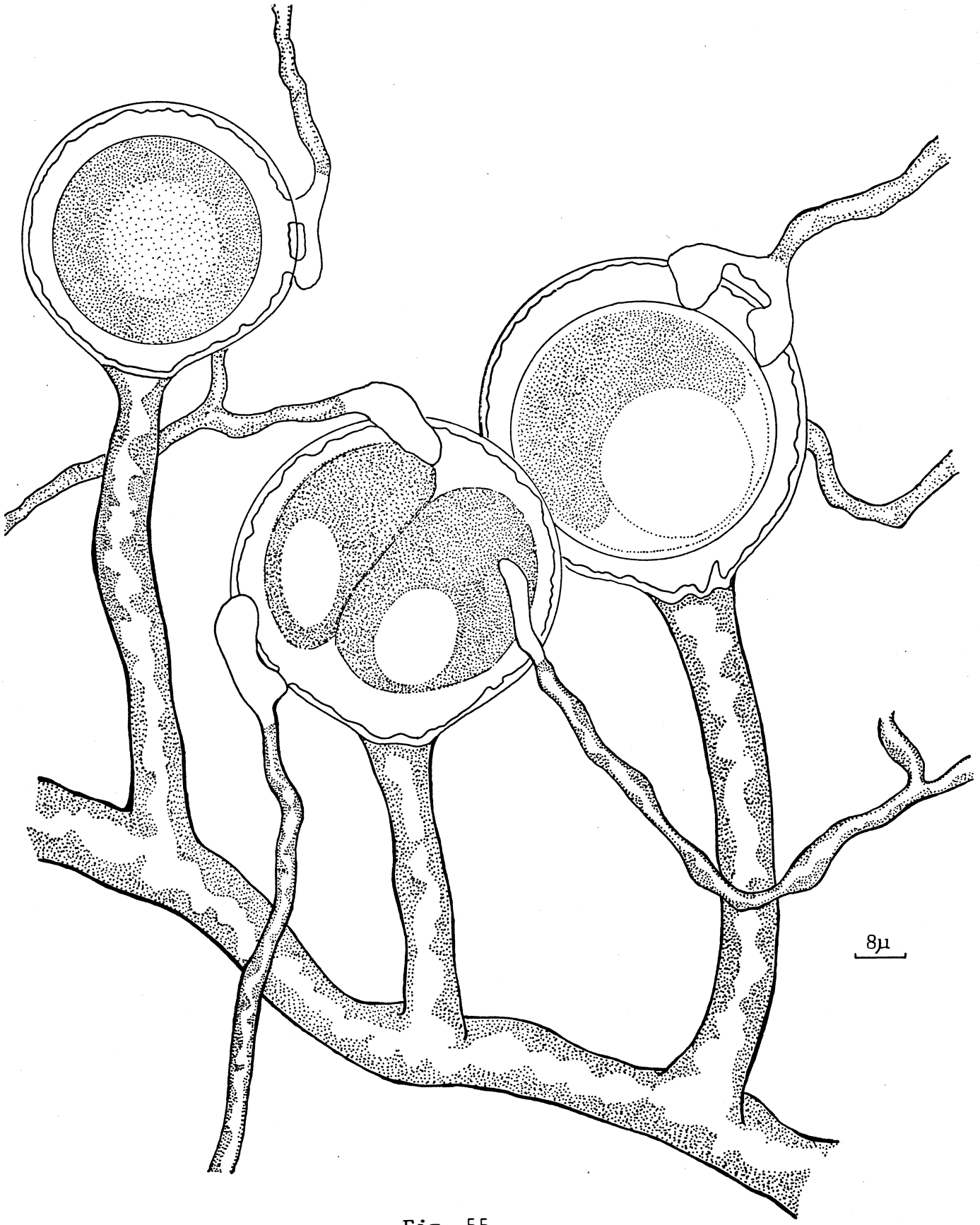

Fig. 55

Achlya prolifera C. G. Nees

Nova Acta Acad. Leop.-Carol., 11: 514. 1823.

Fig. 56. Oogonia and antheridia of Achlya prolifera. Note that the oospores are eccentric, that the oospheres mature and fill the oogonium, and that the irregular, contorted, profusely branched antheridial branches are strictly diclinous.

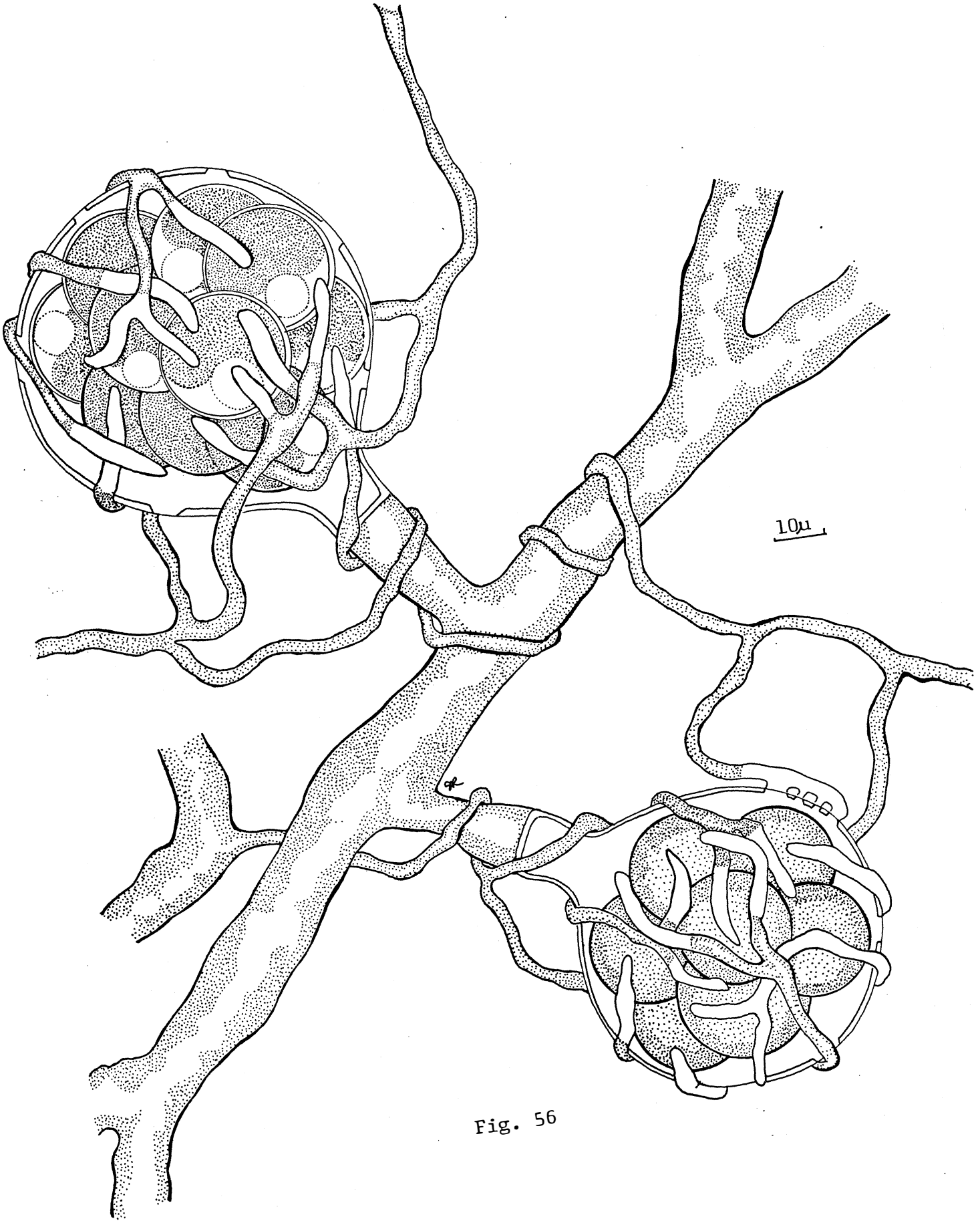

Fig. 56

Achlya klebsiana Pieters

Bot. Gaz., 60: 486. 1915.

Fig. 57. Oogonia and antheridia of Achlya klebsiana. Note that the oospores are eccentric, that the oospheres mature and fill the oogonium, and that the antheridial branches are mostly diclinous, occasionally remotely monoclinous.

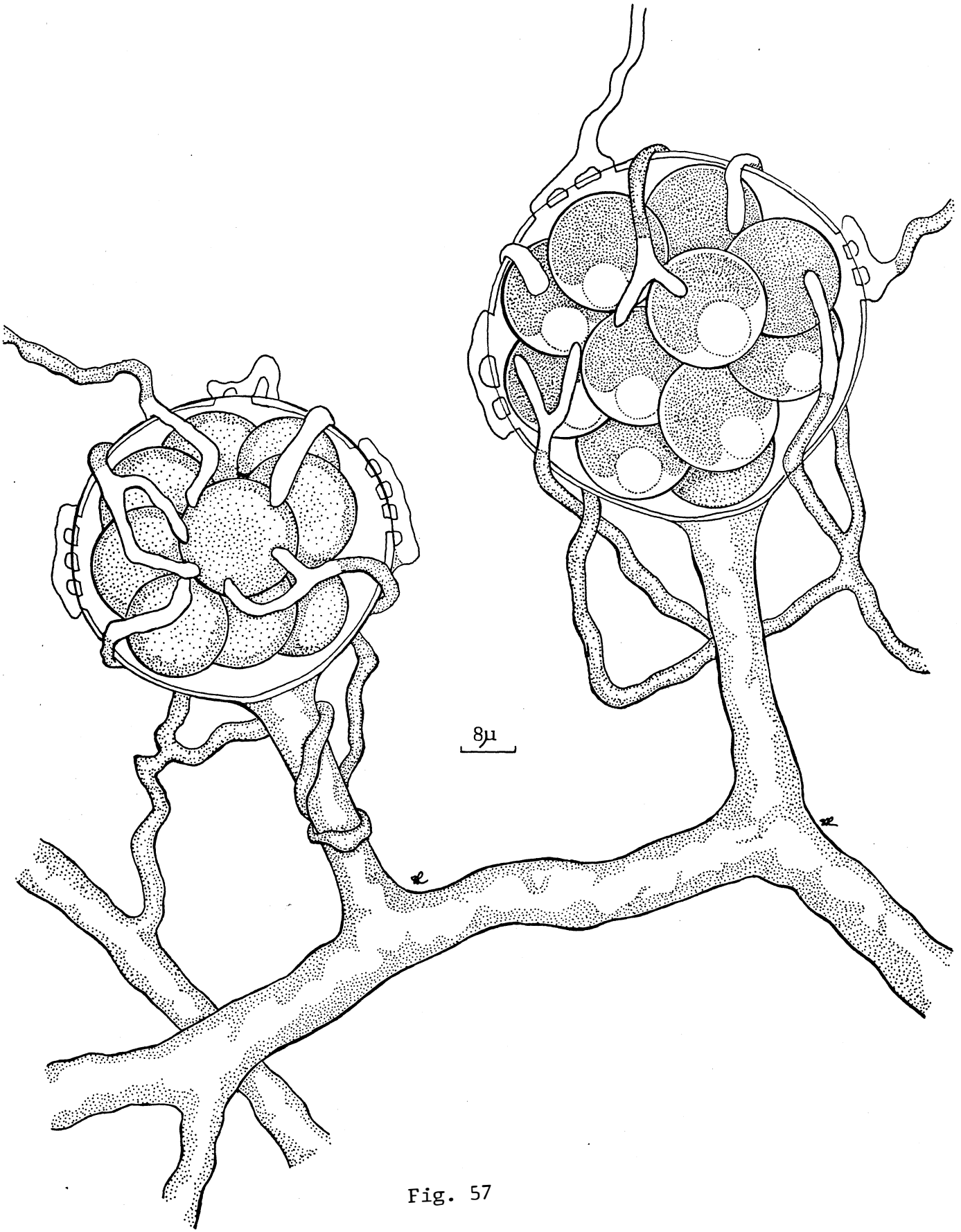

Fig. 57

Achlya colorata Pringsheim

Sitzungsber. Akad. Berlin, p. 889. 1882.

Fig. 58. Oogonia and antheridia of Achlya colorata. Note that the oospores are centric, that the papillate oogonia are pitted only under the point of antheridial attachment, and that the antheridial branches are mostly androgynous.

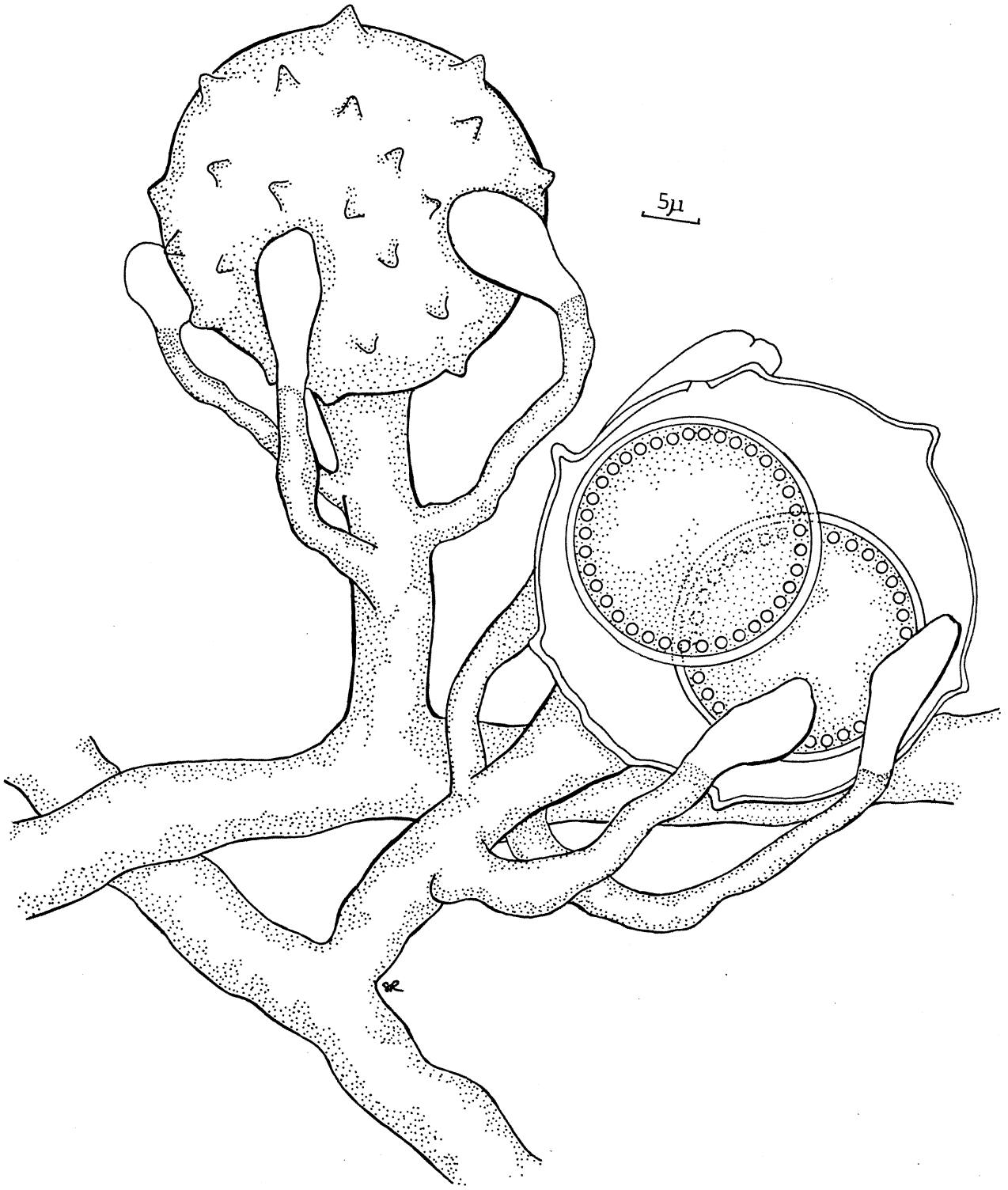

Fig. 58

Achlya spiracaulis Johnson

Mycologia, 41: 678. 1949.

Fig. 59. Oogonia of *Achlya spiracaulis*. Note that the oospores are centric, that the densely ornamented oogonia are unpitted, that the oogonial stalk is coiled, and that antheridia are generally absent.

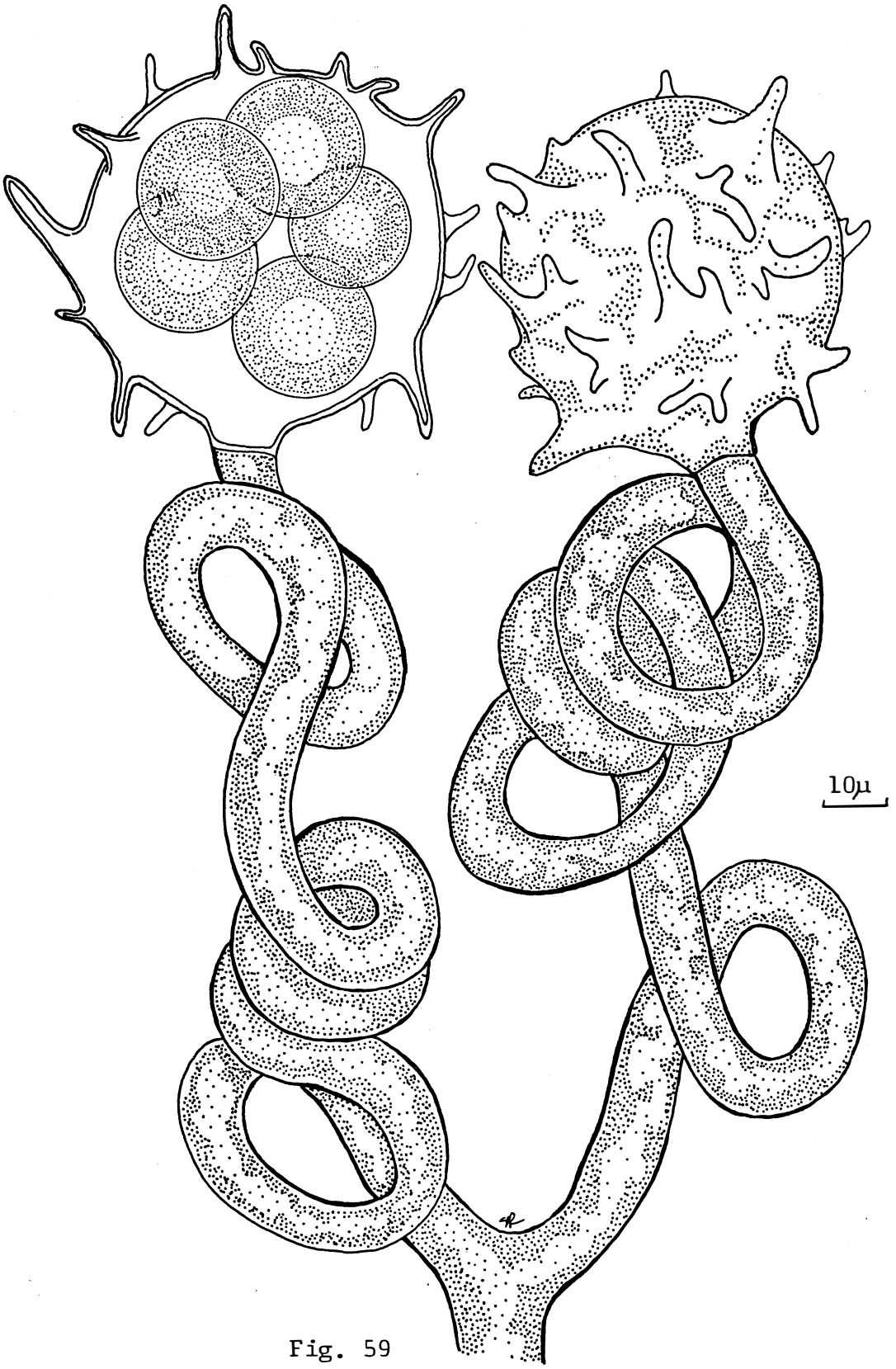

Fig. 59

Achlya papillosa Humphrey

Trans. Amer. Phil. Soc., 17: 125. 1893.

Fig. 60. Oogonia and antheridia of Achlya papillosa. Note that the oospores are centric, that the oogonial wall is densely ornamented and unpitted, and that the antheridial branches are mostly monoclinous.

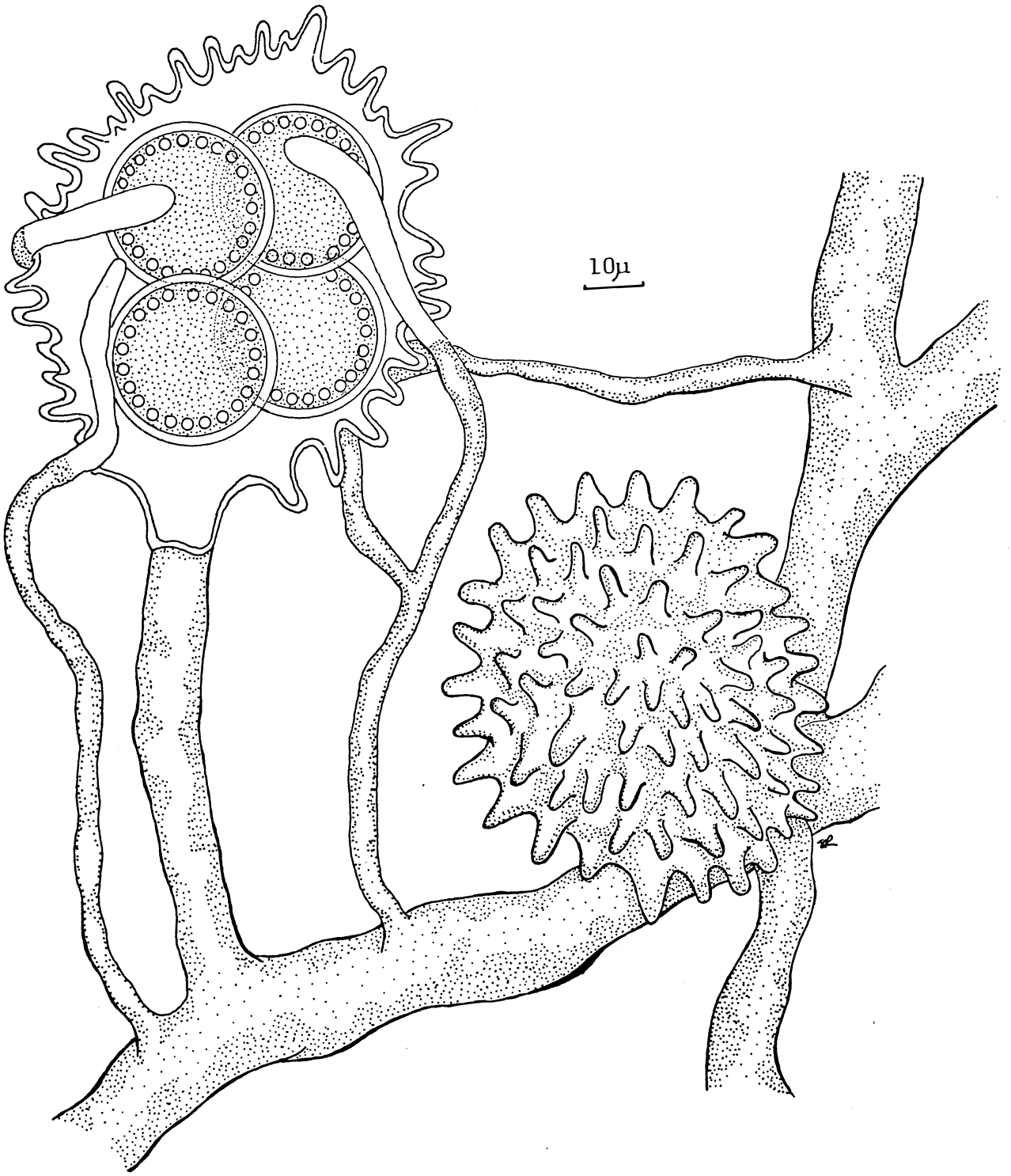

Fig. 60

Achlya oligacantha de Bary

Bot. Zeitung, 46: 647. 1888.

Fig. 61. Oogonia and antheridia of Achlya oligacantha. Note that the oospores are centric; that the oogonial wall is smooth only sparsely ornamented and is unpitted, and that the antheridial branches are mostly monoclinous.

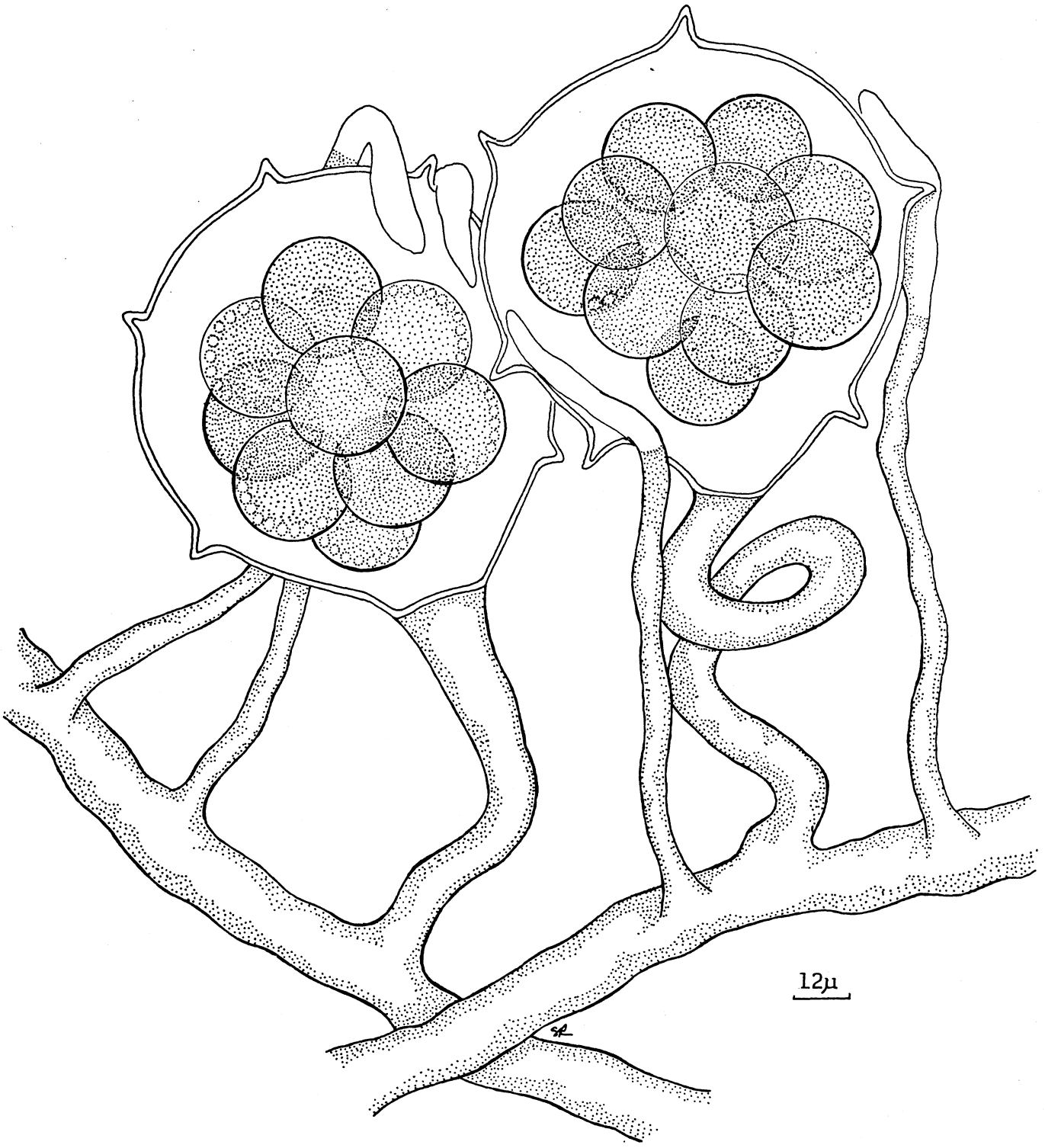

Fig. 61

Achlya radiosa Maurizio

Mittheil. Deutsch. Fischerei-Vereins, 7: 57. 1899.

Fig. 62. Oogonia and antheridia of Achlya radiosa. Note that the oospores are subcentric and few in number and that the oogonial wall is unpitted and provided with mammiform ornamentations.

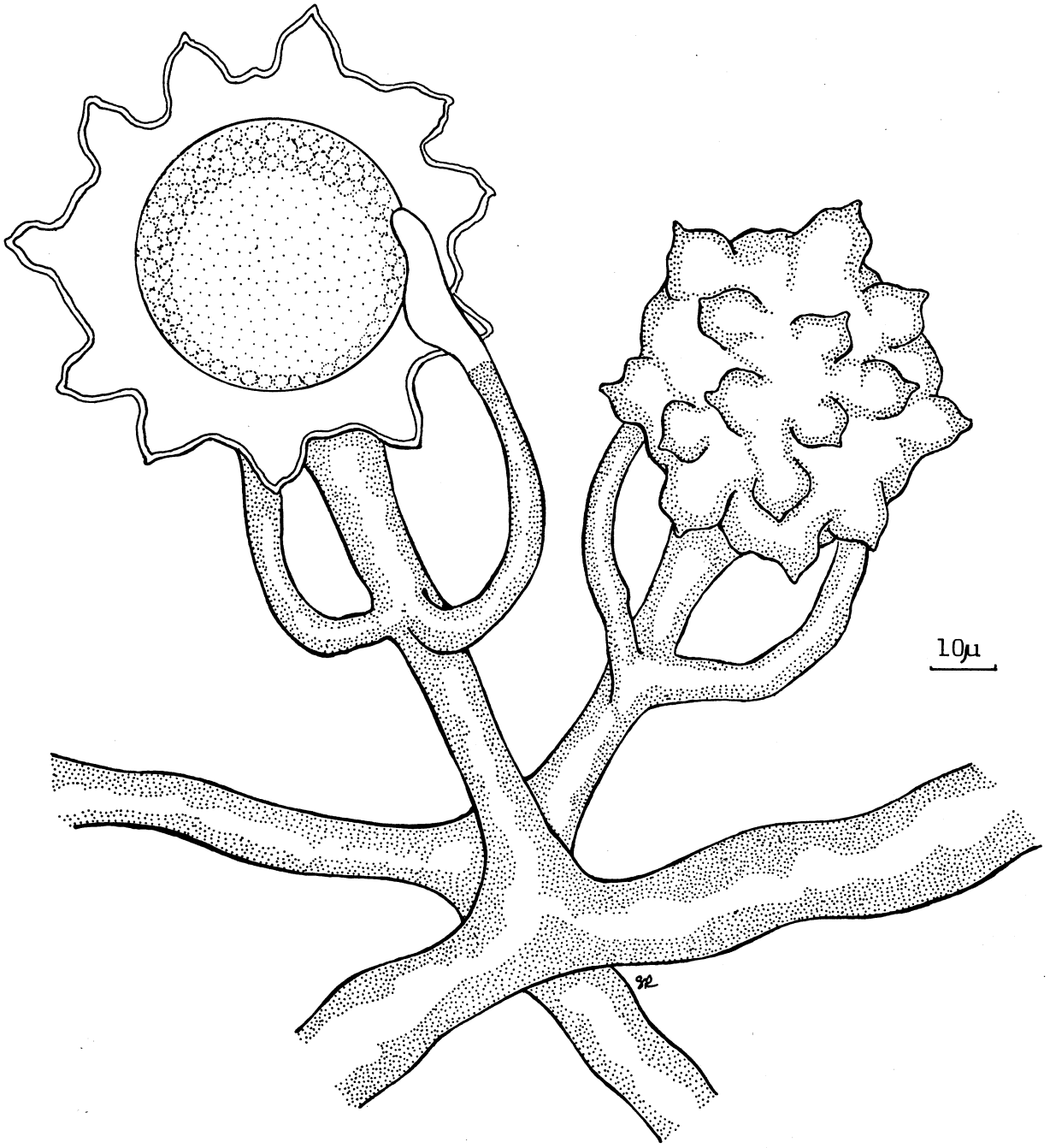

Fig. 62

Achlya treleaseana (Humphrey) Kauffman

Ann. Rept. Mich. Acad. Sci., Arts and Letters, 8: 26. 1906.

Fig. 63. Oogonia and antheridia of Achlya treleaseana. Note that the oospores are subcentric and numerous, and that the oogonial wall is pitted and provided with papillate ornamentations.

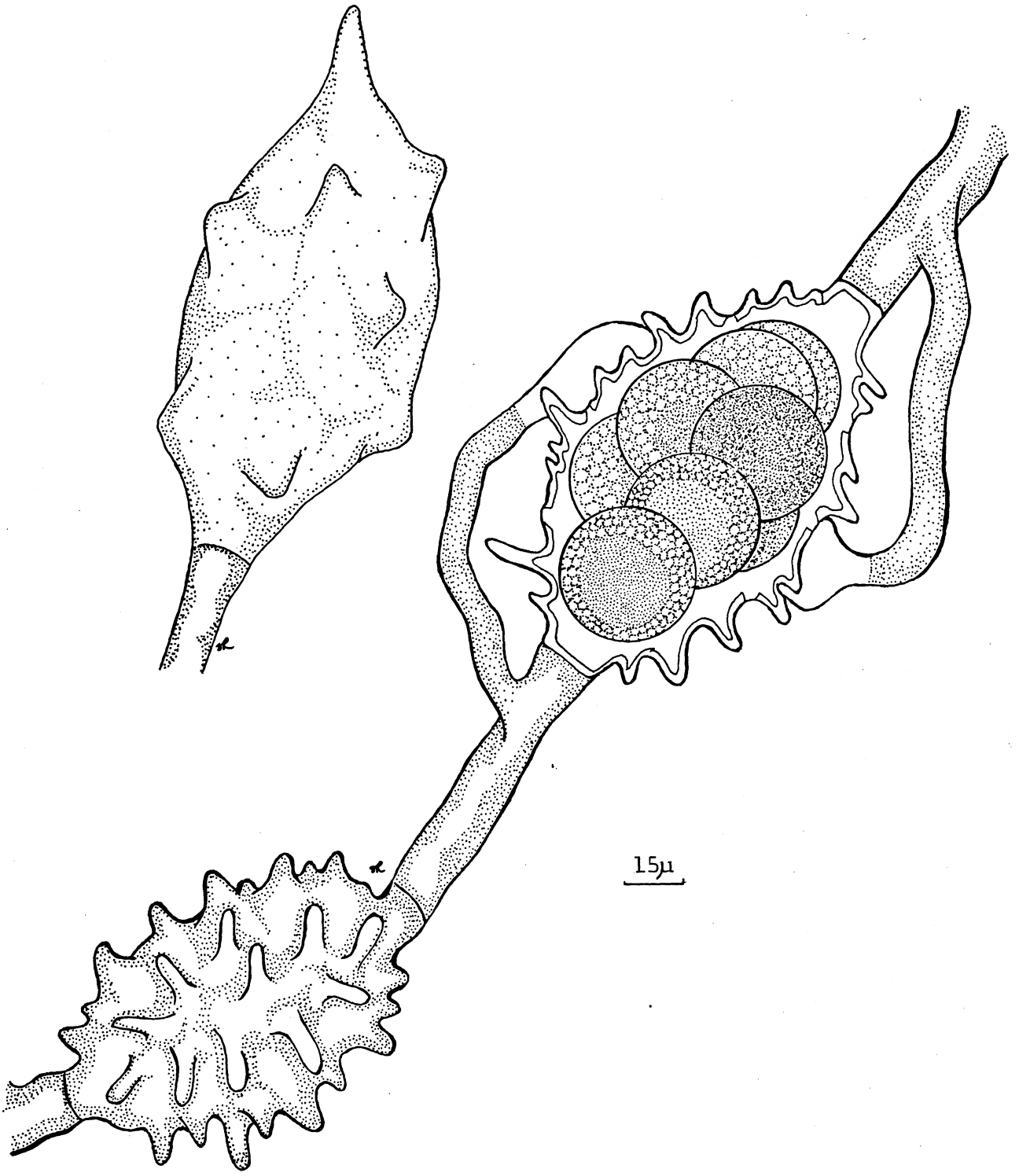

Fig. 63

Achlya recurva Cornu

Ann. Sci. Nat. Bot., Ser. V, 15: 22. 1872.

Fig. 64. Oogonia and antheridia of Achlya recurva. Note that the oospores are eccentric and numerous, that the oogonium is densely ornamented with truncate projections, and that the antheridial branches are usually simple and of androgynous origin.

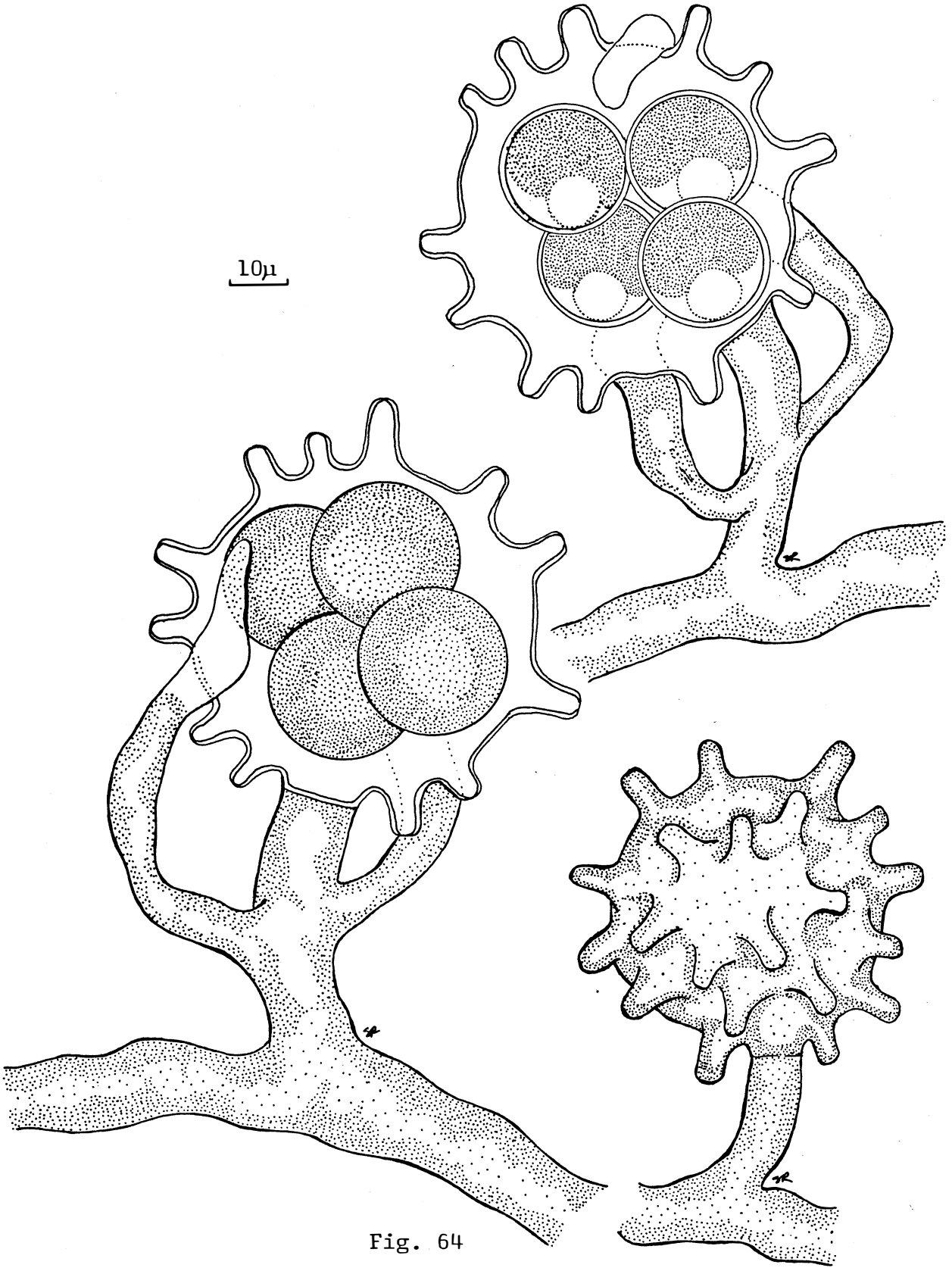

Fig. 64

Achlya #478

Fig. 65. Oogonia and antheridia of Achlya 478. Note that the oospores are eccentric and numerous, that the oogonium is densely ornamented with truncate projections that tend to be somewhat rounded at the tips, and that the antheridial branches are usually branched and mostly of monoclinous origin.

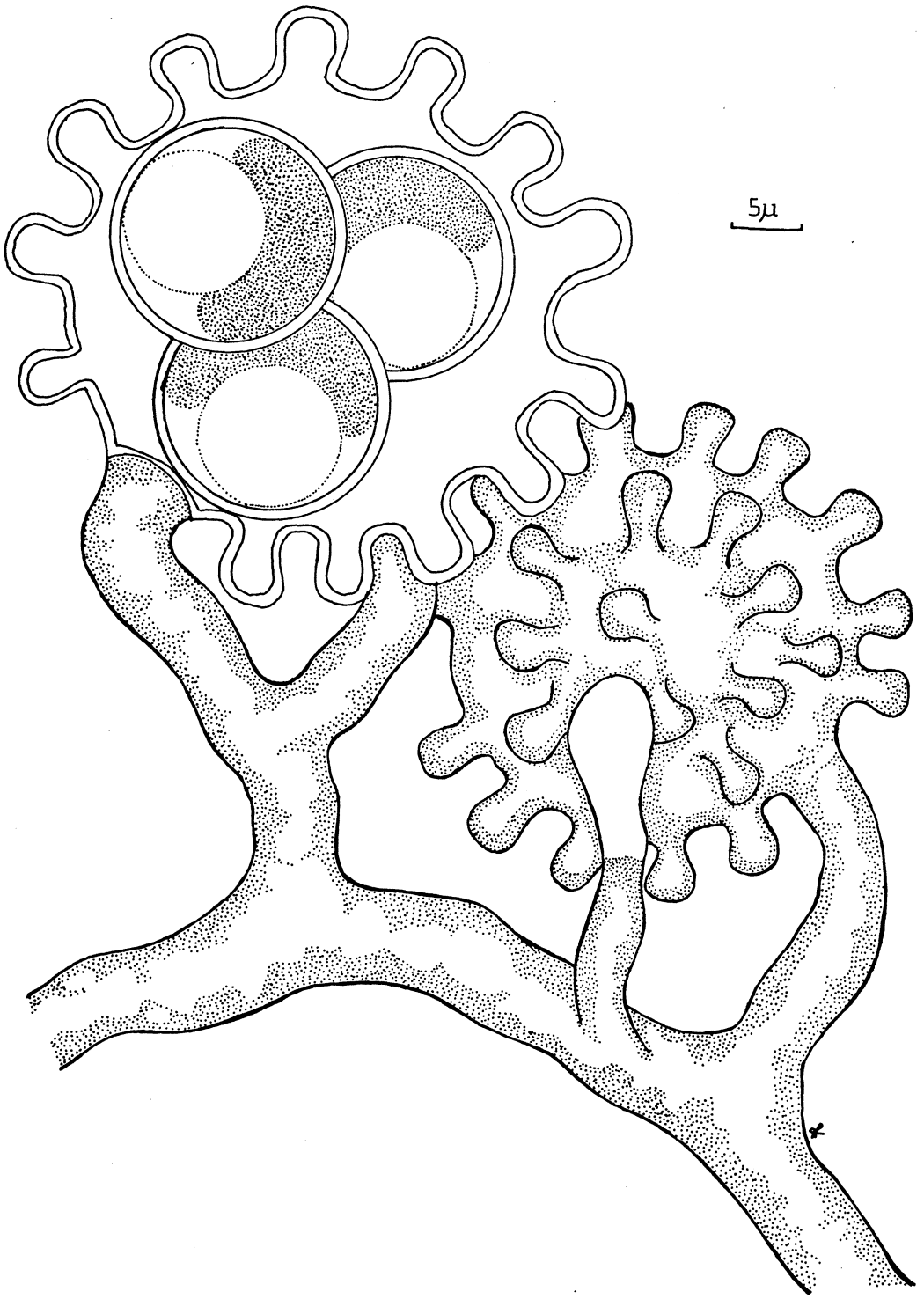

Fig. 65

Achlya glomerata Coker

Mycologia, 4: 325. 1912.

Fig. 66. Oogonia of Achlya glomerata. Note that the oospores are eccentric and single; that the ornamented oogonia are borne on slender, much branched and contorted oogonial stalks; and that the antheridia are usually absent but when present are mostly of androgynous or monoclinous origin.

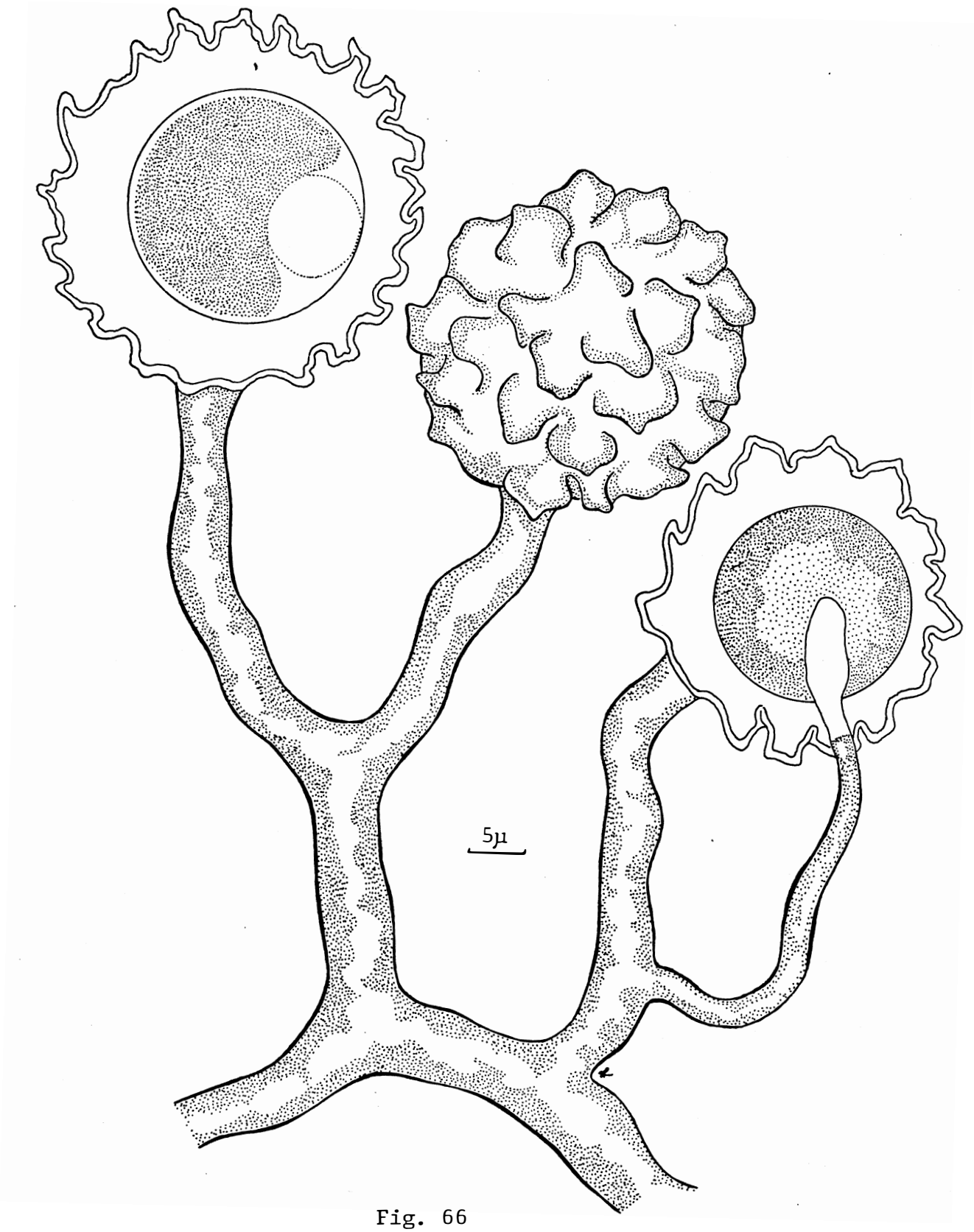

Fig. 66

Achlya crenulata Ziegler

Mycologia, 40: 336. 1948.

Fig. 67. Oogonia of Achlya crenulata. Note that the oospores are eccentric and numerous; that the ornamented oogonia are borne on simple stalks; and that the antheridia are usually absent but when present are mostly of monoclinous or diclinous origin.

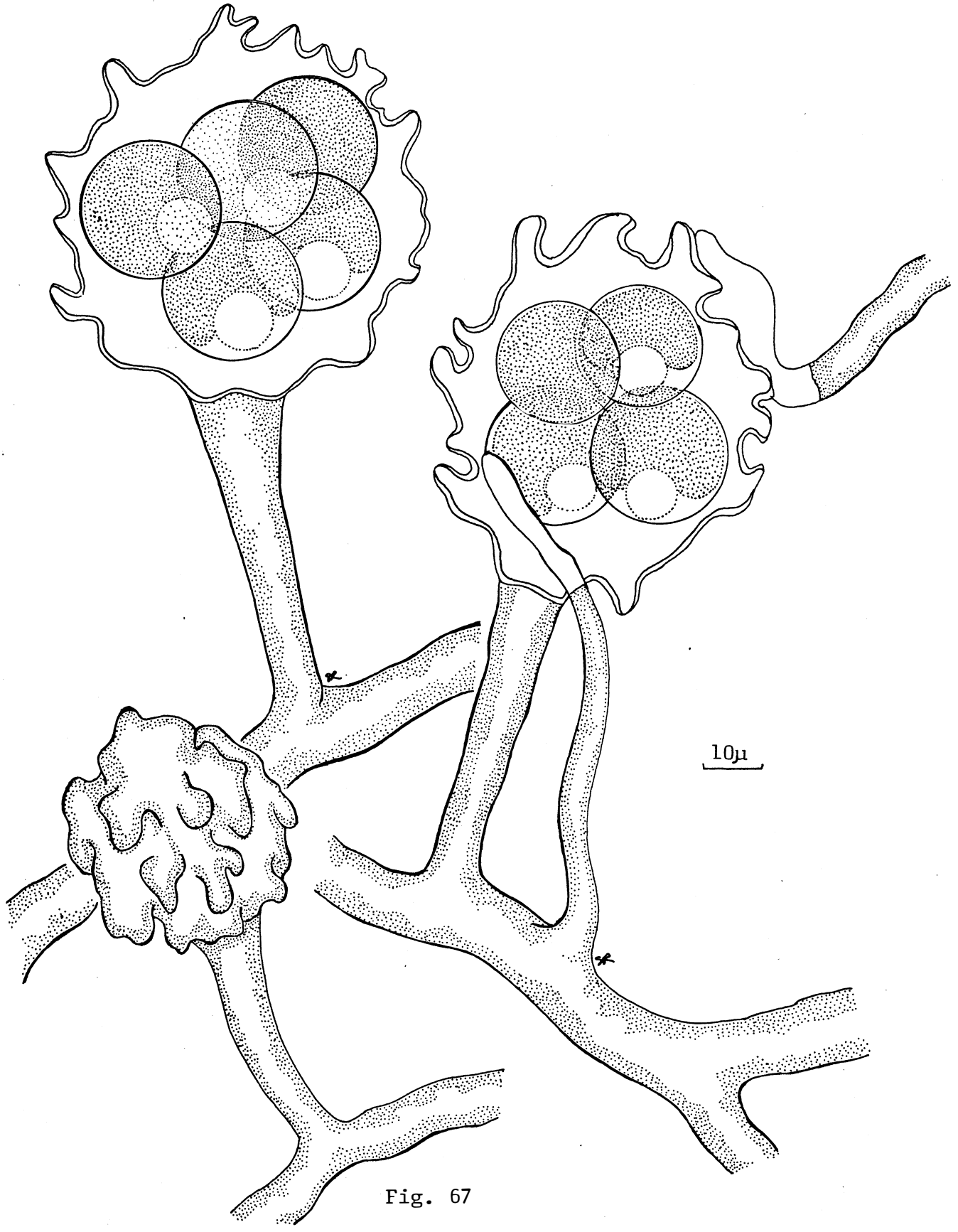

Fig. 67

Genus: Protoachlya Coker

Saprolegniaceae, p. 90. 1923.

The genus Protoachlya, with but three reported species two of which are considered herein, was established to include those isolates with characteristics of both Saprolegnia and Achlya. Although seemingly of an intermediate and variable nature, the features used to distinguish this genus are physiologically stable characteristics and apparently do not vary with changes in environmental conditions. Species of Protoachlya form a mycelium more delicate than in Achlya with mostly clavate to cylindrical zoosporangia usually renewed by cymose branching as in Achlya but also less frequently by internal proliferation as in Saprolegnia (fig. 68). Zoospores are diplanetic, some upon emerging swim away prior to encystment as in Saprolegnia, others from the same zoosporangium encysting at or near the orifice. Oogonia are found singly on short, lateral stalks, and form a few centric oospores per oogonium (figs. 69, 70).

Key to the Illinois Species of *Protoachlya*

1. Antheridia mostly diclinous (fig. 69) . . . . . *P. paradoxa*

1. Antheridia mostly hypogynous (fig. 70) . . . . . *P. hypogyna*

Protoachlya paradoxa (Coker) Coker

Saprolegniaceae, p. 91. 1923.

Fig. 68. Filaments of Protoachlya paradoxa bearing zoosporangia. Note that the zoosporangia are distinctly differentiated from the hyphae, that the zoospores are formed in several rows, and that upon discharge some of the zoospores swim away prior to encystment and some of the zoospores encyst immediately at the mouth of the zoosporangium.

Fig. 69. Oogonia and antheridia of Protoachlya paradoxa. Note that the antheridia are mostly diclinous.

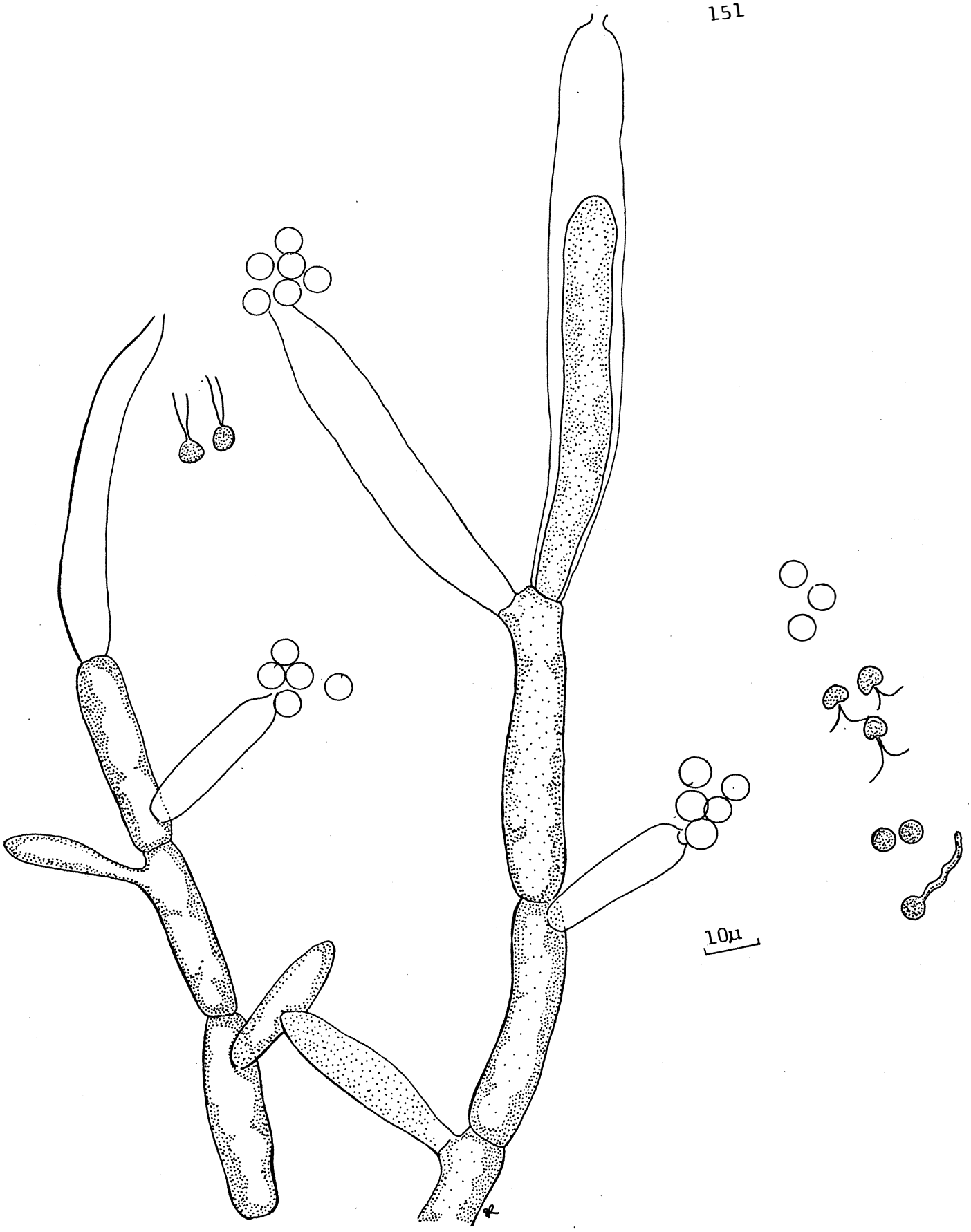

Fig. 68

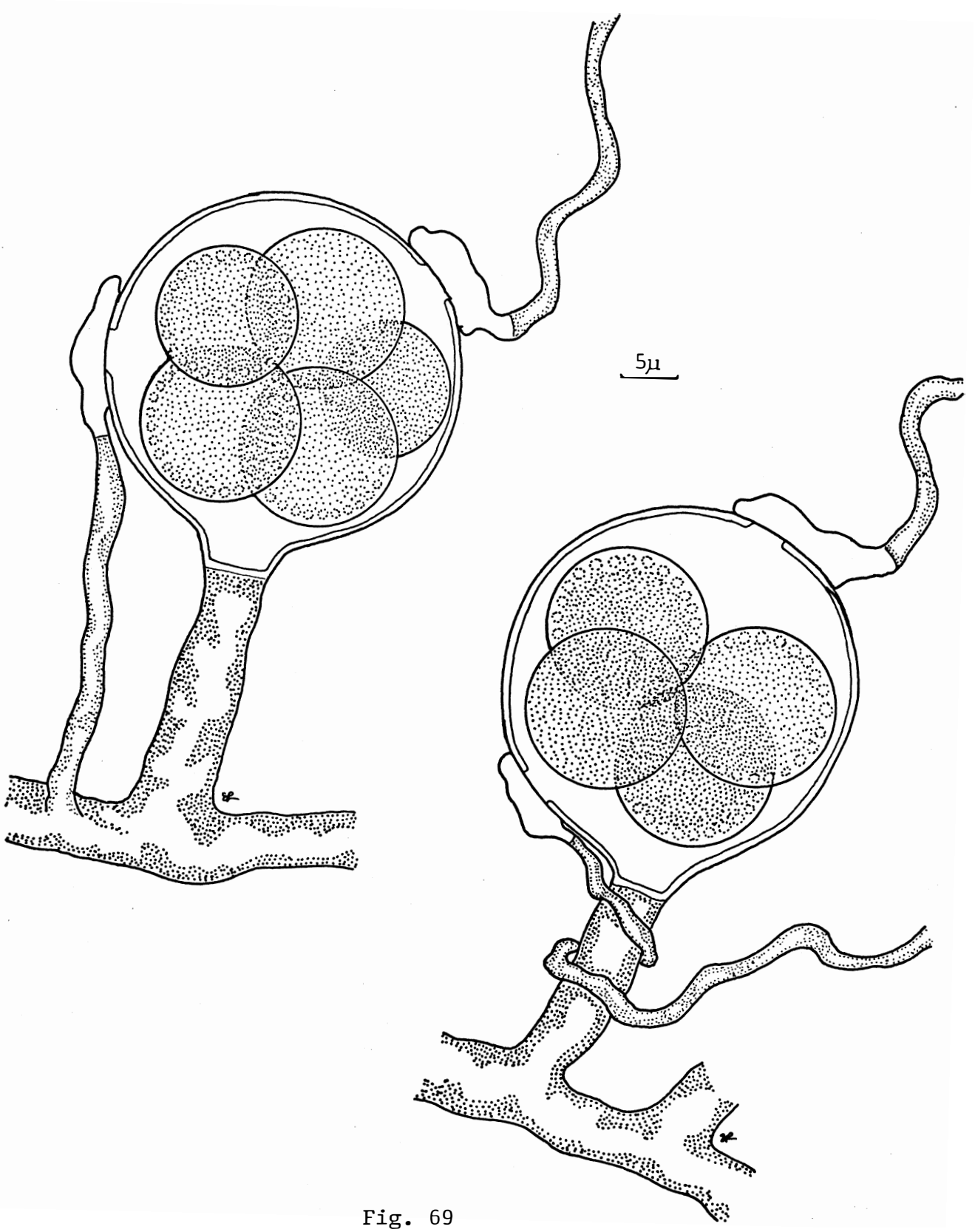

Fig. 69

Protoachlya hypogyna Shanor and Conover

Amer. Midland Nat., 28: 746. 1942.

Fig. 70. Oogonia and antheridia of *Protoachlya hypogyna*. Note that the antheridia are mostly hypogynous.

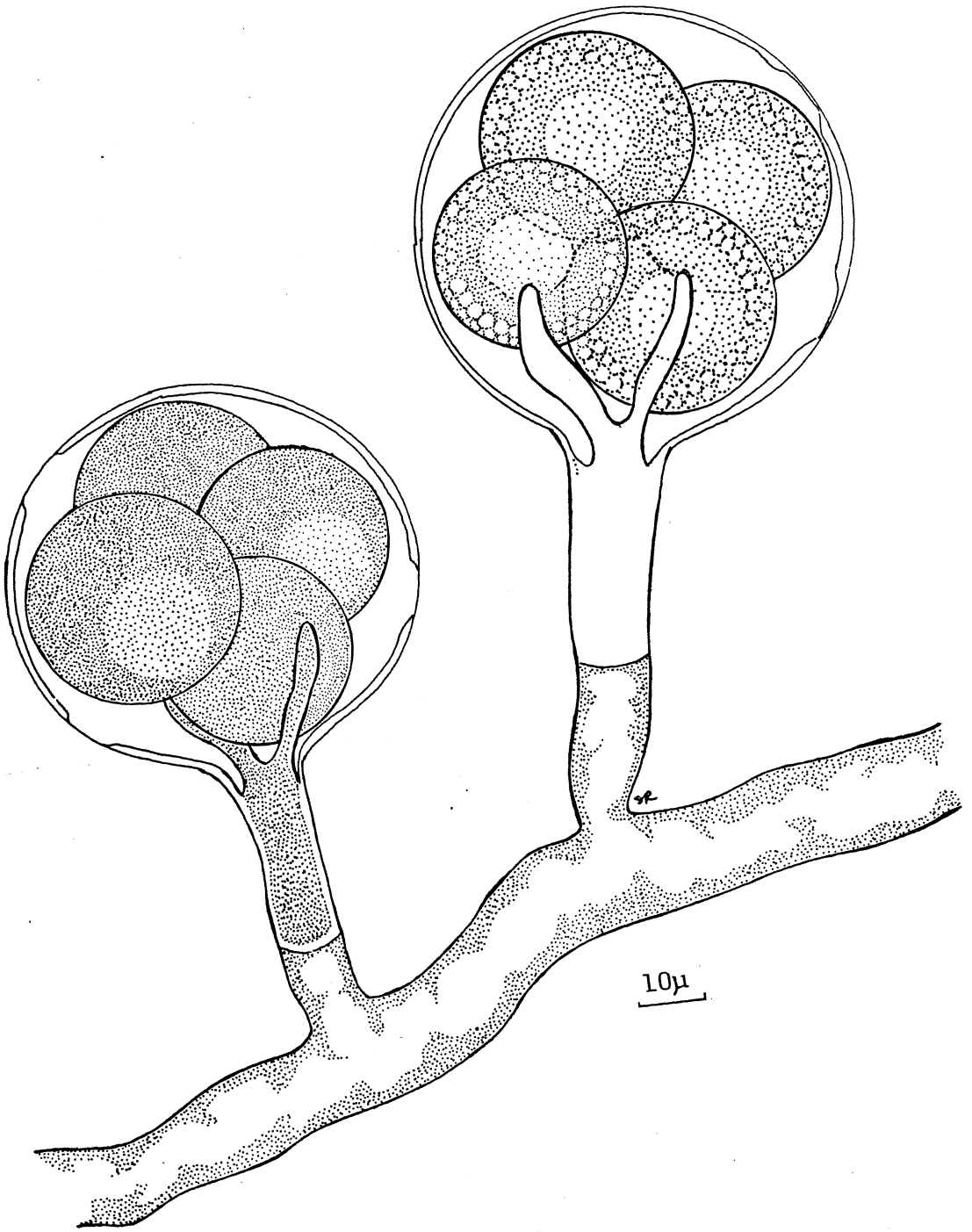

Fig. 70

Genus: Aplanes de Bary

Bot. Zeit. 46: 613, 650. 1888.

The genus Aplanes was established to include certain saprolegniaceous isolates in which the primary zoospores are retained in the zoosporangia germinating there by the formation of germ tubes that grow outward through the zoosporangial wall (fig. 71). Zoosporangia were described as being very scarce often entirely absent for long periods of time in culture. Vegetative growth resembles that found in isolates of Achlya. Oogonia are abundant, often formed in chains and often barrel-shaped as well as spherical, provided with greatly thickened and heavily pitted walls (fig. 72).

It is now known that in all isolates of Aplanes subjected to careful study, achlyoid and/or saprolegnoid zoospore discharge occurred as well as zoospore discharge of an aplanoid nature. Furthermore, in many well-defined species of Achlya, Saprolegnia and other saprolegniaceous genera aplanoid zoospore discharge may occur under abnormal environmental conditions. Johnson (1956) has clearly demonstrated that the most common species, Aplanes treleaseanus, is in fact a species of Achlya. It is quite possible, then, that the remaining species of Aplanes, none of which have been thoroughly studied, belong either in Achlya or Saprolegnia. If such be the case, the genus Aplanes can be suppressed and the species distributed among the proper saprolegniaceous genera. The validity of the genus Aplanes at present rests upon two doubtful criteria; the absence or rarity of zoosporangia, and the germination of zoospores

in situ. The only species of Aplanes reported from Illinois is A. androgynus (figs. 71, 72).

Aplanes androgynus (Archer) Humphrey

Trans. Amer. Phil. Soc., 17: 134. 1892.

Fig. 71. Filaments of Aplanes androgynus bearing zoosporangia. Note that the zoosporangia are differentiated from the vegetative hyphae, that the zoospores are formed in several rows, and the zoospores are retained within the zoosporangium germinating there by the formation of germ tubes that grow outward through the zoosporangial wall.

Fig. 72. Oogonia and antheridia of Aplanes androgynus.

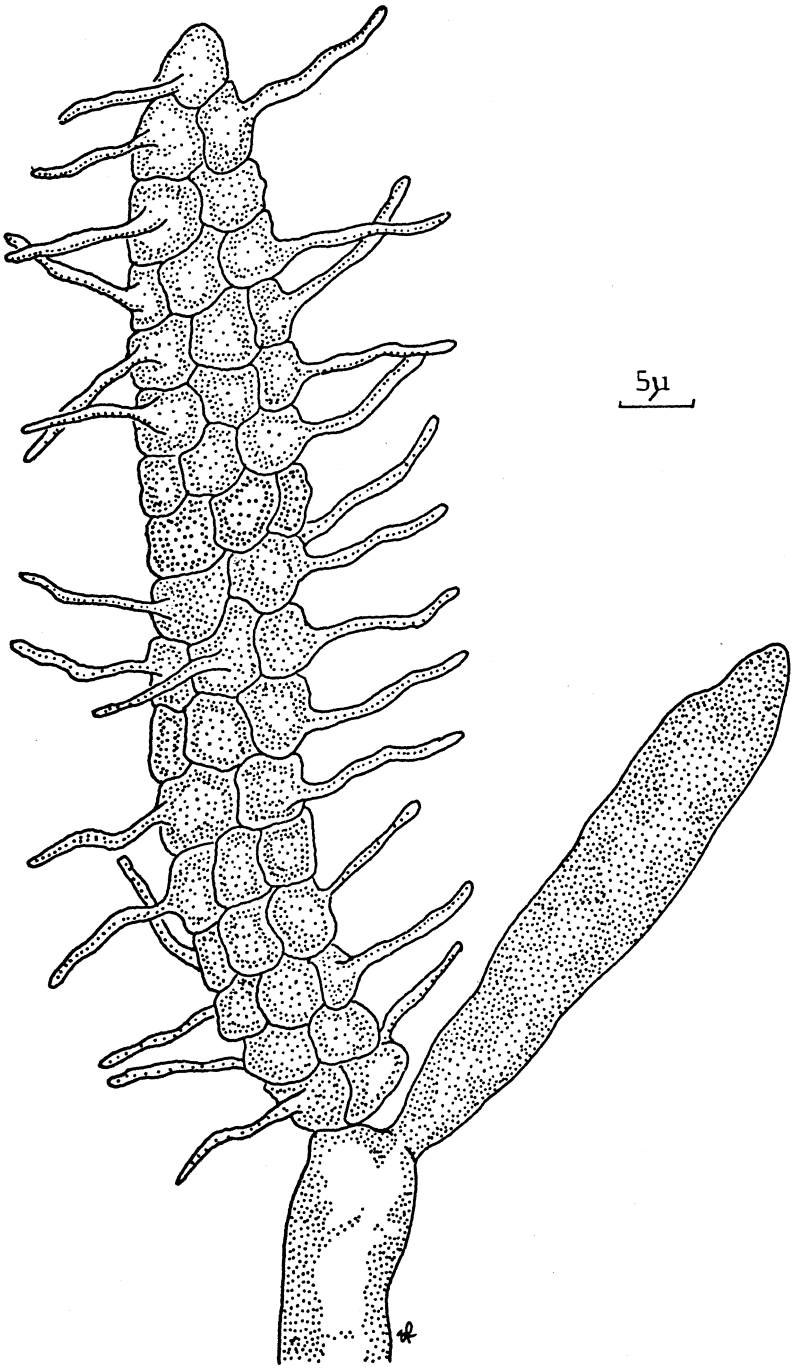

Fig. 71

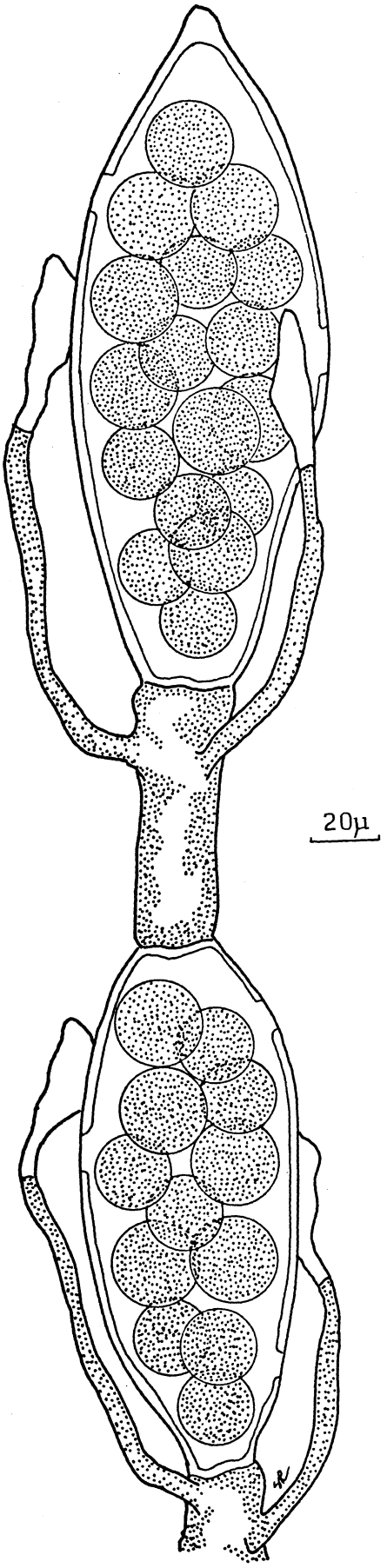

Fig. 72

Genus: Thraustotheca Humphrey

Trans. Am. Phil. Soc., 17: 131. 1893.

The genus Thraustotheca, as at present constituted, consists of only two species. Although small in terms of numbers of species and of relatively rare occurrence, the genus is well-defined and unique among the water molds. Species of Thraustotheca develop a coarse, branching mycelium that resembles the growth habit of Achlya to which these species are most closely related. In fact, in isolates of T. primoachlya the primary zoosporangia discharge zoospores in an achlyoid manner (fig. 75); and in all isolates of Thraustotheca zoosporangia are renewed from below as in Achlya. Zoosporangia are clavate to cylindrical but usually exhibit a strong tendency toward the stout club-shaped form (figs. 73, 75). Species Thraustotheca are unique in that the primary zoospores encyst within the zoosporangium and are liberated by the dissolution of the zoosporangial wall. The encysted primary zoospores may separate and drift passively away or may remain clumpted together in part retaining the same general shape as the original zoosporangium. All isolates of Thraustotheca form oogonia and antheridia readily, the oogonia with several to many eccentric oospores (figs. 74, 76).

Key to the Illinois Species of *Thraustotheca*

1. Oogonial wall smooth; all zoosporangia thraustothecoid (figs. 73, 74) . . . . . *T. clavata*

1. Oogonial wall ornamented; primary zoosporangia achlyoid, others thraustothecoid (figs. 75, 76) . . . . . *T. primoachlya*

Thraustotheca clavata (de Bary) Humphrey

Trans. Amer. Phil. Soc., 17: 131. 1893.

Fig. 73. Filaments of Thraustotheca clavata bearing zoosporangia. Note that the zoosporangia are differentiated from the vegetative hyphae, that the zoospores are formed in several rows within the zoosporangium, and that the zoospores encyst within the zoosporangium and are liberated by the dissolution of the zoosporangial wall.

Fig. 74. Oogonia and antheridia of Thraustotheca clavata. Note that the oogonia are smooth-walled and contain several oospores.

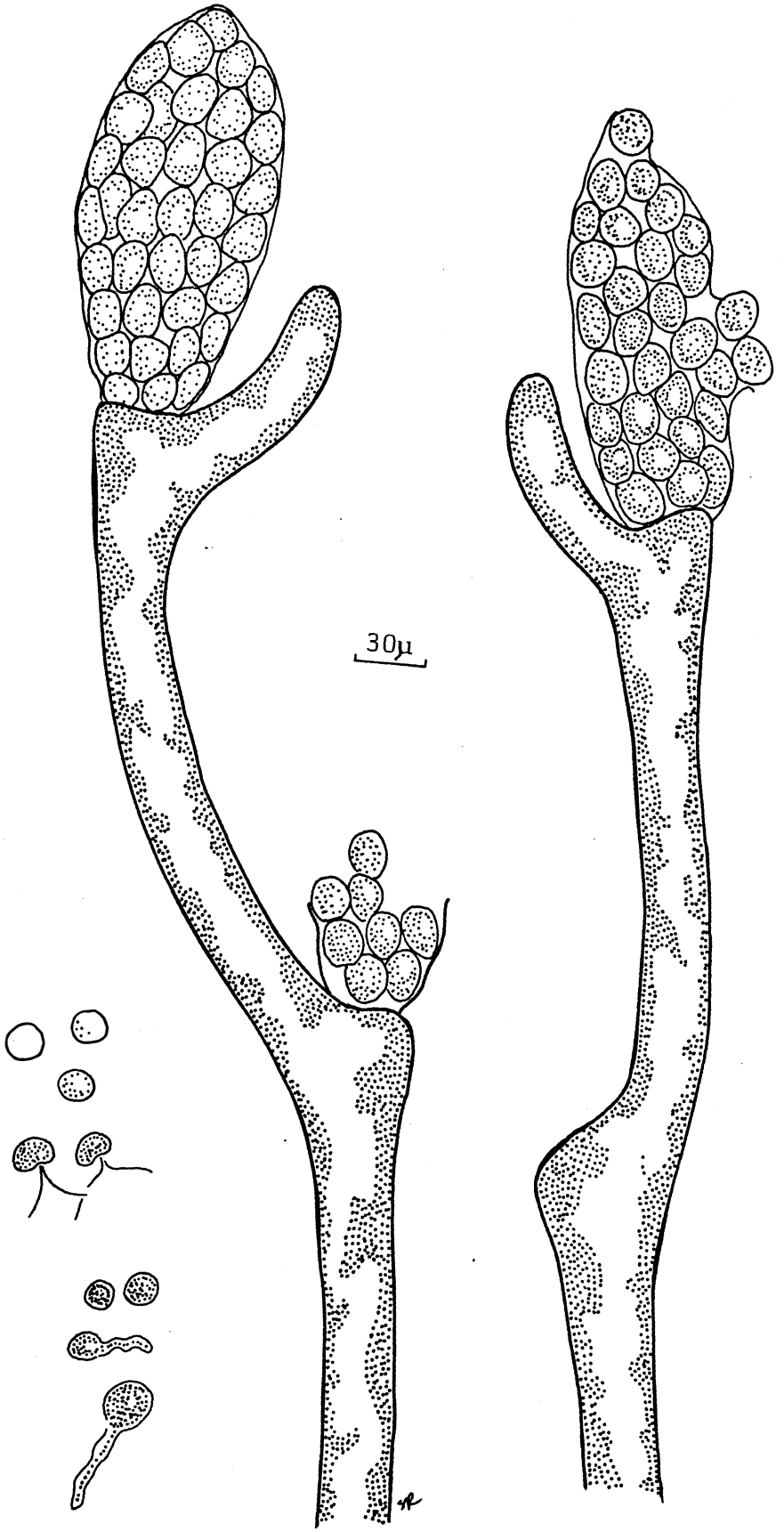

Fig. 73

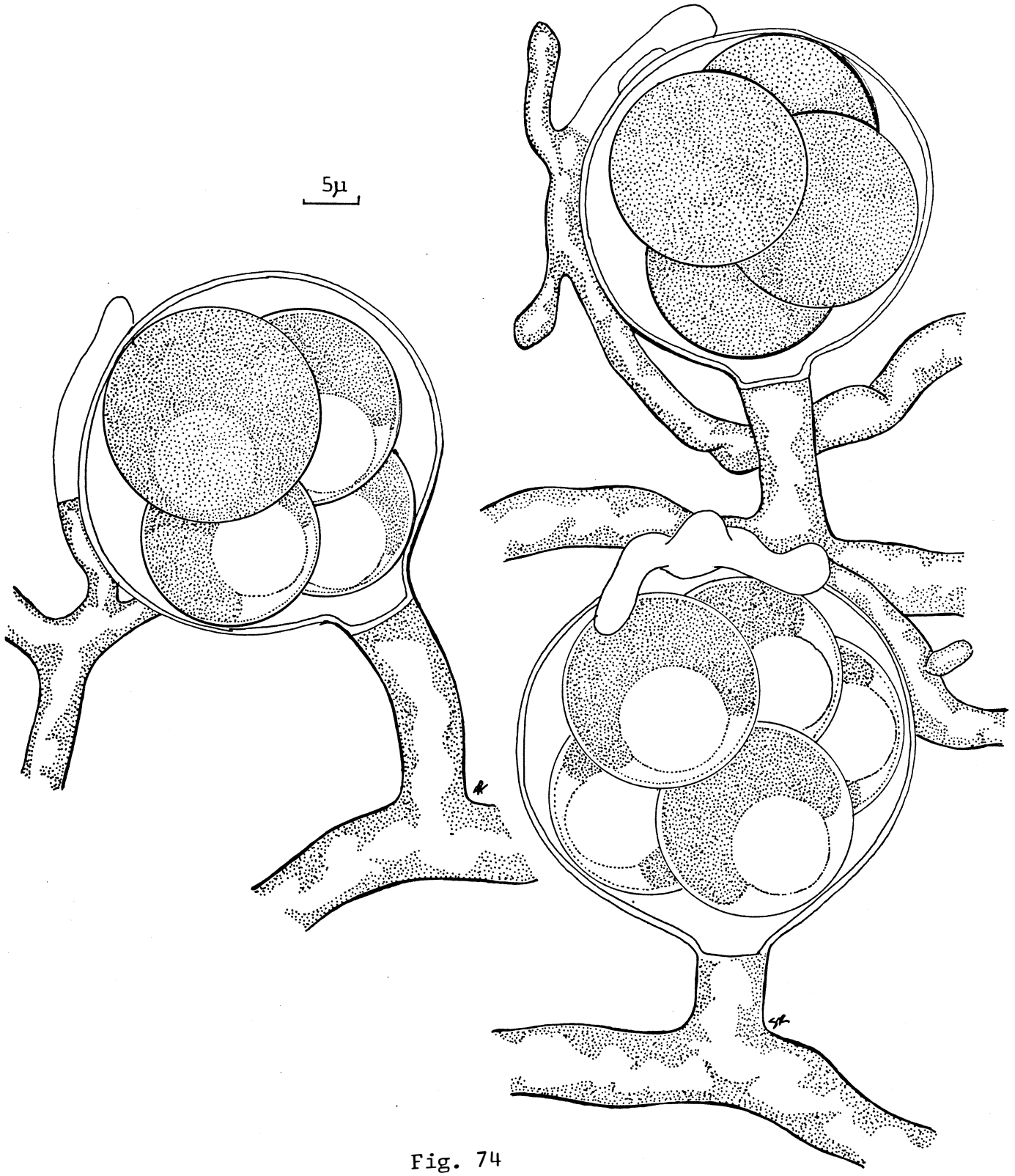

Fig. 74

Thraustotheca primoachlya Coker and Couch

Jour. Elisha Mitch. Sci. Soc., 40: 198. 1924.

Fig. 75. Filaments of Thraustotheca primoachlya bearing zoosporangia. Note that the first-formed zoosporangia are achlyoid and that all subsequently formed zoosporangia are thraustothecoid.

Fig. 76. Oogonia and antheridia of Thraustotheca primoachlya. Note that the oogonia are ornamented with numerous conspicuous projections, and that the oogonium contains several oospores.

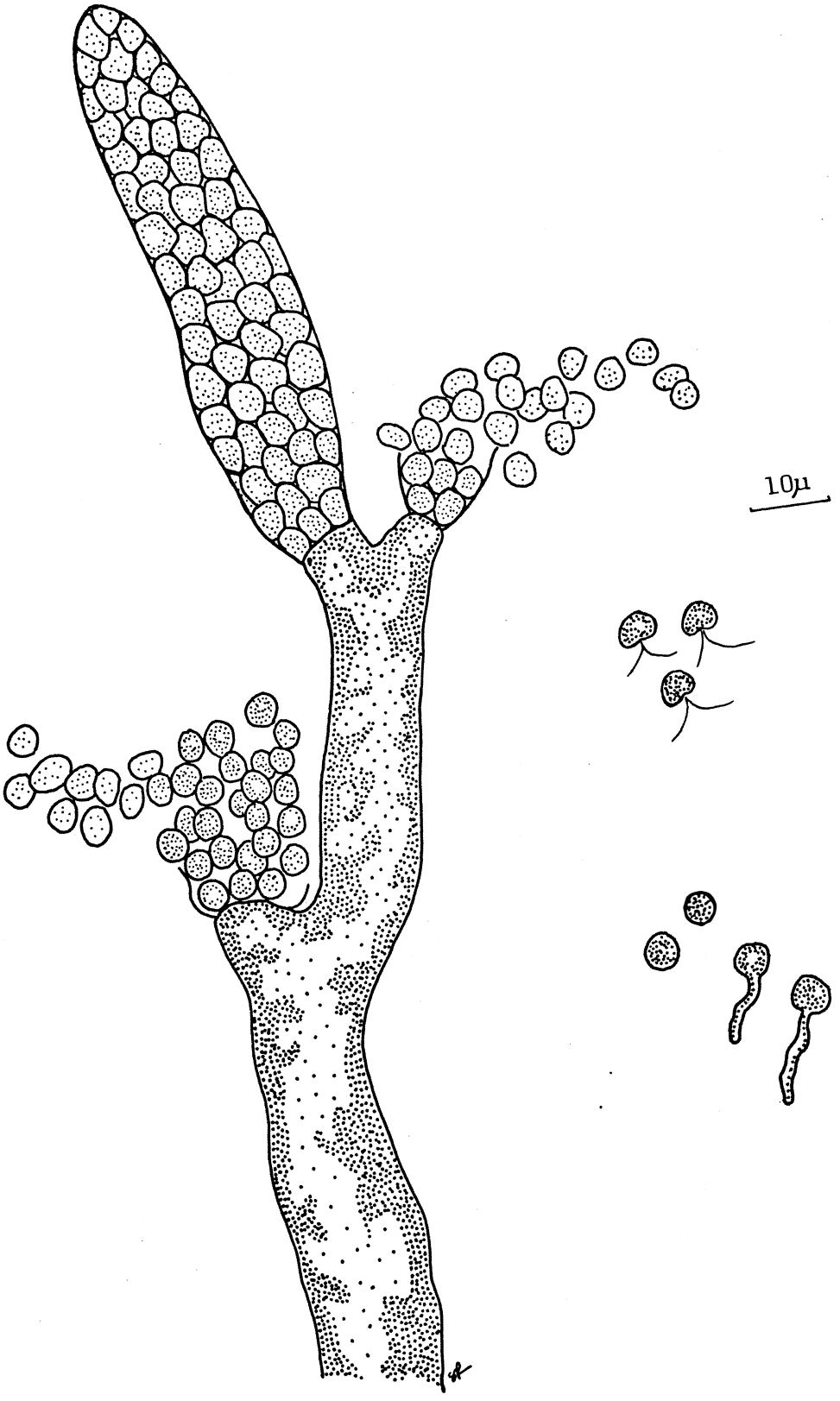

Fig. 75

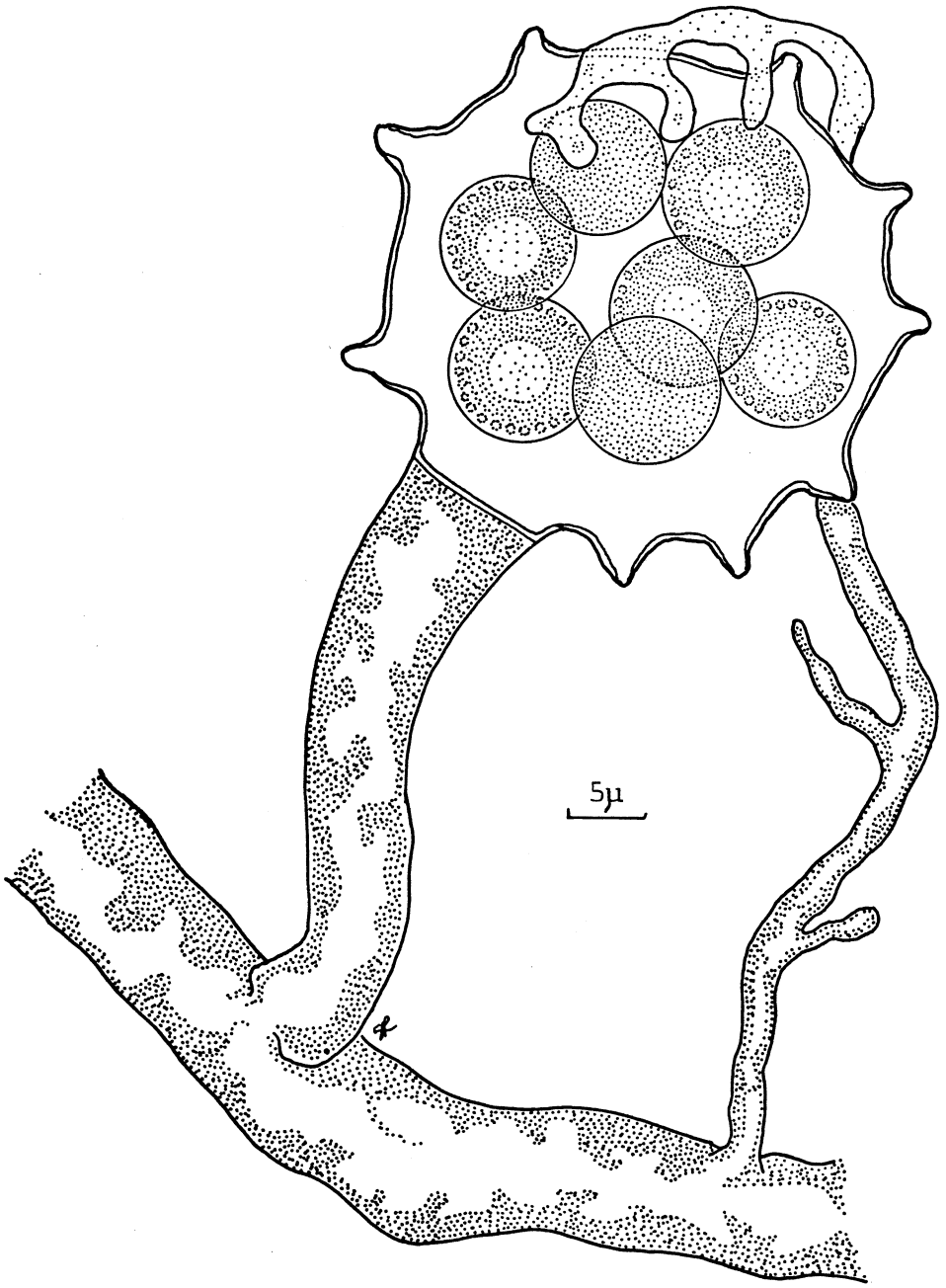

Fig. 76

Genus: *Calyptralegnia* Coker

Jour. Elisha Mitch. Sci. Soc., 42: 219. 1927.

The genus *Calyptralegnia* was established to include those water molds in which primary zoospore discharge is accomplished by the rupture of the zoosporangial wall, the terminal portion of the zoosporangium completely breaking off (fig. 77). Isolates of *Calyptralegnia* are of rare occurrence and when found resemble *Achlya* in their vegetative habit of growth. The primary zoospores encyst as in Thraustotheca within the cylindrical zoosporangium and are liberated in clumps to float passively away following the dehiscence of the zoosporangium. Later, zoospores of the secondary type emerge from the primary zoospore cysts. Oogonia are rarely formed in culture but when observed are smooth-walled and contain one to many, centric oospores (fig. 78). Antheridia are mostly androgynous.

Only the single species, *C. achlyoides*, is known to occur in Illinois (figs. 77, 78).

Calyptralegnia achlyoides (Coker and Couch) Coker

Jour. Elisha Mitch. Sci. Soc., 42: 219. 1927.

Fig. 77. Filaments of Calyptralegnia achlyoides bearing zoosporangia. Note that the zoospores encyst within the zoosporangium and are liberated by the breaking off of the terminal portion of the zoosporangium.

Fig. 78. Oogonia and antheridia of Calyptralegnia achlyoides. Note that the oogonia are smooth-walled and borne on curved or once-coiled oogonial stalks, and that the antheridia are mostly androgynous.

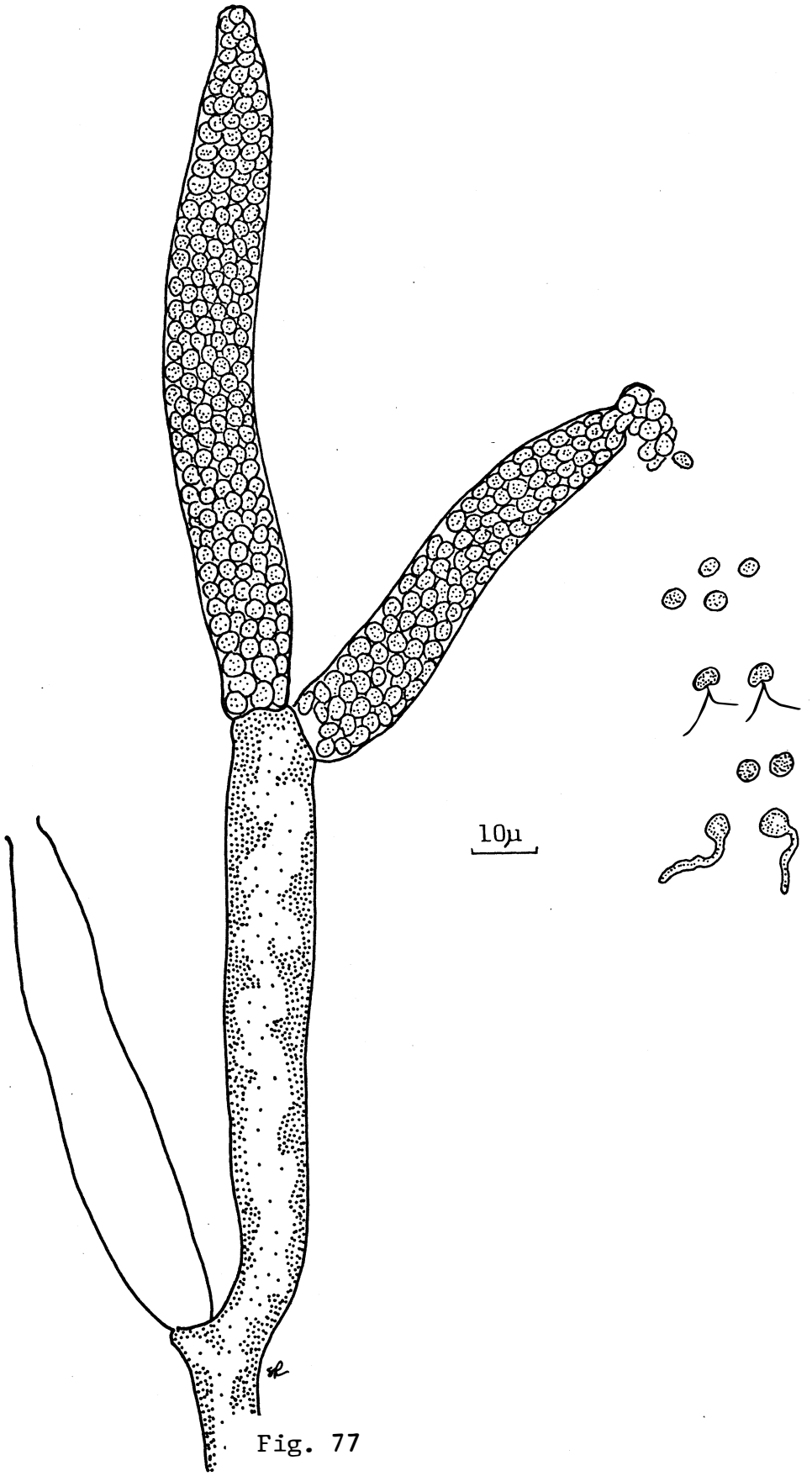

Fig. 77

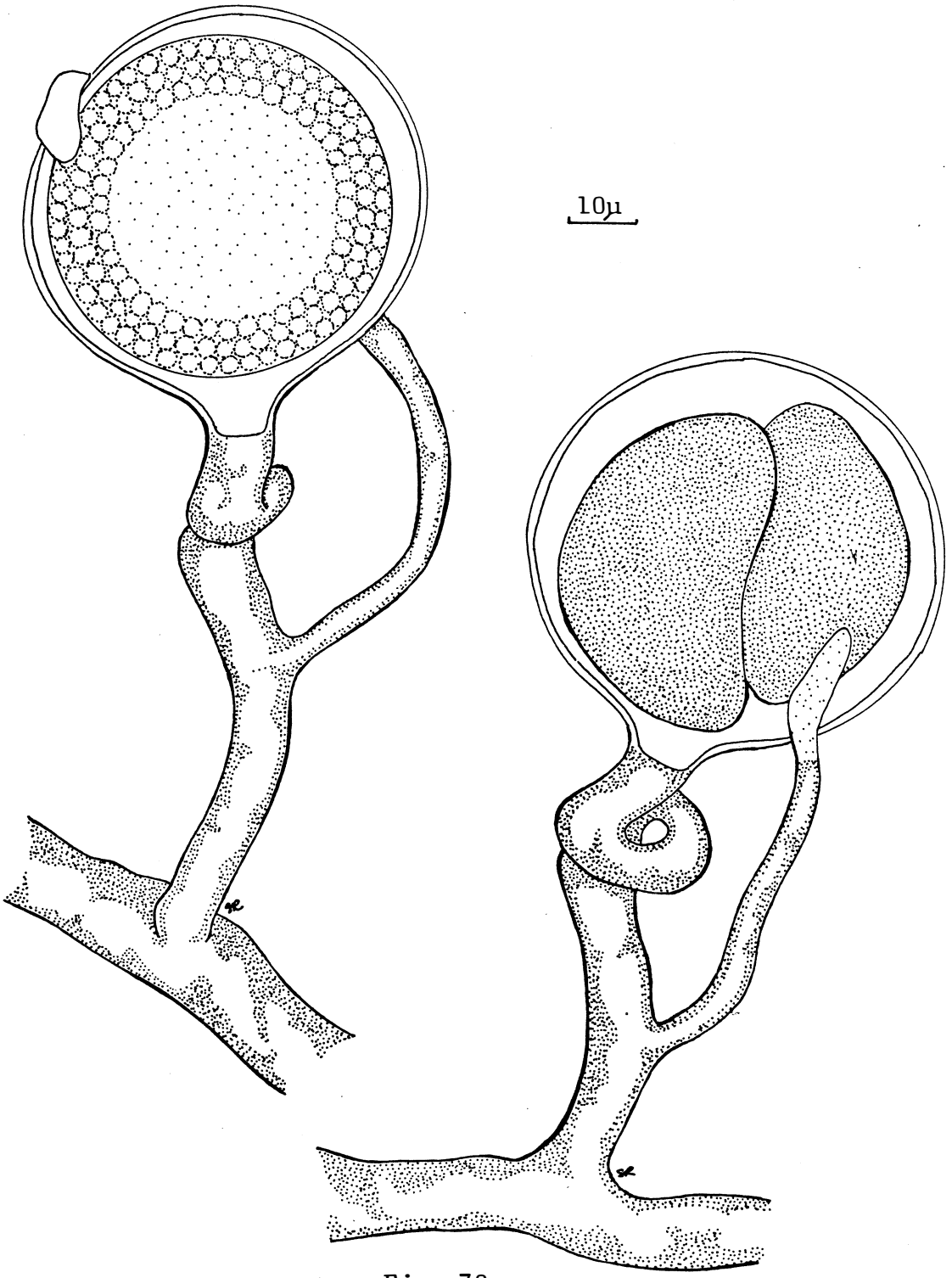

Fig. 78

Genus: Dictyuchus Leitgeb

Bot. Zeit., 26: 503. 1868; Jahrb. wiss. Bot., 7: 357. 1869.

The genus Dictyuchus, a small group of less than ten reported species, was established to include those water molds with a well-developed mycelium and in which the primary zoospore stage is completed suppressed. In all species of Dictyuchus the primary zoospores encyst within the zoosporangium. In some species the zoosporangial wall is persistent and the secondary zoospores emerge through the wall of the zoosporangium leaving behind a network of empty cysts (fig. 79). Such isolates are said to form "true-net" zoosporangia. In such isolates the mature zoosporangia are apt to be deciduous, frequently breaking away from the subtending hyphae and floating free in the water. In other species the zoosporangial wall disappears although the encysted primary zoospores cling together and retain the shape of the zoosporangia (fig. 83). In such isolates the secondary zoospores emerge leaving behind a network of empty cysts in the form of a "false-net" zoosporangium, one without a zoosporangial wall. In a few species of Dictyuchus the primary zoosporangia are always achlyoid and thereafter typical dictyoid zoosporangia are formed (fig. 85). Among isolates of Dictyuchus, gemmae are rarely found and are known to occur in but one species. All species form oogonia with a single oospore; antheridia may be present or not (figs. 80, 81, 82, 84, 86, 87, 89).

Key to the Illinois Species of *Dictyuchus*

1. Zoosporangia all of one type 2
1. Zoosporangia of more than one type 5
    2. Zoosporangia all of true-net type, zoosporangial wall persistent 3
    2. Zoosporangia all of false-net type, zoosporangial wall disappearing (fig. 83) . . . . . *D. missouriensis*
3. Thallus dioecious, antheridial branches formed diclinously from the male thallus (fig. 80). . . . . *D. monosporus*
3. Thallus monoecious, antheridial branches monoclinous or androgynous or entirely absent 4
    4. Antheridial branches mostly monoclinous (fig. 81). . . . . *D. carpophilus*
    4. Antheridial branches entirely absent (fig. 82) . . . . . *D. anomalus*
5. Oogonial wall distinctly papillate (fig. 86) . . . . . *D. achlyoides*
5. Oogonial wall smooth 6
    6. Antheridial branches mostly androgynous, rarely proliferating (fig. 87). . . . . *D. pseudoachlyoides*
    6. Antheridial branches variable, profusely proliferating, tending to engulf the oogonium (fig. 89) . . . . . *D. pseudodictyon*

Dictyuchus monosporus Leitgeb

Jahrb. wiss. Bot., 7: 357. 1869.

Fig. 79. Filaments of Dictyuchus monosporus bearing zoosporangia. Note that the zoospores encyst within the zoosporangium and emerge directly through the zoosporangial wall leaving behind a network of empty cysts in the form of a "true-net" zoosporangium. Note also that the zoosporangia may be deciduous breaking off from the subtending hyphae and floating free.

Fig. 80. Oogonia and antheridia of Dictyuchus monosporus. Note that the smooth-walled oogonia contain a single oospore and that the antheridia are strictly diclinous.

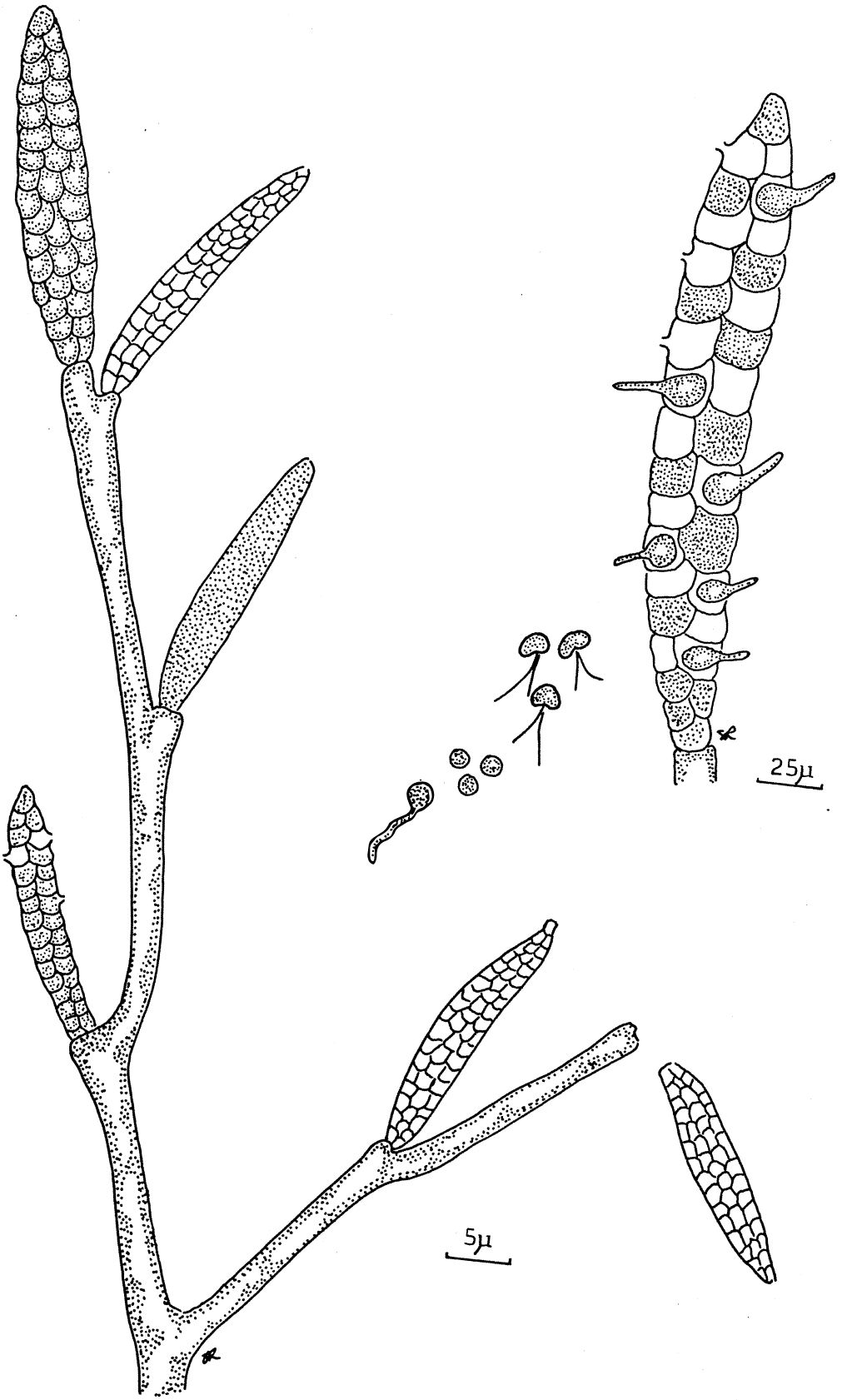

Fig. 79

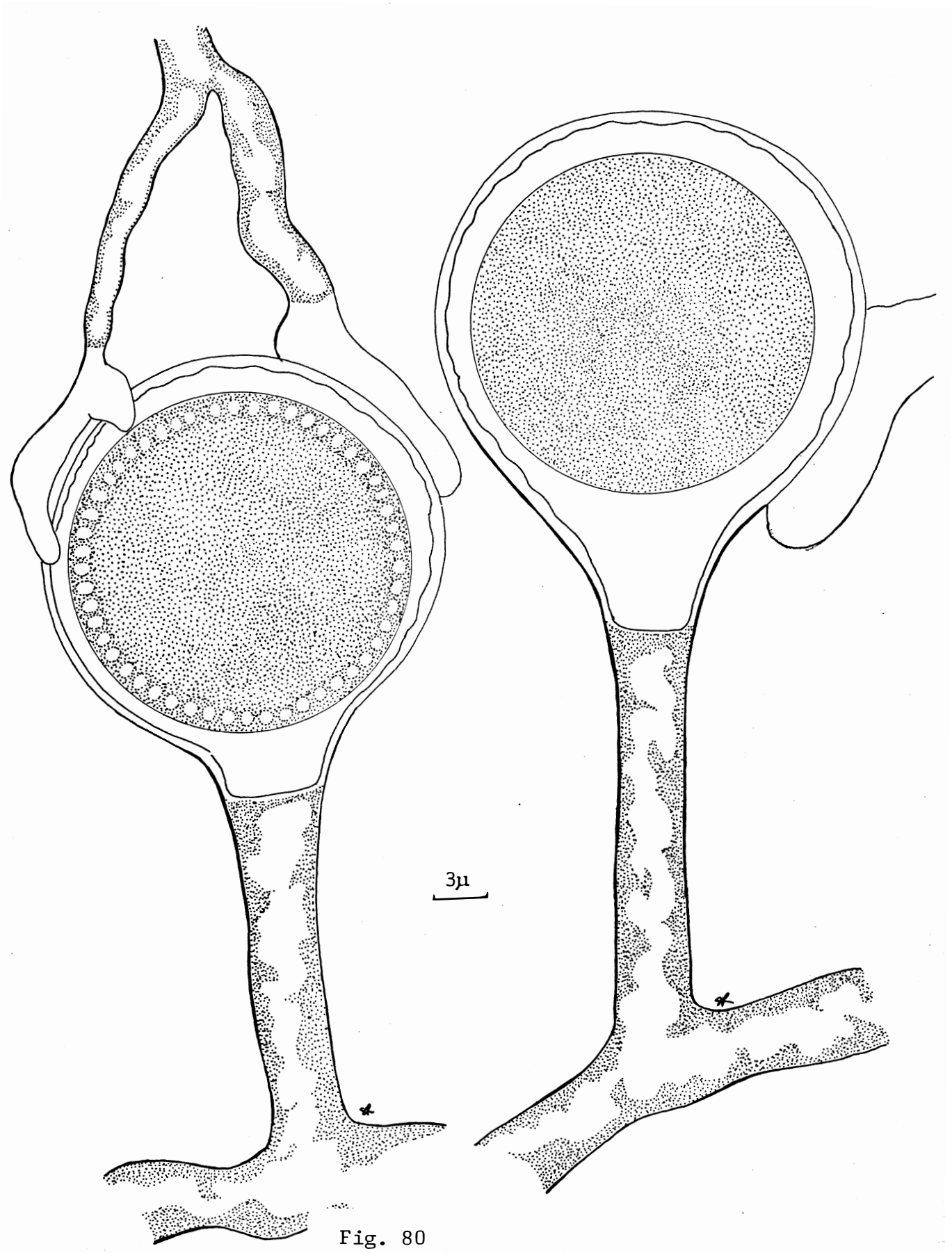

Fig. 80

Dictyuchus carpophorus Zopf

Beitr. Nied. Org., 3: 48. 1893.

Fig. 81. Oogonia and antheridia of Dictyuchus carpophorus. Note that the smooth-walled oogonia contain a single oospore and that the antheridia are mostly monoclinous.

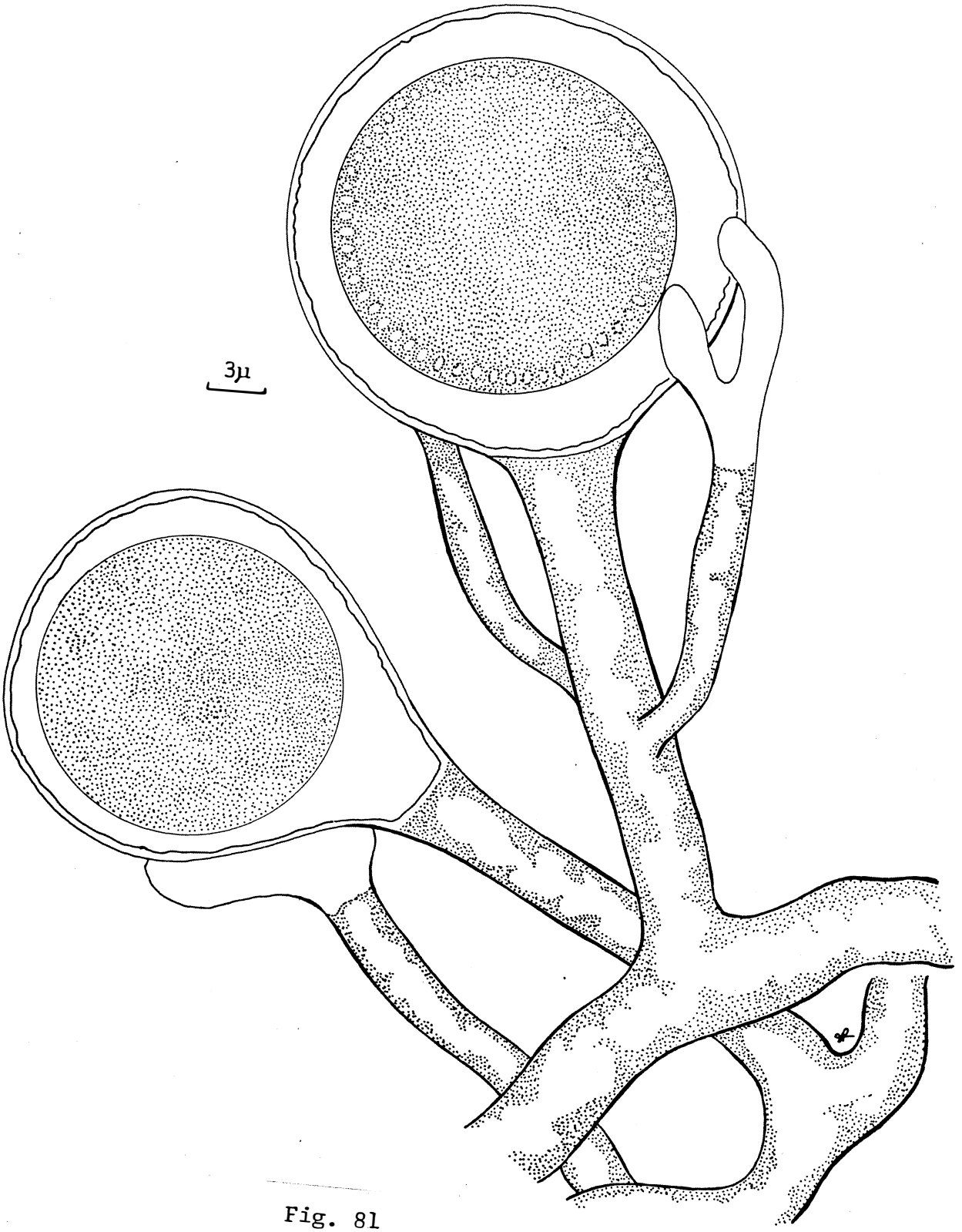

Fig. 81

Dictyuchus anomalus Nagai

Jour. Fac. Agr. Hokkaido Univ., 32: 28. 1931.

Fig. 82. Oogonia of *Dictyuchus anomalus*. Note that the smooth-walled oogonia contain a single oospore and that antheridia are entirely absent.

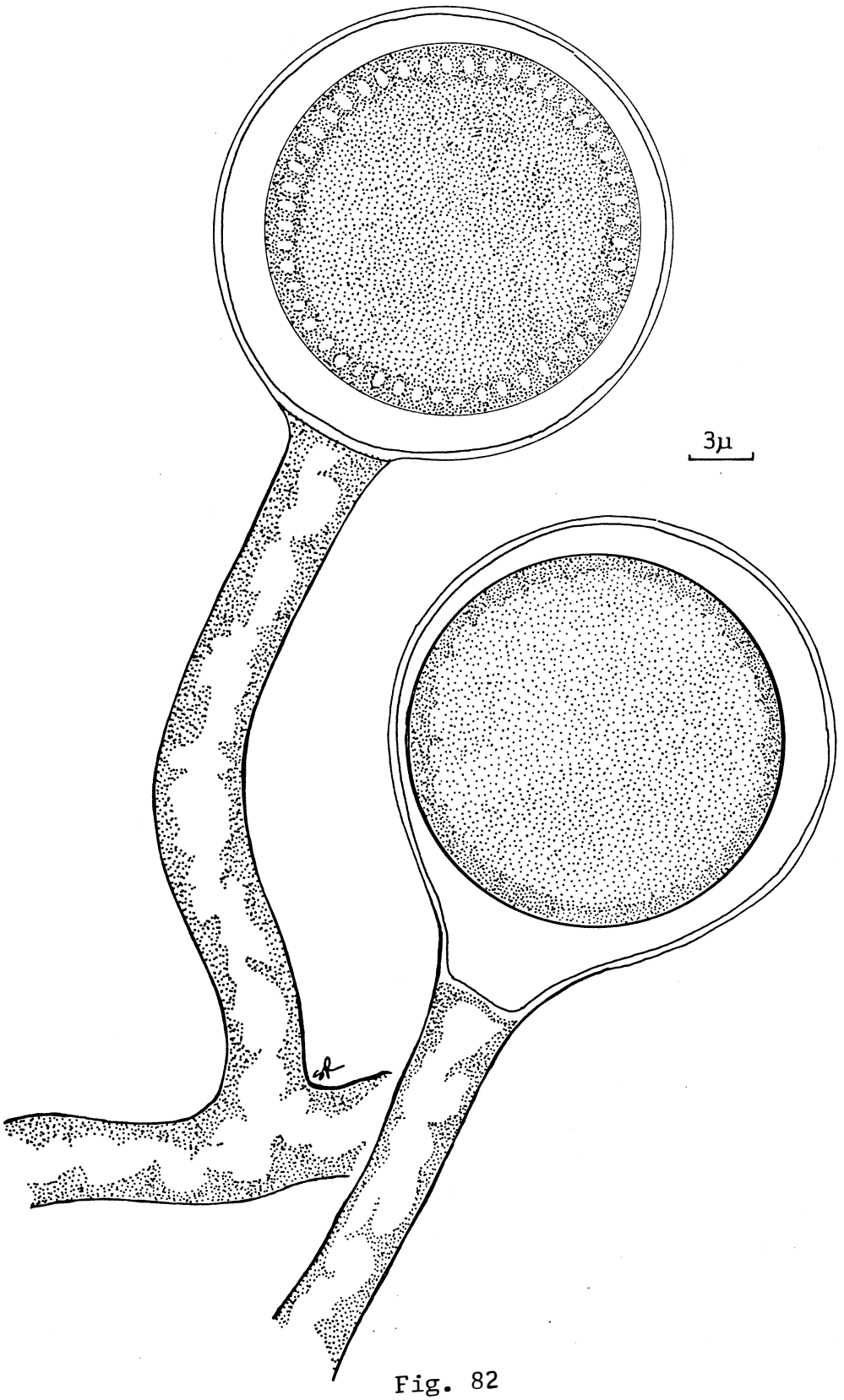

Fig. 82

Dictyuchus missouriensis Couch

Jour. Elisha Mitch. Sci. Soc., 46: 227. 1931.

Fig. 83. Filaments of Dictyuchus missouriensis bearing zoosporangia. Note that the zoospores encyst within the zoosporangium and that the zoosporangial wall disappears prior to the emergence of the secondary zoospores leaving behind a network of empty cysts without an encompassing wall in the form of a "false-net" zoosporangium.

Fig. 84. Oogonia of Dictyuchus missouriensis. Note that the smooth-walled oogonia contain a single oospore and are provided with a neck-like protuberance at the base, that the oogonial stalk is bent and attached to the subtending hypha by a beak-like process, and that antheridia are entirely absent.

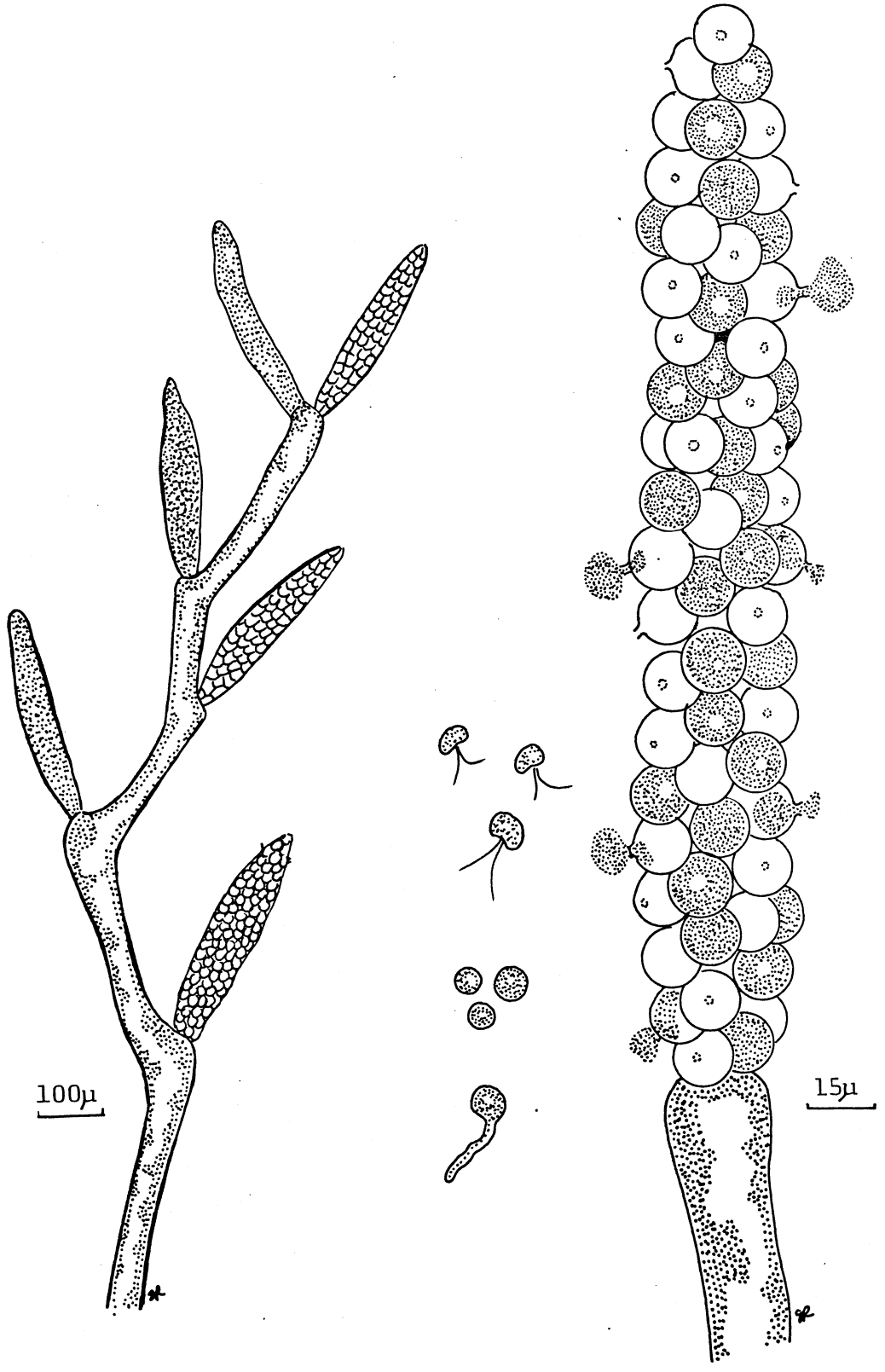

Fig. 83

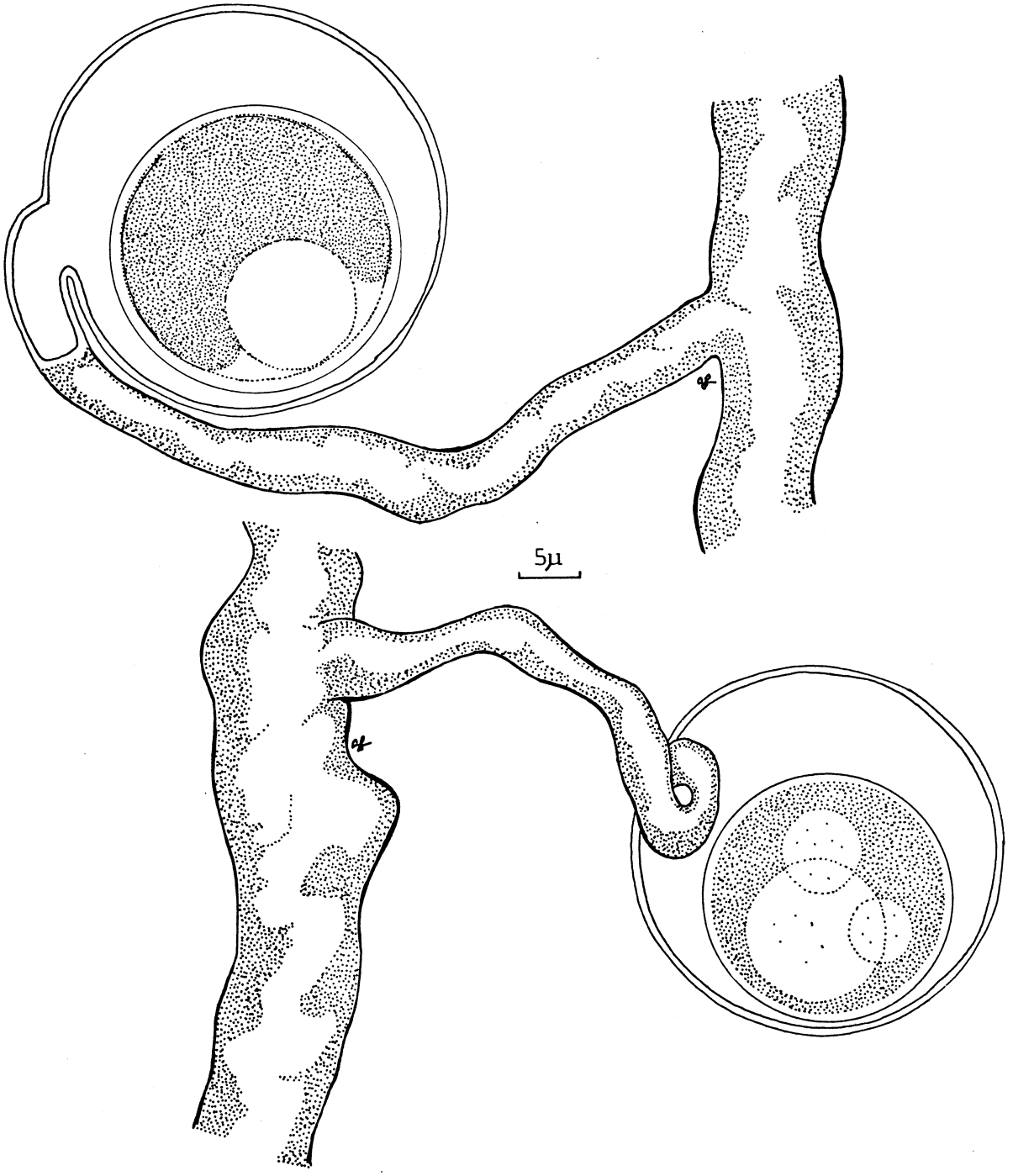

Fig. 84

Dictyuchus achlyoides Coker and Alexander

Jour. Elisha Mitch. Sci. Soc., 42: 218. 1927.

Fig. 85. Filaments of Dictyuchus achlyoides bearing zoosporangia. Note that the zoosporangia are of two types, in the first formed zoosporangia the zoospore behavior is achlyoid, in the later formed zoosporangia zoospore behavior is dictyoid in the form of false-net zoosporangia.

Fig. 86. Oogonia and antheridia of Dictyuchus achlyoides. Note that the oogonium is ornamented with numerous papillate projections and that the simple antheridia are mostly androgynous.

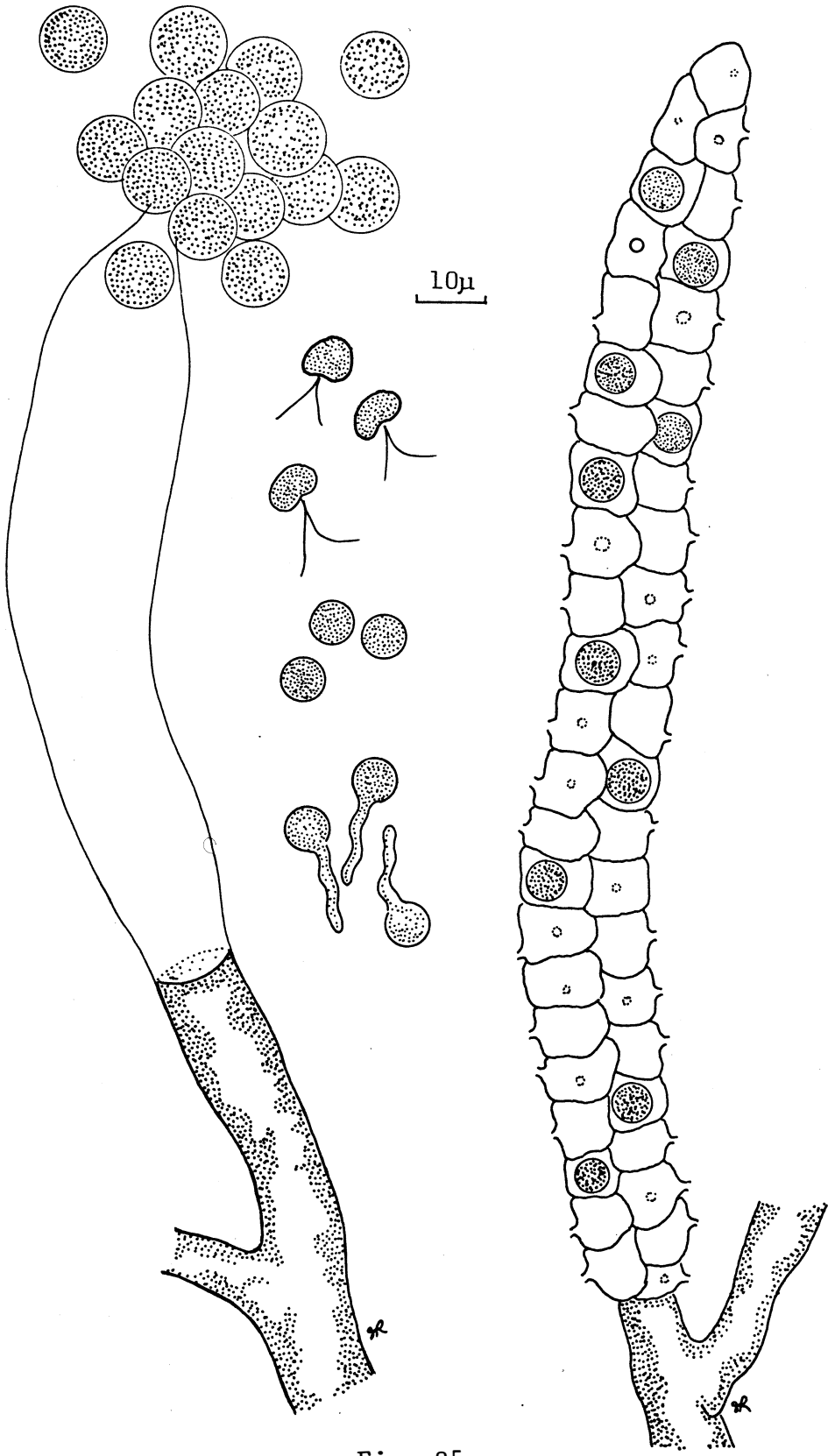

Fig. 85

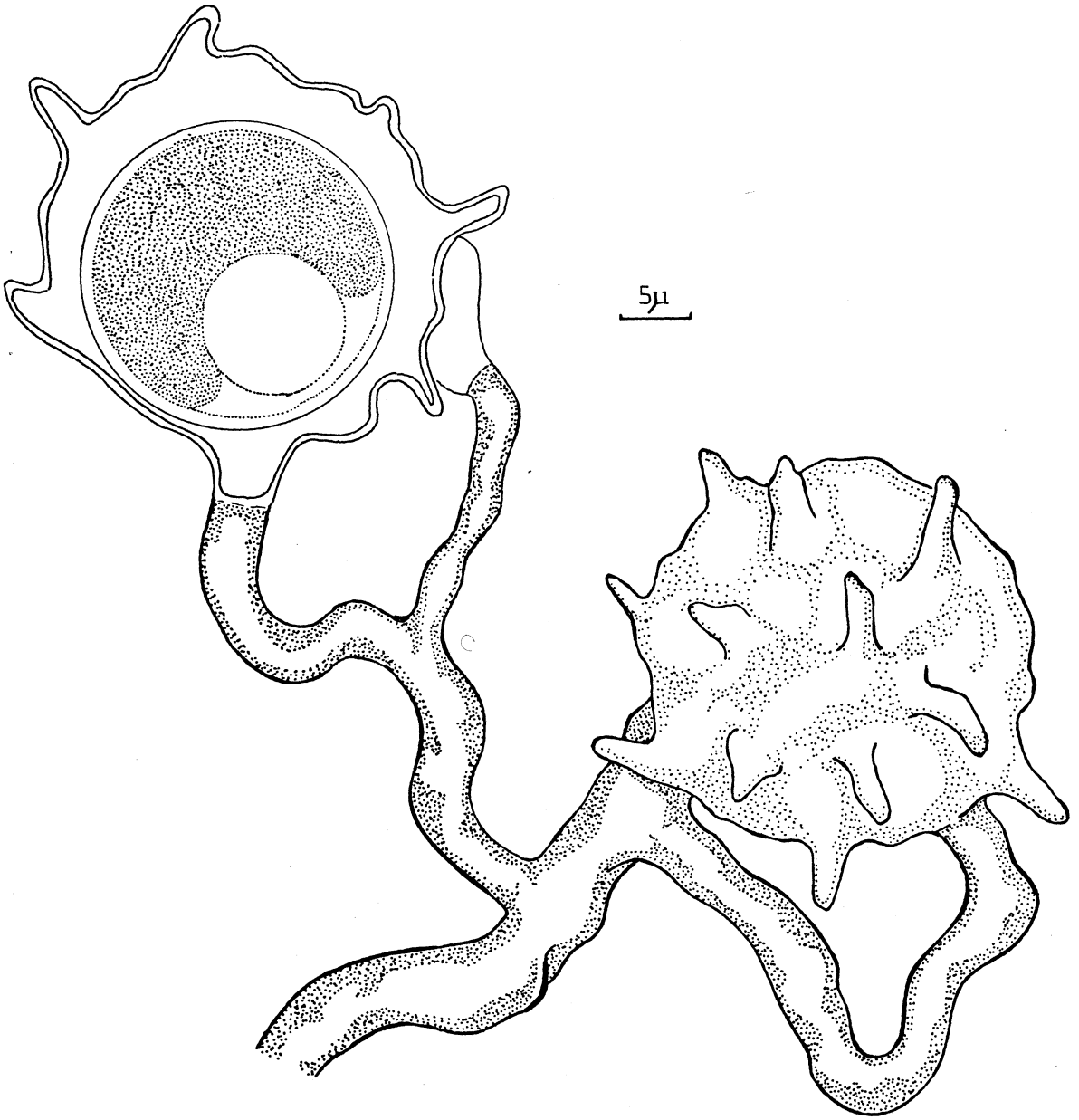

Fig. 86

Dictyuchus pseudoachlyoides Beneke

Jour. Elisha Mitch. Sci. Soc., 64: 263. 1948.

Fig. 87. Oogonia and antheridia of Dictyuchus pseudoachlyoides. Note that the oogonial wall is smooth and that the branched and multiple antheridia are mostly androgynous.

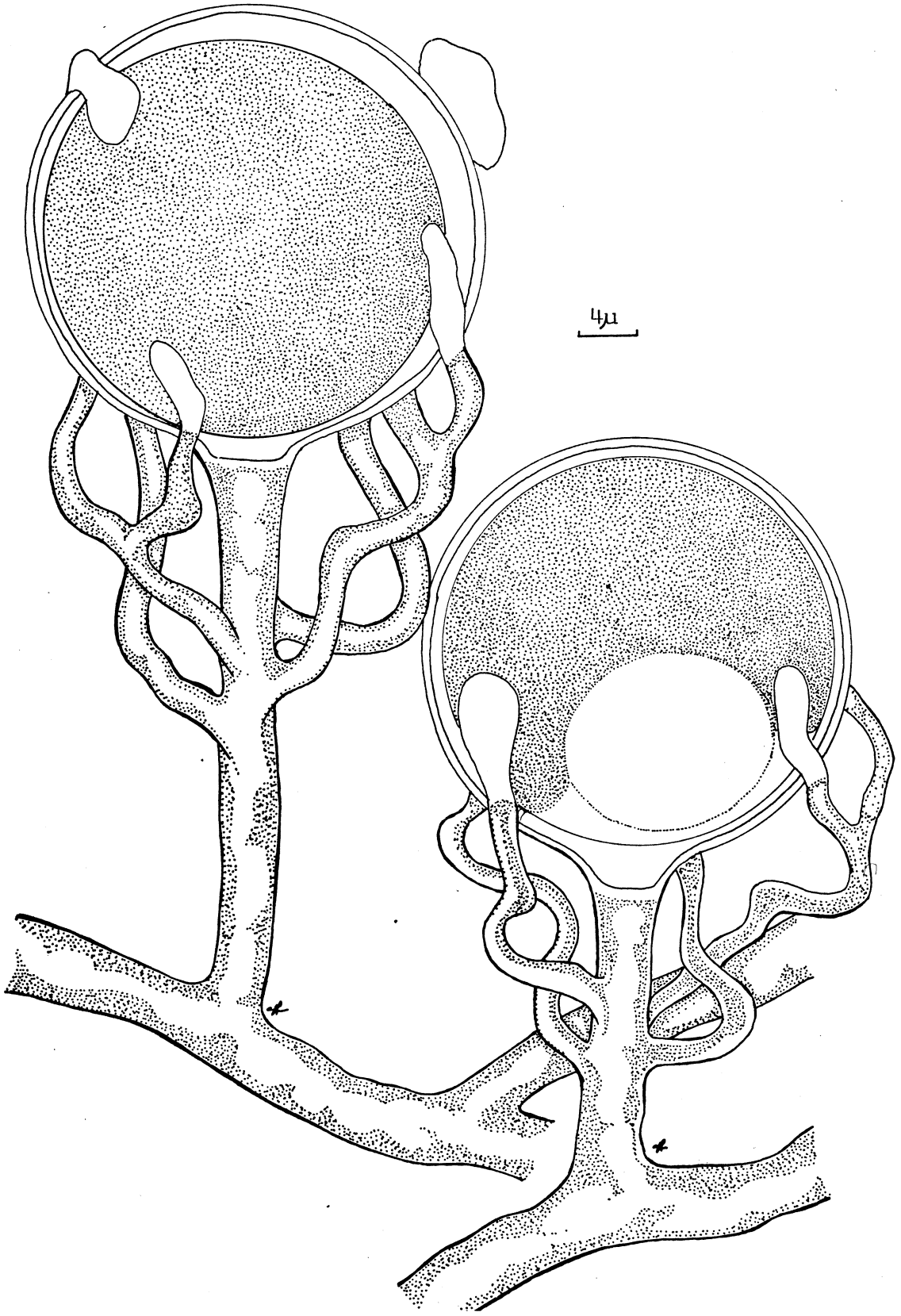

Fig. 87

Dictyuchus pseudodictyon Coker and Braxton

Jour. Elisha Mitch. Sci. Soc., 46: 228. 1931.

Fig. 88. Filaments of Dictyuchus pseudodictyon bearing zoosporangia. Note the presence of "true-net" zoosporangia, "false-net" zoosporangia and achlyoid zoosporangia on the same thallus.

Fig. 89. Oogonia and antheridia of Dictyuchus pseudodictyon. Note that the smooth-walled oogonia contain a single oospore and that the profusely branched antheridia are androgynous and diclinous often almost entirely enwrapping the oogonium.

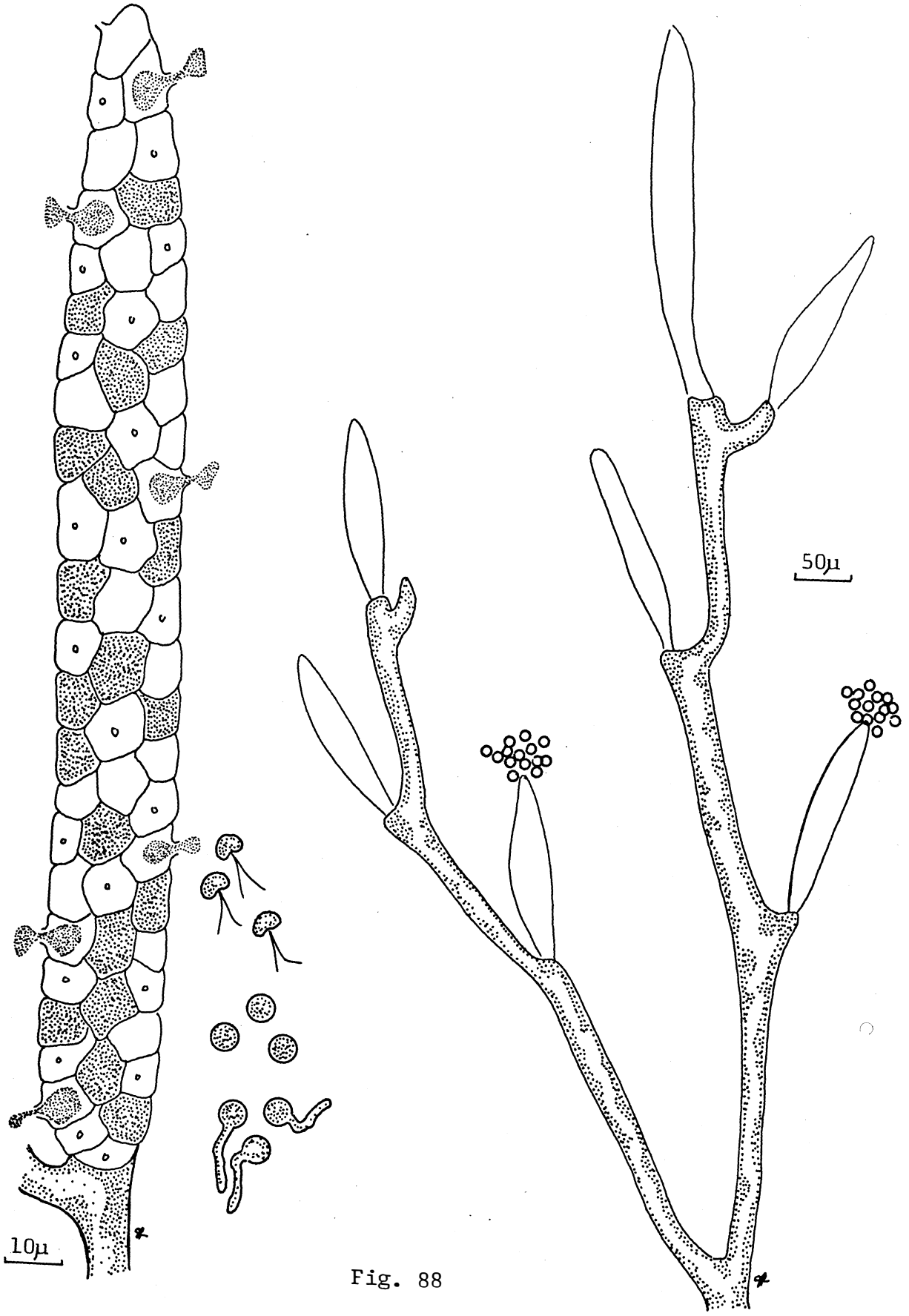

Fig. 88

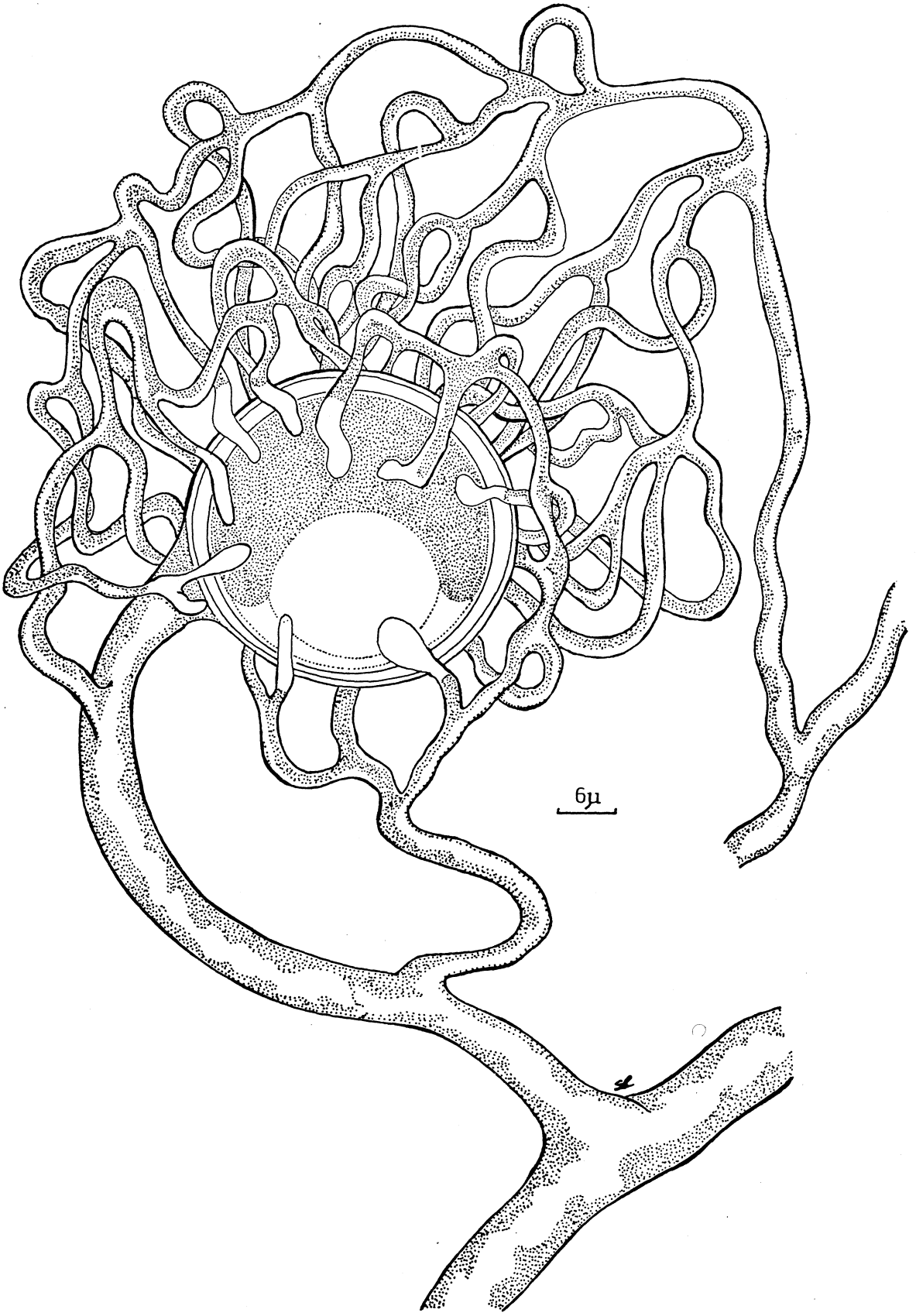

Fig. 89

Genus: Brevilegnia Coker and Couch

Jour. Elisha Mitch. Sci. Soc., 42: 212. 1927.

The genus Brevilegnia was established to include those water molds with thraustothecoid zoospore discharge and oogonia containing a single oospore. As compared to the vigorous and extensive mycelial growth in Dictyuchus, isolates of Brevilegnia are said to be depauperate, the mycelium of very limited growth and of a dense and opaque appearance. In species of this genus the primary zoospores encyst in one to several rows within the clavate to cylindrical zoosporangia; and are liberated by the dissolution of the zoosporangial wall, the primary zoospore cysts separating and drifting away singly or in small clumps (fig. 90). In isolates of Brevilegnia, there is not normally left behind a network of empty cysts as is true in those species of Dictyuchus forming false-net zoosporangia. The oogonia each with a single oospore immediately distinguishes isolates of Brevilegnia from those of Thraustotheca (figs. 91, 92, 94, 96, 98).

It is apparent from the studies by Salvin (1942), Rossy-Valderrama (1956), and Ziegler (1958) that in many isolates of Brevilegnia the asexual characteristics are extremely variable. In some isolates vegetative growth may be quite extensive and zoospore discharge may be thraustothecoid, dictyoid, and achlyoid in the same thallus. It has been proposed that all species and varieties of Brevilegnia be relegated to two species, B. unisperma and B. bispora, and that the genus be reduced to synonomy as a subdivision of the genus Thraustotheca. Johnson (1950) described a

new species of Brevilegnia, one with typical and very stable asexual features; and, hence, opposes any revision of the genus. The taxonomy of Brevilegnia remains in a state of chaos pending further study on species variability.

Key to the Illinois Species of *Brevilegnia*

1. Zoosporangia of two types, the primary zoosporangia achlyoid (fig. 97) . . . . . *B. bispora*
1. Zoosporangia never achlyoid. 2
   2. Gemmae present, oogonia relatively large (fig. 92) . . . . . *B. megasperma*
   2. Gemmae absent, oogonia relatively small. 3
3. Encysted primary zoospores normally germinate by the formation of swimming secondary zoospores (fig. 90). . . . . *B. unisperma*
3. Encysted primary zoospores normally germinate *in situ* by the formation of germ tubes (figs. 93, 95) 4
   4. Zoosporangia short and clavate; antheridia mostly androgynous (figs. 95, 96) . . . . . *B. subclavata*
   4. Zoosporangia long and cylindrical; antheridia mostly diclinous (figs. 93, 94) . . . . . *B. diclina*

Brevilegnia unisperma Coker and Braxton

Jour. Elisha Mitch. Sci. Soc., 42: 213. 1927.

Fig. 90. Filaments of Brevilegnia unisperma bearing zoosporangia. Note that all zoosporangia are of the thraustothecoid type, the zoospores encysting within the zoosporangium and liberated by the disintegration of the zoosporangial wall. Note also that the encysted primary zoospores germinate by the formation of secondary zoospores.

Fig. 91. Oogonia and antheridia of Brevilegnia unisperma. Note that the small oogonia are born on long slender stalks that are often branched and bent, that the oogonial wall is ornamented by very irregular outgrowths, and that the androgynous antheridia are irregularly branched.

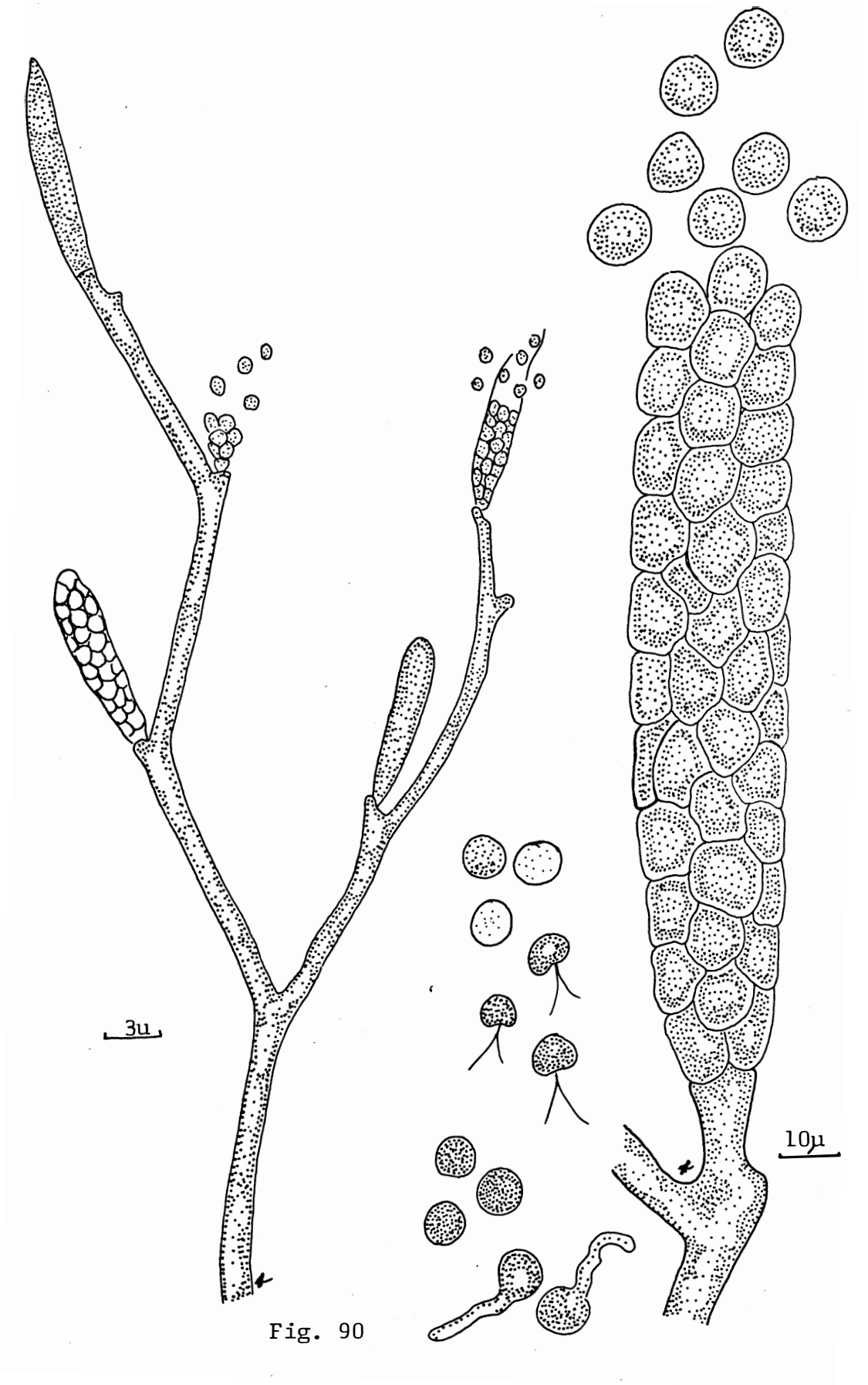

Fig. 90

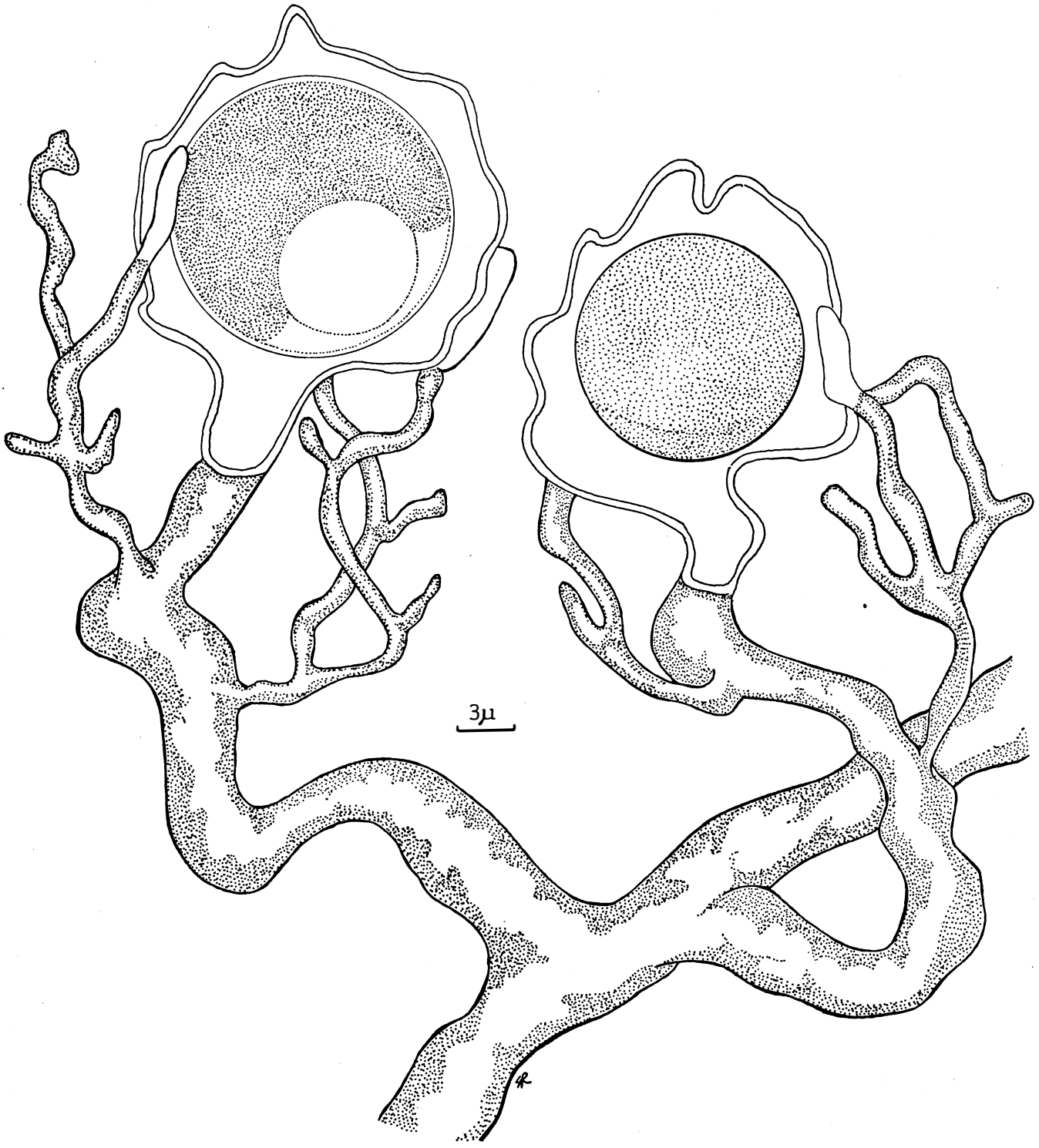

Fig. 91

Brevilegnia megasperma Harvey

Jour. Elisha Mitch. Sci. Soc., 45: 322. 1930.

Fig. 92. Oogonia and antheridia of Brevilegnia megasperma. Note that the large oogonia are borne on long and slender, crooked or coiled stalks that are unbranched, and that the antheridia are usually absent but when present are simple and androgynous.

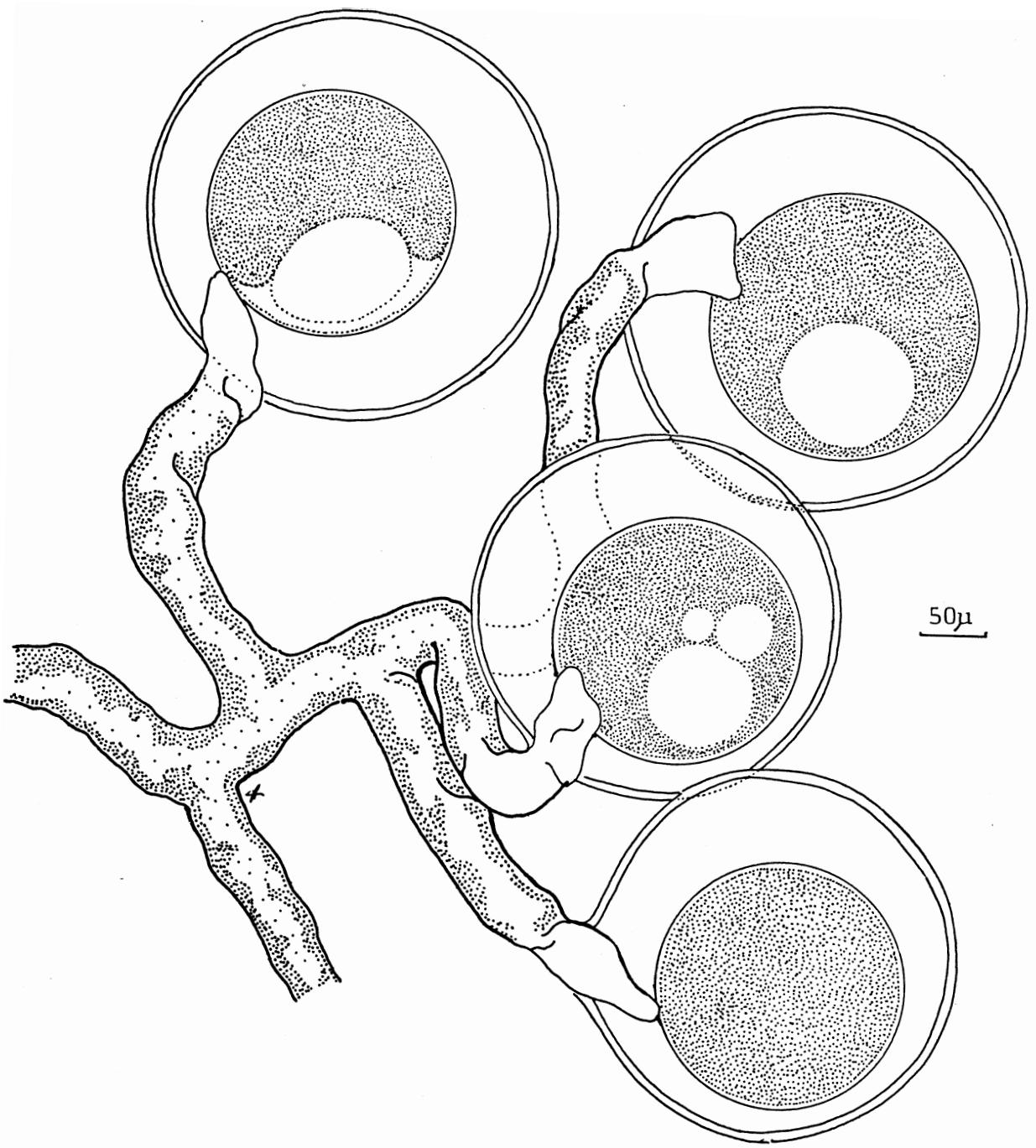

Fig. 92

Brevilegnia diclina Harvey

Jour. Elisha Mitch. Sci. Soc., 42: 243. 1927.

Fig. 93. Filaments of *Brevilegnia diclina* bearing zoosporangia. Note that the long cylindrical zoosporangia are all of the thraustothecoid type. Note also that the encysted primary zoospores germinate by the formation of germ tubes.

Fig. 94. Oogonia and antheridia of *Brevilegnia diclina*. Note that the small oogonia frequently proliferate and are sparsely ornamented, and that the antheridia are often absent but when present are usually diclinous.

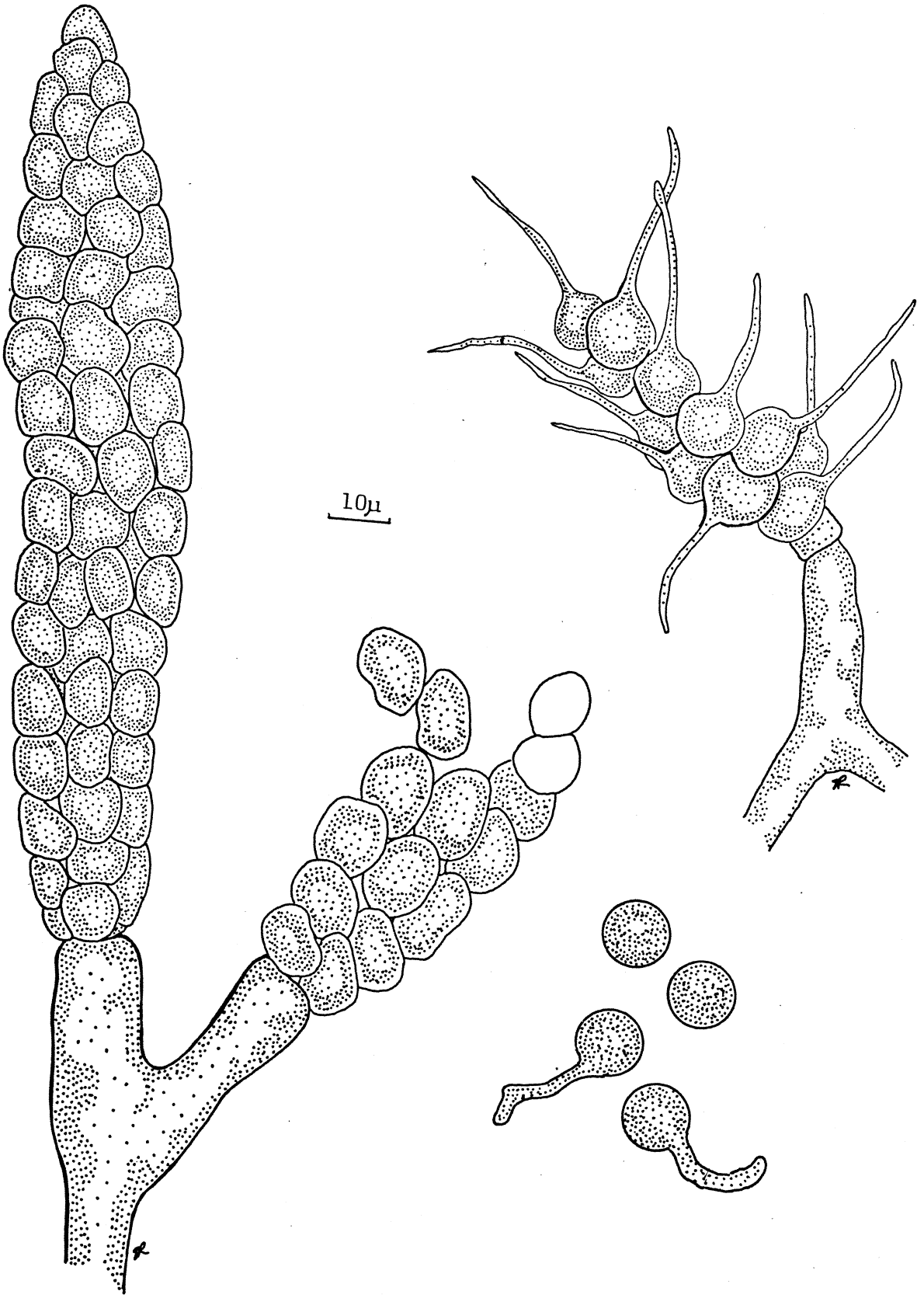

Fig. 93

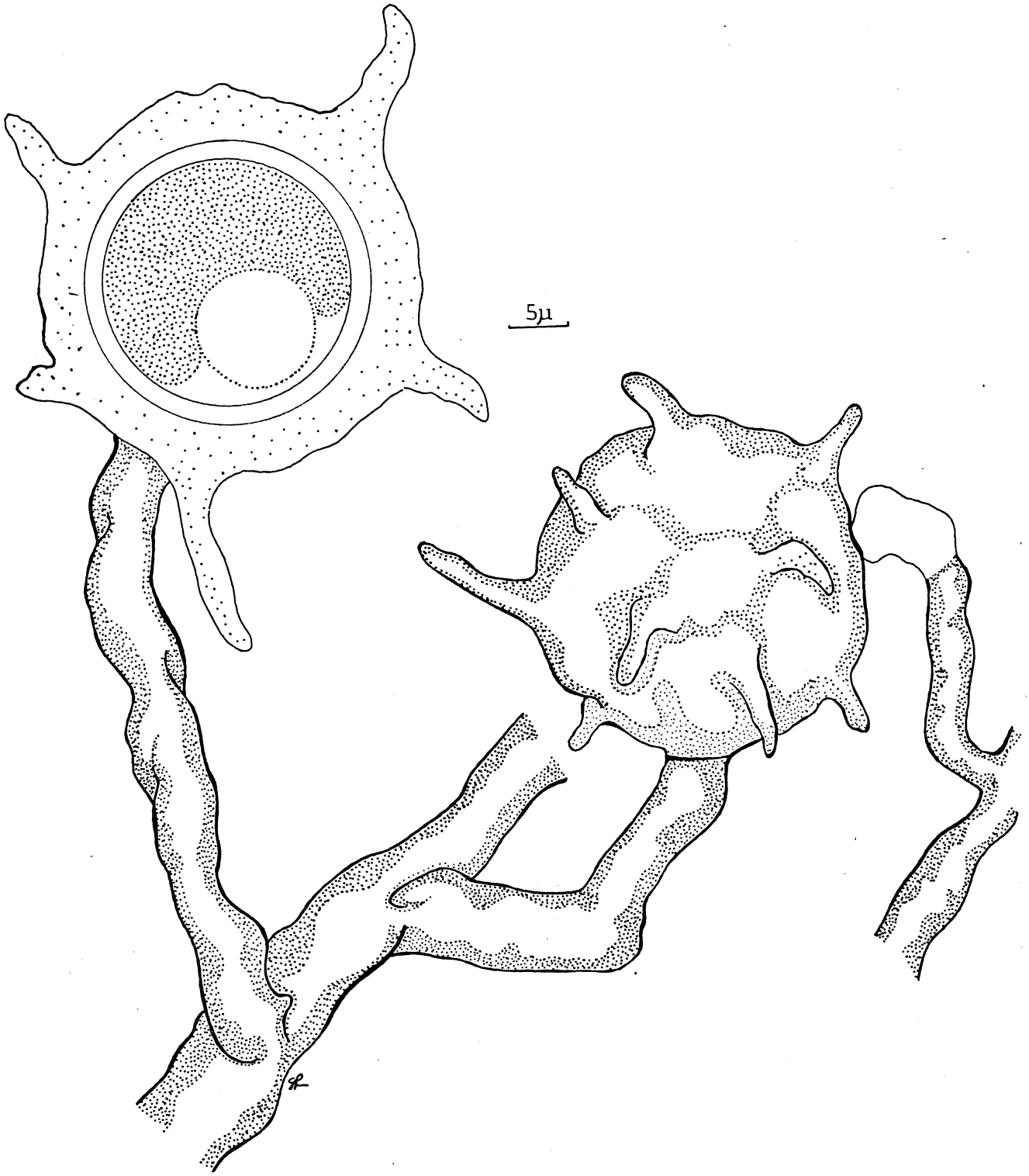

Fig. 94

Brevilegnia subclavata Couch

Jour. Elisha Mitch. Sci. Soc., 42: 229. 1927.

Fig. 95. Filaments of Brevilegnia subclavata bearing zoosporangia. Note that the short club-shaped zoosporangia are all of the thraustothecoid type. Note also that the encysted primary zoospores germinate by the formation of germ tubes.

Fig. 96. Oogonia and antheridia of Brevilegnia subclavata. Note that the small oogonia do not proliferate and are smooth-walled, and that the antheridia are androgynous.

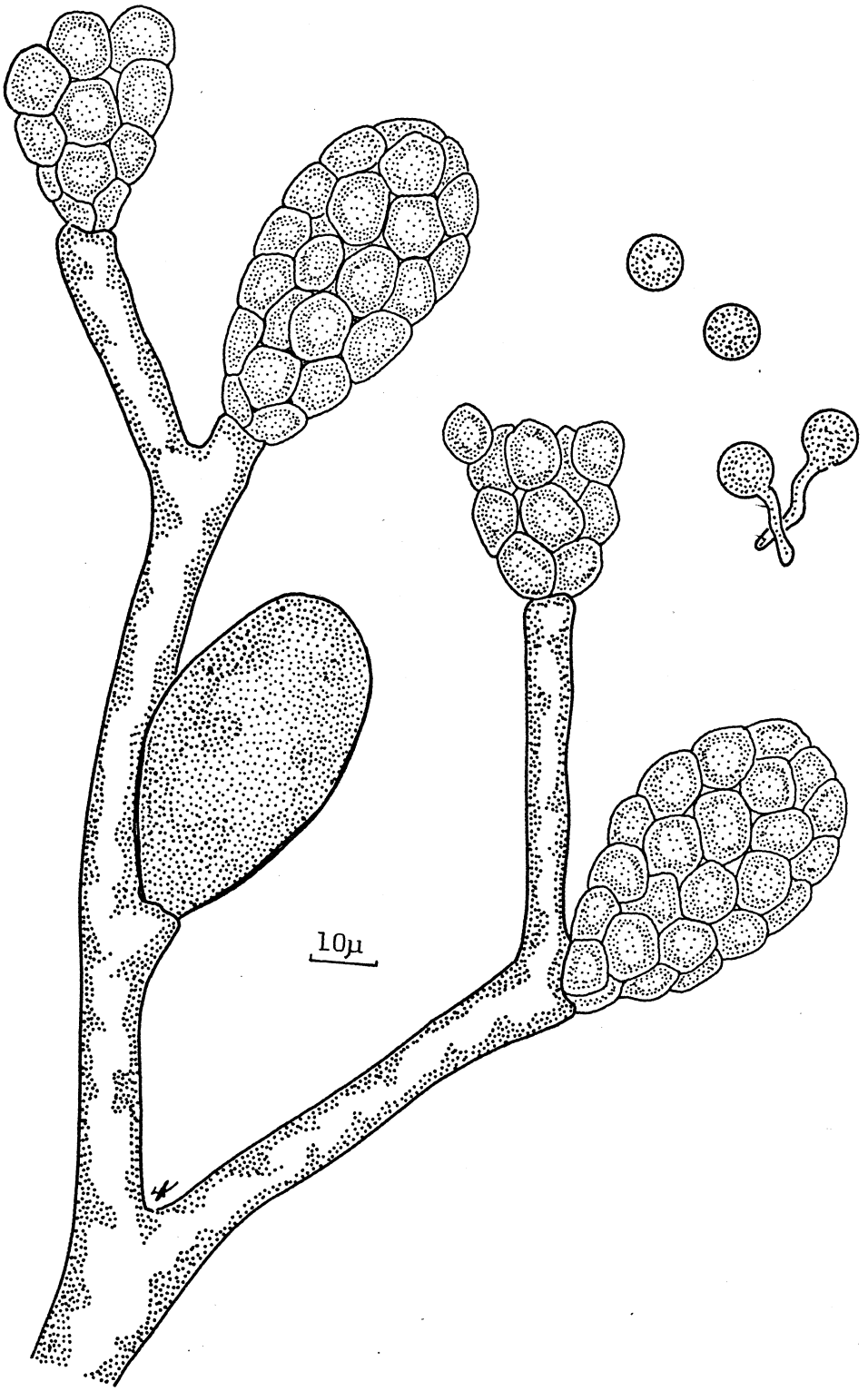

Fig. 95

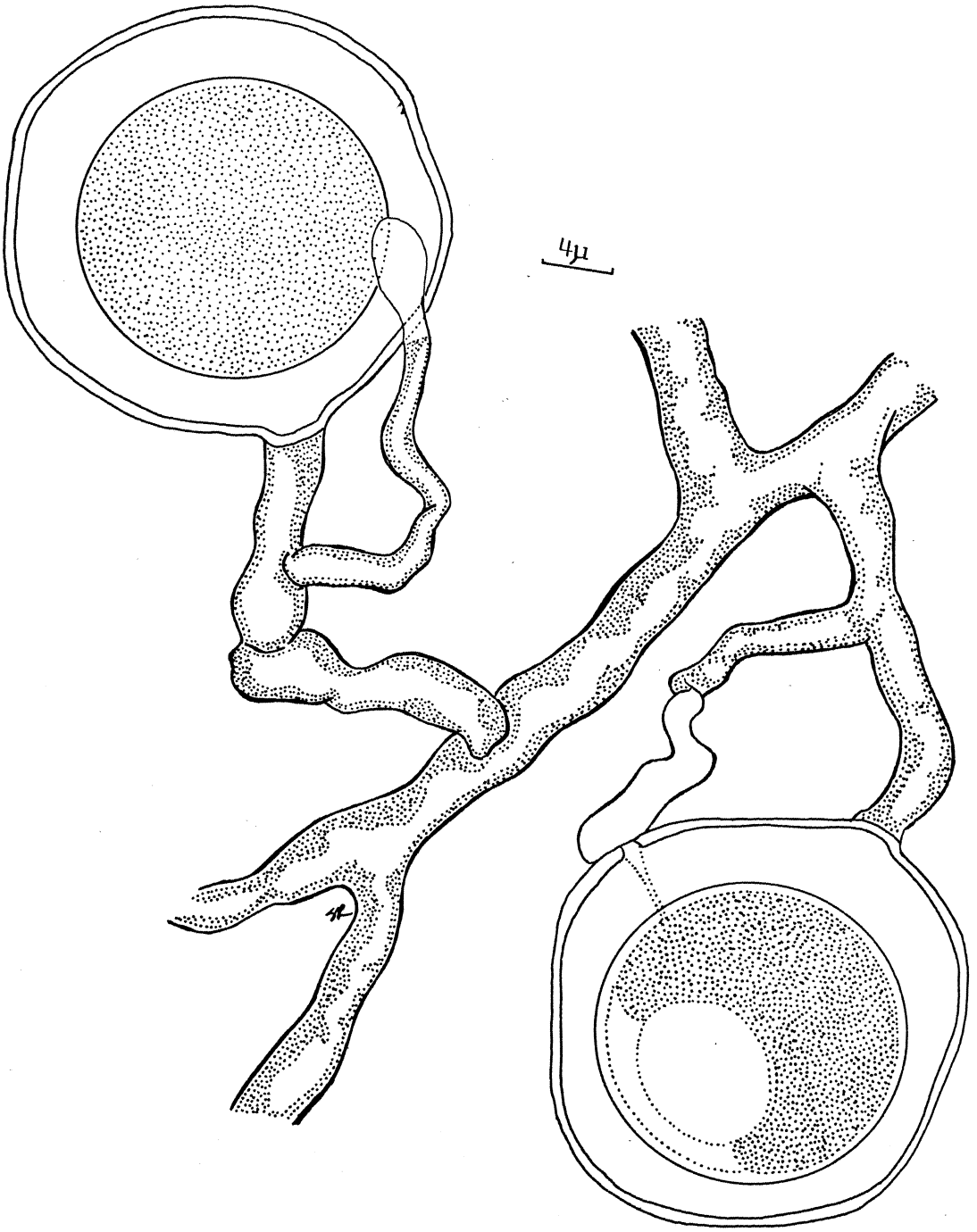

Fig. 96

Brevilegnia bispora Couch

Jour. Elisha Mitch. Sci. Soc., 42: 228. 1927.

Fig. 97. Filaments of Brevilegnia bispora bearing zoosporangia. Note that the zoosporangia are of two types, the first formed zoosporangia exhibit achlyoid zoospore behavior, the later formed zoosporangia exhibit thraustothecoid zoospore behavior and germinate by the formation of germ tubes.

Fig. 98. Oogonia and antheridia of Brevilegnia bispora. Note that the small oogonia are formed singly or in pairs on long slender stalks and are smooth-walled, and that the antheridia are androgynous.

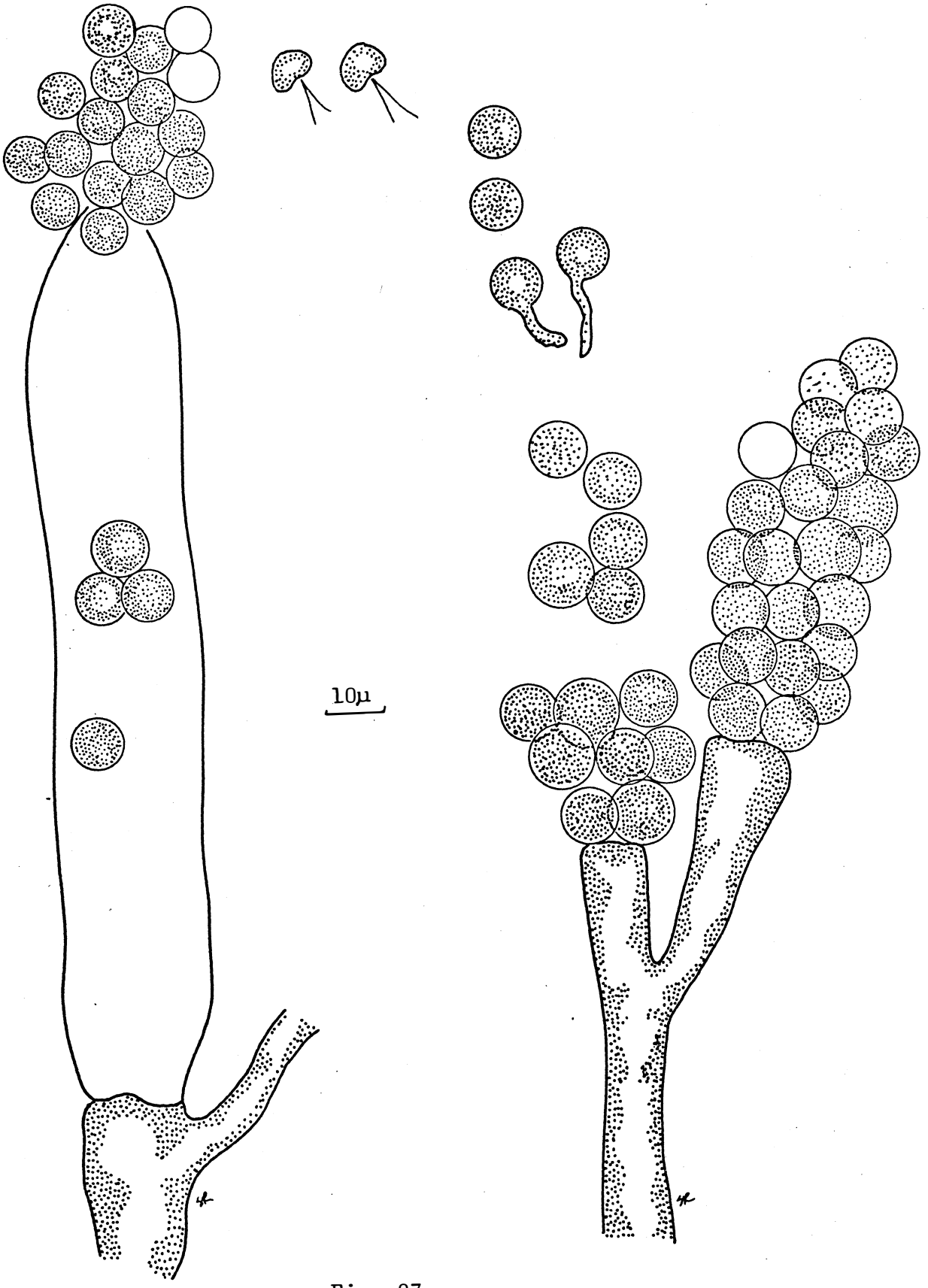

Fig. 97

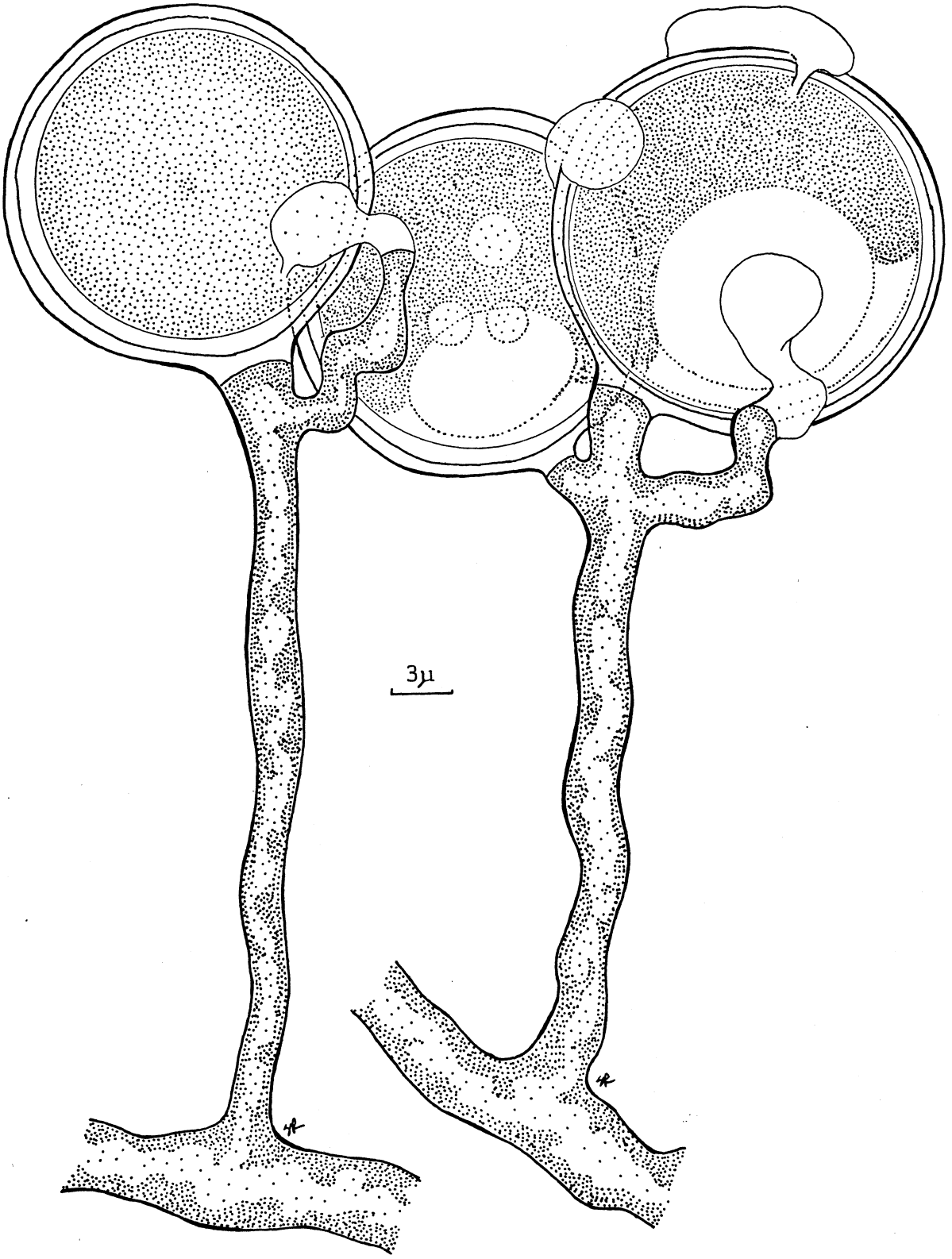

Fig. 98

Genus: Geolegnia Coker

Jour. Elisha Mitch. Sci. Soc., 41: 153. 1925.

The genus Geolegnia was established to include a small number of saprolegniaceous fungi in which the primary zoospores encyst in a single row within the zoosporangium germinating without a motile stage (figs. 99, 101). Species of Geolegnia differ from other water molds in which the dimorphic condition is suppressed in that vegetative growth is very limited forming a depauperate, dense, opaque colony. The hyphae are relatively delicate and the zoosporangia are undifferentiated. Zoospores are thick-walled and very large as compared to the diameter of the zoosporangium often resulting in a regular and conspicuous bulging of the zoosporangial wall. Zoospores are liberated by the decay of the zoosporangial wall and germinate by the formation of germ tubes. Motile stages are entirely lacking.

Two well-defined species of Geolegnia are included herein. In G. inflata the large, thick-walled zoospores are spherical or oval and of greater diameter than the zoosporangium resulting in a bulging of the wall and in the apparent constrictions in the zoosporangial wall above and below the encysted zoospores (fig. 90). In G. septisporangia the zoospores are elongate rather than spherical and of a diameter not sufficient to result in bulges and constrictions in the zoosporangial wall (fig. 101). In this species, however, the zoosporangia are frequently formed in basipetalous succession and give the impression of a single, long zoosporangium segmented by cross walls.

Geolegnia inflata Coker and Harvey

Jour. Elisha Mitch. Sci. Soc., 41: 154. 1925.

Fig. 99. Filaments of Geolegnia inflata bearing zoosporangia. Note that the zoosporangia are slender with relatively large zoospores formed in a single row causing the zoosporangial wall to bulge, and that the zoospores encyst within the zoosporangium and are liberated by the dissolution of the zoosporangial wall.

Fig. 100. Oogonia and antheridia of Geolegnia inflata. Note that the oogonia are smooth-walled borne singly on slender and irregular stalks, and that the antheridia are androgynous.

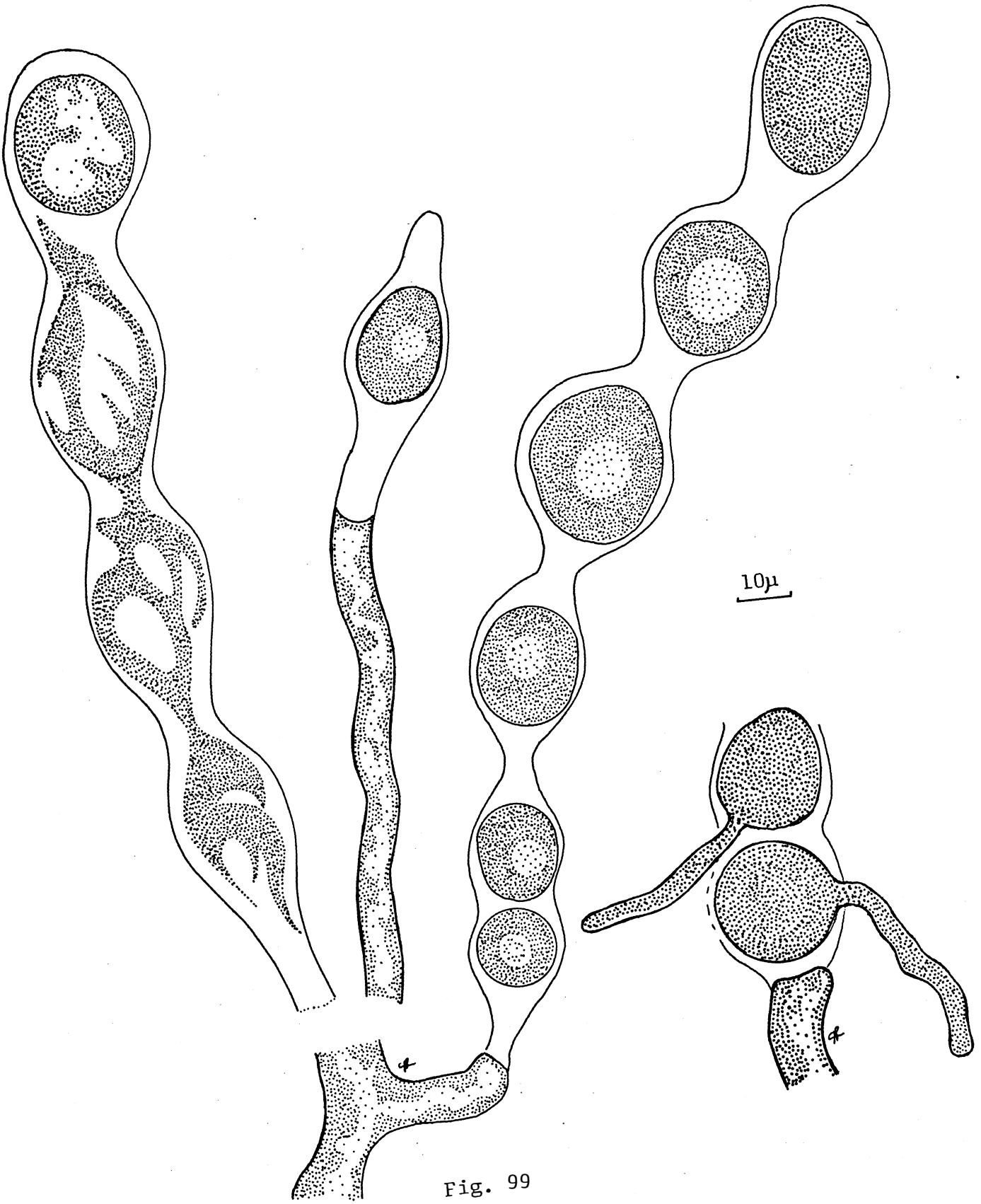

Fig. 99

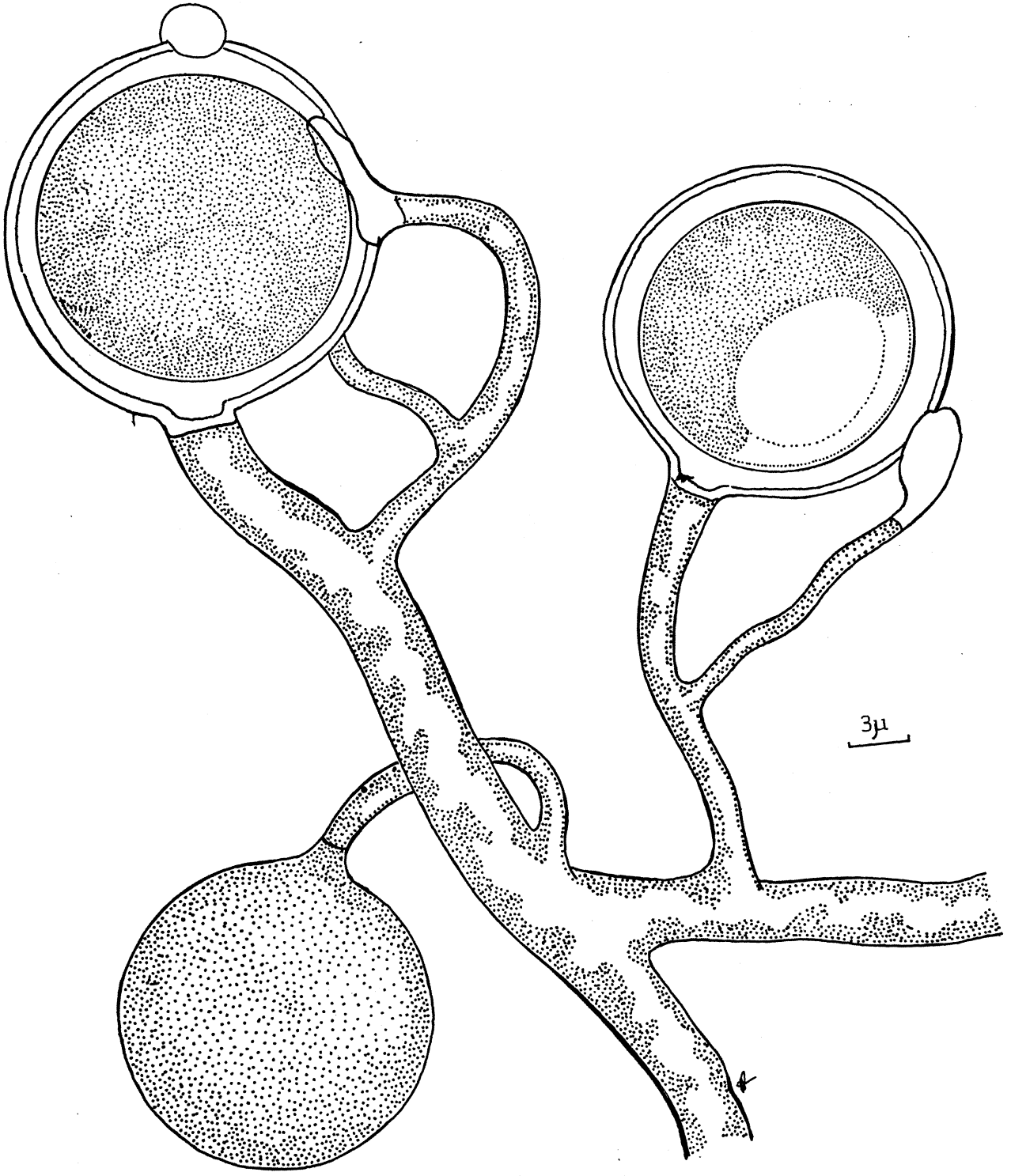

Fig. 100

Geolegnia septisporangia Coker and Harvey

Jour. Elisha Mitch. Sci. Soc., 41: 155. 1925.

Fig. 101. Filaments of Geolegnia septisporangia bearing zoosporangia. Note that the zoosporangia are formed in chains, appearing as a single segmented zoosporangium with large zoospores formed in a single row causing the zoosporangial wall to bulge; that the zoospores encyst within the zoosporangium and are liberated by the dissolution of the zoosporangial wall.

Fig. 102. Oogonia and antheridia of Geolegnia septisporangia. Note that the oogonia are smooth-walled borne singly on slender and straight stalks, and that the antheridia are androgynous.

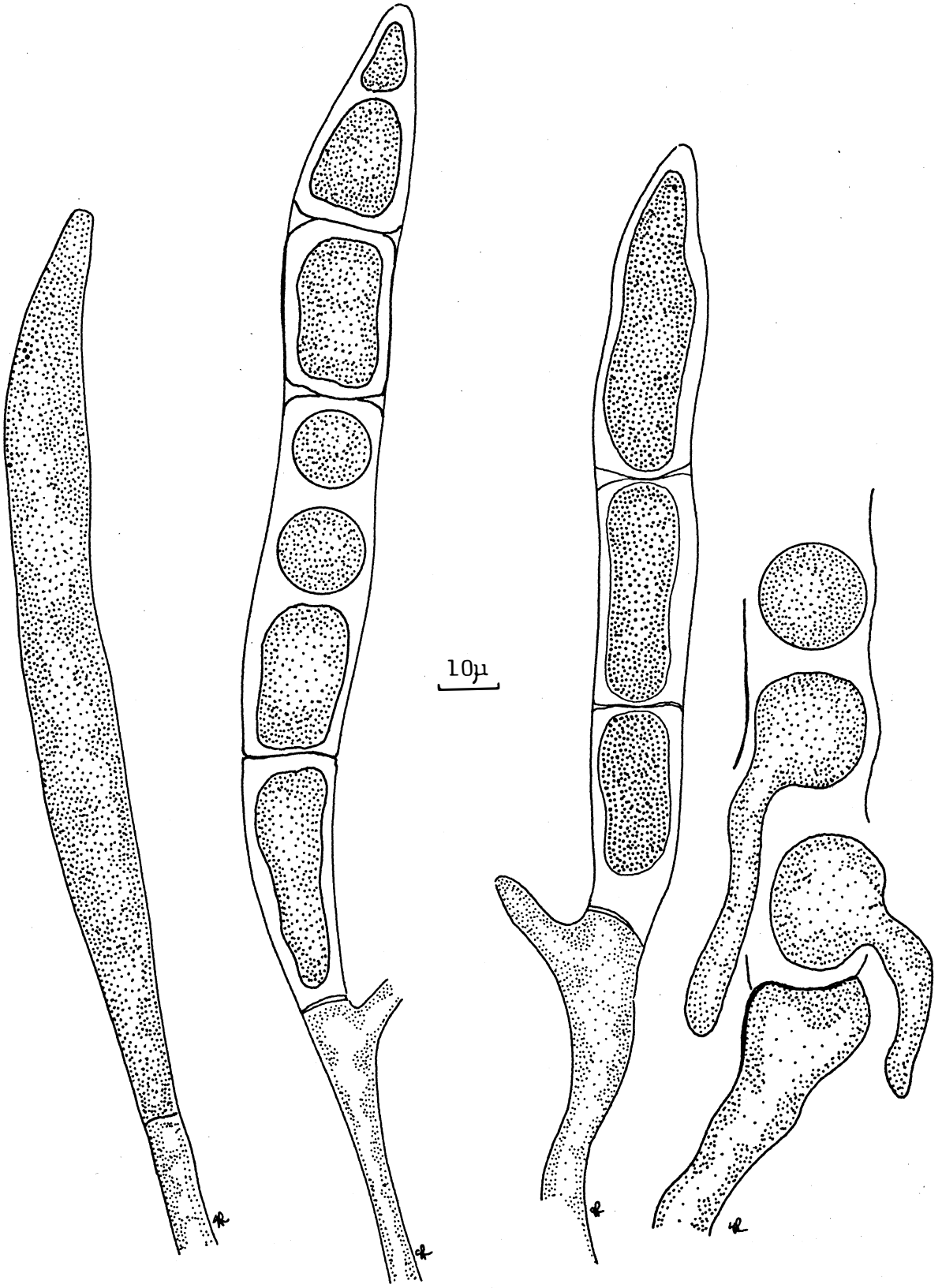

Fig. 101

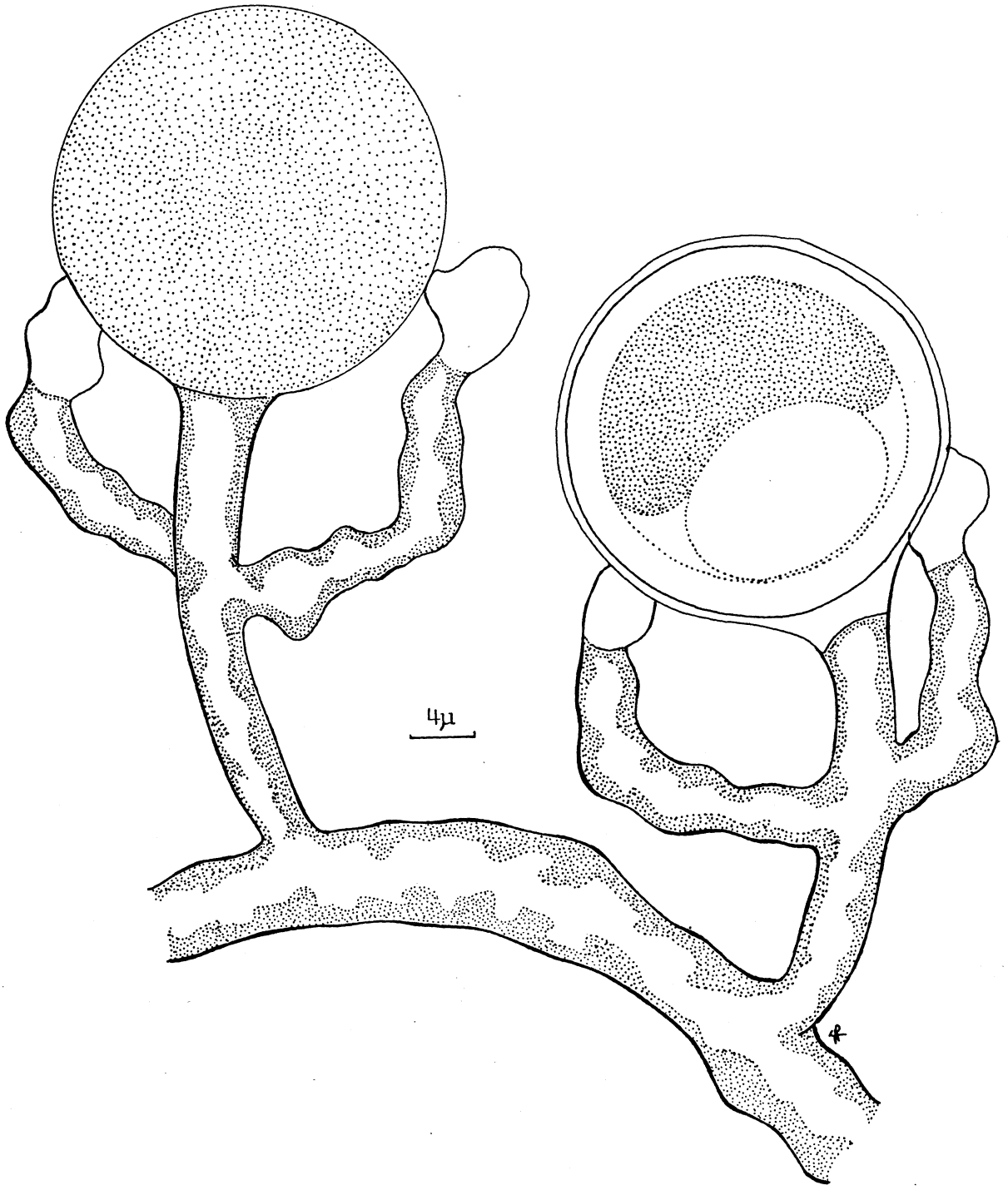

Fig. 102